Maryland
EMERGENCY MANAGEMENT AGENCY

MEMA.MARYLAND.GOV

Larry Hogan | Governor | Boyd K. Rutherford | Lt. Governor | Russell J. Strickland | Executive Director

2021
State Hazard Mitigation Plan
MARYLAND EMERGENCY MANAGEMENT AGENCY

August 2021

This page left blank intentionally

LARRY HOGAN
GOVERNOR

STATE OF MARYLAND
OFFICE OF THE GOVERNOR

August 23, 2021

Mary Ann Tierney
Regional Administrator
FEMA Region III
One Independence Mall, 6th Floor
615 Chestnut Street
Philadelphia, PA 19106

Dear Ms. Tierney,

In accordance with the authority vested in me by the *Annotated Code of Maryland*, Public Safety Article 14 Sections 106(b)(2) and (b)(4), I hereby approve and declare the State of Maryland *2021 State Hazard Mitigation Plan* to be adopted. This plan shall be effective as of August 24, 2021.

The *State of Maryland 2021 Hazard Mitigation Plan* has been developed collaboratively across the state in accordance with the Disaster Mitigation Act of 2000 and 44 CFR Part 201 Mitigation Planning.

The plan exemplifies the need for a whole community approach to reduce disaster risk and build community resilience. This plan shall serve as a guide to implementing transformative mitigation for the State of Maryland.

Sincerely,

Larry Hogan
Governor

Cc: Russell Strickland, Executive Director, Maryland Emergency Management Agency

STATE HOUSE, ANNAPOLIS, MARYLAND 21401
(410) 974-3901 1-800-811-8336
TTY USERS CALL VIA MD RELAY

A Message from Executive Director Russell J. Strickland

The vision of the Maryland Emergency Management Agency (MEMA) is "to shape a resilient Maryland where communities thrive." This vision is achieved through the collaborative efforts of our citizens, community organizations, private partners, and all levels of government. The *State of Maryland 2021 Hazard Mitigation Plan* serves as a roadmap to identify, assess, and address our risk.

This plan includes updated assessments of the eight hazards from the 2016 version. In addition, this reassessment incorporates several new hazards including public health emergencies, soil movement, extreme temperatures, dam failure, and human-caused hazards and threats. Developing a pathway to reduce disaster risk starts first with a comprehensive assessment of what hazards Marylanders face and how they have changed in the last five years.

We have refined the goals of the plan in order to address the changing risk in our communities. The goals prioritize focusing on flood risk occuring outside floodplains to better prepare for smaller, frequent events; addressing inequities to ensure every Marylander has the resources to stay informed and protected before, during, and after an emergency; fostering opportunities for partnerships and collaboration across the whole community; and reducing flood hazards in areas of high risk with repetitive flooding.

Simply put "mitigation is the center of the universe" and by putting mitigation at the forefront we prioritize building community resilience. Doing so permits us to execute all mission areas of Emergency Management from a safer perspective.

U.S. Department of Homeland Security
Region III
One Independence Mall, Sixth Floor
615 Chestnut Street
Philadelphia, PA 19106-4404

FEMA

August 23, 2021

Mr. Russell Strickland
Executive Director/Governor's Authorized Representative
Maryland Emergency Management Agency
5401 Rue Saint Lo Drive
Reisterstown, Maryland 21136

Dear Mr. Strickland:

I am pleased to announce that the State Hazard Mitigation Plan of Maryland has been approved. The plan meets the requirements set forth in Title 44, Chapter 1, Section 201.4, of Code of Federal Regulations (44 CFR 201.4), as authorized by the Disaster Mitigation Act of 2000, by adequately addressing the following required elements: planning process, risk assessment and hazard identification, mitigation strategy, coordination of local mitigation planning, maintenance and implementation, and adoption. In addition, the State Hazard Mitigation Plan meets the requirements to address all dam risks in the mitigation plan.

A FEMA approved state mitigation plan is a condition of receiving certain non-emergency Stafford Act assistance and FEMA mitigation grants from the following programs:

- Public Assistance Categories C-G (PA C-G)
- Fire Management Assistance Grants (FMAG)
- Hazard Mitigation Grant Program (HMGP)
- Building Resilient Infrastructure and Communities (BRIC)
- Flood Mitigation Assistance (FMA)
- Rehabilitation of High Hazard Potential Dams (HHPD)

The State of Maryland must revise its plan and obtain approval within 5 years to continue to be eligible for non-emergency Stafford Act assistance and FEMA mitigation grants. This plan should be reviewed at least annually to keep it relevant to the mitigation goals throughout the state. Please consider the enclosed recommendations to further strengthen your plan during the next plan update.

FEMA recognizes Maryland's dedication demonstrated in your timely preparation and adoption of a strategy to reduce future disaster losses. If you have any questions, please contact Mari Radford, Community Planning Lead, at (267) 319-6310.

Sincerely,

MARYANN E TIERNEY
Digitally signed by MARYANN E TIERNEY
Date: 2021.08.23 19:07:37 -04'00'

MaryAnn Tierney
Regional Administrator

Enclosure

cc: JaLeesa Tate, CFM, State Hazard Mitigation Officer, MEMA
Kyle Overly, Director, Disaster Risk Reduction Directorate, MEMA
Chas Eby, Deputy Executive Director, MEMA

Executive Summary

Hazard mitigation helps to reduce or eliminate potential losses from future disasters. Hazard mitigation planning helps to establish and maintain a process that leads to the implementation of hazard mitigation actions. The State of Maryland is intimately familiar with the impacts of hazards on its residents, visitors, infrastructure, and economy. This 2021 update to the State's Hazard Mitigation Plan (Plan) again re-affirms the state's commitment to continual improvements to its statewide mitigation strategy and program.

The 2021 hazard mitigation planning process began with the identification of a broad-reaching State Hazard Mitigation Team, led by the Maryland Emergency Management Agency (MEMA), which guided the development of the updated plan. Based on significant updates and actions from the major Lead Agencies charged with implementation of the Plan and other stakeholders, as well as the inclusion of five new hazards, this Plan includes significant changes as compared to those completed in a typical update cycle. Since the 2016 Plan was approved, the state has been subjected to six major disasters, a challenge in any operating environment. But 2020 presented a new hurdle, the challenges brought on by the ongoing coronavirus pandemic and COVID-19 response, which necessitated a completely virtual approach to the update, something never before attempted.

The steps involved in plan development included the detailed identification of natural, technological, and human-caused hazards that can impact Maryland and an assessment of the vulnerability, and ultimately the risk, presented by those hazards. Next steps included a thorough evaluation of the state's current mitigation capabilities, followed by an update to the state's mitigation strategy.

This strategy identified five overarching Mitigation Themes, and related Mitigation Objectives, that define Maryland's path forward to implementing hazard mitigation.

Overarching themes of the *2021 State Hazard Mitigation Plan* include:

- Identifying natural hazards that are most likely to impact Maryland now and, in the future, providing an opportunity for a focused risk analysis and prioritization of mitigation strategies and resiliency efforts to include:
- Minimizing the loss of life and personal injuries from all-hazard events
- Reducing losses and damage to state and local governments and private assets
- Decreasing federal, state, local, and private costs of disaster response and recovery
- Developing strategies and actions for five new hazards, including public health emergencies, dam failures (previously in the Plan but removed for security reasons following 9/11), man-made hazards, extreme temperatures, and soil movement

- Supporting mitigation initiatives and policies that promote disaster resiliency, nature-based solutions, cultural resources and historic preservation, and climate adaptation strategies
- Verifying critical facilities and state assets data
- Maximizing opportunities for collaboration and excitement between stakeholders over future hazard mitigation opportunities to ensure the safety of Maryland's citizens, protection of property, environmental sustainability, community resiliency, and the preservation of Maryland's cultural and historic resources for future generations

Implementation of these overarching themes requires goals, strategies, and actions. Section 4 of the Plan outlines these implementation measures for this Plan update. The Steering Committee elected to separate the single goal and the five objectives included in the 2016 Plan Update into six independent goals. In addition, the two goals for RL and SRL properties from the 2016 Plan have been incorporated into this list of goals. The Steering Committee also added new considerations for social equity and environmental justice, bringing the total number of goals to 10, which are listed below. Newly developed goals for the 2021 Plan are emphasized in **bold**.

2021 Maryland Hazard Mitigation Plan Goals

1. Protect life, property, the economy, and the environment from hazard events to the greatest extent possible.
2. Increase public awareness of potential hazards, mitigation actions, preparedness efforts, and resiliency planning.
3. Protect state assets, infrastructure, and critical facilities from hazard events.
4. Enhance coordination across the whole community, including federal, state, and local government, and nongovernmental organizations, by strengthening existing linkages and creating new linkages between state and local mitigation and resiliency efforts.
5. Promote actions that protect natural resources while enhancing hazard mitigation and community resiliency.
6. Identify and implement projects that will reduce the impacts of hazards and efficiently use state resources.
7. **Integrate hazard mitigation planning into other state planning efforts (comprehensive plan, floodplain management regulations, land use/zoning, green infrastructure) and encourage and educate counties and municipalities to integrate across local plans and ordinances.**
8. Identify and reduce flood hazard impacts in areas outside of the Special Flood Hazard Area (SFHA), that have experienced increased frequency and intensity in flooding but do not meet FEMA's RL and SRL criteria.

9. Reduce flood-related losses, with an emphasis on reducing RL and SRL properties over the next hazard mitigation planning cycle.
10. **Promote the development of policies, programs, initiatives, and projects that prioritize diversity, equity, and environmental justice.**

Since the completion of the 2016 Plan, Maryland reevaluated the state's exposure relative to dams and dam safety. In the Summer of 2020, MEMA received formal approval from the Federal Emergency Management Agency (FEMA) for the revised Dam Safety Addendum to be included as part of the 2016 Plan. This Addendum has been incorporated into the Hazard Identification and Risk Analysis of this 2021 Plan Update, and the document in total may be found in Appendix C. This was a significant revision to the Plan, along with the addition of other new hazards as mentioned above.

The final and most important piece of the Plan is defining the path forward. The planning process defined a clear direction for implementation and maintenance. The Plan addresses each required element of 2 CFR §201.4. Finally, MEMA has developed this Plan update to proactively support the new FEMA Hazard Mitigation program and ensure that during the first 5 years of that program's life, MEMA submits applications for mitigation projects that will support the goals and priorities of the Building Resilient Infrastructure in Communities (BRIC) program.

Federal Compliance

The Plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (DMA) (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002 (2 CFR §201.4 and §201.5) and finalized on October 31, 2007. (Hereafter, these requirements, and regulations will be referred to collectively as the Disaster Mitigation Act.)

While the Act emphasizes the need for mitigation plans and coordinated mitigation planning and implementation efforts, the regulations established requirements that hazard mitigation plans must meet in order for a state jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288).

The 2021 Plan falls under assurances proclaimed in this Plan. The State of Maryland assures that it will comply with all applicable federal statutes and regulations in effect with respect to the periods for which it receives grant funding in compliance with 2 CFR Part 200, Subpart C. The state will amend the Plan whenever necessary to reflect changes in state or federal laws and statutes, as required in 2 CFR Part 200, Subpart C. The adoption of this Plan demonstrates the State of Maryland's commitment to fulfilling the mitigation objectives in the Plan and authorizes the agencies identified in the Plan to execute their responsibilities.

TABLE OF CONTENTS

Acronym List v
Section 1: Introduction and Plan Development Process 1
Section 2: Maryland Land Development and Population 14
Section 3: Hazard Identification and Vulnerability Assessment 40
Section 4: Mitigation Strategies 199
Section 5: Mitigation Implementation Status Report 229
Section 6: Management, Local Plans, and Capabilities Assessment 246
Section 7: Repetitive Loss Strategy 296
Section 8: List of Appendices 316

Tables

Table 1-1: State Mitigation Plan Review Guide 1
Table 1-2: Maryland State Hazard Mitigation Plan - Steering Committee 5
Table 1-3: Maryland State Hazard Mitigation Plan - Leadership Team 7
Table 1-4: 2021 Maryland HIRA Meetings 8
Table 1-5: 2021 Maryland Mitigation Strategy Meetings 8
Table 2-1: State Mitigation Plan Review Guide 14
Table 2-2: Maryland Tributary Basins 20
Table 2-3: Maryland Counties 21
Table 2-4: Population of Maryland Jurisdictions 23
Table 2-5: Population Breakdown 25
Table 2-6: Median Household Income by Maryland Jurisdictions 26
Table 2-7: Employment by Industry in Maryland 28
Table 2-8: Major Maryland Employers 28
Table 2-9: Major Public Colleges and Universities in Maryland 30
Table 2-10: Land Use/Land Cover in Maryland (2002–2010) 36
Table 2-11: Federally Owned Land in Maryland by Agency 39
Table 3-1: FEMA Plan Review Criteria 40
Table 3-2: Relevant Hazards for Maryland 42
Table 3-3: Probability Rating 42
Table 3-4: State Assets by Jurisdiction 46
Table 3-5: Critical Facilities by Jurisdiction 48
Table 3-6: Presidentially Declared Disasters 51
Table 3-7: Presidentially Declared Disasters by Hazard 53
Table 3-8: Saffir-Simpson Hurricane Wind Scale 60
Table 3-9: Maryland Sea Level Rise Projections 64
Table 3-10: Flood Risk Refined by Jurisdiction 65
Table 3-11: Critical Facilities within High Hazard Coastal Areas 66

Table 3-12: State Assets within High Hazard Coastal Areas 67
Table 3-13: Sea Level Consequence Analysis 70
Table 3-14: Shoreline Erosion Consequence Analysis 72
Table 3-15: Nor'easter Consequence Analysis 73
Table 3-16: Number of Dams in Each Jurisdiction 76
Table 3-17: Number and Classification of High Hazard Dams 77
Table 3-18: Maryland Dam Failures 79
Table 3-19: Critical Facilities Impacted by Dam Failure by Jurisdiction 83
Table 3-20: State Assets Impacted by Potential Dam Failure by Jurisdiction 84
Table 3-21: Dam Failure Consequence Analysis 85
Table 3-22: Categories of Drought 88
Table 3-23: Critical Facilities Drought Loss Estimations 92
Table 3-24: State Assets Drought Loss Estimations 93
Table 3-25: Drought Consequence Analysis - Impacts 93
Table 3-26: Extreme Temperature Consequence Analysis 99
Table 3-27: FEMA Flood Zones 106
Table 3-28: Critical Facilities within FEMA Flood Zones 108
Table 3-29: Historic Critical Facilities within FEMA Flood Zones 109
Table 3-30: Critical Facilities Loss Estimations 110
Table 3-31: State Assets within FEMA Flood Zones 112
Table 3-32: Historic State Assets within FEMA Flood Zones 113
Table 3-33: State Assets Loss Estimations 114
Table 3-34: Flood Hazard Consequence Analysis 115
Table 3-35: Terrorism Attack Magnitude 122
Table 3-36: NRC Nuclear Event Classification System 123
Table 3-37: Types of Cyber-Attacks 125
Table 3-38: Human-Caused Threats Consequence Analysis 133
Table 3-39: COVID-19 Cases by Jurisdiction (March 2021) 139
Table 3-40: COVID-19 Statistics at a Glance (March 11, 2021) 144
Table 3-41: Public Health Emergency Consequence Analysis 145
Table 3-42: Soil Movement Consequence Analysis 153
Table 3-43: Severe Thunderstorm Watch/Warning Definitions 158
Table 3-44: Critical Facilities Thunderstorm Loss Estimations 160
Table 3-45: Thunderstorm Consequence Analysis 161
Table 3-46: Tornado EF Scale 165
Table 3-47: Critical Facilities Tornado Loss Estimations 167
Table 3-48: State Assets Tornado Loss Estimations 168
Table 3-49: Tornado Consequence Analysis 169
Table 3-50: NFDRS Classification System 172
Table 3-51: Critical Facilities Wildfire Loss Estimations 173
Table 3-52: State Assets Wildfire Loss Estimations 174
Table 3-53: Wildfire Consequence Analysis 175
Table 3-54: Wind Classification Scale 179
Table 3-55: Critical Facilities Wind Loss Estimations 180
Table 3-56: State Assets Wind Loss Estimations 181
Table 3-57: Wind Consequence Analysis 181

Table 3-58: Critical Facilities Winter Weather Loss Estimations....187
Table 3-59: State Assets Winter Weather Loss Estimations....187
Table 3-60: Winter Weather Consequence Analysis....188
Table 3-61: Local Hazard Rankings 2020 – Self-Assessment....195
Table 3-62: Ranking Scales– April 2020....198
Table 4-1: State Mitigation Plan Review Guide....199
Table 4-2: TEAM Model Scoring Mechanism....208
Table 4-3: HMP Mitigation Action Implementation Plan....213
Table 4-4: Mitigation Action Funding Sources....219
Table 5-1: State Mitigation Plan Review Guide....229
Table 5-2: Maryland Jurisdictions Using Federal Funds Since 2016....230
Table 5-3: Status Update Definitions....241
Table 5-4: Past 2016 Actions with Identified Lead Agencies....244
Table 6-1: State Mitigation Plan Review Guide....246
Table 6-2: Commonly Used Non-HMA Federal Grant Programs....250
Table 6-3: Existing Jurisdictional Planning Mechanisms....258
Table 6-4: Jurisdictional Hazard Mitigation Plan Status....261
Table 6-5: Plan Integrated/Reviewed Within HMPs by Jurisdiction....263
Table 6-6: Recommended Plan Integration Review Questions....268
Table 6-7: Program Participation and Capabilities by Jurisdiction....269
Table 6-8: Participating CRS Communities within the State of Maryland, as of October 2020....271
Table 6-9: County/Jurisdiction NFIP Participation Activities....273
Table 6-10: Maryland StormReady Entities....289
Table 7-1: State Mitigation Plan Review Guide....296
Table 7-2: NFIP RL & SLR Data by Jurisdiction....298
Table 7-3: NFIP Policies per Jurisdiction....309
Table 7-4: State of Maryland CRS Participating Communities....311
Table 7-5: NFIP RL & SLR Data by Region....312

Figures

Figure 1-1: MEMA Plan Update Schedule....4
Figure 1-2: Snapshot of the MEMA Plan Update Virtual Room....10
Figure 2-1: General Maryland Map....16
Figure 2-2: Maryland Geologic Regions....18
Figure 2-3: Maryland Tributary Basins....20
Figure 2-4: Jurisdictions of Maryland....22
Figure 2-5: Percent Population Change in Maryland from 2010-2019....24
Figure 2-6: Minority Population Share for Maryland's Jurisdictions....26
Figure 2-7: County and Municipal Growth Areas....35
Figure 2-8: Maryland Land Use/Land Cover Map 2010....36
Figure 2-9: Total Acres Preserved, by County....38
Figure 2-10: Federal Land in Maryland by Percentage....39

Figure 3-1: Map of High and Significant Hazard Dams....78
Figure 3-2: Potential Damage from Dam Failure....78
Figure 3-3: Maryland Drought Conditions (2000–2020)....90
Figure 3-4: Drought Monitor Legend....91
Figure 3-5: NWS Heat Index....97
Figure 3-6: Windchill and Frostbite Incidence....98
Figure 3-7: Heat Deaths by Month, 2014–2018....99
Figure 3-8: Opioid-Related Intoxication Deaths in Maryland by County. First Calendar Quarter, 2020 (preliminary counts).....142
Figure 3-9: Karst Features of Soil Types....149
Figure 3-10: Erosion Maps by Quadrangle....150
Figure 3-11: Overall Ranking Equation....197
Figure 4-1: Sample Mitigation Action Worksheet....205
Figure 4-2: TEAM Scoring Inputs....207
Figure 4-3: Action Priority Ranking Ranges....208
Figure 4-4: Action Development and Scoring Process....209
Figure 5-1: HMA Grants by Region 2016 - 2020....237
Figure 5-2: HMA Funding Applied for by Region – 2016 - 2020....238
Figure 5-3: HMA Applications by Program 2016 - 2020....239
Figure 6-1: Location of StormReady Entities in Maryland....290
Figure 7-1: NFIP RL Data by Jurisdiction....301
Figure 7-2: NFIP SRL Data by Jurisdiction....303
Figure 7-3: Regional RL Distribution....304
Figure 7-4: Regional SRL Distribution....304
Figure 7-5: NFIP RL Claims Data by Jurisdiction....306
Figure 7-6: NFIP SRL Claims Data by Jurisdiction....307
Figure 7-7: NFIP Unmitigated RL & SRL Claims Data by Region....313

Acronym List

This list is provided as a reference for acronyms that may appear frequently throughout the Plan.

ATC	Applied Technology Council
BCA	Benefit-Cost Analysis
BCEGS	Building Code Effectiveness Grading Schedule
BGE	Baltimore Gas and Electric
BI	Blue Infrastructure
BRIC	Building Resilient Infrastructure in Communities
CAP	Continuing Authorities Program
CARES	Coronavirus Aid, Relief, and Economic Security Act
CAV	Community Assistance Visit
CBT	Chesapeake Bay Trust
CCS	Chesapeake and Coastal Services
CDA	Community Development Administration
CDBG	Community Development Block Grants
CDC	Centers for Disease Control and Prevention
CFMGP	Comprehensive Flood Management Grant Program
CIKR	critical infrastructure and key resources
CLG	Certified Local Government
COMAR	Code of Maryland Regulations
Comp Plan	Comprehensive Plan
COOP	Continuity of Operations Plan
CPI	Consumer Price Index
CRAB	Maryland Climate Ready Action Boundary
CRS	Community Rating System
CTP	Cooperating Technical Partner
DGS	Maryland Department of General Services
DHCD	Maryland Department of Housing and Community Development
DHS	Maryland Department of Human Services
DHS	U.S. Department of Homeland Security

DMA	Disaster Mitigation Act of 2000
DNR	Maryland Department of Natural Resources
DRP	Disaster Recovery Plan
DVE	domestic violent extremist
EAP	Emergency Action Plan
EF	Enhanced Fujita (Scale)
EM	emergency (loan)
EMAP	Emergency Management Accreditation Program
EMPG	Emergency Management Performance Grant Program
EMT	emergency medical technician
EOP	Emergency Operations Plan
EPA	U.S. Environmental Protection Agency
EPZ	emergency planning zones
ESD	environmental site design
ESHPF	Emergency Supplemental Funding from the Historic Preservation Fund
EVA	Erosion Vulnerability Assessment Tool
EVIC	Electric Vehicle Infrastructure Council
EWPP	Emergency Watershed Protection Program
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FEMA GO	FEMA Grants Outcomes
FFR	federal financial reports
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FIT	FEMA Integrated Team
FMA	Flood Mitigation Assistance
FMAG	Fire Management Assistance Grant
FMP	Flood Mitigation Plan
FRR	Flood Risk Report
FSA	Farm Service Agency
G3	Green Streets, Green Jobs, Green Towns
GIP	Green Infrastructure Plan

GIS	geographic information system
Guide	*State Mitigation Plan Review Guide*
HIRA	Hazard Identification and Risk Assessment
HMA	Hazard Mitigation Assistance
HMEP	Hazardous Materials Emergency Preparedness
HMGP	Hazard Mitigation Grant Program
HMP	hazard mitigation plan
HSGP	Homeland Security Grant Program
HVE	homegrown violent extremist
LFP	Livestock Forage Disaster Program
LOMA	Letter of Map Amendment
LOMR	Letters of Map Revision
MAC	Mitigation Advisory Committee
MARC	Maryland Area Regional Commuter
MAFSM	Maryland Association of Floodplain and Stormwater Managers
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDH	Maryland Department of Health
MDOT	Maryland Department of Transportation
MDP	Maryland Department of Planning
MEMA	Maryland Emergency Management Agency
MGS	Maryland Geological Survey
MHT	Maryland Historical Trust
MIA	Maryland Insurance Administration
mph	miles per hour
MTA	Maryland Transit Administration
MVA	Motor Vehicle Administration
MW	megawatts
NAIP	National Agriculture Imagery Program
NCA4	Fourth National Climate Assessment
NCDC	National Climatic Data Center
NFDRS	National Fire Danger Rating System

NFIP	National Flood Insurance Program
NFP	Nuisance Flooding Plan
NFPA	National Fire Protection Association
NGO	nongovernmental organization
NOAA	National Oceanic and Atmospheric Administration
NOFO	Notice of Funding Opportunity
NOI	Notice of Interest
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRCS	U.S. Natural Resources Conservation Service
NSGP	Non-Profit Security Grant Program
NWS	National Weather Service
PCS	Property Claim Service
PDM	Pre-Disaster Mitigation
PEPCO	Potomac Electric Power Company
PFA	Priority Funding Area
PHEP	Public Health Emergency Preparedness
PSC	Maryland Public Service Commission
PV	photovoltaic
PWEAA	Public Works and Economic Adjustment Assistance Program
Risk MAP	Risk Mapping, Assessment, and Planning
RL	Repetitive Loss
RPS	Renewable Portfolio Standard
RRC	Risk Reduction Consultation
SARS	severe acute respiratory syndrome
SBA	Small Business Administration
SCADA	Supervisory Control and Data Acquisition
SF	Standard Form
SFHA	Special Flood Hazard Area
SHA	State Highway Administration
SHMO	State Hazard Mitigation Officer
SHSP	State Homeland Security Grant Program

SLOSH	Sea, Lake, and Overland Surges from Hurricanes (model)
SME	Subject Matter Expert
SMECO	Southern Maryland Electric Cooperative, Inc.
SMP	State Mitigation Plan or Plan
SOP	standard operating procedure
SQL	Structured Query Language
SRL	Severe Repetitive Loss
TNC	The Nature Conservancy
UASI	Urban Area Security Initiative
UMBC	University of Maryland Baltimore County
UMCP	University of Maryland, College Park
UMES	University of Maryland Eastern Shore
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey
VPC	Vision Planning & Consulting
WGL	Washington Gas & Light
WHO	World Health Organization
WMATA	Washington Metropolitan Area Transportation Authority
WPFPP	Watershed Protection and Flood Prevention Program
WSSC	Washington Suburban Sanitary Commission
WUI	wildland-urban interface

Section 1: Introduction and Plan Development Process

Maryland's 2021 State Hazard Mitigation Plan Update (Plan) builds on the previous Maryland State Hazard Mitigation Plan of 2001 and subsequent updates, most recently the 2016 Maryland Natural Hazards Mitigation Plan. In addition to ensuring that all requirements outlined in 2 CFR §201.4 are met, sections of the Plan were updated, expanded, newly developed, and consolidated to provide a more concise picture of statewide mitigation.

This plan follows guidance contained in the Federal Emergency Management Agency's (FEMA's) *State Mitigation Plan Review Guide* (Guide). This guide is FEMA's official policy on and interpretation of the natural hazard mitigation planning requirements. The intended use of the Guide is to facilitate consistent evaluation and approval of state mitigation plans, as well as to facilitate state compliance with the mitigation planning requirements when updating plans. The two key elements discussed by FEMA in its Guide, along with the associated requirements, are presented below in Table 1-1.

Table 1-1: State Mitigation Plan Review Guide

Element	Requirement
S1. Does the plan describe the process used to update and develop the plan? [2 CFR §201.4(b) and (c) (1)] **Intent:** To demonstrate a deliberate approach to plan development.	The plan must describe the current process used to update the plan, including how the plan was prepared, the schedule or time frame, specific milestones and activities, the agencies and stakeholders who were involved in the process, and if the mitigation planning process was integrated to the extent possible in other state planning efforts.
S2. Does the plan describe how the state coordinated with other agencies and stakeholders? [2 CFR §201.4(b) and (c) (1)] **Intent:** To actively involve stakeholders with the data and expertise to develop the plan, but also with the responsibility or authority to implement mitigation actions and reduce risk statewide.	The plan must describe how other state and federal agencies and other stakeholders were involved in the process. At a minimum, the plan must describe how the state coordinated with other agencies with other agencies and stakeholders responsible for the following sectors: • Emergency management; • Economic development; • Land use and development; • Housing; • Health and social services; • Infrastructure; and • Natural and cultural resources.

As the following sections will show, the State of Maryland's *2021 State Hazard Mitigation Plan* exceeds the requirements identified above.

1.1 Planning Process

The Maryland Emergency Management Agency (MEMA) is the state entity responsible for maintaining ownership and leading development of the Plan. The

planning process for the 2021 Plan update began in 2016. Throughout the course of the last 4 years, the state, local jurisdictions, and even private interest groups conducted a series of workshops and planning meetings to discuss mitigation activities. In 2020, MEMA secured the services of AECOM, the Maryland Environmental Service, and Vision Planning & Consulting (VPC) to assist with plan development. All three consultants are considered experts in mitigation planning.

The current planning process used to update the Plan entailed the development of individual scopes of work to complete plan elements. These scopes of work included tasks with associated timeframes and milestones.

Using a plan development process focused on individual plan elements ensured that the greatest opportunities for collaboration were made available to federal, state, local, and non-governmental partners. Rather than approaching all partners with an entire plan, using individual plan elements allowed for focused initiatives that were of particular interest to those involved. For consistency, a cutoff date was established for the availability of data: September 1, 2020. Data sets, such as the U.S. Census or new disaster declarations, available after this date were noted for incorporation into future plan updates.

The process to develop the 2021 Plan began in late Spring 2020, right at the outset of the COVID-19 pandemic that has ravaged the nation and the state, creating a new and unique opportunity for outreach and engagement that went beyond the traditional in-person meetings and briefings. This allowed the state to engage stakeholders in a virtual manner, expanding the reach of the information and integrating ideas and thoughts from sectors of the public not typically present during a traditional plan update process. The centerpiece of this effort was the State of Maryland State Hazard Mitigation Plan Update Virtual Room, as discussed below under "Information Distribution."

Traditional outreach and coordination initiatives were also performed continuously throughout the plan development process, though they also occurred via virtual methods such as Microsoft Teams or Webex. These initiatives ranged from the development and dissemination of *State of Maryland Local Hazard Mitigation Plan Guidance*, to the strengthening and expansion of state partnerships resulting in collaborative and meaningful mitigations strategies.

Information regarding the Plan maintenance and update process may be found in Section 6.3.

FEMA supports hazard mitigation planning as a means to:

- Foster partnerships for natural hazard mitigation
- Promote more resilient and sustainable states and communities
- Reduce the costs associated with disaster response and recovery

1.2 2021 Plan Organization

To make the plan more usable and reader friendly, MEMA has restructured this Plan. Several sections from the 2016 Plan have been collapsed/combined with others, or simply reordered for better

readability and flow. In all instances, the FEMA Plan Checklist information is retained so that FEMA and other stakeholders can have quick access to the sections most relevant for approval and for information retrieval.

Each Plan section contains the associated element and requirement within a table format from the FEMA publication, *State Mitigation Plan Review Guide*, released March 2015. The Guide is intended to facilitate consistent evaluation and approval of state mitigation plans, as well as to facilitate state compliance with the mitigation planning requirements when updating plans.

Noting the elements and requirements for each Plan section provides readers an opportunity to review these requirements in association with Maryland's commitment to meet all of the requirements through the presentation of data analysis, maps and figures, activities, capabilities, and ideas for the future, which are presented throughout the document.

Plan sections are presented in the following order:

Section 1.0	Plan Development Process
Section 2.0	Maryland Land Development & Population
Section 3.0	Hazard Identification and Risk Assessment/Vulnerability Assessment
Section 4.0	2021 Mitigation Strategies
Section 5.0	2015–2020 Mitigation Implementation Status Report
Section 6.0	Management & Local Hazard Mitigation Plans; Plan Maintenance and Update
Section 7.0	Repetitive Loss Strategy

1.3 Looking to the Future

Fall of 2020 brought with it the launch of the newest FEMA pre-disaster mitigation program, the Building Resilient Infrastructure and Communities (BRIC) program. MEMA submitted multiple subapplications under the BRIC program for its first year but has also focused on developing its mitigation plans and projects in such a way so that they are competitive in the future. With the goal of developing a comprehensive approach to mitigation, MEMA is using the guiding principles of BRIC, which include nature-based solutions, private partnerships, and innovation, to inform the state's mitigation strategies and actions in the Plan, resulting in a comprehensive approach to mitigation and integrating the core principles of the BRIC program. The Mitigation Strategies and Actions in Section 4 identify opportunities to mitigate damage to critical lifelines, incorporate projects that utilize nature-based solutions, and address additional future climatological conditions, such as sea level rise. Additionally, the state is already well-positioned for success by adopting the 2018 editions of the International Building Codes and has also begun to focus on the integration of local hazard mitigation plans, addressed under Section 1 and 6, something MEMA is well familiar with having done this for the last couple

iterations of the state plan. All of these are criteria fall under the BRIC competition scoring—MEMA is already well positioned to earn those points for any mitigation project that it submits.

1.4 Plan Guidance

MEMA developed the *State of Maryland Local Hazard Mitigation Plan Guidance* in May of 2015 to advise local jurisdictions of available resources, coordination activities, and minimum elements that should be included within their next local hazard mitigation plan updates. Maryland-specific recommendations are presented as well as the introductions of ideas for plan integration, resilience, and climate change. This Guidance is still in use and is updated as needed or as grant program requirements change at the federal level. Additionally, MEMA has a FEMA Integrated Team (FIT) Community Planner and will continue working with FIT personnel to build upon and expand efforts to build planning capability at the local and state level.

1.5 Plan Schedule

A detailed planning schedule was used to ensure a timely completion of the Plan. The planning schedule reduced each major task into subtasks with associated end dates and was followed closely throughout the planning process. Observing the schedule helped facilitate the planning process, provided for timely ongoing draft section reviews by MEMA and associated comment integration, and made sharing task deadlines amongst the different planning teams more seamless. A condensed version of the schedule is shown in Figure 1-1, below, and the detailed planning schedule can be found in Appendix A.

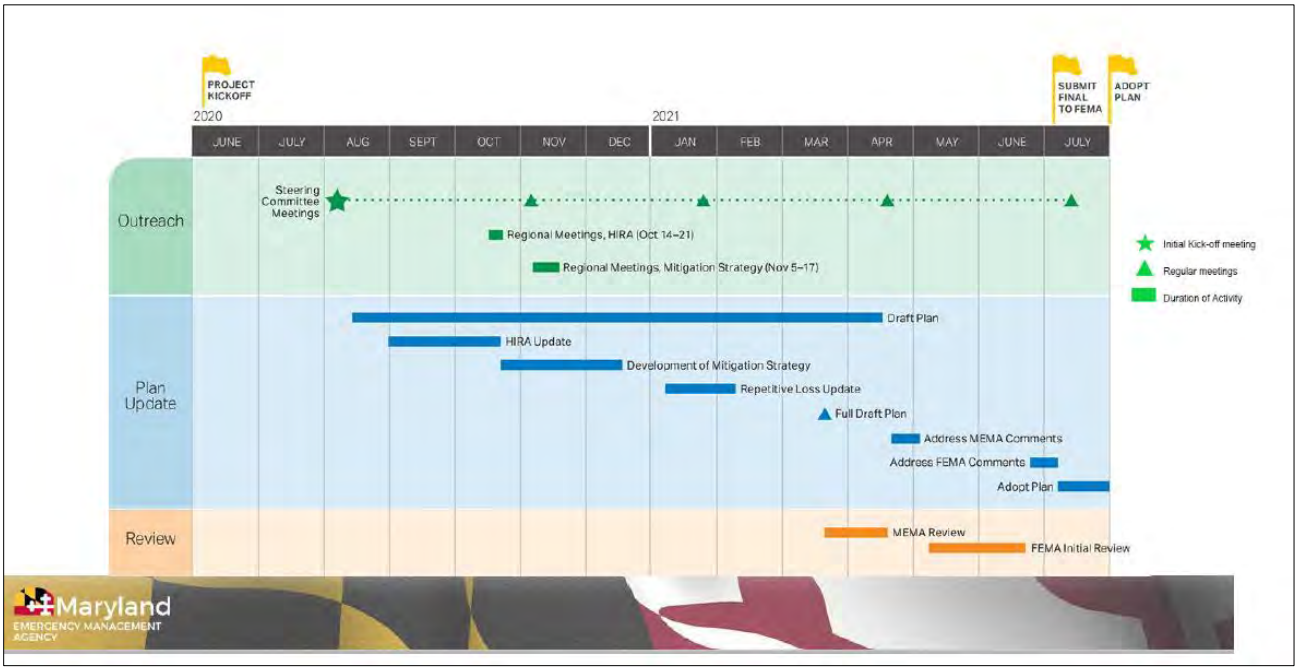


Figure 1-1: MEMA Plan Update Schedule

1.6 Steering Committee

The state and local mitigation planning team was composed of a broad group of state and local agency partners and natural hazard Subject Matter Experts (SMEs) that encompassed a whole community approach. These stakeholders, listed in Table 1-2 below, contributed to Maryland's mitigation program and integrated planning process through a variety of means, including their defined capabilities, ownership of critical facilities, provision of data and information for the risk assessment, participation in the planning process, and their ongoing review and comment on plan drafts throughout the update.

Table 1-2: Maryland State Hazard Mitigation Plan - Steering Committee

Agency
Department of Commerce
Department of Labor, Licensing & Regulation
Department of Human Services
Department of Natural Resources
Department of Planning
Maryland Historic Trust
Department of the Environment
Department of Transportation
Department of General Services
Maryland Insurance Administration
Department of Housing and Community Development
Department of Disabilities
Maryland Emergency Management Agency

1.7 Mitigation Advisory Committee

The Mitigation Advisory Committee (MAC) serves as the leadership group for the Mitigation Mission Area at the state level. The state departments and agencies engaged in mitigation operate according to their statutory authorities in a roundtable, group approach to making decisions. MEMA serves as the lead for the Mitigation Mission Area and the State Hazard Mitigation Officer (SHMO) serves as chair of the MAC. The MAC helps to identify Maryland's threats and hazards and conducts assessments to prioritize threats and hazards according to risk. Additionally, the MAC is responsible for the review and prioritization of Hazard Mitigation Assistance (HMA)-related projects that are recommended and forwarded to FEMA for funding. The final authority to submit projects to FEMA for funding rests

with the Governor's Authorized Representative, which is the Executive Director of MEMA. The MAC is also responsible for the maintenance and revisions of this Plan.

The MAC evaluates and prioritizes all eligible mitigation project applications using a Project Ranking System. The prioritization and ranking system that the MAC uses is found in Section 6.1.2.

The MAC is staffed from, but not limited to, the following departments, agencies, and associations:

- Maryland Emergency Management Agency (MEMA)
- Department of Commerce
- Department of Labor, Licensing & Regulation
- Department of Housing and Community Development (DHCD)
- Department of Human Services (DHS)
- Department of Natural Resources (DNR)
- Department of Planning (MDP)
- Department of the Environment (MDE)
- Department of Transportation (MDOT)
- Department of General Services (DGS)
- Maryland Insurance Administration (MIA)

The MAC met periodically throughout the State Hazard Mitigation Plan update process and participated in stakeholder engagement events.

- Steering Committee Meetings: August 5, 2020; October 26, 2020; February 4, 2021; April 19, 2021; and July 12, 2021
- August 5, 2020: State Hazard Mitigation Plan Update Kickoff Meeting
- October 15, 19 & 20, 2020: State Hazard Mitigation Plan Update Hazard Identification and Risk Assessment (HIRA) Update Meetings
- December 7–9, 2020: State Hazard Mitigation Plan Mitigation Strategies Prioritization

1.8 Plan Update Team

The Planning Team was made up of MEMA staff and a consultant team of AECOM, the Maryland Environmental Service, and VPC. The Planning Team was tasked with day-to-day responsibilities for developing the Plan. Additionally, the Planning Team was responsible for coordination and communication among state, local, and private stakeholders. The Planning Leadership Team members are listed in below in Table 1-3.

Table 1-3: Maryland State Hazard Mitigation Plan - Leadership Team

Organization	Name
MEMA	Kyle Overly
MEMA	JaLeesa Tate
MES	Jen Sparenberg
MES	Michael Manen
AECOM	Lael Holton
AECOM	Amy Baker
VPC	Deepa Srinivasan
VPC	Ashley Samonisky

1.9 Meetings and Coordination

Meetings and coordination were an integral part of the planning process for continued progress on the Plan update. Between 2016 and 2021, the Planning Team and state plan stakeholders conducted a variety of meetings and inter-jurisdictional coordination. These efforts are described below:

1.9.1 Steering Committee Meetings

The 2021 Maryland State Hazard Mitigation Plan Steering Committee was responsible for the high-level decision-making and steering of the Plan update process, including cross-sector coordination and guidance. Members met on a quarterly basis, starting the planning process with a virtual (due to the Covid-19 pandemic) **Kickoff Meeting** on August 5, 2020. The virtual kickoff meeting discussed the high-level strategy for each phase of the planning process, with more focus on methodology and data needs for the HIRA update. The Meetings also served to review, rank, and prioritize the Mitigation Actions.

Additional Committee Meetings occurred in October 2020 and February, April, and July of 2021.

1.9.2 Planning Team Meetings

Following the **Kickoff Meeting**, the Planning Team met bi-weekly (via virtual platforms), utilizing video conference calls and webinars. During these meetings, topics such as progress, updates, data needs/requests, and project timelines were discussed for each phase of the planning process. These meetings were critical in continually advancing the planning process and allowing for consistent communication regarding Plan progress and needs. Every month, the Planning Team provided a status update to MEMA; this update included details on budget, work to date, and upcoming actions and activities of note.

1.9.3 Regional Outreach Meetings

A series of 10 regional outreach meetings were held throughout the state for this Plan update. Five meetings focused on HIRA data and reviewing changes to the state's Vulnerability Assessment and identification of state critical facilities. Basic HIRA meeting information is presented below in Table 1-4.

Table 1-4: 2021 Maryland HIRA Meetings

Location	Date	Number of Attendees	Major Concerns Identified by Participants
Central	10/19/20	39	Participants concerned thunderstorm and extreme temperature risk data were incomplete
Southern	10/19/20	21	Review flooding against August 2020 flood data to ensure that latest events are included in the analysis
Western	10/15/20	27	Participants concerned dam information were incomplete
Upper Eastern Shore	10/20/20	26	Review dam information specifically associated with the Conowingo dam to ensure that relevant data is included in the modeling
Lower Eastern Shore	10/20/20	26	None identified

The remaining five meetings were used to solicit input regarding Mitigation Strategies for inclusion in this update. Mitigation Strategy meetings were held to answer three main questions: 1): What long-term outcomes does the state and its local jurisdictions want to achieve; 2) What specific actions will Maryland jurisdictions take to reduce risk to hazards? and, 3): How will identified mitigation actions be prioritized and implemented? Basic Mitigation Strategy meeting information is presented below in Table 1-5, with detailed information for each meeting provided in Appendix B.

Table 1-5: 2021 Maryland Mitigation Strategy Meetings

Location	Date	Number of Attendees	Major Concerns Identified by Participants
Central	12/7/20	30	No major concerns
Southern	12/8/20	19	St. Mary's and Calvert counties identified needs within their communities and offered reciprocal support.
Western	12/7/20	17	No major concerns
Upper Eastern Shore	12/9/20	24	No major concerns
Lower Eastern Shore	12/9/20	16	No major concerns

The regional outreach meetings provided participants information on the availability of new data, risk products, and technical assistance opportunities. Each meeting was held virtually in an MS Teams environment and facilitated by MEMA. Members of the Steering Committee and Planning Team attended each meeting.

Brief summaries of each meeting are provided in Appendix B.

1.9.4 Additional Stakeholder Meetings

Throughout the 2021 planning cycle, Maryland state mitigation representatives participated in numerous stakeholder meetings to discuss hazards, mitigation efforts, and future strategies. A summary of these meetings is presented in Appendix B. Since the completion of the last Plan update, MEMA has led or participated in nearly 40 stakeholder meetings, forums, and workshops. Many of these sessions were focused on providing information and assistance to stakeholders that need assistance in the development of mitigation plans or projects. These engagements have included training seminars, state mitigation workshops, and grant application informational updates as well as issue-focused presentations and are provided as part of MEMA's commitment to improving the capability of our stakeholders.

MEMA will continue to involve these stakeholders and partners in future discussions.

1.10 Information Distribution

As mentioned above, the challenges presented by the pandemic required the state to develop alternative methods for engagement and information distribution. MEMA utilized traditional methods of soliciting input, such as email surveys for the status of past Mitigation Actions, as well as other less traditional methods such as conducting online polls during virtual meetings. To ensure the widest distribution of information presented at major meetings during this Plan update process, MEMA recorded each meeting and placed the final recordings on MEMA's Virtual Meeting Room, described further below. The recording of meetings, in addition to electronic copies of the presentations, allow viewers to not only consume the same information as those present in the meeting, but also to receive the same explanations, which often go deeper than the talking points on the page.

One of the new resources that MEMA leveraged this year was the development of the State of Maryland Hazard Mitigation Plan Update Virtual Room (MEMA Virtual Room). The MEMA Virtual Room is a virtual engagement tool that provides an immersive, interactive experience for stakeholders to access Plan materials and provide feedback (Figure 1-2).

The MEMA Virtual Room can be accessed at https://aecomviz.com/MEMA-Maryland-360/. Information presented in this virtual room includes a detailed analysis of hazards, threats, maps, owners of critical facilities, and a listing of state-owned facilities by region. The virtual room also includes various hazard identification and mitigation information, such as the 2018 *Flood Mitigation Guide: Maryland's Historic Buildings*, as well as information on the "Maryland Prepares" mobile app and FEMA's mobile app, which contains do-it-yourself mitigation techniques and tips. All

meetings and presentation recordings are also available on the virtual room, providing unique and continuous access for interested stakeholders and the public. MEMA included a link to a Survey123 instrument, designed to allow users to identify problem areas in their community. Information from this survey will be useful to MEMA and local jurisdictions in identifying areas of regional mitigation and crafting a regional/state response. The results of this survey will inform the development of new mitigation projects with a multi-jurisdictional impact. Finally, MEMA included a "comment box" in the virtual room to solicit feedback from visitors that could be included in the Plan. Questions prompted users to review the information presented and to provide any information that they felt was missing from the draft of the Plan sections.

As of the submission to FEMA, MEMA's Virtual Room had over 820 unique visitors with over 1,200 views of the page.

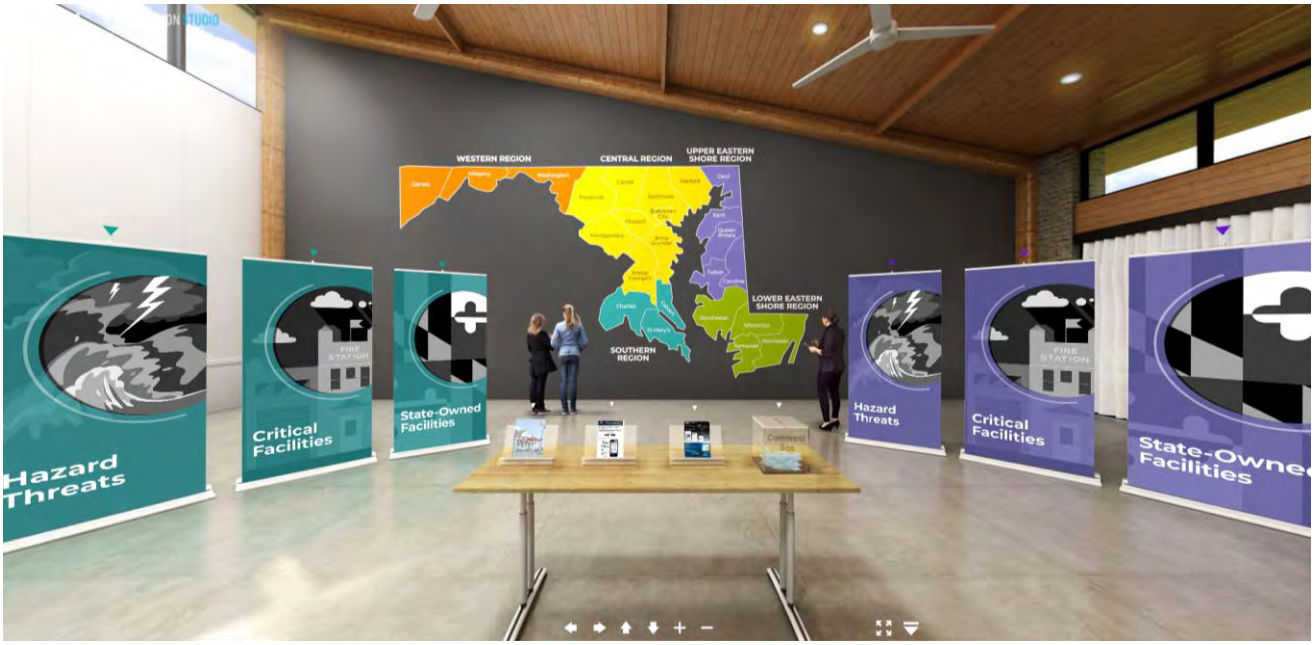


Figure 1-2: Snapshot of the MEMA Plan Update Virtual Room

1.11 Integration with Other State and Federal Planning Efforts

MEMA coordinated the Plan update with other state and federal agencies and stakeholders. Coordinating partners include, but are not limited to:

- *FEMA, Region 3*: MEMA regularly consults with Region 3 on mitigation matters. Since the 2016 update, MEMA and FEMA have met multiple times and hosted major engagements together. FEMA is a strong partner in ensuring that mitigation efforts are synchronized across the region and was regularly invited to the regional stakeholder meetings during the course of this update cycle. In 2021, FEMA executed an agreement with MEMA to

provide a FIT Community Planner to further strengthen planning integration efforts.

- *Maryland Association of Floodplain and Stormwater Managers*: Serving as the Co-Chair of the Mitigation Committee, MEMA participated in the Spring and Annual Conferences to continuously expand the capability of stakeholders through sharing knowledge of mitigation planning and project implementation. Efforts also included dedicated presentations regarding the 2016 Plan implementation and the 2021 Plan update. MEMA planned and conducted a "Lunch and Learn" event to discuss the Repetitive Loss Strategy with stakeholders to get targeted engagement and feedback from floodplain and stormwater management professionals. In addition, MEMA representatives participated in community engagement activities utilizing the Association's 3D Flood Model to teach the general public about water management and flood mitigation. Other activities have included providing subject matter expertise on locally proposed legislation related to natural hazards.
- *Maryland CoastSmart Council:* MEMA participates in quarterly meetings as a member of the CoastSmart Council to provide subject matter expertise on state-proposed legislation, including Nuisance Flood Plans.
- *Maryland Commission on Climate Change:* Adaptation and Resiliency Work Group. MEMA participates in quarterly meetings as a member of the Working Group to provide subject matter expertise. Additionally, MEMA serves on subcommittees to develop the State's Adaptation Framework.
- *Maryland Silver Jackets:* MEMA participates in quarterly Silver Jackets meetings to provide subject matter expertise and to identify flood risk reduction initiatives through the state. MEMA supported and participated in interagency non-structural projects (i.e., regional Floodproofing workshops, Baltimore City Frederick Avenue outreach activities). The Maryland Silver Jackets team won the 2019 Silver Jackets Team of the Year award and MEMA staff was granted the opportunity to attend the 2019 Interagency Flood Risk Management Training Seminars to highlight the team's interagency, non-structural projects.
- *Maryland Department of the Environment:* MEMA works closely with MDE in regard to flood risk management. This includes participating and presenting at Community Rating System (CRS) User Group meetings, participating in project proposal reviews for the Department's Comprehensive Flood Management Grant Program (CFMGP), co-hosting a Flood Insurance Roundtable and annual Risk Reduction Consultations, and working on other mitigation initiatives.
- *Maryland Department of Commerce:* MEMA works closely with Commerce in order to ensure private-sector involvement with risk reduction initiatives. In 2020, a partnership was formed between Commerce, MEMA, the Netherlands Water Partnership, and Baltimore-Rotterdam Sister City Committee to host

an international knowledge exchange to further build capability in Maryland communities and make connections with resilience experts to provide access to additional capacity of Maryland communities.

- *Maryland Resiliency Partnership.* MEMA participates in quarterly meetings and activities, including aiding in the development of a "Flood Awareness Month" that was used to conduct public outreach and education regarding flood risks in Maryland.
- *National Emergency Management Association:* MEMA Executive Director Mr. Russell Strickland was co-chair for the National Emergency Management Association's Resilience Committee during the Plan update. In addition, State Hazard Mitigation Officer Ms. JaLeesa Tate was Chair for the SHMO Subcommittee. These individuals participate in ongoing policy recommendations made to FEMA Administration and most notably contributed to policy recommendations for the implementation of the Disaster Recovery Reform Act of 2018. Executive Director Strickland has also engaged with the House Transportation and House Committee and U.S. Chamber of Commerce related to mitigation and resilience activities.

Additional information on the partners listed above as well as other relevant state programs and planning efforts may be found in Section 6.1.5.

Finally, as it pertains to coordination of planning efforts, in response to a renewed federal focus on Dam Safety and the emergence of the federal Rehabilitation of High Hazard Potential Dams grant program at FEMA, MEMA and MDE undertook a comprehensive study of dams throughout the state. This study, approved by FEMA as an amendment to the 2016 Plan in July 2020, was utilized during the development of this Plan's HIRA and Mitigation Strategy sessions. Dams were reintroduced as a hazard, and the recommendations of the amendment have been included. The entire report can be found in Appendix C. Additional research and coordination will be needed during the lifespan of this Plan to ensure that the dam data are accurate and present an appropriate view of the risk to the people and property surrounding these features. With the support of HMGP funding, MDE is currenting undertaking this data analysis. MEMA anticipates off-cycle revisions to the risk maps and analyses during the next 5 years to more accurately project the risks and vulnerabilities associated with dams.

1.12 Additional Mitigation and Outreach Activities

The MAC will continue to be the monitoring and implementation body for the 2021 Plan, as well as the workgroup to support and inform future Plan updates. Following the adoption of the 2021 Plan, the workgroup will meet periodically throughout the year to discuss mitigation activities, align projects, and seek opportunities to partner and conduct an annual review of the Plan.

As identified in the new Mitigation Actions, MEMA is implementing a regular review and update of state activities. State agencies will also track program implementation

and submit the data annually to MEMA as discussed under Mitigation Action 21, providing an annual summary of activity as required. This report will detail progress toward key mitigation goals and objectives highlighted in the Plan. This process will also allow for timely updates to plan strategies, programs, and hazard analyses. Among the benefits for this report are improved interagency program coordination, as well as regular progress numbers.

In addition to the meetings and events discussed above, MEMA representatives have participated in additional mitigation and outreach activities, including:

- Conducting project kickoff meetings to provide technical assistance for the successful project implementation and grants management of FEMA HMA awards.
- Participating in local outreach events to build public awareness of natural hazards risk and mitigation efforts.
- Participating in local hazard mitigation planning efforts, including regional efforts.
- Participating on review panels for resilience-related grant programs in order to have a comprehensive approach to resilience within the state. This includes DNR's Grants Gateway, MDE's CFMGP, and Chesapeake Bay Trust's (CBT's) Green Streets, Green Jobs, Green Towns (G3) programs.
- Participating in quarterly Appointed Local Emergency Manager meetings and hosted dedicated quarterly webinars for FEMA HMA subrecipients.
- Participating in a variety of studies to aid in public awareness activities locally and nationally, including with the PEW Charitable Trusts, the National Academies of Sciences, and University of Maryland.
- Developed a Subapplicant Guide dedicated to providing Maryland subapplicants with resources to successfully pursue FEMA HMA awards.
- Working with federal and state partners in Region 3 to develop an "integrating green infrastructure into hazard mitigation plan (HMP)" pilot workshop.

Section 2: Maryland Land Development and Population

STATE MITIGATION PLAN REVIEW GUIDE

Released March 2015 FP 302-094-2

This Guide is FEMA's official policy on and interpretation of the natural hazard mitigation planning requirements. The intended use of the Guide is to facilitate consistent evaluation and approval of state mitigation plans, as well as to facilitate state compliance with the mitigation planning requirements when updating plans.

Table 2-1: State Mitigation Plan Review Guide

Element	Requirements
S7. Was the risk assessment revised to reflect changes in development? [2 CFR §201.4(d)17] **Intent** – To ensure that the mitigation strategy addresses the risk and vulnerabilities to existing and potential development and takes into consideration possible future conditions that can impact statewide vulnerability.	The plan must provide a summary of the changes in development that have occurred or are projected to occur in hazard prone areas based on the state, local, and tribal, as applicable, risk assessments, specifically: • Changes in land use and the built environment; • Changes in population demographics that may affect vulnerability to hazard events; and • Changes to the vulnerability of state-owned or operated buildings, infrastructure, and critical facilities. Changes in development means recent development, potential and projected land use and development, or conditions that may affect risk and vulnerability to the state and jurisdictions within the state, such as changes in population demographics.

2.1 Introduction

This section is a state demographic profile of Maryland and includes relevant information that will help inform state and local hazard mitigation activities or decisions. The state demographic profile includes information on Maryland's history, geography, physical features, climate, and watersheds, along with socioeconomic characteristics such as employment and industry, transportation, education, utilities, and land development trends and programs. In terms of hazard mitigation, changes in the state's demographic profile can influence how decisions are made and can help identify potential vulnerable locations in which hazard mitigation and risk reduction efforts should focus. Indirectly, identification of changes within a demographic profile can help decrease risk, thereby potentially reducing hazard related losses to both life and property.

2.2 History

Maryland was established when George Calvert applied for a royal charter for what was to become the Province of Maryland. The charter for "Maryland Colony" was

granted to his son, Cecilius Calvert, 2nd Baron Baltimore, in 1632.[1] St. Mary's City was the seat of the colonial government until 1695.[2] Government activities would then move to Annapolis and a new government was set up that prohibited both Catholicism and Anglicanism.

No significant battles of the American Revolutionary War (1775–1783) occurred in Maryland, although it was in the old Senate chamber that General George Washington resigned his commission as commander in chief of the Continental Army, and was also the location of the ratification of the Treaty of Paris of 1783, which ended the Revolutionary War.[3] During the War of 1812, two notable battles occurred in the state; The Battle of Bladensburg and the Battle of Baltimore in North Point and at Fort McHenry. The bombardment of Fort McHenry inspired Francis Scott Key to write "The Star-Spangled Banner," which later became the national anthem of the United States.[4] During the Civil War era, Maryland remained part of the Union, as the most significant battle fought in the state was the Battle of Antietam. Also in the 1860s, the Maryland Constitution of 1867 replaced the 1864 constitution, which is still in effect today, and provided for the reapportionment of the legislature based on population, not counties, which gave greater political power to more dense urban areas.[5]

Maryland's urban and rural communities had different experiences during the Great Depression. And in addition to the nationwide New Deal reforms, Maryland also took steps to weather the hard times, such as in 1937 when the state instituted its first ever income tax to generate revenue for schools and welfare.[6] In addition to general suburban growth, specially planned new communities sprung up, most notably Columbia, as well as Montgomery Village, Belair at Bowie, St. Charles, Cross Keys, and Joppatowne. Community colleges were established in nearly every county in Maryland. As the 21st century dawned, Maryland joined neighboring states in a new initiative to save the health of the Chesapeake Bay, whose aquatic life and seafood industry are threatened by waterfront residential development, as well as by fertilizer and livestock waste.

2.3 Geography

Located in the United States' middle-Atlantic region, Maryland comprises an area of 12,407 square miles. Figure 2-1 illustrates Maryland's borders, including Pennsylvania to the north, Delaware and the Atlantic Ocean to the east, Virginia, West Virginia, and the District of Columbia to the south, and West Virginia to the west. The state is

---

1 *Maryland's History: Pre-Colonial History*. Maryland Secretary of State Kids Pages. n.d. Accessed April 27, 2021. Available at: https://sos.maryland.gov/mdkids/Pages/Maryland's-History.aspx#:~:text=After%20Calvert%20died%20in%20April,wife%20of%20King%20Charles%20I.&text=Meeting%20resistance%2C%20in%20February%201635%2C%20he%20summoned%20a%20colonial%20assembly.

2 Ibid

3 Ibid.

4 Ibid.

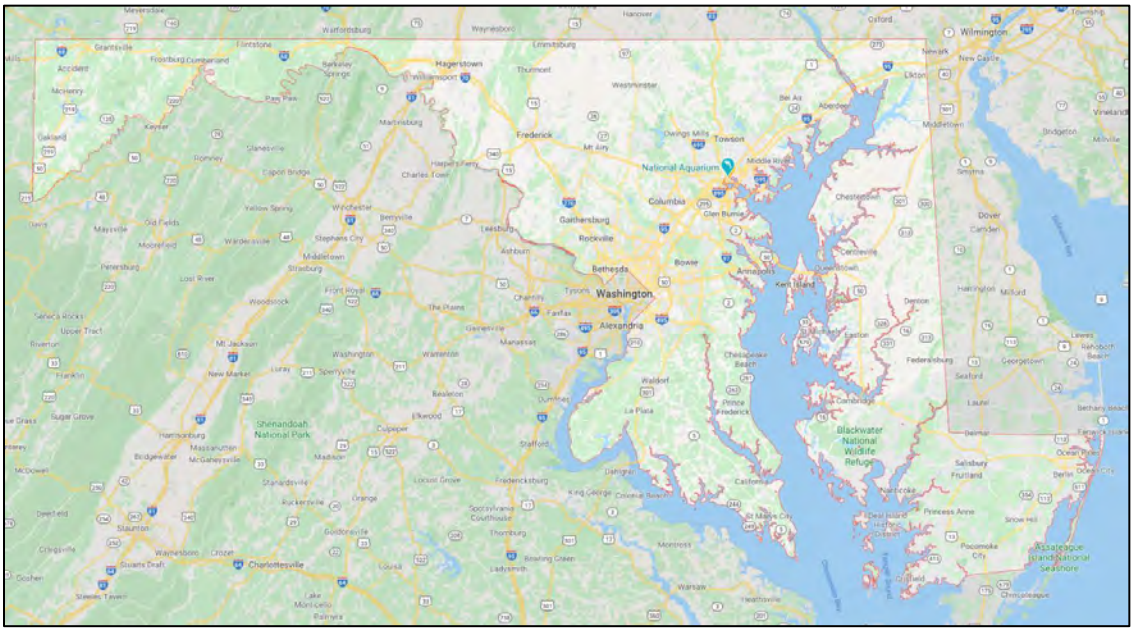
5 Ibid.

6 Ibid.

almost completely bisected by the Chesapeake Bay, which stretches north-to-south from the mouth of the Susquehanna River in northeastern Maryland, to the Virginia border, eventually draining into the Atlantic Ocean in southern Virginia. The Chesapeake Bay is the largest estuary in the United States. It is approximately 2.8 miles wide at its narrowest (between Kent County's Plum Point near Newtown in the east and the Harford County western shore near Romney Creek) and 30 miles (48 km) at its widest (at the mouth of the Potomac River, which divides Maryland from Virginia). Maryland comprises 3,190 miles of shoreline, which plays a large role in the state's vulnerability to hazard events.[7]

Lands east of the Chesapeake Bay are referred to as the Eastern Shore. This area consists of nine counties, seven of which have Chesapeake Bay coastlines. The Eastern Shore is mainly rural in nature and is home to smaller municipalities such as Salisbury, Berlin, Cambridge, Chestertown, Denton, Easton, Ocean City, and Pocomoke City.

Lands west of the Chesapeake Bay are referred to as the Western Shore. This area comprises the Baltimore-Washington Metropolitan Area, the most populated region in the state, and includes the state's capital Annapolis, the City of Baltimore, and Anne Arundel, Baltimore, Frederick, Howard, Montgomery, and Prince George's counties. The far western part of the state is also rural in nature and is bisected by the Appalachian Mountains. This area includes communities such as Cumberland, Deep Creek Lake, and Frostburg.



Source: Google Maps

Figure 2-1: General Maryland Map

[7] *Shoreline Mileage of the United States*. NOAA Office for Coastal Management. n.d. Accessed April 27, 2021. Available at: https://coast.noaa.gov/data/docs/states/shorelines.pdf.

Most of the state's waterways are part of the Chesapeake Bay watershed. Major rivers within this watershed include the Chester River, Choptank River, Middle River, Monocacy River, Nanticoke River, Patapsco River, Patuxent River, Potomac River, Susquehanna River, and Wicomico River. Major lakes include Deep Creek Lake, Loch Raven Reservoir, and Prettyboy Reservoir.

2.4 Physical Features

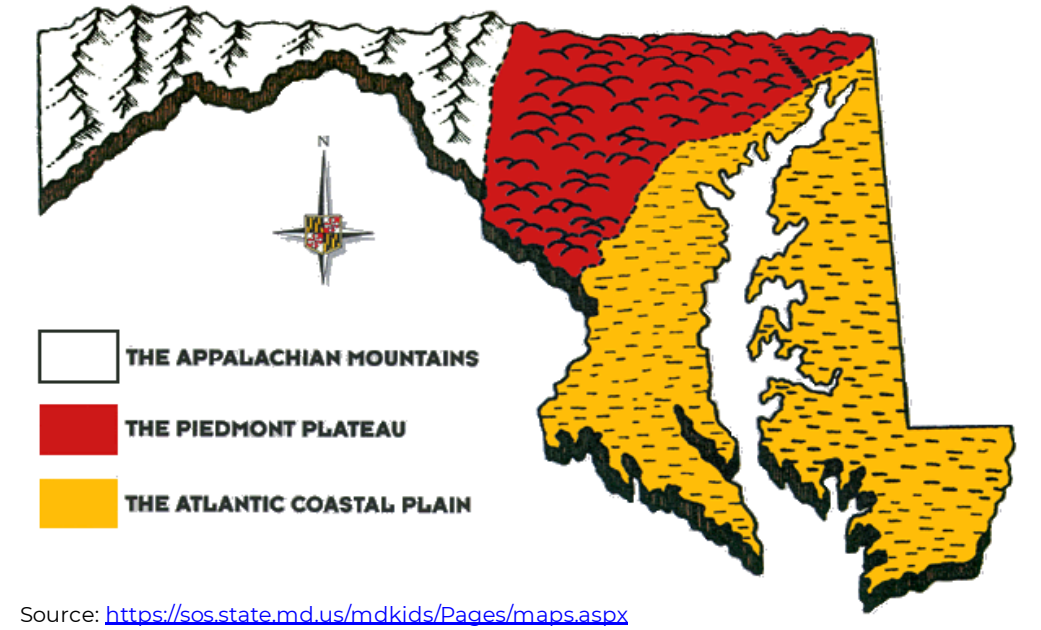
Maryland's topography varies from Atlantic beaches and farmland on the Eastern Shore, to lush wetlands and marshes along the shores of the Chesapeake Bay watershed, to rugged forests and mountainous areas of Appalachia. Because of these diverse features, Maryland possesses the nickname "America in Miniature. "

There are three distinct geologic regions in Maryland: the Atlantic Coastal Plain; the Piedmont Plateau; and the Appalachian Mountains. These regions are depicted in Figure 2-2. Dominating the eastern portion of the state is the Atlantic Coastal Plain. This very flat region is made up of sandy beaches along oceanfront barrier islands, dune systems, inland bays, forested wetlands, coastal salt marshes, rivers/creeks and tidal estuaries, and fertile farmland.

The Piedmont Plateau, which crosses through the central region of the state and up through northeast Maryland, is the transition zone between low-lying coast areas and western mountain ranges. Major rivers such as the Susquehanna, Patapsco, Patuxent, and Potomac cross this region and hardwood forests and suburban areas dominate the landscape. This is the most populated region in Maryland, as it comprises the Baltimore-Washington Metropolitan Area.

The western portion of the state lies within the Appalachian Mountain region. This mainly rural mountainous region includes numerous state forests, including the two largest: Savage River State Forest and Green Ridge State Forest. This region also includes nearly 40 miles of the Appalachian Trail, which stretches from Georgia to Maine.

Maryland's highest point is 3,360 feet above sea level at Hoye-Crest on Backbone Mountain, located along the Maryland-West Virginia border within the Allegheny Mountains. The state's lowest point is sea level, where the Eastern Shore meets the Atlantic Ocean.



Source: https://sos.state.md.us/mdkids/Pages/maps.aspx

Figure 2-2: Maryland Geologic Regions

2.5 Climate

Maryland is classified as temperate of climate, that is, as being located between the Tropic of Cancer and the Arctic Circle in the Northern Hemisphere. Temperate climates are noted for four distinct seasons. The Appalachian Mountain region experiences a continental climate, while the Piedmont Plateau and the Atlantic Coastal Plain areas experience a humid subtropical climate that is heavily influenced by the Chesapeake Bay and Atlantic Ocean. Statewide, the average annual temperature is 55.1 degrees Fahrenheit. High temperatures occur in July, the warmest month, averaging in the mid to upper 80s, while low temperatures in January, the coldest month, average in the low to mid 20s.

Rainfall typically peaks in July and August, with an annual statewide average of 59 inches. During July and August, thunderstorms occur on average once every 5 days. Snowfall rates vary across the state, ranging from an average of 10 inches annually on the Eastern Shore, to 110 inches in the mountainous western most counties. The most snowfall ever recorded in a single winter in Maryland was during the winter of 2009–2010, when 262.5 inches of snow fell at Keysers Ridge in Garrett County. The freeze-free period averages at 185 days a year, ranging from 130 days in Garrett County to 230 days in southern Maryland and the lower Eastern Shore.[8]

[8] *Maryland Manual On-Line: A Guide to Maryland & Its Government*. "Maryland at a Glance: Weather." Maryland State Archives, October 21, 2020. Available at: https://msa.maryland.gov/msa/mdmanual/01glance/html/weather.html

Because of its location along the Atlantic Coast, hurricanes, nor'easters, and tropical storms can affect the state, especially those tracking up the East Coast. Storm impacts and damage can result from high winds, heavy rains, storm surge. and flash flooding. Nor'easters can occur any time of the year, but primarily threaten the state from September to April, and are most severe in the winter months. Hurricanes and tropical storms threaten the state during the hurricane season, which is typically July through October. And while a major hurricane (category 3 or higher) has never hit Maryland directly, since 1950, 131 known hurricanes, tropical storms, and tropical depressions have affected the state.

In addition to hurricanes and tropical storms, high-wind events such as tornadoes and derechos also occur in the state. On average, four tornadoes are reported every year and most often occur between May and July. In 2012, a straight-line wind derecho resulted in over 1,600,000 customers losing power, including some in each of the state's counties. Additional details and further analysis of weather-related hazards are discussed in Section 3 of this Plan.

2.6 Watersheds

Approximately 95 percent of Maryland's watersheds drain into the Chesapeake Bay watershed. Aside from the Chesapeake Bay watershed, a small portion of Western Maryland (just west of the Eastern Continental Divide) is part of the Mississippi River Watershed, a very small portion in the northeast corner of Maryland is part of the Delaware Bay Watershed, and a small portion of the Eastern Shore (the coastal bays) drains directly into the Atlantic Ocean.

In total, the Chesapeake Bay Watershed covers approximately 64,000 square miles and is home to more than 18 million people. More than 100,000 streams, creeks, and rivers—called tributaries—form the Chesapeake Bay watershed, many of which are located outside of Maryland. The largest in-state tributaries flowing directly into the Bay, from north to south, are:

- Susquehanna River
- Patapsco River
- Chester River
- Miles River
- Choptank River
- Patuxent River
- Nanticoke River
- Potomac River
- Pocomoke River

On a smaller scale, there are 12 tributary basins within the State of Maryland, each identified in Table 2-2, and shown in Figure 2-3, below.

Table 2-2: Maryland Tributary Basins

Tributary Basin Names	
Ocean Coastal	Patuxent
Lower Eastern Shore	Lower Western Shore
Choptank	Patapsco-Back
Upper Eastern Shore	Upper Western Shore
Lower Potomac	Upper Potomac
Middle Potomac	Youghiogheny

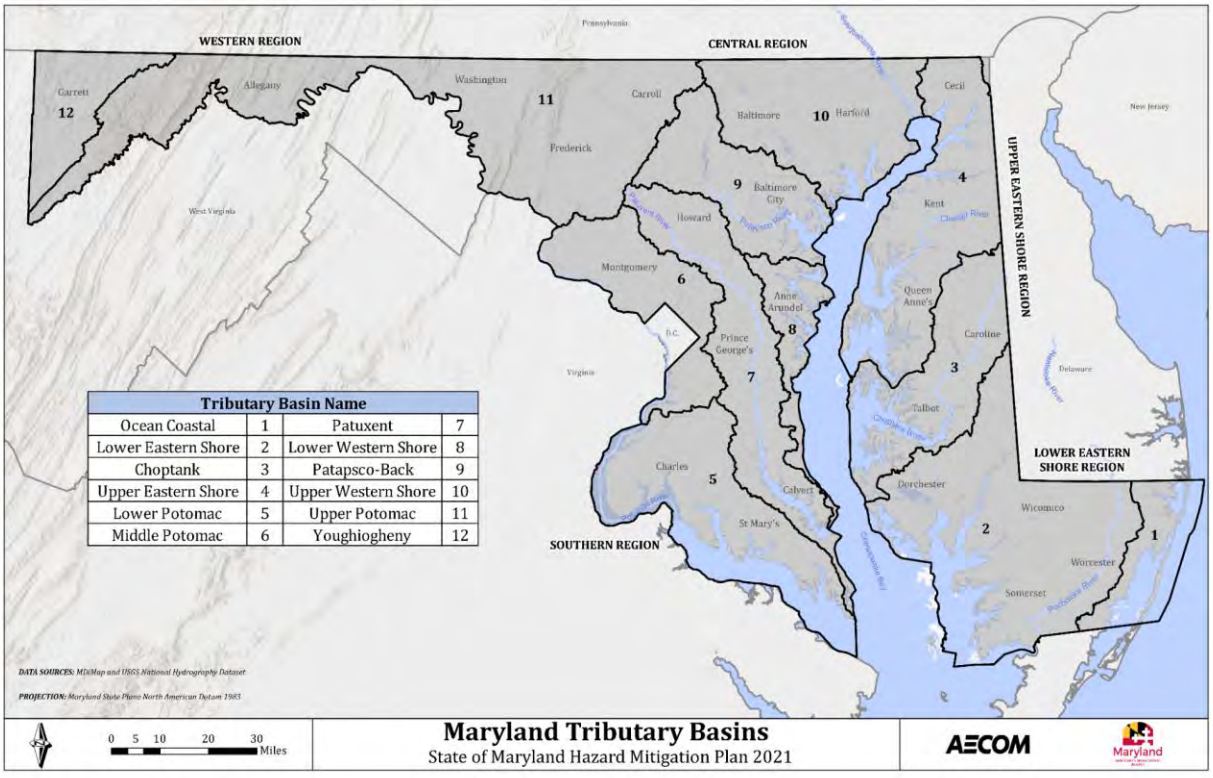


Figure 2-3: Maryland Tributary Basins

2.7 Maryland Jurisdictions

There are 26 emergency management districts within the State of Maryland. This includes 23 counties and Baltimore City, which the Maryland Constitution equates to a county-level government. Table 2-3 and Figure 2-4 identify the 24 county-level or county-equivalent jurisdictions. In addition, each county supports numerous self-

governing municipalities. The City of Annapolis and the Town of Ocean City have Governor-appointed Emergency Managers, and when it comes to emergency management–related decisions, the two are often treated on the same level as the rest of the counties but are not considered county-level equivalents, unlike Baltimore City.

Twelve of Maryland's counties are governed by boards of county commissioners. These include Allegany, Calvert, Caroline, Carroll, Charles, Garrett, Kent, Queen Anne's, St. Mary's, Somerset, Washington, and Worcester counties. Among these, six have adopted a "home rule" form of government: Allegany, Caroline, Charles, Kent, Queen Anne's, and Worcester. "Home rule" empowers the county with broad legislative authority and limits the General Assembly's local legislative powers.

Eleven Maryland counties have ratified charter forms of government: Anne Arundel, Baltimore, Cecil, Dorchester, Frederick, Harford, Howard, Montgomery, Prince George's, Talbot, and Wicomico. All of these are governed by county councils; and all (except Dorchester and Talbot) are led by county executives.

Table 2-3: Maryland Counties

County (or county-level) Jurisdictions	
Allegany County	Harford County
Anne Arundel County	Howard County
Baltimore City	Kent County
Baltimore County	Montgomery County
Calvert County	Prince George's County
Caroline County	Queen Anne's County
Carroll County	St. Mary's County
Cecil County	Somerset County
Charles County	Talbot County
Dorchester County	Washington County
Frederick County	Wicomico County
Garrett County	Worcester County
Non-County Jurisdictions	
City of Annapolis	Town of Ocean City

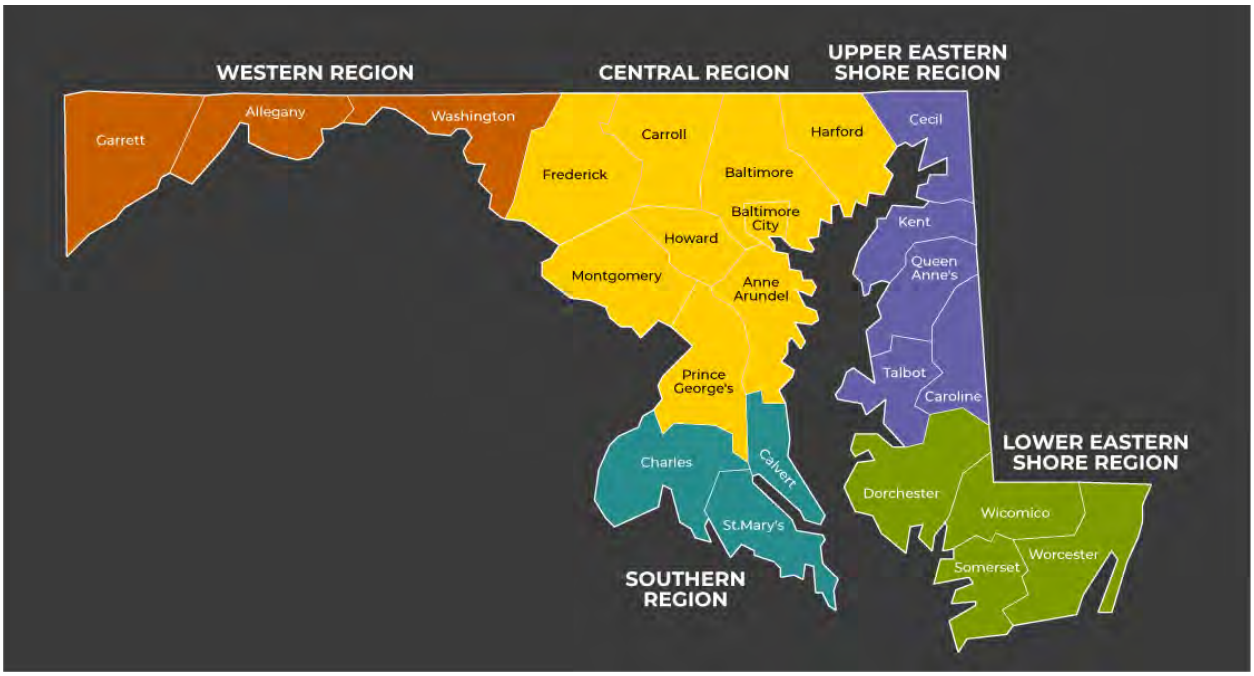


Figure 2-4: Jurisdictions of Maryland

In the 2016 Plan, the state was divided into six regions for ease of mapping, hazard identification and analysis, and the development of mitigation goals and actions. This approach continues with this update; however, MEMA has chosen to regroup the regions into five regions that share similar populations and risk profiles. These regions and their respective counties are as follows:

- Western Region: Allegany, Garrett, and Washington
- Central Region: Anne Arundel, Baltimore, Baltimore City, Carroll, Frederick, Harford, Howard, Montgomery, and Prince George's
- Southern Region: Calvert, Charles, and St. Mary's
- Upper Eastern Shore Region: Caroline, Cecil, Kent, Queen Anne's, and Talbot
- Lower Easter Shore Region: Dorchester, Somerset, Wicomico, and Worcester

2.8 Demographics and Socio-Economic Profile

According to the U.S. Census Bureau's July 2019 estimates, the total population of Maryland is estimated to be 6,045,680 residents.[9] Since 2015, the state's population has seen an increase of 60,118 residents, which amounts to a 1 percent population increase. As shown in Table 2-4, the top five counties with the highest population increase since 2015 include: Frederick County (5.94%), Charles County (4.88%), Howard County (4.62%), Anne Arundel County (2.88%), and Queen Anne's County

[9] Quick Facts: Maryland. July 1, 2019. United States Census Bureau. Available at: https://www.census.gov/quickfacts/MD.

(2.85%). In contrast, the top five jurisdictions with the greatest population losses) include: Baltimore City (-4.66%), Allegany County (-2.82%), Dorchester County (-1.51%), Kent County (-1.49%), and Garrett County (-1.4%). Figure 2-5 also depicts the percent population change for Maryland jurisdictions from 2010 to 2019.

Table 2-4: Population of Maryland Jurisdictions

Place	April 2010 Census	July 2015 Estimate	July 2019 Estimate	Population Change 2015-2019	Percentage Change
Maryland	5,773,552	5,985,562	6,045,680	60,118	1.00%
Allegany County	75,087	72,462	70,416	-2,046	-2.82%
Anne Arundel County	537,656	563,027	579,234	16,207	2.88%
Baltimore County	805,029	827,533	827,370	-163	-0.02%
Calvert County	88,737	90,477	92,525	2,048	2.26%
Caroline County	33,066	32,595	33,406	811	2.49%
Carroll County	167,134	167,132	168,447	1,315	0.79%
Cecil County	101,108	101,108	102,855	1,747	1.73%
Charles County	146,551	155,665	163,257	7,592	4.88%
Dorchester County	32,618	32,419	31,929	-490	-1.51%
Frederick County	233,385	245,001	259,547	14,546	5.94%
Garrett County	30,097	29,426	29,014	-412	-1.40%
Harford County	244,826	249,558	255,441	5,883	2.36%
Howard County	287,085	311,297	325,690	14,393	4.62%
Kent County	20,197	19,715	19,422	-293	-1.49%
Montgomery County	971,777	1,032,814	1,050,688	17,874	1.73%
Prince George's County	863,420	906,197	909,327	3,130	0.35%
Queen Anne's County	47,798	48,984	50,381	1,397	2.85%
St. Mary's County	105,151	110,985	113,510	-71	-0.28%
Somerset County	26,470	25,687	25,616	2,525	2.28%
Talbot County	37,782	37,413	37,181	-232	-0.62%
Washington County	147,430	149,068	151,049	1,981	1.33%
Wicomico County	98,733	101,747	103,609	1,862	1.83%
Worcester County	51,454	51,456	52,276	820	1.59%
Baltimore City	620,961	622,522	593,490	-29,032	-4.66%

Source: https://planning.maryland.gov/MSDC/Documents/pop_estimate/Estimates/municipal/Table4.pdf

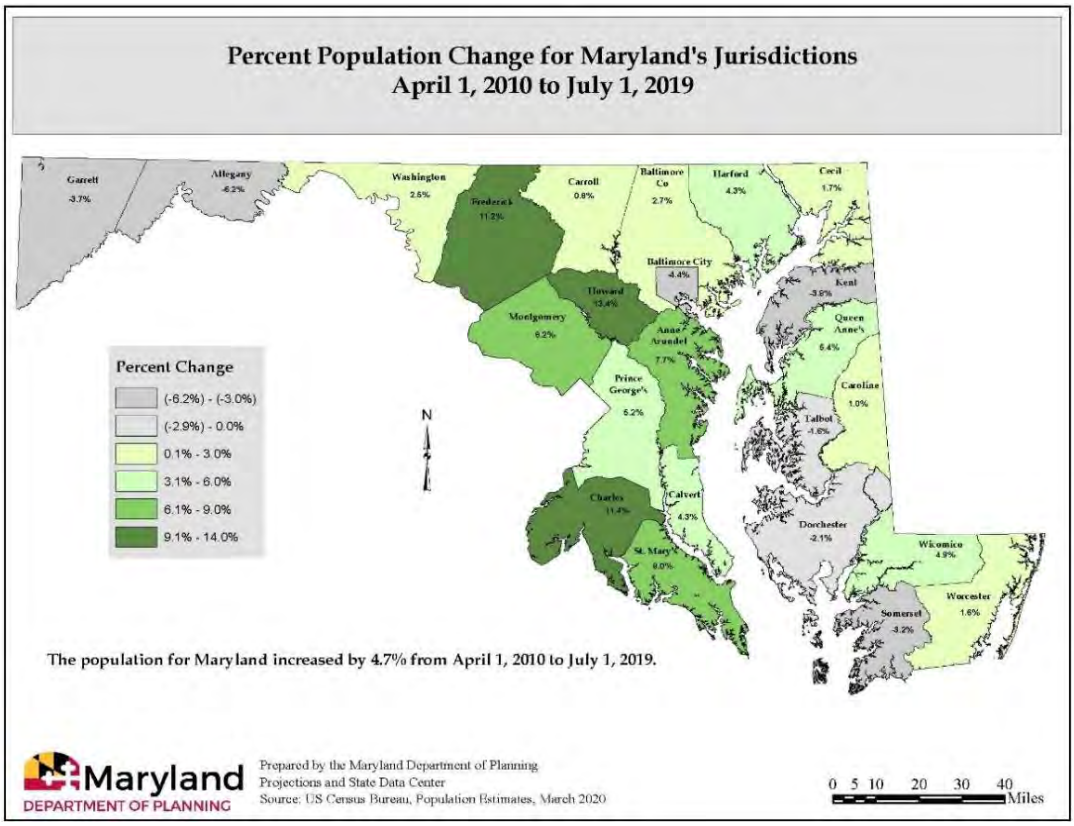


Figure 2-5: Percent Population Change in Maryland from 2010-2019

The demographic breakdown of the 2019 estimates are shown in Table 2-5. The data indicates that a significant percentage of the population is both under 18 years of age (22%), and over 65 years of age (16%). It is estimated that 7.5 percent of people under the age of 65 experience a disability.[10] Additionally, there are an estimated 2,192,518 households in the state, and an average of 2.67 persons per household.[11]

Hazard events would most severely affect vulnerable populations, including the elderly; persons with disabilities, access, or functional needs; low-income households; persons with no social support network; and those with health issues. In the event of a hazard, these subgroups are more vulnerable as they may depend on others to receive required help and/or evacuation, or they may not have easy access to community resources. On the other hand, those persons under 18 years can also impact community vulnerability in a positive manner; they can physically cope and recover more easily from disaster impacts and can help educate their communities how to reduce the impact of disasters.

[10] Ibid.
[11] Ibid.

Table 2-5: Population Breakdown

Population Age Group	Percentage of Total Population
Persons under 5 years	6%
Persons under 18 years	22%
Persons 65 years and over	16%
Persons under 65 years with a disability	7.5%

Source: https://www.census.gov/quickfacts/MD

Overall, Maryland's minority population share is 50 percent. According to the MDP's 2019 estimates, Prince George's County (87.7%) has the highest percentage of minority populations, followed by Baltimore City (72.3%), Charles County (62.8%), Montgomery County (57.1%), and Howard County (49.7%).[12] Figure 2-6 provides minority population share data for each state jurisdiction.

2.9 Employment and Industry Profile

According to the U.S. Census Bureau's American Community Survey 5-year estimates (2014–2018), the median household income in Maryland is $81,868. As shown in Table 2-6, Howard County has the highest median household income at $117,730, while Somerset county has the lowest at $42,165.[13] In comparison to population change since 2015, Howard County saw the greatest population increase and Somerset county was one of the counties that saw a significant population decrease.

[12] "Percent Population Change for Maryland's Jurisdictions, April 1 2010 to July 1 2019." US Census Bureau, Population Estimates, March 2020. Prepared by the Maryland Department of Planning Projections and State Data Center. Available at: https://planning.maryland.gov/msdc/documents/pop_estimate/estimates/county/county-map4.pdf.

[13] Median Household Income for Maryland's Jurisdictions. American Community Survey, Five-Year Estimates, 2014 – 2018. Source: U.S. Census Bureau, American Community Survey, 2019 release. Available at: https://planning.maryland.gov/MSDC/Documents/HH_Income/ACS_5yr_Household_Median_Income_2014-2018.pdf.

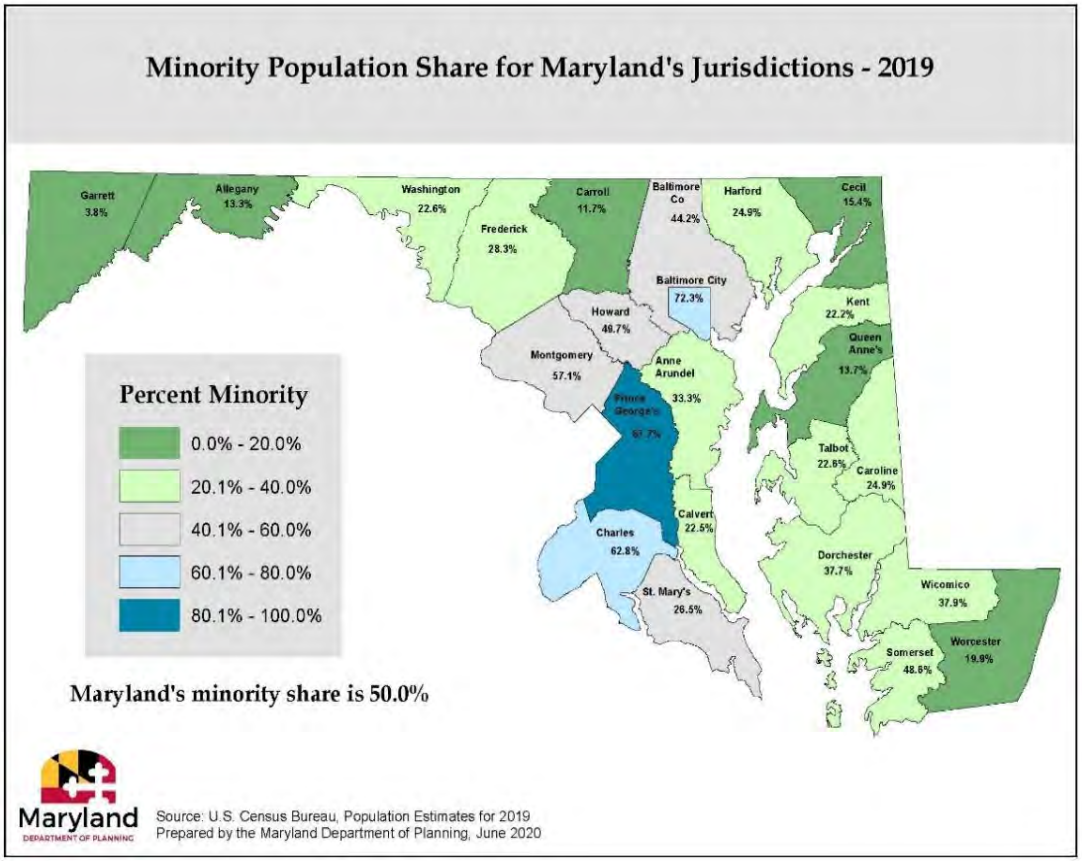


Figure 2-6: Minority Population Share for Maryland's Jurisdictions

The state's per capita income for 12 months (in 2018 dollars) is estimated to be $40,517, while the state poverty rate is 9.4 percent. As can be seen in Table 2-6, Baltimore City has the highest rate of poverty (21.8%), followed by Somerset County (20.4%), Allegany County (16.4%), Dorchester County (15.8%), and Wicomico County (15.2%).[14]

Table 2-6: Median Household Income by Maryland Jurisdictions

Jurisdiction	Median Household Income	Poverty Rate
Maryland	$81,868	9.4%
Allegany County	$44,065	16.4%
Anne Arundel County	$97,810	6%
Baltimore County	$74,127	9.2%

[14] Poverty Rates for Maryland's Jurisdictions. American Community Survey, Five-Year Estimates, 2014 – 2018. Source: U.S. Census Bureau, American Community Survey, 2019 release. Available at: https://planning.maryland.gov/MSDC/Documents/poverty/ACS_5yr_Poverty-Rates_2014-2018.pdf.

Jurisdiction	Median Household Income	Poverty Rate
Calvert County	$104,301	5.1%
Caroline County	$54,956	14.7%
Carroll County	$93,363	5.3%
Cecil County	$72,845	9.4%
Charles County	$95,924	6.1%
Dorchester County	$52,145	15.8%
Frederick County	$91,999	7.1%
Garrett County	$49,619	9.7%
Harford County	$85,942	7.6%
Howard County	$117,730	5.4%
Kent County	$56,009	12.3%
Montgomery County	$106,287	6.9%
Prince George's County	$81,969	8.9%
Queen Anne's County	$92,167	5.5%
St. Mary's County	$90,438	8.3%
Somerset County	$42,165	20.4%
Talbot County	$67,204	9.5%
Washington County	$59,719	12.7%
Wicomico County	$56,608	15.2%
Worcester County	$61,145	9.3%
Baltimore City	$48,840	21.8%

Source: https://planning.maryland.gov/MSDC/Documents/HH_Income/ACS_5yr_Household_Median_Income_2014-2018.pdf; https://planning.maryland.gov/MSDC/Documents/poverty/ACS_5yr_Poverty-Rates_2014-2018.pdf.

According to the Annual Employment Summary for Maryland created by the U.S. Bureau of Labor Statistics, the state's employment growth has averaged 1.1 percent annually since 2010, which amounts to roughly 27,825 jobs per year.[15] The Maryland Department of Labor reported 2.74 million jobs as of 2018. Table 2-7 identifies employment by industry for the state as a whole.

[15] "Maryland experienced slow but positive job growth in 2018; State employment growth averaged 1.1 percent annually since 2010." Annual Employment Summary 2018. Available at: https://planning.maryland.gov/MSDC/Documents/ces/CES2018-Summary.pdf.

Table 2-7: Employment by Industry in Maryland

Industry	Jobs	Percentage
Government	504,600	18.39%
Trade-Transportation-Communication-Utilities (TTCU)	503,900	18.36%
Education and Health Services	472,500	17.2%
Professional and Business Services	451,000	16.4%
Mining-Manufacturing-Logging-Construction	272,700	9.9%

Source: https://planning.maryland.gov/MSDC/Documents/ces/CES2018-Summary.pdf.

Major private employers in Maryland make up a diverse range of industries. Table 2-8 identifies major private employers in Maryland, specifically those employers with more than 2,500 employees.

Table 2-8: Major Maryland Employers

Top Employers	
Amazon Fulfillment Center	Kennedy Krieger Institute
Anne Arundel Medical Center	Laurel Regional Hospital
Arc Employment Center	Lockheed Martin Is & Gs
Bechtel	Marriott International Inc.
BYK Gardner Inc.	Maryland Live! Casino
Clean Harbors Inc.	Med Star Franklin Square Medical Center
Community College- Baltimore County	Medical Oncology
Cristal USA	Mercy Medical Center
Crosby Corp	Northrop Grumman Electronics Systems
Frederick Memorial Hospital	Prometric
Greater Baltimore Medical Center	Sinai Hospital
Holy Cross Hospital	Steven James Association
Johns Hopkins Bayview Medical	Under Armour Inc.
Johns Hopkins Hospital	University of Maryland
Johns Hopkins University Applied Physics Lab	University of Maryland Medical Center (UMGC)
Johns Hopkins University	Western Maryland Regional Medical Center

Source: https://www.dllr.state.md.us/lmi/emplists/maryland.shtml

2.10 Mobility/Transportation

Transportation access across Maryland includes major highway networks, rail networks, waterways, and airports. There are five major interstate highways that serve the state: I-95; I-70; I-68; I-83; and I-81. Rail networks include Amtrak, Maryland Area Regional Commuter (MARC) trains, the Metro SubwayLink, known locally as the Baltimore Metro, operated by the Maryland Transit Administration (MTA), and Metrorail operated by the Washington Metropolitan Area Transit Authority (WMATA). These railways connect people to major Maryland business centers, as well as Washington DC, and in the case of Amtrak, points nationwide. In addition, two Class I carriers, CSX Transportation and Norfolk Southern Railway, provide freight rail connections across the state.

The Port of Baltimore, the closest east coast seaport to the Midwest, is an important deep-water port and is one of the largest automobile handlers in the country. The port is ranked as the 14th largest in the country and also handles millions of tons of cargo every year.

Finally, three commercial airports operate in the state, with the Baltimore-Washington International (BWI) Thurgood Marshall Airport serving as the largest passenger airport and also as a significant cargo hub. Other commercial airports include the Hagerstown Regional Airport and the Salisbury-Ocean City Wicomico Regional Airport. In addition, six reliever airports, nine general aviation airports, 19 public use airports, and five military airfields operate within the state.

2.11 Education/Institutions

Public education is a responsibility shared by state, county, and Baltimore City governments.[16] The State Board of Education sets educational standards, certifies teachers, partially funds school construction and instruction, and monitors school performance. The Board also oversees the State Department of Education.[17] At the same time, county boards of education are significant for public schools because they often set additional requirements, develop new programs, and provide substantial local funding.[18]

In regard to higher education, the state offers 22 4-year colleges and universities, two 2-year colleges, 16 community colleges, and over 150 private career schools approved by the Maryland Higher Education Commission.[19] The state also operates eight regional higher education centers. Regional higher education centers were established by law in 2000 to provide another option for high school graduates

---

[16] *Maryland Manual On-Line: A Guide to Maryland & Its Government*." Maryland at a Glance: Education." November 18, 2020 Maryland State Archives. Available at: https://msa.maryland.gov/msa/mdmanual/01glance/html/edelem.html.

[17] Ibid.

[18] Ibid.

[19] *Maryland Manual On-Line: A Guide to Maryland & Its Government*." Maryland at a Glance: Education, Public Universities and Colleges." November 18, 2020 Maryland State Archives. Available at: https://msa.maryland.gov/msa/mdmanual/01glance/html/edhigh.html#public.

seeking further education.[20] The University System of Maryland is the largest higher education system in the state and is made up of 11 member institutions.

In fall 2018, 300,742 students (undergraduate, graduate, and professional) enrolled at Maryland public universities and colleges. Women accounted for 55.2 percent of all students. Maryland residents constituted 91.2 percent of enrollees at community colleges, 66.7 percent at public 4-year institutions, and 40.3 percent at independent universities and colleges.[21]

Table 2-9 identifies major public universities and colleges in Maryland, as well as some of the most notable private universities and colleges.

Table 2-9: Major Public Colleges and Universities in Maryland

Public Colleges/Universities	Private Colleges/Universities
Baltimore City Community College	Johns Hopkins University
Morgan State University	Loyola University Maryland
St. Mary's College of Maryland	Washington Adventist University [formerly Columbia Union College]
University System of Maryland:	Maryland Institute College of Art
Bowie State University	McDaniel College
Coppin State University	Mount St. Mary's University
Frostburg State University	Stevenson University
Salisbury University	Washington College
Towson University	St. Johns College
University of Baltimore	Hood College
University of Maryland, Baltimore	Goucher College
University of Maryland Baltimore County (UMBC)	Notre Dame of Maryland University
University of Maryland, College Park (UMCP)	
University of Maryland Eastern Shore (UMES)	
University of Maryland Global Campus	

Source: https://msa.maryland.gov/msa/mdmanual/25univ/system/html/syst.html

Finally, the U.S. Naval Academy is a federal military institution located in Annapolis that was founded in 1845. The U.S. Naval Academy prepares students to become professional officers in the U.S. Navy and U.S. Marine Corps.[22] Each academic year,

[20] Ibid.

[21] Maryland Manual On-Line: A Guide to Maryland & Its Government. "University System of Maryland." April 19, 2021 Maryland State Archives. Available at: https://msa.maryland.gov/msa/mdmanual/25univ/system/html/syst.html.

[22] Maryland Manual On-Line: A Guide to Maryland & Its Government." Maryland at a Glance: Education, Public Universities and Colleges." November 18, 2020 Maryland State Archives. Available at: https://msa.maryland.gov/msa/mdmanual/01glance/html/edhigh.html#public.

over 4,000 midshipmen are enrolled at the U.S. Naval Academy as full-time students and after 4 years, graduates are granted a Bachelor of Science degree and are required to serve in the U.S. armed services for a minimum of 5 years.[23]

2.12 Utilities

Major commercial utility suppliers, as well as two electric cooperatives and municipal utilities, provide power to customers in Maryland. Each company owns and operates the distribution infrastructure (the "wires") and provide electricity supply on behalf of its customers within its service territory.[24] Major state electric suppliers include Baltimore Gas and Electric (BGE), Potomac Electric Power Company (PEPCO), Delmarva Power, Potomac Edison Company, Southern Maryland Electric Cooperative, Inc. (SMECO), and Choptank Electric Cooperative.[25]

Three major utilities provide gas supply and service in Maryland. The three primary natural gas providers include BGE, Washington Gas & Light (WGL), and Columbia Gas.[26] There also are several smaller for-profit gas utility companies or municipal utilities. These smaller utilities, regulated by the Maryland Public Service Commission (PSC), include Chesapeake Utilities Corporation, Penn Fuel Gas, Inc., Elkton Gas Company, Easton Utilities Commission, and Eastern Shore Gas Company.[27]

The PSC regulates the rates and services of privately owned water companies in Maryland.[28] About 26 of these companies serve customers in rural and some suburban areas of the state.[29] The Maryland PSC does not regulate publicly run water systems, such as the Baltimore City Department of Public Works or the Washington Suburban Sanitary Commission (WSSC). Most residential households in Maryland receive water and sewer services from public water systems or the WSSC.[30]

For telephone service, Verizon provides local service to residential customers throughout Maryland, except in the northeastern part of the state, where Armstrong is the major provider.[31] A few other companies provide service to residential customers, but service may be available only in limited geographic areas.[32]

---

23 Ibid.

24 Maryland Office of People's Counsel. Consumer Corner – Electricity. 2015. Available at: http://www.opc.maryland.gov/Consumer-Corner/Electricity.

25 Ibid.

26 Maryland Office of People's Counsel. Consumer Corner – Natural Gas. 2015. Available at: http://www.opc.maryland.gov/Consumer-Corner/Natural-Gas.

27 Ibid.

28 Maryland Office of People's Counsel. Consumer Corner – Water/Sewer. 2015. Available at: http://www.opc.maryland.gov/Consumer-Corner/Water-Sewer.

29 Ibid.

30 Ibid.

31 Maryland Office of People's Counsel. Consumer Corner – Telephone. 2015. Available at: http://www.opc.maryland.gov/Consumer-Corner/Telephone.

32 Ibid.

Maryland increased its Renewable Portfolio Standard (RPS) target of 25 percent renewable energy by 2020 to 50 percent by 2030. In 2019, Governor Larry Hogan proposed the Clean and Renewable Energy Standard (CARES) that sets the state on a path to 100 percent clean electricity by 2040 with zero carbon emissions.[33]

Wind energy is also generated and transmitted throughout Maryland. As of June 1, 2017, Maryland had more than 191 megawatts (MW) of installed land-based wind capacity, and in 2016, wind energy accounted for 1.4 percent of all in-state electricity generation, which is enough electricity to power 49,000 Maryland homes.[34]

For solar energy, over recent years, Maryland has increased capacity from 258 MW to 1,000 MW, and Maryland offers programs that support residential, commercial, and community solar projects.[35]

In 2013, the Maryland Offshore Wind Energy Act of 2013 was signed into law. This act amended the RPS to include offshore wind projects located between 10 and 30 miles off Maryland's coast and to provide financial support for projects in the form of Offshore Wind Renewable Energy Credits.[36] The state approved two offshore wind projects in 2017, which are estimated to create 9,700 full-time equivalent jobs and result in more than $2 billion of economic activity in Maryland, including $120 million of investments in port infrastructure and steel fabrication facilities.[37]

The Exelon-owned Calvert Cliffs Nuclear Power Plant is located on the western shore of the Chesapeake Bay in Lusby, Calvert County. The plant has been in operation since 1975 and includes two nuclear reactors generating a total of 1,750 MW.[38] Electricity generated at the nuclear plant is transmitted to other regions in Maryland via high-voltage transmission lines. The Calvert County Division of Emergency Management is responsible for public plant emergency planning efforts.[39]

2.13 Land Development

This section provides a snapshot in time of the general land use for the state, trends in development and housing, and provides details on how the state and its partners preserve land for future enjoyment as well as for mitigation purposes. The information contained here helps to paint the picture of the development atmosphere in Maryland, and how mitigation projects can dovetail with land use policies and best practices.

---

[33] Maryland Energy Administration. Solar Energy Progress. n.d. Accessed April 27, 2021. Available at: https://energy.maryland.gov/Pages/Info/renewable/solar.aspx.

[34] Maryland Energy Administration. Wind Energy in Maryland. n.d. Accessed April 27, 2021. Available at: https://energy.maryland.gov/Pages/Info/renewable/windprograms.aspx.

[35] Maryland Energy Administration. Solar Energy Progress. n.d. Accessed April 28, 2021. Available at: https://energy.maryland.gov/Pages/Info/renewable/solar.aspx.

[36] Maryland Energy Administration. Offshore Wind Energy in Maryland. n.d. Accessed April 28, 2021. Available at: https://energy.maryland.gov/Pages/Info/renewable/offshorewind.aspx.

[37] Ibid.

[38] Calvert County, Maryland. Calvert Cliffs Nuclear Plant. n.d. Accessed April 28, 2021. Available at: https://www.calvertcountymd.gov/319/Calvert-Cliffs-Nuclear-Power-Plant.

[39] Ibid.

The state has several ongoing planning initiatives and planning efforts that contribute significantly to continuing to improve statewide planning for hazard mitigation. There are several MDP planning initiatives that align with MEMA's hazard mitigation planning efforts and are geared to reduce hazard risk throughout the state:

- Statewide land use GIS update
- MDP's annual reporting to the Maryland Commission on Climate Change
- MDP's Local Assistance and Training Unit
- MDP's Growth and Conservation Overlays tool to identify areas of increased development, target growth areas for future development, and identify conservation areas

The Geospatial Data Analysis Group is currently updating the state's 2010 Land Use Map. MDP has almost completed a 2020 update to its Statewide Land Use (formerly "Land Use Land Cover") GIS product. The 2020 Land Use Map is envisioned to show generalized locations of developed land, including varying densities of residential land as well as commercial, industrial, institutional, other developed, and undeveloped resource land. The update to the Statewide Land Use Map is expected to be completed in Fall 2021.

A major component of the Land Use update includes updated land cover information developed by the Chesapeake Conservancy, The Conservancy completed the Chesapeake Bay High-Resolution Land Cover Project, one of the nation's largest, high-resolution land cover datasets, in 2016. The land cover data represents land cover conditions as evident in National Agriculture Imagery Program (NAIP) imagery for 2013 and 2014. Updates for 2017 and 2018 and for 2021 and 2022 are currently planned, assuming NAIP continues as anticipated. Once these updates are complete, they will be integrated into the Statewide Land Use GIS product for final completion.

MDP's annual reporting to the Maryland Commission on Climate Change documents the state's land use programs directed to monitoring land use change and promoting compact development. As noted in Section 6.1.5 of this Plan, MDP administers several smart growth programs, in coordination with other state agencies, to encourage the concentration of development in existing and planned communities and the preservation/conservation of Maryland's natural resources.

MDP's Local Assistance and Training Unit provides significant land planning technical assistance to local governments as they prepare and implement their comprehensive plans. MDP's Regional Planners provide frontline planning services to help local governments. This is a great opportunity to make meaningful change at the local level when it comes to hazard mitigation and land use planning. Some counties may experience a disconnect between the county or municipal hazard mitigation plans and land use planning, zoning, and land development activities. MDP and MEMA and other state and local partners should ensure coordination

between their agencies to promote and strengthen the connection between local hazard mitigation and land use plans.

The Growth and Conservation Overlays mapping tool is used by state agencies and other organizations that submit capital improvement budget requests to the Department of Budget Management. The current mapping tool enables the person preparing the capital budget request to identify whether a series of planning map layers may have some impact on the capital project scope. This tool helps identify local and state targeted growth and conservation areas and will allow Maryland to better coordinate the smart growth efforts and programs of state government. The Smart Growth Subcabinet agencies collaborate with local governments to identify locations where targeted investments can promote growth and protect other areas where preservation and conservation should be a priority. The tool also depicts where recent and proposed developed is occurring throughout the state. This mapping tool helps identify recent and pending development trends and potential future development patterns in specific locations and larger areas around the state that are deemed one or more of the following categories:

- Target Growth and Revitalization Area
- Established Community
- Future Growth Area
- Large Lot Development Area
- Rural Resource Area
- Area Under Discussion

Areas where there is recent, pending, and proposed development include large concentrations between and around Baltimore and Washington D.C., specifically in more urban areas of Montgomery, Howard, and Baltimore counties, and the City of Annapolis.

Other Target Growth and Revitalization Areas are scattered throughout the southern portion of the state, such as in Waldorf and St. Charles in Charles County and along I-95 in the northeast part of Maryland, including Bel Air, Aberdeen, Havre de Grace, Perryville, North East, and Elkton in Cecil County. In Western Maryland, these areas are also scattered, in areas such as Frederick, Brunswick, Hagerstown, Hancock, Thurmont, Cumberland, and Oakland/Mountain Lake Park. On the Eastern Shore of Maryland, target growth and revitalization areas are scattered in areas such as Denton, Easton, Cambridge, St. Michaels, Federalsburg, Salisbury, Princess Anne, Pocomoke City, Berlin, and Ocean City.

This Growth and Conservation Overlays Tool also identifies municipal and county growth areas, as shown in Figure 2-7 below.

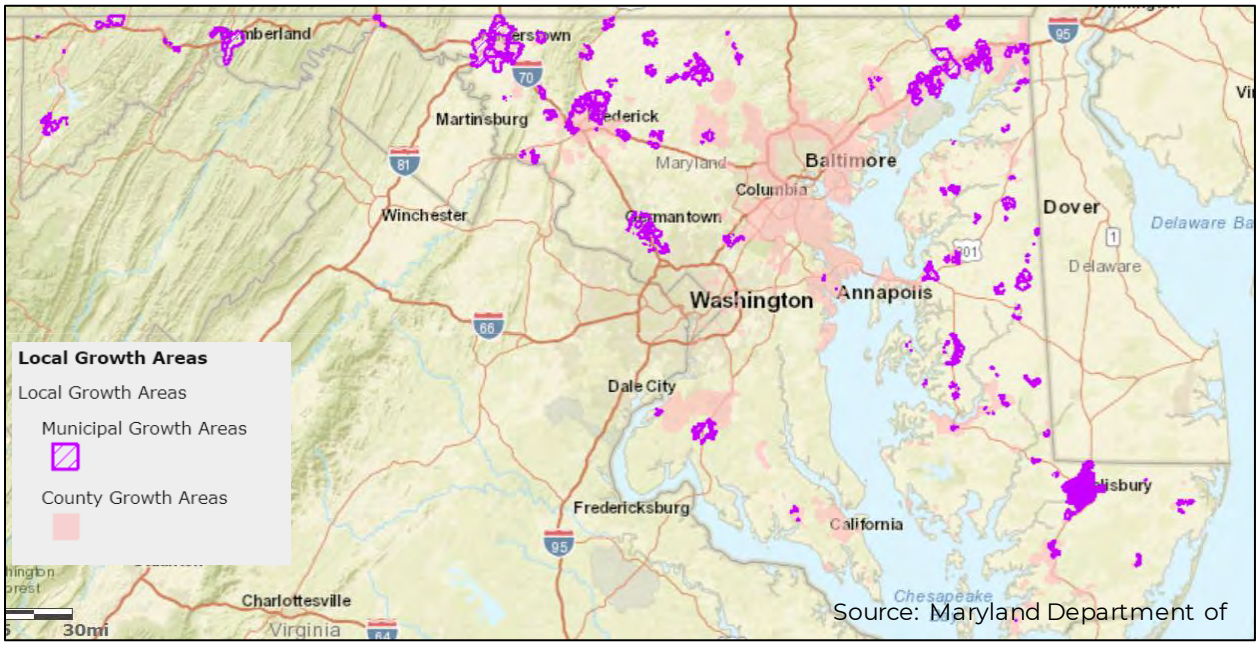


Figure 2-7: County and Municipal Growth Areas

A major goal of MDP's planning initiatives is to concentrate target growth areas, including new development and/or revitalization, within or in very close proximity to established communities. These planning initiatives will likely not contribute to putting more people at risk in Maryland in the future since these target growth areas lie outside of FEMA's established flood zones. However, it is possible that additional development in and around established communities could put strain on aging sewer and infrastructure systems.

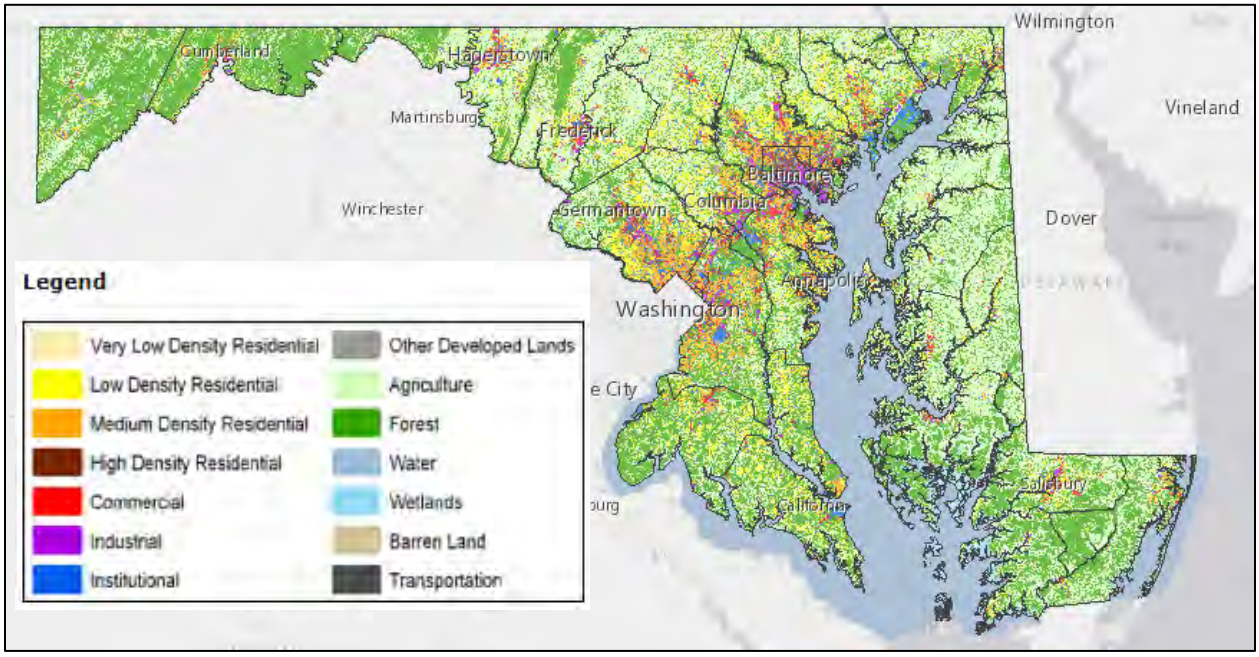
To help mitigate any unforeseen increased risk as a result of recent or future development trends, the State Mitigation Strategy reflects the *"where"* component of recent, pending, and proposed development.

2.13.1 Land Use

Land use in Maryland includes varying densities of residential land, as well as commercial, industrial, institutional, other developed, and undeveloped resource land. According to the MDP's report *A Summary of Land Use Trends in Maryland*, by 2020, Maryland had developed in total more than 1.6 million acres, a significant increase from the approximately 654,000 developed acres in 1973. Table 2-10 breaks down the acreage and percent of land use change from 2002 to 2010 throughout the state, and Figure 2-8 depicts the land uses across the state.

The MDP is starting a 2020 update to its statewide Land Use (formerly "Land Use Land Cover") geographic information system (GIS) product, and is expected to show generalized locations of developed land, including varying densities of residential land as well as commercial, industrial, institutional, other developed, and

undeveloped resource land.[40] Figure 2-8 shows the general land development/land use patterns across the state as of 2010, the last year that data is available. The 2020 update (underway now) is expected to show changes in several different land uses, although the update is expected to reflect similar trends as from 2002 to 2010.



Source: http://mdpgis.mdp.state.md.us/landuse/imap/index.html?dynTheme=dynMain&webmap=40d8b55694b94f86aedaccfeef61c868&extentBBox=-8867121.453183487,4570166.319597734,-8389848.648571078,4834638.437464317&extentSR=102100

Figure 2-8: Maryland Land Use/Land Cover Map 2010

Table 2-10: Land Use/Land Cover in Maryland (2002–2010)[41]

	Land Use in Acres		Land Use Change 2002-2010	
	2002 Acres	2010 Acres	Acres	Percent
Very Low Density Residential	283,741	311,037	27,296	9.6%
Low Density Residential	524,736	567,966	43,230	8.2%
Medium Density Residential	287,143	305,281	18,138	6.3%
High Density Residential	88,685	96,206	7,522	8.5%
Commercial	87,933	98,714	10,781	12.3%
Industrial	57,130	62,382	5,252	9.2%

[40] Maryland Department of Planning. 2020 Statewide Land Use Map Update Project. n.d. Accessed April 28, 2021. Available at: https://planning.maryland.gov/Pages/OurWork/Land-Use/2020-land-use-map-update.aspx.

[41] State of Maryland. New Development 2002–2010. n.d. Available at: https://planning.maryland.gov/Documents/OurProducts/landuse/Statewide.pdf.

	Land Use in Acres		Land Use Change 2002-2010	
	2002 Acres	2010 Acres	Acres	Percent
Other Developed Lands/Institutional/ Transportation	206,892	222,651	15,759	7.6%
Total Developed Lands	**1,536,259**	**1,664,238**	**127,979**	**8.3%**
Agriculture	1,971,969	1,908,887	-63,082	-3.2%
Forest	2,489,680	2,418,478	-71,202	-2.9%
Extractive/Barren/ Bare	13,296	19,522	6,226	46.8%
Wetland	230,221	230,300	78	0.03%
Total Resource Lands	**4,705,166**	**4,577,187**	**-127,979**	**-2.7%**
Total Land	6,241,425	6,241,425		
Water	1,685,265	1,685,265		

Source: https://planning.maryland.gov/Documents/OurProducts/landuse/Statewide.pdf

2.13.2 Housing Trends

Since 2015, the number of authorized housing units initially declined, but then increased considerably in 2018. During 2018, 18,647 permits were authorized for new housing units, which amounted to a 14.9 percent increase in new housing units authorized for construction since 2017.[42] Single-family units accounted for a considerable number of these authorized units. The number of multi-family units authorized every year since 2015 has stayed steady, except for a slight drop in 2017.

2.13.3 Land Preservation

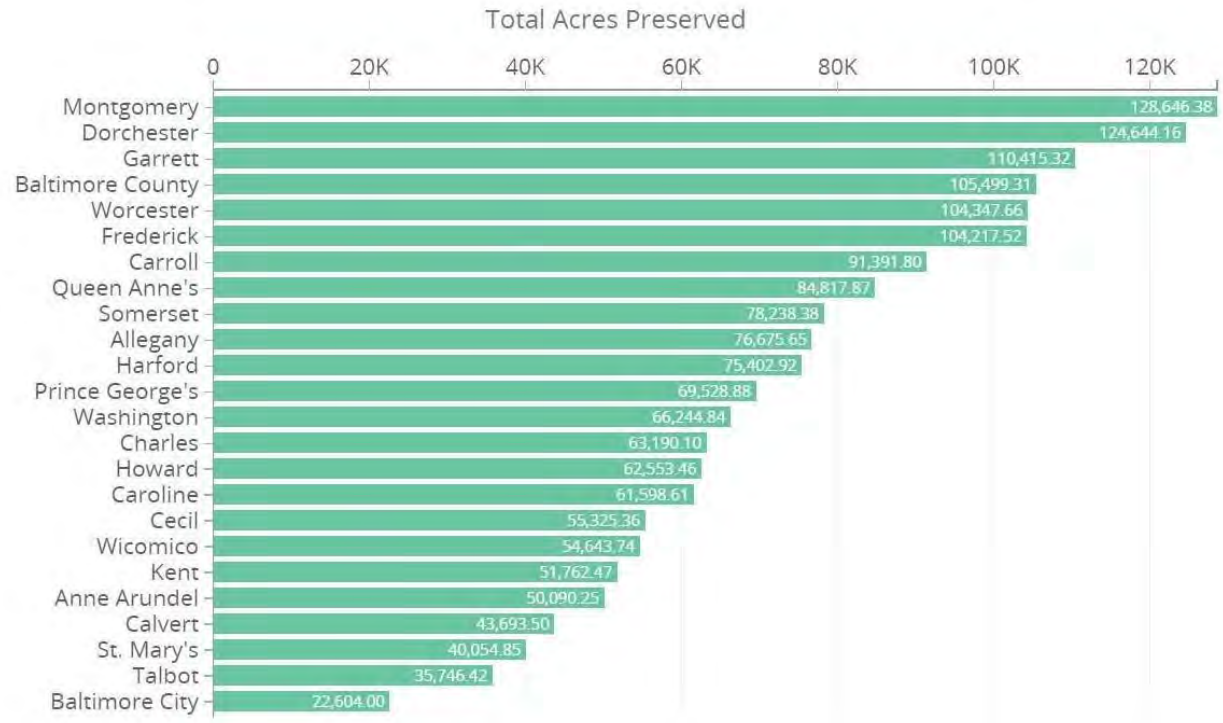
Although Maryland is ranked within the top five states in terms of population density, it has one of the strongest records of land preservation, including agricultural, private, and public lands through various preservation methodologies and programs. Typically, the three primary methods of land preservation include easement sale, easement donation or dedication, and the sale of transferable development rights. Whether land preservation is a required component of land development, such as compliance with the Maryland Forest Conservation Act, or due to an agricultural landowner seeking tax credits through programs such as the Conservation Reserve Enhancement Program or Maryland Environmental Trust, the preserved acreage typically coincides with environmentally sensitive areas, such as stream buffers, riparian areas, high-quality forests, steep slopes, highly erodible soils, or other critical features. Additionally, the Masonville Cove Urban Wildlife Refuge Partnership is the first of its kind in the United States, will be a leader in urban

[42] Maryland Housing Production 2018: New Housing Units Authorized for Construction by Building Permits: 2018. Prepared by MD Department of Planning. Planning Services Division. 2019. Available at: https://planning.maryland.gov/MSDC/Documents/Maryland%20Housing%20Production.pdf.

conservation, and will be known as a community asset and recreation destination where everybody has equal opportunity to benefit.

Land preservation can also be utilized to reduce and minimize losses by restricting development within identified hazard areas. For example, floodplain buyout programs mitigate hazard losses by reducing the number of properties that experience repetitive losses and requiring the property to be deeded open space in perpetuity.

According to the MDP, and as illustrated in Figure 2-9, as of 2019, Montgomery and Dorchester counties have the highest preserved acreage, while St. Mary's and Talbot counties have the lowest. The state had a total of 1,761,332 preserved acres as of April 2020.



Source: https://opendata.maryland.gov/Planning/Total-Acres-Preserved-in-Maryland-Counties-by-Prog/tf6f-d4ak

Figure 2-9: Total Acres Preserved, by County

2.14 Federal Land in Maryland

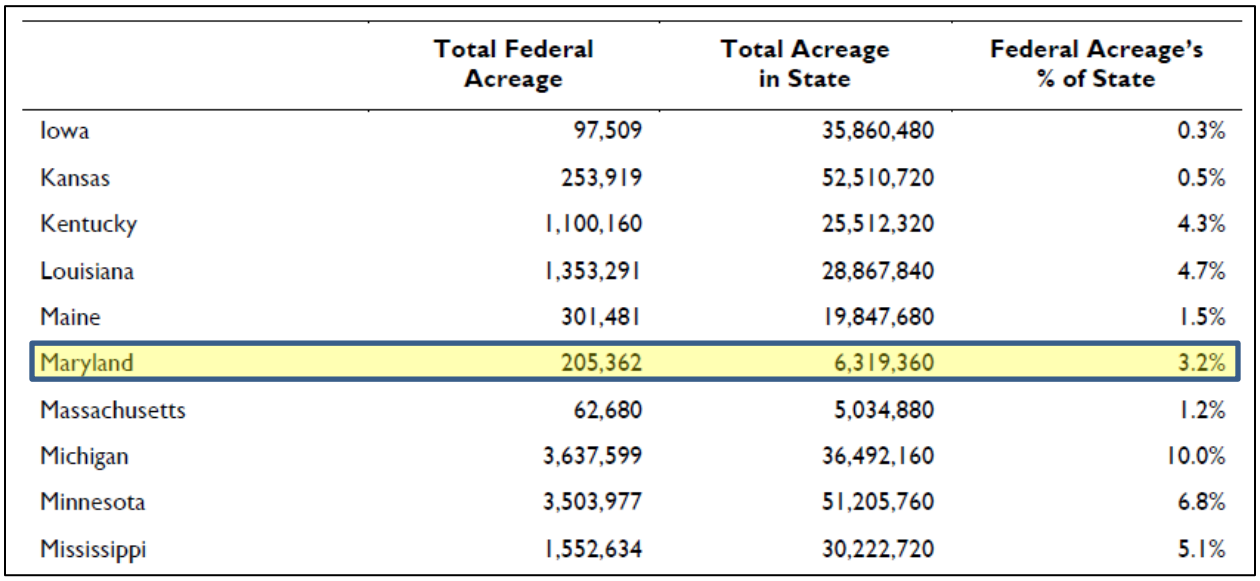
In addition to Maryland's conservation and protection efforts, the state is also home to many National Parks, Battlefields, and Wildlife Refuges. Such national treasures as the Appalachian Trail, Fort McHenry, the Chesapeake & Ohio Canal, Antietam Battlefield, and the Harriet Tubman Underground Railroad Trail all call Maryland home. As of February 21, 2020,[43] the federal government owned 3.2 percent of

[43] Congressional Research Service CRS Report Search page. https://crsreports.congress.gov – Report #R42346.

Maryland's total acreage (Figure 2-10). Table 2-11 outlines federally owned lands in Maryland.

Table 2-11: Federally Owned Land in Maryland by Agency

	Bureau of Land Management	U.S. Forest Services	U.S. Fish and Wildlife Service	National Park Service	Department of Defense
Maryland	548	0	49,795	41,532	113,487
U.S. Total	**244,391,312**	**192,919,130**	**89,205,999**	**79,945,679**	**8,849,476**



	Total Federal Acreage	Total Acreage in State	Federal Acreage's % of State
Iowa	97,509	35,860,480	0.3%
Kansas	253,919	52,510,720	0.5%
Kentucky	1,100,160	25,512,320	4.3%
Louisiana	1,353,291	28,867,840	4.7%
Maine	301,481	19,847,680	1.5%
Maryland	205,362	6,319,360	3.2%
Massachusetts	62,680	5,034,880	1.2%
Michigan	3,637,599	36,492,160	10.0%
Minnesota	3,503,977	51,205,760	6.8%
Mississippi	1,552,634	30,222,720	5.1%

Figure 2-10: Federal Land in Maryland by Percentage

Federally owned lands in Maryland have increased by 18.2 percent since 1990, averaging over 1,000 acres per year. The state continues to work with federal agencies and land management authorities to help protect these invaluable resources, and to coordinate and support planning, preparedness, mitigation, and recovery actions both now and in the future. Maryland commits to working collaboratively with the federal government when it comes to future site development, environmental impact studies, and other projects. This commitment to federal partnerships is detailed in Sections 6.1.5.15 and 6.1.6, which describe partnerships with entities such as the U.S. Army Corps of Engineers (USACE) and programs such as FEMA's RiskMAP, National Weather Service (NWS) StormReady, and CoastSmart (a NOAA-funded program).

Section 3: Hazard Identification and Vulnerability Assessment

The purpose of the HIRA is to identify natural, technological, and human-caused hazards and to evaluate the risk they pose to the State of Maryland, the health and safety of its citizens, property, environment and economy. A vulnerability and risk assessment is a decision support tool for determining the need for and prioritization of mitigation measures to protect assets, processes, and people. While availability of resources limits the ability and extent risks are reduced, vulnerability and risk assessments can help ensure that the available resources and actions taken are justified and implemented based on the threat, vulnerability, and risk.

Table 3-1: FEMA Plan Review Criteria

Element	Requirement
S3. Does the risk assessment include an overview of the type and location of all-natural hazards that can affect the state? [2 CFR §201.4(c)(2)(i)] **Intent:** To understand natural hazards across the state in order to identify which hazard risks have been or may be the most significant and the locations that have been adversely affected.	• The plan must include a current summary of natural hazards that can affect the state. The summary must include information on location, extent, and previous occurrences for each natural hazard, using maps where appropriate. • If any commonly recognized natural hazards are omitted, the plan must provide an explanation.
S4. Does the risk assessment provide an overview of the probabilities of future hazard events? [2 CFR §201.4(b) and (c) (2)(i)] **Intent:** To understand the probability of hazard events in the future as the basis for anticipated impacts of hazard risks statewide.	• a. The risk assessment must provide a summary of the probability of future hazard events that includes projected changes in occurrences for each hazard in terms of location, extent, intensity, frequency, and/or duration. • b. Probability must include consideration of changing future conditions, including the effects of long-term changes in weather patterns and climate on identified hazards.
S5. Does the risk assessment address the vulnerability of state assets located in hazard areas and estimate the potential dollar losses to these assets? [2 CFR §201.4(c)(2)] (ii) and 201.4 (c)(2)(iii)] **Intent:** To understand vulnerability of assets critical for state resilience as a basis for identifying and prioritizing mitigation actions.	• a. The risk assessment must include an analysis of the potential impacts of hazard events to state assets and a summary of assets most vulnerable to the identified hazard. These assets may be located in the identified hazard areas or affected by the probability of future hazard events. • b. The risk assessment must estimate potential dollar losses to state assets located in identified hazard areas. • Vulnerability and potential losses are not a list or inventory of state facilities but a summary of the potential impacts to those assets from the identified hazards. Factors affecting vulnerability may include asset use and function as well as construction type, age, or intended use.

Element	Requirement
S6. Does the risk assessment include an overview and analysis of the vulnerability of jurisdictions to the identified hazards and the potential losses to vulnerable structures? [2 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)] **Intent:** To understand potential impacts of future hazard events on jurisdictions throughout the state as the basis for identifying and prioritizing mitigation actions.	• The risk assessment must provide a current summary of the most vulnerable jurisdictions based on the state, local, and tribal, as applicable, risk assessments. Vulnerability must be analyzed in terms of: o Jurisdictions most threatened by the identified hazards (based on hazard location, extent, and probability). o Jurisdictions most susceptible to damage and loss from hazard events related to populations and assets (such as, structures, infrastructure, critical facilities, and systems). These populations and assets may be located in the identified hazard areas or affected by the probability of future hazard events. • The risk assessment must include a summary of the potential losses to the identified vulnerable structures based on estimates in the local risk assessments as well as the state risk assessment. • If the state is interested in an increased federal cost share under the FMA program, the risk assessment must address repetitive loss (RL) and SRL properties.

This section identifies the current and future hazards that are likely to negatively impact Maryland. Hazard identification and the assessment of associated risks is a shared responsibility between the state and local communities. Both the state and local communities assess the risks from hazards as part of their respective planning processes. While local governments focus on the hazards, vulnerabilities, and risks on a local or regional scale, the state focus remains on the regional and statewide implications of hazards. In addition to the hazard identification, this section also includes the Vulnerability Assessment, individualized for each hazard, as well as the overall Vulnerability Assessment for state and critical facilities. This section comprises what was Sections II and III of the 2016 Plan.

The hazards included in the 2021 Plan were identified through the evaluations of:

- Previous State Plans
- Presidentially Declared Disasters in Maryland
- Insured Losses

The standardized method used for assessing and prioritizing the thirteen identified hazards was based on a blend of quantitative factors extracted (as described below) from the National Climatic Data Center (NCDC) and other available sources. These include, in addition to the information above, historical occurrences and impacts (both in economic and human cost), vulnerability of populations in hazard areas, and local hazard mitigation plan hazard risk rankings.

Based on the information reviewed, hazards identified for Maryland for the 2021 Plan are listed in Table 3-2.

Table 3-2: Relevant Hazards for Maryland

Natural Hazards	
• Coastal • Dam Failures* • Drought • Extreme Temperatures* • Floods • Soil Movement*	• Thunderstorm • Tornado • Wildfires • Wind • Winter Storm • Public Health Emergencies*
Human-Caused Hazards*	
• Terrorism • Active Shooter • Nuclear Incidents	• Civil Unrest • Cyber-Attack • Transportation Accidents

* Indicates hazards added for the 2021 Plan

3.1 Probability

Probability means the likelihood of the hazard occurring and may be defined in terms of general descriptors (e.g., unlikely, likely, highly likely), historical frequencies, statistical probabilities (e.g., 1 percent chance of occurrence in any given year), and/or hazard probability maps.

Each of the 13 identified hazards have been rated using the probability assessment chart below. In-depth risk and vulnerability data and analysis has been included under each hazard within this section of the Plan.

Table 3-3: Probability Rating

Rating	Probability	Maryland Identified Hazards
1	**Unlikely (Hazards generally ranked as Low)** Hazard event is likely to occur less than once every 30 years.	*Note: Hazards that were deemed unlikely were screened out during the initial hazard identification planning process phase.*
2	**Likely (Hazards generally ranked as Medium)** Hazard event is likely to occur less than every 5 years, but more often than once every 30 years.	Dam Failures Drought Extreme Temperatures Human-Caused Hazards Public Health Emergency Soil Movement Tornado Wildfire
3	**Highly Likely (Hazards generally ranked as High)** Hazard event is likely to occur more than once every 5 years.	Coastal Hazards Flood Thunderstorm Winter Storm Wind

The risk and vulnerability assessments consider the likelihood of certain hazard events occurring in the future. Summaries of potential of the probability of future hazard events, including projected changes in terms of location, extent, intensity, and/or frequency have been included under specific hazards within this section of the Plan. Specifically, challenges posed by climate change, such as more intense storms, frequent heavy precipitation, drought, extreme flooding, and higher sea levels, alter the hazards impacting the state, particularly in type and magnitude.

3.1.1 Probability of Future Hazards – National Climate Assessment

The *Fourth National Climate Assessment* (NCA4) published in 2018 summarizes the impacts of climate change on the United States, now and in the future. According to the NCA4 "Highlights for the Northeast Region," the key climate messages include:[44]

KEY MESSAGE 1: CHANGING SEASONS AFFECT RURAL ECOSYSTEMS, ENVIRONMENTS, AND ECONOMIES

The seasonality of the Northeast is central to the region's sense of place and is an important driver of rural economies. Less distinct seasons with milder winter and earlier spring conditions are already altering ecosystems and environments in ways that adversely impact tourism, farming, and forestry. The region's rural industries and livelihoods are at risk from further changes to forests, wildfire, snowpack, and streamflow.

KEY MESSAGE 2: CHANGING COASTAL AND OCEAN HABITATS, ECOSYSTEM SERVICES, AND LIVELIHOODS

The Northeast's coast and ocean support commerce, tourism, and recreation that are important to the region's economy and way of life. Warmer ocean temperatures, sea level rise, and ocean acidification threaten these services. The adaptive capacity of marine

2018 NATIONAL CLIMATE ASSESSMENT

OVERVIEW

"Climate-related risks will continue to grow without additional action. Decisions made today determine risk exposure for current and future generations and will either broaden or limit options to reduce the negative consequences of climate change. While Americans are responding in ways that can bolster resilience and improve livelihoods, neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades."

Source: The Fourth National Climate Assessment (U.S. Global Change Research Program, 2018).

[44] The Fourth National Climate Assessment. *Volume II, Impacts, Risks, and Adaptation in the United States*. Chapter 2: "Our Changing Climate." U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/2/.

ecosystems and coastal communities will influence ecological and socioeconomic outcomes as climate risks increase.

KEY MESSAGE 3: MAINTAINING URBAN AREAS AND COMMUNITIES AND THEIR INTERCONNECTEDNESS

The Northeast's urban centers and their interconnections are regional and national hubs for cultural and economic activity. Major negative impacts on critical infrastructure, urban economies, and nationally significant historic sites are already occurring and will become more common with a changing climate.

KEY MESSAGE 4: THREATS TO HUMAN HEALTH

Changing climate threatens the health and well-being of people in the Northeast through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise. These environmental changes are expected to lead to health-related impacts and costs, including additional deaths, emergency room visits and hospitalizations, and a lower quality of life. Health impacts are expected to vary by location, age, current health, and other characteristics of individuals and communities.

KEY MESSAGE 5: ADAPTATION TO CLIMATE CHANGE IS UNDERWAY

Communities in the Northeast are proactively planning and implementing actions to reduce risks posed by climate change. Using decision support tools to develop and apply adaptation strategies informs both the value of adopting solutions and the remaining challenges. Experience since the last assessment provides a foundation to advance future adaptation efforts.

According to the NCA4, human-induced climate change is increasingly impacting both rural and urban communities. In rural areas, community identity is often built around the prominence of small, multigenerational, owner-operated businesses and the natural resources of the local area. Climate variability can affect human migration patterns and droughts and flooding can adversely affect ecosystem function, the viability of farms, and land use, all of which are concerns for large swathes of our state. Residents in urban areas face multiple "climate hazards," such as temperature extremes, poor air quality, recurrent and persistent waterfront, and coastal flooding as well as intense rainfall events that can put extensive pressure on urban water transmission and filtration systems. These hazards can lead to large numbers of evacuated or displaced populations and damaged infrastructure, as well as force the community to continually fund infrastructure repair and mitigation. Increased rainfall and precipitation drive increased nuisance flooding, which also adversely impacts resident's health and the overall environment. Increases in flood volumes could increase the spread of contaminants into soils and waterways, resulting in increased health risks, not just of people but of the natural ecosystem as well.

Continuing regional impacts for the Northeast, as reported in the NCA4, include the following: heat waves, more extreme precipitation events, and coastal flooding due to sea level rise and storm surge. The assessment also reported impacts for coastal areas, particularly important as so much of the state is coastal, as follows: coastal lifelines, such as water supply infrastructure and evacuation routes, are increasingly vulnerable to higher sea levels and storm surges, inland flooding, and other climate-related changes.

All these conditions exist within Maryland, and they significantly compound the equity challenges faced by the most underrepresented communities. Mitigation strategies proposed in this plan are designed to ensure an equitable approach across all communities to address vulnerabilities and mitigation and resiliency actions are undertaken.

Maintaining functioning, sustainable communities in the face of climate change requires effective adaptation strategies that anticipate and buffer impacts, while also enabling communities to capitalize upon new opportunities. Maryland has been working diligently to assess future vulnerability and identify selective adaptation and mitigation methods, programs, and projects to create a more resilient Maryland. These efforts have been highlighted throughout the Plan, displaying Maryland's collaborative and forward-thinking approach to resiliency.

Note: With this Plan, Maryland has added the Extreme Temperatures Hazard, coinciding with one of the major messages and focal areas of the NCA4. Maryland continues to address the Coastal Flooding and Nuisance Flooding hazards, as well as the newly added Public Health hazard. All of these are considered in the Assessment and are considered to have significant potential risk for the state.

3.2 State Assets

State assets include state-owned and/or operated facilities. The first step in the analysis of potential impacts of hazard events to state assets involved updating the *State Asset Database*. The State Treasurer's Office provided an updated inventory of all state-owned and leased facilities, referred to as *Maryland Property Schedule Database*. This database was modified to include additional attribute categories consistent with the process of the risk and vulnerability assessment, referred to as the *State Asset Database*.

The 2016 *State Asset Database* used during the vulnerability assessment contained 7,891 parcels with facilities. Data entries that lacked point data (x and y coordinates) from the State Treasurer's Office Property Schedule were not included in the 2016 *State Asset Database*. The updated 2020 *State Asset Database* includes 7,381 parcels containing facilities. All data entries from the State Treasurer's Office Property Schedule were included in the 2020 *State Asset Database* and utilized in the 2020 vulnerability assessment update. Table 3-4 identifies the number of state assets in each jurisdiction. Maps for all state assets per jurisdiction may be found in Appendix H.

Facilities were categorized based upon the state agency that owns or operates the facility using the following facility types:

- Administration
- Corrections
- DNR
- Education
- Environmental
- Fire/Police
- Health Related
- Historic
- Judicial/Legal
- Military
- Social Services
- Transportation and
- Utility/Infrastructure.

Table 3-4: State Assets by Jurisdiction

Jurisdiction	State Asset Totals 2020	Historic State Assets	Historic State Assets (Percentage)
Allegany	300	57	19%
Anne Arundel	529	158	30%
City of Annapolis	232	42	18%
Baltimore	745	378	51%
Baltimore City	867	233	27%
Calvert	132	50	38%
Caroline	425	97	23%
Carroll	235	102	43%
Cecil	292	151	52%
Charles	153	40	26%
Dorchester	109	13	12%
Frederick	197	75	38%
Garrett	297	121	41%
Harford	220	82	37%

Jurisdiction	State Asset Totals 2020	Historic State Assets	Historic State Assets (Percentage)
Howard	369	156	42%
Kent	40	5	13%
Montgomery	192	58	30%
Prince George's	628	261	42%
Queen Anne's	98	22	22%
Somerset	324	149	46%
St. Mary's	265	56	21%
Talbot	67	10	15%
Washington	335	121	36%
Wicomico	197	61	31%
Worcester	125	33	26%
Ocean City	8	0	0%
TOTAL	**7381**	**2531**	**34%**

Jurisdictions containing the highest number of state asset facilities include Baltimore, Anne Arundel, and Prince George's counties, along with the City of Baltimore. The state does not assign priority rankings to the facilities that may be susceptible to various hazards, primarily for security and safety reasons. Once a facility has been identified as "critical," that designation is the highest ranking given and the facility is deemed essential for protection. The individual counties may prioritize facilities separately, and the state will coordinate with them to ensure that state programs and funding requests support the mitigation of hazards and protection of these facilities.

3.2.1 Historic State-Owned Structures

The updated *State Asset Database* was further enhanced to include state-owned historic structures. An additional attribute column "Historic" was added to the database. Facilities built in 1965 and earlier were designated as historic within the database. Local jurisdictions containing the highest percentage of state assets that are 50 years and older include Baltimore and Somerset counties. These facilities were built prior to modern codes, which may increase the vulnerability of the historic structures to various hazards.

3.3 Critical Facilities

Critical facilities refer to structures that the state determines must continue to operate before, during, and after an emergency and/or hazard event and/or are vital to health and safety. Maryland published its *Local Hazard Mitigation Plan Guidance* in May of 2015 to ensure continuity between local and State Hazard Mitigation Plan documents. Considering that there are various perspectives on types of facilities designated as critical, the *HAZUS-MH User's Manual* essential facility definition and facility types were adopted as the basis for the minimum critical facility types in Maryland. As part of the local guidance, the state determined at a minimum the following critical facilities must be included in both the state and local plan update process:

- Fire Stations
- Hospital and Medical Clinics
- Police Stations
- Emergency Operations Centers
- Schools (K-12 & Colleges)

Local jurisdictions submitted additional critical facilities information.

The Planning Team continued to follow the 2011 FEMA recommendation and utilize the *State of Maryland Critical Facilities Database* for the vulnerability assessment in the Plan update.

The database contains 2,658 facilities statewide. Many of these facilities were built prior to modern building codes; in fact, 904 facilities were built in 1965 or earlier, and are 50 plus years old.

The jurisdictions containing the highest numbers of critical facilities include Baltimore County, City of Baltimore, Prince George's County, and Montgomery County. Table 3-5 identifies the critical facilities in each jurisdiction. Maps for all critical facilities per jurisdiction may be found in Appendix I.

Table 3-5: Critical Facilities by Jurisdiction

Jurisdiction	Critical Facilities Totals 2020	Historic Critical Facilities	Historic Critical Facilities (Percentage)
Allegany	70	43	61%
Anne Arundel	114	32	28%
City of Annapolis	25	8	32%
Baltimore	427	106	25%
Baltimore City	457	228	50%
Calvert	73	18	25%

Jurisdiction	Critical Facilities Totals 2020	Historic Critical Facilities	Historic Critical Facilities (Percentage)
Caroline	31	13	42%
Carroll	115	38	33%
Cecil	91	41	45%
Charles	80	22	28%
Dorchester	62	30	48%
Frederick	121	41	34%
Garrett	19	9	47%
Harford	116	28	24%
Howard	35	6	17%
Kent	25	11	44%
Montgomery	221	65	29%
Prince George's	251	25	10%
Queen Anne's	49	26	53%
Somerset	43	19	44%
St. Mary's	26	10	38%
Talbot	45	15	33%
Washington	87	37	43%
Wicomico	66	31	47%
Worcester	0	0	0%
Ocean City	9	2	22%
TOTAL	**2658**	**904**	**34%**

3.4 Loss Estimations

Loss estimations were calculated and incorporated into both the *Critical Facilities Database* and the *State Asset Database*. The *Critical Facilities Database* included assessment values for each of the facilities as well as the relevant content value. For the Loss Estimate calculations under each hazard in this section, the results of the risk ranking calculations from the HIRA (see Section 3.26.2 for ranking methodology and data used) were reviewed and those counties ranked as High (or Medium-High in the case of Coastal and Wildfire hazards) risk have been included in the Loss Estimate calculations for each hazard, with tables provided in each section that address the individual hazards. Subsequently, the critical facilities and state assets

were totaled in number and value for each county that received a High-risk ranking. If a historical analysis indicates susceptibility to a particular hazard, only the facilities and assets over 50 years old are included in the totals. The valuation data for the critical facilities and the state assets are managed by the state in the State of Maryland Critical Facility Database and the State Asset Geodatabase respectively. A more detailed methodology of determining Loss Estimations has been included at the start of Appendix H and I. This includes a graphic example showing a sample hazard map overlayed with the Assets or Facilities layer for a single county.

As mentioned above, the state does not assign priority rankings to the facilities that may be susceptible to various hazards, primarily for security and safety reasons. Once a facility has been identified as "critical," that designation is the highest ranking given and the facility is deemed essential for protection. The individual counties may prioritize facilities separately, and the state will coordinate with them to ensure that state programs and funding requests support the mitigation of hazards and protection of these facilities.

Based on the data provided, all the facilities within the *State Asset Database* contained both building and content values designated by the State Treasurer's Office. In some cases, many of the facilities located on one property were assigned the same building and content value. In order to reduce this duplication, only one facility on the entire property was used when summing potential losses. The "comments" filed in the *State Asset Database* designate whether a facility's values include other facilities on the same property.

3.5 Previous State Plans (and new Hazards)

The MEMA Mitigation Team worked with SMEs to review the hazards as listed in the 2016 Plan. For the 2021 update, the Planning Team added several new hazards, including Human-Caused Hazards, Soil Movement, and Extreme Temperatures. These additions reflect the dynamic nature of threat/hazard and a requirement to comply with other standards, including the Emergency Management Accreditation Program (EMAP). In July 2020, MEMA and MDE undertook a comprehensive study of dams throughout the state in response to FEMA's High Hazard Potential Dam Program. The study, approved by FEMA as an amendment to the 2016 Plan, informed this Plan's HIRA and Mitigation Strategy sessions. The entire report can be found in Appendix C. Additional research and coordination will be needed during the lifespan of this Plan to ensure that the dam data are accurate and present an appropriate view of the risk to the people and property surrounding these features. MEMA anticipates off-cycle revisions to the risk maps and analyses during the next 5 years to verify data accuracy.

3.6 Presidentially Declared Disasters in Maryland

The Robert T. Stafford Disaster Relief and Emergency Assistance Act provides the statutory authority for most federal disaster response activities and established the

presidential disaster declaration process whereby the Governor of an affected state formally requests aid from the President.[45]

Federal-level disaster declarations were reviewed to ensure coverage of events in the Plan. Federal declarations are listed in the table below as a consolidated set of data rather than being included in each hazard profile section.

The State of Maryland has received 31 Presidential Disaster Declarations since data became available in 1962. In the last 10 years, the state has received 12 disaster declarations, and since the last publication of the Plan in 2016, the state has received five disaster declarations (declared through September 1, 2020). In addition, on September 3, 2020, Governor Hogan requested a Presidential Disaster Declaration to assist communities impacted by Tropical Storm Isaias in August. This Declaration was granted by President Biden on February 4, 2021 and is included in Table 3-6 below and the total number of declared disasters. This will bring the number to a total of seven since the last plan update and 31 since 1962.

Table 3-6 shows the year, disaster number assigned, type of event, and the designated areas affected for each Presidentially Declared Disaster Declaration.

Table 3-6: Presidentially Declared Disasters

Year	Disaster Number	Event Description	Designated Areas[1]
2020	DR-4583-MD	Tropical Storm Isaias	Calvert, Dorchester and St. Mary's counties
2020	DR-4491-MD	COVID-19 Pandemic	Entire state
2018	DR-4376-MD	Severe Storm and Flooding	Baltimore and Howard counties
2018	DR-4374-MD	Severe Storm and Flooding	Frederick and Washington counties
2016	DR-4279-MD	Severe Storm and Flooding	Howard
2016	DR-4261-MD	Severe Winter Storm and Snowstorm	Allegany, Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, Washington, and Worcester counties
2014	DR-4170-MD	Snowstorm	Baltimore, Carroll, and Howard counties
2012	DR-4091-MD	Hurricane Sandy	Allegany, Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, Somerset, St. Mary's, Talbot, Washington, Wicomico, and Worcester counties

[45] "How a Disaster Gets Declared." FEMA. April 15, 2021. https://www.fema.gov/disasters/how-declared.

Year	Disaster Number	Event Description	Designated Areas[1]
2012	DR-4075-MD	Severe Storms and Straight-line Winds	Baltimore City, Calvert, Charles, Kent, Montgomery, and St. Mary's counties
2011	DR-4038-MD	Remnants of Tropical Storm Lee	Anne Arundel, Baltimore, Cecil, Charles, Harford, Howard, and Prince George's counties
2011	DR-4034-MD	Hurricane Irene	Baltimore City, Baltimore, Calvert, Caroline, Cecil, Charles, Dorchester, Harford, Kent, Queen Anne's, Somerset, St. Mary's, Talbot, Wicomico, and Worcester counties
2010	DR-1910-MD	Severe Winter Storm and Snowstorm	Allegany, Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, Talbot, Washington, and Wicomico counties
2010	DR-1875-MD	Severe Winter Storm and Snowstorm	Anne Arundel, Baltimore City, Baltimore, Caroline, Cecil, Charles, Harford, Howard, Kent, Montgomery, Queen Anne's and Talbot counties
2006	DR-1652-MD	Severe Storm, Flooding, and Tornadoes	Caroline, Dorchester, and Montgomery counties
2003	DR-1492-MD	Hurricane Isabel	Allegany, Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, Somerset, St. Mary's, Talbot, Washington, Wicomico, and Worcester counties
2002	DR-1409-MD	Tornado	Calvert and Charles counties
2000	DR-1324-MD	Severe Winter Storm	Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Charles, Dorchester, Frederick, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, and Talbot counties
1999	DR-1303-MD	Hurricane Floyd	Anne Arundel, Calvert, Caroline, Cecil, Charles, Harford, Kent, Queen Anne's, Somerset, St. Mary's, and Talbot counties
1996	DR-1139-MD	Severe Storms and Flooding associated with Tropical Storm Fran	Allegany, Frederick, and Garrett counties
1996	DR-1094-MD	Severe Storms and Flooding	Allegany, Carroll, Cecil, Frederick, Garrett, and Washington counties

Year	Disaster Number	Event Description	Designated Areas[1]
1996	DR-1081-MD	Blizzard of 96 (Severe Snowstorm)	Allegany, Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, Somerset, St. Mary's, Talbot, Washington, Wicomico, and Worcester counties
1994	DR-1016-MD	Severe Winter Weather and Ice Storms	Anne Arundel, Calvert, Caroline, Charles, Dorchester, Frederick, Prince George's, St. Mary's, and Talbot counties
1989	DR-839-MD	Severe Storms and High Winds	Montgomery County
1986	DR-773-MD	Severe Storm and Flooding	Allegany County
1979	DR-601-MD	Severe Storms, Tornados, and Flooding	Anne Arundel, Baltimore City, Baltimore, Calvert, and Frederick counties
1977	DR-524-MD	Ice Conditions	None
1976	DR-522-MD	Severe Storms and Flooding	Carroll and Frederick counties
1975	DR-489-MD	Heavy Rains and Flooding	Anne Arundel, Baltimore City, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Howard, Kent, Montgomery, Prince George's, Talbot, and Washington counties
1972	DR-341-MD	Tropical Storm Agnes	Allegany, Anne Arundel, Baltimore City, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Harford, Howard, Kent, Montgomery, Prince George's, Somerset, Talbot, Washington, Wicomico, and Worcester counties
1971	DR-309-MD	Severe Storms and Flooding	Anne Arundel, Baltimore City, Baltimore, Carroll, Frederick, Harford, Howard, Montgomery, and Prince George's counties
1962	DR-127-MD	Severe Storms, High Tides, and Flooding	None

[1] These are the Designated Areas for FEMA Public Assistance. With the exception of DR-4279, FEMA HMGP funds were made available to the entire state.

Table 3-7 presents the number of Presidentially Declared Disasters for hazards presented in this Plan.

Table 3-7: Presidentially Declared Disasters by Hazard

Hazard Type	Presidentially Declared Disasters
Coastal (Hurricanes and Tropical Storms)	8

Hazard Type	Presidentially Declared Disasters
Public Health Emergency (COVID-19)	1
Thunderstorm (including tornadoes, high winds, and flooding)	12
Tornado	1
Winter Storm (including ice storms)	8
Wind (Derecho)	1
Total	**31**

Thunderstorms and associated hazards (including tornadoes, high winds, and flooding) are the number one cause for Presidentially Declared Disasters and Emergencies declared in Maryland, with 33 percent more declarations than the second most common hazards, Coastal and Winter Storms.

Maryland also regularly receives U.S. Department of Agriculture (USDA) Secretarial disaster declarations. The Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency (EM) loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as Farm Service Agency (FSA) disaster assistance programs, have historically used disaster designations as an eligibility trigger.

The FSA administers four types of disaster designations:

- USDA Secretarial disaster designation
- Presidential major disaster and Presidential emergency declaration
- FSA Administrator's Physical Loss Notification
- Quarantine designation by the Secretary under the Plant Protection Act or animal quarantine laws

USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA State Executive Director. The Secretarial disaster designation is the most widely used. These declarations typically result from drought, early freezes, and excessive rain.

Since 2016, Maryland has received a Secretarial disaster declaration every year.

3.7 Catastrophic Events

According to the Property Claim Service (PCS), an entity within the property and casualty insurance industry, estimated 2019 catastrophic losses in the United States dropped by about half (52 percent) to $24.4 billion from $50.9 billion in 2018. Insured losses in 2017 were the highest since PCS began collecting insured loss data in 1949.

The number of catastrophes rose to 61 in 2019 from 55 in 2018. The number of catastrophes in 2019 was the highest number of catastrophes in any year, with a threshold of $25 million or more in insured losses.

According to the National Centers for Environmental Information (a division of the National Oceanic and Atmospheric Administration [NOAA]), since 1980, the United States has sustained 273 weather and climate disasters in which overall damages/costs reached or exceeded $1 billion. The total cost of these 273 events exceeds $1.790 trillion.[46] In that same time period, 21 Severe Storm, 10 Tropical Cyclone, 13 Winter Storm, four Flooding, nine Drought, and one Freeze billion-dollar disaster events have affected Maryland.[47]

The COVID-19 pandemic likely will go down as the costliest disaster in state history. According to the Maryland Bureau of Revenue Estimates, the COVID-19 pandemic could cost the state up to $4 billion in losses by 2022. Prior to 2020, the costliest insured catastrophe in Maryland history is estimated to be Hurricane Agnes. This storm was the costliest hurricane to hit the United States at the time, causing an estimated $2.1 billion in damage. Losses in Maryland were estimated to be $110 million along with 19 reported fatalities.[48]

Note: A complete Risk Assessment Methodology and Risk Assessment Datasets, providing detailed information on the ranking parameters, task items, and associated data compilation tables are presented later in this section.

3.8 HIRA Outline

According to 2 CFR §201.4(c)(2)(i)11, state hazard mitigation plans must include a current summary of the natural hazards that can affect the state. The summary must include information on location, extent, and previous occurrences for each natural hazard. Therefore, for each hazard identified above, the Plan includes the following information:

3.8.1 Definition

General definitions and characteristics of hazards are included in the HIRA to provide a common understanding as to what the event is and why it is of enough concern to make it a hazard in Maryland. These definitions and characteristics were reviewed and updated or enhanced for some hazards.

3.8.2 Location

Hazards occurring in Maryland range from statewide to regional with some specifically associated with the geologic attributes of a localized area. The

[46] "U.S. Billion-Dollar Weather & Climate Disasters 1980-2021." NOAA National Centers for Environmental Information. Authors: Adam Smith, Neal Lott, Tamara Houston, Karsten Shein, Jake Crouch, Jesse Enloe. n.d. Available at: https://www.ncdc.noaa.gov/billions/events.pdf.

[47] NOAA National Centers for Environmental Information. "Billion-Dollar Weather and Climate Disasters: Events." 2021. Accessed April 28, 2021. https://www.ncdc.noaa.gov/billions/events/MD/1980-2020.

[48] https://www.weatherconcierge.com/the-devastating-floods-from-agnes-will-never-be-forgotten/.

geographic extent for each hazard is presented in the text and supported by tables or maps where available and appropriate.

3.8.3 Extent (Magnitude/Strength)

Assessment of severity is expressed in terms of consequence of impacts, such as injuries and fatalities; damage to personal property, infrastructure, state or local critical assets, and the environment; negative effects on the economy; and the degree and extent to which the hazard affects the ability to provide essential services. Magnitude and severity is further considered in the vulnerability assessment and consequence analysis.

3.8.4 Previous Occurrences

Every county in the state has experienced the adverse effects of hazards. Descriptions of previous occurrences, or known hazard incidents, are included to help frame the extent of the hazard's impact on areas of Maryland. In some cases, detailed accounts are provided for significant historic hazard events. Occurrences for every hazard from the 2016 Plan were reviewed and updated. Detailed historic events and associated deaths, injuries, and total damage by county are included for some hazards.

3.8.5 Future Probability and Climate Change Conditions

The likelihood of a hazard occurring again looks toward past frequency to assist in determining the probability of future occurrence. For some hazards, the future probability of events is further supported by assumptions that favorable environmental conditions resulting in a hazard event will continue to develop or persist.

FEMA now requires that states evaluate changes to climate conditions that may affect and influence their long-term vulnerability. These changes to climate conditions are described as "climate change" or "future conditions" throughout this Plan. The impact of climate change on location, extent, intensity, frequency, and duration is analyzed for each climate-related natural hazard.

3.8.6 Vulnerability and Impact

Specific characteristics of local jurisdictions may make them more susceptible to damage from a given hazard. It is important to understand the hazards that most impact a jurisdiction and understand the components of vulnerability (people, property, economy, environment, critical infrastructure, etc.) and the resulting losses.

The "Consequence Analysis" subsections for each hazard include a summary table of potential overall consequences of the hazard based on the Impact Analysis of Potential for Detrimental Impacts of Hazards finalized for the EMAP.

Note: The assessment for each hazard contains a subsection on Vulnerability and Impact that provides extended information that the state will use to understand the probability and potential impact of future hazards, as well as a review of, the

vulnerability of critical facilities and infrastructure. The hazard risk assessment tables are included at the end of the sections as well.

This information was previously contained in Section III of the 2016 Plan. Following the hazard-specific information, MEMA has continued the discussion with Vulnerability Assessment on the State Assets and Critical Facilities.

3.9 Coastal Hazards

3.9.1 Definitions

Coastal hazards can take many forms. Often, coastal hazards are interconnected and will include various other individual hazards. Coastal hazards include both tropical and non-tropical cyclones, which cause coastal inundation (including storm surge/storm tide), freshwater flooding, destructive winds, tornadoes, debris flows, rip currents/high surf,[49] which may exacerbate shoreline erosion and longer-term hazards such as sea level rise. Coastal hazards included in this Plan are defined by the NWS[50] as follows:

Tropical depression: "A tropical cyclone in which the 1-minute sustained wind speed is 33 knots (38 mph), or less. The center of the tropical depression may not actually move ashore. The tropical depression will usually include many individual hazards, such as storm surge, freshwater flooding, tornadoes, debris flows, rip currents, etc."

Tropical storm: "A tropical cyclone in which the 1-minute sustained surface wind ranges from 34 to 63 knots (39 to 73 mph) inclusive. The tropical storm will usually include many individual hazards, such as storm tide, freshwater flooding, tornadoes, debris flows, rip currents, etc. Tropical cyclones can move well inland and create damaging winds."

Hurricane: "A tropical cyclone in which the maximum 1-minute sustained surface wind is 64 knots (74 mph) or greater. Tropical cyclones can move well inland and create damaging winds."

Storm surge/tide: "For coastal and select lakeshore areas, the vertical rise above normal water level associated with a storm of tropical origin (e.g., hurricane, typhoon, tropical storm, or subtropical storm), caused by any combination of strong, persistent onshore wind, high astronomical tide and low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries."

Coastal flood: "Flooding of coastal areas due to the vertical rise above normal water level caused by strong, persistent onshore wind, high astronomical tide, and/or low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries. Coastal areas are defined as those portions of coastal land zones (coastal

[49] Storm Data Preparation. NOAA National Weather Service Instruction 10-1605. Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[50] Ibid.

county/parish) adjacent to the waters, bays, and estuaries of the oceans." Inland, flood events are characterized as Flash Flood or Flood instead of Coastal Flood.

Nuisance flood: While not included as a discrete hazard type in the NOAA Storm Events Database, nuisance flooding is impacting Maryland with growing frequency. Nuisance flooding is defined in §3-1001 of the Natural Resource Article of the Maryland Annotated Code as "high-tide flooding that causes public inconvenience." This is similar to how the NOAA defines nuisance flooding or high tide flooding: "flooding that leads to public inconveniences such as road closures."[51]

3.9.2 Location

As the name suggests, coastal hazards are expected to affect coastal areas; however, what constitutes a "coastal area" may vary. NOAA categorizes the coastal population of the United States into two county suites: Coastal Watershed Counties and Coastal Shoreline Counties.

Coastal Watershed Counties are counties where activities affecting land use and water quality can directly affect coastal ecosystems. Residents living in Coastal Watershed Counties can be considered "the population that most directly affects the coast."[52]

Coastal Shoreline Counties are counties located "directly adjacent to the open ocean, major estuaries, and the Great Lakes, and due to their proximity to these waters, bear the most direct effects of coastal hazards and host the majority of economic production associated with coastal and ocean resources." Residents in Coastal Shoreline Counties can be considered the population "most directly affected by the coast."[53] In the context of coastal hazards and community resilience, Coastal Shoreline Counties provides a better contextual framework.[54]

According to NOAA, as of 2010, 39 percent of the nation's population (123.3 million people) reside in a Coastal Shoreline County. In the four decades between 1970 and 2010, the population of Coastal Shoreline Counties increased 39 percent. NOAA projects that between 2010 and 2020, these counties will experience a further 8 percent increase (10 million people), growing to about 133.3 million people.[55]

The Maryland coastal zone comprises the land, water, and subaqueous land between the territorial limits of Maryland in the Chesapeake Bay, Atlantic Coastal Bays, and the Atlantic Ocean. This zone includes the towns, cities, and counties that contain and help govern the thousands of miles of Maryland shoreline. The Maryland coastal zone extends from 3 miles out in the Atlantic Ocean to the inland boundaries of the 16 counties and Baltimore City that border the Atlantic Ocean, Chesapeake

---

[51] *Nuisance Flood Plan Development Guidance October*. Maryland Department of Natural Resources. 2019. Available at: https://dnr.maryland.gov/ccs/Documents/NuisanceFloodPlan.pdf.

[52] Coastal County Definitions. November 2017. NOAA Office for Coastal Management. Available at: https://coast.noaa.gov/data/digitalcoast/pdf/grt-coastal-county-definitions.pdf.

[53] Ibid.

[54] https://aambpublicoceanservice.blob.core.windows.net/oceanserviceprod/facts/coastal-population-report.pdf.

[55] Ibid.

Bay, and the Potomac River up to the District of Columbia. In addition to Baltimore City, the 16 counties are Anne Arundel, Baltimore, Calvert, Caroline, Charles, Cecil, Dorchester, Harford, Kent, Prince George's, Queen Anne's, Somerset, St. Mary's, Talbot, Wicomico, and Worcester. Maryland's coastal zone encompasses two-thirds of the state's land area and is home to almost 70 percent of Maryland's residents.[56]

In 2003, the Maryland Geological Survey (MGS) reported that based on a shoreline interpreted from air photos flown between 1988 and 1995, Maryland's tidal shoreline, bordering the Chesapeake Bay, its tributaries, the coastal bays, and the Atlantic coast, is 7,719 miles long.[57]

With its extensive shoreline, Maryland's coastline experiences flooding and erosion caused by the coastal hazards identified in this section and exacerbated by sea level rise. The 2016 *Maryland Coastal Resiliency Assessment* offers additional analysis on the location of coastal hazards and risk within the State of Maryland. It is a landscape-level spatial analysis and modeling effort that identifies where natural habitats provide the greatest potential risk reduction for coastal communities. Data products included in the Assessment that can provide a more nuanced and granular understanding of coastal hazard location, include:

- Shoreline Hazard Index: identifies high-, moderate-, and low-hazard shorelines.
- Habitat Role and Hazard Reduction: identifies shorelines where habitats play a high, moderate, low, or nonexistent role in hazard reduction.
- Coastal Community Flood Risk Areas: ranks residential areas from very low to very high risk based on probability of exposure to a flood event, population density, and social demographics (age, income, and language proficiency).
- Priority Shoreline Areas: identifies Tier 1 and Tier 2 priorities for conservation and restoration actions. Tier 1 and Tier 2 shorelines represent areas where habitats have the potential to play a high or moderate role in risk reduction, respectively, for adjacent coastal communities.
- Marsh Potential Protection Index: ranks the potential of existing marshes to protect coastal communities based on marsh size, proximity to hazards, proximity to residential areas, proximity to other coastal habitats, and the likelihood that the marsh will persist into the year 2100.

Nuisance flooding in coastal areas of the United States has increased in frequency between 300 and 925 percent since the 1960s. Number of flood days in the cities of

[56] Maryland Department of the Environment. Maryland Coastal Consistency Review: Maryland Coastal Zone Management Program. n.d. Accessed April 28, 2021. Available at: https://mde.maryland.gov/programs/Water/WetlandsandWaterways/Pages/CZM.aspx.

[57] Maryland's Shoreline Length: Background & Guidance Maryland Department of Natural Resources. January 2013. Available at: https://dnr.maryland.gov/ccs/Documents/MDShorelineMilesReference.pdf.

Annapolis and Baltimore have increased in frequency by 920 percent since 1960.[58] Communities throughout Maryland's coastal zone are experiencing increasing disturbances from episodic nuisance flooding.[59] As stated in Maryland House Bill 1427, jurisdictions that experience nuisance flooding are required to develop a plan to address nuisance flooding on or before October 1, 2020.[60]

3.9.3 Extent (Magnitude/Strength)

Based on a tropical cyclone's 1-minute sustained surface wind speed, it may be classified as a tropical depression, tropical storm, or hurricane. For a tropical cyclone to form, it must start with a "pre-existing weather disturbance,"[61] such as a tropical wave. Additional necessary factors include warm ocean water, atmospheric temperature instability, moisture in the mid-level of the atmosphere, generally more than 200 miles north or south of the equator, and low vertical wind shear, which refers to minimal differences in wind speed or direction with vertical change.[62]

Hurricane extent is measured on the Saffir-Simpson Hurricane Wind Scale. It categorizes a hurricane on a scale of 1 to 5 based on its sustained wind speed, which provides an estimate for potential for property damage. Table 3-8 is adapted from the National Hurricane Center and Central Pacific Hurricane Center of NOAA and displays the Saffir-Simpson Hurricane Wind Scale categories and associated types of damage due to the hurricane winds.[63]

Table 3-8: Saffir-Simpson Hurricane Wind Scale

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74–95 mph	**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.

[58] "NOAA: 'Nuisance flooding' an increasing problem as coastal sea levels rise: Study looks at more than 60 years of coastal water level and local elevation data changes." NOAA, U.S. Department of Commerce. July 28, 2014. Available at: https://www.noaa.gov/media-release/noaa-nuisance-flooding-increasing-problem-as-coastal-sea-levels-rise.

[59] *Nuisance Flood Plan Development Guidance*. Maryland Department of Natural Resources. October 2019. Available at: https://dnr.maryland.gov/ccs/Documents/NuisanceFloodPlan.pdf.

[60] Maryland House Bill 1427: *Sea Level Rise Inundation and Coastal Flooding – Construction, Adaptation, and Mitigation*. LegiScan. 2019. Available at: https://legiscan.com/MD/text/HB1427/2019.

[61] "How do hurricanes form"? NOAA National Ocean Service. February 26, 2021. Available at: https://oceanservice.noaa.gov/facts/how-hurricanes-form.html.

[62] Hurricanes. NOAA. May 2020. Available at: https://www.noaa.gov/education/resource-collections/weather-atmosphere/hurricanes.

[63] Saffir-Simpson Hurricane Wind Scale. NOAA National Hurricane Center and Central Pacific Hurricane Center. n.d. Accessed April 28, 2021. Available at: https://www.nhc.noaa.gov/aboutsshws.php.

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
2	96–110 mph	**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 mph	**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 mph	**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 mph or higher	**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 will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

mph = miles per hour
Table source: https://www.nhc.noaa.gov/aboutsshws.php#:~:text=The%20Saffir%2DSimpson%20Hurricane%20Wind,loss%20of%20life%20and%20damage.

Importantly, while Category 3, 4, and 5 hurricanes are classified as "major hurricanes," Category 1 and 2 hurricanes can still cause significant damage and injury. This is because wind speed—the basis of the Saffir-Simpson Hurricane Wind Scale, as evidenced by progressively higher "Category" classification—is not the sole indicator of potential property damage or loss of life resulting from a hurricane.[64]

Storm surge extent is measured by inundation height above the ground (e.g., greater than 3 feet above ground). NOAA, the NWS, and the National Hurricane Center host interactive National Storm Surge Hazard Maps on ArcGIS that compute and display storm surge vulnerability in the United States. Learn more about the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model and view the map at http://noaa.maps.arcgis.com/apps/MapSeries/index.html?appid=d9ed7904dbec441a9c4dd7b277935fad&entry=1.

[64] Hurricanes. NOAA. May 2020. Available at: https://www.noaa.gov/education/resource-collections/weather-atmosphere/hurricanes

Storm surge is the largest threat from a hurricane, as it can result in significant flooding in coastal areas. Almost 50 percent of direct deaths from hurricanes that make landfall in the United States are a result of storm surge.[65] "For coastal areas, normal water level is defined as mean sea level. Basically, storm tide is the sum of storm surge and astronomical tide. If the astronomical tide height for the flooded area is known, it should be subtracted from the total water level/storm tide (run-up/debris line), and the result specifically labeled in the event narrative as 'storm surge.' "[66]

Coastal flooding extent is measured with river/stream gages to determine the height above normal water levels.

For all coastal hazards addressed here, topographical features (particularly elevation), in addition to the storm tide/run-up height, will determine how far inland coastal flooding extends.[67]

3.9.4 Previous Occurrences

The Atlantic hurricane season begins June 1 and ends November 30 each year. Most hurricanes occur between mid-August and late October.

Governor Hogan requested a Presidential Disaster Declaration on September 3, 2020, to assist communities impacted by Tropical Storm Isaias in August.[68] President Biden approved this Disaster Declaration on February 4, 2021, making Isaias the only federally declared coastal hazard event to occur in Maryland since January 2016.

According to the NOAA NCDC Storm Events Database, Maryland has experienced 41 coastal flooding events and three tropical storm events since January 2016. The three tropical storm events are outlined in greater detail below.

Tropical Storm Hermine: On September 2, 2016, "Tropical Storm Hermine moved northeast along the Southeast Coast then off the Mid Atlantic Coast. The system produced a few tropical storm force wind gusts, minor coastal flooding, and locally heavy rainfall across portions of the Lower Maryland Eastern Shore from Friday evening, September 2nd into early Monday morning, September 5th…The areas of Maryland impacted by Tropical Storm Hermine include Inland Worcester, Dorchester, Wicomico, Somerset, and Maryland beaches. Precipitation resulting

[65] Hurricanes. NOAA. May 2020. Available at: https://www.noaa.gov/education/resource-collections/weather-atmosphere/hurricanes.

[66] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605. Operations and Services Performance, NWSPD 10-16,. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[67] Ibid.

[68] "Governor Hogan Requests Presidential Disaster Declaration Following Damages Caused by Tropical Storm Isaias." Maryland Emergency Management Agency. September 3, 2020. Available at: https://news.maryland.gov/mema/2020/09/03/governor-hogan-requests-presidential-disaster-declaration-following-damages-caused-by-tropical-storm-isaias/.

from Tropical Storm Hermine varied from 0.25 to 2.5 inches of rainfall in the impacted regions."[69]

Tropical Storm Dorian: On September 5, 2019, "Hurricane Dorian tracked northeast along the North Carolina coast and just off the Virginia coast produced tropical storm winds and associated wind damage across portions of the Lower Maryland Eastern Shore…Tropical storm winds downed a few trees and power lines, produced minor structural damage, and caused some power outages across the county. Wind gust of 40 knots (46 mph) was measured at Mesonet Station XOCN Ocean City. Wind gust of 37 knots (43 mph) was measured at Mesonet Station ASTM2 Assateague Island. " [70]

Tropical Storm Isaias: Tropical Storm Isaias moved through Maryland on August 4, 2020. Isaias caused 10 tornadoes in addition to extensive flood and wind damage in Maryland.[71] A tree that fell on a moving car caused one fatality. Waterways rose significantly around the state, but major damage caused by flooding largely did not occur.[72] The federal government approved a disaster declaration for this event on February 4, 2021.

3.9.5 Future Probability and Climate Change Conditions

Based on the frequency of previous occurrences, the future probability of coastal hazards in Maryland is highly likely. Additionally, according to NCA4, climate change will impact coastal hazards. NCA4 projects various major trends over the next 25 to 100 years relevant to coastal hazards impacts and future event probability. The strongest hurricanes are expected to "become both more frequent and more intense," and result in more rainfall.[73] Additionally, coastal hazard events interacting with sea level rise amplify many hazard impacts. In the Northeast region of the United States, sea level rise is anticipated to exceed global mean sea rise with an average increase by 2 feet ("Intermediate-Low" sea level rise scenario) and 4.5 feet ("Intermediate" sea level rise scenario). The most extreme sea level rise scenario estimates 11 feet of sea level rise by 2100.[74] Storm surges are higher as a result of sea

[69] Ibid.

[70] Ibid.

[71] "Governor Hogan Requests Presidential Disaster Declaration Following Damages Caused by Tropical Storm Isaias." Maryland Emergency Management Agency. September 3, 2020. Available at: https://news.maryland.gov/mema/2020/09/03/governor-hogan-requests-presidential-disaster-declaration-following-damages-caused-by-tropical-storm-isaias/.

[72] "Maryland Weather: Tropical Storm Isaias Triggers Tornadoes, Strong Winds; At Least One Person Killed." CBS News, Baltimore. By Chelsea Ingram. August 4, 2020. Available at: https://baltimore.cbslocal.com/2020/08/04/maryland-weather-tropical-storm-isaias-latest/.

[73] *Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

[74] Ibid.

level rise. Coastal flooding is also exacerbated, among other phenomena such as erosion.[75]

Published in 2013 by the Scientific and Technical Working Group Maryland Climate Change Commission, the *Updating Maryland Sea-level Rise Projections* report offers mean and relative sea level rise change projections based on the compilation and analysis of several key sea level rise projections. As evidenced in Table 3-9, findings indicate a projected sea level rise of 1.4 feet by 2050 and 3.7 feet by 2100.[76]

Table 3-9: Maryland Sea Level Rise Projections

Maryland Relative Sea-level Rise	Thermal (m)	Glaciers (m)	Greenland (m)	Antarctica (m)	Dynamic (m)	VLM (m)	Relative SLR meters	Relative SLR feet
2050 best	0.10	0.05	0.03	0.09	0.09	0.075	0.4	1.4
2050 low	0.04	0.05	0.02	0.04	0.07	0.065	0.3	0.9
2050 high	0.19	0.06	0.05	0.16	0.10	0.085	0.7	2.1
2100 best	0.24	0.13	0.10	0.30	0.17	0.15	1.1	3.7
2100 low	0.10	0.12	0.08	0.10	0.13	0.13	0.7	2.1
2100 high	0.46	0.17	0.17	0.58	0.19	0.17	1.7	5.7
Land ice change fingerprint scale factors		0.9	0.5	1.25				

Table source: *https://ian.umces.edu/pdfs/ian_report_413.pdf*

As sea levels rise due to changing climate conditions, the impacts on tidal levels can be noted. Nuisance flooding, sometimes known as high-tide flooding or sunny day flooding, is expected to increase through 2021, and more than triple by 2050 according NOAA's *State of High Tide Flooding and Annual Outlook*.[77] "Nuisance flooding is typically unrelated to particular storm events, though it may be exacerbated by long-duration wind events or passing storm systems and the astrological position of the sun and the moon. Over time, however, as a changing climate drives sea levels higher and precipitation events to greater severity, these repeated "nuisance" impacts will become significant stressors on infrastructure, emergency services, public health, and community fabric as they become more

[75] *Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 8: "Coastal Effects." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/8/.

[76] Updating Maryland's Sea-level Rise Projections. University of Maryland Center for Environmental Science, Integration and Application network. Authors: Boesch DF, Atkinson LP, Boicourt WC, Boon JD, Cahoon DR, Dalrymple RA, Ezer T, Horton BP, Johnson ZP, Kopp RE, Li M, Moss RH, Parris A, and Sommerfield CK. IAN Authors: Marcus Griswold, Caroline Donovan, Alexandra Fries, and Jane Hawkey. June 6, 2013. Available at: https://ian.umces.edu/pdfs/ian_report_413.pdf.

[77] *The State of High Tide Flooding and Annual Outlook*. NOAA National Ocean Service. Tides & Currents. n.d. Accessed April 28, 2021. Available at: https://tidesandcurrents.noaa.gov/HighTideFlooding_AnnualOutlook.html.

chronic in nature."[78] In 2019, two tidal stations in Maryland monitored by NOAA broke the record for the number of nuisance flood days: Annapolis and Tolchester Beach. The average number of flood days in 2000 for each location was two, with the record being 18 and 17. By 2030, NOAA is projecting these numbers to increase to 15 to 25 days at each location and by 2050 to 55 to 170 days in Annapolis and 50 to 160 days in Tolchester Beach.

3.9.6 Coastal Communities Flood Loss Estimations FEMA Risk MAP Products

During the preparation of the Plan, FEMA provided Risk Mapping, Assessment, and Planning (Risk MAP) products to all of Maryland's coastal communities. Flood Risk Reports (FRRs) provide non-regulatory information to use in conjunction with other data sources, resulting in a comprehensive picture of flood risk. Flood risk analysis results include potential losses for the refined 1-percent-annual-chance Coastal Flood Risk Study. Potential losses within the various federal financial reports (FFRs) were computed using state-level tax data (parcel centroids from the MDP) and, where available, local building footprints to estimate loss ratios for the 1-percent-annual-chance flood scenario. FRR loss estimations include residential, commercial, and other buildings, and are shown in Table 3-10.

Table 3-10: Flood Risk Refined by Jurisdiction

Jurisdiction	Inventory Estimated Value	1% (100-year) Dollar Losses	Loss Percentage	Data Source
Anne Arundel County	$720,700,000	$86,200,000	11.96%	Hazus Version 2.2
Baltimore City	$132,585,900,000	$1,524,800,000	1.15%	Hazus Version 2.1
Baltimore County	$826,500,000	$103,300,000	12.50%	Hazus Version 2.1
Calvert County	$194,800,000	$20,700,000	10.63%	Hazus Version 2.2
Caroline County	$11,600,000	$1,500,000	12.93%	Hazus Version 2.2
Cecil County	$169,700,000	$41,900,000	24.69%	Hazus Version 2.2
Charles County	$54,900,000	$9,300,000	16.94%	Hazus Version 2.2
Dorchester County	$482,400,000	$37,100,000	7.69%	Hazus Version 2.2
Harford County	$414,100,000	$8,300,000	2.00%	Hazus Version 2.2
Kent County	$289,900,000	$31,500,000	10.87%	Hazus Version 2.1
Prince George's County	$1,100,000	$300,000	27.27%	Hazus Version 2.2
Queen Anne's County	$256,200,000	$21,800,000	8.51%	Hazus Version 2.2
St. Mary's County	$294,500,000	$24,100,000	8.18%	Hazus Version 2.1

[78] *Nuisance Flood Plan Development Guidance*. Maryland Department of Natural Resources. October 2019. Available at: https://dnr.maryland.gov/ccs/Documents/NuisanceFloodPlan.pdf.

Jurisdiction	Inventory Estimated Value	1% (100-year) Dollar Losses	Loss Percentage	Data Source
Somerset County	$594,400,000	$88,500,000	14.89%	Hazus Version 2.2
Talbot County	$340,700,000	$28,200,000	8.27%	Hazus Version 3.1
Wicomico County	$137,600,000	$11,400,000	8.28%	Hazus Version 2.2
Worcester County	$1,633,500,000	$36,800,000	2.25%	Hazus Version 2.2

Note: This represents the best available data at the time of this plan update. MEMA will update information as funding and new data become available from the local communities.

3.9.7 Critical Facilities within High Hazard Coastal Areas

Coastal areas assessed as having the highest risk to coastal hazards include Anne Arundel, Baltimore, Calvert, Charles, Dorchester, Prince George's, Queen Anne's, St. Mary's, Somerset, and Worcester counties, as well as the City of Baltimore, City of Annapolis, and Ocean City. Loss estimations indicate that Anne Arundel, Baltimore, and Prince George's counties as well as the City of Baltimore have the highest critical facility building value and content losses. Table 3-11 lists the number of critical facilities within each jurisdiction at risk from coastal hazards. Please note that given the close relationship that coastal areas have to flood events, the loss estimations table for this hazard has been expanded to account for those facilities and assets within the Medium-High risk areas as well as those within the high risk areas.

Table 3-11: Critical Facilities within High Hazard Coastal Areas

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	114	$790,979,500	$346,814,200	$1,137,793,700
City of Annapolis	25	$277,074,600	$85,820,600	$362,895,200
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Baltimore City	457	$6,678,537,100	$765,069,700	$7,443,606,800
Calvert	73	$456,940,700	$44,494,800	$501,435,500
Charles	80	$589,289,300	$260,895,700	$850,185,000
Dorchester	62	$121,473,700	$13,069,400	$134,543,100
Harford	116	$1,005,729,000	$161,993,400	$1,167,722,400
Kent	25	$67,540,500	$11,812,200	$79,352,700
Prince George's	251	$1,006,600,260	$172,844,080	$1,179,444,340
Queen Anne's	49	$247,202,800	$56,039,700	$303,242,500
St. Mary's	43	$343,849,400	$20,758,800	$364,608,200
Somerset	26	$131,931,500	$10,435,200	$142,366,700

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Talbot	45	$166,116,600	$42,886,300	$209,002,900
Wicomico	66	$699,711,900	$67,275,000	$766,986,900
Worcester	0	$0	$0	$0
Ocean City	9	$34,403,400	$93,374,500	$127,777,900
TOTALS	**1868**	**$14,875,688,260**	**$2,947,181,480**	**$17,822,869,740**

*Calculations have been adjusted to include counties ranked as Medium-High in the HIRA.

3.9.7.1 State Assets within High Hazard Coastal Areas

Coastal areas assessed as having the highest risk to coastal hazards include Anne Arundel, Baltimore, Calvert, Charles, Dorchester, Prince George's, Queen Anne's, St. Mary's, Somerset, and Worcester counties as well as the City of Baltimore, City of Annapolis, and Ocean City. Loss estimations indicate that the City of Baltimore and Somerset County have the highest state asset building value and content losses. Table 3-12 identifies potential losses to state assets within Coastal areas. Please note that given the close relationship that coastal areas have to flood events, the loss estimations table for this hazard has been expanded to account for those facilities and assets within the Medium-High risk areas as well as those within the high risk areas.

Table 3-12: State Assets within High Hazard Coastal Areas

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	529	$2,605,628,861	$350,495,752	$2,956,124,613
City of Annapolis	232	$1,511,516,177	$131,068,888	$1,642,585,066
Baltimore	745	$4,449,953,887	$580,907,824	$5,030,861,711
Baltimore City	867	$9,777,581,486	$954,973,603	$10,732,555,089
Calvert	132	$181,259,297	$25,583,708	$206,843,005
Charles	153	$161,933,486	$19,981,043	$181,914,529
Dorchester	109	$162,627,417	$25,967,064	$188,594,481
Harford	220	$321,074,212	$24,216,692	$345,290,904
Kent	40	$63,596,145	$14,818,061	$78,414,207
Prince George's	628	$4,033,876,220	$510,320,283	$4,544,196,503
Queen Anne's	98	$179,154,426	$22,760,940	$201,915,366
St. Mary's	324	$613,989,775	$146,246,420	$760,236,195
Somerset	265	$12,933,651,348	$282,487,471	$13,216,138,819

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Talbot	67	$86,687,059	$24,073,015	$110,760,073
Wicomico	197	$1,119,733,279	$85,526,547	$1,205,259,826
Worcester	125	$121,352,796	$16,662,363	$138,015,159
Ocean City	8	$1,100,422	$362,274	$1,462,696
TOTALS	**4739**	**$38,324,716,293**	**$3,216,451,948**	**$41,541,168,242**

*Calculations have been adjusted to include counties ranked as Medium-High in the HIRA.

3.9.7.2 Sea Level Rise

Sea level rise within the *Maryland Coastal Resiliency Assessment* is the vulnerability of the coast to long-term sea level change. According to the 2013 *Updating Maryland's Sea-Level Rise Projections*, Maryland is particularly vulnerable to sea level rise because of a combination of rising seas and sinking land. The state is projected to face from 0.7 meters to 1.7 meters in relative sea level rise by the year 2100, with a best-estimate projection of 1.1 meters. Results of the sea level rise hazard rank by county within the *Maryland Coastal Resiliency Assessment* indicate that Charles, Somerset, and Worcester counties are at "Very High Risk," while Caroline, Dorchester, Talbot, and Wicomico counties are at "High Risk."

Maryland Coastal Resiliency Assessment

With its extensive shoreline, Maryland's coasts experience flooding and erosion, caused by tides and storms and exacerbated by sea-level rise. Natural habitats, such as marshes and coastal forests, can reduce the impacts of these hazards through the processes of wave attenuation, increased infiltration and sediment stabilization. While the DNR utilizes various tools to target restoration and protection of habitats based on ecological, water quality and other criteria, these tools do not evaluate the risk-reduction benefits of natural features such as forests, marshes, dunes, oyster reefs, and underwater grasses. To support the DNR in their efforts to incorporate risk-reduction benefits into decision-making, The Nature Conservancy (TNC) partnered with the Chesapeake and Coastal Services (CCS) to conduct a Statewide Coastal Resiliency Assessment.

In order to spatially assess where natural habitats have the greatest potential to reduce risk for people, it is important to address three questions: where are the hazards, where are the people, and where are the habitats? The project team used spatially explicit computer modeling informed by scientific literature and local expert opinion to answer these questions and identify where natural habitats provide the greatest potential risk reduction for Maryland's coastal communities. The products of the Assessment include calculation of a Shoreline Hazard Index, which estimates the relative exposure to coastal hazards for the entire Maryland shoreline; delineation of Coastal Community Flood Risk Areas; selection of Priority Shoreline Areas for conservation and/or restoration; and the calculation of a Marsh Protection Potential Index. Habitats play a large potential role in risk reduction for MD coastal residents. The results of this Assessment provide tools to target coastal adaptation efforts so that protecting or restoring natural habitats also provides the greatest risk reduction benefit to coastal residential communities.

Source: The Nature Conservancy, March 2016. Maryland Coastal Resiliency Assessment. M.R. Canick, N. Carlozo and D. Foster. Bethesda, MD.

The DNR has elevation data collected over the last 10 years using aerial-based laser surveying instruments (LiDAR). These data have been used to identify areas at risk of inundation and flooding in coastal counties. This vulnerability mapping depicts land at risk to inundation under the following sea level rise scenarios: 0–2 feet, 2–5 feet, and 5–10 feet. As new data are collected and added to the database, updated sea level rise inundation zones can be developed for 50- and 100-year planning windows.

Sea Level Rise Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that sea level rise may have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-13.

Table 3-13: Sea Level Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners along the coastline are most at risk to impacts from sea level rise. Impacts to the public include destruction and/or loss of land and property, displacement of populations, and negative economic impacts to coastal tourism. Significant sea level rise is expected to occur over a period of 50 to 100 years, which means it is unlikely that sea level rise will result in injury or loss of life.
Health and Safety of Responders	Similarly to public health and safety, first responders would likely face minimal adverse impacts due to long-term sea level rise. The potential exception would be in the case of a temporary rise in sea level as caused by a severe tropical cyclone event. In this case, first responders would be exposed to the standard occupational hazards involved in dealing with a coastal flooding event.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations will be limited, unless a facility is within the incident area. In this case, state and critical facilities within the high-risk area (defined as "near certain to highly likely of 0–2 feet of inundation") will face economic impacts related to costs of mitigation measures, relocation, and potential damage.
Property, Facilities, and Infrastructure	Home and landowners within coastal regions may experience damage to or loss of property depending upon the severity of water inundation in the area. Infrastructure may experience impacts in the form of damage to roads/bridges and/or the complete loss of transportation routes.
Environment	Sea level rise will alter the landscape. Changes in the shoreline will occur, with some areas of shore becoming completely inundated, while others are damaged from erosion. Vegetation and wildlife habitat along the coast may be damaged or destroyed within inundation areas.
Economic Condition of the State	Sea level rise and major changes to the coastline will drain state, county, and local resources. The economic costs related to mitigation and relocation measures will be high, in addition to the economic burden caused by loss of land.

Subject	Impacts
Public Confidence in State Governance	Public confidence will largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to sea level rise.

3.9.7.3 Shoreline Erosion

The *Maryland Coastal Resiliency Assessment* outlines priority shoreline areas where protection and restoration of natural habitats has the greatest potential to reduce the coastal hazard risk faced by residential communities. Two tiers of priority were determined. Tier 1 or High Priority areas are those shoreline segments where 1) the habitat role in reducing shoreline hazard is high and at least one Coastal Community Flood Risk Area is located within 1.24 miles, or 2) the shoreline hazard transitions from moderate to high if habitats are lost and at least one Coastal Community Flood Risk Area is located within 1.24 miles. Tier 2 or Moderate Priority areas are those shoreline segments where 1) the habitat role in reducing shoreline hazard is moderate and at least one Coastal Community Flood Risk Area is located within 1.24 miles, or 2) the shoreline hazard transitions from low to moderate if habitats are lost and at least one Coastal Community Flood Risk Area is located within 1.24 miles. Shoreline segments that met none of the criteria were not considered priorities in the Assessment but have been priorities for other reasons, such as ecological value. Tier 1 areas compose 22 percent of the Maryland coastline and Tier 2 areas compose an additional 40 percent of the Maryland coastline.

The Erosion Vulnerability Assessment Tool (EVA) is a shoreline planning tool developed by the Baltimore District Army Corps of Engineers and DNR to identify shorelines with historical patterns of instability, as well as shorelines that support valued natural, social, or economic resources. EVA uses a 50-year planning window to estimate and project the shoreline position in 50 years. These projections inform local planners about potential risks to current infrastructure and valued resources. EVA can be used to flag at-risk areas and prioritize erosion control measure sites.

Maryland's *Blue Infrastructure Near-shore Assessment* identifies high-priority shoreline segments and watersheds for conservation and management to maintain and improve coastal habitats. These areas support productive and diverse coastal ecosystems, fisheries, and human uses. Data components of the Blue Infrastructure (BI) include sensitive species, shoreline-dependent species, spawning and nursery areas, protected lands, impervious surface, hardened shores, fish blockages, water quality, and natural infrastructure, such as coastal marshes, submerged aquatic vegetation, oyster bars, and beaches. Maryland's high-priority BI areas have been incorporated into the GreenPrint Targeted Ecological Areas and all BI areas are considered during environmental review and land conservation decisions.

Shoreline Erosion Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that sea level rise may have on the public;

responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-14.

Table 3-14: Shoreline Erosion Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners along the coastline are most at risk to impacts from shoreline erosion. Impacts to the public include destruction and/or loss of land and property. Shoreline erosion can occur suddenly during a tropical cyclone event, such as a hurricane. In this case, people in coastal areas at the time of the event are at an increased risk of injury due to erosion, in addition to the distinct hazards a hurricane brings.
Health and Safety of Responders	First responders would likely face minimal adverse impacts due to long-term shoreline erosion caused by sea level rise. However, an exception would be in the case of sudden erosion, which can be caused by a severe tropical cyclone event. In this case, first responders would be exposed to the standard occupational hazards involved in dealing with a coastal erosion/flooding event.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is within a coastal area during a severe tropical cyclone event that causes shoreline erosion. In this event, delivery of services may be slowed or halted in coastal areas if key roadways become impassable due to erosion.
Property, Facilities, and Infrastructure	Home and landowners within coastal regions may experience damage to or loss of property depending upon the severity of shoreline erosion in the area. Infrastructure may experience impacts in the form of damage to roads/bridges and/or the complete loss of transportation routes.
Environment	Shoreline erosion would negatively impact beaches, wetlands, marshes, and coastal habitats. With the loss of environments, coastal areas may experience more frequent and destructive flooding.
Economic Condition of the State	Currently, nearly 70% of shoreline in the state is estimated to be eroding to some degree. Erosion of the shoreline at this level would drain state, county, and local resources. The economic costs related to mitigation projects, relocation, loss of land, and more severe flooding would be high.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to shoreline erosion.

3.9.7.4 Nor'easter

Nor'easters may occur anytime of the year but are most frequent and strongest between September and April. These storms develop between Georgia and New Jersey within 100 miles of the coastline and generally move north or northeastward. In addition to heavy snow and rain, nor'easters can bring gale force winds greater

than 56 miles per hour (mph). These storms may produce rough seas, coastal flooding, and beach erosion. All of Maryland's coastal communities are vulnerable to nor'easters; however, Ocean City is particularly vulnerable and has experienced notable nor'easter events with reported damages of more than $1 million per event.

Nor'easter Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a nor'easter event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-15.

Table 3-15: Nor'easter Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners along the coastline are most at risk to impacts from a nor'easter event. Impacts to the public include potential for injury or loss of life, and destruction and/or loss of land and property due to flood and high winds.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads, and attend to any injured. For a nor'easter event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is within a coastal area during a severe nor'easter event. Delivery of services may be slowed or halted in coastal areas if key roadways become impassable due to flooding.
Property, Facilities, and Infrastructure	Home and landowners within coastal regions may experience damage to or loss of property depending upon the severity of flooding and winds in the area. Infrastructure may experience impacts in the form of damage to roads and bridges, temporary closure of transportation routes, and the potential inability of the stormwater system to handle floodwaters in a severe event.
Environment	Shoreline erosion would be the major impact to the coastal environment during a nor'easter.
Economic Condition of the State	A major nor'easter event would be costly for state and local governments because of the potential for damages from flooding and high winds. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a nor'easter event.

3.9.8 Vulnerability and Impact

Because of their location, Maryland coastal shoreline areas are most vulnerable to direct impacts from coastal hazards. Damage to public and private property located

on the shoreline would likely be the most directly impacted. Flooded roads, homes, and structures can lead to safety hazards, and in extreme cases, loss of life. Property damage and power outages may also result from coastal hazards. Indirect impacts may result from coastal hazards, for example, supply chain disruption from flooded roads and economic losses for local businesses that have incurred storm or flood damage. "In the case of nuisance flooding, while it may not pose a serious threat or result in major damage, it interrupts and causes impacts to daily routines and can negatively impact commerce."[79]

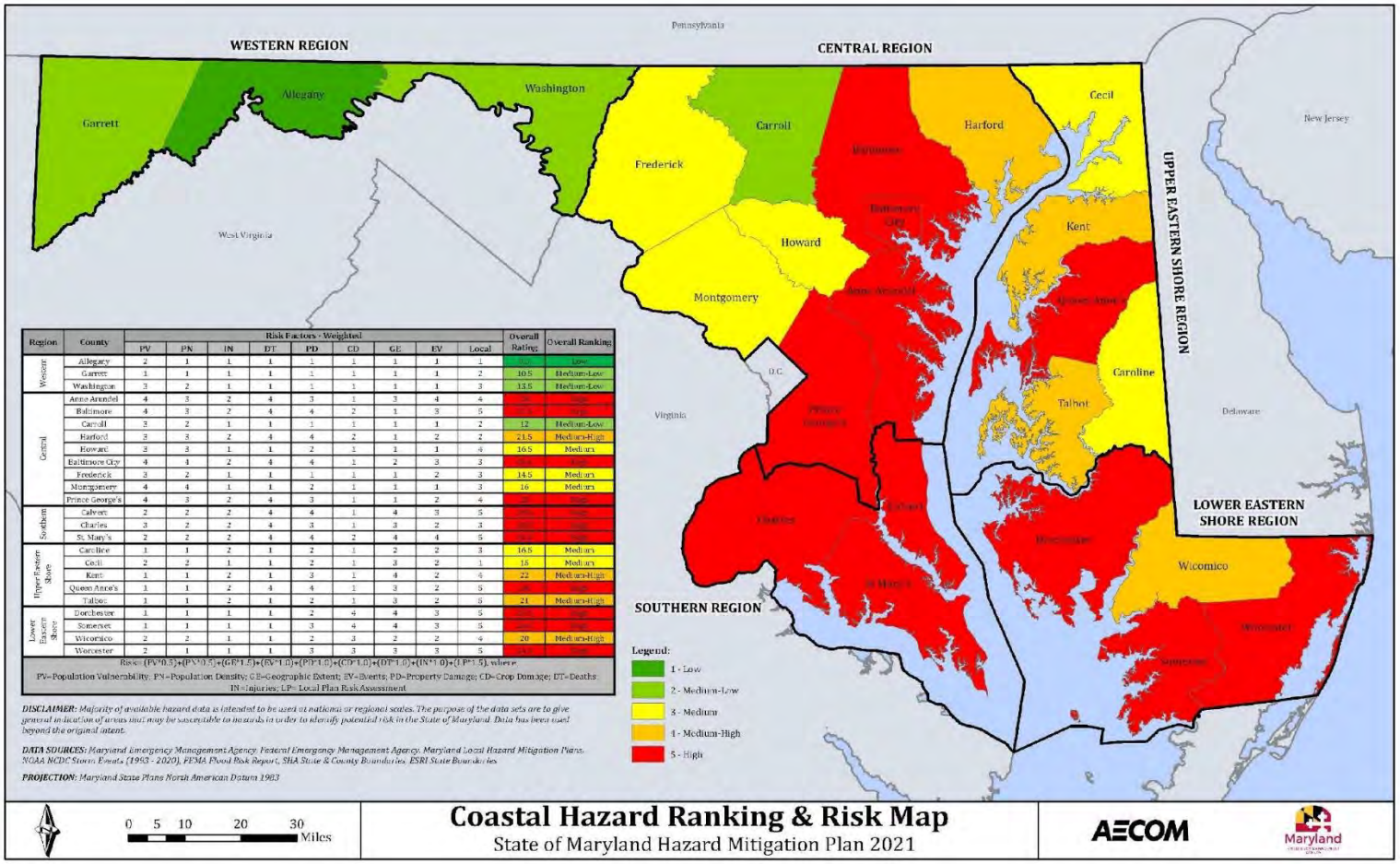
FEMA developed Community Lifelines to reframe incident information, communicate incident impacts, and promote unity of effort across a community. A Lifeline provides a framework for "the continuous operation of critical government and business functions and is essential to human health and safety or economic security." The Community Lifelines vulnerable to coastal hazards in Maryland may be most likely to include the Food, Water, and Shelter; Communications; and Transportation Lifelines. [80]

[79] Ibid.

[80] FEMA Community Lifelines. July 27, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines.

3.9.9 Coastal Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	1	9	Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
Central	Anne Arundel	4	3	2	4	3	1	3	4	4	28	High
	Baltimore	4	3	2	4	4	2	1	3	5	28	High
	Carroll	3	2	1	1	1	1	1	1	2	12	Medium-Low
	Harford	3	3	2	4	4	2	1	2	2	21.5	Medium-High
	Howard	3	3	1	1	2	1	1	1	4	16.5	Medium
	Baltimore City	4	4	2	4	4	1	2	3	3	27	High
	Frederick	3	2	1	1	1	1	1	2	3	14.5	Medium
	Montgomery	4	4	1	1	2	1	1	1	3	16	Medium
	Prince George's	4	3	2	4	3	1	1	2	4	25	High
Southern	Calvert	2	2	2	4	4	1	4	3	5	27	High
	Charles	3	2	2	4	3	1	3	2	3	23	High
	St. Mary's	2	2	2	4	4	2	4	4	5	29	High
Upper Eastern Shore	Caroline	1	1	2	1	2	1	2	2	3	16.5	Medium
	Cecil	2	2	1	1	2	1	3	2	1	18	Medium
	Kent	1	1	2	1	3	1	4	2	4	22	Medium-High
	Queen Anne's	1	1	2	4	4	1	3	2	5	26	High
	Talbot	1	1	2	1	2	1	3	2	5	21	Medium-High
Lower Eastern Shore	Dorchester	1	1	1	1	2	4	4	3	5	25	High
	Somerset	1	1	1	1	3	4	4	3	5	27	High
	Wicomico	2	2	1	1	2	3	2	2	4	20	Medium-High
	Worcester	2	1	1	1	3	3	3	3	5	24.5	High

Risk= $(PV^{*}0.5)+(PN^{*}0.5)+(GE^{*}1.5)+(EV^{*}1.0)+(PD^{*}1.0)+(CD^{*}1.0)+(DT^{*}1.0)+(IN^{*}1.0)+(LP^{*}1.5)$, where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.

DATA SOURCES: Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries

PROJECTION: Maryland State Plane North American Datum 1983

3.10 Dam Failure

3.10.1 Definition

The Code of Maryland Regulations (COMAR) defines a "dam" as any obstruction, wall, or embankment together with its abutments and appurtenant works built for the purpose of storing or diverting water. The seemingly simple act of impounding water for various uses creates an inherent risk of flooding, downstream property damage, and potential for loss of life.[81]

3.10.2 Location

All Maryland counties have dams. And because there are no natural lakes or ponds in Maryland, nearly all bodies of water in the state are formed by dams. According to the *2020 Hazard Mitigation Plan for Dams* produced jointly by MEMA and MDE's Dam Safety Program, there are at least 552 dams in Maryland, ranging in height from 6 to 296 feet. Table 3-16 lists the number of dams by county. The *2020 Hazard Mitigation Plan for Dams* is included as Appendix C.

Table 3-16: Number of Dams in Each Jurisdiction

County Name	Number of Dams	County Name	Number of Dams
Allegany	14	Harford	26
Anne Arundel	35	Howard	42
Baltimore	31	Kent	20
Baltimore City	13	Montgomery	80
Calvert	20	Prince Georges	58
Caroline	8	Queen Anne's	9
Carroll	19	Somerset	2
Cecil	40	St Mary's	10
Charles	8	Talbot	5
Dorchester	7	Washington	30
Frederick	31	Wicomico	17
Garrett	24	Worcester	3
Total	**552**		

[81] *Maryland's Dam Safety Program.* "What is a Dam?" Maryland Department of the Environment. n.d. Accessed April 28, 2021. Available at: https://mde.maryland.gov/programs/Water/DamSafety/Documents/FactSheet-WhatIsADam.pdf.

3.10.3 Extent (Magnitude/Strength)

The hazard classification of a dam is based on the downstream damage that would result if the dam were to fail. The hazard classification has no relationship to the condition of the dam, its structural integrity, operational status, or flood storage capability. In general accordance with dam safety practices nationally, Maryland uses three categories to classify dams: High, Significant, and Low hazard. Table 3-17 further describes of each classification. The associated classifications in the COMAR 26.17.04.05 and by the U.S. Natural Resources Conservation Service (NRCS) are also provided.[82]

Table 3-17: Number and Classification of High Hazard Dams

Maryland Classification	Description	COMAR Classification	NRCS Classification	Number in Maryland
High Hazard	Probable loss of life; major increases in existing flood levels at houses, buildings, major interstates, and state roads with more than six lives in jeopardy	Category I	Class C	100
Significant Hazard	Possible loss of life; significant increased flood risks to roads and buildings with no more than two houses or six lives in jeopardy	Category II	Class B	125
Low Hazard	Unlikely loss of life; minor increases to existing flood levels at road and buildings	Category III	Class A	330

Source: https://mde.maryland.gov/programs/Water/DamSafety/Documents/FactSheetHazardClassificationsofDams.pdf

Figure 3-1 shows the location of High and Significant Hazard dams. As noted below, the majority of these structures are located in the state's Central Region.

[82] *Maryland's Dam Safety Program.* "Hazard Classification of Dams." Maryland Department of the Environment. n.d. Accessed April 28, 2021. Available at: https://mde.maryland.gov/programs/Water/DamSafety/Documents/FactSheetHazardClassificationsofDams.pdf .

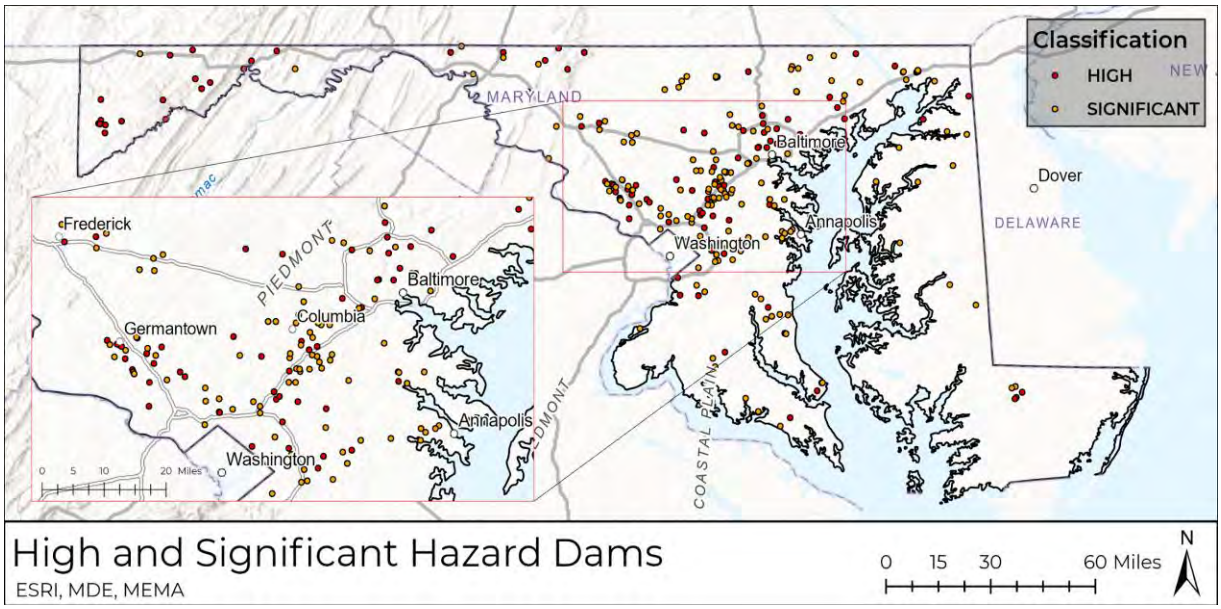


Figure 3-1: Map of High and Significant Hazard Dams

Danger reach is an additional measure of dam failure extent. This refers to the area below a dam that would be flooded as a result of dam failure. The depth of flooding from a dam failure is generally much greater than the normal floodplain, as shown on Figure 3-2.

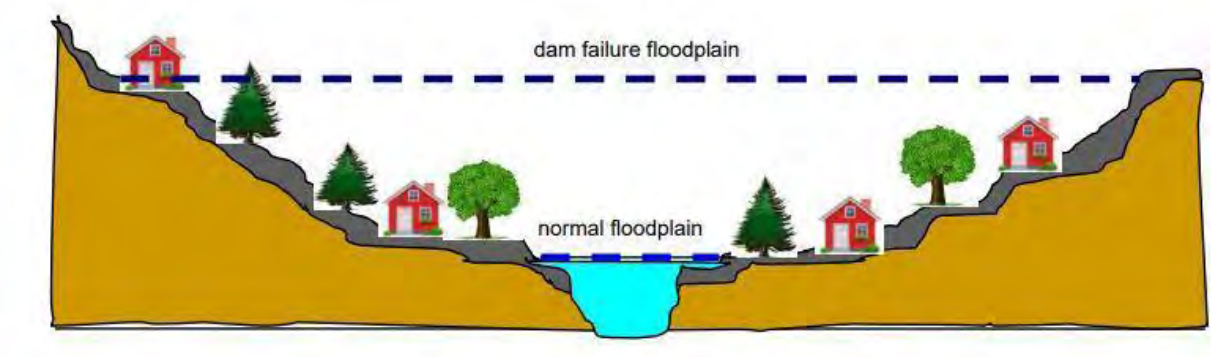


Figure 3-2: Potential Damage from Dam Failure

Maps of the danger reach, sometimes referred to as "inundation maps," are prepared by an engineer based on hydrologic and hydraulic analyses and topography of the affected area. A danger reach analysis typically includes evaluation of several failure scenarios, including "Sunny Day" (dam fails on a sunny day, i.e., not during a storm), "Brim-Up" (reservoir filled to the very top of the dam, perhaps as a result of failed or plugged spillways), and during events such as the 100-year storm or Probable Maximum Flood. The main objective is to identify the downstream properties that would be affected by the sudden release of stored water caused by dam failure.

Danger reach inundation maps serve as the basis of Emergency Action Plans (EAPs).[83]

MDE recommends that analyses and maps be updated a minimum of every 10 years for High Hazard dams and 15 years for Significant Hazard dams. This ensures that the latest data, models, and methodologies are used and can be relied on in an emergency.

3.10.4 Previous Occurrences

At least 45 dam failures or near failures have occurred in Maryland since MDE began maintaining records on dams in the 1930s.[84] Some of these incidents required the evacuation of downstream residents and property owners, and fortunately, there has been no loss of life. Multiple dam failures have caused damage to roads, property, and the environment. Table 3-18 lists the 45 most notable dam failures in Maryland since 1945.

Table 3-18: Maryland Dam Failures

Year	Failure Description
1936	• Flooding on Potomac River caused Potomac River Dam No. 4 to fail
1942/48	• Partially completed Savage River Dam overtopped by floodwaters and breached
1975	• Smithville Dam failed during a storm while under repair
1979	• Tropical Storm David • Lake Roland Dam overtopped and nearly failed • Lower Lake Royer Dam at Fort Ritchie overtopped and needed sandbagging; the Town of Rouzerville, Pennsylvania was evacuated • Lake Waterford Dam overtopped, and the spillway was severely damaged
1979	• Snowmelt Flooding • Wye Mill Dam discharge flooded road, post office, and mill • Mockingbird/Double Mills Dam failed • Big Millpond Dam spillway failed • Barren Creek Dam overtopped, and failure was prevented by emergency action by Wicomico County personnel • Higgins Mill pond dam was severely stressed but was saved by emergency actions taken by Dorchester County staff • Linchester Mill Dam overtopped and failed
1989	• Loveton Stormwater Dam failed during the first storm; damaged Phoenix Road and downstream brook trout habitat
1993	• Annapolis Mall Stormwater Dam failed during the first filling after a storm
1996	January Ice Melt Flooding • Conowingo Dam suffered damage from high flows and ice jams
1996	Heavy Rains

[83] Ibid.

[84] Maryland's 2020 Hazard Mitigation Plan for Dams.

Year	Failure Description
	• Elk Neck State Forest Dam partially failed and was breached by DNR under emergency action
1996	Hurricane Fran • Barton Reservoir emergency spillway channel was severely eroded but the dam did not fail
1999	Heavy Rains - 5 inches in 12 hours • Lake Lanahan Dam overtopped and washed out the spillway
1999	Hurricane Floyd: 15-20 inches of rain in 24 hours in Caroline County • Nagels Mill Dam failed and damaged downstream roadway MD 16 • Stubbs Dam new spillway failed • Foreman Branch Dam overtopped and failed • Jones Lake Dam overtopped and failed • Frazers Mill Dam overtopped and failed • Cabin Creek Dam overtopped and failed • Sassafras Mill Dam overtopped and failed • Von Spreckelson Dam overtopped and failed • Meeks Farm Dam overtopped and failed
1999	Winter Ice Melt • Rolling Green Community Dam failed after 30-year old metal spillway pipe collapsed under normal operating condition
2001	Winter Storm • Woodlawn Landfill stormwater pond dam failed by internal erosion due to improperly installed pipe; severely damaged a trout stream
2003	Severe Storm Event • Hunting Creek Dam spillway flows washed out a state road below the dam and damaged MD Route 77
2006	Severe Flooding after 10-15 Inches of Rain • Lake Needwood Dam developed serious seepage problem and 2,200 people were evacuated, including downtown Rockville; dam was saved by construction of emergency seepage control filters • Galestown Millpond Dam overtopped and failed • Wrights Millpond Dam overtopped and failed • Cabin Creek Dam failed again after it was repaired following 1999 failure • Mill Creek Dam failed • Irving Mill Pond Dam failed
2007	Heavy Warm Rain on Top of Snowmelt • Little Youghiogheny Dam Site 1 (Hospital) spillway was clogged by beavers, which caused lake level to rise to emergency spillway, closing local roads; dam was saved by emergency action taken by the National Guard and the Town of Oakland
2008	Heavy Rains in Anne Arundel County • Chartwell Golf Course Dam and St. Andrews Road collapsed after the spillway became clogged
2011	Heavy Rains • Preference Estates Dam near LaPlata overtopped and failed

Year	Failure Description
2014	Heavy Rains • Blairs Valley Dam saw a flood of record with 2 feet of flow in the emergency spillway; Clear Spring evacuated
2016	Heavy Rains • Riawalkin Dam (Nanticoke Road) overtopped and failed
2016	Heavy Rains • Barren Creek Dam (Barren Creek Road) overtopped and failed • Big Millpond Dam (Sheephouse Road) overtopped and failed; the bridge washed out
2018	Heavy Rains • Cascade Lake Dam overtopped and partially failed; downstream roads closed for 2 weeks while the owner worked to remove the dam

Additional information regarding four recent dam incidents from the table above is presented below. These four incidents showcase how a relatively minor dam's failure can have significant impacts on a community's transportation network and finances.

Riawalkin Pond Dam (2016): On June 28, 2016, a major rainstorm event resulted in the overtopping failure of Riawalkin Pond Dam, located on MD 349. As a result of the overtopping, the southern slope of the dam embankment and MD 349 eastbound roadway shoulder collapsed, leaving a void approximately 8 feet wide, 14 feet long, and 8 feet deep. The void partially extended into and undermined the eastbound travel lane

Barren Creek Dam (2016): A historic rain event washed out a privately owned dam and mill pond that had been there for centuries, along with the county roadway that sat on top of the dam. The storm also washed out large sections of roadway near the dam as water from the 11,000-acre watershed drained into the area. This washout severed a county throughway and resulted in over $4 million in damages.

Big Millpond Dam (2016): During a period of heavy rain, the Big Millpond Dam overtopped and failed, taking the bridge out in the process. This loss of the bridge resulted in over $300,000 in emergency repairs.

Cascade Lake Dam Incident (2018): The Cascade Lake Dam, a 20-foot-high earth and masonry dam with a nearly 6-acre surface area at normal pool was originally constructed in association with a sawmill and is believed to date to the mid - to late-1800s. While the dam and mill experienced many changes over the years and eventually became a regional recreational asset, everything changed after an intense 5- to 6-inch rainfall event overnight on July 25, 2018, resulted in overtopping and partial failure of the dam. The dam owner, recognizing the severity of the situation contacted the Dam Safety Division early on the July 26, and a team was dispatched to Carroll County. Immediately upon arrival, the Dam Safety Division determined that the dam was in imminent danger of failing and directed the owner to immediately activate the EAP (Level 3), lower the water levels, and hire an engineer to coordinate a controlled breach of the dam. This set in motion a number

of emergency actions and required close coordination, communication, and relationship building among the owner, the owner's engineer CSLI, the Dam Safety Division, Carroll County Department of Public Safety, Carroll County Sheriff's Office, Carroll County Department of Public Works, Maryland State Highway Administration, Maryland State Police, and a host of others to ensure the safety of persons within the danger reach and to remove the dam in a safe and controlled manner.[85]

3.10.5 Future Probability and Climate Change Conditions

Primary causes of dam failure include overtopping, piping, foundation defects, cracking, and inadequate maintenance. Between 2010 and 2019, overtopping was the most common primary incident mechanism of dam failure nationwide (of dam failure incidents included in the Association of State Dam Safety Officials *Dam Incident Database*). Overtopping happens when water flows over the top of a dam and can be caused by poor spillway design, blocked spillways, or settling of the crest of the dam. Piping refers to internal erosion as a result of seepage. This erosion happens frequently near pipes and spillways, vegetation roots, and cracks in the dam.[86]

Based on the frequency of previous occurrences of dam incidents in Maryland and the current status of dams in Maryland, future probability of dam failure is highly likely. The average age of dams in Maryland is over 60 years. Dams are complex systems, and the long-term safe performance of a dam embankment depends on careful design, construction, and maintenance by qualified persons. Poor designs, inadequate construction quality control, and lack of regular inspections and preventative maintenance have resulted in an increasing number of dams in Maryland that are in distress. This distress may manifest as embankment slumping, sloughing, or cracking; sinkholes over deteriorated spillway pipes; excessive seepage or wet areas; clogged trash racks; and even failure of the embankment.[87]

The intense amount of rainfall experienced across Maryland in 2018 added another stress to dams and led to a number of dam incidents and failures. Continued climate change impacts, particularly related to precipitation projections, are likely to further impact dams. The NCA4 projects various major trends over the next 25 to 100 years that may pose risks for Maryland's dams. The strongest hurricanes are expected to "become both more frequent and more intense," and result in more rainfall.[88]

---

[85] *Maryland Dam Safety Update*, Issue 4. Maryland Department of the Environment. April 2019. Available at: https://mde.state.md.us/programs/Water/DamSafety/Documents/Maryland%20Dam%20Safety%20Update%20-%20April%202019%20(1).pdf.

[86] Dam Failures and Incidents. Association of State Dam Safety Officials, 2021. Available at: https://damsafety.org/dam-failures.

[87] *Maryland Dam Safety Update*, Issue 4. Maryland Department of the Environment. April 2019. Available at: https://mde.state.md.us/programs/Water/DamSafety/Documents/Maryland%20Dam%20Safety%20Update%20-%20April%202019%20(1).pdf.

[88] *Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; Revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

Continued increases in the frequency and intensity of heavy precipitation in many regions of the United States, including the northeast, are expected.[89]

3.10.6 Critical Facilities and Dam Failure Hazard

Dam failure loss estimations indicate that Montgomery and Prince George's counties have the highest critical facility building value and content loss estimations. Table 3-19 lists the number of critical facilities within each jurisdiction at risk from dam failure.

Table 3-19: Critical Facilities Impacted by Dam Failure by Jurisdiction

Jurisdiction	Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss
Allegany	0	$0	$0	$0
Anne Arundel	54	$381,472,600	$201,463,000	$582,935,600
Baltimore	122	$780,475,700	$280,606,300	$1,644,017,600
Baltimore City	45	$285,092,000	$29,865,600	$1,376,039,600
Calvert	16	$61,826,900	$6,774,800	$383,559,300
Caroline	5	$1,221,500	$13,002,500	$82,825,700
Carroll	49	$689,765,000	$119,570,700	$823,559,700
Cecil	18	$75,495,400	$8,270,300	$893,101,400
Charles	7	$15,911,000	$2,934,500	$102,611,200
Dorchester	0	$0	$0	$18,845,500
Frederick	34	$627,952,700	$93,463,600	$721,416,300
Garrett	0	$0	$0	$721,416,300
Harford	26	$111,626,000	$28,421,100	$140,047,100
Howard	20	$269,323,200	$65,021,400	$474,391,700
Kent	2	$3,558,700	$812,700	$338,716,000
Montgomery	106	$2,009,726,000	$583,853,900	$2,597,951,300
Prince George's	126	$488,335,560	$75,217,080	$3,157,132,540
Queen Anne's	1	$51,581,700	$4,539,300	$619,673,640
St. Mary's	2	$633,000	$344,300	$57,098,300
Somerset	0	$0	$0	$977,300

[89] *Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*. Chapter 2: "Our Changing Climate." Key message 6: Changing U.S. Precipitation. U.S. Global Change Research Program. 2018; Revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/2/#key-message-6.

Jurisdiction	Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss
Talbot	0	$0	$0	$0
Washington	26	$105,835,300	$22,200,500	$128,035,800
Wicomico	26	$480,173,100	$44,463,300	$652,672,200
Worcester	0	$0	$0	$524,636,400
TOTALS	**685**	**$6,440,005,360**	**$1,580,824,880**	**$16,041,660,480**

3.10.7 State Assets and Dam Failure Hazard

Dam failure loss estimations indicate that Anne Arundel, Baltimore, and Prince George's counties have the highest critical facility building value and content loss estimations. Table 3-20 lists the number of state assets in each jurisdiction at risk from dam failure.

Table 3-20: State Assets Impacted by Potential Dam Failure by Jurisdiction

Jurisdiction	State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss
Allegany	0	$0	$0	$0
Anne Arundel	519	$3,146,289,513	$352,121,547	$3,498,411,060
Baltimore	335	$2,775,027,488	$437,156,992	$3,212,184,480
Baltimore City	91	$251,610,349	$71,700,509	$323,310,858
Calvert	8	$889,204	$174,142	$1,063,346
Caroline	336	$93,053,425	$13,612,333	$106,665,758
Carroll	50	$67,184,880	$13,790,196	$80,975,076
Cecil	30	$32,677,027	$5,346,404	$38,023,431
Charles	5	$7,716,062	$1,218,358	$8,934,420
Dorchester	0	$0	$0	$0
Frederick	20	$48,918,290	$13,995,821	$62,914,111
Garrett	1	$26,880	$1,344	$28,224
Harford	17	$40,304,993	$11,979,864	$52,284,857
Howard	139	$511,586,800	$34,330,385	$545,917,185
Kent	1	$208,000	$10,400	$218,400
Montgomery	141	$159,416,757	$6,999,306	$166,416,063
Prince George's	396	$3,331,145,967	$376,239,076	$3,707,385,043
Queen Anne's	1	$14,454	$138,417	$152,871

Jurisdiction	State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss
St. Mary's	13	$1,370,821	$456,940	$1,827,761
Somerset	0	$0	$0	$0
Talbot	7	$1,795,884	$236,745	$2,032,629
Washington	31	$57,450,979	$5,166,067	$62,617,046
Wicomico	136	$982,536,816	$73,449,461	$1,055,986,277
Worcester	0	$0	$0	$0
TOTALS	**2277**	**$11,509,224,589**	**$1,418,124,306**	**$12,927,348,896**

3.10.8 Dam Failure Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a dam failure would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-21.

Table 3-21: Dam Failure Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners within the inundation zone are most at risk to impacts from a dam failure event. Impacts to the public include potential for injury or loss of life, and destruction and/or loss of land and property due to flooding.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads, and attend to any injured. For a dam failure event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility or critical infrastructure component is within the dam failure inundation zone associated with the dam failure. Delivery of services may be slowed or halted in adjacent areas if key roadways become impassable due to flooding or debris blockages.
Property, Facilities, and Infrastructure	Home and landowners within dam inundation zones may experience damage to or loss of property depending upon the severity of flooding in the area. Infrastructure may experience impacts in the form of damage to roads and bridges, temporary closure of transportation routes, and the potential inability of the stormwater system to handle floodwaters.
Environment	Erosion and debris flows would be the major impact to the environment during a dam failure.

Subject	Impacts
Economic Condition of the State	A dam failure event would be costly for state and local governments because of the potential for damages from flooding. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments respond to a dam failure event.

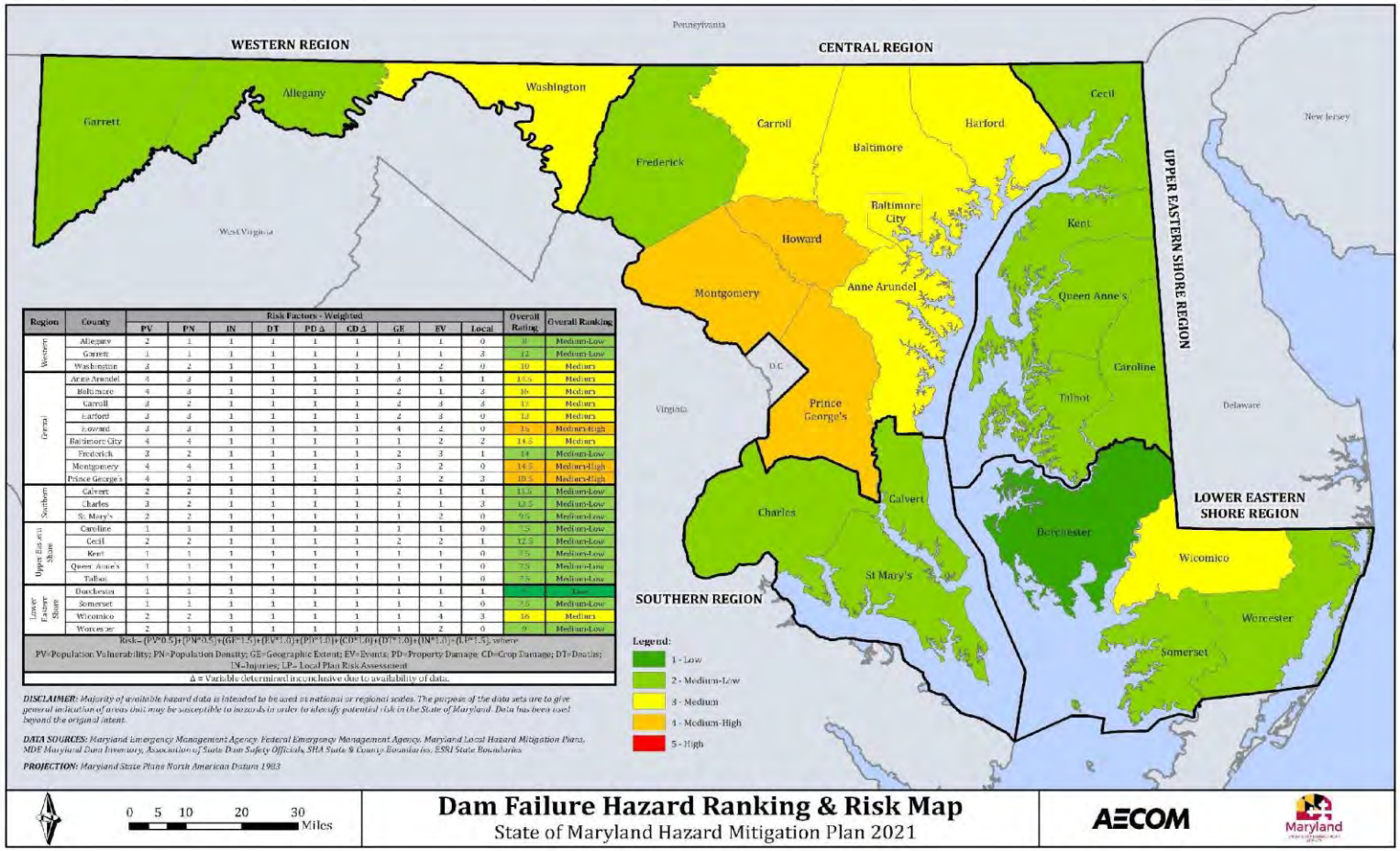
3.10.9 Vulnerability and Impact

Depending on the location, characteristics, and function of the dam, dam failure can have a variety of impacts. As demonstrated by Maryland's classification of Low, Significant, and High Hazard dams, impacts can include loss of human life, property damage to homes and other structures, flooding of major highways, and increased flood risk, among others, depending on what is located downstream of the dam. Depending on the use of the dam, a dam failure or incident could also impact the water supply.

FEMA developed Community Lifelines to reframe incident information, communicate incident impacts, and promote unity of effort across a community. A Lifeline provides a framework for "the continuous operation of critical government and business functions and is essential to human health and safety or economic security." The Community Lifelines vulnerable to dam failure and other dam incidents in Maryland may include the Food, Water, and Shelter Lifeline and the Transportation Lifeline.

3.10.10 Dam Failure Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	0	8	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	1	1	1	1	1	2	0	10	Medium
Central	Anne Arundel	4	3	1	1	1	1	4	1	1	16.5	Medium
	Baltimore	4	3	1	1	1	1	2	1	3	16	Medium
	Carroll	3	2	1	1	1	1	2	3	3	17	Medium
	Harford	3	3	1	1	1	1	2	3	0	12	Medium
	Howard	3	3	1	1	1	1	4	2	0	15	Medium-High
	Baltimore City	4	4	1	1	1	1	1	2	2	14.5	Medium
	Frederick	3	2	1	1	1	1	2	3	1	14	Medium-Low
	Montgomery	4	4	1	1	1	1	3	2	0	14.5	Medium-High
	Prince Georges	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Southern	Calvert	2	2	1	1	1	1	2	1	1	11.5	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	12.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	2	0	9.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Cecil	2	2	1	1	1	1	2	2	1	12.5	Medium-Low
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Lower Eastern Shore	Dorchester	1	1	3	1	1	1	1	1	1	7	Low
	Somerset	1	1	3	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	3	1	1	1	1	4	3	16	Medium
	Worcester	2	1	1	1	1	1	1	2	0	9	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5); where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.

DATA SOURCES: Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries

PROJECTION: Maryland State Plane North American Datum 1983

3.11 Drought

3.11.1 Definition

The NWS[90] defines drought as follows: "Drought is a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizable area. Conceptually, drought is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield. There are different kinds of drought: meteorological, agricultural, hydrological, and social-economic. Each kind of drought starts and ends at different times." The NWS further defines the different categories of drought as shown in Table 3-22.[91]

Table 3-22: Categories of Drought

Category	Description
Meteorological Drought	Based on the degree of dryness or rainfall deficit and the length of the dry period
Agricultural Drought	Refers to the impacts on agriculture by factors such as rainfall deficits, soil water deficits, reduced groundwater, or reservoir levels needed for irrigation
Hydrological Drought	Based on the impact of rainfall deficits on the water supply, such as stream flow, reservoir and lake levels, and ground water table decline
Socioeconomic Drought	Considers the impact of drought conditions (meteorological, agricultural, or hydrological drought) on supply and demand of some economic goods such as fruits, vegetables, grains, and meat Occurs when the demand for an economic good exceeds supply as a result of a weather-related deficit in water supply

3.11.2 Location

Although drought conditions are most severe in the West and Southwest regions of the United States, NCA4 highlighted that the Northern/Southern Great Plains and U.S. islands are also at risk.[92] The National Drought Mitigation Center[93] shows drought risk in the South, Southeast, and Mid-Atlantic regions as well.

According to the National Centers for Environmental Information Storm Events Database (NCDC), drought events have been recorded in every county of the state since record-keeping began in 1997; however, no drought events have been

[90] Storm Data Preparation. NOAA National Weather Service Instruction 10-1605. Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[91] Drought Types, National Weather Service. n.d. Accessed April 28, 2021. Available at: https://www.weather.gov/safety/drought-types.

[92] *Fourth National Climate Assessment*, *Volume II, Impacts, Risks, and Adaptation in the United States*. Chapter 3: "Water." U.S. Global Change Research Program. 2018; Revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/3/.

[93] Drought Risk Atlas, Climate Map Viewer. The National Drought Mitigation Center, University of Nebraska-Lincoln. 2021. Available at: https://droughtatlas.unl.edu/MapViewer/Climate.aspx.

recorded in the NCDC database since 2016. Historically, Kent, Queen Anne's, Cecil, Caroline, and Talbot counties had the highest number of recorded drought hazard events within the NCDC database. Local jurisdictions with the highest recorded crop damages within the NCDC database include Baltimore, Carroll, Frederick, Harford, Howard, Montgomery, and Washington counties. Because of these data, the risk of drought is statewide.

3.11.3 Extent (Magnitude/Strength)

Several scales are commonly referenced to explain drought conditions and that consider different factors of drought. For example, short-term drought conditions can be measured using the Palmer-Z Index on a monthly scale, while the Palmer Crop Moisture Index is used on a weekly scale to quantify agriculture impacts specifically. The Palmer Drought Severity Index (also known as the Palmer Drought Index) is used to monitor the duration and intensity of longer-term circulation patterns that create drought conditions. The Palmer Hydrological Drought Index is used to capture the long-term and more slowly accumulating effects that drought has on reservoirs, groundwater levels, and other hydrologic features. A different approach to measuring drought is the Standardized Precipitation Index, which—unlike the Palmer indices that consider various water balance factors, including precipitation, evapotranspiration, and runoff—uses precipitation probability to indicate both short- and long-term conditions.[94]

As of September 2020, Maryland was not experiencing drought, but Figure 3-3 shows the extent of drought conditions across the state since the U.S. Drought Monitor was established in 1999.[95]

[94] *Measuring Drought*, NOAA, National Centers for Environment Information. n.d. Accessed April 28, 2021. Available at: https://www.ncdc.noaa.gov/monitoring-references/dyk/measuring-drought.

[95] NOAA and Drought.gov. National Integrated Drought Information System, By Location | States: Maryland. n.d. Accessed April 28, 2021. Available at: https://www.drought.gov/drought/states/maryland.

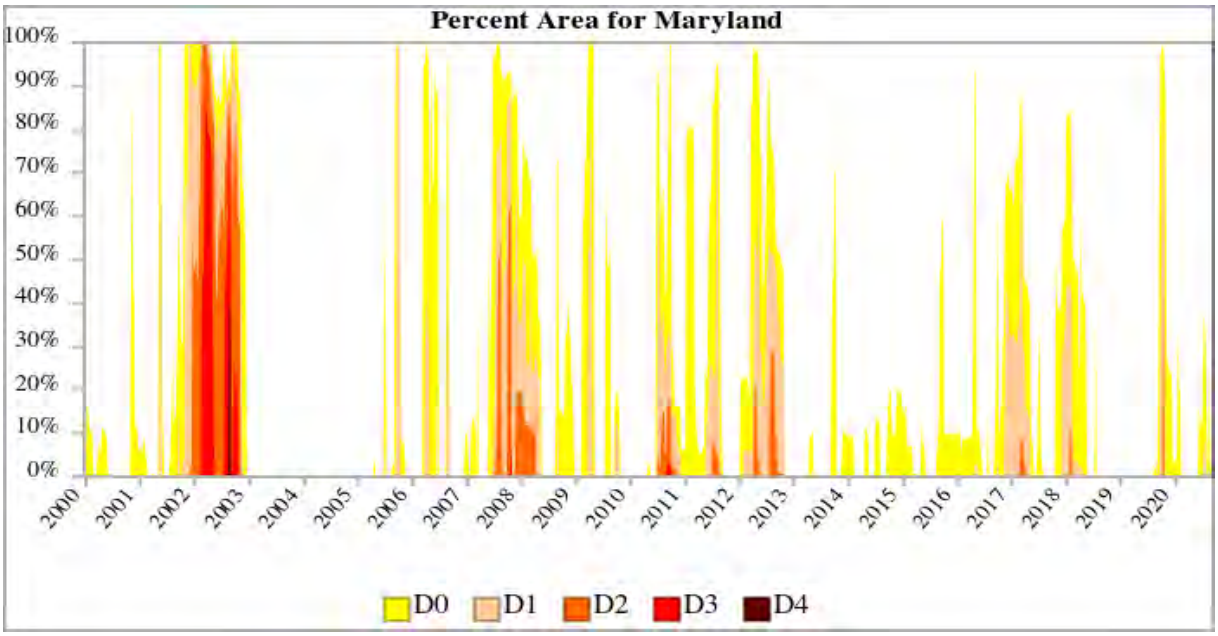


Figure 3-3: Maryland Drought Conditions (2000–2020)

Figure 3-4 outlines the different drought scales represented in Figure 3-3 for the U.S. Drought Monitor.

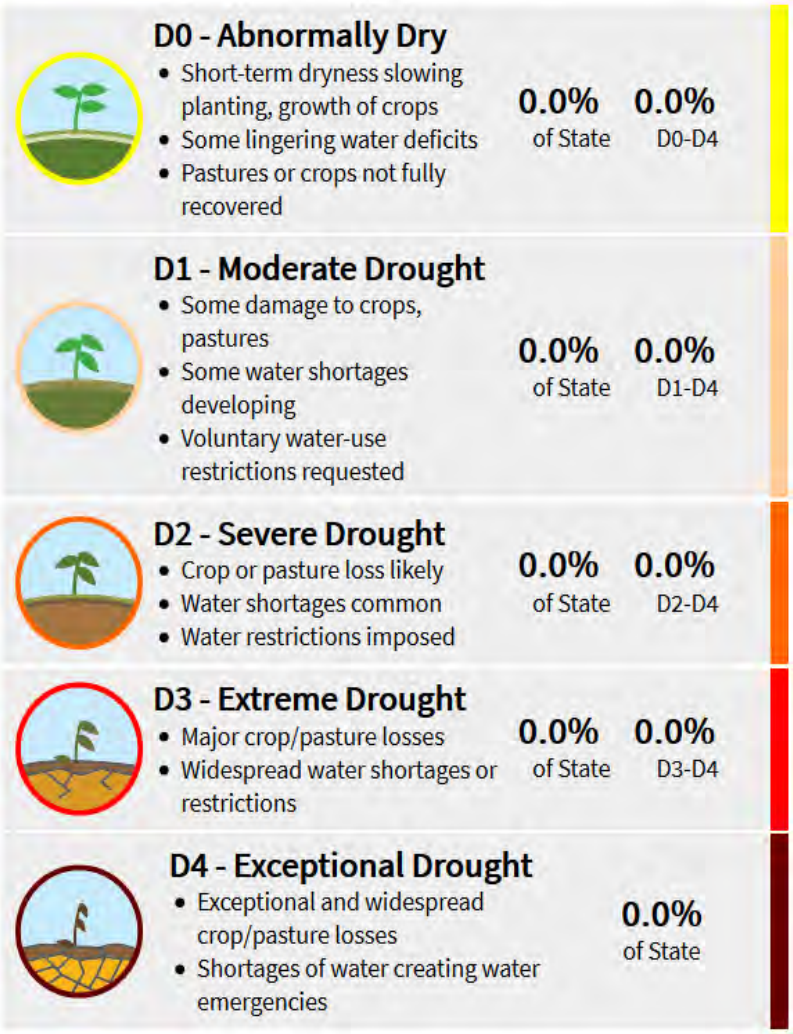


Figure 3-4: Drought Monitor Legend

3.11.4 Previous Occurrences

Since the 2016 Plan, no federally declared drought events have occurred in Maryland. Since tracking for Maryland began, 450 drought events totaling 69 event-days have been recorded in the NCDC (including 3 days with recorded crop damage), none have occurred since 2016. Historically, according to the U.S. Drought Monitor, "since 2000, the longest duration of drought (D1-D4) in Maryland lasted 58 weeks beginning on October 09, 2001, and ending on November 12, 2002. The most intense period of drought occurred the week of August 20, 2002, where D4 affected 39.88 percent of Maryland land."[96]

As noted previously, Maryland regularly receives USDA secretarial disaster declarations. These declarations typically result from drought, early freezes, and

[96] Ibid.

excessive rain. Since 2016, Maryland received a secretarial disaster declaration for drought in 2016 (Allegany, Carroll, Frederick, and Washington counties) and in 2019 (Charles, Frederick, Montgomery, and Washington counties).

3.11.5 Future Probability and Climate Change Conditions

The NCA4 does not reference any shift in drought risk based on climate change in Maryland. However, the NCA4 does highlight recent and projected changes in precipitation, noting that the intensity and duration of precipitation events are likely to increase. These increases are more likely to occur in the winter and spring (summer precipitation is not projected to experience significant shifts)[97] and may decrease long-term drought risk as well as drought impacts on agriculture. Therefore, the future probability of drought events remains unlikely, particularly given the lack of severe droughts since 2016.

Significant scientific evidence ties climate change to increased drought conditions. The NCA4 indicates that rising temperatures will increasingly lead to longer and more powerful drought conditions nationwide.

3.11.6 Critical Facilities and Drought Hazard

Drought loss estimations indicate that Baltimore and Montgomery counties have the highest critical facility building value and content value loss estimations. Table 3-23 lists the number of critical facilities by jurisdiction with potential losses from drought.

Table 3-23: Critical Facilities Drought Loss Estimations

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Carroll	115	$1,060,600,400	$202,732,100	$1,263,332,500
Frederick	121	$1,134,849,300	$164,251,400	$1,299,100,700
Harford	116	$1,005,729,000	$161,993,400	$1,167,722,400
Montgomery	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
TOTAL	**1000**	**$8,831,169,100**	**$2,390,350,300**	**$11,221,519,400**

3.11.7 State Assets and Drought Hazard

Drought loss estimations indicate that Baltimore and Carroll counties have the highest state asset building value and content value loss estimations. Table 3-24 lists the number of state assets by jurisdiction with potential losses from drought.

[97] *Fourth National Climate Assessment, National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

Table 3-24: State Assets Drought Loss Estimations

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Baltimore	745	$4,449,953,887	$580,907,824	$5,030,861,711
Carroll	235	$672,857,398	$79,141,528	$751,998,926
Frederick	197	$251,189,535	$36,724,173	$287,913,708
Harford	220	$321,074,212	$24,216,692	$345,290,904
Montgomery	192	$317,749,390	$55,868,060	$373,617,450
TOTAL	**1589**	**$6,012,824,423**	**$776,858,277**	**$6,789,682,700**

3.11.8 Drought Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a drought event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-25.

Table 3-25: Drought Consequence Analysis - Impacts

Subject	Impacts
Health and Safety of the Public	Droughts can affect home and landowners in a local, regional, or statewide context. Typically, drought events take a long time to develop and may be either short-term or long-term events. Impacts to the public during a drought take the form of crop damage/failures, water rationing and other water source impacts, and wildfires.
Health and Safety of Responders	First responders, such as fire and police, would be most concerned with the secondary impacts of drought, such as wildfires. As such, first responders would be called to incident area(s) to evacuate people from the fire area, close roads, create fire breaks, and attend to any injured. During a wildfire event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations due to drought would be very limited. Generally, buildings and infrastructure, which are essential to continuity of operations and delivery of services, are not impacted by drought.
Property, Facilities, and Infrastructure	Property, facilities, and infrastructure typically are not vulnerable to drought. However, the water supply infrastructure may be impacted by drought during a long-term event.

Subject	Impacts
Environment	Droughts impact the environment by causing wildfires, overloading water and wastewater treatment plants, creating dust storms, and disturbing wildlife and natural areas.
Economic Condition of the State	A major land drought event would draw upon state, county, and local resources. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the state, county, or local government responds to the drought event.

3.11.9 Vulnerability and Impact

As indicated by the different categories of drought in Table 3-20, drought can have various effects on society. Droughts can cause significant impacts to the farming and ranching sectors, to water supplies, and to the recreational industry, among others. Ultimately, drought can be problematic from an economic, social, and public health perspective, while also potentially increasing wildfire risk.[98]

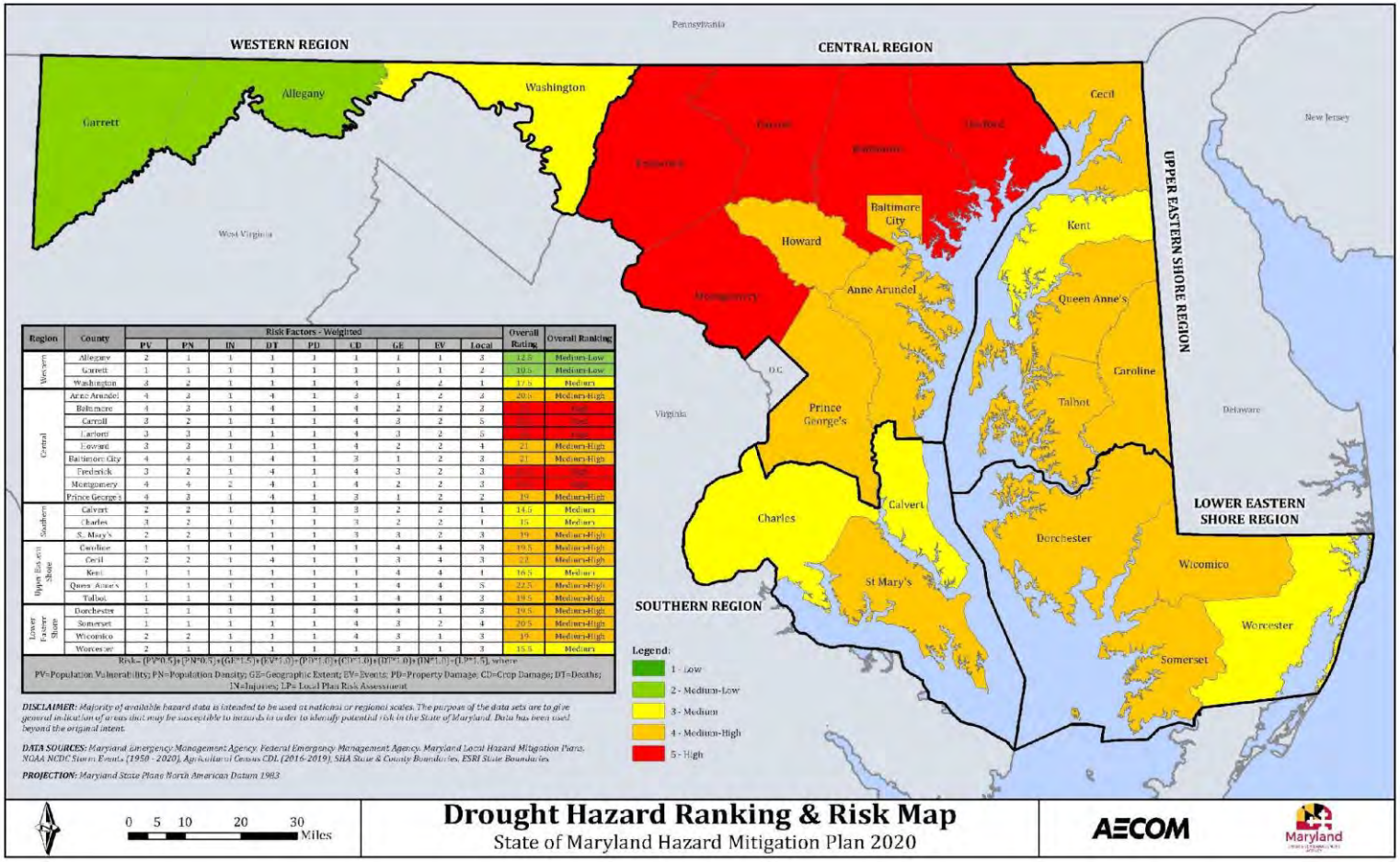
FEMA's Community Lifelines Implementation Toolkit can be used to identify several key functions vulnerable to the impact of drought events in Maryland. Community Lifelines broadly include "critical government and business functions…essential to human health and safety or economic security." The primary Community Lifeline impacted by drought events is the Food, Water, Shelter Lifeline.[99]

[98] Drought: Monitoring Economic, Environmental, and Social Impacts, NOAA National Centers for Environmental Information. n.d. Accessed April 28, 2021. Available at: https://www.ncdc.noaa.gov/news/drought-monitoring-economic-environmental-and-social-impacts.

[99] FEMA Community Lifelines Implementation Toolkit, August 4, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

3.11.10 Drought Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	3	1	3	1	1	3	12.5	Medium-Low
	Garrett	1	1	1	3	1	3	1	1	2	10.5	Medium-Low
	Washington	3	2	1	3	1	3	3	2	1	17.5	Medium
Central	Anne Arundel	4	3	1	4	1	3	1	2	3	20.5	Medium-High
	Baltimore	4	3	1	4	1	4	2	2	3		High
	Carroll	3	2	1	3	1	4	3	2	5		Med
	Harford	3	3	1	3	1	4	3	2	5		High
	Howard	3	3	1	3	1	4	2	2	4	21	Medium-High
	Baltimore City	4	4	1	4	1	3	1	2	3	21	Medium-High
	Frederick	3	2	1	4	1	4	3	2	3		High
	Montgomery	4	4	2	4	1	4	2	2	3		High
	Prince George's	4	3	1	4	1	3	1	2	2	19	Medium-High
Southern	Calvert	2	2	1	3	1	3	2	2	1	14.0	Medium
	Charles	3	2	1	3	1	3	2	2	1	18	Medium
	St. Mary's	2	2	1	3	1	3	3	2	3	19	Medium-High
Upper Eastern Shore	Caroline	1	1	1	3	1	3	4	4	3	19.5	Medium-High
	Cecil	2	2	1	4	1	3	3	4	3	23	Medium-High
	Kent	1	1	1	3	1	3	4	4	1	16.5	Medium
	Queen Anne's	1	1	1	3	1	3	4	4	5	22.5	Medium-High
	Talbot	1	1	1	3	1	3	4	4	3	19.5	Medium-High
Lower Eastern Shore	Dorchester	1	1	1	3	1	4	4	4	3	19.5	Medium-High
	Somerset	1	1	1	3	1	4	3	2	4	20.5	Medium-High
	Wicomico	2	2	1	3	1	4	3	3	3	19	Medium-High
	Worcester	2	1	1	3	1	3	3	3	3	15.5	Medium

Risk = (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDI, (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.12 Extreme Temperatures

3.12.1 Definition

Maryland experiences both extreme cold and excessive heat events, which pose threats to many facets of society, including human health, the economy, and critical infrastructure. The NWS[100] uses the following definitions:

Extreme cold/wind chill: "A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35°F or colder)."

Excessive heat: "Excessive heat results from a combination of high temperatures (well above normal) and high humidity. An excessive heat event occurs and is reported in Storm Data whenever heat index values meet or exceed locally/regionally established excessive heat warning thresholds."

The Centers for Disease Control and Prevention (CDC) estimates that an average of 600 heat-related deaths happen per year, with seniors and children at highest risk.[101] While excessive heat can be fatal, extreme cold is also dangerous to human health and may in fact outpace heat-related fatalities; one report conducted by the U.S. Department of Health and Human Services estimated that between 2006 and 2010, of the more than 10,000 deaths analyzed in the study, approximately one-third of the fatalities were attributed to conditions related to excessive heat and two-thirds of fatalities were attributed to conditions related to extreme cold.[102]

3.12.2 Location

Extreme temperatures can occur at any location across the country and state. The impacts of excessive heat specifically are typically more pronounced in dense areas, where the built environment can increase temperatures through a phenomenon known as the urban heat island effect. According to the U.S. Environmental Protection Agency (EPA), "a review of research studies and data found that in the United States, the heat island effect results in daytime temperatures in urban areas about 1–7°F higher than temperatures in outlying areas and nighttime temperatures about 2–5°F higher."[103] Moreover, humid areas tend to have both more significant temperature differences and more severe impacts.

---

[100] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[101] About Extreme Heat, U.S. Centers for Disease Control and Prevention. June 19, 2017. Available at: https://www.cdc.gov/disasters/extremeheat/heat_guide.html.

[102] Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006 – 2010, National Health Statistics Report, by Jeffrey Berko, M.P.H., Deborah D. Ingram, Ph.D., National Center for Health Statistics; Shubhayu Saha, Ph.D., National Center for Environmental Health; and Jennifer D. Parker, Ph.D., National Center for Health Statistics. July 30, 2014. Available at: https://www.cdc.gov/nchs/data/nhsr/nhsr076.pdf.

[103] Learn about Heat Islands, US Environmental Protection Agency. July 30, 2020. Available at: https://www.epa.gov/heatislands/learn-about-heat-islands.

According to the National Centers for Environmental Information Storm Events Database (NCDC), extreme temperature events have been recorded in every county of the state since record-keeping began in 2000.

3.12.3 Extent (Magnitude/Strength)

The NWS created the Heat Index to demonstrate how humidity impacts what the temperature feels like—and in turn the danger to public health—as shown in Figure 3-5.

According to the Maryland Department of Health, "the National Weather Service [NWS] will issue a Heat Advisory when the heat index value is expected to reach 105 to 109 degrees Fahrenheit within the next 12 to 24 hours...NWS will issue an Excessive Heat Warning when the heat index value is expected to reach or exceed 110 degrees Fahrenheit within the next 12 to 24 hours."[104] Heat advisories may also be used when there are seasonal abnormalities in temperatures or when excessive heat is forecasted to last for several days. The highest temperature recorded in Maryland history is 109°F.[105]

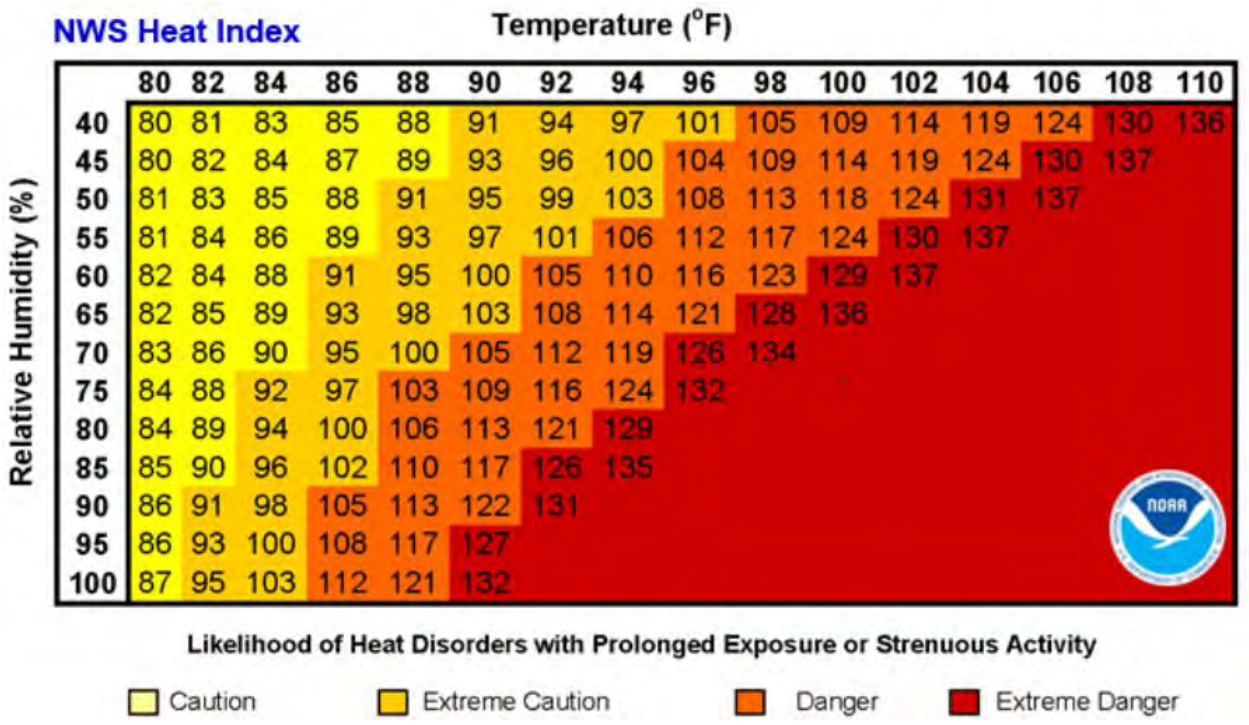


Figure 3-5: NWS Heat Index

[104] 2018 Heat-Related Illness Surveillance Report. Maryland Department of Health. October 10, 2018. Available at: https://preparedness.health.maryland.gov/Documents/2018%20Summary%20Heat%20Report.pdf.

[105] State Climate Extremes Committee, Records. NOAA National Centers for Environmental Information, n.d. Accessed April 28, 2021. Available at: https://www.ncdc.noaa.gov/extremes/scec/records.

In the same way that humidity impacts how hot it feels, wind chill exacerbates cold temperatures, which can have devastating consequences for human health. The NWS created the chart shown in Figure 3-6 to demonstrate how differences in wind chill can impact the onset of frostbite.[106]

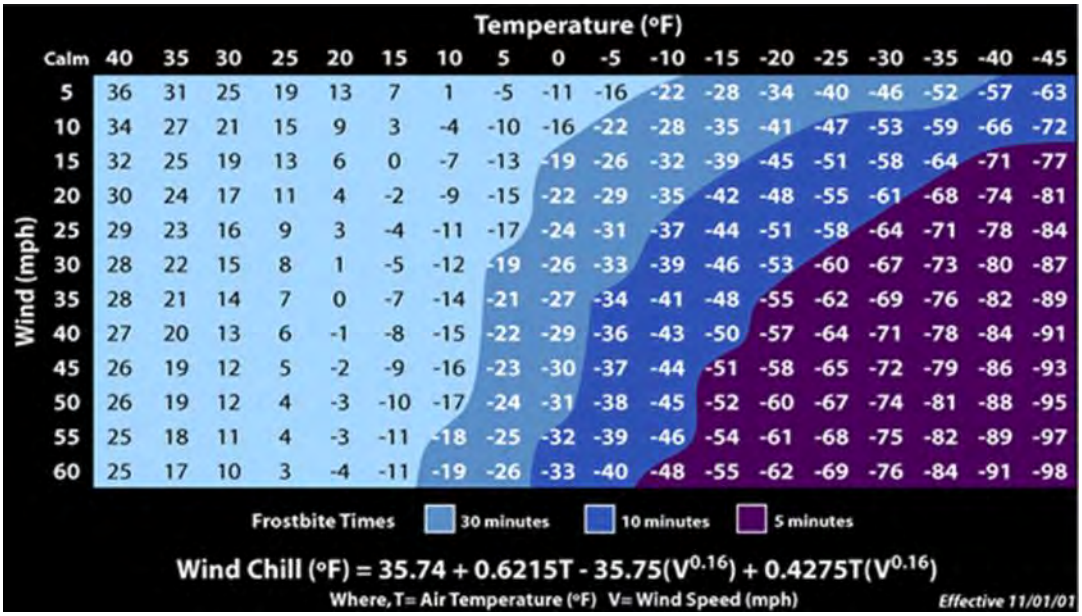


Figure 3-6: Windchill and Frostbite Incidence

The lowest temperature recorded in Maryland history is -40°F.[107]

3.12.4 Previous Occurrences

Since the 2016 Plan, no federally declared extreme temperature events have occurred in Maryland.

Several extreme cold/wind chill events are recorded in the NCDC database, one in January 2018 and two in January 2019. Multiple excessive heat events are also recorded, with at least one event each in the summers of 2016, 2017, 2018, and 2019; however, no excessive heat events were recorded during the summer of 2020.

The Maryland Department of Health *2018 Heat-Related Illness Surveillance Report* indicates that there were 28 heat-related deaths during the summer of 2018, a marked increase in fatalities over the preceding 4 years as indicated in Figure 3-7 below.[108] Nine heat advisories were issued across the state throughout the summer of 2018 between June 18 and September 4.

---

[106] Wind Chill Chart, NOAA National Weather Service, n.d. Accessed April 28, 2021. Available at: https://www.weather.gov/safety/cold-wind-chill-chart.

[107] State Climate Extremes Committee, Records. NOAA National Centers for Environmental Information, n.d. Accessed April 28, 2021. Available at: https://www.ncdc.noaa.gov/extremes/scec/records.

[108] 2018 Heat-Related Illness Surveillance Report, Maryland Department of Health. October 10, 2018. Available at: https://preparedness.health.maryland.gov/Documents/2018%20Summary%20Heat%20Report.pdf.

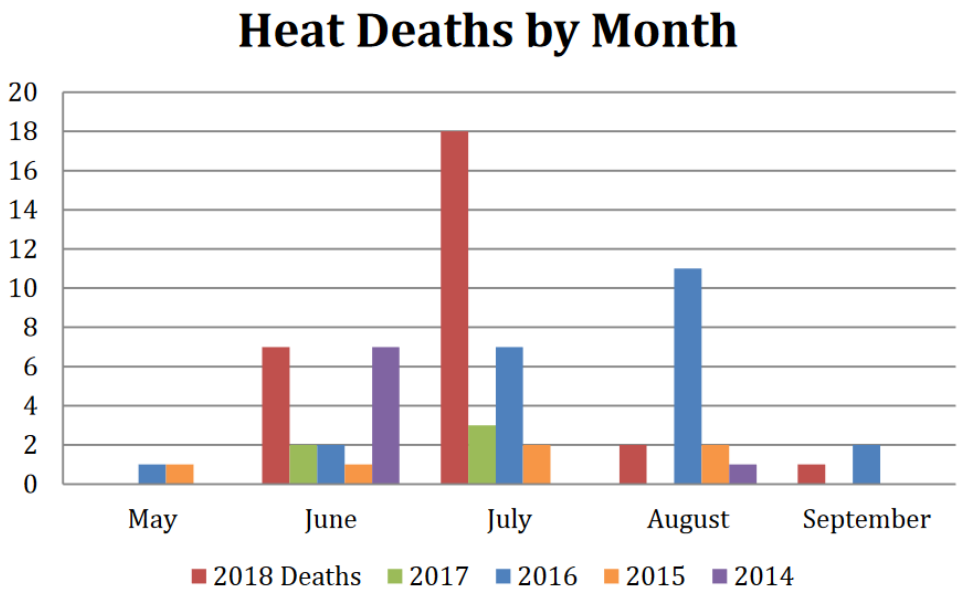


Figure 3-7: Heat Deaths by Month, 2014–2018

3.12.5 Future Probability and Climate Change Conditions

According to the NCA4, "by the middle of this century, winters are projected to be milder still, with fewer cold extremes". On the other end of the spectrum, "the Northeast is projected to experience a significant increase in summer heat and the number and/or duration of heat waves." Based on this assessment, the future probability of extreme cold events is less likely while the future probability of excessive heat events is likely.

3.12.6 Extreme Temperature Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that extreme temperatures would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are show in Table 3-26.

Table 3-26: Extreme Temperature Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners across the state are at risk to the impacts from an extreme temperature event. Impacts to the public include potential for injury or loss of life, and destruction and/or loss of land and property due to extreme temperatures.
Health and Safety of Responders	First responders, such as fire and police, would be called to areas to support potential power outages caused by extreme

Subject	Impacts
	temperature events. They would perform welfare checks, attend to any injured, and support overall incident management. For an extreme temperature event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility or critical infrastructure component is compromised due cascading impacts from extreme temperatures, i.e., power outages.
Property, Facilities, and Infrastructure	Home and landowners across the state may experience damage to or loss of property depending upon the severity of temperature extremes in the area as well as damage due to cascading impacts. Infrastructure may experience impacts in the form of damage to roads and bridges, temporary closure of mass transit, etc., in the event of cascading impacts, such as power outages.
Environment	Loss of crops, impacts to wildlife, and increased propensity towards drought (for high temperatures) would be the major impact to the environment during extreme temperature events.
Economic Condition of the State	An extreme temperature event could be costly for state and local governments, depending on the length and geographic extent of the temperatures because of the potential for crop loss and business disruption from the direct and cascading temperature impacts. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments respond to an extreme temperature event.

3.12.7 Vulnerability and Impact

From a public health perspective, the urban heat island effect can exacerbate other health hazards leading to secondary impacts. The NCA4 highlights that, "in urban areas, the hottest days in the Northeast are also often associated with high concentrations of urban air pollutants including ground-level ozone. This combination of heat stress and poor urban air quality can pose a major health risk to vulnerable groups: young children, elderly, socially or linguistically isolated, economically disadvantaged, and those with preexisting health conditions, including asthma."[109]

[109] *Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

This finding also illustrates the troubling cycle of extreme heat events—it is precisely these conditions when air conditioner usage increases, which in turn further increases ambient air temperatures (and generates more greenhouse gas emissions that further increase global temperatures).[110,111] The increased use of air conditioning also stretches the capacity of the electrical grid, making brownouts and blackouts more likely and further increasing risk to those vulnerable groups, particularly those without air conditioners. As discussed in the NCA4, the increase in excessive heat events, particularly longer-duration events such as heat waves "will further stress summertime energy peak load demands from higher air conditioning use and the greater need to pump and treat water."[112]

FEMA's Community Lifelines Implementation Toolkit can be used to identify several key functions vulnerable to the impact of extreme temperature events in Maryland. Community Lifelines broadly include "critical government and business functions…essential to human health and safety or economic security." The primary Community Lifelines impacted by extreme temperature events are the Health and Medical and Energy (Power and Fuel) Lifelines.[113]

[110] "Anthropogenic Heating of the Urban Environment due to Air Conditioning." By F. Salamanca, M. Georgescu, A. Mahalov, M. Moustaoui, and M. Wang. *Journal of Geophysical Research: Atmospheres*, May 2014; DOI: 10.1002/2013JD021225. Available at: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2013JD021225.

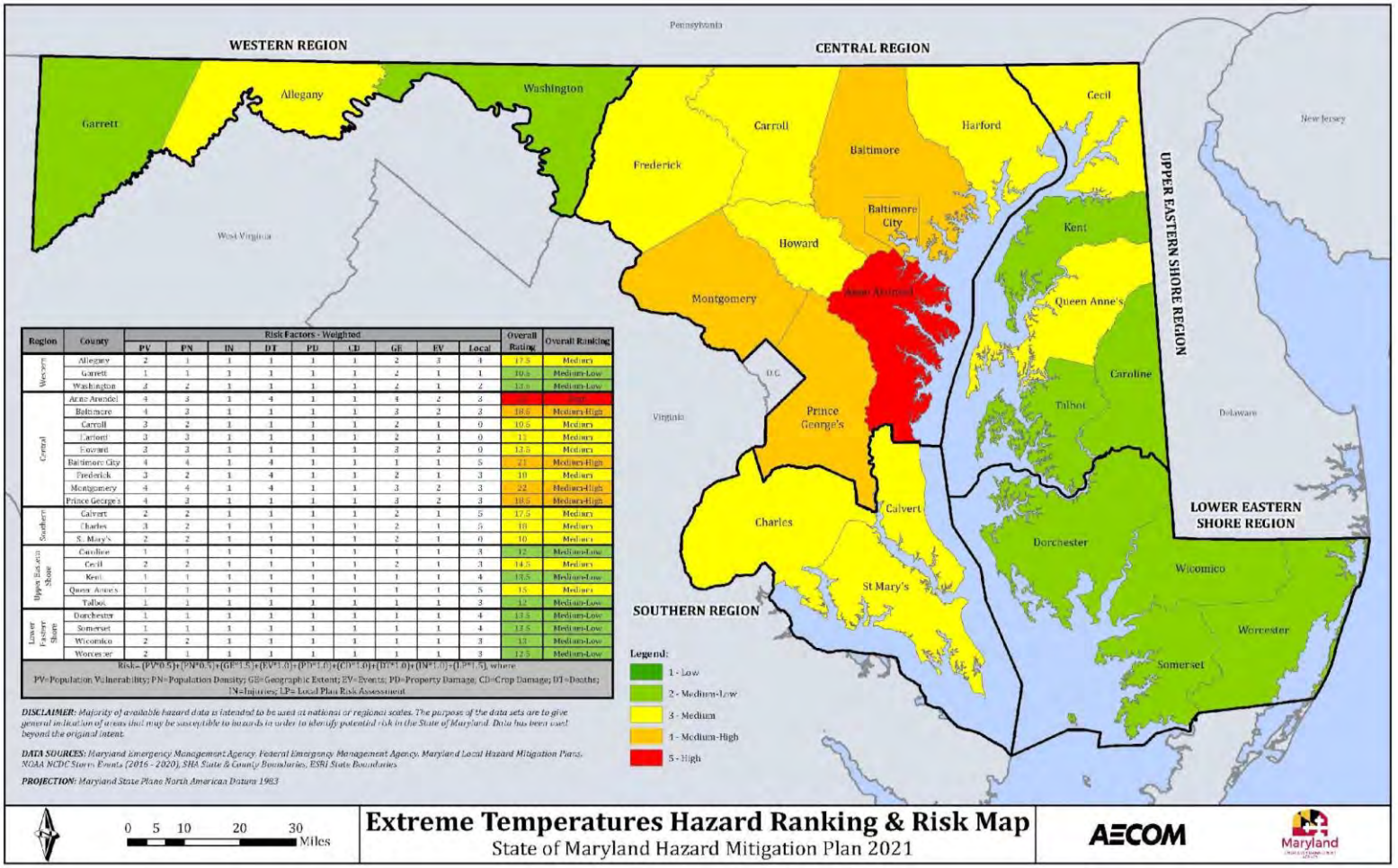
[111] "The World Wants Air-Conditioning. That Could Warm the World." *The New York Times*, May 15, 2018. Available at: https://www.nytimes.com/2018/05/15/climate/air-conditioning.html.

[112] *Fourth National Climate Assessment*, *Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

[113] FEMA Community Lifelines Implementation Toolkit, August 4, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

3.12.8 Extreme Temperatures Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted								Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local	
Western	Allegany	2	1	1	1	1	1	2	3	4	17.5	Medium
	Garrett	1	1	1	1	1	1	2	1	1	10.5	Medium-Low
	Washington	3	2	1	1	1	1	2	1	2	13.5	Medium-Low
Central	Anne Arundel	4	3	1	4	1	1	4	2	3		
	Baltimore	4	3	1	1	1	1	3	2	3	18.5	Medium-High
	Carroll	3	2	1	1	1	1	2	1	0	10.5	Medium
	Harford	3	3	1	1	1	1	2	1	0	13	Medium
	Howard	3	3	1	1	1	1	3	2	0	13.5	Medium
	Baltimore City	4	4	1	4	1	1	1	1	5	21	Medium-High
	Frederick	3	2	1	4	1	1	2	1	3	10	Medium
	Montgomery	4	4	1	4	1	1	3	2	3	22	Medium-High
	Prince George's	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Southern	Calvert	2	2	1	1	1	1	2	1	5	17.5	Medium
	Charles	3	2	1	1	1	1	2	1	5	18	Medium
	S. Mary's	2	2	1	1	1	1	2	1	0	10	Medium
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Cecil	2	2	1	1	1	1	2	1	3	14.5	Medium
	Kent	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	5	15	Medium
	Talbot	1	1	1	1	1	1	1	1	3	12	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	1	3	13	Medium-Low
	Worcester	2	1	1	1	1	1	1	1	3	12.5	Medium-Low

Risks=(PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.

DATA SOURCES: Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries

PROJECTION: Maryland State Plane North American Datum 1983

3.13 Flood Hazard

3.13.1 Definition

The flood hazards in Maryland can be categorized in several different ways. Coastal flooding is addressed in Section 3.9 of this Plan. Flood hazards included in this Plan are defined by the NWS[114] as follows:

Flood: "Any high flow, overflow, or inundation by water which causes damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, that poses a threat to life or property."

Flash Flood: "A life-threatening, rapid rise of water into a normally dry area beginning within minutes to multiple hours of the causative event (e.g., intense rainfall, dam failure, ice jam). Ongoing flooding can intensify to the shorter-term flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters."

Heavy Rain: "Unusually large amount of rain which does not cause a Flash Flood or Flood event, but causes damage, e.g., roof collapse or other human/economic impact."

3.13.2 Location

Flood location is influenced by local topography and the ground's capacity to hold water. Dense population centers and other developed areas are at risk for flash flooding because of the prevalence of impervious surfaces. Highways, roads, parking lots, and other paved areas prevent the ground from absorbing rainfall, thereby increasing runoff and the possibility for flood and flash flood events. Areas near water sources, such as rivers, creeks, or other water bodies are likely to experience flooding. Dam failure has the potential to send dangerous volumes of water downstream and may result in minor or extreme flooding, depending on the nature of the failure.[115] Dam failures are discussed in Section 3.10 of this Plan.

"Maryland is subject to flooding from several different sources. Flash floods tend to come after short periods of heavy rain and most often affect small streams and creeks. General flooding comes from more prolonged steady rain and tends to affect larger streams and rivers. Major rivers such as the Potomac and Susquehanna often reach flood stages because of events in distant areas of their watershed. Finally, hurricanes and tropical storms can cause surges that create tidal flooding along

[114] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[115] Severe Weather 101: Flood Basics. NOAA National Severe Storms Laboratory. n.d. Accessed April 28, 2021. Available at: https://www.nssl.noaa.gov/education/svrwx101/floods/.

Maryland's bays and their tributaries."[116] Flooding from hurricanes and tropical storms is covered Section 3.9 of this Plan.

In Maryland, flood hazard risk assessment results indicate that the local jurisdictions with the highest flooding risk include Anne Arundel, Baltimore, Frederick, Howard, Prince George's, Harford, and Somerset counties, and the City of Baltimore. Garrett, Allegany, Washington, Charles, St. Mary's, Cecil, Queen Anne's, Talbot, Caroline, Dorchester, Somerset, and Worcester counties are all rated as medium-high risk.

3.13.3 Extent (Magnitude/Strength)

Flooding can be connected to a variety of storm typologies that may produce heavy precipitation. Key measures of flood extent are related to precipitation extent. The WSR-88D, one of the most powerful and advanced Weather Surveillance Doppler Radar in the world, displays the location of storms and precipitation. Animations of radar maps show the expected movement of precipitation. This can be a helpful tool to project intensity and duration of precipitation events, and by extension, planning for flash flooding and urban flooding warnings or statements.[117]

Most jurisdictions employ weather monitoring and measuring equipment, such as rain gauges, to determine the extent and impact that heavy rain events have. Rain gauges collect real-time rainfall observations during storms and are the most effective method of quantifying rainfall at a specific location. Duration (time, e.g., 1 minute), maximum rainfall in duration (inches, e.g., 0.16 inches), and time of occurrence (time of day, e.g., 4:15 pm – 4:16 pm) are examples of information recorded by the Ellicott City rain gauge during the May 2018 floods. This information provides a detailed glimpse of the true strength of a flash flood event, since onset speed is a critical dimension of flash flood strength.[118]

Rainfall approximations by satellite, while not as effective as radar or rain gauges, can provide high resolution information about storm systems developing over less populated areas where other rainfall data collection methods may be limited.[119]

3.13.4 Previous Occurrences

Maryland has experienced 300 flash flooding events since January 2016, all caused by heavy rain as categorized by the NOAA Storm Events Database. These flash flooding events resulted in five fatalities. The state has also experienced a significant number of flooding and heavy rain events. According to the NOAA Storm Events Database

---

[116] *Are you in a Flood Prone Area?* Maryland Emergency Management Agency. n.d. Accessed April 28, 2021. Available at: https://mema.maryland.gov/Pages/flood-Prone-Zones.aspx.

[117] Severe Weather 101: Flood Detection. NOAA National Severe Storms Laboratory. n.d. Accessed April 28, 2021. Available at: https://www.nssl.noaa.gov/education/svrwx101/floods/detection/.

[118] "May 27th, 2018 Flooding - Ellicott City & Catonsville, MD." NOAA National Weather Service. Baltimore/Washington Weather Forecast Office. July 2, 2018. Available at: https://www.weather.gov/lwx/EllicottCityFlood2018.

[119] Severe Weather 101: Flood Detection. NOAA National Severe Storms Laboratory. n.d. Accessed April 28, 2021. Available at: https://www.nssl.noaa.gov/education/svrwx101/floods/detection/.

records, since tracking and record keeping began, Maryland has experienced 583 flood events and 168 heavy rain events.

Since January 2016, Maryland has had three flood-related major disaster declarations, as listed below:

Severe Storm and Flooding (DR-4279-MD): "A storm cell dumped nearly 6 inches of rain in the area during a few hours on the evening of July 30, 2016, causing a wall of water to cascade down Main Street of Ellicott City. Two people were killed in the storm, dozens of buildings – many a mix of business and residential – were damaged and about 200 vehicles were swept downstream or flooded. Ellicott City sits at the intersection of the West Branch of the Patapsco River and two smaller streams. Eastern Howard County was severely impacted by this storm."[120] As a result of this storm, 97 homes were damaged or destroyed, nearly 31 percent of which were considered a total loss.

Severe Storms and Flooding (DR-4374-MD): "Beginning in the evening on Tuesday, May 15, 2018, a series of severe thunderstorms containing excessive rain impacted portions of western and central Maryland for several days, leading to widespread urban and stream flooding in portions of Frederick and Washington counties. During the first 2 days, multiple roadways and bridges (state and local) were inundated, with many being "washed out" completely. On Thursday, May 17, 2018, MEMA was notified by the Garrett County Office of Emergency Management (OEM) of an incident in the Kitzmiller area of Garrett County, where a slow-moving mudslide threatened to isolate numerous residences from road access."[121] The storms primarily impacted roads and bridges, with that total FEMA Public Assistance cost estimate of close to $12.6 million in damages.

Severe Storm and Flooding (DR-4376-MD): "On Sunday, May 27, 2018, a heavy line of thunderstorms again impacted portions of central Maryland, this time dropping 9-10 inches of rain in the West Baltimore City, Catonsville (Baltimore County), and Ellicott City over a very short period of time. As a result of this extreme rainfall, catastrophic urban flooding occurred in these three jurisdictions."[122] During this event, a 39-year-old man died when he tried to help another person evacuate and was swept away. Floodwaters on the lower portion of Main Street in the 8000 block (in Ellicott City) reached the bottom of second floors of businesses. In all, dozens of water rescues were performed, most from buildings.[123] Many of the repairs for the damage caused in the 2016 storm were washed away during this event.

---

[120] "Governor Larry Hogan Requests Federal Disaster Declaration in Response to Historic Ellicott City Flooding." Maryland Emergency Management Agency. n.d. Accessed April 28, 2021. Available at: https://news.maryland.gov/mema/2016/08/12/governor-larry-hogan-requests-federal-disaster-declaration-in-response-to-historic-ellicott-city-flooding/.

[121] May 2018 Severe Weather and Flooding After-Action Report (AAR). State of Maryland July 23, 2018. Available at: https://mema.maryland.gov/Documents/May-2018-Severe-Weather-and-Flooding-AAR-FINAL.pdf.

[122] Ibid.

[123] Storm Events Database. NOAA National Centers for Environmental Information. n.d. Accessed April 28, 2021. Available at:https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=759999.

3.13.5 Future Probability and Climate Change Conditions

Based on the frequency of previous occurrences, the future probability of flood hazards in Maryland is highly likely. According to the NCA4, climate change will impact flood hazards. NCA4 projects major trends over the next 25 to 100 years relevant to flood hazard impacts and future event probability. Continued increases in the frequency and intensity of heavy precipitation in many regions of the United States, including the northeast, are expected.[124] The strongest hurricanes are expected to "become both more frequent and more intense," and result in more rainfall.[125]

3.13.6 FEMA Flood Zones

Flood hazard areas identified on a Flood Insurance Rate Map (FIRM) are designated as Special Flood Hazard Areas (SFHAs). High-risk SFHAs are defined as the areas that will be inundated by the flood event having a 1 percent chance of being equaled or exceeded in any given year. The 1-percent-annual-chance flood is also referred to as the base flood or 100-year flood. Moderate to low flood hazard areas, labeled 0.2-percent-annual-chance or Zone X, are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. Table 3-27 defines the FEMA Flood Zones that are found in Maryland.

Table 3-27: FEMA Flood Zones

Flood Zone	Description
SFHA-High Risk Areas	
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
AE	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are provided. Zone AE is now used on new format FIRMs instead of Zones A1–A30.
AH	Areas subject to inundation by 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Base Flood Elevations (BFEs) derived from detailed hydraulic analyses are shown in this zone.
AO	Areas subject to inundation by 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone.
VE	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

[124] *Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States*. Chapter 2: "Our Changing Climate." Key message 6: Changing U.S. Precipitation. U.S. Global Change Research Program. 2018; Revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/2/#key-message-6.

[125] *Fourth National Climate Assessment*, *Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

Flood Zone	Description
Moderate Risk Areas	
X (Shaded) 0.2% Annual Chance Flood Hazard	Areas outside the 1% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No base flood elevations or depths are shown within this zone. Insurance purchase is not required in these zones.
Minimum Risk Areas	
X (Unshaded)	Area of minimal flood hazard usually depicted on FIRMs as above the 500-year flood level. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.

Source: FEMA: Definitions of FEMA Flood Zone Designations

3.13.7 Critical Facilities within FEMA Flood Zones

Prior to the 2016 update of the Hazard Mitigation Plan, the *Maryland Critical Facilities Database* was expanded to include FEMA flood zones. Each critical facility was assessed to determine if the facility was within a flood zone, and, if so, the flood zone was identified within the database. Jurisdictions containing the highest number of critical facilities within one of the FEMA-identified SFHAs include Baltimore City and Dorchester County.

Moderate flood hazard areas and minimal flood hazard areas are also shown on the FIRM and were identified in relation to critical facilities within the database. As a result of climate change impacts, these areas have been considered in light of both current and future conditions. An increase in low-grade flooding, or flooding in areas of moderate or even minimum risk, is likely in Maryland because of sea level rise, an increased number of storms, and increased precipitation during storm events. Increased precipitation and storm intensity may affect critical facilities within the "moderate risk" or 0.2 percent (or 500-year flood) zones, particularly in both Allegany and Baltimore counties, as well as the City of Baltimore. Sea level rise coupled with increases in precipitation and storm intensity may also increase vulnerability to critical facilities in the future, particularly in coastal communities. Baltimore County, Baltimore City, and Prince George's County have many critical facilities within Zone X, the minimal risk area, which may indicate areas of increasing risk over time. The total number of critical facilities within the state currently identified in Zone X, the minimal flooding risk area, is 2,504. Table 3-28 lists the number of critical facilities by jurisdiction and FEMA flood zone.

Table 3-28: Critical Facilities within FEMA Flood Zones

Jurisdiction	Critical Facility Totals	Critical Facilities w/in FEMA Flood Zones						Historical Total built prior to 1965
		SFHA-High Risk			Moderate Risk	Levee	Minimum Risk	
		A	AE	VE	0.2%	X Protected by Levee	X	
Allegany	70	0	7	0	3	1	59	32
Anne Arundel	114	1	0	0	0	0	113	21
City of Annapolis	25	0	0	0	0	0	25	8
Baltimore	427	1	5	0	5	0	416	83
Baltimore City	457	0	11	0	7	0	372	201
Calvert	73	0	0	0	0	0	73	14
Caroline	31	0	1	0	0	0	30	12
Carroll	115	0	0	0	0	0	115	31
Cecil	91	0	2	0	1	0	88	36
Charles	80	0	0	0	0	0	80	13
Dorchester	62	0	8	0	0	0	54	28
Frederick	121	0	5	0	1	0	115	36
Garrett	19	0	0	0	1	0	18	8
Harford	116	0	2	0	0	0	114	21
Howard	35	0	0	0	0	0	35	5
Kent	25	0	1	0	0	0	24	10
Montgomery	221	0	0	0	1	0	220	55
Prince George's	251	0	2	0	2	0	247	16
Queen Anne's	49	0	2	0	0	0	47	26
Somerset	43	0	7	0	2	0	17	9
St. Mary's	26	0	1	0	0	0	42	15
Talbot	45	0	0	0	0	0	45	13
Washington	87	1	1	0	1	0	84	27
Wicomico	66	0	2	0	0	0	64	27
Worcester	0	0	0	0	0	0	0	0
Ocean City	9	0	1	1	0	0	7	1
TOTAL	**2658**	**3**	**58**	**1**	**24**	**1**	**2504**	**748**

3.13.7.1 Historic Critical Facilities within FEMA Flood Zones

Twenty-three critical facilities built either in 1965 or earlier are within a FEMA-designated flood zone. Dorchester County, Baltimore City, and Allegany County have the highest number of historic critical facilities, six, four, and three, respectively. Total loss estimations for both building value and content value indicate that Baltimore City and Allegany and Somerset counties have the highest total loss estimations per jurisdiction. Table 3-29 lists the number of historic critical facilities by jurisdiction with potential losses from flooding.

Table 3-29: Historic Critical Facilities within FEMA Flood Zones

Jurisdiction	Historic Critical Facility Totals in Flood Zones	Loss Estimates		
		Building Value	Content Value	Total Loss
Allegany	3	$4,878,000	$491,700	$5,369,700
Anne Arundel	0	$0	$0	$0
City of Annapolis	0	$0	$0	$0
Baltimore	1	$207,800	$152,700	$360,500
Baltimore City	4	$6,582,300	$3,554,200	$10,136,500
Calvert	0	$0	$0	$0
Caroline	0	$0	$0	$0
Carroll	0	$0	$0	$0
Cecil	1	$138,800	$35,700	$174,500
Charles	0	$0	$0	$0
Dorchester	6	$1,439,000	$140,200	$1,579,200
Frederick	1	$590,500	$481,400	$1,071,900
Garrett	0	$0	$0	$0
Harford	0	$0	$0	$0
Howard	0	$0	$0	$0
Kent	1	$235,500	$56,700	$292,200
Montgomery	0	$0	$0	$0
Prince George's	0	$0	$0	$0
Queen Anne's	1	$200,900	$100,000	$300,900
Somerset	2	$4,209,900	$220,000	$4,429,900
St. Mary's	1	$162,400	$187,200	$349,600
Talbot	0	$0	$0	$0
Washington	2	$734,900	$536,500	$1,271,400

Jurisdiction	Historic Critical Facility Totals in Flood Zones	Loss Estimates		
		Building Value	Content Value	Total Loss
Wicomico	0	$0	$0	$0
Worcester	0	$0	$0	$0
Ocean City	0	$0	$0	$0
TOTAL	**23**	**$19,380,000**	**$5,956,300**	**$25,336,300**

3.13.7.2 Critical Facility Loss Estimations

Loss estimations were completed for all facilities within the *Maryland Critical Facilities Database*. Table 3-30 lists the number of critical facilities by jurisdiction with potential loss estimations and both building and content values. This information is an aggregate of all loss estimation information profiled in each hazard, as well as in the methodology as described in Appendix H.

Table 3-30: Critical Facilities Loss Estimations

Jurisdiction	Critical Facilities Totals	Loss Estimation		
		Building Value	Content Value	Total Loss
Allegany	7	$6,526,300	$659,500	$7,185,800
Anne Arundel	1	$3,181,300	$3,499,200	$6,680,500
City of Annapolis	0	$0	$0	$0
Baltimore	6	$67,085,200	$114,307,500	$181,392,700
Baltimore City	11	$73,855,800	$24,040,000	$97,895,800
Calvert	0	$0	$0	$0
Caroline	1	$53,100	$50,000	$103,100
Carroll	0	$0	$0	$0
Cecil	2	$443,400	$231,200	$674,600
Charles	0	$0	$0	$0
Dorchester	8	$13,285,200	$915,000	$14,200,200
Frederick	5	$18,145,100	$1,763,600	$19,908,700
Garrett	0	$0	$0	$0
Harford	2	$6,969,700	$420,600	$7,390,300
Howard	1	$0	$374,300	$374,300
Kent	1	$235,500	$56,700	$75,500
Montgomery	0	$0	$0	$0
Prince George's	2	$2,132,300	$343,000	$2,475,300

Jurisdiction	Critical Facilities Totals	Loss Estimation		
		Building Value	Content Value	Total Loss
Queen Anne's	2	$1,747,900	$1,364,800	$3,112,700
Somerset	7	$20,320,700	$2,721,000	$23,041,700
St. Mary's	1	$162,400	$187,200	$349,600
Talbot	0	$0	$0	$0
Washington	2	$734,900	$536,500	$1,271,400
Wicomico	2	$8,743,200	$919,300	$9,662,500
Worcester	0	$0	$0	$0
Ocean City	2	$1,482,700	$77,887,500	$79,370,200
TOTAL	**63**	**$225,104,700**	**$230,276,900**	**$455,164,900**

3.13.8 State Assets within FEMA Flood Zones

Prior to the 2016 Hazard Mitigation Plan update, the *Maryland State Asset Database* was expanded to include FEMA flood zones. Each state asset was assessed to determine if the facility was within a flood zone, and, if so, the flood zone was identified within the database. Jurisdictions containing the highest number of state assets within one of the FEMA-identified SFHAs included Caroline, St. Mary's, and Somerset counties.

Moderate flood hazard areas and minimal flood hazard areas are also shown on the FIRM and were identified in relation to critical facilities within the database. As a result of climate change impacts, these areas have been considered for both current and future conditions. An increase in low-grade flooding, or flooding in areas of moderate or even minimum risk, is likely in Maryland because of sea level rise, an increased number of storms, and increased precipitation during storm events. Increased precipitation and storm intensity may affect state assets within the "moderate risk" or 0.2 percent (or 500-year flood) zones, particularly in both Allegany and Baltimore counties and Baltimore City. Sea level rise coupled with increases in precipitation and storm intensity may also increase vulnerability to state assets in the future, particularly in coastal communities. Based on the information in Table 47, Baltimore, Prince George's, and Anne Arundel counties, along with the City of Baltimore, have many state assets within Zone X, the minimal risk area, which may indicate areas of increasing risk over time. The total number of state assets within the state currently identified in Zone X, the minimal flooding risk area, is 6,709. Table 3-31 lists the number of state assets by jurisdiction and FEMA flood zone.

Table 3-31: State Assets within FEMA Flood Zones

Jurisdiction	State Asset Total	State Assets w/in FEMA Flood Zone						Historic State Assets
		SFHA-High Risk			Moderate Risk	Levee	Minimum	
		A	AE	VE	0.2%	X Protected by Levee	X	Total built in Flood Zone
Allegany	300	0	0	0	28	1	300	3
Anne Arundel	528	0	5	0	0	0	524	5
City of Annapolis	232	0	10	0	0	0	222	10
Baltimore	745	0	1	0	12	0	744	1
Baltimore City	867	1	35	0	28	0	831	36
Calvert	132	0		0	0	0	132	0
Caroline	425	0	334	0	0	0	91	334
Carroll	235	1		0	0	0	234	0
Cecil	292	0	1	0	1	0	291	0
Charles	153	0	2	0	0	0	151	2
Dorchester	109	0	8	0	1	0	101	8
Frederick	197	3	3	0	0	0	191	6
Garrett	297	0	4	0	1	0	293	4
Harford	220	0	2	0	1	0	218	2
Howard	369	0		0	0	0	369	0
Kent	40	0	1	0	1	0	39	1
Montgomery	192	0		0	0	0	191	0
Prince George's	628	0	8	0	1	0	620	8
Queen Anne's	98	0	1	0	0	0	97	1
Somerset	324	0	59	0	3	0	206	59
St. Mary's	265	0	82	1	0	0	241	83
Talbot	67	0	1	0	0	0	66	1
Washington	335	1	2	0	0	0	332	3
Wicomico	197	0	19	0	0	0	178	17
Worcester	125	52	28	0	4	0	45	29
Ocean City	8	0	6	0	2	0	2	6
TOTAL	**7380**	**58**	**612**	**1**	**83**	**1**	**6709**	**619**

3.13.8.1 Historic State Assets within FEMA Flood Zones

One hundred thirty-one state assets were either in 1965 or earlier are within a FEMA-designated flood zone. Table 3-32 shows that the City of Baltimore and Somerset County have the highest loss estimations of historic state assets, while Caroline and St. Mary's counties have the highest number of historic state assets, 66 and 39, respectively, within FEMA flood zones.

Table 3-32: Historic State Assets within FEMA Flood Zones

Jurisdiction	Historic State Assets Totals in Flood Zones	Loss Estimates		
		Building Value	Content Value	Total Loss
Allegany	1	$4,419	$1,473	$5,892
Anne Arundel	1	$123,978	$41,326	$165,304
City of Annapolis	4	$5,288,106	$1,272,148	$6,560,254
Baltimore	0	$0	$0	$0
Baltimore City	6	$223,606,282	$2,695,275	$226,301,557
Calvert	0	$0	$0	$0
Caroline	66	$26,172,162	$8,166,443	$34,338,605
Carroll	0	$0	$0	$0
Cecil	0	$0	$0	$0
Charles	0	$0	$0	$0
Dorchester	1	$67,394	$74,653	$142,047
Frederick	1	$3,420,470	$29,900	$3,450,370
Garrett	0	$0	$0	$0
Harford	0	$0	$0	$0
Howard	0	$0	$0	$0
Kent	0	$0	$0	$0
Montgomery	0	$0	$0	$0
Prince George's	0	$0	$0	$0
Queen Anne's	0	$0	$0	$0
Somerset	11	$37,114,511	$328,050	$37,442,561
St. Mary's	39	$3,004,817	$1,127,896	$4,132,713
Talbot	1	$207,508	$21,264	$228,772
Washington	0	$0	$0	$0
Wicomico	0	$0	$0	$0

Jurisdiction	Historic State Assets Totals in Flood Zones	Loss Estimates		
		Building Value	Content Value	Total Loss
Worcester	0	$0	$0	$0
Ocean City	0	$0	$0	$0
TOTAL	**131**	**$299,009,647**	**$13,758,427**	**$312,768,074**

3.13.8.2 State Assets Loss Estimations

Loss estimations were completed for all facilities contained within the updated 2020 *State Asset Database*. Loss estimations include both building and content values. There are 619 state assets within a FEMA-designated flood zone. Table 3-33 shows that the City of Baltimore and Somerset County have the highest state asset loss estimations, while Caroline and St. Mary's counties have the highest number of state assets, 334 and 83, respectively, within FEMA flood zones.

Table 3-33: State Assets Loss Estimations

Jurisdiction	State Asset Totals in Flood Zones	Loss Estimates		
		Building Value	Content Value	Total Loss
Allegany	3	$860,733	$286,911	$1,147,644
Anne Arundel	5	$8,749,164	$2,165,668	$10,914,832
City of Annapolis	10	$9,640,079	$2,566,854	$12,206,933
Baltimore	1	$10,000	$3,333	$13,333
Baltimore City	36	$687,085,087	$22,126,072	$709,211,158
Calvert	0	$0	$0	$0
Caroline	334	$92,962,434	$13,582,003	$106,544,437
Carroll	0	$0	$0	$0
Cecil	0	$0	$0	$0
Charles	2	$156,208	$52,069	$208,277
Dorchester	8	$296,218	$244,108	$540,326
Frederick	6	$37,044,744	$11,237,991	$48,282,735
Garrett	4	$0	$0	$0
Harford	2	$87,817	$29,272	$117,089
Howard	0	$0	$0	$0
Kent	1	$730,875	$243,625	$974,500
Montgomery	0	$0	$0	$0
Prince George's	8	$38,907,166	$2,688,390	$41,595,556

Jurisdiction	State Asset Totals in Flood Zones	Loss Estimates		
		Building Value	Content Value	Total Loss
Queen Anne's	1	$274,400	$91,467	$365,867
Somerset	59	$125,934,107	$1,893,587	$127,827,694
St. Mary's	83	$8,166,469	$2,919,624	$11,086,093
Talbot	1	$207,508	$21,264	$228,772
Washington	3	$223,900	$74,633	$298,533
Wicomico	17	$81,512,863	$1,297,934	$82,810,797
Worcester	29	$36,740,080	$11,763,552	$48,503,632
Ocean City	6	$240,724	$75,708	$316,432
TOTAL	**619**	**$1,129,830,576**	**$73,364,066**	**$1,203,194,641**

3.13.9 Flood Hazard Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a flood event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-34.

Table 3-34: Flood Hazard Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and property owners within the FEMA 100-year flood zone are most at risk to impacts from a flood event. Impacts to the public include potential for injury or loss of life, destruction and/or loss of land and property, and contamination of water due to flooding.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads, and attend to any injured. For a flood event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is within a flood hazard area, during a severe flood event. Delivery of services may be slowed or halted in these areas if key roadways become impassable due to flooding.
Property, Facilities, and Infrastructure	Home and landowners within flood zones may experience damage to or loss of property depending upon the severity of flooding in the area. Infrastructure may experience impacts in the form of damage from flooding, debris blockages, temporary closure of transportation routes, and the potential inability of the stormwater system to handle floodwater in a severe event.

Subject	Impacts
Environment	Floods impact the environment by spreading pollution, overloading water and wastewater treatment plants, carrying silt and debris, and disturbing wildlife and the natural areas.
Economic Condition of the State	A major flood event would be costly for state and local governments in terms of emergency response, delivery of services, disaster cleanup, and future mitigation projects. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a flood event.

3.13.10 Vulnerability and Impact

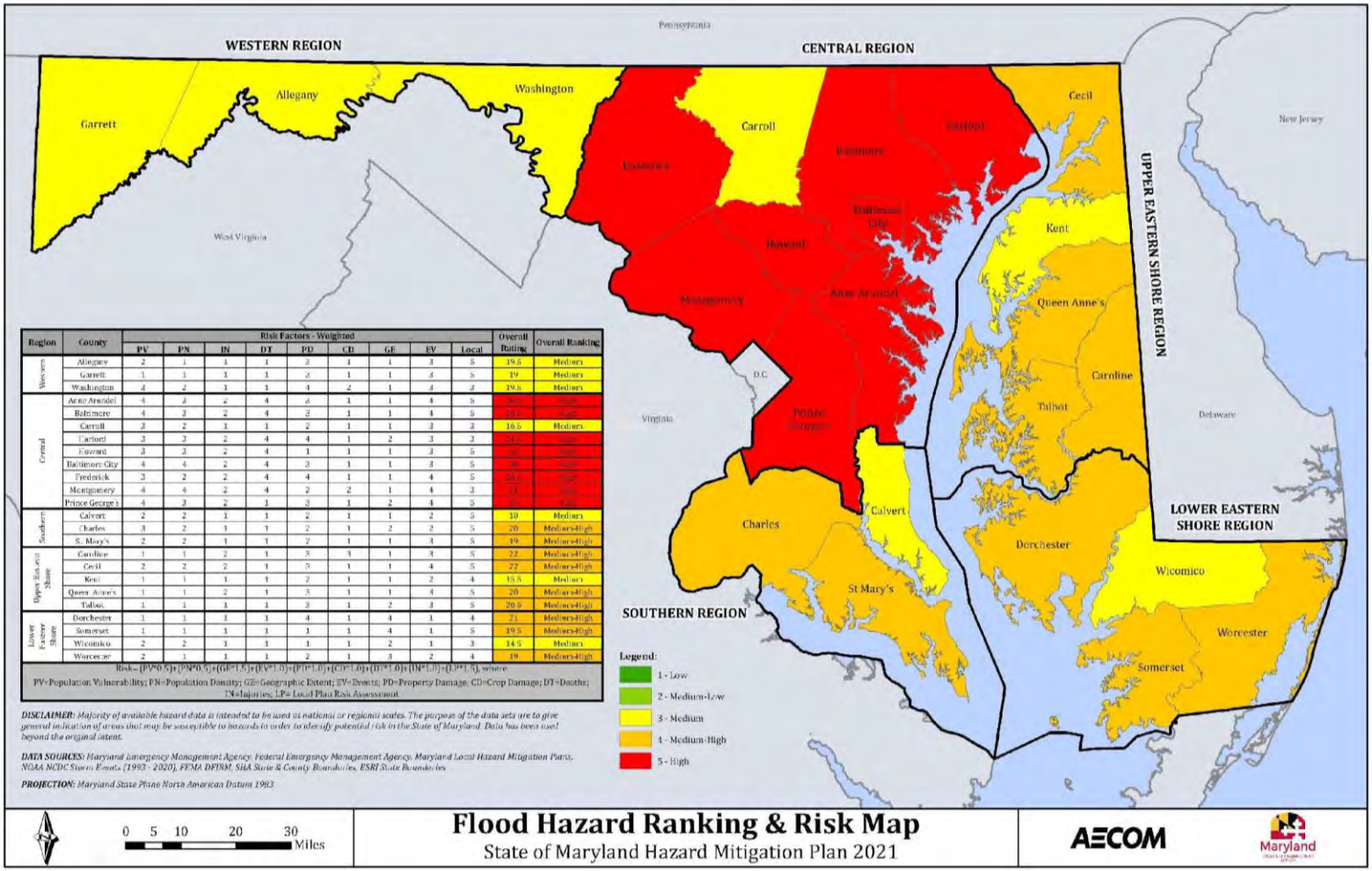
Vulnerability to flood events depends on local topography and elevation, development and extent of impervious surfaces, and precipitation movement and patterns. Rising sea levels will result in more low-lying areas of flooding throughout Maryland. Flooded roads, homes, and structures can lead to safety hazards, and in extreme cases, loss of life. Washed out roads, erosion, and localized landslides can result from flood events and pose additional dangerous conditions. Property damage, power outage, and agricultural impacts from crop inundation may also result from flooding. Indirect impacts may occur depending on the severity of the flood impacts (e.g., supply chain disruption due to flooded roads, economic losses for local businesses that have incurred flood damage).

FEMA developed Community Lifelines to reframe incident information, communicate incident impacts, and promote unity of effort across a community. A Lifeline provides a framework for "the continuous operation of critical government and business functions and is essential to human health and safety or economic security." The Community Lifelines vulnerable to flood hazards in Maryland may be most likely to include the Transportation; Food, Water, and Shelter; and Communications Lifeline.[126]

[126] *Community Lifelines.* FEMA. July 27, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines

3.13.11 Flood Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	3	1	1	3	5	19.0	Medium
	Garrett	1	1	1	1	3	1	1	3	5	19	Medium
	Washington	4	2	1	1	4	2	1	4	3	19.0	Medium
Central	Anne Arundel	4	3	2	4	4	1	1	4	5	[illegible]	[illegible]
	Baltimore	4	3	2	4	3	1	1	4	5	[illegible]	[illegible]
	Carroll	3	2	1	1	2	1	1	3	3	16.5	Medium
	Harford	3	3	2	4	4	1	2	3	3	[illegible]	[illegible]
	Howard	3	3	2	4	1	1	1	3	5	[illegible]	[illegible]
	Baltimore City	4	4	2	4	3	1	1	3	5	[illegible]	[illegible]
	Frederick	3	2	2	4	4	1	1	4	5	[illegible]	[illegible]
	Montgomery	4	4	2	4	2	2	1	4	3	[illegible]	[illegible]
	Prince George's	4	3	2	3	3	1	2	4	5	[illegible]	[illegible]
Southern	Calvert	2	2	1	1	2	1	1	2	5	18	Medium
	Charles	3	2	1	1	2	1	2	2	5	20	Medium-High
	St. Mary's	2	2	1	1	2	1	1	3	5	19	Medium-High
Upper Eastern Shore	Caroline	1	1	2	1	3	1	1	3	5	22	Medium-High
	Cecil	2	2	2	1	3	1	1	4	5	22	Medium-High
	Kent	1	1	1	1	2	1	1	2	4	15.5	Medium
	Queen Anne's	1	1	2	1	3	1	1	4	5	20	Medium-High
	Talbot	1	1	1	1	3	1	2	3	5	20.0	Medium-High
Lower Eastern Shore	Dorchester	1	1	1	1	4	1	4	1	4	21	Medium-High
	Somerset	1	1	1	1	1	1	4	1	5	19.5	Medium-High
	Wicomico	2	2	1	1	1	1	2	1	3	14.5	Medium
	Worcester	2	1	1	1	2	1	3	2	4	19	Medium-High

Risk = (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LO*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.14 Human-Caused Hazards and Threats

3.14.1 Definition

Human-caused hazards have elements of human intent, negligence, or error involving a failure of a manufactured system. These hazards differ from natural disasters, which result from natural hazards. Almost all human-caused hazards result from deliberate, intentional actions taken to threaten or harm the well-being of others. Human-caused hazards include terrorism, active shooter incidents, nuclear incidents associated with power generation, civil unrest, cyber-attacks, and transportation accidents. Each is further described below:

Terrorism: Violent, criminal acts committed by individuals and/or groups to further ideological goals stemming from domestic influences, such as those of a political, religious, social, racial, or environmental nature.[127] The Federal Bureau of Investigation (FBI) further classifies terrorism into two categories:

- *International terrorism:* Violent acts committed by individuals and/or groups inspired by or associated with designated foreign terrorist organizations or nations, and
- *Domestic terrorism:* Acts carried out by individuals and/or groups inspired by or associated with primarily U.S.-based movements that support extremist ideologies of a political, religious, social, racial, or environmental nature.

Active shooter: An Active shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearm(s) and there is no pattern or method to their selection of victims.[128]

Nuclear Incidents: A nuclear and radiation accident is defined by the International Atomic Energy Agency as "an event that has led to significant consequences to people, the environment or the facility."[129]

Civil Unrest: 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 unrest is typically a symptom of and a form of protest against major socio-political problems.

---

[127] What We Investigate. Terrorism. FBI. n.d. Accessed April 29, 2021. Available at: https://www.fbi.gov/investigate/terrorism.

[128] Active Shooter: How to Respond. U.S. Department of Homeland Security. October 2008. Available at: https://www.dhs.gov/xlibrary/assets/active_shooter_booklet.pdf?0.7552442226207703.

[129] "Radiation accidents and incidents. What do we know about the medical management of acute radiation syndrome?" By Laura Cerezo. *Rep Pract Oncol Radiother*. 2011 Jul; 16(4): 119–122. National Center for Biotechnology Information, U.S. National Library of Medicine. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3863134.

Cyber-Attack: An assault launched by cybercriminals using one or more computers against a single or multiple computers or networks.[130] A cyber-attack targets an organization's use of cyberspace for the purpose of disrupting, disabling, destroying, or maliciously controlling a computing environment/infrastructure, or destroying the integrity of the data or stealing controlled information.[131]

Transportation Accident: Any accident (or incident) that occurs during any type of transportation, including accidents occurring during road, air, rail, and waterway transport. It can refer to a simple road traffic accident (including vehicle collision, pedestrian-bicycle collisions, etc.), an aviation accident or incident, railroad accidents (including train and metro derailments), or a marine accident (bridge collisions, shipwrecks, and running aground). Due to their common occurrences, these incidents are collectively the costliest of all hazards in the state in terms of lives lost and injuries.

3.14.2 Location

Because the majority of human-caused hazards can happen anytime and anywhere, the expected location of this hazard is statewide. Locations with higher probabilities for human-caused hazards are further defined below:

Terrorism: Terrorism is unpredictable and typically occurs without warning. And, although the threat of terrorism can be considered statewide, areas that might be at higher risk for terrorist events include "military and civilian government facilities, international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings, water and food supplies, utilities, and corporate centers."[132]

Active Shooter: Like terrorism, active shooter events are unpredictable and have occurred indiscriminately throughout the country. Therefore, this threat is present statewide. However, FBI's database of active shooting events from 2000 to 2018 reveals that the most common locations for active shooter events include the following businesses open to pedestrian traffic (26.7%), pre-K-12 schools (15.2%), open spaces (13.4%), businesses closed to pedestrian traffic (13.4%), government properties (6.9%), and institutes of higher education (5.4%).[133]

Nuclear Incidents: The Exelon Corporation owns and operates the state's only commercial nuclear power plant. The Calvert Cliffs Nuclear Power Plant is a pressurized water reactor located near the town of Lusby in Calvert County,

---

[130] What is a Cyber Attack? Check Point Software Technologies. n.d. Accessed April 29, 2021. Available at: https://www.checkpoint.com/cyber-hub/cyber-security/what-is-cyber-attack/#:~:text=A%20cyber%20attack%20is%20an,launch%20point%20for%20other%20attacks.

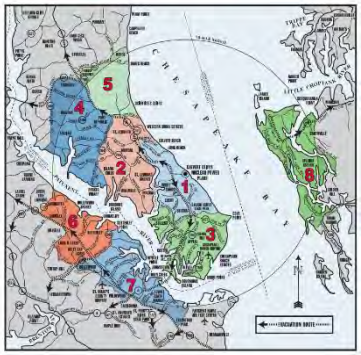
[131] National Institute of Standards and Technology Information Technology Laboratory. Computer Security Resource Center. Glossary: "Cyber Attack." n.d. Accessed April 29, 2021. Available at: https://csrc.nist.gov/glossary/term/Cyber_Attack.

[132] https://www.fema.gov/pdf/areyouready/terrorism.pdf.

[133] Active Shooter Incidents: Topical One-Pagers, 2000 – 2018. Federal Bureau of investigation. December 2019. Available at: https://www.fbi.gov/file-repository/active-shooter-one-page-summaries-2000-2018.pdf/view.

Maryland. The plant has been in operation since 1975 and includes two nuclear reactors generating a total of 1,750 megawatts.

Emergency Planning Zone Map and Designated Evacuation Routes



The Nuclear Regulatory Commission (NRC) mandates that every nuclear power plant identify two emergency planning zones (EPZs) surrounding the plant: a plume exposure pathway zone with a radius of 10 miles, concerned primarily with exposure to, and inhalation of, airborne radioactive contamination; and an ingestion pathway zone of 50 miles, concerned primarily with ingestion of food and liquid contaminated by radioactivity.

The 2010 U.S. population within 10 miles of the Calvert Cliffs Power Plant was 48,798, an increase of 86.4 percent in a decade, according to an analysis of U.S. Census data. The 2010 U.S. population within 50 miles was 2,890,702, a decrease of 2.0 percent since 2000.

Although not in the state, the Peach Bottom Atomic Power Station is a boiling water reactor located on the south bank of the Susquehanna River in York County, Pennsylvania. A portion of northern Harford County lies within the station's 10-mile EPZ, and larger portions of the state lie within the 50-mile ingestion pathway zone.

Civil Unrest: The location of civil unrest events is unpredictable, yet spatial distribution patterns of historical events suggest that dense urban areas, cities, universities, sporting events, and areas where large crowds gather have a higher concentration. Civil unrest usually follows an incident that sparks a reaction. This allows for, at worst, a minimal warning time, to, at best, days or weeks to prepare.

Cyber-Attack: Cyber-attacks are unpredictable and typically occur without warning. According to the FireEye Cyber Threat Map,[134] approximately 725,000 major cyber-attacks occur throughout the world per day. Because cyber-attacks can cause severe disruptions to computers and electronics associated with critical infrastructure, statewide transportation, data centers, public safety, and utility services, all of which use Supervisory Control and Data Acquisition (SCADA) systems, are vulnerable. Because of this, state agencies and municipalities, as well as individuals, businesses, and other institutions are potential targets for cyber-attacks. Finally, the actual cause of cyber-attacks can be difficult to identify because the internet provides cover for those responsible for attack initiation.

[134] Fireeye cyber Threat Map. n.d. Accessed April 29, 2021. Available at: https://www.fireeye.com/cyber-map/threat-map.html.

Transportation Accidents: Maryland's highway transportation network encompasses several key routes for the movement of goods and people. The Maryland highway transportation network consists of 32,269 linear miles of public roadways and 5,357 bridges.[135] There are currently 16 interstate highways that exist entirely or partially in Maryland. Six of these are primary interstates, while 10 are auxiliary interstates related to one of the primary interstates. The longest primary interstate in Maryland is Interstate 95 (commonly abbreviated I-95) at 110.01 miles. In 2018, there were 4,407,973 licensed drivers and 4,204,846 registered vehicles in the state. Highway vehicle-miles traveled was approximately 59,775,000. The sheer amount of roadway coupled with the high volume of traffic creates the potential for serious accidents along the state' s roads and bridges.

Maryland has three primary commercial airports (with BWI being the largest), six reliever airports, nine general aviation airports, 19 public-use airports, and five military airports. Considering the number of commercial air traffic flyovers that occur every day, the potential for air transportation accidents exists statewide. However, a 5-mile radius around each airport can be considered a high-risk area, because most aviation incidents occur near take-off and landing sites.

Rail accidents can occur anywhere along the more than 769 linear miles of track in the state. Rail transportation is divided into two major categories: freight and passenger. Each category can be subdivided according to carrier type: major carrier (CSX, Norfolk Southern, Amtrak, etc.) and local or regional carriers (regional transit agencies, etc.). More than 19 railroad companies operate in Maryland.

Finally, Maryland has over 530 miles of waterways that are used to transport goods along with one major port. The Port of Baltimore is one of the nation's largest ports for total cargo tonnage and overall dollar value of cargo. The port is also one of the most diverse ports in the United States as key commodities include autos, roll on/roll offs, containers, forest products, and project cargo. In addition, vessels traveling to/from the port also can carry a wide variety of hazardous materials. Runaway or poorly piloted vessels can pose a threat to other waterway traffic, physical structures over (bridges) and next to waterways, and even the properties that line waterways.

3.14.3 Extent (Magnitude/Strength)

Terrorism: The extent of terrorism can vary in severity from nominal to catastrophic based on contributing factors such as method of attack, volume of force applied, and the attack location's population density. There may be significant losses of life for humans, property damage, and subsequent economic losses. Additionally, the impact of the attack itself may be exacerbated by disruptions to human services agencies, such health and medical providers, public assistance programs, and social services as a result of physical damage to facilities, supplies, equipment, and communications. Ancillary effects of terrorism, such as urban fires or, in the case of a

[135] Maryland: Transportation by the Numbers. U.S. Department of Transportation Bureau of Transportation Statistics. January 2020. Available at: https://www.bts.dot.gov/sites/bts.dot.gov/files/states2020/Maryland.pdf.

radiological device, radioactive fallout, can exponentially magnify the impact of a terrorist event.

Terrorist attacks can take many forms, each with varying magnitudes and strength. Table 3-35 lists common tactics of terrorism and their expected magnitudes/strengths.

Table 3-35: Terrorism Attack Magnitude

Lower Magnitude	Higher Magnitude
Arson/incendiary attack	Armed attack
Intentional hazardous material release	Chemical agent
Assassination	Biological agent
Hijackings	Radiological agent
Conventional bomb	Nuclear bomb

According to Christopher Wray, the FBI's Director, in a Statement Before the House Homeland Security Committee on September 17, 2020,[136] "The greatest threat we face in the homeland is that posed by lone actors radicalized online who look to attack soft targets with easily accessible weapons. We see this lone-actor threat manifested both within domestic violent extremists (DVEs) and homegrown violent extremists (HVEs), two distinct sets of individuals that generally self-radicalized and mobilized to violence on their own. DVEs are individuals who commit violent criminal acts in furtherance of ideological goals stemming from domestic influences, such as racial bias and anti-government sentiment. HVEs are individuals who have been radicalized primarily in the United States, and who are inspired by, but not receiving individualized direction from, foreign terrorist organizations.

Terror attacks in the United States over the past 30 years have ranged in severity from zero fatalities and wounded (examples include ricin letters delivered to politicians, foiled bombing attempts) to incidents such as 9/11 and the Oklahoma City Bombing where 2,977 and 168 fatalities were recorded, respectively. Under a worst-case scenario, a nuclear detonation in Baltimore City could result in well over 100,000 casualties.

Active Shooter: Active shooter situations are unpredictable and evolve quickly. In most cases, active shooters use firearms and have no pattern or method to their selection of victims. Typically, the immediate deployment of law enforcement is required to stop the shooting and mitigate harm to victims. Because active shooter situations are often over within 10 to 15 minutes, before law enforcement arrives on

[136] Statement Before the Senate Homeland Security and Governmental Affairs Committee: Worldwide Threats to the Homeland. Statement for the Record, Washington, D.C., Given by Christopher Wray, Director, Federal Bureau of Investigation, September 24, 2020. Available at: https://www.fbi.gov/news/testimony/worldwide-threats-to-the-homeland-092420.

the scene, all citizens must be prepared both mentally and physically to deal with an active shooter situation.

Active shooter incidents range in severity from zero fatalities (only wounded), to incidents such as the 2016 Pulse nightclub shootings in Orlando, Florida (33 fatalities), the 2017 Las Vegas shootings at a concert (61 fatalities), and the 2018 Marjory Stoneman Douglas High School shootings in Parkland, Florida (33 fatalities).

Nuclear Incident: A severe nuclear power plant incident at Calvert Cliffs or Peach Bottom would most likely not be a sudden event and would likely take hours or even days to develop. This would enable federal, state, and county officials to assess the situation and take necessary public protective actions in a timely manner.

To ensure safety and to minimize the magnitude of an incident, the concept of "defense in depth" is employed. This means there are several levels of protection or barriers, each of which is independent of others. If one should fail, others would continue to protect the plant, its workers, and the general public. Also, nuclear power plants are designed to prevent the release of radiation. While extremely rare, a nuclear power plant incident could result in the release of radioactive material. In the unlikely event that protective barriers or systems fail to work properly, radioactive material in the form of gases or small particles could escape from the plant into the air. Some radiation may escape as a cloud or "plume" of radioactive steam that would be carried away from the plant by the wind or other environmental factors. The degree of risk to the public would depend on the size of the plume, the direction and speed of the wind, and other factors. Releases of radioactive material that result in the public being exposed to radioactive contamination and possibly receiving a dose of radiation are called "radiological incidents."

Finally, nuclear facilities must notify the appropriate authorities in the event of an accident. The NRC uses four classification levels for nuclear incidents as described in Table 3-36.[137]

Table 3-36: NRC Nuclear Event Classification System

Event Level	Description
Unusual Event	Events are in progress or have occurred that indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.
	Purpose: *The purpose of this classification is to ensure that the first step in future response has been carried out, to bring the operations staff to a state of readiness, and to provide systematic handling of unusual event information and decision-making.*

[137] Emergency Classification. U.S. Nuclear Regulatory Commission. March 29, 2021. Available at: https://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/emerg-classification.html.

Event Level	Description
Alert	Events are in progress or have occurred that involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life-threatening risk to site personnel or damage to site equipment because of hostile actions. Any releases are expected to be limited to small fractions of the Environmental Protection Agency (EPA) Protective Action Guides.
	Purpose: *The purpose of this classification is to ensure that emergency personnel are readily available to respond if the situation becomes more serious or to perform confirmatory radiation monitoring if required and provide offsite authorities current information on plant status and parameters.*
Site Area Emergency	Events are in progress or have occurred that involve actual or likely major failures of plant functions needed for protection of the public or hostile action that results in intentional damage or malicious acts 1) toward site personnel or equipment that could lead to the likely failure of, or 2) that prevent effective access to equipment needed for the protection of the public. Any releases are not expected to result in exposure levels beyond the site boundary that exceed EPA exposure levels.
	Purpose: *The purpose of the Site Area Emergency declaration is to ensure that emergency response centers are staffed, to ensure that monitoring teams are dispatched, to ensure that personnel required for evacuation of near-site areas are at duty stations if the situation becomes more serious, to provide consultation with offsite authorities, and to provide updates to the public through government authorities.*
General Emergency	Events are in progress or have occurred that involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity or hostile action that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA exposure levels offsite for more than the immediate site area.
	Purpose: *The purpose of the General Emergency declaration is to initiate predetermined protective actions for the public, to provide continuous assessment of information from the licensee and offsite organizational measurements, to initiate additional measures as indicated by actual or potential releases, to provide consultation with offsite authorities, and to provide updates for the public through government authorities.*

Although no public study is available on the magnitude and strength of a release from the Calvert Cliffs or Peach Bottom nuclear power plants, under a worst-case scenario, deaths would likely be minimal; however, economic damage could run into the billions.

Civil Unrest: The magnitude or severity of a civil unrest situation coincides with the level of public outrage. Civil unrest situations can take the form of small gatherings or large groups blocking access to buildings or disrupting normal activities. Civil unrest situations can also be peaceful sit-ins or full-scale disruptive demonstrations. The impacts of civil disturbance events are contingent upon numerous factors, including issues, politics, and method of response. Events have resulted in minor injuries to first responders or participants from physical confrontations; vandalism

and damage to property, facilities, and infrastructure; and, in some instances, fatalities. Adequate law enforcement at planned civil disturbance events and around likely target locations, such as the offices of state agencies, minimizes the chances of a small assembly of individuals turning into a significant disturbance.

The worst-case scenario for a civil disturbance event in Maryland would be demonstrations akin to the 2015 Freddie Gray Protests in Baltimore. This week-long event was fueled by police brutality and resulted in at least 20 police officers injured, at least 250 people arrested, 285 to 350 businesses damaged, 150 vehicle fires, 60 structure fires, 27 drug stores looted, thousands of police and Maryland National Guard troops deployed, and a state of emergency declared in the city limits of Baltimore.

Cyber-Attack: In recent years, cyber-attacks have become a significant threat and can impact people, businesses, institutions, local governments, and state agencies to varying degrees. Impacts from a large-scale cyber-attack could disrupt the state's economy and potentially threaten its economic stability. The magnitude of a cyber-attack will vary greatly based on the extent of systems affected, the attacks duration, and the type of attack. Additionally, the magnitude will vary based upon which specific system is affected by an attack and the ability to preempt and address emerging issues. Table 3-37 describes the types of cyber-attacks likely to be encountered.[138]

Table 3-37: Types of Cyber-Attacks

Threat	Description
Malware	Malware is a term used to describe malicious software, including spyware, ransomware, viruses, and worms. Malware breaches a network through a vulnerability, typically when a user clicks a dangerous link or email attachment that then installs risky software. Once inside the system, malware can do the following: • Block access to key components of the network (ransomware) • Install malware or additional harmful software • Covertly obtain information by transmitting data from the hard drive (spyware) • Disrupt certain components and render the system inoperable
Botnet	A collection of computers subject to control by an outside party, usually without the knowledge of the owners, using secretly installed software robots. The robots are spread by trojan horses and viruses. The botnets can be used to launch denial-of-service attacks and transmit spam.
Denial-of-service attack	Flooding the networks or servers of individuals or organizations with false data requests so they are unable to respond to requests from legitimate users.
Phishing	Phishing is the practice of sending fraudulent communications that appear to come from a reputable source, usually through email. The goal is to steal sensitive data such as credit card and login information or to install malware on the victim's machine. Phishing is an increasingly common cyberthreat.

[138] What Are the Most Common Cyber Attacks? Cisco. n.d. Accessed April 29, 2021. Available at: https://www.cisco.com/c/en/us/products/security/common-cyberattacks.html#~types-of-cyber-attacks.

Threat	Description
SQL Injection	A Structured Query Language (SQL) injection occurs when an attacker inserts malicious code into a server that uses SQL and forces the server to reveal information it normally would not. An attacker could carry out an SQL injection simply by submitting malicious code into a vulnerable website search box.
Spoofing	Making a message or transaction appear to come from a source other than the originator. Spyware software that collects information without a user's knowledge and transfers it to a third party.
Trojan horse	A destructive program that masquerades as a benign application. Unlike viruses, Trojan horses do not replicate themselves, but they can be just as destructive. One of the most insidious types of Trojan horse is a program that claims to rid your computer of viruses but instead introduces viruses onto your computer.
Virus	A program designed to degrade service, cause inexplicable symptoms, or damage networks.
Worm	Program or algorithm that replicates itself over a computer network and usually performs malicious actions, such as using up the computer's resources and possibly shutting the system down. A worm, unlike a virus, has the capability to travel without human action and does not need to be attached to another file or program.

According to a February 2018 report from the president's The Council of Economic Advisers, malicious cyber activity cost the U.S. economy between $57 billion and $109 billion in 2016.[139] If a major cyber-attack was to strike the state and cripple power plants and other critical lifeline utilities for an extended time, the economic impact would be in the billions.

Transportation Accidents: Significant passenger vehicle, air, rail, and vessel transportation accidents can result in a wide range of outcomes from damage solely to property to serious injury or death. Most motor vehicle crashes are non-fatal in Maryland and minor in nature; however, fatalities still averaged over 500 per year from 2010 to 2018.

Air accidents are rare, averaging less than six per year over the past 50 years and none associated with commercial air travel. While highway accidents will continue to result in the largest numbers of fatalities, railway accidents pose the greatest transportation risk to Maryland because of the possibility of large-scale hazardous materials release.

3.14.4 Previous Occurrences

Terrorism: Instances of terrorism in Maryland are rare and most involved politically motivated assassinations. Previous terrorism events of note occurring within the state include:

[139] CEA Report: The Cost of Malicious Cyber Activity to the U.S. Economy. National Security & Defense. Council of Economic Advisers. February 16, 2018. Available at: https://trumpwhitehouse.archives.gov/articles/cea-report-cost-malicious-cyber-activity-u-s-economy/.

- *Assassination of Chevy Yosef Alon:* On June 1, 1973, Yosef Alon, the Israeli Air Force attaché in Washington, D.C., was shot and killed outside his home in Chevy Chase, Maryland. The Palestinian militant group Black September was suspected, though the case remains unsolved.
- *Assassination of Akbar Tabatabai:* On July 22, 1980, Ali Akbar Tabatabai, an Iranian exile and critic of Ayatollah Khomeni, was assassinated in his Bethesda, Maryland, home. Dawud Salahuddin, an American Muslim convert, was reportedly paid by Iranians to kill Tabatabai.
- *Washington Sniper Attacks:* Between October 1 and October 24, 2002, John Allen Muhammad and Lee Boyd Malvo shot and killed 10 people and critically injured three others in the cities of Washington D.C., Baltimore, Maryland, and the Commonwealth of Virginia. The pair were also suspected of earlier shootings in Maryland, Alabama, Arizona, Georgia, Louisiana, and Washington. At the 2006 trial of Muhammad, Malvo testified that the aim of the killing spree was to kidnap children for the purpose of extorting money from the government, even though no one was kidnapped.
- *Discovery Communications Headquarters Hostage Crisis:* On September 1, 2010, James J. Lee, armed with two starter pistols and an explosive device, took three people hostage in the lobby of the Discovery Communications headquarters in Silver Spring, Maryland. After nearly 4 hours, Lee was shot dead by police and all hostages were freed without injury. Lee had earlier posted a manifesto railing against population growth and immigration.
- *White Nationalist Domestic Threat:* On January 16, 2020, a federal criminal complaint was filed charging three alleged members of the racially motivated violent extremist group "The Base" with firearms and alien-related charges. According to the criminal complaint, within The Base's encrypted chat rooms, members discussed, among other things, recruitment, creating a white ethno-state, committing acts of violence against minority communities (including African-Americans and Jewish-Americans), the organization's military-style training camps, and ways to make improvised explosive devices.
- *White Nationalist Domestic Threat:* On February 19, 2020, Christopher Paul Hasson was arrested after federal investigators uncovered a cache of weapons and ammunition in his Maryland home that authorities say he stockpiled to launch a widespread domestic terrorist attack targeting politicians and journalists. Mr. Hasson called for "focused violence" to "establish a white homeland" and dreamed of ways to "kill almost every last person on earth," according to court records filed in U.S. District Court in Maryland. According to court documents, Mr. Hasson had been amassing supplies and weapons since 2017 and developed a spreadsheet of targets that included House Speaker Nancy Pelosi. Hasson had searched the internet using phrases such as "best

place in dc to see congress people" and "are supreme court justices protected."[140]

Finally, although not within the state, the nation has suffered several significant terrorist attacks over the past 30 years. The most recent example of "homegrown" terrorism occurred with the insurrection event at the U.S. Capitol on January 6, 2021. While this event did not occur within the state boundaries, through our cooperative support agreements, the Governor sent police and first responders, along with National Guard units, to support the Capitol Police and secure the Capitol building itself. The most significant terrorist attack on U.S. soil occurred on September 11, 2001. Another significant recent terrorist event was the detonation of a pair of homemade pressure cooker bombs at the finish line of the Boston Marathon. This event killed three people and injured 264 people. Finally, on April 19, 1995, a domestic terrorist truck bombing of the Alfred P. Murrah Federal Building in Oklahoma City, Oklahoma, killed 168 people, and injured more than 680 others. Each of these events, and many others, have changed the way American society functions.

Active Shooter: Since 2016, five active shooter incidents have occurred in Maryland in areas of commerce, government, and open space, as categorized by the FBI Active Shooter Incidents in the United States from 2000 to 2018.[141]

- *Prince George's County Police Department District 3 Station:* On March 13, 2016, Michael Ford, armed with a handgun, allegedly began shooting at the Prince George's County Police Department District 3 station in Landover, Maryland. One plain clothes law enforcement officer was killed by friendly fire; no one was wounded. The shooter was wounded in an exchange of gunfire with law enforcement officers before being apprehended.[142]
- *Advanced Granite Solutions and 28th Street Auto Sales and Services:* On October 18, 2017, Radee Labeeb Prince, armed with a handgun, allegedly began shooting fellow employees at Advanced Granite Solutions in Edgewood, Maryland. After killing three people and wounding two, the shooter fled the scene and traveled 52 miles to the 28th Street Auto Sales and Service lot in Wilmington, Delaware, where he shot and wounded another person. Three people were killed; three were wounded. The shooter was apprehended by law enforcement later that night in Newark, Delaware.[143]
- *Multiple Locations in Baltimore, Maryland:* On December 15, 2017, Mausean Vittorio Quran Carter, armed with a rifle and handgun, allegedly began shooting indiscriminately at pedestrians from his vehicle after fleeing from a traffic stop by a law enforcement officer in Baltimore, Maryland, in connection

[140] "Self-proclaimed white nationalist in Maryland planned mass terror attack 'to kill almost every last person on earth,' authorities say." By Lynh Bui, *The Washington Post*. As appearing in the *Chicago Tribune* February 20, 2019. Available at: https://www.chicagotribune.com/nation-world/ct-white-nationalist-planned-terror-attack-20190220-story.html.

[141] Active Shooter Incidents: Topical One-Pagers, 2000 – 2018. Federal Bureau of investigation. December 2019. Available at: https://www.fbi.gov/file-repository/active-shooter-one-page-summaries-2000-2018.pdf/view.

[142] Ibid.

[143]

to a triple shooting the previous week. After a 30-minute pursuit, the shooter came to a stop. His girlfriend, who had been communicating with the shooter by phone during the chase, ran up to the car and pulled him out of his seat, bringing the chase to an end. No one was killed; three were wounded, including one law enforcement officer. The shooter was apprehended by law enforcement.[144]

- *Capital Gazette:* On June 29, 2018, Jarrod Warren Ramos, armed with a shotgun, began shooting in the *Capital Gazette* news offices in Annapolis, Maryland. Although the shooter had smoke grenades in his backpack, he did not deploy them. Five people were killed; two were wounded. The shooter was apprehended by law enforcement at the scene.[145]
- *Rite Aid Perryman Distribution Center's Liberty Support Center:* On September 20, 2018, Snochia Moseley, armed with a handgun, began shooting at coworkers during her shift at the Rite Aid Perryman Distribution Center's Liberty support center in Aberdeen, Maryland. The shooter was a temporary employee at the facility. Three were killed; three were wounded. The shooter committed suicide at the scene before law enforcement arrived.[146]

Nuclear Incidents: Nuclear incidents rarely occur, and there have been no reported cases of radiation releases or fires at the Calvert Cliffs or Peach Bottom power plants. However, several safety violations have shut both the Calvert Cliffs and Peach Bottom plants down for several weeks, including:

- On March 17, 1989, an unannounced federal inspection at Calvert Cliff Units 1 and 2 revealed cracks at pressurized heater sleeves, forcing extended shutdowns. The operator at the time, BGE, was subsequently fined over $100,000 for the violations.
- On September 5, 2013, Unit 2 at the Calvert Cliffs nuclear power plant was shut down after a malfunction during testing. It was re-opened September 10, 2013, after the required maintenance was performed.
- On Oct. 21, 2019, during a routine procedure to shut down operations of its Unit 3 reactor for refueling, the Peach Bottom Atomic Power Station had an equipment malfunction, triggering an emergency declaration. The type of emergency was classified as an "unusual event," which is the least severe on the scale set by the NRC. According to a report from the NRC, operator Exelon went through the protocols of alerting Maryland and Pennsylvania state agencies, local governments, and FEMA.

Although not within the state, significant nuclear incidents have occurred worldwide:

[144] Ibid.
[145] Ibid.
[146] Ibid.

- On March 11, 2011, the Great East Japan Earthquake resulted in a series of equipment failures, nuclear meltdowns, and releases of radioactive materials at the Fukushima Daiichi nuclear reactor in Okuma, Fukushima, Japan.
- On April 26, 1986, the Chernobyl disaster was caused by a nuclear accident that occurred at the No. 4 reactor in the Chernobyl Nuclear Power Plant, near the city of Pripyat in the Ukraine. It is considered the worst nuclear disaster in history and was caused by one of only two nuclear energy accidents rated at seven—the maximum severity—on the International Nuclear Event Scale, the other being the 2011 Fukushima Daiichi nuclear disaster in Japan.
- On March 28, 1979, the worst accident in the history of the U.S. nuclear power industry began when a pressure valve in the Unit 2 reactor at Three Mile Island Nuclear Power Plant Londonderry Township, Pennsylvania, failed to close.

Civil Unrest: Over the past 10 years, Maryland has experienced two occurrences of widespread civil unrest. Each received national attention and focused on police brutality, institutional racism against African Americans, and economic, racial, and social inequality.

- *2015 Death of Freddie Gray Protests*: From April 18, 2015, through May 3, 2015. On April 25, 2015, after hours of large, peaceful demonstrations, select demonstrators protesting the death of Freddie Gray turned destructive. Violence broke out again on April 27 and police responded by trying to contain the crowds with tear gas, pepper spray, and other nonlethal weapons. Maryland Governor Larry Hogan declared a State of Emergency effective on April 27 (rescinded May 6) and enlisted the state's National Guard to contain the violence. Over 113 police officers were reportedly injured during the protests and over 486 individuals were arrested.
- *2020 Death of George Floyd Protests:* From May 28, 2020, through present day, Maryland has seen a series of George Floyd protests with hundreds to thousands of participants marching in demonstrations statewide. Major demonstrations have been held in Annapolis, Baltimore, Bel Air, Bethesda, Bowie, Columbia, Frederick, Germantown, Hagerstown, Pocomoke City, and Salisbury. While the overwhelming majority of these protests have been peaceful, several incidents of property destruction and arrests have occurred.

Cyber Incident/Attack: In addition to large-scale, state-sponsored cyber-attacks, smaller incidents occur on a daily basis. Billions of emails are sent each day, and spam and phishing emails account for a significant share of all email traffic. Additionally, brute force attacks, which are trial-and-error attempts to obtain user passwords and pins, are frequently used by criminals to attempt to crack encrypted data or gain access to private accounts. Most cyber-attacks go either unnoticed or unreported and, therefore, there is no definitive list of attacks. In recent years, several significant cyber-attacks have disrupted or even halted the provision of municipal services, most notably in St. Mary's County (November 2016), Salisbury (January 2019), and Baltimore City (May 2019). These attacks have increased the urgency and

attention to the need for cyber-security protection policies and measures. Cyber-security mitigation measures have been included in this Plan's mitigation actions.

Transportation Accidents: Vehicular transportation accidents are a daily occurrence in Maryland. According to the *Maryland Highway Safety Improvement Program 2018 Annual Report*,[147] highway fatalities in the state were 591 in 2008 and 505 in 2016, and 4,544 serious injuries were reported in 2008 and 3,164 in 2018. These numbers indicate that while both fatalities and serious injuries are trending down, the numbers still represent a significant loss of life and injury.

Aviation accidents are the least frequent type of transportation accident. The National Transportation Safety Board, the federal agency responsible for aviation accident information, indicates that from January 2010 through September 30, 2020, there were 170 air transportation accidents in Maryland. Most of these accidents involved small aircraft and many resulted in only minimal injuries. Of the total reported accidents, 16 were fatal, resulting in 32 deaths.[148]

According to the Federal Railroad Administration, from 2004 to 2020, there have been 2,466 total rail accidents/incidents. These resulted in a total of 882 injuries and 177 deaths. Most of these accidents involved vehicles being struck by trains at crossings; however, two major accidents garnered national attention:

- The Howard Street Tunnel fire (also known as the Baltimore Freight Rail Crash) was a 60-car CSX Transportation freight train derailment that occurred in the Howard Street Tunnel, a freight through-route tunnel under Howard Street in Baltimore, Maryland, on July 18, 2001. The derailment sparked a chemical fire that raged for 5 or 6 days and virtually shut down the downtown area. In the evening of the first day, a water main ruptured causing significant flooding in the streets above. The accident disrupted Northeast Corridor rail service. It also slowed internet service in the United States for several hours as a result of the destruction of a cable passing through the tunnel.
- On June 22, 2009, two trains on the WMATA Red Line collided. A southbound train bound for Shady Grove stopped on the track short of the Fort Totten station, and another southbound train collided with the rear of the first train. The lead car of the moving train telescoped into the rear car of the stationary one. Several surviving and deceased passengers were trapped for hours during the rescue operation. Nine people died and more than 70 were injured.

3.14.5 Future Probability and Climate Change Conditions

The future probability of human-caused hazards affecting Maryland is extremely high.

[147] *Maryland Highway Safety Improvement Program: 2018 Annual Report*. U.S. Department of Transportation Federal Highway Administration. Available at: https://safety.fhwa.dot.gov/hsip/reports/pdf/2018/md.pdf.

[148] Aviation Accident Database & Synopses. National Transportation Safety Board. n.d. Accessed April 29, 2021. Available at: https://ntsb.gov/_layouts/ntsb.aviation/index.aspx.

Terrorism: Based on past historical data and trends and the state's location adjacent to Washington D.C., Maryland can expect to experience several terrorist incidents and suspicious activities each year. Note that this estimate is based on the occurrence of past events over a short period of time and is not the result of detailed statistical sampling. Although previous events have not resulted in what are considered significant terrorist attacks, the severity of a future incident cannot be predicted with a sufficient level of certainty. Prediction of terrorist attacks is almost impossible because terrorism is a result of human factors. As long as fringe groups maintain radically different ideas than that of the government or general population, terrorism is a possibility.

While a direct link between terrorism and climate change has not been established, according to the United Nations, recent scientific evidence has shown that climate change has consequences that reach the very heart of the world's security agenda.[149] As climates change, flooding, disease, and famine may result in human migration on an unprecedented scale in areas of already high tension while drought and crop-failure will lead to intensified competition for food, water, and energy in regions where resources are already stretched to the limit. This in turn will lead to significant economic disruptions, which often leads to increased terrorism.

Active Shooter: Based on past historical data and trends, the future probability of active shooting events in the state is high. Like terrorism, this estimate is based on the occurrence of past events over a short period of time and is not the result of detailed statistical sampling. There has been no direct link between active shooter events and climate change conditions.

Nuclear Incidents: Based on past historical data and trends, the future probability of nuclear incidents occurring in the state is very low. Since the Three Mile Island incident, nuclear power has become significantly safer and is one of the most heavily regulated industries in the nation. Across the United States, a number of Unusual Event and Alert classification level events occur each year at the 100+ nuclear facilities that warrant notification of local emergency managers. Of these, Alert emergencies occur less frequently.

Climate change has the potential to increase the risk posed by this hazard. Because nuclear power is a zero-emission clean energy source, its use may increase in the future.

Civil Unrest: Based on past historical data and trends, the future probability of civil unrest occurring in the state is uncertain. While minor civil disturbances likely will continue to occur throughout the state, accurately predicting the probability and triggers for a large-scale civil disturbance event over the long term is not possible. Civil disturbance is always a possibility as long as there is discrimination or other perceived social or economic injustices.

[149] "The Greatest Threat To Global Security: Climate Change Is Not Merely An Environmental Problem." By Ambassador Emyr Jones Parry. *UN Chronical*. United Nations. n.d. Accessed April 29, 2021. Available at: https://www.un.org/en/chronicle/article/greatest-threat-global-security-climate-change-not-merely-environmental-problem.

Generally, civil unrest will not be affected by climate change.

Cyber-Attack: Based on past historical data and trends, the future probability of cyber-attacks occurring in the state is high. Cyberterrorism is an emerging hazard that has the potential to impact the state's computer infrastructure and the systems and services that are provided to the public. Concerns about cyber-attacks throughout the United States are growing as its impacts could have potentially crippling effects. Security experts describe the threat of cyberterrorism as imminent and highly likely to occur in any given year.

Generally, cyber-attacks will not be affected by climate change.

Transportation Accidents: With the volume of goods and people moving through Maryland, transportation accidents will continue to occur routinely, especially passenger vehicle accidents. In the case of highway accidents, Maryland has taken great strides to reduce the number of highway transportation accidents through programs such as the Highway Safety Improvement Program and participation in the Pennsylvania Highway Safety Corridor.

The number of rail accidents nationally has been falling for the last 4 years. Additionally, the probability of aviation accidents nationwide was 3.45 accidents per 100,000 flight hours in 2016. This accident rate has decreased each year since 2013 when it was 4.95 accidents per 100,000 flight hours (FAA, 2018). This means that the likelihood of air transportation accidents in the state remains low.

Generally, transportation accidents will not be affected by climate change.

3.14.6 Human-Caused Hazards and Threats Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a human-caused hazard or threat would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-38.

Table 3-38: Human-Caused Threats Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Residents across the state are most at risk to impacts from human-caused events. Impacts to the public include potential for injury or loss of life, and disruption in services due to potential interference in day-to-day operations of government services.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads, and attend to any injured for physical impacts like a nuclear or transportation events. For human-caused events, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.

Subject	Impacts
Continuity of Operations (including delivery of services)	Depending on the type of human-caused event, the impacts on continuity of operations would range from limited to severe. If critical infrastructure is located in the close proximity to the occurrence of a terrorist, active shooter, nuclear, or transportation incident, delivery of services may be slowed or halted as key roadways become restricted due to response operations. In the event of a cyber-attack, delivery of services may be slowed or halted completely depending upon the type and extent of the attack and components of government systems impacted.
Property, Facilities, and Infrastructure	Business, home, and landowners within impact zones may experience damage to or loss of property depending upon the severity of a terrorist or nuclear event. Infrastructure may experience impacts from cyber-attacks in the form of revenue loss and temporary closure of critical facilities (water treatment, electrical grid, etc.) because of compromised networks.
Environment	The breadth and depth of impacts from human-caused events would be extensive, ranging from minimal to no damage in the case of ransomware attacks to long-term radiation exposure from a nuclear event.
Economic Condition of the State	Human-caused events would be costly for state and local governments because of the potential for damages from any of the individua elements that make up this hazard. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence will largely depend upon how effectively the State of Maryland and county and local governments respond to a human-caused event.

3.14.7 Vulnerability and Impact

Terrorism: Human life, health, damage to infrastructure (including transportation, critical facilities, etc.), security, and public and private property are vulnerable to acts of terrorism. Because the probability of future terrorism cannot be quantified in the same way as that of many natural hazards, assessing vulnerability in terms of likelihood of occurrence is not possible. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in Maryland, planning efforts can be put in place to reduce the risk of attack.

The loss of lives, property damage, and even economic damage suffered after a major terrorist attack would have a major impact on Maryland.

Active Shooter: No substantive research has yet been compiled to address the state's potential vulnerability to an active shooter incident. Some of these incidents have occurred in public places, and some in places that are considered more restricted (like elementary schools and high schools). There is no discernible pattern to the location chosen by the shooters.

In an active-shooter event, loss of life or serious injury is the most extreme direct impact. Other serious impacts include mental health impacts. Approximately 28

percent of individuals who experience a mass shooting later develop post-traumatic stress disorder and over 30 percent develop acute stress disorder.

Nuclear Incidents: To assess the vulnerability of state-owned or leased facilities and critical facilities to nuclear incidents, all structures located within the 10-mile Plume Exposure EPZ should be included.

The impact of a major nuclear accident in Maryland would be catastrophic. In addition to losing approximately 35 percent of electric generating capacity, a large portion of the state would become uninhabitable.

Civil Unrest: The vulnerability of facilities depends on the type and function of each individual entity as well as the greater geographic context of the facility. For example, as visible symbols of government, government facilities and national monuments are more vulnerable to civil unrest events, but the vulnerability of each facility may change based on the specific issue underlying the protest.

The impacts of civil unrest are hard to predict. Each event has the potential (in terms of injuries, loss of life, and economic, property, and infrastructure damage) to inflict tremendous losses. Factor in the lack of readily available or calculable replacement values for state monuments and certain historic places (some are considered priceless) and potential losses become even harder to quantify.

Cyber-Attack: While physical structures are generally not at risk, in 2020, all networked electronic devices are vulnerable to cyber-attacks. Because computer networks contain sensitive information that is integral to the state's security, they will likely continue to be the focus of coordinated cyber-attacks. Computer networks are also entrusted with many forms of personal and financial information, including tax filings, birth and death records, Social Security numbers, medical information, and more. Additionally, many critical facilities that are essential to state operations rely upon computer networks to monitor and control critical functions. For example, an attack on a nuclear power plant or the power grid could have detrimental impacts on state services and functions. Additionally, a large-scale computer breach would likely lead to significant economic costs in lost productivity to the impacted state agencies and potentially related businesses and industries.

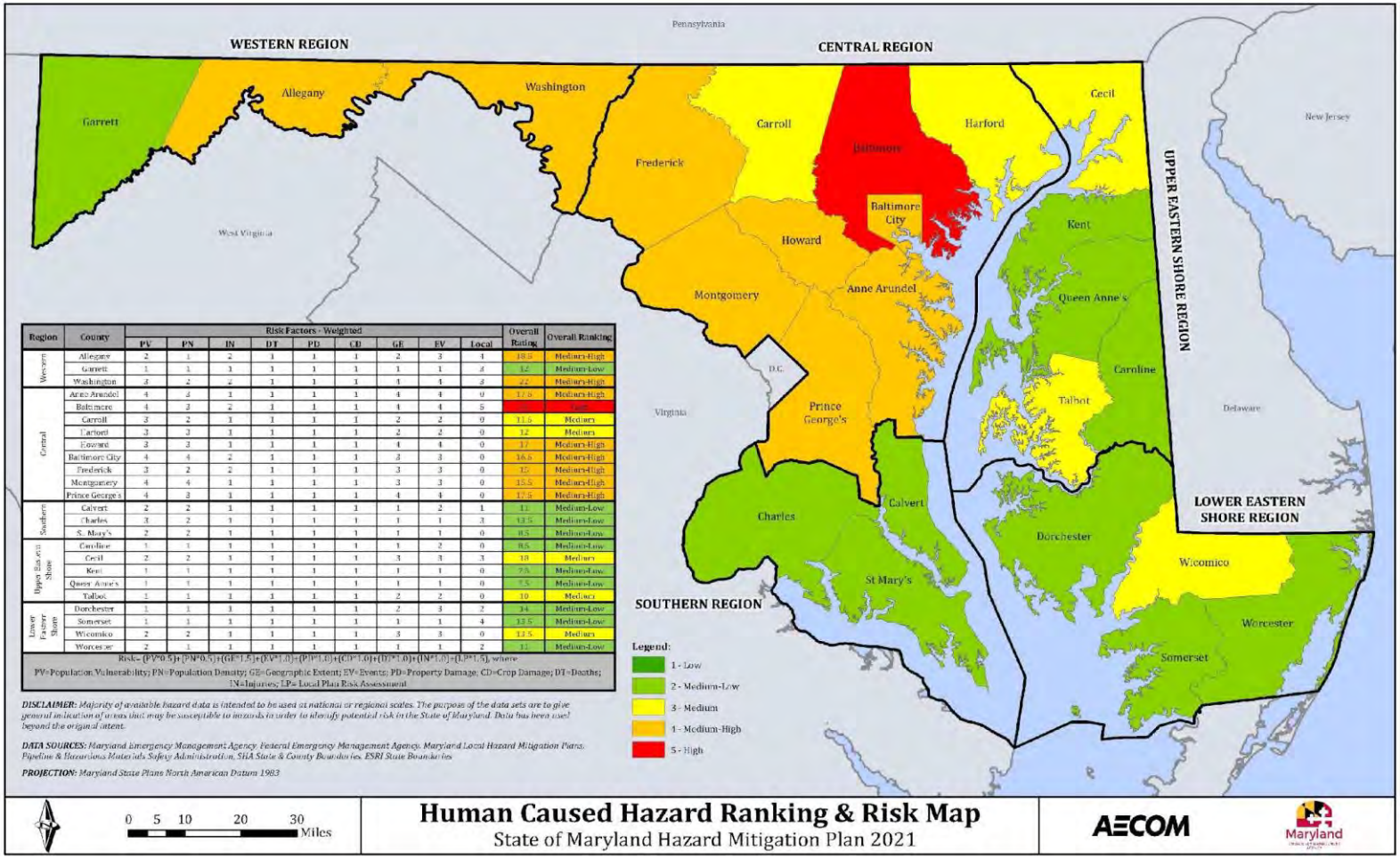
Cyber-attack impacts can range from insignificant to catastrophic. The overwhelming majority of cyber-attacks involve targeted attacks on a single computer. These happen every day and cause little impact on the state as a whole. However, a coordinated, state-sponsored attack could render state- and city-run networks useless. This would, in turn, have a tremendous impact on Maryland residents.

Transportation Accidents: The state's vulnerability to transportation accidents is limited to critical structures located within one-quarter mile of major Interstates, U.S. Highways, and/or state highways, as well as critical structures located within 5 miles of the state's three major commercial airports. With railways, the state's vulnerabilities extend from approximately one-quarter mile of cargo railway lines. Finally, the state's major bridges face limited vulnerabilities to waterway accidents;

however, an accident or intentional attack on the Chesapeake Bay Bridge that resulted in a long-term closure (one month or more) would have catastrophic impacts for residents on Maryland's Eastern Shore.

3.14.8 Human-Caused Hazards Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	2	3	1	18.5	Medium-High
	Garrett	1	1	1	1	1	1	1	1	1	12	Medium-Low
	Washington	3	2	2	1	1	1	1	1	3	22	Medium-High
Central	Anne Arundel	4	3	1	1	1	1	4	4	0	17.5	Medium-High
	Baltimore	4	3	2	1	1	1	4	4	5	25	High
	Carroll	3	2	1	1	1	1	2	2	0	11.5	Medium
	Harford	3	3	1	1	1	1	2	2	0	12	Medium
	Howard	3	3	1	1	1	1	4	4	0	17	Medium-High
	Baltimore City	4	4	2	1	1	1	3	3	0	16.5	Medium-High
	Frederick	3	2	2	1	1	1	3	3	0	15	Medium-High
	Montgomery	4	4	1	1	1	1	3	3	0	15.5	Medium-High
	Prince George's	4	3	1	1	1	1	4	4	0	17.5	Medium-High
Southern	Calvert	2	2	1	1	1	1	1	2	1	11	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	S. Mary's	2	2	1	1	1	1	1	1	0	8.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	2	0	8.5	Medium-Low
	Cecil	2	2	1	1	1	1	3	3	3	18	Medium
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	2	2	0	10	Medium
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	2	3	2	14	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Wicomico	2	2	1	1	1	1	3	3	0	13.5	Medium
	Worcester	2	1	1	1	1	1	1	1	2	11	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plans North American Datum 1983*

3.15 Public Health Emergencies

3.15.1 Definition

A public health emergency is defined as an occurrence or imminent threat of a widespread illness or health conditions that pose a substantial risk of significant human fatalities or permanent/long-term disabilities.[150] Public health emergencies can be caused by an endemic, epidemic, pandemic, or outbreak, or a highly fatal biological agent or toxin release. Each is further defined below:

Endemic: A disease that belongs to a population, environment, or region. Examples of an endemic include chicken pox that occurs at a predictable rate among young school children in the United States and malaria in sub-Saharan areas.

Epidemic: An infectious disease that rapidly affects a large number of people within a community, population, or region. An example epidemic was the 2003 severe acute respiratory syndrome (SARS) event. Although this event took the lives of nearly 800 people, it did not result in a worldwide spread.

Pandemic: An infectious disease outbreak that spreads across countries or continents. It affects more people and takes more lives than an epidemic. The World Health Organization (WHO) declared COVID-19 to be a pandemic when it became clear that the illness was severe and that it was spreading quickly over a wide area.

Outbreak: When an illness happens in unexpectedly high numbers. It may stay in one area or extend more widely. An outbreak can last days or years. Sometimes, medical experts consider a single case of a contagious disease to be an outbreak. This is the case with tuberculous. Outbreaks also may involve an unknown disease, or a disease that has been absent from a community or population for an extended period. If it's not quickly controlled, an outbreak can become an epidemic, which in turn can become a pandemic.

Biological Agent/Toxin: Biological agents and toxins are organisms or toxins that can kill or disable people, livestock, and crops. A biological agent or toxin attack is the deliberate release of germs or other biological substances. Examples of biological agents/toxins that can result in a public health emergency include a deliberate anthrax or ricin release or food safety threats such as Salmonella or E. Coli.

3.15.2 Location

The location at risk for public health emergencies is statewide. The most recent public health emergency, COVID-19, has affected every Maryland jurisdiction. Table 3-39 lists the number of COVID-19 cases by jurisdiction as of March 2021. According to the Maryland Department of Health Corona Disease website, the hardest hit areas coincide with general population trends—the higher the population, the more positive cases reported.

[150] Definitions: emergencies. World Health Organization Humanitarian Health Action. n.d. Accessed April 29, 2021. Available at: https://www.who.int/hac/about/definitions/en/.

Table 3-39: COVID-19 Cases by Jurisdiction (March 2021)

Maryland Jurisdiction	COVID-19 Cases*
Prince George's	74,851
Montgomery	64,399
Baltimore	52,271
Baltimore City	41,282
Anne Arundel	36,655
Frederick	17,324
Howard	16,326
Harford	12,864
Washington	12,599
Charles	9,158
Carroll	7,736
Wicomico	6,859
Allegany	6,432
St. Mary's	5,248
Cecil	5,080
Calvert	3,736
Worcester	3,295
Queen Anne's	2,607
Somerset	2,414
Dorchester	2,382
Caroline	2,063
Talbot	1,911
Garrett	1,854
Kent	1,144

* Data effective March 11, 2021

And while there is a general correlation between public health emergencies and population, there is credible research indicating that certain incidents may affect regions differently. For example, both urban and rural areas face different challenges regarding public health emergencies related to outbreaks, endemics, epidemics, and pandemics. Long-standing systemic health and social inequities have put some rural residents at increased risk of becoming infected with disease or having severe illness. In general, rural Americans tend to have higher rates of cigarette smoking, high blood pressure, and obesity as well as less access to healthcare, which can negatively affect health outcomes. They are also less likely to have health

insurance.[151] Suburban and urban residents face a different set of concerns, as studies have shown that dense environments increase community spread.

3.15.3 Extent (Magnitude/Strength)

While some hazards have widely used scales to measure relative magnitude and strength, public health emergencies are defined by the population affected, transmissibility, and the availability of countermeasures, including personal protective equipment, medical supplies, treatment options, and vaccines.

3.15.4 Previous Occurrences

Public health emergencies, including pandemics, have occurred throughout history, but only in the last century have proper records been kept regarding their cause and origins. According to the CDC, the four most serious nationwide public health emergencies involve influenza virus endemics and viral pandemics. These occurred in 1918, 1957, 2009, and 2020.

3.15.4.1 1918 Spanish Flu Pandemic:

HEN flu is a strain of the influenza virus that still circulates the globe annually. In 1918, it was the type of flu behind the influenza pandemic, sometimes called the Spanish Flu. In Maryland, the first cases of flu had appeared at Camp Meade by Sept. 24, 1918. Although the sick were isolated, no other precautions were taken. Before long, 1,900 soldiers were ill, as were another 300 at the military hospital at Fort McHenry and 1,150 at Aberdeen Proving Ground.

In the months that followed, the flu spread throughout the state. East Baltimore, the city's immigrant neighborhood, was especially ravaged by the pandemic. Crowded housing and unsanitary conditions caused by a lack of resources placed many of Baltimore's recent arrivals at higher risk of contracting influenza.

Baltimore's immigrants were not the only group facing added hardship. Except for the Johns Hopkins Hospital and Bay View (for the city's poor and the insane), the city's African Americans were admitted only to Black-only hospitals. This color line affected not only the sick, but the deceased as well. By October, the city's African American cemetery, Mt. Auburn, was overwhelmed with caskets and not nearly enough graves. Few city employees were willing to dig graves for Blacks. When a call for volunteer gravediggers went unanswered, Mayor Preston appealed to the War Department for assistance. In response, 342 African American soldiers, along with a minister, were assigned the task, which they completed in a single day.

After World War I, cases of the flu slowly declined. None of the suggestions provided at the time (wearing masks, drinking coal oil) were effective cures. By 1919, over 24,000 cases of flu were reported in Baltimore, although the total was probably three

[151] Rural Communities. Centers for Disease Control and Prevention. January 20, 2021. Available at: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/other-at-risk-populations/rural-communities.html.

times as high due to unreported cases, and there were at least 4,125 reported deaths.[152]

3.15.4.2 1957 H2N2 Flu Epidemic:

A major flu outbreak occurred again in 1957. The H2N2 virus, which originated in birds, was first reported in Singapore in February 1957, then in Hong Kong in April 1957. It appeared in coastal cities in the United States in the summer of 1957. By mid-October 1957, there were 13,000 reported cases in Maryland with most cases in the lower Eastern Shore and in Western Maryland. At the height of the epidemic, the state saw approximately 8,000 new cases reported in 7 days, according to *The Evening Sun*. This epidemic killed an estimated 1 to 2 million worldwide, but only around 65 in the Baltimore region.

3.15.4.3 2009 H1N1 "Swine" Flu Pandemic:

In March 2009, the H1N1 virus was first detected in the United States. The virus spread quickly across the country and then the world and made headlines as the swine flu. By April 2009, a public health emergency was declared in the United States and by May 1, the Governor of Maryland declared a statewide Public Health Emergency as the number of "probable" cases reached 11. On June 11, 2009, the WHO signaled that a global pandemic of 2009 H1N1 influenza was underway.

Over the next few months, numerous Maryland schools closed, daily statewide monitoring of patients with influenza-like illness began, and on November 6, 2009, the Governor declared a State of Emergency—authorizing the Maryland Department of Health and MEMA to engage and deploy all resources, and allowing licensed paramedics, emergency medical technicians (EMTs), and cardiac rescue technicians to administer H1N1 vaccines.

By April 2010, over 1,700 cases of swine flu were reported in Maryland, requiring over 990 hospitalizations and resulting in at least 45 deaths. The pandemic ended in 2010 due to widespread deployment of a vaccine.

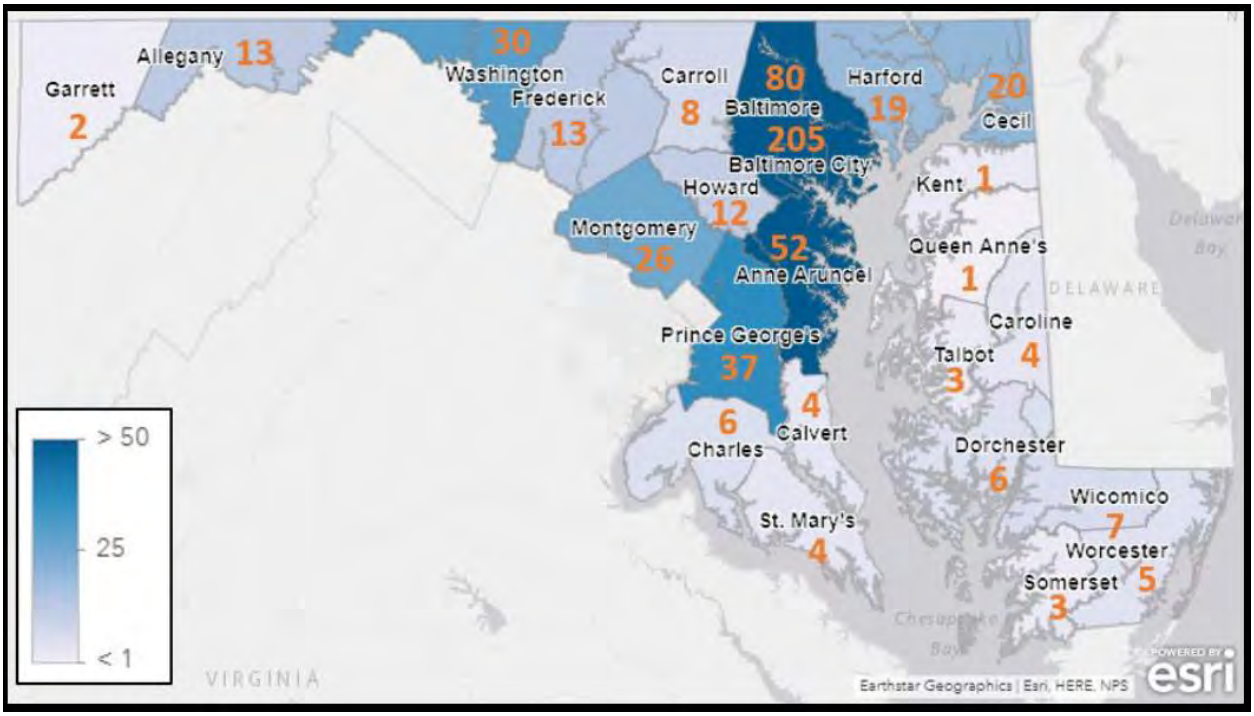
3.15.4.4 2017 Swine Influenza Outbreak:

On September 17, 2017, the Maryland Department of Agriculture (MDA) was notified by fair and 4-H officials of ill swine at an agricultural fair held September 14–17. That day, an investigation of the 107 swine at the fair revealed five swine with fevers and signs of upper respiratory tract illness. On September 18, MDA was notified by fair and 4-H officials that swine exhibitors were also ill. MDA alerted the Maryland Department of Health. In total, 76 persons were tested for influenza and a virus infection was confirmed in 40 patients with exposure to swine at these fairs, including 24 (60%) children under the age of 5. And while two children required hospitalization, all patients recovered.

[152] "The American Influenza Epidemic of 1918–1919." *Influenza Encyclopedia*. The University of Michigan Center for the History of Medicine. n.d. Accessed April 29, 2021. Available at: https://www.influenzaarchive.org/cities/city-baltimore.html#.

3.15.4.5 2017 (Ongoing) Opioid Crisis:

As shown in Figure 3-8, opioid deaths impact every county throughout the State of Maryland. Annual data trends indicate a startling increase in fatalities since 2007, and the impacts of the concurrent public health crisis—COVID-19—have further exacerbated the crisis, with the executive director of the Opioid Operational Command Center stating in the 2020 Second Quarter Report, "during the second quarter of 2020, Maryland saw increases in fatalities related to almost every class of substance."[153] The report goes on to share the sobering statistic that the number of reported unintentional intoxication deaths between January and June 2020 represents an increase of 9.1 percent from the total intoxication deaths reported in the first half of 2019."[154]



Map source:
https://bha.health.maryland.gov/Documents/OOCC%20CY20%20Q1%20OD%20Death%20data%20June2020.pdf

Figure 3-8: Opioid-Related Intoxication Deaths in Maryland by County. First Calendar Quarter, 2020 (preliminary counts).

Governor Hogan has pushed forward several initiatives to address the crisis, including issuing several executive orders and declaring a state of emergency in

[153] Overdose Data and Reports. Maryland Department of Health Behavioral Health Administration. n.d. Accessed April 29, 2021. Available at: https://bha.health.maryland.gov/overdose_prevention/pages/data-and-reports.aspx.

[154] Ibid.

2017.[155] The executive orders were enacted to improve coordination across state and local agencies, appoint senior staff to lead prevention and response efforts, and inject more than $50 million in funding to combat the crisis. Most recently, the state was one of only four nationwide to receive a $4.6 million award from the U.S. Department of Labor to implement the "Support to Communities: Fostering Opioid Recovery through Workforce Development" pilot program.[156] Out of the total $7 million of federal grants Maryland has received since 2018, $500,000 will support two local non-profits focused on providing job training and support services to women impacted by the opioid crisis.

3.15.4.6 2020 COVID-19 Pandemic

COVID-19 is a disease caused by a respiratory virus first identified in Wuhan, Hubei Province, China in December 2019. COVID-19 is a new disease that hasn't caused illness in humans before. Worldwide, COVID-19 has resulted in thousands of infections, causing illness and, in some cases, death. Cases have spread to countries throughout the world, with more cases reported daily.[157]

The first reported cases of COVID-19 in the state occurred on March 3, 2020, when three individuals tested positive for the virus. On this date, the Governor put Maryland under a State of Emergency, and submitted emergency legislation to allow the state to use the "rainy day fund" of up to $50 million from the Revenue Stabilization Account for response efforts.

On March 12, 2020, the state announced the first "community transmission" case (a person to get the virus with no known exposure to it through travel or an infected person). Maryland public schools were closed for 2 weeks and the Governor closed state buildings to the public and activated the Maryland National Guard. Finally, on this date, hospitals begin setting up triage tents around Maryland and set up more restrictive visitor policies.

On March 16, 2020, with 43 reported cases, Governor Hogan ordered all bars, restaurants, movie theaters, gyms, and other recreational businesses to close. He also prohibited events and gatherings of over 50 people. On March 18, the first person in the state died of the virus.

On March 26, 2020, Maryland received a Major Disaster Declaration from FEMA for COVID-19. In a Governor's press release on this day, Mr. Russell Strickland, Executive Director for MEMA, stated "The COVID-19 pandemic is having a significant impact on our entire state and country unlike anything we have seen before."

---

[155] Overdose Prevention in Maryland. Maryland Department of Health Behavioral Health Administration. n.d. Accessed April 29, 2021. Available at: .https://bha.health.maryland.gov/OVERDOSE_PREVENTION/Pages/Index.aspx

[156] "Governor Hogan Announces Maryland Selected for Workforce Development Pilot Program to Combat Opioid Epidemic." Office of Governor Larry Hogan. n.d. Accessed April 29, 2021. Available at: https://governor.maryland.gov/2020/08/28/governor-hogan-announces-maryland-selected-for-workforce-development-pilot-program-to-combat-opioid-epidemic/.

[157] Coronavirus Disease 2019 (COVID-19) Outbreak. Maryland Department of Health. n.d. Accessed April 29, 2021. Available at: https://coronavirus.maryland.gov/.

From April 2020 through March 2021, the number of positive cases and fatalities in Maryland, the United States, and worldwide has continued to increase. Table 3-40 lists the number of positive cases and fatalities as of March 11, 2021. As of this same date, three COVID-19 vaccines had been authorized for emergency use.

Table 3-40: COVID-19 Statistics at a Glance (March 11, 2021)[158]

	Maryland	United States	Worldwide
Positive cases	390,490	29,892,577	118,939,493
Fatalities	8,014	542,795	2,636,923

Other, minor public health emergencies related to biological agents and toxins occur rather frequently. For example, in September 2020, two separate outbreaks of Salmonella were being monitored by CDC officials. These outbreaks resulted in close to 1,400 illnesses and over 100 hospitalizations. In November 2019, an outbreak of E. Coli associated with Romaine lettuce made national news and resulted in 102 people from 23 states becoming ill. Of these, 58 required hospitalization. No deaths have been reported with any of these outbreaks.

3.15.5 Future Probability and Climate Change Conditions

In 2017, the CDC indicated that "While we can't predict exactly when or where the next epidemic or pandemic will begin, we know one is coming."[159] Biological outbreaks are also difficult to predict, yet history dictates that they occur frequently. So, while there is no definite way to predict when public health emergencies may emerge, Maryland must plan for their occurrence.

Although a direct link between climate change and an increase in public health emergencies has not been established, scientists are increasingly studying potential relationships. According to a recent article (August 2020) by Dr. Anthony Fauci, "As human societies grow in size and complexity, we create an endless variety of opportunities for genetically unstable infectious agents to emerge into the unfilled ecological niches we continue to create. There is nothing new about this situation, except that we now live in a human-dominated world in which our increasingly extreme alterations of the environment induce increasingly extreme backlashes from nature."[160]

---

[158] Coronavirus. Worldmeter. April 29, 2021. Available at: https://www.worldometers.info/coronavirus/?fbclid=IwAR0RYMPhu-J9i5t74sla8KOrJFIhGMs--0YIuvQzoxLeFrvwwr5FLpn42Qw.

[159] "Why It Matters: The Pandemic Threat." Centers for Disease Control and Prevention Division of Global Health Protection, Global Health. Originally published in the Winter 2017 (Issue 26) *Updates from the Field*. Last updated April 27, 2021. Available at: https://www.cdc.gov/globalhealth/healthprotection/fieldupdates/winter-2017/why-it-matters.html.

[160] "Emerging Pandemic Diseases: How We Got to COVID-19." David M. Morens and Anthony S. Fauci. *Perspective*. Volume 182, Issue 5, P1077-1092, September 03, 2020. Available at: https://www.cell.com/cell/fulltext/S0092-8674(20)31012-6#secsectitle0065.

3.15.6 Public Health Emergency Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a public health emergency would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-41.

Table 3-41: Public Health Emergency Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Individuals across the state are at risk to impacts from a public health event. Impacts to the public include potential for injury or loss of life.
Health and Safety of Responders	First responders, such as fire and police, would be called to support specific incident area(s) across the state, attend to sick, and respond to normal emergency requests. For a public health emergency event, as with all disaster events, responders would face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations could range from minimal to severe, depending on the impacts to critical personnel and redundancy in staff for continuity of operations. Delivery of services may be slowed or halted in adjacent areas if significant populations of government personnel are sickened.
Property, Facilities, and Infrastructure	Business facilities and infrastructure may experience impacts in the form of damage to response measures required to be put in place for public health precautions during a public health event.
Environment	Secondary impacts to the environment would be anticipated from a public health event, ranging from increased pollution from new personnel protective equipment to accidental spills of decontamination products.
Economic Condition of the State	A public health event would be costly for state and local governments because of the potential for business and government shutdowns. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments respond to a public health event.

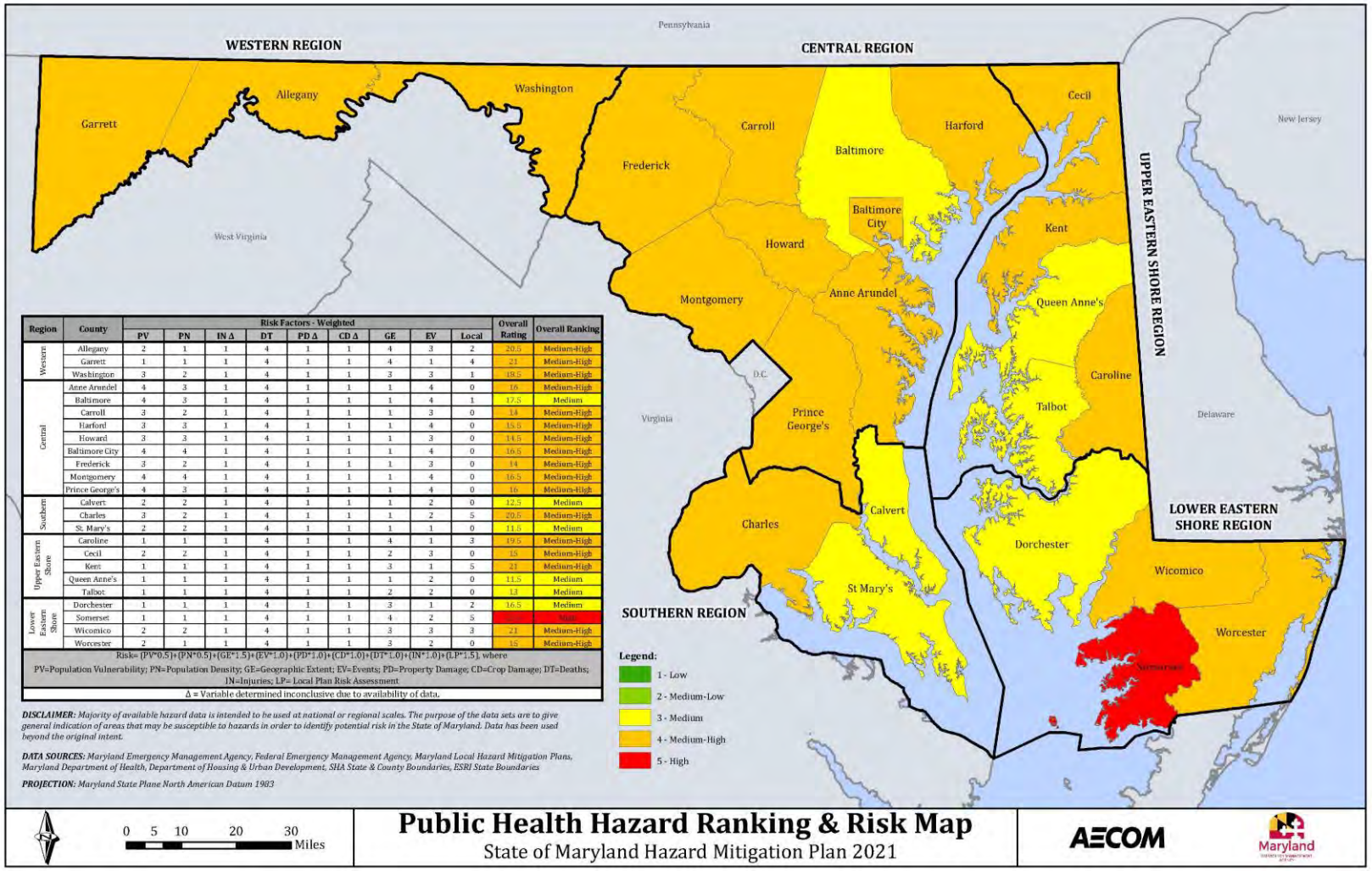
3.15.7 Vulnerability and Impact

Public health emergencies affect populations and demographics differently, and sometimes disproportionately. The State of Maryland will investigate appropriate responses to help mitigate the effects of any public health emergency on vulnerable populations, populations of color or other disadvantaged (economically or otherwise) groups and communities.

And while vulnerabilities are still being studied, a public health emergency's impact can be measured. These events can shut down large segments of the population for long periods of time, which can have far-reaching impacts on diverse segments of society. For example, "Work from Home" policies cause the commercial real estate and energy industry to experience decreased demand. In the medical field, a widespread public health emergency can result in medical personnel quickly becoming overtaxed, and hospitals and medical facilities may be unable to handle the explosion of cases because of space and equipment limitations. And finally, voluntary and forced shutdowns of businesses, travel, and schools result in billions of dollars in losses at the state level and trillions of dollars at the federal level. These impacts, along with many others that likely will emerge, make public health emergencies one of the most damaging hazards.

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.

3.15.8 Public Health Emergencies Hazard Risk Map



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	4	1	1	4	3	2	20.5	Medium-High
	Garrett	1	1	1	4	1	1	4	1	4	21	Medium-High
	Washington	3	2	1	4	1	1	3	3	1	18.5	Medium-High
Central	Anne Arundel	4	3	1	4	1	1	1	4	0	16	Medium-High
	Baltimore	4	3	1	4	1	1	1	4	1	17.5	Medium
	Carroll	3	2	1	4	1	1	1	3	0	14	Medium-High
	Harford	3	3	1	4	1	1	1	4	0	15.5	Medium-High
	Howard	3	3	1	4	1	1	1	3	0	14.5	Medium-High
	Baltimore City	4	4	1	4	1	1	1	4	0	16.5	Medium-High
	Frederick	3	2	1	4	1	1	1	3	0	14	Medium-High
	Montgomery	4	4	1	4	1	1	1	4	0	16.5	Medium-High
	Prince George's	4	3	1	4	1	1	1	4	0	16	Medium-High
Southern	Calvert	2	2	1	4	1	1	1	2	0	12.5	Medium
	Charles	3	2	1	4	1	1	1	2	5	20.5	Medium-High
	St. Mary's	2	2	1	4	1	1	1	1	0	11.5	Medium
Upper Eastern Shore	Caroline	1	1	1	4	1	1	4	1	3	19.5	Medium-High
	Cecil	2	2	1	4	1	1	2	3	0	15	Medium-High
	Kent	1	1	1	4	1	1	3	1	5	21	Medium-High
	Queen Anne's	1	1	1	4	1	1	1	2	0	11.5	Medium
	Talbot	1	1	1	4	1	1	2	2	0	13	Medium
Lower Eastern Shore	Dorchester	1	1	1	4	1	1	3	1	2	16.5	Medium
	Somerset	1	1	1	4	1	1	4	2	5	25	Max
	Wicomico	2	2	1	4	1	1	3	3	3	21	Medium-High
	Worcester	2	1	1	4	1	1	3	2	0	15	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.16 Soil Movement

For the purposes of this plan, soil movement hazards refer to landslides, sinkholes, and coastal erosion because they are the primary geological hazards that have the ability to cause damage to property and potential loss of life.

3.16.1 Definition

Landslides: A landslide is defined as the movement of a mass of rock, debris, or earth down a slope.[161] Landslides can be triggered by natural or man-made circumstances, such as heavy rains, earthquakes, rapid snow melt, erosion, or construction. The two most common types of landslides that affect Maryland are earth/mudslides and rockslides.

Every landslide, or slope movement, is different and unpredictable. However, they are typically associated with other hazards, such as earthquakes and storms with heavy rainfall. Some landslides move slowly over time, while others are quick. Some geological areas are more prone to landslides, such as bases of steep slopes or hillsides. Flatter areas away from slope changes tend to be safer from landslides. Landslides can cause localized property loss and infrastructure damage.

Sinkholes: A sinkhole is an area of ground that has no natural external surface drainage; when it rains, water stays inside the sinkhole and typically drains into the subsurface.[162] Sinkholes can vary from a few feet wide to hundreds of acres and from less than 1 to more than 100 feet deep. Some are shaped like shallow bowls or saucers whereas others have steep, vertical walls.

Sinkholes are dramatic because the ground's surface usually stays intact while the subsurface layer dissolves. Once there is not enough support for the land above the dissolved space, a sudden collapse of the land surface can occur. These collapses can be small and go unnoticed, or they can be large, destroying structures, including buildings and roadways. As with landslides, certain geological areas are more prone to sinkholes than others. Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by groundwater circulating through them. As the rock dissolves, spaces and caverns develop underground. Severe erosion can cause extreme property loss or damage. Sinkholes typically cause very localized property loss and minimal infrastructure damage.

Coastal Erosion: Coastal erosion is the process by which local sea level rise, strong wave action, and coastal flooding wear down or carry away rocks, soils, and/or sands along a coastline. All coastlines affected by storms, tidal action, and other natural events are susceptible to erosion. The extent and severity of the problem is

[161] *Natural Hazards.* "What is a landslide and what causes one?" U.S. Geological Survey. n.d. Accessed April 29, 2021. Available at: https://www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news_science_products=0#qt-news_science_products.

[162] *Geology.* "What is a sinkhole?" U.S. Geological Survey. n.d. Accessed April 29, 2021. Available at: https://www.usgs.gov/faqs/what-a-sinkhole?qt-news_science_products=0#qt-news_science_products.

worsening with global sea level rise. Severe erosion can cause long-term, widespread property loss.

3.16.2 Location

Landslides: Although landslides are rare in Maryland, they can and do happen in the mountainous areas in Western Maryland, as well as in other areas where slopes, both natural and man-made, are prevalent. Based on the geologic makeup of Maryland, the Piedmont, Blue Ridge, Ridge and Valley, and Appalachian Plateaus are more likely to experience naturally occurring landslides, while the risk in the Atlantic Coastal Plain would be much less. Suburban and urban areas, where man-made soil movement has taken place to facilitate development, are also prone to landslide activity. From a number's perspective, most Maryland landslides have occurred in the western region, because of mountainous terrain and changing slopes. However, landslides that occur in the more populous regions of the state attract more recognition.

Therefore, based on this information, landslides would be expected to occur in regions west of the Chesapeake Bay.

Sinkholes: The map below shows a recent mapping of the karst features of soil types that have been documented by the U.S. Geological Survey (USGS) as areas susceptible to sinkholes due to the erodibility of the karst soil type. Although this is not the only indicator and should not be used as the sole means for determining sinkhole risk and location, this information does give some indication as to areas that might be more likely to experience sinkholes in the state. The map, which shows the distribution of carbonite rocks in Maryland, indicates that the Hagerstown Valley, the Frederick Valley, and the Wakefield Valley are all expected to have a higher level of sinkhole activity. To a lesser degree, collapse sinkholes are expected to be found in the Green Spring Valley, Worthington Valley, and the Long Green Valley regions. Atlantic Coastal Plain areas are not expected to have significant sinkhole activity. As with

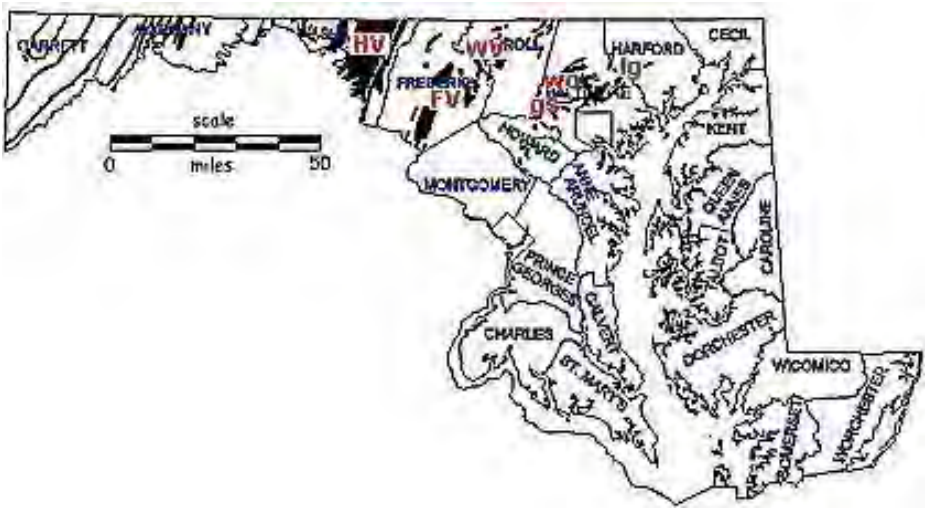


Figure 3-9: Karst Features of Soil Types

landslides, sinkholes would be expected to occur in regions west of the Chesapeake Bay.

Coastal Erosion: By definition, coastal erosion is unique to the communities on Maryland's coastlines. A unique feature of Maryland is its Chesapeake Bay watershed and tidal tributaries. This ecosystem is the single largest estuary in the United States. According to NOAA's Office of Ocean and Coastal Resource Management, Maryland has approximately 3,190 miles of coastal and Chesapeake Bay tidal shoreline susceptible to coastal erosion.

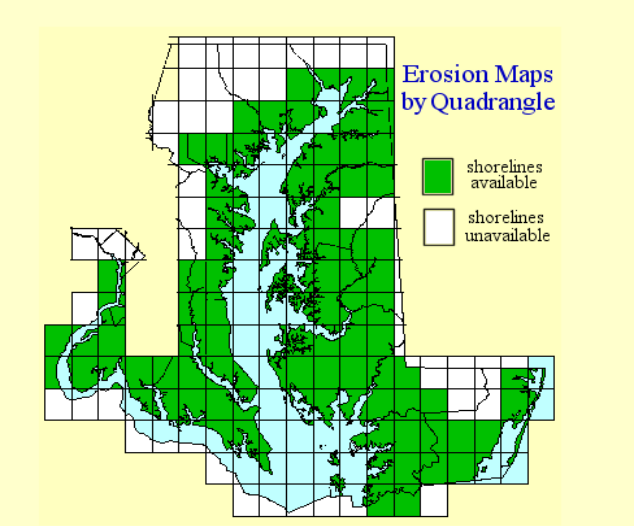


Figure 3-10: Erosion Maps by Quadrangle

Counties expected to be most affected by costal erosion include Kent, Queen Anne's, Talbot, Dorchester, Wicomico, Somerset, and Worchester on the state's Eastern Shore, and Hartford, Baltimore, Anne Arundel, Baltimore City, Calvert, Price George's, Charles, and St Mary's on the Western Shore.

3.16.3 Extent (Magnitude/Strength)

Landslides: Landslide extent can be measured using the size/volume of the debris that was moved during the landslide event. In the western areas of the state where landslides are most prevalent and largest, some landslides have displaced boulders as large as 60 feet in length and 900 tons in weight. Many times, the outflow from these landslide events has moved at upwards of 50 mph, damaging homes, roadways, and other structures along the way. If mitigation measures are not taken, the cost to stabilize areas of possible landslides or to remediate damage once one occurs can be significant.

Sinkholes: No sinkholes are exactly alike. Variations in size and shape, time period under which they occur (i.e., gradually or abruptly), and their proximity to development ultimately determines the magnitude of damage incurred. Sinkholes could result in minor elevation changes or deep, gaping holes in the ground surface. Sudden sinkhole events can cause severe damage in urban environments, resulting in road closures, while more gradual events can be addressed before significant damage occurs. Primarily, problems related to sinkholes include the disruption of transportation networks and utility services, and damage to private and public property, including buildings and parking structures. If long-term sinkhole formation is not recognized and mitigation measures are not implemented, fractures or complete collapse of building foundations and roadways may result. If mitigation measures are not taken, the cost to fill in and stabilize sinkholes can be significant.

Also, sinkholes present unique challenges when it comes to insurance coverage. When private insurance policies are priced, the real estate value of the land is typically excluded. Therefore, because property is insured for what it would cost to rebuild the structure, without respect to the price of the land, costs associated with sinkhole repairs are not covered.

Coastal Erosion: The MGS monitors shoreline changes both in the Bay and along the Atlantic Coast and has compiled erosion data on a series of maps, "Shoreline Change Maps for Tidewater Maryland." Shorelines are depicted from various maps drawn over time, from the mid-1800s through the 1990s. These maps show that erosion of the shoreline in Maryland varies from less than 2 to greater than 8 feet per year. The rate depends upon the erosional forces, mentioned previously, attacking the shoreline and the soil composition of banks, beaches, or marshes. The rate is also influenced by erosion control structures built along a shoreline.

3.16.4 Previous Occurrences

Landslides: Although major landslides are fairly rare in Maryland, many smaller occurrences happen in rural mountainous regions that never go reported. Based on news reports, the three costliest landslide events in Maryland since 2014 are presented below:

- *May 17, 2018, Maryland Heights Landslide:* A 100-foot by 100-foot section of the hillside below Maryland Heights slid following 2 days of unusually heavy rainfall. From May 15 to 17 over 15 inches of rain fell in southern Washington County, Maryland, that's more than double the typical total rainfall for all of May. Since then, the region has continued to experience uncharacteristically high amounts of precipitation, causing flooding in the area and further instability of the slope. After 6 months of repair and stabilization, Washington County opened Harpers Ferry / Sandy Hook Road on October 25, 2018, at a cost of over $4.5 million.
- *May 6, 2015, Piscataway Hills landslide:* A landslide in the Piscataway Hills neighborhood of Fort Washington, Prince Georges County, left six homes destroyed and another 22 damaged. The slide occurred as a result of slope failure associated with Marlboro Clay subsurface. Heavy rain on the days before May 6 was likely the contributing factor in the landslide. The landslide knocked out water and sewer lines, as well as electricity. It also took out part of the road, which winds through the Piscataway Hills subdivision. Prince George's County budgeted approximately $11 million to repair the road and hill, a number that has since proven to be too low. A county spokesperson said the slope failure "is the costliest natural disaster in county history."[163]
- *April 30, 2014, East 26th Street Baltimore Landslide:* A portion of East 26th Street in Baltimore collapsed down onto the CSX tracks below. At least 10 cars

[163] "Fort Washington landslide is costliest natural disaster in PG Co. history." by Tom Roussey, ABC News. March 19, 2015. Available at: https://wjla.com/news/local/fort-washington-landslide-is-costliest-natural-disaster-in-pg-co-history-112435.

parked along the street fell down onto the railroad tracks. "The building shook at about 3:45 like a train derailed. We came running out here and the side of 26th Street just collapsed into the pit where CSX trains go," one man said. "The wall, the lights, the cars–everything parked on that side of the street–gone."[164] The Baltimore Department of Transportation estimated that it would cost at least $18.5 million to repair the street collapse.[165]

Sinkholes: Data on previous occurrences are unavailable; there is no database of sinkhole collapses for the United States or Maryland. As with landslides, many sinkhole collapses are not reported to authorities or news organizations, and many occur in rural areas where they are unobserved. However, review of news articles and technical reports document frequent sinkholes appearing throughout the state after periods of extreme rainfall. These events typically involve pavement collapsing and require several days of emergency repair.

- *July 8, 2019, West Pratt and Howard Street intersection sinkhole:* A sinkhole near the intersection of Howard and Pratt streets swallowed an elevated platform for wheelchair users to access Light Rail trains. As the underground void grew, crews were in the process of removing the ramp and platform when it collapsed. The problems was caused by a water main break that occurred beneath Howard Street, causing a train derailment and flooding areas with inches of muddy water. One electrical worker was seriously injured in an underground collapse.[166]

Coastal Erosion: Unlike other hazards, coastal erosion is a constant occurrence. For centuries, the islands of the Chesapeake Bay have been shrinking and the shape of the Atlantic coastline has been shifting as a result of land subsidence and erosion, compounded by rising seas. Islands that once supported entire communities are rapidly disappearing due to coastal erosion combined with sea-level rise. The best example of coastal erosion is Poplar Island. In 1847, Poplar Island boasted more than 1,100 acres. During the early 1900s, the island supported a thriving community of about 100 residents, several farms, a school, a church, a post office, and a sawmill. By the 1920s, residents began leaving the island as more and more of its landmass fell victim to erosion. The island's remains were still used as a retreat in the 1930s and 1940s, and Presidents Franklin D. Roosevelt and Harry S. Truman were among its visitors. By the early 1990s, all that remained of the original island were several small clusters of islets rising just above the surface of the water. The island had been reduced to just under 4 acres.

---

[164] "Major Landslide Swallows Several Cars Along 26th Street In Baltimore." CBS Baltimore. April 30, 2014. Available at: https://baltimore.cbslocal.com/2014/04/30/major-sinkhole-involving-several-cars-opens-at-26th-street/.

[165] "Baltimore landslide to cost $18.5 million to fix." WTOP News. May 27, 2014. Available at: https://wtop.com/news/2014/05/baltimore-landslide-to-cost-185-million-to-fix/.

[166] "Large hole opens in downtown Baltimore street, swallowing part of Light Rail station; crews preparing for heavy rain Thursday." By Scott Dance, Ian Duncan, and Lillian Reed. *Baltimore Sun*. July 10, 2019. Available at: http://www.baltimoresun.com/maryland/baltimore-city/bs-md-ci-water-main-break-20190710-20190710-kovkeb56g5hhrcja2e6e4qkp7q-story.html.

3.16.5 Future Probability and Climate Change Conditions

Landslides: Although Maryland has experienced landslides, most occurrences were not extremely damaging. Most events occur in the western part of the state where there is more area with drastic slope changes.

However, an increase in the number and intensity of severe storms will likely result in more frequent heavy rains and flooding. And since heavy rains and flooding can trigger landslides, these events may occur more often in suburban and urban areas.

Sinkholes: Sinkholes have affected parts of Maryland throughout history; however, most impacts have been relatively minor. Because the state's geology makes certain areas susceptible to sinkholes, it is almost certain that future events will take place. Similar to landslides, sinkholes can be triggered by heavy rains and flooding. An increase in the number and intensity of severe storms, and resulting heavy rains and flooding, may also result in sinkholes developing more frequently.

Coastal Erosion: As with all states bordering oceans and also having a large estuary and tidal riverine ecosystem, erosion is certain to continue in the future. Studies have also shown that increase in weather extremes affects coastal erosion rates. If continuing extreme storms occur as predicted, shoreline imbalances may happen more frequently. Changing sea levels as a result of warming temperatures also affect erosion rates, and these levels are expected to rise globally and locally. Furthermore, as population increases and more people move to waterfront areas (reducing natural buffer zones), erosion rates are likely to quicken.

3.16.6 Soil Movement Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that soil movement would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in states governance. The results of the consequence analysis are shown in Table 3-42.

Table 3-42: Soil Movement Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Landowners across the state are at risk to impacts from a soil movement event. Impacts to the public include potential for injury or loss of life, and destruction and/or loss of land and property due to emergencies from soil movement.
Health and Safety of Responders	First responders, such as fire and police, would be called to support specific incident area(s) across the state dealing with landslides, sinkholes, and coastal erosion. For a soil movement event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.

Subject	Impacts
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility or critical infrastructure component is within the area of movement zone associated with the soil movement. Delivery of services may be slowed or halted in adjacent areas if key roadways become impassable due to debris blockages or loss of structural integrity.
Property, Facilities, and Infrastructure	Home and landowners within earth movement zones may experience damage to or loss of property depending upon the severity of movement in the area. Infrastructure may experience impacts in the form of damage to roads and bridges, temporary closure of transportation routes, the potential inability of the stormwater system to handle floodwaters, and loss of power.
Environment	Erosion and debris flows would be the major impact to the environment during a significant incident of soil movement.
Economic Condition of the State	A soil movement event would typically be more localized and costly for local governments because of the potential for damages from flooding. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments respond to a soil movement event.

3.16.7 Vulnerability and Impact

Landslides: Landslides may affect large areas at one time, and they can be slow or quick moving. As noted previously, landslides have tended to impact the western side of the state more often than areas in the Atlantic Coastal Plain. The biggest impact caused by landslides is property damage and loss. In severe cases, landslides have caused damage to roads, impacting transportation between large groups of people. Although they are not easily predictable, landslides have harsher impacts after periods of severe rainfall.

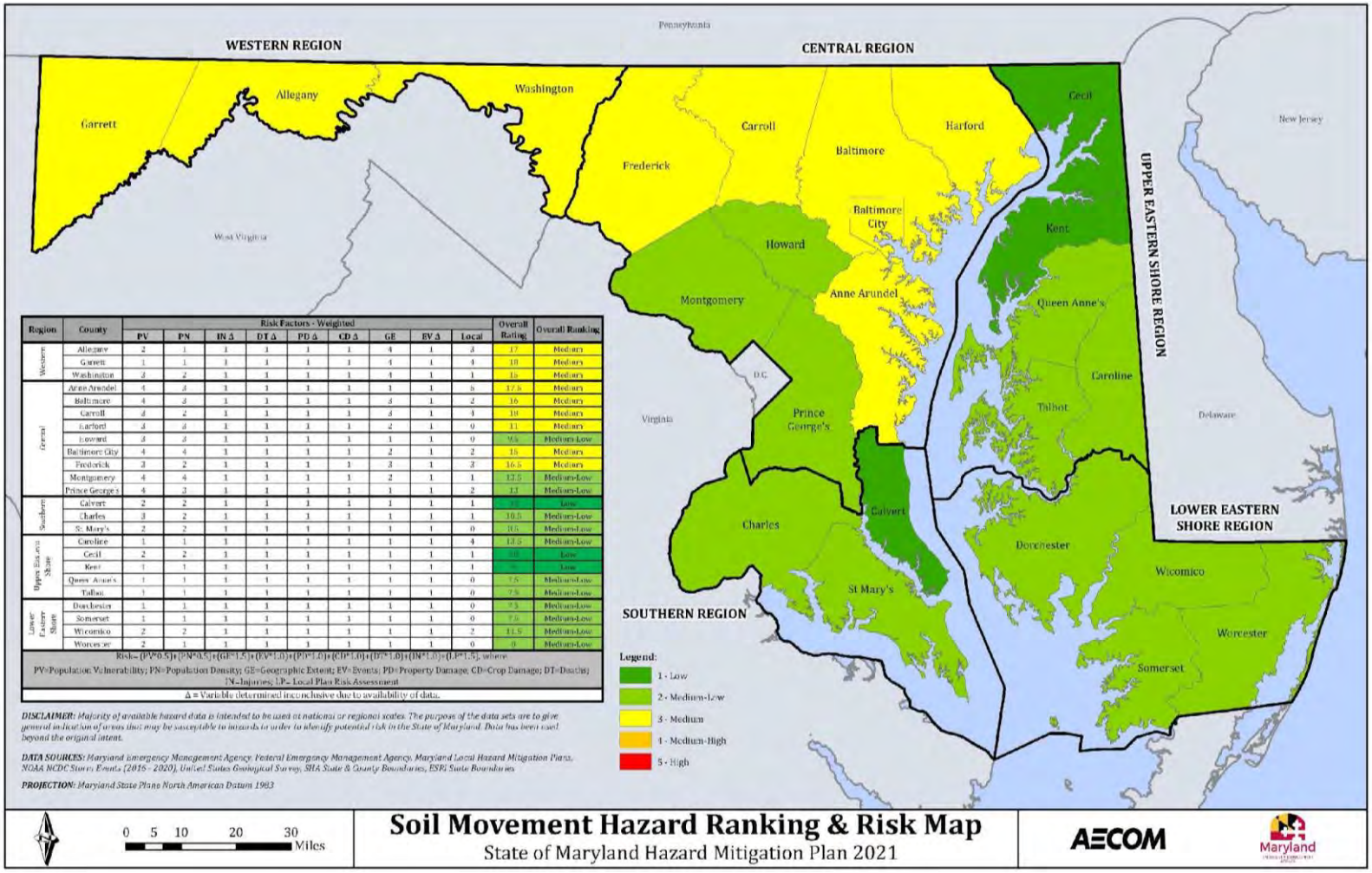
Sinkholes: Sinkholes are relatively unpredictable, which causes greater impacts when they do occur. Historical evidence shows that sinkholes that have an economic impact tend to occur in the central portion of the state, where population density is greater and impacts to the transportation networks create hardships.

Coastal Erosion: While erosion can happen anywhere along the tidal shores, greater impacts are generally seen along the Atlantic seaboard, tidal bays directly west of the ocean, and in areas directly fronting the Chesapeake Bay. Many waterfront communities are affected by erosion every year, especially after severe storms and

during hurricane season. As population continues to increase in waterfront/coastal areas, the impacts of erosion may become even greater. Although waterfront communities try to solve erosion issues by dredging, building bulkheads, and installing riprap shorelines, these are often only temporary solutions to a long-term issue.

3.16.8 Soil Movement Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Western	Allegany	2	1	1	1	1	1	4	1	3	17	Medium
	Garrett	1	1	1	1	1	1	4	1	4	18	Medium
	Washington	3	2	1	1	1	1	4	1	1	16	Medium
Central	Anne Arundel	5	5	1	1	1	1	1	1	5	17.5	Medium
	Baltimore	4	5	1	1	1	1	5	1	2	16	Medium
	Carroll	4	2	1	1	1	1	4	1	1	16	Medium
	Harford	4	4	1	1	1	1	2	1	0	14	Medium
	Howard	5	5	1	1	1	1	1	1	0	9.5	Medium-Low
	Baltimore City	4	4	1	1	1	1	2	1	2	18	Medium
	Frederick	3	2	1	1	1	1	3	1	3	16.5	Medium
	Montgomery	4	4	1	1	1	1	2	1	1	17.5	Medium-Low
	Prince Georges	4	3	1	1	1	1	1	1	2	13	Medium-Low
Southern	Calvert	2	2	1	1	1	1	1	1	1	9.5	Low
	Charles	3	2	1	1	1	1	1	1	1	10.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	1	0	9.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Cecil	2	2	1	1	1	1	1	1	1	9.5	Low
	Kent	1	1	1	1	1	1	1	1	1	9	Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	0	9.5	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	1	2	11.5	Medium-Low
	Worcester	2	1	1	1	1	1	1	1	0	9	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2015 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.17 Thunderstorm

3.17.1 Definition

Maryland is at risk to thunderstorm events, including damage from hail, local or regional power failures, and disruptions to communications infrastructure due to lightning. Although thunderstorms are typically tracked with proactive warnings given to communities, these events still pose a significant risk. Two thunderstorm-related hazard types identified within the 2016 Plan (hail and lightning) are defined by the NWS[167] as follows:

Hail: Frozen precipitation in the form of balls or irregular lumps of ice.

Lightning: A sudden electrical discharge from a thunderstorm, typically resulting in a fatality, injury, and/or damage.

3.17.2 Location

According to NOAA, the United States averages 100,000 tornadoes annually with about 10 percent reaching a "severe" level. Thunderstorms are classified as severe when an event has hail 1 inch or greater in diameter, creates wind gusts exceeding 50 knots, and/or produces a tornado. Although thunderstorms occur year-round, Maryland experiences the bulk of thunderstorms during the spring and summer seasons in the afternoon.[168] For example, during July and August, annual precipitation peaks because thunderstorms occur, on average, once every 5 days.[169]

Thunderstorms impact the entirety of Maryland, and while they are more frequent in the summertime, events can occur year-round. Therefore, unlike some hazards, all areas of Maryland are vulnerable to thunderstorms.[170] Hail can damage large amounts of property in denser urban areas, while rural areas may experience crop destruction or livestock death. Additionally, lightning can interrupt electrical and communications infrastructure while also injuring or killing individuals.[171]

Although thunderstorm events impacted the entirety of the state, between January 2017 and April 2020, out of 20 affected areas, the most frequently impacted areas included Montgomery County (30) and Baltimore County (21).[172] One major event on April 21, 2017, struck Montgomery County and brought hail as large as 1.75 inches in

[167] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[168] Severe Weather 101: Thunderstorm Basics. NOAA National Severe Storms Laboratory. n.d. Accessed April 28, 2021. Available at: https://www.nssl.noaa.gov/education/svrwx101/thunderstorms/.

[169] https://msa.maryland.gov/msa/mdmanual/01glance/html/weather.html.

[170] https://mema.maryland.gov/community/Documents/2016_Maryland_Hazard_Mitigation_Plan_final_2.pdf.

[171] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[172] National Centers for Environmental Information Formerly the National Climatic Data Center (NCDC). Available at: https://www.ncdc.noaa.gov/.

diameter and caused power outages for over 1,900 residents and businesses within the area.[173]

Therefore, based on this information, the locations most at risk for thunderstorms include the central and southern regions of the state.

3.17.3 Extent (Magnitude/Strength)

Thunderstorms occur regularly with potential large impact areas and damage ranging from little to severe. Wind gust speeds vary between individual events; however, strong straight-line winds can reach 120 mph. Additionally, hail can damage crops and kill livestock, while lightning can cause wildfires and human fatalities.[174]

To measure and classify a thunderstorm, the NWS and NOAA examine three factors: wind speed, hail size, and tornadoes. If a thunderstorm meets any of the following criteria, it is categorized as a severe thunderstorm, capable of causing significant destruction:

1. Hail 1 inch or greater in diameter
2. Wind gusts exceeding 50 knots (57.5 mph)
3. Spawns a tornado

Only 10 percent of thunderstorms across the country meet these criteria annually.

While most severe thunderstorms occur in the central United States, from Texas to Minnesota, Maryland is still at risk from severe thunderstorm events.[175] Because events can begin quickly, the NWS[176] utilizes a system of Doppler radar and spotters to forecast and track storm systems. These systems may issue a thunderstorm "watch" or "warning" based on the following.

Table 3-43: Severe Thunderstorm Watch/Warning Definitions

Weather Alert	Description
Severe Thunderstorm Watch	**Be Prepared!** Severe thunderstorms are possible in and near the watch area. Stay informed and be ready to act if a severe thunderstorm warning is issued. The watch area is typically large, covering numerous counties or even states.

[173] "Fast moving storm brings golf ball-sized hail, power outages and downed trees." By Victoria St. Martin. *The Washington Post*. April 21, 2017. Available at: https://www.washingtonpost.com/news/local/wp/2017/04/21/fast-moving-storm-brings-golf-ball-sized-hail-power-outages-and-downed-trees/.

[174] *State of Maryland 2016 Hazard Mitigation Plan, August 2016*. March 2015. FP 302-094-2. Available at: https://mema.maryland.gov/community/Documents/2016_Maryland_Hazard_Mitigation_Plan_final_2.pdf.

[175] Severe Weather 101: Thunderstorm Basics. NOAA National Severe Storms Laboratory. n.d. Accessed April 28, 2021. Available at: https://www.nssl.noaa.gov/education/svrwx101/thunderstorms/.

[176] "Understand Severe Weather Alerts." NOAA National Weather Service. *Safety*. n.d. Accessed April 29, 2021. Available at: https://www.weather.gov/safety/thunderstorm-ww.

Weather Alert	Description
Severe Thunderstorm Warning	**Take Action!** Severe weather has been reported by spotters or indicated by radar. Warnings indicate imminent danger to life and property. Take shelter in a substantial building. Get out of mobile homes that can blow over in high winds. Warnings typically encompass a much smaller area (around the size of a city or small county) that may be impacted by a large hail or damaging wind identified by an NWS forecaster on radar or by a trained spotter/law enforcement who is watching the storm.

3.17.4 Previous occurrences

Since the publication of the 2016 Plan, the state has had one federally declared disaster for severe storms.[177] The event lasted from May 15, 2018, to May 19, 2018, impacting both Frederick and Washington counties. During this time, seven individual hail events took place, with the largest in Frederick County, where hail measuring 2.5 inches was recorded. No property damage or injuries were directly reported during the event from hail or lighting, but power outages and downed trees were reported.[178]

Overall, according to the NCDC database, between January 2017 and April 2020, Maryland has had 148 total thunderstorm events, including 8 lightning events and 140 hail events.[179] In total, these events caused an estimated $13,010 in property damage and caused 19 injuries and 0 deaths. Notably, lightning events were responsible for all the reported injuries and property damage. The single most destructive recent event occurred in July 2017 when lightning in Worcester County caused $10,000 in property damage.

Other notable events include 10 injuries caused by thunderstorms on August 18, 2017, within Harford County.[180] The Harford County Department of Emergency Services building was struck by lightning during a severe storm, injuring 10 employees.[181] This was the largest single grouping of thunderstorm-related injuries since the 2016 Plan was published.

3.17.5 Future Probability and Climate Change Conditions

As stated previously, Maryland has consistent thunderstorms throughout the year, peaking in the summer, with one event on average every 5 days.[182] Therefore, the probability of thunderstorms each year is highly likely.

---

[177] FEMA DR-4374-MD: Maryland Severe Storms and Flooding. Incident Period: May 15, 2018 - May 19, 2018; Declaration Date: Jun 25, 2018. Last updated April 21, 2021. Available at: https://www.fema.gov/disaster/4374.

[178] Storm Events Database. NOAA National Centers for Environmental Information. n.d. Accessed April 29, 2021. Available at: https://www.ncdc.noaa.gov/stormevents/.

[179] Ibid.

[180] Ibid.

[181] "Md. Emergency Crews Respond to Possible Lightning Strikes, Flooded Areas During Severe Weather." CBS Baltimore. August 18, 2017. Available at: https://baltimore.cbslocal.com/2017/08/18/md-emergency-crews-respond-possible-lightning-strikes-flooded-areas-severe-weather-harford-county/.

[182] *Maryland Manual On-Line*. "Maryland at a Glance: Weather." October 21, 2020. Available at: https://msa.maryland.gov/msa/mdmanual/01glance/html/weather.html.

While some hazard events, such as hurricanes, are expected to become more frequent and intense, the future probability of thunderstorms is unclear. According to the NCA4 published in 2018, "tornadoes, hail, and thunderstorms, are also exhibiting changes that may be linked to climate change, but scientific understanding is not yet detailed enough to confidently project the direction and magnitude of future change." However, severe thunderstorm modeling studies suggest that climate change may increase severe thunderstorm frequency and intensity.[183]

3.17.6 Critical Facilities and Thunderstorm Hazard

Thunderstorm loss estimations indicate that Montgomery and Baltimore counties (with Anne Arundel and Harford counties close behind) have the highest critical facility building value and content value loss estimations. Table 3-44 lists the number of critical facilities by jurisdiction with potential losses from thunderstorms.

Table 3-44: Critical Facilities Thunderstorm Loss Estimations

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	114	$790,979,500	$346,814,200	$1,137,793,700
City of Annapolis	25	$277,074,600	$85,820,600	$362,895,200
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Charles	80	$589,289,300	$260,895,700	$850,185,000
Harford	116	$1,005,729,000	$161,993,400	$1,167,722,400
Montgomery	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
Prince George's	251	$1,006,600,260	$172,844,080	$1,179,444,340
TOTALS	**1234**	**$9,299,663,060**	**$2,889,741,380**	**$12,189,404,440**

3.17.7 State Assets and Thunderstorm Hazard

Thunderstorm loss estimations indicate that Anne Arundel, Prince George's, and Baltimore counties have the highest state asset building value and content value loss estimations.

3.17.8 Thunderstorm Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a thunderstorm event would have on the public; responders; continuity of operations, including delivery of services; property,

[183] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-45.

Table 3-45: Thunderstorm Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners throughout the state are at risk to impacts from a thunderstorm event in the form of lightning and hail. Lightning is very dangerous, even when observed at several miles away. As such, members of the public should seek shelter immediately. In addition, hail poses the threat of personal injury, particularly for hail stones of larger sizes.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads due to fallen trees and/or debris blockages, and attend to any injured. For a thunderstorm event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is directly adversely affected by lightning or hail caused by a thunderstorm. Delivery of services may be slowed or halted in affected areas as a result of momentary losses in power and communications.
Property, Facilities, and Infrastructure	Home and landowners throughout the state may experience damage to property depending upon the amount of lightning strikes and severity of hail in the area. Infrastructure may experience impacts in the form of fire caused by lightning strikes, roof and crop damage from hail, and interruptions to above-ground power and communication systems.
Environment	Lightning and hail impact the environment primarily from wildfire caused by lightning and crop damage caused by hail.
Economic Condition of the State	A major thunderstorm event would be costly for state and local governments because of the potential for damages associated with property, debris generation, and loss of power. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a severe thunderstorm event.

3.17.9 Vulnerability and Impact

FEMA's Community Lifelines Implementation Toolkit can be used to identify several key sectors vulnerable to the impact of thunderstorm events in Maryland. Community lifelines broadly include "critical government and business functions…essential to human health and safety or economic security." The primary

Community Lifelines impacted by thunderstorm events are the Energy, Communications, Transportation, and Health and Medical Lifelines.[184]

The Department of Energy maintains a list of vulnerabilities created by thunderstorms, especially lightning, on energy grids, communications infrastructure, and transportation. For example, between 1996 and 2014, North Dakota experienced the highest frequency of thunderstorm events and incurred the greatest property damage to energy infrastructure. Additionally, thunderstorms can hinder transportation networks by falling trees and creating delays due to hazardous driving conditions.[185]

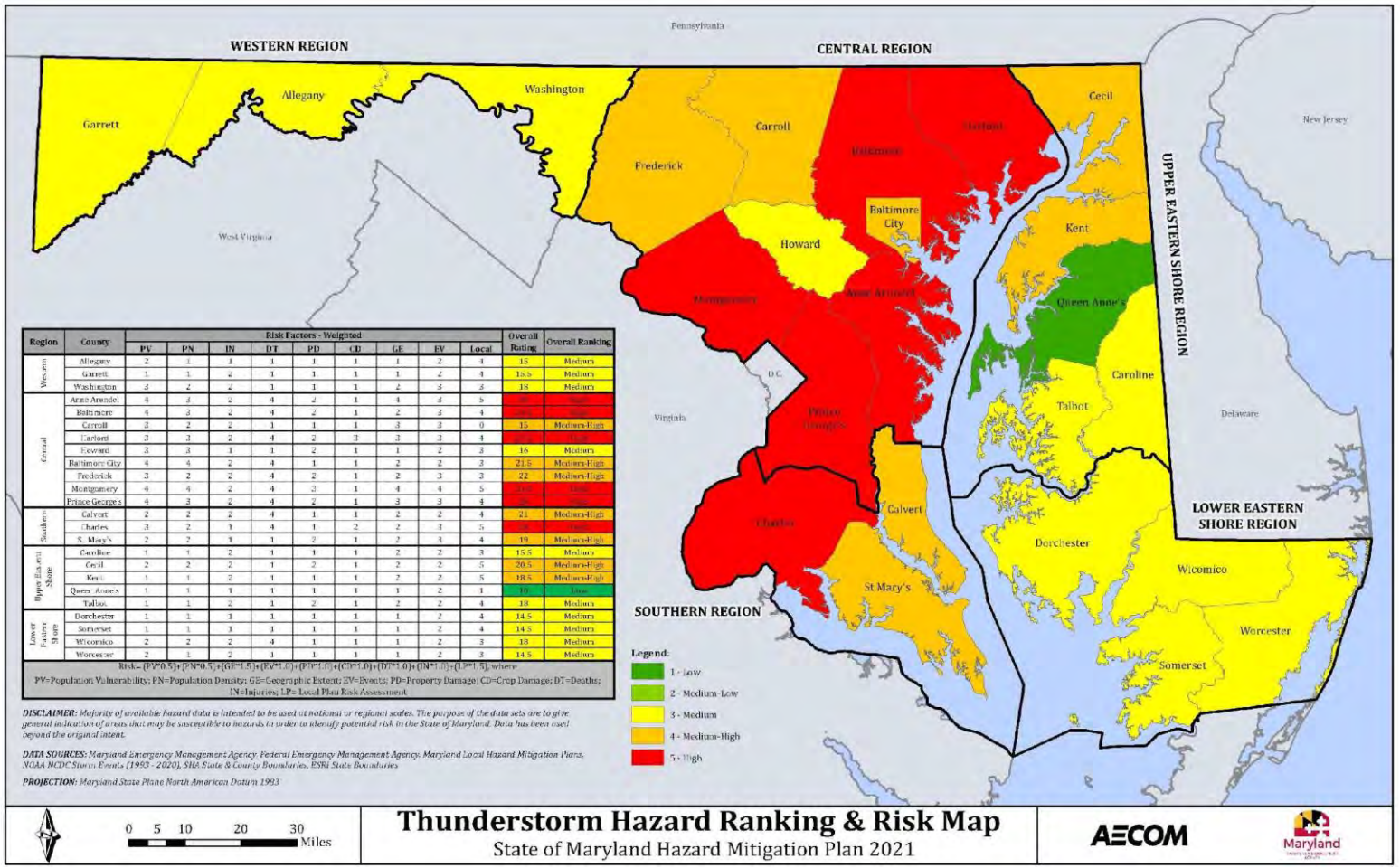
Another impact of thunderstorms, according to the NCA4, is the increase in severe asthma and allergic diseases. The report states "thunderstorms can induce spikes in aeroallergen concentrations and increase the incidence and severity of asthma and other allergic diseases." This finding, paired with the rise in air pollution, indicates thunderstorms pose a public health risk affecting the Health and Medical Lifeline.

[184] *Community Lifelines.* FEMA. July 27, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

[185] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

3.17.10 Thunderstorm Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	2	4	15	Medium
	Garrett	1	1	2	1	1	1	1	2	4	15.5	Medium
	Washington	3	2	2	1	1	1	2	3	3	18	Medium
Central	Anne Arundel	4	3	2	4	2	1	4	4	5	29	High
	Baltimore	4	3	2	4	2	1	2	3	4	25.5	High
	Carroll	3	2	2	1	1	1	3	3	0	15	Medium-High
	Harford	3	3	2	4	2	3	3	3	4	27.5	High
	Howard	3	3	1	1	2	1	1	2	3	16	Medium
	Baltimore City	4	4	2	4	1	1	2	2	3	21.5	Medium-High
	Frederick	3	2	2	4	2	1	2	3	3	22	Medium-High
	Montgomery	4	4	2	4	3	1	4	4	5	31.5	High
	Prince George's	4	3	2	4	2	1	3	3	4	26	High
Southern	Calvert	2	2	2	4	1	1	2	2	4	21	Medium-High
	Charles	3	2	1	4	1	2	2	3	5	25	High
	S. Mary's	2	2	1	1	2	1	2	3	4	19	Medium-High
Upper Eastern Shore	Caroline	1	1	2	1	1	1	2	2	3	15.5	Medium
	Cecil	2	2	2	1	2	1	2	2	5	20.5	Medium-High
	Kent	1	1	2	1	1	1	2	2	5	18.5	Medium-High
	Queen Anne's	1	1	1	1	1	1	1	2	1	10	Low
	Talbot	1	1	2	1	2	1	2	2	4	18	Medium
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	2	4	14.5	Medium
	Somerset	1	1	1	1	1	1	1	2	4	14.5	Medium
	Wicomico	2	2	2	4	1	1	1	2	3	18	Medium
	Worcester	2	1	2	1	1	1	1	2	3	14.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.18 Tornadoes

3.18.1 Definition

Maryland is vulnerable to the impacts of tornado events, which can cause devastating damage to communities either through high wind speeds and gusts or through debris picked up during an event. While some tornadoes are clearly visible, some are obscured by rain and low-hanging clouds. The 2016 Plan identified three tornado hazard types (tornadoes, waterspouts, and funnel clouds), which are defined by the NWS[186] as follows:

Tornado: A violently rotating column of air extending from a cumuliform cloud or underneath a cumuliform cloud, to the ground, and often (but not always) visible as a condensation funnel. Literally, in order for a vortex to be classified as a tornado, it must be in contact with the ground and extend to/from the cloud base. On a local scale, it is the most destructive of all atmospheric phenomena.

Waterspout: A violently rotating column of air usually pendant to a cumulus/cumulonimbus, over a body of water, with its circulation reaching the water.

Funnel Cloud: A rotating visible extension of cloud pendant to a cumulus/cumulonimbus with circulation not reaching the ground or water.

3.18.2 Location

According to NOAA, the United States averages over 1,000 tornadoes annually with about 95 percent falling under an EF3 rating. Two regions, Florida and Tornado Alley, experience a high frequency of these events because of the prevalence of thunderstorms and contributing geographic conditions. For its part, Maryland averages 10 tornadoes annually, with events affecting all regions of the state.[187]

Tornado events can occur throughout Maryland with little to no warning, causing severe damage to relatively small areas. Therefore, unlike some hazards, all areas of Maryland face nearly uniform susceptibility to tornado events.[188] Urban areas, such as Baltimore County, are typically more vulnerable to tornado impacts because of their higher population densities and the number of critical facilities needed to support large population centers.

Generally, Maryland is impacted by several tornado events each year, with most occurring between the months of April and November, between 3:00 PM and 9:00 PM. Although many tornadoes touch down in sparsely populated rural areas and

[186] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[187] Map of the average annual number of tornadoes for each state in the United States. U.S. Tornado Climatology. NOAA National Centers for Environmental Information. Climate Information: Extreme Events. n.d. Accessed April 29, 2021. Available at: https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

[188] *State of Maryland 2016 Hazard Mitigation Plan, August 2016*. March 2015. FP 302-094-2. Available at: https://mema.maryland.gov/community/Documents/2016_Maryland_Hazard_Mitigation_Plan_final_2.pdf.

cause little damage, notable tornadoes have caused significant damage and/or casualties in the Town of LaPlata and in the College Park area.[189]

3.18.3 Extent (Magnitude/Strength)

Tornado events are considered low frequency, high-intensity events capable of creating minimal to catastrophic damage. Wind gust speeds vary between individual events, while damage paths may be up to 1 mile wide and 50 miles long. The buildings most vulnerable to tornado events are typically semi-permanent or constructed using light-weight materials, such as mobile homes.

To measure the magnitude of a tornado, the NWS utilizes the Enhanced Fujita (EF) Scale to assign ratings based on estimated wind speed and observed damage.[190] The EF Scale incorporates 28 indicators to assign a tornado rating from EF0 (Gale) to EF5 (Incredible). According to the NCDC database, in 2019, Maryland experienced six tornado events: 2 EF0 and 4 EF1. Table 3-46 lists the 3-second gust wind speed and types of observed damage for each EF Rating.[191]

Table 3-46: Tornado EF Scale

EF Rating	3 Second Gust (MPH)	Types of Observed Damage
EF0	65–85 mph	**Light:** Chimneys are damaged, tree branches are broken, shallow-rooted trees are toppled.
EF1	86–110 mph	**Moderate:** Roof surfaces are peeled off, windows are broken, some tree trunks are snapped, unanchored mobile homes are overturned, attached garages may be destroyed.
EF2	111–135 mph	**Considerable:** Roof structures are damaged, mobile homes are destroyed, debris becomes airborne, (missiles are generated), large trees are snapped or uprooted.
EF3	136–165 mph	**Severe:** Roofs and some walls are torn from structures, some small buildings are destroyed, nonreinforced masonry buildings are destroyed, most trees in forest are uprooted.
EF4	166–200 mph	**Devastating:** Well-constructed houses are destroyed, some structures are lifted from foundations and blown some distance, cars are blown some distance, large debris becomes airborne.

[189] Tornadoes. Maryland Emergency Management Agency. n.d. Accessed April 29, 2021. Available at: https://mema.maryland.gov/Pages/resources-Tornadoes.aspx#:~:text=The%20most%20common%20time%20of,3%20p.m.%20and%209%20p.m.

[190] Enhanced Fujita Scale. NOAA National Weather Service. Tallahassee, FL, Weather Forecast Office. n.d. Accessed April 29, 2021. Available at: https://www.weather.gov/tae/ef_scale.

[191] https://www.weather.gov/oun/efscale.

EF Rating	3 Second Gust (MPH)	Types of Observed Damage
EF5	Over 200 mph	**Incredible:** Strong frame houses are lifted from foundations, reinforced concrete structures are damaged, automobile-sized missiles become airborne, trees are completely debarked.

3.18.4 Previous Occurrences

Since the publication of the 2016 Plan, no federally declared tornado events have occurred within the state.[192] However, according to the NCDC database, between January 2017 and April 2020, there were 23 tornado events, 21 of which were assigned an EF rating and two of which were identified as funnel clouds.[193] In total, these events caused an estimated $3,078,000 in property damages and caused three injuries and two deaths. The single most destructive recent event occurred in November 2018 when an EF2 tornado caused $900,000 in damages within Carroll County.

Although there have been no recent federally declared disasters, multiple notable tornado events occurred on February 7, 2020. An unprecedented five tornadoes, including four rated EF1 and one rated EF0, touched down in Maryland within hours of one another, causing power outages and felling trees in the roadway.[194] Areas affected included Montgomery County ($162,000 in damages), Frederick County ($340,000 in damages), and Carroll County ($574,000 in damages).

Other notable events include the Kent Island EF2 tornado in Queen Anne's County, which struck on July 24, 2017, with winds of 125 mph and a 2-mile path.[195] Additionally, during August 2020, Tropical Storm Isaias spawned 11 separate tornadoes within Maryland, including multiple EF2 events in Stockton and Wicomico counties.[196] [197]

[192] Declared Disasters. FEMA. Available at: https://www.fema.gov/disasters/disaster-declarations.

[193] Storm Events Database. NOAA National Centers for Environmental Information. n.d. Accessed April 29, 2021. Available at: https://www.ncdc.noaa.gov/stormevents/.

[194] "NWS: 5 tornadoes touched down in Maryland, with 2 in Montgomery and 1 in Frederick County." By Laura Wainman and Jonathan Franklin, WUSA9. Published: February 7, 2020; Updated: February 8, 2020. Available at: https://www.wusa9.com/article/weather/severe-weather/5-tornados-maryland-frederick-montomgery-counties/65-15420f77-096d-4160-bec1-2b5bc0033826.

[195] "EF-2 Tornado Causes Extensive Damage on Kent Island." CBS Baltimore. July 24, 2017. Available at: https://baltimore.cbslocal.com/2017/07/24/severe-weather-queen-annes-co/.

[196] Summary of Tropical Storm Isaias. NOAA National Weather Service. Wakefield, VA, Weather Forecast Office. n.d. Accessed April 29, 2021. Available at: https://www.weather.gov/akq/Aug_4_2020_Isaias.

[197] "16 tornadoes ripped through Md., Va. during Isaias." By Thomas Robertson, WTOP News. August 9, 2020. Available at: https://wtop.com/weather-news/2020/08/national-weather-service-16-tornadoes-ripped-through-va-md-during-isaias/.

3.18.5 Future Probability and Climate Change Conditions

As stated previously, NOAA data show Maryland averages 10 tornado events annually.[198] Therefore, the probability of a tornado event each year is highly likely. While some hazard events, such as hurricanes, are expected to become more frequent and intense, the future probability of tornadoes is unclear.

According to the NCA4, "tornadoes, hail, and thunderstorms, are also exhibiting changes that may be linked to climate change, but scientific understanding is not yet detailed enough to confidently project the direction and magnitude of future change." The difficulty projecting future events can be attributed, in part, to a relative lack of reliable historical data tracking tornadoes and a need for further research.[199]

3.18.6 Critical Facilities and Tornado Hazard

Tornado loss estimations indicate that Baltimore, Frederick, and Montgomery counties have the highest critical facility building value and content value loss estimations. Table 3-47 lists the number of critical facilities by jurisdiction with potential losses from tornadoes.

Table 3-47: Critical Facilities Tornado Loss Estimations

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	139	$1,068,054,100	$432,634,800	$1,500,688,900
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Calvert	73	$456,940,700	$44,494,800	$501,435,500
Charles	80	$589,289,300	$260,895,700	$850,185,000
Frederick	121	$1,134,849,300	$164,251,400	$1,299,100,700
Harford	116	$1,005,729,000	$161,993,400	$1,167,722,400
Howard	35	$448,961,200	$110,140,200	$559,101,400
Montgomery	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
Prince George's	251	$1,006,600,260	$172,844,080	$1,179,444,340
TOTALS	**1,463**	**$11,340,414,260.00**	**$3,208,627,780.00**	**$14,549,042,040.00**

[198] Map of the average annual number of tornadoes for each state in the United States. U.S. Tornado Climatology. NOAA National Centers for Environmental Information. Climate Information: Extreme Events. n.d. Accessed April 29, 2021. Available at: https://www.ncdc.noaa.gov/climate-information/extreme-events/us-tornado-climatology.

[199] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

3.18.7 State Assets and Tornado Hazard

Tornado loss estimations (as shown in Table 3-48 below and on the next page) indicate that Anne Arundel, Baltimore, and Prince George's counties have the highest critical facility building value and content value loss estimations. Table 65 lists the number of state assets by jurisdiction with potential losses from tornadoes.

Table 3-48: State Assets Tornado Loss Estimations

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	761	$4,117,145,038	$481,564,640	$4,598,709,678
Baltimore	745	$4,449,953,887	$580,907,824	$5,030,861,711
Calvert	132	$181,259,297	$25,583,708	$206,843,005
Charles	153	$161,933,486	$19,981,043	$181,914,529
Frederick	197	$251,189,535	$36,724,173	$287,913,708
Harford	220	$321,074,212	$24,216,692	$345,290,904
Howard	369	$590,600,329	$49,053,956	$639,654,285
Montgomery	192	$317,749,390	$55,868,060	$373,617,450
Prince George's	628	$4,033,876,220	$510,320,283	$4,544,196,503
TOTALS	**3,397**	**$14,424,781,394.00**	**$1,784,220,379.00**	**$16,209,001,773.00**

Electrical utilities and communications infrastructure are vulnerable to tornadoes. Damage to power lines or communication towers has the potential to cause power and communication outages for residents, businesses, and critical facilities. In the event of power loss due to a tornado, state and critical facilities utilize a Continuity of Operations Plan (COOP) to continue performance of essential functions. In addition to lost revenues, downed power lines present a threat to public safety and emergency responders. Fire, police, and EMT responders are called upon to perform evacuations, close roads, attend to the injured, and direct traffic away from the impacted area.

3.18.8 Tornado Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a tornado event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-49.

Table 3-49: Tornado Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners throughout the state are at risk to impacts from tornado events. Impacts to the public include potential injury or loss of life, and destruction of property due to rotating vortex and/or straight-line winds.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads because of fallen trees and/or debris blockages, and attend to any injured. For a tornado event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is directly within the path of destruction of a tornado. Delivery of services may be slowed or halted in affected areas as a result of downed trees, blocked roadways, and/or momentary losses in power and communications.
Property, Facilities, and Infrastructure	Home and landowners throughout the state may experience varying levels of damage to property depending upon the severity of winds in the area. Infrastructure may experience impacts in the form of blowing debris, and interruptions to above ground power and communication systems.
Environment	Tornados, much like other high wind events, impact the environment by potentially spreading debris and pollution; damaging sewer and wastewater treatment plants; and disturbing wildlife and natural areas.
Economic condition of the state	A major tornado event would be costly for state and local governments because of the potential for damages associated with property, debris generation, and loss of power. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public confidence in state governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a tornado event.

3.18.9 Vulnerability and Impact

FEMA's Community Lifelines Implementation Toolkit can be used to identify several key sectors vulnerable to the impact of tornado events in Maryland. Community Lifelines broadly include "critical government and business functions…essential to human health and safety or economic security.". The primary Community Lifelines impacted by tornado events are the Energy, Communications, and Food, Water, and Shelter Lifelines.[200]

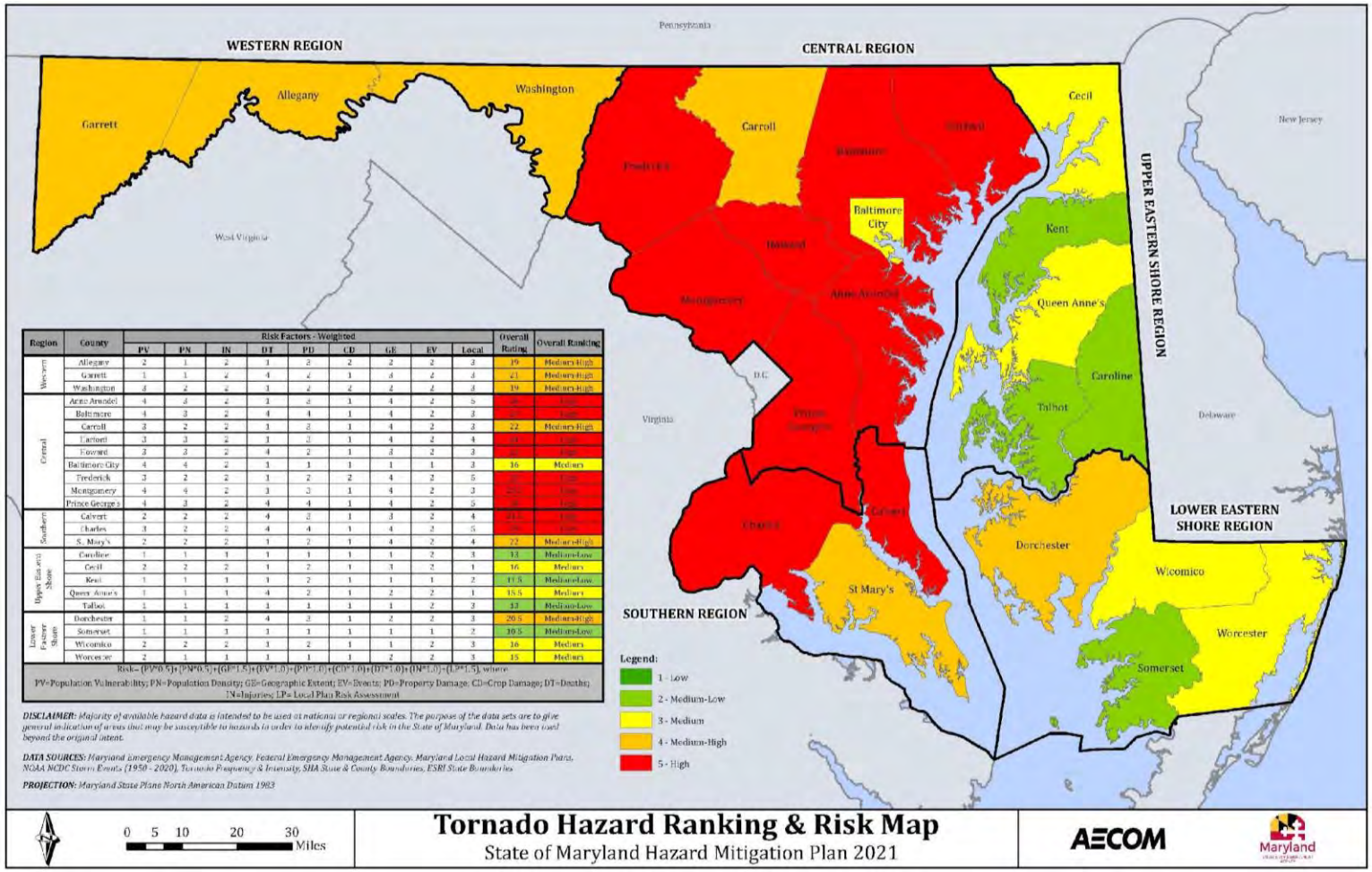
A national example of these impacts occurred in March 2017 when a powerful tornado outbreak impacted the Northeast and Midwest. According to the NCA4, almost 1 million individuals lost power in Michigan alone, disrupting emergency response and communication infrastructure.[201] Another consequence of tornadoes is the destruction of housing for affected areas, which displaces local populations and necessitates rebuilding.

[200] *Community Lifelines.* FEMA. July 27, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

[201] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

3.18.10 Tornado Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	3	2	2	2	3	19	Medium-High
	Garrett	1	1	2	4	2	1	3	2	3	21	Medium-High
	Washington	3	2	2	1	2	2	2	2	3	19	Medium-High
Central	Anne Arundel	4	3	2	1	3	1	4	2	5	25	High
	Baltimore	4	3	2	4	4	1	4	2	3	27	High
	Carroll	3	2	2	1	3	1	4	2	3	22	Medium-High
	Harford	3	3	2	1	3	1	4	2	4	23	High
	Howard	3	3	2	4	2	1	3	2	3	25	High
	Baltimore City	4	4	2	1	1	1	1	1	3	16	Medium
	Frederick	3	2	2	1	2	2	4	2	5	25	High
	Montgomery	4	4	2	1	3	1	4	2	3	25	High
	Prince George's	4	3	2	4	4	1	4	2	5	29	High
Southern	Calvert	2	2	2	4	3	1	3	2	4	24.5	High
	Charles	3	2	2	4	4	1	4	2	5	27	High
	St. Mary's	2	2	2	1	2	1	4	2	4	22	Medium-High
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	2	3	13	Medium-Low
	Cecil	2	2	2	1	2	1	3	2	1	16	Medium
	Kent	1	1	1	1	2	1	1	1	2	11.5	Medium-Low
	Queen Anne's	1	1	1	4	2	1	2	2	1	15.5	Medium
	Talbot	1	1	1	3	1	1	1	2	3	13	Medium-Low
Lower Eastern Shore	Dorchester	1	1	2	4	3	1	2	2	3	20.5	Medium-High
	Somerset	1	1	1	3	1	1	1	1	2	10.5	Medium-Low
	Wicomico	2	2	2	3	2	1	1	2	3	16	Medium
	Worcester	2	1	1	3	1	1	2	2	3	15	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.19 Wildfire

3.19.1 Definition

The primary cause of wildfire in both Maryland and the US is human activity, accounting for 96 percent of the state's wildfires. In Maryland the two leading human causes are improper outdoor burning (28%) and arson (23%), contributing to over half of annual events. Additional sources include smoking, campfires and downed power lines. The most common natural cause of wildfires is lightning; however, this accounts for only 4 percent of Maryland's ignition sources. According to the NWS[202] a wildfire is defined as follows:

Wildfire: Any significant forest fire, grassland fire, rangeland fire, or wildland-urban interface (WUI) fire that consumes the natural fuels and spreads in response to its environment.

3.19.2 Location

Although wildfires have the potential to impact most areas, they typically begin in natural areas and present the greatest threat to communities located within the WUI. This zone is characterized as the area where structures are built in or near natural areas.[203] Based on this information, the western, central, and southern regions of the state are most likely to experience wildfires.

Because most wildfires are human caused, the mixture of human activity and structures near natural fuels in the WUI makes it highly vulnerable to wildfire events. Exacerbating the issue, the number of homes and development occurring in the WUI have increased dramatically in Maryland in recent years, in turn increasing overall wildfire risk.[204]

3.19.3 Extent (Magnitude/Strength)

Fire managers predict daily wildfire potential in an area using the National Fire Danger Rating System (NFDRS). NFRDS is an index that factors in fuels, weather, topography, and risk and translates them into one of five categories. The five classifications include Low, Moderate, High, Very High, and Extreme. Posting that day's classification allows authorities to appropriately prepare for potential wildfires and informs the general public of the area's fire danger level.[205] Table 3-50 defines each of the NFDRS classifications.

---

[202] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[203] Wildland Urban Interface (WUI). U.S. Fire Administration. April 29, 2021. Available at: https://www.usfa.fema.gov/wui/.

[204] Wildland Fire in Maryland: Learn the Facts About Fire Behavior in Maryland. Maryland Department of Natural Resources. n.d. Accessed April 29, 2021. Available at: https://dnr.maryland.gov/forests/Pages/wfm.aspx.

[205] National Fire Danger Rating System. U.S. Department of Agriculture. Forest Service. Cibola National Forest & National Grasslands. n.d. Accessed April 29, 2021. Available at: https://www.fs.usda.gov/detail/cibola/landmanagement/resourcemanagement/?cid=stelprdb5368839.

Table 3-50: NFDRS Classification System

Fire Danger Level	Description
Low	When the fire danger is "low," fuels do not ignite easily from small embers, but a more intense heat source, such as lightning, may start fires in duff or dry rotten wood. Fires in open, dry grasslands may burn easily a few hours after a rain, but most wood fires will spread slowly, creeping or smoldering. Control of fires is generally easy.
Moderate	When the fire danger is "moderate," fires can start from most accidental causes, but the number of fire starts is usually pretty low. If a fire does start in an open, dry grassland, it will burn and spread quickly on windy days. Most wood fires will spread slowly to moderately. Average fire intensity will be moderate except in heavy concentrations of fuel, which may burn hot. Fires are still not likely to become serious and are often easy to control.
High	When the fire danger is "high," fires can start easily from most causes and small fuels (such as grasses and needles) will ignite readily. Unattended campfires and brush fires are likely to escape. Fires will spread easily, with some areas of high intensity burning on slopes or concentrated fuels. Fires can become serious and difficult to control unless they are put out while they are still small.
Very High	When the fire danger is "very high," fires will start easily from most causes. The fires will spread rapidly and have a quick increase in intensity, right after ignition. Small fires can quickly become large fires and exhibit extreme fire intensity, such as long-distance spotting and fire whirls. These fires can be difficult to control and will often become much larger and longer-lasting fires.
Extreme	When the fire danger is "extreme," fires of all types start quickly and burn intensely. All fires are potentially serious and can spread very quickly with intense burning. Small fires become big fires much faster than at the "very high" level. Spot fires are probable, with long-distance spotting likely. These fires are very difficult to fight, may become very dangerous, and often last for several days.

3.19.4 Previous Occurrences

In Maryland, the fire season peaks in the spring when leaves blanket the forest floor, allowing sunlight and wind to dry forest fuels. Combined with relatively low humidity and higher winds, wildfires are more likely to spread and affect a larger area. However, although spring is considered the "fire season," wildfires can still take place throughout the year. Some wildfire events can spread over thousands of acres, but most events in Maryland burn less than 10 acres.

Since the publication of the 2016 Plan, no federally declared wildfire events have occurred within the state.[206] According to the DNR, the Maryland Forest Service responds to an average of 325 wildfires, which burn 3,200 acres of land, each year.[207]

Despite an absence of major wildfire events, toxic smoke from West Coast wildfires affected Maryland in 2019 and 2020. For example, on September 16, 2020, haze from

[206] Declared Disasters. FEMA. Available at: https://www.fema.gov/disasters/disaster-declarations.

[207] Wildland Fire in Maryland: Learn the Facts About Fire Behavior in Maryland. Maryland Department of Natural Resources. n.d. Accessed April 29, 2021. Available at: https://dnr.maryland.gov/forests/Pages/wfm.aspx.

the California wildfires reached Baltimore, impacting air quality and lowering visibility.[208]

Despite the lack of recent major events, it is important for the state to continue to mitigate the wildfire threat, especially within vulnerable areas such as the WUI.[209]

3.19.5 Future Probability and Climate Change Conditions

As stated previously, wildfires occur year-round (peaking in the spring) and are largely caused by human activity. Therefore, the probability of a wildfire event each year is likely. The future increase in global temperatures and frequency are just two factors contributing to a predicted rise in future wildfire events and the expansion of the fire season.

According to the NCA4, "increased wildfire driven by climate change is projected to increase costs associated with health effects, loss of homes and other property, wildfire response, and fuel management.". The report also states that the increase in wildfires due to climate change will present an increased threat to air quality. For example, wildfire smoke can impact areas hundreds of miles away as in 2015 when Canadian wildfires lowered air quality in Baltimore. To effectively plan for future events, Maryland should address the "interconnected impacts" of wildfires to enhance resilience.[210]

3.19.6 Critical Facilities and Wildfire Hazard

Wildfire loss estimations indicate that Anne Arundel, Baltimore, Frederick, Harford and Montgomery counties have the highest critical facility building value and content value loss estimations. Table 3-51 lists the number of critical facilities by jurisdiction with potential losses from wildfires. Please note that given that the risk methodology does not indicate any jurisdictions at a High risk of wildfire, the loss estimations table for this hazard has been expanded to account for those facilities within the Medium-High risk jurisdictions.

Table 3-51: Critical Facilities Wildfire Loss Estimations

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Allegany	70	$405,841,100	$26,074,500	$431,915,600
Anne Arundel	114	$790,979,500	$346,814,200	$1,137,793,700

[208] "Hazy Sunshine from Western Wildfires Sticks Around In Maryland Wednesday." By CBS Baltimore Staff. September 16, 2020. Available at: https://baltimore.cbslocal.com/2020/09/16/hazy-sunshine-from-western-wildfires-sticks-around-in-maryland-wednesday/.

[209] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

[210] Ibid.

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
City of Annapolis	25	$277,074,600	$85,820,600	$362,895,200
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Calvert	73	$456,940,700	$44,494,800	$501,435,500
Frederick	121	$1,134,849,300	$164,251,400	$1,299,100,700
Garrett	19	$118,423,900	$16,147,100	$134,571,000
Harford	116	$1,005,729,000	$161,993,400	$1,167,722,400
Montgomery	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
St. Mary's	43	$343,849,400	$20,758,800	$364,608,200
Washington	87	$772,391,000	$136,656,400	$909,047,400
TOTALS	**1316**	**$10,936,068,900**	**$2,864,384,600**	**$13,800,453,500**

3.19.7 State Assets and Wildfire Hazard

Wildfire loss estimations indicate that Allegany, Anne Arundel, and Baltimore counties have the highest critical facility building value and content value loss estimations. Table 3-52 lists the number of state assets by jurisdiction with potential losses from wildfires. Please note that given that the risk methodology does not indicate any jurisdictions at a High risk of wildfire, the loss estimations table for this hazard has been expanded to account for those assets within the Medium-High risk jurisdictions.

Table 3-52: State Assets Wildfire Loss Estimations

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Allegany	300	$1,092,532,665	$72,024,901	$1,164,557,566
Anne Arundel	529	$2,605,628,861	$350,495,752	$2,956,124,613
City of Annapolis	232	$1,511,516,177	$131,068,888	$1,642,585,066
Baltimore	745	$4,449,953,887	$580,907,824	$5,030,861,711
Calvert	132	$181,259,297	$25,583,708	$206,843,005
Frederick	197	$251,189,535	$36,724,173	$287,913,708
Garrett	297	$393,966,369	$31,509,966	$425,476,335

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Harford	220	$321,074,212	$24,216,692	$345,290,904
Montgomery	192	$317,749,390	$55,868,060	$373,617,450
St. Mary's	324	$613,989,775	$146,246,420	$760,236,195
Washington	335	$486,065,188	$42,699,821	$528,765,009
TOTALS	**3503**	**$12,224,925,356.22**	**$1,497,346,204.72**	**$13,722,271,561.94**

3.19.8 Wildfire Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a wildfire event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-53.

Table 3-53: Wildfire Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners in high wildfire risk zones in the state are most vulnerable to impacts from a wildfire event. Impacts to the public include destruction of property, injuries related to burns and smoke inhalation, and road closures.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people from the fire area, close roads, create fire breaks, and attend to any injured. During a wildfire event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is directly within the path of destruction of a wildfire. Delivery of services may be slowed or halted in affected areas as a result of blocked roadways, and/or momentary losses in power and communications caused by destroyed infrastructure.
Property, Facilities, and Infrastructure	Home and landowners within a wildfire area may experience varying levels of damage to property depending upon the severity of the fire and the amount of decline in air quality within the hazard area. Infrastructure may experience impacts in the form of interruptions to above ground power and communication systems, and road detours and closures.
Environment	Wildfires impact the environment by spreading pollution, creating health problems by reducing air quality from the spread of ash and smoke, and disturbing or destroying wildlife and natural areas.

Subject	Impacts
Economic Condition of the State	A major wildfire event would be costly for state and local governments because of the potential for damages associated with property, infrastructure, and impacts to health and air quality. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a wildfire event.

3.19.9 Vulnerability and Impact

In addition to natural areas, wildfires in Maryland threaten hundreds of homes and buildings annually while also threatening human lives.[211] FEMA's Community Lifelines Implementation Toolkit can be used to identify key sectors vulnerable to the impact of wildfire events in Maryland. Community Lifelines broadly include "critical government and business functions…essential to human health and safety or economic security." The primary Community Lifelines impacted by wildfire events are the Energy; Safety and Security; Health and Medical; and Food, Water, and Shelter Lifelines.[212]

National examples include the Tubbs Fire of October 2017 in California, which caused an estimated $1.2 billion in damages and heavily impacted the WUI of Santa Rosa. Flames destroyed housing stock, strained fire response, and spewed toxic smoke into neighboring areas. The ever-increasing proximity of wildfires to communities increased the total damage, killing dozens and leaving victims homeless.[213]

Although the scale of the Tubbs Fire was larger than any wildfire events in Maryland to date, climate change and expanding development elevate the vulnerability of communities. Addressing this exposure and tailoring plans to specifically address wildfire hazards and dangers will allow Maryland to appropriately prepare for future wildfire events.

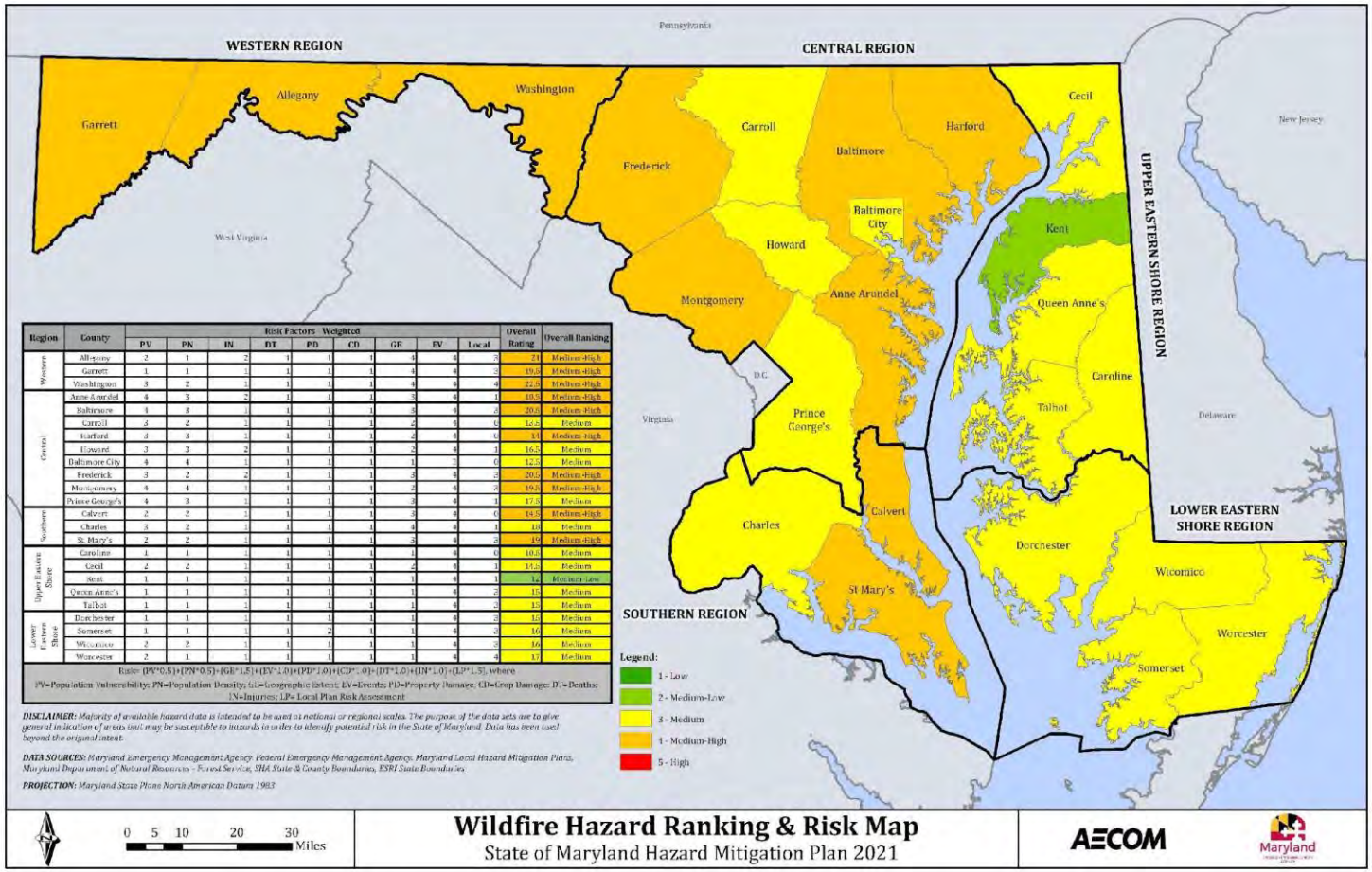
[211] Wildland Fire in Maryland: Learn the Facts About Fire Behavior in Maryland. Maryland Department of Natural Resources. n.d. Accessed April 29, 2021. Available at: https://dnr.maryland.gov/forests/Pages/wfm.aspx.

[212] *Community Lifelines.* FEMA. July 27, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

[213] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

3.19.10 Wildfire Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	4	4	3	21	Medium-High
	Garrett	1	1	1	1	1	1	4	4	3	19.5	Medium-High
	Washington	3	2	1	1	1	1	4	4	4	22.5	Medium-High
Central	Anne Arundel	4	3	2	1	1	1	3	4	1	20.5	Medium-High
	Baltimore	4	3	1	1	1	1	3	4	2	20.5	Medium-High
	Carroll	3	2	1	1	1	1	2	3	0	12.5	Medium
	Harford	3	3	1	1	1	1	2	4	0	14	Medium-High
	Howard	3	3	2	1	1	1	2	4	1	16.5	Medium
	Baltimore City	4	4	1	1	1	1	1	3	0	12.5	Medium
	Frederick	3	2	2	1	1	1	3	4	3	20.5	Medium-High
	Montgomery	4	4	1	1	1	1	2	4	2	19.5	Medium-High
	Prince George's	4	3	1	1	1	1	3	4	1	17.5	Medium
Southern	Calvert	2	2	1	1	1	1	3	4	0	14.5	Medium-High
	Charles	3	2	1	1	1	1	4	4	1	18	Medium
	St. Mary's	2	2	1	1	1	1	3	4	2	19	Medium-High
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	4	0	10.5	Medium
	Cecil	2	2	1	1	1	1	2	4	1	14.5	Medium
	Kent	1	1	1	1	1	1	1	4	1	12	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	4	2	15	Medium
	Talbot	1	1	1	1	1	1	1	4	2	15	Medium
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	4	2	15	Medium
	Somerset	1	1	1	1	2	1	1	4	2	16	Medium
	Wicomico	2	2	1	1	1	1	1	4	2	16	Medium
	Worcester	2	1	1	1	1	1	1	4	4	17	Medium

Rule: (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards to aides to identify potential risk in the State of Maryland. Data has been used beyond the original intent.

DATA SOURCES: Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Natural Resources - Forest Service, SHA State & County Boundaries, ESRI State Boundaries

PROJECTION: Maryland State Plane North American Datum 1983

3.20 Wind

3.20.1 Definition

Wind is the motion of air past a given point caused by a difference in pressure from one place to another. Maryland is vulnerable to two basic types of damaging winds (other than tropical systems): synoptic-scale winds and thunderstorm winds. Synoptic-scale winds are typically caused by a cold front or nor'easter, while thunderstorm winds are caused by downbursts during storms. Wind affects the entirety of Maryland and may result in dangerous debris, fallen trees, and disruptions to over-head electric and communications infrastructure.[214] The three wind hazard types identified in the 2016 Plan (high wind, thunderstorm wind, and strong wind) are defined by the NWS[215] in Table 3-54, below.

3.20.2 Location

Generally, Maryland experiences wind events across the entire state. For example, tornadoes and thunderstorms can appear throughout the state, generating high wind gusts and threatening lives and property despite geography.[216] Wind damage also affects Maryland year-round unlike other hazard types.

However, urban areas, such as Baltimore, may incur more wind damage as a result of their higher population densities and the centrality of electric and communications infrastructure.[217]

3.20.3 Extent (Magnitude/Strength)

According to a Congressional Budget Office study[218], the United States expected annual economic loss due to hurricane wind damage is $14 billion. Paired with an expected increase in severe weather and billion-dollar disasters (i.e., hurricanes), wind damage poses a substantial risk to Maryland.

The classification of individual wind events varies depending on the event type, wind speed, and total damage. According to the NWS, wind damage classifications include high wind, thunderstorm wind, and strong wind. In addition to wind classification, some of the hazard types that cause wind damage also have their own

---

[214] *State of Maryland 2016 Hazard Mitigation Plan, August 2016*. March 2015. FP 302-094-2. Available at: https://mema.maryland.gov/community/Documents/2016_Maryland_Hazard_Mitigation_Plan_final_2.pdf.

[215] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[216] *State of Maryland 2016 Hazard Mitigation Plan, August 2016*. March 2015. FP 302-094-2. Available at: https://mema.maryland.gov/community/Documents/2016_Maryland_Hazard_Mitigation_Plan_final_2.pdf.

[217] "A Model for U.S. Tornado Casualties Involving Interaction between Damage Path Estimates of Population Density and Energy Dissipation." *Journal of Applied Meteorology and Climatology*. By James B. Elsner, Tyler Fricker, and William D. Berry. 01 Sep 2018. DOI: https://doi.org/10.1175/JAMC-D-18-0106.1; Page(s): 2035–2046. Available at: https://journals.ametsoc.org/jamc/article/57/9/2035/107242/A-Model-for-U-S-Tornado-Casualties-Involving.

[218] *Expected Costs of Damage from Hurricane Winds and Storm Related-Flooding. April 10, 2019*. Congressional Budget Office. Available at: https://www.cbo.gov/publication/55019.

respective rating system (e.g., the EF Scale) that are discussed in other sections of this document.[219] Table 3-54 describes the three wind damage classifications.

Table 3-54: Wind Classification Scale

Wind Type	Description
High Wind	Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined).
Thunderstorm Wind	Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage.
Strong Wind	Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.

3.20.4 Previous occurrences

Since the publication of the 2016 Plan, one federally declared severe storm event, with substantial wind damage, occurred within the state. The event affected Washington and Frederick counties between May 15 to May 18, 2018.[220] According to the NCDC database, between January 2017 and April 2020, there have been 1,331 wind events, 1,247 of which were identified as thunderstorm wind and 84 of which were identified as high wind.[221]

These events caused an estimated $3,610,760 in property damages, as well as eight injuries and four deaths. The single most destructive event occurred on April 13, 2020, when Montgomery County experienced multiple severe thunderstorms and incurred $1,278,812 in wind damages within 1 hour, cutting power to many residents and disrupting roadways.[222, 223] Other affected areas that day included Howard ($20,000), Anne Arundel ($5,000), and Baltimore ($5,000) counties.

3.20.5 Future Probability and Climate Change Conditions

As stated previously, wind events happen frequently, occur year-round and stem from multiple hazard types. Therefore, the probability of a wind event each year is highly likely. While some hazard events, such as hurricanes, are expected to become more frequent and intense, the future probability of wind events is unclear.

---

[219] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[220] Declared Disasters. FEMA. Available at: https://www.fema.gov/disasters/disaster-declarations.

[221] https://www.ncdc.noaa.gov/stormevents/.

[222] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[223] NOAA National Weather Service Storm Prediction Center. National Centers for Environmental Prediction: 20200413's Storm Reports (20200413 1200 UTC - 202004141159 UTC). n.d. Accessed April 29, 2021. Available at: https://www.spc.noaa.gov/exper/archive/event.php?date=20200413.

According to the NCA4, "projections of future changes in severe thunderstorms, tornadoes, hail, and strong wind events are uncertain." The difficulty projecting future events can be attributed, in part, to a need for further research and lack of historical data.[224]

3.20.6 Critical Facilities and Wind Hazard

Wind loss estimations Table 3-55)indicate that Baltimore and Montgomery counties, as well as the City of Baltimore, have the highest critical facility building value and content value loss estimations. Table 3-56 lists the number of critical facilities by jurisdiction with potential losses from wind.

Table 3-55: Critical Facilities Wind Loss Estimations

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	139	$1,068,054,100	$432,634,800	$1,500,688,900
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Baltimore City	457	$6,678,537,100	$765,069,700	$7,443,606,800
Calvert	73	$456,940,700	$44,494,800	$501,435,500
Carroll	115	$1,060,600,400	$202,732,100	$1,263,332,500
Cecil	91	$390,260,000	$48,748,200	$439,008,200
Charles	80	$589,289,300	$260,895,700	$850,185,000
Frederick	121	$1,134,849,300	$164,251,400	$1,299,100,700
Montgomery	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
Prince George's	251	$1,006,600,260	$172,844,080	$1,179,444,340
Queen Anne's	49	$247,202,800	$56,039,700	$303,242,500
St. Mary's	43	$343,849,400	$20,758,800	$364,608,200
Somerset	26	$131,931,500	$10,435,200	$142,366,700
TOTAL	**2093**	**$18,738,105,260**	**$4,040,277,880**	**$22,778,383,140**

3.20.7 State Assets and Wind Hazard

Wind loss estimations indicate that Anne Arundel, Baltimore, and Prince George's counties, as well as the City of Baltimore, have the highest state asset building value and content value loss estimations. Table 3-56 lists the number of state assets by jurisdiction with potential losses from wind.

[224] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

Table 3-56: State Assets Wind Loss Estimations

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Anne Arundel	761	$4,117,145,038	$481,564,640	$4,598,709,678
Baltimore	745	$4,449,953,887	$580,907,824	$5,030,861,711
Baltimore City	867	$9,777,581,486	$954,973,603	$10,732,555,089
Calvert	132	$181,259,297	$25,583,708	$206,843,005
Carroll	235	$672,857,398	$79,141,528	$751,998,926
Cecil	292	$196,145,839	$35,864,521	$232,010,360
Charles	153	$161,933,486	$19,981,043	$181,914,529
Frederick	197	$251,189,535	$36,724,173	$287,913,708
Montgomery	192	$317,749,390	$55,868,060	$373,617,450
Prince George's	628	$4,033,876,220	$510,320,283	$4,544,196,503
Queen Anne's	98	$179,154,426	$22,760,940	$201,915,366
St. Mary's	324	$613,989,775	$146,246,420	$760,236,195
Somerset	265	$12,933,651,348	$282,487,471	$13,216,138,819
TOTAL	**4889**	**$37,886,487,125**	**$3,232,424,214**	**$41,118,911,339**

3.20.8 Wind Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a wind event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-57.

Table 3-57: Wind Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners throughout the state are at risk to impacts from a high-wind event. Impacts to the public include potential for injury or loss of life, and destruction of property due to high winds.
Health and Safety of Responders	First responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads due to fallen trees and/or debris blockages, and attend to any injured. For a high-wind event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	The impacts on continuity of operations would be limited, unless a facility is directly adversely affected by a severe wind event. Delivery of services may

Subject	Impacts
	be slowed or halted in affected areas as a result of momentary losses in power and communications.
Property, Facilities, and Infrastructure	Home and landowners throughout the state may experience damage to property depending upon the severity of winds in the area. Infrastructure may experience impacts in the form of blowing debris and interruptions to above-ground power and communication systems.
Environment	High winds impact the environment by potentially spreading debris and pollution, damaging sewer and wastewater treatment plants, and disturbing wildlife and natural areas.
Economic Condition of the State	A major wind event would be costly for state and local governments because of the potential for damages associated with property, debris generation, and loss of power. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a high-wind event.

3.20.9 Vulnerability and Impact

FEMA's Community Lifelines Implementation Toolkit van be used to identify several key sectors vulnerable to the impact of wind events in Maryland. Community Lifelines broadly include "critical government and business functions…essential to human health and safety or economic security.". The primary Community Lifelines impacted by wind events are the Energy; Communications; Transportation; and Food, Water, and Shelter Lifelines.[225]

Similar national examples include Hurricane Maria's high-wind events, which the NCA4 concluded "caused widespread devastation to Puerto Rico's transportation, agriculture, communication, and energy infrastructure."[226] This interruption of services for these sectors led to delays in recovery and rebuilding efforts, demonstrating the adverse impact potential high-wind events pose to these key Lifelines.

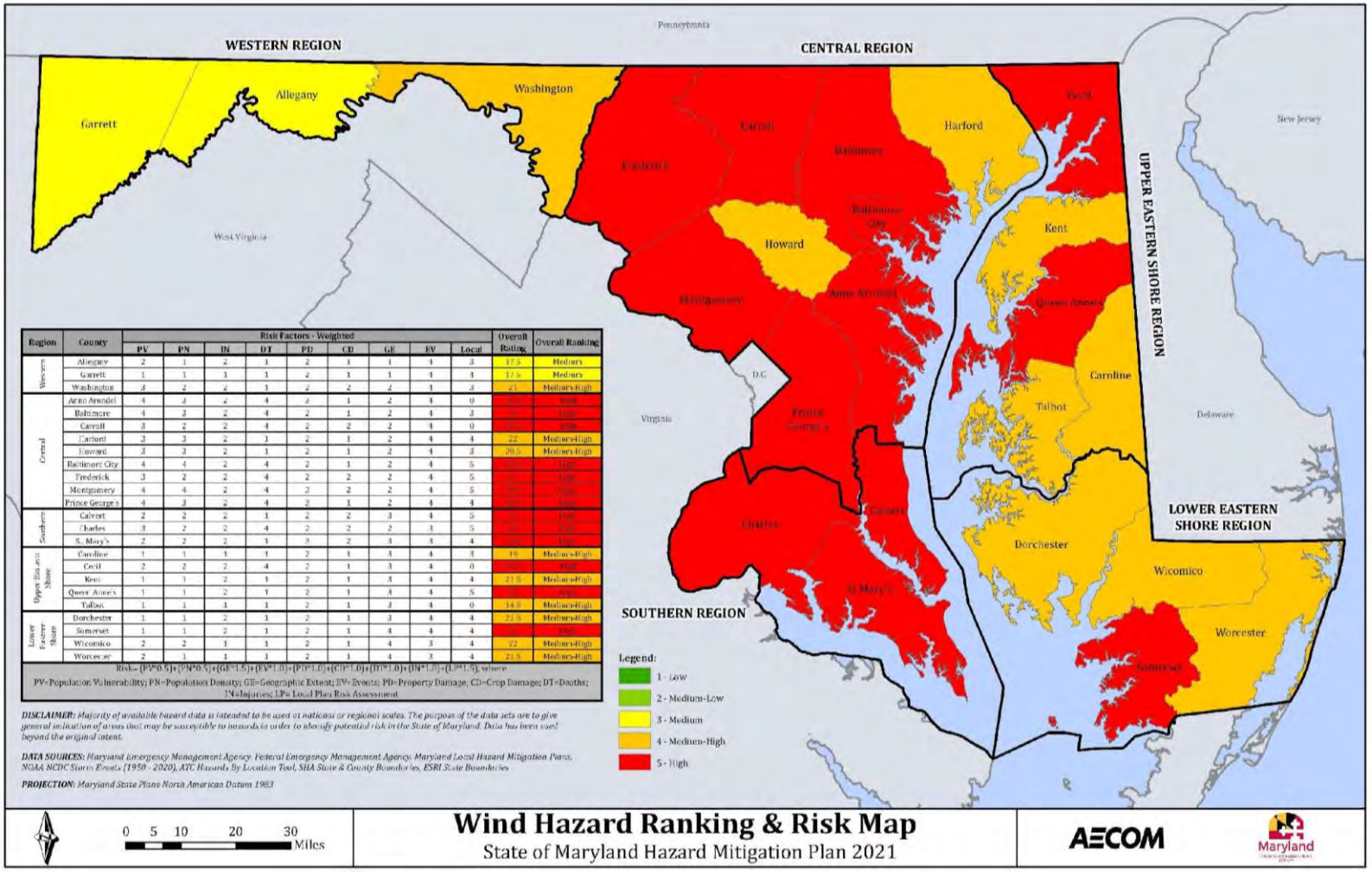
Mitigating the impact of future wind events on these primary sectors may reduce the overall cost of events and lead to a more resilient Maryland.

[225] *Community Lifelines.* FEMA. July 27, 2020. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

[226] *The Fourth National Climate Assessment. Volume II, Impacts, Risks, and Adaptation in the United States.* U.S. Global Change Research Program, 2018.; Revised February 2020. Available at: https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

3.20.10 Wind Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	2	1	1	1	3	17.5	Medium
	Garrett	1	1	1	1	2	1	1	1	1	17.5	Medium
	Washington	3	2	2	1	2	2	2	1	3	23	Medium-High
Central	Anne Arundel	4	3	2	4	2	1	2	1	0	[illegible]	[illegible]
	Baltimore	4	3	2	4	2	1	2	1	3	[illegible]	[illegible]
	Carroll	3	2	2	4	2	2	2	1	0	[illegible]	[illegible]
	Harford	3	3	2	1	2	1	2	4	4	22	Medium-High
	Howard	3	3	2	1	2	1	2	4	3	20.5	Medium-High
	Baltimore City	4	4	2	4	2	1	2	4	5	[illegible]	[illegible]
	Frederick	3	2	2	4	2	2	2	4	5	[illegible]	[illegible]
	Montgomery	4	4	2	4	3	2	2	4	5	[illegible]	[illegible]
	Prince George's	4	3	2	4	3	1	2	4	4	[illegible]	[illegible]
Southern	Calvert	2	2	2	1	2	2	3	4	5	[illegible]	[illegible]
	Charles	3	2	2	4	2	2	2	3	5	[illegible]	[illegible]
	St. Mary's	2	2	2	1	3	2	3	3	4	[illegible]	[illegible]
Upper Eastern Shore	Caroline	1	1	1	1	2	1	3	4	3	19	Medium-High
	Cecil	2	2	2	4	2	1	3	4	0	[illegible]	[illegible]
	Kent	1	1	2	1	2	1	3	4	4	21.5	Medium-High
	Queen Anne's	1	1	2	1	2	1	3	4	5	[illegible]	[illegible]
	Talbot	1	1	1	1	2	1	3	4	0	14.5	Medium-High
Lower Eastern Shore	Dorchester	1	1	2	1	2	1	3	4	4	21.5	Medium-High
	Somerset	1	1	2	1	2	1	4	4	4	[illegible]	[illegible]
	Wicomico	2	2	1	1	2	1	4	3	4	22	Medium-High
	Worcester	2	1	1	1	2	1	4	3	4	21.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.21 Winter Weather

3.21.1 Definition

Maryland has a long history of hazardous winter weather, which can take many forms either as independent events (such as snow, freezing rain, and cold temperature events) or in combination. Some of the most significant winter storms that affect Maryland are known as "nor'easters" because they have strong northeast winds; these storms are also typically accompanied by heavy rain or snowfall and may cause coastal flooding and erosion.[227] The winter weather hazards prevalent in Maryland are defined by the NWS[228] as follows:

Blizzard: "A winter storm which produces the following conditions for 3 consecutive hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile."

Cold/wind chill:[229] "Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -180F or colder) conditions."

Freezing fog: "Fog which freezes on contact with exposed objects and forms a coating of rime and/or glaze, resulting in an impact on transportation, commerce, or individuals. Even small accumulations of ice can have an impact. Freezing fog can occur with any visibility of 6 miles or less."

Frost/freeze: "A surface air temperature of 32 degrees Fahrenheit (F) or lower, or the formation of ice crystals on the ground or other surfaces, for a period of time long enough to cause human or economic impact, during the locally defined growing season."

Heavy snow: "Snow accumulation meeting or exceeding locally/regionally defined 12 and/or 24 hour warning criteria. This could mean values such as 4, 6, or 8 inches or more in 12 hours or less; or 6, 8, or 10 inches in 24 hours or less."

Ice storm: "Ice accretion meeting or exceeding locally/regionally defined warning criteria (typical value is 1/4 or 1/2 inch or more)."

Sleet/freezing rain: "Sleet accumulations meeting or exceeding locally/regionally defined warning criteria (typical value is ½ inch or more)."

Winter storm: "A winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or

[227] Nor'easters are not an event type categorized by NCDC.

[228] Storm Data Preparation, NOAA National Weather Service Instruction 10-1605, Operations and Services Performance, NWSPD 10-16. March 23, 2016. Available at: https://www.ncdc.noaa.gov/stormevents/pd01016005curr.pdf.

[229] Extreme cold/wind chill is included in the Extreme Temperatures hazard category.

snow, sleet and ice) and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements."

Winter weather: "A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria. A Winter Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle). The Winter Weather event can also be used to document out-of-season and other unusual or rare occurrences of snow, or blowing/drifting snow, or freezing rain/drizzle."

3.21.2 Location

Winter weather can occur in nearly all states in the country, and some events can affect entire regions and have widespread impacts across Community Lifelines. Likewise, a single winter weather event can produce varying impacts depending on geographical features or location; for example, more mountainous areas can have more intense impacts (e.g., greater snow accumulation, lower temperatures); whereas, more coastal areas can have milder or different impacts (e.g., sleet instead of snow, coastal flooding due to the effects of wind).

Winter weather is possible in all 24 counties/county equivalents in the State of Maryland and poses a high risk to all counties in the western and central regions. These regions, which include the greater Baltimore and Washington, D.C. areas, are home to more than 70 percent of the state's population, making them particularly vulnerable to hazard impacts.

3.21.3 Extent (Magnitude/Strength)

While some hazards have widely-used scales to measure relative magnitude (such as the Saffir-Simpson Hurricane Wind Scale), winter weather does not have a scale that is broadly accepted, possibly because some localities are more accustomed to dealing with winter weather events as a result of past experience and the predictable nature of winter weather (due to seasonality, for example), making an objective reference difficult. Instead, winter weather is typically measured by metrics such as depth of snowfall, temperature, or wind speed.

Winter weather is most likely to impact the state between November and March, although the state has experienced occasional events in October and April. Average seasonal snowfall is around 20 inches, with snowfall averages ranging from 10 inches in the southeast part of the state to over 100 inches in the westernmost part of the state. Garrett County, the state's westernmost county, has the highest snowfall record for the winter of 2009–2010, when 262.5 inches accumulated in a single season.

The average statewide winter temperature is 34.1 degrees Fahrenheit. Coastal counties tend to have milder temperatures; whereas, western counties experience lower temperatures with some parts of the state averaging around 26 degrees Fahrenheit in Maryland's coldest month of January.

3.21.4 Previous Occurrences

Since the 2016 Plan, no federally declared winter weather events have occurred in Maryland.[230] However, hundreds of winter weather events are noted across the state in the NCDC database, with all but one event type impacting the state since 2016 (with the exception of sleet/freezing rain as an individual event type). Despite all these winter weather events over the past 5 years, only one has recorded deaths and injuries; in December 2016, icy roads resulted in a multi-car accident that caused two deaths and 12 injuries in the Baltimore area.[231]

Despite the lack of federally declared disasters resulting from winter weather, one notable event occurred in January of 2018 when a winter storm caused major impacts to the Transportation Community Lifeline. Hazardous road conditions generated hundreds of calls for assistance, especially in the lower Eastern Shore.[232] The wind from this same storm created the lowest tides experienced in the Chesapeake Bay in nearly 30 years when gauges in the Patapsco River measured water levels at 3.58 feet lower than the mean lower low water mark at Fort McHenry. The U.S. Coast Guard closed the Port of Baltimore in anticipation of strong winds in the Chesapeake Bay, impacting shipping for several days.[233] Gusts peaked at 77 mph at the mouth of the Chesapeake Bay and were recorded at more than 40 mph at the Francis Scott Key Bridge in Baltimore.[234]

3.21.5 Future Probability and Climate Change Conditions

According to the NCA4, "winters have warmed three times faster than summers" in recent years and this trend is expected to continue, likely resulting "in a shorter and less pronounced cold season with fewer frost days and a longer transition out of winter into the growing season."[235] Moreover, the NCA4 projects a shorter snow season, fewer days below freezing, and more winter precipitation falling as rain rather than snow. Despite these trends, the future probability of winter weather events remains highly likely.

---

[230] Winter Storm Jonas, for which a federal disaster declaration was granted in January 2016, was included in the 2016 Plan Update.

[231] Storm Events Database. NOAA National Centers for Environmental Information. n.d. Accessed April 29, 2021. Available at: https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=669815.

[232] "Winter storm results in 382 crashes, 409 disabled vehicle incidents in Va., Md. area." By ABC7 (Washington), January 4, 2018. Available at: https://wjla.com/news/local/winter-storm-causes-277-crashes-226-disabled-vehicle-incidents-in-va-md.

[233] "Coast Guard: No Ships to Enter Baltimore Port Ahead of Storm." CBS Baltimore. January 3, 2018. Available at: https://baltimore.cbslocal.com/2018/01/03/port-of-baltimore-winter-storm-closed/.

[234] "Baltimore records one of lowest tides in decades amid 'bomb cyclone' winds." By Scott Dance, *The Baltimore Sun*. January 04, 2018. Available at: https://www.baltimoresun.com/weather/bs-md-bomb-cyclone-tide-20180104-story.html.

[235] *Fourth National Climate Assessment*, *Volume II, Impacts, Risks, and Adaptation in the United States*, Chapter 18: "Northeast." U.S. Global Change Research Program. 2018; revised February 2020. Available at: https://nca2018.globalchange.gov/chapter/18/.

3.21.6 Critical Facilities and Winter Weather Hazard

Winter weather loss estimations indicate that Baltimore and Montgomery counties as well as the City of Baltimore have the highest critical facility building value and content loss estimations. Table 3-58 lists the number of critical facilities by jurisdiction with potential losses from winter weather.

Table 3-58: Critical Facilities Winter Weather Loss Estimations

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations		
		Building Value	Content Value	Total Loss
Allegany	70	$405,841,100	$26,074,500	$431,915,600
Anne Arundel	139	$1,068,054,100	$432,634,800	$1,500,688,900
Baltimore	427	$2,258,308,000	$793,597,900	$3,051,905,900
Baltimore City	457	$6,678,537,100	$765,069,700	$7,443,606,800
Carroll	115	$1,060,600,400	$202,732,100	$1,263,332,500
Frederick	121	$1,134,849,300	$164,251,400	$1,299,100,700
Howard	35	$448,961,200	$110,140,200	$559,101,400
Montgomery	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
Prince George's	251	$1,006,600,260	$172,844,080	$1,179,444,340
St. Mary's	43	$343,849,400	$20,758,800	$364,608,200
TOTALS	**1,879**	**$17,777,283,260.00**	**$3,755,878,980.00**	**$21,533,162,240.00**

3.21.7 State Assets and Winter Weather Hazard

Winter weather loss estimations indicate that Anne Arundel, Baltimore, and Prince George's counties as well as the City of Baltimore have the highest critical facility building value and content loss estimations. Table 3-59 lists the number of state assets by jurisdiction with potential losses from winter weather.

Table 3-59: State Assets Winter Weather Loss Estimations

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Allegany	300	$1,092,532,665	$72,024,901	$1,164,557,566
Anne Arundel	761	$4,117,145,038	$481,564,640	$4,598,709,678
Baltimore	745	$4,449,953,887	$580,907,824	$5,030,861,711
Baltimore City	867	$9,777,581,486	$954,973,603	$10,732,555,089

Jurisdiction	State Asset Totals	State Assets Loss Estimations		
		Building Value	Content Value	Total Loss
Carroll	235	$672,857,398	$79,141,528	$751,998,926
Frederick	197	$251,189,535	$36,724,173	$287,913,708
Howard	369	$590,600,329	$49,053,956	$639,654,285
Montgomery	192	$317,749,390	$55,868,060	$373,617,450
Prince George's	628	$4,033,876,220	$510,320,283	$4,544,196,503
St. Mary's	324	$613,989,775	$146,246,420	$760,236,195
TOTALS	**4,618**	**$25,917,475,723.00**	**$2,966,825,388.00**	**$28,884,301,111.00**

3.21.8 Winter Weather Consequence Analysis

A consequence analysis, derived from the EMAP, has been performed to better understand and outline the impacts that a winter weather event would have on the public; responders; continuity of operations, including delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the state; and public confidence in state governance. The results of the consequence analysis are shown in Table 3-60.

Table 3-60: Winter Weather Consequence Analysis

Subject	Impacts
Health and Safety of the Public	Home and landowners in northern and western regions of the state are most vulnerable to impacts from a winter weather event, but no portion of the state is invulnerable. Impacts to the public include the potential for freezing temperatures, resulting in dangerous road conditions, accidents, and injury or loss of life.
Health and Safety of Responders	Emergency responders, such as fire and police, would be called to the incident area(s) to evacuate people, close roads due to dangerous conditions, perform wellness checks, and attend to any injured. During a winter weather event, as with all disaster events, responders face the risk of personal injury while performing necessary job functions.
Continuity of Operations (including delivery of services)	Winter weather tends to affect whole regions, and sometimes an entire state. Consequently, continuity of operations may be affected depending upon the geographic extent and severity of the winter weather event. Delivery of services may be slowed or halted in affected areas as a result of freezing temperatures, snow and ice accumulations, dangerous road conditions, and/or momentary losses in power and communications.
Property, Facilities, and Infrastructure	Home and landowners throughout the state may experience varying levels of damage to property depending upon snow and ice loads, though damage is usually minimal. Infrastructure may experience impacts in the form of damage to roadways (particularly during snow removal), and interruptions to above-ground power and communication systems.

Subject	Impacts
Environment	Winter weather impacts the environment by damaging vegetation and tree limbs. Additionally, rapid snowmelt may also lead to flash flood events, which causes further environmental impacts.
Economic Condition of the State	A major winter weather event would be costly for state and local governments because of the potential for damages associated with property (during severe storms), storm cleanup, and loss of power. Some of the costs could be recouped through federal grant reimbursements, but local governments would still feel the fiscal impact of a major event.
Public Confidence in State Governance	Public confidence would largely depend upon how effectively the State of Maryland and county and local governments prepare for and respond to a winter weather event.

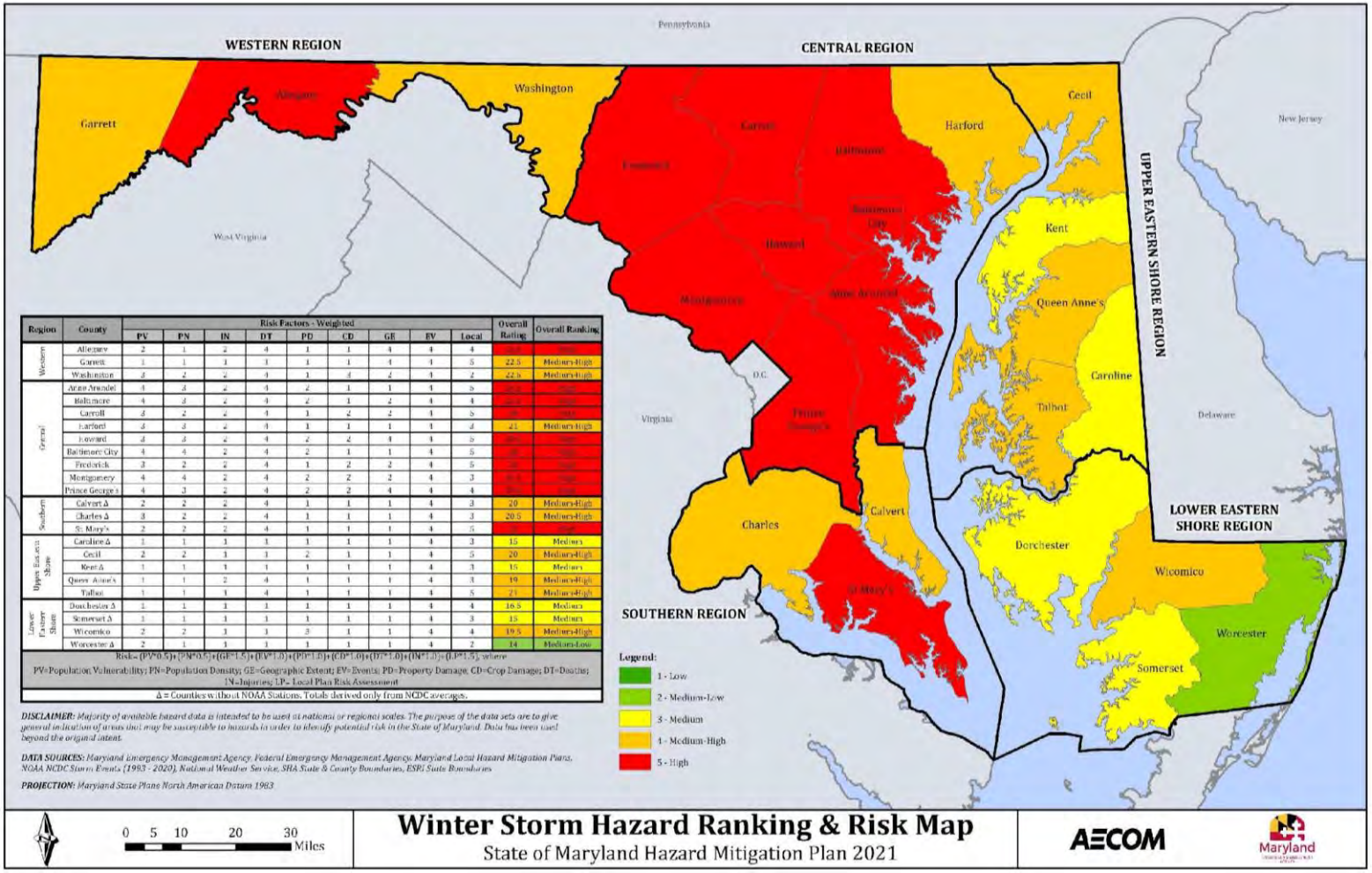
3.21.9 Vulnerability and Impact

FEMA's Community Lifelines Implementation Toolkit can be used to identify several key functions vulnerable to the impact of winter weather events in Maryland. Community Lifelines broadly include "critical government and business functions…essential to human health and safety or economic security." The primary Community Lifeline impacted by winter weather events is the Transportation Lifeline.[236]

[236] FEMA Community Lifelines Implementation Toolkit. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines-toolkit.

3.21.10 Winter Weather Hazard Risk Map

Below is a map depicting the overall risk for Maryland. Full sized pdfs of the maps are available in Appendix K, along with risk maps for individual jurisdictions, found in Appendix D.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	4	1	1	4	4	4		
	Garrett	1	1	1	1	1	1	4	4	5	22.5	Medium-High
	Washington	3	2	2	4	1	3	2	3	2	22.5	Medium-High
Central	Anne Arundel	4	3	2	4	2	1	1	4	5		
	Baltimore	4	3	2	4	2	1	2	4	4		
	Carroll	3	2	2	4	1	2	2	4	5		
	Harford	3	3	2	4	1	1	1	4	3	21	Medium-High
	Howard	3	3	2	4	2	2	4	4	5		
	Baltimore City	4	4	2	4	2	1	1	4	5		
	Frederick	3	2	2	4	1	2	2	4	5		
	Montgomery	4	4	2	4	2	2	2	4	3		
	Prince George's	4	3	2	4	2	2	4	4	4		
Southern	Calvert Δ	2	2	2	4	1	1	1	4	3	20	Medium-High
	Charles Δ	3	2	2	4	1	1	1	4	3	20.5	Medium-High
	St. Mary's	2	2	2	4	1	1	1	4	5		
Upper Eastern Shore	Caroline Δ	1	1	1	3	1	1	1	4	3	15	Medium
	Cecil	2	2	1	3	2	1	1	4	5	20	Medium-High
	Kent Δ	1	1	1	3	1	1	1	4	3	15	Medium
	Queen Anne's	1	1	2	4	1	1	1	4	3	19	Medium-High
	Talbot	1	1	1	4	1	1	1	4	5	21	Medium-High
Lower Eastern Shore	Dorchester Δ	1	1	1	3	1	1	1	4	4	16.5	Medium
	Somerset Δ	1	1	1	3	1	1	1	4	3	15	Medium
	Wicomico	2	2	1	3	3	1	1	4	4	19.5	Medium-High
	Worcester Δ	2	1	1	3	1	1	1	4	2	14	Medium-Low

Risk= (PV^0.5)+(PN^0.5)+((GE^1.5)+(EV^1.0)+(PD^1.5)+(CD^1.0)+(DT^1.0)+(IN^1.0))+(LP^1.5); where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events [1993 - 2020], National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

3.22 Regional Hazard Rankings and Maps

Regional maps were developed for the following regions: Western, Central, Southern, Upper Eastern Shore, and Lower Eastern Shore. Maps depict the following hazards for each region: Coastal, Flood, Winter Storm, Tornado, Wind, Thunderstorm, Wildfire, Drought, Soil Movement, Public Health Emergencies, Dam Failures, Extreme Temperatures, and Human-Caused Hazards and Threats. All the Regional Hazard Maps can be found in Appendix D.

3.22.1 Western Region

The Western Region includes Allegany, Garrett, and Washington counties.

Flood, Thunderstorm, and Soil Movement were ranked "medium" for all counties in the Western Region. The risk assessment ranked Tornado and Public Health Emergencies as "medium-high" for all Western Region counties. Human-Caused Hazards were ranked "medium-low" for Garrett County, and as "medium-high" for Allegany and Washington counties.

3.22.2 Central Region

The Central Region includes Anne Arundel, Baltimore, Carroll, Harford, Howard, Frederick, Montgomery, and Prince George's counties as well as the City of Baltimore.

All counties ranked Flood as "high" except Carroll County, which ranked Flood as "medium." All counties ranked Winter Storm as "high" except Harford County, which ranked Winter Storm as "medium-high." Wind was ranked as "high" for all counties, with the exception of Harford and Howard counties for which Wind was ranked as "medium-high."

3.22.3 Southern Region

The Southern Region includes Calvert, Charles, and St. Mary's counties.

All counties ranked Coastal and Wind as "high," Extreme Temperature as "medium," and Dam Failure and Human-Caused Hazards as "medium-low." Thunderstorm, Tornado, and Winter Storm were ranked as either "medium-high" or "high" for all

3.22.4 Upper Eastern Shore Region

The Upper Eastern Shore Region includes Caroline, Cecil, Kent, Queen Anne's, and Talbot counties.

All counties in the Upper Eastern Shore Region ranked Dam Failures as a "medium-low" hazard, while Wind was ranked as "medium-high" to "high." Public Health Emergencies, Drought, Winter Storm, and Flood were ranked between "medium" to "medium-high." Human-Caused Hazards, Extreme Temperature, and Tornado were ranked as "medium-low" to "medium" for all counties. Soil Movement was ranked as "medium-low" and "low."

3.22.5 Lower Eastern Shore Region

The Lower Eastern Shore Region includes Dorchester, Somerset, Wicomico, and Worcester counties.

All counties ranked Thunderstorm as "medium," while Extreme Temperature and Soil Movement were ranked as "medium-low." Wind and Coastal Hazards were ranked between "medium high" and "high" for all counties, while Drought and Flood were ranked "medium" to "medium-high."

3.23 Risk Assessment Methodology

The risk assessment methodology utilized for assessing and prioritizing the 13 hazards is based on a blend of quantitative factors extracted from the NCDC and other available data sources. These include:

- Historical occurrence
- Vulnerability of population in hazard area
- Historical impacts, in terms of human lives and property
- How the Local plans rank hazards

The following nine ranking parameters were used to develop jurisdictional-based hazard rankings for the 13 hazards: Coastal Hazards, Dam Failure, Drought, Extreme Temperatures, Flood, Human-Caused Hazards, Public Health Emergencies, Soil Movement, Thunderstorm, Tornado, Wildfire, Wind, and Winter Weather. Data sources used in the analysis are listed below for each parameter. Tables outlining data inputs for all these parameters may be found in Appendix J.

3.23.1 Population

- Total Resident Population for Maryland's Jurisdictions, April 1, 2010 through July 1, 2019

3.23.2 Population Vulnerability

- Calculated as a percent of total population in Maryland per County
- Total Resident Population for Maryland's Jurisdictions, April 1, 2010 through July 1, 2019

3.23.3 Population Density

- Calculated on population per square mile for each County divided by total area (square miles)
- Total Resident Population for Maryland's Jurisdictions, April 1, 2010 through July 1, 2019

3.23.4 Injuries and Deaths

- NCDC – Storm Event Database through April 30, 2020 (best available data)

- Maryland Department of Health (Public Health Emergencies only)
- U.S. Department of Transportation (USDOT) Pipeline & Hazardous Materials Safety Administration Incident Reports (Human-Caused Hazards only)

Note: Data unavailable, variable determined inconclusive (Dam Failures & Soil Movement)

3.23.5 Property and Crop Damage

- NCDC – Storm Event Database through April 30, 2020 (best available data)
- USDOT Pipeline & Hazardous Materials Safety Administration Incident Reports (Human-Caused Hazards only)

Note: Data unavailable, variable determined inconclusive (Dam Failure, Public Health Emergencies, and Soil Movement)

The sum of all property and crop damages were calculated per hazard per jurisdiction. Specified date ranges were identified per hazard utilizing best available data. Based upon the date ranges per hazard and the total calculated damages, the Consumer Price Index (CPI) inflation rate was used to adjust the total for 2015 equivalency per those hazards noted on data tables.

3.24 Geographic Extent

The following data sources were used to determine the geographic extent of each hazard in this Plan.

3.24.1 Drought

- 2019 Land in Farms per Acres – USDA Census of Agriculture
- Utilized farmland total acreage per county divided by total land area per county to determine percent of farmland-crop susceptibility

3.24.2 Flood

- Effective FIRMS as of January 24, 2020 – FEMA
- Calculated percent of land within the 100-year flood zone

3.24.3 Coastal

- Maryland Coastal Study – Flood Risk Reports
- Calculated percent of coastal land area within the county

3.24.4 Wind

- 2017 International Building Code and 2017 International Residential Code – Wind Load
- Basic wind speeds for Risk Category III structures per the Applied Technology Council (ATC) Hazards by Location Wind tool

3.24.5 Tornado

- NCDC – Storm Event Database through April 13, 2020 (best available data)
- Sum of all tornadoes and intensity rating per event weighted

3.24.6 Winter Storm

- NWS – Average Annual Snowfall
- Average Annual Snowfall totals for each jurisdiction

3.24.7 Thunderstorm

- NCDC – Storm Event Database through April 30, 2020 (best available data)
- Average number based on: Number of events with 2 inches or greater hail and lightning events with injuries/deaths

3.24.8 Wildfire

- Maryland DNR Forest Service
- The percent of area in "high" and "medium-high" on the Maryland DNR Forest Service Risk Assessment Layer

3.24.9 Soil Movement

- USGS
- The percent of area containing karst from the USGS polygon layer

3.24.10 Public Health Emergencies

- U.S. Department of Housing and Urban Development
- Average annual low median incomes

3.24.11 Dam Failures

- MDE
- Total high hazard dams per county

3.24.12 Extreme Temperatures

- NCDC – Storm Event Database through July 21, 2019 (best available data)
- Average number based on: Number of events with excessive heat or extreme cold/wind chill

3.24.13 Human-Caused Hazards and Threats

- USDOT Pipeline & Hazardous Materials Safety Administration Incident Reports
- Total number of hazmat events per county

3.25 Events

For details on the events and previous occurrences profiled in the 2021 Plan update, the Planning Team used the following data sources:

- NCDC – Storm Event Database through April 30, 2020 (best available data)
- Maryland Department of Health (Public Health Emergencies only)
- Association of State Dam Safety Officials (Dam Failures only)
- USDOT Pipeline & Hazardous Materials Safety Administration Incident Reports (Human-Caused Hazards only)
- Note: Data was unavailable, and therefore the variable was determined as inconclusive for Soil Movement
- Obtained total events for each hazard in each jurisdiction. Calculated for each jurisdiction for annualized events.

3.26 Local Hazard Ranking

For the Local Hazard Rankings, the Planning Team used the following sources:

- Most recent hazard rankings from local hazard mitigation plans
- Jurisdictional Self-Assessment (Table 3-61,)

3.26.1 Jurisdictional Self-Assessment – Local Hazard Rankings (2020)

Table 3-61 presents a compilation of the hazard risk rankings for each county and jurisdiction in Maryland. Hazards included in the Plan were used as a baseline, and each county and jurisdiction were asked to rank the hazards. The rankings in this table were provided by the counties themselves; these rankings do not directly correlate to those of the HIRA analysis; however, in most instances they match up. For the counties or jurisdictions that did not provide feedback, hazard rankings were derived from their HMPs and inserted into the table. Those hazards included in the Plan, but not in a county or jurisdictional HMP, are demarcated by an (-).

Table 3-61: Local Hazard Rankings 2020 – Self-Assessment

Jurisdiction	Flood	Coastal Haz	Winter Storms	Tornado	Thunderstorm	Wind	Wildfire	Soil Mvmt.	Extr. Temp	Dam Failure	Public Health	Human-Caused	Drought
State of Maryland	1	4	2	6	3	5	9	10	8	13	11	12	7
Western Region													
Allegany County	1	13	2	9	3	5	10	8	6	11	4	7	12
Garrett County	2	12	1	11	5	3	6	4	9	8	7	10	13
Washington County	1	13	3	8	2	10	9	11	4	6	5	12	7

Jurisdiction	Flood	Coastal Haz	Winter Storms	Tornado	Thunderstorm	Wind	Wildfire	Soil Mvmt.	Extr. Temp	Dam Failure	Public Health	Human-Caused	Drought
Central Region													
City of Annapolis	2	1	3	9	4	8	13	12	5	10	7	6	11
Anne Arundel County	3	5	2	8	1	6	13	7	4	12	9	10	11
Baltimore City	1	2	5	9	7	4	13	10	3	11	8	6	12
Baltimore County	1	8	7	3	4	5	6	-	-	-	-	9	2
Carroll County	2	3	5	4	-	-	-	6	-	7	-	-	1
Harford County	2	5	3	7	4	6	12	13	8	10	1	11	9
Howard County	3	13	7	4	6	5	11	12	8	9	2	1	10
Frederick County	1	6	2	4	5	3	9	-	8	10	-	-	7
Montgomery County	9	13	2	5	1	7	10	12	4	6	3	8	11
Prince George's County	2	1	4	5	6	10	9	11	12	8	3	7	13
Southern Region													
Calvert County	1	2	5	6	3	7	13	4	8	10	9	11	12
Charles County	3	5	7	-	-	-	15	13	1	12	4	6	14
St. Mary's County	1	3	6	2	5	7	11	12	8	9	4	10	13
Lower Eastern Shore													
Dorchester County	1	2	4	3	5	-	6	-	-	-	-	-	7
Somerset County	2	1	7	9	4	6	8	11	10	13	3	12	5
Town of Ocean City	2	1	4	6	5	3	10	11	9	13	7	8	12
Wicomico County	1	2	5	6	8	3	7	9	-	-	-	-	4
Worcester County	2	1	9	11	3	4	12	5	7	8	6	13	10
Upper Eastern Shore													
Caroline County	2	4	8	6	3	5	9	12	7	13	1	10	11
Cecil County	1	2	8	4	3	12	5	9	7	10	13	11	6
Kent County	2	3	8	12	7	10	13	6	4	11	1	5	9
Queen Anne's County	2	6	5	10	8	4	7	9	12	13	1	11	3
Talbot County	1	2	4	6	3	7	9	11	10	13	5	8	12

Note: * Denotes outdated Local Plan
Note: (-) Indicates that a hazard was not profiled or ranked in the County HMP

3.26.2 Overall Ranking

The Planning Team used the weighted risk factors shown in Figure 3-11 in the equation below to determine each jurisdiction's risk to each hazard. Table 3-62 shows the final Ranking Scales applied to each parameter.

Weighted Risk Factors:		
Population Vulnerability	PV	**0.5**
Population Density	PN	**0.5**
Injuries	*IN*	**1**
Deaths	*DT*	**1**
Property Damage (Annualized)	*PD*	**1**
Crop Damage (Annualized)	*CD*	**1**
Geographic Extent (Hazard Dependent)	*GE*	**1.5**
Events (Annualized)	*EV*	**1**
Local Plan Ranking	*LOCAL*	**1.5**
Equation:		
(PV*0.5) + (PN*0.5) + IN + DT + PD + CD + (GE*1.5) + EV (LOCAL*1.5)		

Figure 3-11: Overall Ranking Equation

Table 3-62: Ranking Scales– April 2020

Score	Population Vulnerability Geometrical Interval	Population Density Geometrical Interval	Annualized Events - All events excluding the following	Annualized Events - Coastal, Dam Failures & Extreme Temps	Annualized Events – Flood	Annualized Events – Human-Caused Hazards	Annualized Events - Public Health Crisis	Injuries/ Deaths	Property Damage	Crop Damage
1	0.00	0	0	0	0	< 0.5	< 12	None	0.00	0.00
2	0.85	174.7392	0.11	0.11	1.50	2	40	Injury	500 K	50 K
3	2.25	546.3805	1.01	0.50	2.30	10	100	N/A	5 M	501 K
4	6.12	1919.7552	2.51	1.00	3.50	> 10	> 100	Death	> 20 M	> 2 M

Overall Score

(>=)	*Hazard Risk Score Rank*
0	**Low**
10.5	**Medium-Low**
14.5	**Medium**
18.5	**Medium-High**
23	**High**

No Local Plan Ranking Score

(>=)	*Hazard Risk Score Rank*
0	**Low**
6	**Medium-Low**
10	**Medium**
14	**Medium-High**
18	**High**

Section 4: Mitigation Strategies

STATE MITIGATION PLAN REVIEW GUIDE

Released March 2015 FP 302-094-2

This Guide is FEMA's official policy on and interpretation of the natural hazard mitigation planning requirements. The intended use of the Guide is to facilitate consistent evaluation and approval of state mitigation plans, as well as to facilitate state compliance with the mitigation planning requirements when updating plans.

Table 4-1: State Mitigation Plan Review Guide

Element	Requirements
S8. Does the mitigation strategy include goals to reduce long-term vulnerabilities from the identified hazards? [2 CFR §201.4(c)(3)(i)[18]] **Intent:** To guide development and implementation of hazard mitigation actions. Goals are statements of the vision for the future.	• The plan must identify hazard mitigation goals representing what the state seeks to accomplish through mitigation plan implementation. • The goals must be consistent with the hazards and vulnerabilities identified in the risk assessment. • The goals must address reducing the vulnerability of jurisdictions within the state as well as the vulnerability of state-owned or operated buildings, infrastructure, and critical facilities. • If the state is interested in an increased Federal cost share under the FMA program, the plan must include goals to address RL and SRL properties.
S9. Does the plan prioritize mitigation actions to reduce vulnerabilities identified in the risk assessment? [2 CFR §§201.4(c)(3)(iii)[19] and (iv)[20]] **Intent:** To establish specific hazard mitigation actions that will be implemented to reduce the vulnerabilities identified in the risk assessment. This is the heart of the mitigation plan and is essential to leading statewide mitigation programs to reduce risk.	• The plan must identify actions based on the current risk assessment to reduce the vulnerability of jurisdictions within the state as well as the vulnerability of state-owned or operated buildings, infrastructure, and critical facilities. • The plan must describe the process used by the state to evaluate and prioritize actions that are cost effective, environmentally sound, and technically feasible. • The plan must describe how each action contributes to the hazard mitigation goals. • The plan must describe how the local and tribal, as applicable, mitigation strategies are linked with the state mitigation strategy.
S10. Does the plan identify current and potential sources of funding to implement mitigation actions and activities? [2 CFR §201.4(c)(3)(iv)] **Intent:** For the responsible entity to take action to complete activities and projects as funding opportunities to implement them arise.	• Each mitigation action or project must include the identification of current and/or potential sources of Federal, state, local, tribal, as applicable, or private funding for implementation. • At a minimum, the plan must identify FEMA mitigation funding sources, including, if applicable, but not limited to HMGP, PDM, FMA, and PA C-G.21 • If the state is interested in an increased Federal cost share under the FMA program, the plan must address identify current and potential sources of funding with respect to RL and SRL properties.

4.1 Additional CFR Requirements for Mitigation Strategy

CFR §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and based on its ability to expand on and improve these existing tools.

CFR §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

CFR §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

CFR §201.6(c)(3) (iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

4.2 Introduction

The Stafford Act directs states to develop hazard mitigation goals and actions and to establish a strategy to implement those actions. The mitigation strategy serves as the long-term road map to reduce the potential losses, vulnerabilities, and gaps identified in the HIRA Section. The mitigation strategy represents the risk-based decisions developed by the state and the MAC, and informed by the HIRA, and includes the prioritization of these actions.

The first step in the development of the mitigation strategy is the formation of goals, or the long-term, broad policy statements, that direct the mitigation strategy. The mitigation strategy also includes a list of specific mitigation actions to address those goals. These actions have been prioritized based on the state's risks, requirements, capabilities, and resources. An effective mitigation strategy should be comprehensive and contain a wide range of actions and projects that span short- and long-term timelines and should be implementable with even a relatively small budget.

Another critical component of updating the state's mitigation strategy is the consideration and inclusion of the local mitigation plan strategies. By incorporating actions identified by the jurisdictions, the state can better support investment at the local level and be better prepared to provide appropriate resources for necessary support when available, such as post-disaster or recovery mitigation assistance.

The goals and actions listed in this section were developed by the Steering Committee, MAC, and Consultant Team to include the mitigation needs identified by stakeholders, including county and local communities. The goals are written to be applicable to all hazards identified in the HIRA, whereas the actions have been

prioritized based on the scoring mechanism described in Section 4.6 - Mitigation Action Worksheet Evaluation, Scoring, and Prioritization. The final section of this chapter consists of a matrix of commonly available sources for mitigation funding as well as information regarding the granting agency, cost share requirements, and contact information.

By avoiding or minimizing the unnecessary exposure to hazard risk, communities can save lives, reduce property damage, and minimize the social, economic, and/or environmental disruptions that commonly follow hazard events. This Plan addresses the current needs of communities and residents and also considers the future needs of Maryland's residents, visitors, businesses, and environment. This focus on an integrated, connected, and future-oriented approach will help create more disaster-resilient communities and a more disaster-resilient state as a whole.

The Mitigation Strategy includes the following eight subsections:

1. Definitions
2. Mitigation Goals
3. Mitigation Action Development Process
4. Mitigation Action Evaluation and Scoring
5. Mitigation Action Categories
6. FEMA Community Lifelines
7. Mitigation Action Implementation Plan
8. Mitigation Action Funding Resources

4.3 Definitions

The following terms are used frequently throughout this section and the Plan as a whole:

Goals: Goals are broad statements achieved through the implementation of more specific actions. Goals provide the framework for achieving the intent of the Plan.

Hazard Mitigation Actions: Actions are defined as specific steps or tasks undertaken to address gaps, in terms of risk or vulnerabilities, in existing buildings, programs, or systems.

Mitigation Action Plan: A mitigation action plan consists of prioritized actions (policies, tasks, and/or projects), hazards addressed, primary and support organizations responsible for implementation, an estimated timeline for completion, and a list of potential funding sources.

4.4 Hazard Mitigation Goals

Maryland's hazard mitigation goals were reviewed carefully by the Steering Committee and updated to represent Maryland's short- and long-term hazard mitigation priorities. The goals identified in this section reflect the hazards and

vulnerabilities identified in the HIRA sections of this Plan, reinforce the state's Repetitive Loss (RL) and Severe Repetitive Loss (SRL) property goals, and support the state's current strategy, growth, and capabilities regarding social equity and environmental justice.

For the 2021 Plan Update, the Steering Committee elected to separate the single goal and the five objectives included in the 2016 Plan Update into six independent goals. In addition, the two goals for RL and SRL properties from the 2016 Plan have been incorporated into this list of goals. The Steering Committee also added new considerations for social equity and environmental justice, bringing the total number of goals to 10, which are listed below. Newly developed goals for the 2021 Plan are emphasized in **bold**.

2021 Maryland Hazard Mitigation Plan Goals

1. Protect life, property, the economy, and the environment from hazard events to the greatest extent possible.
2. Increase public awareness of potential hazards, mitigation actions, preparedness efforts, and resiliency planning.
3. Protect state assets, infrastructure, and critical facilities from hazard events.
4. Enhance coordination across the whole community, including federal, state, and local government, and nongovernmental organizations (NGOs), by strengthening existing linkages and creating new linkages between state and local mitigation and resiliency efforts.
5. Promote actions that protect natural resources while enhancing hazard mitigation and community resiliency.
6. Identify and implement projects that will reduce the impacts of hazards and efficiently use state resources.
7. **Integrate hazard mitigation planning into other state planning efforts (comprehensive plan, floodplain management regulations, land use/zoning, green infrastructure) and encourage and educate counties and municipalities to integrate across local plans and ordinances.**
8. Identify and reduce flood hazard impacts in areas outside of the SFHA, which have experienced increased frequency and intensity in flooding but do not meet FEMA's RL and SRL criteria.
9. Reduce flood-related losses, with an emphasis on reducing RL and SRL properties over the next hazard mitigation planning cycle.
10. **Promote the development of policies, programs, initiatives, and projects that prioritize diversity, equity, and environmental justice.**

4.5 Mitigation Action Development Process

The Risk Assessment provided the foundation for actions that were crafted to reduce the hazard vulnerability of local jurisdictions in the state as well as the vulnerability of state assets, infrastructure, and critical facilities.

During the development of the mitigation strategy, the existing 2016 mitigation actions were reviewed and the Lead Agencies provided updates; however, the focus was on the development of new implementable mitigation actions and ideas to reflect MEMA's change in priorities. New mitigation actions were developed with direct stakeholder input received during the various opportunities provided for stakeholder engagement. The following steps document how various stakeholder engagement opportunities throughout the planning process helped inform development of the mitigation strategy.

- Hazard Identification and Risk Assessment (HIRA);
  - Problem areas identified through the ArcGIS Survey123 instrument – In addition to the overall state HIRA, by inviting local jurisdictions to participate in a hazard area mapping exercise, planners were able to create actions for smaller communities who may not have been well represented in the statewide analysis. With local, "boots-on-the-ground" insight and knowledge, actions can be tailored to the specific needs of the communities.
- Vulnerability Assessment;
  - Hazard rankings completed by County representatives – County representatives were invited to rank the 13 hazards profiled by the state to allow sub-state, location-specific, hazard rankings to guide the actions development process. These rankings are included in Section 3.26. A hazard that was ranked as number one overall by the state may not be ranked number one at the local level. For instance, Allegany, Garrett, and Washington counties ranked coastal hazards towards the bottom, whereas the overall state ranking placed coastal hazards second.
- Capability Assessment
  - Gaps identified through the resource questionnaire – The resource questionnaire was designed to identify plans, programs, and mechanisms already in place at the county level, and to allow mitigation strategies to be developed for any gaps or needs identified.
  - 2016 Plan Mitigation Action Status Updates – A review of the 2016 Plan's past actions provided insight on the status of each action (completed, in progress, or not started) so that new actions could be identified to bolster or support past actions that may require additional resources.

- Stakeholder Engagement
  - Gaps and issues presented during Steering Committee and Regional Meetings – Jurisdictional stakeholders were provided an open platform to discuss concerns or challenges at their local levels, which allowed tailored actions to be developed. In addition, state stakeholders and agencies were provided the opportunity to weigh in on potential costs and funding sources, and to agree upon which agency should be the "lead" for implementation.
  - Stakeholder suggestions through the State and County Stakeholders Survey Monkey – A survey was developed to gather local input on how involved stakeholders felt throughout the process, on county and local National Flood Insurance Program (NFIP) participation, and on participation by vulnerable populations. Stakeholders also used the survey to provide suggestions/recommendations on projects that they felt would be beyond the capability of the jurisdiction to undertake and that would require regional or state support.
- Best Practices – A review of other plans and existing literature helps identify alternative mitigation actions to be considered when evaluating potential mitigation actions. Several FEMA publications, websites, and other resources exist (FEMA Mitigation Ideas, the Guide) to provide information on effective actions in other jurisdictions that have similar circumstances and are facing similar hazards.

Note: Actions from the 2016 Plan have been carried forward if they were deemed "In Progress" or "Ongoing" by their Lead Agency or if the Lead Agency did not provide a status update.

4.6 Mitigation Action Worksheet Evaluation, Scoring, and Prioritization

The mitigation actions form the framework of a hazard mitigation plan and serve as the most outward representation of the planning process to the general public and political leadership throughout the state. Mitigation actions are prioritized to provide, in a systematic manner, the technical, administrative, economic, and other considerations and/or constraints of implementing a particular mitigation action in or across the state. This evaluation is not an appraisal of the general merits of the action, but rather an assessment of the effect(s) the action will have on the specific hazard to be mitigated or on the mitigation goal it supports.

The scoring mechanism used to evaluate and prioritize the actions aims to ensure that each action rated as a "high priority" is cost-effective, environmentally sound, and technically feasible, and that it provides multiple benefits. The objective is to emphasize mitigation actions that provide "whole community" benefits, as opposed to "single asset" benefits. Actions have been linked to the overall goals of the Plan and demonstrate how each mitigation action will contribute to the successful implementation of the Plan.

Figure 4-1 is a sample of one of the Mitigation Action Worksheets. The worksheet shows the scoring, ranking, and implementation planning information for each action. A list with descriptions of the figure sections shaded in grey is included below the figure.

Priority Ranking H	Mitigation Action/Project Title:	#15 – Encourage jurisdictions to incorporate historic, cultural, archaeological sites, and resources resource considerations into all local Hazard Mitigation Plans, with a focus on protecting these resources while maintaining historic integrity, significance, and National Register eligibility.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	The lack of historic preservation considerations in hazard mitigation plans puts historic and cultural resources at risk to natural hazards and the potential loss of their designation if mitigation actions are taken that preclude their eligibility for the register.				
Responsible Agency:	1. Maryland Emergency Management Agency 2. Maryland Historical Trust				
Partners:	1. Maryland Department of Planning 2. Maryland Environmental Service				
Potential Funding:	HMGP, BRIC, FMA, EMPG, ESHPF, National Trust for Historic Preservation				
Cost Estimate:	$ Staff Time	Timeline:	3-5 Years		

Figure 4-1: Sample Mitigation Action Worksheet

1. The Priority Ranking section identifies whether that action has been deemed a high, medium, or low priority, based on the scoring ranges discussed in the next section.
2. The Mitigation Action/Project Title section provides the ID number as well as a description. The Action Ranking row displays the final scoring of the action determined by MEMA and the MAC. The Background/Issue section provides information on the challenges and issues that led to the development of the action and any pertinent information to support the implementation of the action.

3. The Responsible Agency section identifies those agencies and organizations deemed primary or "Lead" for the implementation of the action.
4. The Partners section includes those agencies that can provide additional insight, resources, and assistance for the implementation of the action.
5. The Potential Funding section lists those grants or programs most likely to provide assistance in the implementation of the action.
6. The Cost Estimate section provides either a dollar estimate on the project cost or a written description of the types of costs likely to be incurred, such as new budget line items, staff-time only, or outsourced or consultant fees.
7. The Timeline section indicates whether the project would be a short-, medium-, or long-term project by indicating either a range on the amount of time necessary to implement the action, or a commencement date for the action.

The Joint MAC/Steering Committee meeting held on February 1, 2021, resulted in the prioritization and ranking of the 39 newly identified and implementable mitigation actions. The worksheets were refined, and implementation information was included to develop each worksheet into an implementation plan for the specified action. Implementation Forms (also referred to as Mitigation Action Forms) were completed for each new action; Implementation Worksheets and Scoring/Prioritization forms completed for the 2016 Actions are still being used for those actions carried forward into this 2021 Plan Update. Figure 4-1 (above) provides the priority ranking mechanism used by the MAC and the Steering Committee to review, discuss, and score each of the 39 mitigation implementation strategies. Members of the Steering Committee were asked to prioritize each action according to the following guiding questions:

1. Technical: Is the project technically feasible?
2. Economic: Is the project cost-effective?
3. Administrative: Is there sufficient staffing, support, and oversight in place?
4. Multi-Benefit: Does this action provide multiple benefits?

The following scoring mechanism was designed to incorporate the key elements on which MEMA's strategy is based, such as providing multiple benefits, being cost-effective and efficiently using state resources, and being a concise, repeatable mechanism for other jurisdictions to use if they see fit.

Planning Team's TEAM Scoring Model for Mitigation Action Prioritization

T – Technical

1. Is the proposed action technically feasible?
2. Is the proposed action a short-term or long-term solution?
3. Could the action create any additional problems in the future?

E - Economic

1. Do the benefits exceed the costs?
2. Is there funding already in place to implement this action?
3. Are initial, maintenance, and administrative costs taken into account?

A – Administrative

1. Can the state implement the action?
2. Has someone been identified to coordinate and lead the effort?
3. Are sufficient funding, staff, and technical support available?

M – Multi-Benefit

1. Will it mitigate hazards to people, the economy, and the environment?
2. Does the mitigation action address a high-priority/to- ranked hazard(s)?
3. Will the action mitigate more than one hazard or assist more than one jurisdiction?

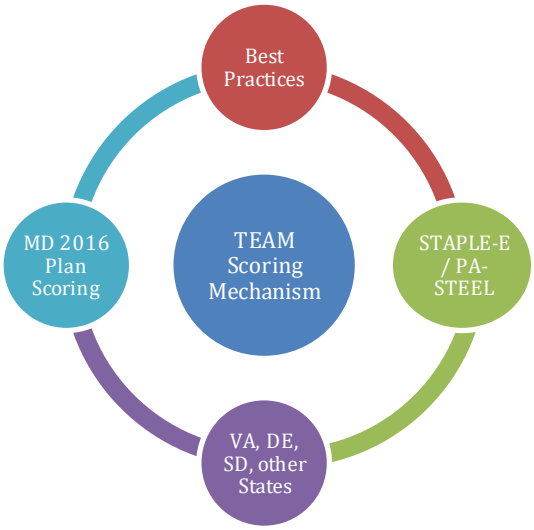


Figure 4-2: TEAM Scoring Inputs

This mechanism was developed to incorporate ideas from FEMA's 386-3 "How-to Guide," the scoring system from the 2016 Plan, and best practices from surrounding states to create a concise format to encourage 100 percent participation by the members of the MAC and the Steering Committee for the scoring exercise. The ranking methodology for these four categories is based around the answers to the three questions under each category:

If the reviewer could answer each question under a category in the affirmative, the action was assigned the full 10 points.

If the reviewer could only answer two of the posed questions in the affirmative, the action was assigned only five points.

If the reviewer could only answer one question in the affirmative, then the action is assigned just two points. Table 4-2 summarizes the TEAM scoring model and the points system used in the TEAM scoring mechanism.

Table 4-2: TEAM Model Scoring Mechanism

	High	Pts	Medium	Pts	Low	Pts
Technical	The proposed action will solve a root problem of the identified hazard(s) with no adverse effects and without creating trickle-down follow-on work.	10	The proposed action may solve a root problem of the identified hazard(s) with little to no adverse effects and with minimal trickle-down follow-on work.	5	The proposed action may solve the identified hazard(s) with little adverse effects, and/or trickle-down follow-on work.	2
Economic	The benefits of the action clearly outweigh the costs to implement it; funding or grants are available; and ongoing maintenance and administrative costs are easily budgeted for.	10	The benefits of the action outweigh the costs to implement it; funding or grants are very likely attainable; and ongoing maintenance and administrative costs are budgeted for.	5	The benefits of the action outweigh the costs to implement it; funding or grants will have to be applied for; and ongoing maintenance and administrative costs can be budgeted for.	2
Administrative	Can be implemented at the state level, and appropriate staff and funding are already in place to lead the effort.	10	Can be implemented at the state level, and staff and funding can be easily assigned to lead the effort, or a budget exists for contractor support.	5	Can possibly be implemented at the state level, and staff and funding will need to be hired/acquired and/or contractor support will be necessary.	2
Multi-Benefit	Action mitigates multiple hazards that were ranked high in the jurisdictions' HIRAs; protects people and the environment; and benefits the economy in more than one jurisdiction.	10	Action mitigates multiple hazards identified in the jurisdictions' HIRAs; protects people and the environment; and/or benefits the economy in more than one jurisdiction.	5	Action mitigates hazards that were ranked in the HIRA and/or protects people, the environment, or the economy in more than one jurisdiction.	2

The priority ranking ranges were selected to ensure an equitable distribution of high-, medium-, and low-priority actions. Mitigation actions that scored 31-40 points were ranked as high, that scored 20-30 points were ranked as medium, and that scored 0-19 points were ranked as low.

Figure 4-3: Action Priority Ranking Ranges

Final scores resulted in seven low-priority actions, 16 medium-priority actions, and 16 high-priority actions. Although all 39 new actions are deemed important and support a specific issue identified or a goal, those actions ranked high can be implemented immediately or conducted "in-house" by MEMA, whereas those ranked low may need additional support, funding, or consultant assistance, and/or may need to meet other requirements from the state and supporting agencies.

To streamline the scoring and review process, and to be cognizant of the unique challenges and constraints presented by the COVID-19 pandemic, preliminary scoring and agency assignments were compiled by MEMA and the Consultant Team in advance, and reviewed and finalized during the February 1, 2021 meeting. MAC and Steering Committee members were given the opportunity to review each action before the meeting, were provided a platform to discuss any recommendations regarding the preliminary scores and information, and were invited to make modifications based on their thoughts or the MAC and Steering Committee discussions.

The action development and scoring process is explained in Figure 4-4. The actions and implementation worksheets were finalized after incorporating the MAC's comments. The results are summarized in Table 4-3 in Section 4.9.

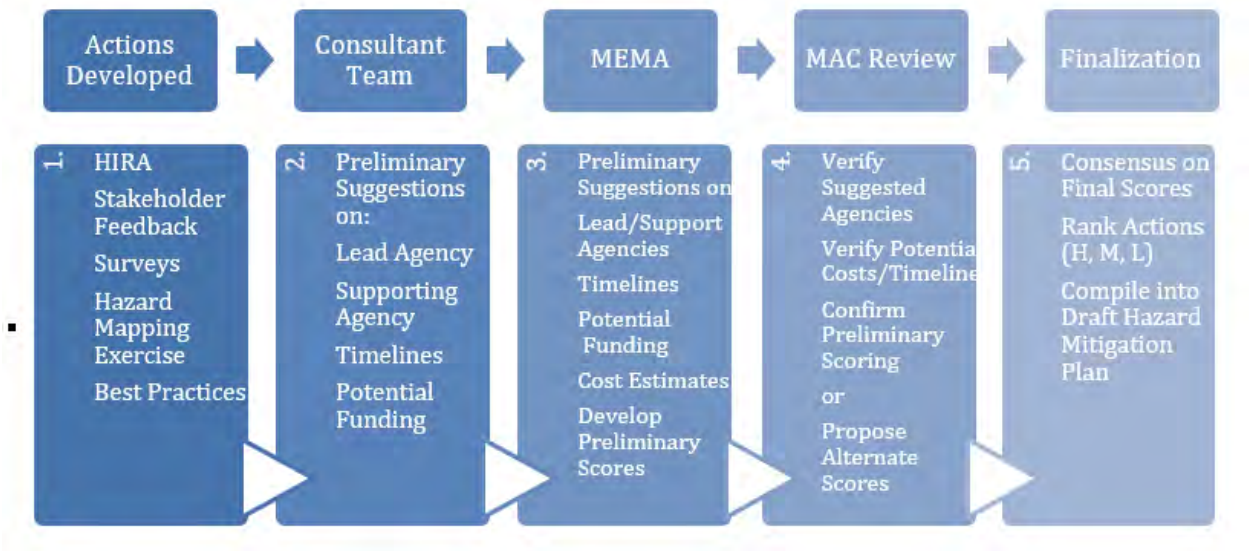


Figure 4-4: Action Development and Scoring Process

4.7 Mitigation Action Categories

In formulating the mitigation strategy, the Steering Committee explored four mitigation categories for achieving the Plan's goals. They include local plans and regulations, structure and infrastructure projects, natural systems protection, and education awareness programs. Additional categories have also been included to organize actions pertaining to MEMA's specific priorities and the public health and

safety sectors: MEMA specific actions, energy/utility security, and public health. These seven categories form the basis for the organization of mitigation actions in this Plan update. Descriptions of the four FEMA categories and examples for each category are included below:

- Local Plans and Regulations - These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built. Examples include comprehensive plans, land use ordinances, subdivision regulations, development review, building codes and enforcement, the NFIP CRS, capital improvement programs, open space preservation plans, stormwater management regulations, and master plans, and other local plans and regulations.
- Structure and Infrastructure Projects - These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct man-made structures to reduce the impact of hazards. Many of these types of actions are projects eligible for funding through the FEMA HMA program. Examples include acquisition and elevation of structures in flood-prone areas, utility undergrounding, structural retrofits, floodwalls and retaining walls, detention and retention structures, culverts, and safe rooms.
- Natural Systems Protection - These are actions that minimize damage and losses and preserve or restore the functions of natural systems. Examples include sediment and erosion control, stream corridor restoration, forest management, conservation easements, and wetland restoration and preservation.
- Education Awareness Programs - These are actions that inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct action. Examples of direct action include radio or television spots, websites with maps and information, real estate disclosures, presentations to school groups or neighborhood organizations, mailings to residents in hazard-prone areas, and communities with StormReady and Firewise programs.

The remaining categories - MEMA specific actions, energy/utility security, and public health – were included to streamline implementation and tracking for the MEMA-led and/or sector-specific actions.

4.8 Community Lifelines

FEMA's new Community Lifelines system enables the continuous operation of critical government and business functions during a natural, technological, or man-made hazard or event. Community lifelines are essential to preserving human health, safety, and/or economic security. They represent "the most fundamental services in a community, that when stabilized, enable all other aspects of society to function."[237] The Community Lifelines program is FEMA's framework for emergency response. It prioritizes the rapid stabilization of community lifelines after a hazard or disaster event.

This "integrated network of assets, services, and capabilities that provide lifeline services are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. When disrupted, decisive intervention, rapid re-establishment, or employment of contingency response solutions is required to stabilize the incident."[238] While the Lifelines were developed to support response planning and operations, the concepts can still be applied through the mitigation and preparedness phases of the emergency management cycle. Efforts to protect lifelines and to prevent and mitigate potential impacts to them will increase the overall resilience of communities, counties, and the state as a whole. By taking these critical services into consideration when conducting mitigation planning efforts, communities help ensure that these Lifelines are either not interrupted, reduce the amount of time they may be down or out of service, and/or provide support to contingency plans already in place. FEMA's seven Community Lifelines are:

1. **Safety and Security –** Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety
2. **Food, Water, Shelter** – Food, Water, Shelter, Agriculture
3. **Health and Medical –** Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
4. **Energy** – Power Grid, Fuel
5. **Communications** – Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
6. **Transportation –** Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
7. **Hazardous Material** – Facilities, HAZMAT, Pollutants, Contaminants

[237] FEMA Community Lifelines Implementation Toolkit. Available at: https://www.fema.gov/emergency-managers/practitioners/lifelines.

[238] Ibid.

4.9 Prioritized Mitigation Action Implementation Plan

The Mitigation Action Implementation Strategy Worksheets, which are provided in Appendix E, were used to generate a numerical priority ranking score for each mitigation action. Individual scores from each MAC and Steering Committee member are not included on the worksheets; however, the final scores and ranking category (H-High, M-Medium, or L-Low) for each action/project are indicated on each implementation worksheet in the "Priority Ranking" box and under "Score."

The actions listed in Table 4-3 are "new" and were developed during this 2021 Plan update cycle. This matrix demonstrates how each action contributes to the overall mitigation strategy by identifying the mitigation goal(s) it applies to, the hazard(s) mitigated, and the FEMA Community Lifeline supported. The matrix also includes: an action ID number, the lead or responsible agency, the action's scores and priority, potential funding sources, cost estimates, and the potential timeline for implementation. Ongoing actions, those that have been carried over from the 2016 Plan, are provided in Appendix E and include status updates for those ongoing actions. Additionally, the Dam Safety Addendum in Appendix C also contains 10 actions related to dam safety; those are specific to the protection of dams and, while essential and important to this specific hazard, were developed specifically for that plan. The creation of the Addendum and this plan update overlapped; at the first annual review cycle, MEMA will revise the table below to include any of those 10 actions that are not captured or represented here to ensure consistency of effort and reduce duplication of activity or confusion.

The State of Maryland recognizes that county and local governments are key partners in the identification and implementation of hazard mitigation projects. Many of the actions are related to supporting local project applications and are linked to local plans. Those actions directly supporting county and local planning and mitigation efforts are designated with an asterisk (*). In addition, the eight highlighted actions are those that can be applied to help mitigate RL and SRL properties.

Table 4-3: HMP Mitigation Action Implementation Plan

ID#	Action	Mitigation Goal(s) Supported	Hazard Mitigated	Lead Agency	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline	Community Lifeline
Structure and Infrastructure Projects													
1*	Provide support for project development through all phases, including but not limited to: feasibility studies, hydrology and hydrologic studies, project identification, design and engineering, and implementation. Prioritize providing technical assistance to low-capacity and low-capability communities.	6, 8, 9, 10	All Hazards	MEMA DNR MDE	**10**	**5**	**2**	**10**	**27**	BRIC, FMA, HMGP, PWEAA, EMPG, UASI, ESHPF, DNR Grants Gateway, MDE CFMGP, USACE	Variable depending on the study	1 Year/ Ongoing	**Safety and Security**
2*	Provide support for installation and maintenance of extreme weather and other warning mechanisms statewide	1, 6	Tornado, Thunderstorm, and Wind Events	MEMA MDE	**5**	**2**	**2**	**10**	**19**	BRIC and FMA (equipment only), PWEAA, UASI	20/30k per siren/gauge, plus maintenance and monitoring	2-3 Years	**Safety and Security**
3*	Conduct consequence analyses for dam failures across the state, including collecting data on downstream inundation areas and potential flood depths.	1, 3, 8	Flood, Dam Failure, Coastal Hazards	MDE MEMA	**5**	**10**	**10**	**10**	**35**	FMA, EMPG, HMGP, HHPD	Medium (Consultant Fees)	1-2 Years	**Safety and Security**
4*	Conduct regular (annual) inspection and maintenance of flood and/or water control systems throughout Maryland and include operational training and community flood risk outreach as part of the maintenance effort.	1, 2, 3, 9	Flood, Dam Failure, Coastal Hazards	MDE	**2**	**10**	**10**	**10**	**32**	PWEAA, FEMA High Hazard Potential Dam program	Variable, state to fund training, external costs for inspection and maintenance	1 Year/ Ongoing	**Safety and Security**
5*	Identify and evaluate funding opportunities and potential projects to decommission low-flow/low- volume dams to restore waterways to their natural state.	5	Flood, Dam Failure, Coastal Hazards	MDE MEMA	**5**	**2**	**2**	**10**	**19**	BRIC, FMA, PWEAA, FEMA HHPD program	Low, internal state cost	3-5 Years	**Safety and Security**
6*	Conduct regional watershed studies to promote and support stormwater management awareness and projects, and to support effective mitigation and planning efforts and policies.	2, 7, 9	Flood, Dam Failure, Coastal Hazards	MDE MEMA MDOT	**5**	**2**	**2**	**10**	**19**	BRIC, FMA, UASI, CDBG-DR/MIT if available, MDE CFMGP, DNR Grantsgateway, USACE	Low; state commission consultant	2-3 Years	**Safety and Security**
7	Develop building standards and incentives to actively encourage the installation of nature-based solutions on state-owned buildings/facilities to reduce the building/facility's carbon footprint, provide additional shade, reduce heat from the roof surface and surrounding air, and assist with water runoff during rain events.	6, 7, 10	Drought, Extreme Temperatures, Flood, Dam Failure, Coastal Hazards	DLLR DNR MDE MEMA	**5**	**10**	**10**	**10**	**35**	UASI, BRIC		2-3 Years	**Safety and Security**
8*	Conduct state-level climate change modeling/analyses, including approaches for changes in precipitation rates and changes in sea level, and provide county-level datasets and reports/projections to jurisdictions to assist them with climate change-related planning and mitigation projects.	4, 7, 10	Flood, Dam Failure, Coastal Hazards	DNR MDE MEMA	**5**	**2**	**10**	**10**	**27**	BRIC, EMPG, UASI, DNR Grants Gateway		1-2 Years	**Safety and Security**
9	Address mitigation and risk reduction considerations on all new state construction through Environmental Site Design (ESD), including considerations such as the maximum allowable impermeable surface for new construction, the use of permeable parking lots and surfaces, and drought-tolerant landscaping.	3, 6, 7	Flood, Dam Failure, Coastal Hazards, Drought	DLLR MDP DNR MDE MEMA	**5**	**5**	**5**	**10**	**25**		Variable/ Unknown	2-3 Years	**Safety and Security**

ID#	Action	Mitigation Goal(s) Supported	Hazard Mitigated	Lead Agency	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline	Community Lifeline
Natural Systems Protections													
10*	Provide support for "Smart City" initiatives, such as Internet of Things (IoT)-connected inlet/reservoir/stream sensors and gauges.	6, 7, 10	Flood, Dam Failure, Coastal Hazards	MDE MEMA MEA	**5**	**2**	**2**	**10**	**19**	BRIC, HMGP, FMA, PWEAA, EMPG, UASI	Variable to High	1-2 Years	**Safety and Security**
11*	Develop guidance/best practices for more efficient crop irrigation methods to assist with balancing agricultural water withdrawals with increased water demand.	1, 5	Drought	MDA MDE	**2**	**5**	**10**	**2**	**19**	USDA	Staff time/ consultants fees to review best practices	1-2 Years	**Food, Water, Shelter**
Local Plans and Regulations													
12*	Develop county-level depth grid data. Develop current and future flood risk visualizations (for use by local governments) that incorporate both storm and nuisance flooding to illustrate potential flood risks to citizens and to help inform local HMP and Risk Assessment update processes.	1, 4, 8, 9	Flood, Dam Failure, Coastal Hazards	MDE DNR MEMA	**5**	**2**	**2**	**10**	**19**	HMGP, BRIC		2-3 Years	**Safety and Security**
13*	Provide incentives to local Planning Commissions to begin preparing for the 2050 projected 100-year and 500-year floodplain delineations (as opposed to the current 100- and 500-year floodplains) by incorporating language into local ordinances (zoning, SALDO) that discusses raising the freeboard and other measures based on these projections.	4, 7, 8	Flood, Dam Failure, Coastal Hazards	MDP MDE MEMA	**2**	**5**	**10**	**10**	**27**	CDBG	Variable - County level cost	3-5 Years	**Safety and Security**
14*	Provide information and encourage counties to obtain the Building Code Effectiveness Grading Schedule (BCEGS) building code evaluation to support Community Rating System (CRS) activities and potentially receive lower insurance rates.	4, 7	All Hazards	DLLR MDP MIA MDE	**2**	**5**	**5**	**10**	**22**	EMPG, CDBG, BRIC		1 Year/ Ongoing	**Safety and Security**
15*	Encourage jurisdictions to incorporate historic, cultural, and archaeological resources and resource considerations into all local hazard mitigation plans (HMPs), with a focus on protecting these resources while maintaining their historic integrity, significance, and National Register eligibility.	3, 4, 7	All Hazards	MHT MEMA	**10**	**10**	**10**	**10**	**40**	HMGP, BRIC, FMA, EMPG, ESHPF, National Trust for Historic Preservation		3-5 Years	**Safety and Security**
16*	Encourage the incorporation of FEMA's seven Lifelines into all local HMPs to prioritize the rapid stabilization of community lifelines after a disaster, and promote the use of FEMA's Guides to Expanding Mitigation by counties and jurisdictions during their local mitigation efforts.	4, 6, 7	All Hazards	MEMA	**10**	**10**	**10**	**10**	**40**	EMPG, UASI, BRIC, HMGP		2-3 Years	**Safety and Security**
17*	Develop a Standard Operating Guide for Hazard Mitigation Planning to streamline the HMP update process for Maryland counties and jurisdictions by providing a model plan outline, to clarify existing guidance (for Emergency Managers), and to support communities developing their HMPs.	4, 6, 7	All Hazards	MEMA MAC	**10**	**5**	**5**	**10**	**30**	HMGP, BRIC	Low cost; state/ consultant fees product	3-5 Years	**Safety and Security**

ID#	Action	Mitigation Goal(s) Supported	Hazard Mitigated	Lead Agency	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline	Community Lifeline
Education and Awareness Programs													
18*	Develop and provide a library of tools and resources to assist jurisdictions with garnering public input and support during the HMP update process and during plan adoption and maintenance processes.	2, 4, 10	All Hazards	MEMA MAC	**10**	**5**	**5**	**10**	**30**	EMPG, UASI, HMGP, BRIC	State led, low cost	2-3 Years	**Communications / Safety and Security**
19*	Develop a project portfolio comprised of statewide hazard mitigation success stories and best practices and post them on the MEMA website for local jurisdictions to refer to during mitigation efforts.	2	All Hazards	MEMA MAC	**10**	**10**	**10**	**10**	**40**	HMGP, EMPG	Low cost; state/ consultant fees product	1-2 Years	**All**
20*	Work with jurisdictions to promote partnerships with local organizations to develop "community resilience hubs" to support residents, coordinate communication, and distribute resources, and to help communities become more self-determining and socially connected before, during, and after hazard events.	2, 4, 10	All Hazards	MEMA MAC	**10**	**5**	**5**	**10**	**30**	UASI, EMPG, HMGP	Variable/ unknown	5 Years	**Communications**
21	Conduct annual reviews of the Plan, and require state departments, counties, and local governments to submit annual updates regarding the implementation status of the actions identified in their previous flood plans and HMPs.	4	All Hazards	MEMA MAC	**10**	**10**	**10**	**10**	**40**	HMGP, EMPG	Staff Time	1 Year/ Ongoing	**All**
22*	Work with county and local communities and provide informational and educational tools and products to promote the local benefits of and to encourage participation in StormReady, CRS, BCEGS, Firewise, or other relevant planning, preparedness, and mitigation incentive programs.	2, 4	Natural Hazards	DLLR MDE MEMA MIA	**10**	**10**	**10**	**10**	**40**	EMPG, UASI, HMGP, CDBG, FMA		1 Year/ Ongoing	**Safety and Security**
23*	Partner with insurance providers and companies directly to encourage coverage of pre-storm actions for hazard mitigation.	1, 4	Natural Hazards	MIA MEMA MDE	**10**	**10**	**10**	**10**	**40**	BRIC, HMGP, EMPG, UASI, FMA	Variable/ unknown	1-2 Years/ Ongoing	**Safety and Security**
24*	Establish a regular schedule to report regional drought conditions to agricultural entities, offices, and stakeholders throughout the state.	4	Drought	MDE MEMA	**2**	**5**	**5**	**2**	**14**	EMPG, LFP	Staff Time	1 Year/ Ongoing	**Food, Water, Shelter**
25*	Provide information to local governments and the public regarding risks to public drinking water (public health) that can arise from various hazards or disasters (dam failure, flooding, etc.).	2, 4, 10	All Hazards	MDE MEMA MDH	**10**	**5**	**5**	**5**	**25**	PWEAA, PHEP, EMPG, UASI	Staff time to develop materials	1-2 Years	**Food, Water, Shelter**
MEMA Specific Actions													
26	Conduct an equity audit to identify how programs and policies are administered and the impacts they have on the diverse stakeholders we serve. Use the results to develop an equity lens to be incorporated into revisions of existing programs and policies, and to be used as a guide when developing new programs and policies. Build capacity to plan for equity in all actions and programs by	4, 10	All Hazards	MEMA MAC	**10**	**5**	**2**	**10**	**27**	EMPG, UASI		2-3 Years	**All**

ID#	Action	Mitigation Goal(s) Supported	Hazard Mitigated	Lead Agency	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline	Community Lifeline
	engaging community leaders from target communities in the planning processes.												
27	Prioritize disaster risk reduction by implementing the Sendai Disaster Risk Reduction Framework in Maryland to prevent new and reduce existing disaster risk by focusing on shared responsibility among stakeholders, including local governments, the private sector, nongovernmental organizations (NGOs), and the public.	1, 4, 6	All Hazards	MEMA MAC	**10**	**5**	**2**	**10**	**27**	EMPG, UASI		3-5 Years	**All**
28	Encourage and foster public-private partnerships (P3s) between state, county, and local governments, and private or non-profit organizations and entities, to take advantage of private expertise, initiatives, and/or resources, and encourage the shared responsibility highlighted under the Sendai Disaster Risk Reduction Framework.	4	All Hazards	MEMA	**10**	**5**	**5**	**10**	**30**	EMPG, UASI, BRIC, and partnerships funding	Staff Time	1-2 Years/ Ongoing	**All**
29	Encourage and support innovative mitigation and planning projects by state agencies and at local levels, by leveraging both FEMA and non-FEMA funding sources.	6, 7	All Hazards	MEMA MAC	**10**	**10**	**5**	**10**	**35**	EMPG, UASI, MDE CFMGP, DNR's Grants Gateway	Staff time/ consultant fees to evaluate framework of funding	1-2 Years/ Ongoing	**All**
30	Convene state and allied stakeholders (NGOs, advocacy organizations, institutions, etc.) on an annual basis to develop innovative risk reduction solutions aimed at improving the quality of Maryland's communities and the lives of Marylanders.	4, 10	All Hazards	MEMA MAC	**10**	**10**	**5**	**10**	**35**	BRIC, EMPG, UASI, HMGP	State staff and venue costs	1 Year/ Ongoing	**Safety and Security**
31	Foster regional cooperation and support the development of regional actions through the local hazard mitigation stakeholder groups and other strategic partnerships.	4, 6	All Hazards	MEMA MAC	**10**	**10**	**5**	**10**	**35**	EMPG, UASI, HMGP	Staff Time	1 Year/ Ongoing	**Safety and Security**
32	Prioritize regional projects over "local-only" projects when evaluating hazard mitigation project applications, notice of interest (NOI) submissions, and other proposed mitigation and planning projects.	4	All Hazards	MEMA	**10**	**10**	**10**	**10**	**40**	BRIC, EMPG	Staff Time	1-2 years/ ongoing	**Safety and Security**
Energy/Utility Security													
33*	Incorporate energy impacts into critical facilities' planning functions, operational decisions, emergency operation plans, and capital improvement budgets by educating state agencies and local governments about the need for energy security.	3, 4, 7	All Hazards	MEA	**10**	**10**	**10**	**5**	**35**	BRIC		1-2 years/ ongoing	**All**
34	Evaluate new and existing state and local government buildings, critical facilities, and infrastructure for solar potential. Prioritize these based on their ability to sustain safe, clean, efficient, and reliable backup solar power systems aligned with location and site characteristics, fuel supply availability, and operational needs.	5, 7	All Hazards	MEA	**5**	**10**	**5**	**10**	**30**	BRIC		2-3 Years	**All**

ID#	Action	Mitigation Goal(s) Supported	Hazard Mitigated	Lead Agency	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline	Community Lifeline
35*	Eliminate or minimize disruption of local government operations caused by natural hazards by enhancing the resilience of identified critical infrastructure, critical facilities, institutions, and services; by adopting a framework for valuing distributed energy resource costs and benefits; and by installing new microgrid systems that include photovoltaic (PV) solar power systems or other sources for local power generation.	1, 3, 7	All Hazards	MEA	**10**	**5**	**5**	**10**	**27**	BRIC		1-2 Years	**All**
36	Support energy security by diversifying supply and improving the reliability and resiliency of utility distribution systems and power-critical infrastructure.	1, 3, 7	All Hazards	MEA	**10**	**5**	**5**	**5**	**25**	BRIC			**All**
Public Health													
37	Increase and maintain surveillance and monitoring activities for public health issues, with special regard for infectious, animal, water, and airborne diseases.	1, 6, 10	Public Health/ Pandemic	MDH, MDE, MEMA	**10**	**10**	**10**	**10**	**40**	BRIC, PHEP, EMPG, UASI	Variable/ unknown	2-3 Years	**Safety and Security / Food, Water, Shelter**
38	Improve food security by creating a Food Resiliency Council to increase and supervise planning efforts to mitigate impacts on agriculture, livestock, and fisheries, and the subsequent food supply chain in Maryland.	1, 7, 10	All Hazards	MDA, MDH, MDE, MEMA	**10**	**5**	**5**	**10**	**30**	BRIC, PHEP, EMPG, UASI, USDA (NIFA) Community Food Projects Competitive Grant Program (CFPCGP)	Variable/ unknown	1-2 Years	**Food, Water, Shelter**
39	Use nature-based solutions for risk reduction in hazardous areas to achieve co-benefits, such as flood reduction, water quality improvement, and other ecosystem benefits.	5, 6	Flood, Dam Failure, Coastal Hazards	MDE DNR	**10**	**5**	**10**	**10**	**35**	EPA's Chesapeake Bay Program Grants, BRIC, FMA, HMGP, DNR's Gateway Grants, MDE CFMGP, USACE, CBT, NOAA	Variable/ unknown	1 Year/ Ongoing	**Food, Water, Shelter**

4.10 Mitigation Action Funding Sources

Federal and state grant funding programs that may assist in implementing both the state and local HMPs and the mitigation action strategies and projects contained therein are listed in Table 4-4. Additional federal, state, and/or private funding sources may be available, depending on project type, area of focus, and eligibility. Table 4-4 highlights only the larger or more common grant programs available at the state and regional level and should not be taken as a comprehensive listing of all available assistance programs.

The table provides the grant program name, name of the lead agency and contact information, eligible activities, cost share information, program characteristics, and application deadlines. For instance, the Emergency Supplemental Funding from the Historic Preservation Fund (ESHPF) is administered by the National Park Service. Compliance activities, including the survey and inventory of historic resources in areas impacted by a disaster or the recovery and repair of historic properties damaged during a disaster, require a federal (75 percent) and local (25 percent) cost share. In addition, all funded repair work must substantially mitigate the threat and include steps to mitigate future damage and is only available after a Presidential Disaster Declaration. For additional information relative to MEMA's use of mitigation funds and cost share mechanisms, see Sections 5.1-2 and 6.1.2.

The Maryland Resiliency Partnership maintains a database of more than 200 federal, state, and foundation grant opportunities for projects related to hazard mitigation, floodplain management, green infrastructure, climate resiliency, water quality, and cultural resources. The database is searchable by using key words, grant title, and/or grantor agency/organization name. The grants are for state and local government, communities, and nonprofit applicants. For more information on these grants or to search for additional public or private funding opportunities, see the Maryland Resiliency Partnership's website.

Table 4-4: Mitigation Action Funding Sources

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Federal Emergency Management Agency, Hazard Mitigation Grant Program (HMGP)	Maryland Emergency Management Agency 5401 Rue Saint Lo Drive Reisterstown, MD 21136	All Hazards Mitigation Planning. Acquisition, relocation, elevation and flood-proofing of flood-prone insured properties, flood mitigation planning, wind retrofit, stormwater improvements, education, and awareness.	Federal - 75% Non-Federal - 25%	Local government must be in compliance with the NFIP to be eligible. Projects must be cost-effective and environmentally sound and must solve a problem. Repetitive loss properties are a high priority.	After a Presidential Disaster Declaration
Federal Emergency Management Agency, Building Resilient Infrastructure in Communities (BRIC) Grant Program (formerly Pre-Disaster Mitigation [PDM])	Maryland Emergency Management Agency 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Eligible BRIC activities include: (1) capability- and capacity-building activities, (2) mitigation projects, (3) management costs, and (4) direct technical assistance to communities.	Federal - 75% Non-Federal - 25%	The BRIC program aims to shift the focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. FEMA anticipates BRIC funding projects that demonstrate innovative approaches to partnerships, such as shared funding mechanisms, and/or to project design.	Annual – October through January
Federal Emergency Management Agency, Flood	Maryland Emergency Management Agency 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Assist states and communities in implementing measures that reduce or eliminate	RL: Federal - 90%	Available once a Flood Mitigation Plan has been developed and approved by FEMA.	Annual – October through January

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Mitigation Assistance Program (FMA)		the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the NFIP.	Non-Federal - 10% SRL: Federal - 100% Non-Federal - 0%		
Building Blocks for Sustainable Communities	U.S. Environmental Protection Agency (EPA) Office of Community Revitalization (MC 1807T) 1200 Pennsylvania Ave NW Washington, D.C. Abby Hall at hall.abby@epa.gov or 202-631-5915 https://www.epa.gov/smartgrowth/building-blocks-sustainable-communities	Applications should focus on regional projects that address a disaster risk faced by communities. Projects should align with and support related efforts and local HMPs. Eligible applicants: local, county, tribal, and nonprofit organizations.		This program provides technical assistance to communities using a variety of tools (e.g., smart growth, climate change, disaster resiliency and recovery, etc.). Grant focus changes yearly.	
Community Assistance Program- State Support Services Element (CAP-SSSE)	Maryland Emergency Management Agency 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Community Eligibility Provision (CEP) Tool; Community Assistance Visit; Floodplain Management Data; State Model Regulation Updates; Community Information System; Floodplain Management Regulation Assistance; Outreach, Workshops and Training; Community Rating System (CRS) Support;	Federal – 75% Non-Federal – 25%	The Tiered State Framework defines the state floodplain management programs and sets forth a process by which states are assessed and aligned to a tier. States must continue to support efforts to improve compliance with the NFIP regulations for new and existing state-	Annual – May through June

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
		Mapping Coordination Assistance; and Assistance to Communities in Responding to Disasters		owned property in the SFHA.	
Certified Local Government (CLG) Program	Maryland Historical Trust (MHT) 100 Community Place, 3rd Floor Crownsville, MD 21032 Nell Ziehl, Chief, Office of Planning, Education and Outreach, nell.ziehl@maryland.gov 410-697-9592	The two grant tracks are education and training and projects. Education and training grants are available for training, workshops, and conferences. Project grants are available for research, survey, documentation, conservation, planning, and educational activities involving historic, architectural, archeological, or cultural resources. Only CLGs are eligible to apply for funding.		Education and training grant awards do not exceed $1,000, while CLG Program grants do not exceed $25,000. Hazard mitigation planning for cultural resources in CLGs may be fundable under this program.	Jan/Feb
Federal Emergency Management Agency, Public Assistance Program	Maryland Emergency Management Agency 5401 Rue Saint Lo Drive Reisterstown, MD 21136	Emergency Work for completion within first 6 months: Debris Removal and Emergency Protective Measures. Permanent Work for completion within 18 months: Roads and Bridges, Water Control Facilities, Public	Federal – 75% Non-Federal – 25%	Applicant must be a state, territory, local government, tribe, or private nonprofit organization. Facility must be a building, public works system, equipment, or natural feature. Applicants may not duplicate benefits	After a Presidential Disaster Declaration. Projects must be completed within the Regulatory deadlines.

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
		Buildings and Contents, Public Utilities, and Parks/Recreational Facilities.		with insurance and must comply with Historic Preservation, Environmental, and Floodplain Management laws as part of the eligibility conditions.	
National Flood Insurance Program (NFIP)	Maryland Department of the Environment 1800 Washington Blvd Baltimore, MD 21230	Provides financial protection by enabling persons to purchase insurance against floods, mudslide, or flood-related erosion.	Varies	Includes federally backed insurance against flooding, available to individuals and businesses that participate in the NFIP. Also includes Cooperating Technical Partners (CTP), which communities can apply to participate in.	Anytime
Emergency Advance Measures for Flood Prevention	U.S. Army Corps of Engineers (USACE) 441 G Street, NW Washington, DC 20314 202-761-0011	USACE is authorized to undertake activities, including disaster preparedness, advance measures, emergency operations (flood response and post-flood response), rehabilitation of flood control works threatened or destroyed by flood, protection/repair of federally authorized shore protective works threatened or damaged	No information provided	There must be an immediate threat of unusual flooding present before advance measures can be considered. Any work performed under this program will be temporary in nature and must have a favorable benefit cost ratio.	Governor of state must request assistance

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
		by coastal storm, and provisions of emergency water due to drought or a contaminated source.			
U.S. Economic Development Administration, Public Works and Economic Adjustment Assistance Program (PWEAA)	U.S. Department of Commerce Economic Development Administration Kevin Quinn Philadelphia Regional Office Robert N.C. Nix Federal Building, 900 Market Street, Room 602, Philadelphia, PA 19107 267-687-4317 kquinn@eda.gov	EA provides a wide range of technical, planning, and public works and infrastructure assistance. The public works program helps distressed communities revitalize, expand, and upgrade their physical infrastructure, and provides support for improvements and reconstruction of public facilities after a disaster or industry closing.	Federal - 50%-80%	Research studies are designed to facilitate economic development. Documenting economic distress and job impact as well as proposing a project that is consistent with a comprehensive economic development strategy are important funding selection criteria.	Anytime
Centers for Disease Control and Prevention, Public Health Emergency Preparedness (PHEP) Cooperative Agreement	Department of Health and Human Services Centers for Disease Control and Prevention 1600 Clifton Rd, NE Mailstop H21-5 Atlanta, GA 30329-027 (404) 639-0817	The PHEP program provides funds for health departments to build and strengthen their abilities to effectively respond to a range of public health threats, including infectious diseases, natural disasters, and biological, chemical, nuclear, and radiological events.	Federal - 90% State - 10%	Preparedness activities funded by the PHEP cooperative agreement are targeted specifically for the development of emergency-ready public health departments that are flexible and adaptable.	Following a Notice of Funding Opportunity (NOFO)

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Small Business Administration (SBA) Disaster Loan Program	Office of Disaster Assistance, Small Business Administration, 409 3rd Street, SW, STE 6050 Washington, DC 20416; 1-800-659-2955	The SBA offers disaster assistance in the form of low-interest loans to businesses, renters, and homeowners located in regions affected by declared disasters.	Loans that exceed $25,000 must be secured	Loans to cover repairs and replacement of physical assets damaged in a declared disaster. Loans to cover small business operating expenses after a declared disaster.	No information
Community Development Block Grants (CDBG) / States Program	U.S Department of Housing and Urban Development, Office of Block Grant Assistance, 451 7th Street SW., Washington, DC 20410-7000 202-708-1112	Used for long-term recovery needs, such as: rehabilitation of residential and commercial buildings; homeownership assistance, including down-payment assistance and interest rate subsidies; construction of new replacement housing; code enforcement; acquisition, construction, or reconstruction of public facilities.	No information	Citizen participation procedures must be followed. At least 70% of funds must be used for activities that principally benefit persons of low and moderate income. Formula grants to states for non-entitlement communities.	After a Presidential Disaster Declaration

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Department of Homeland Security, Emergency Management Performance Grant Program (EMPG)	Department of Homeland Security, Federal Emergency Management Agency, Grant Programs Directorate (800) 368-6498	The EMPG program provides resources to state and local governments to develop an all-hazards planning approach to emergency management and to sustain and enhance all-hazards emergency management capabilities.	Federal - 50%	Every state is eligible for a percentage of the available funds, which are intended to sustain the core capabilities of the five (prevention, protection, mitigation, response, and recovery) mission areas.	Following a NOFO
Department of Homeland Security, Urban Areas Security Initiative (UASI)	Department of Homeland Security, Federal Emergency Management Agency, Grant Programs Directorate (800) 368-6498	The UASI program is intended to provide financial assistance to address the unique multidisciplinary planning, organization, equipment, training, and exercise needs of urban areas, and to assist these areas in building and sustaining capabilities.	None	The UASI program assists high-threat, high-density urban areas in efforts to build and sustain the capabilities necessary to prevent, protect against, mitigate, respond to, and recover from acts of terrorism.	Following a NOFO
Department of Homeland Security, Fire Management Assistance Grant (FMAG) Program	FMAG Program Public Assistance Division, 4th Floor, Rm 408 Federal Emergency Management Agency 500 C Street, SW Washington, D.C. 20472	The FMAGP replaced FEMA's Fire Suppression Assistance Program. Provides real-time assistance for the suppression of any fire on public (non-federal) or privately owned forest or grassland that threatens to become a major disaster. Funds	Federal - 75% Local - 25%	Prior to approval, a state must demonstrate that total eligible costs for the declared fire meet or exceed either the individual fire cost threshold, which applies to single fires, or the cumulative fire cost threshold, which recognizes numerous	After an uncontrolled fire declaration

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
		from the President's Disaster Relief Fund are used in a designated emergency or major disaster area.		smaller fires burning throughout a state.	
Emergency Supplemental Funding from the Historic Preservation Fund (ESHPF)	National Park Service 1849 C Street, NW Mail Stop 7360 Washington, DC 20240	Various recovery projects, including compliance activities, surveys, and inventories of historic resources in areas impacted by the disaster, recovery and repair of historic properties damaged during the disaster, and other disaster recovery-related activities as approved by the National Park Service.	Federal - 75% Local - 25%	All funded repair work must substantially mitigate the threat and include steps to mitigate future damage.	After a Presidential Disaster Declaration
Transportation: Emergency Relief Program	Federal Highway Administration, FHWA, DOT, 1200 New Jersey Avenue Washington, DC 20590; 202-366-4043	Provides aid for the repair of federal-aid roads, roads on federal lands and county level federal-aid roads.	Federal - 100%	Application is submitted by the state department of transportation for damage to federal-aid highway routes, and by the applicable federal agency for damage to roads on federal lands.	After serious damage to federal-aid roads/roads on federal lands caused by a natural disaster or catastrophic failure.
Livestock Forage Disaster Program (LFP)	Maryland FSA State Office 339 Busch's Frontage Road, Suite 104,	To help livestock producers in approved counties when the growth and yield of hay and pasture have been	No information	Assistance is provided by the Secretary of Agriculture to harvest hay or graze cropland or other commercial use of	Anytime

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
	Annapolis, MD 21409-5561 443-482-2760	substantially reduced because of a widespread natural disaster.		forage devoted to the Conservation Reserve Program in response to a drought or other similar emergency.	
Emergency Watershed Protection Program (EWPP)	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250 Maryland contact J'Que Jones 443-482-2912 jque.jones@usda.gov	Implementing emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed.	Federal - 75% Local - 25%	It cannot fund operation and maintenance work or repair private or public transportation facilities or utilities. The work cannot adversely affect downstream water rights, and funds cannot be used to install measures not essential to the reduction of hazards.	For emergency situations: within 10 days of a disaster For non-emergency situations: within 60 days of a disaster
Watershed Protection and Flood Prevention Program (WPFPP)	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250 Maryland contact J'Que Jones 443-482-2912 jque.jones@usda.gov	To provide technical and financial assistance in carrying out works of improvement to protect, develop, and utilize the land and water resources in watersheds.	Varies due to project type.	Watershed area must not exceed 250,000 acres. Capacity of a single structure is limited to 25,000 acre-feet of total capacity and 12,500 acre-feet of floodwater detention capacity. At least 20% of the total project benefits must be directly related to agriculture.	Anytime

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Flood Emergency Assistance	Baltimore District Corporate Communication Office 2 Hopkins Plaza Baltimore, MD 21201 1-800-434-0988 Baltimore District Emergency Management 410-962-2013 CENAB-EOC@usace.army.mil	Authorizes flood rehabilitation efforts to restore pre-storm conditions through technical and direct assistance.	Varies with project type	Direct assistance includes provision of sandbags, pumps, other flood-fighting material, and emergency contracting for raising and stabilizing threatened flood risk management projects.	Varies with project type
Continuing Authorities Program (CAP)	USACE 441 G Street, NW, Washington DC 20314; 202-761-0011	Initiates a short reconnaissance effort to determine federal interest in proceeding. If there is interest, a feasibility study is performed.	Federal - 65% Local- 35%	A local sponsor must identify the problem and request assistance. Small flood control projects are also available.	Anytime
Hazardous Materials: State Access to the Oil Spill Liability Trust Fund	USCG National Pollution Funds Center U.S. Coast Guard Stop 7605 2703 Martin Luther King Jr. Avenue, SE Washington, DC 20593-7605 202-795-6000	To encourage greater state participation in response to actual or threatened discharges of oil.	The fund can provide up to $1 billion for any one oil pollution incident	States and U.S. Trust Territories and possessions are eligible.	Anytime

Section 5: Mitigation Implementation Status Report

STATE MITIGATION PLAN REVIEW GUIDE

Released March 2015 FP 302-094-2

This Guide is FEMA's official policy on and interpretation of the natural hazard mitigation planning requirements. The intended use of the Guide is to facilitate consistent evaluation and approval of state mitigation plans as well as state compliance with the mitigation planning requirements when updating plans. This section also includes information relative to the enhanced Plan requirements established by FEMA.

Table 5-1: State Mitigation Plan Review Guide

Element	Requirements
S11. Was the plan updated to reflect progress in statewide mitigation efforts and changes in priorities? [2 CFR §201.4(d)] **Intent:** To evaluate progress in implementing the mitigation strategy and to ensure the plan reflects current conditions, including financial, legal, and political realities and post-disaster conditions.	• The plan must describe the status of hazard mitigation actions in the previous plan by identifying those that have been completed or not completed. For those actions not completed, the plan must provide a narrative describing the status (for example, is the action relevant or will it be included in the plan update). • The prioritization of mitigation actions and activities must be updated based on the updated analysis of risks, capabilities, and progress.
E6. With regard to HMA, is the state maintaining the capability to meet application timeframes and submitting complete project applications? [2 CFR §201.5(b)(2)(iii)(A)[46]]	• All applications and amendments are submitted by the end of each program's respective application period. • All applications are entered into FEMA's electronic data systems (such as, NEMIS and/or eGrants). • Eligibility and Completeness Checklist is prepared for all applications. • All applications are determined to be complete by FEMA within 90 days of submittal or selection for further review. Required environmental and historic preservation reviews and consultations will not be included in the 90-day review timeframe calculation.
E7. With regard to HMA, is the state maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [2 CFR §201.5(b)(2)(iii)(B)47]	• All applications and amendments are determined to be complete by FEMA within 90 days of submittal or selection for further review, including all data requested by FEMA to support Cost Effectiveness determinations and environmental/historic preservation compliance reviews. Required environmental and historic preservation reviews and consultations will not be included in the 90-day review timeframe calculation.
E8. With regard to HMA, is the state maintaining the capability to submit complete and accurate quarterly progress and financial	• All progress reports must be complete and submitted on time. Information in reports must accurately describe grant activities, including data related to the completion of individual property acquisitions. Incomplete progress reports that do not provide information on all open grants

Element	Requirements
reports on time? [2 CFR §201.5(b)(2)(iii)(C)48]	and subgrants or include all information required by the HMA Guidance are not considered on time. • All federal financial reports (FFR), Standard Form (SF) SF-425 are submitted on time. Information in reports must accurately describe grant activities, as described in the HMA Guidance. • State consistently complies with the Financial Management Standard requirements described in 2 CFR §§200.300 to 200.309.

5.1 Hazard Mitigation Grant Reporting

Hazard mitigation projects that have been awarded, initiated, and/or completed using HMGP, Flood Mitigation Assistance (FMA), BRIC, and Pre-Disaster Mitigation (PDM) grant funding since 2016 include four project categories: (1) Structure and Infrastructure Projects; (2) Natural Systems Protections; (3) Local Plans and Regulations; and (4) Education Awareness Programs. Table 5-2 below lists all awarded or pending projects using federal grant funds within the past 5 years, including those self-identified by the jurisdictions.

Table 5-2: Maryland Jurisdictions Using Federal Funds Since 2016 [239]

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
Statewide				
Hazard Mitigation Plan Update	DR-4261	Plan updates	HMGP 2016	$300,000.00
Ground Water Treatment Plant Generator	DR-4374	Generator enhancements for GWTP	HMGP 2018	$210,811.25
MDE GIS Dam Breach Data	DR-4376	Data collection and creation	HMGP 2018	$147,800.00
MDE - Hyattsville Nature-Based Solution	-	Hyattsville Nature-Based Solution	BRIC 2020*	$232,491.36
Western Region				
Allegany County				
2016 Mitigation Plan Update	-	Plan Updates	PDM 2016	$28,000.00
Garden City Mobile Home Acquisition Demolition Project	DR-4261	Acquisition and Demolition	HMGP 2016	$1,030,000.00

[239] The amounts in this table show the federal share of the project cost and do not include amounts that may be allowed for management costs under FEMA's HMA Guidance.

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
Garrett County				
2016 Mitigation Plan Update	-	Plan Updates	PDM 2016	$28,000.00
2016 Warning and Notification System Project	DR-4261	Warning and notification systems project	HMGP 2016	$56,000.00
Garrett County - HMP Update 2021	-	HMP Plan Updates	BRIC 2020*	$22,470.00
Garrett - Deep Creek VFD Generator	-	Generator Upgrades	BRIC 2020*	$58,420.00
Garrett - Eastern Garrett VFD Generator	-	Generator Upgrades	BRIC 2020*	$56,500.00
Washington County				
Mitigation Plan Update	-	Plan Updates	PDM 2016	$40,000.00
Central Region				
City of Annapolis				
City of Annapolis Stormwater and Flood Mitigation Project	DR-4261	Build a pumping station and other protections to mitigate flooding in downtown Annapolis	HMGP (pending)	$6,108,441.00
Weather It Together	N/A	Update the Hazard Mitigation Plan and add a Cultural Resource Hazard Mitigation Plan addendum	2015 PDM	$106,612.50
Annapolis Flood Mitigation Plan	N/A	Development of a Flood Mitigation Plan.	2019 FMA	$31,250.00
Anne Arundel County				
2016 Hazard Mitigation Plan Update	-	Hazard Mitigation Plan Update	PDM 2016	44,627.50
Wastewater Treatment Plant	DR-4261	Generator-related enhancement project at the WWTP.	HMGP 2016	$3,687,500

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
(WWTP) Generators Project				
Roadway Vulnerability Study	-	Roadway Vulnerability Study	BRIC 2020*	$250,000.00
Sawmill Creek Stream Restoration	-	Sawmill Creek Stream Restoration	BRIC 2020*	$8,439,129.46
Fire Station Generator Replacement	-	Fire Station Generator Replacement	BRIC 2020*	$470,000.00
Baltimore City				
Frederick Ave Flood Mapping Study Advance Assistance	-	Engineering/flood mitigation study of Frederick Avenue	FMA 2018	$200,000)
Frederick Ave Sensors	DR-4374	Purchase and installation of flood warning sensors at low point along Frederick Avenue	HMGP 2018	$54,000
HMP Update (DP3)	DR-4261	2018 Update of HMP	HMGP 2016	$103,750
South Baltimore Gateway Partnership - Middle Branch	-	South Baltimore Gateway Partnership - Middle Branch	BRIC 2020*	$47,139,468.00
Baltimore County				
North Point and Edgemere and VFD Generator Project	DR-4261	Generator-related enhancements	HMGP 2016	$79,200
Lenore Court 6 Property Acquisition Demolition Project	DR-4261	Property acquisition and demolition	HMGP 2016	$1,278,000
Hazard Mitigation Plan Update	DR-4374	2018 Hazard Mitigation Plan Update	HMGP 2018	31,400
Carroll County				
CC Maintenance Center Generator	DR-4261	Replace and upgrade generator at Carroll County Maintenance Center	HMGP 2016	$264,031
Westminster FD Generator	DR-4261	Replace and upgrade generator at Westminster Fire Department	HMGP 2016	$235,000
Harford County				
2016 Conowingo Road Acquisition Demolition Project	DR-4261	Acquisition and Demolition	HMGP 2016	$276,000

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
Howard County				
Main Street Culvert Modification Project	DR-4279	Replacing 200' of underground culvert, increasing size of culvert, replacing an upstream headwall, roadway storm drainage improvements along Main Street in Ellicott City, MD	HMGP	$1,490,410
Hazard Mitigation Plan Update Project	DR-4261	Plan updates	HMGP 2016	$80,000
Howard Culvert West End Drainage Network	DR-4376	Culverts and drainage enhancements.	HMGP 2018	$2,980,626
Frederick County				
Town of Thurmont - Municipal Building Generator	DR-4374	Generator enhancements to the municipal building in the Town of Thurmont.	HMGP 2018	$39,499
Hazard Mitigation Plan Update	DR-4376	Plan updates	HMGP 2018	$145,000
Frederick - Motter Ave Area Community Flood Mitigation	-	Motter Ave Area Community Flood Mitigation	FMA 2020*	$713,302.02
Montgomery County				
Mitigation Plan Update	-	Plan Updates	PDM 2016	$53,000
Montgomery - Wheaton Branch Flood Mitigation	-	Wheaton Branch Flood Mitigation	BRIC 2020*	$2,332,851.10
Prince George's County				
Prince George's - 2022 HMP Update	-	Plan Updates	BRIC 2020*	$67,750.00
Southern Region				
Calvert County				
4 Property Elevation Project	DR-4261	Elevation of four homes	HMGP 2016	483,699.00
Calvert County Acquisition Projects 4261-18	DR-4261	Acquisition of three homes	HMGP 2016	579,815.00
Easterbell Road Acquisition Demolition	DR-4374	Acquisition of one home	HMGP 2018	366,170.00

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
Calvert - 2023 HMP Update	-	Plan updates	BRIC 2020*	$39,387.00
MDOT - St. George Island Living Shoreline Wetland Restoration	-	St. George Island Living Shoreline Wetland Restoration	BRIC 2020*	$235,000.00
Calvert - 12186 Laramie Lane Acq/Dem	-	ACQ/DEM of 12186 Laramie Lane	BRIC 2020*	$373,713.00
Calvert - 3610 Bay View Drive Acq/Dem	-	Acq/Dem of 3610 Bay View Drive	BRIC 2020*	$632,625.00
Calvert - 9333 Bay Ave North Beach Elevation	-	Elevation of 9333 Bay Ave North Beach	BRIC 2020*	$88,150.00
Charles County				
Hazard Mitigation Plan Update	-	Update of the Charles County Hazard Mitigation Plan	PDM 2016	$95,760
St. Mary's County				
River Road Elevation Project	DR-4261	Elevation project	HMGP 2016	$146,750
Lower Eastern Shore				
Dorchester County				
Elevation Project	-	Elevation	PDM	$80, 000.00
HMP and FMA Plans	-	Plan updates	PDM 2019 and FMA 2015	$60, 000.00
Green Point Road Elevation (1 property)	-	Under Review - Pending Final Approval	PDM 2019	
Advance Assistance for Twin Point Cove Shoreline Resiliency Plan	-	City of Cambridge - Advance Assistance for Twin Point Cove Shoreline Resiliency Plan	PDM 2019	$50,000
Flood Mitigation Plan Update	-	Plan Updates	FMA 2019	$30,000
Advance Assistance Development of Flood Mitigation Strategies	-	City of Cambridge - Advance Assistance Development of Flood Mitigation Strategies	FMA 2019	$250,000
Cambridge - Sewer System Hardening Resilience	-	Sewer System Hardening Resilience	BRIC 2020*	$5,147,800.00
Dorchester - 2007 Farm Creek Road Elevation	-	2007 Farm Creek Road Elevation	BRIC 2020*	$125,461.30

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
Somerset County				
Mitigation Plan Update	-	Plan Updates	PDM 2016	$40,000
Tidal Gauge Project	DR-4261	Tidal Gauge Project	HMGP 2016	$9,925
City of Crisfield Elevation Project	DR-4261	Elevation project in City of Crisfield	HMGP 2016	$235,875
Somerset County Flood Mitigation Plan	-	Plan Updates	FMA 2018	$33,299
Long Point Road Elevation	-	Road Elevation	PDM 2019	$70,188
Riverview Road Home Elevation (1 property)	-	Elevation Project	PDM 2019	$112,410
Somerset - HMP Update	-	Plan Updates	BRIC 2020*	$40,000.00
Town of Ocean City				
Ocean City Check Valve Project	DR-4261	Check valve installation and improvements	HMGP 2016	$118,323
Wicomico County				
2016 HMP	-	HMP update	HMGP	$35,200.00
Sharptown Water Treatment Plant (WTP) Generator	DR-7374	Generator enhancements for the Sharptown WWTP	HMGP 2016	$48,200
Town of Hebron Generator for Water Tower	-	Generator for Water Tower	PDM 2018	$104,490
Hazard Mitigation Plan Update	-	Plan Updates	PDM 2019	$50,000
Cove Road Acquisition (1 property)	-	Acq/Dem. project	PDM 2019	$251,759
Nanticoke Drive Elevation (1 property)	-	Elevation project	PDM 2019	$174,458
Worcester County				
Ocean City - HMP Update		Plan Updates	BRIC 2020*	$30,000.00
Upper Eastern Shore				
Caroline County				
2019 Hazard Mitigation Plan Update	-	Development of new HMP Update via contractor assistance.	PDM 2016	$36,787

Project Title	Disaster Number (if applicable)	Project Description	Funding Source (PDM, HMGP, etc.)	Total Cost (grant and match)
COOP/Recovery Plan	-	COOP/Recovery Plan Development	CARES	
Cecil County				
Cecil County Elevation Project 509 S. Main Street	FEMA-DR-4170-03-MD-0011	Elevation and retrofitting of a residential structure in the 100-year floodplain.	HMGP	$128,400.00
Cecil County Elevation Project 36 Pennsylvania Avenue	FEMA-DR-4170-03-MD-0007	Elevation- PROJECT WITHDRAWN AND FUNDS DEOBLIGATED	HMGP	$112,155.00
Hazard Mitigation Plan Update	-	Hazard Mitigation Plan Update	PDM 2019	$40,000
Kent County				
HMP Update	-	Plan updates	HMGP	$27,000
Town of Betterton Shoreline Erosion Mitigation Project	-	Shoreline Erosion Mitigation Project	PDM 2017	$648,456
Queen Anne's County				
Town of Millington Acquisition Demolition Project	DR-4261	Acquisition and Demolition	HMGP 2016	$101,950
Sta 400 Generator Project	DR-4374	Critical facility generator – Mission essential generator	HMGP 2018	$57,000
Hazard Mitigation Plan Update	-	Plan Revision	PDM 2016	$81,250
Talbot County				
Claiborne Tide Gauge	-	Tide gauge installed on Claiborne Landing to provide data to Talbot and Queen Anne's County in the area of Eastern Bay. Having ability to make better informed decisions related to changing tides during tidal events.	HMPG	$9,925
Hazard Mitigation Plan Update	-	Plan updates	PDM 2019	$50,000
Easton - Utilities, Maryland Windmill Sewage Pumping Station	-	Utilities, Maryland Windmill Sewage Pumping Station	BRIC 2020*	$4,432,405.00
TOTAL				**$94,775,125.24**

* = Grant still under review

5.2 Federal Funding by Region and Type

As shown in Table 5-2 above, since the last 2016 Plan, the state has submitted 85 subapplications for a total of nearly $95 million in federal mitigation funds. The figures below show the dispersion of the subapplications by region as well as the program types that were applied for. Based on this data and as Figure 5-1 below shows, the Central Region submitted the most applications (27) and requested the highest amount of federal share ($76.7 million). Of the individual jurisdictions tracked by Table 5-2, Baltimore City requested over $47 million in four subapplications. Calvert and Dorchester counties submitted the highest number of subapplications (eight each), but only requested a combined federal share of $8.5 million. The top five jurisdictions (by federal share requested) are:

- Baltimore City ($47.3 million)
- Anne Arundel County ($12.9 million)
- City of Annapolis ($6.2 million)
- Dorchester County ($5.7 million)
- Howard County ($4.69.6 million)

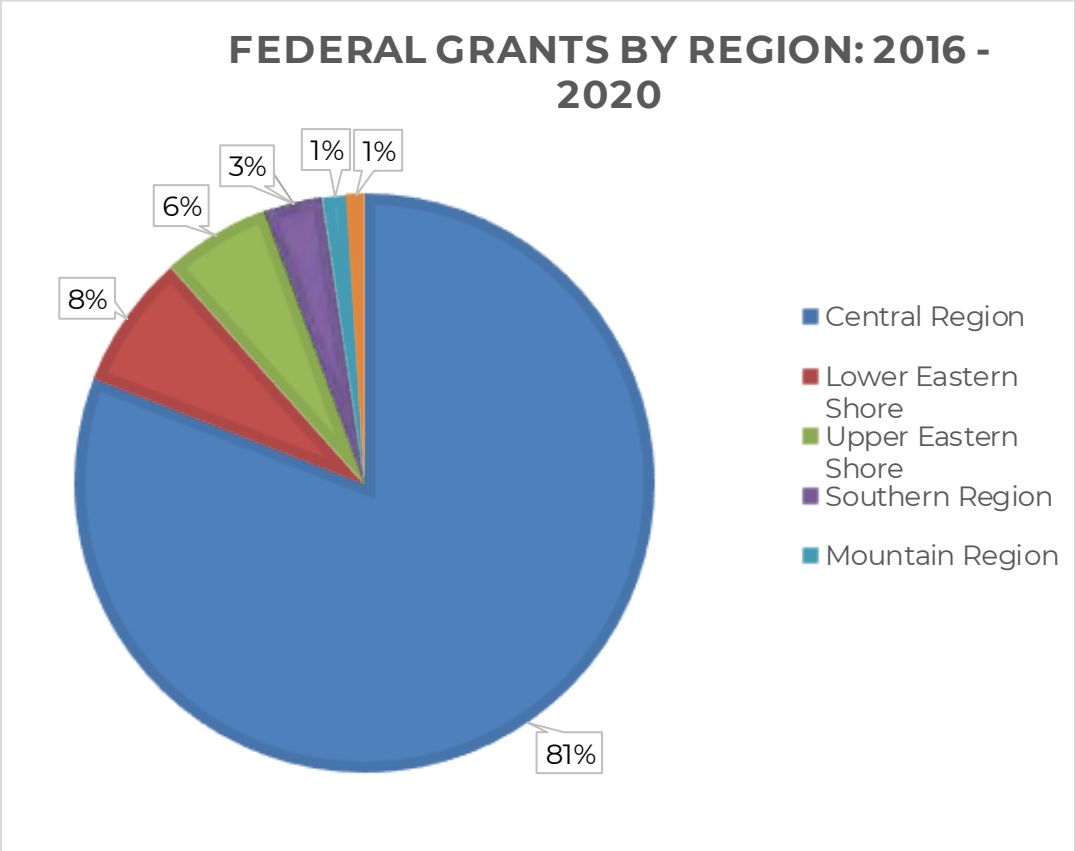


Figure 5-1: HMA Grants by Region 2016 - 2020

The map below shows a regional breakout of the HMA funding amounts that have been applied for since 2016.

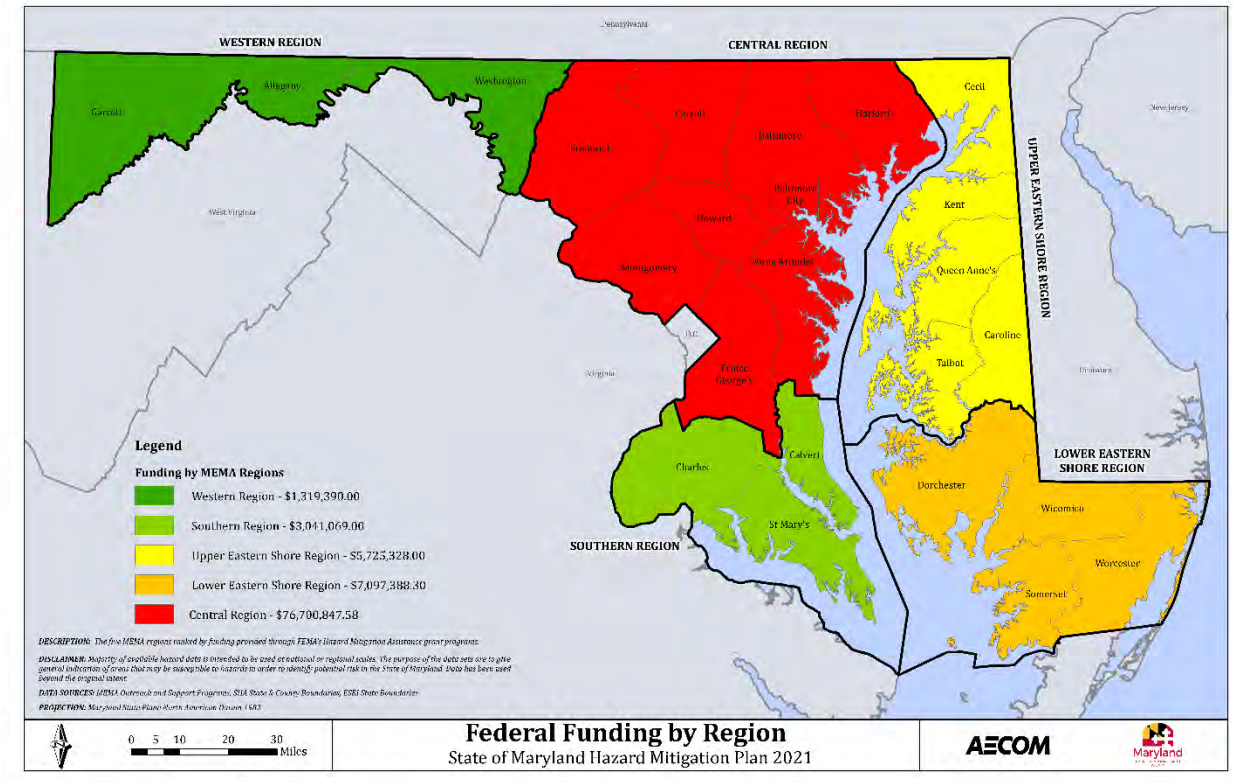


Figure 5-2: HMA Funding Applied for by Region – 2016 - 2020

The federal programs applied for were fairly typical based on the programs that the state has applied for in the past: the HMGP subapplications lead the way in total number of applications (34), but was second in federal share requested ($20 million) to the newly launched BRIC program which received the highest single amount of interest for any given year, generating over $70 million in federal share requested from only 20 subapplications. The legacy PDM program, replaced by BRIC in FY20, had the second highest submission rate (23 subapplications). Figure 5-3 below shows the overall program dispersion. Over the next 5 years, MEMA will seek to leverage these typical funding sources with other non-FEMA sources such as HUD, EPA or non-governmental sources as discussed previously.

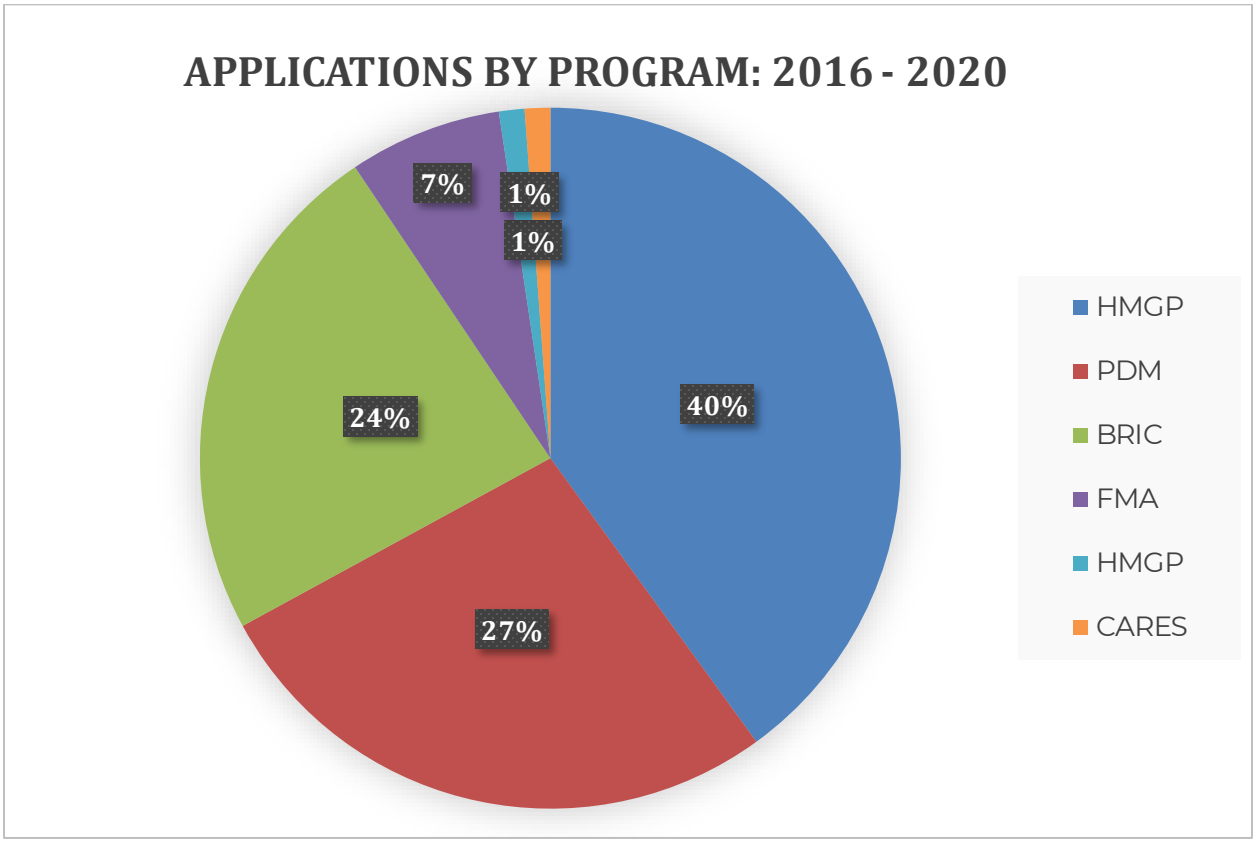


Figure 5-3: HMA Applications by Program 2016 - 2020

Project types were distributed fairly evenly between the five categories listed below, although Planning Projects are clearly the primary funding type. For this analysis, all plans, plan updates, and studies fall into "Planning Projects" while anything else, not designated as an acquisition, demolition, elevation or generator were classified as "Mitigation Projects."

- Planning Projects (36)
- Mitigation Projects (16)
- Elevation Projects (12)
- Generator Projects (12)
- Acquisition/Demolition Projects (9)

Planning projects accounted for almost $50 million of the submissions, while Mitigation projects accounted for $33 million, showing that, at least in the last 5 years, Planning has been the most sought-after mitigation activity. Given the lifespan of hazard mitigation plans, it makes sense that during the last 5 years most of Maryland's jurisdictions needed funds for mitigation plans and updates – this was also the top project type nationally of the legacy PDM program. However, for this trend to continue, Maryland will need to start using more of its other federal sources

for planning, as the BRIC program is capped at 50 percent of the state's allocation for planning activities. Additionally, FEMA is encouraging states that receive disaster declarations that make them eligible for HMGP to utilize the maximum amount of the HMGP funding (up to 7 percent of the grant award) for planning and planning related activities. MEMA will review its program applications and subapplications over the coming years to ensure that it is maximizing its planning funding usage, while still devoting most of its funding requests to mitigation projects themselves.

MEMA anticipates similar application types over the next 5 years and has designed this Plan update to stimulate mitigation projects that will fit within the BRIC program criteria and meet these new program goals. In future years, more projects will include a nature-based solution.

MEMA's multi-pronged approach to disaster risk reduction and mitigation has provided ample opportunities to further mitigation through awareness and outreach, planning and risk analysis, construction projects, and more. In January 2021, the Maryland Department of Commerce, MEMA, the Netherlands Water Partnership, and the Baltimore-Rotterdam Sister City Committee hosted a conference to provide technical assistance to Maryland communities and build partnerships with resilience experts in the Netherlands. Partnerships such as these works to directly build the capabilities at the state and local level within Maryland.

While the majority of the external engagements can be found in the table of additional stakeholder meetings found in Appendix B, some specific project examples, Planning Implementation and Grants Development Workshops, year-round technical assistance, and trainings which show how Maryland has enhanced capability are identified below.

Project Examples

- Technical Assistance Examples: Six component webinar series between September and October 2020, led by MEMA, for local governments on the new FEMA BRIC program, common elements of mitigation applications, and state requirements.

Workshop Examples:

- Maryland-Netherlands Flood Resiliency / Smart Cities 2019 (March 27-30)
- Maryland-Netherlands – Building a Climate Resilient Maryland Together 2021 (January 26)

5.3 Status of Past Actions

The Lead Agencies identified in the 2016 Plan reviewed each action from the original plan assigned to their agency and discussed and categorized those actions based on definitions given in Table 5-3 below.

Action items from the 2016 Plan that have been completed, deemed infeasible, or merged/combined with another action item have been removed from this plan. Those actions are itemized, described, and justified in Appendix E. Actions determined to be In Progress, On Going, or Not Started have been carried forward into this 2021 Plan. These can also be found in Appendix E. Based on new or updated hazards and rankings, altered or reorganized capabilities, and MEMA's changing priorities, the MAC will revisit the remaining past actions and reevaluate them for relevance, urgency, and importance every 2 years.

Table 5-3: Status Update Definitions

Status	Definition
In Progress	Work has been initiated on these actions. These projects have a definite end-date.
On-Going	Actions that are performed on a regular and continuous basis by the County.
Completed	The lead department has completed the action since the development of the 2016 plan.
Not Applicable	Actions that were deemed by the Steering Committee to not apply to the Plan.
Cancelled	Officials have decided to terminate the project.
Infeasible	After further study this project was deemed to be infeasible based on benefit/cost analysis, engineering study, or another criterion.
Not Started	No work has begun on this action; however, the action has not been cancelled or determined infeasible.

There were 13 lead agencies identified in the 2016 Plan update. In order to update mitigation actions identified in the 2016 Plan, the State Hazard Mitigation Officer along with the MAC developed a point of contact listing and requested information or a status update from the lead agencies for each action. A customized Past Action Status Form was developed for each agency and distributed in September of 2020.

The Agencies listed below identify the Lead Agencies for the 2016 Plan mitigation actions. If the agency provided status updates for their assigned actions during this data collection effort, those updates are included on the worksheets in Appendix E. Agencies not providing updates will have their actions reviewed and reevaluated during the annual review.

The findings of the past actions data collection indicate that of the 36 action items that were developed in 2016, seven have been completed. Five of the 2016 actions were deemed no longer applicable and/or infeasible and were recommended for removal by the respondents. Seventeen of the actions were determined to be in progress or ongoing and have been carried forward in this Plan update.

The 2016 actions carried forward into the 2021 Plan are listed below. They will maintain their rankings and implementation planning information from the 2016 scoring process.

2016 Plan Actions Carried Forward

- #2 – Elevation Project Application Enhancement
- #3 – Enhance Maryland Flood Maps (www.mdfloodmaps.org)
- #4 – Elevation Project Application Enhancement – Historic Structures
- #6 – Develop Flood Risk Freeboard Layer – mdfloodmaps.org
- #7 – Education & Outreach on Historic Properties and Coastal Hazards Mitigation and Climate Change Resiliency
- #10 – Incorporation of HAZUS Runs (Planning & Recovery efforts post disaster) for www.mdfloodmaps.org
- #11 – Complete Vulnerability Assessment for Hurricane Wind Enhanced HAZUS
- #13 – Obtain Elevation Certificates for State Facilities (including Critical Facilities) in Special Flood Hazard Areas (SFHA) – Integrate all Elevation Certificates into Online System
- #14 – All Hazards Risk, Mitigation & Resiliency Outreach
- #15 – Coastal Restoration to Mitigate Hazards for Vulnerable Communities
- #16 – Statewide Participation in the NFIP
- #17 – All Hazards Plan Integration – State to Local Implementation
- #18 – Increase opportunities for communication about adaptation planning in Maryland, facilitate the exchange of ideas between Chesapeake Bay watershed partners, and pilot green/grey infrastructure to prepare for and respond to climate impacts in vulnerable communities.
- #19 – Resiliency Partnership Resource Website
- #20 – Maryland Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Property Inventory Update
- #22 – Technical Assistance to Identify, Address, and Incorporate Coastal Hazards into Local Planning
- #23 – Complete FEMA Form AW-501 to Support Update of the FEMA SRL and RL Property Databases
- #24 – Develop and Promote Tabletop Exercises Prior to Flood Event / Hazard
- #26 – Mobile Lidar Capture
- #27 – Development of Backup Groundwater Systems

- #31 – Gather and Present Mitigation GIS Data that can be used Operationally during Response and Recovery
- #32 – Increase All Hazards Private Sector Resiliency
- #34 – Target Restoration, Preservation, & Mitigation within Special Flood Hazard Areas using the Water Resource Registry
- #36 – Floodplain Management Training

Table 5-4: Past 2016 Actions with Identified Lead Agencies

Action	MEMA	MDE	MHT	MES	MD DNR	MD SHA	MTA	CBP	WSSC	Balt City	EPA	Local	County Health
1. EC Historic Properties	X	X	X										
2. Elevation Application	X			X									
3. MD Flood Maps		X											
4. Historic Elevation			X										
5. Flood Guidance Historic			X										
6. Freeboard Layer		X											
7. Outreach Historic Properties			X										
8. Historic Properties Survey			X										
9. HM/CC Officer			X										
10. Hazus Flood Maps	X	X		X									
11. Wind Hazus	X											X	
12. MAC Ranking	X												
13. EC State Facilities	X	X											
14. HM/R Outreach	X												
15. Coastal Restoration	X				X			X					
16. Statewide National Flood Insurance Program (NFIP)	X	X										X	
17. HMP Integration	X												
18. Climate Resiliency					X			X					

Action	MEMA	MDE	MHT	MES	MD DNR	MD SHA	MTA	CBP	WSSC	Balt City	EPA	Local	County Health
19. Resiliency Website					X								
20. SRL Inventory		X		X									
21. SHA Integration		X											
22. Coastal Hazards					X								
23. SRL Prioritization		X										X	
24. Table-Top Exercises	X	X			X							X	
25. Archeological Survey			X										
26. Mobile Lidar		X				X							
27. Backup Groundwater									X	X			
28. Coast Smart Council	X	X			X								
29. Data Availability							X						
30. Well Inventory													X
31. GIS Data	X												
32. Private Sector	X												
33. Roadway Flooding						X							
34. Target Restoration	X	X			X	X					X		
35. FME Tool	X	X											
36. Floodplain Training	X	X											

Section 6: Management, Local Plans, and Capabilities Assessment

STATE MITIGATION PLAN REVIEW GUIDE
Released March 2015 FP 302-094-2

This Guide is FEMA's official policy on and interpretation of the natural hazard mitigation planning requirements. The intended use of the Guide is to facilitate consistent evaluation and approval of state mitigation plans, as well as to facilitate state compliance with the mitigation planning requirements when updating plans.

Additional CFR Requirements for Plan Integration

CFR §201.6(b)(3) Review and incorporate, if appropriate, existing plans, studies, reports, and technical information.

CFR §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Table 6-1: State Mitigation Plan Review Guide

Element	Requirements
S12. Does the plan discuss the evaluation of the state's hazard management policies, programs, capabilities, and funding sources to mitigate the hazards identified in the risk assessment? [2 CFR §201.4(c)(3)(ii) [22]] **Intent:** To identify and build the state's capabilities to reduce risk and increase resilience.	The plan must describe existing state pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the state, including: • An evaluation of state laws, regulations, policies, and programs related to hazard mitigation, as well as to development in hazard-prone areas, to include the state's administration of the: o National Flood Insurance Program (NFIP) and Community Rating System (CRS); and o Risk Mapping, Assessment, and Planning (Risk MAP) program. • A discussion of state funding capabilities for hazard mitigation projects, including: o A general description of how the state has used its own funds for hazard mitigation projects; and o A general discussion of how the state has used FEMA mitigation programs and funding sources, including but not limited to: ▪ HMGP, PDM, and FMA; and ▪ PA C-G. • A general summary of: o Obstacles and challenges; and o Changes since the previous plan approval.
S13. Does the plan generally describe and analyze the effectiveness of local and tribal, as applicable, mitigation policies, programs, and capabilities? [2 CFR §201.4(c)(3)(ii)]	• The plan must provide a general summary of current local and tribal, as applicable, policies, programs, and capabilities of jurisdictions to accomplish hazard mitigation. • The plan must describe the effectiveness of local and tribal, as applicable, mitigation policies, programs, and capabilities,

Element	Requirements
Intent: To ensure the state understands the local and tribal, as applicable, jurisdictions' capabilities to accomplish hazard mitigation, particularly as capability varies across jurisdictions.	including: o Challenges to implementing local and tribal, as applicable, mitigation policies, programs, and capabilities. • Opportunities for implementing mitigation actions through local and tribal, as applicable, capabilities.
S14. Does the plan describe the process to support the development of approvable local and tribal, as applicable, mitigation plans? [2 CFR §§201.3(c)(5)[23] and 201.4(c)(4)(i)[24]] **Intent:** To direct state resources toward effective local and tribal, as applicable, mitigation planning.	• The plan must describe how the state supports developing or updating FEMA-approvable local and tribal, as applicable, mitigation plans, including the process used to provide: o Training; o Technical assistance; and o Funding *[NOTE: criteria for prioritizing funding for planning and project awards are addressed in S15]*. • The plan must provide a summary of the: o FEMA-approved local and tribal, as applicable, mitigation plan coverage; o Barriers to developing or updating, adopting, and implementing FEMA-approved local and tribal, as applicable, mitigation plans; and • Approach to remove barriers in order to advance local and tribal, as applicable, mitigation planning.
S15. Does the plan describe the criteria for prioritizing funding? [2 CFR §201.4(c)(4)(iii)[25]] **Intent:** To guide investment decisions and communicate state priorities for mitigation actions.	The plan must describe criteria for prioritizing jurisdictions to receive planning and project grants under available Federal and non-Federal programs. A principal criterion for prioritizing grants shall be the extent to which benefits are maximized.
S16. Does the plan describe the process and timeframe to review, coordinate, and link local and tribal, as applicable, mitigation plans with the state mitigation plan? [2 CFR §§201.3(c)(6),[26] 201.4(c)(2)(ii), 201.4(c)(3)(iii), and 201.4(c)(4)(ii)[27]] **Intent:** To streamline the review and approval of local and tribal, as applicable, mitigation plans, create a common understanding of risk, and align mitigation strategies between state, local, and tribal, as applicable, plans	• The plan must describe the process and timeframe used by the state to review and submit approvable local and tribal, as applicable, mitigation plans to FEMA. • The plan must describe the process and timeframe used by the state to coordinate and link risk assessments and mitigation strategy information from local and tribal, as applicable, mitigation plans into the state mitigation plan.
E6. With regard to HMA, is the state maintaining the capability to meet application timeframes and submitting complete project applications? [2 CFR §201.5(b)(2)(iii)(A)[46]]	• All applications and amendments are submitted by the end of each program's respective application period. • All applications are entered into FEMA's electronic data systems (such as, NEMIS and/or eGrants). • Eligibility and Completeness Checklist is prepared for all applications. • All applications are determined to be complete by FEMA within 90 days of submittal or selection for further review. Required

Element	Requirements
	environmental and historic preservation reviews and consultations will not be included in the 90-day review timeframe calculation.
E7. With regard to HMA, is the state maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [2 CFR §201.5(b)(2)(iii)(B)47]	• All applications and amendments are determined to be complete by FEMA within 90 days of submittal or selection for further review, including all data requested by FEMA to support Cost Effectiveness determinations and environmental/historic preservation compliance reviews. Required environmental and historic preservation reviews and consultations will not be included in the 90-day review timeframe calculation.
E8. With regard to HMA, is the state maintaining the capability to submit complete and accurate quarterly progress and financial reports on time? [2 CFR §201.5(b)(2)(iii)(C)48]	• All progress reports must be complete and submitted on time. Information in reports must accurately describe grant activities, including data related to the completion of individual property acquisitions. Incomplete progress reports that do not provide information on all open grants and subgrants or include all information required by the HMA Guidance are not considered on time. • All Federal financial reports (FFR), Standard Form (SF) SF-425 are submitted on time. Information in reports must accurately describe grant activities, as described in the HMA Guidance. • State consistently complies with the Financial Management Standard requirements described in 2 CFR §§200.300 to 200.309.

6.1 Capability Assessment

The Capability Assessment serves to identify existing gaps, conflicts, and/or shortcomings that may need to be addressed through future mitigation actions. The Capability Assessment is critical to developing a comprehensive and implementable mitigation strategy, in that it highlights the mitigation actions that have been completed or are in progress, or that merit continued support and enhancement through future efforts. The Capability Assessment also helps to determine whether proposed mitigation actions are practical, while considering the local jurisdictions' ability to implement them.

This Capability Assessment comprises nine components:

1. Introduction
2. Grants Management
3. Funding Sources
4. Local Plans and Ordinances and Plan Integration Review
5. State Programs and Capabilities
6. Regional and Federal Partnerships
7. Advocacy and Non-Governmental Organizational Resources

The state's Capability Assessment has been updated to reflect changes to risk reduction policies, programs, and funding opportunities since the 2016 Plan, that are

managed by various 1) state departments/agencies, 2) county and local stakeholders, and 3) advocacy groups and non-governmental organizations. In October of 2020, these three stakeholder groups were asked to review their respective capabilities, programs, and resources since 2016, and complete a questionnaire with the following three questions:

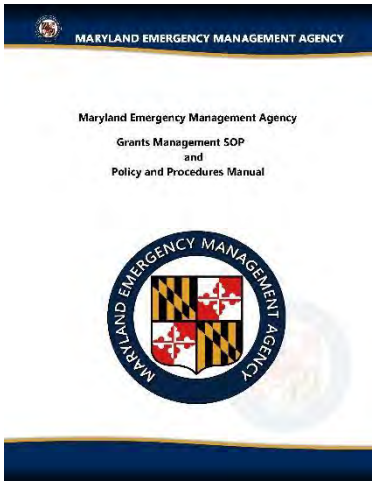
1. What emergency preparedness, planning, and mitigation programs/initiatives programs does your agency have in place?
2. What hazard/disaster mitigation– related data or resources does your agency maintain that are available freely online to other state departments, county or local governments, or the general public?
3. What SME can you provide in: a) various natural/man-made hazards, such as drought, public health emergencies, flooding, etc., and/or b) fields of concentration, such as historic/cultural resources, climate change, economic development, etc.?

The results of this questionnaire were summarized and used to inform the update of this Capability Assessment and other plan components.

6.1.1 Grants Management

Grants management and performance, including regular reporting, are a significant component of the Enhanced Plan requirements for FEMA. This section details the long-standing policies and procedures that MEMA and the state have implemented to assist in the development and submission of applications, the provision of technical assistance as needed, the management and monitoring of grants received for mitigation and the procedures used for closing out grant awards. These policies and procedures are reviewed and updated on a constant basis to ensure the most efficient administration of the grants.

6.1.2 MEMA and Grants Management Performance



MEMA, as an Agency of the State of Maryland, is subject to the rules and regulations governing grant funds promulgated by the state. MEMA has identified Grants Management Standard Operating Procedures (SOPs) in its Maryland Emergency Management Agency Grants Management SOP and Policy and Procedures Manual, revised and updated in February 2017.

This manual governs all aspects of Agency grants management from pre-application, application, award acceptance, monitoring, and closeout and reporting. This publication establishes policies and procedures and assigns responsibility associated with the management of grants administered by MEMA and applies to all MEMA staff and contractors that manage or support the management of the various grant programs listed below:

Table 6-2: Commonly Used Non-HMA Federal Grant Programs

Grant Program	Acronym	Federal Agency
Homeland Security Grant Program	HSGP	DHS/FEMA
State Homeland Security Grant Program	SHSP	DHS/FEMA
Urban Area Security Initiative	UASI and NCR UASI	DHS/FEMA
Emergency Management Performance Program	EMPG	DHS/FEMA
Non-Profit Security Grant Program	NSGP	DHS/FEMA
Hazardous Materials Emergency Preparedness	HMEP	US DOT

The Grants Manual requires that all grant-funded programs have a Program Manager and Project Manager that are responsible for all compliance, monitoring, and reporting requirements, particularly those on a quarterly basis. These functions and expectations are enumerated in Parts II and III of the Manual. Additionally, it is the responsibility of the Project Manager to ensure timely performance of all subgrantees and their agents, as well as procurement procedures. MEMA has three dedicated Grants Management Officers to assist in the implementation and management of all federal and non-federal grant awards.

MEMA anticipates that updates to the Manual will be made in the near term to reflect new requirements presented by the roll-out of FEMA's new application system, FEMA Grants Outcomes (FEMA GO). This Plan will be updated with a new Appendix should these policies change.

MEMA has standardized the application and reporting procedures in this document. Standard Forms and Checklists, compliant with all FEMA Grants Management requirements include:

- MEMAGMS – Grant Creation Checklist
- MOA Tracking Procedure for HMEP Award
- Sub-Grantee Monitoring Protocols
- SAA Monitoring Questions
- Grant Monitoring Template
- Procurement Checklist
- Monitoring Risk Formula
- Equipment Sampling Criteria
- Monitoring Schedule
- HMEP Administration Checklist and Forms

The full Grants Manual has been included in Appendix F.

Over the course of several years MEMA's Grant Management capabilities have continued to increase at a steady pace. However, constant turnover has created delays in the Agency's ability to continue progressing in certain areas. The development of the SOPs has served a beneficial aide to assist new employees with managing the grants as turnover occurs. Best practices from the document are being applied to the management of the Hazard Mitigation Assistance grants and in the future SOPs will be developed for these awards as well to incorporate FEMA GO and the identified best practices. Additionally, the programmatic and financial staff have established monthly meetings to discuss changes in awards, reconcile awards, and communicate any additional information. Throughout this process we have identified consistent communication as the key to ensuring we maintain strong grants management practices despite the turnover we have experienced. Additionally, the Fiscal Services Branch is continuing to increase their staffing levels to better perform grant management duties.

6.1.2.1 Application Scoring, Ranking, and Submission Procedures

As mentioned in Section 1, the MAC is responsible for the review and prioritization of HMA-related projects that are recommended and forwarded to FEMA for funding. The final authority to submit projects to FEMA for funding rests with the Executive Director of MEMA. The MAC is also responsible for the maintenance and revisions of this Plan.

The MAC evaluates and prioritizes all eligible mitigation project applications using the following Project Ranking System (Note: The percentages and priorities noted below are based on the most recent FEMA mitigation grant guidance when this plan was most recently updated. The federal guidance and the total funds available may change each fiscal year.):

- Priority 1 – Hazard Mitigation Plan updates: Valid, adopted HMPs are a pre-requisite for project eligibility in a local jurisdiction. HMP updates are the first priority for all HMA programs. Funds may be allocated to these projects within applicable limits. For example, up to 7 percent of HMGP funds available may be allocated to the preparation of local HMPs and the Plan.
- Priority 2 – 5 Percent Initiative (HMGP Only): Up to 5 percent of HMGP funds available may be allocated for projects that do not meet normal benefit-cost analysis (BCA) but contribute to hazard mitigation goals. Typically, these are public information, and alert and warning projects.
- Priority 3 – Hazard Mitigation Projects (excluding generators): The balance of funding after allocation above is available for standard mitigation projects, such as those listed below (items below are in no particular order). Please note that this priority includes those RL/SRL properties that are identified for mitigation, and projects that mitigate the risk to these properties will be considered for funding first:
- Structure Elevations (both residential and non-residential)
- Structure Acquisition/Demolition (both residential and non-residential)

- Flood proofing (non-residential structures only)
- Public Infrastructure Retrofit

  Note: Standard Hazard Mitigation projects, including elevations and acquisitions that exceed FEMA cost caps must complete a BCA.
- Priority 4 – Generators for Critical Facilities: The balance of funds available after all other priorities have been met will be applied to generators using a three-step process.

The establishment of set ranking criteria has greatly increased the efficacy of the Hazard Mitigation program. The criteria have increased the capabilities at the local and subapplicant level by providing a set of priorities and other metrics from them to build projects upon. The criteria more formally set State priorities for mitigation and provide a mechanism for fair and equitable project prioritization. However, as Federal, State, and local disasters occur and programs evolve the MAC will need to periodically revisit the scoring, ranking, and submission procedures in order to ensure they are still effective in guiding the State towards developing high quality, competitive projects.

In order to maintain the capability to provide thorough reviews of projects, MEMA's Hazard Mitigation Branch staff are required to complete the following courses:

- IS-393.B: Introduction to Hazard Mitigation
- IS-2700: National Mitigation Framework
- IS-318: Mitigation Planning for Local and Tribal Communities
- IS-328: Plan Review for Local Mitigation Plans
- IS-329: State Hazard Mitigation Planning
- IS-212.B: Introduction to Unified Hazard Mitigation Assistance
- IS-253.A: Overview of FEMA's Environmental and Historic Preservation Review
- E705: Fundamentals of Grants Management

Additional training and courses are dependent upon the availability of FEMA to provide those courses, such as in-depth Benefit Cost Analysis training. These courses are required as part of the on-boarding process. However, constant turnover has impacted the Branch's ability to maintain numerous staff members who have training beyond what is available through the independent study courses. As an increased capability, MEMA has established an on-call contract in order to get on-demand technical assistance and additional staff as needed to ensure capacity and capabilities are maintained in the Hazard Mitigation program.

MEMA's grant application processes are designed to ensure that all subapplications are received in plenty of time for the MAC and MEMA to review, score, and then rank the subapplications. MEMA publishes the annual subapplication deadline, typically in late fall, well in advance so that all subapplicants have enough time to solicit input and technical assistance from the state. Following this deadline, MEMA reviews and

packages all eligible subapplications into the relevant grant package and submits to FEMA (or other granting agency) well before the submission deadline.

For any projects that are deemed "eligible for further review" or for which further information is requested, MEMA ensures that the request is documented, and the information developed and resubmitted within the timeframes required, typically less than 90 days.

For all other grant application and implementation requirements, such as BCA and Environmental Planning and Historic Preservation reviews, performance monitoring and mitigation grant reporting, as well as final award closeout procedures, MEMA has designed processes that conform to all FEMA requirements.

6.1.3 Funding Sources

In order to successfully conduct hazard mitigation activities, funds from numerous sources are required. Maryland routinely utilizes disaster-based funds from Sections 404 and 406 (typically referred to as HMGP and PA Mitigation), but also relies heavily on non-disaster funds as well. As described under previous Sections (4.10 and 5.1-2), the state has a successful track record of managing FEMA's PDM and FMA program funds. The new BRIC program is replacing the legacy PDM program – in FY20, the inaugural year of the program, MEMA submitted 20 subapplications totaling $78 million in federal share. MEMA has received notice from FEMA that approximately $49 million in BRIC and FMA FY 20 projects have been identified for further review, almost 63% of the state's total submission. As profiled in Section 5.1, Maryland has recently used these various funds for numerous projects from updating state and local hazard mitigation plans to substantial flood protection and mitigation projects.

Although the FEMA Hazard Mitigation Assistance grants serve as a gateway to ensure the implementation of mitigation planning and projects there are also times in which this funding is not awarded for much needed projects. For example, in FY2018 MEMA submitted 3 local hazard mitigation plans for funding; all 3 projects were denied. Two of those communities were 3 years out from their expiration and according to the FEMA 5-year Planning Wheel we are the opportune time to obtain funding to successfully update their Plan. As a result, two of those plans were submitted for HMGP funding that was available. Due to the length of time the FEMA reviews and approvals took, the funding was not awarded in time for the communities to carry out a planning process prior to their expiration. This is indicative of the need to have separate, dedicated funding for hazard mitigation planning.

Timing is also a challenge with utilizing the HMA funds. Outside of a Presidential Disaster Declaration, States must wait until the annual non-disaster awards become available. This creates a challenge for significant flooding and other natural events that occur throughout the year; we are not able to access the HMA funding in order to mitigate these issues post-event. Due to these limitations, MEMA has been actively exploring grants outside of FEMA that provide additional flexibility in regard to timing, funding amounts, and activity eligibility.

Since 2016, the state has received five major disaster declarations with Public Assistance (PA) awarded. Outside of the COVID disaster (which is atypical and does not include HMGP as part of the award, or permanent work for PA), the vast majority of funding has been used for repairs to roads in the state and for costs of emergency protective measures to include Emergency Operations Centers, Fire and Police response, and debris removal. Much of the funding has been in Howard County, which received two declarations in this time period with repetitive losses in similar infrastructure and locations in Ellicott City. All the damages were caused by flooding due to various storms from tropical storms to severe thunderstorms.

The General Assembly has recently passed legislation that institutes the Resilient Maryland Revolving Loan Fund, designed to provide a stable and renewable source of funding for mitigation and resiliency focused projects across the state. This Fund will be initially capitalized with $25 million in funding starting in 2021.

Another new federal source that MEMA will begin to pursue is the High Hazard Potential Dam Grant program from FEMA. This program will provide the state with additional funds to implement mitigation actions identified in the Mitigation Plan for Dams attached in Appendix C.

More detailed information on funding sources that MEMA utilizes for mitigation projects may be found in Section 4.10, including those utilized for cost sharing and from external partners and stakeholders.

Federal mitigation grants typically require a cost share or match of at least 25 percent. MEMA has typically relied on the following sources to provide this cost share:

- General Fund mitigation dollars
- In-kind services that can be quantified as federal match per federal guidelines
- Other external sources

6.1.4 Local Plans and Ordinances and Plan Integration Review

Preparedness and preventative measures are important for county and local communities to focus on for hazard mitigation efforts, as they are some of the most cost-effective means of reducing the probability of future losses to residents, property, or the environment.

Over the course of the past several years, MEMA has made significant strides in consistent engagement with local jurisdictions to ensure they are following the FEMA 5-year planning wheel and avoiding the expiration of their local hazard mitigation plans. This includes timely notification of upcoming grant cycles, training, and technical assistance for developing scopes of work for grants, and assistance with developing the Plan. However, there are opportunities to strengthen integration across the State's planning efforts. For example, MEMA's Preparedness Branch has developed the Maryland Integrated Preparedness Programmatic Process and Assessment Cycle. This cycle provides the opportunity to further integrate hazard mitigation planning into the State's THIRA, SPR, and Integrated

Preparedness Plan. This not only provides an opportunity to advance plan integration at the State level, but from a training perspective this provides an opportunity to formalize MEMA's local hazard mitigation planning in coordination with the activities of MEMA's Preparedness Branch. The cycle may be found in Appendix M. In addition to managing the cycle, the Preparedness Branch is developing a revised Planning Library and Repository to enhance the awareness of all planning products that support the State across local, State and Federal jurisdictions. Finally, it should be noted that Maryland is accredited through the Emergency Management Accreditation Program (EMAP) and through compliance with the EMAP standard, Maryland has integrated a variety of planning products across the spectrum to support the development of statewide consequence management and risk reduction. This information informed the consequence analyses found in the HIRA of this plan.

In 2020, MEMA was assigned a FEMA Community Planner through the FEMA Integrated Team Member (FIT) initiative. This provides an opportunity to offer continuous training and technical assistance to local jurisdictions as they progress through the FEMA 5-year planning cycle.

Plans and ordinances that assist with reducing the impacts of hazards on Maryland's residents through preventative measures include zoning ordinances, subdivision and land development ordinances, floodplain management ordinances, comprehensive plans, etc. Additionally, emergency plans such as COOPs, Emergency Operations Plans (EOPs), and Disaster Recovery Plans (DRPs) play a critical role in preparing jurisdictions to respond to and recover from hazards in an efficient and methodical manner.

For this plan update, a plan integration review was conducted to gather a snapshot of emergency and hazard mitigation-related plans, documents, studies, and reports within each county and jurisdiction in the state, as shown in Table 6-1. The purpose of a plan/ordinance review as part of this planning process was trifold:

- To identify existing jurisdiction and county-level integration initiatives
- To provide an inventory and review of plans and ordinances at the jurisdictional level and describe the sections in these documents that address hazard mitigation–related issues; and
- To provide a platform to integrate plans and other documents so recommendations and strategies are not contradictory to one another.

These plans are important to be considered while developing this HMP as they include emergency management-, environmental-, and planning-specific information, and it is important to ensure the HMP aligns with, and does not contradict, ongoing planning efforts and vice versa. Feedback on specific plans and documents were requested from all counties and jurisdictions. Where feedback regarding existing planning efforts was not provided, desktop research was performed and information available through county or jurisdiction websites, was integrated into this Plan Update.

Additionally, each county and jurisdiction's local HMP was analyzed to identify who had performed plan integration and which specific plans and studies were reviewed and integrated into each local HMP. Although, typically plans that were found to be most commonly integrated were those related to flooding, such as floodplain or stormwater management ordinances, other plans that were integrated into local HMPs within Maryland include Comprehensive Plans, Capital Improvements Plans, Building Codes, Zoning Ordinances, etc. Several counties also performed a Safe Growth Audit as part of the County/jurisdictional HMP Update, which included a review of the Capital Improvements Plan, Zoning Ordinance, Subdivision and Land Use Ordinance, and the previous HMP.

To help track plan integration efforts across the state, the information and matrices included in this section should be regularly updated and improved. To continue to track emergency and hazard-related planning efforts in individual counties and jurisdictions across the state, it is recommended that this information be updated during this Plan's Annual Review process; MEMA will reach out to all counties and jurisdictions regarding new or updates to ongoing emergency or hazard planning efforts. This information would inform any annual updates to this Capability Assessment.

The following plan integration review information is based on self-reporting, and for those who did not self-report, additional desktop research was conducted. It must be noted that this section is not comprehensive, since some jurisdictions that did not self-report and many of the identified plans are not available through county websites. During the regular mitigation action status review cycle called for in Mitigation Action 21, MEMA will reach out to counties and jurisdictions to obtain and update the status of the relevant plans.

The following counties also reported plans and ordinances within their local municipal jurisdictions:

- Anne Arundel County
- Calvert County
- Caroline County
- Carroll County
- Cecil County
- Charles County
- Frederick County
- Prince Georges County
- Talbot County
- Washington County

A full breakdown of this additional and optional reporting can be found in Table 6-3, below. A total of eight counties did not self-report any planning products, so desktop research was conducted to identify any public-facing plans openly available on those jurisdictions' websites.

The following acronyms are used to populate the Table below.

- HMP – Hazard Mitigation Plan
- FMP – Flood Mitigation Plan
- EOP – Emergency Operations Plan
- GIP – Green Infrastructure Plans

- DRP – Disaster Recovery Plan
- NFP – Nuisance Flooding Plan
- COOP – Continuity of Operations Plan
- Comp Plan – Comprehensive Plan

Table 6-3 provides a snapshot of all emergency and hazard mitigation-related planning products for each county and jurisdiction within the state. In Maryland, the 23 counties, Baltimore City, as well as the non-county jurisdictions of Annapolis and Ocean City, are the 26 emergency management districts required to develop plans and have mandatory requirements. All other jurisdictions fall under a county.

Legend

X – County has adopted this plan Year – Year adopted/updated where available

(-) – County does not have this plan in place or did not report this plan

Table 6-3: Existing Jurisdictional Planning Mechanisms
(Dates included are adoption dates, not expiration dates)

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
State of Maryland	Update in Progress	(-)	(-)	(-)	2015	(-)	(-)	(-)	(-)	(-)	(-)
Western Region											
Allegany County	2018	(-)	2020	(-)	(-)	(-)	(-)	2014	(-)	(-)	(-)
Garrett County	2018	(-)	(-)	(-)	2017	(-)	(-)	2018	(-)	(-)	(-)
Washington County	2018	(-)	2012	(-)	2012	2017	2020	2012	(-)	(-)	(-)
Central Region											
City of Annapolis	2018	2023	2016	(-)	2020	2014	2020	2020	(-)	2020	(-)
Anne Arundel County	2020	(-)	2015	2005 adopted in County Code	2018	2021 in progress	2018	2021 in progress	2002 2021 in progress	2020	(-)
Baltimore County	2014	(-)	(-)	(-)	2019	(-)	(-)	2020	(-)	2020	(-)
Baltimore City	2018 (DP3)	(-)	X	X	X	In prog.	X	X	X Green Network Plan	10/2020	EAP for reservoirs/ dams
Carroll County	2014 Update in Progress	Part of HMP	Yes – under revision, target completion late fall	N/A	2017	Yes-Draft	Yes-Draft	2019	No	N/A	(-)
Harford County	2017	(-)	2016	(-)	(-)	(-)	(-)	2016	2018	(-)	(-)

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Howard County	2018	2018	2016	(-)	2019	2019	2020	2015	2018	(-)	(-)
Frederick County	2016	(-)	(-)	(-)	(-)	(-)	(-)	2010	(-)	(-)	(-)
Montgomery County	2018	(-)	(-)	(-)	2017	(-)	2009	(-)	(-)	(-)	(-)
Prince George's County	2017	(-)	2016	(-)	2020 EOP & DRP	(-)	(-)	2014	7/2016	01/2021	(-)
Southern Region											
Calvert County	2018	10/2020	(-)	(-)	01/2019	(-)	03/2020	08/2019	(-)	10/2020	REP- 05/2019
Charles County	2018	(-)	(-)	(-)	X	(-)	X	2016	(-)	X	(-)
St. Mary's County	2017	(-)	11/11/2014	(-)	2019	(-)	Updating	3/23/2010	N/A	(-)	(-)
Lower Eastern Shore Region											
Dorchester County	2017	2017	2015	2017	Draft	(-)	Draft	1996- under update	(-)	2017 Part of FMP	(-)
Somerset County	2017	(-)		2014	(-)	(-)	(-)	2010	(-)	2019	(-)
Town of Ocean City	2017	(-)	2015	(-)	2013	(-)	(-)	2017	(-)	2020	(-)
Wicomico County	2017	(-)	(-)	(-)	Annual Update	(-)	2020 Annual Update	2017	(-)	2020	CCTA 2019
Worcester County	2020	Need updated	(-)	Need updated	2015	Need updated	Need updated	Need updated	Need updated	10/1/20	(-)

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Upper Eastern Shore Region											
Caroline County	2019	None	2014 (amended 2015)	Follows state	2017	New plan in progress	20	2010 Next update exp. 2022	Within Comp plan	Draft under review (2020)	(-)
Cecil County	2022	(-)	(-)	(-)	2017	(-)	2019	2010	2019	2020	(-)
Kent County	Update in Progress	(-)	(-)	(-)	2009, update in progress exp. 2021	(-)	2016, On-going with updates expected post-Covid	2018	(-)	2019	(-)
Queen Anne's County	2019	Medium Priority in the QAC HMP (page 15-8)	2014 (corresponding Map update)	1996 (Update in Progress)	2016	(-)	In Progress	2010 (Update in Progress)	GI data layer held by MD DNR	2020	2016 Sea level Rise/Vuln Plan and 2019 Debris Mgmt Plan
Talbot County	2017	(-)	(-)	(-)	2014	(-)	2012	2016	Update In Progress	(-)	(-)

Note: (-) Indicates that this plan was not found readily on the county website.

6.1.4.1 Local Hazard Mitigation Plan Status

MEMA provides local jurisdictions with guidance and support for its mitigation planning initiatives. MEMA Hazard Mitigation staff has worked with local governments to ensure that they have the resources necessary for effective and relevant hazard mitigation planning. Combined with the efforts outlined in 6.1.4 above, these initiatives and training events have borne significant fruit, greatly reducing the number of local plans that are currently expired or in danger of expiring. The table outlining the Additional Stakeholder Meetings, found in Appendix B, demonstrates MEMA's commitment to providing ongoing technical assistance and training to mitigation practitioners. For plans that have been approved, and those under development, MEMA has provided financial support through several federally funded hazard mitigation grant programs. MEMA-administered programs include the PDM Program, the HMGP, and the FMA Program. MEMA has also provided planning assistance to Maryland's 23 counties, and to 123 of the state's 157 municipalities, including Baltimore City, City of Annapolis, and the Town of Ocean City. Consequently, nearly all county and municipal jurisdictions throughout Maryland have FEMA-approved and locally adopted hazard mitigation plans in effect. To ensure that a local jurisdiction's hazard mitigation plan does not expire, MEMA reaches out to the jurisdiction at least 24 months prior to offer support and to make certain that the plan does not expire without an updated plan in place. MEMA developed the *State of Maryland Local Hazard Mitigation Plan Guidance* in May of 2015 to advise local jurisdictions of available resources, coordination activities, and minimum elements that should be included within their next local hazard mitigation plan updates. Maryland-specific recommendations are presented as well as the introductions of ideas for plan integration, resilience, and climate change. This Guidance is still in use and is updated as needed or as grant program requirements change at the federal level. Additionally, MEMA has a FEMA Integrated Team (FIT) Community Planner and will continue working with FIT personnel to build upon and expand efforts to build planning capability at the local and state level. To support the jurisdictions in their plan development efforts, MEMA conducts regular trainings and informational sessions designed to support the development of mitigation plans, mitigation strategies and the sharing of mitigation best practices across all its communities. Some of these sessions are detailed in the table of additional meetings in Appendix B. Table 6-4 indicates each jurisdiction's hazard mitigation plan status as of March 2021.

Table 6-4: Jurisdictional Hazard Mitigation Plan Status

	Plan Expiration	Municipal (Adopted)	Funding (HMGP, HMA, etc.)	Comments
State of MD	08/01/2021	24 (22)	HMGP	Update in Progress
Western Region				
Allegany	11/4/2023	(7)		--
Garrett	12/2/2023	(8)		--

	Plan Expiration	Municipal (Adopted)	Funding (HMGP, HMA, etc.)	Comments
Washington	7/16/2023	9	HMGP	--
Central Region				
Annapolis	3/18/2023			Applying for BRIC Grant
Anne Arundel	06/15/2025			Adopted
Baltimore City	12/19/2023		HMGP	Seeking funding for new 5-year update
Baltimore Co.	7/15/2020			Expired
Carroll	3/23/2019	(1)		Expired/Update in Progress
Harford	7/31/2022			
Howard	01/01/2024		HMGP	Period of Performance (9/4/17 – 1/10/21)
Frederick	4/17/2022	(12)		--
Montgomery	4/7/2024			--
Prince George's	11/12/2022	26	HMGP	Update will start in 2021
Southern Region				
Calvert	07/2023		BRIC 2020	Applying for funding
Charles	12/10/2023	3 (2)		--
St. Mary's	12-2022			
Lower Eastern Shore				
Dorchester	9/4/2022	9 (8)	HMGP	Update has not started
Somerset	11/13/2022			--
Town of Ocean City	4/30/2022	-		--
Wicomico	2/23/2022	8	HMGP	Update in Progress
Worcester	10/2/2025	Not yet		Need FEMA approval on changes
Upper Eastern Shore				
Caroline	06/10/2024	10	PDM	Plan implementation
Cecil	05/23/2022	5 (8)	HMGP	PDM Awarded for update; not started
Kent	12/17/2019		HMGP	Update in Progress – expected to be final 12/2020
Queen Anne's	5/27/2024	8 (5)	HMGP	Update Complete
Talbot	9/25/2022	5 (4)	PDM	Update in Progress

6.1.4.2 Plan Integration Trends

Integration of other planning measures into the HMP, as well as integration of HMP principles into other community planning efforts, helps strengthen intergovernmental coordination and helps further establish roles and responsibilities before, during, or after a hazard or emergency.

The following table identifies those jurisdictions that have performed plan integration in their HMP. Common plans that have been integrated into local HMPs within Maryland include Comprehensive Plans, Capital Improvements Plans, Floodplain Ordinances, Stormwater Management Ordinances, Building Codes, Zoning Ordinances, Sea Level Rise Reports, Commodity Flow Studies, Wetlands Regulations, and more. For the jurisdictions that did not provide this information, content included was pulled from the HMP included on the respective county or jurisdiction's website.

Table 6-5: Plan Integrated/Reviewed Within HMPs by Jurisdiction

Plan/Study/Report Integrated	Year of Plan	Comments
Western Region		
Allegany County		
Comprehensive Plan	2014	Plan integrated hazard mitigation in the following chapters: Chapter 6: Public Facilities; Chapter 8: Sensitive Areas; and Chapter 11: Land Use.
Building Code of Allegany County	2007	In Part III – Building Planning and Construction, Chapter 3 Building Planning, the Climatic and Geographic Design Criteria were revised.
Garrett County		
Comprehensive Plan	Update in progress	Recommendations for Plan Integration from the hazard mitigation plan update will be provided to the county plan office.
Water And Sewer Plan	2014	Water and Sewer Plan shares many of the goals and objectives set forth in the Comprehensive Plan, including the concentration of development in areas having adequate water and sewer service and the elimination or treatment of hazardous pollutants.
Building Code	2015	The 2015 Garrett County Building Code adopts the 2015 International Building Code, 2015 International Residential Code, and 2015 Energy Conservation Code with certain modifications and amendments.
Floodplain Regulations and Flood Insurance Program	2013	Garrett County has a FEMA-approved floodplain ordinance that requires 1 foot of freeboard for the first floor of new structures

Plan/Study/Report Integrated	Year of Plan	Comments
		and additions. The ordinance also requires a setback from stream channels
Washington County		
Various Comprehensive Plans of jurisdictions in Washington County	Multiple	Used as reference for development trends, general information of the jurisdictions, and project ideas.
Hazardous Materials Commodity Flow Study I-68 and I-70 Interchange	2013	Referenced for information on hazardous materials in the county.
Flood Risk Report Washington County Maryland.	--	Used as technical information for new FEMA flood maps in the area.
State of Maryland Heroin and Opioid Emergency Task Force.	2015	Used as reference for opioid research.
Central Region		
City Annapolis		
Comprehensive Plan	2009	--
2015-2020 Capital Improvement Program	2015	--
Zoning Ordinance	--	--
Subdivision of Land	--	--
Anne Arundel County		
General Development Plan	2009	The 2009 General Development Plan is the County's current long-range land use plan.
Baltimore City		
Climate Adaptation Plan	N/A	This was never a separate plan, it integrated adaptive strategies from the start.
Baltimore County		
Emergency Operations Plan	2011	Provides guidance for mass sheltering in the event of a natural disaster.
Carroll County		
	--	--
Charles County		
Nuisance & Urban Flooding Plan	2020	**--**
Hartford County		
-	-	-
Howard County		
Flood Mitigation Plan	2018	--

Plan/Study/Report Integrated	Year of Plan	Comments
Manmade and Technological Hazards Annex	2019	--
Historical and Cultural Resources Annex	2021 (projected date)	--
Frederick County		
--	--	--
Town of Thurmont		
--	--	--
Montgomery County		
Emergency Operations Plan	--	--
Capital Improvements Plan	--	--
Climate Actions Plan	2009	--
Watershed Restoration Implementation Strategy	--	--
Prince George's County		
General Plan	2014	--
Subdivisions Regulations	--	--
Stormwater and Wetlands Requirements	--	--
Floodplain Ordinance	2016	--
St. Mary's County		
Require 3-foot free board	2011	--
Lower Eastern Shore		
Dorchester County		
--	--	--
Somerset County		
--	--	--
Town of Ocean City		
Comprehensive Plan	--	Elements of the Hazard Mitigation Plan will be incorporated and referenced into the Ocean City, Maryland Comprehensive Plan.
Zoning Ordinance	--	--
Subdivision of Land	--	--
Capital Improvements Plan	2014	--
Wicomico County		
Comprehensive Plan	--	--

Plan/Study/Report Integrated	Year of Plan	Comments
Zoning Ordinance	--	--
Subdivision of Land	--	--
Capital Improvements Plan	2015	--
Worcester County		
Comprehensive Plan	--	--
Zoning Ordinance	--	--
Subdivision of Land	--	--
Capital Improvements Plan	2015	--
Upper Eastern Shore		
Caroline County		
All Municipal Comprehensive Plans	2009-2010	Comprehensive plans, a Maryland requirement for municipalities with land use authority, were completed by the county and all 10 municipalities.
Cecil County		
2010 Cecil County Comprehensive Plan	2010	--
2011 Cecil County Zoning Ordinance	2011	--
2011 Cecil County Subdivision Regulations	2011	--
Cecil County Floodplain Ordinance	--	--
Building Code	--	--
2008 Charlestown Comprehensive Plan	2008	--
Charlestown Subdivision Ordinance		--
Charlestown Zoning Ordinance		--
2003 Elkton Downtown Master Plan	2003	--
2009 Port Deposit Comprehensive Plan Water Resource Element	2009	--
2013 Port Deposit Floodplain Management Ordinance	2013	--
2009 Chesapeake City Comprehensive Plan: A Plan for 2030	2009	--

Plan/Study/Report Integrated	Year of Plan	Comments
2010 Town of Elkton Comprehensive Plan	2010	--
Kent County		
Preparing for Tomorrow's High Tide 2014 Sea Level Rise – 2014 Sea Level Rise Workshop Proceedings and Interim Implementation Plan	2014	--
Queen Anne's County		
Nuisance Flood Plan	2020	--
THIRA	2019	--
Flood Mitigation Plan	Unknown	--
Talbot County		
2015 Draft Comprehensive Plan	2015	--
Zoning Ordinance	--	--
Subdivision of Land	--	--
Capital Improvement Plan	2014/2015	--

The following is a summary of observations and takeaways from this plan integration exercise:

- The most common plan that has been reviewed and integrated into the HMP is the County Comprehensive/Master/General Plan.
- Several counties and jurisdictions performed plan integration through a Safe Growth Audit.
- Several counties included a review of all local municipal comprehensive plans.
- Several counties have revised their building code to address their unique challenges and concerns.

Communities often have many assorted plans, ordinances, and programs that shape their future and serve as road maps to development. All relevant community plans and ordinances should be collected and analyzed to identify risk reduction principles, through plan evaluation. This may be conducted through a series of review questions within the community planning framework on where hazard mitigation can be integrated. To assist in uniform and more coordinated plan integration efforts across the state, Table 6-6 provides a series of questions by various community-specific plans or ordinance topics to lay out the framework to integrate plans. Addressing these questions is an important step toward an integrated planning approach. These questions will primarily be utilized during the annual review cycle that is being instituted by new Mitigation Action 21; however, the state

also plans to utilize these as it reviews letters of intent for HMA and other federal applications.

Table 6-6: Recommended Plan Integration Review Questions

Land Use
Does the land use plan include policies to restrict or regulate the density of new development in high-hazard areas or guide new development away from high-hazard areas?
Has the community encouraged agricultural and other landowners to implement pre-disaster mitigation measures?
Transportation and Infrastructure
Does the plan identify critical facilities and infrastructure that are located in vulnerable areas and should be protected, repaired, or relocated (e.g., town facilities, bridges, roads, wastewater facilities)?
Does the transportation network provide redundancy (i.e., alternate routes) if certain key nodes or routes are affected by disaster?
Emergency Management
Does the community emergency operations plan show major evacuation routes that are prone to flooding or vulnerable to other natural hazards?
Has the community adopted an evacuation and shelter plan to deal with emergencies from natural hazards?
Environment/Open Space
Has the community adopted riparian and wetland buffer requirements?
Does the plan encourage using green infrastructure techniques to help prevent flooding?
Zoning Ordinance
Does the ordinance prohibit development within, or filling of, wetlands, floodways, and floodplains?
Do zoning or floodplain regulations require elevation of 2 or more feet above base flood elevation?
Subdivision and Land Development Ordinance
Do the subdivision regulations restrict the subdivision of land within or adjacent to identified natural hazard areas?
Are there any specific mitigation measures included, such as additional setbacks in critical erosion zones, conservation of dunes or vegetation, floodproofing of facilities and utilities, and/or structural wind resistance and floodplain management?

The counties and jurisdictions were asked to provide information regarding participation in certain incentive programs or current technological capabilities as part of the Capability Assessment. Table 6-7 below profiles the programs in which the county or jurisdiction currently participates, and their current capabilities. The table identifies whether Maryland jurisdictions participate in specific federal programs that enhance local capabilities and assist in the mitigation of various hazard impacts.

- StormReady is a nationwide program designed to help counties and communities take a proactive approach to the kinds of severe weather that affect their areas by improving local hazardous weather operations and heightening public awareness. Counties work with the NWS, State Emergency Management, and the media to become StormReady.[240]
- Firewise communities are those that have taken appropriate measures to become more resistant to wildfire structural damage and are certified by the National Fire Protection Association (NFPA).[241]
- Communities with GIS capabilities have the ability to create their own map products and conduct internal mapping analyses to better protect their community and better identify areas at risk.
- Communities who developed a critical infrastructure and key resources (CIKR) database, which establishes documented CIKR locations within the jurisdiction, contribute a unique coordination and information-sharing product that unifies protection of our nation's CIKR into an integrated plan, helping to protect critical community assets.[242]

All of these programs contribute to communities having a greater capability to mitigate hazards and hazard impacts.

As noted in Table 6-7, the majority of jurisdictions in the Central Region (including the Baltimore-Washington Metropolitan Area), as well as certain counties in the Western, Southern, and Eastern Shore Regions have developed CIKR databases.

Note: a (-) indicates no response from the jurisdiction, and the number in ( ) indicates the number of communities that are currently participating.

Table 6-7: Program Participation and Capabilities by Jurisdiction

Jurisdiction	StormReady	FireWise	CRS Program	GIS Capabilities	CIKR Database
Western Region					
Allegany	Yes	No	Yes (2)	Yes	No
Garrett	Yes	No	No	No	Yes
Washington	Yes	No	No	Yes	No
Central Region					
Annapolis	Yes	No	No	Yes	Yes
Anne Arundel	Yes	No	No	Yes	Yes

[240] https://www.weather.gov/cae/stormready.html

[241] https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA/Become-a-Firewise-USA-site/Frequently-asked-questions#:~:text=What%20makes%20a%20community%20%22Firewise,available%20on%20the%20Firewise%20website.

[242] https://www.dhs.gov/blog/2009/11/19/cikr

Jurisdiction	StormReady	FireWise	CRS Program	GIS Capabilities	CIKR Database
Baltimore City	Yes	No	Yes	Yes	Yes
Baltimore Co.	(-)	(-)	(-)	(-)	(-)
Carroll	(-)	(-)	(-)	(-)	(-)
Harford	Yes	No	Yes (3)	No	Yes
Howard	Yes	No	Yes	Yes	Yes
Frederick	(-)	(-)	(-)	(-)	(-)
Montgomery	Yes	No	No	Yes	Yes
Prince George's	No	No	Yes (1)	Yes	Yes
Southern Region					
Calvert	No	No	No	Yes	No
Charles	(-)	(-)	(-)	(-)	(-)
St. Mary's	Yes	No	Yes	Yes	Yes
Lower Eastern Shore					
Dorchester	(-)	(-)	(-)	(-)	(-)
Somerset	Yes	No	No	No	No
Town of Ocean City	Yes	No	Yes	No	No
Wicomico					
Worcester	Yes	No	No	Yes	Yes
Upper Eastern Shore					
Caroline	No	No	Yes (7)	Yes	Yes
Cecil	Yes	No	Yes (0)	Yes	No
Kent	No	No	No	Yes	Yes
Queen Anne's	Yes	No	Yes	Yes	No
Talbot	Yes	No	Yes	Yes	Yes

Note: A blank indicates no response from the jurisdiction. Number in parenthesis indicates number of communities participating.

6.1.4.3 NFIP and the Community Rating System

MDE, with the support of MEMA, manages the NFIP and encourages local participation in the CRS. As part of local mitigation plan updates, the state recommends that all mitigation strategies that may be undertaken to qualify for CRS points, be denoted. In addition, the three components utilized for NFIP compliance are encouraged within all local plans:

- Floodplain Identifications and Mapping;

- Floodplain Management; and
- Flood Insurance Education and Outreach.

The CRS is administered by FEMA's NFIP. The goal of the CRS program is to provide incentives for communities to go beyond the minimum floodplain management requirements and to develop additional measures to provide protection from flooding. The incentives are in the form of premium discounts. Under the CRS, flood insurance premiums for properties in participating communities are reduced to reflect the flood protection activities that are being implemented. A community receives a CRS classification based upon the credit points it receives for its activities. It can take on a wide range of activities that reduce flood losses. These activities include but are not limited to better mapping, regulations, public information, flood damage reduction, and/or flood warning and preparedness programs.

As of October 2020, over 1,700 communities in the United States participated in the CRS. The State of Maryland had 16 communities participating in the CRS, 15 of the 26 counties and jurisdictions do not currently participate in the CRS.

Table 6-8: Participating CRS Communities within the State of Maryland, as of October 2020[243]

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
240087	Baltimore, City of	5/1/2016	5/1/2016	5	25	10	C
240042	Bel Air, Town of	10/1/1993	5/1/2017	6	20	10	C
240011	Calvert County	5/1/2015	5/1/2015	8	10	5	C
240130	Caroline County	10/1/1996	5/1/2017	8	10	5	C
240015	Carroll County	10/1/2007	5/1/2018	7	15	5	C
240019	Cecil County	10/1/2013	10/1/2018	7	15	5	C
240026	Dorchester County	10/1/2013	5/1/2019	6	20	10	C
240030	Frederick, City of	10/1/2012	10/1/2012	7	15	5	C
240040	Harford County	10/1/1991	10/1/2000	7	15	5	C
240043	Havre de Grace, City of	5/1/2009	5/1/2018	7	15	5	C
240044	Howard County	10/1/2007	5/1/2018	6	20	10	C
240012	North Beach, City of	1/1/1992	10/1/2008	10	0	0	R
245207	Ocean City, Town of	10/1/1992	5/1/2017	6	20	10	C
240068	Oxford, Town of	5/1/2020	5/1/2020	7	15	5	C

[243] FEMA National Flood Insurance Program Community Rating System. April 7, 2021. Available at: https://www.fema.gov/flood-insurance/rules-legislation/community-rating-system.

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
245208	Prince George's County	10/1/1991	10/1/2001	5	25	10	C
240066	Talbot County	10/1/2014	10/1/2020	7	15	5	C

Table 6-9 identifies NFIP participation across jurisdictions in the following three categories: Flood Identification and Mapping; Floodplain Management; and Flood Insurance. The information included has been self-reported by the counties and jurisdictions.

Note: "X" – Participates in Activity "—" – Does not Participate in NFIP

Blank – Participates in NFIP but did not Indicate Specific Activities

Table 6-9: County/Jurisdiction NFIP Participation Activities

NFIP Activities	Allegany Co.	Garrett Co.	Washington Co.	Annapolis	Anne Arundel Co.	Baltimore City	Baltimore Co.	Carroll Co.	Harford Co.	Howard Co.	Frederick Co.	Montgomery Co.	Prince Geo Co.	Calvert Co.	Charles Co.	St Marys Co.	Dorchester Co.	Somerset Co.	Ocean City	Wicomico Co.	Worcester Co.	Caroline Co.	Cecil Co.	Kent Co.	Queen Anne Co.	Talbot Co.
Flood Identification and Mapping																										
Does the county/jurisdiction make the Flood Insurance Rate Map (FIRM) and Flood Insurance Studies (FISs) available to the public?	X	X	--		X	X			X	X		X		X		X		--	X		X	X	X		X	X
Will the recently developed Digital Flood Insurance Rate Maps be made available to the public as well?	X	X	--		X	X			X	X		X		X				--	X		X	X	X		X	X
Are Letters of Map Revisions (LOMRs) reviewed and signed by county/jurisdiction officials?	X	X	--		X	X			X	X		X		X				--	X		X	X			X	
If during the subdivision review process a new development determines a reduction in the floodplain delineation of the FIRM floodplain, is the developer required to submit a LOMR submission to FEMA?	X	X	--		X	X			X			X		X		X		--	X		X	X			X	
Does the county/jurisdiction provide advice to community residents regarding elevation certificates and Letter of Map Amendment (LOMA) applications?	X	X	--		X	X			X	X		X		X		X		--	X			X	X		X	X
Does the county/jurisdiction maintain records of approved letters of map change?	X	X	--		X	X			X	X		X		X		X		--	X		X	X	X		X	X
Does the county/jurisdiction assist residents in interpreting the FIRM and flood studies to	X	X	--		X	X			X	X		X		X		X		--	X			X	X		X	X

NFIP Activities	Allegany Co.	Garrett Co.	Washington Co.	Annapolis	Anne Arundel Co.	Baltimore City	Baltimore Co.	Carroll Co.	Harford Co.	Howard Co.	Frederick Co.	Montgomery Co.	Prince Geo Co.	Calvert Co.	Charles Co.	St Marys Co.	Dorchester Co.	Somerset Co.	Ocean City	Wicomico Co.	Worcester Co.	Caroline Co.	Cecil Co.	Kent Co.	Queen Anne Co.	Talbot Co.
determine the property's status in the floodplain?																										
Floodplain Management																										
Are any restrictions on floodplain use enforced through the subdivision and building permit process?	X	X	--	X	X	X			X	X		X		X		X		--	X		X	X	X		X	X
Do all proposed developments require plans to go through the county/jurisdiction's subdivision approval process or to acquire a building permit for new structures?	X	X	--	X	X	X			X	X		X		X		X		--	X		X	X			X	X
Is freeboard required for new structures?		X	--	X	X	X			X	X		X		X		X		--	X						X	
Flood Insurance																										
Is the county/jurisdiction committed to educating residents about the value and availability of flood insurance?		X	--	X	X	X			X	X		X		X		X		--	X						X	X
Is an annual letter sent to residents in the floodplain explaining the importance of flood insurance and where it may be obtained?			--			X			X					X				--	X			X				
Does the county/jurisdiction assist residents in interpreting the FIRM and flood studies to determine the resident's property's flood plain status, and offer advice regarding elevation certificates and LOMA applications?	X	X	--		X	X			X	X		X		X				--	X		X	X			X	X

NFIP Activities	Allegany Co.	Garrett Co.	Washington Co.	Annapolis	Anne Arundel Co.	Baltimore City	Baltimore Co.	Carroll Co.	Harford Co.	Howard Co.	Frederick Co.	Montgomery Co.	Prince Geo Co.	Calvert Co.	Charles Co.	St Marys Co.	Dorchester Co.	Somerset Co.	Ocean City	Wicomico Co.	Worcester Co.	Caroline Co.	Cecil Co.	Kent Co.	Queen Anne Co.	Talbot Co.
Did the county/jurisdiction meet the requirements for continued participation in the NFIP during the last Community Assistance Visit (CAV)?		X	--	X	X	X			X	X		X		X				--	X		X	X			X	

"X" – Participates in Activity "—" – Does not Participate in NFIP Blank – Participates in NFIP but did not Indicate Specific Activities

6.1.5 State Programs and Capabilities

While jurisdictions develop and implement their own local hazard mitigation plans, various state programs are responsible for mitigation actions and funding. Together, these programs work in conjunction on risk reduction, resiliency measures, mitigation, and the integration of mitigation programs at all levels of state operations. As established in new Mitigation Action 21, an annual review of the 13 lead agencies and their implementation status will be conducted to ensure that the state has the current and demonstrated capacity for mitigation across multiple programs. This section discusses the current capabilities of MEMA and Maryland as well as highlights anticipated improvements within the next 5 years of this plan's implementation.

Before individual capabilities are discussed, the following overall capability strengths and weaknesses should be noted. When combined with the obstacles and challenges identified in Section 6.2, they provide an evaluation of the state's existing capabilities.

6.1.5.1 Overall Capability Strengths

Increased engagement with local jurisdictions and potential subrecipients has resulted in Mitigation being integrated more into the Emergency Management programs within these entities. Stakeholders have expressed greater interest and pursued a greater number of projects than previous years.

Starting in 2018, the MEMA Hazard Mitigation Branch began hosting Quarterly Subrecipient Webinars to provide updates on HMA grants, highlight a mitigation success story, and discuss any additional topics of interest. These webinars have also included special guests, such as FEMA Region III to speak about developing high quality SOWs for planning activities.

6.1.5.2 Overall Capability Weaknesses

Staff turnover does not provide consistency and hinders the ability to sustain capacity and capabilities. Subsequent to the adoption and approval of the 2016 State Hazard Mitigation Plan, MEMA experienced significant turnover in the Hazard Mitigation Branch program and lost the capability to champion the implementation of many actions within the Plan.

Increasing frequency of hazardous events has caused the Hazard Mitigation Branch to constantly shift priorities and focus to address immediate needs. Since the 2016 Plan, Maryland has had five (5) events, which resulted in a Presidential Disaster Declaration. This does not include significant events that did not meet the thresholds to activate the Stafford Act.

6.1.5.3 Legislative Initiatives and Executive Actions

The recent passage of mitigation and resiliency-focused measures in the General Assembly has strengthened the state's commitment to mitigation, resilience, and preparedness. Multiple bills were proposed for mitigation-related studies, including

those on food resiliency and the establishment of a cybersecurity department, but most important is Senate Bill 901. This legislation establishes the Resilient Maryland Revolving Loan Fund. The revolving loan fund will be initially funded with $25 million and will be available for resilience- and mitigation-focused projects.

A companion piece of legislation, SB 68, reorganizes MEMA into the Maryland Department of Emergency Management and elevates its Director to a Cabinet-level Secretary. The passage of this legislation provides a signal to all partners that Maryland is dedicated to risk reduction, resilience, and mitigation from all types of hazards.

6.1.5.4 Floodplain Management Programs

The MDE Flood Hazard Mitigation Program helps communities identify their flooding risks, and through a variety of programs, assists them in reducing risk. To better identify flood risk, MDE is exploring improved methods of mapping areas subject to flooding and posting these maps on its web page. Changes since the 2016 Plan Update included the addition of Maryland DFIRM Outreach Website, available at https://mdfloodmaps.net/. MDE created Maryland's Flood Risk Mapping Application to help communities and citizens make informed decisions about flood risk (https://mdfloodmaps.net/map/). Using the schedule for map production in 2017, the average age of the digital FIRM products in Maryland is 4 years, with 75 percent of the state at 3 years or less. Currently, four of the six oldest floodplain mapping products are in production to be remapped.

MDE's flood mitigation program works with communities in finding ways to reduce or even eliminate risks to safety and property. The CFMGP assists communities in funding mitigation projects such as acquisitions, elevations and relocations of flood-prone structures, and constructing flood control projects. Most importantly, MDE assists communities in establishing sustainable floodplain management programs to prevent flooding risks from occurring in the future.

6.1.5.5 Floodplain Management Model Ordinance

The *Maryland Model Floodplain Ordinance* (January 2018) was prepared by MDE in response to the requirement that local jurisdictions adopt regulations that fully comply with the requirements of the NFIP. For most communities, the requirement to update regulations is triggered by revisions to the FIRMs and associated Flood Insurance Study (FIS). One of the more significant features of the model ordinance is the requirement of coastal communities to 1) implement a minimum 2-foot freeboard (additional elevation requirement); 2) require all new and replaced HVAC units to be elevated; and 3) require all fuel storage tanks to be anchored or elevated.

6.1.5.6 Maryland's Stormwater Management Program

The State of Maryland has developed comprehensive stormwater management, erosion, and sediment control programs to reduce the adverse impacts of development on stormwater runoff. This program addresses both the temporary and the permanent impacts associated with development activities. The goal is to:

manage stormwater by using environmental site design (ESD) to the maximum extent practicable to maintain or lower the amount of run-off generated by the site after development, review the predevelopment runoff characteristics, and reduce stream channel erosion, pollution, siltation and sedimentation, and local flooding, and use appropriate structural best management practices only when necessary. Information on the MDE website describes the program and its requirements and presents guidance on how to implement stormwater management in Maryland. Guidance, data, and training provided includes:

- Erosion and Sediment Control and Stormwater Management Plans;
- Plan Review for State and Federal Projects;
- Stormwater Vegetation Guidance;
- National Pollutant Discharge Elimination System (NPDES) stormwater permits;
- Fact Sheet on NPDES Phase II MS4 Permit restoration reporting and the database structure; and
- Guidelines for Embankment Retrofit Design.

Additional stormwater programs and initiatives are described below.

6.1.5.7 Maryland's Stormwater Design Guidance

MDE has published guidance on various technical procedures and calculations relevant to implementing ESD for both new development and redevelopment. The following publications provide additional information for use when designing or reviewing a stormwater plan and provide additional information and guidance on the use of alternative/innovative technologies for addressing Maryland's Stormwater Management requirements:

- Maryland's Stormwater Program & Alternative/Innovative Technologies (December 2019)
- Stormwater Design Guidance – Green Roofs & Runoff Curve Numbers (March 2018)
- MDE's List of Reviewed Alternative/Innovative Technologies (September 2017)
- Environmental Site Design and Innovative Technology (May 2013)
- Stormwater Design Guidance – Solar Panel Installations (January 2013)
- Stormwater Design Guidance – Addressing Quantity Control Requirements (June 2012)
- Stormwater Design Guidance – Rainwater Harvesting (June 2012)
- Stormwater Design Guidance – Submerged Gravel Wetlands (June 2012)
- Environmental Site Design Redevelopment Examples (December 2010)
- Model Standard Plan for Residential Construction (October 2009)

6.1.5.8 Maryland Association of Floodplain and Stormwater Managers

The Maryland Association of Floodplain and Stormwater Managers (MAFSM) was organized in 2004 by a group of private and public partners. The Association is organized exclusively for charitable, educational, or scientific purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code.

The purpose of MAFSM is to:

- Provide educational opportunities and dissemination of general and technical information to individuals concerned with sound floodplain and stormwater management.
- Promote public awareness of sound floodplain and stormwater management and the linkages between them.
- Encourage the exchange of information, ideas, experiences, etc., among the practitioners of floodplain and stormwater management.
- Promote the professional status of floodplain and stormwater managers.
- Inform and provide technical information relative to legislation pertinent and necessary to the effective implementation of sound floodplain and stormwater management practices.
- Promote environmentally sound solutions to floodplain and stormwater problems.

6.1.5.9 MAFSM Mitigation Committee

The Mitigation Committee provides membership with information on flood hazard mitigation planning-, project-, and outreach-related activities, as well as federal/state mitigation funding available in Maryland. Committee members include representatives of state and local governments, as well those from the private sector who can offer guidance on effective flood management. With the goal of promoting the Association's interest in *reducing loss of life and damage to property from flooding,* the Mitigation Committee prepares news articles and conducts informational sessions on mitigation programs, actions, and processes.

6.1.5.10 MAFSM Stormwater Committee

MAFSM members are individuals working with floodplains and stormwater. Stormwater regulations in Maryland are one of the most advanced and fastest evolving regulations in the country. The President's Executive Order for the Chesapeake Bay Protection and Restoration and Maryland's Act of 2007 have significantly overhauled stormwater management policies and regulations of state and local agencies throughout the State of Maryland. The Stormwater Committee provides updates to changes of these policies and regulations through MAFSM's newsletters and technical sessions at its annual conference and conducts educational fun field trips. Future activities of this Committee include educational technical seminars.

6.1.5.11 Maryland Priority Funding Areas

Priority Funding Areas (PFA) are geographic growth areas, either as defined under state law or as designated by local jurisdictions, where the state targets investments in infrastructure. The law directs the use of state funds for roads, water and sewer plants, economic development, and other "growth-related" projects to PFAs, recognizing that these investments are the most important tool the state has to influence growth and development.

PFAs have been established to meet three key goals:

- To preserve existing communities;
- To make the most efficient and effective use of taxpayer dollars for costly infrastructure by targeting state resources to build on past investments; and
- To reduce development pressure on critical farmland and natural resource areas by encouraging projects in already developed areas.

According to the MDP, despite state programs designed to reverse the urban sprawl trend, sprawling land use is still a concern. Maryland continues to develop and implement programs designed to protect farms and forests, to limit development along the shoreline of the Chesapeake and its tidal tributaries, and to foster growth generally within the boundaries of existing communities. PFAs were created in 1997 to encourage development in and around existing towns and cities by concentrating public investment for new infrastructure such as roads and schools in those areas.

State Funding Subject to the PFA Law – "Growth-Related" Projects

Department of Housing and Community Development (DHCD) – DHCD Programs defined as "growth-related," for which funding is limited to PFAs, include:

- Programs under the Community Development Administration (CDA) and Maryland Home Finance Program, Subtitles 2, 3, and 8, of Title 4, Housing and Community Development Article – These programs provide low-interest mortgages to qualified first time homebuyers for the construction or purchase of newly constructed single-family homes.
- CDA's program under Subtitles 2, 4, and 15, of Title 4 for the acquisition or construction of newly constructed multi-family rental housing.
- State funding for neighborhood revitalization projects, which include the Community Legacy program, the Community Investment Tax Credit, the Neighborhood Business Works program, and the Strategic Demolition and Smart Growth Impact Fund.

Department of General Services (DGS) – While it has no capital budget, the DGS is responsible for acquiring, leasing, and maintaining most of the state's facilities. Thus, DGS is responsible for ensuring that the state's "growth related funding" for leases and land acquisition of property by the state is limited to PFAs.

Department of Commerce – Commerce programs defined as "growth-related," and therefore subject to PFA restrictions, include:

- The Maryland Small Business Development Financing Authority, which provides financial assistance to small businesses that are not able to qualify for financing from private lending institutions or are owned by socially and economically disadvantaged persons.
- The Maryland Economic Development Assistance Authority Fund, which provides loans and grants to businesses and local jurisdictions.
- The Economic Development Opportunities Program Fund (Sunny Day Fund), which promotes Maryland's participation in extraordinary economic development opportunities that provide significant returns to the state through creating and retaining employment and the creation of significant capital investments in PFAs.
- Maryland Economic Adjustment Fund, which assists business entities located in the state with modernization of manufacturing operations, the development of commercial applications for technology, and exploration of new markets.

Maryland Department of the Environment (MDE) - The following MDE programs are subject to PFA restrictions:

- The Maryland Water Quality Revolving Loan Fund, which provides financial assistance to local governments and public or private entities for a wide variety of projects to protect or improve the quality of Maryland's rivers, streams, lakes, the Chesapeake Bay, and other water resources.
- The Water Supply Financial Assistance Program, which provides financial assistance to local governments for the acquisition, construction, rehabilitation, and improvement of publicly owned water supply facilities throughout the state.
- The Supplemental Assistance Program, which provides grants to local governments for planning, design, and construction of needed wastewater treatment facilities.
- Maryland Drinking Water Revolving Loan Fund, which provides financial assistance to local governments and private citizens to protect or improve the quality of community water systems and ensure their compliance with national primary drinking water standards.

Maryland Department of Transportation (MDOT) – For MDOT, "growth-related" projects include all major capital projects, defined as "any new, expanded, or significantly improved facility or service that involves planning, environmental studies, design, right-of-way, construction, or purchase of essential equipment related to the facility or service." MDOT lists such projects in its Consolidated Transportation Program as "Major Projects," and details the PFA status of each project as part of that report.

MDOT's modal administrations that undertake major capital projects for which PFA restrictions apply include the State Highway Administration (SHA), the MTA, the Maryland Aviation Administration, the Maryland Port Administration, the Motor Vehicle Administration (MVA), the Secretary's Office, and payments to WMATA.

Transportation projects that are explicitly excluded from PFA restrictions include existing Maryland Transportation Authority facilities projects, project planning, initial project planning, and "Minor Capital Projects," which are projects for the preservation and rehabilitation of existing facilities or services that do not increase capacity. A number of MDOT's capital projects are not location-specific, meaning that they involve system-wide improvements, such as local transit assistance programs and transit vehicle acquisition by MTA, and facility management system improvements by MVA.

Maryland Historical Trust (MHT) – Though not required to do so by law, MHT voluntarily restricts certain aspects of its programs to PFAs and gives higher priority to them during review and analysis in order to further the aims of Smart Growth. MHT gives preference to commercial applicants for the Heritage Structure Rehabilitation Tax Credit, formerly known as Sustainable Communities Tax Credit, whose projects are located in PFAs.

Priority Funding Areas and Hazard Mitigation

MDP has developed a PFAs mapping tool to identify priority areas. This tool can be found at http://mdpgis.mdp.state.md.us/pfa/. PFAs are shown on map products and are displayed as color differentiated polygons, depending on whether the property is located within county or municipal boundaries, or areas designated as rural village. The polygonal PFA areas encompass an entire designated area, typically the entire parcel of land. This methodology of PFA identification and delineation does not account for potential hazard areas that are not suitable for development. Rather the polygon/parcel-level representation on mapping products may lead to misunderstandings as to where suitable land exists for development, let alone, for prioritization. Consideration should be given to hazard areas and should not be included within PFA mapping products.

6.1.5.12 Maryland Silver Jackets

The Maryland Silver Jackets Team first convened in 2010. The Team's activities have included levee risk outreach, holding coastal flood training, conducting nonstructural assessments, holding floodproofing workshops, and working on the creation of a flood warning tool. In addition, the Team is focused on data sharing among team members and the Maryland Hazard Mitigation Grant program. Programs and activities include:

- Flood Warning Tool – The Maryland Silver Jackets team is in the process of developing an innovative tool that predicts flood inundation based on the integration of the NWS's new National Water Model and recent HEC-RAS modeling associated with FEMA's RiskMAP process. The test case for this project is Whitemarsh Run in Baltimore County.

- Flood Proofing Workshops – The Maryland Silver Jackets team held floodproofing workshops in Cambridge, Prince Frederick, and Hagerstown in August of 2018. The National Nonstructural Floodproofing committee discussed techniques that home and business owners could incorporate to reduce their flooding risk. The other team partners (MDE, MEMA, FEMA, USACE, etc.) provided information and discussed the types of state and federal programs available to assist communities and homeowners.
- Which Map Should I Use? Comparing Coastal Inundation Maps – The Maryland Silver Jackets team, working in partnership with the USACE, FEMA, and NOAA, developed a short paper for local community officials and residents on the key differences and appropriate uses of Storm Surge Inundation Maps created as part of a Hurricane Evacuation Study and FIRMs developed for the NFIP.
- Interagency Outreach on Risk and Benefits of New Flood Risk Management Project – The Maryland Silver Jackets team developed an outreach brochure for the Cumberland-Ridgeley levee systems in Maryland and West Virginia, respectively, to distribute to homeowners, business owners, and other stakeholders to communicate the associated benefits and risks of the project. Partners include the USACE, FEMA, NWS, MDE, and the City of Cumberland.
- Baltimore City Nonstructural Flood Proofing Analysis – The City of Baltimore has approximately 8,000 historic structures within the regulatory floodplain, mainly within the neighborhoods of Fells Point, Dickeysville, Mill Valley, Federal Hill, and Locust Point. The Maryland Silver Jackets team investigated potential nonstructural floodproofing measures for these structures in particular. The City is in the process of developing a design guidance manual for floodproofing these historic structures and plans to incorporate recommendations from the Silver Jackets report into this guidance document.

6.1.5.13 Maryland Historical Trust – Cultural Resources Hazard Mitigation Planning Program

The Cultural Resources Hazard Mitigation Program is aimed at protecting historic places, archeological sites, and cultural landscapes from the effects of natural hazards, such as flooding, wind, and coastal erosion. The impacts of Hurricane Sandy in Maryland to historical communities along the East Coast highlighted the need to protect the many landmarks, districts, and sites that contribute so much to our economy and quality of life.

MHT promotes a planning framework based on FEMA's Integrating Historic Property and Cultural Resources into Hazard Mitigation Planning, which is currently being utilized in Annapolis. MHT has developed an Architectural Survey Form for Hazard Mitigation Planning[244] to help communities to conduct a risk assessment for historic structures that are important to the community and vulnerable to flooding. MHT

[244] https://mht.maryland.gov/grants_hazardmitigation.shtml.

also offers one-on-one technical assistance to aid local governments in plan development and mitigation projects involving cultural resources.

MHT has created five Training Modules on different steps in the hazard mitigation planning process for cultural resources:

- Module 1 – Intro to Protecting Historic Places from Flooding and Other Hazards
- Module 2 – How to Organize Your Resources
- Module 3 – Risk Assessment for Cultural Resources
- Module 4 – Prioritizing Cultural Resources
- Module 5 – Estimating the Economic Impact of Flooding on Historic Properties

These Training Modules have been aligned with MHT's Flood Mitigation Guide for Maryland's Historic Buildings

- Module 1 – Introduction to Protecting Historic Resources from Floods
- Module 2 – Evaluate Planning Options and Recruit a Planning Team
- Module 3 – Risk Assessment for Historic Resources
- Module 4 – Estimating the Economic Impact of Flooding on Historic Resources
- Module 5 – Establishing Local Preservation Priorities and Developing Mitigation Goals, Objectives and Actions

6.1.5.14 Maryland Department of Transportation Climate Change Programs

MDOT has developed programs and initiatives to reduce air pollution and greenhouse gas emissions throughout the State of Maryland. These programs focus on an integrated and multimodal approach, leveraging public-private partnerships and ensuring equity to accomplish these goals.[245] MDOT climate-related programs and initiatives include:

- MDOT Electric Vehicle Infrastructure Council (EVIC) to promote electric vehicle usage and the installation of electric vehicle infrastructure in Maryland. EVIC issues an Annual Report.
- MDOT maintains a vested interest in the reduction of carbon dioxide emissions through technology that meets the Corporate Average Fuel Economy standards for cars and light-duty vehicles.
- MDOT Renewable Energy Program and has installed solar, wind, and geothermal energy systems at a number of MDOT facilities. In 2016, these systems reduced carbon dioxide emissions by 1,285 metric tons.

[245] https://www.mdot.maryland.gov/tso/pages/Index.aspx?PageId=169.

- MDOT's Solar Program has recently established a Renewable Energy Development Contract. This contract will allow a number of photovoltaic (PV) systems to be installed on MDOT properties, and many of these facilities will run on solar power. Additionally, this contract can be used by Maryland state agencies, counties, municipalities, and non-profits to install PV systems on their own properties.
- MDOT is developing vulnerability assessment data and resiliency plans to address the current and future impacts of climate change on the transportation network. Data from the vulnerability assessment will be integrated into all aspects of planning, programming and design to ensure resilient and reliable transportation is available for counties to utilize.

6.1.5.15 Maryland Commission on Climate Change

Maryland's Commission on Climate Change is charged with advising the Governor and General Assembly on ways to mitigate the causes of, prepare for, and adapt to, the consequences of climate change and maintaining and strengthening the state's existing Greenhouse Gas Reduction Plan. Commission priorities include building broader partnerships with federal, state, and local governments and the private sector to reduce greenhouse gas emissions and prepare for the likely impacts of climate change in Maryland, better communicating with and educating Marylanders about the urgency of the challenge, and options to address it, as well as establishing action plan goals and timetables for implementation.

Maryland has documented a sea level rise of more than 1 foot in the last century, due to increasing water temperatures in the Chesapeake Bay, more rain and flooding in the winter and spring, and more arid summers. Maryland's people and their property, natural environment, and public investments are extremely vulnerable to climate change impacts.

The Commission, originally created by a 2007 Executive Order, was strengthened by a 2014 Executive Order and 2015 legislation with requirements to expand the Commission membership and maintain a comprehensive action plan, with 5-year benchmarks, to achieve science-based reductions in Maryland's greenhouse gas emissions. The Commission is supported by a Steering Committee and four working groups. These working groups represent diverse stakeholder interests and bring broad perspective and expertise to the Commission's work. This Commission is served by four working groups: Adaptation and Resiliency; Education, Communication and Outreach; Greenhouse Gas Mitigation; and Science and Technical.

6.1.5.16 Community Resilience Program

Maryland's Community Resilience Program leverages state and federal funding to promote and support comprehensive and holistic projects that address both water quality and quantity through a watershed-scale planning approach. More information about the funding that supports this program can be found below:

- Coast Smart Communities is supported by funding from NOAA and helps local communities understand and plan for coastal impacts, such as storm surge, shoreline erosion, sea level rise, and nuisance flooding.
- Green Infrastructure Resilience is supported by funding from the Environmental Protection Agency and helps local communities understand and plan for stormwater and riparian flooding hazards.
- Resiliency through Restoration Initiative is supported by state capital funds and helps local communities design and implement natural and nature-based resilience projects.

These three separate funding sources are managed cohesively to help local communities become more resilient to flooding hazards, from initial risk assessments through on-the-ground restoration.

6.1.5.17 Coast Smart Communities

Coast Smart Communities is a program dedicated to assisting Maryland's coastal communities by addressing short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. Coast Smart connects local government staff and partners to essential information, tools, people, and trainings. The Coast Smart Communities Program aims to take action before an event occurs to reduce the risk to life, property, and natural resources.

The impacts of both short- and long-term hazards will be most intensely experienced within local communities, and therefore, require local action. Coast Smart provides resources to local government and communities to plan, prepare, and increase resilience both short and long term.[246] Coast Smart provides:

- Financial assistance through Outcome 2 of Chesapeake & Coastal Grants Gateway
- Technical assistance to local communities
- Training opportunities for local practitioners
- Links to supportive information, federal and state resources, tools, visualizations, and networks

Coast Smart Council

The Council provides financial and technical support to municipal and county governments to incorporate coastal hazard and climate change resiliency into local planning and policies. Additionally, the Council provides guidance for the purposes of adopting specific Coast Smart siting and design criteria to address impacts associated with sea level rise and coastal flooding on future capital projects.[247]

[246] CoastSmart. Maryland Department of Natural Resources. Chesapeake & Coastal Service. n.d. Accessed April 29, 2021. Available at: https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx.

[247] Maryland CoastSmart Council. Maryland Department of Natural Resources. Chesapeake & Coastal Service. n.d. Accessed April 29, 2021. Available at: https://dnr.maryland.gov/climateresilience/Pages/cs_Council.aspx.

Potentially Eligible Projects include:

- Updates to flood ordinances, building codes
- Updates to hazard mitigation, comprehensive and critical areas
- Updates to Capital Improvement Project plans
- Applications to the CRS
- Adoption of a Sea Level Rise Overlay District

Coast Smart Construction Program

The Coast Smart Construction Program includes guidelines and other directives applicable to the preliminary planning and construction of proposed capital projects to address sea level rise and coastal flood impacts; a requirement that the lowest floor elevation of proposed structures located within a Special Flood Hazard Area be built at an elevation of at least 2 feet above the base flood elevation; and provisions establishing a process to allow a Unit of State Government to obtain a categorical exception and/or waiver from complying with specific implementation requirements.

The Coast Smart Construction Program is for the use of all State of Maryland agencies that design and build facilities or prepare programs and budgets for the design and construction of facilities. It is intended specifically for the use of project managers, capital planners, and the professionals who will design and operate state-owned facilities. The Program will be reviewed annually by the Council and revised as necessary to address issues that may occur as the building of state facilities and knowledge of Coast Smart building practices evolves. The most recent version of the design documents may be found on DNR's website here.

6.1.6 Federal and Regional Programs and Partners

The state works closely with our regional and federal partners to provide resources and technical assistance to counties and local jurisdictions to prepare for, respond to, and recover from disasters. Many federal mitigation funding opportunities, policies, and programs are administered by FEMA and carried out at the state level by MEMA.

MEMA is committed to using all available mitigation capabilities and funds as effectively and efficiently as possible to improve capacities and reduce risk. In general, local jurisdictions across the state have shown a strong commitment to mitigation through the improved quality of their local hazard mitigation plans, and the state continues to emphasize the comprehensiveness and timely update of these plans. The state has been efficient in the use of its mitigation funds for planning, mitigation, and elevation projects, as elaborated in Section 5.2. The 25 percent required local match has been a challenge for local communities to meet. The state has addressed this shortcoming by enacting the Resilient Maryland Revolving Loan Fund which provides low and no-interest loans to communities implementing resilience actions. This fund can also be used to satisfy the non-federal match requirement for mitigation grants.

To further improve federal and regional cooperation, MEMA proposes the following improvements:

- MEMA's robust proposed maintenance schedule elaborated in Section 6.3 involves process improvements that will benefit the jurisdictions through training and capacity building.
- MEMA will continue to expedite grant application reviews and will provide the required technical assistance to subapplicants.
- MEMA will provide a resource list of matching funds for local government reference.
- MEMA will encourage public and private universities to participate in the hazard mitigation planning processes of their respective counties to share a role in the community's emergency response.

The evaluation of local mitigation capabilities has been a challenge as a result of inconsistent methodologies, short turn-around times, and the lack of standard tracking and reporting processes. Local mitigation project information is often missing, or incomplete, so the overall capability by jurisdiction is not well documented. To address this need, MEMA will develop and distribute a Local Capability Assessment Survey annually that asks local officials to provide information relating to their administrative, regulatory, planning, technical, staffing, fiscal, and political capabilities as well as address any gaps, challenges, and limitations. The survey will be distributed annually, along with the mitigation action status document. This annual assessment will improve the state's ability to evaluate the effectiveness of local mitigation capabilities and will allow the state to address gaps through training, technical assistance, etc.

6.1.6.1 Risk Mapping, Assessment, and Planning

Risk MAP supports community resilience by providing data, building partnerships, and supporting long-term hazard mitigation planning. In particular, Risk MAP's Flood Risk Products work alongside regulatory products to provide flood risk information and support a community's overall floodplain management and hazard mitigation strategies.

The Flood Risk Products and datasets present information that can enhance hazard mitigation planning activities, especially the risk and vulnerability assessment portion of a hazard mitigation plan, and the development of risk-based mitigation strategies. Flood Risk Products can also help guide land use and development decisions and help communities take mitigation action by highlighting areas of highest risk, areas in need of mitigation, and areas of floodplain change. Flood Risk Products help state, tribal, and local governments and community officials view and visualize their local flood risk, allowing communities to make informed decisions about reducing flood loss and mitigating potential damage from flood hazards. These individuals may include property owners, emergency management officials, community planners and developers, real estate and insurance specialists, and other professionals and community decision-makers.

Maryland worked closely with FEMA to provide high-quality flood maps and information, and as of August 10, 2020, FEMA Region 3 is the first in the country to have wall-to-wall coverage in digital maps – a big step forward in ensuring the safety of local communities from flooding. FEMA Region 3, which includes Delaware, Washington, D.C., Maryland, Pennsylvania, Virginia, and West Virginia, leads the country in providing up-to-date flood hazard information to local communities.

6.1.6.2 U.S. Army Corps of Engineers – Baltimore District

The USACE, Baltimore District, supports engineering and construction services in the areas of water resources, design, construction, and environmental restoration. It is involved in flood management projects, wetlands restoration, dam and lake projects, drought and flood relief, and disaster preparedness. Its mission is to "Deliver vital engineering solutions in collaboration with our partners to serve and strengthen the Nation, energize the economy and reduce disaster risks." The state works closely with the Baltimore District on emergency response activities for natural disaster incidents, such as Hurricanes Sandy, and for long-term projects, such as the Chesapeake Bay Program.

6.1.6.3 National Weather Service - StormReady

StormReady is a nationwide program that helps communities better protect citizens during severe weather, encourages communities to take a proactive approach to improving local hazardous weather operations, and provides guidance to emergency managers on how to improve hazardous weather operations. There are 23 StormReady entities in Maryland as of October 1, 2020, including 20 counties, one community, one university, one commercial entity, and five supporters.[248] These entities are listed in Table 6-10, and their locations are shown in Figure 6-1.

Table 6-10: Maryland StormReady Entities

Counties		Communities
Allegany	Howard	Town of Ocean City
Anne Arundel	Montgomery	**Commercial Entities**
Baltimore	Prince George's	Six Flags America
Carroll	Queen Anne's	**Universities**
Cecil	Saint Mary's	University of Maryland
Charles	Somerset	**Supporters**
Dorchester	Talbot	Arundel Mills
Frederick	Washington	Clarksburg Premium Outlets
Garrett	Wicomico	Hagerstown Premium Outlets
Harford	Worcester	Queenstown Premium Outlets
		Towson University

[248] StormReady® in Maryland. NOAA National Weather Service. n.d. Accessed April 29, 2021. Available at: https://www.weather.gov/stormready/md-sr.

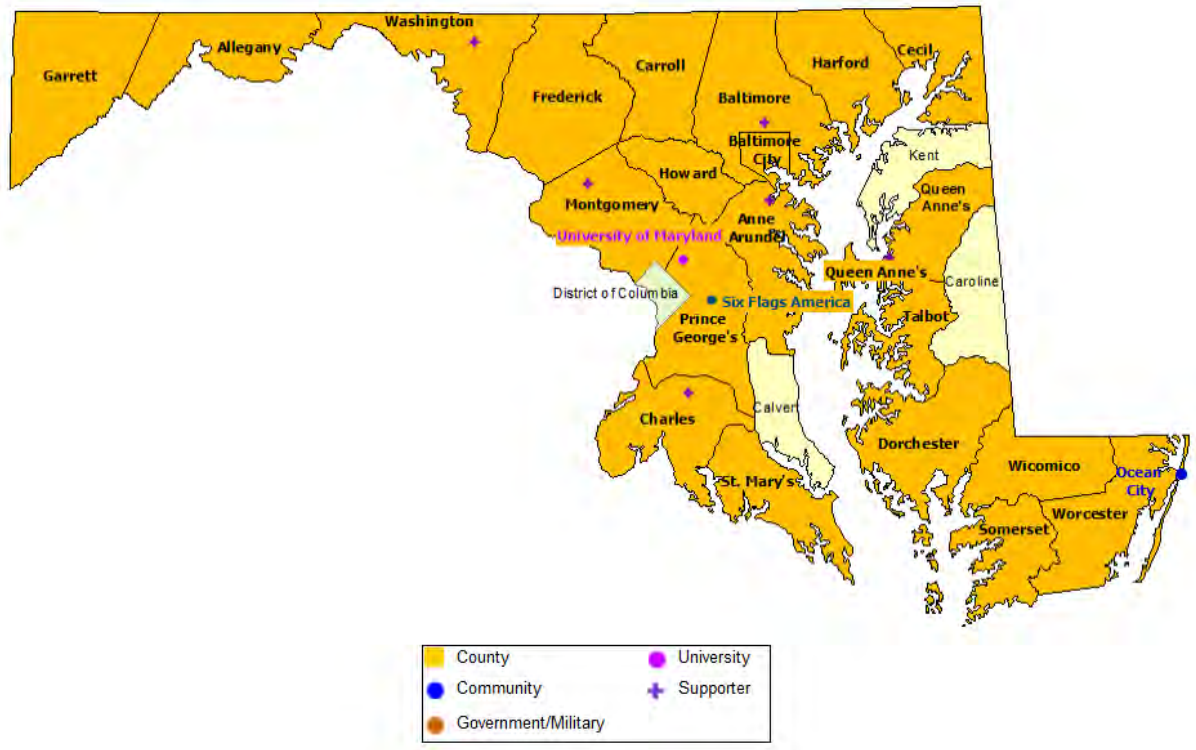


Figure 6-1: Location of StormReady Entities in Maryland

6.1.7 Advocacy, Institutional, and Non-Governmental Organizational Resources

According to MEMA's Director in recent remarks, "mitigation is the center of the universe," and as such, MEMA is continuously expanding its partnership network. Not only does this practice serve MEMA well by ensuring that its culture of mitigation and preparedness is shared by external stakeholders and practitioners across the state, but it also meets a significant criterion under the new BRIC program. FEMA recognizes that mitigation cannot be accomplished by federal dollars alone – recent studies by the National Emergency Management Association, the American Society of Civil Engineers, and the National Institute of Building Sciences and more repeatedly show that the mitigation gap across the nation is in the billions of dollars. BRIC and other federal programs will begin to reward state applicants for pursuing partnerships and building a network that will leverage this national investment in mitigation.

The State of Maryland also partners with several advocacy, university, and non-governmental organizations to promote hazard mitigation. These partnerships provide additional outreach channels, resources, and areas of expertise to benefit the state's hazard planning and mitigation projects. These partnerships are

demonstrated in the table of additional stakeholder meetings found in Appendix B, as well as fully explored in Section 1.

6.1.7.1 Coordinating Technical Partners Program

MDE leverages partnerships under the Cooperating Technical Partners (CTP) program in the delivery of high-quality mapping products, risk assessment tools, and planning and outreach support. This enables communities to take action to reduce risk based on informed multi hazard-based data and resources. CTP provides outreach support and empowers Maryland's communities to take action to reduce risk based on informed multi-hazard-based data and resources.

6.2 Obstacles, Challenges, and Issues

As noted in Section 6.1.5.2, staff turnover and the increasing rate of hazardous events is an identified weakness in the capability of Maryland to execute a fully realized hazard mitigation program. The remainder of this section evaluates challenges related to development of data, provision of adequate funding at the state and federal level, and also notes recent legislative success that will improve upon the weaknesses and challenges evaluated.

An ongoing challenge over the many hazard mitigation plans developed for both the state and local jurisdictions has been the gathering and organization of local and county information and data, integration across the counties' and jurisdictions' planning mechanisms, and stakeholder participation at the local, county, and state levels. Specifically, obtaining ongoing planning effort information and plan integration information proved difficult and required additional desktop research rather than actual feedback to address the missing information.

The continuation of funding programs that support hazard mitigation at both the county/jurisdictional and state level is necessary. The challenge of having too many priority projects and not enough funding to complete those projects and activities continue to hamper the state. Despite challenges, Maryland and its local communities are not daunted and continue to pursue hazard mitigation and resilience strategies. For more information on potential funding opportunities, see Section 4.10 for a table of funding sources.

An enhanced state must demonstrate that it has adequate staffing to successfully manage pre- and post-disaster programs, as well as to effectively spend additional HMGP funds. This is an obstacle for many states, including Maryland. However, staffing obstacles are not unique to MEMA, as the pandemic and subsequent budget shortfalls have posed this challenge to departments and agencies statewide. However, MEMA is attempting to rise above this challenge – the agency has 13 of approximately 100 professional positions dedicated to planning, risk reduction, and mitigation, as well as three grants management officers dedicated to ensuring the timely expenditure of funds within federal guidelines. Additionally, should Senate Bill (SB) 22 pass the General Assembly in the 2021 Session, MEMA will officially establish a state Office of Resilience under MEMA's purview, responsible for guiding the state's

resilience initiatives. This Bill provides an additional $276,000 for 4 positions in the first fiscal year of operation.

The passage of SB68 establishes MEMA as a Cabinet level department, further demonstrating Maryland's commitment to mitigation. These actions serve to signal to federal and state mitigation partners that Maryland's commitment to funding and implementing mitigation activity is strong and ready for the future.

Finally, the emergence of the COVID-19 pandemic has created a unique challenge all its own, particularly for the development of a hazard mitigation plan. A plan of this nature thrives on public involvement and engagement – indeed, without it, the plan becomes a document that sits on the shelf with little impetus to be accomplished. From the outset of the update process, right as the pandemic was taking over our state and nation, MEMA encouraged the planning team to find virtual methods to engage our stakeholders and practitioners. The development of the Virtual Room, the provision of plan update materials online, and the use of virtual meeting technologies and editing procedures maintained the excitement surrounding the Plan Update. All principal lead agencies and many partners participated in the meetings conducted by MEMA and consequently, MEMA believes that this update still has seen a robust measure of public engagement and participation.

6.3 Plan Maintenance and Updates

Upon approval from FEMA, this Plan will be adopted by MEMA and its participating jurisdictions. This State Mitigation Plan (SMP) Update is intended to be a living document and plan adoption should be considered the first step to realization.

The plan monitoring and maintenance schedule is a cycle of events that involves periodic review, adjustments, and improvement. This section establishes a method to monitor how the Plan will be evaluated and maintained in the future.

This 2021 SMP Update will be monitored by MEMA for the following purposes:

1. To maintain the currency of hazard and risk information.
2. To ensure mitigation projects and actions reflect the priorities of the state, the counties and jurisdictions, the SMP Steering Committee, and the general public.
3. To stay in compliance with FEMA requirements for SMP maintenance.
4. To maintain eligibility for federal disaster assistance and mitigation grants.

6.3.1.1 Annual Reviews

In order to ensure that the SMP continues to provide a framework of reducing risk in the state, the SHMO will take responsibility to convene an annual meeting of the Hazard Mitigation Plan Steering Committee to conduct an annual review to evaluate the SMP's effectiveness, applicability, and ongoing strategy. The Committee will comprise members who were involved in the preparation of the 2021 Plan Update as well as regional or county representatives.

Based on the challenges discussed in Section 6.2, MEMA proposed an action (Mitigation Action 21) to set the stage for an annual review process to review the status of each action. Due to data gaps, non-responsiveness from counties, and planning products that were still under development during the SMP development period, MEMA was unable to incorporate data and information from all 26 of its emergency management districts. During the annual review period, MEMA will identify outstanding items and will incorporate appropriate content to address any weaknesses/challenges. The data call for jurisdictions will inform the annual review process, which will also include mitigation action status. The request for information from the jurisdictions will be similar to the process used in this plan update. Information gathered will be incorporated into the annual plan review.

Each action proposed in the Mitigation Plan will be categorized as one of the following: in progress, ongoing, completed, not started, infeasible, not applicable, or cancelled. MEMA, with assistance from the Steering Committee, will prepare a status report of the mitigation actions based on the annual report forms from the lead departments/agencies, as well as counties/jurisdictions.

MEMA's target schedule for annual reviews is as follows:

1. Request information from state departments and lead agencies in the spring;
2. Compile results and conduct action reviews in the summer; and
3. Publish results of the Annual Review in the late summer/early fall.

Note: The results will also inform the state's HMA funding requests. The Risk Reduction Consultation (RRC) is usually held in June/July, so this review schedule will allow the state to assist jurisdictions in proposing funding requests that support the implementation of this plan and its goals. MEMA will be able to strategically inform local jurisdictions of what project proposals may be prioritized for funding as they prepare their letters of intent for funds such as BRIC, FMA, or future instances of HMGP. This will also apply to other federal programs, such as the High Hazard Potential Dam program or various EPA programs.

In addition to conducting an annual review of the SMP, the Steering Committee will also review the SMP within 90 days after a declared disaster. Each goal and objective will be examined for its relevance and validity to the changing situation, and each mitigation action will be reviewed to ensure that it addresses any recent issues that may have stemmed from the disaster events. During quiet (non-disaster) times, the SMP will be updated every 5 years to reflect the current risk, vulnerabilities, and development trends and to develop relevant mitigation actions. Although an annual report will be competed each year, any state and/or federal mandates from MEMA and/or FEMA respectively, will be addressed in the 5-year update.

Upon adoption of this SMP, MEMA will annually convene a meeting of representatives from the Steering Committee to discuss accomplishments or any challenges to implementation, as well as any recommended solutions. The Steering Committee will continue to represent the various departments and organizations involved in this current update. MEMA will also be responsible for monitoring and preparing the annual progress reports and will utilize the data obtained from the

annual meeting to note the progress made on mitigation action items in annual progress reports.

6.3.1.2 Ad Hoc Reviews

Circumstances or conditions under which the SHMO will initiate SMP reviews and updates:

1. On the recommendation of the Governor, the Director of MEMA, or on its own initiative, the SHMO may initiate a SMP review at any time.
2. At approximately the 1-year anniversary of the SMP's re-adoption and at the same time every year thereafter.
3. After a natural hazard event that appears to significantly change the apparent risk, state assets, operations, and/or citizens.
4. Upon receipt of new or updated data or information that may significantly affect the HIRA.
5. When activities within the state, region, or country significantly alter the potential effects of natural hazards on state assets, operations, and/or citizens. Examples include completed mitigation projects that substantially reduce risk, or actions or circumstances that increase risk.

In addition to the circumstances listed above, revisions that warrant changing the text of this SMP or incorporating new information may be prompted by identification of specific new mitigation projects, completion of mitigation actions, or requirements for qualifying for specific funding. Minor revisions may be handled by addenda.

6.3.1.3 Statewide Involvement

This 2021 SMP Update will be posted on the state's website under the MEMA section. Additionally, notices of the Plan's availability on the website will be distributed to the following groups:

- The federal and state agencies that were notified and invited to participate in the SMP's development;
- The organizations, agencies, and jurisdiction officials who received notices of public meetings; and,
- Citizens who attended public meetings and provided contact information.

6.4 Conclusion

The State of Maryland has the initiative and drive to implement mitigation actions for a variety of hazards affecting the state; however, there are still challenges to hazard mitigation at both the county and local levels. These challenges come in the form of insufficient funds available for action implementation; lack of training or education on various hazards, technologies, policies, or laws; limited emergency response staffing; insufficient or limited data and information available for various analyses; and the absence of meaningful and productive partnerships with both

public and private stakeholders. Mitigation actions have been developed to address these limitations.

This State Hazard Mitigation Plan provides the vehicle to begin the process of addressing these challenges. However, in order to succeed, clearly articulating the benefits of participating in and sustaining the statewide mitigation planning process is required. One of the best ways to obtain buy-in and long-term success is to identify and implement achievable mitigation actions (as listed in this Plan Mitigation Strategy) that will facilitate continued intergovernmental coordination.

Section 7: Repetitive Loss Strategy

A Repetitive Loss Strategy identifies actions to reduce damage to RL and SRL properties throughout the state.

STATE MITIGATION PLAN REVIEW GUIDE

Released March 2015 FP 302-094-2

This Guide is FEMA's official policy on and interpretation of the natural hazard mitigation planning requirements. The intended use of the Guide is to facilitate consistent evaluation and approval of state mitigation plans, as well as to facilitate state compliance with the mitigation planning requirements when updating plans.

Table 7-1: State Mitigation Plan Review Guide

Element	Requirements
RL. Did the state develop a Repetitive Loss Strategy? [2 CFR §201.4(c)(3)(v)] **Intent:** Describe how the state intends to reduce the number of repetitive loss properties (which must include severe repetitive loss properties).	RL1. Did Element S6 (risk assessment) address RL and SRL properties? [2 CFR §§201.4(c)(2)(ii), 201.4(c)(2)(iii), and 201.4(c)(3)(v)] RL2. Did Element S8 (mitigation goals) address RL and SRL properties? [2 CFR §§201.4(c)(3)(i) & 201.4(c)(3)(v)] RL3. Did Element S9 (mitigation actions) address RL and SRL properties? [2 CFR §§201.4(c)(3)(iii) & 201.4(c)(3)(v)] RL4. Did Element S10 (funding sources) address RL and SRL properties? [2 CFR §§201.4(c)(3)(iv) and 201.4(c)(3)(v)] RL5. Did Element S13 (local and tribal [as applicable] capabilities) address RL and SRL properties? [2 CFR §§201.4(c)(3)(ii) and 201.4(c)(3)(v)] RL6. Did Element S15 (prioritizing funding) address RL and SRL properties? [2 CFR §§201.4(c)(4)(iii) and 201.4(c)(3)(v)]

7.1 Repetitive Loss and Severe Repetitive Loss Properties

A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling 10-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

On October 1, 2019, FEMA's NFIP transitioned to a new system, PIVOT, as their system of record for all policy and claims data, including RL and SRL properties. With the system change, a loss of classification / characterization data that were utilized in the 2016 Plan occurred with respect to SRL properties. The new system does not offer the ability to differentiate validated and unvalidated SRL properties. As a result of this definitional change, evaluation of the SRL data versus what was presented in the 2016 Plan is not appropriate. All analysis and mitigation strategy development will be

based upon the data obtained from the PIVOT Portal functionality within the NFIP General Support System on November 5, 2020.

According to the PIVOT Portal, there are 1,150 non-mitigated RL properties scattered throughout Maryland as of November 5, 2020, and 106 SRL properties.

Local jurisdictions containing the highest concentrations of FEMA-defined RL properties are Anne Arundel County, Baltimore County, Baltimore City, Prince George's County, and Worcester County (including Snow Hill); refer to the data on *NFIP Repetitive Loss (RL) & Severe Repetitive Loss (SRL) Data by Jurisdiction* table (Table 7-2) below.

Local jurisdictions containing the highest concentration of SRL properties include:

- Baltimore County
- Montgomery County
- Washington County

Severe Repetitive Loss (SRL) properties are defined as single or multifamily residential properties that are covered under an NFIP flood insurance policy and:

> That have incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
>
> For which at least two separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the property.

In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim.

Additional SRL Definition, from 2015 HMA Guidance, page 116:

> *A **repetitive loss property is** a structure covered by a contract for flood insurance made available under the NFIP that:*
>
> *(a) Has incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event*
> *and*
> *(b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.*
>
> *The Biggert-Waters Flood Insurance Reform Act of 2012 cites the repetitive loss structure definition located in Section 1370 of the Flood Insurance Act. This is the definition that communities typically reference when trying to determine eligibility for Increased Cost of Compliance when a property has sustained multiple losses that cumulatively equal or exceed 50 percent of the structure's value. For a structure to be eligible for the increased Federal Cost share of 90 percent, a property must meet the FMA repetitive loss definition in the Biggert-Waters Flood Insurance Reform Act of 2012.*

Table 7-2: NFIP RL & SLR Data by Jurisdiction

County (Total, inclusive of Municipality) *Municipality*	Repetitive Loss (RL) Total Number	Severe Repetitive Loss (SRL) Total Number
Allegany County	**21**	**1**
City of Cumberland	*1*	
Midland	*1*	
Unincorporated	*15*	
Westernport	*4*	
Annapolis, City of	**9**	**1**
Anne Arundel	**99**	**7**
Unincorporated	*99*	
Baltimore City	**65**	**7**
Baltimore County	**156**	**13**
Unincorporated	*156*	
Calvert	**45**	**0**
Chesapeake Beach	*2*	
North Beach	*5*	
Unincorporated	*38*	
Caroline	**2**	**0**
Carroll	**8**	**2**
Cecil	**56**	**7**
Charlestown	*1*	
Elkton	*13*	
North East	*12*	
Perryville	*2*	
Port Deposit	*12*	
Unincorporated	*16*	
Charles	**33**	**5**
Dorchester	**52**	**2**
Cambridge	*2*	
Unincorporated	*50*	
Frederick	**27**	**7**
City of Frederick	*4*	
Rock Hall	*3*	
	20	

County (Total, inclusive of Municipality) *Municipality*	Repetitive Loss (RL) Total Number	Severe Repetitive Loss (SRL) Total Number
Unincorporated		
Garrett	**16**	**2**
Harford *Aberdeen* *Havre de Grace* *Unincorporated*	**11** *3* *3* *5*	**1**
Howard	**50**	**6**
Kent *Chestertown* *Millington* *Unincorporated*	**6** *2* *1* *3*	**0**
Montgomery	**52**	**22**
Ocean City, Town of	**43**	**3**
Prince George's	**64**	**0**
Queen Anne's	**36**	**1**
St. Mary's *Leonardtown* *Unincorporated*	**62** *2* *60*	**4**
Somerset *Crisfield* *Unincorporated*	**61** *16* *45*	**1**
Talbot *Oxford* *St. Michaels* *Unincorporated*	**25** *11* *3* *11*	**1**
Washington *Funkstown* *Hagerstown* *Hancock* *Sharpsburg* *Unincorporated* *Williamsport*	**50** *1* *2* *3* *2* *38* *4*	**8**

County (Total, inclusive of Municipality) *Municipality*	Repetitive Loss (RL) Total Number	Severe Repetitive Loss (SRL) Total Number
Wicomico	**32**	**3**
Salisbury	*10*	
Unincorporated	*22*	
Worcester	**69**	**2**
Snow Hill	*1*	
Unincorporated	*68*	

Source: Spreadsheet developed from PIVOT data-November 5, 2020

RL properties are found in every county within the State of Maryland. Of the 26 jurisdictions (for this planning purpose) that make up the five regions within the state, 23 contain SRL structures (or 88 percent of the jurisdictions). This distribution is shown in Figure 7-1 and Figure 7-2. From the coastal regions to the western mountain areas of the state, no jurisdiction is immune to the threat of repetitive flooding. The Central Region has the highest concentration of RL and SRL structures, with the Lower Eastern Shore Region the second highest. The regional distribution of RL and SRL structures is shown in Figure 7-3 and Figure 7-4.

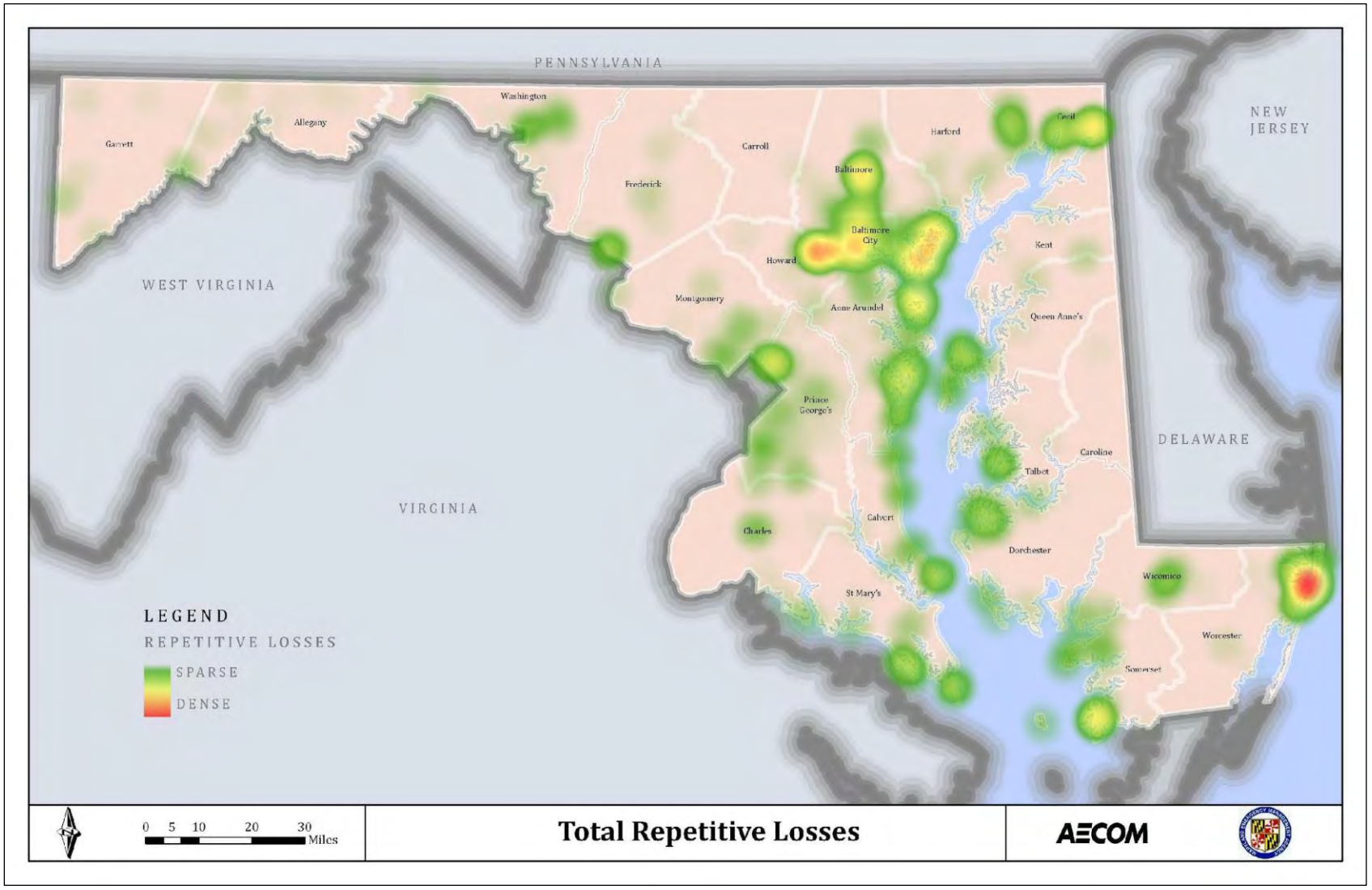


Figure 7-1: NFIP RL Data by Jurisdiction

The repetitively flooded properties discussed in this plan do not account for all properties in the State of Maryland that experience repeated flooding. These repetitively flooded properties are defined as RL and SRL because they have an active NFIP flood insurance policy and have submitted claims. There are properties throughout the state that may have experienced several flood events but are not classified as RL or SRL properties because:

1. The property owner has flood insurance but has not submitted claims.
2. The property owner has flood insurance through a non-government backed insurance program.
3. The property is located outside the SFHA where flood insurance is not mandated on federally backed mortgages, and therefore the owner does not have a flood insurance policy.
4. The property is located within the SFHA without a flood insurance policy. This typically happens when the citizen owns the property outright, with no mortgage, and thus, avoids triggering the federal mandate for flood insurance.
5. It is difficult to accurately track repetitively flooded properties for which claims are not submitted, or insurance is not held. In these cases, the best source of data may come from the local jurisdictions themselves, to inform mitigation planning going forward.

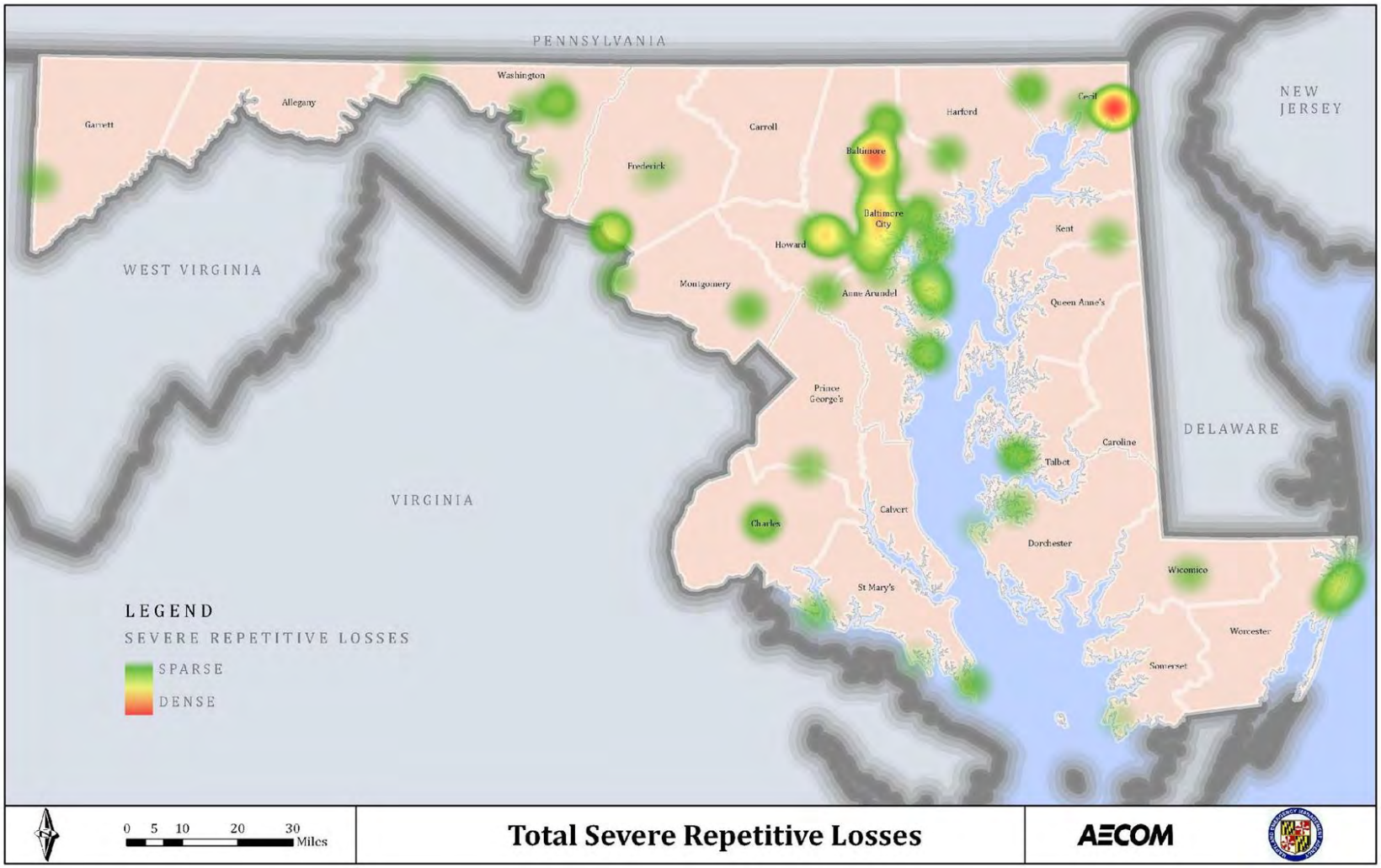


Figure 7-2: NFIP SRL Data by Jurisdiction

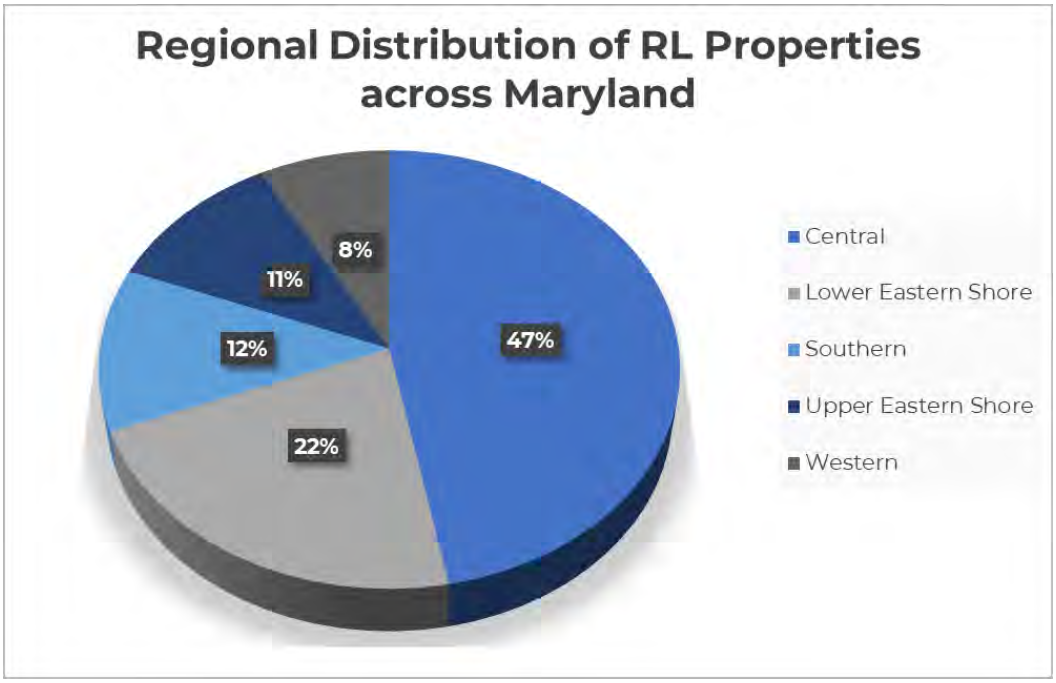


Figure 7-3: Regional RL Distribution

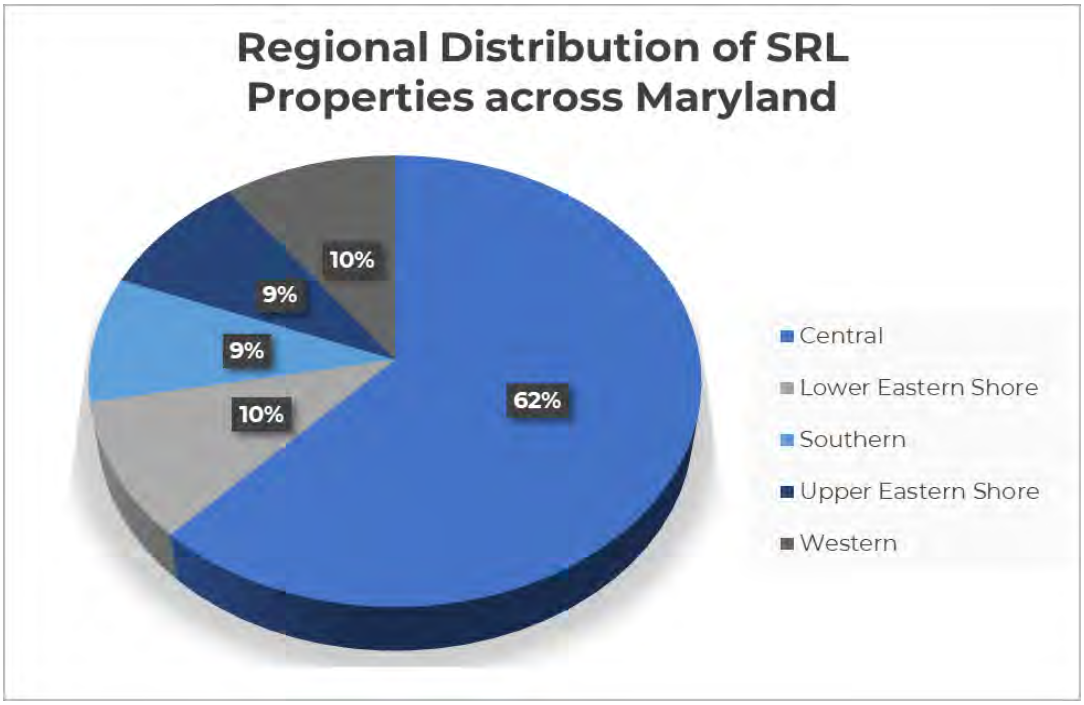


Figure 7-4: Regional SRL Distribution

7.2 NFIP Policies and RL & SRL Claims

There are 65,358 total NFIP policies within the State of Maryland, roughly a 52 percent increase from the number of policies in effect at the time of the 2016 Plan. While the number of policies increased substantially, the fees paid into the NFIP increased by only 0.2 percent. During this same time period, the NFIP has been undergoing rate adjustments per the Biggert-Waters Act of 2012, which aims to bring NFIP flood insurance premiums more in-line with actuarial rates. This disconnect between the significant increase in NFIP policies in the state, with relatively minimal increased premium revenues highlights an ongoing concern related to the NFIP solvency because of drain from RL and SRL claims. The disconnect may be attributed to multiple reasons, including any single or combination of the following:

- Increase in non-SFHA located policies, for which premiums are significantly lower in cost
- Reduction in SFHA-based policies with higher premium generation due to risk level. The reduction can occur for multiple reasons, including but not limited to, mortgage payoff, sale of structure, or the mitigation of property resulting in lower risk.

The counties/jurisdictions with the highest numbers of NFIP policies in the state include Anne Arundel County, Baltimore County, the Town of Ocean City, and Worcester County.

Approximately 35 records obtained from the FEMA PIVOT system on the number of NFIP Policies currently active in the State of Maryland contained incomplete data fields. Specifically, the County Name (Number) was listed as “Unknown” for communities. To resolve this issue, the corresponding County Name (Number) where the jurisdiction resides, was tagged to that entry. Additionally, a community that is not located in the State of Maryland (New York, the City of), was included in the data output from PIVOT. The data associated with this community was removed. With a set of complete records for County Name (Number), Community Name (Number), Contract Count, Policy Count, Total Coverage, and the Total Premium + Fee, the following data analysis was completed. Figure 7-5 and Figure 7-6 show the geographical distribution of the number of claims for repetitively flooded properties throughout the state.

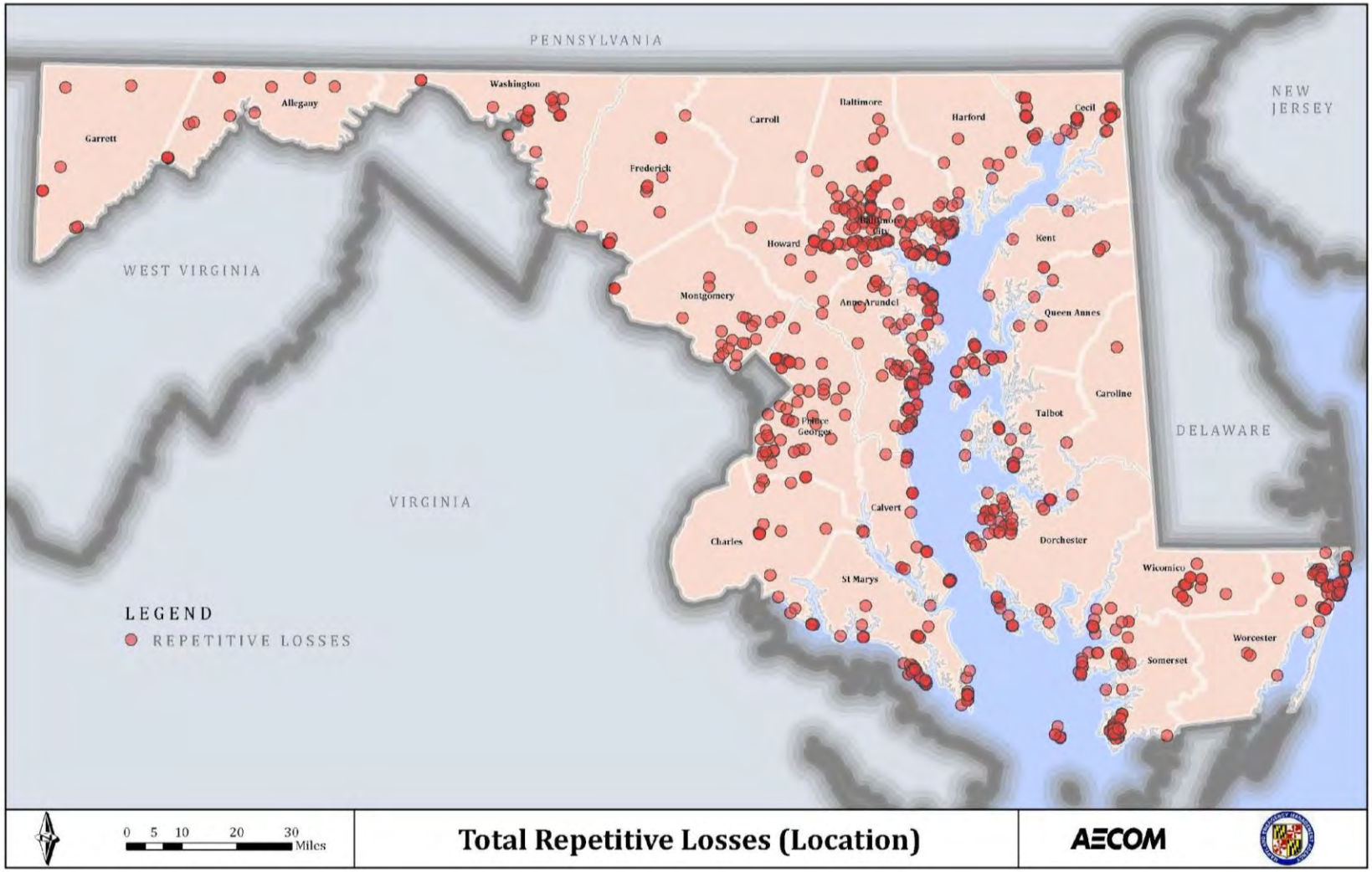


Figure 7-5: NFIP RL Claims Data by Jurisdiction

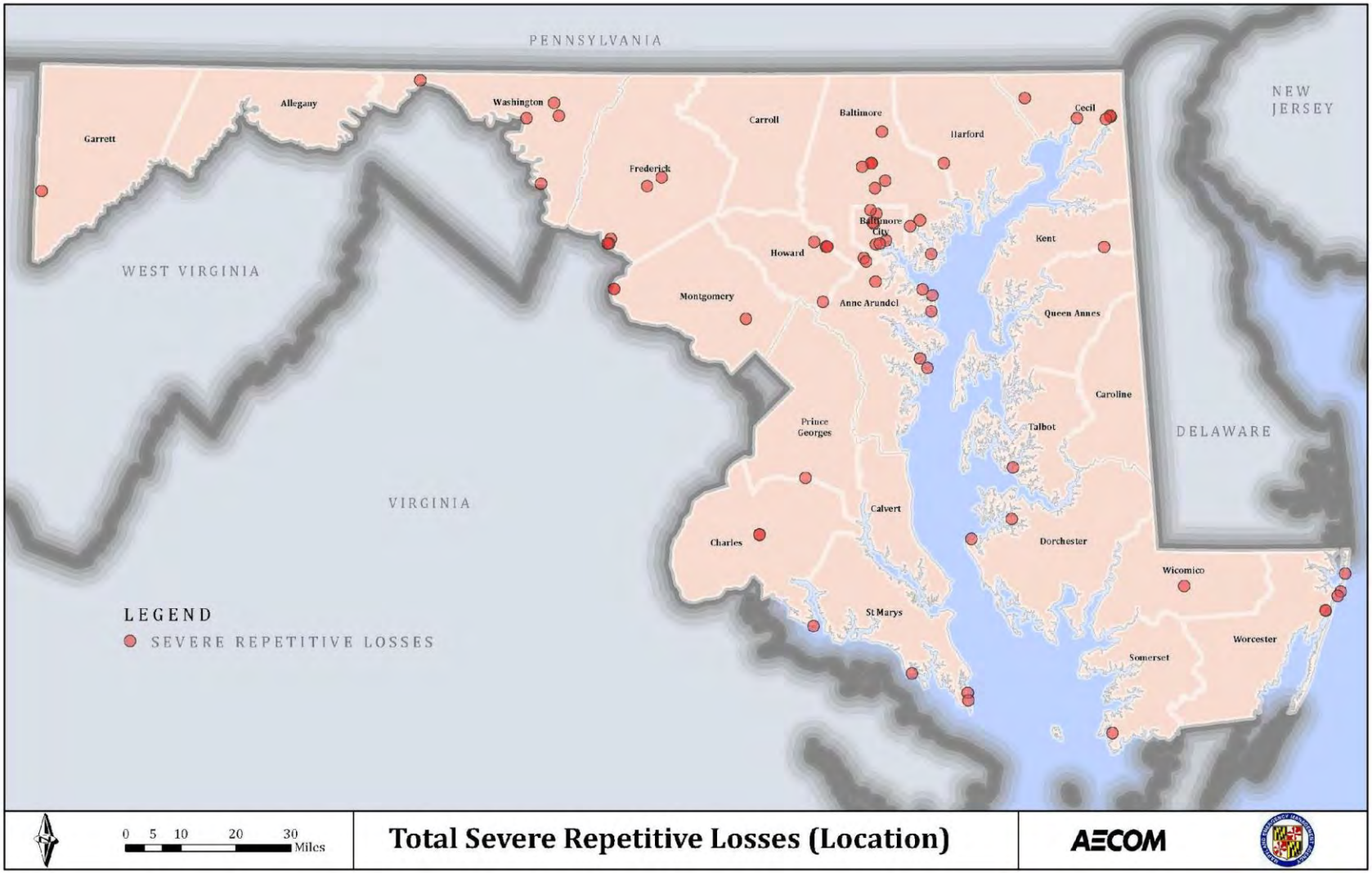


Figure 7-6: NFIP SRL Claims Data by Jurisdiction

Table 7-3 shows the 10-year contribution of a jurisdiction, based on current premiums and fees, along with the total unmitigated RL and SRL claims to date. Previous analyses have indicated that RL and SRL properties are often proportionally a significantly higher contributor to claims across NFIP policies, and therefore a significant drain contributing to the solvency issues of the NFIP. An analysis by the Pew Charitable Trusts indicates that while repetitively flooded properties account for approximately 1 percent of all NFIP policies, they make up 25 percent of the NFIP claims. (The Pew Charitable Trusts, 2016). That is a 25:1 national ratio of percent of repetitive claims vs policies. By working to address this disproportionality, the State of Maryland (and its residents) will increase its overall financial and physical resilience to repetitive flooding by mitigating the physical risk and reducing the long-term financial risks, thereby reducing the state's impact on the NFIP. By developing strategies and actions addressing the disproportionality, the State of Maryland is working towards a goal of having a net zero impact on the solvency of the NFIP, i.e., where the total claims are equal or less than the policies premiums and fees. To achieve this goal, the total flood claims across the state must be equal to or less than the premiums and fees paid into the system.

An analysis of the NFIP policy and claims and premium data for Maryland in Table 7-3 highlights the impacts across the state where there has been success in reducing the impact of repetitive claims as a disproportionate consumer of premiums and fees. Jurisdictions exceeding this national average and requiring immediate (short-term) attention to reduce the impact of disproportionate repetitive flood claims (ratio > 25:1) are highlighted in red. The next tier of jurisdictions to turn attention to would be those with ratios between 10<Ratio<25 (highlighted in yellow), as bringing these jurisdictions are already closer to a potential self-sustaining payment model. Together, these policies account for 23 percent of the repetitive loss policies, but if mitigated would address 45 percent of the claims.

The intent with minimizing unmitigated repetitive claims is to reduce the overall impact those claims have relative to the drain on the NFIP in addition to increasing life safety and improving community resilience.

Table 7-3: NFIP Policies per Jurisdiction

Jurisdiction	NFIP Policy Totals	RL / SRL Policy Totals	Total Premiums & Fees Paid for 10-Yr Period (Based on annual value)	Total Unmitigated RL & SRL Claims Paid [1]	% of Policies that are RL / SRL	% of NFIP Premiums that Unmitigated RL & SRL Consume [2]	Repetitive Loss Ratio Claims to Fee Impact vs Policies
Allegany	219	21	$2,738,290	$855,089	9.6%	31%	3.2
Annapolis, City of	845	9	$4,815,200	$1,689,712	1.1%	35%	31.8
Anne Arundel	5,346	99	$37,782,130	$6,603,362	1.9%	17%	8.9
Baltimore	3,502	65	$38,440,870	$11,636,694	1.9%	30%	15.8
Baltimore City	2,915	156	$32,521,140	$13,299,337	5.4%	41%	7.6
Calvert	845	45	$7,089,780	$1,657,269	5.3%	23%	4.3
Caroline	177	2	$1,725,930	$139,357	1.1%	8%	7.3
Carroll	214	8	$2,364,690	$37,450	3.7%	2%	0.5
Cecil	899	56	$9,465,260	$3,423,187	6.2%	36%	5.8
Charles	732	33	$4,856,170	$2,246,717	4.5%	46%	10.2
Dorchester	1,487	52	$12,330,530	$2,214,350	3.5%	18%	5.1
Frederick	647	27	$7,330,680	$687,205	4.2%	9%	2.1
Garrett	90	16	$750,490	$232,236	17.8%	31%	1.7
Harford	866	11	$6,923,480	$897,538	1.3%	13%	10.0
Howard	922	50	$8,546,480	$10,559,168	5.4%	124%	23.0
Kent	572	6	$5,758,620	$293,108	1.0%	5%	5.0
Montgomery	2,333	52	$13,483,020	$695,002	2.2%	5%	2.3
Ocean City, Town of	25,482	43	$76,448,720	$3,169,167	0.2%	4%	20.0
Prince George's	3,599	64	$29,030,920	$2,582,429	1.8%	9%	5.0

Jurisdiction	NFIP Policy Totals	RL / SRL Policy Totals	Total Premiums & Fees Paid for 10-Yr Period (Based on annual value)	Total Unmitigated RL & SRL Claims Paid [1]	% of Policies that are RL / SRL	% of NFIP Premiums that Unmitigated RL & SRL Consume [2]	Repetitive Loss Ratio Claims to Fee Impact vs Policies
Queen Anne's	2,271	36	$14,683,310	$1,663,509	1.6%	11%	6.9
Somerset	1,765	62	$14,850,790	$2,096,551	3.5%	14%	4.0
St. Mary's	1,246	61	$10,496,700	$3,043,959	4.9%	29%	5.9
Talbot	2,077	25	$14,545,090	$2,152,967	1.2%	15%	12.5
Washington	411	50	$4,042,720	$1,204,462	12.2%	30%	2.5
Wicomico	728	32	$5,609,990	$2,688,849	4.4%	48%	10.9
Worcester	5,168	69	$31,829,490	$1,387,421	1.3%	4%	3.1
TOTALS	**65,358**	**1,150**	**$401,083,200**	**$77,166,095**	**1.8%**	**19%**	**10.6**

Note: Totals for Anne Arundel, Baltimore, and Worcester counties are exclusive of the City of Annapolis, the City of Baltimore, and the Town of Ocean City. This exclusion was calculated manually, as these jurisdictions were tagged to the County in the PIVOT system. Claims paid have been rounded to the nearest dollar value.

[1] Source: Spreadsheet developed from PIVOT data-January 13, 2021

[2] Pay-in assumed based on 10 years of annual premiums (since RL/SRL based on 10-year rolling calendar)

The State of Maryland offers communities multiple layers of support and resources to address the current repetitive flooding issue and to stem the tide of additional properties being added to both lists. This support is not limited to site-specific mitigation measures, such as elevation and acquisition that address current RL and SRL properties, but also focuses on a holistic approach to breaking the repetitive flooding property cycle. Through the development of statewide datasets for climate change and flood layers, jurisdictions have, or will have, data available to help identify potential areas of repetitive flooding based on future conditions from which to develop measures ranging from changes in zoning to building code adoption to undertaking watershed analysis and drainage improvements. These efforts can be leveraged by communities participating in the FEMA CRS program to help increase their rating, resulting in additional benefits to the community's residents and the State of Maryland, through flood insurance premium reductions. Currently, the State of Maryland has 15 communities with current status participating in the CRS program as shown in Table 7-4:

CRS Success Story

IN OCTOBER 2020 TALBOT COUNTY IMPROVED ITS CRS RATING FROM CLASS 8 TO CLASS 7. THIS RESULTS IN ADDITIONAL AN ADDITIONAL 5% DISCOUNT FOR POLICIES IN THE SFHA (**TOTAL OF 15% DISCOUNT).**

Table 7-4: State of Maryland CRS Participating Communities

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
240087	Baltimore, City of	5/1/2016	5/1/2016	5	25	10	C
240042	Bel Air, Town of	10/1/1993	5/1/2017	6	20	10	C
240011	Calvert County	5/1/2015	5/1/2015	8	10	5	C
240130	Caroline County	10/1/1996	5/1/2017	8	10	5	C
240015	Carroll County	10/1/2007	5/1/2018	7	15	5	C
240019	Cecil County	10/1/2013	10/1/2018	7	15	5	C
240026	Dorchester County	10/1/2013	5/1/2019	6	20	10	C
240030	Frederick, City of	10/1/2012	10/1/2012	7	15	5	C
240040	Harford County	10/1/1991	10/1/2000	7	15	5	C
240043	Havre de Grace, City of	5/1/2009	5/1/2018	7	15	5	C
240044	Howard County	10/1/2007	5/1/2018	6	20	10	C
240012	North Beach, City of	1/1/1992	10/1/2008	10	0	0	R
245207	Ocean City, Town of	10/1/1992	5/1/2017	6	20	10	C
240068	Oxford, Town of	5/1/2020	5/1/2020	7	15	5	C

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
245208	Prince George's County	10/1/1991	10/1/2001	5	25	10	C
240066	Talbot County	10/1/2014	10/1/2020	7	15	5	C

Data as of October 2020; Status: C=Current, R=Rescinded, N/A = Not Applicable

The purchase of flood insurance obtained through the NFIP across the regions is disproportionately distributed throughout the state, as shown in Table 7-5 and Figure 7-7. The Lower Easter Shore Region has the highest number of policies, while only being composed of five jurisdictions, followed by the Central Region with 10 jurisdictions. The Lower Eastern Shore Region has achieved relative success in communicating the need for and benefit of flood insurance to its residents. The overall volume of flood insurance policies helps to offset the number of repetitive loss policies in that region. Additional factors that can influence the number of insurance policies and, therefore, number of insured RL/SRL properties in each region as mentioned in Section 7.1. In rural areas, where incomes may be lower, the cost of flood insurance, may also be a prohibitive factor, limiting the number of flood insurance policies purchased. Table 7-5 highlights that no jurisdictions in the Western Region participate in the CRS program, which could offer financial incentives (discounts) for the purchase of flood insurance. Additional efforts to increase the purchase of flood insurance should be explored in the other four Regions, utilizing best practices from, where appropriate, and capitalizing on the benefits of, the CRS program, including jurisdictional-wide premium discounts based on CRS class.

Table 7-5: NFIP RL & SLR Data by Region

Region	NFIP Policy Totals	RL Total Number (% of Policies)	SRL Total Number (% of Policies)
Central	21,189	*541 (2.55%)*	66 (0.31%)
Southern	*2,823*	*140 (4.96%)*	9 (0.32%)
Western	*720*	*87 (12.08%)*	11 (1.53%)
Upper Eastern Shore	*5,996*	*125 (2.08%)*	9 (0.15%)
Lower Eastern Shore	*34,630*	*257 (0.74%)*	11 (0.03%)

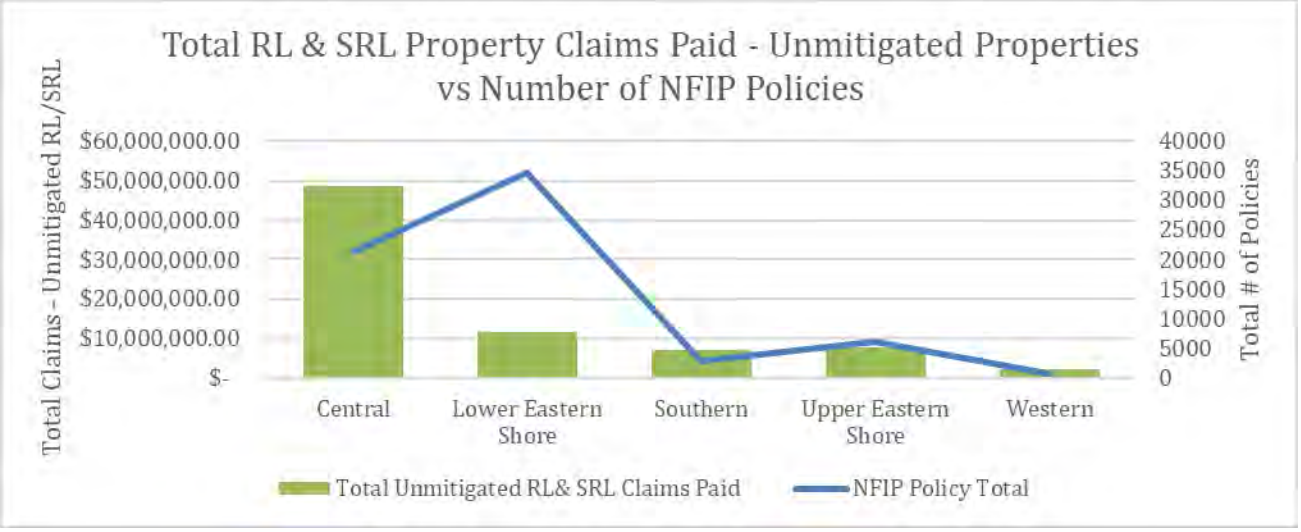


Figure 7-7: NFIP Unmitigated RL & SRL Claims Data by Region

7.3 Repetitive Loss and Severe Repetitive Loss Mitigation Goal and Mitigation Actions

RL and SRL Goals are included in Section 4 – Mitigation Strategies. Please refer to Section 4 for a discussion of specific RL and SRL Goals and mitigation actions.

The State of Maryland recognizes that acquisition and elevation by themselves will not holistically address the RL/SRL property situation. For long-term mitigation, it is not sufficient to address only the properties currently on the RL/SRL list; the state and jurisdictions also need to take actions to minimize additional properties from future classification as RL or SRL. To that end, the state is focusing on providing tools and resources that will help identify areas that are prone to higher volumes of RL/SRL properties. For example, development of statewide climate change models will produce data that jurisdictions can use to identify hot spots for increased flooding and targeted mitigation to minimize those hot spots.

In advancing the mission of providing tools and resources to county and local jurisdictions so that they can mitigate RL properties in the manner that best meets their individual community needs, the State of Maryland is undertaking multiple efforts. A summary of key actions includes:

- MDE is working with communities across the state to connect communities interested in acquisition/demolition to The Buy-In Community Planning, Inc (https://buy-in.org/). This group is a not-for-profit organization focused on working with individuals, local organizations, and governments to identify holistic solutions to flood risks.
- MEMA continues to assist jurisdictions with identifying asset-based and community-based projects to reduce high-hazard areas of repeated flooding.

- MEMA, MDE, and MIA co-hosted a Flood Insurance Roundtable on May 8, 2019, to spread awareness regarding flood insurance with local communities and real estate agencies.
- MEMA and MDE are engaging with flood risk professionals from across the state through professional organizations such as MAFSM on the RL/SRL strategy. As part of this plan development, MEMA presented to and obtained input on the 2021 RL/SRL strategy from MAFSM in February 2021. An overarching component of this strategy is to engage with the flood risk professionals on a yearly basis to review progress on actions to reduce the impacts of repetitive flooding and identify new concerns, trends, and support needs.

SUCCESS of CFMGP

SINCE INCEPTION, THE CFMGP HAS ACQUIRED 400+ FLOOD-PRONE PROPERTIES

FOR MORE INFORMATION:

Https://mde.maryland.gov/programs/water/floodhazardmitigation/pages/floodmgmt.aspx

- In January 2021, MDE released the Maryland Climate Ready Action Boundary (CRAB). This data layer communicates risk (and resiliency) to anyone adjacent to a coastal floodplain (https://mdfloodmaps.net/CRAB/). The CRAB contains a statewide digital elevation model that can be accessed by individuals, planners, engineers, etc. Using this newly available data, jurisdictions will be able to obtain the ground elevation of a RL or SRL structure. This provides a base layer of information that jurisdictions can build from, estimating the FEMA Flood Elevation, through quick site visits to the structure, as well as estimating the depth of flooding at the structure. With the estimated depth of flooding (for a 0.2 percent annual chance event), a community could prioritize mitigation of RL and SRL properties by the potential depth of flooding at the structure, and not just historical claims data and can be used to develop a rough estimate of future loss calculation (savings to the NFIP and the community), supporting benefit-cost calculations for grant funding.

7.4 Repetitive Loss and Severe Repetitive Loss Funding Sources

The NFIP is continually faced with the task of paying claims while trying to maintain affordable flood insurance premiums. The program continues to struggle to reach solvency mainly due to repetitive loss properties. FEMA reported that repetitive loss properties represent only 1 percent of all flood insurance policies yet result in nearly 25 to 30 percent of all flood claims.

Mitigation of flood risk to RL properties will reduce the overall costs to the NFIP as well as to individual property owners. Accordingly, over the years, Congress has created a variety of funding sources to help RL property owners reduce their exposure to flood damage. Additional sources of funding for flood risk mitigation at

the community level can come from the FMA program, as well as the newly launched BRIC program and are offered on an annual basis from FEMA's HMA Division. Should a disaster occur within the state, with a Presidential declaration made, funding for flood risk mitigation can also be sought via FEMA's post-disaster HMGP.

The State of Maryland established its own grant program to address flood management in 1976. The program, the CFMGP, is a program administered by the MDE, in close coordination with MEMA, and can be used to address RL and SRL properties through flood control projects, acquisition of flood-damaged owner-occupied dwellings, and/or elevation and relocation of homes. The program can be used in concert with federal mitigation funding, such as BRIC or HMGP, or by itself. When used by itself, the cost share is 75/25, state/local participation.

To achieve community-wide mitigation of RL and SRL properties, funding from a single source is typically insufficient. To that end Maryland MAC member, MES, maintains a database of over 250 grant funding programs/sources available to jurisdictions in the state. These programs are federal, state, and philanthropic programs, each with their own set of unique requirements. Not all are applicable to RL and SRL properties, but many are and can be coupled with FEMA grant programs to achieve measurable success. The database is available at the Maryland Resiliency Partnership website (https://resiliencypartnership.com/).

7.5 Repetitive Loss and Severe Repetitive Loss Prioritization

Prioritization of RL and SRL Goals and mitigation actions is included in Chapter 4 – Mitigation Strategies. Please refer to Section 4 for discussion on RL and SRL Goals and mitigation actions.

Section 8: List of Appendices

The following list identifies all the Appendices that have been referenced by the Plan narrative. These Appendices will be available on the MEMA State Hazard Mitigation Plan website.

8.1 Appendices List

Appendix A – Plan Update Schedule

Appendix B – Outreach and Meeting Materials

Appendix C – Dam Safety Addendum

Appendix D – Regional Hazard Maps

Appendix E – Mitigation Action Worksheets and Past Action Status Forms

Appendix F – MEMA Grants Management SOP

Appendix G – Local Jurisdiction Plan Reporting

Appendix H – State Assets Maps

Appendix I – Critical Facilities Maps

Appendix J – Risk Assessment Data Tables

Appendix K – Risk Assessment Maps

Appendix L – Flood Risk Reports

Appendix M – Maryland Integrated Preparedness Programmatic Process & Assessment Cycle

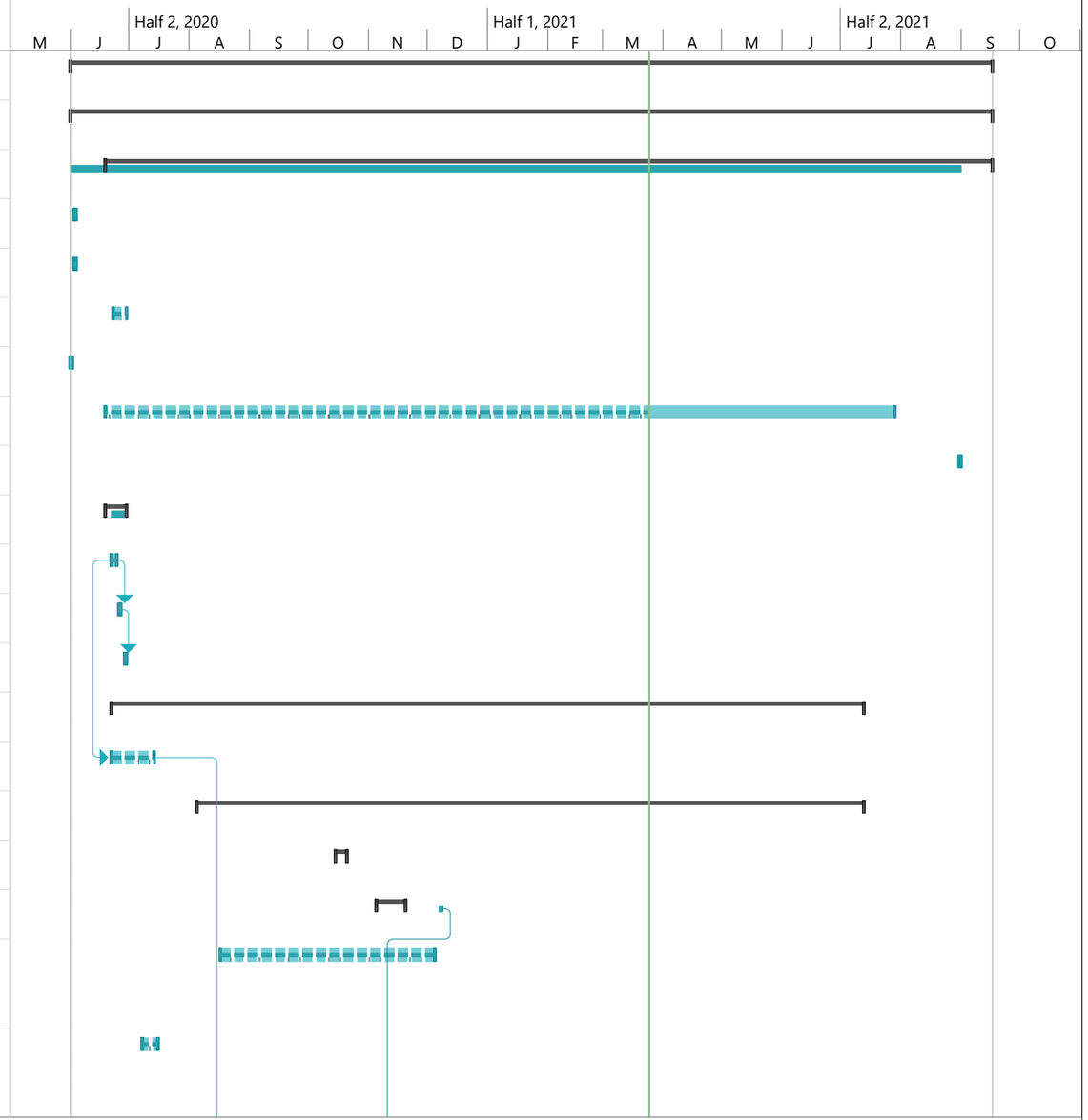
APPENDIX A

Plan Update Schedule

This Appendix contains the overall Microsoft Project Schedule and Gantt Chart for the Maryland State Hazard Mitigation Plan Update process. This process began in early 2020, convening the MAC and the Steering Committee and concluded with the plan submission to FEMA Region III in August 2021.

MD SHMP UPDATE
Project Schedule

ID	Task Mode	WBS	Task Name	% Comple	Duration	Start	Finish	Predecesso
1		**1**	**<New Summary Task>**	**62%**	**473 days**	**Mon 6/1/20**	**Thu 9/16/21**	
2		**1.1**	**<New Summary Task>**	**62%**	**473 days**	**Mon 6/1/20**	**Thu 9/16/21**	
3		**1.1.1**	**Task 1 - Project Management**	**62%**	**455 days**	**Fri 6/19/20**	**Thu 9/16/21**	
4		1.1	Kick off Meeting	100%	1 day	Wed 6/3/20	Wed 6/3/20	
5		1.2	Obtain Data from 2016 SHMP from MES/MEMA	100%	1 day	Wed 6/3/20	Wed 6/3/20	
6		1.3	Draft PWP	100%	5 days	Tue 6/23/20	Mon 6/29/20	
7		1.4	Google Drive	100%	1 day	Mon 6/1/20	Mon 6/1/20	
8		1.5	Monthly PM Duties	61%	325 days	Fri 6/19/20	Wed 7/28/21	
9		1.6	Closeout Meeting	0%	1 day	Tue 8/31/21	Tue 8/31/21	
10		**2**	**Task 2 - Review 2016 SHMP / Gap Analysis**	**100%**	**7 days**	**Fri 6/19/20**	**Mon 6/29/20**	
11		2.1	Review 2016 SHMP & Perform GAP Analysis	100%	3 days	Mon 6/22/20	Wed 6/24/20	
12		2.2	Review GAP Analysis w MES/MEMA	100%	1 day	Fri 6/26/20	Fri 6/26/20	11
13		2.3	Finalize GAP Analysis	100%	1 day	Mon 6/29/20	Mon 6/29/20	12
14		**3**	**Task 3 - Planning Process**	**100%**	**386 days**	**Mon 6/22/20**	**Mon 7/12/21**	
15		3.1	Outreach Strategy	100%	16 days	Mon 6/22/20	Mon 7/13/20	11SS
16		**3.2**	**Steering Committee Meetings (5) (Quarterly)**	**100%**	**342 days**	**Wed 8/5/20**	**Mon 7/12/21**	
22		**3.3**	**Regional Meetings (5) - HIRA Update**	**100%**	**6 days**	**Thu 10/15/20**	**Tue 10/20/20**	
28		**3.4**	**Regional Meetings (5) - Mitigation Strategy**	**100%**	**11 days**	**Thu 11/5/20**	**Thu 11/19/20**	
34		3.5	Data Collection (Development of Input Collection Mechanisms)	100%	80 days	Mon 8/17/20	Fri 12/4/20	
35		3.6	Develop Web Content	100%	6 days	Wed 7/8/20	Wed 7/15/20	

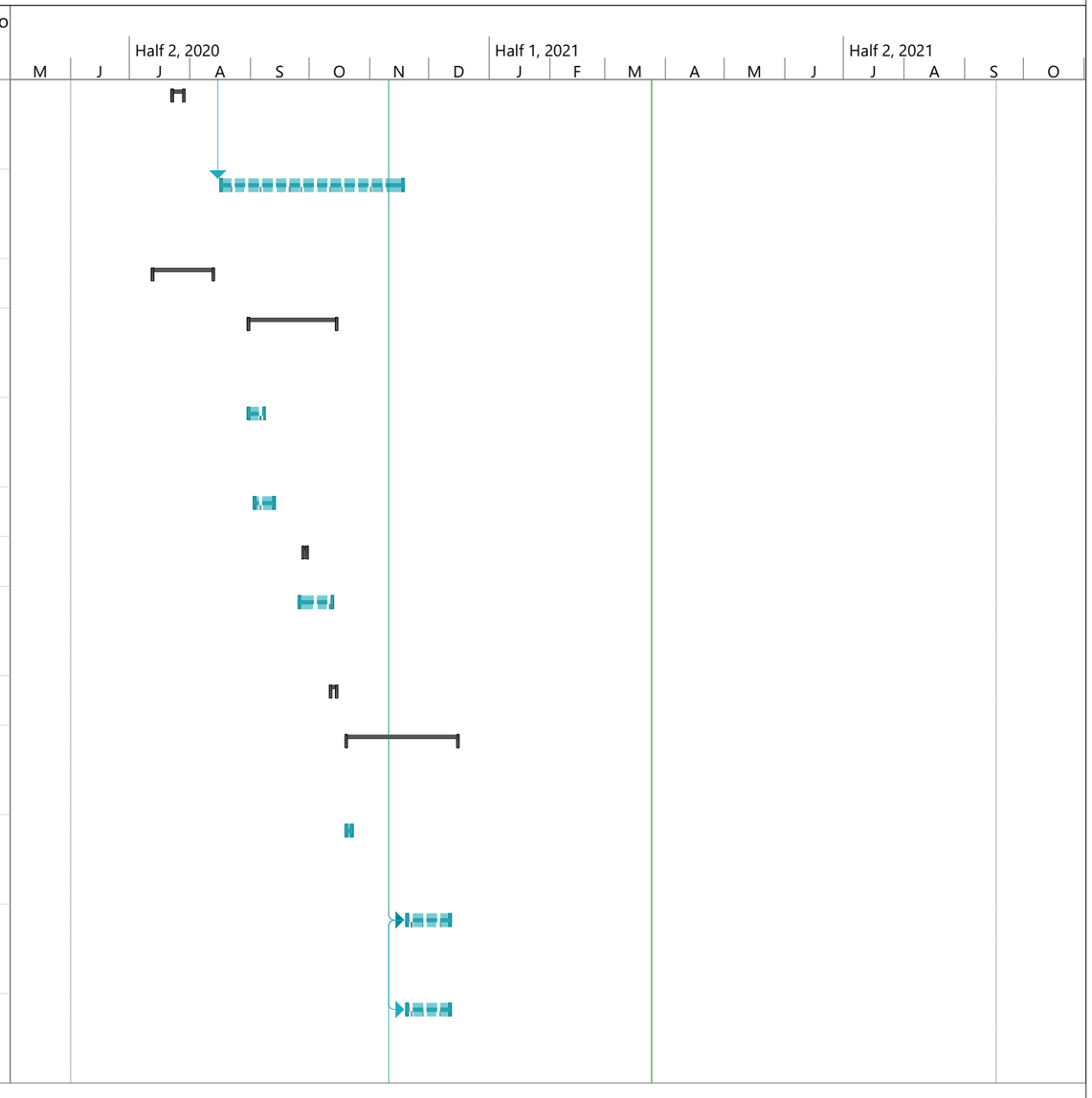


Project: MEMA SHMP Project 2
Date: Thu 3/25/21

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

MD SHMP UPDATE
Project Schedule

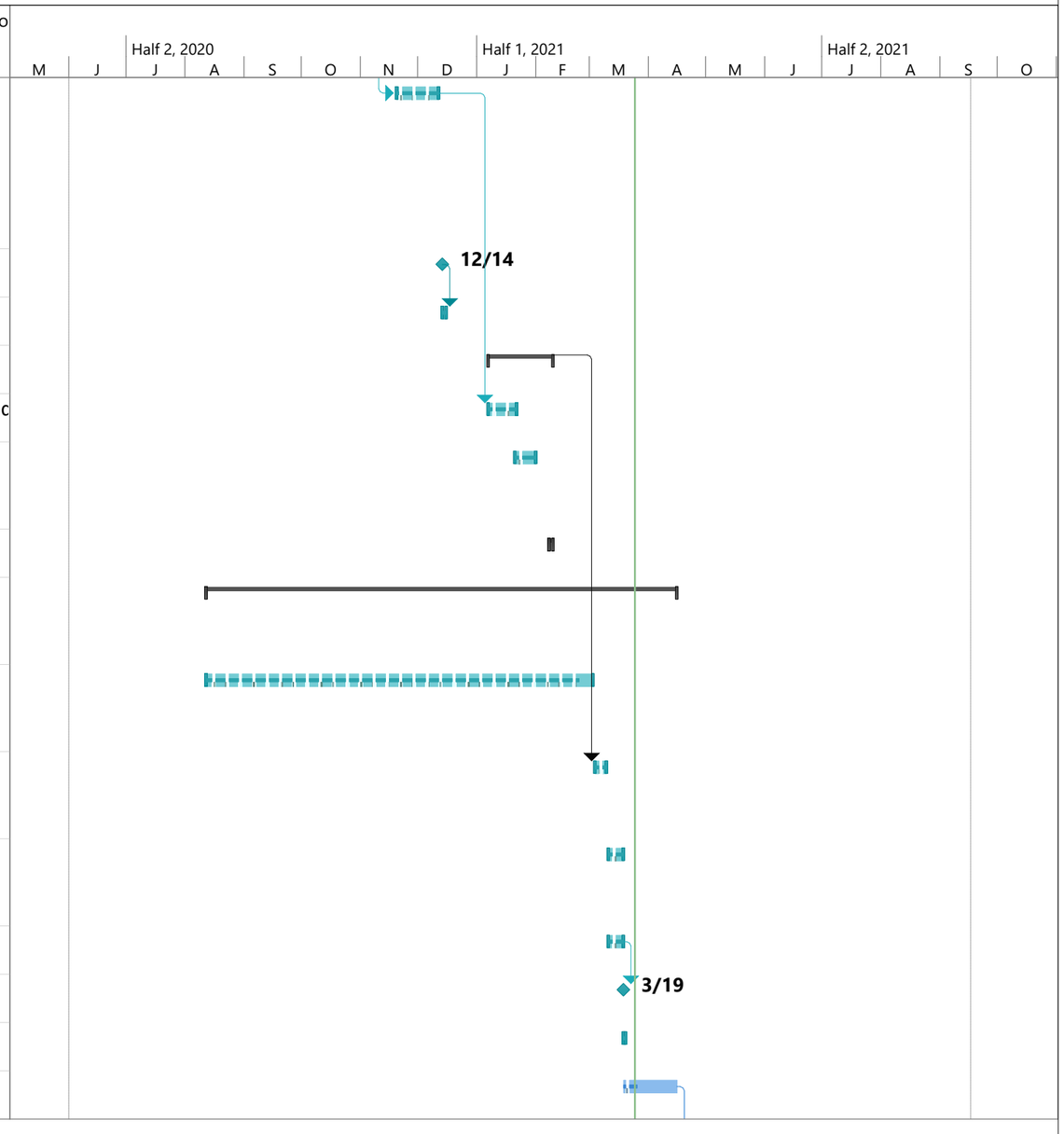
ID	Task Mode	WBS	Task Name	% Comple	Duration	Start	Finish	Predecesso
36		**3.7**	**Demographic, Sociioeconimic & Land Development Review & Analysis - Review & Update**	**100%**	**6 days**	**Thu 7/23/20**	**Tue 7/28/20**	
40		3.8	Develop Social Media Content	100%	69 days	Mon 8/17/20	Tue 11/17/20	15
41		**3.9**	**Capability & Resource Review & Update**	**100%**	**31 days**	**Mon 7/13/20**	**Wed 8/12/20**	
45		**4**	**Task 4 - Hazard Identification & Risk Assessment**	**100%**	**45 days**	**Mon 8/31/20**	**Wed 10/14/20**	
46		4.1	Update Hazard Identification Section	100%	6 days	Mon 8/31/20	Mon 9/7/20	
47		4.2	Update 8 Hazard Risk Profiles	100%	8 days	Thu 9/3/20	Sat 9/12/20	
48		**4.3**	**Create 5 New Hazard RIsk Profiles**	**100%**	**2 days**	**Mon 9/28/20**	**Tue 9/29/20**	
51		4.4	Update Vulnerability Assessment for 8 Existing Hazards	100%	12 days	Sat 9/26/20	Mon 10/12/20	
52		**4.5**	**Create Vulnerability Assessment for 5 New Hazards**	**100%**	**3 days**	**Mon 10/12/20**	**Wed 10/14/20**	
55		**5**	**Task 5 - Development of Mitigation Strategy**	**100%**	**57 days**	**Tue 10/20/20**	**Tue 12/15/20**	
56		5.1	Review & Confirm State Mitigation Goals	100%	3 days	Tue 10/20/20	Thu 10/22/20	
57		5.2	Update Mitigation Action Development (Based on meetings)	100%	16 days	Fri 11/20/20	Fri 12/11/20	28
58		5.3	Update Mitigation Implementation Strategy Sheets (and create new)	100%	16 days	Fri 11/20/20	Fri 12/11/20	57SS



Project: MEMA SHMP Project 2
Date: Thu 3/25/21

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

ID	Task Mode	WBS	Task Name	% Comple	Duration	Start	Finish	Predecesso
59		5.4	Update Mitigation Implementation Status Report (Complete, No Longer Applicable, New Actions) (MEMA/MES to provide data on status)	100%	16 days	Fri 11/20/20	Fri 12/11/20	57SS
60		5.5	Draft Mitigation Strategy	100%	0 days	Mon 12/14/20	Mon 12/14/20	
61		5.6	MEMA/MES Draft Review of Section	100%	2 days	Mon 12/14/20	Tue 12/15/20	60
62		**6**	**Task 6 - Repetitive Loss Strategy**	**100%**	**34 days**	**Thu 1/7/21**	**Tue 2/9/21**	
63		6.1	Update RL & SRL Data by Jurisdiction	100%	11 days	Thu 1/7/21	Thu 1/21/21	59FS+18 d
64		6.2	Update NFIP Policies & Projected Refined Losses per Jurisdiction	100%	8 days	Thu 1/21/21	Sun 1/31/21	
65		**6.3**	**Update Remaining Portion of Section**	**100%**	**2 days**	**Mon 2/8/21**	**Tue 2/9/21**	
68		**7**	**Task 7 - Draft Plan**	**85%**	**247 days**	**Wed 8/12/20**	**Thu 4/15/21**	
69		7.1	Incorporate Edits from Tasks 2 - 6	95%	147 days	Wed 8/12/20	Tue 3/2/21	
70		7.2	Review Sections I- VIII (of Plan) against GAP and for completeness	100%	4 days	Thu 3/4/21	Tue 3/9/21	62FS+2 days
71		7.3	Perform Internal Review of Plan using FEMA Guidance	100%	6 days	Thu 3/11/21	Thu 3/18/21	
72		7.4	Address Internal Edits	100%	6 days	Thu 3/11/21	Thu 3/18/21	
73		7.5	Full Draft Plan	100%	0 days	Fri 3/19/21	Fri 3/19/21	72
74		7.5	Submit to MEMA for Review	100%	1 day	Fri 3/19/21	Fri 3/19/21	
75		7.6	MEMA Review	19%	26 days	Fri 3/19/21	Thu 4/15/21	

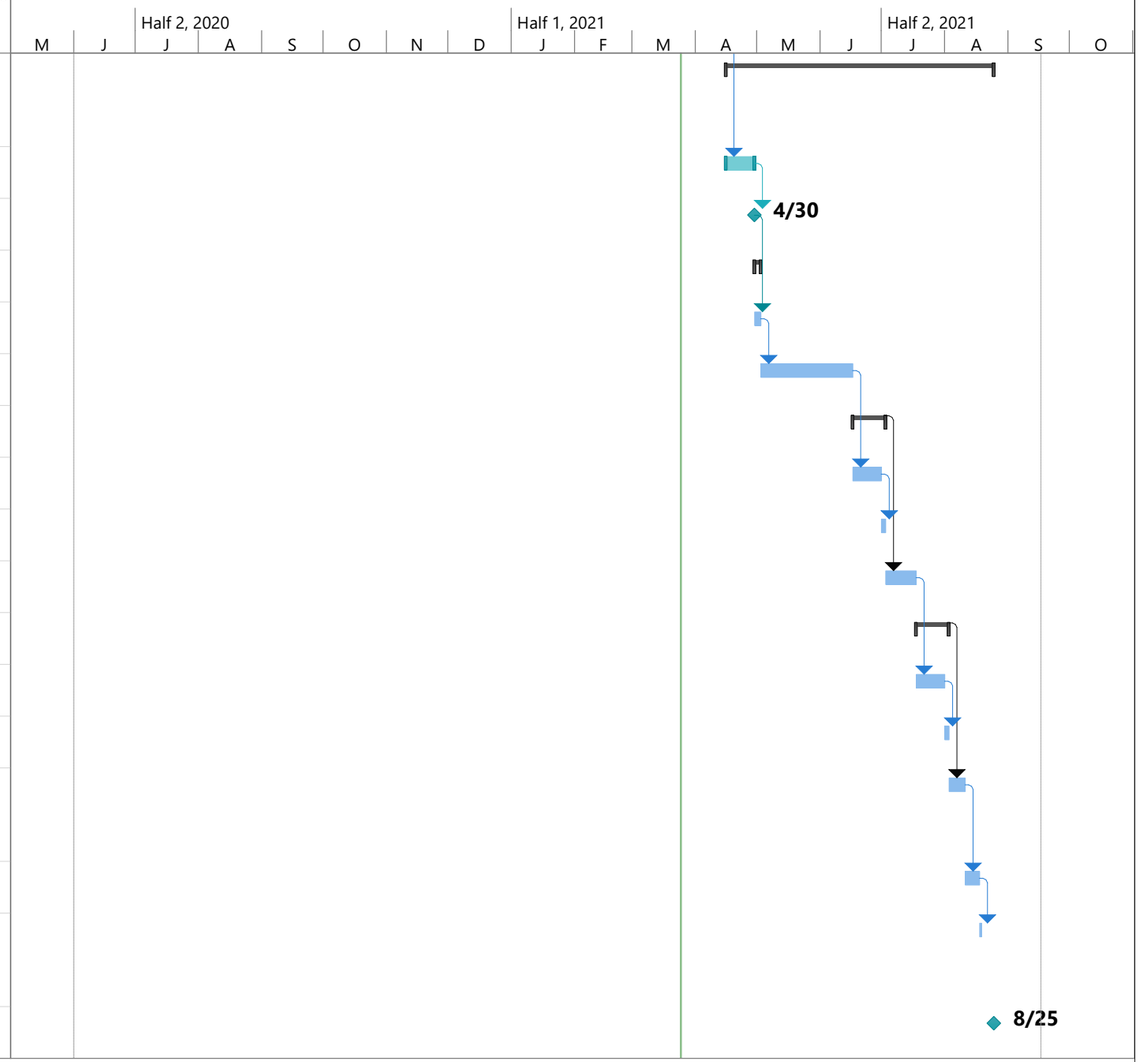


Project: MEMA SHMP Project 2
Date: Thu 3/25/21

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

MD SHMP UPDATE
Project Schedule

ID	Task Mode	WBS	Task Name	% Comple	Duration	Start	Finish	Predecesso
76		**8**	**Task 8 - Final Plan (Submission to MEMA & FEMA, Adoption)**	**0%**	**131 days**	**Fri 4/16/21**	**Wed 8/25/21**	
77		8.1	Finalize & Incorporate MEMA Edits & Print Plan	0%	14 days	Fri 4/16/21	Thu 4/29/21	75
78		8.2	Submit Final Draft Plan to State	0%	0 days	Fri 4/30/21	Fri 4/30/21	77
79		**8.3**	**MEMA Prep to FEMA**	**0%**	**3 days**	**Fri 4/30/21**	**Sun 5/2/21**	
80		8.3	Final Draft SHMP to FEMA	0%	3 days	Fri 4/30/21	Sun 5/2/21	78
81		8.4	FEMA Review #1	0%	45 days	Mon 5/3/21	Wed 6/16/21	80
82		**8.5**	**Address FEMA Round 1 Comments**	**0%**	**16 days**	**Thu 6/17/21**	**Fri 7/2/21**	
83		8.5.1	Address FEMA Comments & Print	0%	14 days	Thu 6/17/21	Wed 6/30/21	81
84		8.5.2	Ship	0%	2 days	Thu 7/1/21	Fri 7/2/21	83
85		8.6	2nd FEMA Review	0%	15 days	Sat 7/3/21	Sat 7/17/21	82
86		**8.7**	**Address FEMA Round 2 Revisions to Plan**	**0%**	**16 days**	**Sun 7/18/21**	**Mon 8/2/21**	
87		8.7.1	FEMA Round 2 Revisions Addressed & Print	0%	14 days	Sun 7/18/21	Sat 7/31/21	85
88		8.7.2	Ship Hard copy	0%	2 days	Sun 8/1/21	Mon 8/2/21	87
89		8.6	Submit Final Plan for FEMA Review (Round 3) & APA Notitification	0%	8 days	Tue 8/3/21	Tue 8/10/21	86
90		8.7	State Adoption of Plan	0%	7 days	Wed 8/11/21	Tue 8/17/21	89
91		8.8	State Submittal of Final Plan with Adoption Resolution to FEMA & Agencies	0%	1 day	Wed 8/18/21	Wed 8/18/21	90
92		9	FEMA 2016 Plan EXPIRATION	0%	0 days	Wed 8/25/21	Wed 8/25/21	



Project: MEMA SHMP Project 2
Date: Thu 3/25/21

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

APPENDIX B
Outreach and Meeting Materials

This page left blank intentionally

Stakeholder Participation

The information contained in this Appendix provides a snapshot of participation and input received for this Plan Update.

MD HMP Stakeholder Participation Tracker – March 2, 2021

Stakeholders	HIRA Meeting	Mitigation Meeting	Questions/ Worksheet	Survey	Past Actions Status	Hazard Ranking	Identified Hazard Areas/ Maps	Reviewed Draft Plan
State Departments								
MEMA	X	X	N/A	N/A		N/A	N/A	
MDE	X	X		X	X	N/A	N/A	
MHT		X	X	X	X	N/A	N/A	
MDP	X	X	X	X	X	N/A	N/A	
MD DNR	X			X	X	N/A	N/A	
DNR - CAC	X		X	X	N/A	N/A	N/A	
MD SHA					X	N/A	N/A	
MTA					X	N/A	N/A	
MDOT	X	X			X	N/A	N/A	
DoIT					N/A	N/A	N/A	
DLLR	X			X	N/A	N/A	N/A	
MD General Services		X			N/A	N/A	N/A	
MD Geological				X	N/A	N/A	N/A	
MD Commerce	X	X	X	X	N/A	N/A	N/A	
DHS	X	X			N/A	N/A	N/A	
CBP						N/A	N/A	
MES	X	X				N/A	N/A	
MD Insurance	X	X			N/A	N/A	N/A	
DHCD	X				N/A	N/A	N/A	
MDHS	X				N/A	N/A	N/A	
Preservation Maryland					N/A	N/A	N/A	
Jurisdictions/Counties								
Allegany	X			X	N/A	X	X	
City of Annapolis	X	X	X	X	N/A	X		
Anne Arundel	X	X	X	X	N/A	X	X	
Baltimore					N/A			
Baltimore City	X		X	X	N/A	X		
Calvert	X	X	X	X	N/A	X		
Caroline		X	X	X	N/A	X		

Stakeholders	HIRA Meeting	Mitigation Meeting	Questions/ Worksheet	Survey	Past Actions Status	Hazard Ranking	Identified Hazard Areas/ Maps	Reviewed Draft Plan
Carroll	X		X		N/A			
Cecil		X	X	X	N/A	X	X	
Charles	X		X		N/A			
Dorchester	X	X	X		N/A		X	
Frederick					N/A			
Thurmont	X		X	X	N/A	X		
Garrett				X	N/A	X	X	
Harford	X			X	N/A	X		
Howard	X	X	X	X	N/A	X	X	
Kent	X	X	X	X	N/A	X	X	
Montgomery				X	N/A	X		
Town of Ocean City				X	N/A	X		
Prince George's	X		X	X	N/A	X		
Laurel	X		X	X	N/A	X		
Queen Anne's		X	X	X	N/A	X		
St. Mary's		X	X	X	N/A	X	X	
Somerset				X	N/A	X	X	
Talbot			X	X	N/A	X	X	
Washington			X	X	N/A	X	X	
Wicomico			X		N/A			
Worcester			X	X	N/A	X		
Universities/Institutions								
Towson University					N/A	N/A		
UMD Sea Grant					N/A	N/A		
Salisbury University					N/A	N/A		
Federal Agencies/Regional Partners								
USACE Silver Jackets			N/A	N/A	N/A	N/A	N/A	
EPA			N/A	N/A	N/A	N/A	N/A	
NWS/NOAA			N/A	N/A	N/A	N/A	N/A	
FEMA	X	X	N/A	N/A	N/A	N/A	N/A	
NPS			N/A	N/A	N/A	N/A	N/A	
USDA – USFS	X		N/A	N/A	N/A	N/A	N/A	
WSSC			N/A	N/A	N/A	N/A	N/A	

Stakeholders	HIRA Meeting	Mitigation Meeting	Questions/ Worksheet	Survey	Past Actions Status	Hazard Ranking	Identified Hazard Areas/ Maps	Reviewed Draft Plan
NIST – Research Team			N/A	N/A	N/A	N/A	N/A	
Non Profits/NGOs								
Chesapeake Bay Trust					N/A	N/A		
Eastern Shore Land Conservancy					N/A	N/A		
The FEWSS Project					N/A	N/A		
Maryland VOAD					N/A	N/A		
The Nature Conservancy					N/A	N/A		

Additional Stakeholder Meetings

2018 - 2021

This page left blank intentionally

Additional Stakeholder Meetings

Throughout the 2021 planning cycle Maryland state mitigation representatives participated in numerous stakeholder meetings to discuss hazards, mitigation efforts, and future strategies. A summary of these meetings is presented below.

Table B-1: Additional Stakeholder Meetings

Date	Type of Outreach	Participants/Partners	Purpose
6-6-18	MAFSM Spring Event 2018	Floodplain and Stormwater Professional	Overview of Mitigation Branch, FEMA HMA Grants, and 2016 SHMP
8-7-18 to 8-9-18	Floodproofing Workshop	UASCE, MDE, MHT, Public	Overview of Mitigation Branch and FEMA HMA Grants
8-29-18	2018 Risk Reduction Consultation	Federal, State, and selected local stakeholders	Develop Statewide risk reduction goals and review implementation of 2016 SHMP.
9-5-18 to 9-6-18	FEMA G-318 Course	Local Jurisdictions	Planning Course
9-27-18	FEMA G-318 Course	Local Jurisdictions	Planning Course
11-8-18	14th Annual MAFSM Conference	Floodplain and Stormwater Professional	Overview of Mitigation Branch and FEMA HMA Grants
11-19 to 11-20-18	G393 Mitigation for Emergency Managers	Local Jurisdictions	Planning Course
11-13-19	ALEMD Quarterly Meeting	Local Jurisdictions	Present State Ranking Criteria for FEMA HMA grants and provide opportunity for ALEMD to provide feedback.
11-30-18	Hazard Mitigation Technical Assistance Workshop	Local Jurisdictions/HMA Sub-applicants	Increased knowledge of HMA application components for successful app development
12-13-18	MD CRS Workshop	Local Jurisdictions and State partners	Overview of Mitigation Branch and FEMA HMA Grants, Overlap of CRS and HM Planning
1-10-19	Mitigation Advisory Committee Meeting	State Partners	Review FEMA HMA applications
3-13-19	EPA National Estuaries Program 2019 Training Workshop	Federal and State partners	Presented on integrating GI into hazard mitigation planning
3-14-19	CBT Lessons Learned on Integrating Water Quality and Nature Based Approaches into HMP	Grantors	Presented on integrating GI into hazard mitigation planning

Date	Type of Outreach	Participants/Partners	Purpose
4-4-19	HMA Stakeholder Presentation	Local and Federal Partners	Overview of Mitigation Branch and FEMA HMA Grants. MEMA Solicitation and Review process.
4-30-19, 5-1-19, 5-9-19, 5-10-19	Mitigation Workshops	Local and State Partners	Overview of Mitigation Branch and FEMA HMA Grants. Overview of other State mitigation focused grants at MDE and DNR.
5-22-19	Mitigation Advisory Committee Meeting	State Partners	Review FEMA HMA applications
5-29-19	MDEMA Symposium: Mitigating Against the Impacts of Sea Level Rise in Your Community	State and Local partners	Overview of Mitigation Branch and FEMA HMA Grants; incorporating climate change impacts into hazard mitigation planning.
5-31-19	MDEMA Symposium	State and Local partners	Mock Disaster Service Center
6-19-19	MAFSM Spring Event 2019	Floodplain and Stormwater Professional	Overview of Mitigation Branch, FEMA HMA Grants, and 2016 SHMP
6/25/2020	SCF Leadership Meeting	State Partners	Education and awareness for State mitigation initiatives, partnership building, and P3 potential under BRIC.
7/31/19	2019 Maryland Risk Reduction Consultation	Federal, State, and selected local stakeholders	Develop Statewide risk reduction goals and provide an opportunity for engagement in the 2021 SHMP planning process.
8-12 & 8-13-19	MD Plan Implementation and Grant Development Workshop	Local/state/Federal partners	Overview of HMA, Federal and State Mitigation processes, implementing local hazard mitigation plans.
9-10-10 and 9-11-19	BCA Training	Local partners	FEMA BCA training to increase capabilities required for HMA subapplications.
9-12-19	FY 19PDM/FMA Technical Assistance Refresher Workshop	Local partners	Overview of Mitigation Branch with specific information on sub-application development for FEMA FY19PDM-FMA Grants
9-21-19	Anne Arundel Co. Preparedness Expo	Local and the public	Educated public on flood reduction measures and risk reduction projects
9-28-19	Prince George's Preparedness Month Summit	Local and the public	Educated public on flood reduction measures and risk reduction projects

Date	Type of Outreach	Participants/Partners	Purpose
11-7-19	MAFSM Annual Conference	Floodplain and Stormwater Professional	Provide information on mitigation planning and project implementation.
01-07-19	Mitigation Advisory Committee Meeting	State Partners	Review FEMA HMA applications
01-28-20	PSIP Summit	Private Sector Partners	Education and awareness for State mitigation initiatives, partnership building, and P3 potential under BRIC.
6-16-20	MEMA Quarterly Subrecipient Webinar dedicated to Planning SOW Development	State Partners	Capability building for developing SOW for local HMPs.
6-17-20	MAFSM Spring Conference	Floodplain and Stormwater Professional	Provide information on mitigation planning and opportunity for engagement in 2021 SHMP planning process.
7-10-20	2020 Risk Reduction Consultation	Federal, State, and selected local stakeholders	Develop Statewide risk reduction goals and provide an opportunity for engagement in the 2021 SHMP planning process.
10-27-20	MD Green Infrastructure and Hazard Mitigation Planning Workshop	Federal, State, and Local flood risk and water quality professionals.	Capability building for integrating green infrastructure, water management, and hazard mitigation planning.
11-6-20	MAFSM Annual Conference	Floodplain and Stormwater Professional	Provide information and opportunity for engagement in 2021 SHMP planning process.
11-12-20	American Council of Engineering Companies- MD Environmental Forum	Engineers	Provide information on mitigation planning and opportunity for engagement in 2021 SHMP planning process.
01-26-21	Building a climate-resilient Maryland together	Resilience Professional across all sectors	Partnership building and knowledge exchange
02-24-21	MAFSM Lunch and Learn State Repetitive Loss Strategy	Floodplain and Stormwater Professional	Review the 2021 Repetitive Loss Strategy for the SHMP.
03-05-21	Private Sector Integration Meeting	Private Sector	To provide an overview of the planning process, HIRA, and NGS focused mitigation actions for input from the private sector

This page left blank intentionally

Steering Committee Membership list

This page left blank intentionally

Mitigation Advisory Committee Member
MEMA Employee

Sector	Representative	Agency	Title	Email	Representative	Agency	Title	Email
Emergency Management	**Representative**	**Agency**	**Title**	**Email**	**Representative**	**Agency**	**Title**	**Email**
Regional Emergency Management Associations	Joe Theobald	MD Emergency Management Association	President					
Police and fire protection agencies	Sgt. Travis Nelson	Maryland State Police/MEMA	Liaison Officer	travis.nelson@maryland.gov				
University and Colleges								
Amateur Radio Emergency Services (ARES)								
Nat'l. Emergency Management Assoc. Mitigation Committee	Russ Strickland	MEMA	Executive Director/Co-Chair NEMA Resiliency Committee	russ.strickland@maryland.gov	JaLeesa Tate	MEMA	SHMO/Chair NEMA SHMO Subcommittee	jaleesa.tate@maryland.gov
Economic Development								
Department of Commerce	Tim LaValle	Commerce	Director, Office of General Services	timothy.lavalle@maryland.gov				
State Insurance Administration	Joy Hatchette	Insurance	Associate Commissioner for Consumer Education and Advocacy	joy.hatchette@maryland.gov				
Small Business Administration (SBA)	Jessica Nusbaum	MEMA	State IA Officer and Community Preparedness Coordinator	jessica.nusbaum@maryland.gov				
Economic Development Corporations								
Regional economic employers								
State Chambers of Commerce								
Education institutions								
Private Sector	Allegra Tartaglia	MEMA	Private Sector Liaison & Preparedness Specialist	allegra.tartaglia@maryland.gov				
Agriculture	Jason Keppler	Maryland Department of Agriculture	Watershed Implementation Program Administrator	jason.keppler@maryland.gov				
Land Use and Development								
Planning Department	Jesse Ash	Department of Planning	Senior Planner	jesse.ash@maryland.gov				
Land trust groups	Jim Bass	Eastern Shore Land Conservancy	Coastal Resilience Program Manager	jbass@eslc.org				
American Planning Association (APA) State Chapter								
Housing								
Inspection and Code Authorities	Norman Wang	Department of Labor, Licensing & Regulatio	Director, Building Codes Administration	norman.wang1@maryland.gov				
Housing & Community Development Authorities	Cindy Stone	DHCD	Director, Community Development Programs	cindy.stone@maryland.gov	Jack Daniels	DHCD		jack.daniels2@maryland.gov
	Sara Luell	DHCD	Director of Communications	sara.luell@maryland.gov				
National Builder Groups								
National Association of Realtors								
National Association of Professional Insurance Agents								
American Planning Association (APA) State Chapter								
Health and Social Services								
Public health	Sara Barra	Health	Emergency Operations Manager, OPPR	sara.barra@maryland.gov				
Human Services	Bethany Brown	Department of Human Services		bethany.brown@maryland.gov				
Aging	Cee Cee Molineaux	Department of Aging	Special Assistant					
Developmental disabilities	Cecilia Warren	Maryland Department of Disabilities	Director of Preparedness	cecilia.warren@maryland.gov				
Education								
Volunteer Organizations Active in Disaster (VOAD)	Jessica Nusbaum	MEMA	State IA Officer and Community Preparedness Coordinator	jessica.nusbaum@maryland.gov				
Red Cross								
Community Emergency Response Team (CERT)	Tasha McNutt	MEMA	Communications & Outreach Specialist	tasha.mcnutt@maryland.gov				
Hospitals								
Schools	Kate Hession	MD Center for School Safety	Executive Director	kate.hession1@maryland.gov				
Infrastructure								
Transportation Departments	Mark Harris	Transportation	Emergency Planner	mharris@mdot.state.md.us				
Port Authorities	Jill Lemke	Transportation, Port Authority	Manager of Strategic Planning and Special Projects	jlemke@marylandports.com				
Water & Wastewater Authorities								
American Council of Engineering Companies (ACEC)								
American Society of Civil Engineers (ASCE)								
American Public Works Association (APWA)								
U.S. Coast Guard and Army Corps of Engineers	Stacey Underwood	USACE	Silver Jackets Coordinator	STACEY.M.UNDERWOOD@usace.army	Jason Stick	USACE		Jason.T.Stick@usace.army.mil
Energy Administrations & Rural Electric Cooperatives	Caitlin Madera	Maryland Energy Administration	Energy Program Manager	caitlin.madera@maryland.gov				
General Services	Jennifer Edwards	General Services	Director of Emergency Management	jennifer.edwards1@maryland.gov				
Natural and Cultural Resources								
Historic Societies (SHPO)	Steven Allan	Historic Trust		steven.allan@maryland.gov	Elizabeth Hughes	Historic Trust	Director/SHPO	elizabeth.hughes@maryland.gov
Department of Natural Resources	Sasha Land	Natural Resources	Coastal Planner/Coastal Training Program	sasha.land@maryland.gov				
Department of the Environment	Dave Guignet	Environment	State NFIP Coordinator	dave.guignet@maryland.gov	Kevin Wagner	Environment	Environmental Planner	kevin.wagner@maryland.gov
Department of Parks								
The Nature Conservancy	Kelly Leo	TNC	Resilient Coasts Program Director	kleo@tnc.org				
Watershed Stewardship Programs								
Natural Resource Defense Council (NRDC)								
State Arts Council								
Archeological Associations								

This page left blank intentionally

Steering Committee Meeting Information

This page left blank intentionally

MEMA SHMP 2021 Update Kickoff Meeting

This page left blank intentionally

VIRTUAL 2021 State Hazard Mitigation Plan
Steering Committee Meeting
August 13, 2020
1:00 – 2:00PM

Overall Outcome

- Kick-off for the update to the State's Hazard Mitigation Plan; provide introductions of the planning team; identify the schedule; and outline the roles of the Steering Committee.

Agenda

- Welcome and Introductions
- Overview of Hazard Mitigation Planning Process
- 2021 Update Schedule
- Role of the Steering Committee
    - Steering Committee Meeting dates: October 26, February 1, April 19, and July 12
    - Regional HIRA Meetings (10/14 – 10/21)
    - Regional Mitigation Strategy Meetings (11/16 – 11/23)
- Wrap-up/Questions

Location/Logistics

- LOCATION: Teams Meeting via AECOM

  Join Microsoft Teams Meeting

  +1 443-833-0028 United States, Baltimore (Toll)
  (877) 286-5733 United States (Toll-free)
  Conference ID: 630 264 372#
  Local numbers | Reset PIN | Learn more about Teams | Meeting options
  Join with a video conferencing device
  176484854@teams.bjn.vc VTC Conference ID: 1145173878
  Alternate VTC dialing instructions

- LOGISTICS: This meeting will be recorded for FEMA documentation purposes; Please mute your mics and cameras unless you are speaking and use the "hand raise" feature in Teams.
- Slido Interactive Presentation: Please visit www.slido.com on your mobile device and enter meeting #57191 to participate in the interactive components of the presentation.
- Please note the State-wide Kick-off meeting will immediately follow. While material may be similar, we would like the Steering Committee to attend to hear state-wide concerns and provide support to the Planning Team.

This page left blank intentionally

2021 State of Maryland Hazard Mitigation Plan

JaLeesa Tate, CFM
State Hazard Mitigation Officer
Branch Manager

Hazard Mitigation Planning

Opportunity to identify policies and actions that can be implemented over the long term to reduce risk and future losses from hazards.

- Hazard Identification and Risk Assessment (HIRA)
- Vulnerability Assessment
- Capability Assessment
- Mitigation Strategy

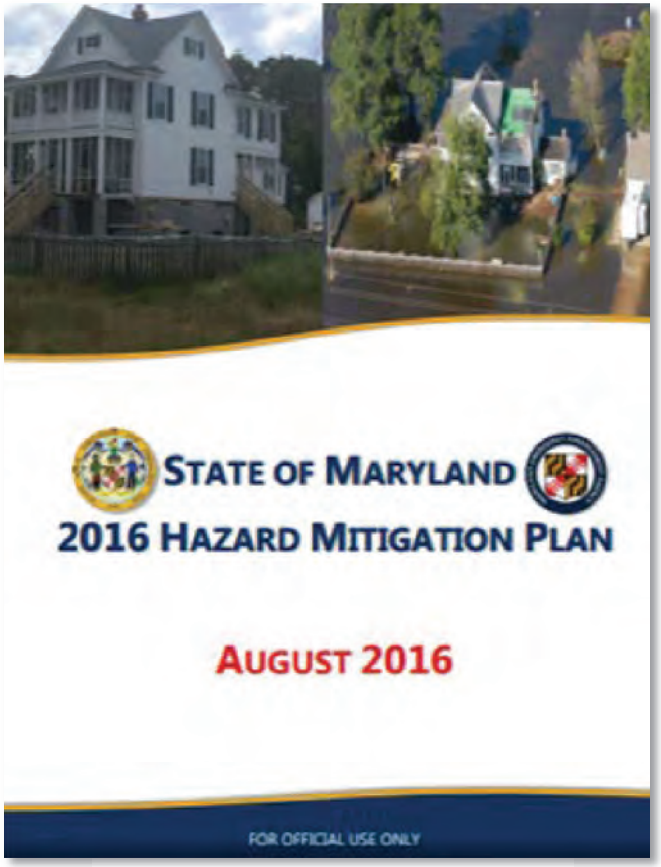
Benefits:

- Increase community awareness and builds buy -in
- Identify capabilities and gaps in order to prioritize actions
- Integrate existing community plans to develop a comprehensive approach
- Minimize future recovery efforts
- Leverage resources
- Break the disaster cycle

Federal Requirements

2016 Plan expires August 26, 2021

- CFR requires States update Plan every 5 years
- CFR requires an active Plan to be eligible for certain Federal disaster assistance

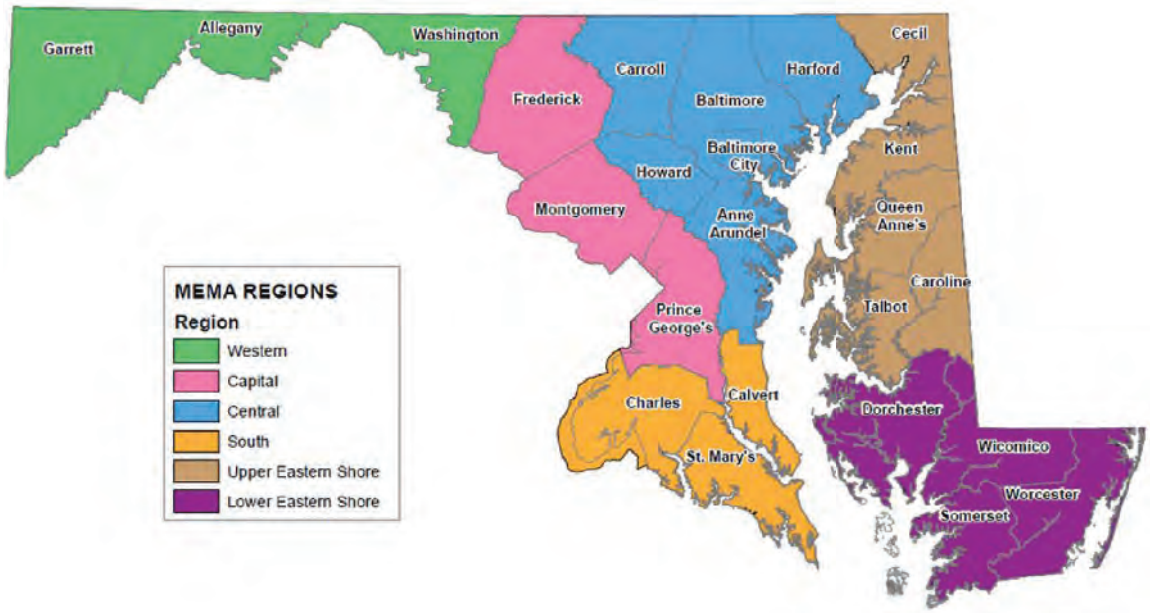


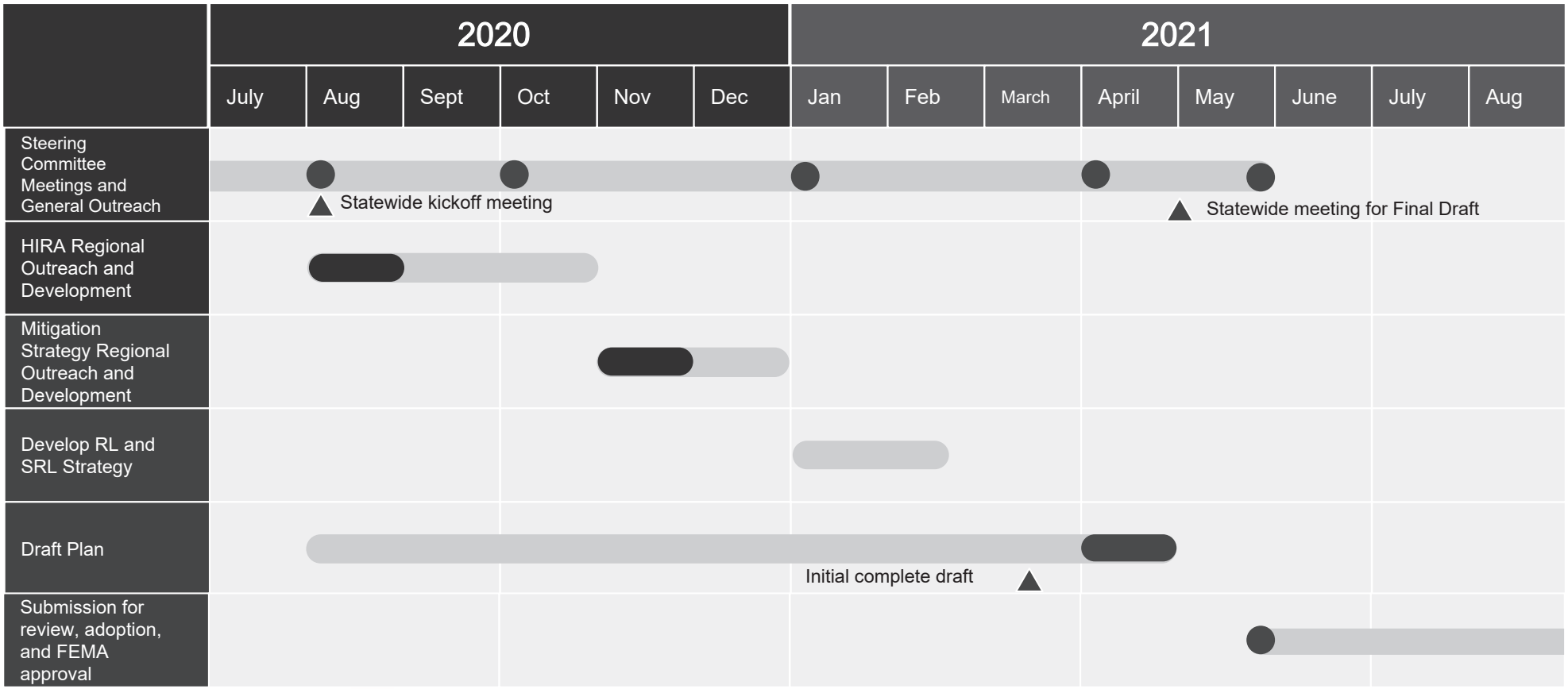
Planning Process

Organize the Planning Process and Resources	Assess Risks and Capabilities	Develop a Mitigation Strategy	Adopt and Implement the Plan
• Planning focus area • Planning team • Stakeholders • Outreach strategy • Opportunities for integration	• Policies, programs, funding, staff, etc. • Historical occurrences • Magnitude • Geographical extent • Future Conditions	• Set goals • Identity actions • Lead agencies for implementation • Prioritize actions	• Identify and obtain funding • Conduct Annual Reviews • Continue to build awareness and buy-in

Organizing the Planning Process and Resources

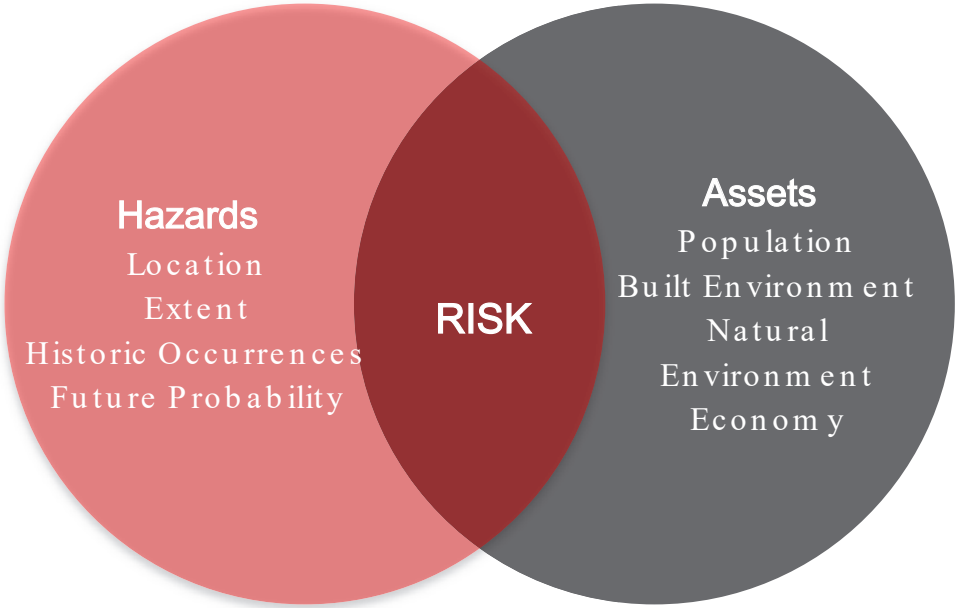
- Steering Committee composed of representatives from the following sectors:
  - Emergency Management
  - Economic Development
  - Land Use and Development
  - Housing
  - Health and Social Services
  - Infrastructure
  - Natural and Cultural Resources
- Stakeholders based on focus areas
- 1 Statewide kickoff meeting
- 10 regional meetings
  - 2 for each MEMA region
- Aiming for Enhanced Plan status




2020
2021
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
May
June
July
Aug
Steering Committee Meetings and General Outreach
Statewide kickoff meeting
Statewide meeting for Final Draft
HIRA Regional Outreach and Development
Mitigation Strategy Regional Outreach and Development
Develop RL and SRL Strategy
Draft Plan
Initial complete draft
Submission for review, adoption, and FEMA approval

Assess Risks and Capabilities

- What hazards impact the community?
- Who and what is vulnerable to those hazards?
- What resources do you have to address these risks?



2016 Existing Hazards

- Coastal Hazards
- Winter Storm
- Tornado
- Wind
- Thunderstorm
- Wildfire
- Drought

2018 New Hazards to be Assessed

- Soil Movement (subsidence, landslides, karst, sinkholes)
- Public Health Emergencies (pandemics, opioids, etc.)
- Dam failure, release, and high hazard dams
- Extreme Temperatures
- Human -caused hazards and threats (terrorism, cyber security, etc.)

Develop a Mitigation Strategy

- Goals: What long term outcomes do you want to achieve?
- Actions: What specific actions will stakeholders take to reduce risk to hazards?
- Action Plan: How will the actions be prioritized and implemented?

Mitigation Implementation Strategy	
Mitigation Action/Project Title:	#9 - Hazard Mitigation / Climate Change Resiliency Officer Position
Priority Ranking	SCORE L
Background/Issue:	Currently this position is funded only for two (2) years under a Hurricane Sandy Disaster Relief Grant from the National Park Service. When the two (2) year period ends, there is no one at Maryland Historical Trust (MHT) with experience in hazard mitigation planning or floodplain regulations who can continue to participate meaningfully in the Maryland Resiliency Partnership or the Maryland Silver Jacket or who can advise the SHPO or the Office Chiefs at the MHT on matters related to mitigation and resilience and cultural resources.
Ideas for Integration:	Continued participation and representation in the Maryland Resiliency Partnership and the Maryland Silver Jackets.
Responsible Agency:	Maryland Historical Trust
Partners:	Maryland Department of the Environment Maryland Emergency Management Agency DNR US Army Corp. of Engineers Preservation Maryland Local governments
Potential Funding:	Maryland Department of the Environment Maryland Emergency Management Agency Maryland Department of Natural Resources US Army Corp of Engineers Preservation Maryland Local governments
Cost Estimate:	$55,000/year
Benefits: (Losses Avoided)	Continued integration among state agencies in matters of mitigation planning and projects to leverage state resources and provide a coordinated response to increasing resiliency across the state.
Timeline:	1-2 Years

Adopt and Implement the Plan

Bring the Plan to life!

- Continue public outreach
- Conduct Annual Reviews
- Pursue funding opportunities to implement Mitigation Strategy

Maryland
EMERGENCY MANAGEMENT AGENCY

The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

JaLeesa Tate 443 -900 -0073 jaleesa.tate@maryland.gov

mitigation.mema@maryland.gov

This page left blank intentionally

VIRTUAL MEMA State Hazard Mitigation Plan
Steering Committee Meeting
October 19, 2020
1:00 – 2:00PM

Overall Outcome

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda

- **Welcome and Introductions – MEMA**
- **Role of the Steering Committee – MEMA**
- **Plan Update Progress – Plan Update Team**
- **Regional HIRA Meetings Summary Report – Plan Update Team**
- **Engagement and Outreach Summary Report – Plan Update Team**
- **Goal Setting - MEMA**
- **Next Steps – MEMA**
- **Discussion/Wrap Up**

Notes from the meeting:

Welcome - Meeting started at 1:00PM

- JaLeesa Tate (MEMA) welcomed everyone to the second HMP Update Steering Committee meeting and provided a logistical overview of today's meeting, including how to use Teams and a quick run through the Agenda and goal for the meeting.
- 26 total attendees (See attached attendee list)

Progress Update

- The Planning Team provided an update on progress since the August 13th Steering Committee meeting
- No questions

HIRA update

- The Planning Team provided an update on the five HIRA meetings that took place October 15 - 20, 2020
- Questions and discussion:
    - Jesse Ash, Maryland Planning - why is at-risk population not incorporated in risk quantification?

- Planning Response: High hazard dam inundation impacts were not available to the planning team to incorporate into the risk calculation. Ranking focused on high hazard dams.
- ACE has the inundation layer, check the MDI map?
- Dave Guinnet - grant request this year to get the data set in a more public facing manner, should be able to get from MDE as a shapefile
  - Planning Team: We would need it by year end for the HIRA
- Dave G - will facilitate a meeting w/ Dam Safety

o JaLeesa - what was the reason that dams weren't included in 2016?

- They were in 2011, but removed from 2016
  - Dave G - Dams became a potential terror threat, so didn't want to be publicized at the time

Stakeholder Participation and Survey information

- The Planning Team provided an update on the information received from the stakeholder outreach, and requested additional help in generating responses
  - o Dave G - send out the emails to remind them, particularly to those who submitted an application for FMA/BRIC
  - o JaLeesa - will send out from HER email rather than the HMAUpdate email; also discussing w/ Kyle on how to get information out to the NGOs and non-profits/private agencies to discuss what role they can have in the mitigation plan update
  - o Steven Allan - Good idea to send emails in addition to those from the hmp account.
  - o Dona Sorce - Hi, Maryland CDBG has an application training on November 19th which will be attended by many jurisdictions. This is an outreach opportunity; Maryland CDBG can also post information on our Facebook page.
  - o Dave Guinnet - MASFM is early November - Give me or Kevin a Blurb of what you want to say.
  - o Kevin Wagner - We submitted our Action sheets on Friday afternoon to the generic MEMA email address that was provided. No one acknowledged receipt, so let me know if you did not receive it.

Goal Setting

- JaLeesa opened up the floor for conversation after providing an update on the direction for goals for the Plan update.
  - o Kevin Wagner - how about setting goals that we can measure success of?
- Ashley S - MD plan has one goal and 5 objectives; is this the way we want to continue?
- Kyle Overly - need to be measurable, but can't make them too overly specific
- Dave G - how many buildings are in the floodplain, etc - should pull down reductions b/w 21 and 25
- Dona S - How we collaborate with community-based organizations to increase public awareness such as Shore Rivers, Adkins Arboretum, the Chesapeake Bay Maritime Museum?
- Kevin W - The only problem with is flood risk will change over time as climate changes, sea levels rise, lands subside and erosion happens, etc

Wrap up

- JaLeesa noted the upcoming meetings for the Steering Committee, as well as the upcoming Mitigation Strategy meetings (12/7 (2), 12/8 (1) and 12/9 (2)

- JaLeesa will begin to send out the reminders of surveys, meetings and informational tools. This includes Survey123 and the Virtual Meeting Room

Meeting concluded at 2:03PM

Attendee List – affiliation listed, if known (26 total)

JaLeesa Tate (MEMA)	Dave Guinnet
Kristen Forti (MEMA)	Joy Hatchette
Kyle Overly (MEMA)	Mark Harris
Jen Sparenberg (MES)	Joey Krastel
Lael Holton (AECOM)	Tim La Valle
Amy Baker (AECOM)	Tasha McNutt
Deepa Srinivasan (VPC)	Jessica Nusbaum
Ashley Samonisky (VPC)	Dave Robbins
Andrew Estrain (VPC)	Dona Sorce
Steve Allan	Norman Wang
Jesse Ash	Jennifer
Tara Espinola	+1 410-767-2202

Teams meeting information

Join Microsoft Teams Meeting

+1 443-833-0028 United States, Baltimore (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 230 135 86#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

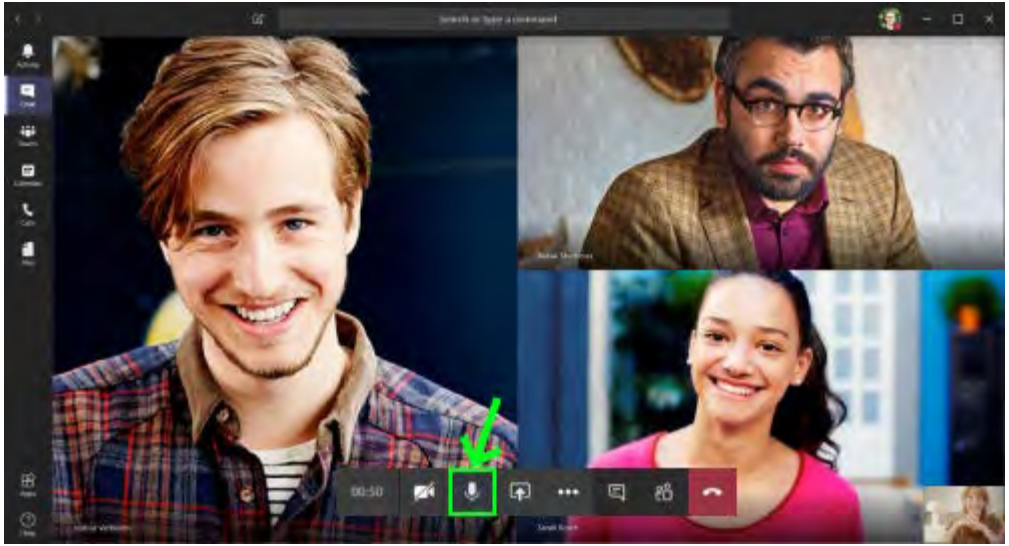
Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1175073886

Alternate VTC dialing instructions

Logistics

- The meeting is being recorded.
- Mute your microphone and turn off your camera when not speaking.
- Utilize the hand raise feature on MS Teams or enter questions through the chat.

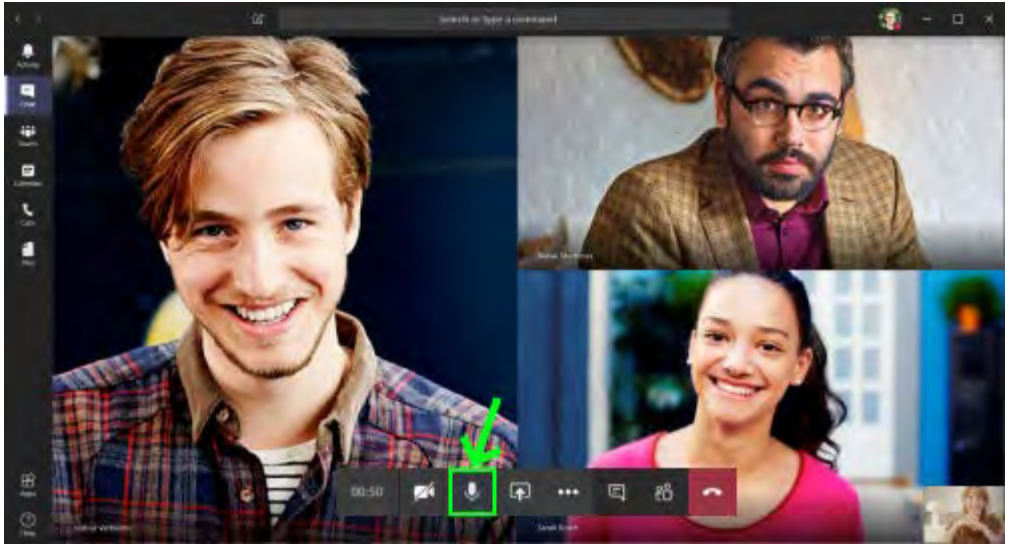


2021 State of Maryland Hazard Mitigation Plan

Steering Committee
10/26/2020

Logistics

- The meeting is being recorded.
- Mute your microphone and turn off your camera when not speaking.
- Utilize the hand raise feature on MS Teams or enter questions through the chat.

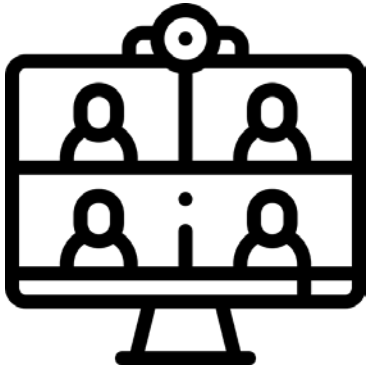


Overview

- Welcome and Introductions
- Role of the Steering Committee
- Progress Update
- Regional HIRA Meeting Summary Report
- Engagement and Outreach Summary Report
- Goal Setting
- Next Steps
- Discussion/Wrap Up

Role of Steering Committee

- Participate in engagement opportunities.
- Provide recommendations on the planning process and content.
- Provide data to keep the plan current and strategize actions.
- Identify agency capabilities and actions.
- Coordinate and/or lead subcommittees to address special topics.
- Review Plan drafts.
- Coordinate plan implementation efforts by linking resources and funding to actions.
- Identify stakeholder success stories.



Progress Report

Completed activities:

- Gap analysis
- Section IV - Land development, Demographics and Socio-economic analysis

In Progress activities:

- Updating Sections II/II – HIRA and vulnerability analysis, including maps. Presented to regions, in refinement stage
- Surveys to gather data and input for HIRA and strategy sessions

Progress Report – Upcoming activities

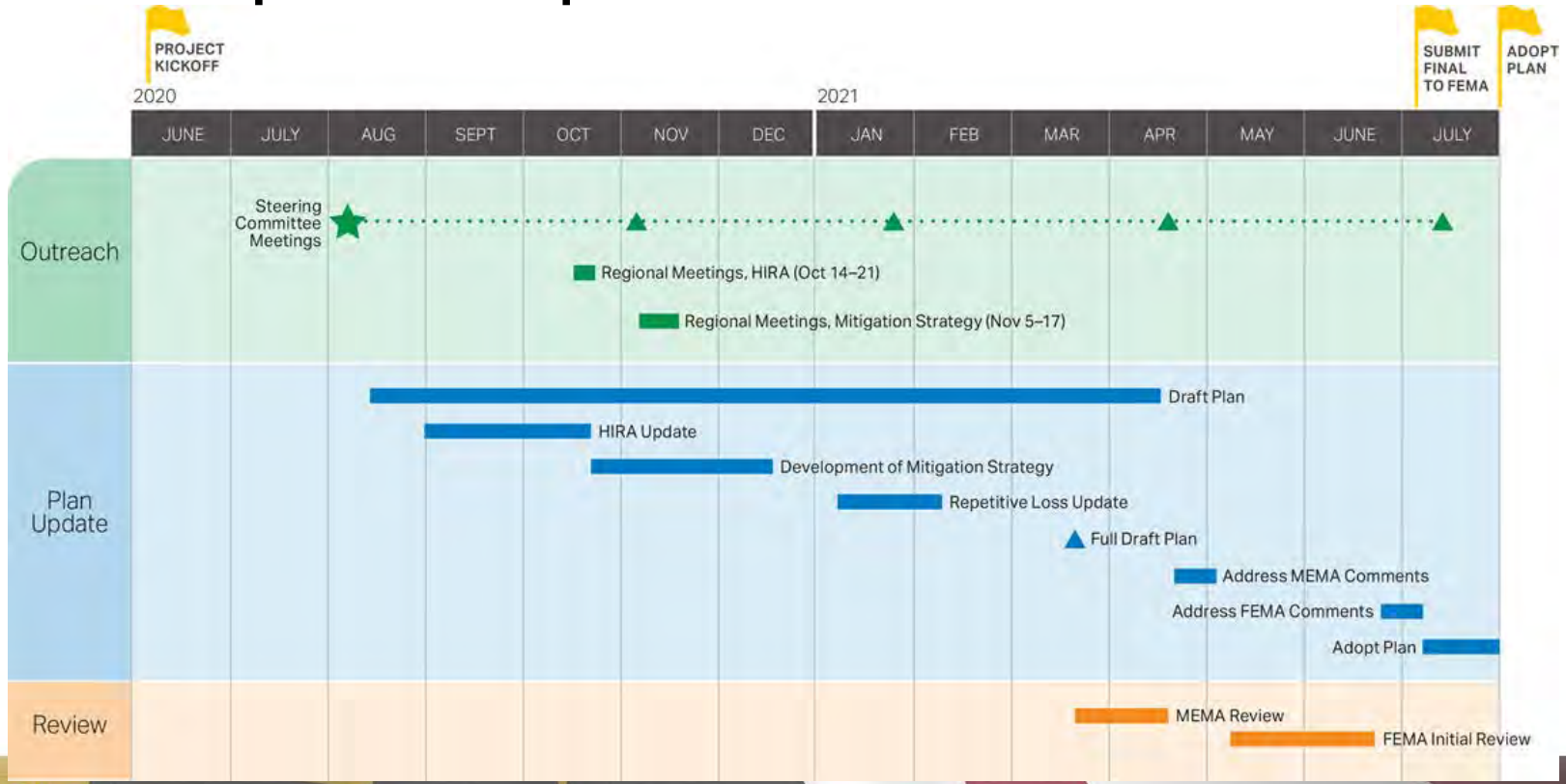
Before January meeting:

- Conduct Regional mitigation strategy meetings (December)
- Complete HIRA portions and submit for public review
- Begin RL/SRL review

Still to come in 2021:

- Finalize Draft Plan Update
- Conduct reviews and adoption meetings
- Submit to FEMA RIII

Roadmap to Adoption



2021 Maryland HIRA

Meetings Summary

Meeting Details

Dates:

- Western – 10/15/2020
- Central – 10/19/2020
- Southern – 10/19/2020
- Upper Eastern Shore – 10/20/2020
- Lower Eastern Shore – 10/20/2020
- **Total attendees - 131**

Logistics:

- Completed virtually (via MS Teams)
- Meetings were recorded and attendance and key information captured by planning team
- Following meetings, information compiled in summary reports for ease of documentation

Key Takeaways

Overall notes:

- Review Dam Safety addendum, re-scale maps in accordance with information
- Double check that recent storms/events are included in the data as appropriate
- Additional data needs:
  - Complete wildfire analysis
  - Incorporate Dam Addendum

Region specific:

- Western – concerns with dam information
- Central – review Thunderstorm and Extreme Temperature risk data
- Southern – Review flooding against August 2020 flood data
- Upper Eastern Shore – review the dam information, specifically around Conowingo
- Lower Eastern Shore – no issues raised.

Handouts and Maps

To be provided separately

We expect to provide in a Word doc that you can share:

- Statewide comparison table showing 2016 vs 2021 assessment
- Critical and State Facilities Table
- State-wide maps for all hazards (13 total in pdf)

Stakeholder Participation (10/20/20)

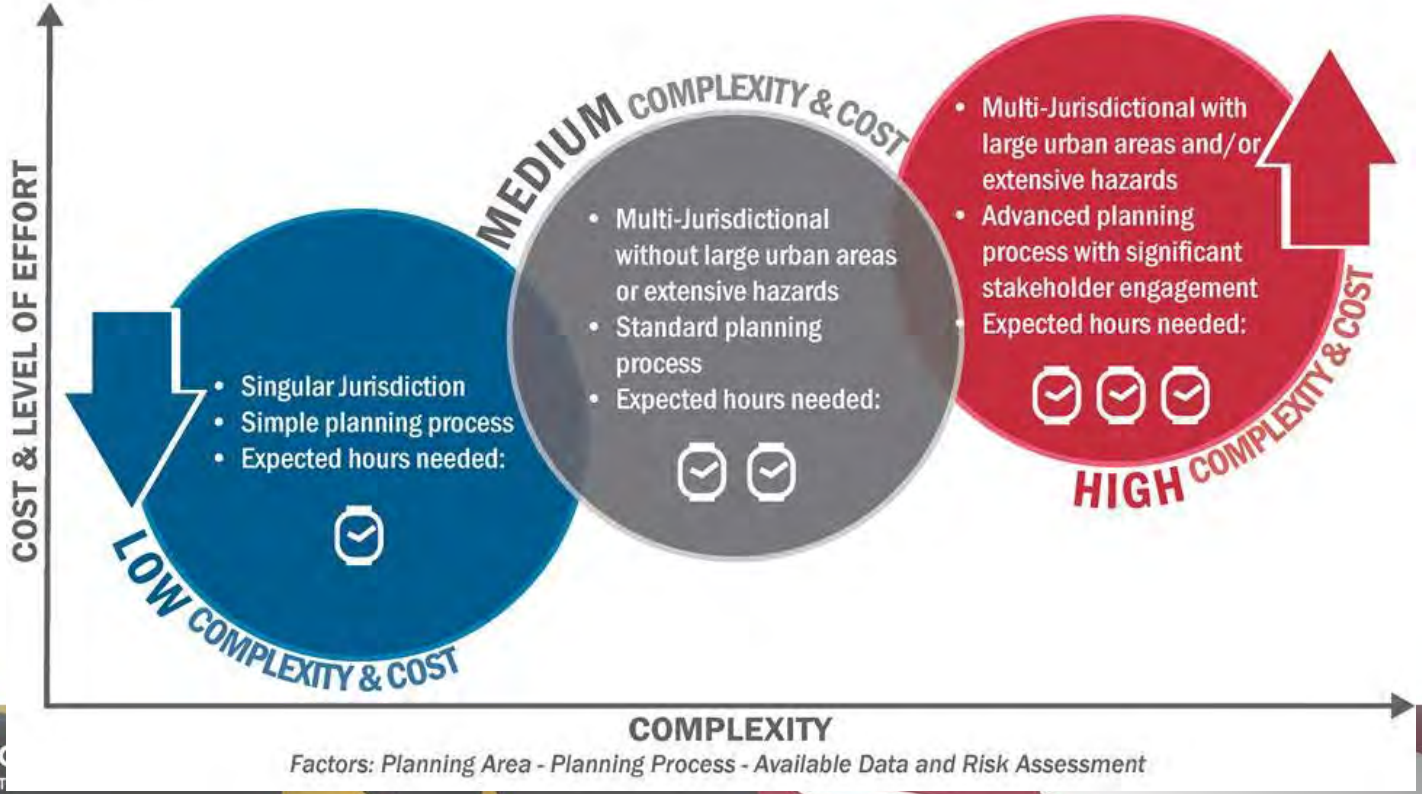
Outreach Activities	State (22)	County/Juris (28)	Univ (3)	Fed (5)	NGO (7)
HIRA Meeting	13	14	0	2	0
Mitigation Meeting	--	--	--	--	--
Questionnaire	4	8	0	0	0
Survey	5	5	0	5	0
Past Action Status	1	N/A	N/A	N/A	N/A
Mapping Survey123	--	--	--	--	--

Note: Number of invitees in parentheses

Potential Next Steps:

- Send reminders every three days
- Promote the process on Social Media
- Reach out directly to lead agencies for Past Action Status updates
- Move final Due Date for all outreach instruments to November 6th
- Carrot/Stick – Advise departments/jurisdictions that if they do not provide feedback, they will be marked as "non participatory" in the final Plan document and this could affect funding

Goal Setting



Approved and Budgeted SOW

Project Goals:

- Improve the preparedness of the State of Maryland and local jurisdictions as it related to identifying and mitigation hazards and threats.
- Use results of HIRA to develop mitigation strategies and inform efficacy of Hazard Mitigation Program.
- Ensure integration of State plans, policies, programs, and initiatives in the State level Hazard Mitigation Plan.
- Demonstrate effective implementation of mitigation in the STate of Maryland, including grant management.
- Actively engage the public and other members of the Maryland Emergency Management System throughout the update process.

- Meet the requirements of:
  - 44 CFR 201.5 (Enhanced State Mitigation Plan);
  - FEMA State Mitigation Plan Review Guidance;
  - Emergency Management Accreditation Program (EMAP).

Approved and Budgeted SOW

Existing Hazards:

- Coastal Hazards
- Flood Hazard
- Winter Storm
- Tornado
- Wind
- Thunderstorm
- Wildfire
- Drought

New Hazards:

- Soil Movement
- Public Health Emergencies
- Dam Risk
- Extreme Temperatures
- Human-Caused Hazards and Threats

- Update State Assets Information
- Update Critical Facilities Information
- Update probability of future hazards to address Climate Change and Future Conditions.
- Update RL/SRL Strategy

Outreach and Engagement:

- 1 Project Team Kickoff Meeting
- 5 Steering Committee Meetings (Quarterly)
- 10 Regional Outreach Meetings
- 1 Project Team Closeout Meeting

Hazard Mitigation Plan Goals - Review

2016 Plan Goal

- To protect life, property, and the environment from hazard events through:
  - Increased public awareness of hazards, mitigation, preparedness, and resiliency.
  - Enhanced coordination with local jurisdictions and linkages between state and local mitigation and resiliency efforts.
  - Protection of State assets, infrastructure, and critical facilities.
  - Promote actions that protect natural resources, while enhancing hazard mitigation and community resiliency.
  - Efficient use of State resources

Implementation Action Categories

Strategies and Actions fall into at least one:

- Prevention
- Property Protection
- Public Education & Awareness
- Natural Resources Protection
- Emergency Services
- Structural Projects

Are these still relevant?

Are there new ones?

Next Steps/Upcoming Meetings

- Finalize Survey review and data collection
- Finalize HIRA for public review/comment
- Conduct Region -wide Mitigation Strategy meetings
- **Next Steering Committee Meeting: February 1, 2021 at 1:00pm**

Proposed Mitigation Strategy Meeting Dates

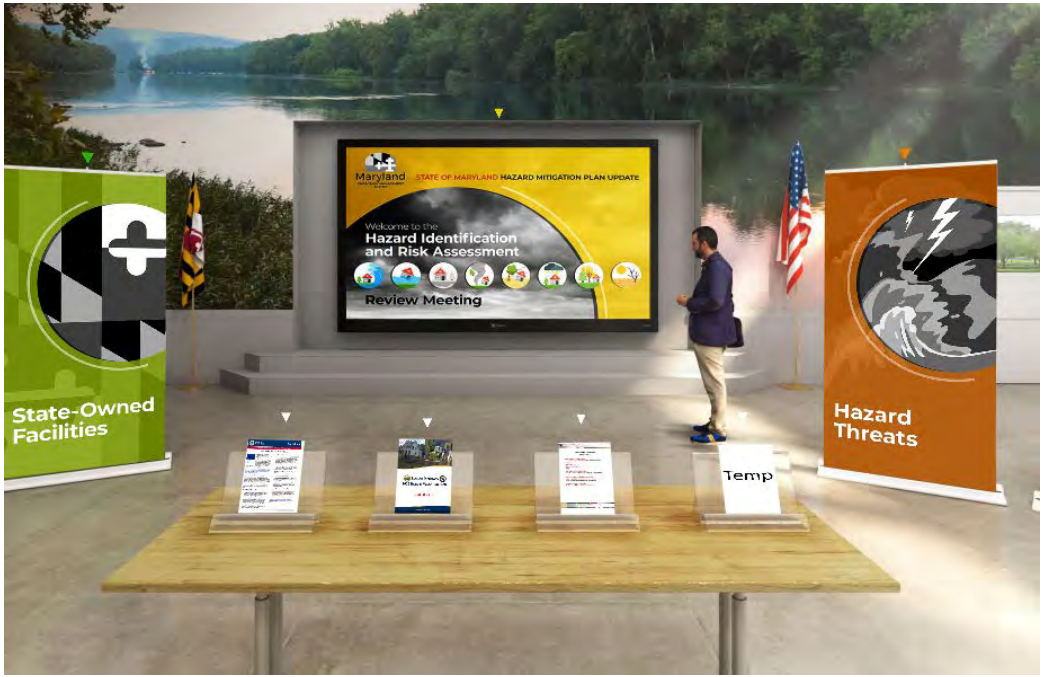
- Western Region: December 7th – 2:00pm
- Central Region: December 8th – 10:00am
- Southern Region: December 8th – 2:00pm
- Upper ES Region: December 9th – 10:00am
- Lower ES Region: December 9th – 2:00pm

Note: Proposed meeting schedule is based on assumption that 75% of state agencies and counties have returned information. If this baseline is not reached, meetings may have to be rescheduled to January 2021.

MEMA SHMP Update Virtual Room

Hold as a placeholder to start the Virtual Room discussion

Website: [MEMA-Maryland-360]



Discussion

Maryland

EMERGENCY MANAGEMENT AGENCY

The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

HMPProjectTeam@Maryland.gov

VIRTUAL MEMA State Hazard Mitigation Plan
Steering Committee Meeting
February 4, 2021
1:00 – 2:30PM

Overall Outcome:

- Provide the Steering Committee and the MAC with an update on the progress of the update to the 2021 Plan; solicit feedback on updated goals and proposed new actions, as well as the action prioritization and scoring; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Progress Update – MEMA**
  - **Action Implementation Surveys**
  - **Repetitive Loss Strategy**
- **Mitigation Actions Prioritization - VPC**
- **Next Steps - MEMA**
- **Discussion/Wrap-up - MEMA**
- **Adjournment**

Notes from the meeting:

- No suggestions or recommendations from the Counties/Jurisdictions
- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.

Meeting concluded at

Attendee List – affiliation listed, if known (17 total)

Joey Krastel	**Ashley Samonisky**
Joy Hatchette	**Deepa Srinivasan**
Norman Wang	**Andrew Estrain**
Bucovetsky, Joseph	**Jennifer Sparenberg**
Mark Harris	**Holton, Lael**
Joseph Rogers	**JaLeesa Tate - MEMA**
Jesse Ash (Guest)	**Kayhla Cornell-MEMA**
Tara Espinola	**Kristen Forti-MEMA**
	Dave Robbins - MEMA

Teams meeting information:

Join Microsoft Teams Meeting

+1 443-833-0028 United States, Baltimore (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 791 543 493#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

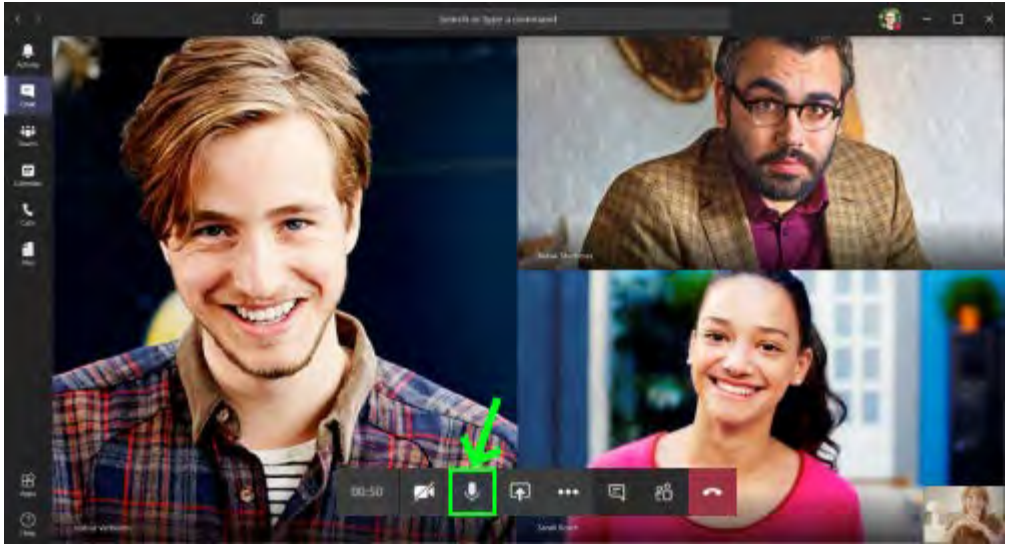
Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1111684239

Alternate VTC dialing instructions

Logistics

- The meeting is being recorded.
- Mute your microphone and turn off your camera when not speaking.
- Utilize the hand raise feature on MS Teams or enter questions through the chat.

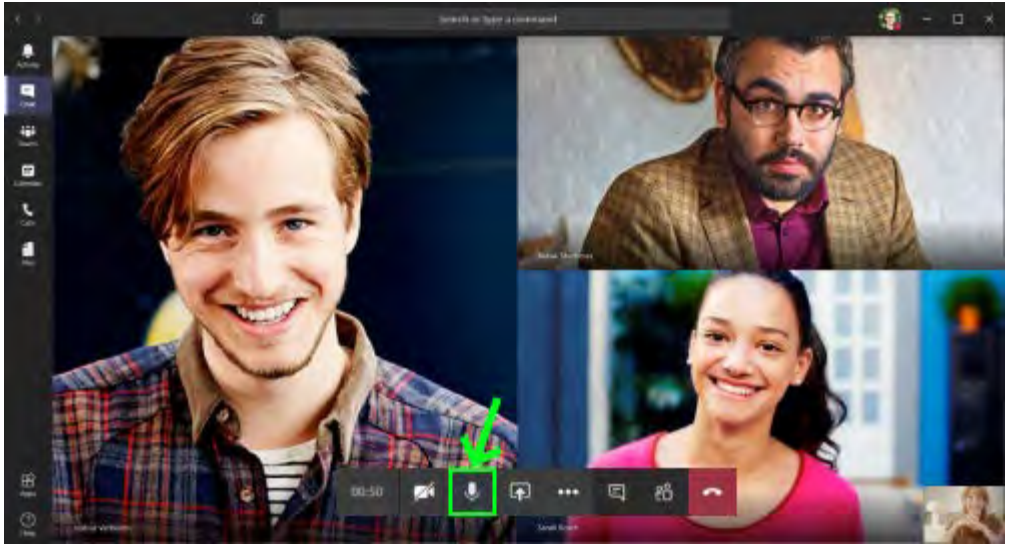


2021 State of Maryland Hazard Mitigation Plan

Steering Committee
02/04/2021

Logistics

- The meeting is being recorded.
- Mute your microphone and turn off your camera when not speaking.
- Utilize the hand raise feature on MS Teams or enter questions through the chat.



Overview

- Welcome
- Progress Update
  - Action Implementation Surveys
  - Repetitive Loss Strategy
- Mitigation Actions Prioritization
- Next Steps
- Discussion/Wrap Up

Progress Report

Completed activities:

- Gap analysis
- Sections II/III – HIRA and Vulnerability Analysis, including maps
- Section IV - Land development, Demographics and Socio-economic Analysis

In Progress activities:

- Section I - Plan Development Process
- Section VI - Implementation Status Report
- Section V - Mitigation Strategy, finalizing prioritization of actions
- Repetitive Loss Strategy

Stakeholder Participation (10/2020)

Outreach Activities	State (22)	County/Juris (28)	Univ (3)	Fed (5)	NGO (7)
HIRA Meeting	13	14	0	2	0
Mitigation Meeting	--	--	--	--	--
Questionnaire	4	8	0	0	0
Survey	5	5	0	5	0
Past Action Status	1	N/A	N/A	N/A	N/A
Mapping Survey123	--	--	--	--	--

Note: Number of invitees in parentheses

Stakeholder Participation (02/2021)

Outreach Activities	State (22)	Local (28)	Uni (3)	Fed (5)	NGO (7)
HIRA Meeting	13	14	0	2	0
Strategy Meeting	10	10	0	1	0
Questionnaire	4	20	0	0	0
Survey	8	22	0	0	0
Past Action Status	7	N/A	N/A	N/A	N/A
Mapping Survey123					

Note: Number of invitees in parentheses

Additional Stakeholder Engagement

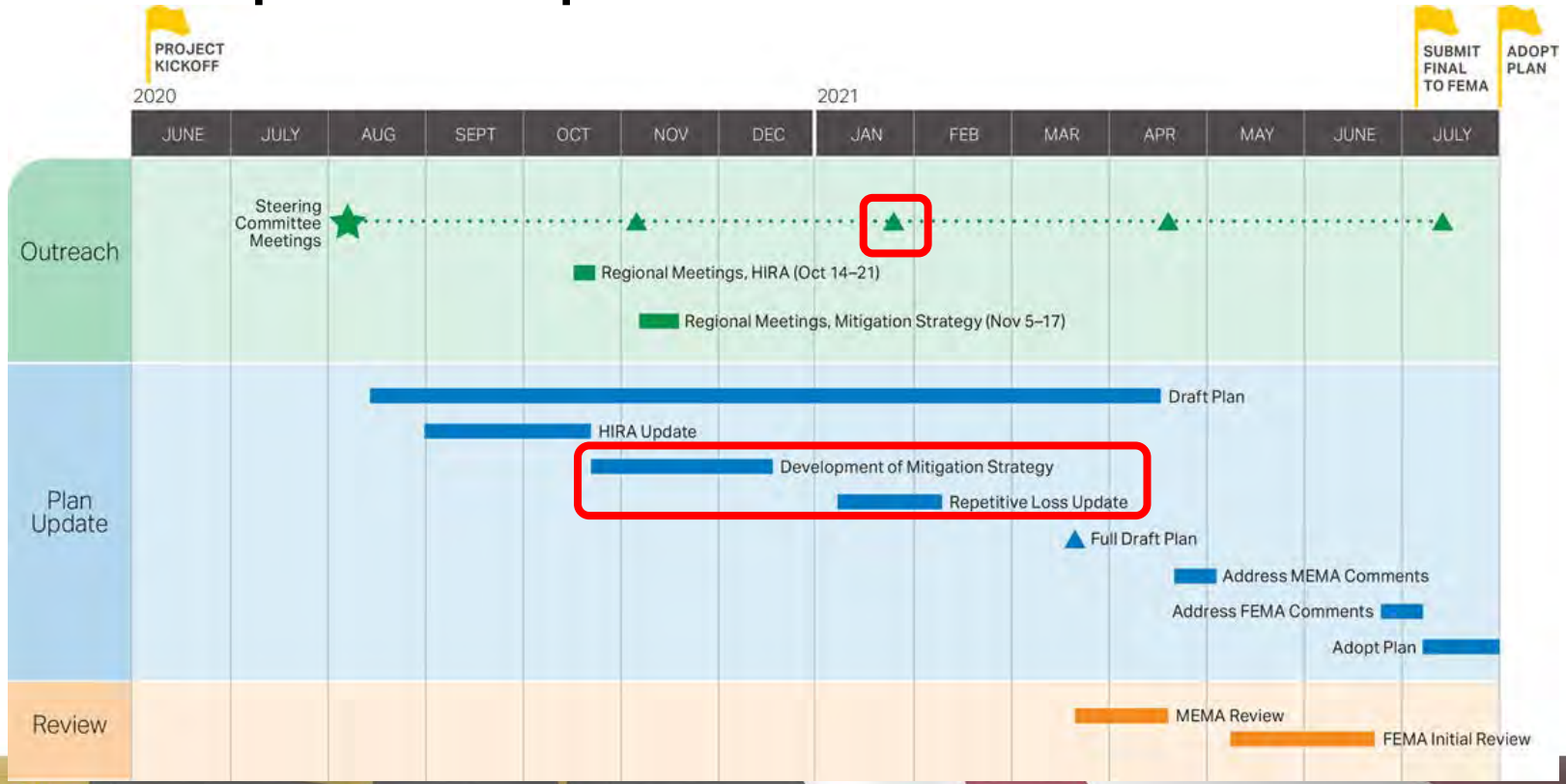
Completed:

- January 6, 2021: Risk & Hazards that Impact your Business in Maryland

Upcoming:

- February 24, 2021: MD Association of Floodplain and Stormwater Managers Lunch and Learn: State Repetitive Loss Strategy

Roadmap to Adoption



Repetitive Loss Strategy

2016 Plan (BureaNet):

- 964 non mitigated RL structures
- 16 validated Severe Loss structures

2021 data (PIVOT):

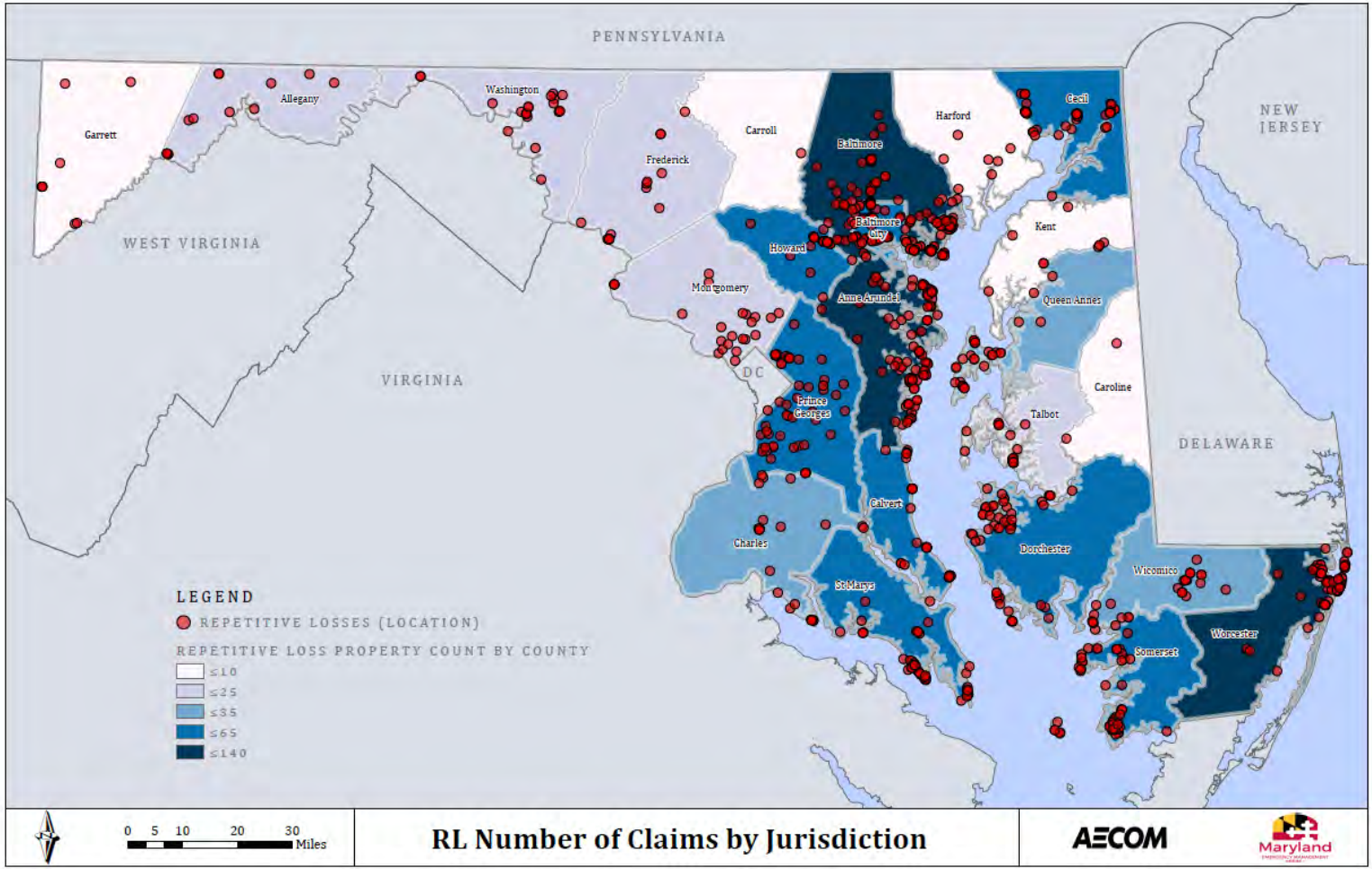
- 1,153 non mitigated RL structures
- 107 Severe Loss structures

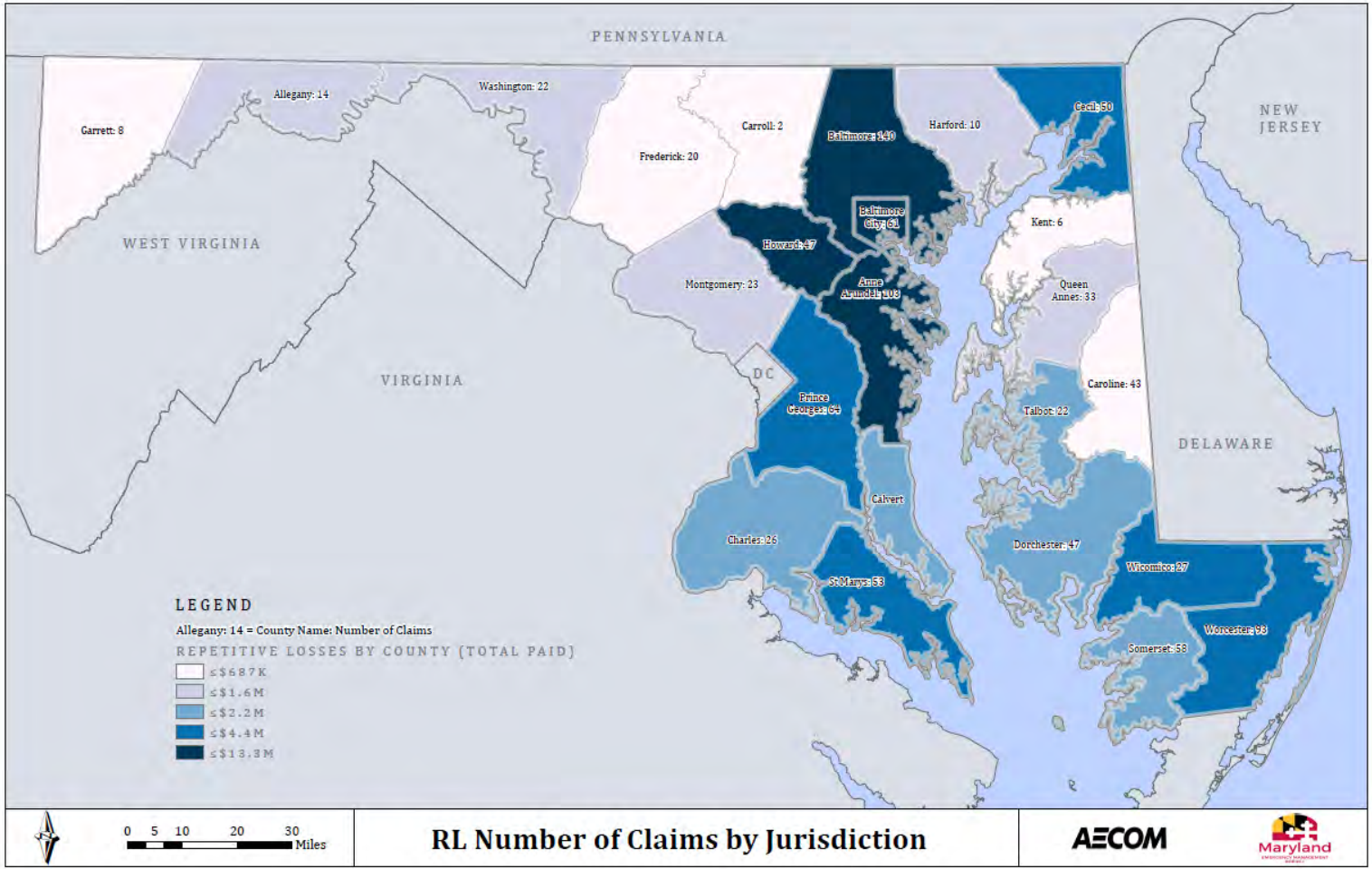
Between 2016 and now there has been some significant flooding, so the net increase of 189 RL properties (19%) could be realistic.

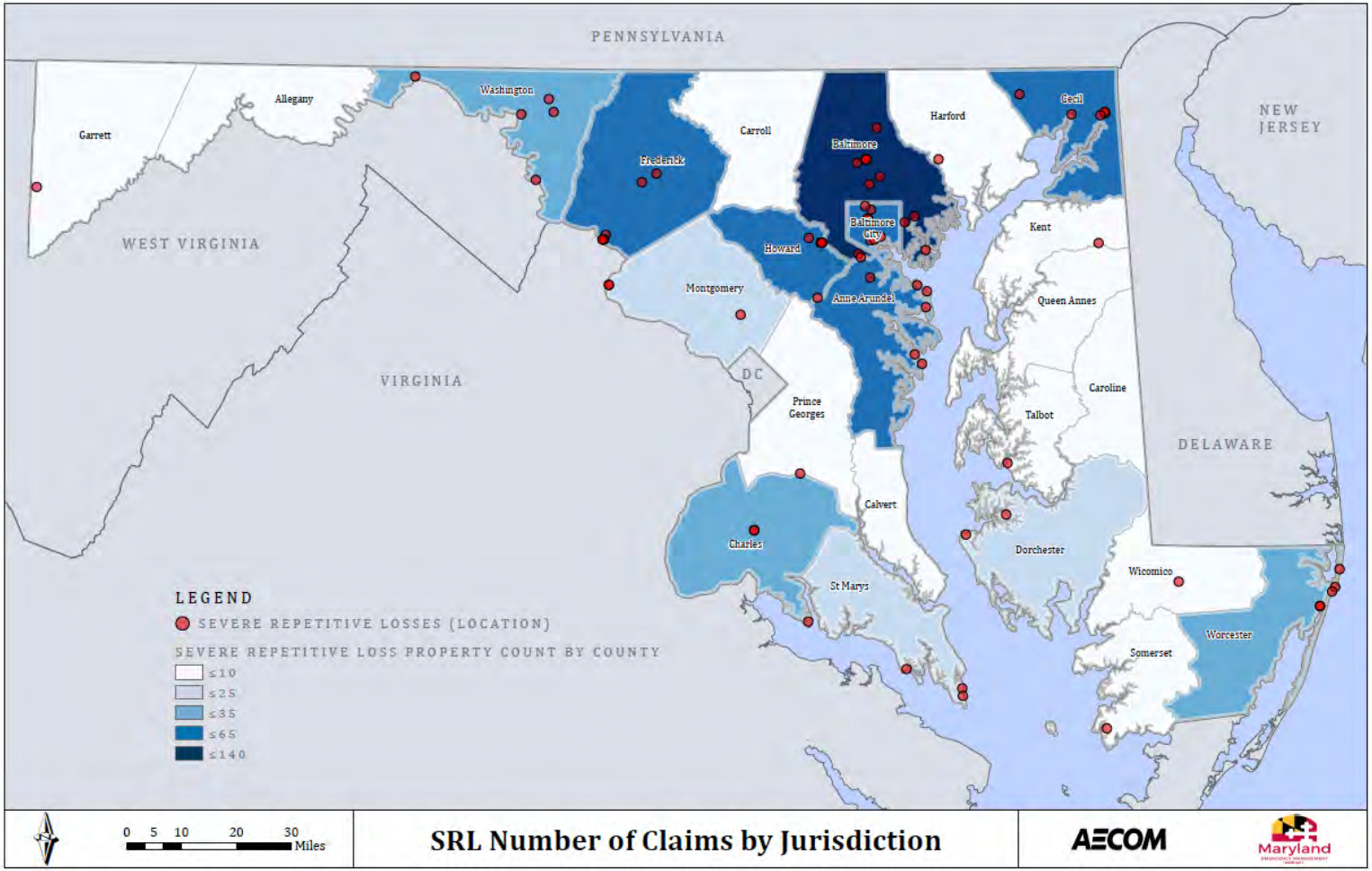
The net increase of 91 SRL properties (568%) seems abnormally high. This could be from the potential that in the move to the Pivot system, SRL properties that were classified as validated and pending were lumped together.

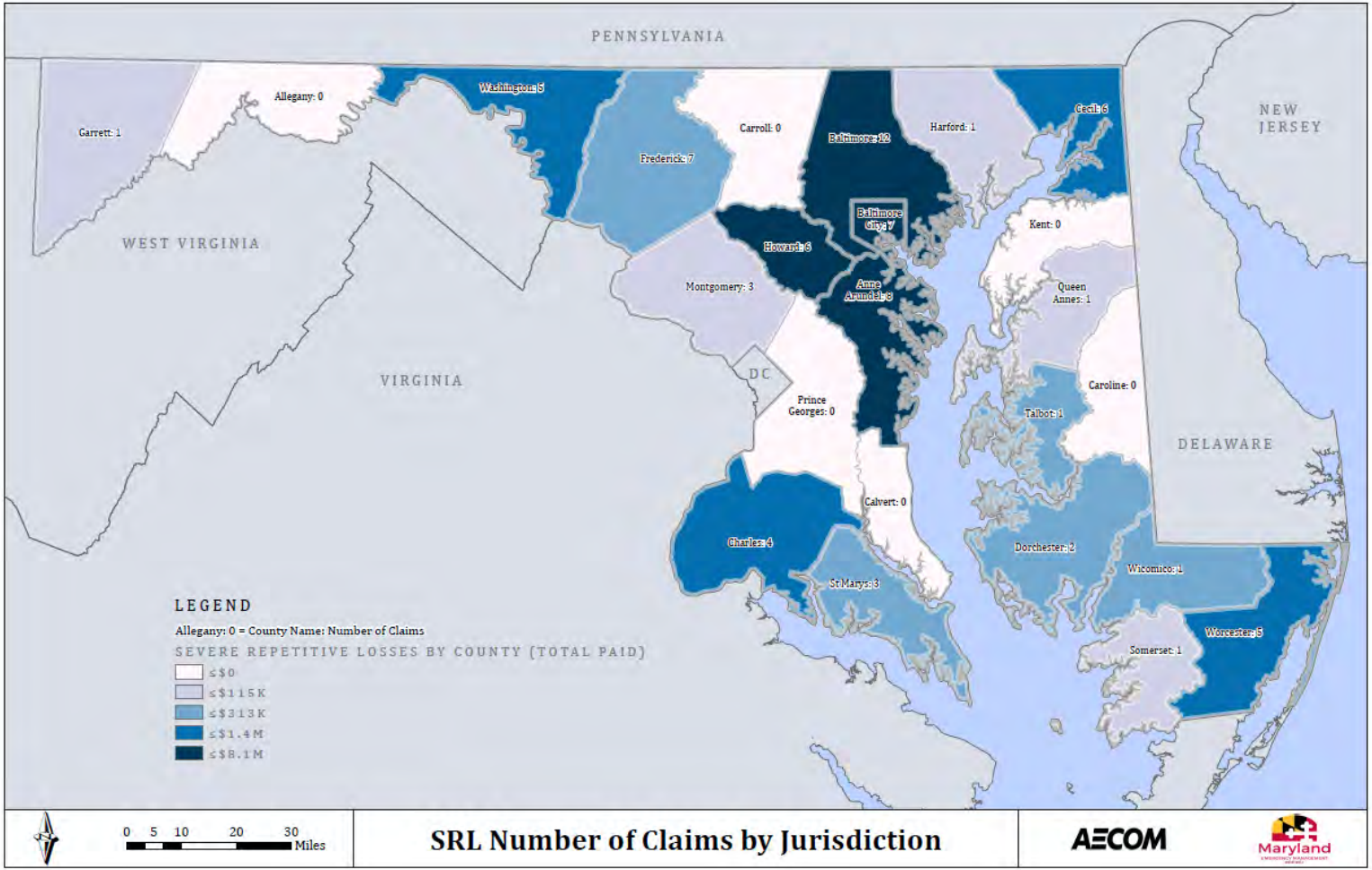
2021 Approach

- Reached out to FEMA for clarification, but no response to date.
- Utilizing best available PIVOT data as of 01/14/2021.
- Some records were designated as having an "unknown" County. These records were manually changed to reflect the proper County based on the jurisdiction where the property is physically located.


PENNSYLVANIA
WEST VIRGINIA
VIRGINIA
DELAWARE
NEW JERSEY
DC
Garrett
Allegany
Washington
Frederick
Carroll
Harford
Cecil
Baltimore
Baltimore City
Howard
Montgomery
Anne Arundel
Kent
Queen Annes
Caroline
Talbot
Prince Georges
Calvert
Charles
St Marys
Dorchester
Wicomico
Somerset
Worcester
LEGEND
REPETITIVE LOSSES (LOCATION)
REPETITIVE LOSS PROPERTY COUNT BY COUNTY
≤10
≤25
≤35
≤65
≤140
0 5 10 20 30
Miles
RL Number of Claims by Jurisdiction
AECOM
Maryland

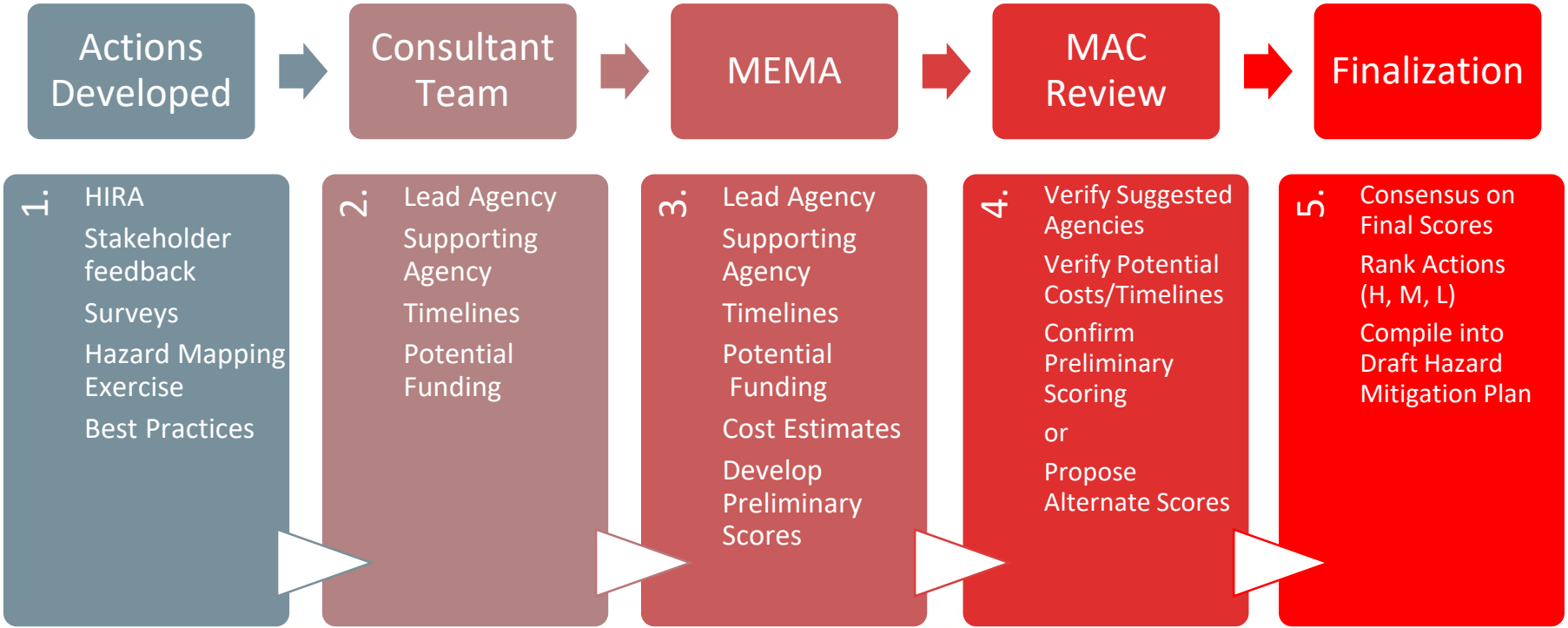

PENNSYLVANIA
NEW JERSEY
WEST VIRGINIA
VIRGINIA
DC
DELAWARE
Garrett: 8
Allegany: 14
Washington: 22
Frederick: 20
Carroll: 2
Baltimore: 149
Harford: 10
Cecil: 50
Baltimore City: 62
Howard: 47
Kent: 6
Montgomery: 23
Anne Arundel: 108
Queen Annes: 33
Caroline: 43
Prince Georges: 64
Talbot: 22
Calvert
Charles: 26
Dorchester: 47
Wicomico: 27
St Marys: 53
Worcester: 38
Somerset: 58
LEGEND
Allegany: 14 = County Name: Number of Claims
REPETITIVE LOSSES BY COUNTY (TOTAL PAID)
≤$687K
≤$1.6M
≤$2.2M
≤$4.4M
≤$13.3M
0 5 10 20 30
Miles
RL Number of Claims by Jurisdiction
AECOM
Maryland


PENNSYLVANIA
NEW JERSEY
WEST VIRGINIA
VIRGINIA
DELAWARE
DC
Garrett
Allegany
Washington
Frederick
Carroll
Baltimore
Harford
Cecil
Baltimore city
Howard
Montgomery
Anne Arundel
Kent
Queen Annes
Caroline
Talbot
Prince Georges
Calvert
Charles
St Marys
Dorchester
Wicomico
Somerset
Worcester
LEGEND
SEVERE REPETITIVE LOSSES (LOCATION)
SEVERE REPETITIVE LOSS PROPERTY COUNT BY COUNTY
≤10
≤25
≤35
≤65
≤140
0 5 10 20 30
Miles
SRL Number of Claims by Jurisdiction
AECOM
Maryland


PENNSYLVANIA
NEW JERSEY
WEST VIRGINIA
VIRGINIA
DC
DELAWARE
Garrett: 1
Allegany: 0
Washington: 5
Frederick: 7
Carroll: 0
Baltimore: 12
Harford: 1
Cecil: 6
Baltimore City: 7
Howard: 6
Anne Arundel: 8
Montgomery: 3
Prince Georges: 0
Kent: 0
Queen Annes: 1
Caroline: 0
Talbot: 1
Calvert: 0
Charles: 4
St Marys: 3
Dorchester: 2
Wicomico: 1
Somerset: 1
Worcester: 5
LEGEND
Allegany: 0 = County Name: Number of Claims
SEVERE REPETITIVE LOSSES BY COUNTY (TOTAL PAID)
≤$0
≤$115K
≤$313K
≤$1.4M
≤$8.1M
0 5 10 20 30
Miles
SRL Number of Claims by Jurisdiction
AECOM
Maryland

Mitigation Actions
Prioritization

Explanation of the Action Scoring/Ranking Process



Scoring System Development

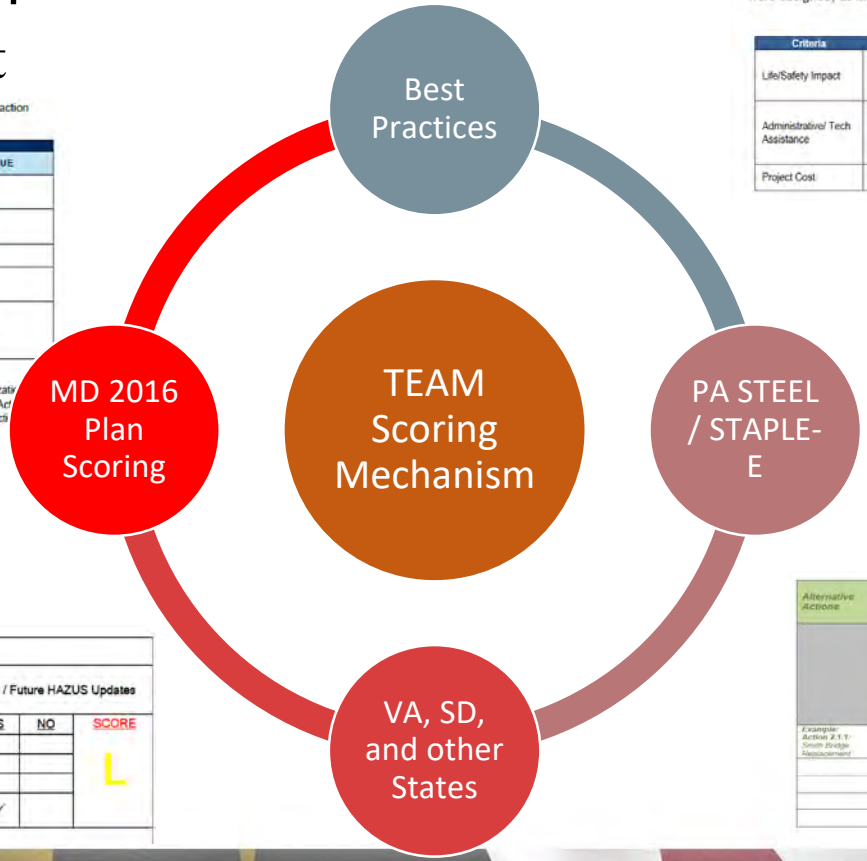
Scores were assigned to each criterion using the weighted, multi-objective mitigation action prioritization criteria outlined in Table 6.2.3-1.

Table 6.2-3 Multi-Objective Mitigation Action Prioritization Criteria

MITIGATION ACTION RANKING CRITERIA	CRITERIA DESCRIPTION	WEIGHT VALUE
Effectiveness	The extent to which an action reduces the vulnerability of people and property.	20%
Efficiency	The extent to which time, effort, and cost is well used as a means of reducing vulnerability.	30%
Multi-Hazard Mitigation	The action reduces vulnerability for more than one hazard.	20%
Addresses High Risk Hazard	The action reduces vulnerability for people and property from a hazard(s) identified as high risk.	15%
Addresses Critical Communications/Critical Facilities	The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.	15%

Scores of 0, 1, 2, or 3 were assigned for each multi-objective mitigation action prioritizati criterion where 0 does not meet the criteria and 3 overwhelmingly meets the criteria. Ac were then prioritized using the cumulative score assigned to each. Each mitigation acti given a priority ranking (Low, Medium, and High) based on the following scale:

- High Priority: 2.5 – 3
- Medium Priority: 1.9 – 2.4
- Low Priority: 0 – 1.8



For each criterion, the level of importance (high, medium, or low) was determined and corresponding points were assigned, as indicated in Table 6.4.

Table 6.6. Evaluation Criteria for Project Prioritization

Criteria	Points	High	Points	Medium	Points	Low
Life/Safety Impact	10	Significant impact on public safety for businesses, residents and/or properties	6	Direct impact on businesses, residents and/or properties	2	Minimal/negligible impact on businesses, residents and/or properties
Administrative/ Tech Assistance	5	No additional staff or technical support needed to implement action	3	Some administrative and technical support needed to implement action	1	Significant administrative and technical support needed to implement action
Project Cost	5	Low cost (<$25,000)	3	Moderate cost ($25,000-$100,000)	1	High cost to implement (>$100,000)

Mitigation Implementation Strategy

Mitigation Action/Project Title:	#35 - FME (Feature Manipulation Engine) Tool Integration / Future HAZUS Updates			
Priority Ranking	QUESTIONS	YES	NO	SCORE
	Is the project cost-effective?			L
	Is the project environmentally sound?			
	Is the project technically feasible?			
	Does the project meet at least one (1) of the MAC Priority Ranking Parameters?	✓		

PA STEEL Criteria Considerations

+ Favorable — Less favorable N Not Applicable

Alternative Actions	P Political		A Administrative			S Social		T Technical		E Economic				E Environmental					L Legal		
	Political Support	Local Champion	Public Support	Staffing	Funding Available	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on Wetlands	Consistent w/ Community Vision/Overall Goals	Complies w/ Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge
Example: Action #1.1: Smith Bridge Replacement	+	+	-	N	+	+	+	+	-	-	N	+	+	N	+	-	-	+	-	-	N	+	+

TEAM Scoring System

T – Technical
- Is the proposed action technically feasible?
- Is the proposed action a short -term or long -term solution?
- Could the action create any additional problems in the future?

E - Economic
- Do the benefits exceed the costs?
- Is there already funding in place to implement this action?
- Are initial, maintenance, and administrative costs taken into account?

A – Administrative
- Can the state implement the action?
- Has someone been identified to coordinate and lead the effort?
- Are sufficient funding, staff and technical support available?

M – Multi -Benefit
- Will it mitigate hazards to people, the economy, and the environment?
- Does the mitigation action address a high priority/top ranked hazard(s)?
- Will the action mitigate more than one hazard or assist more than one jurisdiction?

	High	Pts	Medium	Pts	Low	Pts
Technical	The proposed action will solve a root problem of the identified hazard(s) with no adverse effects, and without creating trickle-down follow-on work.	10	The proposed action will solve a root problem of the identified hazard(s) with little to no adverse effects, and with minimal trickle-down follow-on work.	5	The proposed action will solve the identified hazard(s) with little adverse effects, and/or trickle-down follow-on work.	2
Economic	The benefits of the action clearly outweigh the costs to implement; funding or grants are available; and ongoing maintenance and administrative costs are easily budgeted for.	10	The benefits of the action outweigh the costs to implement; funding or grants are very likely attainable; and ongoing maintenance and administrative costs are budgeted for.	5	The benefits of the action outweigh the costs to implement; funding or grants will have to be applied for; and ongoing maintenance and administrative costs can be budgeted for.	2
Administrative	Can be implemented at the state level and appropriate staff and funding are already in place to lead the effort.	10	Can be implemented at the state level and staff and funding can be easily assigned to lead the effort or a budget exists for contractor support.	5	Can possibly be implemented at the state level, and staff and funding will need to be hired/acquired and/or contractor support is necessary.	2
Multi-Benefit	Action mitigates multiple hazards that were ranked high in the jurisdictions HIRA and protects people, the environment, and benefits the economy in more than one jurisdiction.	10	Action mitigates multiple hazards from the jurisdictions HIRA and protects people, the environment, and/or benefits the economy in more than one jurisdiction.	5	Action mitigates hazards that were ranked in the HIRA and/or protects people, the environment, or the economy in more than one jurisdiction.	2

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
1	Provide support for project development through all phases to include, but not be limited to: feasibility studies, Hydrology and Hydrologic studies, project identification, design and engineering, and implementation. Prioritize providing technical assistance to low-capacity and low-capability communities.	MEMA	10	5	2	10	27	BRIC, FMA, PWEAA, EMPG, UASI, ESHPF	Variable depending on the study	1 Year/ Ongoing
2	Provide support for installation and maintenance of extreme weather and other warning mechanisms statewide.	MEMA MDE	5	2	2	10	19	BRIC, FMA, PWEAA, UASI	20/30k per siren, plus maintenance	2-3 Years
3	Conduct consequence analyses for dam failures across the State, including collecting and determining information on downstream inundation areas and potential flood depths.	MDE MEMA	5	10	10	10	35	FMA, EMPG	Consultant, medium	1-2 Years
4	Conduct regular (annual) inspection and maintenance of levee systems throughout Maryland, and include operational training and community flood risk outreach as part of the maintenance effort.	MDE MEMA	2	10	10	10	32	BRIC, FMA, PWEAA, FEMA High Hazard Potential Dam program	Variable, State to fund training, external costs for inspection and maintenance	1 Year/Ongoing
5	Identify and evaluate funding opportunities and potential projects to decommission low flow/low volume dams to restore waterways to their natural state.	MDE MEMA	5	2	2	10	19	BRIC, FMA, PWEAA,FEMA HHPD program	Low, internal state cost	3-5 Years

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
6	Conduct regional watershed studies to promote and support stormwater management awareness and projects, and to support effective mitigation and planning efforts and policies.	MDE MEMA	5	2	2	10	19	BRIC, FMA, UASI, CDBG-DR/MIT if available	Low; State commission consultant	2-3 Years
7	Develop building standards and incentives to actively encourage the installation of nature-based solutions on State-owned buildings/facilities to: reduce the building/facility's carbon footprint; provide additional shade; reduce heat from the roof surface and surrounding air; and assist with water runoff during rain events.	MDE MEMA	5	10	10	10	35	UASI, CDBG, FMA, HMGP		2-3 Years
8	Conduct State-level climate change modeling/analyses, including approaches for changes in precipitation rates and changes in sea level, and provide county-level datasets and reports/projections to jurisdictions to assist them with climate change-related planning and mitigation projects	MDE MEMA	5	2	10	10	27	BRIC, EMPG, UASI		1-2 Years
9	Address mitigation and risk reduction considerations on all new state construction through Environmental Site Design (ESD) including considerations such as: maximum allowable impermeable surface for new construction, encouraging the use of permeable parking lots and surfaces, and drought-tolerant landscaping.	MDE MEMA	5	5	5	10	25	BRIC, HMGP, USAI		2-3 Years

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
10	Provide support for "Smart City" initiatives, such as IoT-connected inlet/reservoir/stream sensors and gauges.	MDE MEMA	5	2	2	10	19	BRIC, HMGP, FMA, PWEAA, EMPG, UASI	Variable to High	1-2 Years
11	Develop guidance/best practices for more efficient crop irrigation methods to assist with balancing agricultural water withdrawals with increased water demand.	MDE MEMA	2	5	10	2	19	EMPG, USDA	Staff time/ consultants to review best pratctices	
12	Develop county-level depth grid data and develop current and future flood risk visualizations for use by local governments, that incorporates both storm and nuisance flooding, to illustrate potential flood risks to citizens, and to help inform local HMP and Risk Assessment update processes.	MDE MEMA	5	2	2	10	19	EMPG, UASI, HMGP		2-3 Years
13	Provide incentives to local Planning Commissions to begin preparing for the 2050 projected 100-year and 500-year floodplain delineations (as opposed to current 100/500-year floodplains) by incorporating language into local ordinances (Zoning, SALDO) that discusses raising the freeboard, and other measures, based on these projections.	MDE MEMA	2	5	10	10	27	BRIC, FMA, CDBG, EMPG	Variable - County level cost	3-5 Years
14	Provide information and encourage counties to obtain the BCEGS building code evaluation to support CRS activities and potentially receive lower insurance rates.	MDP MEMA	2	5	5	10	22	EMGP, CDBG, BRIC		1 Year/Ongoing

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
15	Encourage jurisdictions to incorporate historic, cultural, archaeological sites, and resources resource considerations into all local Hazard Mitigation Plans, with a focus on protecting these resources while maintaining historic integrity, significance, and National Register eligibility.	MEMA MHT	10	10	10	10	40	HMGP, EMPG, ESHPF, National Trust for Historic Preservation		3-5 Years
16	Encourage the incorporation of FEMA's seven lifelines into all local Hazard Mitigation Plans, to prioritize the rapid stabilization of Community Lifelines after a disaster, and promote the use of FEMA's *Guides to Expanding Mitigation* by counties and jurisdictions during their local mitigation efforts.	MEMA	10	10	10	10	40	EMPG, UASI, BRIC, HMGP		2-3 Years
17	Develop a *Standard Operating Guide for Hazard Mitigation Planning*, to streamline the HMP update process for Maryland counties and jurisdictions by providing a model plan outline, to clarify existing guidance (for Emergency Managers), and to support communities developing their HMPs.	MEMA	10	5	5	10	30	HMGP, BRIC		3-5 Years
18	Develop and provide a library of tools and resources to assist jurisdictions with garnering public input and support during the HMP update process and plan adoption and maintenance processes.	MEMA	10	5	5	10	30	EMPG , UASI, HMGP, BRIC	State led, low cost	2-3 Years

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
19	Develop a project portfolio comprised of statewide hazard mitigation success stories/best practices and post them on the MEMA website for local jurisdictions to refer to during mitigation efforts.	MEMA	10	10	10	10	40	HMGP, EMGP	Low cost; state/consultant product	1-2 Years
20	Work with jurisdictions to promote partnerships with local organizations to develop “Community Resilience Hubs” to support residents, coordinate communication, distribute resources, and to help communities to become more self-determining and socially connected, before, during, and after hazard events.	MEMA	10	5	5	10	30	UASI, EMPG, CDBG, HMGP		5 Years
21	Conduct annual reviews and require state departments, counties, and local governments to submit annual updates regarding implementation status of the actions identified in their Hazard Mitigation Plans.	MEMA	10	10	10	10	40	EMPG, UASI, HMGP, CDBG, FMA		1 Year/Ongoing
22	Work with county and local communities, and provide informational and educational tools and products, to promote the local benefits of to encourage participation in the StormReady, CRS, BCEGS, Firewise, or other relevant planning, preparedness, and mitigation incentive programs.	MEMA, MDE, MIA, MD DLLR	10	10	10	10	40	EMPG, UASI, HMGP		1 Year/ Ongoing

2021 Mitigation Actions Preliminary Scoring

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
23	Partner with insurance providers/companies directly to encourage coverage of pre-storm actions for hazard mitigation.	MIA, MDE, MEMA	10	10	10	10	40	BRIC, HMGP, EMPG, UASI, FMA	Variable/ unknown	1-2 Years/ Ongoing
24	Establish a regular schedule to report regional drought conditions to agricultural entities, offices, and stakeholders throughout the State.	MDE MEMA	2	5	5	2	14	EMPG, LFP		1 Year/ Ongoing
25	Provide information to local governments and the public regarding risks to public drinking water (public health) that can arise from various hazards or disasters (dam failure, flooding, etc.).	MDE MEMA MDH	10	5	5	5	28	PWEAA, PHEP, EMPG, UASI	Staff time to develop materials	1-2 Years
26	Conduct an equity audit to identify how programs and policies are administered, and the impacts they have on the diverse stakeholders we serve. Utilize the results to develop an equity lens to be incorporated into revisions of existing programs and policies, and to be used as a guide when developing new programs and policies. Build capacity to plan for equity in all actions and programs by engaging community leaders from target communities in the planning processes.	MEMA	10	5	2	10	27	EMPG, UASI		2-3 Years
27	Prioritize disaster risk reduction by implementing the Sendai Disaster Risk Reduction Framework in Maryland to prevent new and reduce existing disaster risk by focusing on shared responsibility amongst stakeholders, including local governments, the private sector, NGOs, and the public.	MEMA	10	5	2	10	27	EMPG, UASI		3-5 Years

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
28	Encourage and foster Public - Private Partnerships (P3s) between state, county, and local governments, and private or non-profit organizations and entities, to take advantage of private expertise, initiatives, and/or resources, and encourage the shared responsibility highlighted under the Sendai Framework.	MEMA	10	5	5	10	30	EMPG, UASI, BRIC partnerships funding	Staff Time	1-2 Years/ Ongoing
29	Encourage and support innovative mitigation and planning projects by state agencies and at local levels, by leveraging both FEMA and non-fema funding sources.	MEMA	10	10	5	10	35	EMPG, UASI	Staff time; consultant to evaluate framework of funding	1-2 Years/ Ongoing
30	Convene state and allied stakeholders on an annual basis to develop innovative risk reduction solutions aimed at improving the quality of Maryland's communities and the lives of Marylanders	MEMA	10	10	5	10	35	BRIC, EMPG, UASI, HMGP	staff and venue cost	1 Year/ Ongoing
31	Foster regional cooperation and support the development of regional actions through the Local Hazard Mitigation Stakeholder Groups and other strategic partnerships.	MEMA	10	10	5	10	35	EMPG, UASI, HMGP		1 Year/ Ongoing

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
32	Prioritize regional projects over "local-only" projects when evaluating hazard mitigation project applications, notice of interest (NOI) submissions, and other proposed mitigation and planning projects.	MEMA	10	10	10	10	40	BRIC, EMGP		1-2 Years/ Ongoing
33	Incorporate energy impacts into critical facilities' planning functions, operational decisions, emergency operation plans, and capital improvement budgets by educating state agencies and local governments about the need for energy security	MEA	10	10	10	5	35	BRIC		1-2 years/ Ongoing
34	Evaluate new and existing state and local government buildings, critical facilities, and infrastructure for solar potential. Prioritize these based on their ability to sustain safe, clean, efficient, and reliable backup solar power systems aligned with locational and site characteristics, fuel supply availability, and operational needs.	MEA	5	10	5	10	30	BRIC		2-3 Years
35	Eliminate or minimize disruption of local government operations caused by natural hazards by enhancing the resilience of identified critical infrastructure and critical facilities, institutions, and services by installing and implementing microgrids that include photovoltaic (PV) solar power systems or other sources for local power generation.	MEA	10	5	5	10	27	BRIC		1-2 years

Final Rankings	High 31-40 pts	Medium 20-30 pts	Low 8-19 pts

2021 Mitigation Actions Preliminary Scoring

	Action	Lead Agency for Implementation	T	E	A	M	Total	Possible Funding Source	Approx. Cost	Project Timeline
36	Support energy security by diversifying supply and improving the reliability and resiliency of utility distribution systems, and power critical infrastructure	MEA	10	5	5	5	25	BRIC		
37	Increase and maintain surveillance and monitoring activities for public health issues, with special regard for infectious, animal, water, and airborne diseases.	MDH, MDE, MEMA	10	10	10	10	40	BRIC, PHEP, EMPG, UASI		2-3 Years
38	Improve food security by creating a food resiliency council to increase and supervise planning efforts to mitigate hazardous impacts on agriculture, livestock, and fisheries.	MDA, MDE, MEMA, MDH	10	5	5	10	30	BRIC, PHEP, EMPG, UASI		1-2 Years

Next Steps/Upcoming Meetings

- **Next Steering Committee Meeting: April 19, 2021 at 1:00pm**
- Finalize Draft Plan Update
- Conduct reviews and adoption meetings
- Submit to FEMA RIII

Discussion

Maryland

EMERGENCY MANAGEMENT AGENCY

The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

HMPProjectTeam.mema@Maryland.gov

VIRTUAL MEMA State Hazard Mitigation Plan
Steering Committee Meeting
April 19, 2021
1:00 – 2:00PM

Overall Outcome:

- Provide the Steering Committee and the MAC with an update on the progress of the update to the 2021 Plan, specifically focused on the draft completion and upcoming submission to FEMA. Additionally, MEMA began the implementation discussion, laying out the timeline for upcoming meetings and the summer grant cycle.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Progress Update – MEMA**
- **Discussion of upcoming plan submission to FEMA - MEMA**
- **Early Implementation Planning and Grant Cycles - MEMA**
- **Next Steps - MEMA**
- **Discussion/Wrap-up - MEMA**
- **Adjournment**

Notes from the meeting:

- One request to conduct the meetings via Google Meet
- No issues with the timelines proposed.

Meeting concluded at 1:24 PM

Attendee List – affiliation listed, if known (24 total)

Joey Krastel	**Ashley Samonisky**
Joy Hatchette	**Deepa Srinivasan**
Norman Wang	**Jennifer Sparenberg**
Jessica Nusbaum	**Holton, Lael**
Mark Harris	**Kyle Overly - MEMA**
Kevin Wagner	**JaLeesa Tate - MEMA**
Joy Hatchette	**Jesse Delpj -MEMA**
Tara Espinola	**Nevin Stambaugh-MEMA**
Tim Lavalle	**Dave Robbins - MEMA**
Bethany Brown	
Dave Guignet	**Phone Guests:**
Steve Allan	**410-767-3000**
Sasha Land	**410-767-4274**
Dona Sorce	**410-496-0585**

Teams meeting information:

Join Microsoft Teams Meeting

+1 443-833-0028 United States, Baltimore (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 142 568 819#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1185296448

Alternate VTC dialing instructions

Mitigation Advisory Committee Meeting Information

This page left blank intentionally

The Five-Year Planning Cycle

- Current State Hazard Mitigation Plan (SHMP) approved August 26, 2016.
- Expires August 26, 2021.
- Approximately 19 months from expiration date.

Mitigation Planning Process

Task	Activity
1	Determine the Planning Area and Resources
2	Build the Planning Team
3	Create an Outreach Strategy
4	Review Community Capabilities
5	Conduct a Risk Assessment
6	Develop a Mitigation Strategy
7	Keep the Plan Current/Plan Maintenance
8	Review and Adopt the Plan
9	Create a Safe and Resilient Community

Types of State Hazard Mitigation Plans

Standard

- Meet the requirements established in 44 CFR §201.4
- This plan is a condition of receiving non-emergency Stafford Act assistance and FEMA mitigation grants

Enhanced

- Meet the requirements established in 44 CFR §201.4 and §201.5
- Makes state eligible to receive increased funds under the Hazard Mitigation Grant Program
- State must demonstrate that:
  - Comprehensive mitigation program
  - Capability to manage increased funding to achieve its mitigation goals
  - Plan Integration

Standard SHMP (CFR 201.4)

- **Plan Requirement**: State must have an approved plan to receiving non-emergency Stafford Act assistance and FEMA mitigation grants.
- **Planning Process**: Coordination across all levels of government, involvement of stakeholders, and integration with other ongoing efforts.
- **Plan Content**:
  - Document the planning process
  - Conduct Risk Assessment (HIRA, vulnerability assessment, potential loss estimates)
  - Mitigation Strategy
  - Coordination of Local Mitigation Planning
  - Plan Maintenance Process
  - Plan Adoption Process
  - Assurances

Enhanced SHMP (CFR 201.5)

- **Integration**: To the extent possible with practicable state and/or regional planning initiatives (capital improvement, land development, emergency management) and FEMA mitigation programs.
- **Implementation**: Demonstrate capability to administer mitigation program, including established eligibility criteria, system to determine cost-effectiveness, meeting FEMA mitigation timeframes, accurate reporting, system to assess success of mitigation actions
- **Effectiveness**: Utilize mitigation programs to achieve goals.
- **Commitment**: Local mitigation planning support, statewide hazard mitigation program, financial support, enforce higher building codes, critical facility protection, and integration of mitigation into post-disaster recovery operations.

Role of the MAC

Serve as Planning Team

- Attend meetings
- Provide recommendations on the planning process and content
- Provide data to keep the plan current and strategize actions.
- Identify agency mitigation capabilities and actions
- Coordinate and/or lead steering committees to address special topics
- Review drafts
- Coordinate plan implementation efforts by linking resources and funding to actions
- Identify stakeholder success stories

The Planning Team & Stakeholders: Collaboration Across Sectors

The National Mitigation Framework has identified that in order to maximize State mitigation planning efforts, it is important to develop and maintain cooperative relationships between these seven sectors. Coordination among these 7 sectors is also a FEMA requirement.

Emergency Management

- The planning process is typically led at the State's emergency management agency by the State Hazard Mitigation Officer (SHMO), State mitigation planner, or designee
- Opportunity to integrate results from the Threat and Hazard Identification and Risk Assessment (THIRA)
- Staff from Emergency Support Function (ESF) and Recovery Support Function (RSF) agencies can serve on the planning team
  - MEMA utilizes State Coordinating Functions (SCFs)

Team Members & Stakeholders can include:

- Regional Emergency management Associations
- Police and fire protection agencies
- University and Colleges
- Amateur Radio Emergency Services (ARES)
- National Emergency Management Association Mitigation Committee and State Chapter

Economic Development

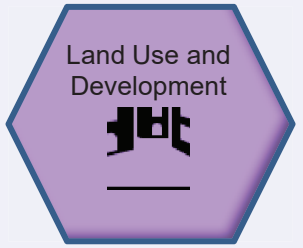
- Stakeholders and planning members from the economic development sector should have knowledge and understanding of current business and employment activities that are crucial for assessing State risk and developing a sound mitigation strategy
- Coordination with economic development agencies and business development agencies establishes a pre-disaster network that can be included in the State Hazard Mitigation Plan

Team Members & Stakeholders can include:

- Department of Commerce
- State Insurance Administration
- Small Business Administration (SBA)
- Economic Development Corporations
- Regional economic employers
- State Chambers of Commerce
- Education institutions

Land Use & Development

- How and where we build is intrinsically linked to how we are impacted by disasters
  - Existing, future development trends.
  - Land use regulations greatly reduce risks
  - Combining State planning efforts with hazard mitigation efforts will better position the State when making decisions that will prevent losses and result in long-term risk reduction.
- Develop model ordinances that will be adopted to local development controls and zoning regulations that are also aligned with the Hazard Mitigation Plan.



Team Members & Stakeholders can include:

- Planning Department
- Land trust groups
- American Planning Association (APA) State Chapter

Housing

- The housing sector provides insight into high risk areas and at risk populations
- Provide model building codes and other minimum standards for development that can reduce losses
- Opportunities to combine mitigation resources through Housing and Urban Development (HUD)
  - Coordinate HMGP funded projects with HUD CDBG-DR projects.
  - Integrate State mitigation planning with the goals of HUD's Consolidated Plan which assess States' affordable housing and community development.

Team Members & Stakeholders can include:

- Inspection and Code Authorities
- Housing & Community Development
- National Builder Groups
- National Association of Realtors
- National Association of Professional Insurance Agents
- American Planning Association (APA) State Chapter

Health & Social Services

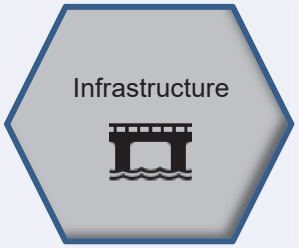
- The Health and Social Services sector plays an important role in providing social vulnerability assessments that are vital to State resilience and help ensure continuity of public service delivery during post recovery
- Opportunities to combine traditional mitigation funding sources with health related funding - linking vulnerable populations to grants and other assistance before and after a disaster
- Relevant state agencies might include:
  - Public health
  - Human services
  - Aging
  - Developmental disabilities
  - Education

Team Members & Stakeholders can include:

- Health and Social Service
- Department of Aging
- Volunteer Organizations Active in Disaster (VOAD)
- Red Cross
- Community Emergency Response Team
- Hospitals
- Schools

Infrastructure

- The infrastructure sector will assist in setting priorities and building resiliency as infrastructure is built and/or upgraded
- Planning Team members and stakeholders in this sector make decisions concerning the location and extension of roads and utilities through planning, budgets, regulations, codes, and other standards. They provide valuable information and data for the risk assessment and vulnerability analysis.



Team Members & Stakeholders can include:

- Transportation Departments/ Port Authorities
- Water and Wastewater Authorities
- American Council of Engineering (ACEC)
- American Society of Civil Engineers (ASCE)
- American Public Works Association (APWA)
- U.S. Coast Guard and Army Corps of Engineers – Navigable Waters
- Energy Administrations & Rural Electric Cooperatives

Natural & Cultural Resources

- Stakeholders from this sector can assist with identifying natural and cultural resources and informing the risk assessment. Including historic preservation-related mitigation actions can build public support for the plan.
- Environmental resources can play a key role in reducing future disaster losses by providing areas that naturally accommodate and buffer hazards.
- Natural and Cultural Resources Sector have the opportunity to effect policy change and to combine funding resources for structural mitigation projects.

Team Members & Stakeholders can include:

- Historic Societies and Trusts (SHPO)
- Department of Natural Resources
- Department of the Environment
- Department of Parks
- The Nature Conservancy
- Watershed Stewardship Programs
- Natural Resource Defense Council (NRDC)
- State Arts Council
- Archeological Associations

Who’s missing?

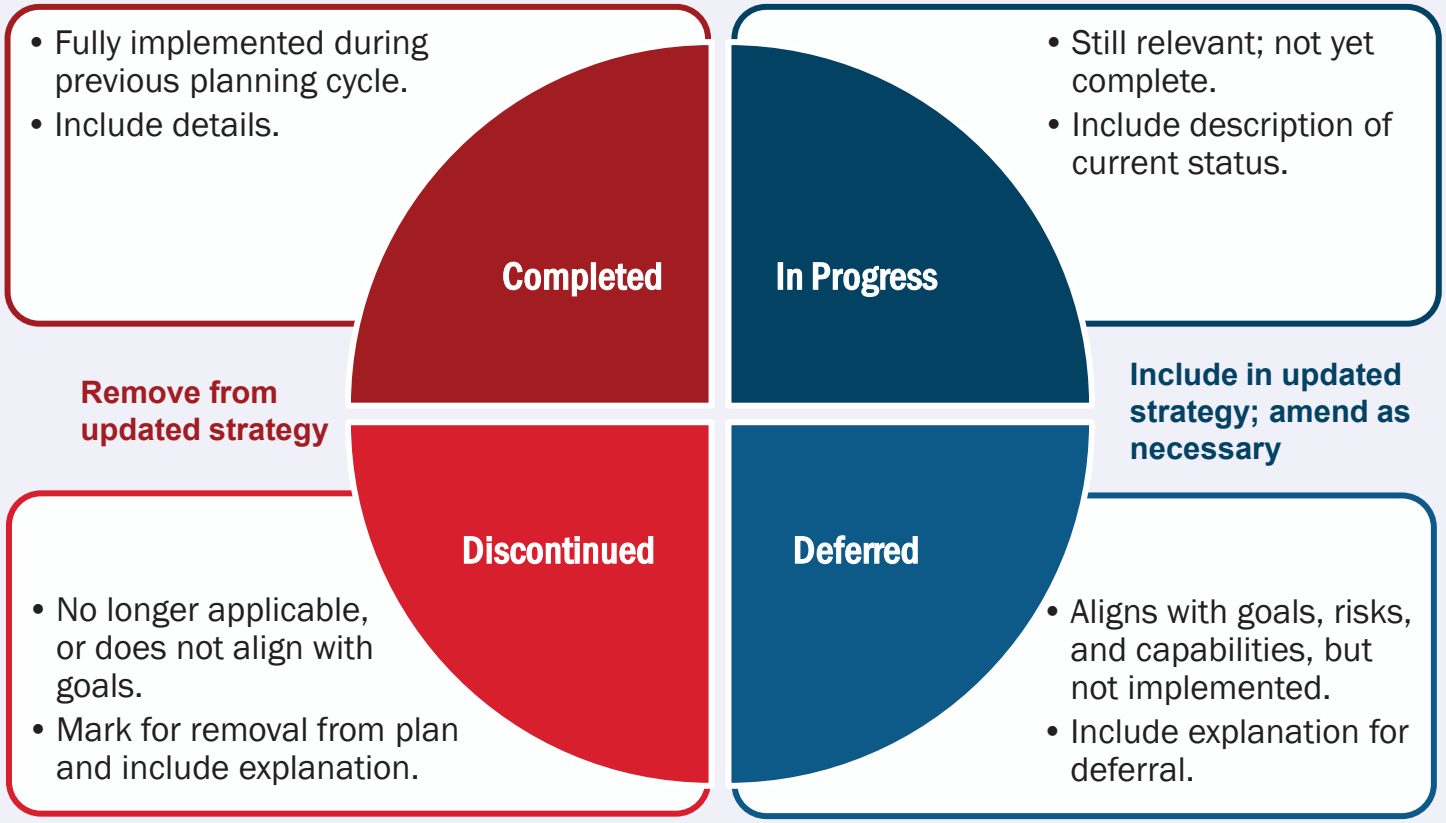
Review of 2016 SHMP

- Did the strategies lead to mitigation projects?
- Were there successes?
- Are the strategies long-term?
- Are the strategies applicable to current and future vulnerabilities?
- Do the strategies support changes in capabilities?
- Do the strategies conflict with or support other State initiatives?
- What is no longer relevant and should be eliminated?
- What areas require more time and resources?

2016 SHMP Strategies

- **Strategy 1**: Expand and enhance both the use and functionality of the MD FloodMap website as a "One-Stop-Shop" for all flood hazard related date and products.
- **Strategy** 2: Integrate historical and cultural resources into hazard mitigation data gathering analysis and planning initiatives.
- **Strategy 3**: Complete hazard mitigation plan specific activities for the 2016-2021 plan cycle.
- **Strategy 4**: Complete hazard mitigation and resiliency public outreach and training.
- **Strategy 5**: Target efforts to improve resiliency state-wide.
- **Strategy 6**: Continue data gathering and analysis specific to roadway flooding and sea-level rise.
- **Strategy 7**: Conduct non-flood related hazard risk and vulnerability assessments.
- **Strategy 8**: Refine and improve accuracy and dissemination of Repetitive Loss data and tools.

2016 SHMP Actions (36 total)



Goal Setting for 2021 Update

- Incorporating FEMA community lifelines and aligning the 7 seven sectors with the lifelines
- Integrating results from THIRA
- Ideas for public engagement and participation
- Special interests and steering committees
  - Future Conditions
  - Climate Change
  - SLR
- Frequency of MAC meetings

This page left blank intentionally

Hazard Identification/Risk Assessment Meeting Information

This page left blank intentionally

VIRTUAL MEMA State Hazard Mitigation Plan
Meeting Summary
Hazard Identification and Risk Assessment (HIRA)
October 15, 19 and 20, 2020

Overall Focus and Intent

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Notes were captured by the AECOM Team

Agenda

- **Welcome and Introductions – MEMA**
- **Hazard Identification and Risk Assessment (including Region specific maps) Overview and Briefing – Plan Update Team**
- **Questions/Discussion - MEMA**
- **Overview of Virtual Room and Stakeholder Engagement activities - MEMA**

Total attendees: 131

Key takeaways from the meetings:

- Overall: Review Dam Safety addendum, re-scale maps in accordance, double check that recent storms/events are included in the data as appropriate
- Western Region – concerns with dam information
- Central Region – review Thunderstorm and Extreme Temperature risk data
- Southern Region – Review flooding against August 2020 flood numbers
- Upper Eastern Shore Region – review the dam information, specifically around Conowingo
- Lower Eastern Shore Region – no issues raised.
- Additional data needs and tasks:
    - Complete wildfire analysis
    - Incorporate Dam addendum into HIRA

VIRTUAL MEMA State Hazard Mitigation Plan
Western Region Meeting
Hazard Identification and Risk Assessment (HIRA)
October 15, 2020
1:00 – 2:00PM

Overall Outcome

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda

- **Welcome and Introductions – MEMA**
- **Hazard Identification and Risk Assessment (including Region specific maps) Overview and Briefing – Plan Update Team**
- **Questions/Discussion - MEMA**
- **Overview of Virtual Room and Stakeholder Engagement activities - MEMA**

Attendee List – affiliation listed, if known (27 total)

MEMA and Planning Team	Attendees
Kyle Overly (MEMA)	Jesse Ash
JaLeesa Tate (MEMA)	Joseph Bucovetsky
Kristen Forti (MEMA)	Marcos Collins - DHS
Jen Sparenberg (MES)	Dave G
Lael Holton (AECOM)	Eric Hodge
Amy Baker (AECOM)	Joey Krastel
Aranzazu Pacqua (AECOM)	Tim La Valle
Natalie Ciletti (AECOM)	Brian Lowman
Jessica Bennett (AECOM)	Tasha McNutt
Jennifer Kellar (AECOM)	Joshua Norris
Deepa Srinivasan (VPC)	John Reginaldi
Ashley Samonisky (VPC)	Kristen Skogsberg
	Kevin Wagner – MDE
	Norman Wang

MEMA and Planning Team	Attendees
	Amy (**last name not provided**)

Notes from the meeting:

- Kevin Wagner - make sure the subsidence and saltwater intrusion are included for consideration/mitigation strategies.
  - JaLeesa Tate- will do; SWI could go in Coastal; Subsidence should already be covered in Land Movement
- Dave G - expressed concerns about Dam Safety, that the Western rating seems low given the prevalence of large dams in Garrett, Allegany, the City of Oakland
  - JaLeesa Tate /Natalie Ciletti - we will review the scaling
  - Amy Baker – there will be a possible connection to the Mitigation Strategies
  - JaLeesa Tate - since the hazard is new, this could very well be a baselining map that requires more work in the next 5 years with Dam Safety
- Overall positive reactions to the material and the Virtual Room; link to the virtual room will be sent out after the meetings are over.

Meeting concluded at 1:56 PM

Teams meeting information

Join Microsoft Teams Meeting

+1 213-204-2377 United States, Los Angeles (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 420 992 481#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1175942800

Alternate VTC dialing instructions

VIRTUAL MEMA State Hazard Mitigation Plan
Central Region Meeting
Hazard Identification and Risk Assessment (HIRA)
October 19, 2020
10:00 – 11:00AM

Overall Outcome

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda

- **Welcome and Introductions – MEMA**
- **Hazard Identification and Risk Assessment (including Region specific maps) Overview and Briefing – Plan Update Team**
- **Questions/Discussion - MEMA**
- **Overview of Virtual Room and Stakeholder Engagement activities - MEMA**

Notes from the meeting:

- Make sure participants get the presentation (via JaLeesa)
- Megan E Granato - I am surprised that Howard County had a lower thunderstorm risk rating than the surrounding counties, especially given the loss of life associated with the EC storms.
  - Answer: EC storms covered under flooding, not Thunderstorm
- Sally Claggett Public health stats are very limited. We use stats like access to parks/open space.
- Sally Claggett - for flood issues, what about showing the risk in terms of loss of flood-abating land cover like wetlands, natural shorelines, and forests?
  - Answer: Yes, we have those data sources.
- Dave Robbins - MEMA: Weighted Scale, more specifically, anywhere in the plan in the plan of risk vs. hazard
  - Might be able to get hands on layer of high landslide risk. Will send to JaLeesa
  - Might be able to get a contact at Forest Service

- Sally Claggett We also have maps that show risks of extreme heat if helpful. How are "critical" facilities defined? Sorry if I missed it. What about risks to drinking water (public health)?
  - Answer: Could include protection of well heads, surface water sources (well buffered by beneficial land uses)
  - Answer: Saltwater intrusion could fall into here.
- Sally Claggett That virtual room is cool

Meeting concluded at 10:56AM

Attendee List – affiliation listed, if known (41 total)

JaLeesa Tate (MEMA)	**Megan E Granato**
Kristen Forti (MEMA)	Alexandra D. Harris
Jen Sparenberg (MES)	Mark Harris
Lael Holton (AECOM)	Chris Hiles (OEM)
Amy Baker (AECOM)	Valerie D. Hawkins
Aranzazu Pacqua (AECOM)	Jim Hummerick
Natalie Ciletti (AECOM)	Joey Krastel
Jessica Bennett (AECOM)	Dave Mandell
Jennifer Kellar (AECOM)	Lisa McNeilly (DOP)
Deepa Srinivasan (VPC)	Dawn Hawkins-Nixon
Ashley Samonisky (VPC)	Joshua Norris
Steve Allan	Dave Robbins (MEMA)
Jesse Ash	Small, Darrell
Bethany Brown	Talay, Tiffany
Joseph Bucovetsky	Kerry Topovski (Guest)
Sally Claggett	Patrick Varga
Christina Cornwell	Kevin Wagner – MDE
John Dulina	Norman Wang
Tara Espinola	David Zarnick
Aubrey Germ (DOP)	

Teams meeting information

Join Microsoft Teams Meeting

+1 213-204-2377 United States, Los Angeles (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 617 052 750#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1165944243

Alternate VTC dialing instructions

VIRTUAL MEMA State Hazard Mitigation Plan
Southern Region Meeting
Hazard Identification and Risk Assessment (HIRA)
October 19, 2020
2:00 – 3:00PM

Overall Outcome

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda

- **Welcome and Introductions – MEMA**
- **Hazard Identification and Risk Assessment (including Region specific maps) Overview and Briefing – Plan Update Team**
- **Questions/Discussion - MEMA**
- **Overview of Virtual Room and Stakeholder Engagement activities - MEMA**

Notes from the meeting:

- Kevin Wagner - There was some significant flooding in Leonardtown in August 2020, so I don't understand how the County's flood risk went down.
  - Answer: The team cut off the data pull in early August; this can be incorporated back in with the final product.
- During the August 2020 flooding, a pond failed at Secretariat Drive, Hollywood, MD. It wasn't designed to be dam.
- Michael Grierson - Where do we capture the coastal erosion for the Cliffs (Calvert)
  - Answer: We will check the erosion section to see if it fits.
- Michael Grierson - Isaias - is it in the data?
  - Answer: It was not included for the data runs, but IS identified as awaiting a declaration in the narrative.
- Kara Buckmaster - will send updated information to Ashley Samonisky/JaLeesa Tate
- Kara Buckmaster - This is a very cool resource. Great job!

Meeting concluded at 2:48PM

Attendee List – affiliation listed, if known (21 total)

MEMA and Planning Team	Attendees (Cont)
JaLeesa Tate (MEMA)	Kara R. Buckmaster
Kristen Forti (MEMA)	Joseph Bucovetsky
Jen Sparenberg (MES)	Michael E. Grierson
Lael Holton (AECOM)	Joy Hatchette
Amy Baker (AECOM)	Mark Harris
Aranzazu Pacqua (AECOM)	Colleen Kenny
Natalie Ciletti (AECOM)	Joey Krastel
Ashley Samonisky (VPC)	Joshua Norris
	Dona Sorce
Attendees	Jennifer (Guest)
Jennifer Adams	Kevin Wagner
Jesse Ash	+1 301-429-7502

Teams meeting information

Join Microsoft Teams Meeting

+1 213-204-2377 United States, Los Angeles (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 132 626 379#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1174153532

Alternate VTC dialing instructions

VIRTUAL MEMA State Hazard Mitigation Plan
Upper Eastern Shore Region Meeting
Hazard Identification and Risk Assessment (HIRA)
October 20, 2020
10:00 – 11:00AM

Overall Outcome

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda

- **Welcome and Introductions – MEMA**
- **Hazard Identification and Risk Assessment (including Region specific maps) Overview and Briefing – Plan Update Team**
- **Questions/Discussion - MEMA**
- **Overview of Virtual Room and Stakeholder Engagement activities - MEMA**

Notes from the meeting:

- Kevin Wagner – That's interesting that Cecil County got a Medium Risk rating for dams. The Conowingo Dam is a massive structure and its failure would be catastrophic for Port Deposit. In addition to that, how might the water quality side fit in? Sedimentation behind the dam is problematic. Exelon settled to provide more than $200 million toward Chesapeake Bay restoration and environmental projects. That might help supplement other FEMA projects.
  - Answer: MDE completed a Dam Addendum in July, the Team will review this for inclusion. As to the water quality, that is an effect of good mitigation, so will be considered with Strategies.
- Virginia Gregg – why a difference in Extreme Temps? Where is erosion considered?
  - Answer – The team will review the data to ensure that it is consistent; erosion is in Coastal Hazards

Meeting concluded at 10:41AM

Attendee List – affiliation listed, if known (21 total)

MEMA and Planning Team	Attendees (Cont)
JaLeesa Tate (MEMA)	Irvin Church (MDHS)
Kyle Overly (MEMA)	Alexandra DeWeese
Kristen Forti (MEMA)	Tara Espinola
Jen Sparenberg (MES)	Virginia Gregg
Lael Holton (AECOM)	Michael E. Grierson
Amy Baker (AECOM)	Dave Guignet
Aranzazu Pacqua (AECOM)	Joy Hatchette
Natalie Ciletti (AECOM)	Mark Harris
Jennifer Kellar (AECOM)	Joey Krastel
Ashley Samonisky (VPC)	Joshua Norris
	Linda Ploener
Attendees	Kevin Wagner
Jennifer Adams	+1 443-744-9073
Jesse Ash	+1 443-744-9073
Joseph Bucovetsky	+1 443-875-8085
Nicole Carlozo	

Teams meeting information

Join Microsoft Teams Meeting

+1 213-204-2377 United States, Los Angeles (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 165 520 932#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1196583542

Alternate VTC dialing instructions

VIRTUAL MEMA State Hazard Mitigation Plan
Lower Easter Shore Region Meeting
Hazard Identification and Risk Assessment (HIRA)
October 20, 2020
2:00 – 3:00PM

Overall Outcome

- Provide regional stakeholders with an update on the progress of the HIRA for the update to the State's Hazard Mitigation Plan; provide an overview of findings to date, solicit additional information/data and provide information for the stakeholders to access and review the Plan Update documents.

Location/Logistics

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda

- **Welcome and Introductions – MEMA**
- **Hazard Identification and Risk Assessment (including Region specific maps) Overview and Briefing – Plan Update Team**
- **Questions/Discussion - MEMA**
- **Overview of Virtual Room and Stakeholder Engagement activities - MEMA**

Notes from the meeting:

- No Comments from the attendees

Meeting concluded at 10:41AM

Attendee List – affiliation listed, if known (21 total)

MEMA and Planning Team	Attendees
JaLeesa Tate (MEMA)	Irvin Church (MDHS)
Kyle Overly (MEMA)	Alexandra DeWeese
Kristen Forti (MEMA)	Tara Espinola
Jen Sparenberg (MES)	Virginia Gregg
Lael Holton (AECOM)	Michael E. Grierson
Amy Baker (AECOM)	Dave Guignet
Aranzazu Pacqua (AECOM)	Joy Hatchette
Natalie Ciletti (AECOM)	Mark Harris

MEMA and Planning Team	Attendees
Jennifer Kellar (AECOM)	Joey Krastel
Ashley Samonisky (VPC)	Joshua Norris
	Linda Ploener
Attendees	Kevin Wagner
Jennifer Adams	+1 443-744-9073
Jesse Ash	+1 443-744-9073
Joseph Bucovetsky	+1 443-875-8085
Nicole Carlozo	

Teams meeting information

Join Microsoft Teams Meeting

+1 213-204-2377 United States, Los Angeles (Toll)

(877) 286-5733 United States (Toll-free)

Conference ID: 857 609 438#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

176484854@teams.bjn.vc VTC Conference ID: 1181416730

Alternate VTC dialing instructions

_____The

_____

2021 Maryland HIRA

Western Region

Hazard Identification

2016 Mitigation Plan

- Coastal Hazards
- Drought
- Flood
- Thunderstorm
- Tornado
- Wildfire
- Wind
- Winter Storm

2021 Mitigation Plan

- Same 8 hazards in 2016 plan
- 5 new hazards:
  - Dam Failure
  - Extreme Temperatures
  - Human Caused Hazards
  - Public Health Emergencies
  - Soil Movement

Region's Risk

	2016 Plan			2021 Update		
Hazard	**Allegany**	**Garret**	**Washington**	**Allegany**	**Garret**	**Washington**
Coastal Hazards	Low	Medium-Low	Medium-Low	Low	Medium-Low	Medium-Low
Drought	Medium-Low	Medium-Low	Medium-High	Medium-Low	Medium-Low	Medium
Flood	Medium-High	Medium	Medium	Medium	Medium	Medium
Thunderstorm	Medium-High	Medium	Medium	Medium	Medium	Medium
Tornado	Medium-High	Medium-High	Medium	Medium-High	Medium-High	Medium-High
Wildfire	Medium-High	Medium-High	Medium	Medium-High	Medium-High	Medium
Wind	Medium	Medium	Medium-High	Medium	Medium	Medium-High
Winter Storm	High	High	High	High	Medium-High	Medium-High

Region's Risk

New Hazards

	2021 Plan		
Hazard	**Allegany**	**Garret**	**Washington**
Dam Failure	Medium-Low	Medium-Low	Medium
Extreme Temperatures	Medium	Medium-Low	Medium-Low
Human Caused	Medium	Medium-Low	Medium-Low
Public Health	Medium-High	Medium-High	Medium-High
Soil Movement	Medium	Medium	Medium

Methodology

Nine ranking parameters used:

- Population Vulnerability
- Population Density
- Injuries
- Deaths
- Property Damage
- Crop Damage
- Events
- Geographic Extent
- Local Hazard Ranking

Weighted Risk Factors

Population Vulnerability	*PV*	0.5
Population Density	*PN*	0.5
Injuries	*IN*	1
Deaths	*DT*	1
Property Damage (Annualized)	*PD*	1
Crop Damage (Annualized)	*CD*	1
Events (Annualized)	*EV*	1
Geographic Extent (Hazard Dependent)	*GE*	1.5
Local Plan Ranking	*LOCAL*	1.5

Overall Score

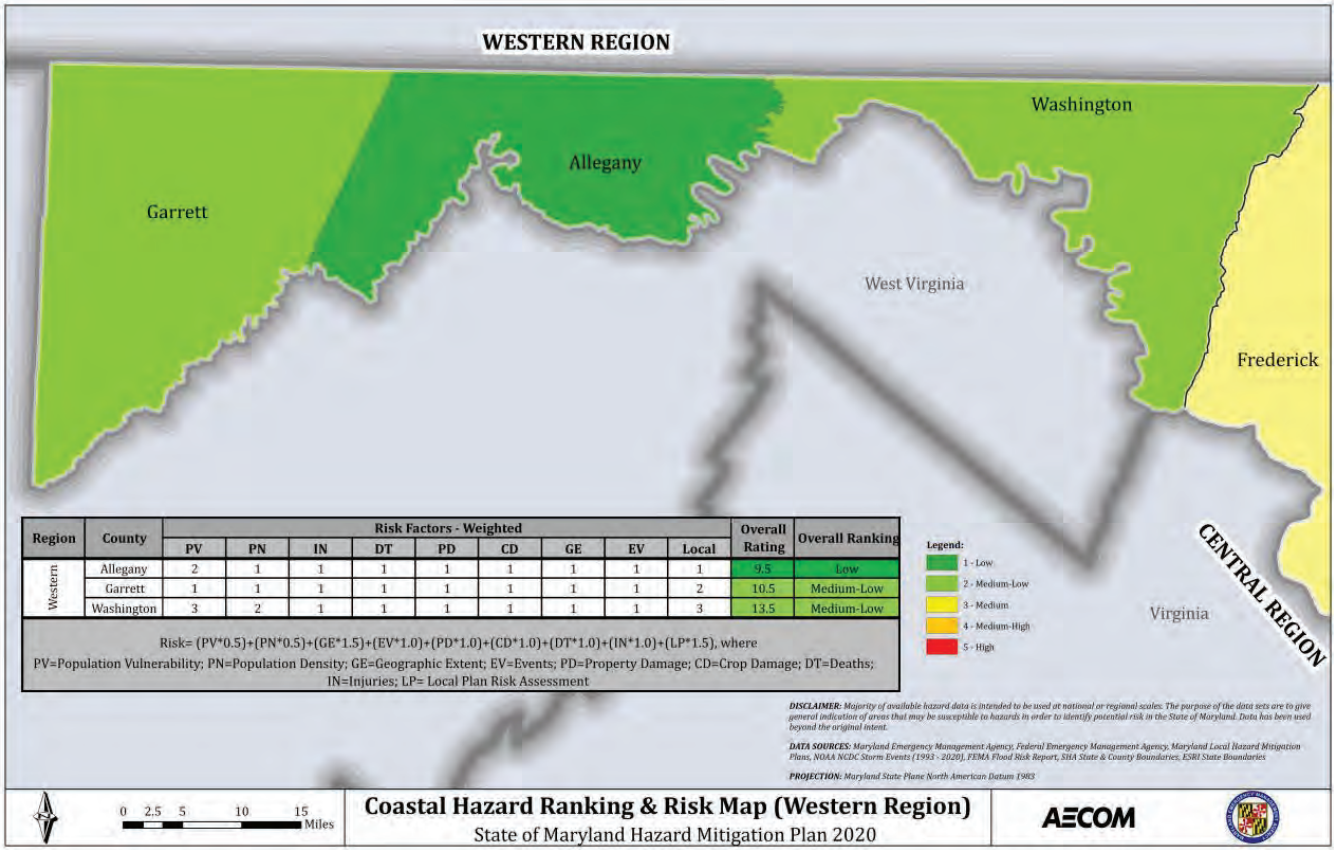
Score (>=)	*Hazard Risk Rank*
0	Low
10.5	Medium-Low
14.5	Medium
18.5	Medium-High
23	High

No Local Plan Ranking Score

Score (>=)	*Hazard Risk Rank*
0	Low
6	Medium-Low
10	Medium
14	Medium-High
18	High

Coastal Hazard

- Low – Medium Low Risk
- Data Sources include NCDC and Maryland Coastal Study Flood Risk Reports
- Calculated using % of Coastal Land Area



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	1	9.5	Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	1	1	1	3	13.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

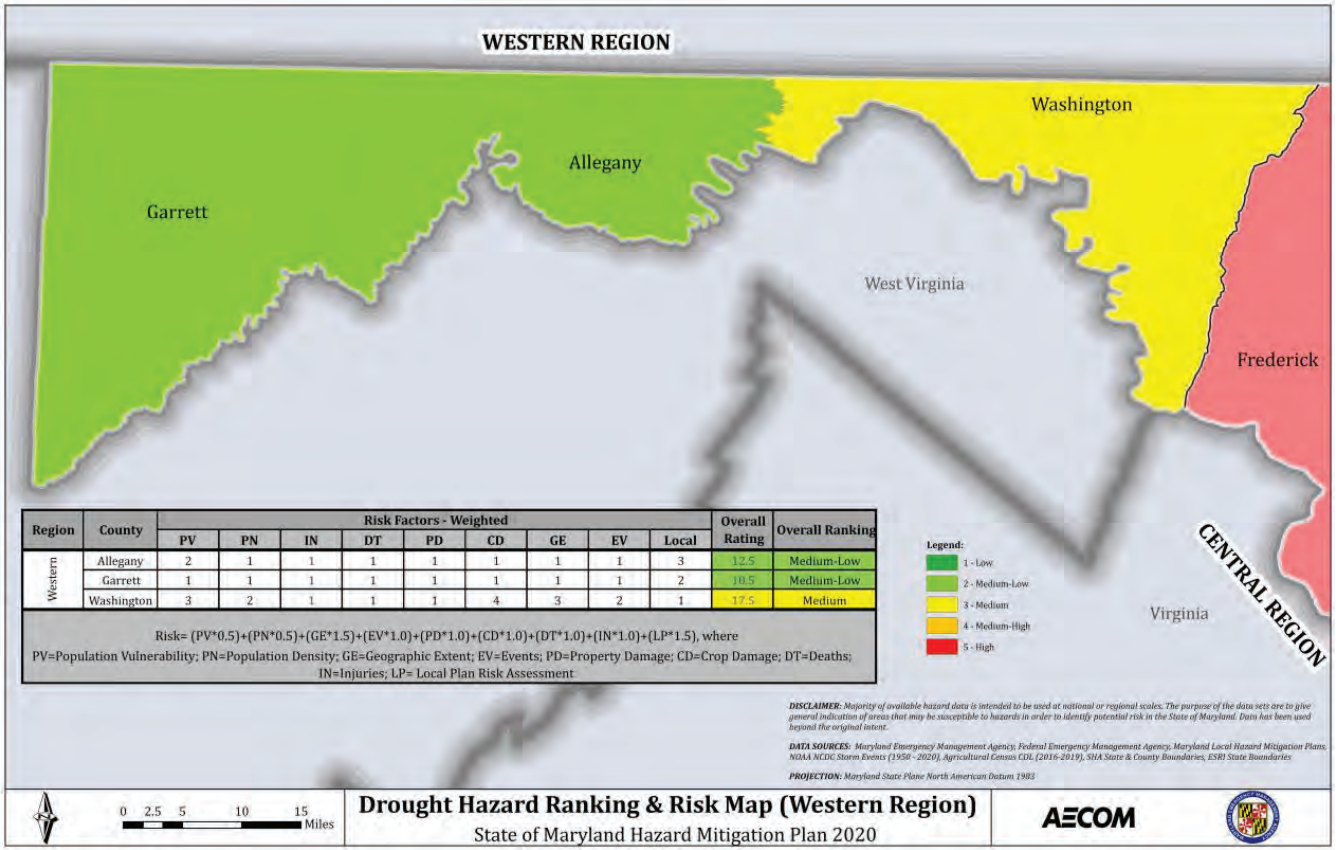
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Drought

- Medium Low - Medium Risk
- Data Sources include USDA Census of Agriculture and CDL MD
- Calculated using % of Crop Area



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	3	12.5	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	4	3	2	1	17.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

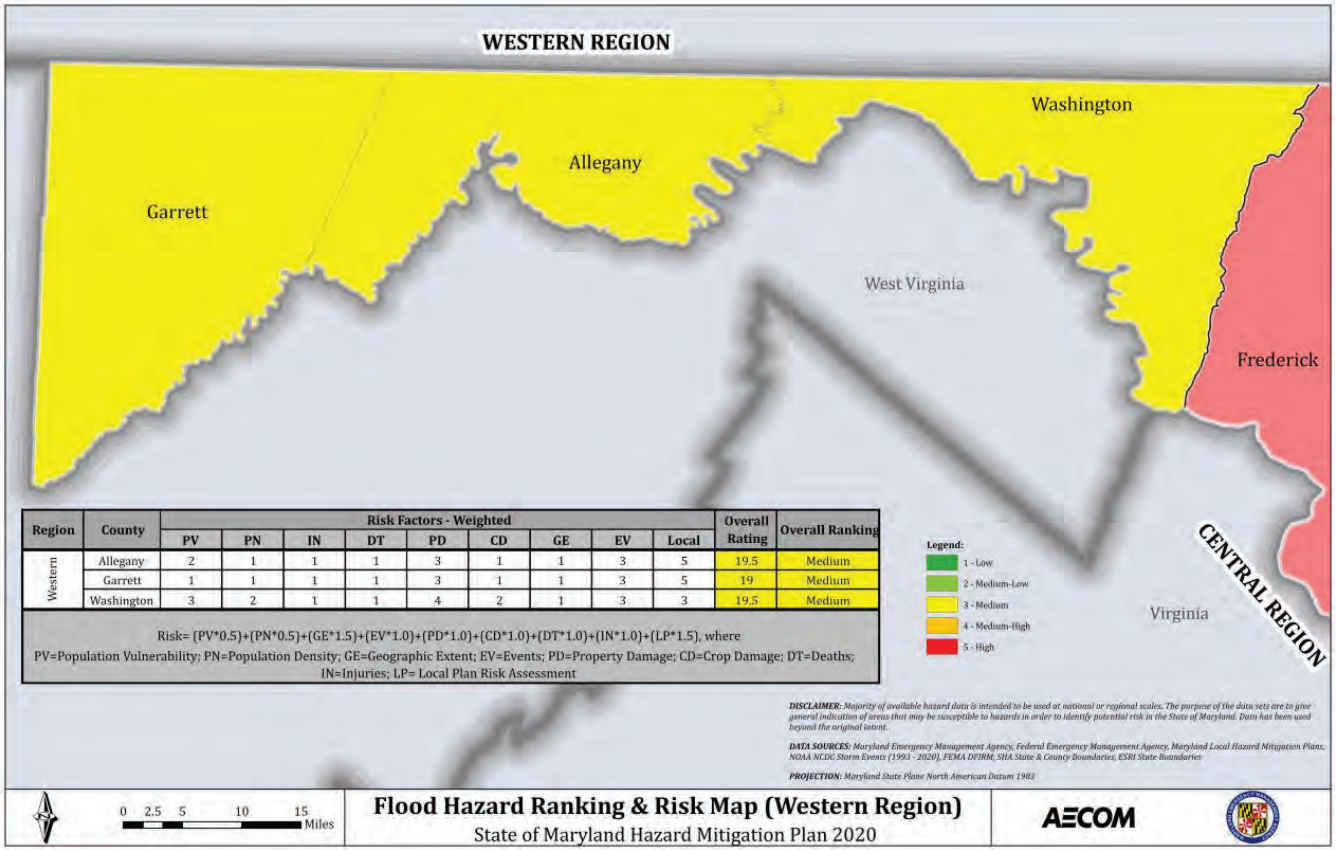
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Flood Hazard

- Medium Risk
- Data Sources include FEMA Preliminary and Effective DFIRMS
- Calculated using % Area in 100-year Floodplain



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	3	1	1	3	5	19.5	Medium
	Garrett	1	1	1	1	3	1	1	3	5	19	Medium
	Washington	3	2	1	1	4	2	1	3	3	19.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

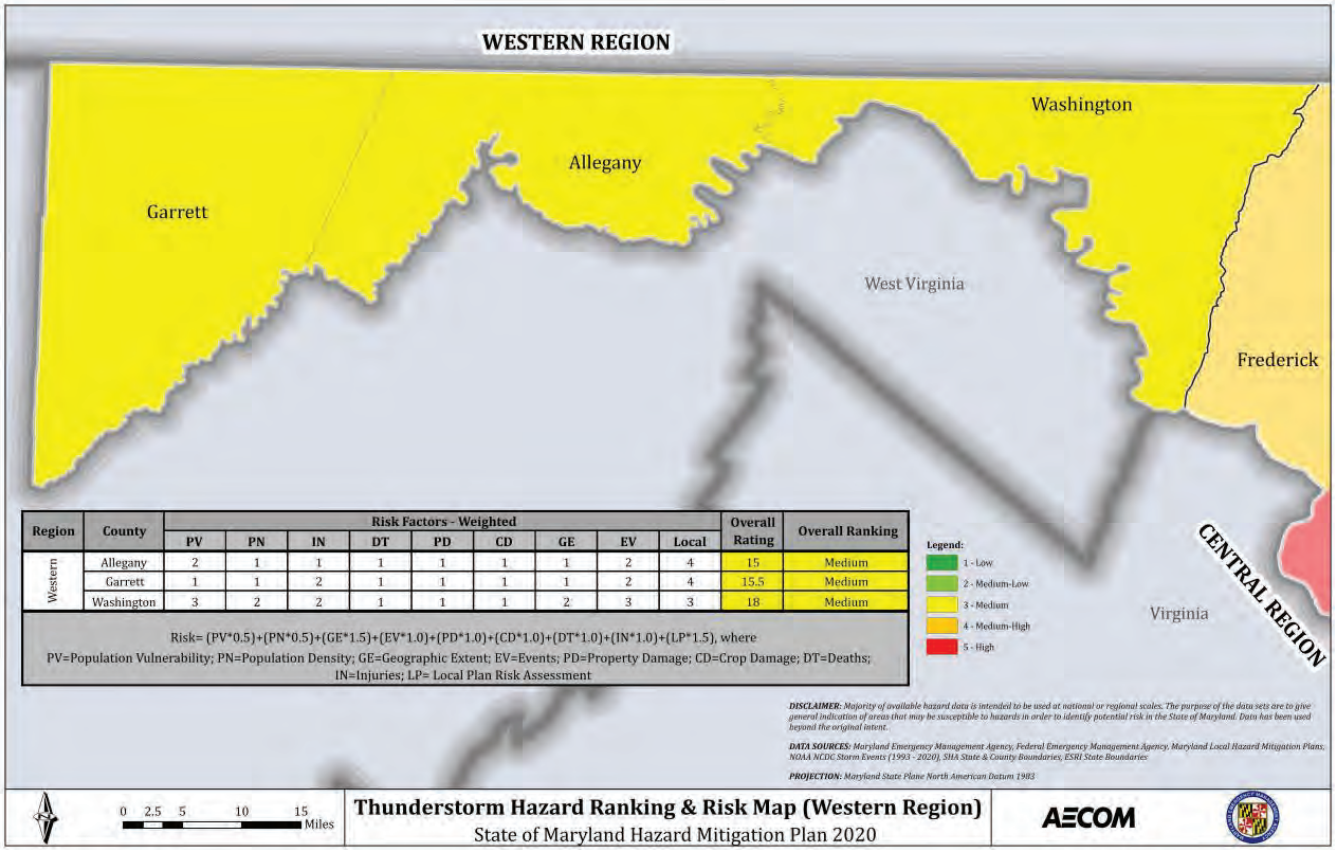
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Thunderstorm

- Medium Risk
- Data Sources include NCDC Storm Events Database
- Average number of events with greater than 2", hail and lightening events with Injuries/Deaths



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	2	4	15	Medium
	Garrett	1	1	2	1	1	1	1	2	4	15.5	Medium
	Washington	3	2	2	1	1	1	2	3	3	18	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

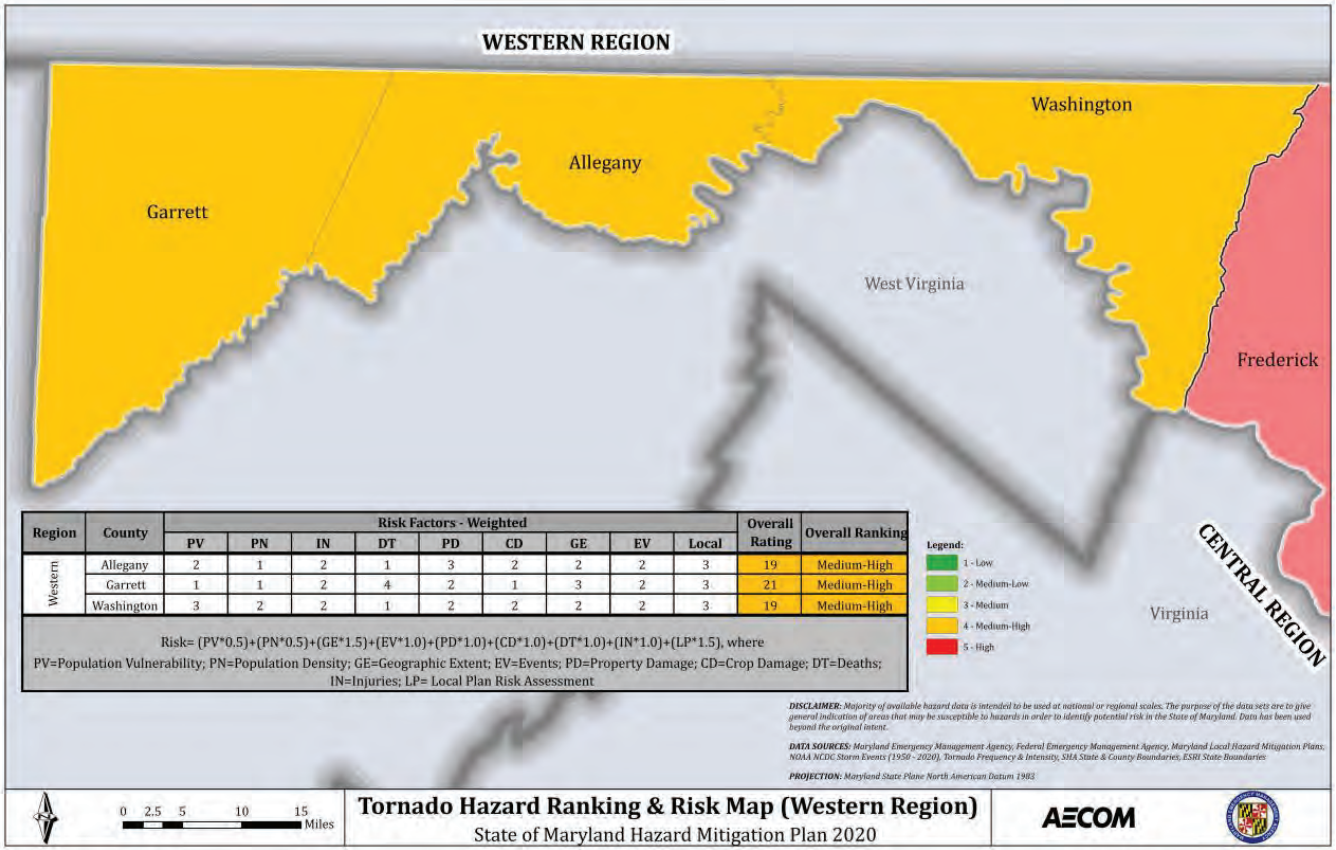
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Tornado

- Medium High Risk
- Data Sources include NCDC Storm Events Database
- Calculated using sum of all tornados weighted by intensity (F-scale)



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	3	2	2	2	3	19	Medium-High
	Garrett	1	1	2	4	2	1	3	2	3	21	Medium-High
	Washington	3	2	2	1	2	2	2	2	3	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

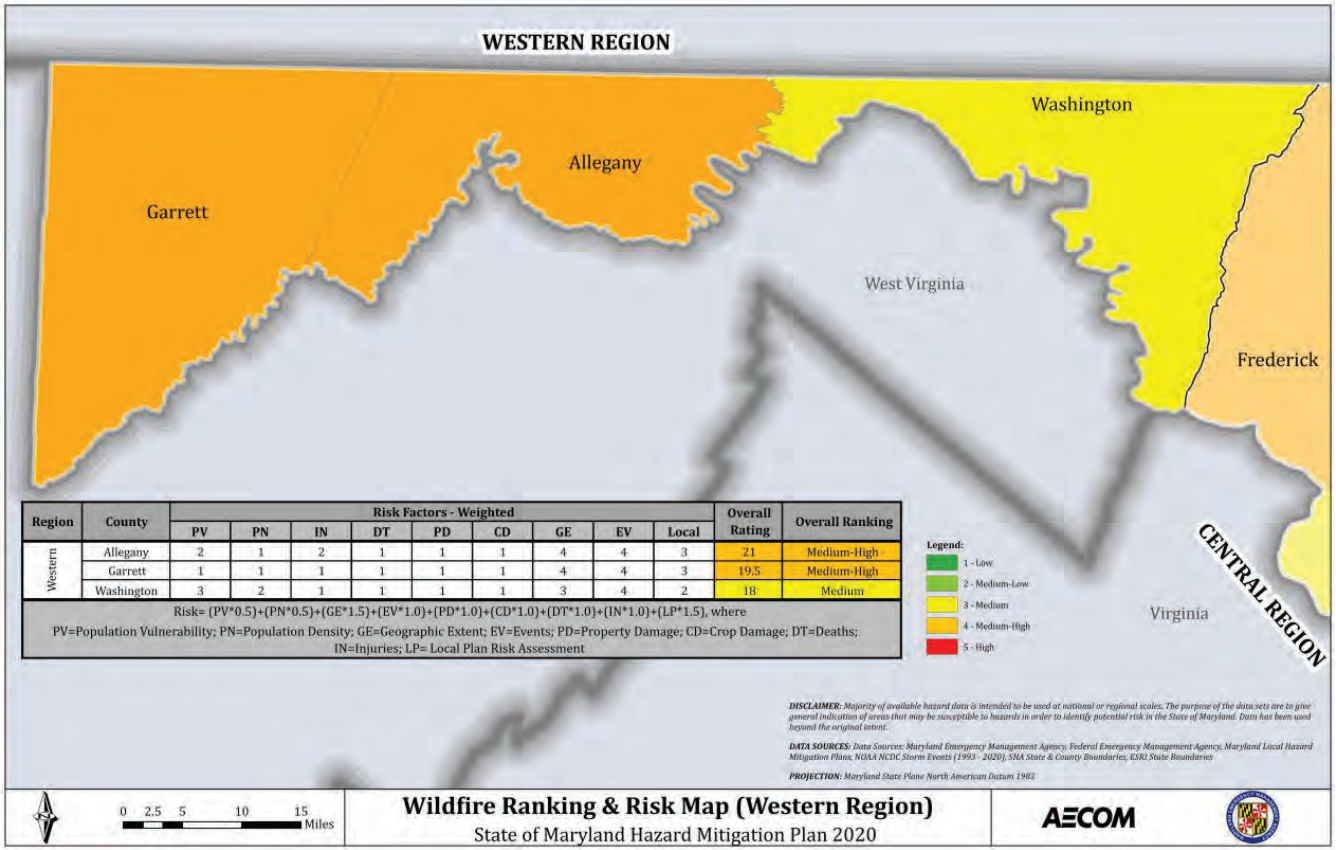
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Wildfire

- Medium - Medium High Risk
- Data Sources include MD DNR Forest Service Risk Assessment Layer
- Calculated using % area found in high and medium-high risk area.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	4	4	3	21	Medium-High
	Garrett	1	1	1	1	1	1	4	4	3	19.5	Medium-High
	Washington	3	2	1	1	1	1	3	4	2	18	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

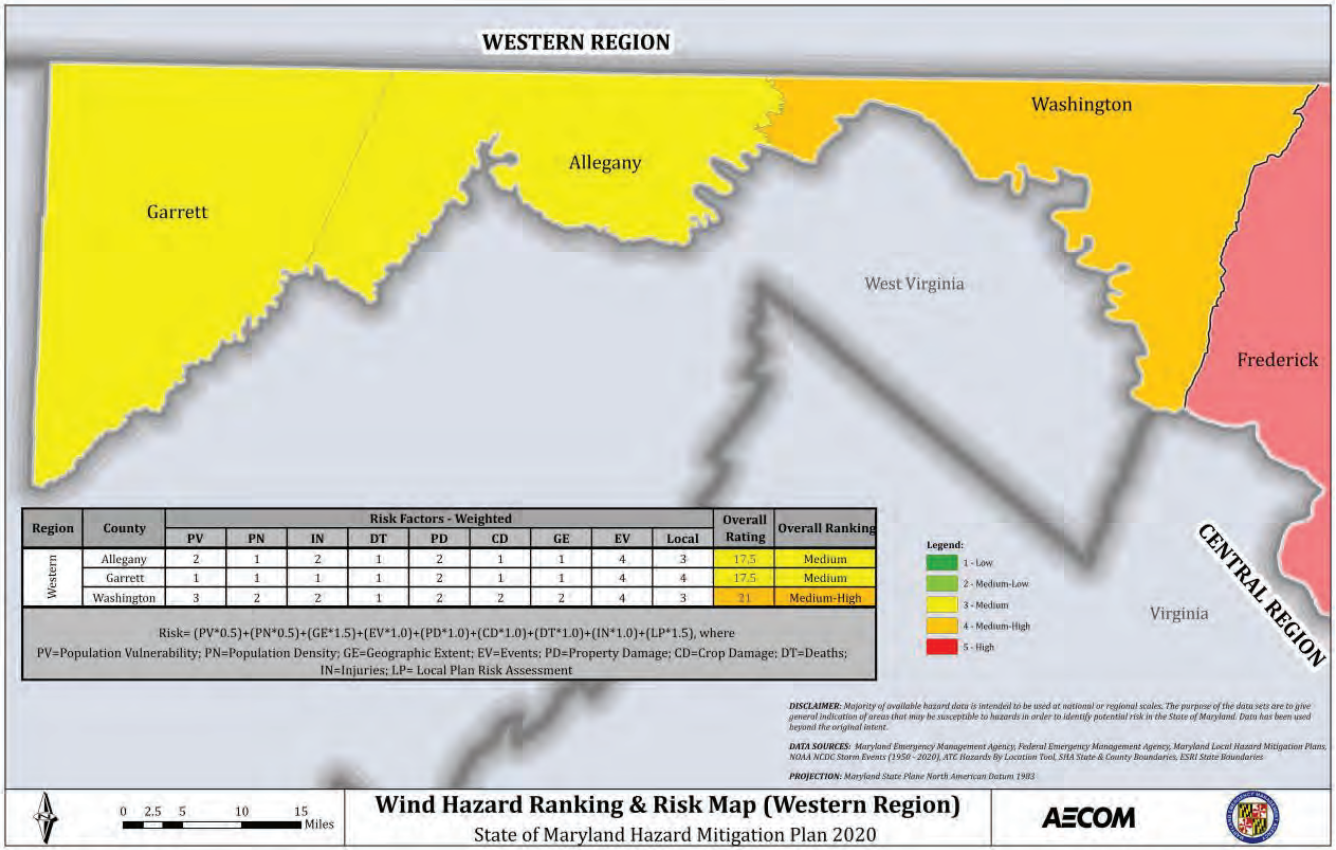
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Data Sources: Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Wind Hazard

- Medium - Medium High Risk
- Data Sources include NCDC Storm Event Database and ASCE
- Calculated using ASCE Design Wind Speeds



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	2	1	1	4	3	17.5	Medium
	Garrett	1	1	1	1	2	1	1	4	4	17.5	Medium
	Washington	3	2	2	1	2	2	2	4	3	21	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

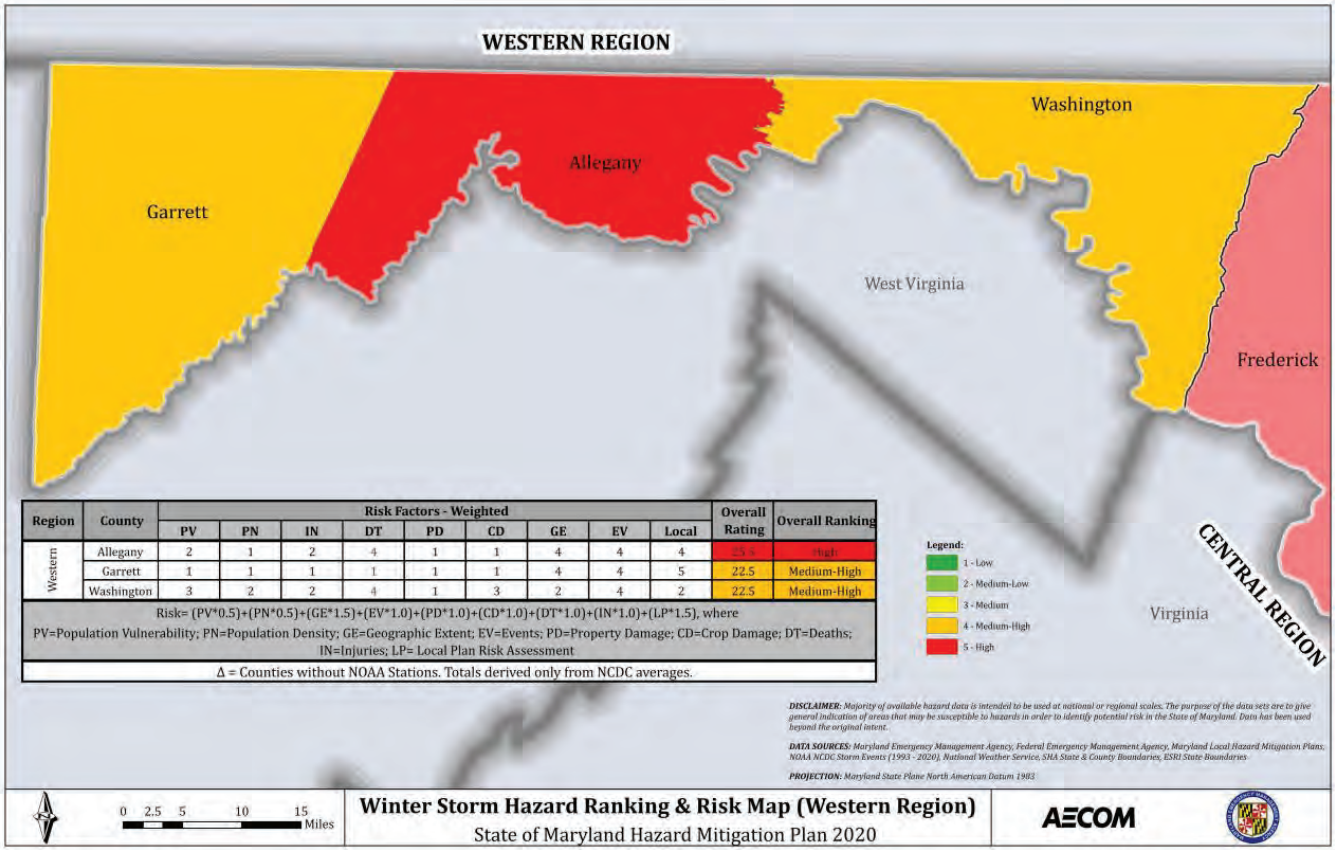
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Winter Storm

- Medium High – High Risk
- Data Sources include National Weather Service
- Calculated using Average total Snowfall



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	4	1	1	4	4	4	25 *	High
	Garrett	1	1	1	1	1	1	4	4	5	22.5	Medium-High
	Washington	3	2	2	4	1	3	2	4	2	22.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

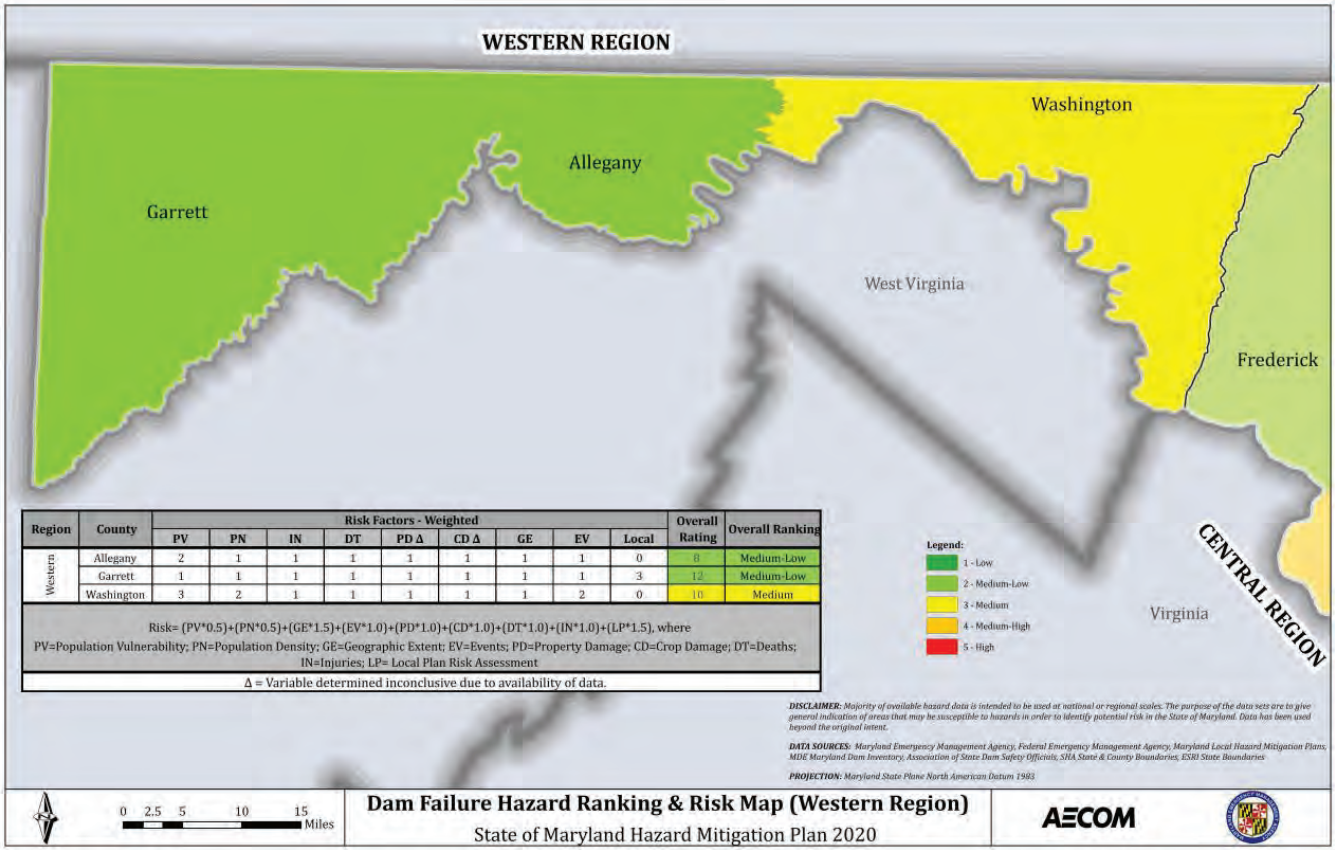
DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

NEW HAZARDS

Dam Failure

- Medium Low - Medium Risk
- Data Sources include MDE High Hazard Dams
- Calculated using sum of high hazard dams per county.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	0	8	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	1	1	1	1	1	2	0	10	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

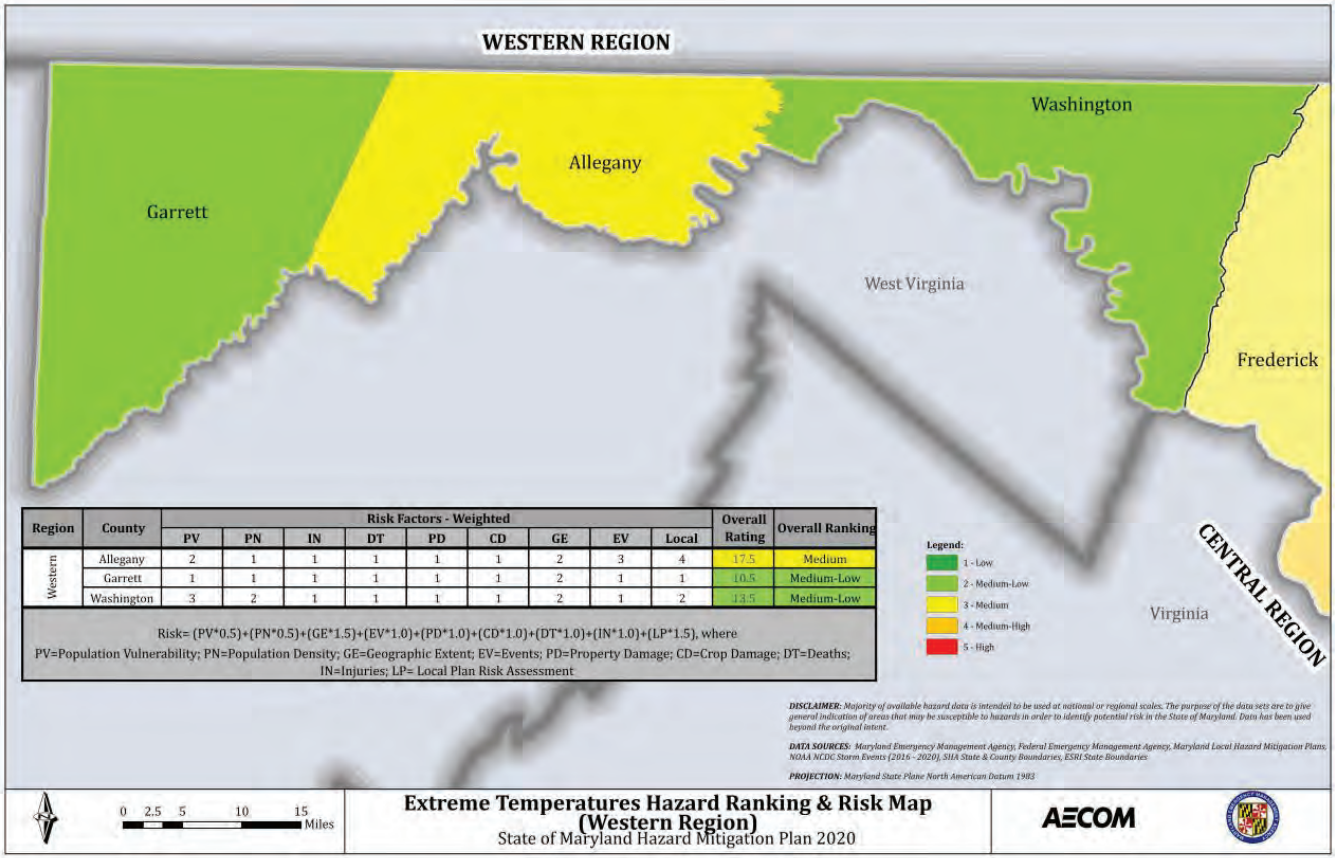
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans; MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Extreme Temperatures

- Medium Low - Medium Risk
- Data Sources include NCDC Storm Database
- Average number of extreme temperature events (Excessive Heat & Extreme Cold/Wind Chill)



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	2	3	4	17.5	Medium
	Garrett	1	1	1	1	1	1	2	1	1	10.5	Medium-Low
	Washington	3	2	1	1	1	1	2	1	2	13.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

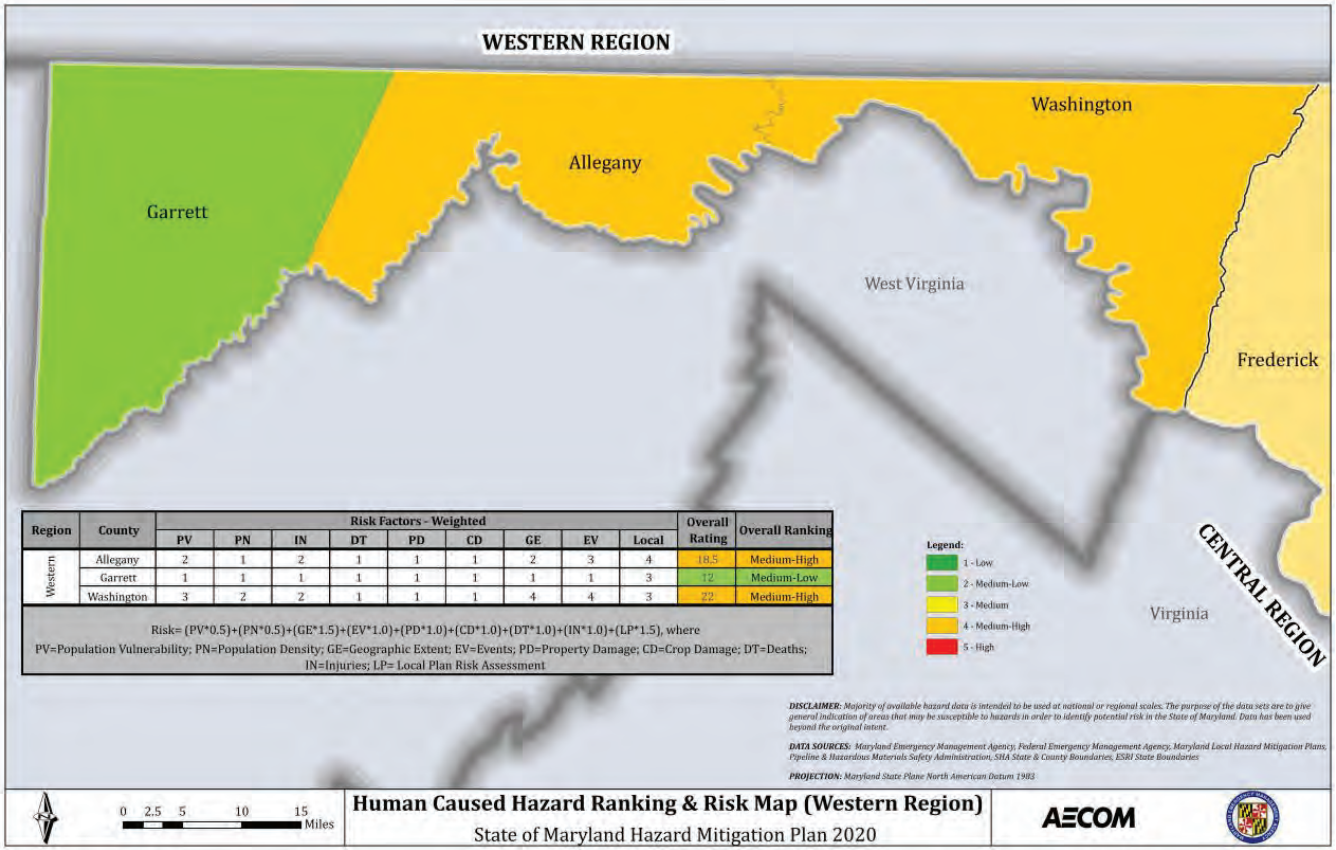
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Human-Caused Hazards & Threats

- Medium Low – Medium High Risk
- Data Sources include PHMSA
- Calculated based on number of Hazmat events



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	2	3	4	18.5	Medium-High
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	2	1	1	1	4	4	3	22	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

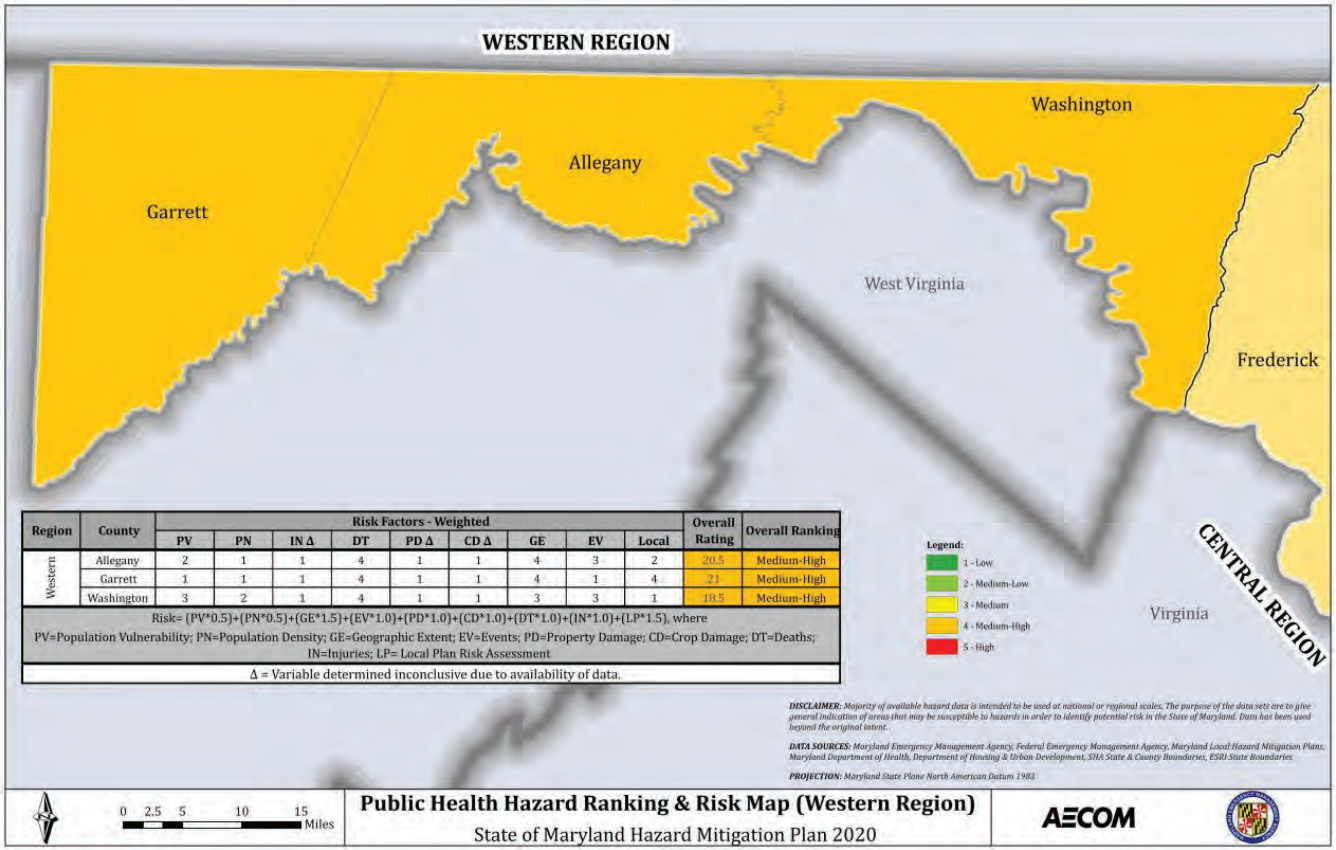
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Public Health

- Medium High Risk
- Data Sources include HUD
- Calculated based on Median Income



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	4	1	1	4	3	2	20.5	Medium-High
	Garrett	1	1	1	4	1	1	4	1	4	21	Medium-High
	Washington	3	2	1	4	1	1	3	3	1	18.5	Medium-High

Risk= {PV*0.5}+{PN*0.5}+{GE*1.5}+{EV*1.0}+{PD*1.0}+{CD*1.0}+{DT*1.0}+{IN*1.0}+{LP*1.5}, where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

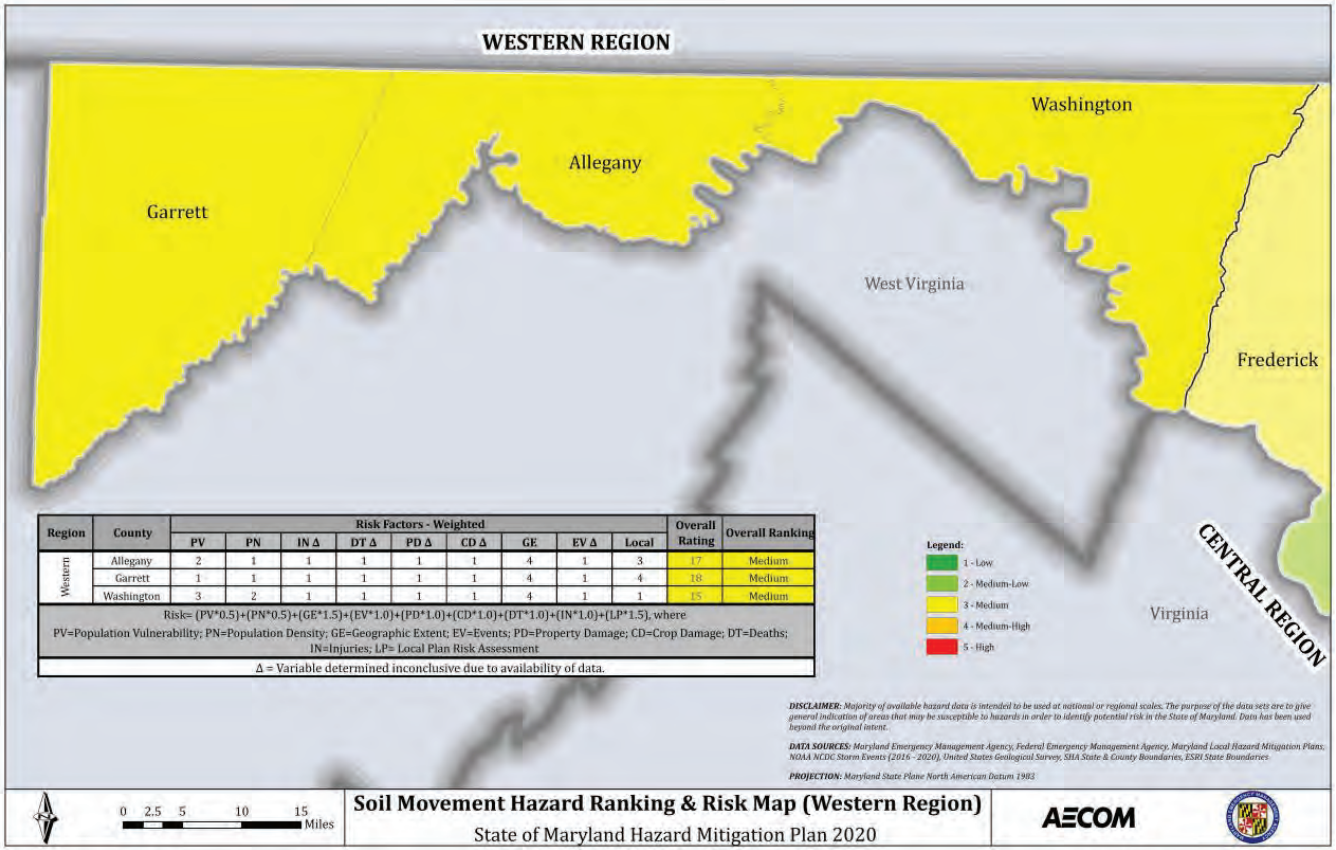
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Soil Movement

- Medium Risk
- Data Sources include USGS KARST Data
- Calculated using % KARST area



Region	County	Risk Factors - Weighted								Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local	
Western	Allegany	2	1	1	1	1	1	4	1	3	17	Medium
	Garrett	1	1	1	1	1	1	4	1	4	18	Medium
	Washington	3	2	1	1	1	1	4	1	1	15	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

State Assets and Critical Facilities

State Assets

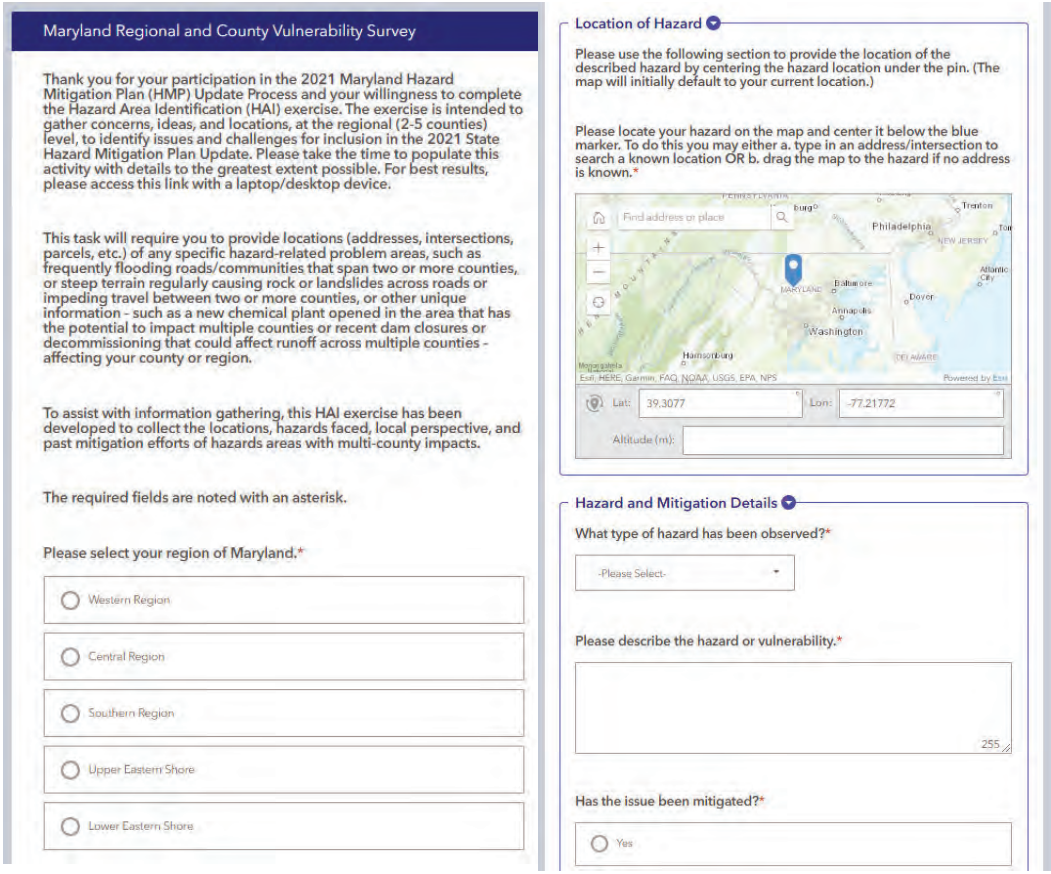
Jurisdiction	State Asset Totals	State Assets Loss Estimations 2016			State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Allegany	326	$1,123,857,400	$75,691,400	$1,199,548,800	300	$1,092,532,665	$72,024,901	$1,164,557,566
Garrett	319	$406,378,700	$34,084,600	$440,463,400	297	$36,724,173	$31,509,966	$68,234,139
Washington	367	$517,704,700	$47,365,500	$565,070,100	335	$486,065,188	$42,699,821	$528,765,009
	1012	**$ 2,047,940,800**	**$ 157,141,500**	**$ 2,205,082,300**	**932**	**$ 1,615,322,025**	**$ 146,234,688**	**$ 1,761,556,713**

Critical Facilities

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations 2016			Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Allegany	70	$407,256,100	$135,752,000	$543,008,100	70	$405,841,100	$26,074,500	$431,915,600
Garrett	19	$118,508,900	$39,503,000	$158,011,900	19	$118,423,900	$16,147,100	$134,571,000
Washington	87	$772,391,000	$257,463,700	$1,029,854,700	87	$772,391,000	$136,656,400	$909,047,400
	176	**$ 1,298,156,000**	**$ 432,718,700**	**$ 1,730,874,700**	**176**	**$ 1,296,656,000**	**$ 178,878,000**	**$ 1,475,534,000**

Maryland Regional and County Vulnerability Survey

- Online survey to provide feedback for known regional hazards and mitigation efforts
- Link to survey can be found in our Virtual Room and below



https://survey123.arcgis.com/share/75bc824859ea4f3d8558bc349273d10c

Questions?

MEMA SHMP Update Virtual Room

Hold as a placeholder to start the Virtual Room discussion

Website: [MEMA-Maryland-360]

Maryland
EMERGENCY MANAGEMENT AGENCY

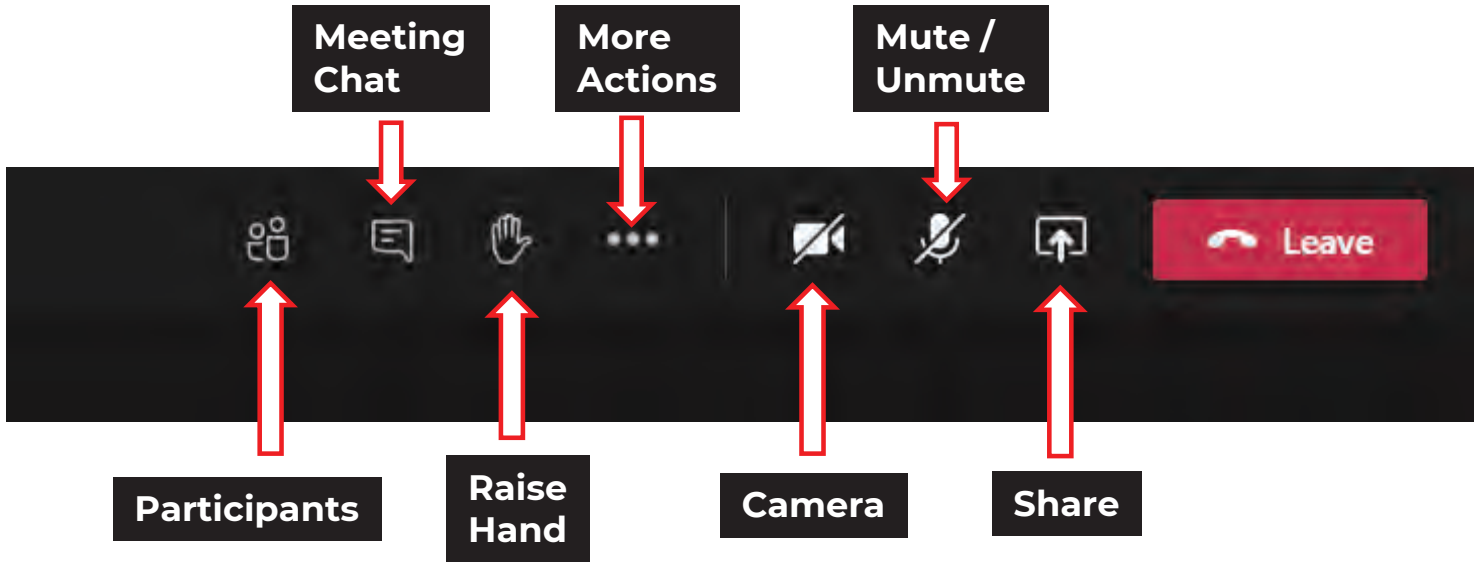
The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

JaLeesa Tate, CFM (410) 517-3617 jaleesa.tate@maryland.gov

2021 Maryland HIRA

Central Region

Teams Overview



Hazard Identification

2016 Mitigation Plan

- Coastal Hazards
- Drought
- Flood
- Thunderstorm
- Tornado
- Wildfire
- Wind
- Winter Storm

2021 Mitigation Plan

- Same 8 hazards in 2016 plan
- 5 new hazards:
  - Dam Failure
  - Extreme Temperatures
  - Human Caused Hazards
  - Public Health Emergencies
  - Soil Movement

Region's Risk

	2016 Plan			2021 Update		
Hazard	Anne Arundel	Baltimore	Carroll	Anne Arundel	Baltimore	Carroll
Coastal Hazards	High	High	Medium-Low	High	High	Medium-Low
Drought	Medium-High	High	High	Medium-High	High	High
Flood	High	High	Medium	High	High	Medium
Thunderstorm	Medium-High	High	Medium	Medium-High	High	Medium-High
Tornado	High	High	Medium-High	High	High	Medium-High
Wildfire	Medium-High	Medium-High	Medium-Low	Medium-High	Medium-High	Medium-Low
Wind	High	Medium-High	High	High	High	High
Winter Storm	High	High	High	High	High	High

Region's Risk

	2016 Plan			2021 Update		
Hazard	Harford	Howard	Baltimore City	Harford	Howard	Baltimore City
Coastal Hazards	Medium-High	Medium	High	Medium-High	Medium	High
Drought	High	High	Medium	High	Medium-High	Medium-High
Flood	Medium-High	High	High	High	High	High
Thunderstorm	High	Medium	Medium-High	High	Medium	Medium-High
Tornado	Medium-High	Medium-High	Medium	High	High	Medium
Wildfire	Medium	Medium	Medium-Low	Medium	Medium	Medium-Low
Wind	Medium-High	Medium-High	Medium-High	Medium-High	Medium-High	High
Winter Storm	High	High	High	Medium-High	High	High

Region's Risk

	2016 Plan			2021 Update		
Hazard	Frederick	Montgomery	Prince George's	Frederick	Montgomery	Prince George's
Coastal Hazards	Medium	Medium	Medium-High	Medium	Medium	High
Drought	Medium-High	High	Medium-High	High	High	Medium-High
Flood	High	Medium-High	High	High	High	High
Thunderstorm	Medium-High	High	High	Medium-High	High	High
Tornado	High	Medium-High	High	High	High	High
Wildfire	Medium-High	Medium	Medium-High	Medium-High	Medium	Medium-High
Wind	High	High	High	High	High	High
Winter Storm	High	High	High	High	High	High

Region's Risk

New Hazards

	2021 Plan		
Hazard	Anne Arundel	Baltimore	Carroll
Dam Failure	Medium	Medium	Medium
Extreme Temperatures	High	Medium-High	Medium
Human Caused	Medium-High	High	Medium
Public Health	Medium-High	Medium	Medium-High
Soil Movement	Medium	Medium	Medium

Region's Risk

New Hazards

	2021 Plan		
Hazard	Harford	Howard	Baltimore City
Dam Failure	Medium	Medium-High	Medium
Extreme Temperatures	Medium	Medium	Medium-High
Human Caused	Medium	Medium-High	Medium-High
Public Health	Medium-High	Medium-High	Medium-High
Soil Movement	Medium	Medium-Low	Medium

Region's Risk

New Hazards

	2021 Plan		
Hazard	Frederick	Montgomery	Prince George's
Dam Failure	Medium-Low	Medium-High	Medium-High
Extreme Temperatures	Medium	Medium-High	Medium-High
Human Caused	Medium-High	Medium-High	Medium-High
Public Health	Medium-High	Medium-High	Medium-High
Soil Movement	Medium	Medium-Low	Medium-Low

Methodology

Nine ranking parameters used:

- Population Vulnerability
- Population Density
- Injuries
- Deaths
- Property Damage
- Crop Damage
- Events
- Geographic Extent
- Local Hazard Ranking

Weighted Risk Factors

Population Vulnerability	*PV*	0.5
Population Density	*PN*	0.5
Injuries	*IN*	1
Deaths	*DT*	1
Property Damage (Annualized)	*PD*	1
Crop Damage (Annualized)	*CD*	1
Events (Annualized)	*EV*	1
Geographic Extent (Hazard Dependent)	*GE*	1.5
Local Plan Ranking	*LOCAL*	1.5

Overall Score

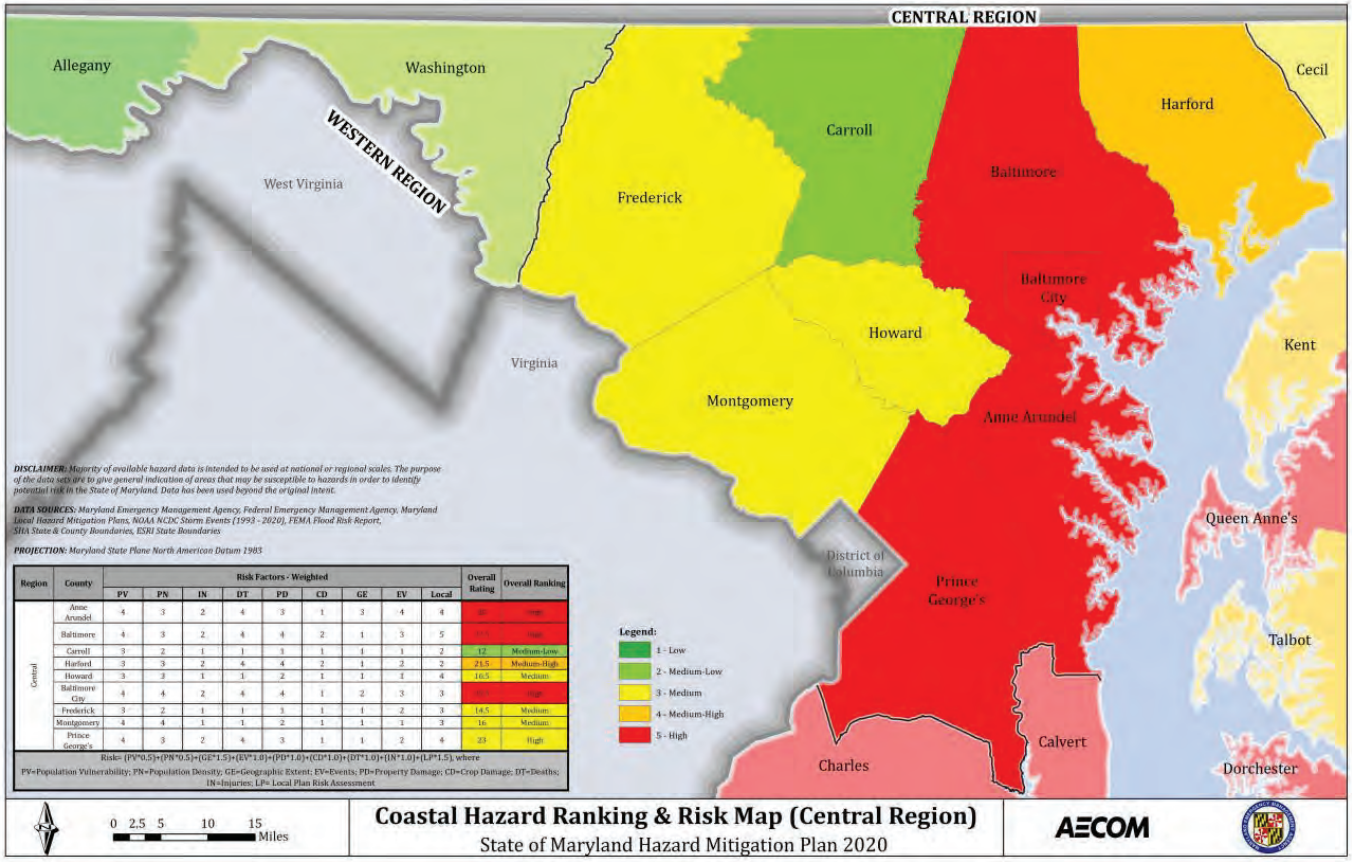
Score (>=)	*Hazard Risk Rank*
0	Low
10.5	Medium-Low
14.5	Medium
18.5	Medium-High
23	High

No Local Plan Ranking Score

Score (>=)	*Hazard Risk Rank*
0	Low
6	Medium-Low
10	Medium
14	Medium-High
18	High

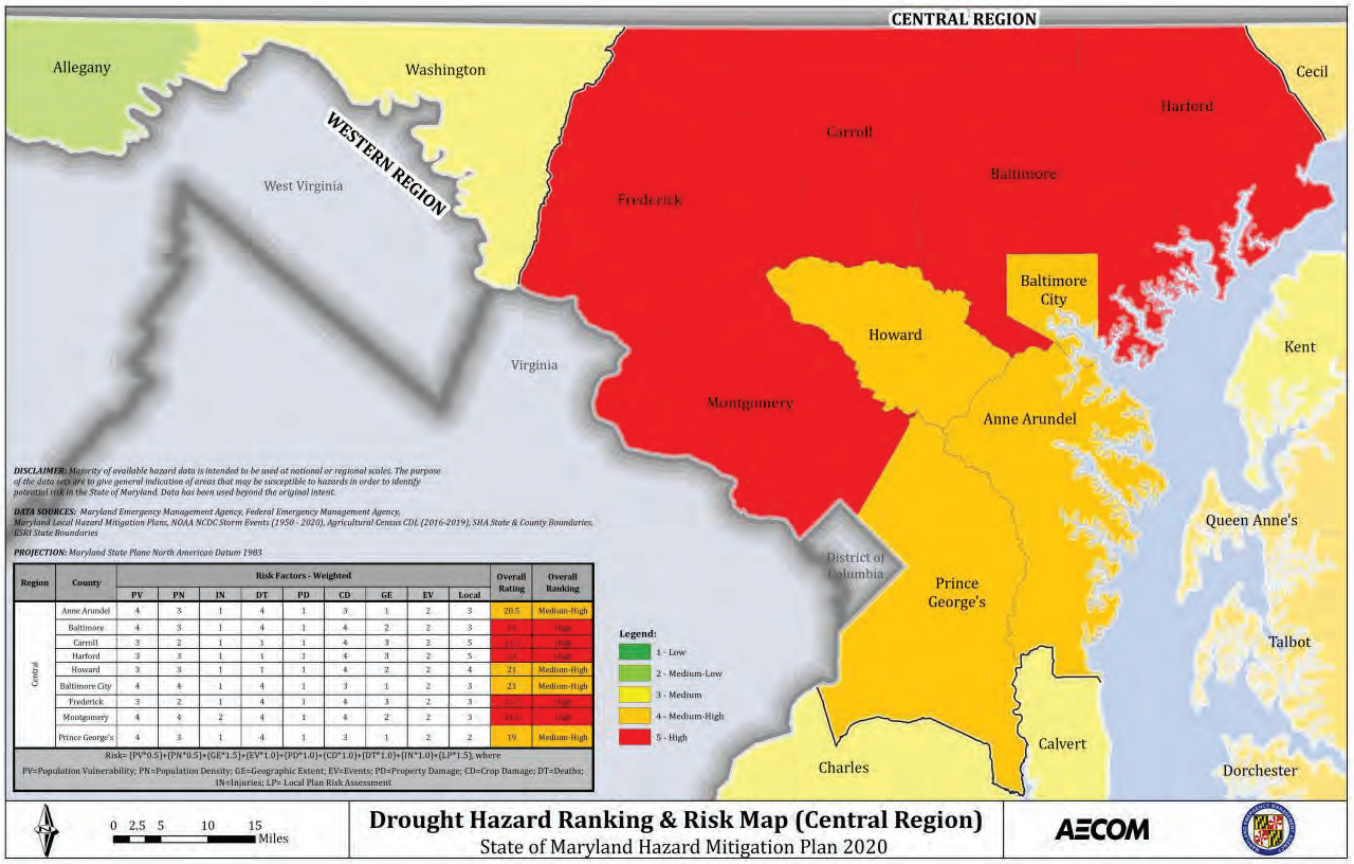
Coastal Hazard

- Medium Low – High Risk
- Data Sources include National Climatic Data Center and Maryland Coastal Study Flood Risk Reports
- Calculated using % of Costal Land Area



Drought

- Medium High - High Risk
- Data Sources include USDA Census of Agriculture and the Cropland Data Layer of Maryland (CDL)
- Calculated using % area of cropland



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indications of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

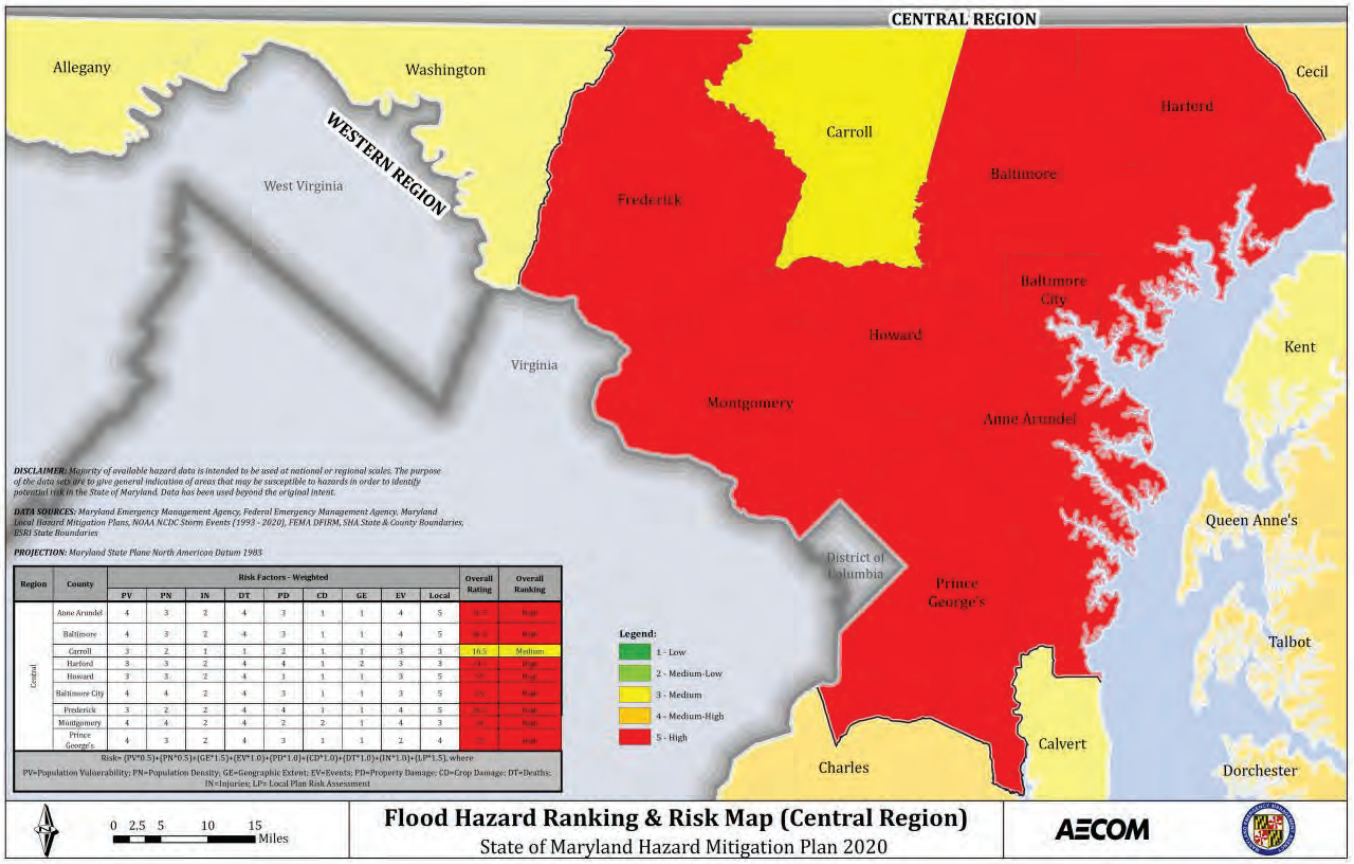
PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	1	4	1	3	1	2	3	20.5	Medium-High
	Baltimore	4	3	1	4	1	4	2	2	3	[illegible]	[illegible]
	Carroll	3	2	1	3	1	4	3	2	5	[illegible]	[illegible]
	Harford	3	3	1	1	1	4	3	2	5	[illegible]	[illegible]
	Howard	3	3	1	1	1	4	2	2	4	23	Medium-High
	Baltimore City	4	4	1	4	1	3	1	2	3	23	Medium-High
	Frederick	3	2	1	4	1	4	3	2	3	[illegible]	[illegible]
	Montgomery	4	4	2	4	1	4	2	2	3	[illegible]	[illegible]
	Prince George's	4	3	1	4	1	3	1	2	2	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

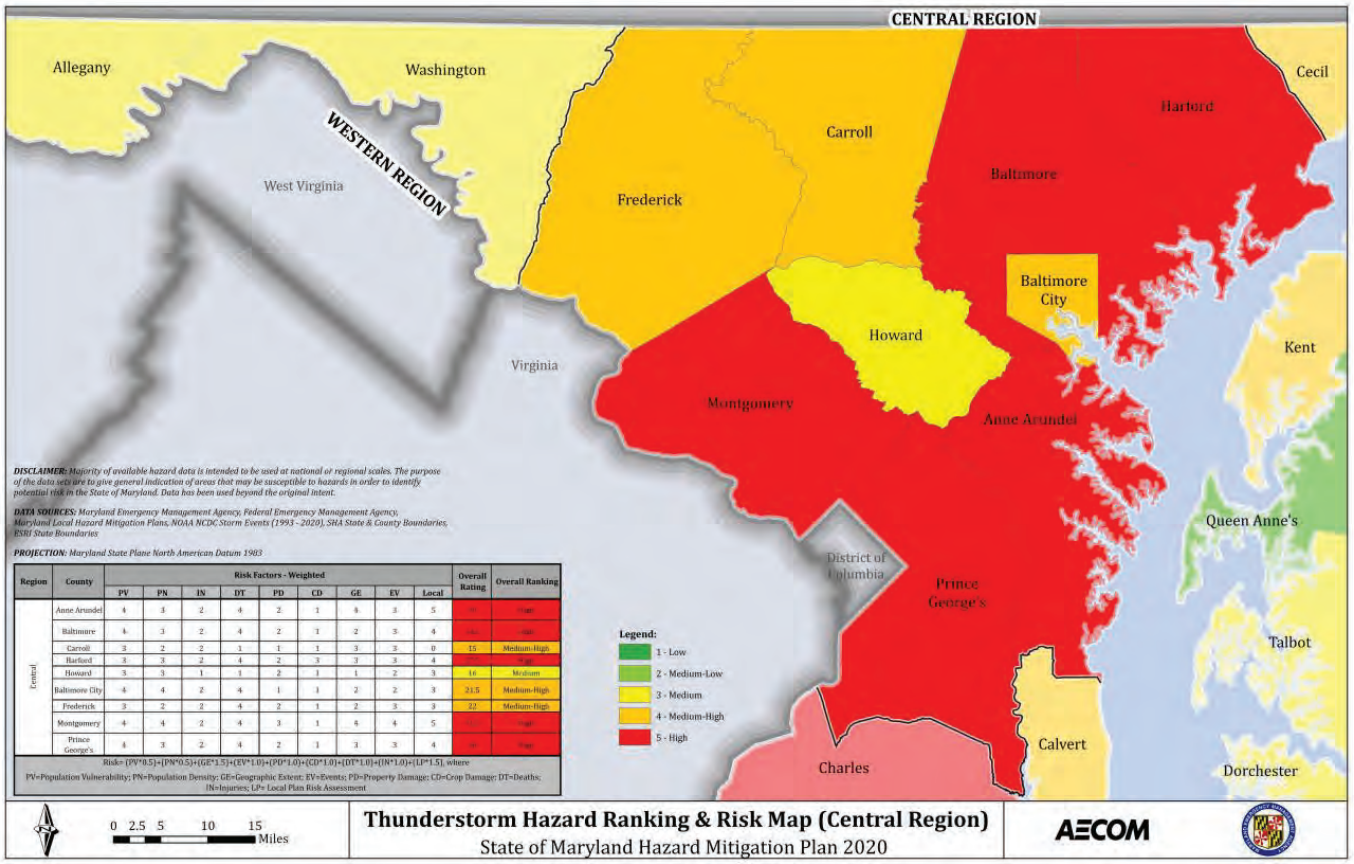
Flood Hazard

- Medium & High Risk
- Data Sources include NCDC & FEMA Preliminary and Effective DFIRMS
- Calculated using % area in 100-year Floodplain



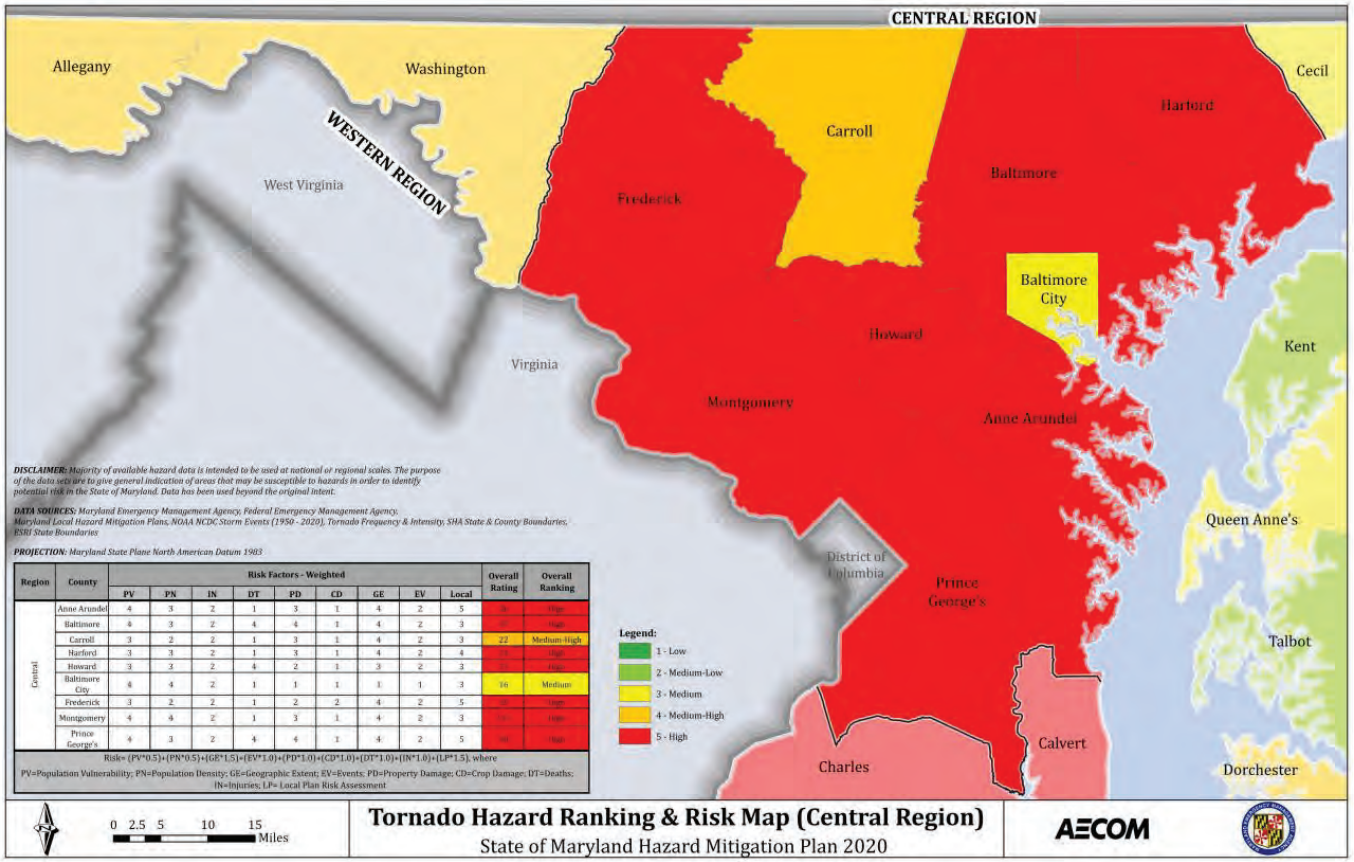
Thunderstorm

- Medium - High Risk
- Data Sources include National Climatic Data Center (NCDC) Storm Events Database
- Average number of events greater than 2“ of rain, hail, and lightening events that caused Injuries/Deaths



Tornado

- Medium - High Risk
- Data Sources include NCDC Storm Events Database
- Calculated using sum of all tornados weighted by intensity (F-scale or EF-scale)

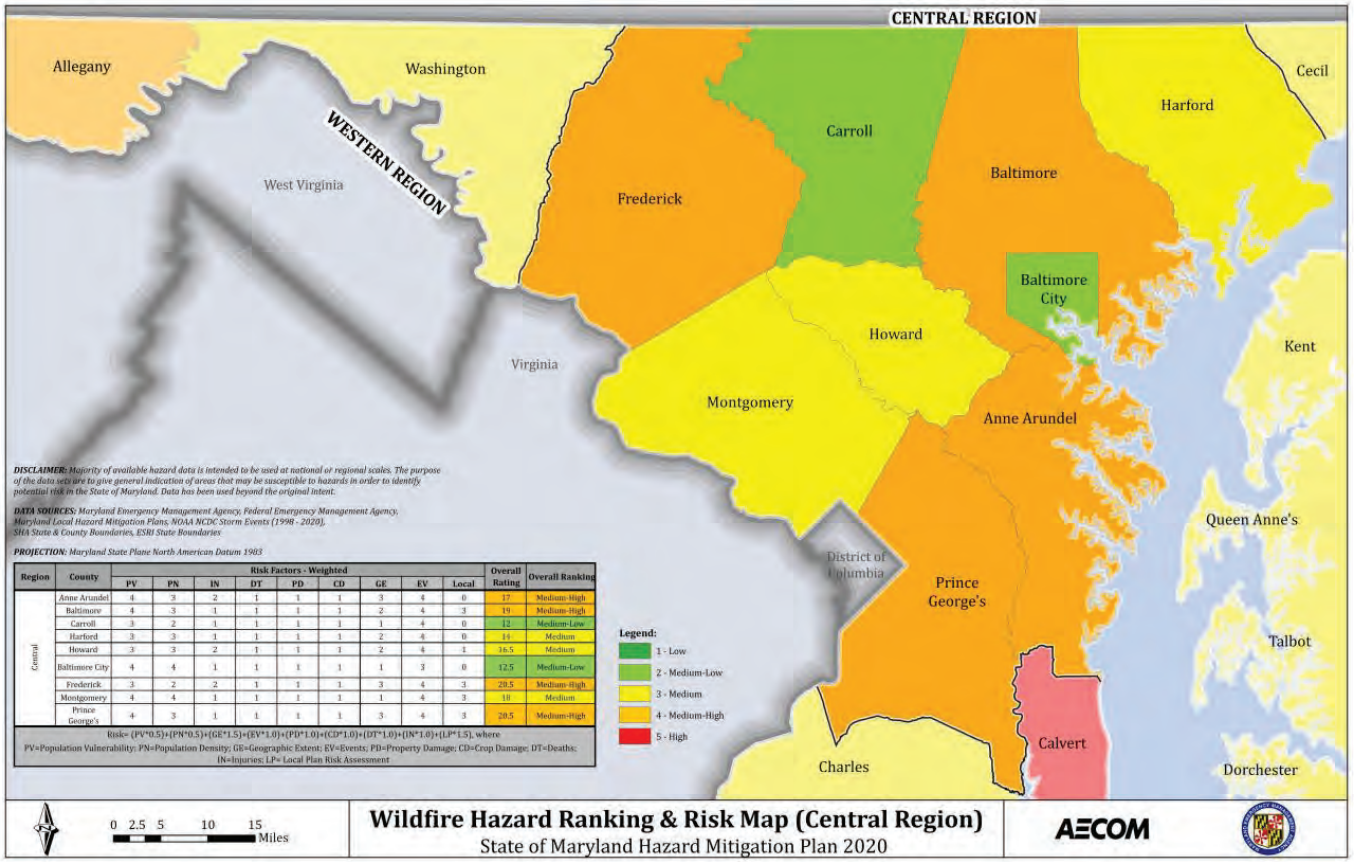


Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	1	3	1	4	2	5	[illegible]	[illegible]
	Baltimore	4	3	2	4	4	1	4	2	3	[illegible]	[illegible]
	Carroll	3	2	2	1	3	1	4	2	3	22	Medium-High
	Harford	3	3	2	1	3	1	4	2	4	[illegible]	[illegible]
	Howard	3	3	2	4	2	1	3	2	3	[illegible]	[illegible]
	Baltimore City	4	4	2	1	1	1	1	1	3	16	Medium
	Frederick	3	2	2	1	2	2	4	2	5	[illegible]	[illegible]
	Montgomery	4	4	2	1	3	1	4	2	3	[illegible]	[illegible]
	Prince George's	4	3	2	4	4	1	4	2	5	[illegible]	[illegible]

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Wildfire

- Medium Low – Medium High Risk
- Data Sources include MD Department of Natural Resources (DNR) Forest Service Risk Assessment Layer
- Calculated using % area found in high and medium-high risk area.



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1998 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

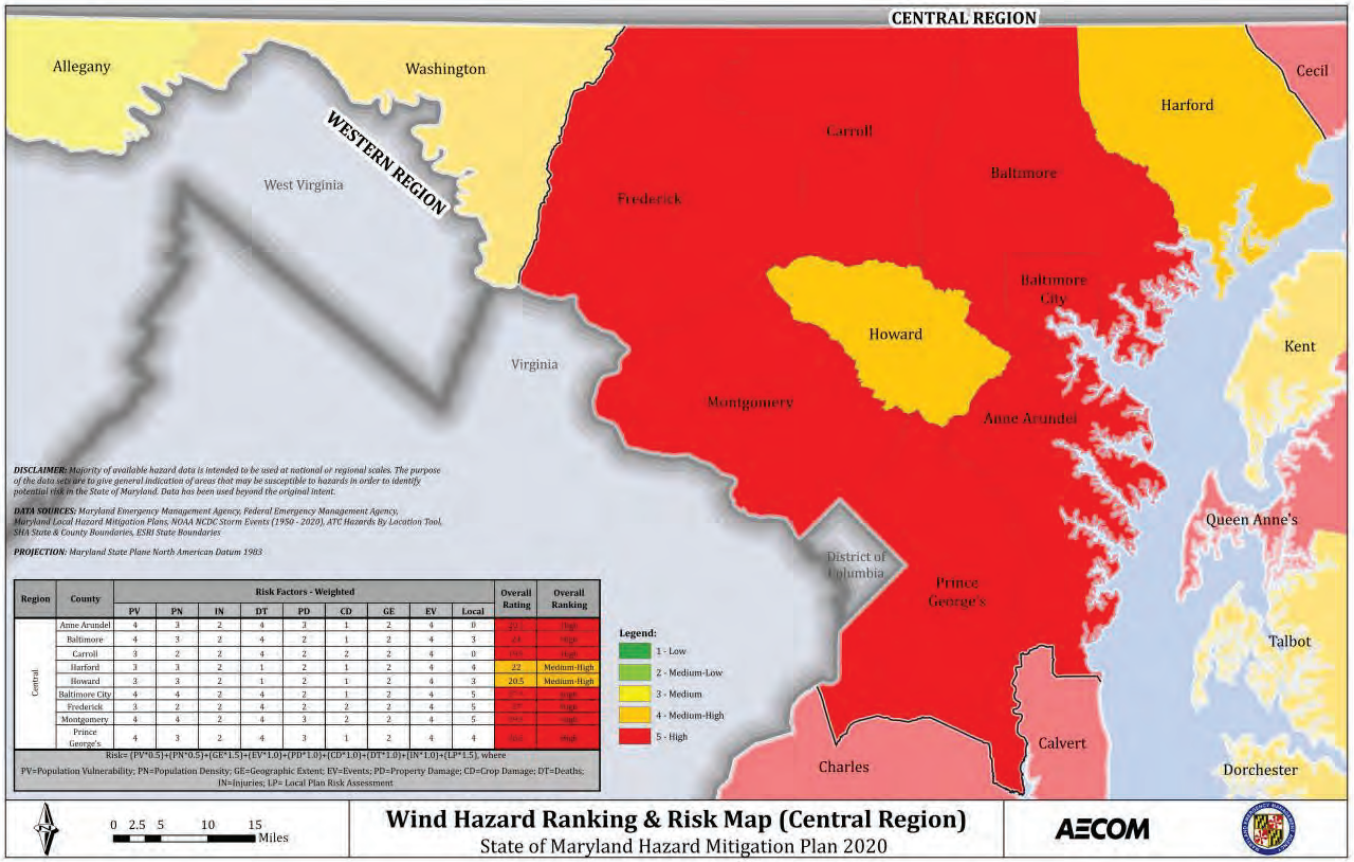
PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted								Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local	
Central	Anne Arundel	4	3	2	1	1	1	3	4	0	17	Medium-High
	Baltimore	4	3	1	1	1	1	2	4	3	19	Medium-High
	Carroll	3	2	1	1	1	1	1	4	0	12	Medium-Low
	Harford	3	3	1	1	1	1	2	4	0	16	Medium
	Howard	3	3	2	1	1	1	2	4	1	16.5	Medium
	Baltimore City	4	4	1	1	1	1	1	3	0	12.5	Medium-Low
	Frederick	3	2	2	1	1	1	3	4	3	20.5	Medium-High
	Montgomery	4	4	1	1	1	1	1	4	3	18	Medium
	Prince George's	4	3	1	1	1	1	3	4	3	20.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

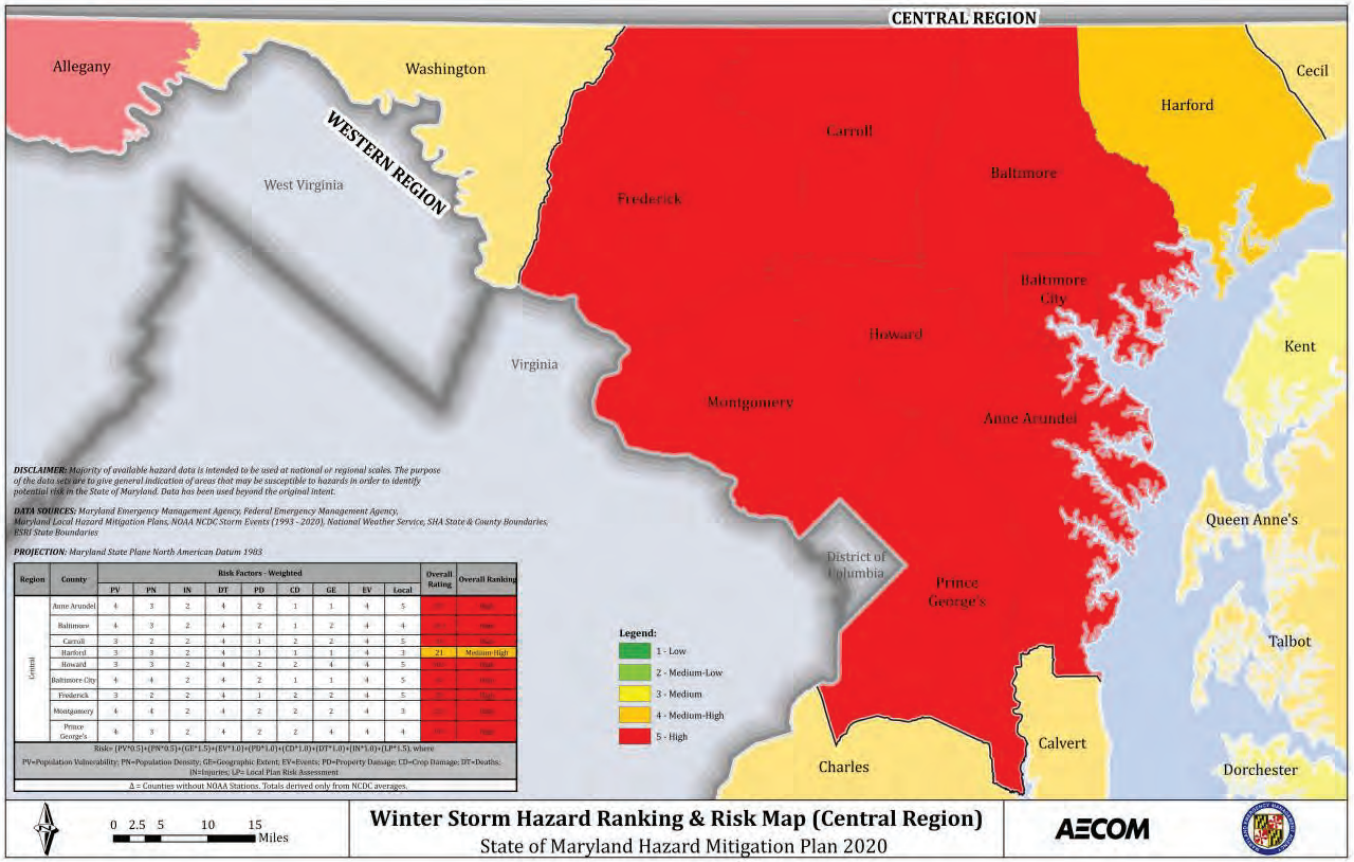
Wind Hazard

- Medium High - High Risk
- Data Sources include NCDC Storm Event Database and American Society of Civil Engineers (ASCE)
- Calculated using ASCE Design Wind Speeds



Winter Storm

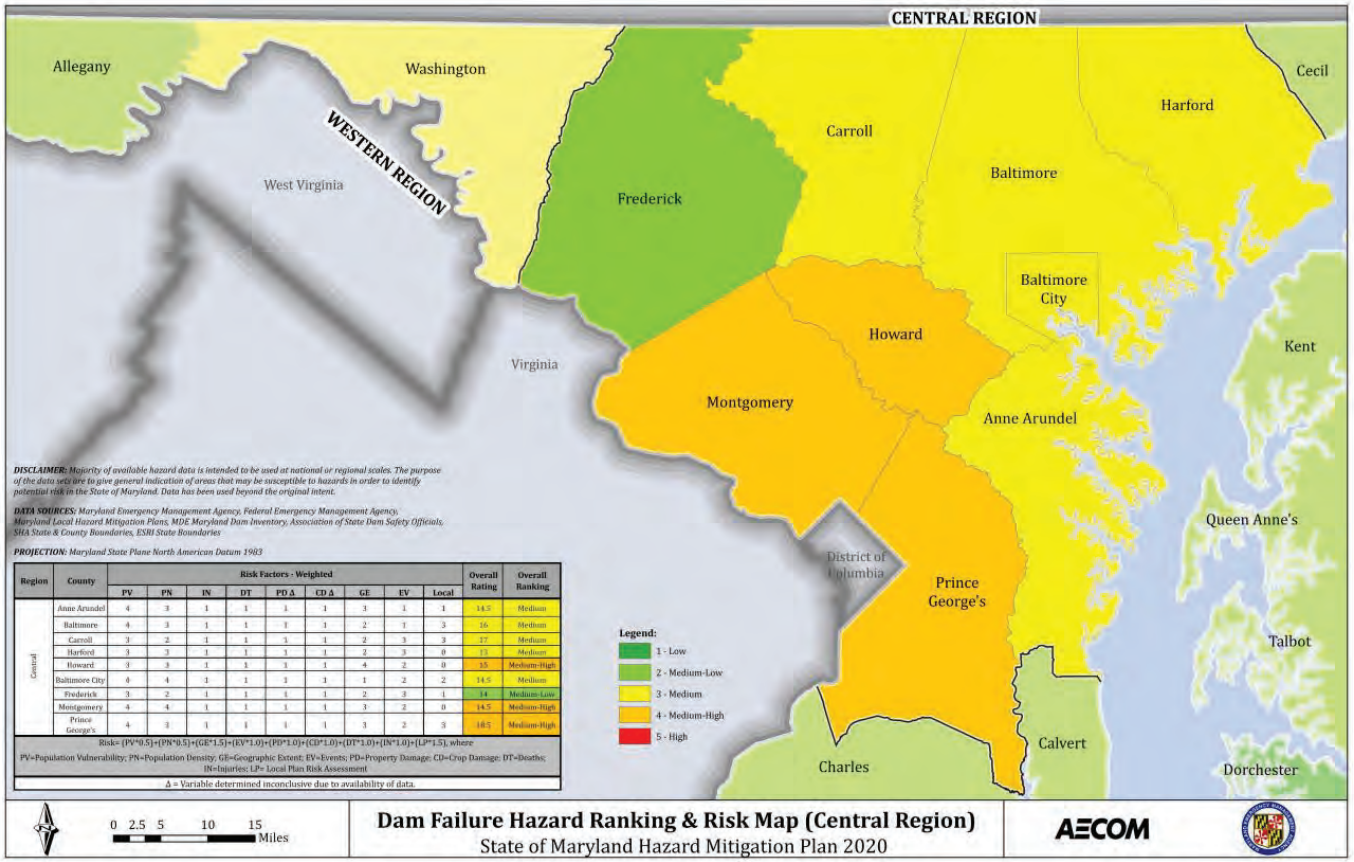
- Medium High – High Risk
- Data Sources include NCDC & National Weather Service
- Calculated using Average total Snowfall



NEW HAZARDS

Dam Failure

- Medium Low – Medium High Risk
- Data Sources include Maryland Department of the Environment (MDE) High Hazard Dams and 20 recent dam incidents
- Calculated using sum of high-hazard dams per county.



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Central	Anne Arundel	4	3	1	1	1	1	3	1	1	14.5	Medium
	Baltimore	4	3	1	1	1	1	2	1	3	16	Medium
	Carroll	3	2	1	1	1	1	2	3	3	17	Medium
	Harford	3	3	1	1	1	1	2	3	0	15	Medium
	Howard	3	3	1	1	1	1	4	2	0	15	Medium-High
	Baltimore City	4	4	1	1	1	1	1	2	2	14.5	Medium
	Frederick	3	2	1	1	1	1	2	3	1	14	Medium-Low
	Montgomery	4	4	1	1	1	1	3	2	0	14.5	Medium-High
	Prince George's	4	3	1	1	1	1	3	2	3	18.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

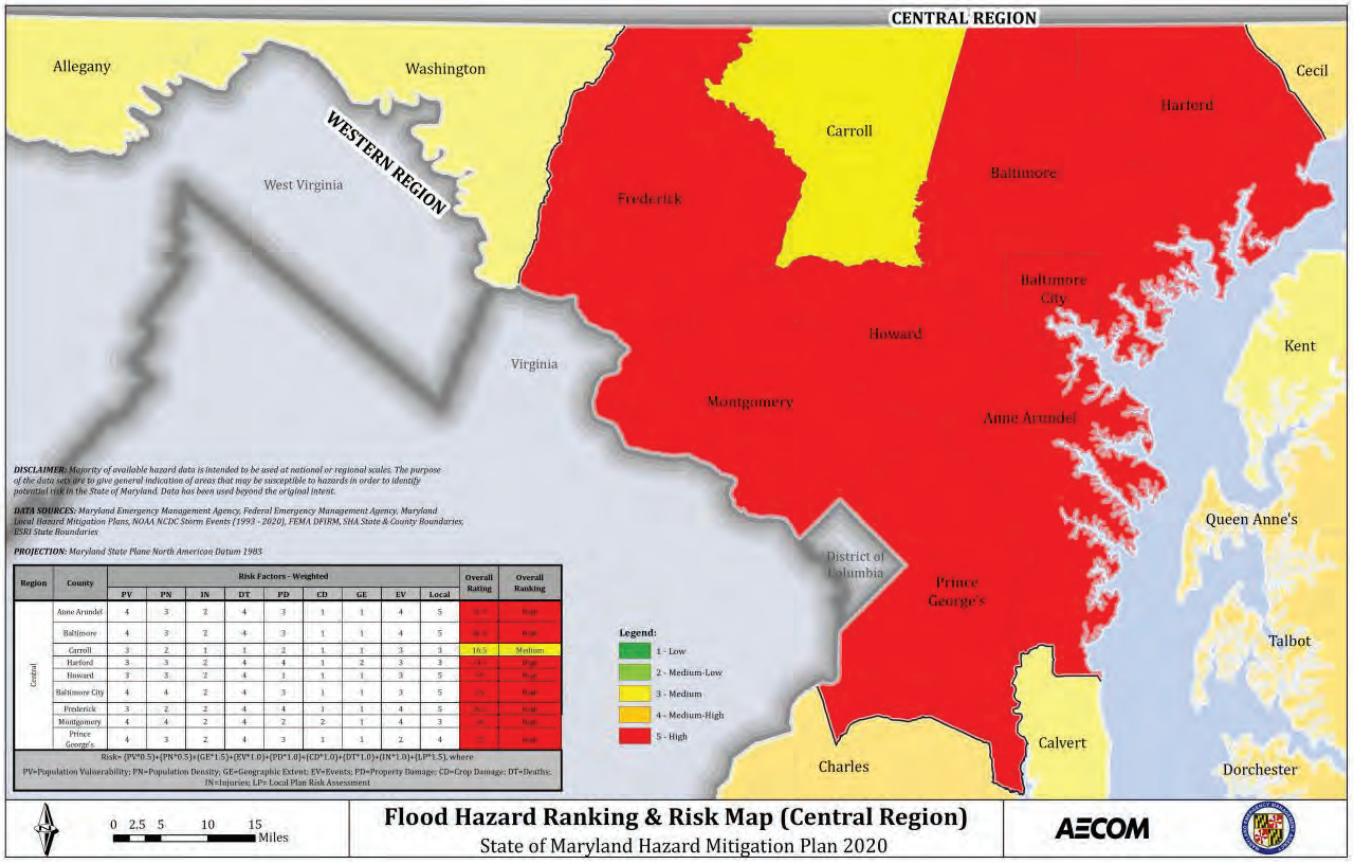
DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

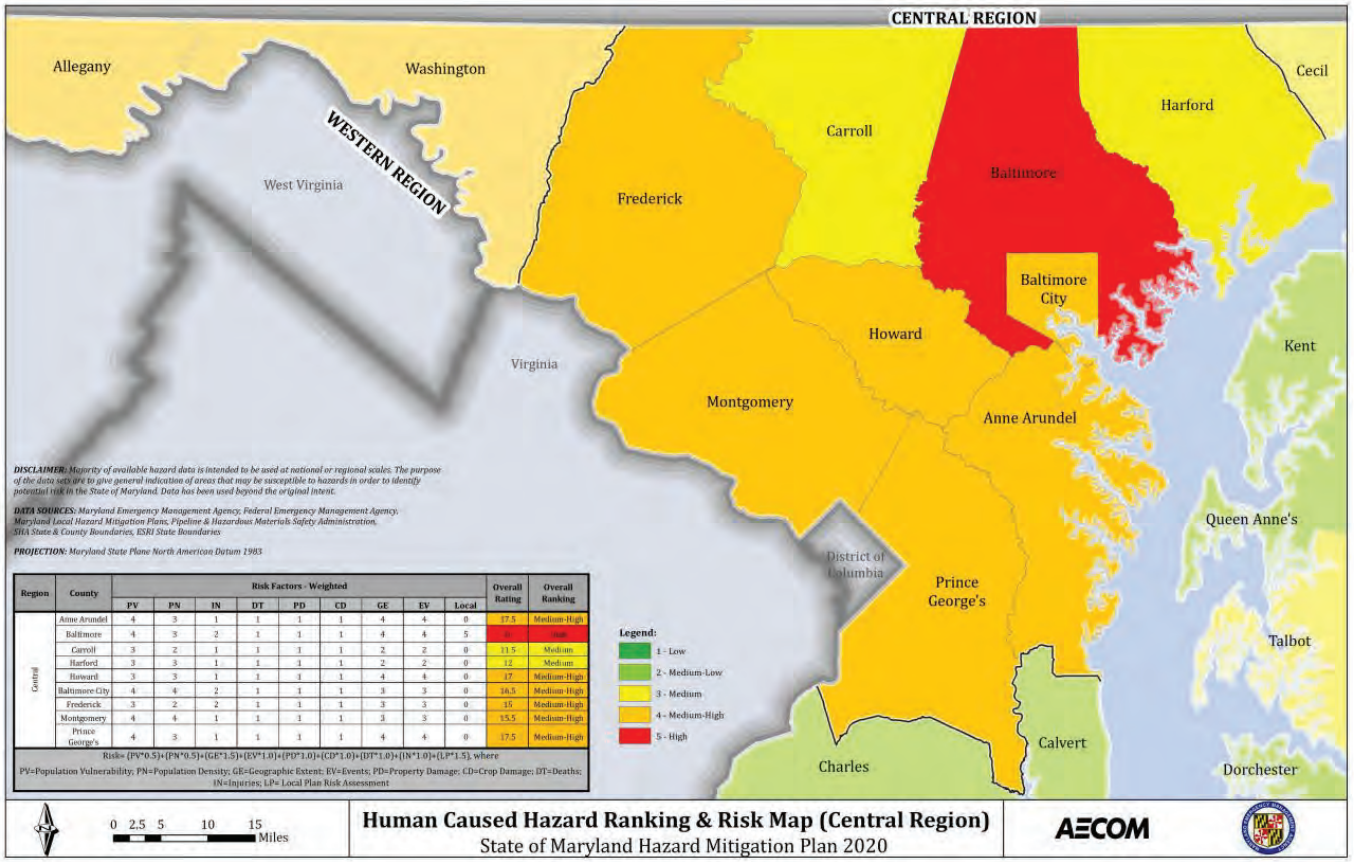
Extreme Temperatures

- Medium & High Risk
- Data Sources include NCDC Storm Database
- Average number of extreme temperature events (Excessive Heat & Extreme Cold/Wind Chill)



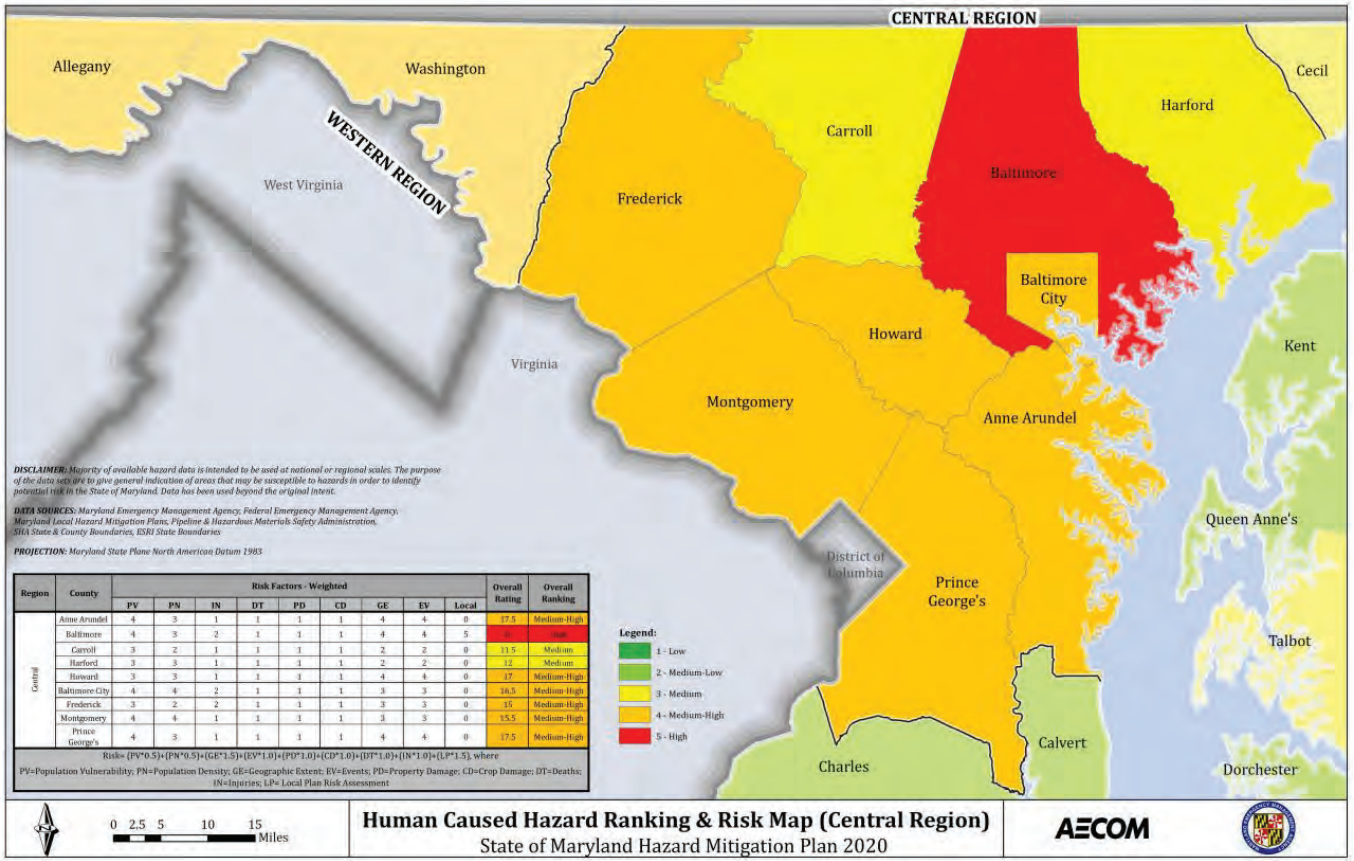
Human-Caused Hazards & Threats

- Medium - High Risk
- Data Sources include Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Calculated based on number of Hazmat events



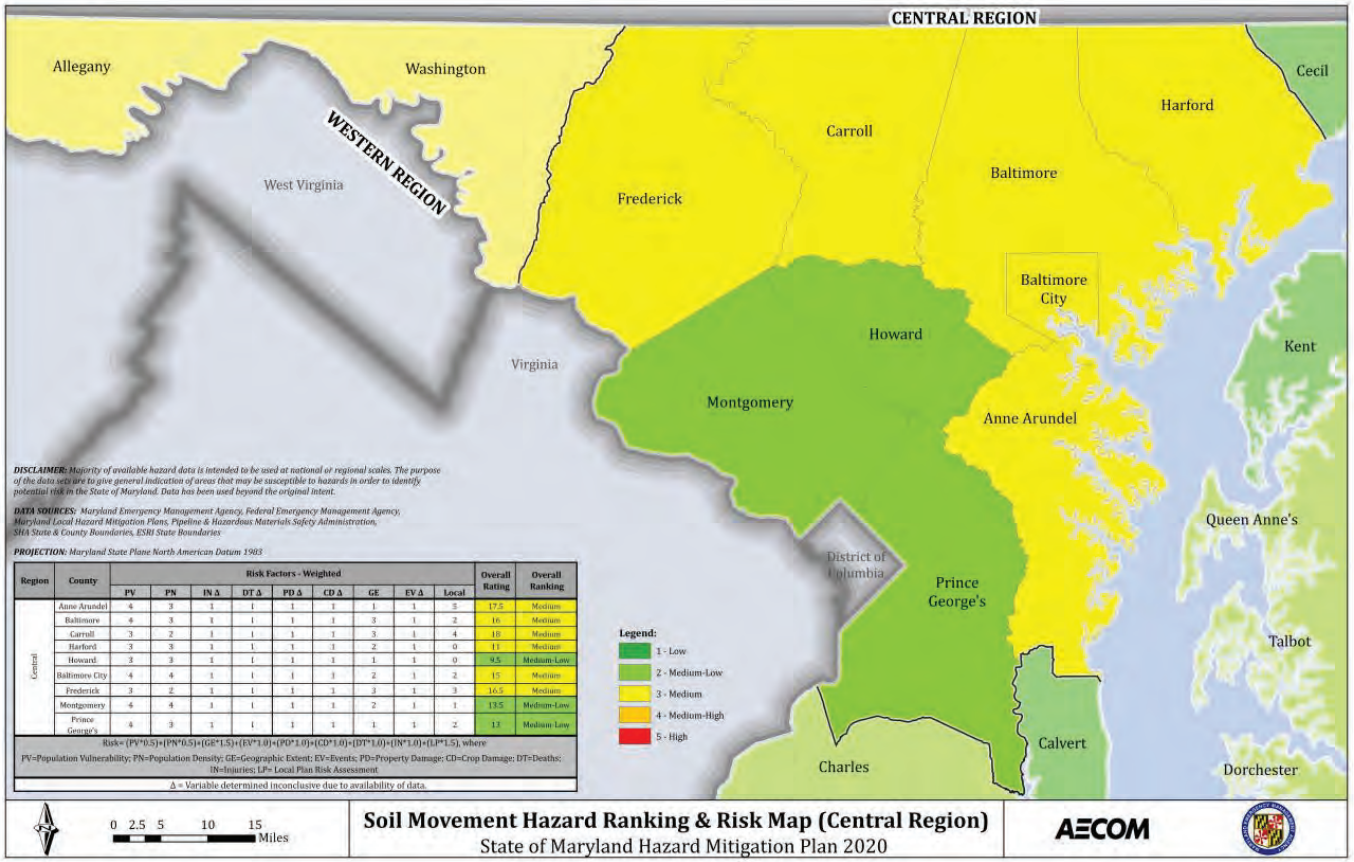
Public Health

- Medium - High Risk
- Data Sources include Housing and Urban Development & Maryland Department of Health
- Calculated based on Median Income & opioid related incidents.



Soil Movement

- Medium Low - Medium Risk
- Sources include US Geological Survey Karst data layer
- Calculated using % Area of KARST



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Central	Anne Arundel	4	3	1	1	1	1	1	1	3	17.5	Medium
	Baltimore	4	3	1	1	1	1	3	1	2	16	Medium
	Carroll	3	2	1	1	1	1	3	1	4	18	Medium
	Harford	3	3	1	1	1	1	2	1	0	11	Medium
	Howard	3	3	1	1	1	1	1	1	0	9.5	Medium-Low
	Baltimore City	4	4	1	1	1	1	2	1	2	15	Medium
	Frederick	3	2	1	1	1	1	3	1	3	16.5	Medium
	Montgomery	4	4	1	1	1	1	2	1	1	13.5	Medium-Low
	Prince George's	4	3	1	1	1	1	1	1	2	13	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

State Assets and Critical Facilities

State Assets

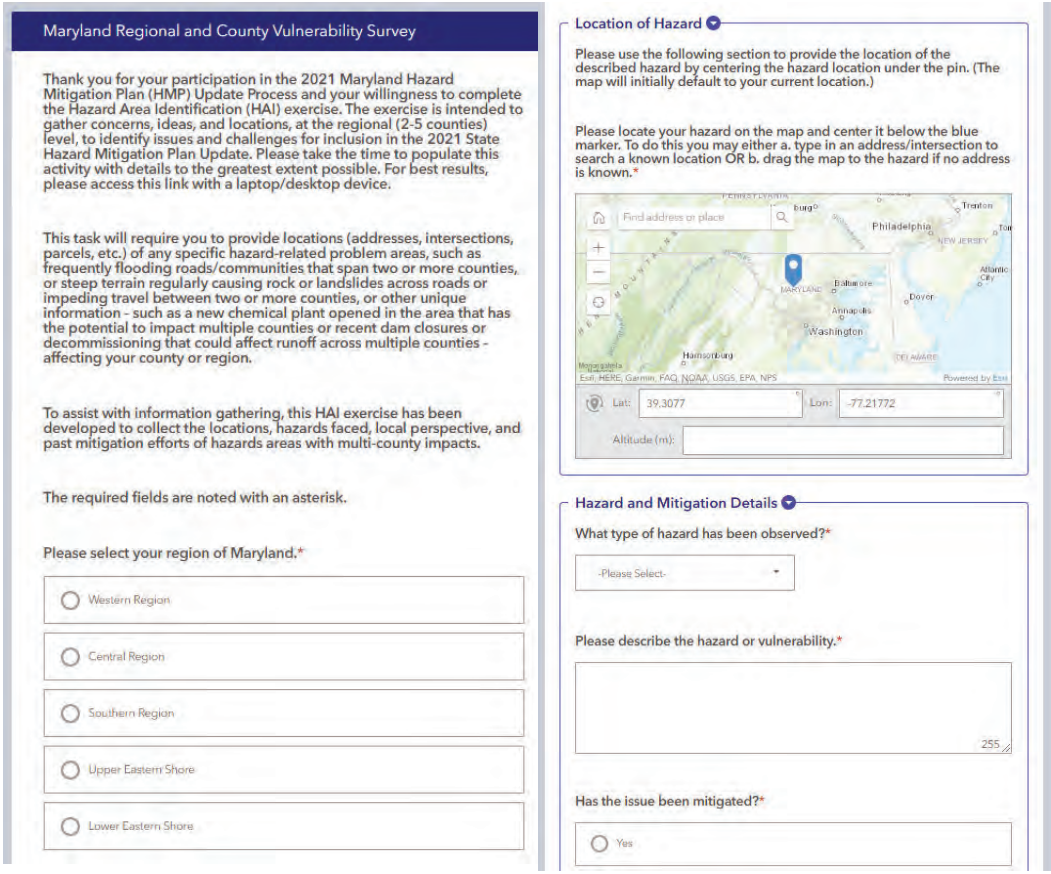
Jurisdiction	State Asset Totals	State Assets Loss Estimations 2016			State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Anne Arundel	652	$3,444,136,800	$429,712,400	$3,873,849,200	761	$4,117,145,038	$481,564,640	$4,598,709,678
Baltimore	837	$4,732,739,000	$628,197,700	$5,360,936,700	745	$4,449,953,887	$580,907,824	$5,030,861,711
Baltimore City	938	$10,704,503,400	$1,130,865,100	$11,835,368,600	867	$9,777,581,486	$954,973,603	$10,732,555,089
Carroll	247	$689,289,500	$80,955,400	$770,244,800	235	$672,857,398	$79,141,528	$751,998,926
Cecil	143	$225,324,000	$44,458,100	$269,782,100	292	$196,145,839	$35,864,521	$232,010,360
Frederick	205	$259,073,800	$37,040,300	$296,114,000	197	$251,189,535	$36,724,173	$287,913,708
Harford	243	$374,275,300	$32,597,000	$405,920,300	220	$321,074,212	$24,216,692	$345,290,904
Howard	425	$661,902,900	$67,393,100	$729,296,200	369	$590,600,329	$49,053,956	$639,654,285
Montgomery	227	$407,932,200	$68,334,100	$476,266,300	192	$317,749,390	$55,868,060	$373,617,450
Prince George's	755	$4,547,775,200	$674,511,300	$5,222,286,600	628	$4,033,876,220	$510,320,283	$4,544,196,503
	4672	**$ 26,046,952,100**	**$ 3,194,064,500**	**$ 29,240,064,800**	**4506**	**$ 24,728,173,334**	**$ 2,808,635,280**	**$ 27,536,808,614**

Critical Facilities

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations 2016			Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Anne Arundel	139	$1,070,254,100	$356,751,400	$1,427,005,500	139	$1,068,054,100	$432,634,800	$1,500,688,900
Baltimore	427	$2,356,871,700	$785,623,900	$3,142,495,600	427	$2,258,308,000	$793,597,900	$3,051,905,900
Baltimore City	458	$6,985,107,300	$2,328,369,100	$9,313,476,400	457	$6,678,537,100	$765,069,700	$7,443,606,800
Carroll	115	$1,069,909,600	$356,636,500	$1,426,546,100	115	$1,060,600,400	$202,732,100	$1,263,332,500
Frederick	120	$1,157.114.300	$385,704,800	$1,542,819,100	121	$1,134,849,300	$164,251,400	$1,299,100,700
Harford	115	$1,007,301,700	$335,767,200	$1,343,068,900	116	$1,005,729,000	$161,993,400	$1,167,722,400
Howard	112	$915,094,400	$305,031,500	$1,220,125,900	35	$448,961,200	$110,140,200	$559,101,400
Montgomery	220	$3,373,282,400	$1,124,427,500	$4,479,282,400	221	$3,371,682,400	$1,067,775,500	$4,439,457,900
Prince George's	250	$1,005,822,580	$335,274,200	$1,341,096,800	251	$1,006,600,260	$172,844,080	$1,179,444,340
	1956	**$ 16,868,549,380**	**$ 6,313,586,100**	**$ 25,235,916,700**	**1882**	**$ 18,033,321,760**	**$ 3,871,039,080**	**$ 21,904,360,840**

Maryland Regional and County Vulnerability Survey

- Online survey to provide feedback for known regional hazards and mitigation efforts
- Link to survey can be found in our Virtual Room and below



https://survey123.arcgis.com/share/75bc824859ea4f3d8558bc349273d10c

Questions?

MEMA SHMP Update Virtual Room

Hold as a placeholder to start the Virtual Room discussion

Website: [MEMA-Maryland-360]

Maryland
EMERGENCY MANAGEMENT AGENCY

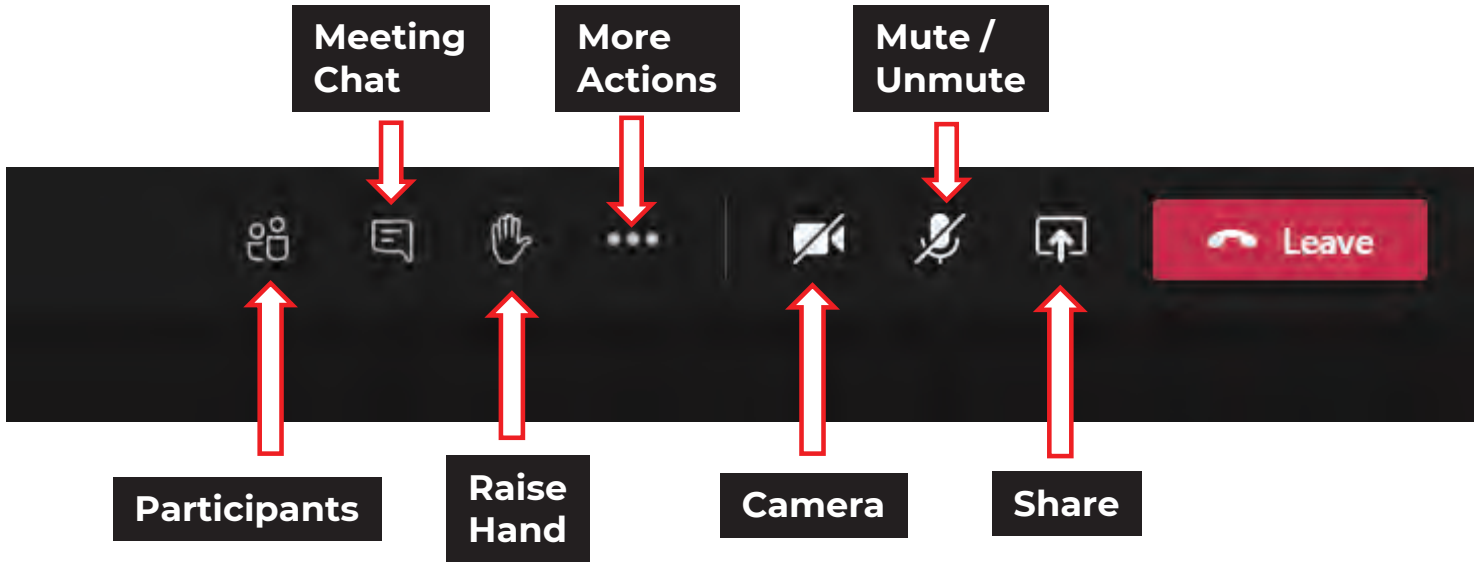
The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

JaLeesa Tate, CFM (410) 517-3617 jaleesa.tate@maryland.gov

2021 Maryland HIRA

Southern Region

Teams Overview



Hazard Identification

2016 Mitigation Plan

- Coastal Hazards
- Drought
- Flood
- Thunderstorm
- Tornado
- Wildfire
- Wind
- Winter Storm

2021 Mitigation Plan

- Same 8 hazards in 2016 plan
- 5 new hazards:
  - Dam Failure
  - Extreme Temperatures
  - Human Caused Hazards
  - Public Health Emergencies
  - Soil Movement

Region's Risk

	2016 Plan			2021 Update		
Hazard	Calvert	Charles	St. Mary's	Calvert	Charles	St. Mary's
Coastal Hazards	High	High	High	High	High	High
Drought	Medium	Medium	Medium	Medium	Medium	Medium-High
Flood	Medium-High	Medium	High	Medium	Medium	Medium
Thunderstorm	Medium-High	High	Medium-High	Medium-High	High	Medium-High
Tornado	High	High	Medium-High	High	High	Medium-High
Wildfire	High	Medium	Medium	High	Medium	Medium
Wind	Medium-High	High	Medium-High	High	High	High
Winter Storm	High	Medium-High	High	Medium-High	Medium-High	High

Region's Risk

New Hazards

	2021 Plan		
Hazard	Calvert	Charles	St. Mary's
Dam Failure	Medium-Low	Medium-Low	Medium-Low
Extreme Temperatures	Medium	Medium	Medium
Human Caused	Medium-Low	Medium-Low	Medium-Low
Public Health	Medium-High	Medium	Medium
Soil Movement	Medium-Low	Low	Medium-Low

Methodology

Nine ranking parameters used:

- Population Vulnerability
- Population Density
- Injuries
- Deaths
- Property Damage
- Crop Damage
- Events
- Geographic Extent
- Local Hazard Ranking

Weighted Risk Factors

Population Vulnerability	*PV*	0.5
Population Density	*PN*	0.5
Injuries	*IN*	1
Deaths	*DT*	1
Property Damage (Annualized)	*PD*	1
Crop Damage (Annualized)	*CD*	1
Events (Annualized)	*EV*	1
Geographic Extent (Hazard Dependent)	*GE*	1.5
Local Plan Ranking	*LOCAL*	1.5

Overall Score

Score (>=)	*Hazard Risk Rank*
0	Low
10.5	Medium-Low
14.5	Medium
18.5	Medium-High
23	High

No Local Plan Ranking Score

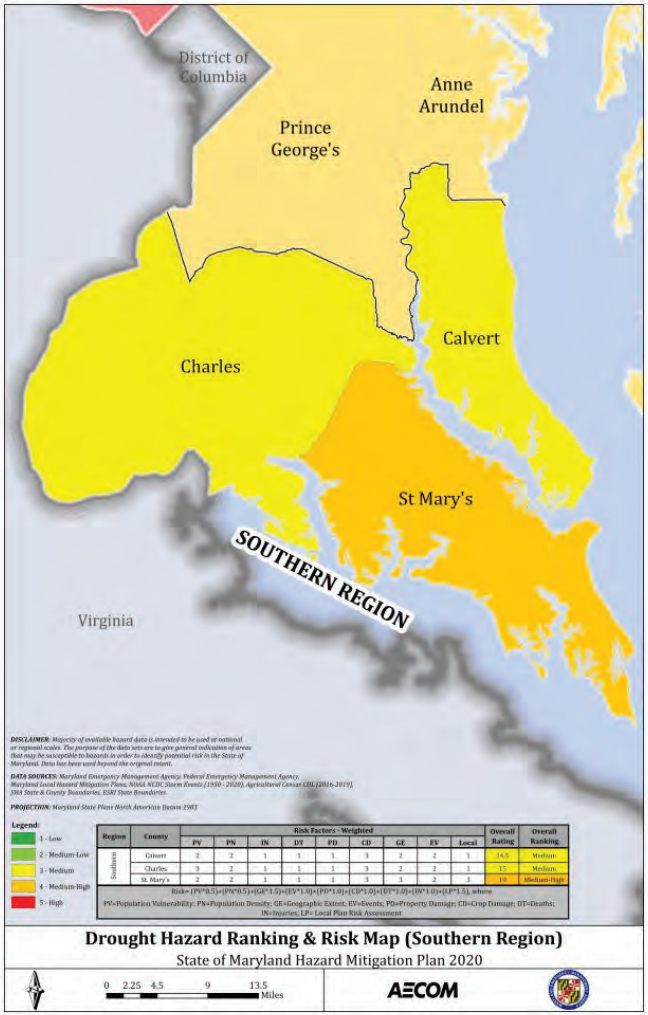
Score (>=)	*Hazard Risk Rank*
0	Low
6	Medium-Low
10	Medium
14	Medium-High
18	High

Coastal Hazard

- High Risk
- Data Sources include National Climatic Data Center and Maryland Coastal Study Flood Risk Reports
- Calculated using % of Costal Land Area

Drought

- Medium – Medium High Risk
- Data Sources include USDA Census of Agriculture and the Cropland Data Layer of Maryland (CDL)
- Calculated using % area of cropland

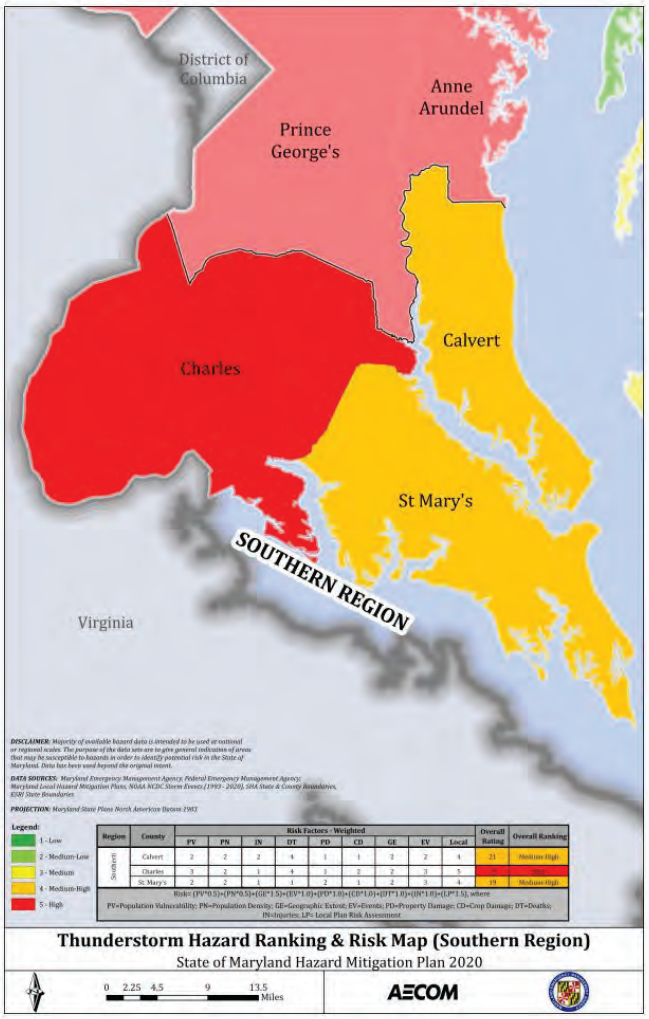


Flood Hazard

- Medium Risk
- Data Sources include NCDC & FEMA Preliminary and Effective DFIRMS
- Calculated using % area in 100-year Floodplain

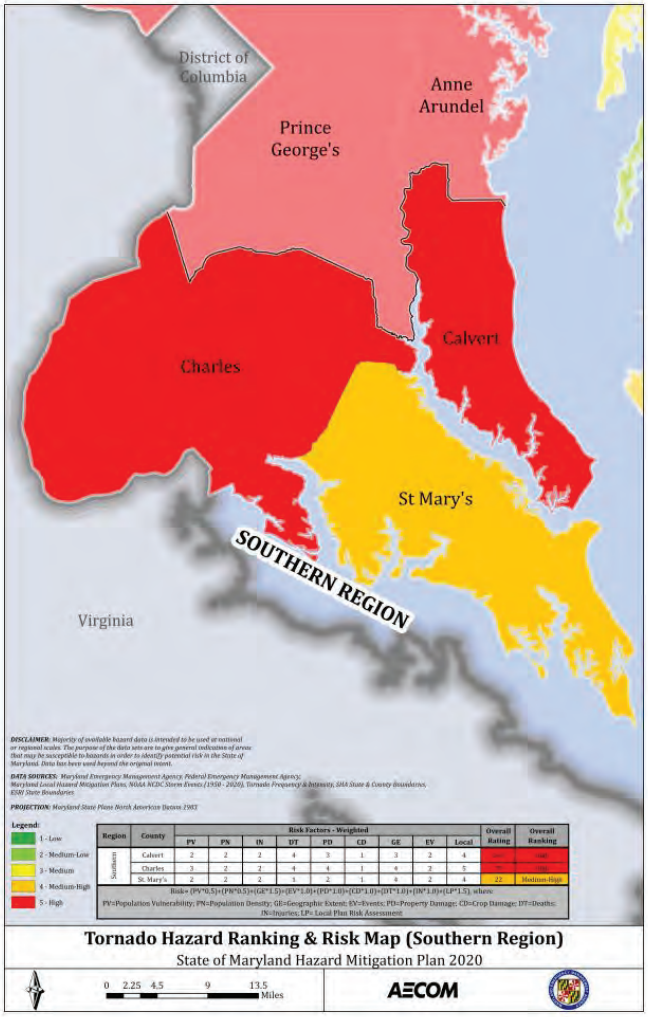
Thunderstorm

- Medium High - High Risk
- Data Sources include National Climatic Data Center (NCDC) Storm Events Database
- Average number of events greater than 2“ of rain, hail, and lightening events that caused Injuries/Deaths



Tornado

- Medium High - High Risk
- Data Sources include NCDC Storm Events Database
- Calculated using sum of all tornados weighted by intensity (F-scale or EF-scale)



Wildfire

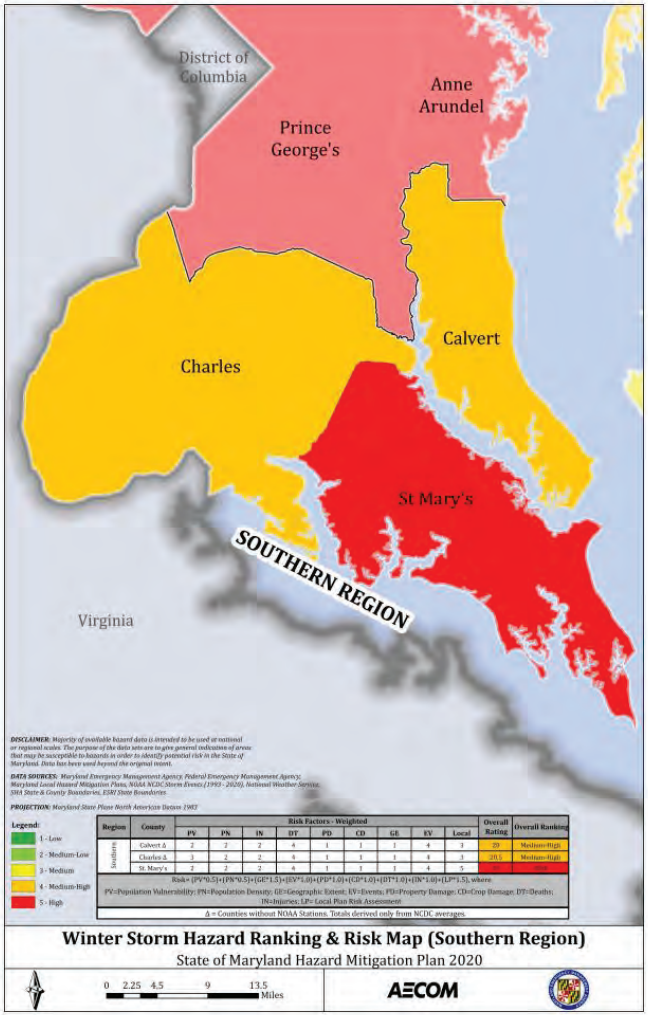
- Medium & High Risk
- Data Sources include MD Department of Natural Resources (DNR) Forest Service Risk Assessment Layer & NCDC
- Calculated using % area found in high and medium-high risk area.

Wind Hazard

- High Risk
- Data Sources include NCDC Storm Event Database and American Society of Civil Engineers (ASCE)
- Calculated using ASCE Design Wind Speeds

Winter Storm

- Medium High – High Risk
- Data Sources include NCDC & National Weather Service
- Calculated using Average total Snowfall



NEW HAZARDS

Dam Failure

- Medium Low Risk
- Data Sources include Maryland Department of the Environment (MDE) High Hazard Dams and 20 recent dam incidents
- Calculated using sum of high-hazard dams per county.

Extreme Temperatures

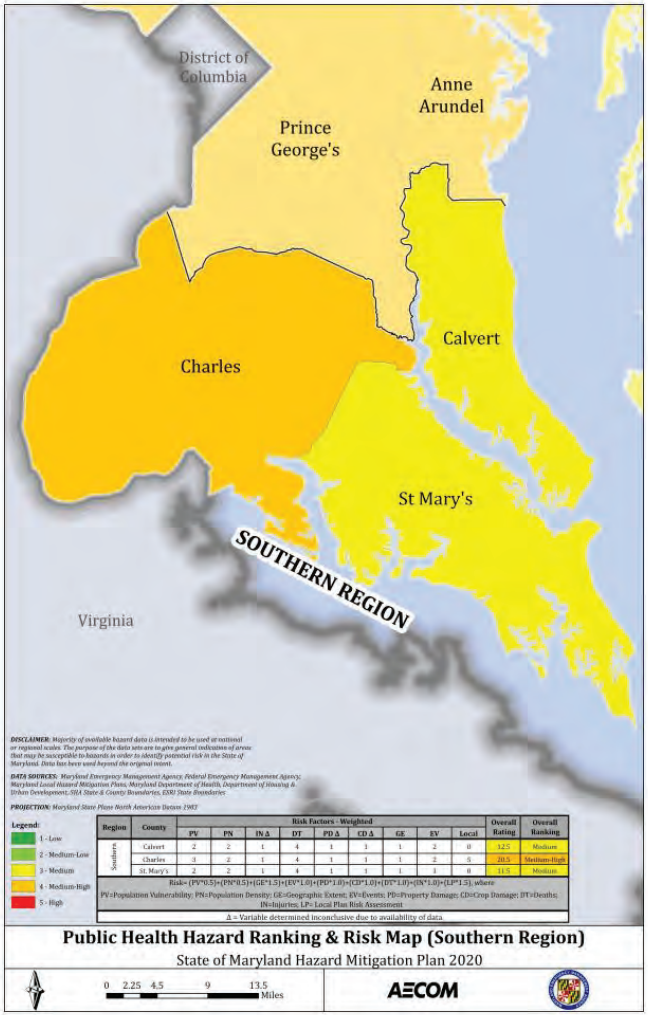
- Medium Risk
- Data Sources include National Climatic Data Center (NCDC) Storm Database
- Average number of extreme temperature events (Excessive Heat & Extreme Cold/Wind Chill)

Human-Caused Hazards & Threats

- Medium Low Risk
- Data Sources include Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Calculated based on number of Hazmat events

Public Health

- Medium – Medium High Risk
- Data Sources include Housing and Urban Development & Maryland Department of Health
- Calculated based on Median Income & opioid related incidents.



Soil Movement

- Low - Medium Low Risk
- Sources include US Geological Survey Karst data layer
- Calculated using % Area of KARST

State Assets and Critical Facilities

State Assets

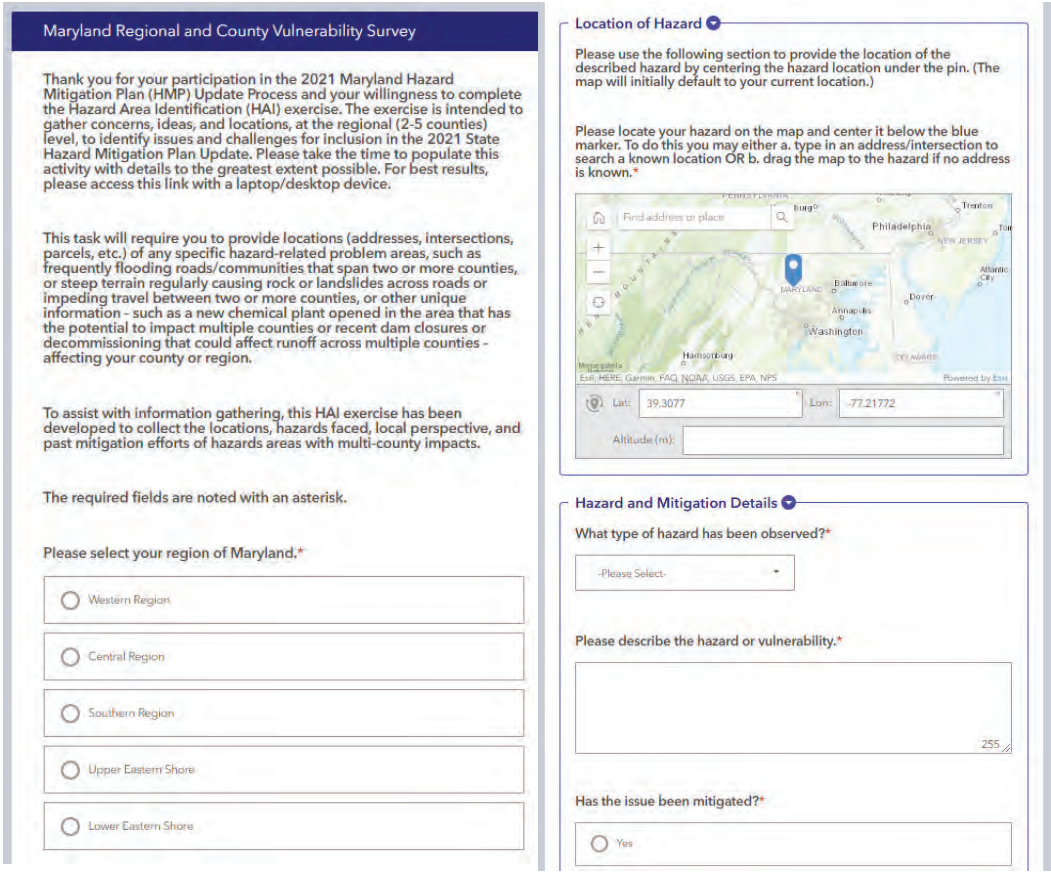
Jurisdiction	State Asset Totals	State Assets Loss Estimations 2016			State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Calvert	156	$240,181,600	$34,055,500	$274,237,200	132	$181,259,297	$25,583,708	$206,843,005
Charles	166	$166,512,000	$20,856,900	$187,369,000	153	$161,933,486	$19,981,043	$181,914,529
St. Mary's	368	$959,812,500	$245,592,000	$1,205,404,500	324	$613,989,775	$146,246,420	$760,236,195
	690	**$ 1,366,506,100**	**$ 300,504,400**	**$ 1,667,010,700**	**609**	**$ 957,182,558**	**$ 191,811,171**	**$ 1,148,993,729**

Critical Facilities

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations 2016			Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Calvert	73	$463,442,100	$154,480,700	$617,922,800	73	$456,940,700	$44,494,800	$501,435,500
Charles	80	$589,289,300	$196,429,800	$785,719,100	80	$589,289,300	$260,895,700	$850,185,000
St. Mary's	43	$343,849,400	$114,616,500	$458,465,900	43	$343,849,400	$20,758,800	$364,608,200
	196	$ 1,396,580,800	$ 465,527,000	$ 1,862,107,800	196	$ 1,390,079,400	$ 326,149,300	$ 1,716,228,700

Maryland Regional and County Vulnerability Survey

- Online survey to provide feedback for known regional hazards and mitigation efforts
- Link to survey can be found in our Virtual Room and below



https://survey123.arcgis.com/share/75bc824859ea4f3d8558bc349273d10c

Questions?

MEMA SHMP Update Virtual Room

Hold as a placeholder to start the Virtual Room discussion

Website: [MEMA-Maryland-360]

Maryland
EMERGENCY MANAGEMENT AGENCY

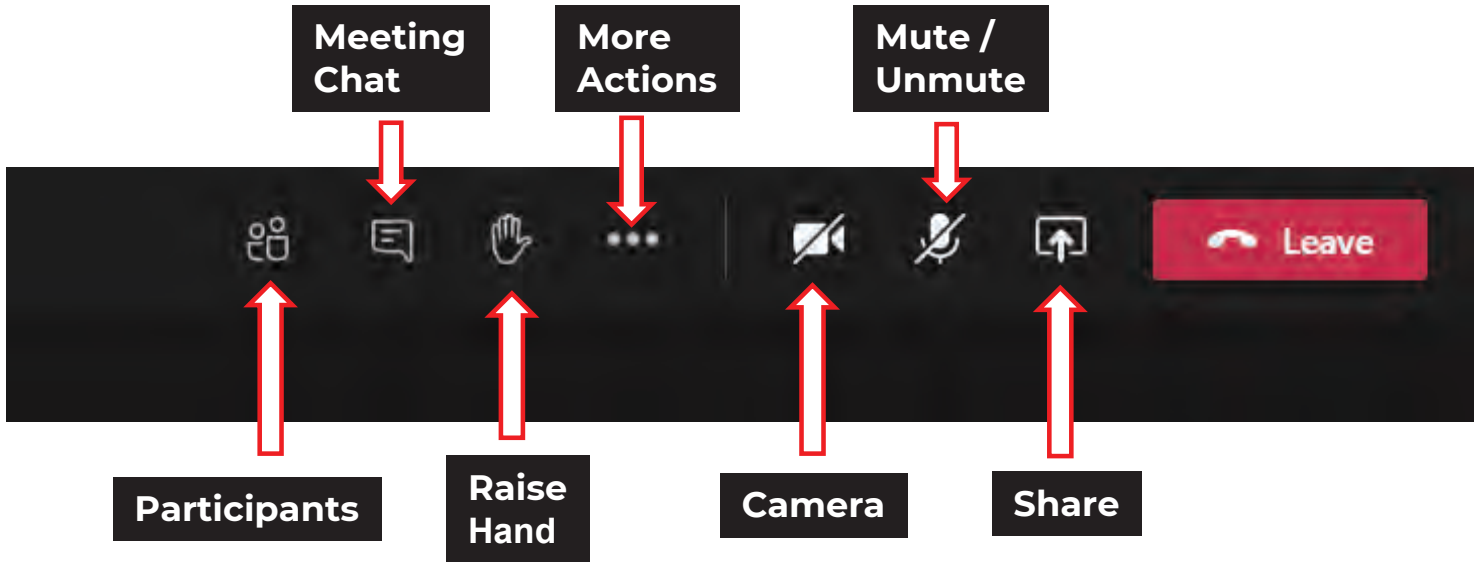
The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

JaLeesa Tate, CFM (410) 517-3617 jaleesa.tate@maryland.gov

2021 Maryland HIRA

Upper Eastern Shore Region

Teams Overview



Hazard Identification

2016 Mitigation Plan

- Coastal Hazards
- Drought
- Flood
- Thunderstorm
- Tornado
- Wildfire
- Wind
- Winter Storm

2021 Mitigation Plan

- Same 8 hazards in 2016 plan
- 5 new hazards:
  - Dam Failure
  - Extreme Temperatures
  - Human Caused Hazards
  - Public Health Emergencies
  - Soil Movement

Region's Risk

	2016 Plan			2021 Update		
Hazard	Caroline	Cecil	Kent	Caroline	Cecil	Kent
Coastal Hazards	Medium	Medium	High	Medium	Medium	Medium-High
Drought	Medium-High	High	Medium-High	Medium-High	Medium-High	Medium
Flood	Medium	Medium-High	Medium-High	Medium-High	Medium-High	Medium
Thunderstorm	Medium	Medium-High	Medium	Medium	Medium-High	Medium-High
Tornado	Medium-Low	Medium-High	Low	Medium-Low	Medium	Medium-Low
Wildfire	Medium-Low	Medium	Medium	Medium-Low	Medium	Medium
Wind	Medium	Medium-High	Medium	Medium-High	High	Medium-High
Winter Storm	Medium	Medium-High	Medium-High	Medium	Medium-High	Medium

Region's Risk

	2016 Plan		2021 Update	
Hazard	Queen Anne's	Talbot	Queen Anne's	Talbot
Coastal Hazards	High	Medium-High	High	Medium-High
Drought	Medium-High	Medium-High	Medium-High	Medium-High
Flood	Medium-High	Medium-High	Medium-High	Medium-High
Thunderstorm	Medium-Low	Medium	Low	Medium
Tornado	Low	Medium-Low	Medium	Medium-Low
Wildfire	Medium	Medium	Medium	Medium
Wind	Medium	Medium	High	Medium-High
Winter Storm	Medium-High	Medium-High	Medium-High	Medium-High

Region's Risk

New Hazards

	2021 Plan		
Hazard	Caroline	Cecil	Kent
Dam Failure	Medium-Low	Medium-Low	Medium-Low
Extreme Temperatures	Medium-Low	Medium	Medium-Low
Human Caused	Medium-Low	Medium	Medium-Low
Public Health	Medium-High	Medium-High	Medium-High
Soil Movement	Medium-Low	Low	Low

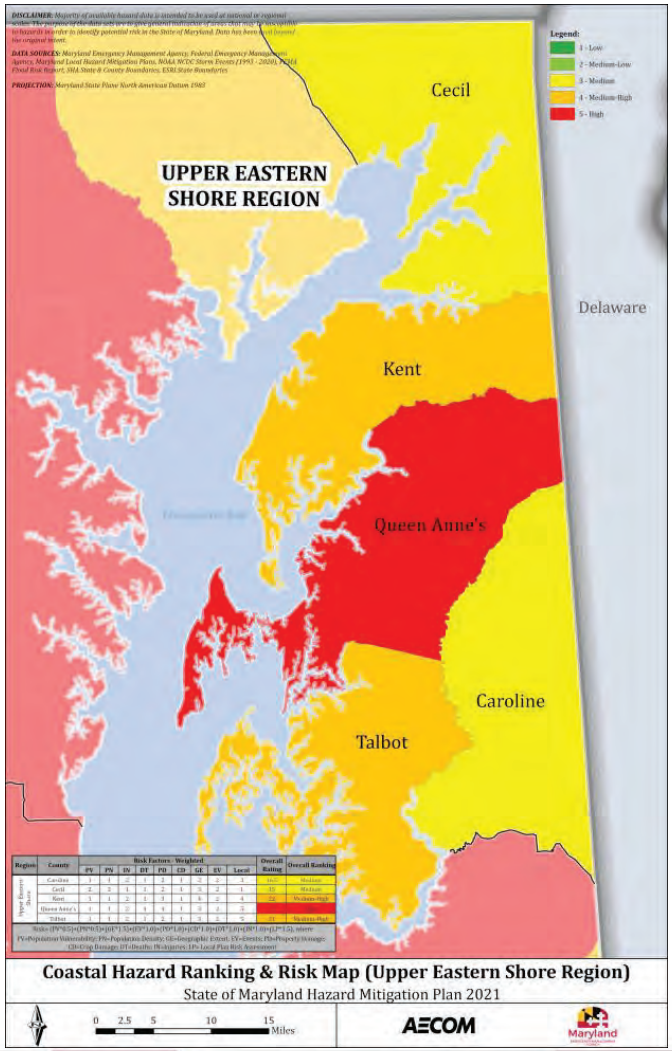
Region's Risk

New Hazards

	2021 Plan	
Hazard	Queen Anne's	Talbot
Dam Failure	Medium-Low	Medium-Low
Extreme Temperatures	Medium	Medium-Low
Human Caused	Medium-Low	Medium
Public Health	Medium	Medium
Soil Movement	Medium-Low	Medium-Low

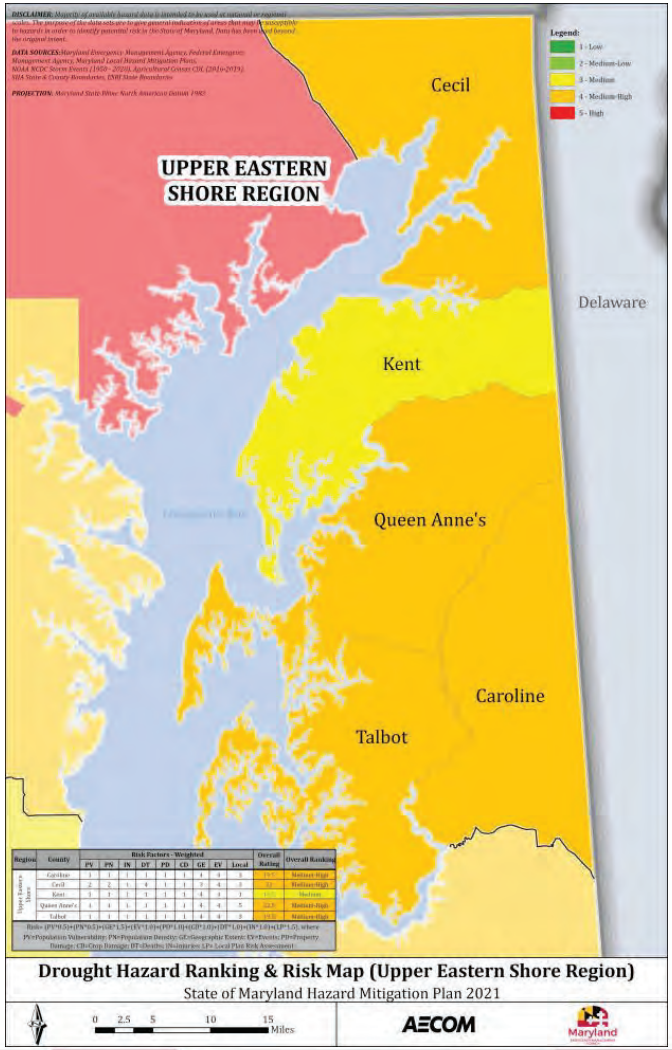
Coastal Hazard

- Medium - High Risk
- Data Sources include National Climatic Data Center and Maryland Coastal Study Flood Risk Reports
- Calculated using % of Costal Land Area



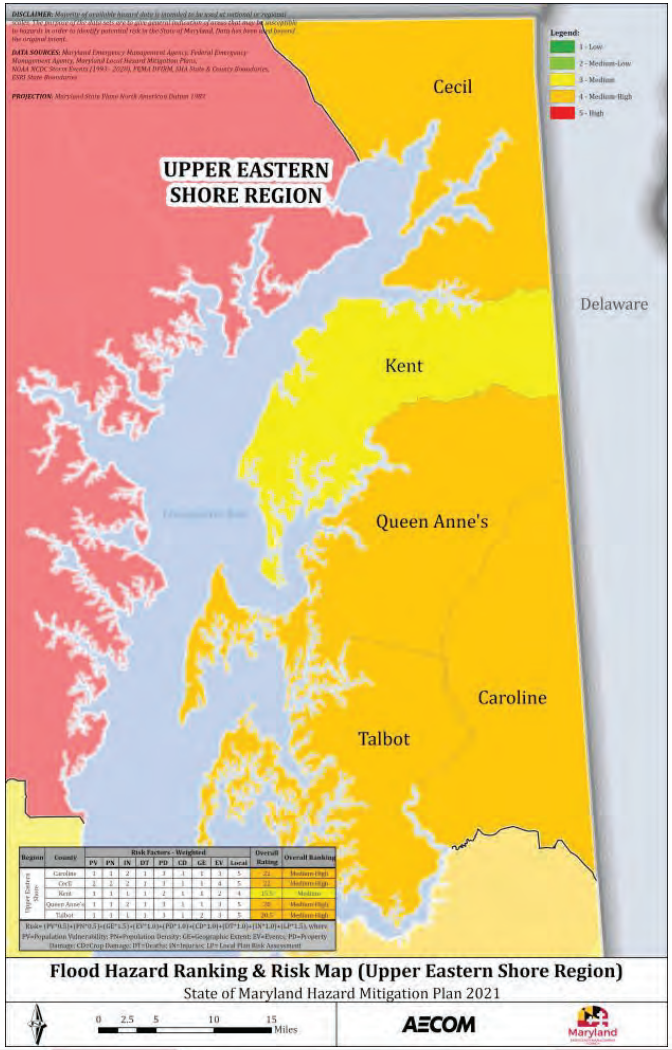
Drought

- Medium – Medium High Risk
- Data Sources include USDA Census of Agriculture and the Cropland Data Layer of Maryland (CDL)
- Calculated using % area of cropland



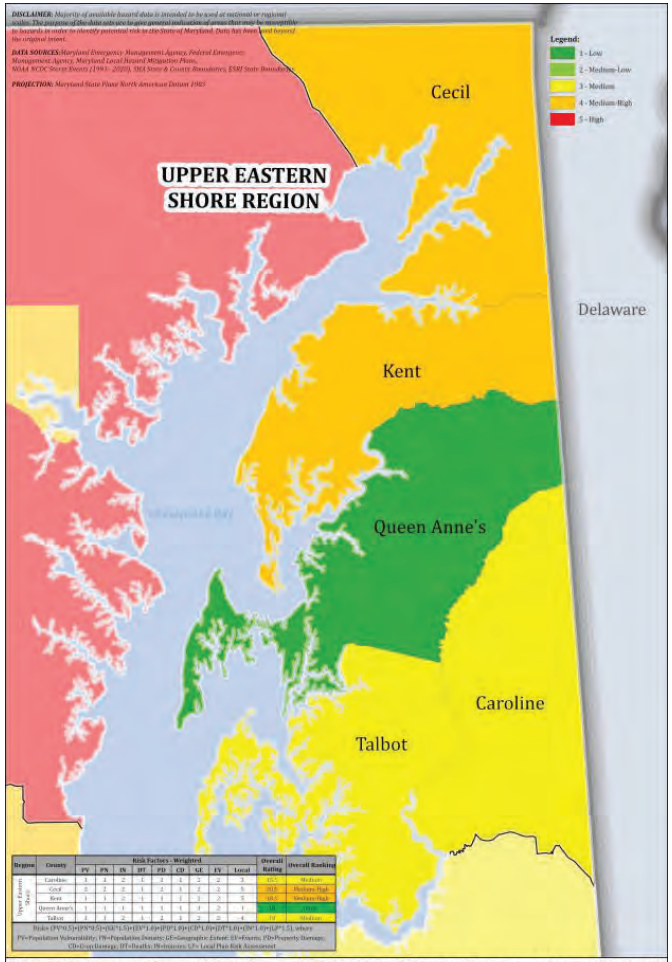
Flood Hazard

- Medium Risk
- Data Sources include NCDC & FEMA Preliminary and Effective DFIRMS
- Calculated using % area in 100-year Floodplain



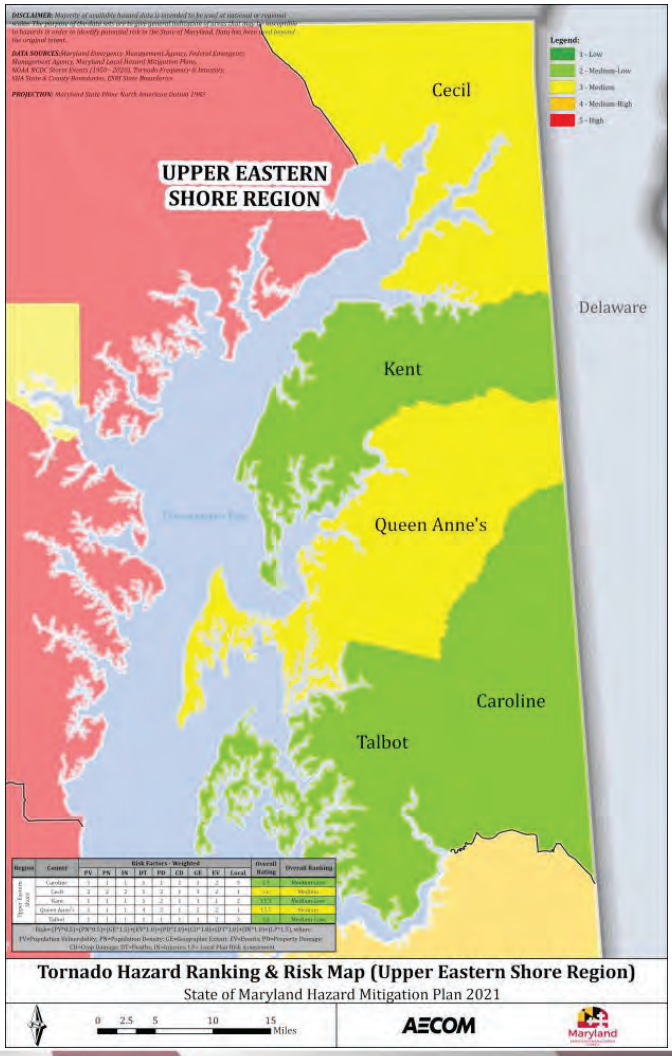
Thunderstorm

- Low - Medium High Risk
- Data Sources include National Climatic Data Center (NCDC) Storm Events Database
- Average number of events greater than 2“ of rain, hail, and lightening events that caused Injuries/Deaths



Tornado

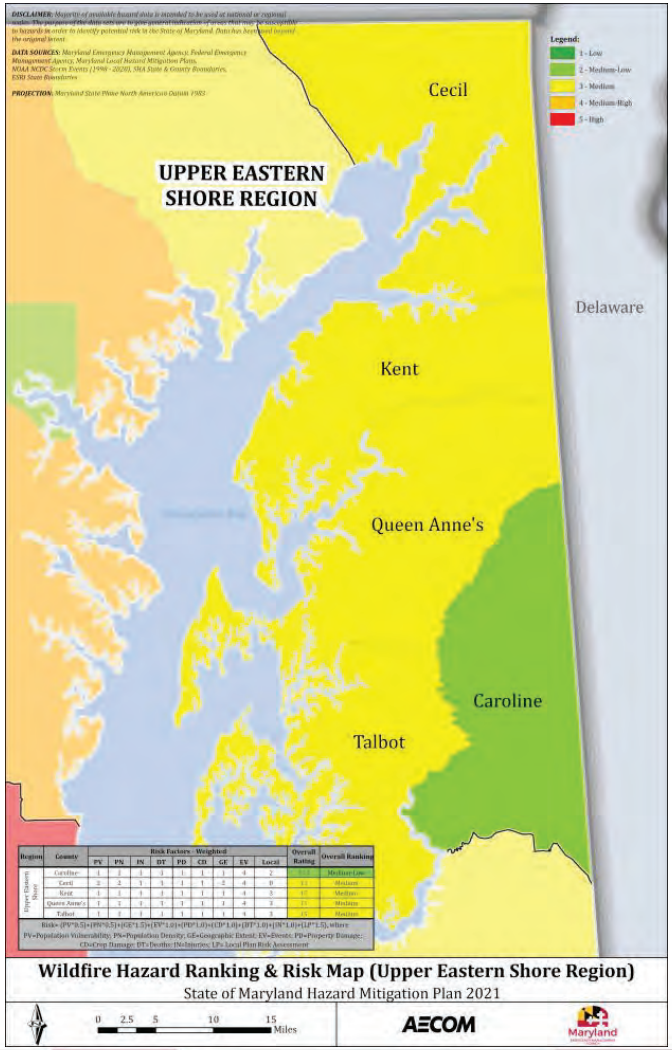
- Medium Low - Medium Risk
- Data Sources include NCDC Storm Events Database
- Calculated using sum of all tornados weighted by intensity (F-scale or EF-scale)



Tornado Hazard Ranking & Risk Map (Upper Eastern Shore Region)
State of Maryland Hazard Mitigation Plan 2021

Wildfire

- Medium Low - Medium Risk
- Data Sources include MD Department of Natural Resources (DNR) Forest Service Risk Assessment Layer & NCDC
- Calculated using % area found in high and medium-high risk area.

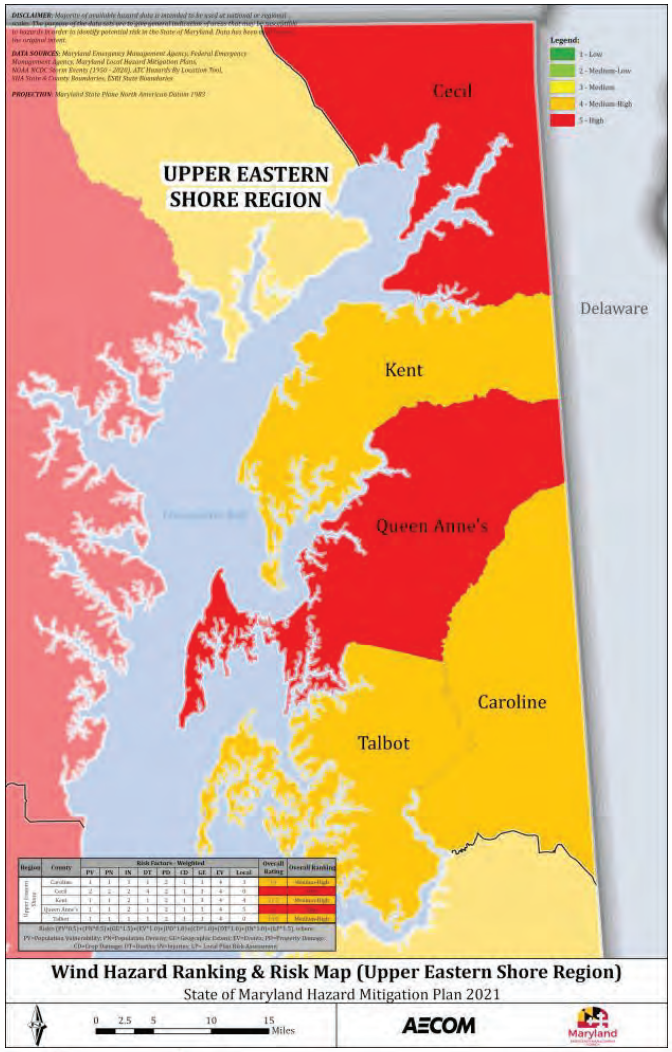


Wildfire Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2021

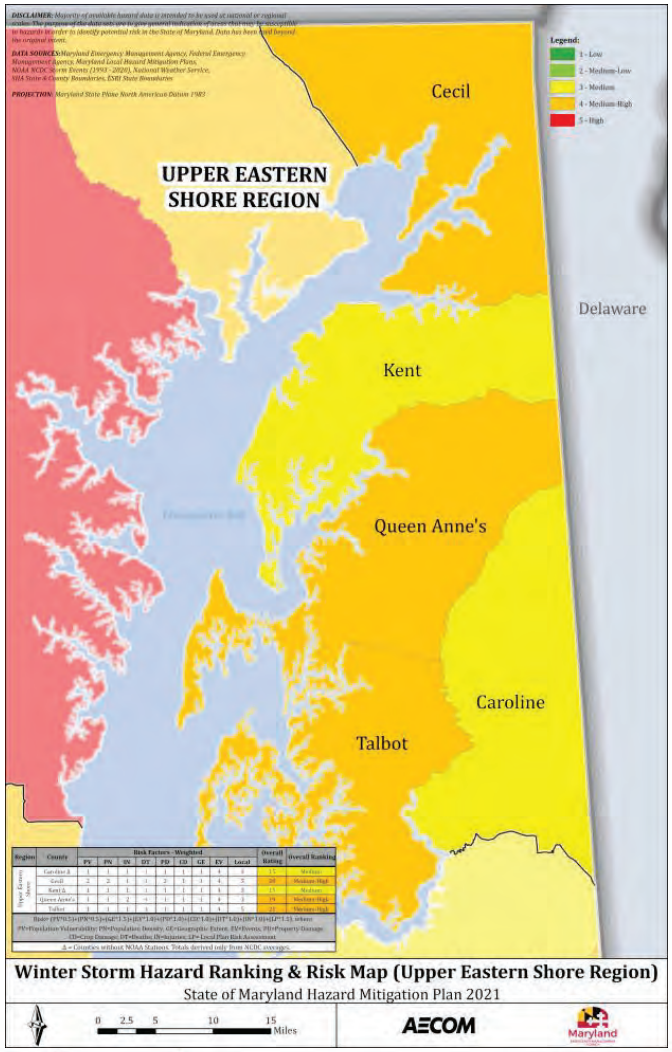
Wind Hazard

- Medium High - High Risk
- Data Sources include NCDC Storm Event Database and American Society of Civil Engineers (ASCE)
- Calculated using ASCE Design Wind Speeds



Winter Storm

- Medium - Medium High Risk
- Data Sources include NCDC & National Weather Service
- Calculated using Average total Snowfall

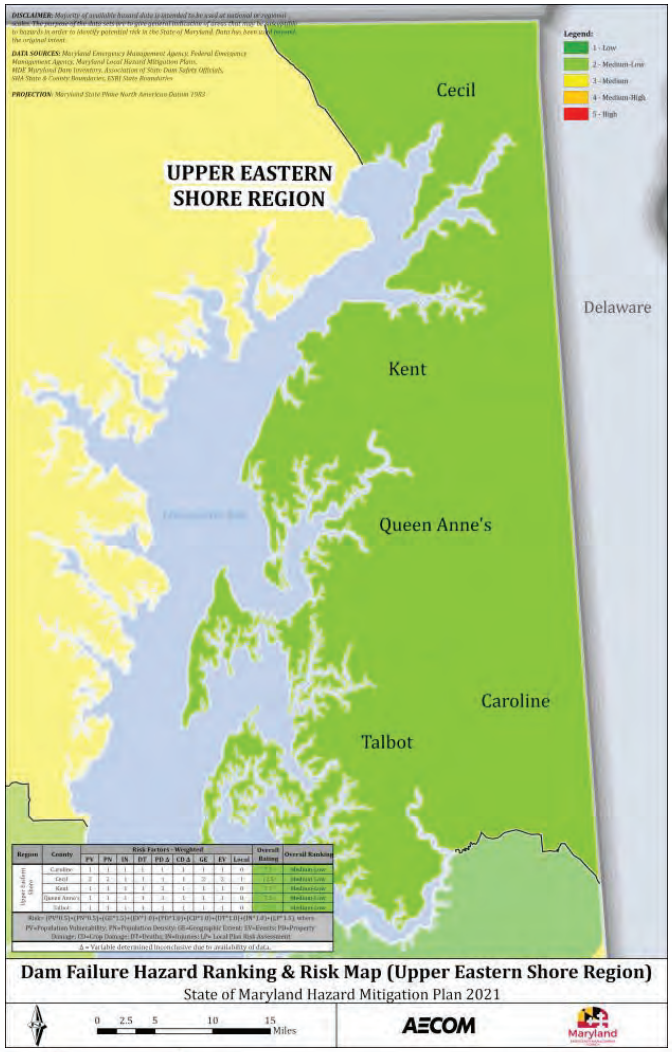


Winter Storm Hazard Ranking & Risk Map (Upper Eastern Shore Region)
State of Maryland Hazard Mitigation Plan 2021

NEW HAZARDS

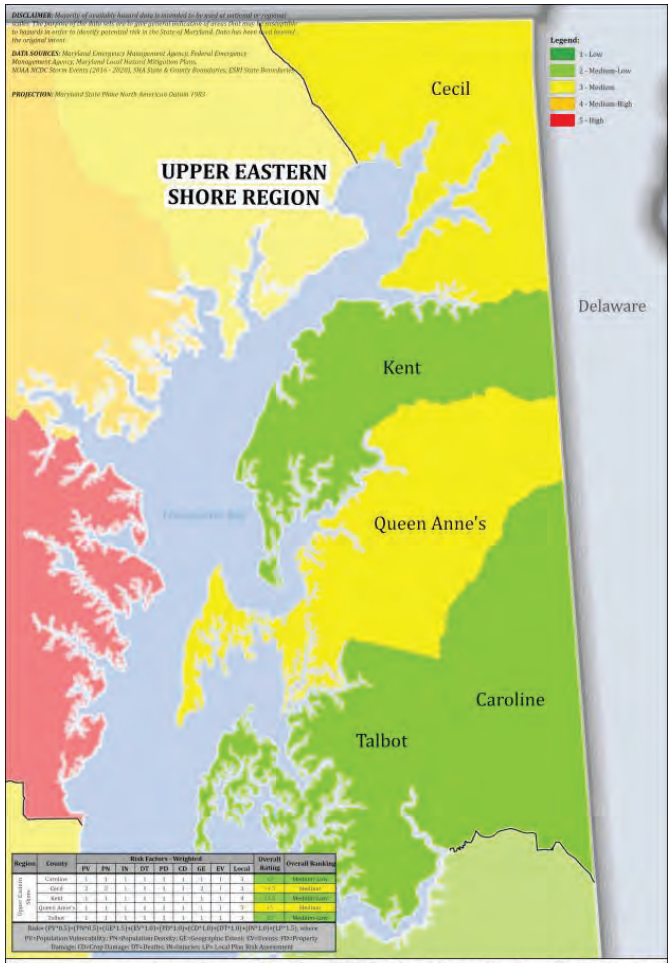
Dam Failure

- Medium Low Risk
- Data Sources include Maryland Department of the Environment (MDE) High Hazard Dams and 20 recent dam incidents
- Calculated using sum of high-hazard dams per county.



Extreme Temperatures

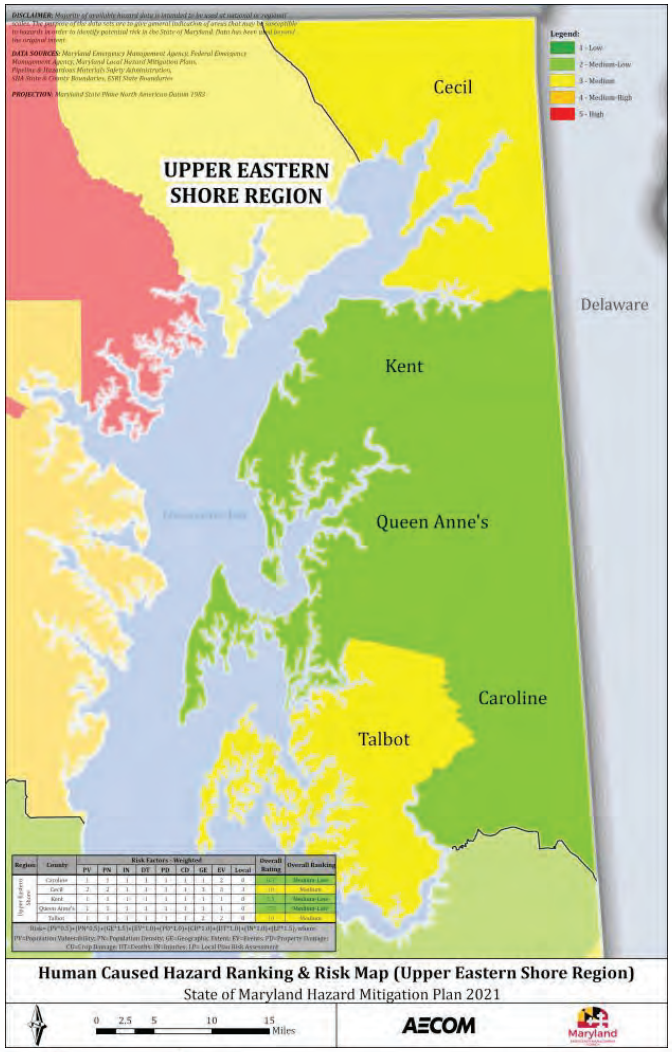
- Medium Low - Medium Risk
- Data Sources include National Climatic Data Center (NCDC) Storm Database
- Average number of extreme temperature events (Excessive Heat & Extreme Cold/Wind Chill)



Extreme Temperatures Hazard Ranking & Risk Map (Upper Eastern Shore Region)
State of Maryland Hazard Mitigation Plan 2021

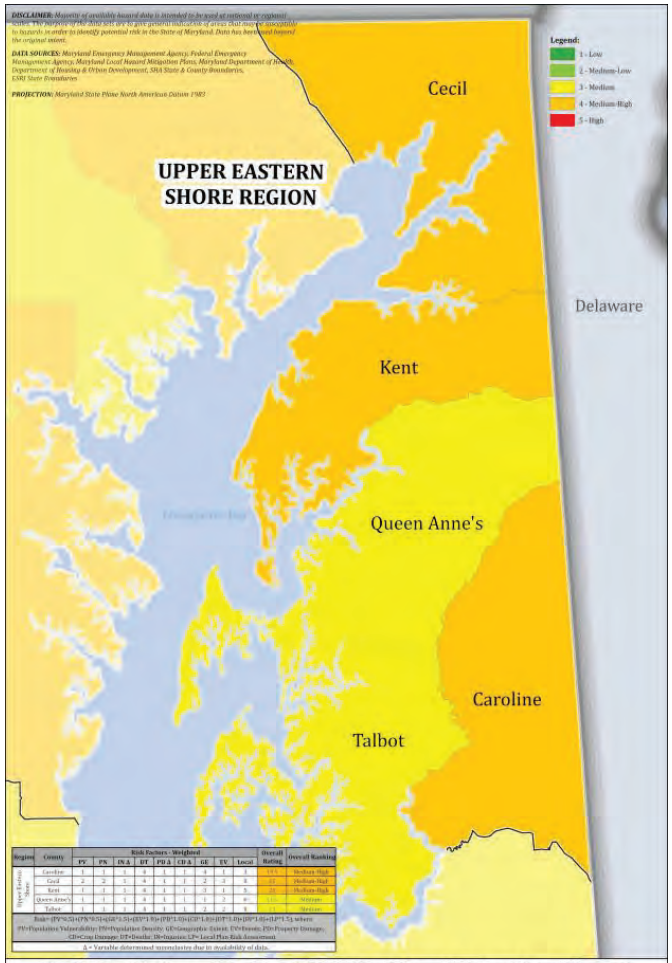
Human-Caused Hazards & Threats

- Medium Low – Medium Risk
- Data Sources include Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Calculated based on number of Hazmat events



Public Health

- Medium – Medium High Risk
- Data Sources include Housing and Urban Development & Maryland Department of Health
- Calculated based on Median Income & opioid related incidents.



Public Health Hazard Ranking & Risk Map (Upper Eastern Shore Region)
State of Maryland Hazard Mitigation Plan 2021

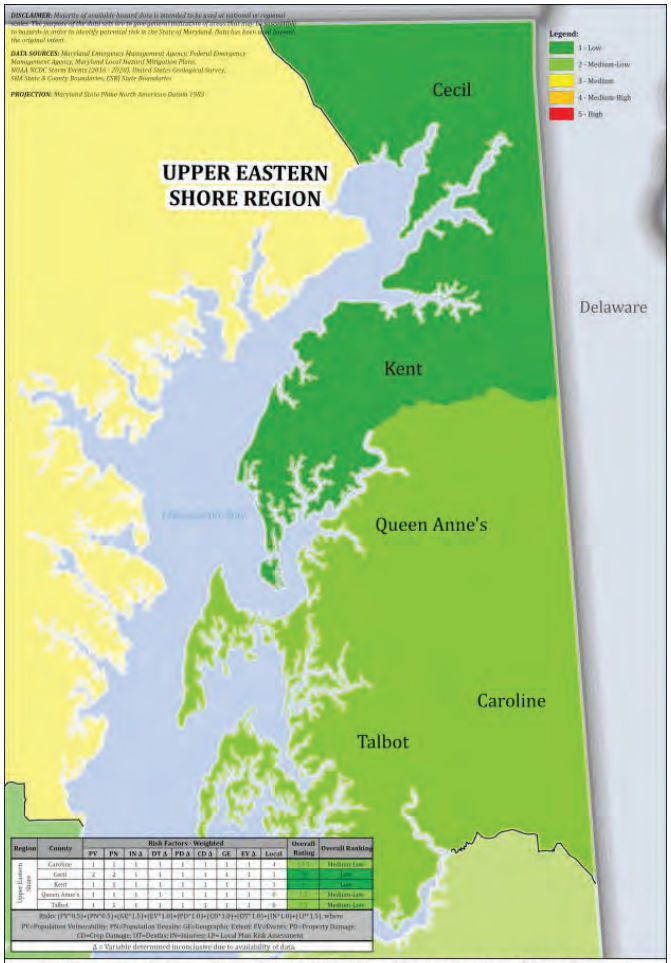
0 2.5 5 10 15 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Soil Movement

- Low - Medium Low Risk
- Sources include US Geological Survey Karst data layer
- Calculated using % Area of KARST



Soil Movement Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2021

0 2.5 5 10 15 Miles

AECOM

State Assets and Critical Facilities

State Assets

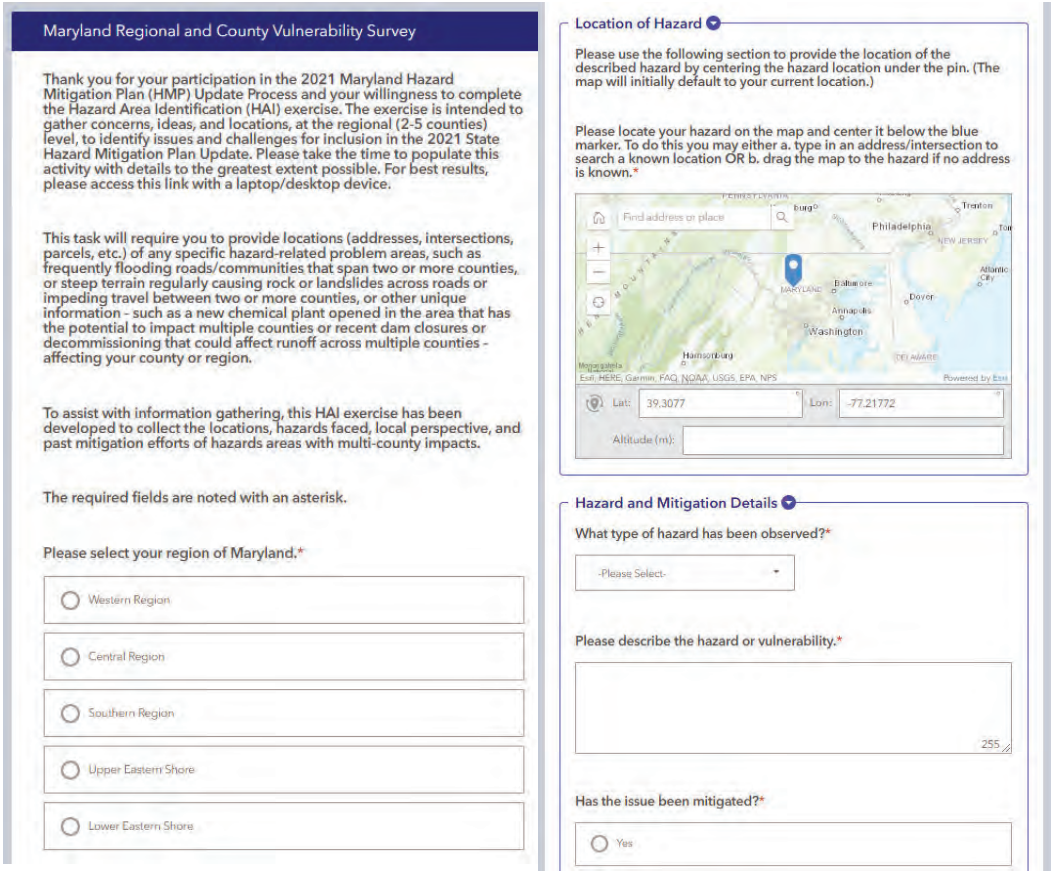
Jurisdiction	State Asset Totals	State Assets Loss Estimations 2016			State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Caroline	425	$165,490,901	$26,930,594	$192,421,495	425	$165,490,901	$26,930,594	$192,421,495
Cecil	143	$225,324,000	$44,458,100	$269,782,100	292	$196,145,839	$35,864,521	$232,010,360
Kent	54	$69,165,300	$15,149,500	$84,314,800	40	$63,596,145	$14,818,061	$78,414,207
Queen Anne's	117	$185,617,500	$22,860,800	$208,478,400	98	$179,154,426	$22,760,940	$201,915,366
Talbot	67	$86,687,059	$24,073,015	$110,760,073	67	$86,687,059	$24,073,015	$110,760,073
	806	**$ 732,284,760.15**	**$ 133,472,008.51**	**$ 865,756,868.66**	**922**	**$ 691,074,370.18**	**$ 124,447,131.37**	**$ 815,521,501.55**

Critical Facilities

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations 2016			Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Caroline	31	$84,756,700	$6,948,700	$91,705,400	31	$84,756,700	$6,948,700	$91,705,400
Cecil	91	$390,260,000	$130,086,700	$520,346,700	91	$390,260,000	$48,748,200	$439,008,200
Kent	25	$67,540,500	$22,513,500	$90,054,000	25	$67,540,500	$11,812,200	$79,352,700
Queen Anne's	49	$255,792,800	$85,264,300	$85,264,300	49	$247,202,800	$56,039,700	$303,242,500
Talbot	45	$166,116,600	$42,886,300	$209,002,900	45	$166,116,600	$42,886,300	$209,002,900
	119	**$ 489,449,900**	**$ 150,664,100**	**$ 384,321,200**	**119**	**$ 480,859,900**	**$ 110,738,200**	**$ 591,598,100**

Maryland Regional and County Vulnerability Survey

- Online survey to provide feedback for known regional hazards and mitigation efforts
- Link to survey can be found in our Virtual Room and below



https://survey123.arcgis.com/share/75bc824859ea4f3d8558bc349273d10c

Questions?

MEMA SHMP Update Virtual Room

Hold as a placeholder to start the Virtual Room discussion

Website: [MEMA-Maryland-360]

Maryland
EMERGENCY MANAGEMENT AGENCY

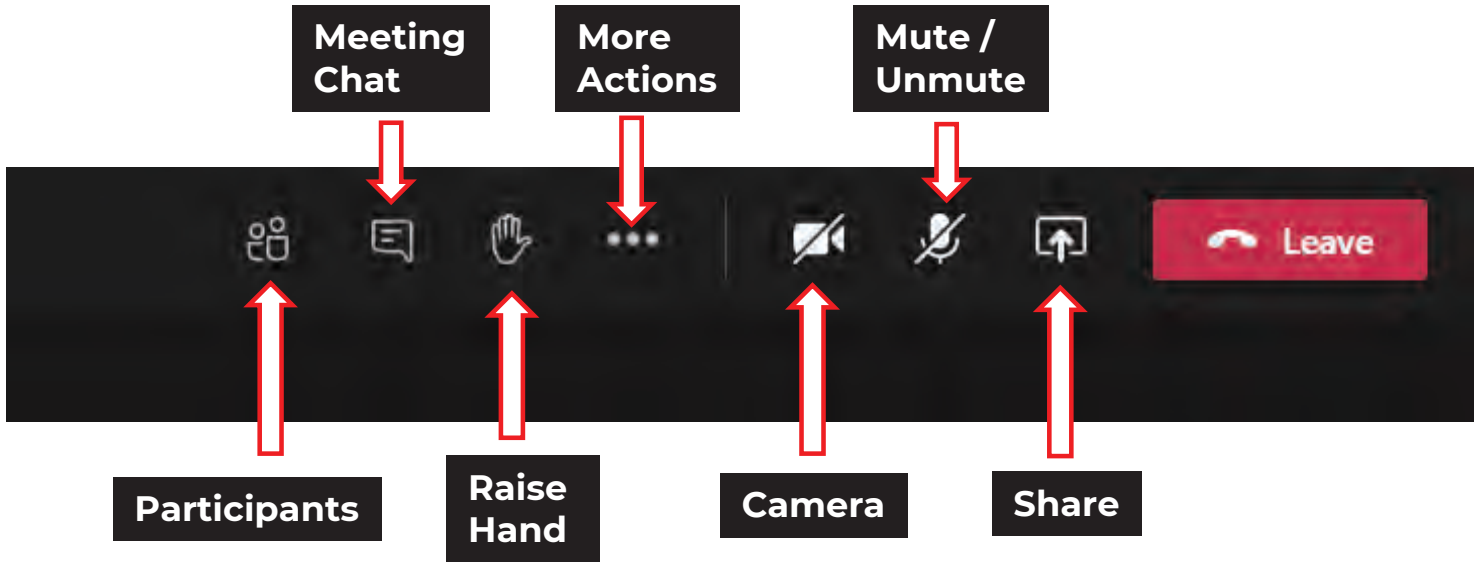
The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

JaLeesa Tate, CFM (410) 517-3617 jaleesa.tate@maryland.gov

2021 Maryland HIRA

Lower Eastern Shore Region

Teams Overview



Hazard Identification

2016 Mitigation Plan

- Coastal Hazards
- Drought
- Flood
- Thunderstorm
- Tornado
- Wildfire
- Wind
- Winter Storm

2021 Mitigation Plan

- Same 8 hazards in 2016 plan
- 5 new hazards:
  - Dam Failure
  - Extreme Temperatures
  - Human Caused Hazards
  - Public Health Emergencies
  - Soil Movement

Region's Risk

	2016 Plan				2021 Update			
Hazard	Dorchester	Somerset	Wicomico	Worcester	Dorchester	Somerset	Wicomico	Worcester
Coastal Hazards	High	High	Medium-High	High	High	High	Medium-High	High
Drought	Medium	Medium	Medium	Medium	Medium-High	Medium-High	Medium-High	Medium
Flood	Medium-High	High	Medium	Medium-High	Medium-High	Medium-High	Medium	Medium-High
Thunderstorm	Medium	Medium	Medium-High	Medium-Low	Medium	Medium	Medium	Medium
Tornado	Medium	Medium-Low	Medium-Low	Medium-Low	Medium-High	Medium-Low	Medium	Medium
Wildfire	Medium	Medium	Medium	Medium-High	Medium	Medium	Medium	Medium-High
Wind	Medium-High	Medium-High	Medium-High	Medium-High	Medium-High	High	Medium-High	Medium-High
Winter Storm	Medium	Medium	Medium-High	Medium-Low	Medium	Medium	Medium-High	Medium-Low

Region's Risk

New Hazards

	2021 Plan			
Hazard	Dorchester	Somerset	Wicomico	Worcester
Dam Failure	Low	Medium-Low	Medium	Medium-Low
Extreme Temperatures	Medium-Low	Medium-Low	Medium-Low	Medium-Low
Human Caused	Medium-Low	Medium-Low	Medium	Medium-Low
Public Health	Medium	High	Medium-High	Medium-High
Soil Movement	Medium-Low	Medium-Low	Medium-Low	Medium-Low

Methodology

Nine ranking parameters used:

- Population Vulnerability
- Population Density
- Injuries
- Deaths
- Property Damage
- Crop Damage
- Events
- Geographic Extent
- Local Hazard Ranking

Weighted Risk Factors

Population Vulnerability	*PV*	0.5
Population Density	*PN*	0.5
Injuries	*IN*	1
Deaths	*DT*	1
Property Damage (Annualized)	*PD*	1
Crop Damage (Annualized)	*CD*	1
Events (Annualized)	*EV*	1
Geographic Extent (Hazard Dependent)	*GE*	1.5
Local Plan Ranking	*LOCAL*	1.5

Overall Score

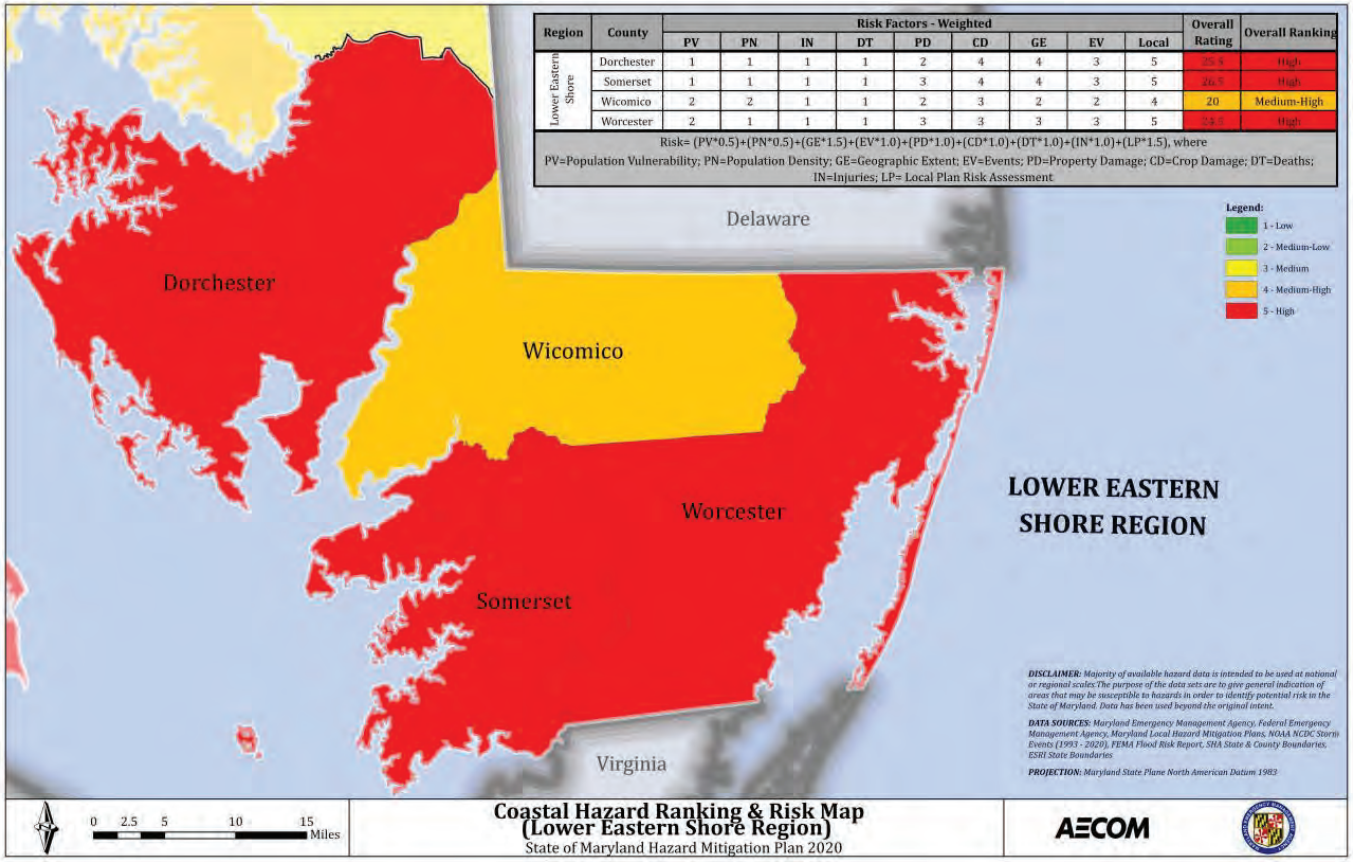
Score (>=)	*Hazard Risk Rank*
0	Low
10.5	Medium-Low
14.5	Medium
18.5	Medium-High
23	High

No Local Plan Ranking Score

Score (>=)	*Hazard Risk Rank*
0	Low
6	Medium-Low
10	Medium
14	Medium-High
18	High

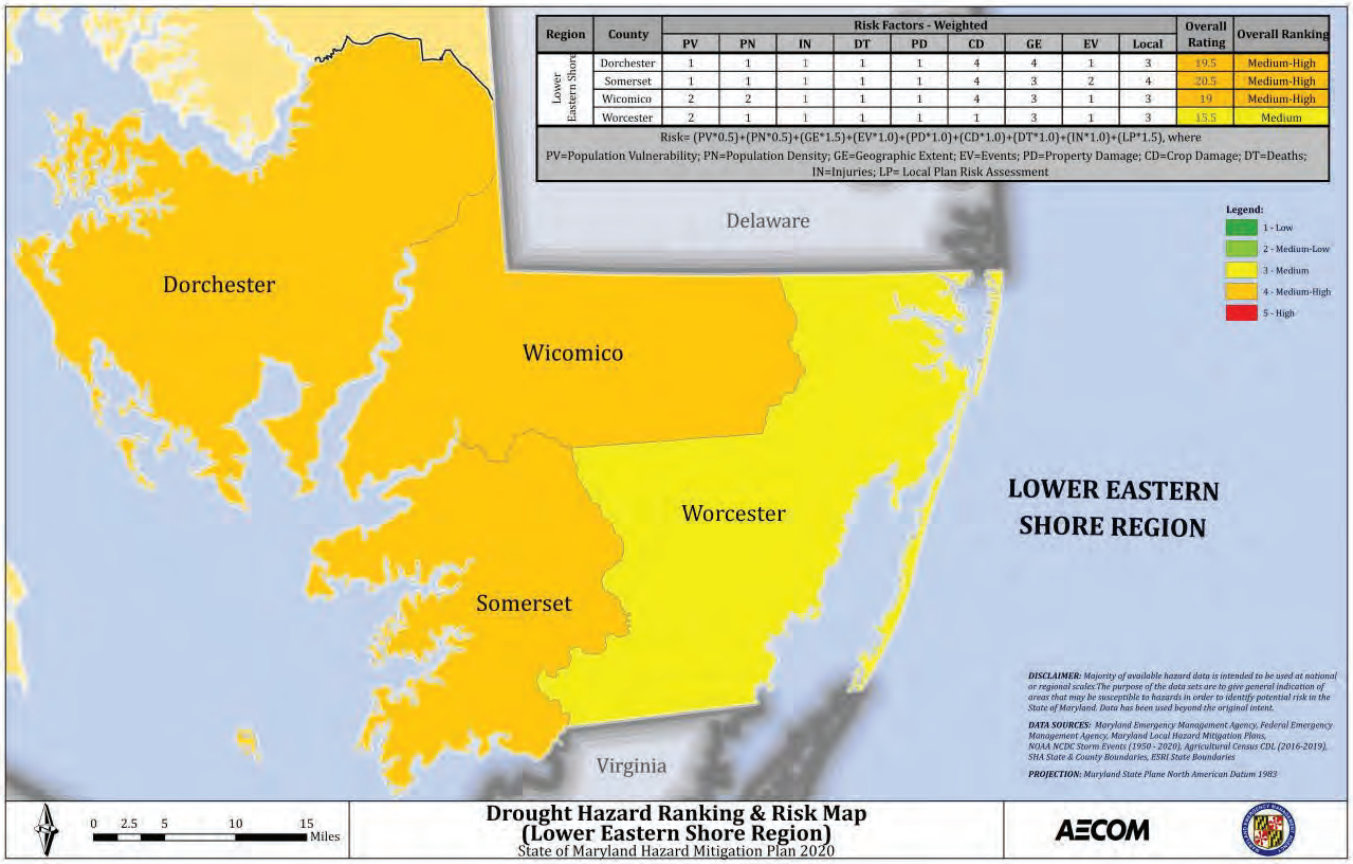
Coastal Hazard

- Medium High – High Risk
- Data Sources include National Climatic Data Center and Maryland Coastal Study Flood Risk Reports
- Calculated using % of Costal Land Area



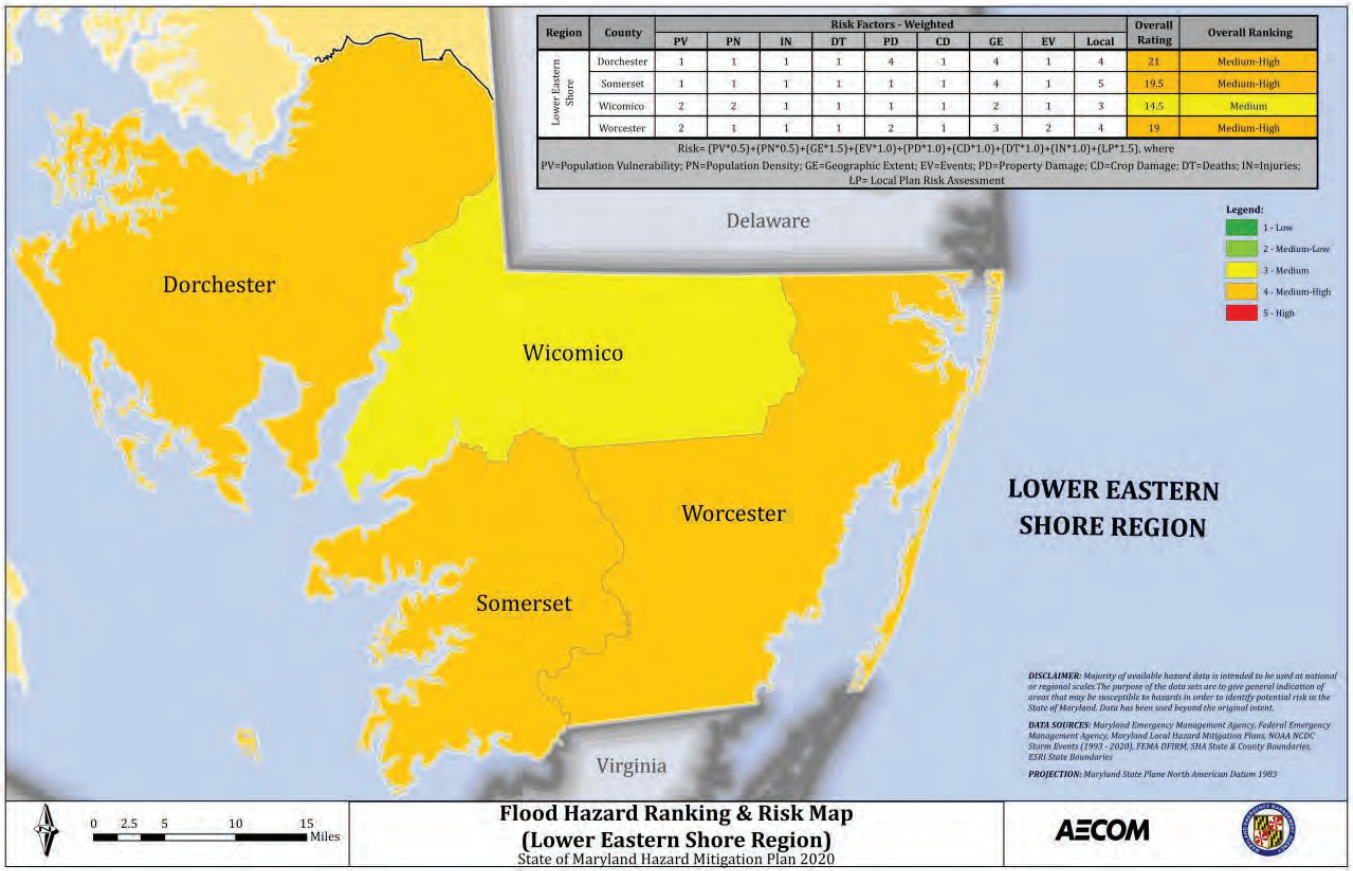
Drought

- Medium – Medium High Risk
- Data Sources include USDA Census of Agriculture and the Cropland Data Layer of Maryland (CDL)
- Calculated using % area of cropland



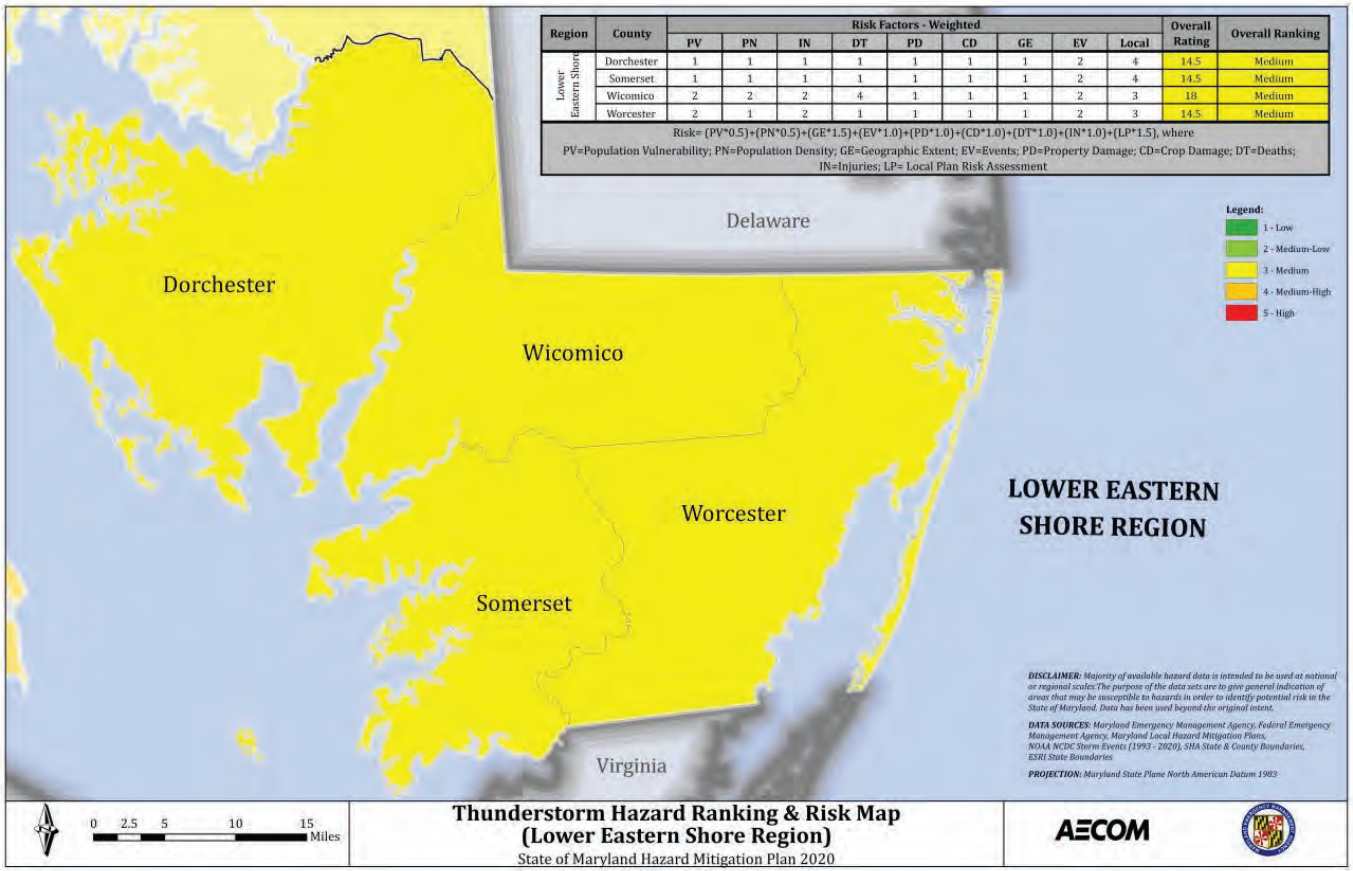
Flood Hazard

- Medium – Medium High Risk
- Data Sources include NCDC & FEMA Preliminary and Effective DFIRMS
- Calculated using % area in 100-year Floodplain



Thunderstorm

- Medium Risk
- Data Sources include National Climatic Data Center (NCDC) Storm Events Database
- Average number of events greater than 2“ of rain, hail, and lightening events that caused Injuries/Deaths

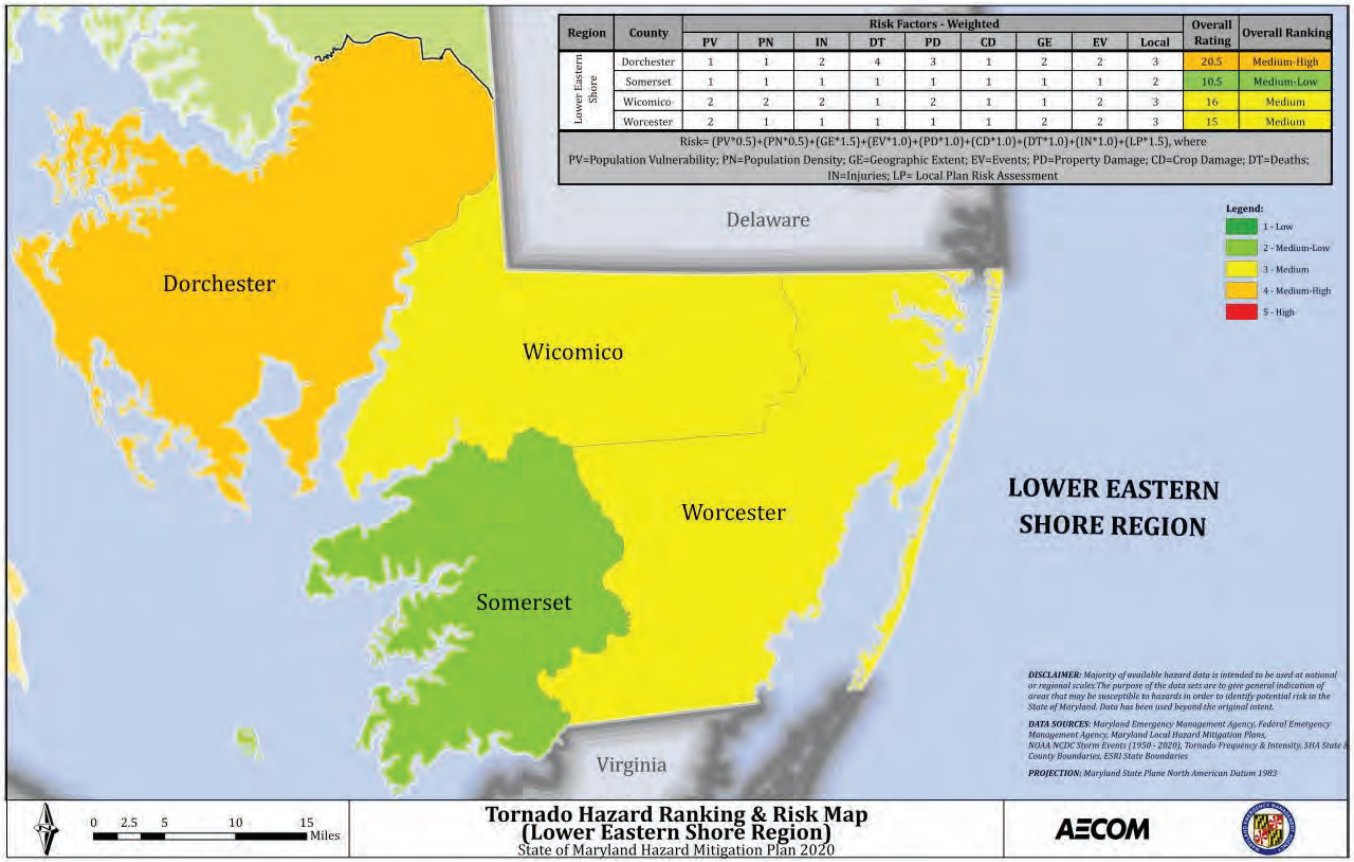


Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	2	4	14.5	Medium
	Somerset	1	1	1	1	1	1	1	2	4	14.5	Medium
	Wicomico	2	2	2	4	1	1	1	2	3	18	Medium
	Worcester	2	1	2	1	1	1	1	2	3	14.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

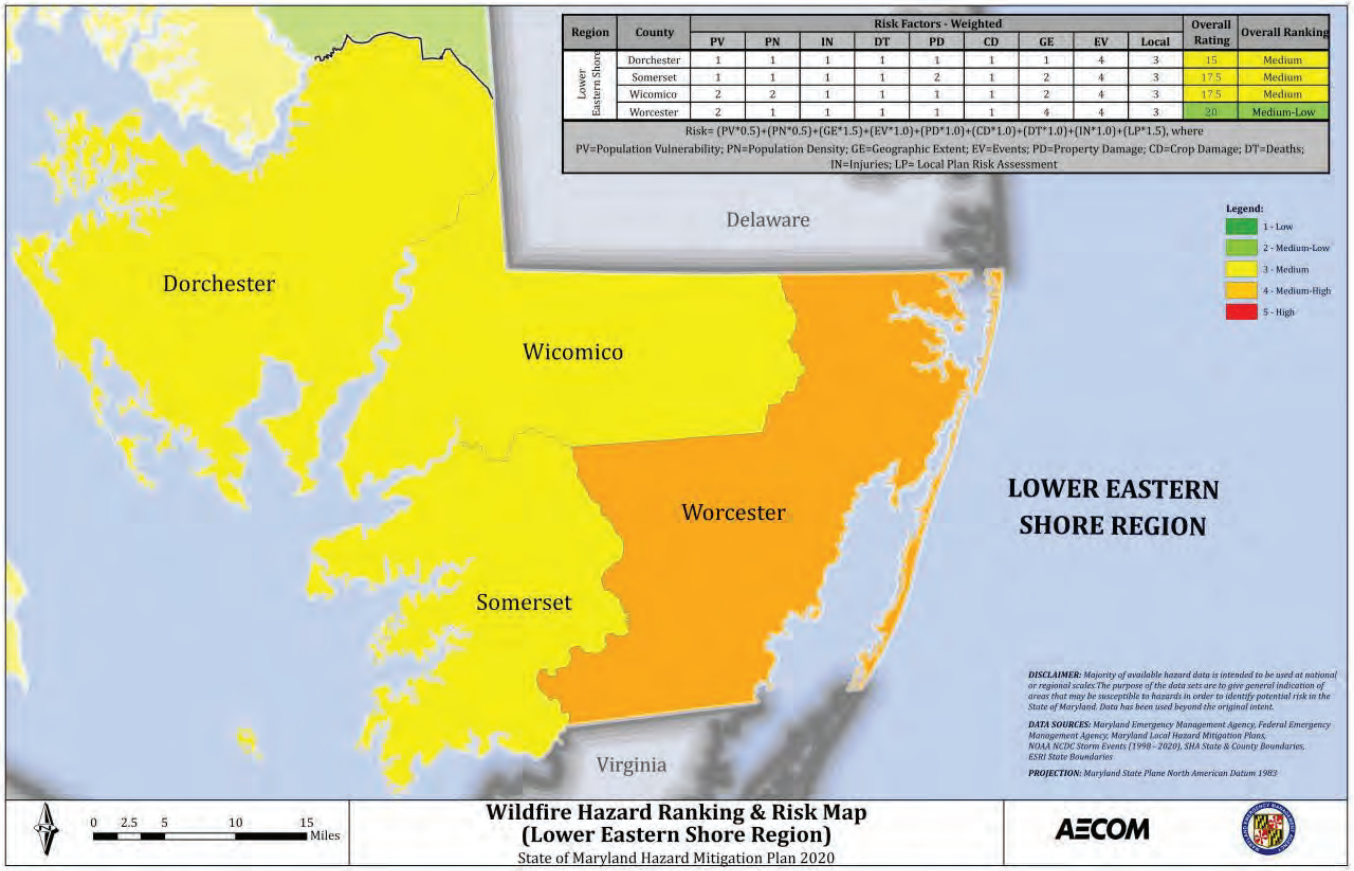
Tornado

- Medium Low – Medium High Risk
- Data Sources include NCDC Storm Events Database
- Calculated using sum of all tornados weighted by intensity (F-scale or EF-scale)



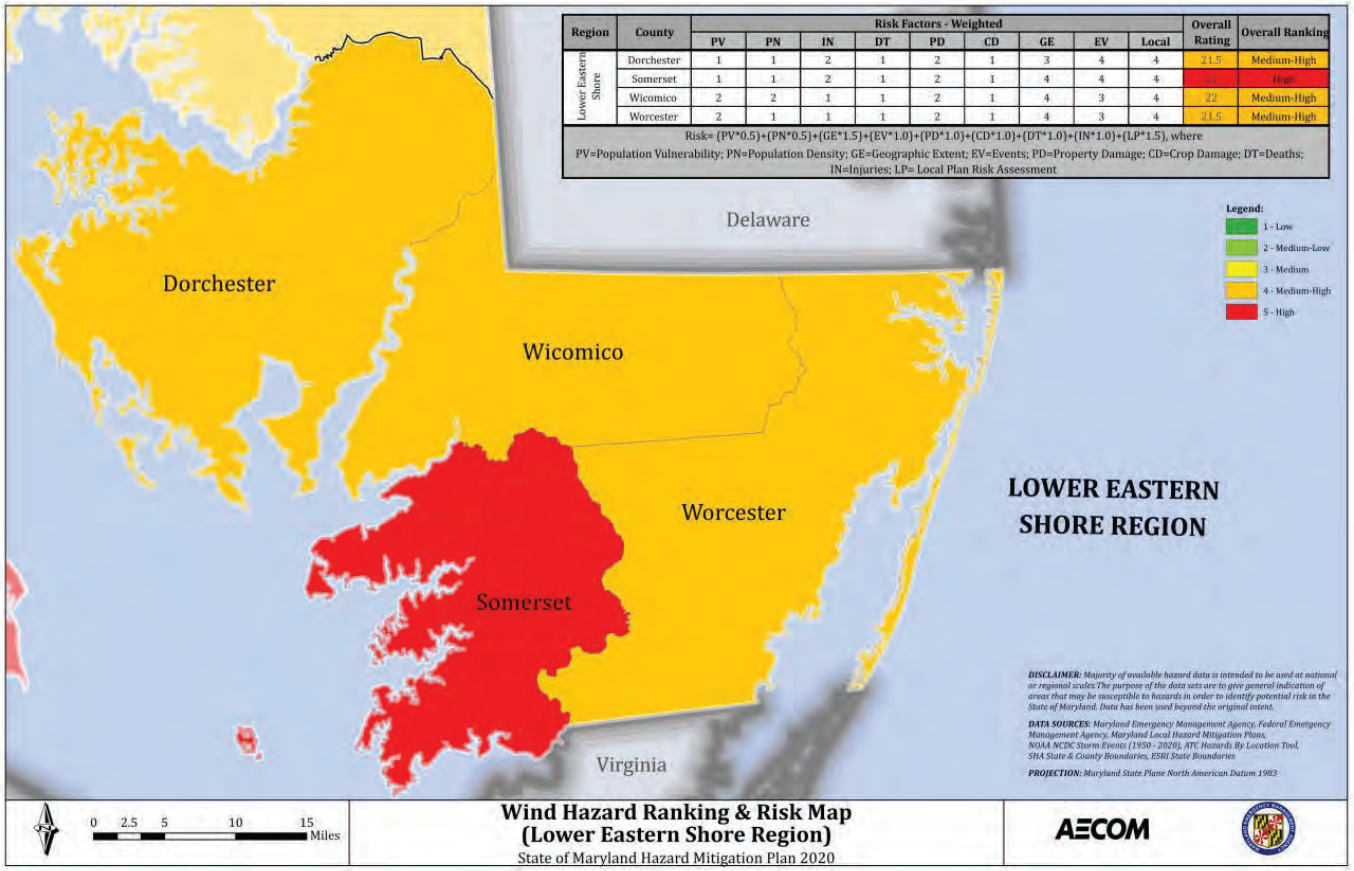
Wildfire

- Medium – Medium High Risk
- Data Sources include MD Department of Natural Resources (DNR) Forest Service Risk Assessment Layer
- Calculated using % area found in high and medium-high risk area.



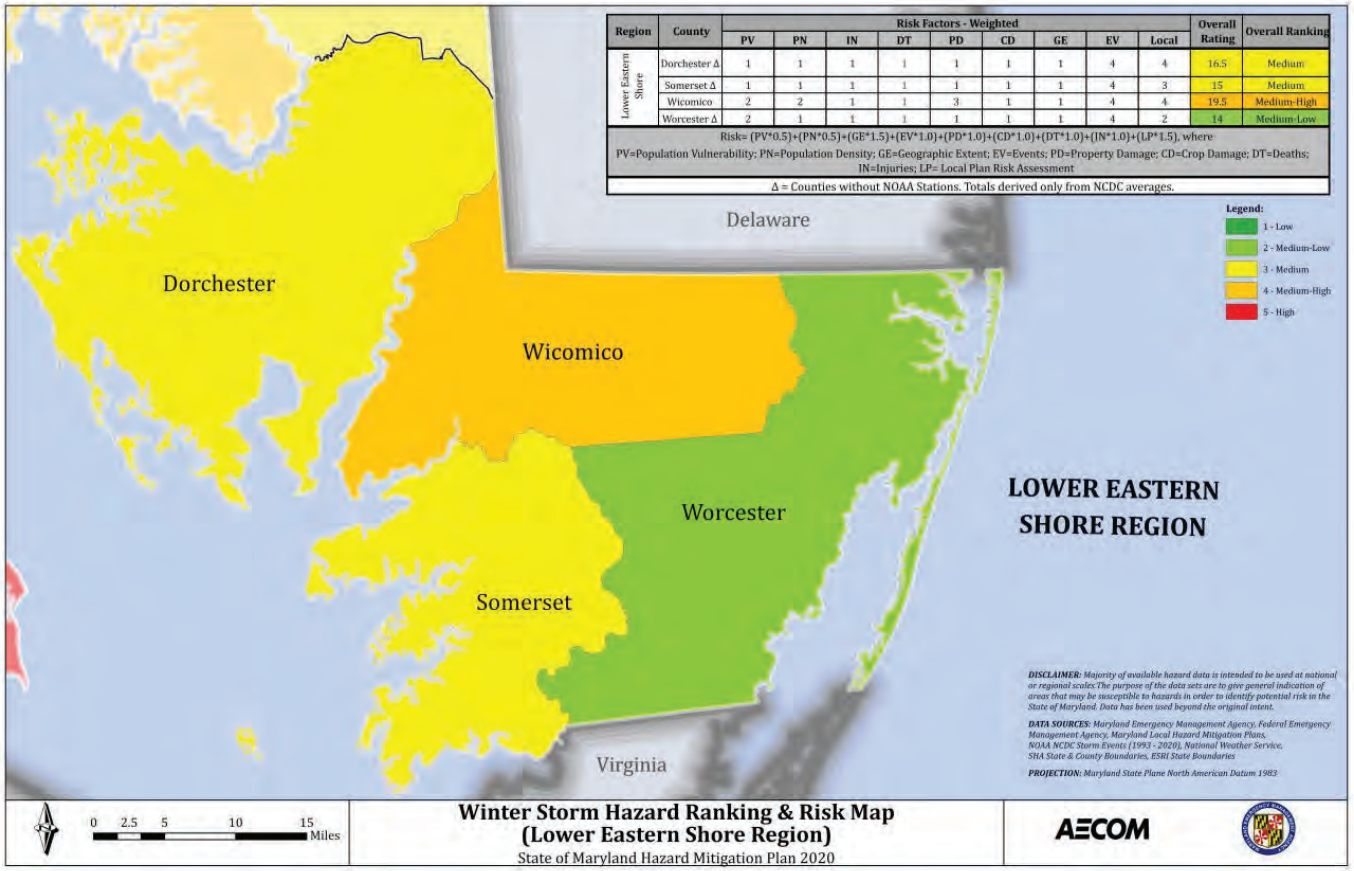
Wind Hazard

- Medium High - High Risk
- Data Sources include NCDC Storm Event Database and American Society of Civil Engineers (ASCE)
- Calculated using ASCE Design Wind Speeds



Winter Storm

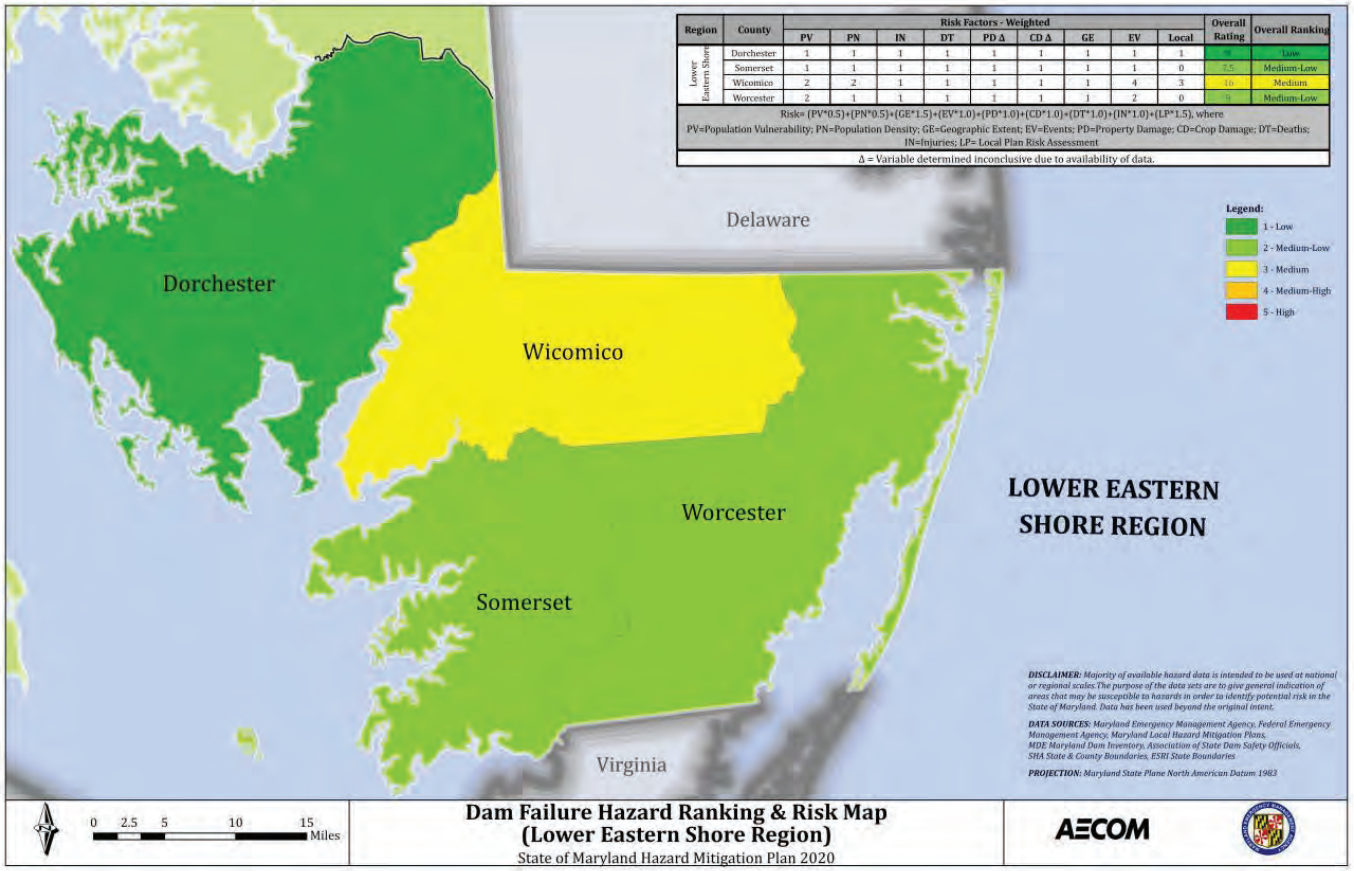
- Medium Low – Medium High Risk
- Data Sources include NCDC & National Weather Service
- Calculated using Average total Snowfall



NEW HAZARDS

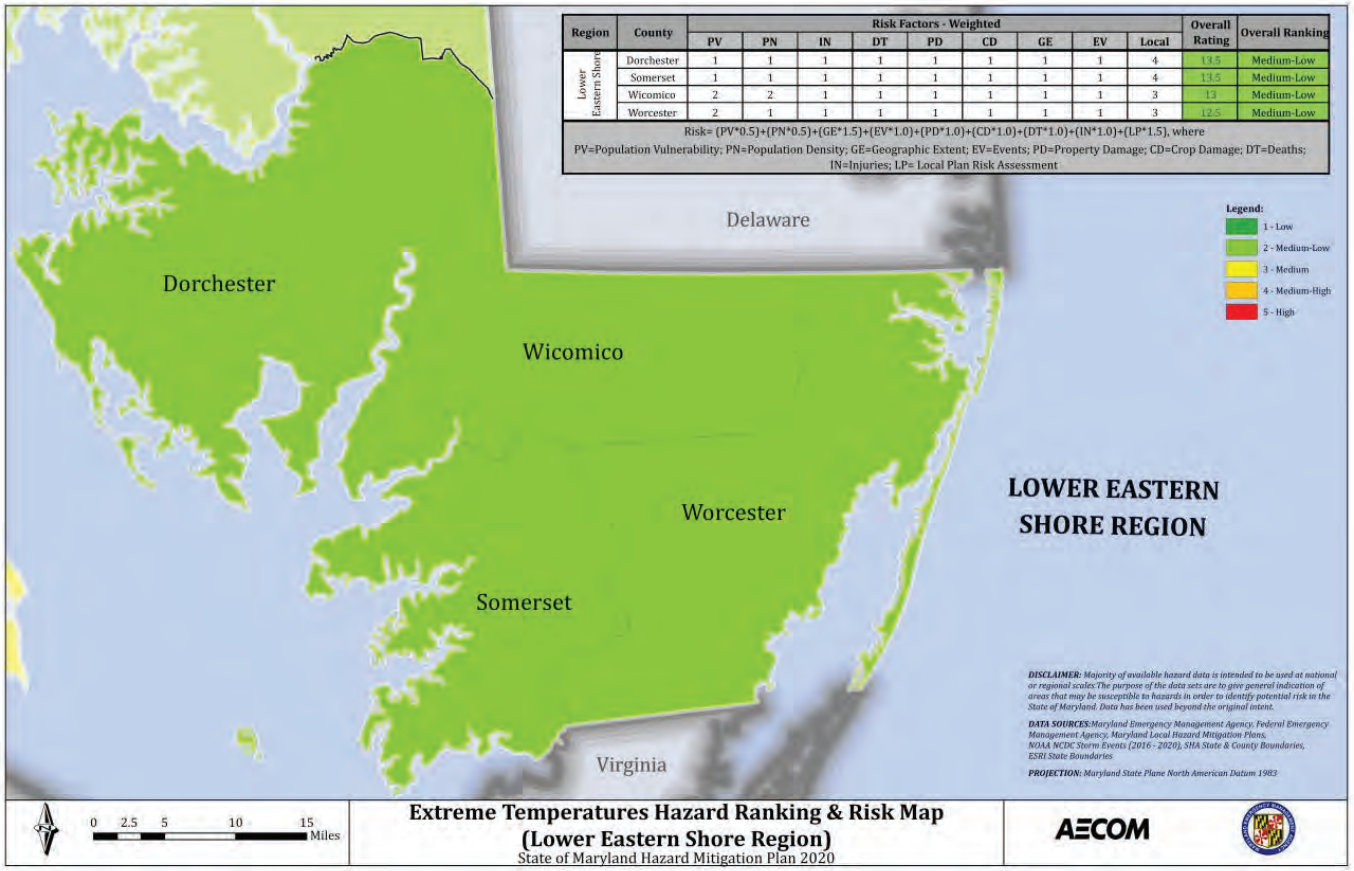
Dam Failure

- Low – Medium Risk
- Data Sources include Maryland Department of the Environment (MDE) High Hazard Dams and 20 recent dam incidents
- Calculated using sum of high-hazard dams per county.



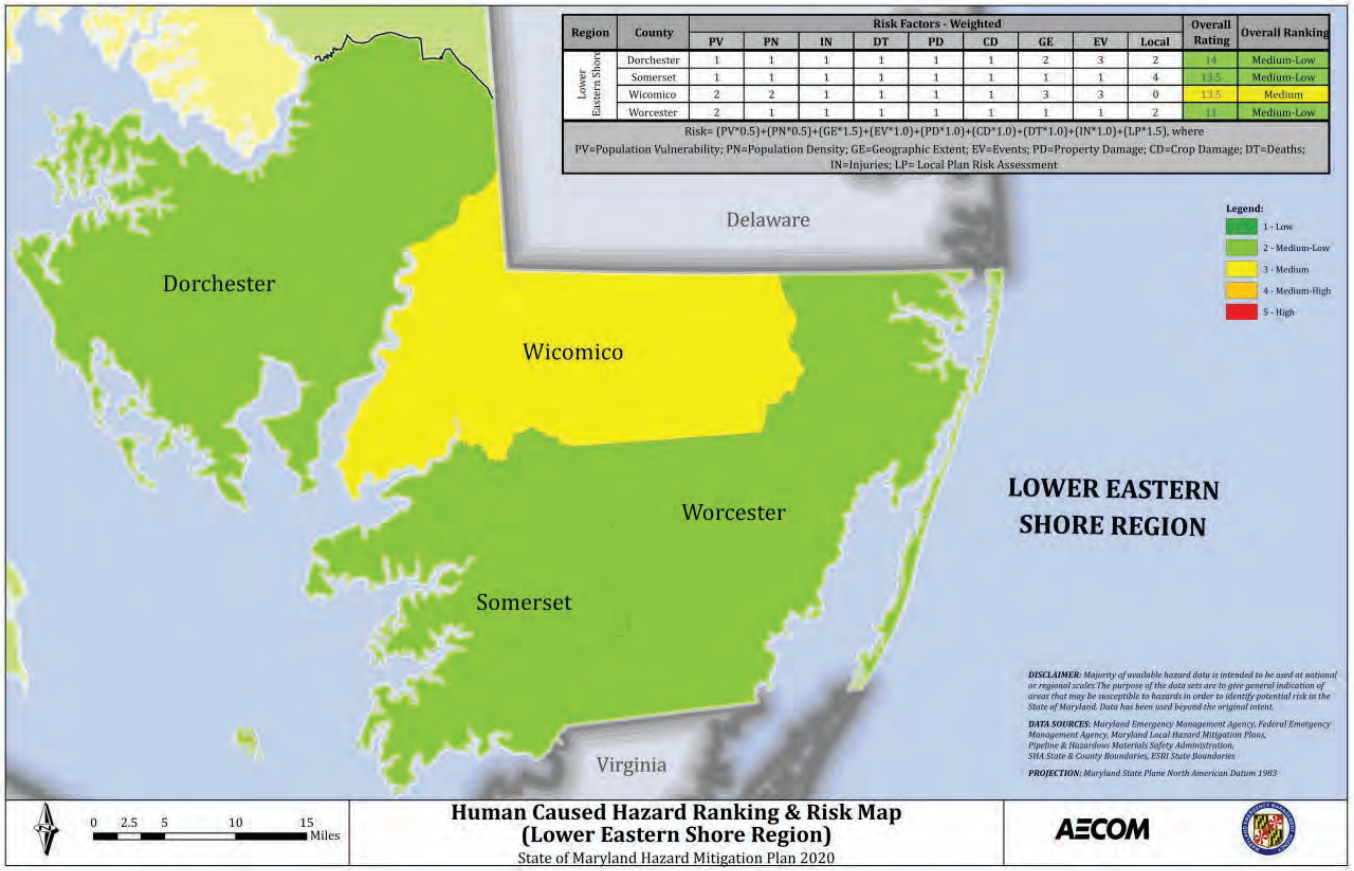
Extreme Temperatures

- Medium Low Risk
- Data Sources include NCDC Storm Database
- Average number of extreme temperature events (Excessive Heat & Extreme Cold/Wind Chill)



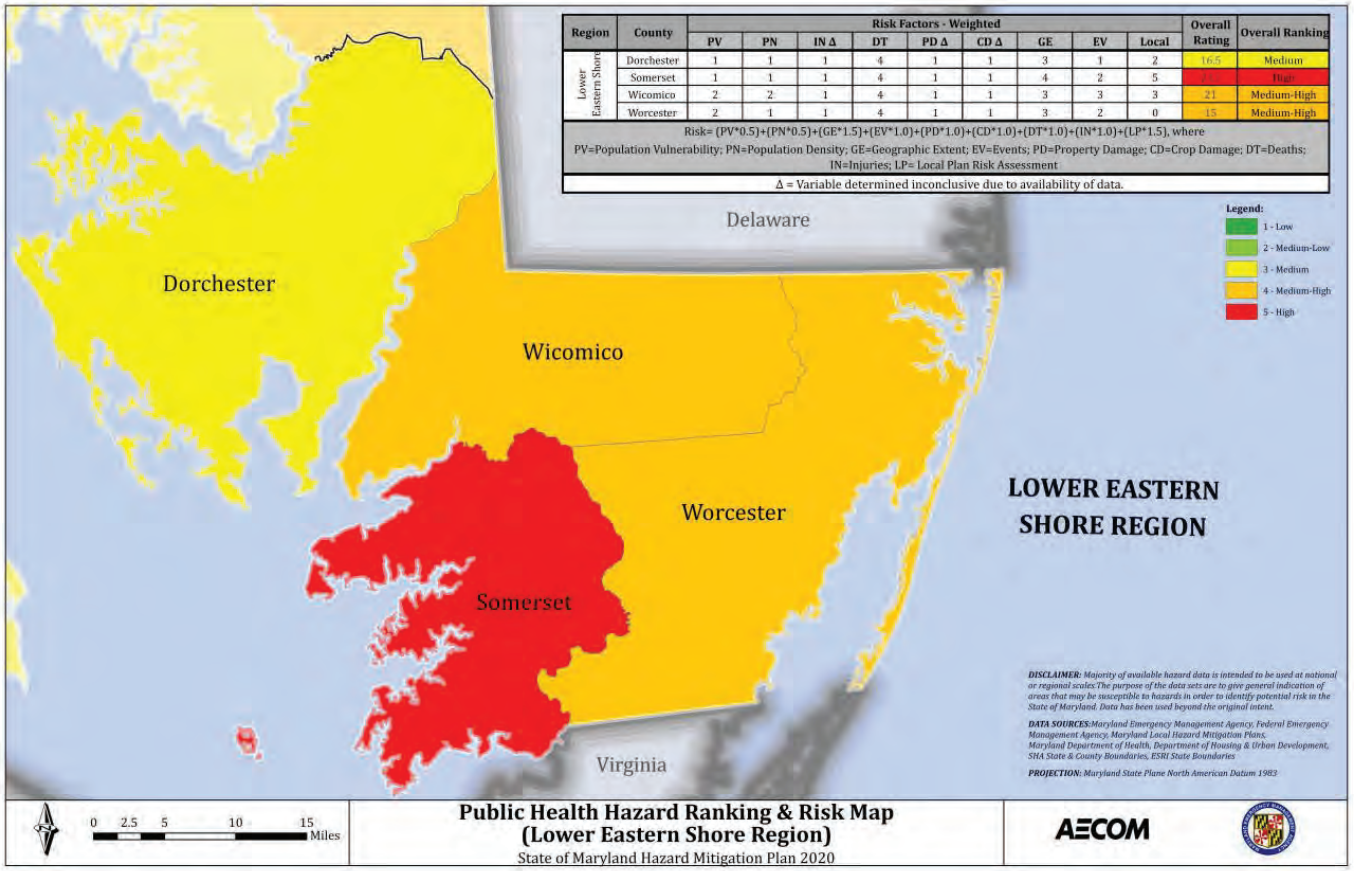
Human-Caused Hazards & Threats

- Medium Low - Medium Risk
- Data Sources include Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Calculated based on number of Hazmat events



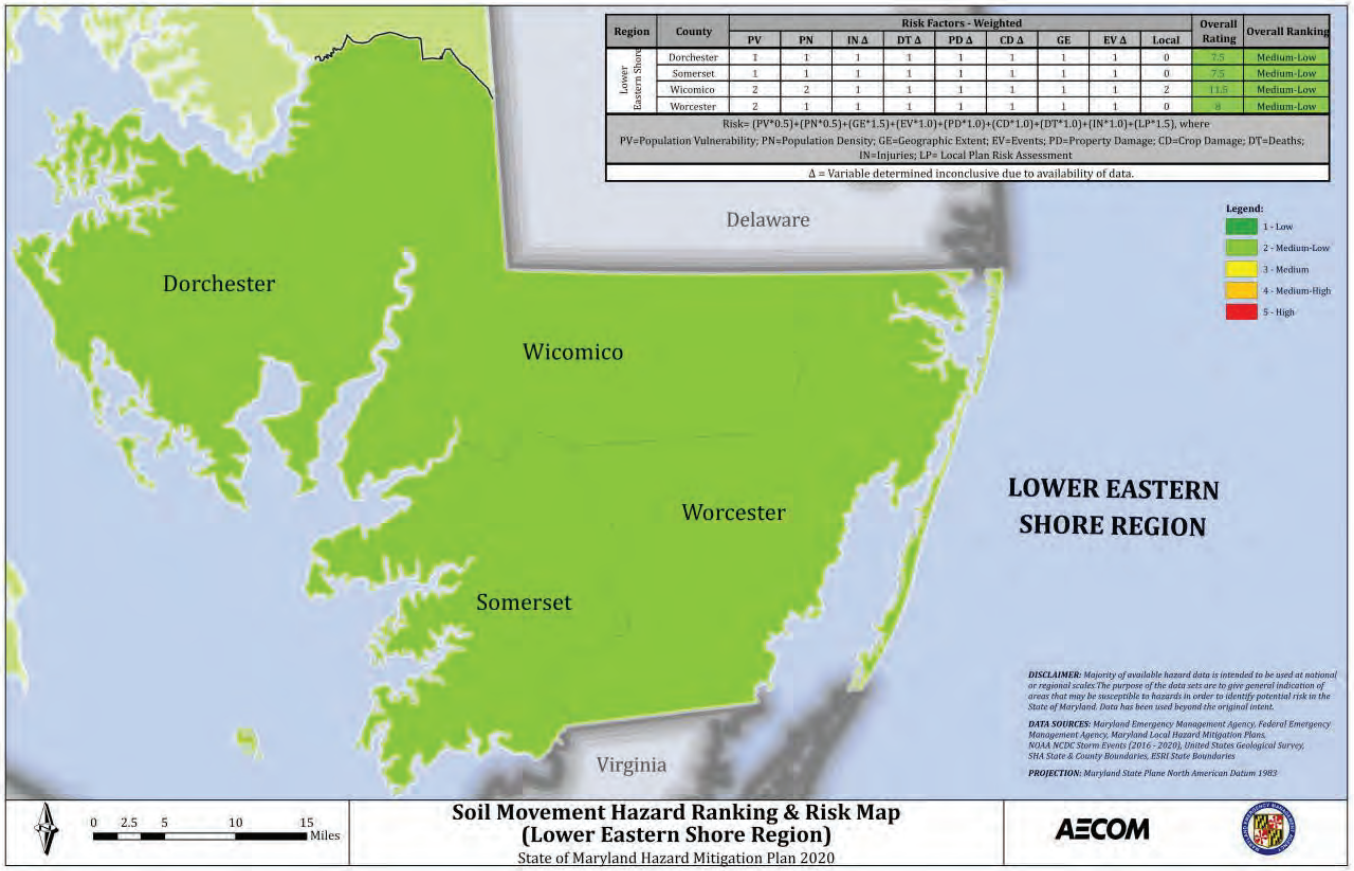
Public Health

- Medium - High Risk
- Data Sources include Housing and Urban Development & Maryland Department of Health
- Calculated based on Median Income & opioid related incidents.



Soil Movement

- Medium Low Risk
- Sources include US Geological Survey Karst data layer
- Calculated using % Area of KARST



State Assets and Critical Facilities

State Assets

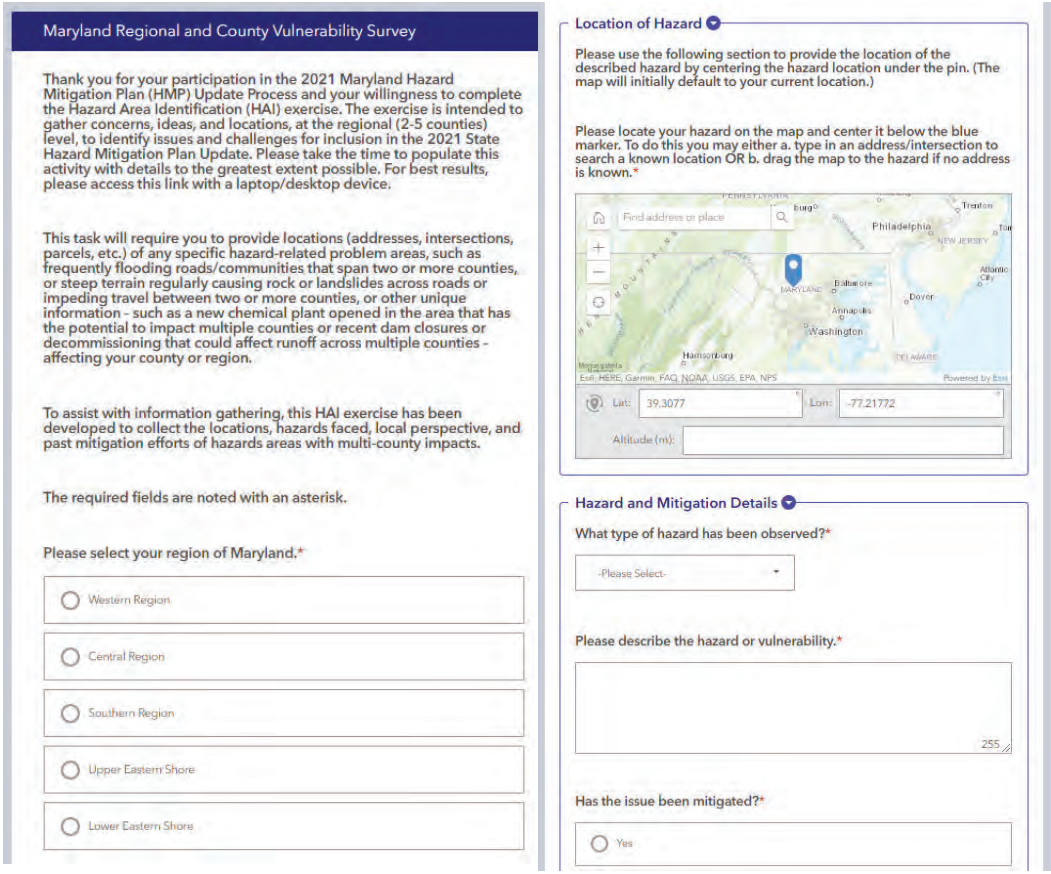
Jurisdiction	State Asset Totals	State Assets Loss Estimations 2016			State Asset Totals 2020	State Assets Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Dorchester	174	$263,837,200	$37,364,000	$301,201,200	109	$162,627,417	$25,967,064	$188,594,481
Somerset	275	$12,984,385,500	$284,245,000	$13,268,630,400	265	$12,933,651,348	$282,487,471	$13,216,138,819
Wicomico	197	$1,119,733,279	$85,526,547	$1,205,259,826	197	$1,119,733,279	$85,526,547	$1,205,259,826
Worcester	143	$124,020,600	$17,071,800	$141,092,200	133	$122,453,218	$17,024,637	$139,477,856
	615	**$ 14,228,139,379**	**$ 386,843,347**	**$ 14,614,982,426**	**595**	**$ 14,175,837,845**	**$ 385,038,655**	**$ 14,560,876,500**

Critical Facilities

Jurisdiction	Critical Facilities Totals	Critical Facilities Loss Estimations 2016			Critical Facilities Totals 2020	Critical Facilities Loss Estimations 2020		
		Building Value	Content Value	Total Loss		Building Value	Content Value	Total Loss
Dorchester	44	$59,832,900	$19,944,300	$79,777,200	62	$121,473,700	$13,069,400	$134,543,100
Somerset	26	$131,931,500	$43,977,200	$175,908,700	26	$131,931,500	$10,435,200	$142,366,700
Wicomico	66	$699,711,900	$67,275,000	$766,986,900	66	$699,711,900	$67,275,000	$766,986,900
Worcester	43	$183,102,800	$61,034,300	$244,137,100	9	$34,403,400	$93,374,500	$127,777,900
	135	**$ 1,014,746,200**	**$ 172,286,500**	**$ 1,187,032,700**	**101**	**$ 866,046,800**	**$ 171,084,700**	**$ 1,037,131,500**

Maryland Regional and County Vulnerability Survey

- Online survey to provide feedback for known regional hazards and mitigation efforts
- Link to survey can be found in our Virtual Room and below



https://survey123.arcgis.com/share/75bc824859ea4f3d8558bc349273d10c

Questions?

MEMA SHMP Update Virtual Room

Hold as a placeholder to start the Virtual Room discussion

Website: [MEMA-Maryland-360]

Maryland
EMERGENCY MANAGEMENT AGENCY

The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

JaLeesa Tate, CFM (410) 517-3617 jaleesa.tate@maryland.gov

This page left blank intentionally

Mitigation Strategy Meeting Information

This page left blank intentionally

VIRTUAL MEMA State Hazard Mitigation Plan
Regional Stakeholder Meetings
December 7 - 9, 2020
Overall Summary

Overall Outcome:

- Provide regional stakeholders with an update on the progress of the updated Goals for the 2021 Plan; provide an overview of proposed new actions based on the HIRA, stakeholder feedback, available resources, and best practices; solicit feedback on updated goals and proposed new actions; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Agenda:

- **Welcome and Introductions – MEMA**
- **Review Updated 2021 Hazard Mitigation Plan Goals - VPC**
- **Solicit Potential Additional Goals or Suggested Edits - VPC**
- **Review New Proposed 2021 Hazard Mitigation Actions - VPC**
- **Solicit Additional Actions or Suggested Edits - VPC**
- **Questions/Discussion - MEMA**
- **Adjournment**

Total Attendees: 96

Key takeaways from the meetings:

- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.
- St Mary's County had a couple questions regarding new proposed actions, which were addressed during the call and the 1-2 notes were incorporated into the Mitigation Strategy in real time.
- St. Mary's County and Calvert County were able to identify needs within the counties and offer reciprocal support in identifying available resources and guidance.
- No remaining suggestions or recommendations from the Counties/Jurisdictions that need to be addressed

VIRTUAL MEMA State Hazard Mitigation Plan
Central Regional Stakeholder Meeting
December 7, 2020
10:00 – 11:00AM

Overall Outcome:

- Provide regional stakeholders with an update on the progress of the updated Goals for the 2021 Plan; provide an overview of proposed new actions based on the HIRA, stakeholder feedback, available resources, and best practices; solicit feedback on updated goals and proposed new actions; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Review Updated 2021 Hazard Mitigation Plan Goals - VPC**
- **Solicit Potential Additional Goals or Suggested Edits - VPC**
- **Review New Proposed 2021 Hazard Mitigation Actions - VPC**
- **Solicit Additional Actions or Suggested Edits - VPC**
- **Questions/Discussion - MEMA**
- **Adjournment**

Notes from the meeting:

- No suggestions or recommendations from the Counties/Jurisdictions
- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.

Meeting concluded at 10:35AM

Attendee List – affiliation listed, if known (30 total)

Joey L. Henderson	**Williamson, Nicole**
David Mandell	**Talay, Tiffany**
Kerry Topovski	**Varga, Patrick**
Kyle Overly	**Hinson, Michael**
Kristen Forti-MEMA	**Steven Allan**
Jesse Ash	**Germ, Aubrey (DOP)**
Kayhla Cornell-MEMA	**Richard Ortt**
Jaleesa Tate - MEMA	**Tara Espinola**
Jessica Nusbaum	**Bucovetsky, Joseph**
Jessica Nusbaum	**Ashley Samonisky**
Chris Clavin	**Deepa Srinivasan**
Jennifer XX	**Andrew Estrain**
Joey Krastel	**Jennifer Sparenberg**
Raymond Bahr	**Holton, Lael**
Jessica Nusbaum	
Mark Harris	

Teams meeting information:

Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting
Join with a video conferencing device
176484854@teams.bjn.vc
Video Conference ID: 114 878 509 3
Alternate VTC dialing instructions
Or call in (audio only)
+1 443-833-0028,,924359935# United States, Baltimore
(877) 286-5733,,924359935# United States (Toll-free)
Phone Conference ID: 924 359 935#
Find a local number | Reset PIN
Learn More | Meeting options

VIRTUAL MEMA State Hazard Mitigation Plan
Western Regional Stakeholder Meeting
December 7, 2020
2:00 – 3:00PM

Overall Outcome:

- Provide regional stakeholders with an update on the progress of the updated Goals for the 2021 Plan; provide an overview of proposed new actions based on the HIRA, stakeholder feedback, available resources, and best practices; solicit feedback on updated goals and proposed new actions; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Review Updated 2021 Hazard Mitigation Plan Goals - VPC**
- **Solicit Potential Additional Goals or Suggested Edits - VPC**
- **Review New Proposed 2021 Hazard Mitigation Actions - VPC**
- **Solicit Additional Actions or Suggested Edits - VPC**
- **Questions/Discussion - MEMA**
- **Adjournment**

Notes from the meeting:

- No suggestions or recommendations from the Counties/Jurisdictions
- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.

Meeting concluded at 10:35AM

Attendee List – affiliation listed, if known (17 total)

Joey Krastel	**Ashley Samonisky**
Joy Hatchette	**Deepa Srinivasan**
Norman Wang	**Andrew Estrain**
Bucovetsky, Joseph	**Jennifer Sparenberg**
Mark Harris	**Holton, Lael**
Joseph Rogers	**JaLeesa Tate - MEMA**
Jesse Ash (Guest)	**Kayhla Cornell-MEMA**
Tara Espinola	**Kristen Forti-MEMA**
	Dave Robbins - MEMA

Teams meeting information:

Join on your computer or mobile app
Click here to join the meeting
Join with a video conferencing device
176484854@teams.bjn.vc
Video Conference ID: 111 262 672 5
Alternate VTC dialing instructions
Or call in (audio only)
+1 443-833-0028,,802770133# United States, Baltimore
(877) 286-5733,,802770133# United States (Toll-free)
Phone Conference ID: 802 770 133#
Find a local number | Reset PIN
Learn More | Meeting options

VIRTUAL MEMA State Hazard Mitigation Plan
Southern Regional Stakeholder Meeting
December 8, 2020
2:00 – 3:00PM

Overall Outcome:

- Provide regional stakeholders with an update on the progress of the updated Goals for the 2021 Plan; provide an overview of proposed new actions based on the HIRA, stakeholder feedback, available resources, and best practices; solicit feedback on updated goals and proposed new actions; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Review Updated 2021 Hazard Mitigation Plan Goals - VPC**
- **Solicit Potential Additional Goals or Suggested Edits - VPC**
- **Review New Proposed 2021 Hazard Mitigation Actions - VPC**
- **Solicit Additional Actions or Suggested Edits - VPC**
- **Questions/Discussion - MEMA**
- **Adjournment**

Notes from the meeting:

- No suggestions or recommendations for the revised Goals from the Counties/Jurisdictions
- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.
- St Mary's County had a couple questions regarding new proposed actions, which were addressed during the call and the 1-2 notes were incorporated into the Mitigation Strategy in real time.
- St. Mary's County and Calvert County were able to identify needs within the counties and offer reciprocal support in identifying available resources and guidance.

Meeting concluded at 11:18AM

Attendee List – affiliation listed, if known (19 total)

Kristen Skogsberg	**Ashley Samonisky**
Amy Bledsoe	**Jennifer Sparenberg**
Terri McAllister	**Deepa Srinivasan**
Tara Espinola	**Holton, Lael**
Gerald Gardiner	**JaLeesa Tate - MEMA**
Buckmaster, Kara R.	**Baker, Amy**
Norman Wang	**Kayhla Cornell-MEMA**
Tim La Valle	**Kristen Forti-MEMA**
Norris, Joshua	
Bucovetsky, Joseph	
Sasha Land	

Teams meeting information:

Join on your computer or mobile app
Click here to join the meeting
Join with a video conferencing device
176484854@teams.bjn.vc
Video Conference ID: 114 077 490 8
Alternate VTC dialing instructions
Or call in (audio only)
+1 443-833-0028,,32654229# United States, Baltimore
(877) 286-5733,,32654229# United States (Toll-free)
Phone Conference ID: 326 542 29#
Find a local number | Reset PIN
Learn More | Meeting options

VIRTUAL MEMA State Hazard Mitigation Plan
Upper Eastern Shore Regional Stakeholder Meeting
December 9, 2020
10:00 – 11:00AM

Overall Outcome:

- Provide regional stakeholders with an update on the progress of the updated Goals for the 2021 Plan; provide an overview of proposed new actions based on the HIRA, stakeholder feedback, available resources, and best practices; solicit feedback on updated goals and proposed new actions; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Review Updated 2021 Hazard Mitigation Plan Goals - VPC**
- **Solicit Potential Additional Goals or Suggested Edits - VPC**
- **Review New Proposed 2021 Hazard Mitigation Actions - VPC**
- **Solicit Additional Actions or Suggested Edits - VPC**
- **Questions/Discussion - MEMA**
- **Adjournment**

Notes from the meeting:

- No suggestions or recommendations from the Counties/Jurisdictions
- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.

Meeting concluded at 10:42AM

Attendee List – affiliation listed, if known (24 total)

Jeffrey Ludwig	**Holton, Lael**
Kristen Skogsberg	**Ashley Samonisky**
Joey Krastel	**Deepa Srinivasan**
Betsy Vennell	**Baker, Amy**
Virginia Gregg	**Jennifer Sparenberg**
Tara Espinola	**Kayhla Cornell-MEMA (Guest)**
Bethany Brown	**JaLeesa Tate - MEMA (Guest)**
Norris, Joshua	**Kristen Forti-MEMA (Guest)**
Steve Layden	**Kyle Overly**
Scott Haas	**Joseph Bucovetsky**
Samuel Grant	**Bill Hildebrand**
Michelle Lloyd	
Lori Morris	

Teams meeting information:

Join on your computer or mobile app
Click here to join the meeting
Join with a video conferencing device
176484854@teams.bjn.vc
Video Conference ID: 117 812 870 9
Alternate VTC dialing instructions
Or call in (audio only)
+1 443-833-0028,,100570612# United States, Baltimore
(877) 286-5733,,100570612# United States (Toll-free)
Phone Conference ID: 100 570 612#
Find a local number | Reset PIN
Learn More | Meeting options

VIRTUAL MEMA State Hazard Mitigation Plan
Lower Eastern Shore Regional Stakeholder Meeting
December 9, 2020
2:00 – 3:00PM

Overall Outcome:

- Provide regional stakeholders with an update on the progress of the updated Goals for the 2021 Plan; provide an overview of proposed new actions based on the HIRA, stakeholder feedback, available resources, and best practices; solicit feedback on updated goals and proposed new actions; and provide an open forum for stakeholders to suggest additional new actions or goals.

Location/Logistics:

- REGISTRATION: conducted via MS Teams, invitations sent via MEMA
- LOGISTICS: Cameras on for when speaking and capture will be offline by the AECOM Team

Day of Access Issues:

- Contact AECOM Facilitator – Lael Holton at lael.holton@aecom.com or 225-229-2188

Agenda:

- **Welcome and Introductions – MEMA**
- **Review Updated 2021 Hazard Mitigation Plan Goals - VPC**
- **Solicit Potential Additional Goals or Suggested Edits - VPC**
- **Review New Proposed 2021 Hazard Mitigation Actions - VPC**
- **Solicit Additional Actions or Suggested Edits - VPC**
- **Questions/Discussion - MEMA**
- **Adjournment**

Notes from the meeting:

- No suggestions or recommendations from the Counties/Jurisdictions
- Goals and proposed new actions were very well received and many stakeholders indicated excitement as to the services/resources the new actions will provide.

Meeting concluded at 10:40AM

Attendee List – affiliation listed, if known (16 total)

Amanda Pollack	**Ashley Samonisky**
Steven Allan	**Deepa Srinivasan**
Mark Harris	**Holton, Lael**
Steve Garvin	**JaLeesa Tate - MEMA (Guest)**
Tara Espinola	**Jennifer Sparenberg**
Norris, Joshua	**Kristen Forti-MEMA (Guest)**
Bucovetsky, Joseph	**Baker, Amy**
Deborah Herr Cornwell	**Kayhla Cornell - MEMA**

Teams meeting information:

Join on your computer or mobile app
Click here to join the meeting
Join with a video conferencing device
176484854@teams.bjn.vc
Video Conference ID: 115 146 773 7
Alternate VTC dialing instructions
Or call in (audio only)
+1 443-833-0028,,176046604# United States, Baltimore
(877) 286-5733,,176046604# United States (Toll-free)
Phone Conference ID: 176 046 604#
Find a local number | Reset PIN
Learn More | Meeting options

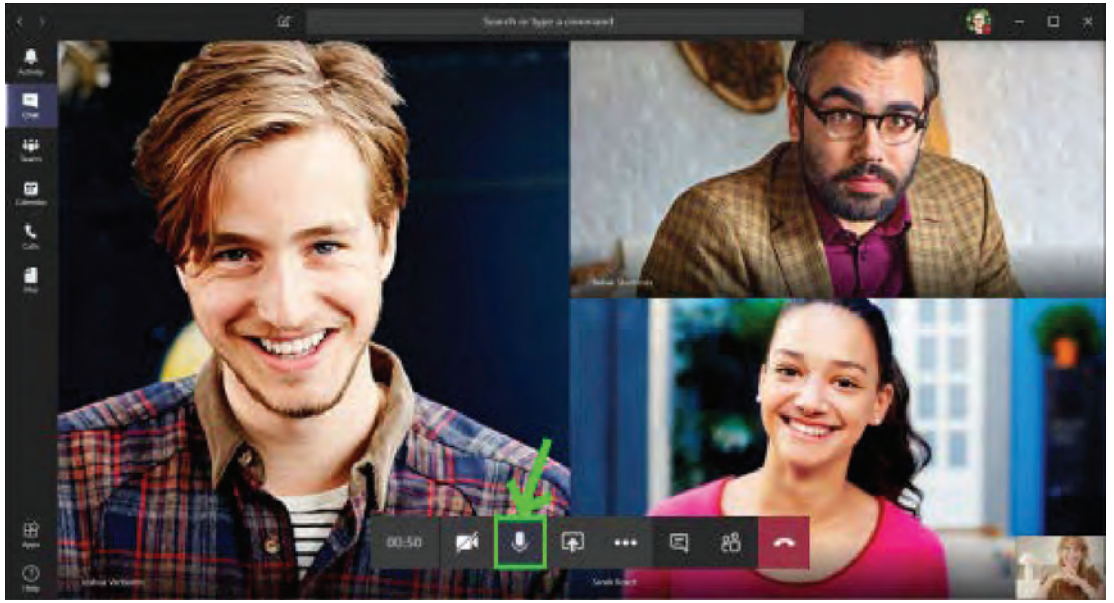
This page left blank intentionally

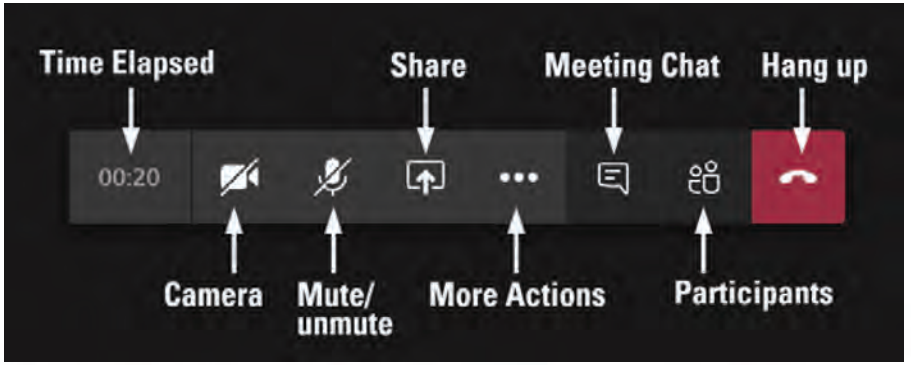
2021 State of Maryland Hazard Mitigation Plan

JaLeesa Tate, CFM
State Hazard Mitigation Officer
Branch Manager

Logistics

- The meeting is being recorded.
- Mute your microphone and turn off your camera when not speaking.
- Utilize the hand raise feature on MS Teams or enter questions through the chat.



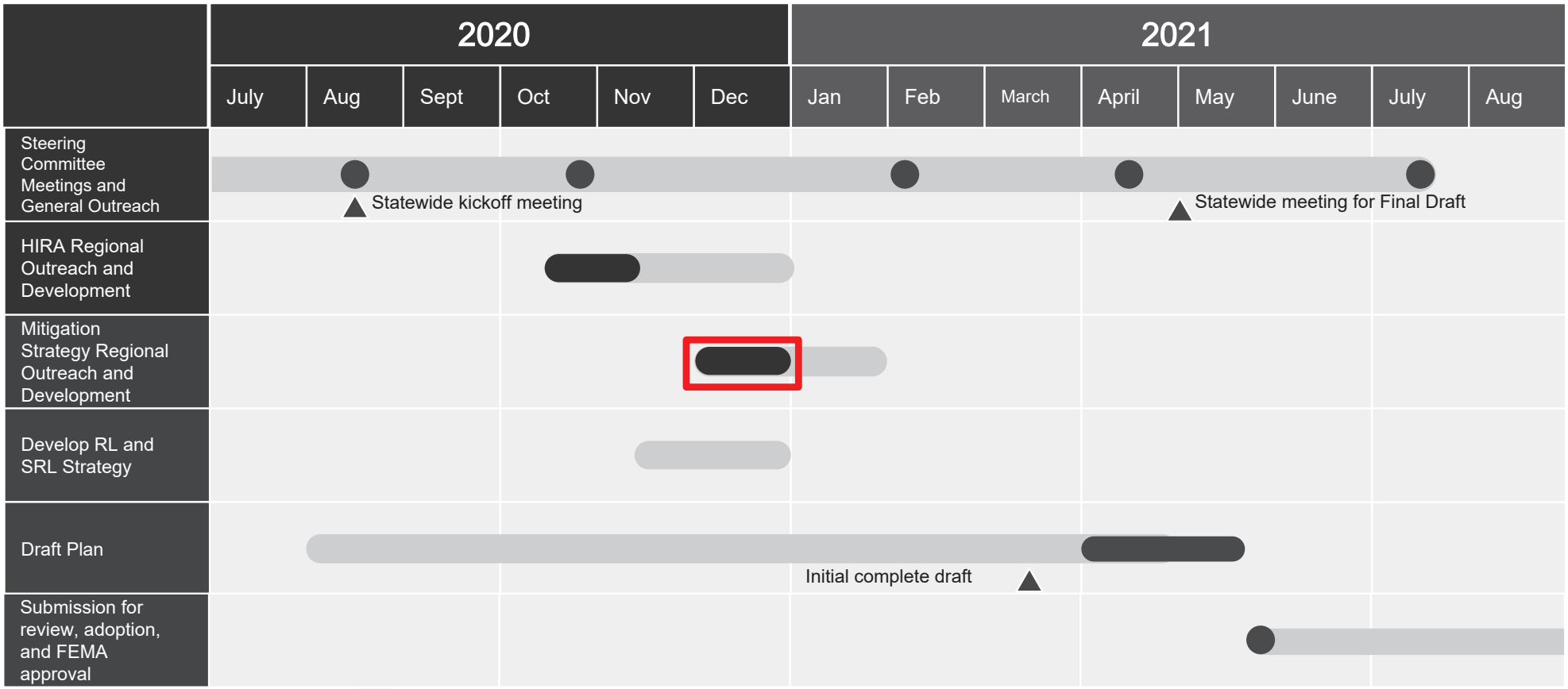


Overview

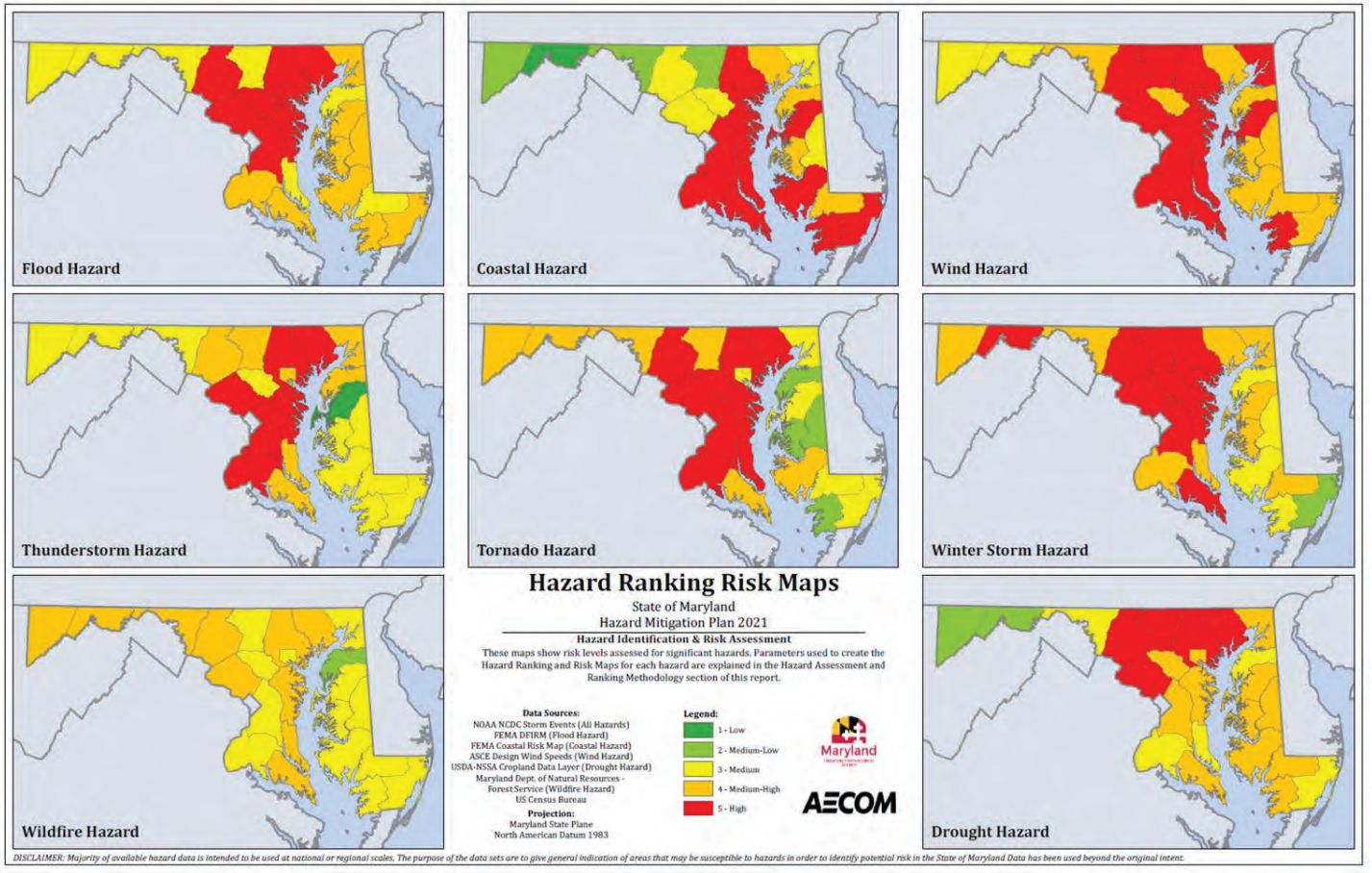
- Welcome and Introductions
- Overview of Hazard Mitigation Planning Process
- Progress To -date
- 2021 Mitigation Strategy
  - Goals
  - Actions
- Wrap -up/Questions

Planning Process

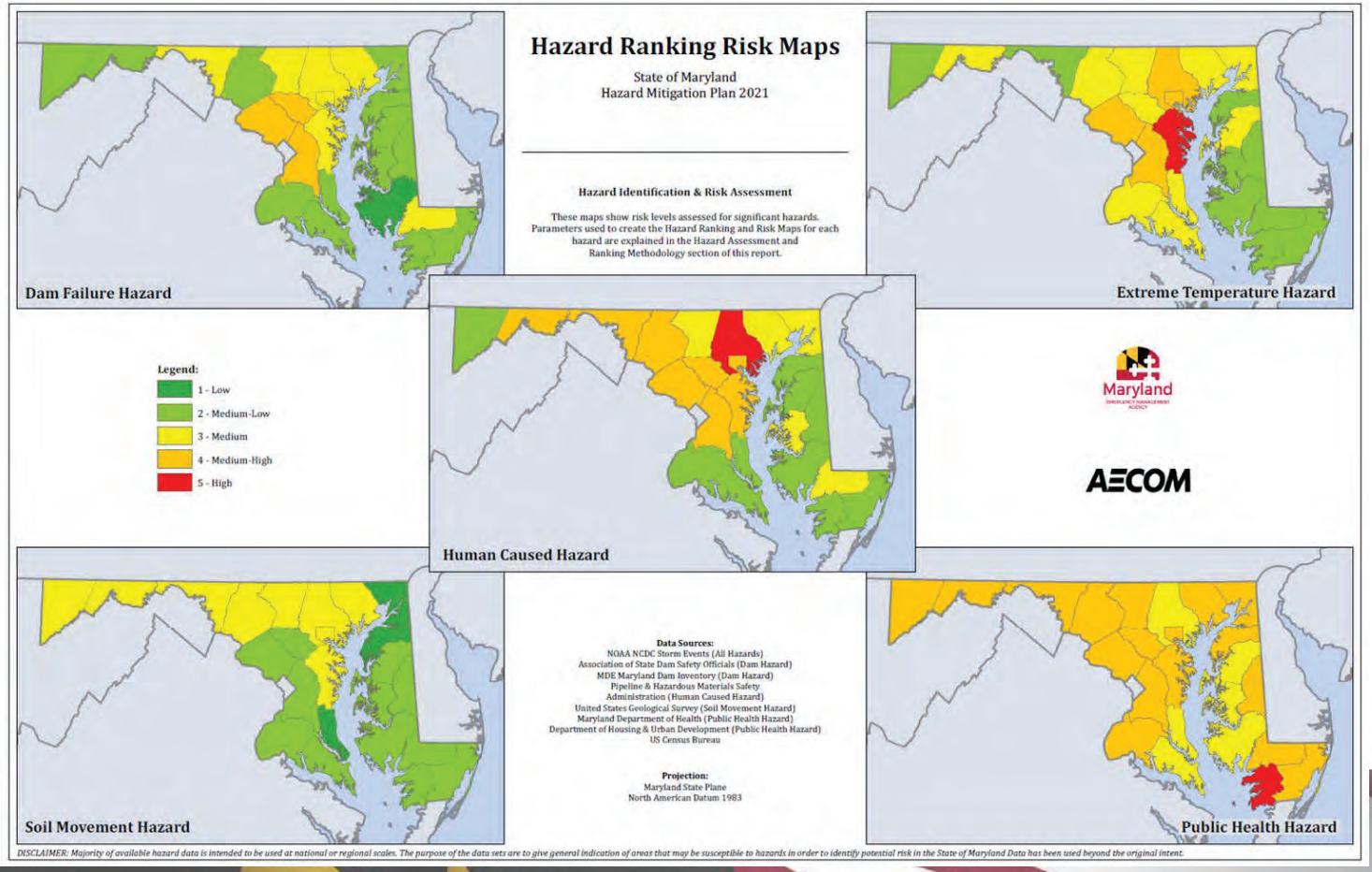
Organize the Planning Process and Resources	Assess Risks and Capabilities	Develop a Mitigation Strategy	Adopt and Implement the Plan
• Planning focus area • Planning team • Stakeholders • Outreach strategy • Opportunities for integration	• Policies, programs, funding, staff, etc. • Historical occurrences • Magnitude • Geographical extent • Future Conditions	• Set goals • Identity actions • Lead agencies for implementation • Prioritize actions	• Identify and obtain funding • Conduct Annual Reviews • Continue to build awareness and buy-in


2020
2021
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
May
June
July
Aug
Steering Committee Meetings and General Outreach
Statewide kickoff meeting
Statewide meeting for Final Draft
HIRA Regional Outreach and Development
Mitigation Strategy Regional Outreach and Development
Develop RL and SRL Strategy
Draft Plan
Initial complete draft
Submission for review, adoption, and FEMA approval

2021 Hazard Identification and Risk Assessment Recap



2021 Hazard Identification and Risk Assessment Recap



Mitigation Strategy

- Goals: What long term outcomes do we want to achieve?
- Actions: What specific actions will stakeholders take to reduce risk to hazards?
- Action Plan: How will the actions be prioritized and implemented?

New Mitigation Action Development

1. Hazard Identification and Risk Assessment (HIRA);
2. Vulnerability Assessment;
3. Hazard Rankings completed by County representatives;
4. Regional “Problem Areas” identified through the ArcGIS Survey123 mapping instrument;
5. Gaps identified through the Resource Questionnaire;
6. Past Action Status Updates;
7. Gaps and issues presented during Steering Committee, Regional, and Public Meetings;
8. Stakeholder suggestions through the State and County Stakeholders Survey Monkey; and
9. Best Practices and FEMA Guidance Resources.

2021 Hazard Mitigation Plan Goals

1. Protect life, property, the economy, and the environment from hazard events to the greatest extent possible.
2. Increase public awareness of potential hazards, mitigation actions, preparedness efforts, and resiliency planning.
3. Protect State assets, infrastructure, and critical facilities from hazard events.
4. Enhance coordination across the whole community, to include Federal, State, and local government, and non -governmental organizations, by strengthening existing, and creating new, linkages between state and local mitigation and resiliency efforts.
5. Promote actions that protect natural resources, while enhancing hazard mitigation and community resiliency.

2021 Hazard Mitigation Plan Goals

6. Identify and implement projects that will reduce the impacts of hazards and efficiently use State resources.
7. Integrate hazard mitigation planning into other State planning efforts (comprehensive plan, floodplain management regulations, land use/zoning, green infrastructure, etc.) and encourage and educate counties and municipalities to integrate across local plans and ordinances.
8. Reduce flood -related losses, with an emphasis on reducing Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties over the next hazard mitigation planning cycle.
9. Identify and reduce flood hazard impacts in areas outside of the Special Flood Hazard Area (SFHA), which have experienced increased frequency and intensity in flooding, but do not meet FEMA's RL and SRL criteria.
10. Promote the development of policies, programs, initiatives, and projects which prioritize diversity, equity, and environmental justice.

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated	
	Structure and Infrastructure Projects				
1	Provide support for project development through all phases to include, but not be limited to, feasibility studies, Hydrology and Hydrologic studies, project identification, design and engineering, and implementation. Prioritize providing technical assistance to low-capacity and low-capability communities.	Y	Community	All Hazards	
2	Provide support for installation and maintenance of extreme weather and other warning mechanisms statewide.	Y	Community	Tornado, Thunderstorm, and Wind Events	
3	Conduct consequence analyses for dam failures across the State, including collecting and determining information on downstream inundation areas and potential flood depths.		Community	Flood, Dam Failure, Coastal Hazards	
4	Conduct regular (annual) inspection and maintenance of levee systems in Central Maryland, and include operational training and community flood risk outreach as part of the maintenance effort.	Y	Community	Flood, Dam Failure, Coastal Hazards	
5	Identify and evaluate funding opportunities and potential projects to decommission low flow/low volume dams to restore waterways to their natural state.	Y	Community	Flood, Dam Failure, Coastal Hazards	
6	Conduct regional watershed studies to promote and support stormwater management awareness and projects, and to support effective mitigation and planning efforts and policies.	Y	Community	Flood, Dam Failure, Coastal Hazards	

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated
	Structure and Infrastructure Projects			
7	Develop building standards and incentives to actively encourage the installation of nature-based solutions on State-owned buildings /facilities to: reduce the building /facility's carbon footprint; provide additional shade; reduce heat from the roof surface and surrounding air; and assist with water runoff during rain events.		Single Asset	Drought, Extreme Temperatures
8	Conduct State-level climate change modeling/analyses, including approaches for changes in precipitation rates and changes in sea level, and provide county-level datasets and reports/projections to jurisdictions to assist them with climate change-related planning and mitigation projects.	Y	Community	Natural/Weather Hazards
9	Address mitigation and risk reduction considerations on all new state construction through Environmental Site Design (ESD) including considerations such as maximum allowable impermeable surface for new construction, encouraging the use of permeable parking lots and surfaces, and drought-tolerant landscaping.	Y	Single Asset	Drought, Extreme Temperatures, Flood, Dam Failure, Coastal Hazards

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated	
	Natural Systems Protections				
10	Provide support for "Smart City" initiatives, such as IoT-connected inlet/reservoir/stream sensors and gauges.	Y	Community	Flood, Dam Failure, Coastal Hazards	
11	Develop guidance/best practices for more efficient crop irrigation methods to assist with balancing agricultural water withdrawals with increased water demand .		Community	Drought	

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated	
	Local Plans and Regulations				
12	Develop county-level depth grid data and develop current and future flood risk visualizations for use by local governments, that incorporates both storm and nuisance flooding, to illustrate potential flood risks to citizens, and to help inform local HMP and Risk Assessment update processes.		Community	Flood, Dam Failure, Coastal Hazards	
13	Provide incentives to local Planning Commissions to begin preparing for the 2050 projected 100-year and 500-year floodplain delineations (as opposed to current 100/500-year floodplains) by incorporating language into local ordinances (Zoning, SALDO) that discusses raising the freeboard, and other measures, based on these projections.	Y	Community	Flood, Dam Failure, Coastal Hazards	
14	Provide information and encourage counties to obtain the BCEGS building code evaluation to support CRS activities and potentially receive lower insurance rates.	Y	Community	All Hazards	
15	Encourage jurisdictions to incorporate historic, cultural, archaeological sites, and resources resource considerations into all local Hazard Mitigation Plans, with a focus on protecting these resources while maintaining historic integrity, significance, and National Register eligibility.		Single Asset	All Hazards	
16	Encourage the incorporation of FEMA's seven lifelines into all local Hazard Mitigation Plans, to prioritize the rapid stabilization of Community Lifelines after a disaster, and promote the use of FEMA's *Guides to Expanding Mitigation* by counties and jurisdictions during their local mitigation efforts.	Y	Community	All Hazards	
17	Develop a *Standard Operating Guide for Hazard Mitigation Planning*, to streamline the HMP update process for Maryland counties and jurisdictions by providing a model plan outline, to clarify existing guidance (for Emergency Managers), and to support communities developing their HMPs.		Community	All Hazards	

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated	
	Education and Awareness Programs				
18	Develop and provide a library of tools and resources to assist jurisdictions with garnering public input and support during the HMP update process and plan adoption and maintenance processes.	Y	Community	All Hazards	
19	Develop a project portfolio comprised of statewide hazard mitigation success stories/best practices and post them on the MEMA website for local jurisdictions to refer to during mitigation efforts .		Community	All Hazards	
20	Work with jurisdictions to promote partnerships with local organizations to develop "Community Resilience Hubs" to support residents, coordinate communication, and distribute resources, and to help communities to become more self-determining, socially connected, before, during, and after hazard events.		Community	All Hazards	
21	Conduct annual reviews and require state departments, counties, and local governments to submit annual updates regarding implementation status of the actions identified in their Hazard Mitigation Plans .		Community	All Hazards	
22	Re-engage stakeholders annually to determine which actions from the 2016 Maryland State HMP are still a priority.		Community and Single Asset	All Hazards	
23	Work with county and local communities to encourage participation in the StormReady, CRS, BCEGS, Firewise, or other relevant planning, preparedness, and mitigation incentive programs .		Community	Natural Hazards	

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated	
	Education and Awareness Programs				
24	Partner with insurance providers/companies directly to encourage coverage of pre-storm actions for hazard mitigation.	Y	Community and Single Asset	Natural Hazards	
25	Establish a regular schedule to report regional drought conditions to agricultural entities, offices, and stakeholders throughout the State.		Community	Drought	
26	Provide information to local governments and the public regarding risks to public drinking water (public health) that can arise from various hazards or disasters (dam failure, flooding, etc.).		Community	All Hazards	
27	Provide informational and educational tools and products to promote the local benefits of the CRS program, to encourage all communities (with floodplains in their jurisdictions) to participate in the CRS Program, and to promote ways to improve class ratings for communities already participating in CRS.		Community	Flood, Dam Failure, Coastal Hazards	
28	Conduct an equity audit to gain identify how programs and policies are administered and the impacts they have on the diverse set of stakeholders we serve. Utilize results to develop an equity lens to be incorporated in revisions of existing programs and policies and used as a guide when developing new programs and policies.		Community	All Hazards	

New 2021 Mitigation Actions

#	Proposed Action	BRIC Guiding Principles	Single Asset vs Community	Hazard(s) Mitigated	
	Disaster Risk Reduction				
29	Prioritize disaster risk reduction by implementing the Sendai Disaster Risk Reduction Framework in Maryland to prevent new and reduce existing disaster risk by focusing on shared responsibility with other stakeholders including local governments, the private sector, and other stakeholders.		Community	All Hazards	
30	Encourage and foster Public - Private Partnerships (P3s) between state, county, and local governments and private or non-profit organizations and entities to take advantage of private expertise, initiatives, and/or resources and encourage shared responsibility under the Sendai Framework.		Community	All Hazards	
31	Encourage and support innovative mitigation and planning projects by state agencies and at local levels, by leveraging both FEMA and non-fema funding sources.		Community	All Hazards	

Questions and Discussion

Next Steps/Upcoming Meetings

- Finalize Mitigation Strategy
- Update Repetitive and Severe Repetitive Loss Strategy
- Complete final draft of Plan
- Public Stakeholder Meeting for Final Draft in Late Spring 2021

STATE OF MARYLAND
HAZARD MITIGATION
PLAN UPDATE
WESTERN REGION
Carroll
Baltimore
Baltimore City
Howard
Anne Arundel
Kent
Queen Anne's
Talbot
FIRE STATION
State-Owned Facilities
Hazard Threats
Come explore
Maryland Emergency Management Agency's
360° virtual open house space
✔ Participate in the State Hazard Mitigation Planning process
✔ Access the Community Vulnerability Engagement Tool
✔ Review materials, provide input and more
Maryland
EMERGENCY MANAGEMENT AGENCY
https://aecomviz.com/MEMA-Maryland-360/
Open 24/7 — We look forward to your participation!

Maryland
EMERGENCY MANAGEMENT AGENCY

The mission of the Maryland Emergency Management Agency is to proactively reduce disaster risks and reliably manage consequences through collaborative work with Maryland's communities and partners.

HMPProjectTeam.mema@Maryland.gov

APPENDIX C

Maryland's 2020 Hazard Mitigation Plan

for Dams

This page left blank intentionally

Maryland's
2020 Hazard Mitigation Plan
for Dams

Maryland Emergency Management Agency
Hazard Mitigation Branch
5401 Rue Saint Lo Drive
Reisterstown, MD 21136

Maryland Department of the Environment
Dam Safety Program
1800 Washington Boulevard
Baltimore, Maryland 21230

Maryland's 2020 Hazard Mitigation Plan for Dams

Mission Statement: *Efficiently use State resources to minimize the loss of life and property from dam or levee failures and protect critical infrastructure and environmental resources*

The Maryland Dam 2020 Hazard Mitigation Plan is an important part of the State of Maryland's 2021 Hazard Mitigation Plan (currently under development). Dams and waterway impoundments in the State provide public benefits through the storage of water for flood control, recreation, drinking water, generation of hydroelectric power, stormwater management, wildlife habitat creation, and irrigation. However a dam's basic function, to store water, creates a potential hazard. Dam failures can result in loss of life and significant property and environmental damage. Dam failures occur for a variety of reasons including seepage, overtopping, and structural collapse during both severe weather events and normal periods. At all times the risks associated with the storage of water must be managed to reduce the probability of failure.

Dam owners and the design engineers are inherently liable for the potential serious consequences of dam failures. Determining the hazard classification of a dam or waterway impoundment is essential to understanding its threat posed to public safety. Dams in Maryland are classified as low, significant, or high hazard structures. The hazard classification dictates what criteria shall be used to design and construct the dam, and what actions must be taken in the event of an impending failure. This is the case for proposed new dams as well as for the repair or retrofit of existing structures.

Dams in Maryland are regulated by Maryland Department of the Environment's (Department) Dam Safety Program. The Department defines a dam as any obstruction, wall, or embankment constructed in, along, or across a watercourse, together with its appurtenant works, for the purpose of storage, control, or diversion of water, temporarily or permanently. While dams in Maryland are constructed of earth, rock, and concrete, most consist of an earthen embankment in combination with overflow spillways.

I. Planning Process

The State's mitigation planning goals are to reduce long-term vulnerabilities from eligible high hazard potential dams that pose an unacceptable risk to the public including:

- Protection against the catastrophic loss of life and property
- Protection of State assets, infrastructure, and critical facilities
- Enhanced coordination with local jurisdictions and linkages between State and local mitigation and resiliency efforts
- Increased public awareness of hazards, mitigation, preparedness, and resiliency

- Promote actions that protect natural resources, while enhancing hazard mitigation and community resiliency

The Maryland Dam 2020 Hazard Mitigation Plan was developed collaboratively with the Maryland Emergency Management Agency (MEMA). The Department's Dam Safety Program has been active in the State's hazard mitigation planning efforts during the 2011 and 2016 planning processes. The Dam Safety Program has provided valuable input in order to contribute to the development of the mitigation actions identified in the 2016 State of Maryland Hazard Mitigation Plan as noted in Section VI: Mitigation Implementation Status Report. This Plan takes into consideration the dam safety concerns noted in the 2016 State of Maryland Hazard Mitigation Plan, such as High Hazard Dam failure on the lower eastern shore. Through the development of this Plan, MDE and MEMA coordinated continously. Representatives from each agency met weekly in order to jointly identify and address Dam risk.

The Dam Safety Program has also utilized guidance and tools from the Federal Emergency Management Agency (FEMA) regarding high hazard potential dam risk assessment. The FEMA-developed computer model DSS Wise-Lite, including the Human Consequences Outcome Module, were used to analyze a subset of Maryland's high hazard potential dams. Model output showed downstream dam failure inundation areas and determined the population at risk (PAR) in helping to prioritize dams for mitigation repairs. With assistance from a pending FEMA grant, the Department plans to expand the use of DSS Wise-Lite modeling to all dams in Maryland for a more comprehensive State comparative dam risk analysis.

II. Hazard Identification

The two most common modes of dam failure for embankment dams are internal erosion (piping) and over-topping. High and significant hazard dams are designed to prevent over-topping during most storm events occurring in the State. The high hazard dam structures are designed to prevent over-topping during a Probable Maximum Flood (PMF), an extreme event well in excess of a 100-year storm. Significant hazard dam structures are designed to prevent over-topping during one half of the PMF. While the PMF can range in size across Maryland, the average PMF is approximately 27" of rain in 6 hours.

Dam failures due to piping may occur at any time. Piping is internal erosion inside the dam embankment. This condition may take years to develop and may be difficult to detect. Piping failure may be prevented through proper inspection and maintenance. The Department provides regular inspections of all dams and requires corrective actions if piping conditions are observed.

While overtopping and piping are the two most common types of dam failures, other conditions alone or in combination may also lead to dam failures, including:

- Prolonged periods of rainfall and flooding

- Inadequate spillway capacity, resulting in excess overtopping flows
- Internal erosion of embankment or foundation due to seepage or piping
- Improper maintenance, including failure to remove trees, repair internal seepage problems and rodent burrows, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, and other operational components
- Improper design or construction, including the use of improper construction materials and construction practices
- Negligent operation, including the failure to remove or open gates or valves during high flow periods
- Failure of upstream dams on the same waterway
- Landslides into reservoirs, which cause surges that could result in overtopping
- High winds, which can cause significant wave action and result in substantial erosion
- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments, which can weaken entire structures
- Debris blockages of spillways
- Sabotage or vandalism

History of Dam Failures

There have been at least 45 dam failures or near failures in Maryland since the Department began maintaining records on dams in the 1930s. Some of these incidents required the evacuation of downstream residents and property owners, and fortunately, there has been no loss of life. Multiple dam failures have caused damage to roads, property, and the environment.

1936	1) Flooding on Potomac River caused Potomac River Dam No. 4 to fail
1942 & 1948	2) Partially completed Savage River Dam overtopped by floodwaters and breached
1975	3) Smithville dam failed during a storm while under repair
1979	Tropical Storm David
	4) Lake Roland Dam overtopped and nearly failed 5) Lower Lake Royer Dam at Fort Ritchie overtopped and needed sandbagging; the Town of Rouzerville, Pennsylvania was evacuated
1979	Snowmelt Flooding
	6) Wye Mill Dam discharge flooded road, post office, and mill 7) Mockingbird/Double Mills Dam failed 8) Big Millpond Dam spillway failed 9) Barren Creek Dam overtopped and failure was prevented by emergency action by Wicomico County personnel

10) Higgins Mill pond dam was severely stressed but was saved by emergency actions taken by Dorchester County staff
11) Linchester Mill Dam overtopped and failed

1979 Tropical Storm David

12) Lake Roland Dam overtopped and partially failed again
13) Lake Waterford Dam overtopped and the spillway was severely damaged

1989 14) Loveton Stormwater Dam failed during the first storm; damaged Phoenix Road and downstream brook trout habitat

1993 15) Annapolis Mall Stormwater Dam failed during the first filling after a storm

1996 January Ice Melt Flooding

16) Conowingo Dam suffered damage from high flows and ice jams

1996 Heavy Rains

17) Elk Neck State Forest dam partially failed and was breached by DNR under emergency action

1996 Hurricane Fran

18) Barton Reservoir emergency spillway channel was severely eroded but the dam did not fail

1999 Heavy Rains - 5 inches in 12 hours

19) Lake Lanahan Dam overtopped and washed out the spillway

1999 Hurricane Floyd: 15-20 inches of rain in 24 hours in Caroline County

20) Nagels Mill Dam failed and damaged downstream roadway MD 16
21) Stubbs Dam new spillway failed
22) Foreman Branch Dam overtopped and failed
23) Jones Lake overtopped and failed
24) Frazers Mill Dam overtopped and failed
25) Cabin Creek Dam overtopped and failed
26) Sassafras Mill Dam overtopped and failed
27) Von Spreckelson Dam overtopped and failed
28) Meeks Farm Dam overtopped and failed

1999 Winter Ice Melt

29) Rolling Green Community Dam failed after 30-year old metal spillway pipe collapsed under normal operating condition

2001 Winter Storm

30) Woodlawn Landfill stormwater pond dam failed by internal erosion due to improperly installed pipe; severely damaging a trout stream

2003 Severe Storm Event

31) Hunting Creek Dam spillway flows washed out a State road below the dam and damaged MD Route 77

2006 Severe Flooding after 10-15 Inches of Rain

32) Lake Needwood Dam developed serious seepage problem and 2,200 people were evacuated, including downtown Rockville; dam was saved by construction of emergency seepage control filters
33) Galestown Millpond Dam overtopped and failed
34) Wrights Millpond dam overtopped and failed
35) Cabin Creek Dam failed again after it was repaired following 1999 failure
36) Mill Creek Dam failed
37) Irving Mill Pond Dam failed

2007 Heavy Warm Rain on Top of Snowmelt

38) Little Youghiogheny Dam Site 1 (Hospital) spillway was clogged by beavers which caused lake level to rise to emergency spillway, closing local roads; dam was saved by emergency action taken by the National Guard and the Town of Oakland

2008 Heavy Rains in Anne Arundel County
39) Chartwell Golf Course Dam and St. Andrews Road collapsed after the spillway became clogged

2011 Heavy Rains

40) Preference Estates Dam near LaPlata overtopped and failed

2014 Heavy Rains

41) Blairs Valley Dam saw a flood of record with two feet of flow in the emergency spillway; Clear Spring evacuated

2016 Heavy Rains

42) Riawalkin Dam (Nanticoke Road) overtopped and failed

2016 Heavy Rains

43) Barren Creek Dam (Barren Creek Road) overtopped and failed
44) Big Millpond Dam (Sheephouse Road) overtopped and failed, the bridge washed out

2018 Heavy Rains

45) Cascade Lake Dam overtopped and partially failed. Downstream roads closed for two weeks while the owner worked to remove the dam

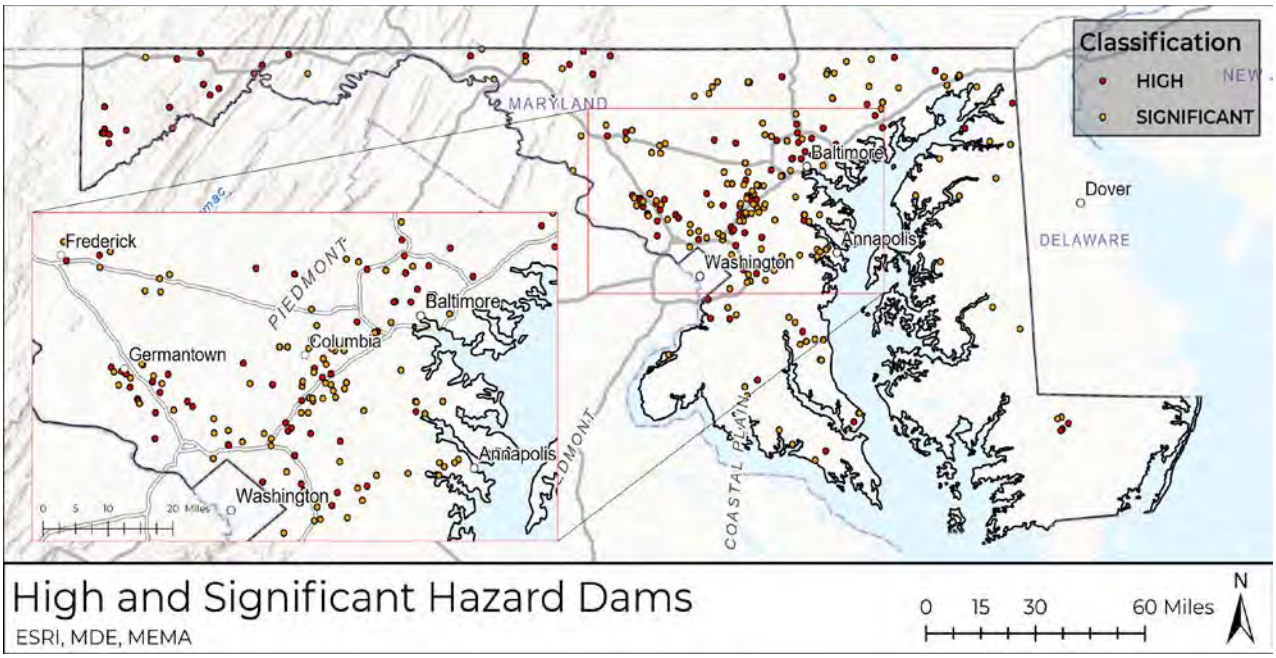
III. Dam Hazard Classification and Risk Assessment

Dam hazards can be localized, regional, or statewide depending on the cause (e.g., blocked control structure on a specific dam, widespread rain event triggered by a tropical storm). Catastrophic dam failures cause immediate water and debris inundation of downstream properties (e.g., farms, forests, residential and commercial development) and infrastructure (e.g., culverts, roads, bridges, railways). Design criteria for high and significant hazard dams include an analysis that considers the instantaneous release of the reservoir during a dam breach. Based on the hazard potential and the possible inundation zone location, dams in Maryland are classified in three categories:

- *High Hazard Dams*: Probable loss of life; major increases in existing flood levels at houses, buildings, major interstates and state roads with more than six lives in jeopardy
- *Significant Hazard Dams*: Possible loss of life; significant increased flood risks to roads and buildings with no more than two houses or six lives in jeopardy
- *Low Hazard Dams*: Unlikely loss of life; minor increases to existing flood levels at road and buildings

Maryland's Dam Inventory currently comprises nearly 600 dams, including 100 high hazard, 149 significant hazard, and 304 low hazard dams (there are also approximately 60 dams on the list that have been removed). See Appendix A for Maryland's Dam Inventory and pertinent information including name, location, and hazard classification. Map 1 depicts the High and Significant Hazard Dams within the State.

Map 1: High and Significant Hazard Dams



Risk Exposure and Residual Risk

Risk exposure is defined as the population, infrastructure, and other valued resources that would be adversely impacted by a dam failure. The risk can be to the dam itself, or it can be risk related to the damage that occurs directly as a result of a dam failure. Residual risk is the risk that remains after all mitigation actions and risk reductions actions have been completed. With respect to dams, FEMA defines residual risk as "risk remaining at any time". It is the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk.

A risk analysis is used to identify the risks associated with a dam. A risk analysis identifies the failure modes that are most likely to occur at the dam based on the site-specific characteristics. A risk analysis is used to determine risk exposure related to a potential dam failure and also used to make risk management decisions. Risk analyses help dam owners prioritize mitigation and preparedness activities when not all risks can be removed in a risk management plan.

There are many potential contributing factors to risk exposure and residual risk, including hazard creep, non-breach dam events, flawed design and construction, overdue maintenance and repair, earthquakes, uncertainties in forecasting models, extreme weather, and upstream dam events. Below is a summary of the most common factors that contribute to dam risk exposure.

Hazard Creep (also referred to as risk creep) results from new development construction in the dam breach inundation zone below a dam, which increases the dam's hazard potential classification. This is an issue for older dams which were constructed decades ago in predominantly rural areas of Maryland that were previously classified as Low or Significant

Hazard at the time they were built. As a result of the increased hazard class, it is likely that the dam does not meet the requirements of COMAR (spillway design capacity, inspection, and maintenance requirements, etc.) for its new hazard potential classification.

Non-Breach Dam Events: A non-breach dam event is an event that will not, by itself, lead to a breach of the dam, but is a residual risk that can lead to flooding of upstream and downstream areas, and requires notification of State and local emergency personnel.

Upstream Flooding: Improper operation, malfunction of a gate, flood events that exceed the design event, or other conditions can cause a higher than normal reservoir elevation and lead to upstream flooding. If an easement is not in place to prevent construction in the high pool area upstream of the dam, buildings may be flooded due to an increase in reservoir pool elevation. Appropriate land use planning can be used to reduce construction in the high pool area upstream of the dam if an easement is not in place. Events upstream of a given dam may pose residual risk to that dam (e.g., misoperation or failure of an upstream dam, partial or full release of an upstream reservoir).

Large Reservoir Releases: Short, intense storms can create conditions that require the release of dam reservoir storage to reduce the risk of overtopping or catastrophic dam failure. Large releases intended to prevent a breach of the dam may result in downstream flooding. It is important for the dam owner to communicate pending large releases of reservoir storage with State and local emergency managers and be detailed in the EAP for the dam. Although most dams in Maryland do not have large gated spillways where this is a concern, those that do (i.e., Brighton, Duckett, Conowingo, and Savage River dams) include provisions in their EAPs for notification of downstream residents and municipalities of the high flows.

Controlled and Partial Breaches: The dam owner, in coordination with an engineer, local emergency managers, and others, may implement a controlled or partial breach of the dam to reduce the risk of catastrophic dam failure. A partial or controlled breach could result in a large release of reservoir storage and flood downstream areas. Dam owners should provide advance notice or communicate the schedule of controlled and partial breaches to State and local emergency managers as indicated in the EAP for the dam.

Dam Design, Construction, and Repair: Risk exposure can be increased by flaws in the original design or construction of a dam. Human error, such as miscalculations or misapplication of dam engineering methods in the design, can result in a higher risk of failure. Risk exposure can increase if dam repairs have not been adequately carried out due to lack of funding or for other reasons. If appurtenances are critical to the function of the dam, such as gates, valves, bottom drains, or conduits, the lack of repairs can result in a drastic increase of the risk exposure.

Lack of Rehabilitation: Although it may be prudent for a dam owner to rehabilitate a dam, regulations might not specifically require it. For example, older dams may not have been

designed to a standard, or may have been designed to federal, State, or other specific design standards that are no longer the current dam engineering state of practice. An older dam may have an unknown inflow design flood that does not meet current requirements for a spillway design, but dam rehabilitation is not specifically required by the regulations. Such a scenario would increase the risk of that dam and associated downstream assets by increasing the chances of the dam being overtopped.

Uncertainties in Inundation and Forecasting Models: The accuracy of topographic maps, new development, bridge and culvert measurements, or improper weather forecast modeling can drastically affect the accuracy of inundation models, placing dams in greater risk. If forecasts do not provide adequate time to react, or models significantly underestimate the precipitation, area impacted, intensity, duration, antecedent soil conditions, or other parameters, the dam will be in greater risk than anticipated and EAP determinations may not be adequate.

Population at Risk

The Maryland Dam Inventory database includes a field for Population at Risk (PAR). However, the data are incomplete and only available for a limited number of dams. In 2004, Towson University produced a list of impacted buildings (schools, police and fire, etc.) and infrastructure (roads) by superimposing shapefiles over other GIS layers. However, that information is out of date. Values for PAR can be estimated in real time by overlaying updated shape files of dam failure inundation maps (available for nearly all High and Significant hazard dams for various scenarios such as sunny day failure or failure during a large flood) over census data to determine the population that would be impacted by dam failure. PAR can also be estimated from the list of impacted properties listed in the EAP for each dam.

Maryland has submitted a proposed scope of work to FEMA/MEMA to use Hazard Mitigation Grant Program (HMGP) funds to create consistent dam failure inundation maps for all dams, regardless of hazard classification, with the FEMA tool DSS-Wise Lite. The maps from this effort, called the Maryland Dam Inundation Mapping Project, will be publicly available on MDFloodMaps.net. This will allow the public to determine whether they are in a dam failure inundation zone, and the maps can also be used by local planning and zoning agencies to determine if proposed development might affect the hazard classification of existing dams. An outcome from this effort will develop a PAR value for each dam.

Land Use and New Development

Land use and new development in or near the inundation zone of a dam can be de-conflicted through proper preparedness and mitigation planning. To minimize loss of life and property damage local governments can pro-actively implement land use and development restrictions in dam inundation zones. Because accurate and consistent inundation zone mapping is often unknown, local governments have little information in which to base these important zoning

decisions. Maryland's number one proposed number mitigation strategy is to create consistent inundation zone maps for all facilities on Maryland's Dam Inventory by using DSS-Wise Lite.

While land use decisions remain a local prerogative, the Department can work cooperatively with municipal and county governments by providing them with the best available inundation zone mapping. The Department also requires that all new dam property owners enter into land restriction easements that must be recorded on local development plats. State and local dam safety programs cooperatively work to provide the public with information on dams, potential failures, and what to do in an emergency.

Emergency Action Plans

Maryland's Dam Safety Program staff work with all significant and high hazard dam operators and owners to develop Emergency Action Plans (EAP) and update them annually. Hydrologic and hydraulic models are used to predict the dam inundation path and provide the dam operator with procedures to follow in order to safeguard the lives and property of people downstream. Inundation maps show the downstream areas that would be impacted as a result of a catastrophic dam failure, flood wave arrival times, and the depth and velocity of the water. This assists emergency personnel in notifying the people that need to be evacuated, and the closing of buildings and critical infrastructure (e.g., roads, bridges, railroads).

Dam owners are required to exercise their EAPs at least once every five years in coordination with local and State emergency and hazard mitigation personnel. Maryland's Dam Safety Program provides outreach to dam owners and helps to facilitate table top emergency exercises on a county and regional basis.

High Hazard Potential Dam (HHPD) Selection

The President signed the "Water Infrastructure Improvements for the Nation Act" or the "WIIN Act," on December 16, 2016, which adds a new grant program under FEMA's National Dam Safety Program (33 U.S.C. 467f). Section 5006 of the Act, Rehabilitation of High Hazard Potential Dams, provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. In both Fiscal Year 2020 and 2021 FEMA was appropriated $10 million to implement the Rehabilitation of High Hazard Potential Dams Grant Program. Maryland's Dam Safety Program in cooperation with MEMA will be applying for the HHPD Grant Program for the first time in Fiscal Year 2021.

Maryland currently has 100 high hazard dams, and 90 were included on the 2018 National Inventory of Dams (NID). Since then, several dams on Maryland's Dam Inventory have been reclassified or added, and the State is working with FEMA to update the NID to reflect these changes. Based on Maryland's current inventory data, about 40 dams are listed as being in poor, very poor, unsafe, or unsatisfactory condition. From this list, hydropower dams and dams

designed/constructed by the US Department of Agriculture were excluded per FEMA's HHPD selection criteria, leaving 30 high hazard dams that qualify for the grant program.

The dams were then ranked by spillway capacity (i.e., percent of PMF that a dam can safely pass). Six dams have a spillway capacity of 50% or less of the PMF. The population at risk (PAR) was then determined for the number of people living below each of these dams. The FEMA computer model DSS Wise-Lite, including the Human Consequences Outcome Module, were used to show downstream dam inundation areas to determine the PAR. All dams were assumed to fail with the reservoir at the maximum possible level (i.e., brim-up condition). The time for complete failure for each dam was estimated to be 15 minutes and the size of the breach width at three times the dam height. These values were used in order to provide PAR estimates in a consistent manner and in accordance with the HHPD Notice of Funding Opportunity. These data were used in the final selection of dams by the Department and MEMA for Fiscal Year 2021 and the dam owners have been notified of the potential funding opportunity.

IV. Mitigation Strategies

Maryland's dam safety mitigation strategies are divided into two categories, ongoing and proposed activities. Each of these strategies are based on the mitigation planning objectives for addressing the reduction of vulnerabilities from eligible high hazard potential dams. Both the ongoing strategies and proposed activities were ranked using the following criteria:

- Protection of life and property
- Protection of State assets
- Coordination with local jurisdictions
- Increased public awareness
- Recommended program improvements from the American Society of Civil Engineers (ASCE) and the Association of State Dam Safety Officials (ASDSO)
- Promotion of actions that protect natural resources

Anticipated budgets for each strategy are prorated based on the percent of staff workload directed toward the activity and the Dam Safety Program's FY 20 budget of $1,000,000. Enhancements from grants appear in addition to the Program's annual budget (e.g., National Dam Safety Program Grant, Building Resilient Infrastructure and Communities Grant).

Ongoing mitigation strategies include:

1. Maintain the State's inventory of dams, including hazard classifications and safety status
2. Prioritize and inspect all dams on Maryland's Dam Inventory
3. Facilitate exercises for significant and high hazard dam EAPs
4. Give dam safety workshops on current hot topics
5. Provide public outreach and education

New mitigation strategies include:

6. FEMA grant funding for GIS mapping of Maryland dam inundation zones
7. Update dam permitting SOPs and technical assistance to improve safety design
8. Develop SOP for statewide hurricane/tropical storm dam safety response
9. Prioritize high hazard potential dams and provide owners assistance for dam repairs
10. Develop comprehensive risk based assessment inspection outreach

Mitigation Strategy Implementation Summary Charts

Mitigation Action 1	
Maintain the State's Inventory of Dam Hazard Classification and Status	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$300,000 in Staff and Resources
Existing and potential funding sources	State Operating Budget National Dam Safety Program Grant (FEMA)
Timeframe	Annually
Priority	High
Status (Ongoing or New)	Ongoing

Mitigation Action 2	
Prioritize and Inspect All Dams on Maryland's Dam Inventory	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$300,000 in Staff and Resources

Existing and potential funding sources	State Operating Budget National Dam Safety Program Grant (FEMA)
Timeframe	Annually
Priority	High
Status (Ongoing or New)	Ongoing

Mitigation Action 3	
Facilitate Exercises for Significant and High Hazard Dam EAPs	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment Local Government Agencies
Anticipated Cost	$50,000 in Staff and Resources
Existing and potential funding sources	State Operating Budget National Dam Safety Program Grant (FEMA) Local Government Budgets
Timeframe	Annually
Priority	High
Status (Ongoing or New)	Ongoing

Mitigation Action 4
Give Dam Safety Workshops on Current Hot Topics

Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$50,000 FEMA Grant and Staff and Resources
Existing and Potential Funding Sources	State Operating Budget National Dam Safety Program Grant (FEMA)
Timeframe	Annually
Priority	Medium
Status (Ongoing or New)	Ongoing

Mitigation Action 5	
Provide Public Outreach and Education	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$50,000 in Staff and Resources
Existing and potential funding sources	State Operating Budget National Dam Safety Program Grant (FEMA)
Timeframe	Annually
Priority	Medium
Status (Ongoing or New)	Ongoing

Mitigation Action 6

Contract with FEMA for GIS Mapping of Maryland Dam Inundation Zones	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$100,000 FEMA Grant and Staff and Resources
Existing and Potential Funding Sources	State Operating Budget Building Resilient Infrastructure and Communities Grant (FEMA)
Timeframe	Three Years
Priority	High
Status (Ongoing or New)	New

Mitigation Action 7	
Update Dam Permitting SOPs and Technical Assistance to Improve Safety Design	
Responsible Agency	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$100,000 Staff and Resources
Existing and Potential Funding Sources	State Operating Budget
Timeframe	Two Years
Priority	High
Status (Ongoing or New)	New

Mitigation Action 8	
Developing SOP for Statewide Hurricane/Tropical Storm Dam Safety Response	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$50,000 Staff and Resources
Existing and Potential Funding Sources	State Operating Budget
Timeframe	One Year
Priority	High
Status (Ongoing or New)	New

Mitigation Action 9	
Prioritize High Hazard Potential Dams and Provide Owners Assistance for Dam Repairs	
Responsible Agency	Maryland Dam Safety Program, Water Quality Financing Administration, Maryland Department of the Environment; Maryland Emergency Management Administration
Anticipated Cost	50,000 Staff and Resources (for HHPD application and administration costs only)
Existing and Potential Funding Sources	State Operating Budget High Hazard Potential Dam Grant Program (FEMA)State Water Infrastructure Emergency Repair Program
Timeframe	Annually
Priority	Medium

Status (Ongoing or New)	New

Mitigation Action 10	
Develop Comprehensive Risk Based Assessment Inspection Outreach	
Responsible Department	Maryland Dam Safety Program Maryland Department of the Environment
Anticipated Cost	$50,000 Staff and Resources
Existing and Potential Funding Sources	State Operating Budget
Timeframe	Five Years
Priority	Medium
Status (Ongoing or New)	New

Bibliography

2018-2023 Colorado Hazard Mitigation Plan, Division of Homeland Security and Emergency Management, Colorado Department of Public Safety, 9195 East Mineral Avenue, Suite 200, Denver, Colorado

2019 New York State Hazard Mitigation Plan, Division of Homeland Security and Emergency Services (DHSES) - Mitigation Planning, 1220 Washington Ave., Building 7a, 4th Floor, Albany New York

Montana High Hazard Potential Dam Grant Program, Risk-Based Prioritization Process, 1-19186-DNRC Emergency Planning Workshops 2019

Montgomery County, Maryland, Hazard Mitigation Plan 2018 Addendum A -- Dams and Levees, Office of Emergency Management & Homeland Security, Rockville, Maryland

Information on Risk Exposure and Residual Risk Related to Dams in Maryland adapted from the Federal Emergency Management Administrtion's advisory publications DR-4285-NC and DR-4286-SC

Appendix A

County	Dam Name	Hazard Classification	Dam Type	Year Completed	Dam Height
Allegany	Rocky Gap Dam	HIGH	Earth	1969	98
Allegany	Don Pleasants Dam	SIGNIFICANT	Earth	1977	50
Alleganym	Industrial Dam (Blue Bridge)	LOW	Gravity,Earth	1954	40
Allegany	Koontz Run Reservoir Tanks	HIGH	Tank	2015	21
Allegany	Borden Shaft-Carlos Reservoir	LOW	Earth	1960	20
Allegany	Klondike Reservoir No. 1 (Lower)	LOW	Gravity	1930E	10
Allegany	Klondike Reservoir No. 2 (Upper)	LOW	Earth	1880E	22
Allegany	Lonaconing Reservoir	HIGH	Earth,Masonry	1895	20
Allegany	Midland-Gilmore Reservoir	HIGH	Earth,Masonry	1903	19
Allegany	NewPage Westvaco Dam	LOW	Gravity	1913	7
Allegany	Pinto Utilities Dam	LOW	Earth	1968	18
Allegany	Roeder Farm Pond	LOW	Earth	1974	12
Allegany	Dry Run Detention Dam and Culvert	HIGH	Gravity,Earth	1949	16
Allegany	Upper Potomac Industrial Park Levee	HIGH	Earth	2005	8
Anne Arundel	Saefern Dam	LOW	Earth	1967	26
Anne Arundel	Burba Lake (Roberts Avenue)	SIGNIFICANT	Earth	1917	16
Anne Arundel	Lake Allen Dam	LOW	Earth	1947	10
Anne Arundel	Lake of the Pines (Tarnans Branch Crossing)	SIGNIFICANT	Earth	1981	22
Anne Arundel	Annapolis Reservoir	SIGNIFICANT	Buttress,Concrete	1920E	15
Anne Arundel	Heritage Harbour (Mastline Drive)	LOW	Earth	1974	34
Anne Arundel	Lake Waterford Dam	SIGNIFICANT	Earth	1925	18
Anne Arundel	Fort Meade Water Supply	LOW	Gravity	1938	9
Anne Arundel	Seven Oaks SWM Dam	LOW	Earth	1989	17
Anne Arundel	Russett Center Lower Dam / Pond #1	LOW	Earth	1990	34
Anne Arundel	Jessup Prison Dam	SIGNIFICANT	Earth	1982	31
Anne Arundel	Rock Creek Dredge Disposal	LOW	Earth	1991	23

Anne Arundel	Russett Center Upper Dam / Pond #2	LOW	Earth	1990	27
Anne Arundel	Shipleys Choice Section II SWM Dam	HIGH	Earth	1981	27.25
Anne Arundel	Windgate SWM Dam 3 (Burtons Cove Way)	SIGNIFICANT	Earth	1994	23
Anne Arundel	Annapolis Mall SWM Pond	LOW	Earth	1993	30
Anne Arundel	Riva Trace Community Pond	SIGNIFICANT	Earth	1985	15
Anne Arundel	Cristal Global Hawkins Point Plant Settling Basins	LOW	Earth	1960E	20.5
Anne Arundel	Gateway Village Parole Town Center Dam	LOW	Earth	1996	20.5
Anne Arundel	South River Colony Parcel A SWM Lake	LOW	Earth	1991	14
Anne Arundel	Shipleys Crossing North Dam 1 (Galiot Dr)	SIGNIFICANT	Earth	2008	9
Anne Arundel	Shipleys Crossing North Dam 2 (Wherry Ct)	SIGNIFICANT	Earth	2008	14
Anne Arundel	Chartwell Country Club Dam	SIGNIFICANT	Earth	2010	22
Anne Arundel	Crofton Farms Regional SWM Pond	LOW	Earth	1998	15
Anne Arundel	Aisquith Farm Dam (Breckenridge Way)	LOW	Earth	1991	20
Anne Arundel	Eisenhower Golf Course Dam	LOW	Earth	1998	22
Anne Arundel	Anne Arundel Community College SWM Dam	LOW	Earth	1992	23
Anne Arundel	Park Retreat SWM Pond	LOW	Earth	2013	20
Anne Arundel	BWI Pond B12	SIGNIFICANT	Earth	1995	21
Anne Arundel	Lake Median	LOW	Earth	1990	25
Anne Arundel	Cox Creek DMCF	LOW	Earth	1960E	36
Anne Arundel	Harry S. Truman Pkwy Park N Ride SWM Pond	SIGNIFICANT	Earth	1987	14.47
Anne Arundel	Annapolis Plaza Dam, JR Plaza Pond	LOW	EARTH		20
Anne Arundel	Route 97 SHA BMP 020165	LOW	Earth		33
Anne Arundel	Jennifer Road SWM Route 50 and Route 2	SIGNIFICANT	Earth	1985E	46.9
Baltimore	Prettyboy Dam	HIGH	Gravity	1936	155
Baltimore	Loch Raven Dam	HIGH	Gravity,RCC	1923	130
Baltimore	Liberty Dam	HIGH	Gravity	1953	175

Baltimore	UMBC Dam	HIGH	Earth	1976	38
Baltimore	Lake Roland Dam	HIGH	Gravity,Earth	1861	42
Baltimore	Pikesville Reservoir Storage Tanks	HIGH	TANK	2007	22
Baltimore	Daniels Dam	LOW	Buttress,Concrete	1833	27
Baltimore	Camp Fretterd Miltary Reservation Dam	LOW	Earth	1967	24
Baltimore	Gwynns Falls Dam	LOW	Gravity	1902	4
Baltimore	Gores Mill Dam	LOW	Gravity	1823	11
Baltimore	Gwynn Oak Park Dam	LOW	Earth,Other	1914E	12
Baltimore	Chenoweth Farm Pond	LOW	Earth	1990	24
Baltimore	Castanea/Chestnut Ridge Irrigation Pond No. 3	LOW	Earth	1955	17.5
Baltimore	GBMC Pond	SIGNIFICANT	Earth	1993	13
Baltimore	Owings Mills Commerce Center	LOW	Earth	1991	30
Baltimore	Old Loch Raven Dam	LOW	Masonry	1875	20
Baltimore	Mays Chapel Reservoir	HIGH	Earth	1965E	20
Baltimore	Towson Reservoir Storage Tanks	HIGH	Tank	2013	40
Baltimore	Queen Annes Village SWM Pond No. 1	SIGNIFICANT	Earth	2007	19.5
Baltimore	Greenspring Quarry Dam	SIGNIFICANT	Earth	2007	16
Baltimore	Velvet Hills South SWM Dam	SIGNIFICANT	Earth	1987	15.1
Baltimore	Roland Run Levee	HIGH	Earth	1982	15
Baltimore	Painters Mill Levee	SIGNIFICANT	Earth	1989	13.5
Baltimore	UMBC Central Campus Dam	SIGNIFICANT	Other	1975E	10
Baltimore	Fullerton Reservoir Tanks	HIGH	Tank	2020	15
Baltimore	Greenspring East SWM Pond No. 3	LOW	Earth	1995	33.6
Baltimore	Pleasant Hills SWM Dam (Gentlebrook Road)	LOW	Earth	1988	17
Baltimore	Baltimore Country Club West Pond	LOW	Earth	1989	14
Baltimore	Catonsville Community Park Regional SWM	HIGH	Earth	1985	21
Baltimore	Beaver Dam Run Levee	SIGNIFICANT	Earth	1970E	15
Baltimore	Dinning Farm Pond Dam	LOW	Earth	1979	20

Baltimore City	Pecks Branch Dam (Ashburton)	HIGH	Earth	1956	59
Baltimore City	Guilford Reservoir Storage Tanks	HIGH	Tank	1893	35
Baltimore City	Lake Montebello	HIGH	Earth	1880	30
Baltimore City	Lake Ashburton Reservoir and Storage Tanks	HIGH	Earth,Rockfill,Tank	1910	40
Baltimore City	Druid Hill Lake Reservoir and Storage Tanks	HIGH	Earth,Tank	1871	118
Baltimore City	Montebello Waste Water Lake	LOW	Earth	1915	46
Baltimore City	Dickeyville Dam	LOW	Gravity	1808	15
Baltimore City	Jones Falls	LOW	Masonry	1800E	8
Baltimore City	Hillen Road Water Supply Tank	HIGH	Tank	1920	36
Baltimore City	Johns Hopkins Bayview Campus SWM Pond	SIGNIFICANT	Earth,Other	2004	20
Baltimore City	Masonville DMCF	LOW	Earth		18
Baltimore City	Amtrak Railroad Culvert 100.18	SIGNIFICANT	Earth	1888E	24
Baltimore City	Gwynns Falls Reclamation	LOW	Earth	1950E	9.5
Calvert	Chesapeake Ranch Estates Dam (Chisolm Trail)	HIGH	Earth	1965	46
Calvert	Cove Point LNG Main Dam	SIGNIFICANT	Earth	1974	74
Calvert	Lake Ridge Community Pond Dam (Alta Drive)	SIGNIFICANT	Earth	1969	28
Calvert	Cove Point LNG Secondary Dam	SIGNIFICANT	Earth	1974	35
Calvert	Shores of Calvert Lower Dam	LOW	Earth	1972	15
Calvert	Running Hare Vineyard Lake	LOW	Earth	1970	20
Calvert	Ferry Landing Woods Pond	LOW	Earth	1981	22
Calvert	Calvert Gateway	SIGNIFICANT	Earth,Other	2000	19.7
Calvert	Victoria Station Community Lake	HIGH	Earth	1986	23
Calvert	Starkey Pond	LOW	Earth	1950E	11
Calvert	Queensberry Drive SWM Pond	SIGNIFICANT	Earth	2001	19
Calvert	Prince Frederick WWTP Pond 2	LOW	Earth	2002	65
Calvert	Shores of Calvert Upper Dam (Rivershore Drive)	SIGNIFICANT	Earth	1972	25
Calvert	Sunderland Railroad Embankment Pond	LOW	Earth	1850E	25

Calvert	Lake Karylbrook Community Pond	SIGNIFICANT	Earth	1990E	30
Calvert	Queensberry Drive Playground Dam	SIGNIFICANT	Earth	1981E	28
Calvert	Twin Lakes Upper Pond (Hoile Lane)	SIGNIFICANT	Earth	1970E	15
Calvert	Lusby Southern Connector Road West Pond No.4	LOW	Earth	2010	25
Calvert	Stoneleigh Community Pond (Stoneleigh Court)	SIGNIFICANT	Earth	1978	24
Calvert	Gunsmoke Trail Golf Course Dam	LOW	Earth	1965E	16.5
Caroline	Smithville Dam (Possum Hill Road)	LOW	Earth	1980	14
Caroline	Nagels Mill Pond	SIGNIFICANT	Earth	1860E	16
Caroline	Lake Bonnie	LOW	Earth	1850	14
Caroline	Williston Mill Dam (MD 617 Old Harmony Road)	LOW	Earth	1936	18
Caroline	Tuckahoe State Park Dam (Crouse Mill Road)	LOW	Earth	1975	14
Caroline	Chambers Lake	SIGNIFICANT	Earth	1937	11
Caroline	Scull Farm Pond	LOW	Earth	1974	22
Caroline	Idylwild Wildlife Mgmt Pond	LOW	Other	1987	8
Carroll	Cranberry Branch Dam	SIGNIFICANT	Earth	1957	32
Carroll	Piney Run Dam	HIGH	Earth	1974	73
Carroll	Hampstead Industrial Center Dam	LOW	Earth	1956	28
Carroll	Joseph A. Banks SWM Pond	LOW	Earth	1975	15
Carroll	Union Mills Dam	LOW	Other	1800E	6
Carroll	Otterdale Mill Dam	LOW	Gravity	1800E	7
Carroll	Snell Estates	LOW	Earth	1979	14
Carroll	Medford Quarry Wash Pond	SIGNIFICANT	Earth	1988	26
Carroll	Carroll County Farm Museum Dam	SIGNIFICANT	Earth	1964	20
Carroll	Lineboro Fire Company	LOW	Gravity	1936	10
Carroll	Roberts Field Basin 1	SIGNIFICANT	Earth	1992E	25
Carroll	Roberts Field Basin 2	SIGNIFICANT	Earth	1992E	22
Carroll	Roberts Field Basin 3 (Sycamore Drive)	SIGNIFICANT	Earth	1992	18
Carroll	Town Mall SWM Pond	SIGNIFICANT	Earth	1985E	12

Carroll	Baugher Enterprises Dam	LOW	Earth	1990	21
Carroll	Carroll County Air Business Center SWM Pond	LOW	Earth	1992	14
Carroll	Elderwood SWM Basin No.2	LOW	Earth	1987	20
Carroll	Shannon Run Dam	LOW	Earth	1992	23
Carroll	Finksburg Industrial Park SWM Dam	LOW	Earth	2017	20
Cecil	Indian Acres of the Chesapeake Bay (Holly Drive)	LOW	Earth	1973	15
Cecil	Mason-Dixon Water Supply Pond	LOW	Earth	1966	67
Cecil	Stancills Inc. Settling Pond	LOW	Earth	1976	26
Cecil	Mason Dixon Original Settling Pond	LOW	Earth	1966	52
Cecil	Gilpin Falls	LOW	Gravity	1735E	6
Cecil	Court House Point Disposal Area	LOW	Earth	1968	7
Cecil	Pearce Creek Disposal Area	HIGH	Earth	1968	40
Cecil	Grove Point Disposal Area	LOW	Earth	1968	20
Cecil	Chesapeake City East Disposal Area, Bethel Road	HIGH	Earth	1968	42
Cecil	Chesapeake City West Disposal Area	LOW	Earth	1968	27
Cecil	Emily Point Disposal Area No. 21	LOW	Earth	1968	42
Cecil	Bohemia Mill (Old Telegraph Road)	LOW	Earth	1913	15
Cecil	Panagopulos Farm Pond	LOW	Earth	1974	20
Cecil	Back Creek Dam (Old Telegraph Road)	LOW	Earth	1900	11
Cecil	Mason-Dixon Settling Pond No. 1	LOW	Earth	1971	31
Cecil	Mason-Dixon Settling Pond No. 2	LOW	Earth	1971	40
Cecil	Mason-Dixon Settling Pond No. 3	LOW	Earth	1971	27
Cecil	Mason-Dixon Settling Pond No. 4	LOW	Earth	1971	26
Cecil	York Building Products Pond No. 5	LOW	Earth	1971	44
Cecil	York Building Products Pond No. 6	LOW	Earth	1971	30
Cecil	Elk Neck State Park Dam	LOW	Earth	1960	25
Cecil	Perryville Water Supply	SIGNIFICANT	Gravity,Other	1900E	15
Cecil	Hall Creek Dam	SIGNIFICANT	Earth	1930E	11
Cecil	Hexton Farms	LOW	Earth	1966	15

Cecil	Penn Railroad Dam	LOW	Gravity	1900	10
Cecil	York Bldg Products Settling Pond 9	SIGNIFICANT	Earth	1988	43
Cecil	Elkton Water Supply Dam	LOW	Gravity	1900	5
Cecil	York Bldg Products Settling Pond 10	SIGNIFICANT	Earth	1991	48
Cecil	Rising Sun Waste Water Lagoon	LOW	Earth	1964	10
Cecil	York Bldg Products Settling Pond 11	SIGNIFICANT	Earth	1999	51
Cecil	York Bldg Products Settling Pond 12	SIGNIFICANT	Earth	2004	70
Cecil	Spectron Dam	LOW	Gravity	1900E	10
Cecil	Cecil Sand and Gravel Pond 6	SIGNIFICANT	Earth	2006	49
Cecil	Keppels Mill Dam	LOW	Masonry	1800E	15
Cecil	York Bldg Products Settling Pond 13	SIGNIFICANT	Earth	2016	45
Cecil	Chesapeake Bay Golf Club North East Dam	SIGNIFICANT	Earth	1990	25
Cecil	Woodlawn Railroad Embankment on Basin Run	HIGH	Earth	1940E	40
Cecil	Pearce Creek Lake	LOW	Earth	1800E	20
Cecil	York Building Products Pond No. 7 Dam	LOW	Earth	1971	30
Cecil	Cecil Sand and Gravel Pond 7	SIGNIFICANT	Earth	2017	24
Charles	Gilbert Run Dam 1 (Trinity Church)	SIGNIFICANT	Earth	1964	41
Charles	Gilbert Run Dam 3 (Jameson Dam)	HIGH	Earth	1964	37
Charles	Gilbert Run Dam 2 (Wheatley)	SIGNIFICANT	Earth	1968	37
Charles	Mc Allister Pond No. 1	LOW	Earth	1967	22
Charles	Myrtle Grove Lake	LOW	Earth	1965	14
Charles	Green Tree Reservoirs	LOW	Earth	1950	5
Charles	Westlake Village Lake 3	LOW	Earth,Other	1984	11
Charles	Indian Head Riverview SWM Pond	SIGNIFICANT	Earth	1990	21
Dorchester	Galestown Millpond (Galestown-Reliance Road)	LOW	Earth	1972	9
Dorchester	Higgins Millpond	LOW	Earth	1801	9
Dorchester	Hurlock Oxidation Ponds	LOW	Earth	1968	24
Dorchester	Mill Creek Dam	LOW	Earth	1930	11
Dorchester	Irving Pond	LOW	Earth	1900	9

Dorchester	Big Millpond Dam Rt 50	LOW	Rockfill	1979	6
Dorchester	Wrights Millpond Dam	LOW	Earth	1901	10
Frederick	Fishing Creek Dam	HIGH	Earth	1925	58
Frederick	Emmitsburg Dam	HIGH	Earth	1950E	30
Frederick	Lake Linganore	HIGH	Earth	1972	63
Frederick	Hunting Creek Dam	HIGH	Earth	1969	79
Frederick	Lake Merle (Eaglehead Drive)	SIGNIFICANT	Earth	1971	43.65
Frederick	Lake Anita Louise	LOW	Earth	1973	40
Frederick	Lake Marian (Woodridge Road)	LOW	Earth	1973	50
Frederick	Urbana	LOW	Earth	1963	25
Frederick	Damazo Pond	LOW	Earth	1975	22
Frederick	Bond Farm Pond	LOW	Earth	1973	17
Frederick	Starners Dam	LOW	Masonry	1850E	11
Frederick	Bentz Community Pond	LOW	Masonry	1930	13
Frederick	Cohen Pond	SIGNIFICANT	Earth	1952	33
Frederick	Kump's Dam	LOW	Gravity	1900E	14
Frederick	Lake Jennifer	LOW	Earth	1963	15
Frederick	St Clair Farm Pond	SIGNIFICANT	Earth	1968	18
Frederick	Reichs Ford Landfill SWM Dam	LOW	RCC	1995	39
Frederick	Holly Hills Section 4 SWM Pond 1	SIGNIFICANT	Earth	2001	26
Frederick	Emergency Management Institute	LOW	Gravity	1800E	8
Frederick	Mason-Dixon Farms Irrigation Pond	LOW	Earth	1984	14.5
Frederick	Monocacy Boulevard Dam	HIGH	Earth	2011	15
Frederick	Spring Ridge SWM Pond No. 4	LOW	Earth	1994	21.4
Frederick	Spring Ridge SWM Pond No. 4A	LOW	Earth	1994	16
Frederick	Spring Ridge SWM Pond 7 (Newport Drive)	LOW	Earth	1990E	20
Frederick	Frederick Research Park Lot 4 SWM Pond	SIGNIFICANT	Earth	1990E	20
Frederick	Twin Ridge Subdivision Pond No. 1	SIGNIFICANT	Earth	1990	28
Frederick	Summit Lake Church Camp Dam	LOW	Earth	1930E	15
Frederick	Hampton Inn Dam	LOW	Concrete	1980E	4

Frederick	Mt Airy Park-n-Ride SWM Pond	SIGNIFICANT	Earth	1972	15
Frederick	PB Dye Golf Course Irrigation Pond Dam	LOW	Earth	1990	22
Frederick	Point of Rocks Dam	SIGNIFICANT	Earth	1990E	13.8
Garrett	Deep Creek Dam	HIGH	Earth,Other	1925	85
Garrett	Frostburg Reservoir	HIGH	Earth	1990	46
Garrett	Western Maryland 4H Center	LOW	Earth	1937	22
Garrett	Herrington Manor	LOW	Earth	1938	24
Garrett	Savage River Dam	HIGH	Earth,Rockfill	1952	184
Garrett	Little Youghiogheny Site 7	HIGH	Earth	1960	45
Garrett	Little Youghiogheny Site 2	HIGH	Earth	1962	35
Garrett	Little Youghiogheny Site 6 (Broadford)	HIGH	Earth	1971	46
Garrett	Little Youghiogheny Site 1	HIGH	Earth	1964	33
Garrett	Little Youghiogheny Site 3	HIGH	Earth	1965	35
Garrett	Little Youghiogheny Site 5	HIGH	Earth	1968	41
Garrett	Meadow Run Dam	HIGH	Earth	1969	25
Garrett	Jennings Randolph	HIGH	Rockfill	1981	296
Garrett	New Germany State Park Dam	LOW	Earth	1930	12
Garrett	Lake Louise	SIGNIFICANT	Rockfill	1930E	21
Garrett	Bittinger Farm Pond	LOW	Earth	1968	17
Garrett	Kemp Farm Pond	LOW	Earth	1971	28
Garrett	Waterfront Greens Community Pond	LOW	Earth	1986	27
Garrett	Kitzmiller	LOW	Rockfill	1985	7
Garrett	Platter Farm Pond	LOW	Earth	1968	22
Garrett	Piedmont Water Supply Intake Dam	LOW	Gravity	1911	8
Garrett	Rock Lodge Dam	LOW	Concrete	1920	7
Garrett	Thousand Acres Dam	LOW	Earth	2007	14
Garrett	Adventure Sports Center Pond	LOW	Earth	2007	27
Harford	Broad Creek Dam	HIGH	Gravity,Earth	1948	36
Harford	Little Deer Creek Site 1	SIGNIFICANT	Earth	1958	45
Harford	Little Deer Creek Site 2A (McKnight/Rutledge)	SIGNIFICANT	Earth	1962	44

Harford	Little Deer Creek Site 3	SIGNIFICANT	Earth	1962	45
Harford	Atkisson Dam	HIGH	Gravity	1942	60
Harford	Lake Serene (Edgewater Drive)	HIGH	Earth	1971	29
Harford	Priestford Hills	LOW	Earth	1974	24
Harford	Campus Hills Pond	LOW	Earth	1969	23
Harford	Club House Road Pond	LOW	Earth	1983	4
Harford	Eden Mill Dam	SIGNIFICANT	Gravity	1917	18
Harford	Rock Mill Pond - Susquehanna State Park	LOW	Other	1804	16
Harford	Wilson Mill Dam	LOW	Gravity	1800E	9
Harford	Winters Run Mill Dam	LOW	Gravity	1920	6
Harford	Van Biber Dam	LOW	Gravity	1954	14
Harford	Grimmel's Pond	LOW	Earth,Other	1950E	9
Harford	Grande View Farms Community Pond	SIGNIFICANT	Earth	1969	22
Harford	Briar Ridge Farm Pond	LOW	Earth	1966	26
Harford	Oaks of Harford (Tollgate Road)	LOW	Earth	1984	43
Harford	Hunters Run SWM Dam	SIGNIFICANT	Earth	1996	30.4
Harford	Rolling Green Community Pond	SIGNIFICANT	Earth	1965	22
Harford	Winters Run Belair Intake	LOW	Gravity	1900E	6
Harford	Glen Elyn Lower Dam (Forest Glen Drive)	SIGNIFICANT	Earth	1975E	21.5
Harford	Glen Elyn Upper Dam	SIGNIFICANT	Earth	1975E	19.2
Harford	Village of Scots Fancy SWM Pond	SIGNIFICANT	Earth	1991	27
Harford	Martindale Pond	SIGNIFICANT	Earth	1975	20
Harford	Mt. Soma Reservoir	HIGH	Earth	2018	61.3
Howard	Wilde Lake Dam	SIGNIFICANT	Gravity	1967	28
Howard	Columbia Gateway Dam	HIGH	Earth	1972	36
Howard	Lake Elkhorn	HIGH	Earth	1974	26
Howard	Lake Kittamaqundi	LOW	Earth	1967	7
Howard	Riggs Farm Pond	LOW	Earth	1988	24
Howard	Johns Hopkins University APL Dam (Pond Road)	LOW	Earth	1954	22
Howard	Centennial Park Dam	HIGH	Earth	1985	42

Howard	Hickory Ridge	LOW	Earth	1985	20
Howard	Woodmark Community Pond	SIGNIFICANT	Earth	1968	11.7
Howard	Warfield Pond	LOW	Earth	1969	13
Howard	Wyndemere SWM Pond	SIGNIFICANT	Earth	1995	13.2
Howard	North Laurel Park SWM Pond (Sewall Avenue)	SIGNIFICANT	Earth	1998	30
Howard	Highland Lake	LOW	Earth	1960	22
Howard	Pushcart Pond	LOW	Earth	1975E	15
Howard	Great Star Drive SWM Dam	LOW	Earth	1997	20
Howard	Hobbits Glen Golf Course Dam	SIGNIFICANT	Earth	1966	21.5
Howard	Oakhurst Section 1 SWM Dam (Oakhurst Drive)	HIGH	Earth	1998	12
Howard	Laurel Lumber Dam	SIGNIFICANT	Earth	2007	12
Howard	Jessup Park Dam	SIGNIFICANT	Earth	2010	10
Howard	Holly House Meadows Dam	HIGH	Earth	1983	20.2
Howard	Gateway Village Pond	SIGNIFICANT	Earth	1988	18.5
Howard	Lutheran Village at Millers Grant Pond 1	SIGNIFICANT	Earth	2015	18
Howard	Mary Lee Lane SWM Dam	SIGNIFICANT	Earth	1985E	11
Howard	Waverly Woods Section 4 SWM Pond	LOW	Earth	1996	18
Howard	Linden Chapel Road SWM Dam	SIGNIFICANT	Earth	1989	16
Howard	Dobbin Road SWM Pond	SIGNIFICANT	Earth	1987	36
Howard	Bonnie Branch Mill Dam	LOW	Masonry	1860E	19.5
Howard	Davis Mill Dam	LOW	Masonry	1878E	14
Howard	Strawberry Fields	SIGNIFICANT	Earth	1985	20
Howard	Diversified Lane Pond Dam	SIGNIFICANT	Earth	1992	8.3
Howard	Glenmar Pond 2 Dam	SIGNIFICANT	Earth	1984	3.2
Howard	Waiting Springs SWM Pond	SIGNIFICANT	Earth	1971	12
Howard	Gerwig Lane SWM	SIGNIFICANT	Earth	1980E	
Howard	Montgomery Run SWM Pond 1	SIGNIFICANT	Earth	1990	20
Howard	Country Meadows SWM Pond	SIGNIFICANT	Earth	1988	17
Howard	Guilford Road Dam	SIGNIFICANT	Earth		
Howard	Whiskey Bottom West SWM	SIGNIFICANT	Earth	1978	10

Howard	Jackson Pond Dam	LOW	Earth	1960s	
Howard	Junction Industrial Park	SIGNIFICANT	Earth	1984	18
Howard	Murray Hill 2 SWM Pond (Vollmerhausen Road)	LOW	Earth	1980	20
Howard	Warfield Range Dam (Hunters Way)	SIGNIFICANT	Earth	1980	20
Howard	MD Route 104 SWM Pond (SHA BMP 130077)	SIGNIFICANT	Earth	1990E	16.5
Kent	Urieville Dam (Augustine Herman Hwy)	LOW	Earth	1955	17
Kent	Sassafras Mill Dam	SIGNIFICANT	Earth	1934	10
Kent	Fairlee Lake	LOW	Earth	1828E	20
Kent	St. Pauls Millpond	SIGNIFICANT	Earth	1900E	15
Kent	Chestertown Stablization Pond No. 1	LOW	Earth	1967	29
Kent	Chestertown Stablization Pond No. 2	LOW	Earth	1967	32
Kent	Carpenter Farm Pond	LOW	Earth	1968	9
Kent	Riley Mill Pond	LOW	Earth	1950	14
Kent	Chester River Country Club Lake	LOW	Earth	1930	3
Kent	Stillpond Creek Dam	SIGNIFICANT	Earth	1963	14
Kent	Watts Farm Pond	LOW	Earth	1977	16
Kent	Elgin Farm Pond	LOW	Earth	1965	14
Kent	Stubbs Farm Dam	LOW	Earth	1996	11
Kent	Wick Nursery Pond	LOW	Earth	1950	12
Kent	Teels Lake Dam	LOW	Earth	1961	11
Kent	Riley Mill Dam - Lower Pond	LOW	Earth	1950	14
Kent	Richard Smith Dam	LOW	Earth	1970	9
Kent	Eaton-Raimond Pond	LOW	Earth	1960	16
Kent	Big Meadows Farm Dam	LOW	Earth	1979	13
Kent	Shellman Farm Dam	LOW	Earth	1979	10
Montgomery	Brighton Dam	HIGH	Buttress,Earth	1943	80
Montgomery	Little Falls Dam - Potomac River	LOW	Gravity	1958	12
Montgomery	Wheaton Regional Park Dam	SIGNIFICANT	Earth	1962	24
Montgomery	Lake Needwood	HIGH	Earth	1965	65
Montgomery	Great Falls Estate Dam	LOW	Earth	1963	34

Montgomery	Lake Frank	HIGH	Earth	1967	78
Montgomery	Lake Whetstone Dam	SIGNIFICANT	Earth	1966	36
Montgomery	Lake Walker Dam - Pond 1	HIGH	Earth	1966	35
Montgomery	Lake Nirvana Dam (Main Street)	SIGNIFICANT	Earth	1967	29
Montgomery	Seneca State Park Dam (Seneca Creek Road)	HIGH	Earth	1975	64
Montgomery	Lake Churchill (Wynnfield Drive)	LOW	Earth	1971	44
Montgomery	Poolesville Public Golf Course	LOW	Earth	1953	25
Montgomery	Wheaton Branch Storm Water Management	HIGH	Earth	1979	27
Montgomery	Goldberg Pond	LOW	Earth	1965	20
Montgomery	Inspiration Lake	HIGH	Earth	1950E	40
Montgomery	Lake Placid Dam (Edison Park Drive)	SIGNIFICANT	Earth	1963	26
Montgomery	Lake Walker Dam - Pond 2 (Russell Avenue)	LOW	Earth	1977	17
Montgomery	Crabbs Branch SWM Facility (Redland Road)	HIGH	Earth	1983	27
Montgomery	Sunshine Acres Pond	LOW	Earth	1981	26
Montgomery	Burnt Mills Dam	SIGNIFICANT	Buttress,Concrete	1930	23
Montgomery	Tivoli Stormwater Management Pond	LOW	Earth	1986	27
Montgomery	Lakeview Dam/Westlake Dam	LOW	Earth	1960	26
Montgomery	Little Seneca Dam	HIGH	Earth,Rockfill	1984	99
Montgomery	Gunners Lake (Wisteria Drive)	SIGNIFICANT	Earth	1985	28
Montgomery	Avenel - TPC Dam #3	LOW	Earth	1986	30
Montgomery	Hallowell SWM Dam	LOW	Earth	1990	29
Montgomery	Lake Helene Dam	HIGH	Earth	1950E	27
Montgomery	North Creek Dam	LOW	Earth	1977	24
Montgomery	Summit Hall Park Dam	HIGH	Earth	1993	14
Montgomery	Damascus High School SWM Dam	LOW	Earth	1995	27
Montgomery	Railroad Branch SWM Pond	HIGH	Earth	1990	25
Montgomery	Milestone SWM Pond No. 4	LOW	Earth	1995	26

Montgomery	Montgomery College - Germantown Campus	LOW	Earth	1987	21
Montgomery	Rattlewood Golf Course	SIGNIFICANT	Earth	1975	30.5
Montgomery	Tower Oaks	LOW	Earth	1999	25
Montgomery	Southlawn Industrial Ctr SWM Pond #2	LOW	Earth	1999	25
Montgomery	Little Bennett Golf Course	LOW	Earth	1992	22
Montgomery	Brighton West SWM Pond	LOW	Earth,Other	1975	16
Montgomery	Dumont Oaks SWM Pond North Basin	LOW	Earth	1986	32
Montgomery	Falls Road Golf Course	HIGH	Earth	1990	25
Montgomery	Gudelsky Pond Dam	HIGH	Earth	1987E	20
Montgomery	Great Falls Dam, Lock No. 20	LOW	Masonry	1850E	8
Montgomery	Fairfield East Dam	HIGH	Earth	2004	18
Montgomery	Cloppers Mill West Pond F (Cricket Hill Drive)	SIGNIFICANT	Earth	1996	26.1
Montgomery	Montgomery Auto Park Dam	LOW	Earth	1987E	29
Montgomery	Izaak Walton League Sligo Creek Pond	LOW	Earth	1975	22
Montgomery	Lake Lynette	LOW	Earth	1965E	21
Montgomery	Ashton Community Pond Dam	SIGNIFICANT	Earth	1959	22
Montgomery	Montgomery College - Rockville Campus	SIGNIFICANT	Earth	1965E	13.79
Montgomery	Lake Kirsten Dam	LOW	Earth	1967E	10
Montgomery	Fairland Park Dam	LOW	Earth	1975E	22
Montgomery	Montgomery Airpark Dam (Asset 11568)	HIGH	Earth	1985E	21.6
Montgomery	Rolling Hills SWM Pond	HIGH	Earth	1982	15
Montgomery	Chadswood SWM Pond (Cross Laurel Drive)	SIGNIFICANT	Earth	1981	20
Montgomery	Plantations II SWM Dam	LOW	Earth	1980E	20
Montgomery	Valley Park SWM (Valley Park Drive)	LOW	Earth	1980E	17
Montgomery	Neelsville Estates Dam	SIGNIFICANT	Earth	1995	14.5
Montgomery	Gunners Lake Village SWM Dam	LOW	Earth	1988	24
Montgomery	Plumgar I Regional SWM Dam	LOW	Earth	1989	24
Montgomery	Marriott Headquarters Lake	LOW	Earth	1988	20.4

Montgomery	Christie Estates SWM Dam (Lindenwood Drive)	LOW	Earth	1991	21
Montgomery	Germantown Estates Regional Facility SWM Dam	LOW	Earth	1995	22
Montgomery	Koteen Property Dam	LOW	Earth	1991	24.8
Montgomery	Marriott SWM Pond No. 1B	LOW	Earth	1962	8
Montgomery	Hampshire Greens SWM Pond A	LOW	Earth	1998	11
Montgomery	Lake Varuna (Lakelands Drive)	LOW	Earth	1992	18
Montgomery	Seneca Meadows SWM Dam	LOW	Earth	1994	16.9
Montgomery	Martin Luther King Jr. Park Dam	LOW	Earth	1978	26.6
Montgomery	Isen Property Facility SWM Dam	LOW	Earth	1988	22
Montgomery	Clarksburg Town Center Pond 2	LOW	Earth	2010	16
Montgomery	Rabbitt Road SWM Pond	LOW	Earth	1981	23
Montgomery	Victory Farms	SIGNIFICANT	Earth	1973	23
Montgomery	Greencastle Lakes (Ballenger Drive)	LOW	Earth	1965	36
Montgomery	Willow Cove Regional Pond	LOW	Earth	1990	18
Montgomery	Hunters Wood I Dam	LOW	Earth	1981	18
Montgomery	Manchester Farm Regional SWM Pond Dam	SIGNIFICANT	Earth	1990E	21.2
Montgomery	West Farm Regional SWM Pond	SIGNIFICANT	Earth	1987	25
Montgomery	Turkey Branch Levee	SIGNIFICANT	Earth	1975E	12
Montgomery	Montclair Manor Levee (Asset 14616)	SIGNIFICANT	Earth	2004	15
Montgomery	Peachwood II	LOW	Earth	2000	8.4
Montgomery	Chevy Chase Lakes	SIGNIFICANT	Earth	1900	24
Prince Georges	Greenbelt Dam	HIGH	Earth	1936	22
Prince Georges	Cash Lake Dam	HIGH	Earth	1937	13
Prince Georges	T. Howard Duckett Dam	HIGH	Buttress,Concrete	1953	139
Prince Georges	Cosca Regional Park Dam	HIGH	Earth	1970	28
Prince Georges	Contee Main Settling Pond	HIGH	Earth	1973	41
Prince Georges	Lake Arbor (Lake Arbor Way)	HIGH	Earth	1971	38
Prince Georges	Soil Conservation Service Lake	LOW	Earth	1939	17

Prince Georges	Redington Lake (Tram Route)	LOW	Earth	1940	13
Prince Georges	Allen Pond (Nottinghill Drive)	LOW	Earth	1972	16
Prince Georges	Laurel Lakes No 2 (Upper) Oxford Drive	LOW	Earth	1986	14
Prince Georges	Laurel Lakes No 1 (Lower)	SIGNIFICANT	Earth	1986	21
Prince Georges	Indian Creek Site 2	HIGH	Earth	1983	19.5
Prince Georges	Indian Creek Site 3	HIGH	Earth	1983	25
Prince Georges	Prince George Country Club Dam	HIGH	Earth	1982	22
Prince Georges	Parker Farms Dam	LOW	Earth	1978	32
Prince Georges	Laurel Sand & Gravel Wash Pond	LOW	Earth	1993	23
Prince Georges	Summerfield SWM Pond No. 1 (Chatsfield Way)	LOW	Earth	1994	25
Prince Georges	Madison Hill SWM Pond 1 (Silk Tree Drive)	SIGNIFICANT	Earth	1994	18
Prince Georges	Center Park SWM Pond	LOW	Earth	1985	12
Prince Georges	Fedex Field Pond No. 1	HIGH	Earth	1997	28
Prince Georges	Parker Meadows Hillantrae SWM Pond 1	LOW	Earth	1997	30
Prince Georges	Perrywood Section 2, Pond 1	LOW	Earth	1996	22
Prince Georges	UMSTC Upper Dam (Melford Blvd)	LOW	Earth	1989	23.5
Prince Georges	UMSTC Lower Dam (Curie Drive)	SIGNIFICANT	Earth	2001	38
Prince Georges	Marlton South SWM Dam	LOW	Earth	2000	24
Prince Georges	Beechtree Dam	LOW	Earth	2002	43
Prince Georges	Lake Largo Town Center Dam (Kings Way)	SIGNIFICANT	Earth	1973E	26.7
Prince Georges	Heritage Glen Dam	SIGNIFICANT	Earth	2004	12
Prince Georges	Tall Oaks Crossing (Peach Tree Lane)	SIGNIFICANT	Earth	1985	14
Prince Georges	Ritchie Hill SWM Pond	SIGNIFICANT	Earth	2008	15
Prince Georges	Linwood Knolls Regional SWM Pond No. 2	LOW	Earth	2004	22
Prince Georges	Snowden Pond (Beech Forest Road)	LOW	Earth	1947	21
Prince Georges	Cherry Hill Park Dam	SIGNIFICANT	Earth	1986	13
Prince Georges	Bowie Gateway SWM Pond Dam	LOW	Earth	1992	28
Prince Georges	Cherryvale Neighborhood Park Pond	SIGNIFICANT	Earth	1960E	10

Prince Georges	Bowie Town Center Lake	HIGH	Earth	1990E	20
Prince Georges	Collington Life Care Center Lake	LOW	Earth	1986E	25
Prince Georges	Tinkers Creek Regional SWM Pond No. 8	SIGNIFICANT	Earth	1991	17.5
Prince Georges	Collington Facility 9 Dam (Dunwood Crossing Dr)	SIGNIFICANT	Earth	1990	20.8
Prince Georges	Stonegate SWM Dam (Cherryfield Road)	LOW	Earth	2003	25
Prince Georges	Northridge SWM Pond (Quisinberry Way)	SIGNIFICANT	Earth	1989	28
Prince Georges	Penn East Business Park Dam	LOW	Earth		20
Prince Georges	Collington Facility 14 SWM Dam	LOW	Earth	1992	16
Prince Georges	Karington SWM Dam	LOW	Earth	2007	15
Prince Georges	Piscataway WWTP Ponds	LOW	Earth	1960E	18
Prince Georges	Lake Artemesia	LOW	Earth	1890	5
Prince Georges	Henson Creek Flood Control Dam #17	SIGNIFICANT	Earth	1992	22
Prince Georges	Allison Street Levee (Mt. Ranier)	HIGH	Earth	1988	15
Prince Georges	Frost Pond (MLK Jr. Hwy)	SIGNIFICANT	Earth	1988	27
Prince Georges	New Bald Eagle Road SWM	HIGH	Earth	2006	43.5
Prince Georges	Secret Service Training Facility Pond #1	LOW	EARTH	1995	15
Prince Georges	Perrywood (Water Fowl Way)	LOW	Earth	2003	18.75
Prince Georges	Perrywood (Manor House Drive)	SIGNIFICANT	Earth	1984E	16.3
Prince Georges	Ashcroft Drive - Woodbridge Pond	HIGH	Earth		20
Prince Georges	Van Dusen Road	SIGNIFICANT		1988	23
Prince Georges	Summit Creek - Mount Auburn Dr	SIGNIFICANT	EARTH	2000E	15
Prince Georges	Hanson Oaks SWM (BMP Structure 1558-002)	HIGH	Earth	1900E	20
Prince Georges	Aragona Village	HIGH	Earth	1991	21
Queen Anne's	Wye Mills Dam	SIGNIFICANT	Earth	1682	20
Queen Anne's	Unicorn Branch Dam	SIGNIFICANT	Earth	1964	13
Queen Anne's	Mezick Farm Pond	LOW	Earth	1974	16
Queen Anne's	Jones Lake Dam	LOW	Earth	1930	13
Queen Anne's	Owings Farm Pond	SIGNIFICANT	Earth	1967	16
Queen Anne's	Foreman Branch Dam	LOW	Earth	1955	7

Queen Anne's	Claiborne Gooch	LOW	Earth	1982	6
Queen Anne's	Dodd Farm Pond	LOW	Earth	1984	27
Queen Anne's	Boxers Rest Farm Pond	LOW	Earth	1975	8
Somerset	Deal Island Wildlife	LOW	Earth	1950	4
Somerset	Fairmount Wildlife Area	LOW	Other	1950E	4
St. Marys	St Marys River Watershed Site 1	HIGH	Earth	1975	38
St. Marys	Patuxent Naval Air Station, Pond No. 3	LOW	Earth	1958	13
St. Marys	Tower Hill Community Pond Dam	SIGNIFICANT	Earth	1975	18
St. Marys	Clair Peake Dam (MD 235)	LOW	Earth	1983	26
St. Marys	Claude Johnson Dam	LOW	Earth	1960	11
St. Marys	Ledford Pond Dam	SIGNIFICANT	Earth	1975	30
St. Marys	Breton Bay Golf and Country Club Dam	SIGNIFICANT	Earth	1970E	45
St. Marys	Norris Dam	LOW	Earth	1990	10
St. Marys	Wildewood Community Dam	LOW	Earth	1989E	30
St. Marys	Wildewood Dam on St Marys River	LOW	Earth	1989	10
Talbot	Easton Primary Sewage Lagoon	LOW	Earth	1962	15
Talbot	Easton Secondary Sewage Lagoon	LOW	Earth	1962	12
Talbot	Boyd Farm Pond	LOW	Earth	1958	27.5
Talbot	Talbot Country Club Pond (Country Club Drive)	LOW	Earth	1963	12
Talbot	High Banks	LOW	Earth	1974	19
Washington	Warner Gap Hollow Dam	HIGH	Earth	1902	65
Washington	Smithsburg Reservoir	SIGNIFICANT	Earth	1881	16
Washington	Greenbrier State Park Dam & Dike	HIGH	Earth	1965	64
Washington	Blairs Valley Dam	HIGH	Earth	1968	34
Washington	Little Tonoloway Dam	LOW	Earth	1953	17
Washington	Lower Lake Royer	HIGH	Earth,RCC	1898	19
Washington	Potomac River Dam #4	LOW	Masonry,Gravity	1869	20
Washington	Hancock Sewage Lagoon	LOW	Earth	1963	8
Washington	R. Paul Smith Dam	LOW	Gravity	1923	6

Washington	Potomac River Dam #5	LOW	Masonry,Gravity	1850	20
Washington	Lake Jenkins	LOW	Arch,Masonry	1936	35
Washington	Upper Lake Royer	LOW	Earth	1898	12
Washington	Oliver Company (Lower Pond)	SIGNIFICANT	Earth	1957	14
Washington	Security Mill Dam	LOW	Gravity,Other	1900E	8
Washington	Devils Backbone Dam	LOW	Gravity	1910	8
Washington	Doubs Mill	LOW	Gravity	1815	10
Washington	Keedysville Dam	LOW	Masonry	1900E	11
Washington	Long Hollow Dam	LOW	Other	1940	25
Washington	Hagerstown Municipal Pwr Plant Dam	LOW	Gravity	1950	10
Washington	Hagerstown City Park Lake (Key Street)	LOW	Earth	1920	10
Washington	Kemps Mill	LOW	Gravity	1746	13
Washington	Charles Mill	LOW	Masonry	1800E	16
Washington	Kurt Sherman Dam (Upper Pond)	HIGH	Earth	1957	28
Washington	Widmyer Park	LOW	Gravity	1900E	4
Washington	Cortland Manor SWM Dam	LOW	Earth	2006	14.5
Washington	Willson Water Treatment Plant Levee	SIGNIFICANT	Earth	1927	30
Washington	Valley Mall Expansion SWM Dam	LOW	Earth	1987	19
Washington	Widmyer Park Upper	LOW	Gravity	1900E	7
Washington	Volvo Hagerstown SWM	SIGNIFICANT	Earth	1961	6.5
Washington	Vista Business Park	HIGH	Concrete Weir	2020	12.5
Wicomico	Johnsons Pond	SIGNIFICANT	Gravity	1936	23
Wicomico	Powellville Dam	LOW	Earth	1940	9
Wicomico	Tony Tank Pond (Riverside Drive)	LOW	Earth,Other	1948	6
Wicomico	Camden Avenue Dam	LOW	Earth	1921	12
Wicomico	Parker Pond (N. Shumaker Drive)	LOW	Earth	1956	11
Wicomico	Rewastico Pond (Athol Road)	LOW	Earth	1911	10
Wicomico	Allen Town Pond (Allen Road)	LOW	Earth	1700E	8
Wicomico	Anderson Mill Pond (Pemberton Drive)	LOW	Earth	1900	11

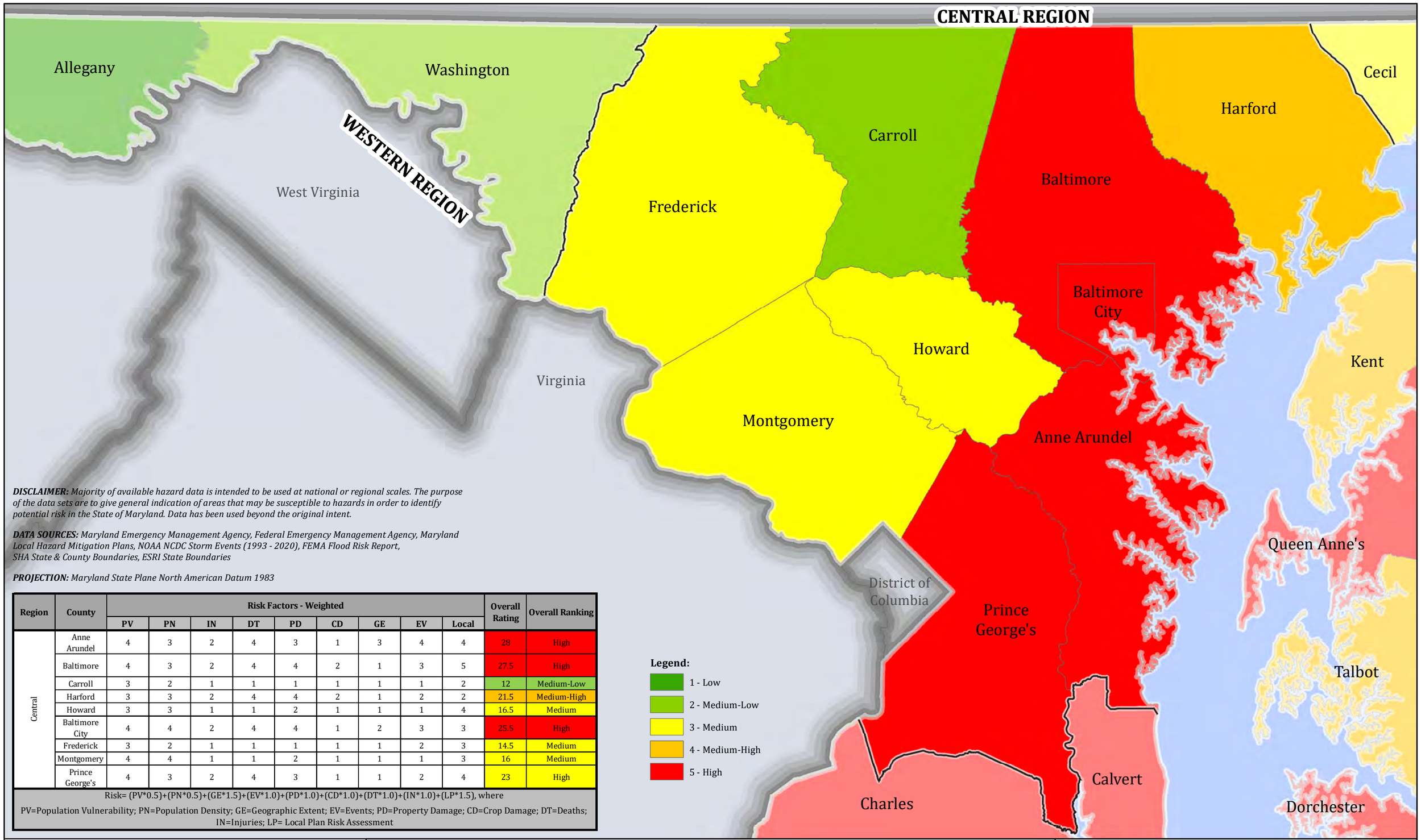
Wicomico	Riawakin Pond (Nanticoke Road)	LOW	Earth	1950	12.5
Wicomico	Beaglin Park Dam (Beaglin Park Drive)	HIGH	Earth	1976	21
Wicomico	Leonard Pond	LOW	Earth	1914	11
Wicomico	Coulbourn Mill Dam (South Division Street)	HIGH	Earth	1947	12
Wicomico	Morris Mill Pond (South Division Street)	HIGH	Earth	1947	11.9
Wicomico	Mitchell Pond #1 (Nanticoke Road)	SIGNIFICANT	Earth	1937	9
Wicomico	Mitchell Pond #2 (Mitchell Road)	LOW	Earth	1937	9
Wicomico	Mitchell Pond #3 (Fitzwater Street)	LOW	Earth	1937	10
Wicomico	Columbia Creek Dam	LOW	Earth	1987	13.5
Worcester	Big Millpond Dam	LOW	Earth	1900E	9
Worcester	Pocomoke City Sewage Lagoon No.1	LOW	Earth	1972	10
Worcester	Pocomoke City Sewage Lagoon No. 2	LOW	Earth	1972	10

This page left blank intentionally

APPENDIX D

Regional Hazard Maps

This page left blank intentionally



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	4	3	1	3	4	4	28	High
	Baltimore	4	3	2	4	4	2	1	3	5	27.5	High
	Carroll	3	2	1	1	1	1	1	1	2	12	Medium-Low
	Harford	3	3	2	4	4	2	1	2	2	21.5	Medium-High
	Howard	3	3	1	1	2	1	1	1	4	16.5	Medium
	Baltimore City	4	4	2	4	4	1	2	3	3	25.5	High
	Frederick	3	2	1	1	1	1	1	2	3	14.5	Medium
	Montgomery	4	4	1	1	2	1	1	1	3	16	Medium
	Prince George's	4	3	2	4	3	1	1	2	4	23	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

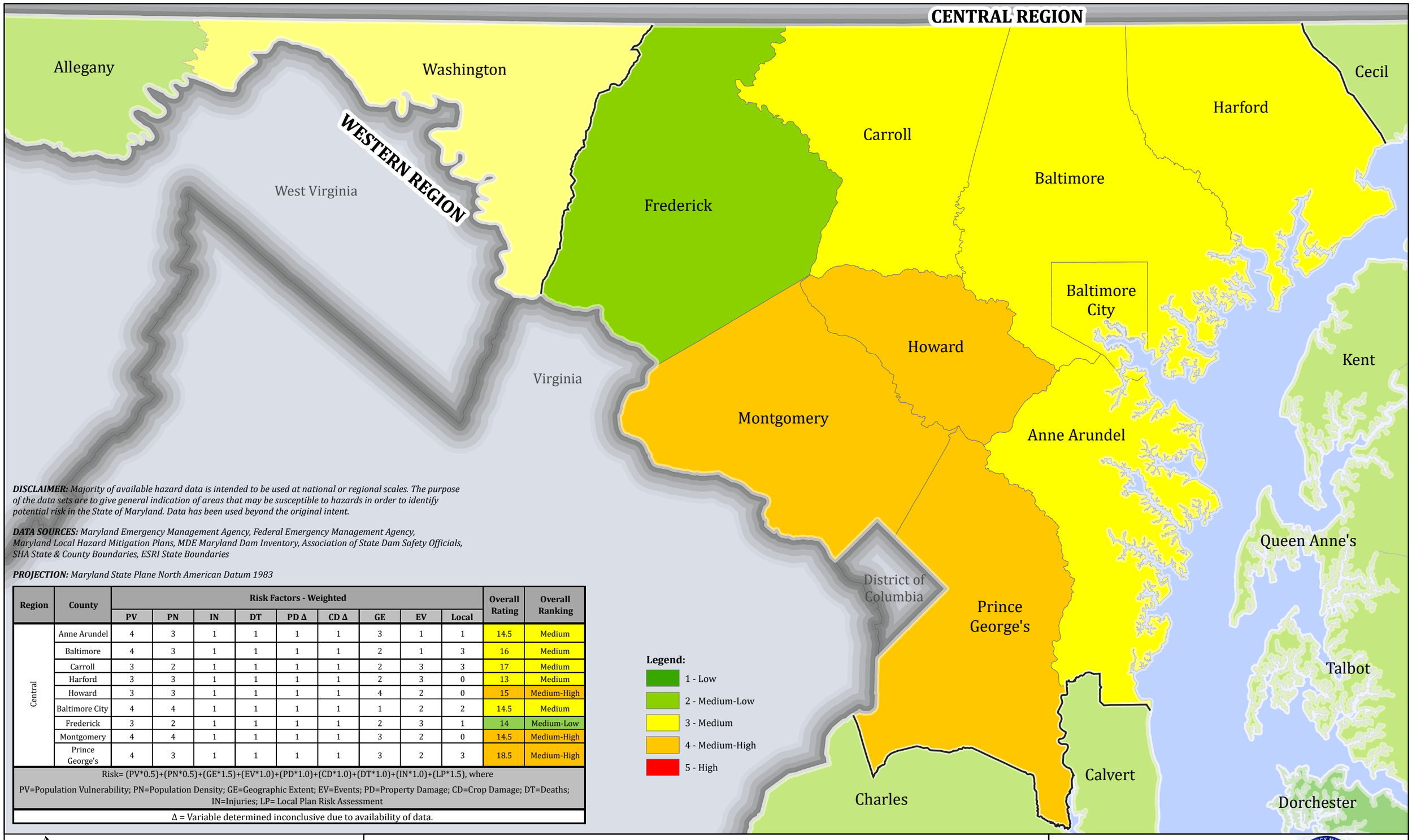
N

0 2.5 5 10 15 Miles

Coastal Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Central	Anne Arundel	4	3	1	1	1	1	3	1	1	14.5	Medium
	Baltimore	4	3	1	1	1	1	2	1	3	16	Medium
	Carroll	3	2	1	1	1	1	2	3	3	17	Medium
	Harford	3	3	1	1	1	1	2	3	0	13	Medium
	Howard	3	3	1	1	1	1	4	2	0	15	Medium-High
	Baltimore City	4	4	1	1	1	1	1	2	2	14.5	Medium
	Frederick	3	2	1	1	1	1	2	3	1	14	Medium-Low
	Montgomery	4	4	1	1	1	1	3	2	0	14.5	Medium-High
	Prince George's	4	3	1	1	1	1	3	2	3	18.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

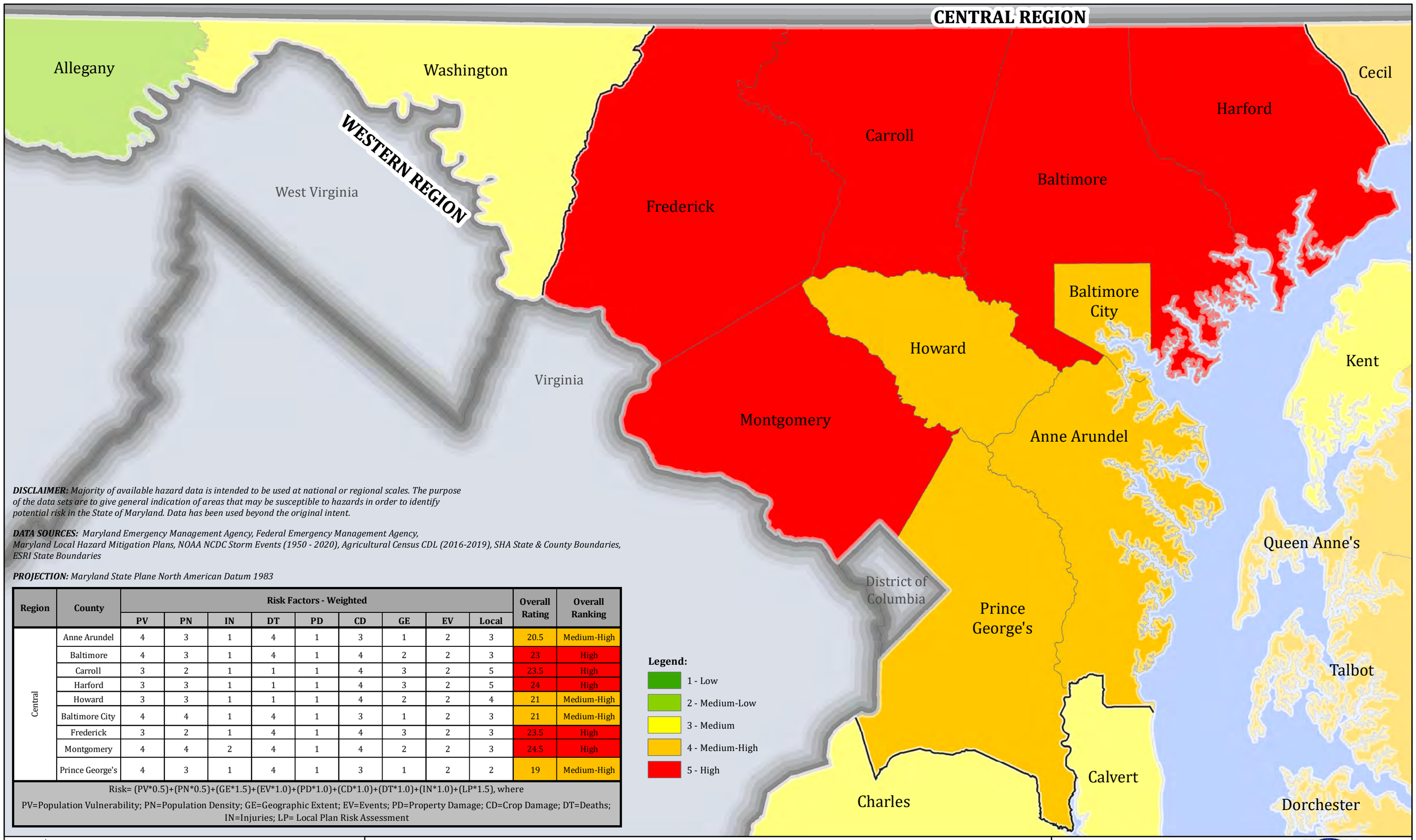
Δ = Variable determined inconclusive due to availability of data.

0 2.5 5 10 15 Miles

Dam Failure Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	1	4	1	3	1	2	3	20.5	Medium-High
	Baltimore	4	3	1	4	1	4	2	2	3	23	High
	Carroll	3	2	1	1	1	4	3	2	5	23.5	High
	Harford	3	3	1	1	1	4	3	2	5	24	High
	Howard	3	3	1	1	1	4	2	2	4	21	Medium-High
	Baltimore City	4	4	1	4	1	3	1	2	3	21	Medium-High
	Frederick	3	2	1	4	1	4	3	2	3	23.5	High
	Montgomery	4	4	2	4	1	4	2	2	3	24.5	High
	Prince George's	4	3	1	4	1	3	1	2	2	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

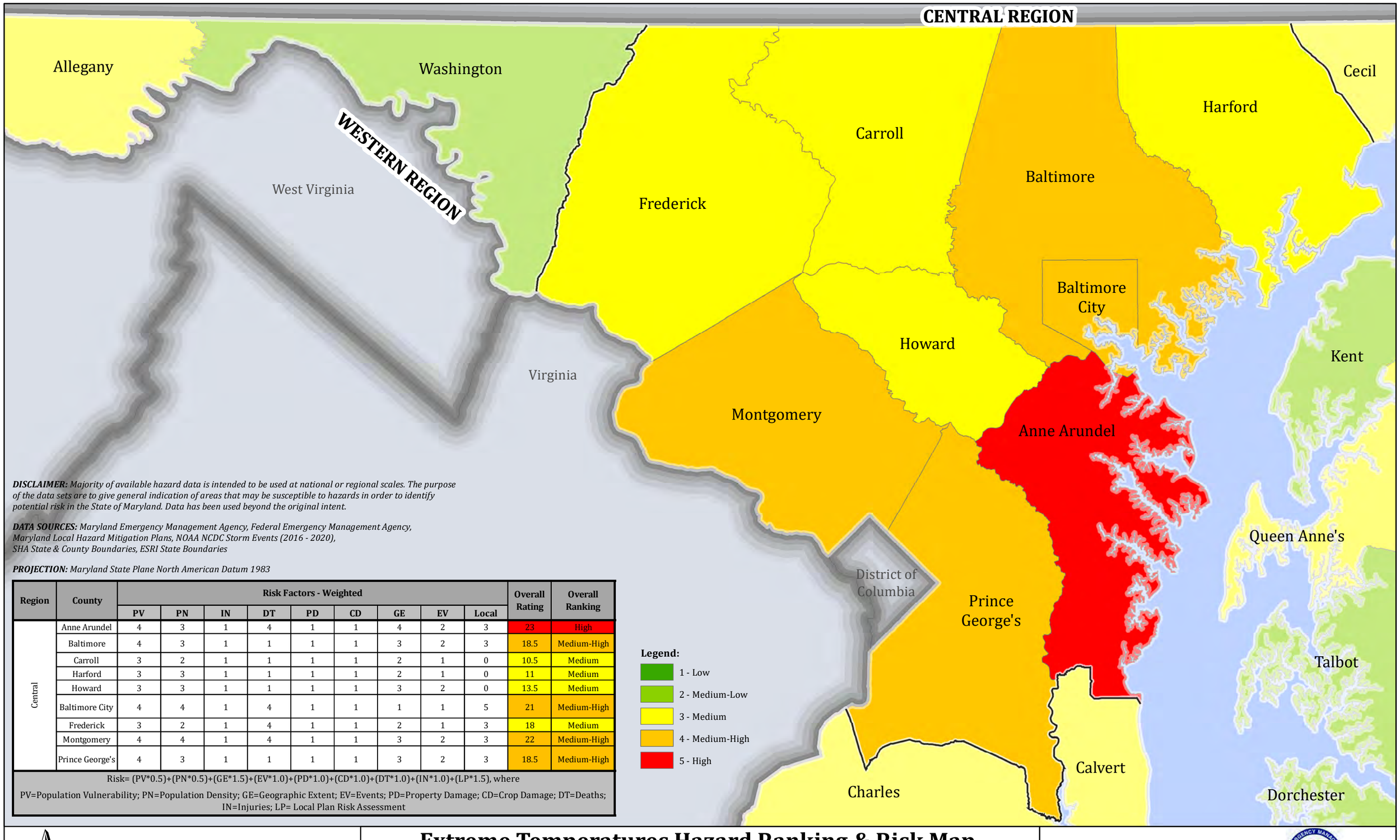
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

0 2.5 5 10 15 Miles

Drought Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	1	4	1	1	4	2	3	23	High
	Baltimore	4	3	1	1	1	1	3	2	3	18.5	Medium-High
	Carroll	3	2	1	1	1	1	2	1	0	10.5	Medium
	Harford	3	3	1	1	1	1	2	1	0	11	Medium
	Howard	3	3	1	1	1	1	3	2	0	13.5	Medium
	Baltimore City	4	4	1	4	1	1	1	1	5	21	Medium-High
	Frederick	3	2	1	4	1	1	2	1	3	18	Medium
	Montgomery	4	4	1	4	1	1	3	2	3	22	Medium-High
	Prince George's	4	3	1	1	1	1	3	2	3	18.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

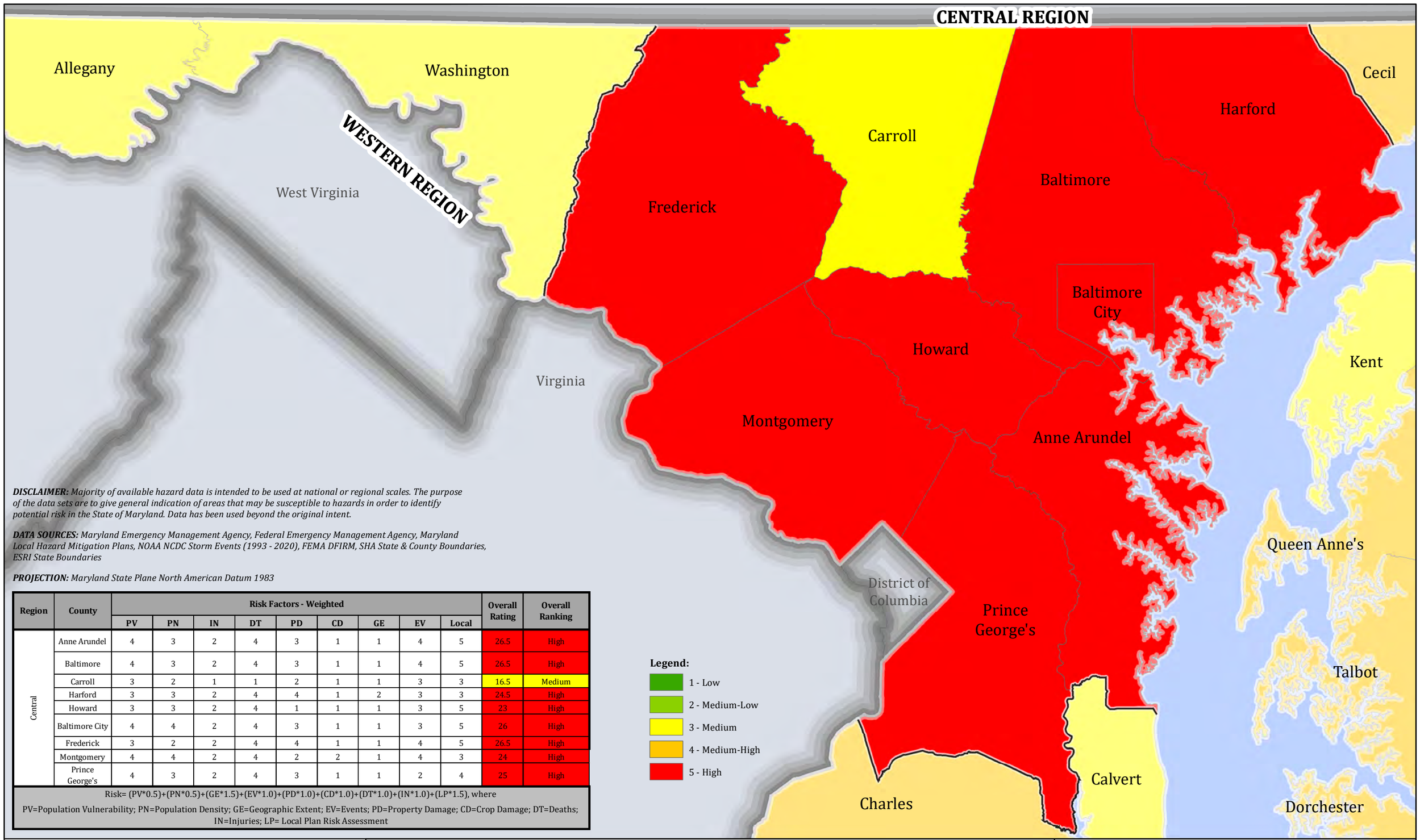
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

0 2.5 5 10 15 Miles

Extreme Temperatures Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	4	3	1	1	4	5	26.5	High
	Baltimore	4	3	2	4	3	1	1	4	5	26.5	High
	Carroll	3	2	1	1	2	1	1	3	3	16.5	Medium
	Harford	3	3	2	4	4	1	2	3	3	24.5	High
	Howard	3	3	2	4	1	1	1	3	5	23	High
	Baltimore City	4	4	2	4	3	1	1	3	5	26	High
	Frederick	3	2	2	4	4	1	1	4	5	26.5	High
	Montgomery	4	4	2	4	2	2	1	4	3	24	High
	Prince George's	4	3	2	4	3	1	1	2	4	25	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

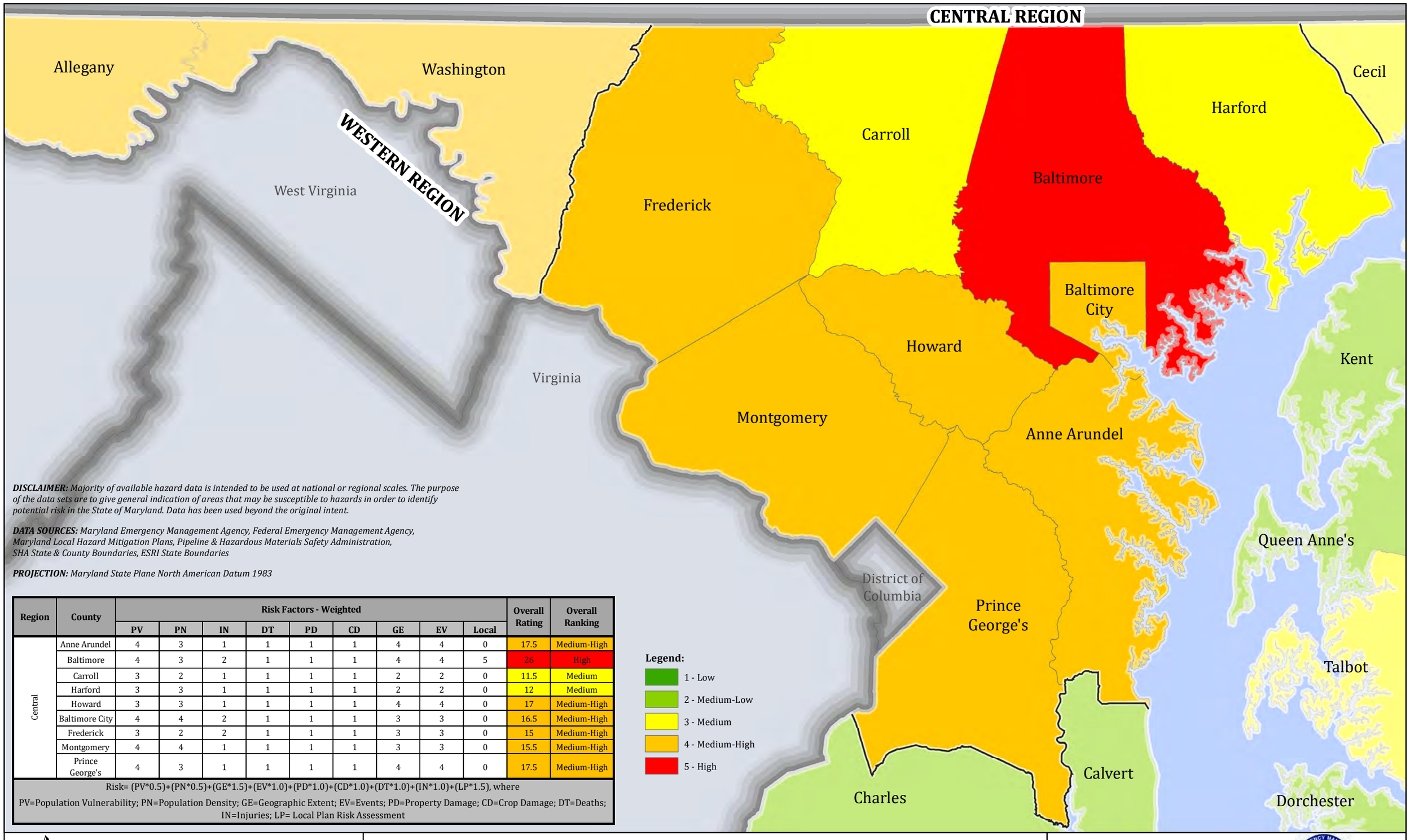
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

0 2.5 5 10 15 Miles

Flood Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	1	1	1	1	4	4	0	17.5	Medium-High
	Baltimore	4	3	2	1	1	1	4	4	5	26	High
	Carroll	3	2	1	1	1	1	2	2	0	11.5	Medium
	Harford	3	3	1	1	1	1	2	2	0	12	Medium
	Howard	3	3	1	1	1	1	4	4	0	17	Medium-High
	Baltimore City	4	4	2	1	1	1	3	3	0	16.5	Medium-High
	Frederick	3	2	2	1	1	1	3	3	0	15	Medium-High
	Montgomery	4	4	1	1	1	1	3	3	0	15.5	Medium-High
	Prince George's	4	3	1	1	1	1	4	4	0	17.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

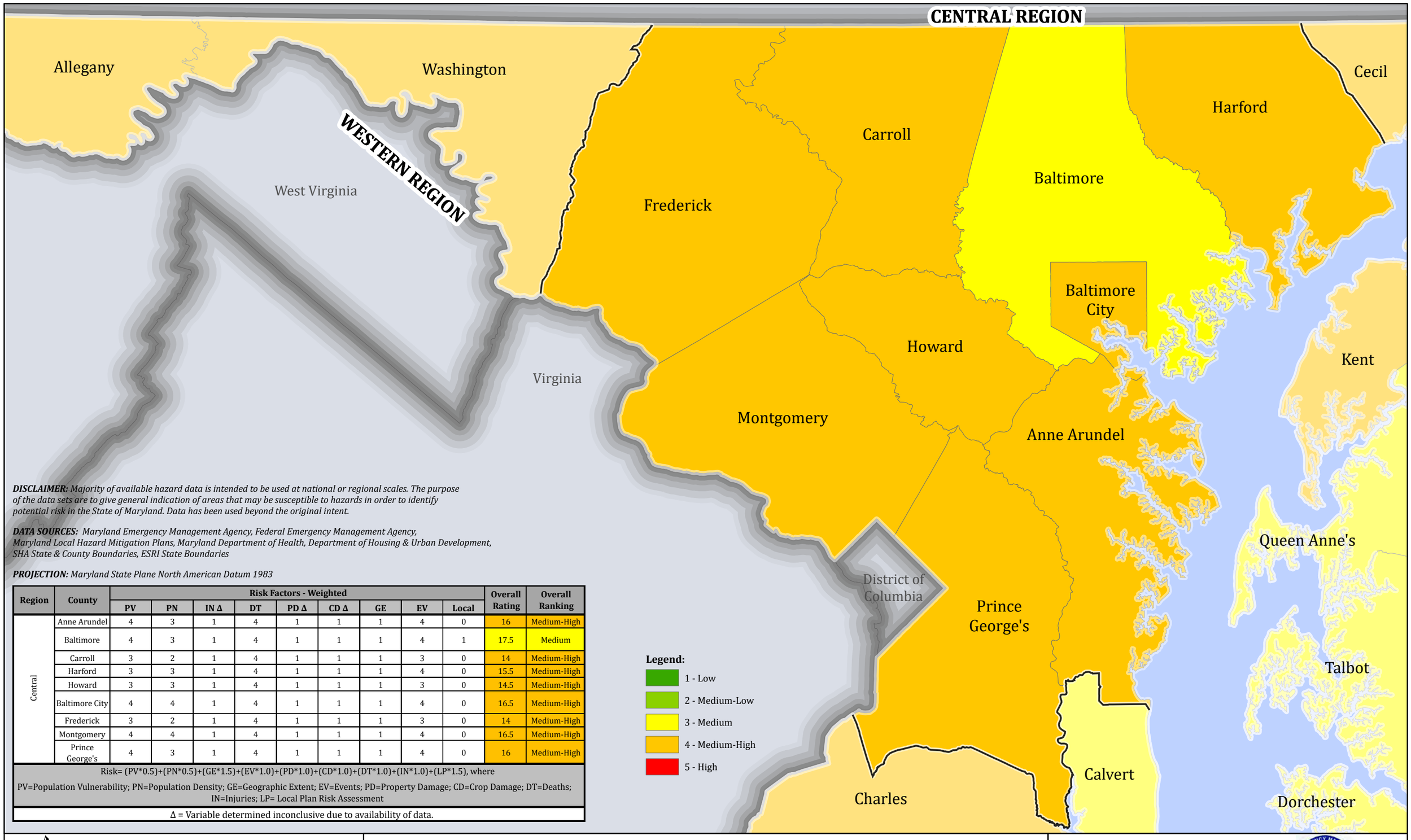
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

0 2.5 5 10 15 Miles

Human Caused Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Central	Anne Arundel	4	3	1	4	1	1	1	4	0	16	Medium-High
	Baltimore	4	3	1	4	1	1	1	4	1	17.5	Medium
	Carroll	3	2	1	4	1	1	1	3	0	14	Medium-High
	Harford	3	3	1	4	1	1	1	4	0	15.5	Medium-High
	Howard	3	3	1	4	1	1	1	3	0	14.5	Medium-High
	Baltimore City	4	4	1	4	1	1	1	4	0	16.5	Medium-High
	Frederick	3	2	1	4	1	1	1	3	0	14	Medium-High
	Montgomery	4	4	1	4	1	1	1	4	0	16.5	Medium-High
	Prince George's	4	3	1	4	1	1	1	4	0	16	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

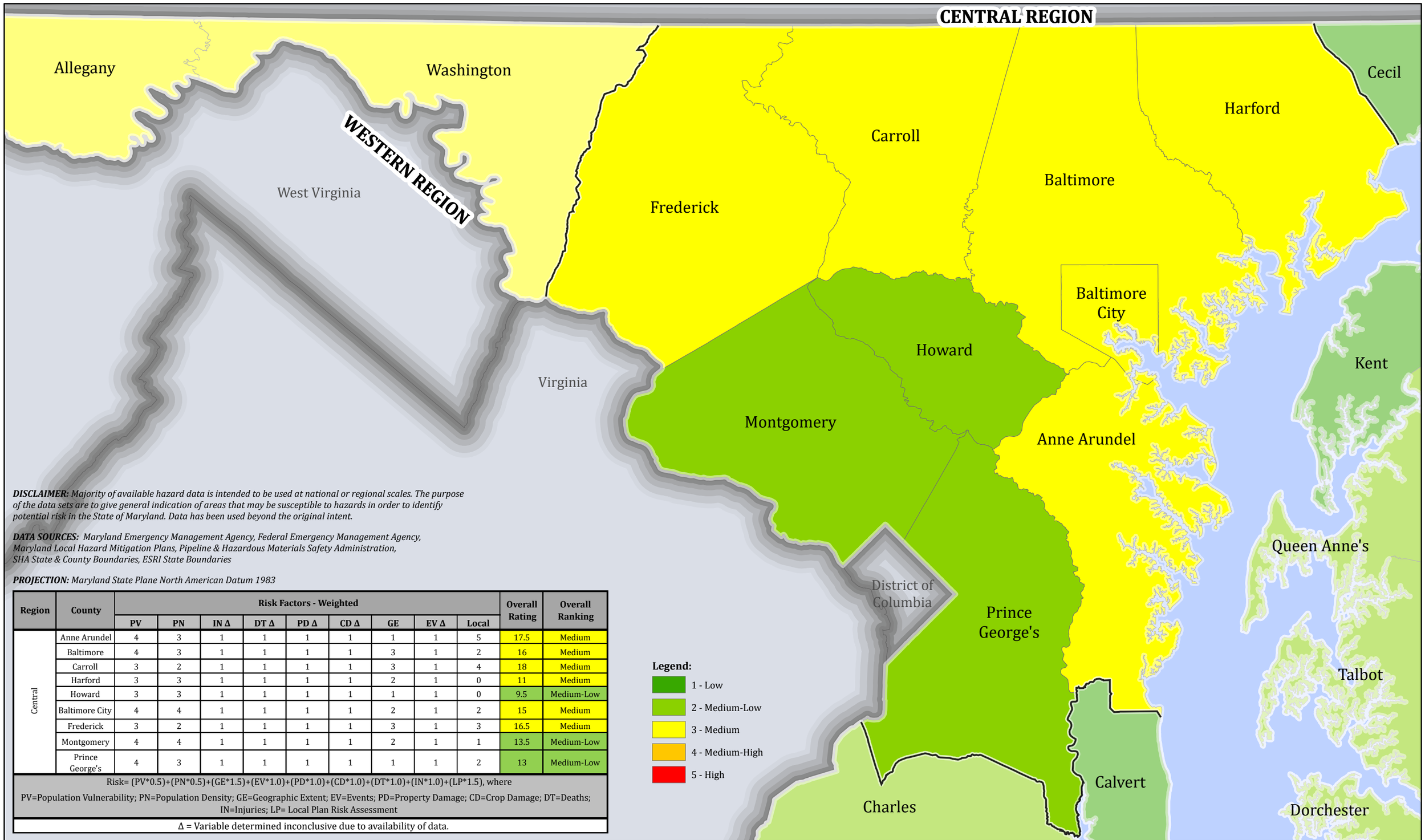
Δ = Variable determined inconclusive due to availability of data.

0 2.5 5 10 15 Miles

Public Health Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Central	Anne Arundel	4	3	1	1	1	1	1	1	5	17.5	Medium
	Baltimore	4	3	1	1	1	1	3	1	2	16	Medium
	Carroll	3	2	1	1	1	1	3	1	4	18	Medium
	Harford	3	3	1	1	1	1	2	1	0	11	Medium
	Howard	3	3	1	1	1	1	1	1	0	9.5	Medium-Low
	Baltimore City	4	4	1	1	1	1	2	1	2	15	Medium
	Frederick	3	2	1	1	1	1	3	1	3	16.5	Medium
	Montgomery	4	4	1	1	1	1	2	1	1	13.5	Medium-Low
	Prince George's	4	3	1	1	1	1	1	1	2	13	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

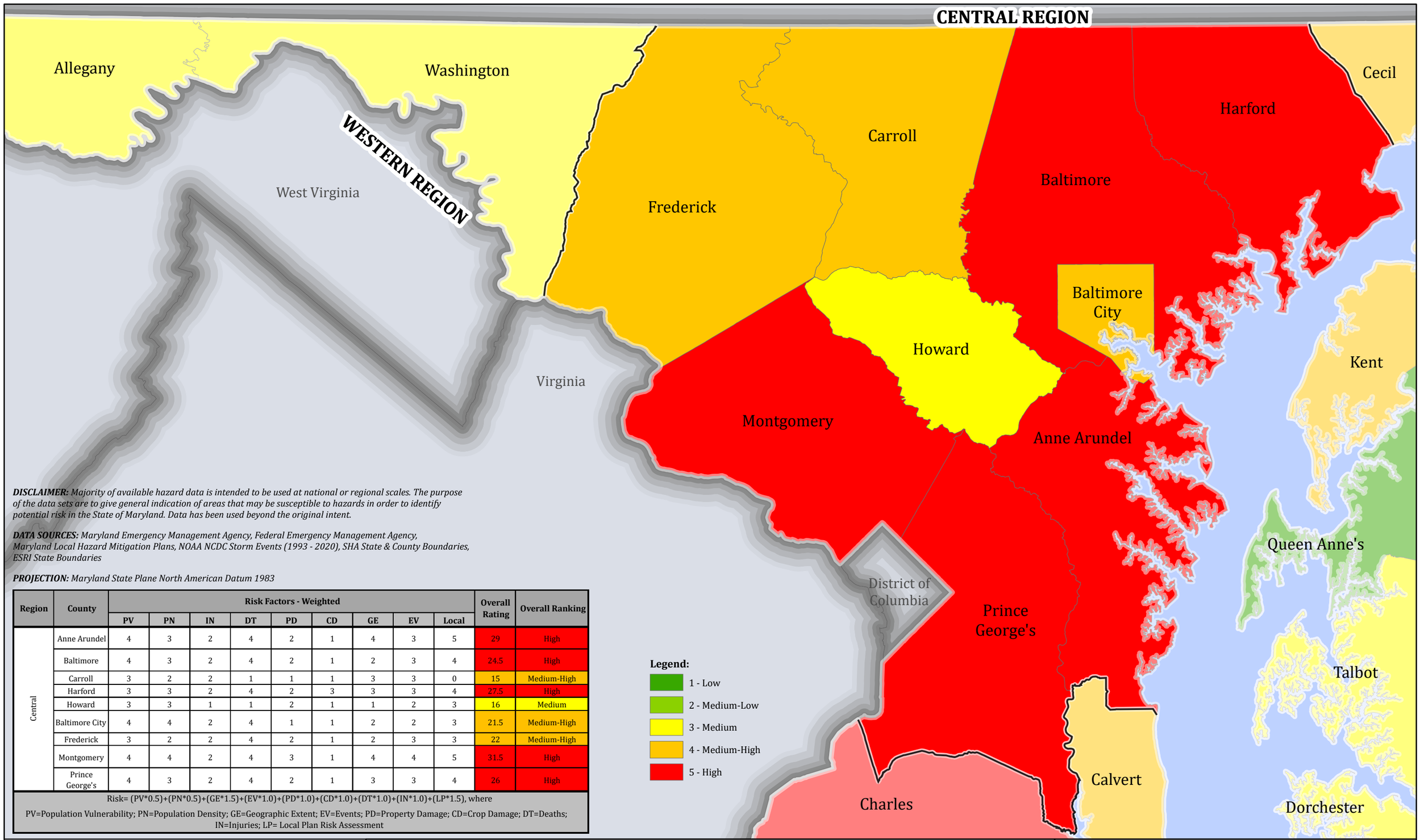
Δ = Variable determined inconclusive due to availability of data.

0 2.5 5 10 15 Miles

Soil Movement Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	4	2	1	4	3	5	29	High
	Baltimore	4	3	2	4	2	1	2	3	4	24.5	High
	Carroll	3	2	2	1	1	1	3	3	0	15	Medium-High
	Harford	3	3	2	4	2	3	3	3	4	27.5	High
	Howard	3	3	1	1	2	1	1	2	3	16	Medium
	Baltimore City	4	4	2	4	1	1	2	2	3	21.5	Medium-High
	Frederick	3	2	2	4	2	1	2	3	3	22	Medium-High
	Montgomery	4	4	2	4	3	1	4	4	5	31.5	High
	Prince George's	4	3	2	4	2	1	3	3	4	26	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

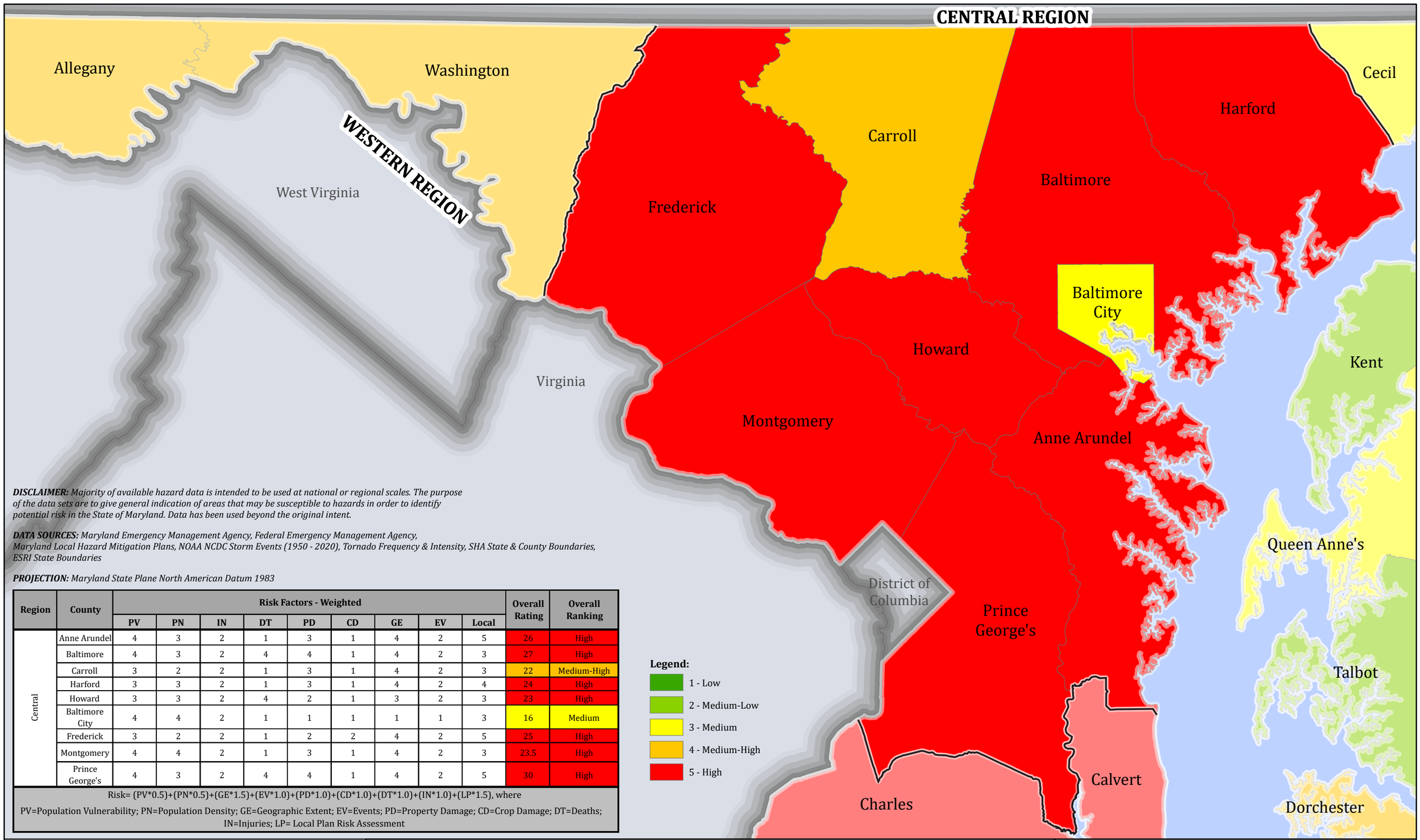
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

0 2.5 5 10 15 Miles

Thunderstorm Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	1	3	1	4	2	5	26	High
	Baltimore	4	3	2	4	4	1	4	2	3	27	High
	Carroll	3	2	2	1	3	1	4	2	3	22	Medium-High
	Harford	3	3	2	1	3	1	4	2	4	24	High
	Howard	3	3	2	4	2	1	3	2	3	23	High
	Baltimore City	4	4	2	1	1	1	1	1	3	16	Medium
	Frederick	3	2	2	1	2	2	4	2	5	25	High
	Montgomery	4	4	2	1	3	1	4	2	3	23.5	High
	Prince George's	4	3	2	4	4	1	4	2	5	30	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

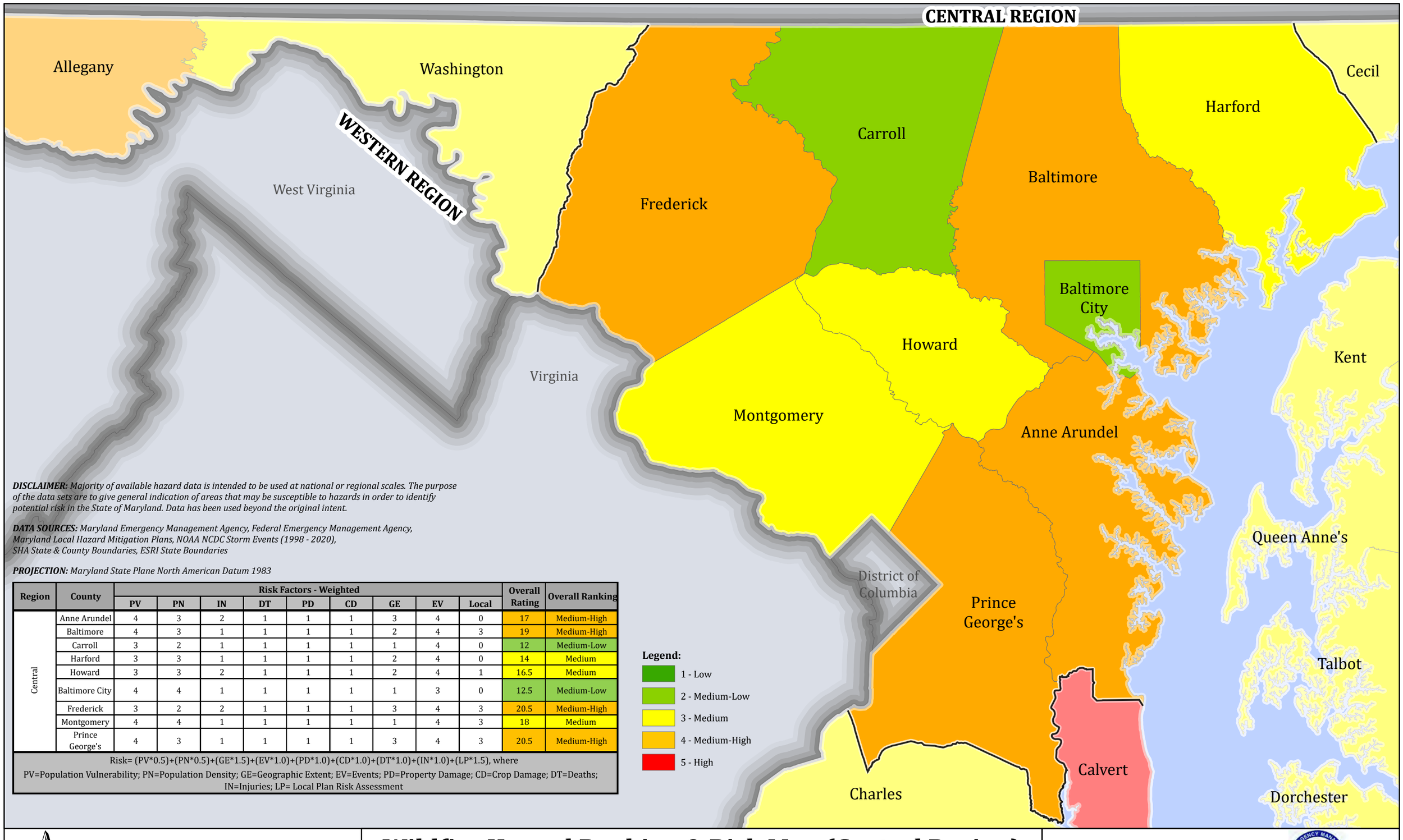
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

0 2.5 5 10 15 Miles

Tornado Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1998 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	1	1	1	3	4	0	17	Medium-High
	Baltimore	4	3	1	1	1	1	2	4	3	19	Medium-High
	Carroll	3	2	1	1	1	1	1	4	0	12	Medium-Low
	Harford	3	3	1	1	1	1	2	4	0	14	Medium
	Howard	3	3	2	1	1	1	2	4	1	16.5	Medium
	Baltimore City	4	4	1	1	1	1	1	3	0	12.5	Medium-Low
	Frederick	3	2	2	1	1	1	3	4	3	20.5	Medium-High
	Montgomery	4	4	1	1	1	1	1	4	3	18	Medium
	Prince George's	4	3	1	1	1	1	3	4	3	20.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Legend:

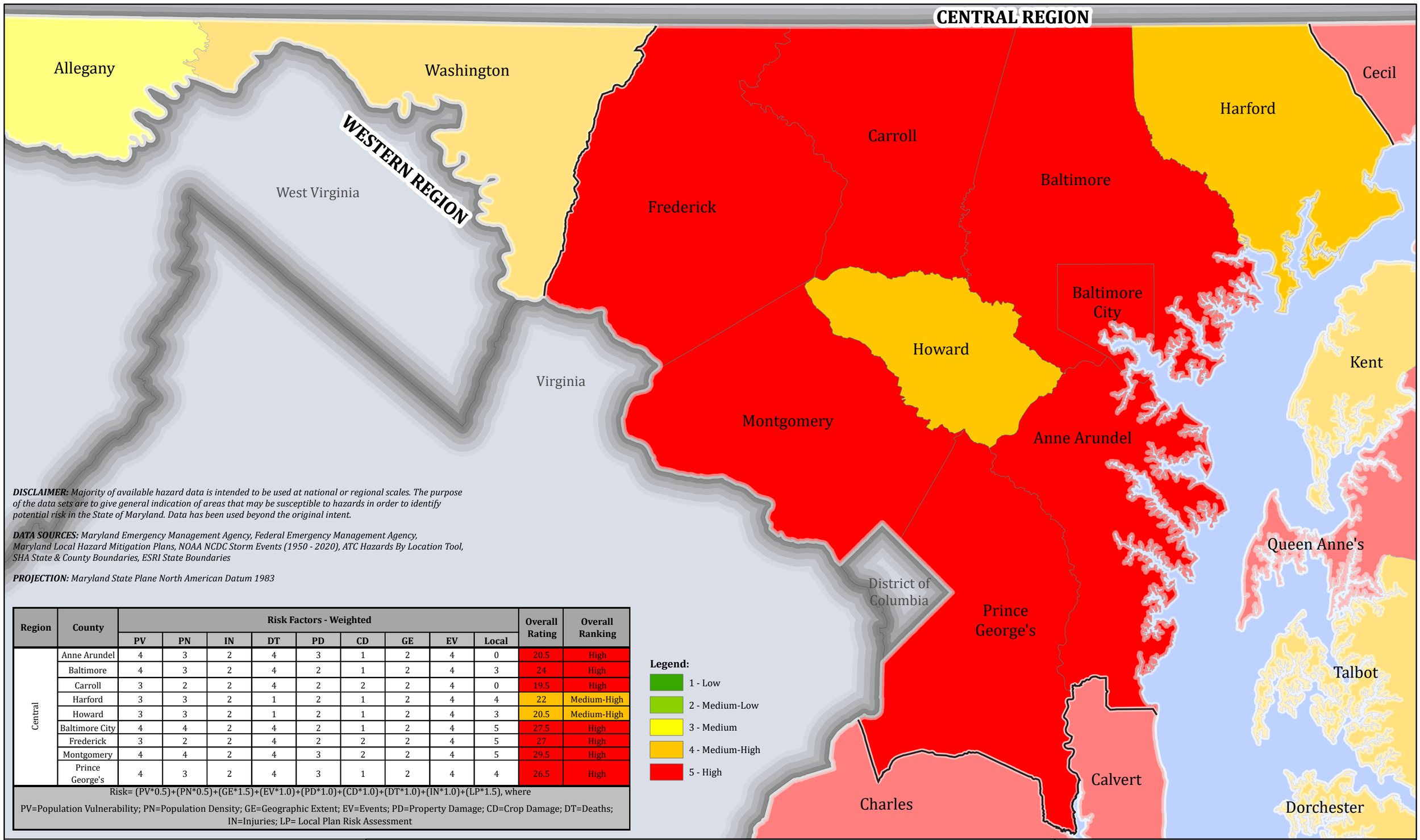
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

0 2.5 5 10 15 Miles

Wildfire Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	4	3	1	2	4	0	20.5	High
	Baltimore	4	3	2	4	2	1	2	4	3	24	High
	Carroll	3	2	2	4	2	2	2	4	0	19.5	High
	Harford	3	3	2	1	2	1	2	4	4	22	Medium-High
	Howard	3	3	2	1	2	1	2	4	3	20.5	Medium-High
	Baltimore City	4	4	2	4	2	1	2	4	5	27.5	High
	Frederick	3	2	2	4	2	2	2	4	5	27	High
	Montgomery	4	4	2	4	3	2	2	4	5	29.5	High
	Prince George's	4	3	2	4	3	1	2	4	4	26.5	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Legend:

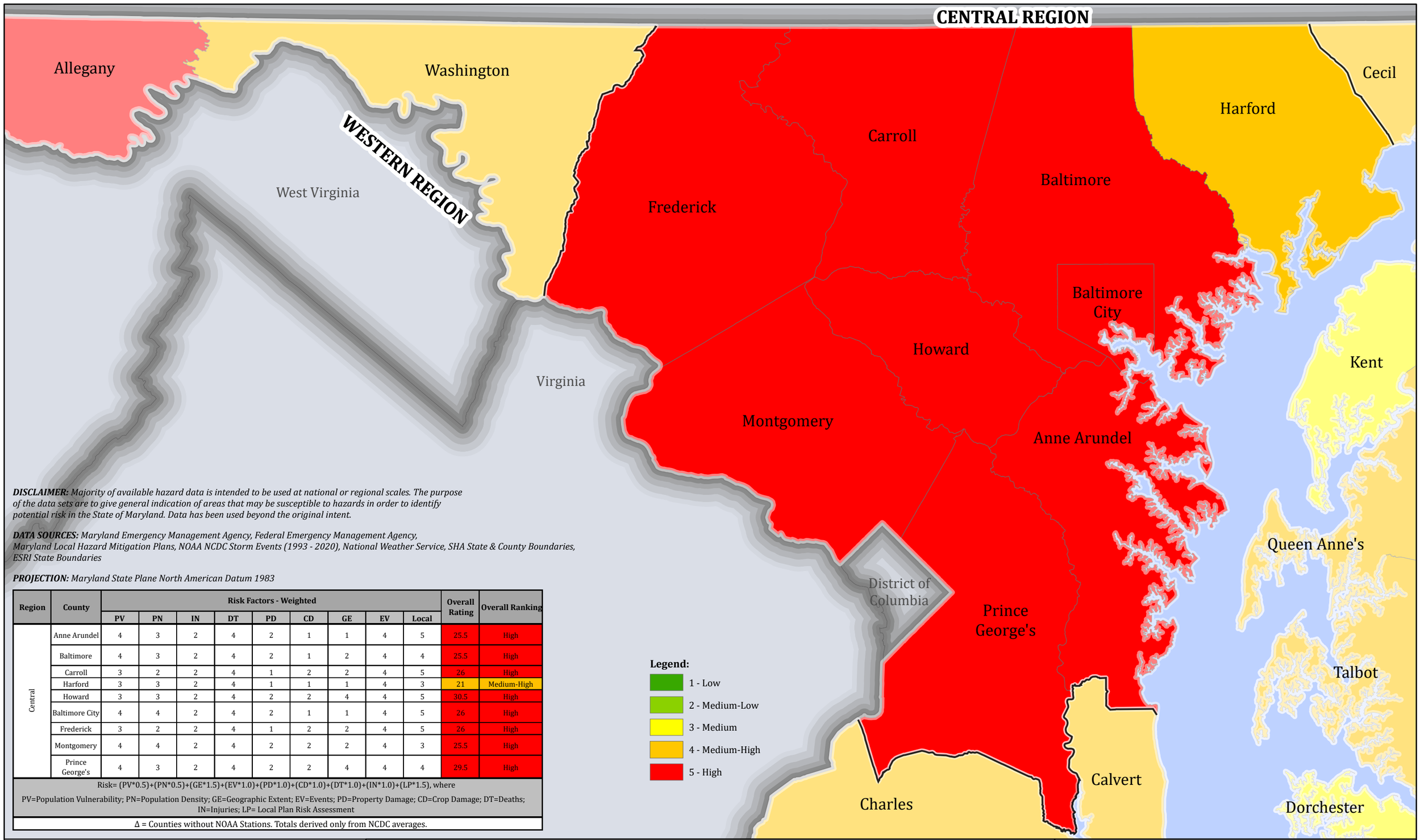
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

0 2.5 5 10 15 Miles

Wind Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Central	Anne Arundel	4	3	2	4	2	1	1	4	5	25.5	High
	Baltimore	4	3	2	4	2	1	2	4	4	25.5	High
	Carroll	3	2	2	4	1	2	2	4	5	26	High
	Harford	3	3	2	4	1	1	1	4	3	21	Medium-High
	Howard	3	3	2	4	2	2	4	4	5	30.5	High
	Baltimore City	4	4	2	4	2	1	1	4	5	26	High
	Frederick	3	2	2	4	1	2	2	4	5	26	High
	Montgomery	4	4	2	4	2	2	2	4	3	25.5	High
	Prince George's	4	3	2	4	2	2	4	4	4	29.5	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

0 2.5 5 10 15 Miles

Winter Storm Hazard Ranking & Risk Map (Central Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

This page left blank intentionally

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	2	4	4	3	5	25.5	High
	Somerset	1	1	1	1	3	4	4	3	5	26.5	High
	Wicomico	2	2	1	1	2	3	2	2	4	20	Medium-High
	Worcester	2	1	1	1	3	3	3	3	5	24.5	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Worcester

Somerset

LOWER EASTERN SHORE REGION

Delaware

Virginia

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Coastal Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	1	9	Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	4	3	16	Medium
	Worcester	2	1	1	1	1	1	1	2	0	9	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Caroline

Talbot

Dorchester

Wicomico

Worcester

Somerset

Delaware

Virginia

LOWER EASTERN SHORE REGION

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Dam Failure Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	4	4	1	3	19.5	Medium-High
	Somerset	1	1	1	1	1	4	3	2	4	20.5	Medium-High
	Wicomico	2	2	1	1	1	4	3	1	3	19	Medium-High
	Worcester	2	1	1	1	1	1	3	1	3	15.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline
Talbot
Dorchester
Wicomico
Somerset
Worcester
Delaware
Virginia
LOWER EASTERN SHORE REGION

Legend:
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Drought Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	1	3	13	Medium-Low
	Worcester	2	1	1	1	1	1	1	1	3	12.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline
Talbot
Dorchester
Wicomico
Somerset
Worcester
Delaware
Virginia
LOWER EASTERN SHORE REGION

Legend:
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES:*Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Extreme Temperatures Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	4	1	4	1	4	21	Medium-High
	Somerset	1	1	1	1	1	1	4	1	5	19.5	Medium-High
	Wicomico	2	2	1	1	1	1	2	1	3	14.5	Medium
	Worcester	2	1	1	1	2	1	3	2	4	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Worcester

Somerset

LOWER EASTERN SHORE REGION

Delaware

Virginia

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Flood Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	2	3	2	14	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Wicomico	2	2	1	1	1	1	3	3	0	13.5	Medium
	Worcester	2	1	1	1	1	1	1	1	2	11	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Worcester

Somerset

Delaware

Virginia

LOWER EASTERN SHORE REGION

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Human Caused Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	4	1	1	3	1	2	16.5	Medium
	Somerset	1	1	1	4	1	1	4	2	5	23.5	High
	Wicomico	2	2	1	4	1	1	3	3	3	21	Medium-High
	Worcester	2	1	1	4	1	1	3	2	0	15	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Caroline

Talbot

Dorchester

Wicomico

Somerset

Worcester

LOWER EASTERN SHORE REGION

Delaware

Virginia

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES:*Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Public Health Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	1	2	11.5	Medium-Low
	Worcester	2	1	1	1	1	1	1	1	0	8	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Caroline

Talbot

Dorchester

Wicomico

Worcester

Somerset

Delaware

Virginia

LOWER EASTERN SHORE REGION

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Soil Movement Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	2	4	14.5	Medium
	Somerset	1	1	1	1	1	1	1	2	4	14.5	Medium
	Wicomico	2	2	2	4	1	1	1	2	3	18	Medium
	Worcester	2	1	2	1	1	1	1	2	3	14.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Somerset

Worcester

Delaware

Virginia

LOWER EASTERN SHORE REGION

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Thunderstorm Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	2	4	3	1	2	2	3	20.5	Medium-High
	Somerset	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Wicomico	2	2	2	1	2	1	1	2	3	16	Medium
	Worcester	2	1	1	1	1	1	2	2	3	15	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Somerset

Worcester

LOWER EASTERN SHORE REGION

Delaware

Virginia

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Tornado Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	4	3	15	Medium
	Somerset	1	1	1	1	2	1	2	4	3	17.5	Medium
	Wicomico	2	2	1	1	1	1	2	4	3	17.5	Medium
	Worcester	2	1	1	1	1	1	4	4	3	20	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Somerset

Worcester

Delaware

Virginia

LOWER EASTERN SHORE REGION

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1998 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Wildfire Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester	1	1	2	1	2	1	3	4	4	21.5	Medium-High
	Somerset	1	1	2	1	2	1	4	4	4	23	High
	Wicomico	2	2	1	1	2	1	4	3	4	22	Medium-High
	Worcester	2	1	1	1	2	1	4	3	4	21.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Caroline

Talbot

Dorchester

Wicomico

Somerset

Worcester

Delaware

Virginia

LOWER EASTERN SHORE REGION

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Wind Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Lower Eastern Shore	Dorchester Δ	1	1	1	1	1	1	1	4	4	16.5	Medium
	Somerset Δ	1	1	1	1	1	1	1	4	3	15	Medium
	Wicomico	2	2	1	1	3	1	1	4	4	19.5	Medium-High
	Worcester Δ	2	1	1	1	1	1	1	4	2	14	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

Caroline

Talbot

Dorchester

Wicomico

Worcester

Somerset

LOWER EASTERN SHORE REGION

Delaware

Virginia

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales.The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Winter Storm Hazard Ranking & Risk Map (Lower Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

This page left blank intentionally

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	2	4	4	1	4	3	5	29.5	High
	Charles	3	2	2	4	3	1	3	2	3	23.5	High
	St. Mary's	2	2	2	4	4	2	4	4	5	31.5	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Coastal Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Prince George's

Anne Arundel

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Southern	Calvert	2	2	1	1	1	1	2	1	1	11.5	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	2	0	9.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Dam Failure Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	1	1	1	3	2	2	1	14.5	Medium
	Charles	3	2	1	1	1	3	2	2	1	15	Medium
	St. Mary's	2	2	1	1	1	3	3	2	3	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

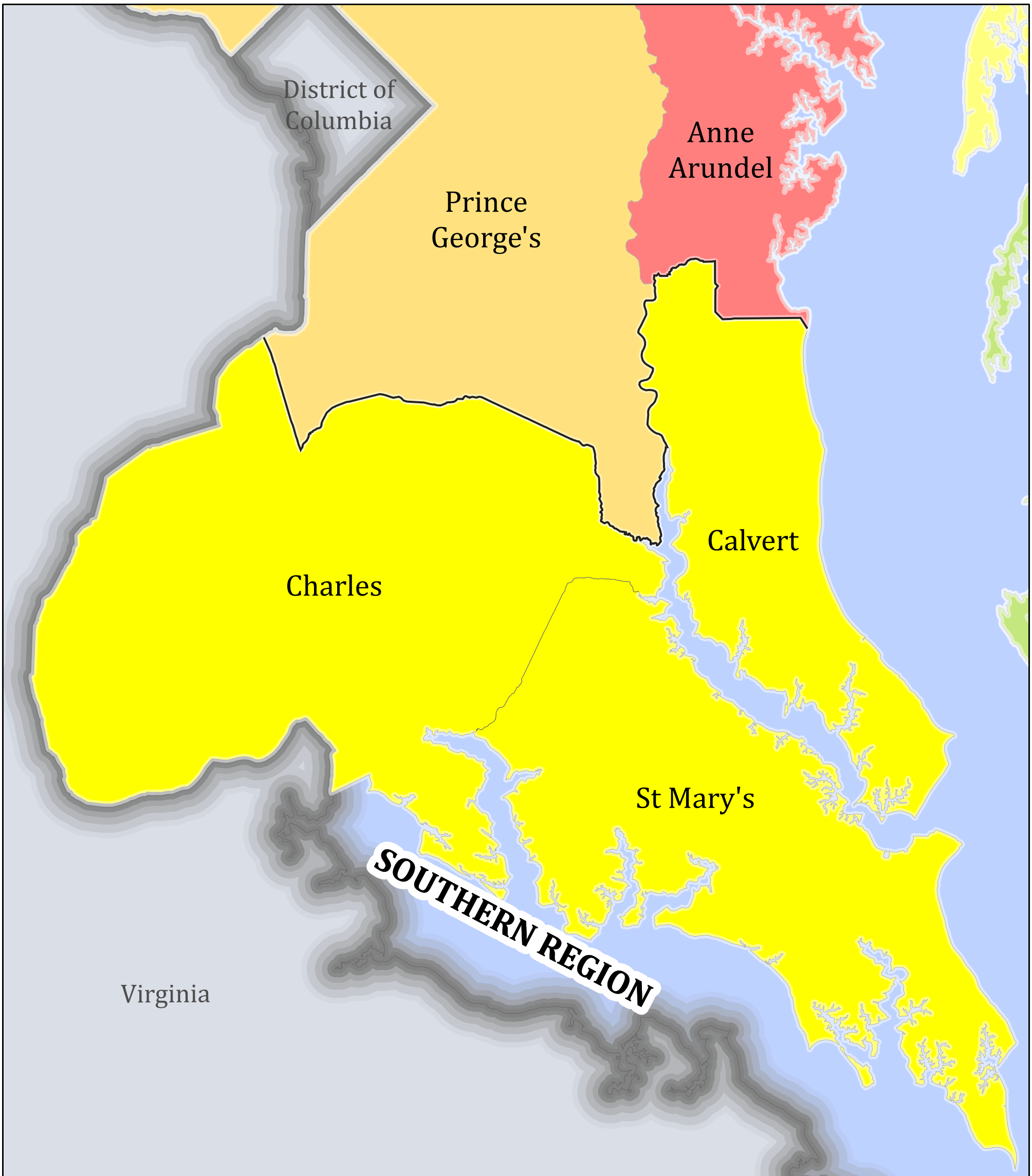
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Drought Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	1	1	1	1	2	1	5	17.5	Medium
	Charles	3	2	1	1	1	1	2	1	5	18	Medium
	St. Mary's	2	2	1	1	1	1	2	1	0	10	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Extreme Temperatures Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Prince George's

Anne Arundel

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	1	1	2	1	1	2	5	18	Medium
	Charles	3	2	1	1	2	1	2	2	5	20	Medium-High
	St. Mary's	2	2	1	1	2	1	1	3	5	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Flood Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	1	1	1	1	1	2	1	11	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	1	0	8.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Human Caused Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Southern	Calvert	2	2	1	4	1	1	1	2	0	12.5	Medium
	Charles	3	2	1	4	1	1	1	2	5	20.5	Medium-High
	St. Mary's	2	2	1	4	1	1	1	1	0	11.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Public Health Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Southern	Calvert	2	2	1	1	1	1	1	1	1	10	Low
	Charles	3	2	1	1	1	1	1	1	1	10.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	1	0	8.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Soil Movement Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	2	4	1	1	2	2	4	21	Medium-High
	Charles	3	2	1	4	1	2	2	3	5	24	High
	St. Mary's	2	2	1	1	2	1	2	3	4	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Thunderstorm Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Prince George's

Anne Arundel

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	2	4	3	1	3	2	4	24.5	High
	Charles	3	2	2	4	4	1	4	2	5	29	High
	St. Mary's	2	2	2	1	2	1	4	2	4	22	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Tornado Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Prince George's

Anne Arundel

Calvert

Charles

SOUTHERN REGION

St Mary's

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1998 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	1	1	1	1	4	4	5	23.5	High
	Charles	3	2	1	1	1	1	4	4	1	18	Medium
	St. Mary's	2	2	1	1	1	1	4	4	1	17.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Wildfire Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Anne Arundel

Prince George's

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert	2	2	2	1	2	2	3	4	5	25	High
	Charles	3	2	2	4	2	2	2	3	5	26	High
	St. Mary's	2	2	2	1	3	2	3	3	4	23.5	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Wind Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

District of Columbia

Prince George's

Anne Arundel

Calvert

Charles

St Mary's

SOUTHERN REGION

Virginia

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Southern	Calvert Δ	2	2	2	4	1	1	1	4	3	20	Medium-High
	Charles Δ	3	2	2	4	1	1	1	4	3	20.5	Medium-High
	St. Mary's	2	2	2	4	1	1	1	4	5	23	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

Winter Storm Hazard Ranking & Risk Map (Southern Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.25 4.5 9 13.5 Miles

AECOM

This page left blank intentionally

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	2	1	2	1	2	2	3	16.5	Medium
	Cecil	2	2	1	1	2	1	3	2	1	15	Medium
	Kent	1	1	2	1	3	1	4	2	4	22	Medium-High
	Queen Anne's	1	1	2	4	4	1	3	2	5	26	High
	Talbot	1	1	2	1	2	1	3	2	5	21	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Coastal Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Cecil	2	2	1	1	1	1	2	2	1	12.5	Medium-Low
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Dam Failure Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES:*Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	4	4	3	19.5	Medium-High
	Cecil	2	2	1	4	1	1	3	4	3	22	Medium-High
	Kent	1	1	1	1	1	1	4	4	1	16.5	Medium
	Queen Anne's	1	1	1	1	1	1	4	4	5	22.5	Medium-High
	Talbot	1	1	1	1	1	1	4	4	3	19.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Drought Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Cecil	2	2	1	1	1	1	2	1	3	14.5	Medium
	Kent	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	5	15	Medium
	Talbot	1	1	1	1	1	1	1	1	3	12	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Extreme Temperatures Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

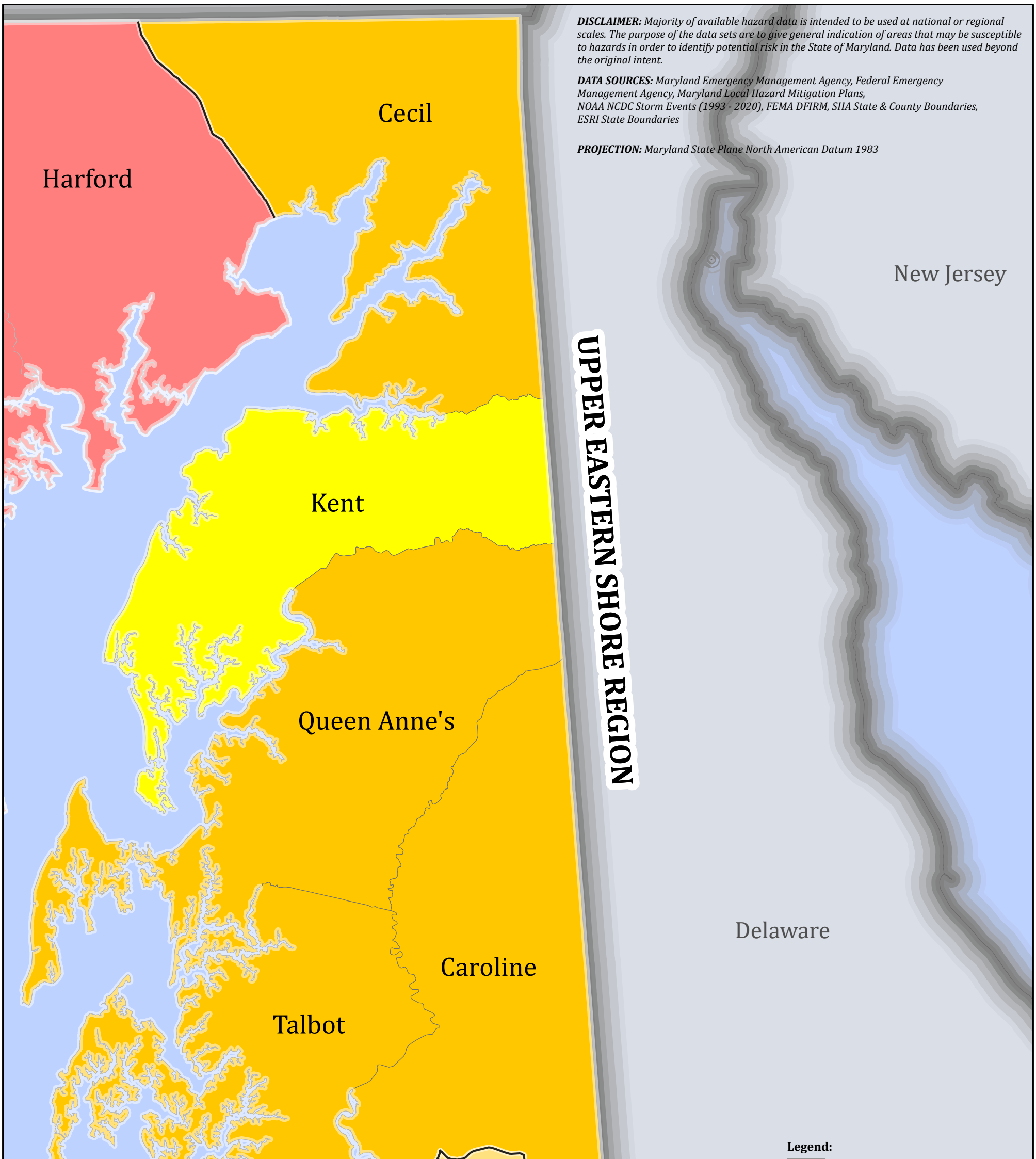
0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	2	1	3	3	1	3	5	22	Medium-High
	Cecil	2	2	2	1	3	1	1	4	5	22	Medium-High
	Kent	1	1	1	1	2	1	1	2	4	15.5	Medium
	Queen Anne's	1	1	2	1	3	1	1	3	5	20	Medium-High
	Talbot	1	1	1	1	3	1	2	3	5	20.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Flood Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	2	0	8.5	Medium-Low
	Cecil	2	2	1	1	1	1	3	3	3	18	Medium
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	2	2	0	10	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Human Caused Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	4	1	1	4	1	3	19.5	Medium-High
	Cecil	2	2	1	4	1	1	2	3	0	15	Medium-High
	Kent	1	1	1	4	1	1	3	1	5	21	Medium-High
	Queen Anne's	1	1	1	4	1	1	1	2	0	11.5	Medium
	Talbot	1	1	1	4	1	1	2	2	0	13	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Public Health Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Cecil	2	2	1	1	1	1	1	1	1	10	Low
	Kent	1	1	1	1	1	1	1	1	1	9	Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

Soil Movement Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES:*Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	2	1	1	1	2	2	3	15.5	Medium
	Cecil	2	2	2	1	2	1	2	2	5	20.5	Medium-High
	Kent	1	1	2	1	1	1	2	2	5	18.5	Medium-High
	Queen Anne's	1	1	1	1	1	1	1	2	1	10	Low
	Talbot	1	1	2	1	2	1	2	2	4	18	Medium

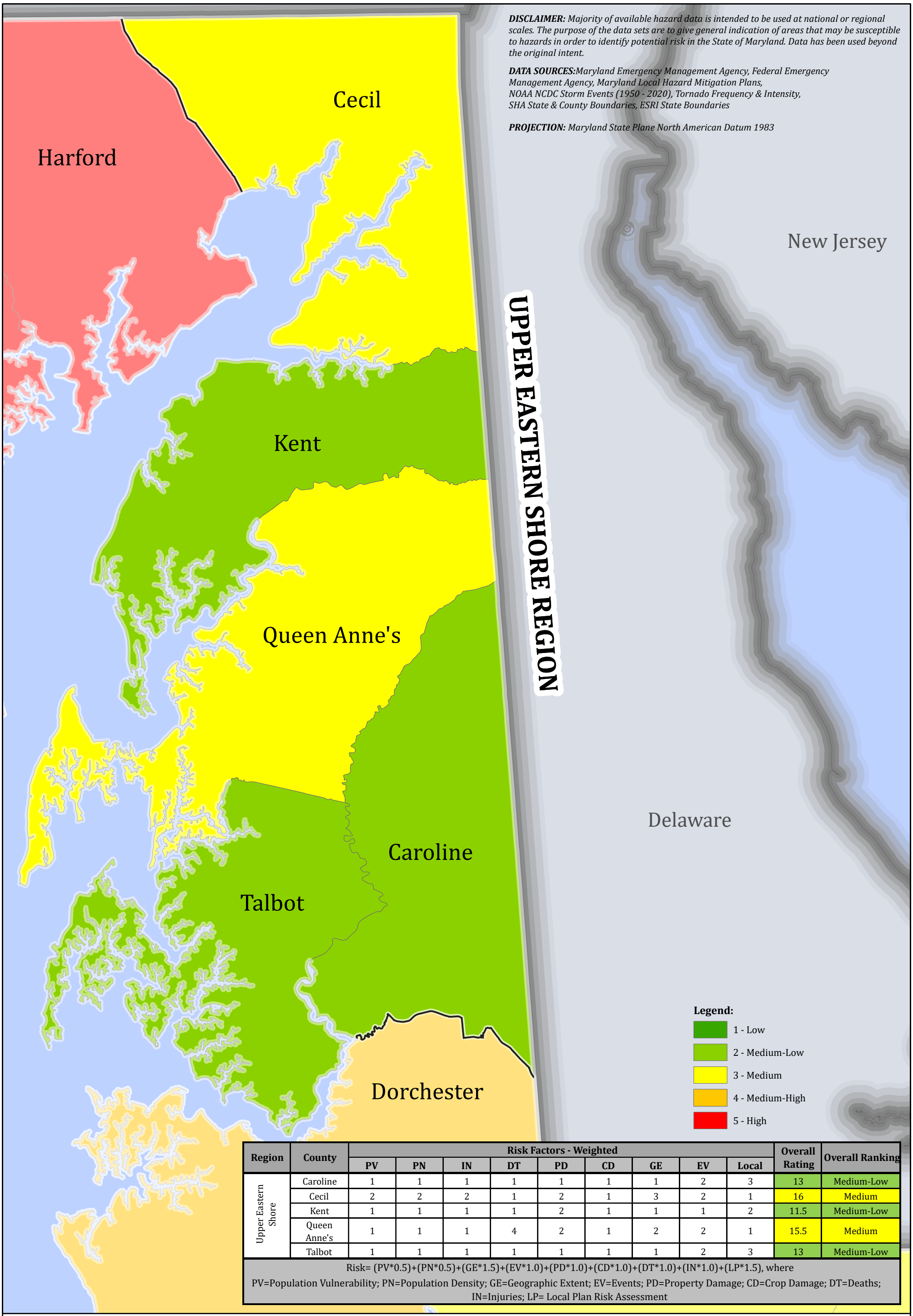
Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Thunderstorm Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES:*Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	2	3	13	Medium-Low
	Cecil	2	2	2	1	2	1	3	2	1	16	Medium
	Kent	1	1	1	1	2	1	1	1	2	11.5	Medium-Low
	Queen Anne's	1	1	1	4	2	1	2	2	1	15.5	Medium
	Talbot	1	1	1	1	1	1	1	2	3	13	Medium-Low

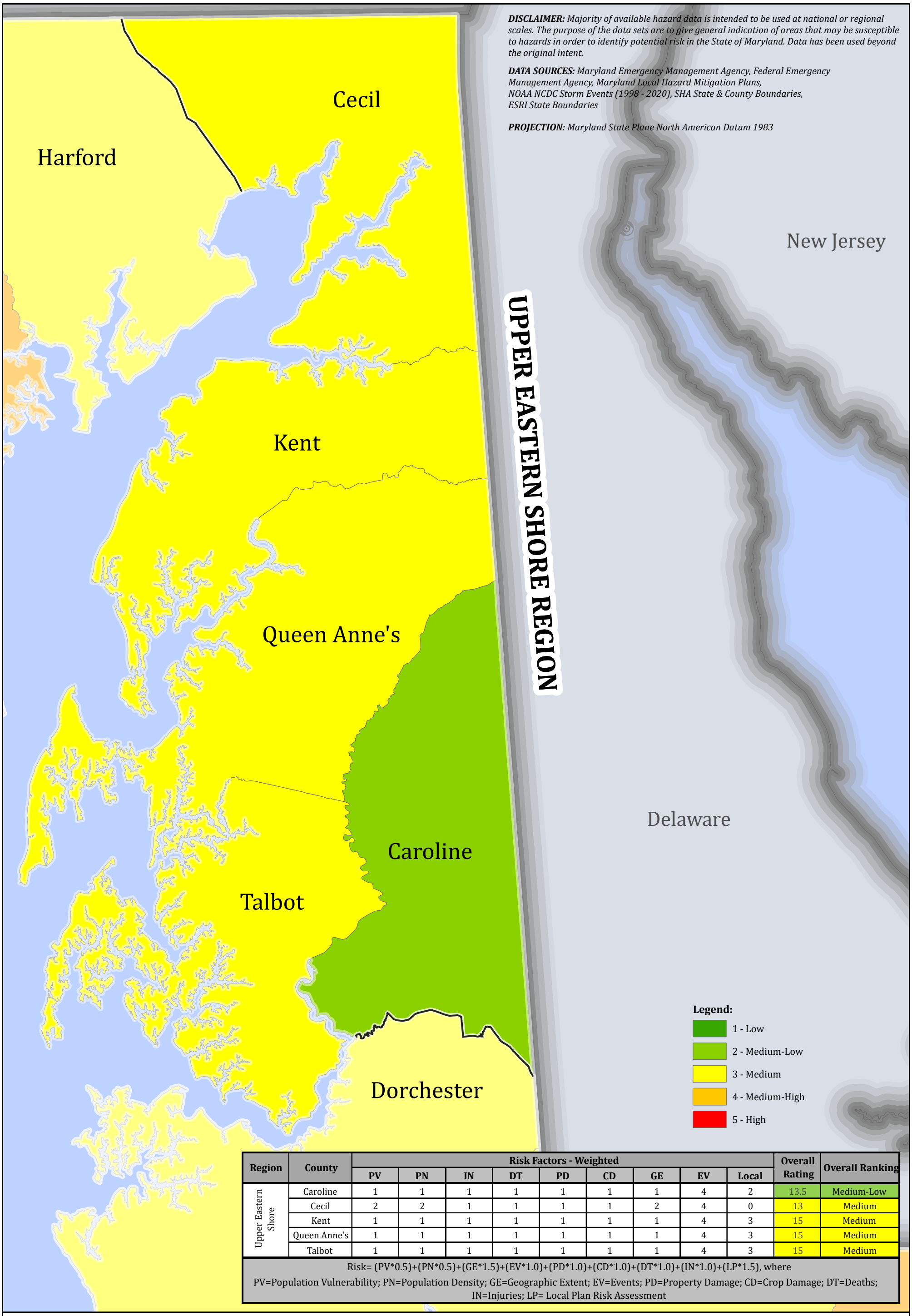
Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Tornado Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1998 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	4	2	13.5	Medium-Low
	Cecil	2	2	1	1	1	1	2	4	0	13	Medium
	Kent	1	1	1	1	1	1	1	4	3	15	Medium
	Queen Anne's	1	1	1	1	1	1	1	4	3	15	Medium
	Talbot	1	1	1	1	1	1	1	4	3	15	Medium

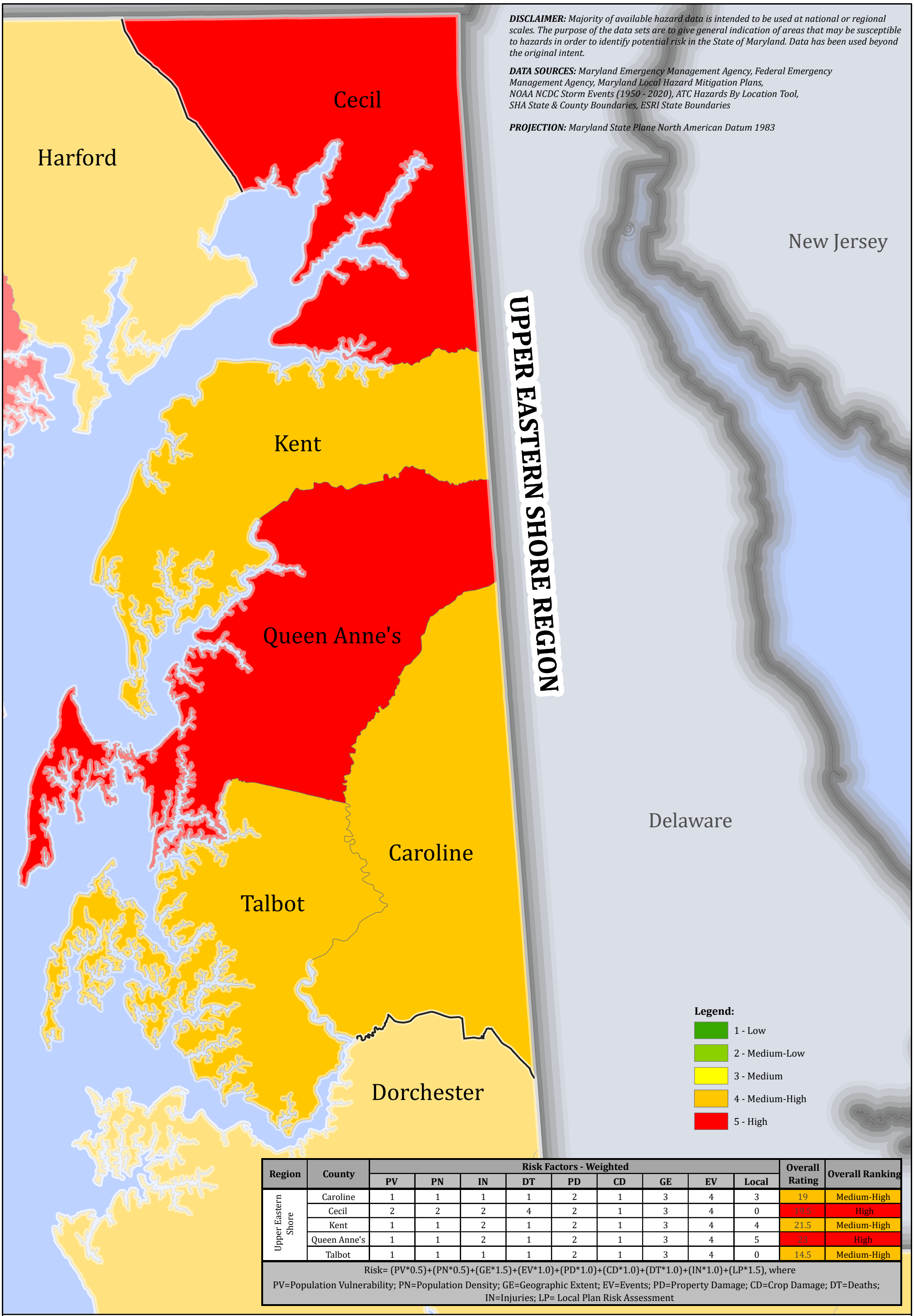
Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Wildfire Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM



DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline	1	1	1	1	2	1	3	4	3	19	Medium-High
	Cecil	2	2	2	4	2	1	3	4	0	19.5	High
	Kent	1	1	2	1	2	1	3	4	4	21.5	Medium-High
	Queen Anne's	1	1	2	1	2	1	3	4	5	23	High
	Talbot	1	1	1	1	2	1	3	4	0	14.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Wind Hazard Ranking & Risk Map (Upper Eastern Shore Region)

State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES:*Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

Cecil

Harford

Kent

Queen Anne's

Caroline

Talbot

Dorchester

UPPER EASTERN SHORE REGION

New Jersey

Delaware

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Upper Eastern Shore	Caroline Δ	1	1	1	1	1	1	1	4	3	15	Medium
	Cecil	2	2	1	1	2	1	1	4	5	20	Medium-High
	Kent Δ	1	1	1	1	1	1	1	4	3	15	Medium
	Queen Anne's	1	1	2	4	1	1	1	4	3	19	Medium-High
	Talbot	1	1	1	4	1	1	1	4	5	21	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

Winter Storm Hazard Ranking & Risk Map (Upper Eastern Shore Region)

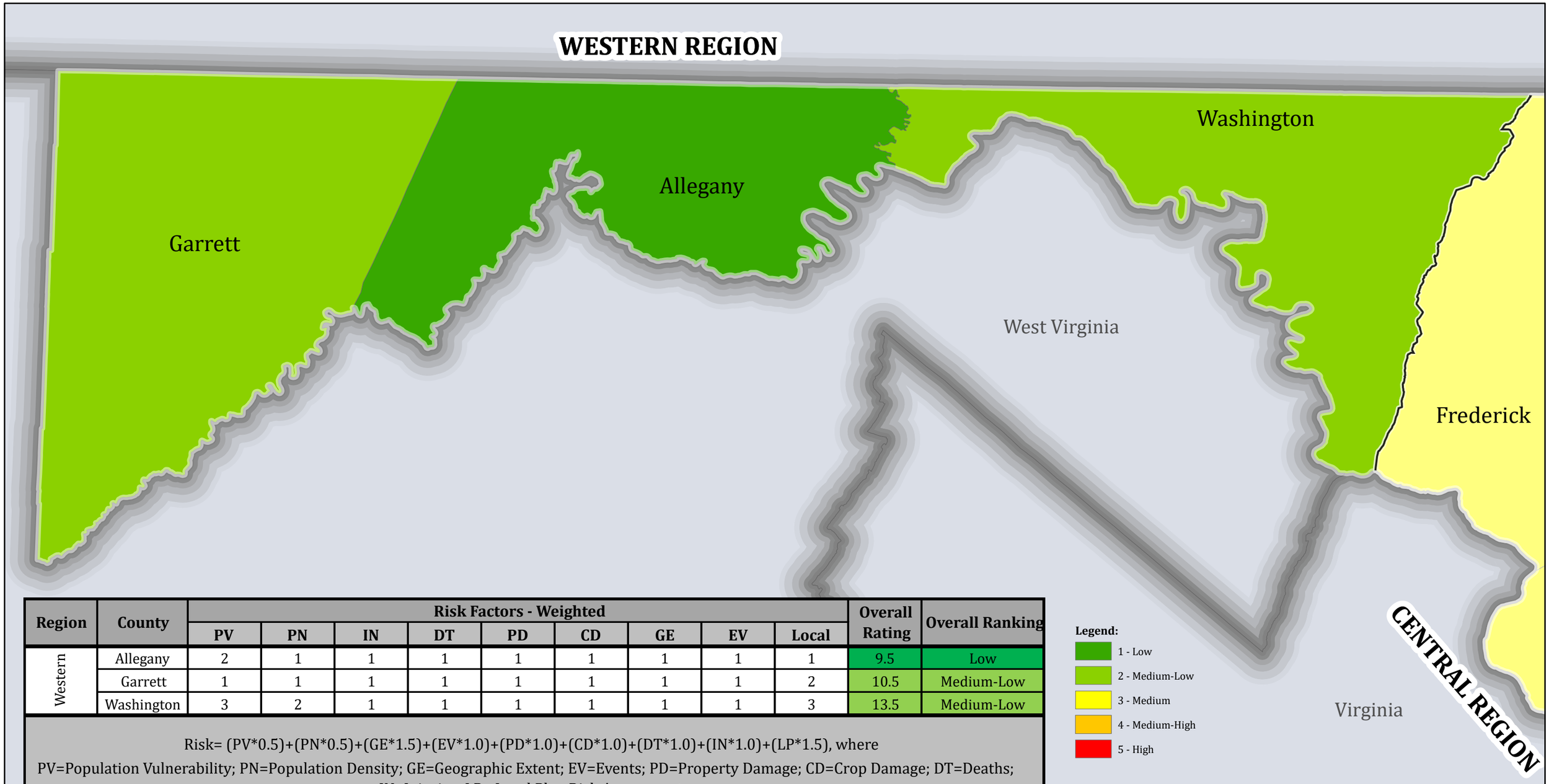
State of Maryland Hazard Mitigation Plan 2020

0 2.5 5 10 15 Miles

AECOM

This page left blank intentionally

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	1	9.5	Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	1	1	1	3	13.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

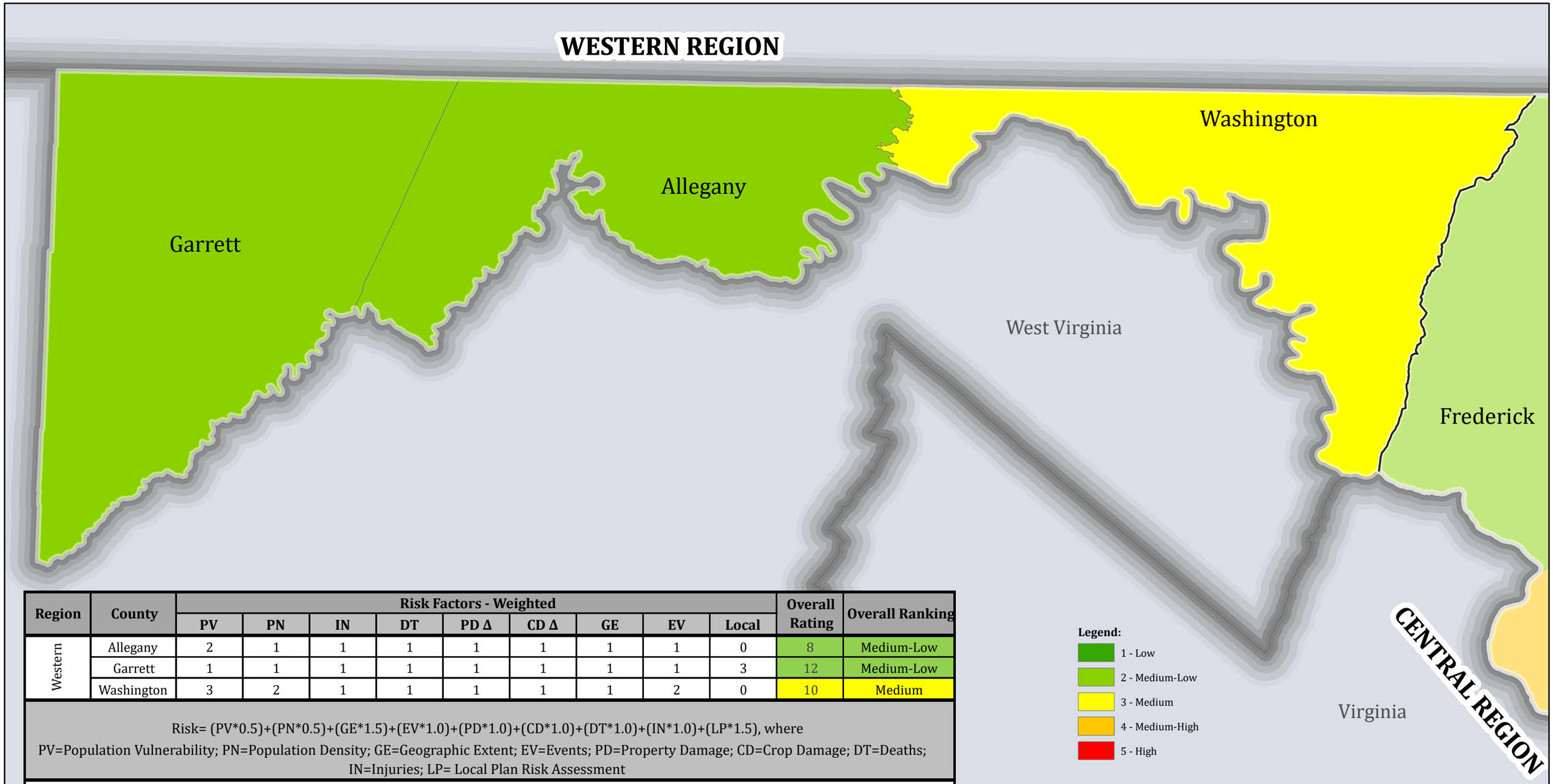
0 2.5 5 10 15 Miles

Coastal Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	0	8	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	1	1	1	1	1	2	0	10	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

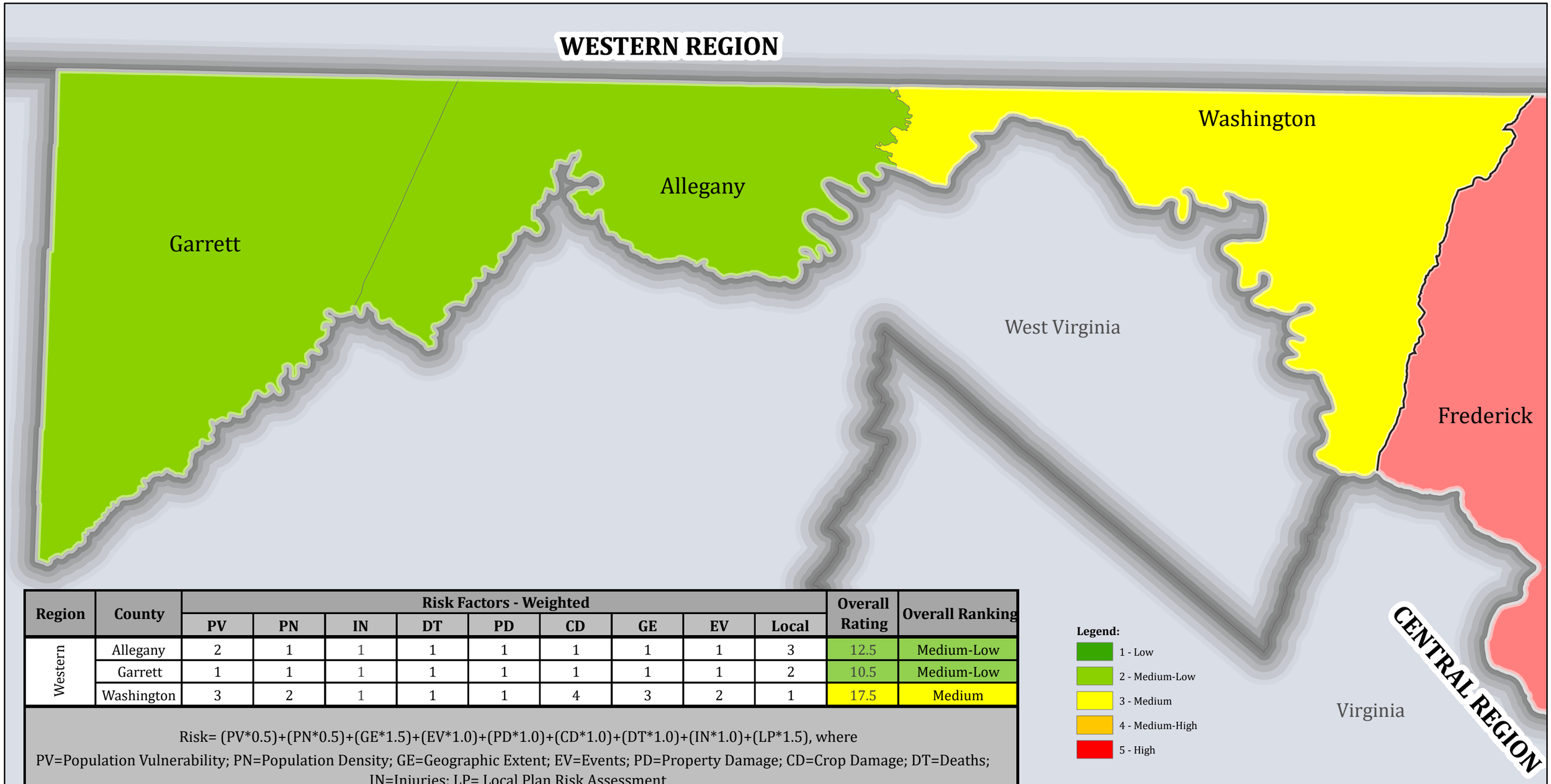
PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Dam Failure Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	3	12.5	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	4	3	2	1	17.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

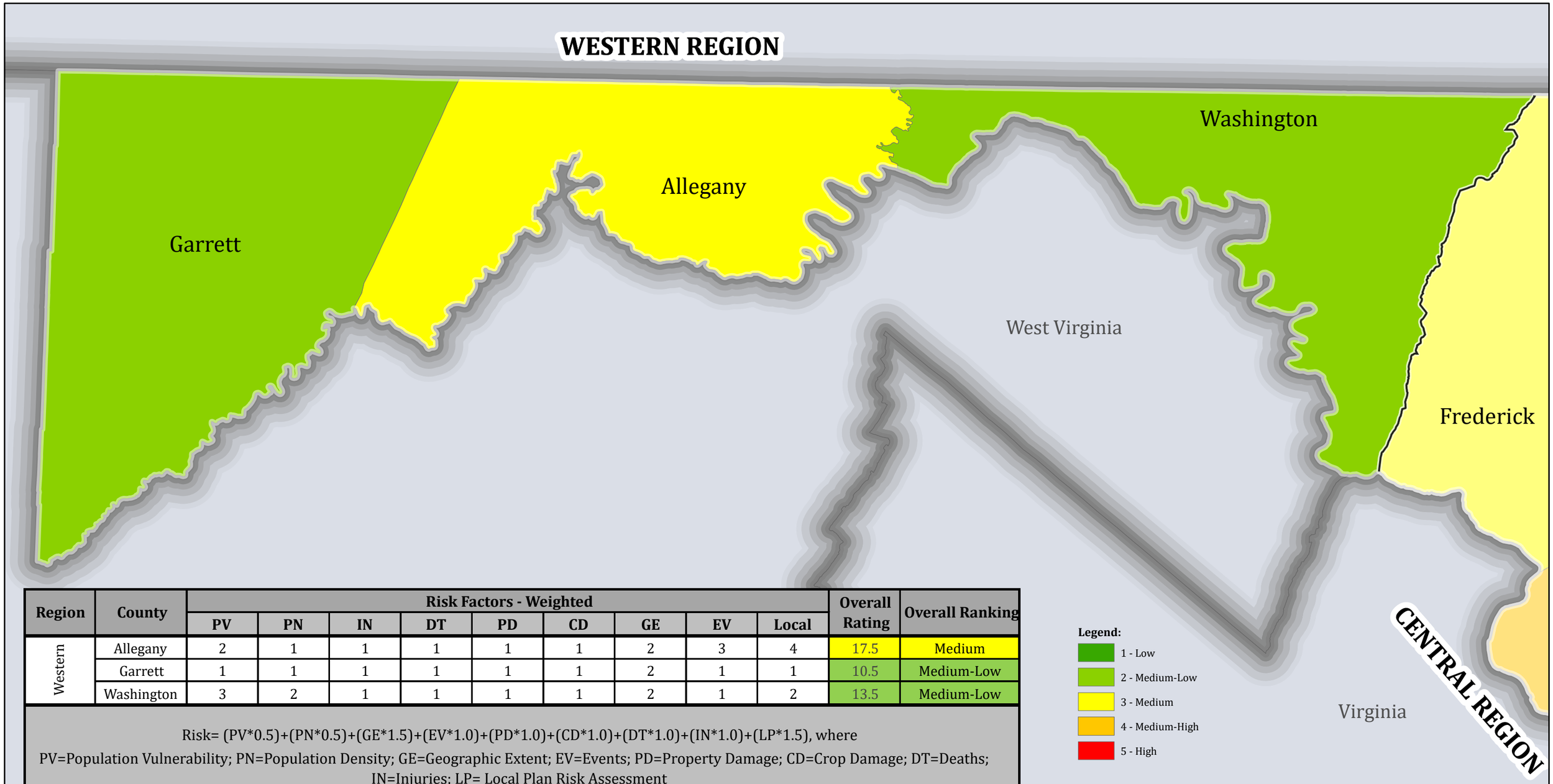
0 2.5 5 10 15 Miles

Drought Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	2	3	4	17.5	Medium
	Garrett	1	1	1	1	1	1	2	1	1	10.5	Medium-Low
	Washington	3	2	1	1	1	1	2	1	2	13.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

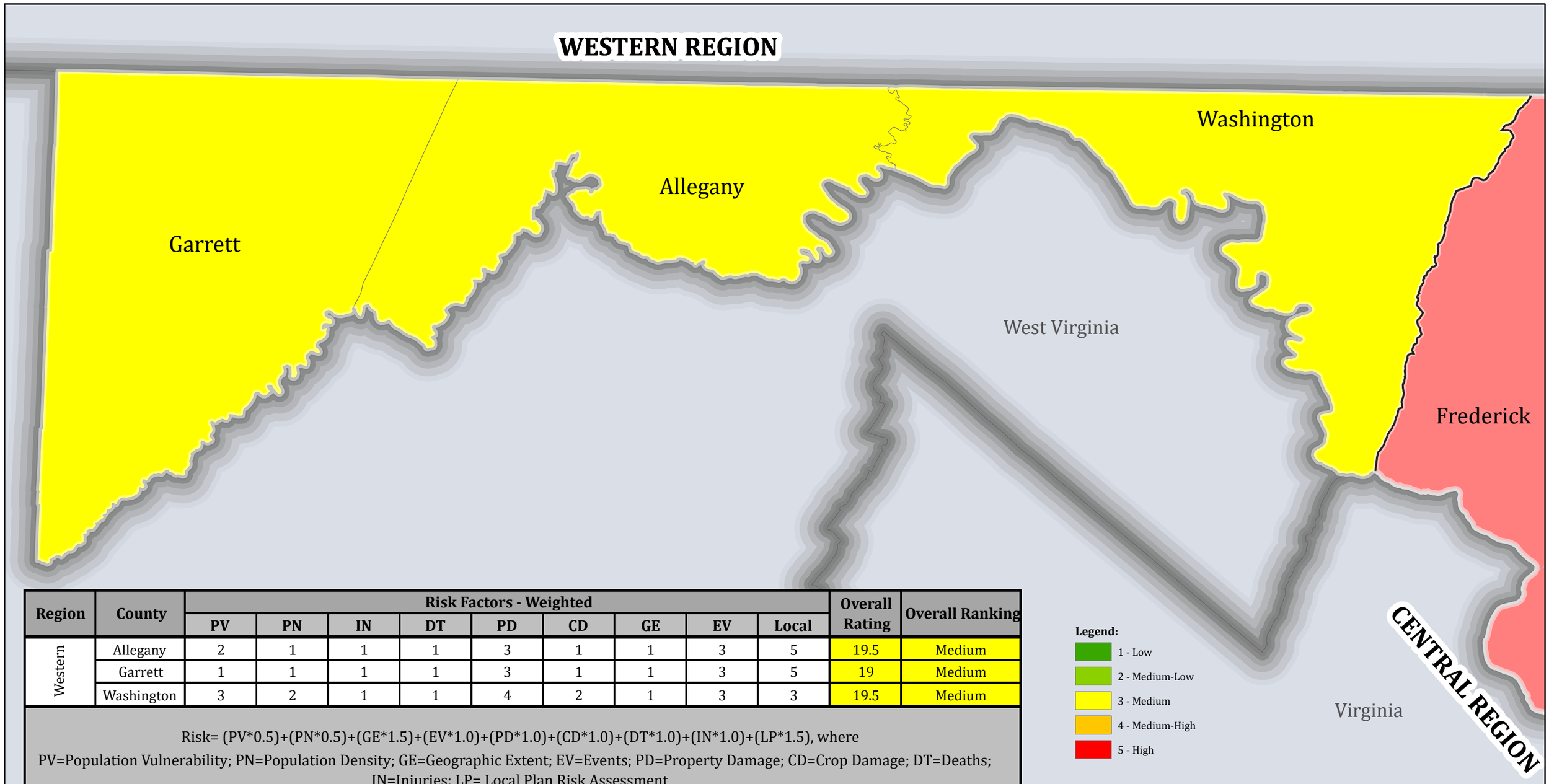
PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Extreme Temperatures Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	3	1	1	3	5	19.5	Medium
	Garrett	1	1	1	1	3	1	1	3	5	19	Medium
	Washington	3	2	1	1	4	2	1	3	3	19.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

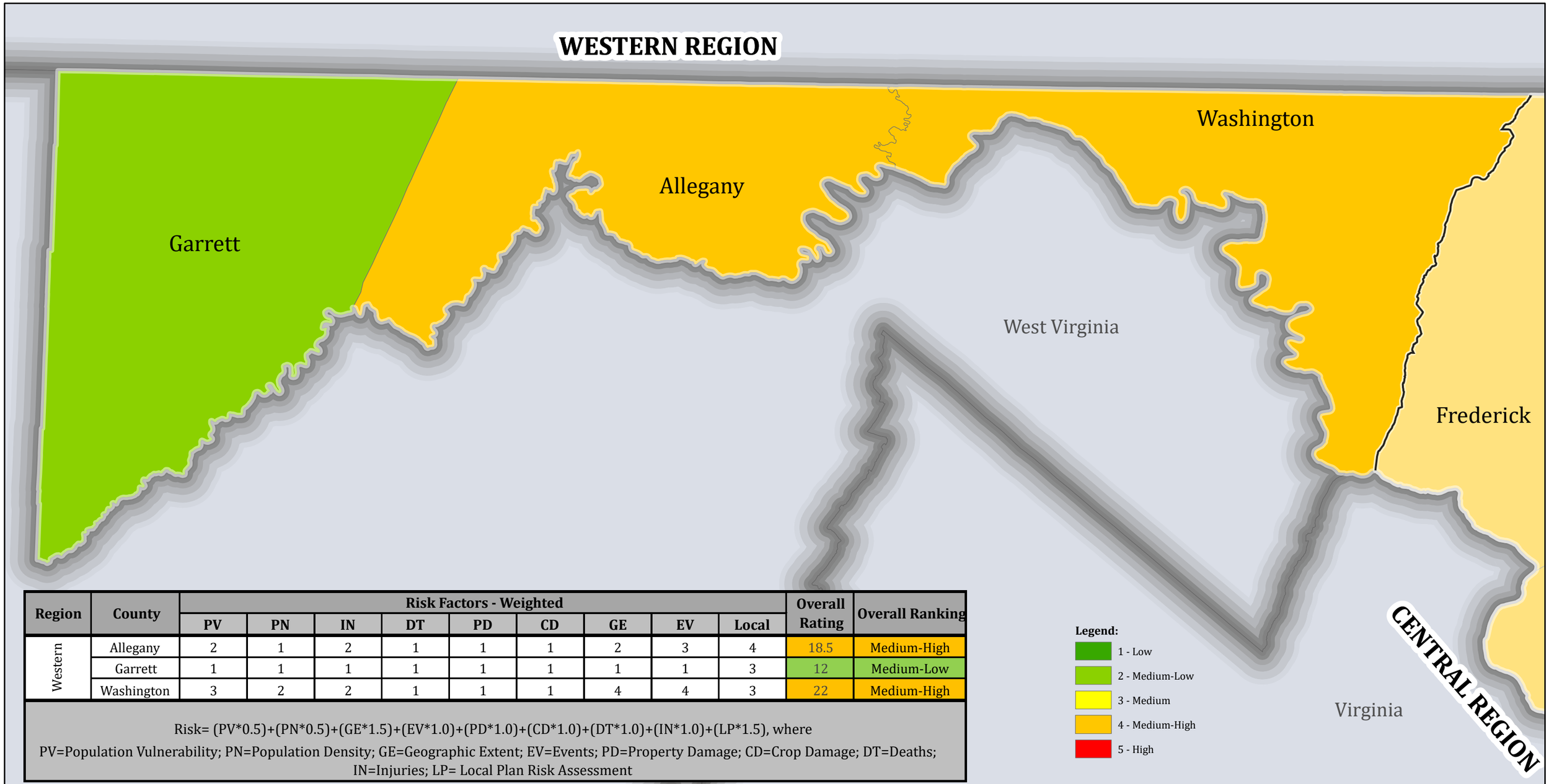
0 2.5 5 10 15 Miles

Flood Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	2	3	4	18.5	Medium-High
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	2	1	1	1	4	4	3	22	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

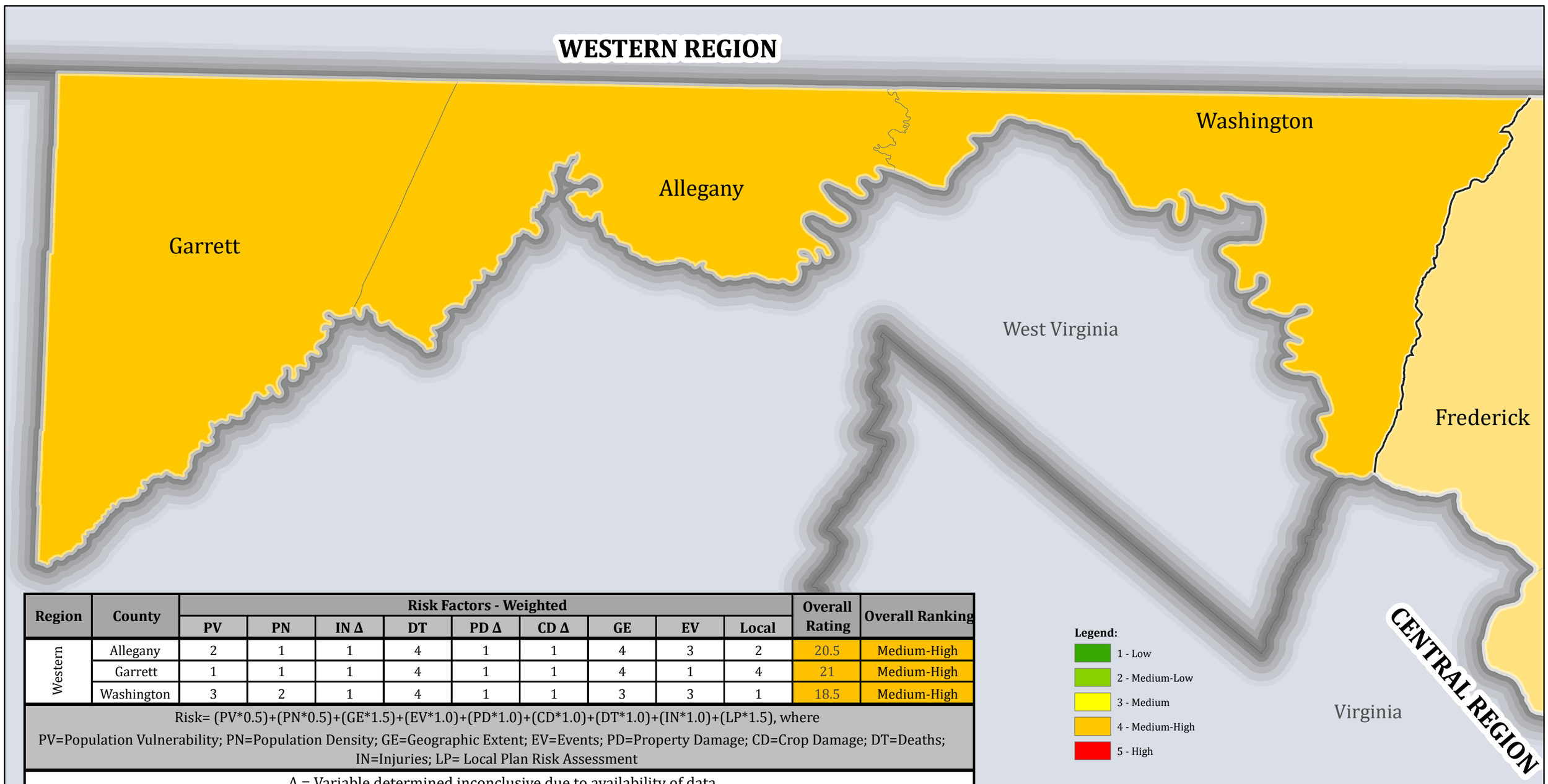
0 2.5 5 10 15 Miles

Human Caused Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	4	1	1	4	3	2	20.5	Medium-High
	Garrett	1	1	1	4	1	1	4	1	4	21	Medium-High
	Washington	3	2	1	4	1	1	3	3	1	18.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

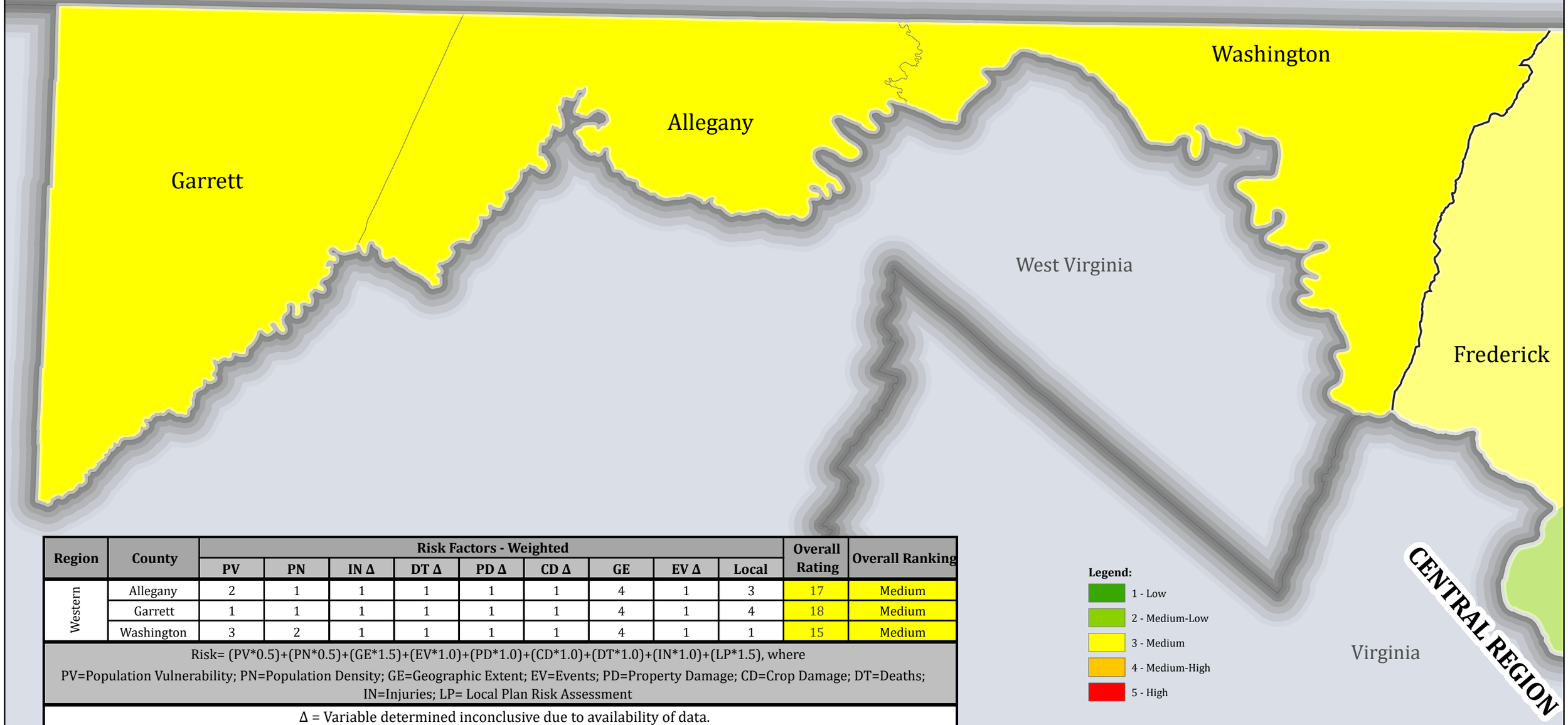
0 2.5 5 10 15 Miles

Public Health Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Western	Allegany	2	1	1	1	1	1	4	1	3	17	Medium
	Garrett	1	1	1	1	1	1	4	1	4	18	Medium
	Washington	3	2	1	1	1	1	4	1	1	15	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

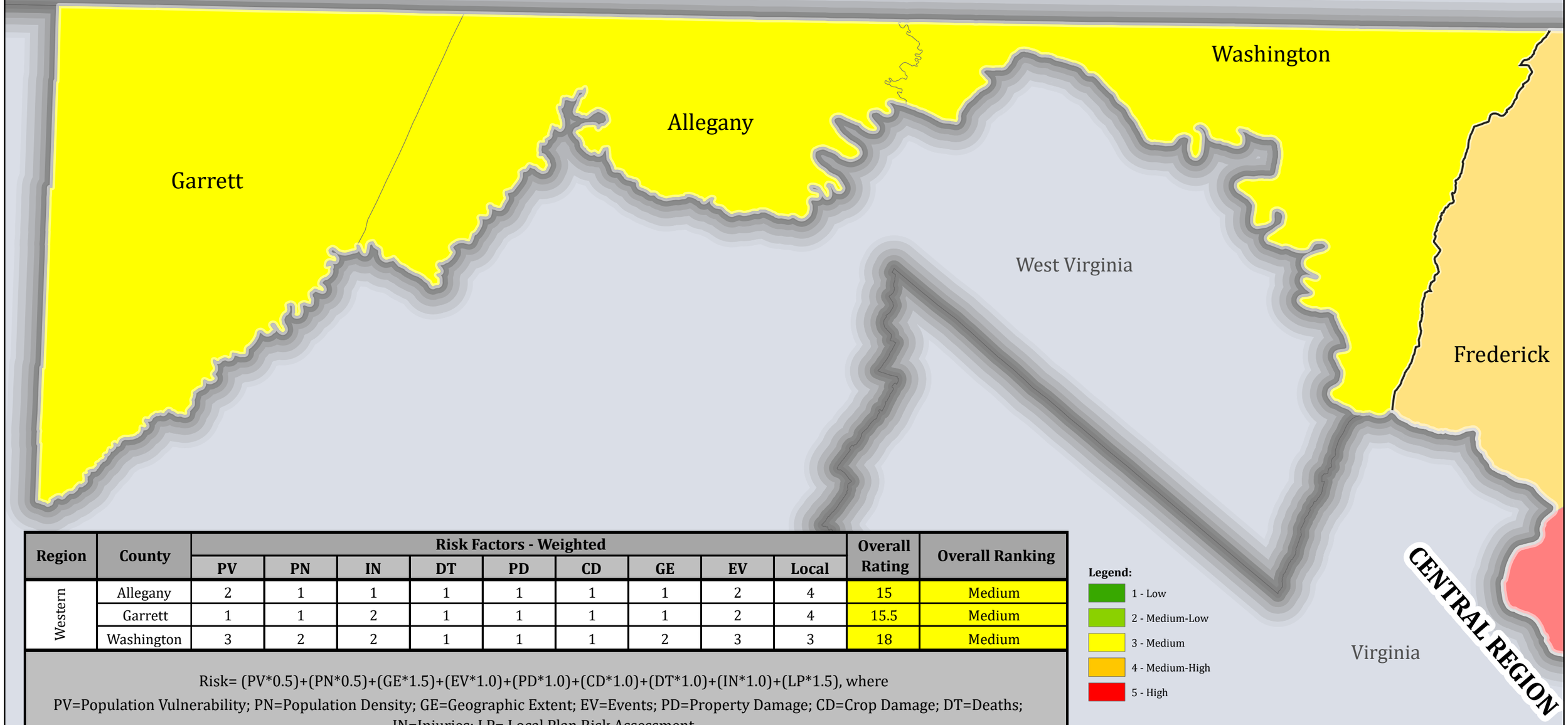
0 2.5 5 10 15 Miles

Soil Movement Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	2	4	15	Medium
	Garrett	1	1	2	1	1	1	1	2	4	15.5	Medium
	Washington	3	2	2	1	1	1	2	3	3	18	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

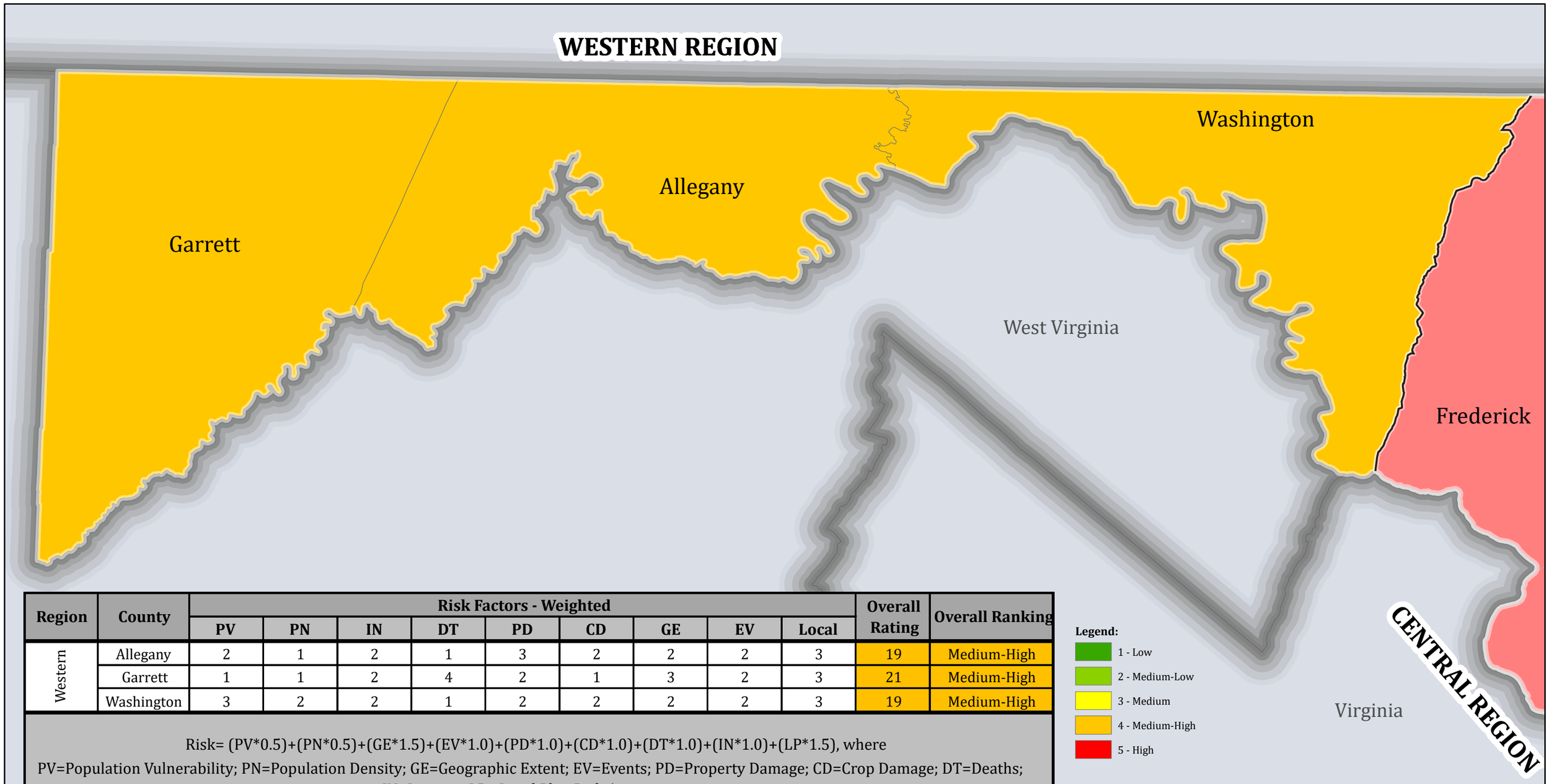
PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Thunderstorm Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	3	2	2	2	3	19	Medium-High
	Garrett	1	1	2	4	2	1	3	2	3	21	Medium-High
	Washington	3	2	2	1	2	2	2	2	3	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

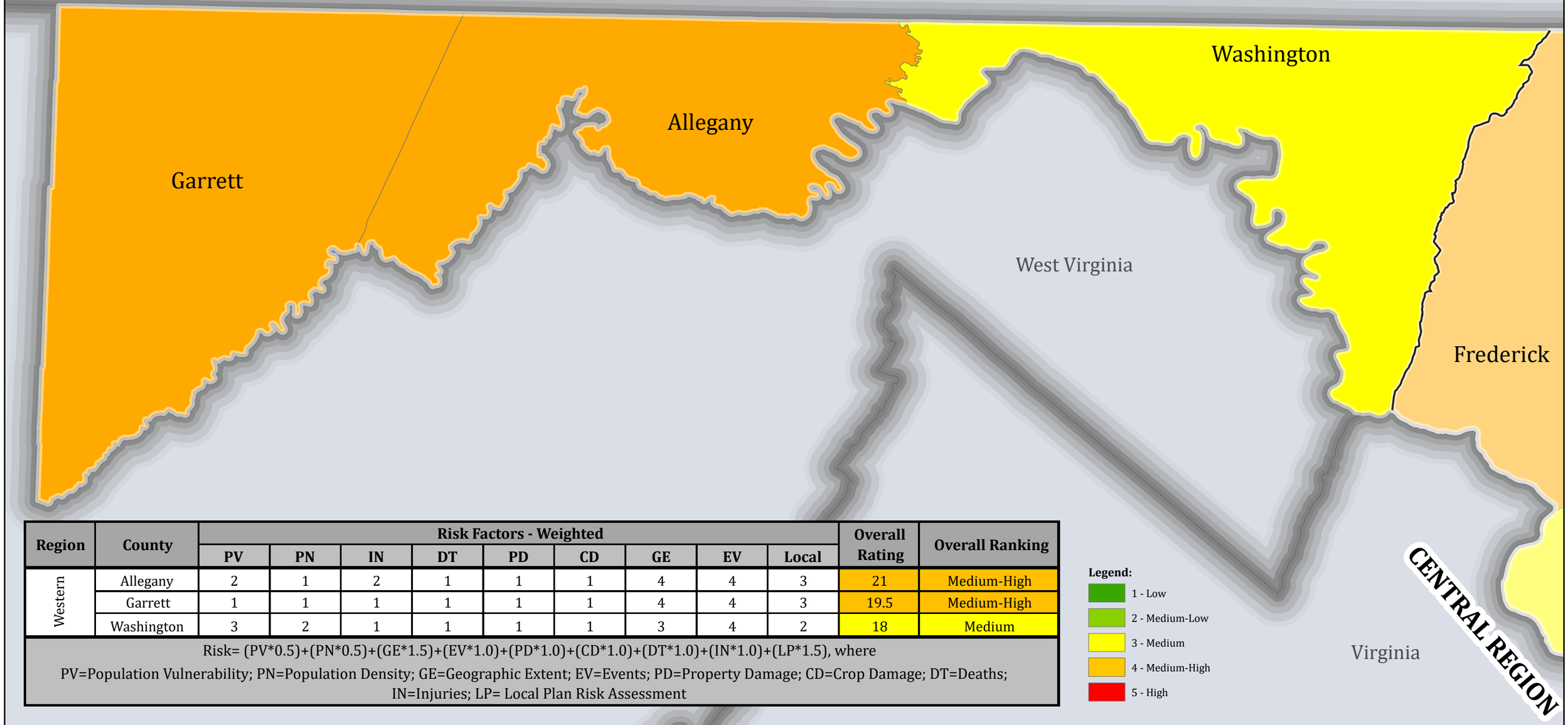
0 2.5 5 10 15 Miles

Tornado Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	4	4	3	21	Medium-High
	Garrett	1	1	1	1	1	1	4	4	3	19.5	Medium-High
	Washington	3	2	1	1	1	1	3	4	2	18	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Data Sources: Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

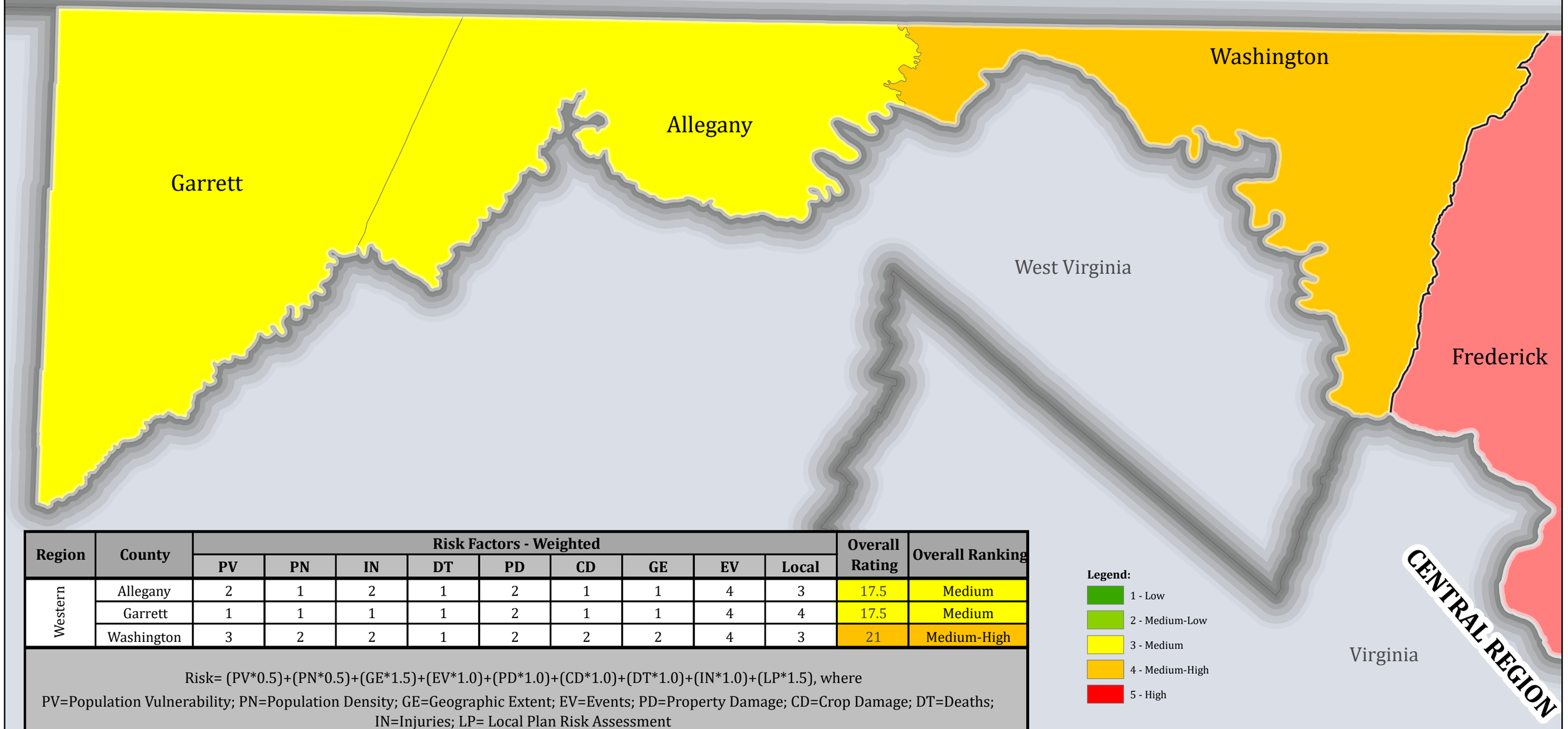
0 2.5 5 10 15 Miles

Wildfire Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	2	1	1	4	3	17.5	Medium
	Garrett	1	1	1	1	2	1	1	4	4	17.5	Medium
	Washington	3	2	2	1	2	2	2	4	3	21	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

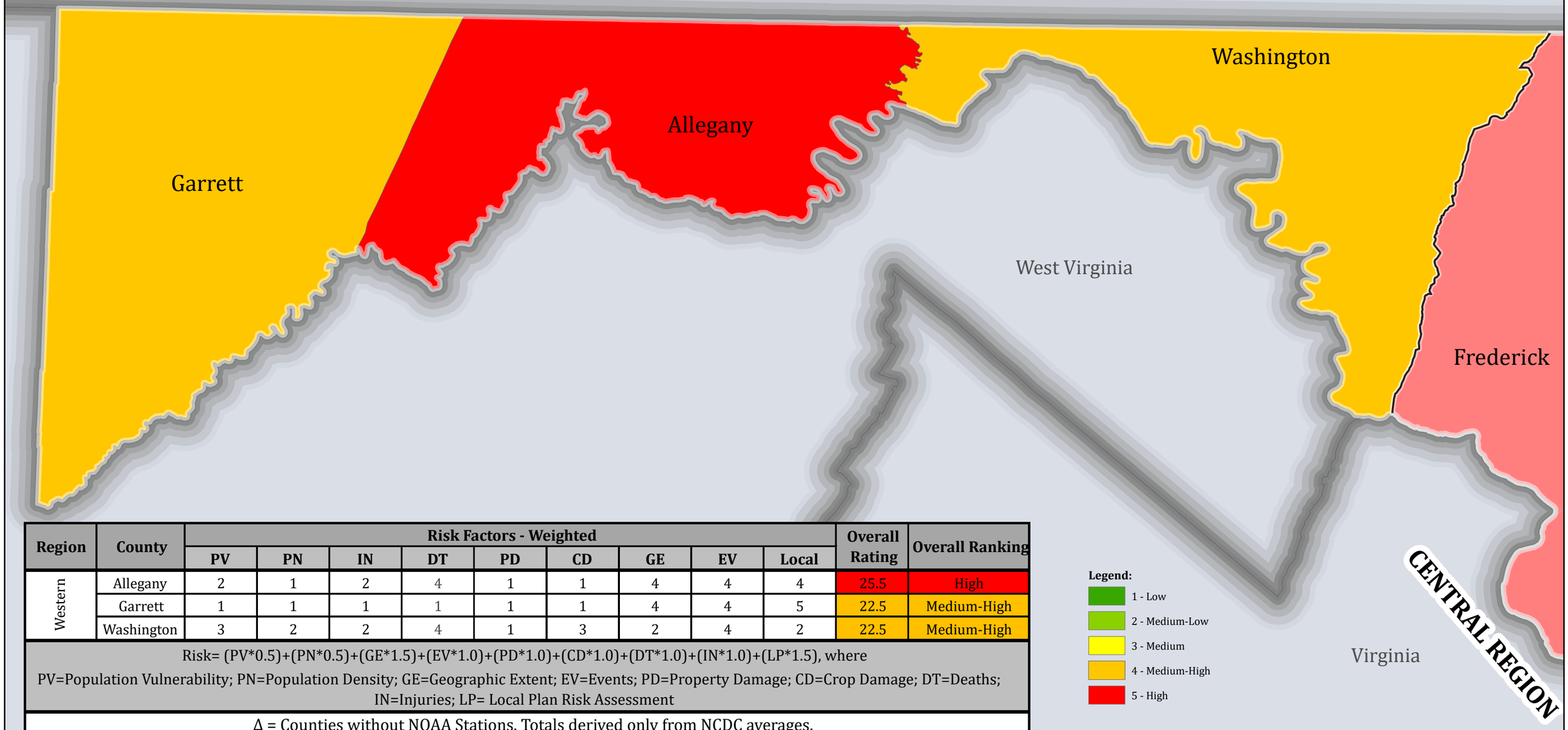
0 2.5 5 10 15 Miles

Wind Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

WESTERN REGION



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	4	1	1	4	4	4	25.5	High
	Garrett	1	1	1	1	1	1	4	4	5	22.5	Medium-High
	Washington	3	2	2	4	1	3	2	4	2	22.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

Legend:

- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 2.5 5 10 15 Miles

Winter Storm Hazard Ranking & Risk Map (Western Region)

State of Maryland Hazard Mitigation Plan 2020

AECOM

This page left blank intentionally

APPENDIX E

2021 Mitigation Action Worksheets

And

Past Action Status Forms

2021 Mitigation Action Worksheets

Appendix E – 2021 Mitigation Action Worksheets

This Appendix provides detailed information on the 39 NEW Mitigation Actions included in the 2021 Hazard Mitigation Plan – Section 4.9. These Actions are summarized in the Tables found in the Plan.

Priority Ranking M	Mitigation Action/Project Title:	#1 – Provide support for project development through all phases to include, but not be limited to: feasibility studies, Hydrology and Hydrologic studies, project identification, design and engineering, and implementation. Prioritize providing technical assistance to low-capacity and low-capability communities.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	2	10	27
Background/Issue:	Pre-engineering grants will help low capacity/low capability communities with planning and development of mitigation and protection/restoration projects. The State can leverage project scoping and direct technical assistance funding from FEMA BRIC and FMA programs				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Maryland Department of Natural Resources • Maryland Department of the Environment • Maryland Department of Planning • Maryland Historical Trust • Maryland Department of Transportation • Maryland Department of Housing and Community Development • Maryland Environmental Service				
Potential Funding:	BRIC, FMA, HMGP, PWEAA, EMPG, UASI, ESHPF, DNR Grants Gateway, MDE CFMGP, USACE				
Cost Estimate:	$ Variable depending on the study		Timeline:	1 Year/Ongoing	

Priority Ranking L	Mitigation Action/Project Title:	#2 – Provide support for installation and maintenance of extreme weather and other warning mechanisms statewide.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	2	2	10	19
Background/Issue:	The incidence of tornadic activity has increased drastically over the past 20 years. Many of the hardest hit areas are southern Maryland and the lower Eastern Shore counties. Additionally, funding for weather and stream gauge equipment and monitoring has been unstable.				
Responsible Agency:	• Maryland Emergency Management Agency • Maryland Department of the Environment				
Partners:	• Maryland Environmental Service • Maryland Department of Transportation • Federal Emergency Management Agency • United State Geological Survey • National Weather Service				
Potential Funding:	BRIC and FMA (equipment only), PWEAA, UASI				
Cost Estimate:	$20/30k per siren/gauge, plus maintenance and monitoring		Timeline:	2-3 Years	

Priority Ranking H	Mitigation Action/Project Title:	#3 – Conduct consequence analyses for dam failures across the State, including collecting and determining information on downstream inundation areas and potential flood depths.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	10	10	10	35
Background/Issue:	Conowingo and several other high hazard dams have the potential to cause catastrophic destruction downstream. Providing these analyses to counties and jurisdictions will allow them to bolster their mitigation and response planning efforts.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency				
Partners:	• Maryland Environmental Service				
Potential Funding:	FMA, EMPG, HMGP, HHPD				
Cost Estimate:	$ Medium (Consultant Fees)		Timeline:	1-2 Years	

Priority Ranking H	Mitigation Action/Project Title:	#4 - Conduct regular (annual) inspection and maintenance of flood and/or water control systems throughout Maryland and include operational training and community flood risk outreach as part of the maintenance effort.				
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**	
	2	10	10	10	32	
Background/Issue:	Lack of these resources to counties and jurisdictions hinders effective education, mitigation, and planning efforts. This is a BRIC compatible action that protects the whole community from flood, dam failure, and coastal hazards.					
Responsible Agency:	• Maryland Department of the Environment					
Partners:	• Maryland Environmental Service					
Potential Funding:	PWEAA, FEMA High Hazard Potential Dam program					
Cost Estimate:	$ Variable, State to fund training, external costs for inspection and maintenance		Timeline:	1 Year/Ongoing		

Priority Ranking L	Mitigation Action/Project Title:	#5 – Identify and evaluate funding opportunities and potential projects to decommission low flow/low volume dams to restore waterways to their natural state.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	2	2	10	19
Background/Issue:	Dams impede the natural flow and absorption of water and impacts natural systems that provide flood protection and water run off services. This action protects the whole community from flood, dam failure, coastal hazards.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency				
Partners:	• Maryland Environmental Service				
Potential Funding:	BRIC, FMA, PWEAA, FEMA HHPD program				
Cost Estimate:	$ Low, internal state cost	Timeline:	3-5 Years		

Priority Ranking L	Mitigation Action/Project Title:	#6 – Conduct regional watershed studies to promote and support stormwater management awareness and projects, and to support effective mitigation and planning efforts and policies.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	2	2	10	19
Background/Issue:	A lack of comprehensive watershed studies hinders effective mitigation and planning efforts. This will provide detailed analyses for each jurisdiction in the State.				
Responsible Agency:	• Maryland Department of the Environment				
Partners:	• Maryland Environmental Service • Maryland Emergency Management Agency • Maryland Department of Transportation				
Potential Funding:	BRIC, FMA, UASI, CDBG-DR/MIT if available, MDE CFMGP, DNR Grants gateway, USACE				
Cost Estimate:	$ Low; State commission consultant	Timeline:	2-3 Years		

Priority Ranking H	Mitigation Action/Project Title:	#7 – Develop building standards and incentives to actively encourage the installation of nature-based solutions on State-**owned buildings/facilities to: reduce the building/facility's** carbon footprint; provide additional shade; reduce heat from the roof surface and surrounding air; and assist with water runoff during rain events.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	10	10	10	35
Background/Issue:	In addition to the impervious surfaces preventing groundwater infiltration, urban heat islands also reduce air quality and pose public health hazards. Recent federal programs are prioritizing projects that incorporate building codes and NBS.				
Responsible Agency:	• Maryland Department of Labor, Licensing, and Regulation				
Partners:	• Maryland Department of Natural Resources • Maryland Department of the Environment • Maryland Environmental Service • Maryland Emergency Management Agency				
Potential Funding:	UASI, BRIC				
Cost Estimate:	$		Timeline:	2-3 Years	

Priority Ranking M	Mitigation Action/Project Title:	#8 – Conduct State-level climate change modeling/analyses, including approaches for changes in precipitation rates and changes in sea level, and provide county-level datasets and reports/projections to jurisdictions to assist them with climate change-related planning and mitigation projects.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	2	10	10	27
Background/Issue:	Insufficient climate change analyses/studies hinder effective mitigation and planning efforts. This action will greatly benefit future regional planning regarding Climate hazards (storms, extreme temps, etc.), instead of each jurisdiction taking their own approach to what a 10-year storm will look like in 2050 or 2100.				
Responsible Agency:	• Maryland Department of Natural Resources • Maryland Department of the Environment • Maryland Emergency Management Agency				
Partners:	• Maryland Environmental Service • University of Maryland Center for Environmental Science				
Potential Funding:	BRIC, EMPG, UASI, DNR Grants Gateway				
Cost Estimate:	$		Timeline:	1-2 Years	

Priority Ranking M	Mitigation Action/Project Title:	#9 – Address mitigation and risk reduction considerations on all new state construction through Environmental Site Design (ESD) including considerations such as: maximum allowable impermeable surface for new construction, encouraging the use of permeable parking lots and surfaces, and drought-tolerant landscaping.				
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**	
	5	5	5	10	25	
Background/Issue:	Impermeable surfaces prevent stormwater absorption and promote runoff and nuisance flooding in urban environments. Conversely, the overuse of irrigation for landscaping and aesthetics can limit availability for critical agricultural and farming purposes.					
Responsible Agency:	• Maryland Department of Labor, Licensing, and Regulation • Maryland Department of Planning					
Partners:	• CoastSmart Council • Maryland Department of Natural Resources • Maryland Department of the Environment • Maryland Department of General Services • Maryland Emergency Management Agency					
Potential Funding:						
Cost Estimate:	$		Timeline:		2-3 Years	

Priority Ranking L	Mitigation Action/Project Title:	#10 **– Provide support for "Smart City" initiatives, such as** Internet of Things (IoT)-connected inlet/reservoir/stream sensors and gauges.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	2	2	10	19
Background/Issue:	A lack of connected gauges and sensors prevents monitoring and early warning system activities for a variety of hazards. Having these systems in place allows significant additional warning time and provides data for future analyses.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Energy Administration				
Partners:	• Maryland Environmental Service				
Potential Funding:	BRIC, HMGP, FMA, PWEAA, EMPG, UASI				
Cost Estimate:	$ Variable to High	Timeline:	1-2 Years		

Priority Ranking L	Mitigation Action/Project Title:	#11 – Develop guidance/best practices for more efficient crop irrigation methods to assist with balancing agricultural water withdrawals with increased water demand.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	2	5	10	2	19
Background/Issue:	As droughts intensify, there is increased water demand within the agriculture sector, and too much water usage can deplete a water source during drought conditions.				
Responsible Agency:	• Maryland Department of Agriculture				
Partners:	• Maryland Department of the Environment				
Potential Funding:	USDA				
Cost Estimate:	$ Staff time/consultants fees to review best practices	Timeline:	1-2 Years		

Priority Ranking L	Mitigation Action/Project Title:	#12 – Develop county-level depth grid data and develop current and future flood risk visualizations for use by local governments, that incorporates both storm and nuisance flooding, to illustrate potential flood risks to citizens, and to help inform local HMP and Risk Assessment update processes.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	5	2	2	10	19
Background/Issue:	Lack of updated depth grid data hinders comprehensive planning efforts and prevents preparation of visual aids/resources to illustrate flood hazards to citizens.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Department of Natural Resources				
Partners:	• Maryland Environmental Service				
Potential Funding:	HMGP, BRIC,				
Cost Estimate:	$		Timeline:	2-3 Years	

Priority Ranking M	Mitigation Action/Project Title:	#13 – Provide incentives to local Planning Commissions to begin preparing for the 2050 projected 100-year and 500-year floodplain delineations (as opposed to current 100/500-year floodplains) by incorporating language into local ordinances (Zoning, SALDO) that discusses raising the freeboard, and other measures, based on these projections.				
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**	
	2	5	10	10	27	
Background/Issue:	The lack of planning for the changing environment and sea level projections puts properties, infrastructure, and communities at risk. Plans should incorporate the increased risk of flooding due to Projected Sea Level Rise (USACE, SLR, or MD CRAB projections) to develop strategies and determine the jurisdictions level of risk tolerance to mitigate the impact of projected sea level rise and major storms out to the year 2100.					
Responsible Agency:	• Maryland Department of Planning					
Partners:	• Maryland Department of the Environment • Maryland Department of Natural Resources • Maryland Historical Trust • Maryland Department of Housing and Community Development • Maryland Insurance Administration • Maryland Emergency Management Agency					
Potential Funding:	CDBG					
Cost Estimate:	$ Variable - County level cost		Timeline:	3-5 Years		

Priority Ranking M	Mitigation Action/Project Title:	#14 – Provide information and encourage counties to obtain the BCEGS building code evaluation to support CRS activities and potentially receive lower insurance rates.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	2	5	5	10	22
Background/Issue:	The Building Code Effectiveness Grading Schedule (BCEGS®) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. Non BCEGS communities may contain potentially dangerous buildings, suffer more damage, and may suffer higher or uninsured losses from catastrophes.				
Responsible Agency:	• Maryland Department of Labor, Licensing, and Regulation • Maryland Department of Planning • Maryland Insurance Administration				
Partners:	• Maryland Emergency Management Agency				
Potential Funding:	EMGP, CDBG, BRIC				
Cost Estimate:	$		Timeline:	1 Year/Ongoing	

Priority Ranking H	Mitigation Action/Project Title:	#15 – Encourage jurisdictions to incorporate historic, cultural, archaeological sites, and resources resource considerations into all local Hazard Mitigation Plans, with a focus on protecting these resources while maintaining historic integrity, significance, and National Register eligibility.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	The lack of historic preservation considerations in hazard mitigation plans puts historic and cultural resources at risk to natural hazards, and the potential loss of their designation if mitigation actions are taken that precludes their eligibility for the register.				
Responsible Agency:	• Maryland Emergency Management Agency • Maryland Historical Trust				
Partners:	• Maryland Department of Planning • Maryland Environmental Service				
Potential Funding:	HMGP, BRIC, FMA, EMPG, ESHPF, National Trust for Historic Preservation				
Cost Estimate:	$		Timeline:	3-5 Years	

Priority Ranking H	Mitigation Action/Project Title:	#16 **– Encourage the incorporation of FEMA's seven lifelines into** all local Hazard Mitigation Plans, to prioritize the rapid stabilization of Community Lifelines after a disaster, and **promote the use of FEMA's Guides to Expanding Mitigation by** counties and jurisdictions during their local mitigation efforts.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	The 2021 Maryland HIRA takes into consideration the new Lifelines guidance from FEMA and begins tying HMPs and Actions to the Lifelines. By encouraging incorporation of the Lifelines into county and local planning efforts, such as for transportation, to decrease interruptions to the food supply chain, MEMA can help provide consistency and integration of planning efforts throughout the State.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Maryland Department of Planning • Maryland Environmental Service				
Potential Funding:	EMPG, UASI, BRIC, HMGP				
Cost Estimate:	$		Timeline:	2-3 Years	

Priority Ranking M	Mitigation Action/Project Title:	#17 – Develop a Standard Operating Guide for Hazard Mitigation Planning, to streamline the HMP update process for Maryland counties and jurisdictions by providing a model plan outline, to clarify existing guidance (for Emergency Managers), and to support communities developing their HMPs.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	5	10	30
Background/Issue:	There is little consistency between MD plans. Providing guidance for each county to develop their plan based on SOG requirements, it would standardize the update process at the local level, and would make the plan review process faster at the state level.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	HMGP, BRIC				
Cost Estimate:	$		Timeline:	3-5 Years	

Priority Ranking M	Mitigation Action/Project Title:	#18 – Develop and provide a library of tools and resources to assist jurisdictions with garnering public input and support during the HMP update process and plan adoption and maintenance processes.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	5	10	30
Background/Issue:	There is a growing lack of public participation in local HMP update processes. This lack of interest is compounded by recent Covid-19 restrictions. Lack of participation could lead to the State and FEMA not approving the Plan. This is especially important in the age of COVID-19 where all interactions must be digital and many citizens may not be computer literate or technologically savvy.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	EMPG, UASI, HMGP, BRIC				
Cost Estimate:	$ State led, low cost	Timeline:	2-3 Years		

Priority Ranking H	Mitigation Action/Project Title:	#19 – Develop a project portfolio comprised of statewide hazard mitigation success stories and best practices, and post them on the MEMA website for local jurisdictions to refer to during mitigation efforts.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	Communities may not have an idea of what actions are acceptable or applicable to their jurisdictions or what the outcomes of such actions might be. A portfolio of tried and tested actions and success stories will allow jurisdictions to choose those most appropriate for their communities. While similar resources may be available from an assortment of agencies and jurisdictions, housing all of these resources on the MEMA website will make it an easy to use "one-stop shop" for Maryland's planners and jurisdictions. The focus will be on non-traditional hazard mitigation actions. These can include efforts taken by DNR, MHT, MTA, and other State agencies that may not fall squarely in the realm of emergency management.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	HMGP, EMGP				
Cost Estimate:	$ Low cost; state/consultant fees product	Timeline:	1-2 Years		

Priority Ranking M	Mitigation Action/Project Title:	#20 – Work with jurisdictions to promote partnerships with local **organizations to develop "Community Resilience Hubs" to** support residents, coordinate communication, distribute resources, and to help communities to become more self-determining and socially connected, before, during, and after hazard events.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	5	10	30
Background/Issue:	Often, county or jurisdictional agencies are not clear on specific roles and responsibilities during a hazard or disaster situation. Having a tool outlining this information provides agencies and the public a quick "one-stop shop" for critical information. Community Resilience Hubs (http://resilience-hub.org/) assist with a jurisdiction's: community resilience, emergency management, climate change mitigation, and social equity while also providing opportunities for communities to become more self-determining, socially connected, and successful before, during, and after hazard events or disruptions.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	UASI, EMPG, HMGP				
Cost Estimate:	$		Timeline:	5 Years	

Priority Ranking H	Mitigation Action/Project Title:	#21 – Conduct annual reviews of the State HMP, and require state departments, counties, and local governments to submit annual updates regarding implementation status of the actions identified in their previous Flood and Hazard Mitigation Plans.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	High staff turnover due to promotions, retirements, and "pass through" leave many jurisdictions without the institutional knowledge regarding past mitigation actions. This can hinder the HMP update process and any actions that may have been infeasible or not applicable could be carried forward without proper background or information, wasting both time and resources. Additionally, changing MEMA priorities have limited progress on many past actions. Annual reviews will keep consistency with State priorities and plan integration efforts.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	HMGP, EMGP				
Cost Estimate:	$ Staff Time		Timeline:	1 Year/Ongoing	

<table>
<tr><td>Priority Ranking
H</td><td>Mitigation Action/Project Title:</td><td colspan="5">#22 – Work with county and local communities, and provide informational and educational tools and products, to promote the local benefits of to encourage participation in the StormReady, CRS, BCEGS, Firewise, or other relevant planning, preparedness, and mitigation incentive programs.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>10</td><td>10</td><td>10</td><td>40</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">Some communities in the floodplain still do not participate in the CRS Program, and others could improve their class rating with additional activities. This helps communities receive insurance discounts. With the additional resources provided to jurisdictions by the State under this HMP, such as outreach tools and a project library, participation and maintenance may be easier for many jurisdictions.

Communities not meeting StormReady or other incentive program requirements may not have appropriate planning, mitigation, monitoring, forecasting, and warning capabilities. StormReady ensures communities: establish a 24-hour warning points, have more than one way to receive severe weather warnings and forecasts and to alert the public, monitor weather conditions locally, promote the importance of public readiness, and develop formal hazardous weather plans.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">● Maryland Department of Labor, Licensing, and Regulation
● Maryland Department of the Environment
● Maryland Emergency Management Agency
● Maryland Insurance Administration</td></tr>
<tr><td>Partners:</td><td colspan="5">● Maryland Department of Planning
● Maryland Environmental Service</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">EMPG, UASI, HMGP, FMA</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$ Staff Time</td><td>Timeline:</td><td colspan="2">1 Year/Ongoing</td></tr>
</table>

Priority Ranking H	Mitigation Action/Project Title:	#23 – Partner with insurance providers/companies directly to encourage coverage of pre-storm actions for hazard mitigation.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	A lack of partnerships with insurance providers or underwriters may lead to residents being under or not insured, and can lead to costly repairs or replacements that could have been prevented with routine maintenance. A prime example is that payment for preventative maintenance such as tree removal is less costly than for roof replacement or structural damage after a storm.				
Responsible Agency:	• Maryland Insurance Administration • Maryland Emergency Management Agency • Maryland Department of the Environment				
Partners:	• Maryland Environmental Service				
Potential Funding:	BRIC, HMGP, EMPG, UASI, FMA				
Cost Estimate:	$ Variable/unknown	Timeline:	1-2 Years/Ongoing		

Priority Ranking L	Mitigation Action/Project Title:	#24 – Establish a regular schedule to report regional drought conditions to agricultural entities, offices, and stakeholders throughout the State.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	2	5	5	2	14
Background/Issue:	Lack of regular water table and drought conditions monitoring may hinder planning and response efforts. Several stakeholders indicated a lack of information regarding conditions in their survey responses.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency				
Partners:	• Maryland Environmental Service				
Potential Funding:	EMPG, LFP				
Cost Estimate:	$		Timeline:	1 Year/Ongoing	

Priority Ranking M	Mitigation Action/Project Title:	#25 – Provide information to local governments and the public regarding risks to public drinking water (public health) that can arise from various hazards or disasters (dam failure, flooding, etc.).			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	5	5	25
Background/Issue:	A lack of understanding regarding a hazard's effects on ground water and drinking water by the public can cause public health crisis following a natural hazard event.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Department of Health				
Partners:	• Maryland Environmental Service				
Potential Funding:	PWEAA, PHEP, EMPG, UASI				
Cost Estimate:	$ Staff time to develop materials	Timeline:	1-2 Years		

<table>
<tr><td>Priority Ranking
M</td><td>Mitigation Action/Project Title:</td><td colspan="5">#26 – Conduct an equity audit to identify how programs and policies are administered, and the impacts they have on the diverse stakeholders we serve. Utilize the results to develop an equity lens to be incorporated into revisions of existing programs and policies, and to be used as a guide when developing new programs and policies. Build capacity to plan for equity in all actions and programs by engaging community leaders from target communities in the planning processes.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>5</td><td>2</td><td>10</td><td>27</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">MEMA is committed to diversity, equity, and social and environmental justice. MEMA will evaluate programs and policies to ensure equity across the State.

Minorities are disproportionately affected by the impacts of power plants located in or near their neighborhoods. A national study found that, even after accounting for income, Black or Hispanic communities have fewer distributed solar facilities (i.e., rooftop solar) than predominantly white communities. Additionally, low to moderate (LMI) communities typically lack the resources to pursue energy improvements in their own homes due to limited or nonexistent discretionary income, or they reside in leased properties where they do not have the authority to implement facility upgrades.

The State's Resiliency Hubs Grant Program provides incentives to developers to install solar plus energy storage systems at facilities that could provide critical services to low- and moderate-income neighborhoods during a grid outage. The MEA Resilient Maryland Program encourages projects that benefit LMI communities over those that do not. This is given priority consideration in the review of proposals. Effective equity planning requires that leaders from the communities that the associated programs and policies are designed to benefit be actively included in this planning and take leading roles. Community leaders understand the unique needs of those they serve and hold their trust and confidence.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">● Maryland Emergency Management Agency
● Maryland Energy Administration</td></tr>
<tr><td>Partners:</td><td colspan="5">● Mitigation Advisory Committee</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">EMPG, UASI</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">2-3 Years</td></tr>
</table>

<table>
<tr><td rowspan="2">Priority Ranking
M</td><td>Mitigation Action/Project Title:</td><td colspan="5">#27 – Prioritize disaster risk reduction by implementing the Sendai Disaster Risk Reduction Framework in Maryland to prevent new and reduce existing disaster risk by focusing on shared responsibility amongst stakeholders, including local governments, the private sector, NGOs, and the public.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>5</td><td>2</td><td>10</td><td>27</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">The view of shared responsibility amongst stakeholders, including local governments, the private sector, NGOs, and the public ensure participation and ownership of planning, implementation, and maintenance at every level.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">• Maryland Emergency Management Agency</td></tr>
<tr><td>Partners:</td><td colspan="5">• Mitigation Advisory Committee</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">EMPG, UASI</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">3-5 Years</td></tr>
</table>

<table>
<tr><td>Priority Ranking
M</td><td>Mitigation Action/Project Title:</td><td colspan="5">#28 – Encourage and foster Public - Private Partnerships (P3s) between state, county, and local governments, and private or non-profit organizations and entities, to take advantage of private expertise, initiatives, and/or resources, and encourage the shared responsibility highlighted under the Sendai Framework.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>5</td><td>5</td><td>10</td><td>30</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">By implementing the Sendai Disaster Risk Reduction Framework in Maryland to share responsibility amongst stakeholders, and encouraging Public - Private Partnerships between state, county, and local governments, and private or non-profit organizations and entities, the State can encourage the shared responsibility highlighted under the Sendai Framework. Strategic partnerships provide a platform to discuss potential regional strategies and projects.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">● Maryland Emergency Management Agency</td></tr>
<tr><td>Partners:</td><td colspan="5">● Maryland Department of Commerce
● Maryland Environmental Service</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">EMPG, UASI, BRIC, and partnerships funding</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$ Staff time</td><td>Timeline:</td><td colspan="2">1-2 Years/Ongoing</td></tr>
</table>

Priority Ranking H	Mitigation Action/Project Title:	#29– Encourage and support innovative mitigation and planning projects by state agencies and at local levels, by leveraging both FEMA and non-fema funding sources.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	5	10	35
Background/Issue:	MEMA's priorities for the Hazard Mitigation Cycle include expanding potential funding sources (including private and non-traditional sources) and supporting new and innovative projects and initiatives statewide.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	EMPG, UASI, MDE's Comprehensive Flood Management Grant Program, DNR's Grants Gateway				
Cost Estimate:	$ Staff time/consultant fees to evaluate framework of funding	Timeline:	1-2 Years/Ongoing		

<table>
<tr><td rowspan="2">Priority Ranking
H</td><td>Mitigation Action/Project Title:</td><td colspan="5">#30 – Convene state and allied stakeholders (NGOs, advocacy organizations, institutions, etc.) on an annual basis to develop innovative risk reduction solutions aimed at improving the quality of Maryland's communities and the lives of Marylanders.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>10</td><td>5</td><td>10</td><td>35</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">By implementing the Sendai Disaster Risk Reduction Framework in Maryland to share responsibility amongst stakeholders, and encouraging Public - Private Partnerships between state, county, and local governments, and private or non-profit organizations and entities, the State can take advantage of private expertise, initiatives, and/or resources, and encourage the shared responsibility highlighted under the Sendai Framework. Meeting regularly with these stakeholders provides a funnel for those insights and resources to planning and implementation efforts.

MEMA will continue to convene the Mitigation Advisory Committee to discuss risk reduction projects and implementation of the State Hazard Mitigation Plan and determine where it would be applicable for the MAC to serve as a technical expert committee for other workgroups throughout the State. This action will also be supported by reconvening the Disaster Risk Reduction Working Group staffed by MEMA.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">● Maryland Emergency Management Agency</td></tr>
<tr><td>Partners:</td><td colspan="5">● Mitigation Advisory Committee</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">BRIC, EMPG, UASI, HMGP</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$ State staff and venue costs</td><td>Timeline:</td><td colspan="2">1 Year/Ongoing</td></tr>
</table>

<table>
<tr><td>Priority Ranking
H</td><td>Mitigation Action/Project Title:</td><td colspan="4">#31 – Foster regional cooperation and support the development of regional actions through the Local Hazard Mitigation Stakeholder Groups and other strategic partnerships.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>10</td><td>5</td><td>10</td><td>35</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">By implementing the Sendai Disaster Risk Reduction Framework in Maryland to share responsibility amongst stakeholders, and encouraging Public - Private Partnerships between state, county, and local governments, and private or non-profit organizations and entities, the State can prioritize regional and “whole community” actions over single asset actions, and encourage the shared responsibility highlighted under the Sendai Framework. Meeting regularly with these multi jurisdiction committees, organizations, and stakeholders provides a platform to discuss potential regional strategies and projects.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">• Maryland Emergency Management Agency</td></tr>
<tr><td>Partners:</td><td colspan="5">• Mitigation Advisory Committee</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">EMPG, UASI, HMGP</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">1 Year/Ongoing</td></tr>
</table>

Priority Ranking H	Mitigation Action/Project Title:	#32 – Prioritize regional projects over "local-only" projects when evaluating hazard mitigation project applications, notice of interest (NOI) submissions, and other proposed mitigation and planning projects.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	10	40
Background/Issue:	By implementing the Sendai Disaster Risk Reduction Framework in Maryland to share responsibility amongst stakeholders, and encouraging Public - Private Partnerships between state, county, and local governments, and private or non-profit organizations and entities, the State can prioritize regional and "whole community" actions over single asset actions, and encourage the shared responsibility highlighted under the Sendai Framework. Meeting regularly with these multi jurisdiction committees, organizations, and stakeholders provides a platform to discuss potential regional strategies and projects.				
Responsible Agency:	• Maryland Emergency Management Agency				
Partners:	• Mitigation Advisory Committee				
Potential Funding:	BRIC, EMGP				
Cost Estimate:	$	Timeline:	1-2 Years/Ongoing		

Priority Ranking H	Mitigation Action/Project Title:	#33 – Incorporate energy impacts into critical facilities' planning functions, operational decisions, emergency operation plans, and capital improvement budgets by educating state agencies and local governments about the need for energy security.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	10	10	5	35
Background/Issue:	Buildings and infrastructure systems depend on electric power and fuel supplies to support services and businesses. Although a hospital or emergency operations center may not be physically damaged by a weather event, loss of power will equate to loss of services and disrupted operations. Power failures lead to the inability to sustain electric powered equipment such as lighting, heating, ventilation, air conditioning systems, appliances, medical equipment; communication equipment, fire and security systems, water and waste disposal systems, etc. While backup generators provide some level of resiliency/redundancy to critical infrastructure operations, their fuel supplies are generally limited in volume. Pursuing resilient energy systems in capital planning, such as those that include solar PV, battery storage, and/or combined heat and power (CHP) technologies increases facility resiliency when the fuel supply is continuous – i.e. solar systems produce electricity during the daytime and CHP systems will continue operating as long as they are fitted with black start/islanding technologies and are connected to natural gas.				
Responsible Agency:	• Maryland Energy Administration				
Partners:	• Maryland Emergency Management Agency • Maryland Department of the Environment • Maryland Environmental Service				
Potential Funding:	BRIC				
Cost Estimate:	$		Timeline:	1-2 years/Ongoing	

<table>
<tr><td rowspan="2">Priority Ranking
M</td><td>Mitigation Action/Project Title:</td><td colspan="5">#34 – Evaluate new and existing state and local government buildings, critical facilities, and infrastructure for solar potential. Prioritize these based on their ability to sustain safe, clean, efficient, and reliable backup solar power systems aligned with locational and site characteristics, fuel supply availability, and operational needs.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>5</td><td>10</td><td>5</td><td>10</td><td>30</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">Public buildings and infrastructure, including state, local government, universities, schools, and other facilities guided by state or local policy, provide an ideal opportunity for accelerating solar development in the built environment. Maryland operates more than 2,000 facilities across 50 plus agencies. Many of these facilities and sites may be suitable for solar; however, they must be evaluated to assess issues such as viewshed, historic status, shading, facility condition, long term disposition, potential alternative future uses and more.

The Governor's Task Force on Renewable Energy Development and Siting recommends a collaborative approach including the development of guidelines to identify cost-effective thresholds for when solar should be included, or facilities made solar-ready, for state projects and those heavily- funded by the state. MEA offers the Public Facility Solar Grant Program to local and state government facilities for the installation of solar PV systems on existing infrastructure. MEA also opened the Solar Technical Assistance Program which pays for solar PV feasibility assessments for local and state governments as well as public educational institutions. These feasibility assessments are completed by the Maryland Environmental Service (MES).</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">• Maryland Energy Administration</td></tr>
<tr><td>Partners:</td><td colspan="5">• Maryland Emergency Management Agency
• Maryland Department of the Environment
• Maryland Historical Trust
• Maryland Department of Planning
• Maryland Environmental Service</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">BRIC</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">2-3 Years</td></tr>
</table>

<table>
<tr><td>Priority Ranking
M</td><td>Mitigation Action/Project Title:</td><td colspan="4">#35 – Eliminate or minimize disruption of local government operations caused by natural hazards by enhancing the resilience of identified critical infrastructure, critical facilities, institutions, and services, by adopting a framework for valuing distributed energy resource costs and benefits, and installing new microgrid systems that include photovoltaic (PV) solar power systems or other sources for local power generation.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>5</td><td>5</td><td>10</td><td>27</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">Climatologists predict an increase in the number and intensity of severe weather events. More storms with higher, more damaging wind speeds will increase the chance that the power infrastructure will be impacted. Extreme temperatures are predicted to increase as well. During the hot summer months, the potential for customer power demand for power to exceed supply has the potential to lead to more blackouts and brownouts. Additionally, climatologists predict an increase in precipitation, which may lead to more damaging winter weather that damages power infrastructure and causes additional power failures.

The electricity industry's traditional rate design is based on the premise that all ratepayers share the costs of the system. The framework of rate determination does not prescribe an outcome that costs be shared either equally or proportionally. Because microgrids are designed to directly serve only a certain number of ratepayers within a defined geographic area, the benefit must be fully understood before a tariff can be formulated (e.g. Does the benefit extend to the entire customer base through added grid resiliency, or is it generally provided to the customers connected to the microgrid?). These metrics must be fully understood before a framework can be proposed.

MEA, in partnership with other state agencies, has initiated a first-of-its-kind resilient power system assessment process for businesses, state and local facilities, and other organizations in Maryland. MEA is reaching out to state/local agencies to identify potential candidate facilities and is providing support to help agencies select the most viable projects. The Resilient Maryland Program in FY21 will help plan and design resilient energy systems that use solar energy storage, and other distributed energy resources (DER) technologies in support of microgrids, including vital public safety and essential state and local facilities.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">• Maryland Energy Administration</td></tr>
<tr><td>Partners:</td><td colspan="5">• Maryland Emergency Management Agency
• Maryland Department of the Environment
• Maryland Department of Planning
• Maryland Environmental Service</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">BRIC</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">1-2 years</td></tr>
</table>

Priority Ranking M	Mitigation Action/Project Title:	#36 – Support energy security by diversifying supply and improving the reliability and resiliency of utility distribution systems, and power critical infrastructure.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	5	5	25
Background/Issue:	Distribution systems are vulnerable to multiple hazard events, including tree-related damage during wind events, failure of utility poles during hurricanes and tornadoes; circuit overload, fire and other damage caused by lightning strikes. An aging energy system is a major issue in many older urban and suburban areas, increasing the vulnerability of their residents, businesses and critical and essential facilities and services. Resilient energy systems, such as community/campus microgrids, solar PV systems, large battery systems, and other grid-interactive technologies such as smart HVAC systems that can dynamically respond to grid conditions have potential to aid in distribution grid resiliency. By leveraging customer DER systems such as these, distribution utilities can both bolster grid resilience through diversifying sources of supply and demand modulation and they can prolong the replacement of existing distribution infrastructure in a way that minimizes ratepayer impact.				
Responsible Agency:	• Maryland Energy Administration				
Partners:	• Maryland Emergency Management Agency • Maryland Department of the Environment • Maryland Department of Planning • Maryland Environmental Service				
Potential Funding:	BRIC				
Cost Estimate:	$	Timeline:			

<table>
<tr><td>Priority Ranking
H</td><td>Mitigation Action/Project Title:</td><td colspan="4">#37 – Increase and maintain surveillance and monitoring activities for public health issues, with special regard for infectious, animal, water, and airborne diseases.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>10</td><td>10</td><td>10</td><td>40</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">The Covid-19 Pandemic has identified data, surveillance, and monitoring deficiencies at the federal, state, and local levels, including: lack of monitoring/surveillance of potentially infectious agents locally, regionally, and nationally; limited availability of data by race, ethnicity, geography, disability and other demographic variables; and the incidence and prevalence of infectious agents in health care facilities, schools, workplaces, and the general public.

The current Presidential Administration has secured funding and Congressional support to establish an integrated, National Center for Epidemic Forecasting and Outbreak Analytics to modernize global early warning and trigger systems to prevent, detect, and respond to biological threats. The CDC will also maintain public dashboard data at the county level on key pandemic related metrics.

The State intends to support this Federal initiative by: 1) expanding surveillance and monitoring for hotspots, variants of concern, and emerging infectious disease threats and 2) bolstering the tracking of state-data on a range of metrics including cases, tests, vaccinations, hospital admissions, nursing home capacity, hospital bed capacity, supply chain shortages, and other critical markers. The State may also provide data, with non-personally identifiable information, to the public and machine-readable data to assist county and local governments to track performance, support forecasting, and ensure transparency. Additionally, this will allow the State to quickly identify disinformation and misinformation and work closely with stakeholders to ensure that accurate, science-based information is available to Maryland residents and governments.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">● Maryland Department of Health
● Maryland Department of the Environment
● Maryland Emergency Management Agency</td></tr>
<tr><td>Partners:</td><td colspan="5">● Maryland Environmental Service</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">BRIC, PHEP, EMPG, UASI</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">2-3 Years</td></tr>
</table>

<table>
<tr><td>Priority Ranking
M</td><td>Mitigation Action/Project Title:</td><td colspan="4">#38 - Improve food security by creating a Food Resiliency Council to increase and supervise planning efforts to mitigate impacts on agriculture, livestock, and fisheries, and the subsequent food supply chain in Maryland.</td></tr>
<tr><td rowspan="2">Action Ranking</td><td>T – Technical</td><td>E - Economic</td><td>A – Administrative</td><td>M – Multi-Benefit</td><td>Total</td></tr>
<tr><td>10</td><td>5</td><td>5</td><td>10</td><td>30</td></tr>
<tr><td>Background/Issue:</td><td colspan="5">The Covid-19 Pandemic has identified a need to: address the food insecurity crisis in the State; develop recommendations to increase the long-term resiliency of the food system; develop a plan to increase the production and procurement of Maryland certified food; improve food security in food deserts and for underserved populations; and to develop recommendations on a statewide food policy.</td></tr>
<tr><td>Responsible Agency:</td><td colspan="5">● Maryland Department of Agriculture
● Maryland Department of Health
● Maryland Department of the Environment
● Maryland Emergency Management Agency</td></tr>
<tr><td>Partners:</td><td colspan="5">● Maryland Environmental Service</td></tr>
<tr><td>Potential Funding:</td><td colspan="5">BRIC, PHEP, EMPG, UASI, USDA (NIFA) Community Food Projects Competitive Grant Program (CFPCGP)</td></tr>
<tr><td>Cost Estimate:</td><td colspan="2">$</td><td>Timeline:</td><td colspan="2">1-2 Years</td></tr>
</table>

Priority Ranking H	Mitigation Action/Project Title:	#39 – Utilize nature-based solutions for risk reduction in hazardous areas to achieve co-benefits such as flood reduction, water quality improvement, and other ecosystem benefits.			
Action Ranking	**T – Technical**	**E - Economic**	**A – Administrative**	**M – Multi-Benefit**	**Total**
	10	5	10	10	35
Background/Issue:	Nature-based solutions, also known as green or natural infrastructure, harness the inherent value of landscape-level natural systems to improve water quality, prevent erosion, while also serving as a viable control measure for addressing water quantity issues in flood-prone areas. Targeting areas for restoration and preservation using nature-based solutions is a resilient best management practice that will yield supplemental ecosystem service benefits to communities for generations to come.				
Responsible Agency:	• Maryland Department of the Environment • Maryland Department of Natural Resources				
Partners:	• Maryland Department of Planning • Maryland Emergency Management Agency • Maryland Environmental Service • Maryland Department of Transportation				
Potential Funding:	EPA's Chesapeake Bay Program Grants, BRIC, FMA, HMGP, DNR's Gateway Grants, MDE CFMGP, USACE, CBT, NOAA				
Cost Estimate:	$ Variable depending on the project or plan		Timeline:	1 Year/Ongoing	

Past Action Status Forms

Appendix E – 2016 Past Action Status Forms

This Appendix provides updates on Mitigation Actions included in the 2016 Hazard Mitigation Plan (past actions). Actions that have not started, have not been completed, or did not present a current status have been carried forward into the 2021 HMP Update. Those actions completed, cancelled, or are otherwise deemed infeasible or not applicable are also detailed in the tables below.

Priority Ranking **H**	**Mitigation Action/ Project Title:**	**#1 – Completion of Elevation Certificates for Historic Properties at Risk to Flooding**
Background/ Issue:	More and more historic and cultural resources are lost to natural hazards and disasters every year. Historic buildings have been completely destroyed by flood waters, as seen in Ellicott City, and historic cemeteries are washing out into the Bay and rivers throughout the State, due to sea-level-change.	
Action Description:	Reduce flood risk for historic properties Statewide, by obtaining 250 elevation certificates for structures within SFHA; these may include residential or commercial structures. The acquisition of Elevation Certificates and the application of flood risk mitigation practices to reduce possible damages in ways that also preserve the historic integrity of the properties and allow properties listed in the National Register of Historic Places could help retain their historic designation. Perform analysis to identify high-risk structures and where the highest priorities are. Identify structures or communities where depth-of-flooding is 3' or greater in relation to the base flood elevation. Use the information gathered from the elevation certificate to perform a HAZUS UDF file and begin creating the cost/benefit analysis for anticipated potential losses to these structures or communities. This cost/benefit analysis will be used to identify processes to flood prevention for historical structures in the future.	

Ideas for Integration:	Use risk data with HAZUS to populate cost/benefit analysis in order to inform project application and provide funding for the project. Incorporate information into local hazard mitigation plans.		
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Historical Trust		
Partners:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Historical Trust • Maryland Environmental Service		
Potential Funding:	Hazard Mitigation Assistance		
Benefits: (Losses Avoided)	Mitigate losses to historical structures within the state of Maryland in order to preserve the history and culture of the State.		
Cost Estimate:	$250,000	**Timeline:**	1 Year
Current Status:	**Not started/Cancelled:** This action is no longer a priority for the Agency. MEMA is focused on community-based risk reduction vs. assets-based risk reduction. However, ranking criteria was developed to prioritize community-based projects. The mapping and quantification of flood risk data exists, and the data acquisition phase of this project is largely complete. However, it has not been applied to historic structures, nor has there been acquisition of elevation certificates for historic structures. The State did, however, develop a BFE+3' layer called the Climate Ready Action Boundary (CRAB).		

Priority Ranking L	Mitigation Action/ Project Title:	#2 – Elevation Project Application Enhancement		
Background/ Issue:	Enhance the conceptual elevation project application process with a working process.			
Action Description:	Develop electronic/web-based applications for structural elevation projects that are not difficult to manage and are not often misunderstood by local residents/county staff.			
Ideas for Integration:	Provide engineering contract/analysis for pre-application review process			
Responsible Agency:	• Maryland Emergency Management Agency • Maryland Environmental Service			
Partners:	• Maryland Department of the Environment • Maryland Historical Trust			
Potential Funding:	Hazard Mitigation Assistance			
Benefits: (Losses Avoided)	Positive cost benefit and assurance going into projects for staff and resident			
Cost Estimate:	$10,000 - $20,000 per elevation project – associated engineering & soil analysis cost	**Timeline:**	1 year (Declaration Dependent)	
Current Status:	**Ongoing –** Project is ongoing and on time. Project is providing benefits through the increasing accessibility of Sub-application and resources. MEMA has increased the number of proposals submitted to the State. Funding is difficult to obtain for pre-award costs, such as engineering, however BRIC now has a dedicated category for Capacity and Capability Building. MEMA has refined its priorities and is focused on community-based risk reduction vs. assets-based risk reduction. MEMA is putting more focus on streamlining Sub-applications and increasing accessibility for community-based projects.			

Priority Ranking **H**	**Mitigation Action/Project Title:**	**#3 – Enhance Maryland Flood Maps (www.mdfloodmaps.org)**
Background/ Issue:	The State recognizes that floodplains are constantly changing throughout the permitting processes in addition to supplemental LOMAs and LOMRs issued through FEMA. As a result, the State would like to create an upload functionality for models, photos, etc. in order to maintain a comprehensive repository of flood-related data for Maryland.	
Action Description:	MD Flood Maps has integrated updated DFIRMs and other State data to date. Newly completed non-regulatory coastal HAZUS data and proposed HAZUS riverine data (when completed) should be integrated with MDE Flood Maps to expand the application and account for all aspects of flood risk in the State. Also, Maryland Historical Trust, other critical infrastructure, and relevant datasets will be included as input from the State Hazard Mitigation Plan for Maryland. Outreach will also be necessary to inform local Floodplain Managers and Engineers how to use this tool. Finally, the State would like to ensure there is no disparity between the data that Maryland has inside of *MD Flood Maps* versus FEMA data sources. Workflow processes will be established and implemented in order to ensure that systems between State and Federal government are in sync.	
Ideas for Integration:	Using one application to account for all Maryland flood risk data will enable Maryland to have a one-stop site for data sharing and opportunities for related data and collaboration.	
Responsible Agency:	• Maryland Department of the Environment	
Partners:	• Maryland Department of the Environment • Maryland Environmental Service • Maryland Emergency Management Agency • Maryland Historical Trust	
Potential Funding:	• Pre-Disaster Mitigation Assistance • Hazard Mitigation Grant Program • Cooperating Technical Partners • CBIG	
Benefits: (Losses Avoided)	One stop shop for flood risk evaluation and mitigation opportunities. This information will be extremely valuable to local Floodplain Managers, Engineers, and the public for submitting permit applications for waterway construction permits in addition to grant	

<table>
<tr><td></td><td colspan="3">applications for Hazard Mitigation Grant Program funding. Additionally, the public will be able to use these resources in order to better evaluate their risk, estimated losses, flood zone designations, water surface elevations, depth of flooding, etc.</td></tr>
<tr><td>Cost Estimate:</td><td>$87,000</td><td>Timeline:</td><td>• Predicated on funding availability: Upload functionality – eight (8) weeks; Integrating HAZUS data as identified in benefits section – two (2) weeks; Document and implement sync protocol between state and federal partners – four (4) weeks; Education and Outreach – ten (10) weeks</td></tr>
<tr><td rowspan="2">Current Status:</td><td colspan="3">In Progress, on-going (as noted):

• HAZUS datasets (coastal and riverine non-regulatory products) from the 2016 State Hazard Mitigation Plan are currently being loaded into Maryland iMAP. Once the upload is complete, users can add this information to the Flood Risk Application using the Add Data function.
• Medusa (MHT) Cultural Resources Data Integration – This subcomponent is still in-progress. This information is currently accessed through the Add Data function and information is static, not hyperlinked back to MHT's documentation.
• Upload for models and photographs – These functions have not yet been added.
• LOMA/LOMR data integrated into the Maryland Flood Risk Application as an interactive operational layer that shows their location and provides detailed information (e.g., Case Number, Status, etc.) that allows the user to research the LOMA/LOMR on FEMA's Map Service Center to find additional details.
• Workflow processes to ensure State and Federal data are synchronized have been developed and implemented. The data in the Flood Risk Application is updated monthly with information downloaded from FEMA's Map Service Center. The symbology for Maryland FIRM data is currently being updated to match FEMA's symbology for the Special Flood Hazard Area on the Effective and Preliminary FIRMs. Note: This sub-task is ongoing.</td></tr>
<tr><td colspan="3">Partners utilized: Maryland Department of the Environment, Maryland Emergency Management Agency, Maryland Department of Technology, Maryland Environmental Service. New Partnerships created: Maryland Association of Realtors (MAR)

New Benefits Realized: There has been an increase in awareness and communication by working alongside the Maryland Association of Realtors and their membership base. Under the Insurance Section of</td></tr>
</table>

	the template contract used for the sale of a residential home in Maryland, the MAR has included reference to the FEMA NFIP and *mdfloodmaps.com* as a free resource recommended as a one-stop 'understanding and learning about flood risk' shop, in Maryland. Successes/Challenges: The State continues to leverage partnerships across state agencies, breaking down silos of information, and working collaboratively to share information and enhance the Flood Risk Application Supporting Statistics: An average of 60,000 – 80,000 homes are purchased/sold in any given year in Maryland. Each transaction includes a buyer and a seller, resulting in 120,000 – 160,000 opportunities to connect and communicate flood risk to the citizens of Maryland on an annual basis.

Priority Ranking M	Mitigation Action/ Project Title:	#4 – Elevation Project Application Enhancement – Historic Structures	
Background/ Issue:	N/A		
Action Description:	The current survey collector application can be adapted to capture information on flood and coastal hazards for use in developing mitigation actions or to be used post-disaster to record information on damages and specific impacts of events.		
Ideas for Integration:	Local Hazard Mitigation Plans and local Preservation Plans		
Responsible Agency:	• Maryland Historical Trust		
Partners:	• Local governments • National Park Service • Maryland Emergency Management Agency		
Potential Funding:	• CLG (Certified Local Government) • Pre-Disaster Mitigation Grant Program		
Benefits: (Losses Avoided)	Preservation of Cultural Resources		
Cost Estimate:	None Provided	**Timeline:**	2-3 years
Current Status:	**In progress:** The National Park Service post disaster survey app has been developed. MHT is currently working with NPS to create a digital version of the vulnerability and hazard assessment form. MHT is also working with Calvert County to develop an archaeological collector app.		

Priority Ranking **M**	**Mitigation Action/ Project Title:**	**#5 – Develop Flood Mitigation Guidance for Historic Properties**	
Background/ Issue:	Guidance for managing changes to historic properties is provided by the Department of the Interior through the National Park Service, which maintains the National Register of Historic Places. No guidance has been forthcoming, which leaves State Historic Preservation Offices and local government at a loss for how to address mitigation actions and their impacts to historic properties comprehensively and consistently.		
Action Description:	Guidance is needed at the State level so that the Maryland Historical Trust can provide a path forward for historic property owners who wish to become more resilient to natural hazards and climate change while respecting the historic integrity of the property.		
Ideas for Integration:	Preserve Maryland (Statewide Preservation Plan); State Hazard Mitigation Plan; National Park Service		
Responsible Agency:	• Maryland Historical Trust		
Partners:	• National Park Service		
Potential Funding:	• Staff time		
Benefits: (Losses Avoided)	Mitigation of historic properties in ways that balance preservation and protection from the effects of natural hazards and climate change.		
Cost Estimate:	None Provided	**Timeline:**	1 year
Current Status:	**Completed:** "The Flood Mitigation Guide: Maryland's Historic Buildings" was completed in 2018 based on work assisted by a grant from the National Park Service. The document is a "road map" to help local governments and preservation advocates protect historic properties in their communities from flooding. While it addresses specific strategies, such as floodproofing and elevating buildings, that may be useful for property owners. The Guide focuses on what communities can do before, during, and after a flood to ensure that historic preservation is considered within the ongoing process of emergency management. https://mht.maryland.gov/documents/PDF/plan/floodpaper/2018-06-30_MD%20Flood%20Mitigation%20Guide.pdf		

	MHT's Statewide Preservation Plan - Preserve Maryland II (2019-2023) was integrated with this action.

Priority Ranking **H**	**Mitigation Action/ Project Title:**	**#6 – Develop Flood Risk Freeboard Layer - *MDFloodMaps***	
Background/ Issue:	Multiple Maryland jurisdictions implement freeboard/elevation requirements for development/permitting which is enforced with the current regulatory boundaries. however, a layer does not currently exist to assess increased flood risk/freeboard outside of the 100-year extents.		
Action Description:	Develop additional floodplain boundaries reflecting selected freeboard increases (1-ft, 2-ft, 3-ft, etc.).		
Ideas for Integration:	Information can be included into the local plans and support local permitting.		
Responsible Agency:	• Maryland Department of the Environment		
Partners:	• Maryland Emergency Management Agency • State Highway Administration		
Potential Funding:	• Hazard Mitigation Assistance • Cooperating Technical Partner Program		
Benefits: (Losses Avoided)	Support local permitting and floodplain management.		
Cost Estimate:	$500,000	**Timeline:**	TBD
Current Status:	**In Progress:** In cooperation with Maryland's Coast Smart Council, a Climate Ready Action Boundary (CRAB) data layer was created for tidal and coastal floodplain areas that adds three (3) feet of freeboard to the Base Flood Elevation on FEMA's Flood Insurance Rate Maps (FIRMs) and extends the elevation out laterally to show the horizontal extents of potential flooding. There are plans to include riverine (non-tidal) areas in this data layer.		

Priority Ranking M	Mitigation Action/ Project Title:	#7 – Education & Outreach on Historic Properties and Coastal Hazards Mitigation and Climate Change Resiliency
Background/ Issue:	Local government may not have the technical knowledge or staff to plan for the protection of historic properties and other cultural resources in ways that balance protection with preservation. This leaves historic properties vulnerable to the effects of natural hazards and leaves property owners trapped in a cycle of damage and repair. For example, historic properties have not been protected from flooding because they were perceived as too difficult to work with and due to grandfathering and low flood insurance premiums. Historic property owners have not had received encouragement or impetus to mitigate their property. However, Biggert-Waters and the HFIAA eliminated the grandfathering of pre-FIRM structures and required flood insurance premiums to slowly increase to reflect the actuarial cost of the risk of flood. This creates a situation where historic property owners will begin to seek mitigation to reduce the cost of their flood insurance.	
Action Description:	Online training modules and conducting onsite workshops (in conjunction with the Maryland Resiliency Partnership) can help local government to learn how to integrate historic properties into hazard mitigation and climate change resiliency plans and actions. Workshops can be held to help historic property owners learn how to protect their property from the effects of coastal hazards and climate change (mostly flood- and sea level rise-related).	
Ideas for Integration:	Preserve Maryland (Statewide Preservation Plan); State Hazard Mitigation Plan (Future Plan Update: Develop Cultural Resource Section); CRS Users Group meetings and outreach.	
Responsible Agency:	• Maryland Historical Trust	
Partners:	• Maryland Emergency Management Agency • Maryland Department of the Environment • Department of Natural Resources • Preservation Maryland • Local governments • Maryland Silver Jackets	
Potential Funding:	• CLG (Certified Local Governments); • HMGP; • Technical assistance available from state agencies.	

Benefits: (Losses Avoided)	Increase local awareness of hazard risk and opportunities for mitigation and resiliency of historic properties; all the same things in the "All Hazards Risk, Mitigation & Resiliency Outreach" example provided at meeting with MEMA.		
Cost Estimate:	$25,000 Annually	**Timeline:**	1 year
Current Status:	**Completed/Ongoing:** Several efforts have already been conducted/completed as shown below, but new/additional education and outreach efforts will continue going forward. • 2016-2017. Created five (5) Training Modules on different steps in the hazard mitigation planning process for cultural resources. • 2018-2019. Revised Training Modules to align with MHT's Flood Mitigation Guide: Maryland's Historic Buildings. • 3-17-2017. "Mother Nature Bats Last: Climate Change, Natural Hazards, and Archaeological Sites" at the Middle Atlantic Archaeological Conference will present different approaches taken in Maryland to survey and document vulnerable archaeological sites. • 5-25-2017. "Weather It Together: Protecting Maryland's Historic Buildings from Floods." Planning for nuisance flooding and flood events, perspectives on flood mitigation and adaptation, and tools and resources for communities. • 4-13-2018. Society for American Archaeology's Annual Meeting. "Scylla or Charybdis: Prioritizing the Investigation of Sites Endangered by Natural Hazards." MHT's planning process for managing vulnerable sites was presented as a model for other jurisdictions. • 6-28-2018. "Hazards Planning Workshop for Small Sites & Museums", in conjunction with the Anacostia Trails Heritage Area, presented information on flood preparedness, and post-flood response for small sites and museums. • 10-10-2018. "Emergency Preparedness Workshop" Individual emergency preparedness, special planning considerations for businesses, and understanding risks and how to prepare to reduce flood damages to buildings and contents. Funding for above listed efforts: National Park Service Hurricane Sandy Disaster Relief Grant. • 7-24-2019. "Planning for Climate Change and Cultural Heritage." Old Line State Summit, Frederick. This session outlined the State of Maryland's work related to climate change and cultural heritage and the resources available to communities interested in climate		

	change planning for historic properties and archaeological sites, featuring the work of two communities. • 10-7-2019. "Weather We Like it or Not: Preserving Our Heritage in a Changing Climate" American Planning Association Maryland Chapter conference, Rocky Gap, MD • 10-8-2019. "Historic Preservation, Planning and Climate Change: State and Local Partnerships." American Planning Association Maryland chapter conference, Rocky Gap, MD Exploring how climate change is affecting Maryland communities now. This session demonstrated how state and local preservation planners are stepping up to the challenge of identifying threatened resources, developing collaborative and comprehensive hazard mitigation plans, and implementing them in urban, suburban and rural settings. • 8-7-2020. "Planning for Climate Change and Cultural Heritage." National Alliance of Preservation Commissions.

Priority Ranking H	Mitigation Action/ Project Title:	#8 – Conduct Survey & Evaluation of Historic Properties and other Cultural Resources in Coastal High Risk Hazard Areas – AE & VE Zones	
Background/ Issue:	There have been only few surveys of these properties conducted since the 1990s – It is not known how many historic properties and cultural resources are at risk to damage/destruction by natural hazards and the effects of climate change.		
Action Description:	A risk assessment cannot be conducted nor can protection measures be identified without knowing where properties are, or determining their importance in the local community.		
Ideas for Integration:	• Maryland Historical Trust's Preserve Maryland Plan (not correct title) • Local Hazard Mitigation Plans • Local Preservation Plans • Local Flood Mitigation Area Plans		
Responsible Agency:	• Maryland Historical Trust		
Partners:	• Maryland Emergency Management Agency • Maryland Department of the Environment		
Potential Funding:	• CLG (Certified Local Government) • CoastSmart, • Pre-Disaster Mitigation Grant Program • Flood Mitigation Assistance • Hazard Mitigation Grant Program • Technical assistance available from state agencies		
Benefits: (Losses Avoided)	Preserving Historical Properties & Cultural Resources		
Cost Estimate:	$15,000-30,000/Community	**Timeline:**	Local Hazard Mitigation Plan Cycle (5 years)
Current Status:	**Completed:** Between FY18 – FY21, MHT's Non-Capital Grant Program gave special priority to projects designed to assess, document, or address the impact of natural disasters, ongoing natural processes and/or climate change to threatened resources. FY18 projects included historic structures documentation in Somerset and Dorchester counties, and archaeological surveys on the Honga River in Dorchester County. FY19 projects included historic structures documentation in		

	Somerset and Dorchester counties, and two archaeological surveys at an important prehistoric site complex in Jug Bay in Anne Arundel County, and in the Fishing Bay watershed at the mouth of the Nanticoke River in Dorchester County. FY20 projects included the Lower Eastern Shore Threatened Sites Survey Phase III and the Parsons Island survey in Queen Anne's County, which is eroding at a rate of an acre per year. Funding was provided through MHT's Non-Capital Grant Program.

Priority Ranking L	Mitigation Action/ Project Title:	#9 – Hazard Mitigation / Climate Change Resiliency Officer Position	
Background/ Issue:	Currently this position is funded only for two (2) years under a Hurricane Sandy Disaster Relief Grant from the National Park Service.		
Action Description:	When the two (2) year period ends, there is no one at Maryland Historical Trust (MHT) with experience in hazard mitigation planning or floodplain regulations who can continue to participate meaningfully in the Maryland Resiliency Partnership or the Maryland Silver Jacket or who can advise the SHPO or the Office Chiefs at MHT on matters related to mitigation and resilience and cultural resources.		
Ideas for Integration:	Continued participation and representation in the Maryland Resiliency Partnership and the Maryland Silver Jackets.		
Responsible Agency:	• Maryland Historical Trust		
Partners:	• Maryland Department of the Environment • Maryland Emergency Management Agency DNR • US Army Corp. of Engineers • Preservation Maryland • Local governments		
Potential Funding:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Department of Natural Resources • US Army Corp of Engineers • Preservation Maryland • Local governments		
Benefits: (Losses Avoided)	Continued integration among state agencies in matters of mitigation planning and projects to leverage state resources and provide a coordinated response to increasing resiliency across the state.		
Cost Estimate:	$55,000/year	**Timeline:**	1-2 Years
Current Status:	**Completed:** A position has not been created, but duties have been assigned to a permanent, full-time MHT employee to continue the Weather It Together: Protecting Maryland's Historic Places from Natural Hazards Program. These duties were assigned to the Maryland Historical Trust's Local Assistance and Trainer Planner, who is housed in the Office of Planning,		

	Outreach, and Education. This position is a permanent full-time position within the State and not a contractual position.

Priority Ranking H	Mitigation Action/ Project Title:	#10 – Incorporation of HAZUS Runs (Planning & Recovery efforts post disaster) for www.mdfloodmaps.org		
Background/ Issue:	Mdfloodmaps.org has received approximately 130K site hits to date since its creation.			
Action Description:	Incorporate HAZUS runs (Coastal and Riverine) into existing online tool to show public users their risk to multiple hazards. Framework is in existence on tool, only requires minimal development time. The information currently maintained in the state plan will be available through the site in the form of HAZUS returns for the following: Debris Tons/Loss Estimates per structures/Population displacement/Shelters			
Ideas for Integration:	Dissemination of information to both the public and state and local agencies is the next step in the process of communicating risk.			
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Environmental Service			
Partners:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Environmental Service • FEMA Region III			
Potential Funding:	Hazard Mitigation Assistance			
Benefits: (Losses Avoided)	Public Outreach-Communication Risk			
Cost Estimate:	$15,000 (framework is currently in available at *mdfloodmaps.com*) the cost will cover mockups and implementation of currently available datasets for communities within the state.	**Timeline:**	1 year and as new HAZUS runs are performed throughout the State.	
Current Status:	**In Progress:** HAZUS datasets (coastal and riverine non-regulatory products) from the 2016 State Hazard Mitigation Plan are currently being loaded into Maryland iMAP. Once the upload is complete, users can add this information to the Flood Risk			

	Application using the Add Data function. This project is on budget. Partnering Agencies: Maryland Department of the Environment, Maryland Emergency Management Agency Source of Funding: Maryland Department of the Environment Successes/Challenges: The State continues to leverage partnerships across state agencies, break down silos of information, and work collaboratively to share information and enhance the Flood Risk Application. An appropriate website to HAZUS house data still needs to be determined. This has only been completed for select jurisdictions. Project is over budget at $300,000.

Priority Ranking H	Mitigation Action/ Project Title:	#11 – Complete Vulnerability Assessment for Hurricane Wind Enhanced HAZUS		
Background/ Issue:	An enhanced HAZUS has been completed for Coastal Risk Map products in Maryland. This analysis did not contain information specific to hurricane wind risk.			
Action Description:	HAZUS has a separate model to determine hurricane wind risk. HAZUS hurricane wind runs should include critical facilities, state assets, as well as damage and loss estimations. In addition, the Enhanced HAZUS Hurricane Wind should include debris generation and shelter needs as results from the study.			
Ideas for Integration:	• Local Hazard Mitigation Plans • Flood Mitigation Assistance Plans			
Responsible Agency:	• Maryland Emergency Management Agency • Local Jurisdictions			
Partners:	• Maryland Emergency Management Agency • Local Jurisdictions • FEMA			
Potential Funding:	• Hazard Mitigation Assistance • State Funding			
Benefits: (Losses Avoided)	Life savings, Property Protection, Improved Future Development Planning			
Cost Estimate:	$8,000 per jurisdiction / 17 MD Coastal Jurisdictions		**Timeline:**	1-5 Years
Current Status:	**In Progress**: Additional HAZUS has been completed, but not made publicly available. This has only been completed for select jurisdictions. An appropriate website to HAZUS house data needs to be determined. This has only been completed for select jurisdictions. Project is over budget at $300,000.			

Priority Ranking H	Mitigation Action/ Project Title:	#12 – Review & Revise the Mitigation Advisory Committee (MAC) Project Priority Ranking System to include Consideration and Prioritization of SRL and RL related projects.	
Background/ Issue:	N/A		
Action Description:	At this time, no formal priority regarding Repetitive Loss (RL) and Severe Repetitive Loss (SRL) exists within the Mitigation Advisory Council's (MAC) Project Ranking System.		
Ideas for Integration:	Advise project applicants of the changes to the MAC's Project Ranking System and the emphasis placed on RL & SRL projects. Include information regarding projects involving RL or SRL components within information packet provided to MAC members.		
Responsible Agency:	• Maryland Emergency Management Agency		
Partners:	• Mitigation Advisory Committee		
Potential Funding:	N/A		
Benefits: (Losses Avoided)	Prioritization of Flood Mitigation Projects related to RL & SRL		
Cost Estimate:	N/A	**Timeline:**	Less than one year
Current Status:	**Completed:** Project was completed on time and on budget with participation from partners. Definitive metrics for sub applicants to develop proposals were created. Although single properties are no longer a priority for the agency, MEMA has focused on community-based risk reduction vs. assets based risk reduction. Ranking criteria was developed to prioritize community-based projects.		

Priority Ranking H	Mitigation Action/ Project Title:	#13 – Obtain Elevation Certificates for State Facilities (including Critical Facilities) in Special Flood Hazard Areas (SFHA) – Integrate all Elevation Certificates into Online System		
Background/ Issue:	A more effective method to evaluate flood risk at State and critical facilities in SFHA is required.			
Action Description:	The new Maryland Hazard Mitigation State Facility Database has identified State Facilities within the SFHA. The next steps include: • Assess the risk of flooding based on flood depths using the available data in Maryland. • Identify high-risk versus low-risk facilities (depth of flooding 3' or greater, depth of flooding 0'-3', etc.). • Fieldwork/Evaluate Structures/Obtain elevation certificates for pre-firm structures. • Document strategies for mitigating high-risk facilities.			
Ideas for Integration:	This information may be used by various state agencies and will be made available at a one-stop Maryland data website.			
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency			
Partners:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Insurance Agency • Maryland Department of Information Technology • Maryland Environmental Service • Department of General Services			
Potential Funding:	• Pre-Disaster Mitigation Assistance • Hazard Mitigation Grant Program • Cooperating Technical Partners			
Benefits: (Losses Avoided)	Provides a better understanding of risk and opportunity to prioritize projects based on new flood depth grids and facility elevation certificates.			
Cost Estimate:	Can be tiered based on available funding to complete a given work activity. Total cost will be variable based on how many high-risk facilities are identified. In the planning phase of the project. Total estimated cost to complete project: $250,000 – Any remaining funds would be applied to implement	**Timeline:**	1-3 years, based on funding availability.	

	portions of mitigation strategies identified at high-risk facilities.		
Current Status:	**In Progress:** Due to funding constraints and a lack of comprehensive analysis', planning/prioritization of efforts has been conducted to determine the number of State facilities that are in the SFHA, and to determine the level of vulnerability that may exist for each. One building was identified as being in the SFHA during an NFIP Community Assistance Visit tour of the floodplain. MES is currently evaluating options to reduce the building's flood risk and enhance the resiliency of the shoreline and docking facilities to sea level rise. Partnering Agencies: Maryland Department of the Environment. Potential Partner: Talbot County Department of Planning and Zoning Successes/Challenges: Funding will need to be secured in order to establish a comprehensive plan (including a data management plan), which provides for identification of state facilities at risk, their level of risk, field verification including Elevation Certificates where appropriate, and establishment of best practices for mitigating potential damages to at-risk structures. MEMA has deemed this potentially infeasible due to lack of financial or staff resources to complete.		

Priority Ranking H	Mitigation Action/ Project Title:	#14 – All Hazards Risk, Mitigation & Resiliency Outreach	
Background/ Issue:	The public should have access to coordinated, timely, reliable, and actionable information through the use of clear, consistent, assessable, and culturally and linguistically appropriate methods to effectively relay information regarding hazards.		
Action Description:	Digital media: 1. Quarterly spread safety warnings through Twitter to 4 million people in the State (including Tweets and Retweets). 2. Quarterly spread safety warnings through Facebook to an excess of a million followers. 3. Quarterly, update the MEMA website to provide risk, mitigation & resiliency (all hazards) information. 4. Produce one YouTube video per year to highlight a Maryland hazard. Promote hazard mitigation and resiliency opportunities through social media.		
Ideas for Integration:	MEMA State Mitigation Operations Plan		
Responsible Agency:	• Maryland Emergency Management Agency		
Partners:	• Maryland Silver Jackets • Mitigation Advisory Committee		
Potential Funding:	FEMA Hazard Mitigation Grant Program (HMGP) Information and technical assistance available from State agencies		
Benefits: (Losses Avoided)	• Increase public awareness of Maryland's hazard risk and opportunities for mitigation and resiliency. • Using outreach activities to facilitate technical assistance programs that address measures that citizens can take or facilitate funding for mitigation measures. • Encourage homeowners to undertake mitigation measures such as the installation of backflow valves. • Educating citizens about safety measures minimizes potential loss of life, injuries and property damage.		
Cost Estimate:	Community Outreach Efforts - $25,000 annually	**Timeline:**	Hazard Mitigation Plan Cycle - 2016-2021

Current Status:	**Ongoing** – This project is on time and on budget and has achieved increased public awareness and built-up community buy-in.

Priority Ranking H	Mitigation Action/ Project Title:	#15 – Coastal Restoration to Mitigate Hazards for Vulnerable Communities
Background/ Issue:	Natural feature complexes can reduce the impacts of coastal hazards (i.e., flooding and erosion) on vulnerable jurisdictions and state facilities. DNR's Coastal Resiliency Assessment identifies residential areas at risk to coastal hazards and prioritizes shorelines for proactive restoration to enhance coastal community resiliency.	
Action Description:	Maryland DNR is working to plan, design and pursue construction of on-the-ground resiliency projects - such as living shorelines, wetland restoration, and stormwater management - to reduce the vulnerability of jurisdictions of the State. The Climate Resiliency Workgroup is working to better understand the impacts of climate change on best management practices. Partners are exploring connections between water quantity and water quality benefits.	
Ideas for Integration:	A number of tools are available to target implementation of restoration projects that will enhance community resiliency: • MEMA's State Hazard Mitigation Plan identifies critical infrastructure at risk to coastal hazards; DNR's Coastal Resiliency Assessment identifies residential areas at risk to coastal hazards; SHA's Vulnerability Study identifies highways vulnerable to flooding/Sea-level rise; and local jurisdictions identify areas of hazard/risk in local hazard mitigation and nuisance flooding plans. State, County, and Federal protected lands offer opportunities for natural feature restoration to enhance resiliency of nearby communities. These tools will be considered together to identify, plan, and implement restoration projects that will reduce vulnerability of jurisdictions within the state. • The State's Adaptation & Resiliency Workgroup is supporting development of a Water Quality and Climate Change Resiliency Portfolio to identify projects that will optimize water quality, resiliency and greenhouse gas benefits in Maryland.	
Responsible Agency:	• MD DNR, MEMA, and Chesapeake Bay Program Climate Resiliency Workgroup	
Partners:	• Local/State floodplain managers or planners • Land owners (public or private)	
Potential Funding:	• FEMA Hazard Mitigation Grant Program / BRIC • MDE Comprehensive Flood Management Grant Program	

	• Chesapeake & Atlantic Coastal Bays Trust Fund • Community Resilience Program – Green Infrastructure Resilience • Community Resilience Program – Resiliency through Restoration Initiative • NFWF National Coastal Resilience Fund • NOAA Regional Coastal Resilience, Coastal Ecosystem Resiliency, Coastal and Marine Habitat Restoration USFWS National Coastal Wetlands Conservation Grant Program EPA Integrating Human Health and Well-Being with Ecosystem Services		
Benefits: (Losses Avoided)	Demonstrate benefits of natural features (i.e., water quality, habitat, and coastal protection). Enhance ability of vulnerable communities to recover from hazards.		
Cost Estimate:	Cost will depend on Project and Scale. Estimates include $8,000/acre for wetland restoration, $6,000/acre for forest restoration, and $150 – $1,500/foot for living shorelines depending on energy environment.	**Timeline:**	2016-2025
Current Status:	**On-going:** MD DNR launched the Resiliency through Restoration Initiative in 2017 to design and construct restoration projects that enhance the resiliency of vulnerable communities to flooding and erosion. Funded through the State Capital Budget, this initiative has supported eighteen projects which are underway and in various phases of planning, design and construction. This action will demonstrate benefits of nature-based features once all projects are implemented. MD DNR is partnering with Chesapeake Bay National Estuarine Research Reserve and University of Maryland Center for Environmental Science on project monitoring. MEMA and other state agencies have participated in proposal review for this program to inform project selection, and partners are exploring connections with FEMA's BRIC Program and other federal grants. The Chesapeake Bay Program Climate Resiliency Workgroup is working to develop design guidance for best management practices impacted by climate change while also exploring implementation strategies such as blue carbon crediting.		

Priority Ranking M	Mitigation Action/ Project Title:	#16 - Statewide Participation in the NFIP
Background/ Issue:	Currently seven (7) jurisdictions within the State of Maryland do not participate. Those jurisdictions include: Town of Friendship Heights, Town of Goldsboro, Town of Hebron, Town of Laytonsville, Town of North Chevy Chase, Town of Pittsville, and City of Taneytown. Both Goldsboro and Taneytown contain floodplain areas.	
Action Description:	Encourage full statewide participation in the NFIP.	
Ideas for Integration:	Include NFIP participation in the Montgomery, Caroline, Wicomico and Carroll County local hazard mitigation plan updates. Also include NFIP participation in county comprehensive plans and municipal growth plans.	
Responsible Agency:	• Maryland Department of Environment • Maryland Emergency Management Agency • Maryland Local Governments	
Partners:	• State and Local Floodplain Managers and Planners	
Potential Funding:	• FEMA Hazard Mitigation Grant Program (HMGP) • Technical assistance available from State agencies	
Benefits: (Losses Avoided)	• More than 20% of NFIP claims come from outside the mapped Special Flood Hazard Areas. • About 25% of all flood insurance claims are paid out for losses located in low to moderate risk flood hazard areas. • FEMA can sanction communities by placing them on probation or suspending them from the NFIP. Probation is the first step towards suspension and gives communities time to bring violations into compliance with the ordinance. During probation policyholders will see a $50 surcharge on their flood insurance premiums when a policy is renewed or issued. If communities neglect to address violations during probation, FEMA will place them on suspension. When communities are suspended, policies will not be renewed or issued. Property owners located within the SFHA will not receive federal disaster assistance or federally insured loans or financing. • Fees are not required for a community to join the NFIP. All that is required for a community to join is that it adopt and enforce a flood plain management ordinance regulating development within the Special Flood Hazard Area (SFHA) identified on a FEMA flood insurance rate map.	

Cost Estimate:	Technical Assistance and Community Outreach Efforts - $5,000 - $10,000	**Timeline:**	Hazard Mitigation Plan Cycle - 2016-2021
Current Status:	**In Progress:** This project is nearly complete. The Town of Laytonsville (Montgomery County) is the only remaining non-participating community listed on FEMA's Community Status Book, https://www.fema.gov/cis/MD.html. The Village of Friendship Heights is a special taxing district, and not an incorporated municipality. It falls under the participation of Montgomery County.		

Priority Ranking L	Mitigation Action/ Project Title:	#17 - All Hazards Plan Integration – State to Local Implementation	
Background/ Issue:	N/A		
Action Description:	Utilize FEMA guidance and State integration results from the 2016 State Plan to assist implement at local levels.		
Ideas for Integration:	State to local consistency Local plan recognition		
Responsible Agency:	• Maryland Emergency Management Agency		
Partners:	• Maryland Department of Planning • Maryland Department of Natural Resources • Maryland Department of the Environment • Maryland Historical Trust		
Potential Funding:	• DNR Coast Smart Communities Grant • MEMA HMA – HMGP/PDM (Planning Funds) • Addendum studies to local plans		
Benefits: (Losses Avoided)	Agency awareness and Recognition of resources		
Cost Estimate:	$20,000/County	**Timeline:**	1-15 Years
Current Status:	**Ongoing:** This project is on time and on budget and has had cooperation from the identified partners.		

Priority Ranking **H**	Mitigation Action/ Project Title:	**#18 - Increase opportunities for communication about adaptation planning in Maryland, facilitate the exchange of ideas between Chesapeake Bay watershed partners, and pilot green/grey infrastructure to prepare for and respond to climate impacts in vulnerable communities.**
Background/ Issue:	The Climate Resiliency Workgroup coordinates climate-related efforts to address climate resiliency for the Chesapeake Bay Program. The Workgroup consists of representatives from the Chesapeake Bay watershed states and jurisdictions, as well as federal agencies.	
Action Description:	The State of Maryland and the Chesapeake Bay Program Climate Resiliency Workgroup supports the following actions to enhance the resiliency of Chesapeake Bay communities to the impacts of coastal erosion, coastal flooding, more intense and more frequent storms and sea level rise. • **Support Green/Gray Pilot Projects:** Pursue implementation of pilot projects through the Systems Approach to Geomorphic Engineering (SAGE) community of practice to test new and emerging design principles and implementation methodologies for green/gray infrastructure; and investigate climate resilience indicators to assess the effectiveness and ecological response of green/gray infrastructure to coastal storms and climate change effects. • **Outreach & Professional Sharing:** Facilitate a workshop on the role of natural infrastructure/living shorelines as part of adaptation/mitigation strategies for the built environment, and share information across sectors on climate change indicators identified by partners such as the Department of Interior	
Ideas for Integration:	• Information exchange about the ability of natural and nature-based infrastructure to reduce vulnerabilities to coastal communities can be integrated into local and state hazard mitigation plans within Maryland and other Bay watershed states and jurisdictions.	
Responsible Agency:	• Chesapeake Bay Program Climate Resiliency Workgroup • Maryland Department of Natural Resources	
Partners:	• Chesapeake Bay Program Office	
Potential Funding:	Hazard Mitigation Assistance	
Benefits: (Losses Avoided)	• Increase the resiliency of the Chesapeake Bay Watershed, including its living resources, habitats, public infrastructure and communities, to withstand adverse impacts from	

	changing environmental and climate conditions. • Continually pursue, design, and construct restoration and protection projects to enhance the resiliency of Bay and aquatic ecosystems from the impacts of coastal erosion, coastal flooding, more intense and more frequent storms, and sea level rise.		
Cost Estimate:	None Provided	**Timeline:**	2016-- 2025
Current Status:	**On-going:** DNR has continued to work alongside the Chesapeake Bay Program's Climate Resiliency Working Group to further adaptation projects and efforts since the adoption of the 2016 HMP. Most Workgroup activities have focused on monitoring and assessment to inform adaptation efforts, which will be a focus over the next 2 years. Partners collaborated on the development of climate change indicators (Available on Chesapeake Progress) to allow measurement of progress and improvement in Bay Watershed living resources. Upcoming activities include evaluating climate change impacts to best management practices, exploring financing strategies, implementing social marketing strategies for nature-based solutions, and tracking impacts of physical indicators on living resources. Overall, this activity has included consistent engagement from MD DNR at the CRWG meetings by one or more DNR staff members. In 2020, MD DNR, MDE and MEMA helped plan a 2020 Local Government Forum on "Building Local Community Resilience Against Climate-Related Flooding," which included discussions about green/gray solutions. Partnership on these efforts and this scope goes beyond just DNR and the Bay Programs Climate Resilience Workgroup.		

Priority Ranking M	Mitigation Action/ Project Title:	#19 – Resiliency Partnership Resource Website	
Background/ Issue:	Create a central location for all agency work relating to flood hazard awareness and mitigation.		
Action Description:	Create central location for all agency work relating to flood awareness hazard mitigation.		
Ideas for Integration:	• Integrating all agencies – open to state & local programs		
Responsible Agency:	• Jointly shared among partners		
Partners:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Department of Natural Resources • Maryland Department of Transportation		
Potential Funding:	• NOAA • FEMA BRIC		
Benefits: (Losses Avoided)	Collaboration and programmatic sustainability. Effort of agencies – (Less) work reduction. Broader outreach to mitigation stakeholders in local government.		
Cost Estimate:	$20,000 (On-going maintenance)	**Timeline:**	1 Year Development-Ongoing
Current Status:	**In Progress:** Currently updates to the existing Maryland Resiliency Partnership website are paid by the Maryland Department of the Environment. However, this is a short-term fix, and a long-term solution is needed. This project should be moved forward again as something participating agencies in the Partnership would like to see funded.		

Priority Ranking H	Mitigation Action/ Project Title:	#20 – Maryland Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Property Inventory Update		
Background/ Issue:	The last statewide inventory of repetitive loss properties was completed in 2002. It included a GIS shapefile with locations, elevations, pictures and mitigation recommendations. Since that time, there have been several flood disasters resulting in numerous properties being added to the repetitive loss and severe repetitive loss lists.			
Action Description:	This information would help the Maryland Emergency Management Agency (MEMA) in identifying mitigation projects, and communities participating in or interested in joining the Community Rating System (CRS).			
Ideas for Integration:	Results could be included in future updates of the State and Local Hazard Mitigation Plans. The data could also assist communities participating in, or interested in joining, the CRS as part of their annual outreach requirements for locally identified repetitive loss areas.			
Responsible Agency:	• Maryland Department of the Environment (MDE) • Maryland Environmental Service (MES)			
Partners:	• Maryland Emergency Management Agency (MEMA) • Local Floodplain Managers • Local Emergency Managers			
Potential Funding:	Hazard Mitigation Assistance			
Benefits: (Losses Avoided)	A consistent, Statewide dataset ould reduce time, effort and lower cost to locals in analyzing the RL and SRL data as part of their hazard mitigation plan update and annual outreach requirements for CRS.			
Cost Estimate:	$3,000-$10,000 per County (more if building elevations are obtained)	**Timeline:**	Approximately 18 months (longer if elevations are obtained): Research: 2-3 months; Field work: 6-8 months; Data development and analysis: 2-3 months; Coordination with local jurisdictions: 3-4 months	
Current Status:	**In Progress:** Changes in FEMA's RL/SRL database and restrictions on access to RL/SRL data have slowed the implementation of this action. Should this data become available through the current effort to update the State Hazard Mitigation			

	Plan and upgrade the plan to an Enhanced Plan, this project could be able to move forward. Project is on budget. Partnering Agencies: Maryland Department of the Environment. Potential Partner: Talbot County Department of Planning and Zoning Source of Funding: Maryland Environmental Service

Priority Ranking M	Mitigation Action/ Project Title:	#21 – State Highway Administration (SHA) and other State Agency Data Integration to Support Flood Risk Enhancement	
Background/ Issue:	N/A		
Action Description:	SHA possesses/has access to existing and future information (Bridge data/TOPO data) that can support the enhancement of existing flood risk models as well as supplement MD flood maps information. This information will be submitted to FEMA upon request.		
Ideas for Integration:	SHA partnership with Maryland Department of the Environment and FEMA		
Responsible Agency:	• Maryland Department of the Environment (MDE)		
Partners:	• State Highway Administration • FEMA		
Potential Funding:	TBD		
Benefits: (Losses Avoided)	Improved flood risk information to support more informed decision making.		
Cost Estimate:	TBD	**Timeline:**	0-3 Years
Current Status:	**Complete:** In October 2018, a report entitled "Recommendations for Hydraulic Analyses in FEMA Special Flood Hazard Areas in Maryland", was prepared by the Maryland Hydraulics Panel. The report was co-signed by the Administrator of State Highway Administration, Maryland Department of Transportation and Director of the Water and Science Administration, Maryland Department of the Environment. A copy of the report can be downloaded at: http://www.gishydro.eng.umd.edu/hydraulics_panel.htm.		

Priority Ranking H	Mitigation Action/ Project Title:	#22 – Technical Assistance to Identify, Address, and Incorporate Coastal Hazards into Local Planning
Background/ Issue:	The Chesapeake & Coastal Service at Maryland Department of Natural Resources provides technical assistance to local partners through the Coast Smart Communities Program, Working Waterfronts Program, Coastal Atlas data viewing platform, and data products such as the Coastal Resiliency Assessment. These programs and tools are available to assist counties and municipalities in identifying, addressing, and incorporating coastal hazards into their planning efforts.	
Action Description:	The Coast Smart Communities Program offers competitive grants to address the impacts of hazards, including localized flooding, storm events and sea level rise. The Working Waterfronts Program offers grants to support the revitalization of working waterfront communities and economies through planning or implementation that considers flooding and storm surge impacts.	
Ideas for Integration:	Technical assistance to local communities often results in new or revised authorities, local codes and ordinances, programs, or comprehensive/waterfront plans that are adopted by a municipality or county. The development and implementation of these products is often advanced through collaboration with state agencies and partners, such as the Maryland Department of Planning, Maryland Emergency Management Agency, or Critical Area Commission. Financial assistance through the Working Waterfronts Program has been included in the Chesapeake Bay Program's Climate Resiliency two (2) year work plan to enhance the resiliency of Chesapeake communities.	
Responsible Agency:	• Maryland Department of Natural Resources	
Partners:	• Local and state planners and floodplain managers • MEMA, MDP, Critical Area • Chesapeake Bay Program Climate Resiliency Workgroup	
Potential Funding:	• NOAA • FEMA Hazard Mitigation Grant Program	
Benefits: (Losses	Provide the resources and technical expertise required to identify and address coastal hazards in day-to-day decision-	

Avoided)	making and long-term planning for community development, preservation, and perseverance. • Support a watershed approach addressing both tidally influenced/coastal flooding and localized flooding caused by rain/storm events. • Increase the awareness of residents, business owners, elected officials, and planners around existing hazards and actions that can be taken to maintain a community's identity and cultural heritage while acknowledging changes that could impact that vision. • Pursuing green infrastructure that will help address floodplain and stormwater management while also improving water quality.		
Cost Estimate:	Up to an additional $75,000 needed	**Timeline:**	2016-2021
Current Status:	**On-going:** This program is now the Community Resilience Grant program of which Coast Smart communities is one element. The funding source has also evolved and can now support projects to understand and plan for coastal hazards and climate impacts such as increased precipitation. Also included is the Restoration for Resilience program which supports nature-based restoration projects a community level. Between 2016-2021 this program has supported over 40 projects.		

Priority Ranking M	Mitigation Action/ Project Title:	#23 – Complete FEMA Form AW-501 to Support Update of the FEMA SRL and RL Property Databases	
Background/ Issue:	Each jurisdiction should be categorized and those communities containing ten (10) or more Repetitive Loss properties that have not been mitigated should be prioritized.		
Action Description:	RL & SRL data provided to local jurisdictions should be verified on a regular basis. Repetitive Loss listings should be reviewed for accuracy, correct addresses, and to determine whether the properties are actually in the community's corporate limits, and to determine whether the insured building(s) have been removed, retrofitted, or otherwise protected from the cause of repetitive flooding. The results of the review should then be recorded on the Repetitive Loss List Community Certification (CC-RL). Those properties that are identified as in need of update are then placed on the Repetitive Loss Update Worksheet (AW-501) and submitted to FEMA.		
Ideas for Integration:	Use updated and verified information in hazard mitigation and flood mitigation planning documents. This information may then be used to designate Repetitive Loss Areas within local communities.		
Responsible Agency:	• Local Jurisdictions • Maryland Department of the Environment		
Partners:	• Maryland Emergency Management Agency (MEMA) • Local Floodplain Managers • Local Emergency Managers		
Potential Funding:	• Hazard Mitigation Grant Program (HMGP) • Flood Mitigation Assistance (FMA) • Pre-Disaster Mitigation (PDM)		
Benefits: (Losses Avoided)	Prioritization of Flood Mitigation Projects		
Cost Estimate:	$3,000-$5,000 per jurisdiction	**Timeline:**	1-5 years

Current Status:	**On-going:** In 2019, FEMA switched to a new data management system to handle NFIP data called PIVOT. There is an increased focus on protecting Personally Identifiable Information (PII), and before states, and communities, can get access to RL and SRL data, they must sign an Information Sharing Access Agreement (ISAA). In addition, the repetitive loss categories to obtain credit in Activity 510, Developing a Repetitive Loss Area Analysis, of the *CRS Coordinator's Manual* changed in 2017. A community will fall into one of three categories: Category A – No unmitigated repetitive loss properties, Category B – More than 1 but fewer than 49 unmitigated repetitive loss properties, Category C – 50 or more unmitigated repetitive loss properties.

Priority Ranking H	Mitigation Action/ Project Title:	#24 – Develop and Promote Tabletop Exercises Prior to Flood Event / Hazard
Background/ Issue:	Tabletop exercises should be conducted with State and local government to identify actions and responsibilities for entities prior to an event occurring. Focus on the integration of floodplain management and risk data within the local Emergency Operation Center.	
Action Description:	Annually, the State emergency officials alongside community/local emergency managers and Department of Public Works (DPW) and Planners, etc.(State agencies that could be involved) will meet to discuss way to minimize community risk in addition to identifying areas of concern and ways to reduce potential flood damage through tours of the areas and identifying/clearing potential stream blockages, etc. As a large-scale event, such as a hurricane, approaches the region, the State will host a webinar to outline what actions the community should be taking to prepare for the event in an effort to reduce potential losses from both an insurance and emergency standpoint.	
Ideas for Integration:	Identify insurance and mitigation needs that may be identified prior to, during, and following a disaster event. Emphasize the integration of data acquisition into all phases of emergency management, to ensure that opportunities are not overlooked.	
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Local Government • Department of Natural Resources	
Partners:	• Maryland Department of the Environment • Maryland Emergency Management Agency • Local Government • CoastSmart • Metropolitan Planning Organization	
Potential Funding:	• Emergency Advance Measures for Flood Prevention • Emergency Management Preparedness Grant	
Benefits: (Losses	• Mitigate losses in community.	

<table>
<tr><td>Avoided)</td><td colspan="3">Improves coordination and data gathering, analysis, and project development.

Identifies and solidifies partnerships.</td></tr>
<tr><td>Cost Estimate:</td><td>$3,000 per Tabletop Exercise</td><td>Timeline:</td><td>Annual face to face meeting with communities

Webinar open to all communities within the state, days prior to large scale events such as hurricanes and tropical storms, when available.</td></tr>
<tr><td>Current Status:</td><td colspan="3">On-going: In March 2017, numerous state agencies participated in a USACE Flood Exercise in Baltimore, MD. In May 2017, MDE and MEMA participated in an EMI Virtual Tabletop Exercise (VTTX) – Flood Focus, Course # V-0007. In April 2018, Maryland held its own flood tabletop workshop. An article was developed by the Maryland Association of Floodplain and Stormwater Managers (MAFSM). Select details are included below.

Practice to Prepare: Practitioners Work Through Floodplain Management Emergency Scenarios During Tabletop Workshop

On April 11, 2018, over 60 floodplain administrators, emergency management professionals, planners, engineers, public works officials, code enforcement officers and GIS staff gathered at the Kent Island Fire Department in Chester, Maryland to attend the Maryland Flood Tabletop Workshop. This day-long workshop was led by Maryland Department of the Environment, the State Coordinating Office of the National Flood Insurance Program (NFIP), and FEMA Region III's Floodplain Management & Insurance Branch with support from the Maryland Emergency Management Agency, Maryland Resiliency Partnership and the Maryland Silver Jackets team.</td></tr>
</table>

Priority Ranking L	Mitigation Action/ Project Title:	#25 – Archeological Survey on State-Owned Land and Water in High Hazard Areas	
Background/ Issue:	Natural hazards and climate change are damaging and destroying terrestrial, submerged and semi-submerged archeological sites. Coastal erosion along Maryland's western shore is particularly destructive to unidentified sites and inundation due to flooding and sea level rise on the Eastern Shore will also negatively impact archeological sites.		
Action Description:	Both soft and hard shoreline protection actions are destructive to terrestrial and marine archeological sites. Survey and evaluation are needed to identify archeological sites and determine the need for further work or protection in situ in areas vulnerable to coastal hazards and in areas slated to receive shoreline protective measures.		
Ideas for Integration:	• Preserve Maryland (Statewide Preservation Plan) • State Hazard Mitigation Plan		
Responsible Agency:	• Maryland Historical Trust		
Partners:	• DNR • Archeological Society of Maryland		
Potential Funding:	• Technical assistance from state agencies • NOAA • National Park Service		
Benefits: (Losses Avoided)			
Cost Estimate:	None Provided	**Timeline:**	1-5 Years
Current Status:	**Completed:** In 2019 MHT embarked on a comprehensive survey of DNR owned or controlled lands to identify the full range of archaeological sites located on State owned lands. In 2018 the Billingsley property and Wye Island Natural Resource Management Area were both surveyed using remote sensing techniques to identify hot spots for subsequent archaeological testing in 2019. While no new cultural resources were identified on two of the subject properties, magnetic susceptibility surveys at Billingsley refined site boundaries and led to further work in		

	the 2019 field session, and in 2020 looking for a Native American site on a promising field and an historic cellar feature near the standing house. Ground truthing of LIDAR anomalies at Fort Frederick led to the identification of a possible early road trace and CCC encampment. In 2020 remote sensing projects were conducted at the CCC camp and a suspected Indian fort at Merkle Wildlife Sanctuary, resulting in the discovery of a colonial site. All work is/was funded through MHT's Non-Capital Grant Program and staff time.

Priority Ranking H	Mitigation Action/ Project Title:	#26 – Mobile Lidar Capture		
Background/ Issue:	N/A			
Action Description:	In order to enhance both planning and design and maintain our roadway assets, the Maryland State Highway Administration is exploring moving to a 3D point cloud capture via mobile Lidar. *Note: Point cloud assets provided via image*			
Ideas for Integration:	MEMA, MDE, DNR, DOIT, USACE, SILVER JACKETS			
Responsible Agency:	• Maryland Department of the Environment • State Highway Administration			
Partners:	• Silver Jackets • Department of Information Technology			
Potential Funding:	• Federal Transportation Funds			
Benefits: (Losses Avoided)	• Increase spatial accuracy of assets • Reusable asset capture • Line of sight hazard detection • Crossfall curvature of roadway			
Cost Estimate:	TBD - Estimates about $1M / year	**Timeline:**	1-2 Years	
Current Status:	**Not Started:** Action #26 was never funded but may still be a part of the asset management office future data collection plans.			

Priority Ranking L	Mitigation Action/ Project Title:	#27 – Development of Backup Groundwater Systems	
Background/ Issue:			
Action Description:	With increases in watershed development and potential increases in strong storms, surface water reservoirs are more readily polluted. Backup groundwater supply systems would mitigate potential disasters.		
Ideas for Integration:	• Washington Suburban Sanitary Commission (SSC) • City of Baltimore		
Responsible Agency:	• WSSC • City of Baltimore		
Partners:	• Local Jurisdictions • WSSC • City of Baltimore • Maryland Department of the Environment		
Potential Funding:	• Mitigation Grant Programs • WSSC • City of Baltimore		
Benefits: (Losses Avoided)	Alternate Water Supply, Public Safety		
Cost Estimate:	Needs to be developed	**Timeline:**	Less than 10 years
Current Status:	Not completed. Preliminary conversations have occurred with WSSC and they submitted a BRIC application last year for increasing the current holding capacity and a smart grid. However, the application did not advance through the State's review process.		

Priority Ranking M	Mitigation Action/ Project Title:	#28 – CoastSmart Council Implementation to Mitigate Coastal Hazards for Vulnerable State Capital Projects
Background/ Issue:	The MD CoastSmart Council was created in response to the House Bill 615 enacted during the 2014 legislative session to ensure the State makes safe and fiscally wise capital investments in the future. In July of 2015, the Council released the first draft of the MD Coast Smart Construction Program, a guidance document intended to support State agency efforts to incorporate Coast Smart siting and design criteria into new construction and major reconstruction projects to avoid or minimize hazards from coastal flooding, sea-level rise and storm surge.	
Action Description:	Beginning October 1, 2016, and for every year thereafter, all Units of State Government shall report to the Coast Smart Council on individual State agency actions, which will be undertaken within the previous fiscal year and related to the Coast Smart Construction Program.	
Ideas for Integration:	• State Hazard Mitigation Plan/State Disaster Recovery Plan • Maryland Coastal Resiliency Assessment • SHA Vulnerability Assessment • State agency programs/guidance • Chesapeake Bay Program Climate Resiliency Workgroup	
Responsible Agency:	• Maryland Department of Natural Resources • MEMA • Maryland Department of the Environment	
Partners:	Coast Smart Council Members from the following state, local and private sector partners: Maryland Department of Planning, BayLand Consultants & Designers, University of Maryland Center for Environmental Science, Maryland Department of Budget and Management, Maryland Department of the Environment, Town of Ocean City, GWWO Architects, University of Maryland College Park, Maryland Department. of Transportation, Maryland Department of Commerce, Maryland Department of General Services, Maryland Emergency Management Agency, Somerset County, and Maryland Critical Area Commission.	
Potential Funding:	DNR-funded staff may benefit from potential funding for tool development and/or integration of existing tools	

Benefits: (Losses Avoided)	Ensure the State makes safe and fiscally wise capital investments in the future.		
Cost Estimate:	Cost estimates for building resiliency to be included in Council annual report	**Timeline:**	2014-Ongoing
Current Status:	**On-going:** The Coast Smart Council has made some great progress since its establishment in 2014. Coast Smart siting and design criteria were developed and required that a 2-foot freeboard be applied to state-funded projects within the FEMA-mapped Special Flood Hazard Area. The Coast Smart Council has met quarterly every year since 2014 to address topics related to coastal resiliency and the Coast Smart Construction Program Guidelines. In 2018 and 2019, legislation was passed that expanded the scope of the Coast Smart applicability and necessitated a program document update. In 2018, House Bill 1350 was passed requiring structures be designed and constructed or reconstructed with the Category 2 storm surge in mind. However, Category 2 storm surge data does not have an elevation tied to it, so it was decided to use the Base Flood Elevation on FEMA's Flood Insurance Rate Maps (FIRMs), and to add a 3-foot freeboard vertically and horizontally. This new layer is called the Climate Ready Action Boundary (CRAB). Currently, it is only available in coastal areas, but there are plans to develop a similar layer in riverine areas. As of September 1, 2020, all construction of a highway facility or building, or reconstruction of a building within state and local capital projects, over $500K and at least 50% state funded will need to comply with the 2020 Program Guidelines. The council has continued to meet quarterly and will do so going forward. The 2020 update also included the identification of a new boundary to delineate vulnerability, referred to as the Coast Smart Climate Ready Action Boundary (CS-CRAB). The CS-CRAB adds a layer of resilience on top of the FEMA 100-year floodplain. A copy of Maryland Coast Smart Council, Coast Smart Construction Program 2020 document can be downloaded at: https://dnr.maryland.gov/climateresilience/Documents/2020-Coast-Smart-Program-Document-FINAL.pdf.		

Priority Ranking L	Mitigation Action/ Project Title:	#29 – Improve Knowledge / Data Availability	
Background/ Issue:			
Action Description:	Maryland Transit Administration, through an environmental management system, has developed GIS data that is viewable agency wide. Planning and engineering data and studies, as well as other state data has not been shared there.		
Ideas for Integration:	Internet Message Access Protocol (IMAP) linkage, Maryland Department of the Environment linkage, Reference/create engineering & planning data, local jurisdiction links supplemental customization.		
Responsible Agency:	• Maryland Transit Administration		
Partners:	• Maryland Emergency Management Agency • Maryland Department of the Environment • Department of Information Technology		
Potential Funding:	• Transportation Alternatives Program • Hazard Mitigation Grant Program • Capital Budget (MTA)		
Benefits: (Losses Avoided)	Encourages consideration of resilience in project development and system preservation.		
Cost Estimate:	$25,000	**Timeline:**	1 year
Current Status:	**Cancelled:** No longer a priority action.		

Priority Ranking H	Mitigation Action/ Project Title:	#30– Inventory Susceptible Wells & Retrofit with Protection	
Background/ Issue:			
Action Description:	Wells are direct access routed to drinking water aquifers. If a well is flooded, floodwaters will get into the aquifer creating a polluted water supply. If floodwater reach a well or covers the top of the well casing, assume the well is contaminated. Water from the well should not be used for drinking, cooking, or brushing teeth.		
Ideas for Integration:	• Local counties • Department of Housing and Mental Hygiene • MD Geological Survey (DNR)		
Responsible Agency:	• County Health Departments		
Partners:	• Local Counties • Department of Housing and Mental Hygiene • Maryland Department of the Environment • MD Geological Survey		
Potential Funding:	• Department of Housing and Mental Hygiene • Hazard Mitigation Assistance		
Benefits: (Losses Avoided)	Maintenance of Drinking Water Supply		
Cost Estimate:	$150K/county for inventory	**Timeline:**	Inventory: 1 year
Current Status:	**Cancelled:** No longer a priority action.		

Priority Ranking M	Mitigation Action/ Project Title:	#31 – Gather and Present Mitigation GIS Data that can be used Operationally during Response and Recovery	
Background/ Issue:	N/A		
Action Description:	Maryland's emergency mapping solutions, like OSPREY and MD Geo Share, are built to present and share situational awareness and support prioritization and decision-making. Currently some operations staff are not aware of the multiple types of mitigation data that present risk during planned events or potential affected areas and severity during unplanned events.		
Ideas for Integration:	Gather best current data, evaluate plan to keep updated on different mitigation plan cycles. Have plans in place for pre-landfall storm study data to be able to quickly support Emergency Management. Easily consumable by current viewers used in EOCs like OSPREY		
Responsible Agency:	• Maryland Emergency Management Agency		
Partners:	• Maryland Department of the Environment		
Potential Funding:	• Federal Emergency Management Agency • Flood Mitigation Assistance Program (FMA)		
Benefits: (Losses Avoided)	Riverine depth grids can show the potentials damage of residences in a 10-100yr flood. USGS high water marks during an event for a flood study can create a depth grid to help inform during recovery.		
Cost Estimate:	None Provided	**Timeline:**	None Provided
Current Status:	**Ongoing:** This project has no identified budget. MEMA established a Risk Analysis program to provide 24/7, 365 risk briefings.		

Priority Ranking L	Mitigation Action/ Project Title:	#32 – Increase All Hazards Private Sector Resiliency	
Background/ Issue:	N/A		
Action Description:	The private sector is incredibly important during disaster recovery. People are dependent on specific business types and on continued employment at a stable workplace, especially in smaller communities.		
Ideas for Integration:	Analysis of new state business data for vulnerabilities and prioritization of outreach.		
Responsible Agency:	• Maryland Emergency Management Agency		
Partners:	• Maryland Emergency Management Agency		
Potential Funding:	• Federal Emergency Management Agency • Flood Mitigation Assistance Program (FMA)		
Benefits: (Losses Avoided)	Business downtime shortened or removed after disaster to support community. Less jobs lost or shorter working down time.		
Cost Estimate:	None Provided	**Timeline:**	None Provided
Current Status:	**Ongoing:** No update Provided		

Priority Ranking H	Mitigation Action/ Project Title:	#33 – Roadway Flooding Vulnerability Assessment	
Background/ Issue:	N/A		
Action Description:	Assess vulnerability to roadway flooding of all tidally influenced counties. Analysis includes current storm related flooding in 2015 as well as sea level change predictions for 2050 and 2100 with storm surge.		
Ideas for Integration:	Data can be utilized in state and county hazard mitigation plans.		
Responsible Agency:	• Maryland State Highway Administration		
Partners:	• Salisbury University ESRGC • Department of Information Technology		
Potential Funding:	FHWA/State of Maryland		
Benefits: (Losses Avoided)	Identification of vulnerability		
Cost Estimate:	To date: $700k Future: $500k	**Timeline:**	Complete December 2017
Current Status:	**Completed** - Future budget may allow a data refresh based on current USACE tidal gage projections, as the baseline was begun in 2015 using those estimates. These change yearly, but budget does not allow refresh.		

Priority Ranking H	Mitigation Action/ Project Title:	#34 – Target Restoration, Preservation, & Mitigation within Special Flood Hazard Areas using the Water Resource Registry
Background/ Issue:	Watershed Resource Registry (WRR) is an interactive resource screening GIS tool created to improve resource planning and mitigation decision-making using the watershed approach, by integrating regulatory and non-regulatory programs. WRR includes modeling to target areas for restoration and preservation of wetlands, riparian natural stormwater infrastructure. The Maryland State Highway Administration uses the WRR to identify potential mitigation and stewardship opportunities. The WRR began as a pilot Registry that grew out of the Green Highways Partnership and a project proposed by the Maryland State Highway Administration for US 301 in Prince George's and Charles Counties, Maryland. The analysis was expanded to the remaining portions of the state.	
Action Description:	One of the greatest problems of floodplain management in urbanizing areas is the increase in peak flow caused by watershed development. As forests, fields and farms are covered by impermeable surfaces, such as streets, rooftops and parking lots, more rain runs off at a faster rate. When an area is urbanized, the rate of runoff can increase five-fold or more. A great deal of damage from local drainage problems can be avoided by requiring all structures to be elevated. Sediment from disturbed ground can reduce the capacity of the drainage system and adversely affect water quality. Regulating developments according to a stormwater management **master plan** that analyzes the combined effects of existing and expected development on drainage through and out of the watershed.	
Ideas for Integration:	Using information within the WRR to assist in stormwater management master plan development and plan updates for regulating development earns points under the NFIP-Community Rating System. This information may also be used in both Flood Mitigation Plans and Hazard Mitigation Plans. Evaluate inventory of areas representing buy-out locations for opportunities of restoration and/or preservation of wetlands and riparian corridors using the WRR analyses.	

Responsible Agency:	• Environmental Protection Agency • Maryland State Highway Administration • Maryland Department of the Environment • Maryland Emergency Management Agency • Maryland Department of Natural Resources • Maryland Department of Transportation • Maryland Environmental Service		
Partners:	• US Army Corp of Engineers • USFUS • Environmental Protection Agency • Maryland State Highway Administration • Maryland Department of the Environment • Maryland Department of Natural Resources		
Potential Funding:	• CBRAP • CGIG • Hazard Mitigation Grant Program		
Benefits: (Losses Avoided)	Minimize loss of life & property; Address water quality; and Less erosion (bank stabilization)		
Cost Estimate:	1. Study SFHA's for potential restoration and preservation $ 2. Implementation – varies	**Timeline:**	Ongoing
Current Status:	**On-going**: The WRR has incorporated new high-resolution land cover and LIDAR data into the application and have also included the Flood Hazard Zones layer developed by FEMA. The additional layers help to support identification of restoration and preservation opportunities. The responsible agencies have changed slightly and should include Maryland Department of Transportation and Maryland Environmental Service. One additional use for the Flood Hazard Areas is for support at the local level in their development of Nuisance Flooding Plans. Discussions are on-going with other State agencies on collaboration. Partners utilized thus far: Maryland Department of the Environment, Maryland Environmental Service, Maryland Department of Natural Resources, Maryland Emergency Management Agency, Maryland Department of Transportation, Maryland Department of Planning, USEPA, USFWS, USACE New Partnerships Created: Yes, with other State/Federal Resource/Regulatory/ Transportation agencies in FEMA Region 3		

	Source of Funding: Maryland Department of the Environment, Benefits Realized: No New Benefits: Unknown (action still in progress) Successes/Challenges: Obtaining funding for restoration and preservation of wetlands and Natural or Nature-based Features across the landscape for flood Mitigation have proven challenging. This is due in large part to the difficulties obtaining a benefit cost analysis score that would make a given project fundable through a given FEMA grant program. Restoration and preservation are occurring but through requirements driven by water quality permitting for NPDES MS4 Jurisdictions authorized by the USEPA and administered by the Maryland Department of the Environment in Maryland often missing the opportunity to identify locations where a given project may contain water quantity benefits in addition to those related to water quality.

Priority Ranking L	Mitigation Action/ Project Title:	#35 – FME (Feature Manipulation Engine) Tool Integration / Future HAZUS Updates	
Background/ Issue:	N/A		
Action Description:	FEMA is developing a FME (Feature Manipulation Engine) tool to support future building footprint and other data updates. This tool will facilitate efficient periodic HAZUS updates based on improved data.		
Ideas for Integration:	Local and state planning and decision-making.		
Responsible Agency:	• Maryland Department of the Environment		
Partners:	• Maryland Emergency Management Agency		
Potential Funding:	• Hazard Mitigation Assistance		
Benefits: (Losses Avoided)	Enhanced and more accurate loss assessments		
Cost Estimate:	Est. $100k annually	**Timeline:**	Annually, beginning in 2017
Current Status:	**Infeasible:** While this toolkit can offer some advantages (e.g., states that have multiple separate CAMA systems), its pilot study and workflow for MD was determined to not be feasible. By positioning parcel information as a centroid within building footprints (as opposed to LAG placement which was already being performed in MD), hundreds of structures that intersect the regulatory SFHA and have some risk exposure were missed (again, resulting from the tool's automated centroid placement). The tool also failed to properly handle various nuances of the source data, such building footprints that are supposed to be split among multiple parcels as well as individual buildings that are inadvertently bisected by parcel boundaries (resulting in many missing and/or duplicative points). The toolkit had also only duplicated some of the automated field attribution that was already in place for MD HAZUS projects, without providing additional value through a more efficient process. And finally, the		

	toolkit required additional and expensive ArcGIS licensing cost that MD did not already have in place.

Priority Ranking L	**Mitigation Action/ Project Title:**	**#36 – Floodplain Management Training**	
Background/ Issue:	N/A		
Action Description:	1. Emergency Disaster Management Training for non-emergency managers 2. Surveyor Elevation Certificate (EC) Training – Statewide 3. Provide FEMA training for floodplain managers/planners/city works/engineers: • Specific to surveyors for EC • All staff (County) that might be involved in disaster response.		
Ideas for Integration:	MDE, MEMA, and County Staff: • Identify importance for Hazard Mitigation Assistance (HMA) application EC is correct. • ESF at county and state with county emergency management staff.		
Responsible Agency:	• Maryland Department of the Environment • Maryland Emergency Management Agency		
Partners:	• Resiliency Partnership		
Potential Funding:	• Hazard Mitigation Assistance		
Benefits: (Losses Avoided)	Better educated staff and disaster awareness		
Cost Estimate:	$30,000	**Timeline:**	1-2 Years

Current Status:	**On-going:** Since the last State plan update, we have done numerous trainings throughout the state to a variety of stakeholders on a variety of topics. Training is an on-going process and is never really complete.

This page left blank intentionally

APPENDIX F

MEMA Grants Management SOP

This page left blank intentionally

Maryland Emergency Management Agency

Grants Management SOP
and
Policy and Procedures Manual

February 2017

TABLE OF CONTENTS

Introduction

1. Purpose
2. Scope

Grants Programs by Federal Agency

GRANT MANAGEMENT STAGES

Part I. Pre-Award Stages

1. Responsibilities
2. Standard Policies and Procedures

Part II. Award Stage

1. Definitions
2. Responsibilities
3. Standard Policies and Procedures

Part III. Post-Award Stage

1. Responsibilities

Part IV. Closeout

1. Responsibilities

Part V. Post Closeout

2. Responsibilities

Appendices

A MEMAGMS - Grant Creation Checklist

B MOA Tracking Procedure for HMEP Award

C Sub-Grantee Monitoring Protocols

D SAA Monitoring Questions

E Grant Monitoring Template

F Procurement Checklist

G Monitoring Risk Formula

H Equipment Sampling Criteria

I Monitoring Schedule

J HMEP Administration Checklist and Forms

Introduction

1. Purpose

This publication establishes policies and procedures and assigns responsibility associated with the management of grants administered by the Maryland Emergency Management Agency (MEMA).

2. Scope

This SOP applies to all MEMA staff and contractors that manage or support the management of the various grant programs seen in the table below.

Program Type	Grant Program	Acronym	Federal Agency
Preparedness	**Homeland Security Grant Program**	HSGP	DHS/FEMA
	State Homeland Security Grant Program	SHSP	DHS/FEMA
	Urban Area Security Initiative	UASI and NCR UASI	DHS/FEMA
	Emergency Management Performance Program	EMPG	DHS/FEMA
	Non-Profit Security Grant Program	NSGP	DHS/FEMA
	Hazardous Materials Emergency Preparedness	HMEP	US DOT

Recovery	Public Assistance Program	PA	FEMA
	Individual Assistance Program	IA	FEMA
Hazard Mitigation	Hazard Mitigation Assistance	HMA	FEMA
	Hazard Mitigation Grant Program	HMGP	FEMA
	Pre-Disaster Mitigation	PDM	FEMA
	Flood Mitigation Assistance	FMA	FEMA

Part I. Pre-Award Stage

1. Responsibilities

a. Administration Directorate– Grants Management Branch

i. Program Manager (PM) monitors DHS/FEMA & PHMSA websites, press releases, program announcements and other directives for funding opportunities. Most grants are announced on an annual basis.

ii. PM applies for grant program funding on an as-required and as eligible basis.

iii. PM participates in DHS/FEMA, PHMSA sponsored conferences, meetings, video and teleconference calls to maintain situational awareness of preparedness funding programs and related programmatic and fiscal requirements. iv. PM ensures local, state, private, and non-profit stakeholders are informed on new and evolving FEMA, PHMSA grant program requirements. Assists sub-grantees determine program scope and eligibility. Advises and monitors development of local threat/hazard assessment and risk identification documents to support requirements development.

b. Operations Directorate - Hazard Mitigation Grants Branch

i. PM applies for FEMA Hazard Mitigation and Pre-Disaster Mitigation grant programs funding on an annual basis to provide funding to the State of Maryland for Hazard Mitigation projects.

ii. PM participates in FEMA conference calls to maintain situational awareness of Hazard Mitigation programs and any special program guidance that will be important for that specific fiscal year's application process as well as any programmatic differences.

iii. PM provides outreach to local, state, private, and non-profit stakeholders announcing FEMA's release of the guidance as well as the State's funding allocation for specific Hazard Mitigation programs. Inform and educate all stakeholders on preparedness programmatic differences from previous fiscal years.

iv. PM assists in the post-disaster damage assessment process to advise FEMA representatives on potential local/regional mitigation projects.

c. Administration Directorate- Public Assistance Branch

i. Post-disaster the PM initiates and compiles damage assessments to public properties in conjunction with FEMA damage assessment teams.

ii. Upon confirmation that minimum damage assessment thresholds are met, PM prepares and processes requests for a Disaster Declaration to FEMA.

iii. PM applies for Public Assistance Grants upon receipt of a Disaster Declaration.

d. Strategy Directorate- Individual Assistance Office

i. Post-disaster the PM conducts in conjunction with FEMA staff damage assessments for homeowners and businesses.

ii. PM submits a request for a Disaster Declaration to FEMA if the State meets its minimum damage threshold for the FEMA Individual Assistance Program.

iii. PM assists eligible applicants prepare applications for individual assistance grants or applicable Small Business Administration grants.

e. Administration Directorate – MEMA Finance Branch

i. Finance Manager (FM) provides individual program managers with recurring expenditure budgets to include payroll and operating expenditures and general fund appropriation amounts for match as applicable.

ii. FM will provide Executive approved non-recurring project data and funding data under the awards to the individual

program managers to enable budget and application development

2. Standard Policies and Procedures

Administration Directorate – Grants Management Branch

a. Grant Program Guidance Review

1. Upon release via www.grants.gov of a FEMA or USDOT Notice of Funding Opportunity announcement, grant program managers will review the guidance, issue application instructions to eligible applicants, and follow-up with all stakeholders to assure awareness of program requirements.
2. In the review, program managers will the obtain the following information:
    - **Notice of Funding Opportunity Description**: This provides an overview of the program including investment strategies and priorities that define the scope of the program as well as individual funding priorities within the program.
    - **Award Information**: This provides information for authorizing statutes, period of performance, and available funding both nationally and for state/territory allocations.
    - **Eligibility Information:** This establishes who can apply for funding as well as governance for establishing who is eligible to receive federal funds. (This may differ by specific program).

Application and Submission Information: This establishes the steps for submitting an application, content and form of the application, submission dates, intergovernmental review (this will differ by program), funding restrictions, and other submission requirements.

- **Application Review Information:** This section establishes review criteria, review and selection criteria, and anticipated announcement and award dates. (This will differ by program).
- **Award Administration Information:** This establishes the notice of award (NOA), administrative and national policy requirements, and reporting requirements
- **FEMA Contacts:** This establishes POC's by program at the federal level.
- **Other Information:** This provides investment justification and budget templates, reporting templates, data tables and other helpful products for application content.

b. Application Period

1. Program managers will validate their personal account in FEMA's NDGrants system before submitting an application in www.grants.gov.
2. Program Managers will submit the agency applications via www.grants.gov for their program(s) of responsibility.
3. After the application has been submitted via www.grants.gov, program manager will provide outreach to eligible stakeholders to begin the solicitation of Investment Justifications and supporting sub award applications from interested qualified applicants.
4. Preparedness award PMs will build awards in MEMAGMS in accordance with Appendix A – MEMAGMS Grant Creation Checklist.
5. HMEP award PM will build award in accordance with Appendix J – HMEP Administration Checklist and Forms

c. Application Submission

1. Program guidance provides the program manager with instructions on how to apply for funding via Grants.gov and ND Grants. Depending upon the program the State of Maryland may receive a fixed allocation or instructions on submission of competitive application at the state or

sub-grantee level. The Program Manager will consult with MEMA Executive Staff and the Governor's Office of Homeland Security and the SERC to coordinate sub-grantee award guidance and individual sub grantee distribution formulas. Once approved the program manager will initiate the following steps.

Obtain MEMA information such as the agency Dun and Bradstreet Universal Numbering System (DUNS) number, verify active and valid Central Contractor Registration (CCR), and obtain the agency username/password for the www.grants.gov.

- Complete a detailed budget for the award in the format required by program guidance. MEMA retained funding is budgeted as instructed by MEMA Executive Staff.
- Program managers prepare and submit via www.grants.gov the appropriate application documentation. Program managers will commonly submit the following forms regardless of programs:
  - SF-424 Application for Federal Assistance
  - SF-424A Budget Information for Non-Construction Programs
  - SF-424B Assurances for Non-Construction Programs
  - SF-424C Budget Information for Contraction Programs
  - SF-424D Assurances for Construction Programs

  After successful completion and submission of the forms above via www.grants.gov, Grants.gov will notify DHS/FEMA or PHMSA program analyst that the applicant is eligible and approved. Then the preparedness awards will be posted into FEMA's ND-Grants system: https://portal.fema.gov Copies of all submitted documents should be posted as a backup on the office server H-drive in the appropriate year and award folders under the ADMINISTRATION\OFFICE OF THE DIRECTOR\DEPUTY DIRECTOR\GRANTS folders.
- Concurrent with the above application efforts, the program manager will establish and maintain continuous coordination with potential sub-grantees to ensure a common understanding of grant program requirements. The sub-grantee application process will begin with release of this information. Program

manager will provide outreach to eligible stakeholders to begin the solicitation of Investment Justifications and supporting sub award applications from interested qualified applicants.

- Depending on the program, either the program manager alone or a panel of SME's will complete a feasibility review. For competitive grant programs, DHS/FEMA provides IJ scoring criteria to assist in sub-grantee application development. Based upon these criteria the SAA will prioritize local applications, consolidate and submit to DHS/FEMA via FEMA's ND-Grants https://portal.fema.gov
  HSGP and NPSG program manager will submit Investment Justifications via the Grant Reporting Tool https://www.reporting.odp.dhs.gov/
- Program managers await issuance of the award from DHS/FEMA or PHMSA and then proceed to preparation and issuance of sub awards under the Award Stage.
- HMEP PM will review applications daily, using the Power Point Presentation and the Expenditures Guide provided by the Pipeline & Hazardous Material Safety Administration (PHMSA) And consolidate budget and project summaries in preparation for application to USDOT.

Operations Directorate - Hazard Mitigation Branch

a. Grant Program Guidance Review

1. Applicable program guidance will be released as a Notice of Funding Opportunity announcement via www.grants.gov. Upon release grant program managers will review the guidance, forward the guidance to all eligible applicants, and provide follow-on agency guidance and outreach to assure full awareness of program goals and guidance.
2. In the review, program managers will the obtain the following information:
   - **Notice of Funding Opportunity Description**: This provides an overview of the program including investment strategies and

priorities that define the scope of the program as well as individual funding priorities within the program.

- **Award Information**: This provides information for authorizing statutes, period of performance, and available funding both nationally and for state/territory allocations.
- **Eligibility Information:** This establishes who can apply for funding as well as governance for establishing who is eligible to receive federal funds. (This may differ by specific program).
- **Application and Submission Information:** This establishes the steps for submitting an application, content and form of the application, submission dates, intergovernmental review (this will differ by program), funding restrictions, and other submission requirements.
- **Application Review Information:** This section establishes review criteria, review and selection criteria, and anticipated announcement and award dates. (This will differ by program).
- **Award Administration Information:** This establishes the notice of award (NOA), administrative and national policy requirements, and reporting requirements

  FEMA Contacts: This establishes POC's by program at federal level.
- **Other Information:** This provides investment justification and budget templates, sample templates, and other helpful products for application content.

b. Application—

a. Program Managers will submit the agency initial application via www.grants.gov . Program managers will ensure application was received and verified by grants.gov.

c. Sub-Grantee Application Submission

a. Upon receipt of SAA application guidance. PM will provide outreach to eligible stakeholders to begin the solicitation of Investment Justifications and supporting sub award applications from interested qualified applicants.

b. Sub-grantees will complete and return their completed application within the prescribed time period (HMGP =1 year after the declaration PDM= within time period noted in the NOFO).
c. Program managers will review submitted applications for completeness, adherence to local/state strategies and conformance with FEMA program guidance. Completed applications will be submitted to NEMIS https://www.fema.gov/nemis-system for Hazard Mitigation Grant Program or Egrants https://portal.fema.gov/famsVuWeb/home for other program(s) of responsibility. Upon approval a Memorandum of Understanding (MOU) will be released for local review/signature.
d. PM will create a hard copy and electronic folder on the hdrive for each project and ensure it contains all documentation items required for close out as noted in the close out kits for the applicable awards. Links provided under Close Out Section.
e. PM will build award in MEMAGMS pre Appendix A checklist.
f. MEMAGMS System Administrator (MSA) will address all system errors with the vendor and track for resolution. MSA will approve or deny any new users under existing Subgrantees but PM will be responsible for adding new Subgrantees and their users System Administration using the Subgrantee and User Manager functions.

Administration Directorate – Public Assistance Branch and
Strategy Directorate – Individual Assistance Branch

a. Pre-Disaster Declaration Activities

1. Post-disaster, MEMA Public Assistance and Individual Assistance staff begins to collect damage assessment data to establish the need and eligibility for FEMA's Public Assistance (PA) Program and Individual Assistance (IA) grants. Generally, the following steps are followed.
    - Initial Damage Assessments are conducted by local jurisdictions to establish the need for a formal coordinated local/state/FEMA review. Upon request of the local jurisdiction the PA/IA officers will schedule with FEMA dates for a Preliminary Damage Assessment. The results of this effort will determine state eligibility for an Emergency Declaration.
        - PA Officer and Deputy PA Officer collect damage estimates for publically owned properties, response expenses, and emergency protective measures for both State and Local entities.
        - IA Officer collects damage estimates for residential and private businesses.
    - Damage estimates are compiled for statewide PA and IA programs.
    - Maryland must meet the minimum financial threshold for each program to be eligible for assistance from FEMA.
    - A Disaster Declaration Letter is drafted and submitted to FEMA for consideration.

b. Post-Disaster Declaration Activities

1. Public Assistance
    - Once a declaration for Public Assistance is received, PA Officer completes the Application for Federal Assistance (SF424) and Assurances for Construction Program (SF424D) to FEMA via the Emergency Management Mission Integrated Environment (EMMIE).
    - Potential local and state applicants are required to file a Request for Public Assistance (RPA) (FEMA Form 90-49) with MEMA

within 30 days from the date of the Presidential Declaration. The PA Officer and FEMA will use the information submitted on the RPA to determine if an applicant is eligible for Public Assistance.

- Eligible applicants (Sub-grantees) in coordination with FEMA develop Project Worksheets, which outline associated costs/expenses/damages associated with the incident for which the declaration was received. The Project Worksheets become the basis for Sub-grantee award.
- Once the Project Worksheet is approved by PA Officer and FEMA, FEMA releases funding to the State utilizing HHSSmarklink II. The PA Officer then releases the funding to the applicant (Sub-grantee) upon verification that all Project Worksheet requirements are met.

Part II. Award Stage

1. Definitions

A. Grant Award Notice or Grant Adjustment Notice (GAN): Also referred to as Subrecipient Agreement (SRA) and Memorandum of Agreement (MOA):

Once executed by all parties, this is a legal document authorizing the grantee or sub grantee to request payment under the specific terms and conditions noted in the document.

B. Special Terms and Conditions or Agreement Articles: General and special arrangements, provisions, requirements, rules, specifications, and standards that form an integral part of the award document.

C. Financial Management Information System (FMIS): State of Maryland's electronic financial management system.

D. MEMA Grants Management System (MEMAGMS): MEMA's electronic grants management system for all FEMA preparedness grants. https://www.memagms.org/index.k2

E. Grants Management Electronic File System (GMEFS): Electronic files housed on the MEMA shared Hdrive which are organized by subgrantee, then federal fiscal year and then award which contain a host of subgrantee

documents pertaining to their subgrants. This system is accessible to all subgrantees but rarely used by them since the advent of MEMAGMS which supports all FFY 08 and later Preparedness grants. H:/GMEFS

F. **NCR Grants Management System (NCRGMS):** The National Capital Region's electronic grants management system for administration of the sub awards of NCR UASI Funding to MEMA. User application and access is gained at https://www.ncrgms.com/index.k2

G. **Non-Disaster Grants Management System:** The FEMA grants management system developed to support the application for and management of FEMA Non-Disaster grants. https://portal.fema.gov/famsVuWeb/home

H. **Grant Budget Worksheets:** Excel Workbooks created and maintained by Agency Grants Specialist which are reconciled to FMIS on a monthly basis containing original award budgets and expenditures. These are housed on the H drive under H:\ADMINISTRATION\Fiscal Services \Grants.

I. **NEMIS and Egrants:** The FEMA grants management system developed to support the application for and management of FEMA Disaster Grants.

2. Responsibilities

a. **Program Managers-** Program Managers will receive the GAN from FEMA/DHS/ NCR or PHMSA and process the award and return a completed copy to the issuing office or its designated agent. Program managers will provide a copy of the award to MEMA finance staff. They will advise other agency sections and the NCR Project Managers of their reporting responsibilities, format and deadlines. PMs are responsible for reporting sub awards of $25,000 under FFATA by the end of the month following the month of the award date. Instructions can be located at https://www.fsrs.gov . At award closeout any amounts that have been revised during the performance period will need to be revised in the system.

b. **Project Managers-** Project Managers will prepare any necessary EHP review paperwork for their respective projects and submit to Grant Data Coordinator for processing for preparedness awards. State Hazard Mitigation Officer will coordinate and file any Hazard Mitigation EHP reviews for those projects in the hard and digital project files.

c. **Grants Staff-** Grant Data Coordinator (GDC) will collect and process any Subgrantee required EHP reviews and post requests and approvals in

electronic format in both MEMAGMS (on application page) and GMEFS in the Subgrantees EHP Folder.

Tracking of these will be performed through use of an excel spreadsheet housed on the shared drive H: Administration\Deputy Director\Grants\EHP.

d. Finance Staff

1. Department of Military (DMIL) Finance staff is responsible for setting up a new award in FMIS pursuant to approved budget provided by program managers and providing MEMA Finance Branch and PM with the budget code and PCA for the award..
2. Agency Grants Specialist (AGS) will create FMIS Grant Budget Worksheets for each award per the approved federal budget as required by the individual grant guidance for budget tracking and reconciliation between FMIS and the various independent grant management systems in use.
3. DMIL Finance staff will initiate supporting budget amendment documents and submit to the Maryland Department of Budget and Management for review/approval.

3. Standard Policies and Procedures

a. Program Managers – Preparedness Awards

1. When FEMA/DHS/NCR issues MEMA a GAN, the Program Manager (PM) is notified via ND Grants. The GAN is printed by the PM and signed by the Executive Director of MEMA (when an electronic signature is not sufficient). After the Executive Director signs, it is fully executed and uploaded to either NDGrants or NCRGMS as appropriate. An electronic copy is posted in the appropriate year and award folders as a backup under the H drive- OFFICE OF THE DIRECTOR\DEPUTY DIRECTOR\GRANTS. PM supplies a scanned electronic copy to the MEMA Finance Branch for fiscal processing. PM advises MEMA Finance Branch of any modifications to award performance periods and/or award amounts. In agency status and processing of the Subgrantee GAN will be tracked and uploaded by the Grant Data Coordinator however it is the Program Manager's responsibility to follow up with Subgrantees on delinquent GANS.

2. Preparedness Grants Program Managers will create a new award in MEMAGMS entering the award amount, eligible sub-grantees and project

information. Specific instructions for program manager responsibilities are attached as Appendix A.

3. Program Managers for other grants will begin setting up assigned awards based on their individual award requirements, needs and responsibilities as outlined in the applicable FEMA guidance.
4. To comply with Executive Order 12372, Program Managers will prepare and submit clearinghouse forms to the Maryland Department of Planning per form instructions and submit grant award documentation upon receipt.
5. HMEP Program Manager will follow Appendix J – HMEP Administration Checklist for award stage activities.

b. Finance Staff

1. MEMA Finance Manager (FM) will forward a scanned copy of the fully executed FEMA Grant Award Notice and any subsequent Grant Adjustment Notices to the Finance Chief at the Maryland Department of Military to be processed, coded, and activated into FMIS as a new or modified award accompanied by the federally approved object class budget of any MEMA retained funding.
2. FM will provide the grant award number and PCA to the PM for entry into MEMAGMS.
3. FM will direct Agency Grants Specialist (AGS) to create a Grant Budget Worksheet for each award based on the federally approved budget which will also detail budgeted match requirements, budgeted mema expenditures by summary cost code and budgeted subgrantee awards as well as budgeted match expenditures where applicable. These amounts will be detailed by award designated cost category as required by the individual grant guidance.

Part III. Post-Award Stage

1. Responsibilities

a. Program Managers-

i. Support MEMA grant monitoring protocols through a systematic process of desk top audits of all reimbursement claims.

ii. Ensure that any equipment invoices submitted are accurately entered into MEMAGMS with quantity and unit cost before approval. This is a federal requirement for reporting purposes and we can no longer allow invoicing of a quantity of one (1) and the total amount. It is still permissible for the expenditure request to be approved that way prior to the quantity and unit cost being known as a placeholder but the invoice must reflect the actual items and cost. The PM will also ensure that Subgrantee personnel costs (including overtime) are reported by each individual position AEL code with the employee name and % of time devoted to the program detailed in the notes field prior to approval of a claim.

iii. Project change requests exceeding 10% of award amount require pre-approval of awarding entity. PM is responsible for obtaining the approval and uploading this document to the MEMAGMS application page and/or the shared drive. iv. PM is responsible for obtaining and supplying to GDC any required MEMA expenditure sole-source approval related to their award expenditures. PM will coordinate this with DMIL Purchasing staff.

v. For all HMEP applications, quarterly status reports and reimbursement requests received from sub-recipients, a hard copy must be filed in the binder and an electronic copy filed on the H share drive. Quarterly reports and reimbursements requests are entered in the Delphi Envoicing system http://einvoice.esc.gov/

vi. At least twice weekly PM should check for and process applications, GANs, expenditures, reimbursements and change requests as appropriate per applicable guidance. No transactions should remain in queue longer than two weeks unless PM is on leave for an extended period of time.

vii. Review all project expenditure requests for eligibility and conformance with approved application. Coordinate corrective action as required. Forward to AGS via MEMGMS approved requests and manual requests for reimbursement.

viii. Supply match data (if applicable) quarterly to FM for SF 425 reporting.

ix. Complete and submit quarterly and semi-annual ND grants system, NEMIS, GRT, Einvoice and Egrants progress and expenditure reports (systems are award dependent).

x. HMA PM will administer Administrative funds according to the admin plan filed with FEMA for each award.

b. Project Managers

i. Support program managers as directed.

ii. Plan, coordinate and oversee execution of all phases of the project ensuring timelines are met and reimbursements processed and submitted for payment.

iii. Provide as requested updates on project progress and unresolved issues and budget modifications.

c. MEMA Administrative Staff

i. Purchasing Specialist (PS) will process MEMA equipment and supply requests.

ii. PS receives/distributes supplies and equipment. When feasible, marks equipment with appropriate DHS statement.

iii. Logistics Specialist (LS) will provide PM with equipment serial numbers for entry into MEMAGMS.

iv. LS will issue and inventory equipment in compliance with applicable state and federal guidelines.

v. Grant Data Coordinator (GDC) will pull journal entry and expenditure folders from finance office at least once weekly.

vi. GDC will check to see if credits were already applied. Code 412 = Credit. Code 413 – Charge or Debit In MEMAGMS, go to Admin Menu>> Adhoc Reports>> Accounting Reports>>Credit History Report>> from 'Subgrantees' select MEMA, from 'Grant Years' select year, then select the Grant Group. Select 'All Report Dates' click 'Next Step' and verify the information. Click on 'View Reports' then download in excel. Format the spreadsheet to suit your search. Most spreadsheets will have merged cells; select the area you need to work with and on the home tab, click on the Merge & Center drop down arrow and choose 'unmerge cells'. Look for the credit amount in the 'total' column; you may also search by entering the amount in the search field by using the find (CTRLf)

feature. (The credit amount will not be found in MEMAGMS expenditure list, the amount can be found only on the credit report, if it was already applied).

vii. To apply credit, GDC will alias log in as MEMAADMIN user and go to the Subgrantee expenditure list, click on 'Maryland Emergency Management Agency' and search for the original charge (use the document number and supporting FMIS pages to verify that you have chosen the correct charge). Please note that for payrolls, the same document numbers are used each year, so it is important to take note of the date and the supporting document. If you locate the same document number and you are unsure it is the one you need, click on the date it was posted and view the supporting documentation to ensure you are not duplicating entries.

viii. If the credit was not already applied, GDC will click on the word 'credit' and reduce the 'unit cost' amount by the amount to be credited, reduce the 'assigned' amount by the same amount (to be credited), and enter a reason (found on the journal adjustment). Upload the part of the journal adjustment that applies to that credit. Please include the cover page of the journal adjustment, click 'submit'. If the original charge was not posted in GMS, the credit should not be applied. This will occur because the system does not permit over expenditure of budgeted funds unlike FMIS.

ix. If credits or charges have already been applied, GDC will note that on the journal adjustment or invoice. GDC will also note on all current charges and credits that they have been entered in MEMAGMS.

x. GDC will post charges, alias log in as MEMA Admin, go to the appropriate project and post the charge. Ensure object codes are entered in MEMAGMS and enter as much detail as possible so that the expenditure can be easily identified. Upload the scanned part of the journal adjustment that applies to that charge and include the cover of the journal adjustment.

d. Finance Staff-

i. Finance Manager (FM) will provide Grant Data Coordinator (GDC) with approved and appropriately coded purchase orders and requisitions for entry into MEMAGMS.

ii. Agency Grants Specialist (AGS) will review approved MEMAGMS reimbursement requests in MEMAGMS and voucher and code (PCA/OBJ)

iii. Fiscal Specialist (FS) will enter charges and credits in FMIS and submit to DMIL Finance for payment or credit.

iv. AGS will review approved paper reimbursement requests, copy, scan and post to GMEFS and enter in FMIS and submit to DMIL for payment.

v. When items are paid in FMIS, AGS will record on grants budget worksheets and if applicable Complete transactions in MEMAGMS.

vi. AGS will prepare and maintain grants budget worksheets for all HMEP, PA and HMA awards to include local tabs for every award and house them on hdrive under the appropriate year and award folder under Finance/Grants. Back up to external hard drive monthly. vii. AGS will reconcile MEMGMS to FMIS for budgeted and expended federal, general and match funds on a monthly basis as of month end date. Clear all reconciliation exceptions by the following month end.

viii. AGS will post entire Grant Budget workbooks for Preparedness grants to the Hdrive to include local tabs for every award and back up to external drive no less frequently than monthly.

ix. AGS will print and supply FMIS MEMA Expenditure detail not entered in memgms monthly and supply to GDC for entry into MEMAGMS.

AGS will print and Supply NCR award FMIS expenditures and payroll detail and supporting invoices monthly to NCR Program Manager. NCR Program Manager will enter and submit reimbursements in NCRGMS. NCR Project Manager will collect and submit Program Management Plans for the respective projects and supply to NCR Program Manager to submit.

x. FM will file SFR425's for all agency awards on a quarterly basis after having met with the PM to reconcile award and project documentation.

xi. FM will compute and process journal entries for applicable indirect costs on a quarterly basis. Provide to GDC for entry in MEMAGMS.

Part IV. Closeout

1. Responsibilities

a. Program Managers-

i. Will conduct quarterly reviews of grant expenditure rates and coordinate with sub-grantees when required to ensure full expenditure of awarded funds.

ii. Issue close-out GANs or notices to sub-grantees. Modify existing awards when required to correspond with actual expenditures.

iii. Review/process sub-grantee close-out reports to include performing grant adjustment requests and releasing and tracking associated close out GANs for returned funding and reallocation, when applicable. Closeout GANs are the only GANs permitted to be "dummied" through the system in order to facilitate closeout and the MEMAGMS System Administrator (MSA) must be advised of the issuance of these in advance.

iv. Complete and submit final ND grants, Egrants, GRT, Einvoice or NEMIS system progress report.

v. For Public Assistance and HMA awards perform closeout in accordance with applicable instruction and close out kits from FEMA. Links below: http://www.fema.gov/media-library-data/14243681157 3486cfbaeb456f7c1d57a05d3e8e08a4bd/FINAL_CloseoutToolkit_Close out_FAQ_13FEB15_508complete.pdf http://www.fema.gov/medialibrary-data/1424368115734-86cfbaeb456f7c1d57a05d3e8e08a4bd/FINAL_CloseoutToolkit_Closeout_Checklist_13FEB15_508complete.pdf http://www.fema.gov/media-library-data/1424368115734-86cfbaeb456f7c1d57a05d3e8e08a4bd/FINAL_CloseoutToolkit_MgtCosts_11FEB15_508complete.pdf

vi. Update FFATA FSRS data base with final expenditure amounts.

vii. If applicable, an inventory of all construction projects that used funds from this program has to be reported using the Real Property Status Report (Standard Form SF 429) available at http://www.whitehouse.gov/sites/default/files/omb/grants/approved_forms/sf-429.pdf.

b. After award is closed PA AND HMA Program Managers will provide Grants Compliance Monitor with a listing of all equipment purchased under the awards to include, entity name and contact information, physical location of equipment, cost and date of project completion and or final inspection.

c. **Project Managers**

i. Verify project completion and final user acceptance as required.

ii. Compile, verify and submit final invoices for processing on or before the end of the grant performance period. Coordinate with Program Manager ninety (90) days in advance of POP end if postPOP expenditure requests will be required.

d. **MEMA Administrative Staff**

i. Logistics Specialist (LS) will continue inventory of equipment until disposed.

ii. LS will ensure grant funded equipment is disposed of IAW established agency policies and applicable federal requirements.

iii. LS will maintain equipment inventory and disposition records for thirty six months beyond issuance of close-out GAN by DHS/FEMA.

e. Finance Staff-

i. FM will provide Grant Data Coordinator with approved and appropriately coded purchase orders and requisitions for entry into MEMAGMS.

ii. AGS will review approved MEMAGMS reimbursement requests, voucher and code (PCA/OBJ); FS will enter in FMIS and submit to DMIL Finance for payment.

iii. AGS will finalize approved paper reimbursement requests, copy, and FS will enter in FMIS and AGS will record on grant budget worksheets. FS will submit to DMIL Finance for payment.

iv. AGS will complete vouchers in MEMAGMS once paid in FMIS and record as paid on grants budget worksheets.

v. FM will liquidate all obligations incurred under the award no later than 90 calendar days after the end date of the period of performance or expiration of a GAN that closes out the award, whichever comes first and file final SFR425.

Part V. Post Closeout

1. **Responsibilities**

    A. Grant Compliance Monitor (GCM)- Conduct desk and on site monitoring in accordance with the attached appendices C through I.

APPENDICES

A MEMAGMS - Grant Creation Checklist

B MOA tracking Procedure for HMEP Award

C Sub-Grantee Monitoring Protocols

D SAA Monitoring Questions

E Grant Monitoring Template

F Procurement Checklist

G Monitoring Risk Formula

H Equipment Sampling Criteria

I Monitoring Schedule

J HMEP Grant Administration Checklist and Forms

APPENDIX A

MEMAGMS
Building a Grant
Checklist

_____January/February time frame you should confirm the components of last year's formula are updated where applicable and check with Director to see if any formula factors are being considered for revision i.e. Increase in base, change in pass through amounts, MEMA specific funds retention, specific projects or entities to be funded etc. Build folder structure on Hdrive and copy any relevant files into it from last year. Back up everything submitted in federal government systems to the Hdrive for the award throughout the performance period and closeout.

_____ March/April time frame release of NOFO. Email copy to MEMA finance and DMIL finance. Completely read and compare both the NOFO and the Terms and Conditions and make note of any significant changes in either policy or funding when compared to prior years guidance. If there are significant changes a summarizing memo should be prepared and submitted to the Director.

_____Advise System Administrator immediately if the guidance contains any new reporting requirements that need to be addressed so the vendor can be advised of any necessary modifications to facilitate the new reporting.

.

_____Submit initial application in Grants.gov

_____Distribute to other agency sections or other agencies (i.e. Planning, E&T or MCAC/MSP) any portions of the application template that they are required to complete with a specified due date sufficient to allow inclusion in the final application. Use reporting log specific to the award to ensure all documents are distributed to and received from the relevant entities responsible party.

_____Prepare NDGrants and GRT final applications per NOFO instructions and submit timely.

_____Send Maryland Department of Planning clearinghouse letter and application copy on submission of application. Package requires Narrative and Budget. Upon receipt the MDOP will mail you a form to complete and return when you receive the actual award document.

_____ If this is a new award type or the State or Urban Area Strategy has been revised and approved by DHS, it will be necessary for you to load any applicable strategy and investment plans under Project Administration on the Admin Menu in MEMAGMS.

_____ Load this year's investments or copy last years under the Investment Justifications Manager.

_____ On announcement of award funding ("NOFO" release) go to MEMAGMS admin menu, grant manager, select year and "add new grant" button. Grant name is 4 digit year, space and award acronym. Check "Include on BSIR" for all DHS awards. Set state end date to precede federal end date by 3 months for EMPG and 1 year and 3 months for HSGP awards. You will need to initially list the award date as the date of NOFO in order to allow release of the applications to the field. Award number will remain blank until we receive the award from DHS. Complete all other blank fields under each button in the grant manager and allow the eligible recipients by checkbox. Budget code for locals is always 1299, leave state budget code blank always. Enter any match requirements and M and A limits. Always check box to allow other SAA users to access award.

_____Develop and load instructions for Pre-Application and Application for both local and state Subgrantee in grant distribution.

_____Update local distribution template with current award data. Develop allocation formula and calculate grant distribution and enter into MEMAGMS and assign funding by sub grantee. You MUST check the Pre-Gan box to the left of the entity to put the award in local build status.

_____Approve applications as they are submitted but do not release SRA/GAN until award is received from DHS.

_____Prepare FMIS budget for MEMA retained portion of funding and load budget in MEMAGMS using FMIS cost codes. Distribute to finance sections at MEMA and DMIL.

_____Under forms Manager load copy of NOFO, DHS Terms and Conditions and MEMA Agreement Articles and authorize for award(s). Name these consistently with prior year formats. Authorize all other documents that apply to the award, i.e. 2cfr, instructional PowerPoints etc.

_____Re-write the Agreement Articles from Prior year to include any new DHS Articles and changes in grant guidance or MEMA policy. Give to System Administrator in word

format to load to SRA and GAN for the current year. Load copy in pdf format to forms manager and authorize for award.

_____After award GAN is received from DHS revisit grant manager and add Federal Grant Number and correct performance period begin date. Also advise System Administrator to load award number and authorizing and funding authority on SRA, GAN and Agreement Articles. These tasks must be completed PRIOR to the release of any GANs.

_____Release Gans within specified 45 day period (if applicable to the award) to obligate funding to subgrantees. Follow up on completion of these within specified completion period.

_____Email DHS award notice to finance at both MEMA and DMIL. Provide them again the award budget and instruction for start date for use of new funding.

_____Complete and mail the Maryland Department of Planning form on receipt of award from DHS

_____Add any new sub grantees and/or users under the Subgrantee Manager and Administrative account. Advise the Grant Manager of the addition and advise System Administrator of any training needs for the new users.

_____Authorize all users of each affected sub grantee for access to the award under the edit function next to the user name in Administrative Account (system defaults only authorizes the POC)

_____For the NPSG awards enter the projects per the approved state grant application investment justifications for all sub grantees. (UASI will be loaded by the UAWG) Deactivate any users no longer requiring access.

_____If desired, develop a quarterly programmatic reporting form template and post to forms menu, authorizing for all affected users. Email all affected sub grantees the template and instructions to upload the report quarterly to the grant application page.

____Revisit and revise performance periods if there is a blanket federal or individual state extension of the end performance date.

_____Monitor award through closeout documents submission to DHS for uncommitted funds. Ensure closeout occurs in MEMAGMS for all awards.

Appendix B

Maryland Emergency Management Agency

MOA Tracking Procedures for HMEP Awards

The following procedures will be utilized for grants managed by this agency that are not compatible with the MEMAGMS system:

New or Amended Memorandums of Agreement

1. Program Managers generate MOA template and email to local Director with any attached special terms and conditions and grant guidance. A blank copy of the MOA should be posted in Grants Management Electronic File System (GMEFS) under the appropriate sub grantee, award year and award.
2. An excel worksheet will be maintained on the Hdrive to track release, receipt and execution of the MOAs. It should be edit protected by the grant Data Coordinator (GDC) and the applicable password shared only with the Assistant Director of Administration.
3. On receipt of a Subgrantee signed MOA, GDC delivers the MOA to the Executive Director's assistant for his signature.
4. When the MOA is signed, GDC will scan and post the signed MOA to the appropriate folders in GMEFS and insert a hard copy into the binder and provide an electronic copy to the Grant Budget Specialist so it may be recorded on the Grant Budget Worksheet as received. In the event it is an amended MOA the Grant Budget Specialist will revise the budget on the Grant Budget Worksheet accordingly. If two or more local hard copies are received, the excess originals are returned to the Subgrantee via USPS. Otherwise GDC will email the local Director/Emergency Manager the PDF of the signed MOA and cc the local grant contact.
5. Program Manager marks the MOA complete on the excel tracking worksheet.
6. No reimbursement requests will be approved prior to completion of supporting MOA.

Appendix C

Maryland Emergency Management Agency

Grant Monitoring Site Visit Protocols

General

1. Purpose: Site visits are a critical link in the grant oversight process identifying areas for improvement, Best Practices for further dissemination, and reinforcing working relationships between agency and local grants management staffs.
2. Scope: Site visits will encompass open grants and recently closed grants. The monitoring will be both programmatic and financial in nature.
3. Responsibilities: Program managers are responsible for coordinating site visits IAW the below procedures or in coordination with other members of the Agency Grants Staff.
4. Visit Frequency: The following outlines the site visit monitoring protocols:
   a) Local Jurisdiction Preparedness Grant Programs- approximately 30% to 35% site visits annually chosen through application of Exhibit H Risk Formula.
   b) Agencies/ Contractors whose awards/ contracts exceed $500,000.00 and include equipment, approximately 50% site visits annually.
   c) Non-Profit Organizations- 100% site visits at close out if equipment or construction is funded.
   d) Hazard Mitigation Programs – 100% site visits at close out on all land, structure and equipment projects to be performed by Hazard Mitigation staff. Equipment to be site inspected 100% every other year post close out until disposition by the Grant Compliance Monitor.
   e) Monitoring visits may be conducted at any time Agency grant or program staff believes problems or issues at the sub-grantee level warrant closer grant oversight.
5. Documentation: The "Monitoring Schedule" will list the grantees scheduled to be visited, record the grant years and or projects to be reviewed and summarize the completed visits on a calendar year basis annually.

Site Visit Preparation

1. Monitoring personnel will contact the appropriate Regional Administrator as well as the Local or Agency Program Director via email and notify them of at least a two month window to complete the site visit to obtain a list of available dates. Upon reaching a mutually agreeable schedule, an official letter with the accompanying monitoring template (Appendix E) and/or equipment listing will be sent (via regular and email) confirming the appointment, stating the purpose of the site visit and providing a detailed listing of information, documentation and equipment that will need to be available for review and inspection.

2. Prior to the site visit, monitoring personnel will desk review applicable awards, grant budget worksheets and reimbursement requests to identify projects and equipment to be covered. Purchases are reviewed for program and administrative/fiscal compliance. If the Agency has submitted single audit report(s) for either of the last two fiscal years that have been flagged as containing either a qualified opinion or reportable condition(s), the applicable section of the report should be copied for follow up during the monitoring visit.

3. Where desk reviews of submitted reimbursement requests contain a purchase amount of $50,000 or more, identify the items purchased and request procurement documentation and proof of payment (if not previously provided with reimbursement claim) be made available for the site visit on a representative sample of these.

Site Visit

In addition to the review of requested documentation and discussion of program progress and other programmatic issues, an inspection of DHS/FEMA funded equipment will be performed. Sample size will be determined by applicable formula on Appendix H. Technical assistance will also be provided as necessary.

Specific areas of review include:

1 Reconciliation of awarded Amounts:

a. Tie awardee's records to MEMA disbursements by comparing to general ledger. Review to ensure no duplicate requests for reimbursement were submitted.
b. Generate amended MOAs as necessary
c. Validate program costs, resolve identified issues
d. Verify match requirements
e. Review program income and supporting documentation
f. Review indirect costs schedules if applicable
g. Validate procurement processes through use of the Appendix F Procurement Checklist
h. Verify M&A expenses and cost tracking
i. Review personnel classifications and costs

2 Local Sub Awards: review supporting MOAs and oversight procedures to include property inventory and tracking. Verify local asset control thresholds, review inventory procedures, selectively inspect equipment. Verify equipment locations and serial numbers. Verify equipment is maintained and secured.

3 Single Audit – Implement and or review corrective action plans as appropriate; verify implementation and results.

4 Technical Assistance/Training: Determine training shortfalls or technical assistance requirements to enhance local grant management operations. Special consideration is to be given to sub-grantee staff which has experience recent staff turnover.

Post Site Visit

Monitoring and program personnel will review the monitoring template as a team. Within 15 days of the site visit the completed monitoring template will be sent to the grantee explaining any necessary corrective actions or recommendations, if applicable, with a stated time frame to implement.
Upon resolution of all noted issues a Monitoring Results Letter will be generated indicating that either no exceptions were noted or all exceptions were cleared and the agency visit marked as completed on the Monitoring Schedule.

Maryland Emergency Management Agency

SAA Monitoring Visit Questions

Program Questions

1. What method does the entity use to track equipment? Is equipment tagged or marked for inventory control? What is the equipment tracking threshold? Are inspections being performed at a minimum of every other year? Is the equipment secured? Is the equipment maintained? Is the staff properly trained on the equipment use?

2. If the program produced written products, were they marked "This document was prepared under a grant from FEMA's Grants Programs Directorate, U.S. Department of Homeland Security. Points of view or opinions expressed in this document are those of the authors and do not necessarily represent the official position or policies of FEMA's Grants Programs Directorate or the U.S. Department of Homeland Security"?

3. If the program included an exercise component, was an After Action Report / Improvement Plan developed?

4. Is the entity/jurisdiction compliant with the National Incident Management System (NIMS) requirements?

5. Will the program finish within the period of performance of the sub-grant? If not, will an extension be requested?

6. Please list any risks or delays that any project is experiencing. Please list any changes of scope or budget for any project.

Appendix D SAA Monitoring Visit Questions

Financial Questions

7. How does the agency keep track of project related expenses and requests for reimbursement in addition to MEMAGMS? Do they have an asset tracking/inventory system in use?

8. Do they have any relevant findings on their 3 most recent Single Audit reports (if so, please explain)?

9. Is the entity/jurisdiction delinquent on any debts to the U.S. Federal Government?

10. After comparison of the listing of reimbursement requests in MEMAGMS with subgrantee financial records, are there are any discrepancies between MEMAGMS and supporting financial records?

11. Who is responsible for entering information into MEMAGMS? Does this individual need any additional MEMAGMS training?

12. What measures are in place to ensure that federal funds are not used to supplant (replace) local funds allocated for the same purpose?

13. Do you have copies of all contracts and procurements associated with the program? How are these copies stored/maintained/accessed? Locally or in central accounting office?

Appendix D SAA Monitoring Visit Questions

Policies and Procedures

14. Does the entity/jurisdiction have a written policy regarding allowable costs for travel related to business? **On file in GMEFS of link provided?**

15. Does the entity/jurisdiction have a written policy regarding procurement and purchasing? **Link or document on file in GMEFS?**

16. Does the entity/jurisdiction have a written policy or system in place regarding how you allocate personnel expenses to funding sources (particularly grants)? **Link or document on file in GMEFS?**
17. Does the entity/jurisdiction have a written policy or system in place regarding inventory management? **Link or document on file in GMEFS?**

18. Does the entity/jurisdiction have a written policy or system in place for accounting and financial management of grant funds? **Link or document on file in GMEFS?**

19. Does the entity/jurisdiction have an approved indirect cost rate agreement with a federal agency? **Link or document on file in GMEFS?**

20. Does the entity/jurisdiction have policy regarding how charges are allocated to grants and how these allocations are approved? Is this policy written? **Yes/No**
    Link or document on file in GMEFS?

SITE VISIT ONLY

The SAA staff inspected the following (where checked✓):

The project file (award letter, GAN's and status reports)

- Examples of how equipment is inventoried and tracked
- Demonstration of your entity/jurisdiction's financial system and how grant funds are tracked in this system
- Procurement files and contracts associated with the project
- Example of how financial records documenting grant funded expenditures are maintained
- Physical inspection of items purchased or products produced with project funds
- The written policies/procedures listed above (#14-20)

Maryland Emergency Management Agency
Appendix E Grants Monitoring Template

Instructions: The following serves as a guidance for conducting financial monitoring activities site visits for all MEMA award recipients. The requirements set forth apply to **all** non-Federal entities, except where it specifically highlights state only requirements (Financial Management Systems, Procurement by State and Procurement of Recovered Materials). In this instance, the state will follow the guidance applicable to them. All other non-Federal entities will follow all other requirements.

Please note: The Protocol was developed as a reporting tool and is not a comprehensive listing of all 2 CFR 200 requirements; rather it contains references to primary administrative requirements and historical areas of concern related to recipient compliance.

The document is intended to document and report on the results of the review.

Recipient Information							
Recipient Name:							
Type of Organization:							
Recipient Contact:							
Telephone:				Fax:			
Email:							
Address:							
City:		State:	MD	Zip:		Country:	USA
Other Individuals Involved:							

Review Information			
Desk Review or Site Visit:			
Desk Review Final Contact Date/ Site Visit Completion Date:			
Region:	Lower Shore		
MEMA Reviewer(s):	Toni Cosden		

Grant Information					
Grant Number	**Program**	**Grant Amount**	**Funds Remaining**	**Start Date**	**End Date**

	HMEP				
	SHSGP				
	UASI				
	EMPG				
	NCR				
	HAZARD MITIGATION				

Monitoring History	Yes	No
Are any of the monitored grants closed or expired?		
If yes, please list here.		
Were any significant problems identified during quarterly reviews of the FFR/SF-425s that require follow-up during the financial monitoring review?		
If yes, please list here.		
Has the Recipient received prior financial monitoring reviews?		
If yes, please list here.		
Has the Recipient received prior programmatic monitoring visits?		
If yes, please list here.		
Do any prior monitoring reports have actions that still need to be resolved?		
If yes, please list here.		
Was a pre-monitoring meeting conducted with the Programmatic Staff and/or GMS?		
If yes, please provide any relevant information here.		

Summary of Findings and Recommended Corrective Actions				
Finding	**Recommended Corrective Action(s)**	**Award(s) Affected**	**Category**	**Sub-Category**
			Choose a Category	Choose a Subcategory

			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
Response due to MEMA by:				

xecutive Summary/Additional Review Notes/Comments
sert appropriate review notes and general comments to document information associated with the review. Please use as much space as needed.

ummary of Findings and Recommended Corrective Actions		

Maryland Emergency Management Agency
Appendix E Grants Monitoring Template

Finding	Recommended Corrective Action(s)	Award(s) Affected	Category	Sub-Category
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
			Choose a Category	Choose a Subcategory
Response due to MEMA by:				

Executive Summary/Additional Review Notes/Comments

Section I: Post Federal Award Requirements

2 CFR 200.300 – 200.345

STANDARDS FOR FINANCIAL AND PROGRAM MANAGEMENT (200.300 – 200.309)	
Guidance	**Source**
Statutory and National Policy Requirements (200.300)	
The non-Federal entity is responsible for complying with all requirements of the Federal award. For all Federal awards, this includes the provisions of FFATA, which includes requirements on executive compensation, and also requirements implementing the Act for the non-Federal entity at 2 CFR part 25 Financial Assistance Use of Universal Identifier and Central Contractor Registration and 2 CFR part 170 Reporting Sub-award and Executive Compensation Information. See also statutory requirements for whistleblower protections at 10 U.S.C. 2409, 41 U.S.C. 4712, and 10 U.S.C. 2324, 41 U.S.C. 4304 and 4310.	200.300 (b)
Comment:	
Financial Management Systems (200.302)	
For States: Verify that the state expends and accounts for the Federal award in accordance with state laws and procedures for expending and accounting for the state's own funds. In addition, the state's and the other non-Federal entity's financial management systems, including records documenting compliance with Federal statutes, regulations, and the terms and conditions of the Federal award, must be sufficient to permit the preparation of reports required by general and program-specific terms and conditions; and the tracing of funds to a level of expenditures adequate to establish that such funds have been used according to the Federal statutes, regulations, and the terms and conditions of the Federal award. See also §200.450 Lobbying.	200.302 (a), Also Reference: 200.450
Comment:	
For all non-federal entities: The financial management system of each non-Federal entity must provide for the following: 1) Verify that the non-federal entity can identify, in its accounts, all Federal awards received and expended and the Federal programs under which they were received. Federal program and Federal award identification must include, as applicable, the CFDA title and number, Federal award identification number and year, name of the Federal agency, and name of the pass-through entity, if any.	200.302 (b)(1)
Comment:	

2) Verify that the recipient's financial management system provides for accurate, current, and complete disclosure of the financial results of each Federal award or program in accordance with the reporting requirements set forth in §§200.327 Financial reporting and 200.328 Monitoring and reporting program performance.	200.302 (b)(2) Also Reference: 200.327 and 200.328

Comment:	
3) Verify that the non-federal entity's records identify adequately the source and application of funds for federally-funded activities. These records must contain information pertaining to Federal awards, authorizations, obligations, unobligated balances, assets, expenditures, income and interest and be supported by source documentation.	200.302(3)
Comment:	
4) Verify the non-federal entity has effective control over, and accountability for, all funds, 200.302 property, and other assets. The non-Federal entity must adequately safeguard all assets and assure that they are used solely for authorized purposes. See §200.303 Internal controls. 200.303	(4) Also Reference:
Comment:	
5) Verify the non-federal entity compares expenditures with budget amounts for each Federal award.	200.302 (5)
Comment:	
6) Verify the non-federal entity has written procedures to implement the requirements of §200.305 Payment	200.302 (6) Also Reference 200.303
Comment:	
7) Verify the non-federal entity has written procedures for determining the allowability of costs in accordance with Subpart E—Cost Principles of this part and the terms and conditions of the Federal award.	202.302 (7)
Comment:	
Internal Controls (200.303)	

Verify that the non-Federal entity has internal controls that: • Establishes and maintains effective internal control over the Federal award that provides reasonable assurance that the non-Federal entity is managing the Federal award in compliance with Federal statutes, regulations, and the terms and conditions of the Federal award. • (b) Complies with Federal statutes, regulations, and the terms and conditions of the Federal awards. • (c) Evaluates and monitors the non-Federal entity's compliance with statutes, regulations and the terms and conditions of Federal awards. • (d) Takes prompt action when instances of noncompliance are identified including noncompliance identified in audit findings. • (e) Takes reasonable measures to safeguard protected personally identifiable information and other information the Federal awarding agency or pass-through entity designates as sensitive.	200.303 (a) – (e)
Comment:	

Payment (200.305)	
Payment (States): Ensure that the payments follow Treasury-State CMIA agreements and default procedures codified at 31 CFR Part 205 and TFM 4A-2000	200.305(a)
Comments:	
Payment (all other Non-Federal Entities): Verify that payment methods minimize the time elapsing between the transfer of funds from the Treasury or pass-through entity and the disbursement by the non-Federal entity despite method of payment.	200.305 (b) Also Reference 200.302 (b) (6)
Comments:	
Payment (all other Non-Federal Entities): If the recipient request advance payments, verify that the recipient is maintaining advanced payments in interest bearing accounts whenever possible or unless the conditions described in 200.305(b)(8)(i)-(iv) apply.	200.305 (b)(8)
Comments:	
***Payment (all other Non-Federal Entities):** Verify that the non-federal entity tracks interest on (b)(9) advance payments deposited into interest bearing accounts. Also verify that the non-entity remits any interest earned on advance payments that exceeds $500 per year to HHS on at annual basis.	200.305 federal least an
Comments:	
Cost Sharing or Matching (200.306)	

***Cost Sharing or Matching:** Verify that all matching contributions, including cash and third party in-kind contributions are documented, are allowable under the program guidance/regulations and cost principles, and properly valued.	200.306 (b) - (k)
Comments:	
Program Income (200.307)	
***Program Income:** Verify that the recipient is earning income to defray program cost where appropriate and that the income is used in accordance with 2 CFR 200 regulations.	200.307 (a) – (g)
Comments:	
Budget and Program Plans (200.308)	
***Revision of Budget and Program Plans:** If the recipient makes changes to their budget or program plan, verify that prior approval was granted.	200.308 (a) - (i)
Comments:	
Period of Performance (200.309)	
***Period of Performance:** Verify that the recipient is only incurring allowable cost during the period of performance, unless authorized by the awarding agency.	200.309 Also Reference 200.461
Comments:	

PROPERTY STANDARDS (200.310 – 200.316)	
Guidance	**Source**
Insurance Coverage: Verify that the non-Federal entity provides the equivalent insurance coverage for real property and equipment acquired or improved with Federal funds as provided to property owned by the non-Federal entity. Federally-owned property need not be insured unless required by the terms and conditions of the Federal award.	200.310
Comments:	
Real Property: Verify that any real property purchased with Federal funds is being utilized for its intended purpose and under the obligations and conditions set forth in this section.	200.311(b)
Comments:	

***Federally-owned and Exempt Property:** If a non-federal entity has Federally-owned property, verify that recipient submitted an annual inventory list of all federally-owned property under its custody, and that property no longer needed is reported to the Federal agency.	200.312 (a)
Comments:	
Equipment (States): Verify that the State uses, manages, and disposes of equipment acquired under a grant by the State in accordance with State laws and procedures.	200.313 (b)
Comments:	
Equipment (all other non-federal entities): Ensure that the recipient has the appropriate mechanisms in place to oversee the equipment and that it meets all the standards set forth in this section, including • Verify that the non-federal entity maintains all necessary property records which include a description of the property, source of the funding, serial number, acquisition date, etc. • Verify that non-federal entity has taken a physical inventory once every two years and that the results have been reconciled with property records. • Verify that non-federal entity maintains a control system to ensure adequate safeguards to prevent against loss, damage, or theft. • Verify that the non-federal entity has developed adequate maintenance to keep the property in good condition. • Verify if the non-federal entity is authorized or required to sell the property, they have proper sales procedures in place to ensure the highest possible return.	200.313 (d)
Comments:	

PROCUREMENT STANDARDS (200.317 – 200.326)	
Guidance	**Source**
Procurement by States: Ensure that the state agency is following the same policies and procedures it uses for procurements from its non-Federal funds. The state will comply with §200.322 Procurement of recovered materials and ensure that every purchase order or other contract includes any clauses required by section §200.326 Contract provisions.	200.317
Comments:	

General Procurement Standards (all other non-federal entities): Ensure the non-federal entity has the following included in their procurement standards: • Verify that the non-Federal entity uses its own documented procurement procedures which reflect applicable State, local, and tribal laws and regulations, provided that the procurements conform to applicable Federal law and the standards identified in this part. • Verify that the Non-Federal entity maintains oversight to ensure that contractors perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders. • Verify that the non-Federal entity maintains written standards of conduct covering conflicts of interest and governing the actions of its employees engaged in the selection, award and administration of contracts. • Ensure that the non-federal entity's procedures address avoiding acquisition of unnecessary or duplicative items. • Verify that the non-federal entity maintains records sufficient to detail the history of procurement. These records will include, but are not necessarily limited to the following: rationale for the method of procurement, selection of contract type, contractor selection or rejection, and the basis for the contract price. • Ensure the non-federal entity has standards for the settlement of all contractual and administrative issues arising out of procurements.	200.318(a) – (k)
Comments:	
Competition: Verify that all procurement transactions are conducted in a manner providing full and open competition with all Federal standards in this section.	200.319 (a) - (d)
Comments:	
Methods of Procurement to Follow: Ensure that recipients follow: • Verify that the recipient is following appropriate micro purchases, small purchase, sealed bid and competitive procedures as needed. • Verify that the procurement lends itself to a firm fixed price contract and the selection is made principle on price • Verify the requirements for a sealed bid (as needed) • Verify the recipients process for non-competitive proposals (as needed)	200.320 (a) – (f)

Comments:	
Contracting with Small and Minority-owned Business: Verify that the recipient is taking all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible.	200.321(a) & (b)

Comments:	
Procurement of Recovered Materials (For States): Verify that States or agencies of political subdivisions of a state and its contractors comply with section 6002 of the Solid Waste Disp. Act.	200.322
Comments:	
Contract Cost and Price: Verify that the recipient performed or followed the appropriate cost or pricing guidelines related to procurement action.	200.323(a) – (d)
Comments:	
Contract Provisions: Verify that the non-federal entity's contracts contain the applicable provisions described in Appendix II to Part 200 – Contract Provisions for non-Federal Entity Contracts under Federal Awards	200.326; Also Reference Appendix II
Comments:	
SUBRECIPIENT MONITORING AND MANAGEMENT (200.330 – 200.332)	
Requirements for pass-through entities: Verify that the pass-through entity's sub-awards contain all the information required by 2 CFR 200.331(a).	200.331 (a)(1) – (6)
Comments:	
Evaluating sub-recipient risk: Ensure that the pass-through entity is evaluating each subrecipient's risk of noncompliance with Federal statutes, regulations, and award terms and conditions.	200.331 (b)
Comments:	
***Monitoring sub-recipient activities:** Ensure that the non-federal entity is monitoring the activities of their sub-recipient/s. Pass-through monitoring must include: 1. Reviewing financial and performance reports required by the pass-through entity. 2. Following-up and ensuring that the sub-recipient takes timely and appropriate action on all deficiencies pertaining to the Federal award provided to the sub-recipient from the passthrough entity detected through audits, on-site reviews, and other means. 3. Issuing a management decision for audit findings pertaining to the Federal award provided to the sub-recipient from the pass-through entity as required by §200.521 Management decision.	200.331 (c)
Comments:	

***Fixed Amount Subawards**: If the non-federal entity is awarding fixed amount subawards, verify that they received prior written approval from FEMA to do so.	200.332
Comments:	

ADDITIONAL MISCELLANEOUS ITEMS FOR REVIEW	
Guidance	**Source**
***Record Retention Requirements:** Verify that the recipient is following requirements for record retention according to the guidance (i.e. three years from the date of the submission of the final expenditure report or FFR), and that there are processes in place for transfer, collection, transmission, storage and access to all records.	200. 333(a) (f), 200.335 and 200.336; Also Reference 200.302(b)
Comments:	
***Debarred or Suspended Awards:** Verify that the recipient does not make any award (subrecipient or contract) to any party which is debarred, suspended, or otherwise ineligible from participating in Federal assistance programs.	200.212
Comments:	
Documentation Supporting Salaries and Wages. Verify that the recipient maintains appropriate source documentation for salaries and wages.	200.430(i)
Written Travel Policy. Verify that the recipient has a written travel policy in place. In the absence of an acceptable, written governmental unit policy regarding travel costs, the recipient must comply with the lodging and subsistence limits outlined by Chapter 57 of Title 5, or GSA per diem amounts.	400.474(b)(3)
Closeout: Verify that the recipient has submitted or plans to submit all financial, performance and other required reports to FEMA within 90 calendar days after the end of the period of performance.	200.343
Comments:	

Audits: Verify that the recipient is obtaining audits as required by applicable laws and guidance. Also, verify that the recipient is monitoring its sub-recipients to ensure they are receiving A-133 audits as appropriate.	200.501 – 200.511
Comments:	
Federal Funding Accountability and Transparency Act (FFATA)	
Prime Executive Compensation Reporting. Review the expiration date of the recipient's SAM.gov to verify active registration. Also, cross reference the recipient's DUNS# with the grant application, these numbers must be the same.	FFATA or Transparency Act (P.L.109-282), 2 CFR 170
Comments:	
Prime Executive Compensation Reporting. If the recipient is required to report executive compensation, Transparency Act verify that reporting was conducted by the end of the month, following the month the obligation (P.L.109-282), 2 was made.	FFATA or award or CFR 170
Comments:	
Sub-Award Reporting. Verify that the recipient has reported all required actions in the FFATA Sub-award Reporting System (FSRS) within the required timeframe for sub-awards. The prime recipient must report all sub-awards over $25,000 by the end of the month, following the month the sub-award or obligation was made. If the prime recipient is required to report the Executive Compensation for a sub-award, they must also do so by the end of the month following the month the award or obligation was made.	FFATA or Transparency Act (P.L.109-282), 2 CFR 170
Comments:	

Section III: Expenditure Review

Only questioned or disallowed costs not resolved during the review should be recorded in the chart below. These costs should be sent back to the recipient requesting additional information and justification in the financial monitoring results letter. This section may be deleted if not applicable for a particular review.

Maryland Emergency Management Agency
Appendix E Grants Monitoring Template

Recipient Questioned or Disallowed Costs				
	Cost Description	**Amount**	**General Ledger Identification (Document/warrant number, etc.)**	**Reason Questioned**
1.				
2.				
	Add more rows as necessary.			

Appendices

Instructions: If appropriate, please include any additional information which supports the report in the Appendix section. This section maybe deleted if not applicable for a particular review.

Appendix F Procurement Checklist

Checklist for Reviewing Procurements by Federal Grant Recipients and Subrecipients

This checklist was created to assist FEMA recipients and Subrecipients in complying with the federal requirements that procurements must meet in order for FEMA to reimburse eligible expenses. Importantly, this checklist is intended to provide general guidance only and does not provide a detailed explanation of the Federal procurement requirements – it is not intended to serve as legal advice and FEMA makes no guarantee that adherence to this checklist will result in full reimbursement of eligible expenses. To understand the requirements fully, the user should review the provisions of 2 C.F.R. § 200.317 – 326, which is the source of these requirements. In addition, the user may review FEMA's Field Manual, Public Assistance Grantee and Subgrantee Procurement Requirements, which is available on the internet by searching for "FEMA
Procurement Field Manual." While the Field Manual was drafted to specifically address the Federal procurement standards that were in effect prior to 26 December 2014 (44 C.F.R. § 13.36(a)-(i) – States, Local and Tribal Governments; and 2 C.F.R. § 215.40-48 – Institutions of Higher Education, Hospitals, and other Non-Profit Organizations), many of the concepts are similar or identical in substance, and thus remains an excellent tool for navigating the current Federal procurement standards. If any questions arise, please contact your servicing attorney or legal counsel for assistance.

2 C.F.R. § 200.317 – 326 became effective on December 26, 2014. For disasters (and their associated projects) declared prior to that date, the relevant procurement standards can continue to be found in 44 C.F.R. § 13.36(a)-(i) (States, local and tribal governments) and 2 C.F.R. § 215.40-48 (Institutions of Higher Education, Hospitals, and Private Non-Profits).[1] As indicated above, while many of the concepts are similar or identical, there are some substantive differences between the old and the new standards. Accordingly, this checklist should not be used for procurements associated with declarations issued prior to 26 December 2014. Instead, see procurement standards Checklists 13.36 and 215.

1 This includes projects associated with declarations issued prior to 26 December 2014, regardless of project start date. For example, if a disaster was declared on 1 November 2014, but contracting for a project under that declaration did not begin until 1 April 2015, then a State (or state agency/instrumentality) would still utilize the old procurement standards found at 44 C.F.R. § 13.36(a); local and tribal governments would follow § 13.36(b)-(i); and Institutions of Higher Education, Hospitals, and Private Non-Profits would use 2 C.F.R. §§ 215.40-48.

Instructions: Each standard below is followed by a block for "Yes", "No", or in some cases, "Not applicable". Red font is used to indicate the response which, if checked, indicates that the contract does not comply with federal requirements.

The term "non-Federal entity" (NFE) below refers to the entity that is conducting the procurement action (i.e., the state, local, or tribal government or private-non-profit entity).

1. Does the procurement comply with the State's own procurement laws, rules, and procedures? §200.317 **Yes No**

2. Does the procurement comply with the requirement to make maximum use of recovered/recycled materials? § 200.317, § 200.322. **Yes No N/A – work does not involve the use of materials (e.g., debris removal or other services)**

3. **Does the contract include the following clauses?**[2] a. If the contract amount exceeds[3] $150,000, does it address **administrative, contractual, or legal remedies** in instances where contractors violate or breach contract terms, and provide for sanctions and penalties? **Yes No N/A**

   b. If the contract amount exceeds $10,000, does it address **termination for cause and for convenience, including the manner by which it will be effected and the basis for settlement**? **Yes No N/A**

   c. If the contract is for construction, does it include the required **Equal Employment Opportunity clause**[4]? **Yes No N/A**

   d. For construction contracts exceeding $2,000 awarded under a Federal grant, does the contract include a **Davis-Bacon Act clause**[5] and **Copeland "Anti- Kickback" Act clause**[6] addressing prevailing wage rates? [Note that Public Assistance and Hazard Mitigation Grant Program contracts do NOT require these clauses.] **Yes No N/A**

2 See Appendix II of 2 CFR part 200 for a more detailed description of these clauses. See also PDAT Manual, section IV.H for a detailed discussion of these clauses, including sample text.

3 $150,000 is the current dollar threshold for the simplified acquisition threshold, as authorized by 41 U.S.C. § 1908.

4 The EEO clause can be found at 41 C.F.R. § 60-1.4(b).

5 [Insert sample text]

6 The clause may read as follows:

Compliance with the Copeland "Anti-Kickback" Act

(1) Contractor. The contractor shall comply with 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

(2) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clause above and such other clauses as the FEMA may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.

(3) Breach. A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.

e. If the contract amount exceeds $100,000 and involves the employment of mechanics or laborers, does the contract include a **Contract Work Hours and Safety Standards clause**[7]? **Yes No N/A**

a. Rights to Inventions Made Under a Contract or Agreement.[8] ☐ N/A

b. If the contract or subgrant amount exceeds $150,000, does the contract include clauses addressing the **Clean Air Act and the Federal Water Pollution Control Act**[9]? **Yes No N/A**

c. Does the contract include mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. § 6201)? ☐ Yes ☐ No

d. Does the contract include a **Suspension and Debarment clause**?[10] **Yes**[11] **No**

e. Does the contract include an **Anti-Lobbying clause**?[12] Yes No

7 Must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation.

8 As FEMA does not award grants or subgrants associated with research and development projects, this contract clause is inapplicable.

9 The clause may read as follows:
Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387), and will report violations to FEMA and the Regional Office of the Environmental Protection Agency (EPA).

10 See PDAT Manual, pgs. 99-100 for sample text.

11 A prospective contractor that is listed on the government-wide Excluded Parties List System in the System for Award Management (www.SAM.gov) as suspended or debarred, **CANNOT** be awarded a contract funded with Federal assistance.

12 See PDAT Manual, pgs. 127-129. The clause may read substantially as follows:

Byrd Anti-Lobbying Amendment, 31 U.S.C. § 1352 (as amended). Contractors who apply or bid for an award of $100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non- Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

i. For contracts exceeding $100,000, have bidders submitted an Anti- Lobbying Certification? **Yes No N/A**

f. Does the contract include a clause requiring the contractor to maximize use of **recovered/recycled materials**? **Yes No N/A – work does not involve the use of materials (e.g., debris removal or other services)**

If a State agency is awarding the contract, stop here. If the contract is being awarded by a local or tribal government or private nonprofit entity, continue with the checklist.

[13] [14]

4. **General requirements** a. Does the procurement comply with the NFE's own procurement laws, rules, and procedures? §200.318(a) **Yes No**

b. Does the NFE maintain contract oversight to ensure that contractors perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders? §200.318(b) □ Ye s □ No

c. Does the NFE have - §200.318(c)(1): i. Written standards of conduct covering conflicts of interest and governing the actions of its employees engaged in the selection, award and administration of contracts? **Yes No**

ii. Any employee, officer, or agent participating in the selection, award, or administration of a contract supported by a Federal award that has an actual [15] or apparent conflict of interest? □ Ye s □ No

iii. Any employee, officer, or agent that has solicited and/or accepted gratuities, favors, or anything of monetary value from contractors or parties to [16] subcontracts? □ Ye s □ No

iv. Written standards of conduct that provide for disciplinary actions to be applied for violations of such standards by officers, employees, or agents of the non-Federal entity. □ Ye s □ No

13 See, 2 C.F.R. § 200.318
14 Non-Federal Entity (NFE)

15 Such a conflict of interest would arise when the employee, officer, or agent, any member of his or her immediate family, his or her partner, or an organization which employs or is about to employ any of the parties indicated herein, has a financial or other interest in or a tangible personal benefit from a firm considered for a contract.

16 However, NFEs may set standards for situations in which the financial interest is not substantial or the gift is an unsolicited item of nominal value.

d. If the non-Federal entity has a parent, affiliate, or subsidiary organization that is not a state, local government, or Indian tribe, does the non-Federal entity have written
17 standards of conduct covering organizational conflicts of interest? § 200.318(c)(2) **Yes No N/A**

e. The NFE must avoid acquisition of unnecessary or duplicative items. Has the NFE considered consolidating or breaking out procurements to obtain a more economical purchase? Where appropriate, has the NFE considered lease versus purchase alternatives? § 200.318(d) **Yes No**

18

f. Encouraged, but not required standards.

g. Is the contract being awarded to a responsible contractor possessing the ability to perform successfully under the terms and conditions of the proposed procurement, giving consideration to such matters as contractor integrity, compliance with public policy, record of past performance, and financial and technical resources? § 200.318(h) **Yes No**

h. Is the NFE keeping records sufficient to detail the history of the procurement, including, but not limited to, records documenting the rationale for the method of procurement, selection of contract type, contractor selection or rejection, and the basis for the contract price? § 200.318(i) **Yes No**

19

i. Is the contract a time-and-materials contract? § 200.318(j) **Yes No** i. If so, has the NFE documented why no other contract is suitable? **Yes No**

17 Organizational conflicts of interest means that because of relationships with a parent company, affiliate, or subsidiary organization, the NFE is unable or appears to be unable to be impartial in conducting a procurement action involving a related organization.

18 §200.318(e) – to foster greater economy and efficiency, the NFE is encouraged to enter into state and local intergovernmental agreements or inter-entity agreements where appropriate for procurement or use of common or shared goods and services (this section provides the authority for state schedule and mutual aid agreements, for example); §200.318(f) – NFEs are encouraged to use Federal excess and surplus property in lieu of purchasing new equipment and property whenever such use is feasible and reduces project costs; and §200.318(g) – NFEs are encouraged to use value engineering clauses in contracts for construction projects (value engineering is a systematic and creative analysis of each contract item or task to encourage the contractor to develop more cost effective means to produce or procure requirements.).

19 Time and materials type contract means a contract whose cost to a non-Federal entity is the sum of: (i) The actual cost of materials; and (ii) Direct labor hours charged at fixed hourly rates that reflect wages, general and administrative expenses, and profit. Because this formula generates an open-ended contract price, a time-andmaterials contract provides no positive profit incentive to the contractor for cost control or labor efficiency. Therefore, a time-and-materials contract must set a ceiling price that the contractor exceeds at its own risk. Further, the nonFederal entity awarding such a contract must assert a high degree of oversight in order to obtain reasonable assurance that the contractor is using efficient methods and effective cost controls. [**Note that FEMA will only**

reimburse costs under a time-and-materials contract for the first 70 hours of work performed. See FEMA PA Guide (2007 ed.), pg. 53.]

ii. Does the contract include a ceiling price that the contractor exceeds at its own risk? **Yes No**

j. Is the NFE alone responsible, in accordance with good administrative practice and sound business judgment, for the settlement of all contractual and administrative issues arising out of procurements? §200.318(k) □ Yes □ No

5. **Competition:**

a. All procurement transactions must be conducted in a manner providing **full and open competition** consistent with the standards of this section. Does the procurement involve any of the following § 200.319(a): i. Placing unreasonable requirements on firms in order for them to qualify to do business? **Yes No** ii. Requiring unnecessary experience and excessive bonding? **Yes No** iii. Noncompetitive pricing practices between firms or between affiliated companies? Yes No iv. Noncompetitive contracts to consultants that are on retainer contracts? Yes No

v. Organizational conflicts of interest? Yes No

vi. Specifying only a "brand name" product instead of allowing "an equal" product to be offered and describing the performance or other relevant requirements of the procurement? **Yes No**

vii. Any arbitrary action in the procurement process? **Yes No**

b. Was the contractor that is bidding on the contract also involved with developing or drafting the specifications, requirements, statement of work, invitation for bids or request for proposals? (If so, that contractor must be excluded from competing for such procurements) § 200.319(a) □ Yes □ No □ N/A

20 This list is non-exclusive and only serves as an example of some of the types of situations that are considered to be restrictive of competition.

21 For example, bid suppression or bid rigging.

22 For example, out-of-scope disaster work added to the consultant's work on retainer. 23 See, Fns 14 & 16.

c. Does the contract include a state or local geographic preference for local

[24] contractors? § 200.319(b) **Yes No**

d. Do the NFE's written procurement procedures ensure that all solicitations comply with the following: § 200.319(c) i. Incorporate a clear and accurate description of the technical requirements for the material, product, or service to be procured? § 200.319(c)(1) **Yes No**

ii. Identify all requirements which the offerors must fulfill and all other factors to be used in evaluating bids or proposals? § 200.319(c)(2) **Yes No**

e. If the NFE is using a prequalified list of persons, firms, or products which are used in acquiring goods and services: § 200.319(d) □ N/A i. Is the list current? □ Ye s □ No

ii. Does the list include enough qualified sources to ensure maximum open and free competition? □ Ye s □ No

iii. Were any potential bidders precluded from qualifying during the solicitation period?[25] Yes No

6. **Method of Procurement**

1. Is the NFE using one of the following acceptable methods of procurement? § 200.320 i. **Micro-purchase** (i.e., purchases below $3,000, see, §200.67 Micro-purchases). § 200.320(a) **Yes No** 1. [Note: Micro-purchases may be awarded without soliciting competitive quotations if the non-Federal entity considers the price to be reasonable.]
2. To the extent practicable, is the NFE distributing micro-purchases equitably among qualified suppliers? **Yes No N/A – not practicable**

24 Geographic preferences are generally not allowed under FEMA grants. The only exception is that when contracting for architectural and engineering (A/E) services, geographic location may be a selection criterion provided its application leaves an appropriate number of

qualified firms, given the nature and size of the project, to compete for the contract.

25 Also, the non-Federal entity must not preclude potential bidders from qualifying during the solicitation period.

ii. **Small purchase procedures** § 200.320(b) **Yes No**

1. [Note: Small purchase procedures are those relatively simple and informal procurement methods for securing services, supplies, or other property that do not cost more than the **lesser** of either (1) the federal small purchase threshold (i.e., $150,000), or (2) whatever amount State or local procurement rules set as the small purchase threshold – if more restrictive than the federal threshold.]

2. Did the NFE obtain price or rate quotations from an adequate number
26 of qualified sources? Yes No

27 iii. **Sealed bids** § 200.320(c) Yes No 1. [Note: Bids are publicly solicited and a firm fixed price contract (lump sum or unit price) is awarded to the responsible bidder whose bid, conforming with all the material terms and conditions of the invitation for bids, is the lowest in price. Sealed bidding is the preferred method for procuring construction]

2. Are all of the following conditions to use sealed bidding present? § 200.320(c)(1) **Yes No** a. A complete, adequate, and realistic specification or purchase description is available **Yes No**

b. Two or more responsible bidders are willing and able to compete effectively for the business **Yes No**

c. The procurement lends itself to a firm fixed price contract and the selection of the successful bidder can be made principally on the basis of price **Yes No**

3. If sealed bids are used, the following requirements apply: § 200.320(c)(2)

26 FEMA has determined that for simplified purchase procedures, an adequate number of qualified sources is considered to be three (3). See, FEMA Recovery Fact Sheet 9580.212 – Public Assistance Grant Contracting Frequently Asked Questions (FAQ), FAC No. 3. 27 Sealed bidding is generally used where price is the most important evaluation factor for the NFE. Accordingly, contract award under the sealed bidding method of procurement is made to the bidder submitting the lowest priced, responsive and responsible bid. "Responsive" refers to whether the bidder meets all the material requirements of the Invitation for Bid (IFB), while "Responsibility" is described at § 200.318(h).

a. Did the NFE solicit bids from an adequate number[28] of known suppliers, providing them sufficient response time prior to the date set for opening the bids? **Yes No**

b. If the NFE is a local or tribal government, was the invitation for bids publically advertised? **Yes No N/A**

c. Did the invitation for bids include any specifications and pertinent attachments, and define the items or services in order for the bidder to properly respond? **Yes No**

d. Did the NFE open all bids at the time and place prescribed in the invitation for bids? **Yes No**

e. For local and tribal governments, were the bids opened publicly? **Yes No N/A**

f. Did the NFE award a firm fixed price contract award in writing to the lowest responsive and responsible bidder? **Yes No**

g. If any bids were rejected, was there a sound documented reason supporting the rejection? □ Ye s □ No □ N/A

iv. **Procurement by competitive proposals**[29] § 200.320(d) **Yes No** 1. [Note: The technique of competitive proposals is normally conducted with more than one source submitting an offer, and either a fixed price or costreimbursement type contract is awarded. It is generally used when conditions are not appropriate for the use of sealed bids.]

2. Did the NFE publicize the Requests For Proposals (RFPs) and identify all evaluation factors and their relative importance? **Yes No**

28 Unlike, for simplified purchase procedures, FEMA has not defined an "adequate number" of known sources under the sealed bidding method. While left undefined, a NFE is likely to meet this requirement through the application of "full and open competition." (See fn. 26)

29 Whereas contract awards under sealed bidding are focused on selecting the lowest responsive responsible bid, NFEs under the competitive procurement method may prioritize non-price factors, such as technical capability or past performance, over price and therefore award a contract to a contractor whose proposal is more expensive but reflects a better overall value to the NFE (e.g. "best value" contracting).

3. Did the NFE solicit proposals from an adequate number of qualified sources?[30] Yes No

4. Did the NFE have a written method for conducting technical evaluations of the proposals received and for selecting recipients? **Yes No**

5. Did the NFE award the contract to the responsible firm whose proposal is most advantageous to the program, with price and other factors considered? **Yes No**

6. [Note regarding architectural/engineering (A/E) professional services: The NFE may use competitive proposal procedures for qualificationsbased procurement of A/E professional services whereby competitors' qualifications are evaluated and the most qualified competitor is selected, subject to negotiation of fair and reasonable compensation. **The method, where price is not used as a selection factor, can only be used in procurement of A/E professional services. It cannot be used to purchase other types of services though A/E firms that are a potential source to perform the proposed effort**.]

v. **Noncompetitive proposals** § 200.320(f)[31] Yes No 1. [Note: Procurement by noncompetitive proposals is procurement through solicitation of a proposal from only one (or an improperly limited number of) source(s)]

2. Do one or more of the following circumstances apply? **Yes No**

a. The item is available only from a single source **Yes No**

b. The public exigency or emergency[32] for the requirement will not permit a delay resulting from competitive solicitation **Yes No**

c. The Federal awarding agency or pass-through entity expressly authorizes noncompetitive proposals in response to a written request from the non-Federal entity **Yes No**

d. After solicitation of a number of sources, competition is determined inadequate.[33] Yes No

30 Unlike, for simplified purchase procedures, FEMA has not defined an "adequate number" of qualified sources under the competitive procurement method. While left undefined, a NFE is likely to meet this requirement through the application of "full and open competition." 31 § 200.320(e) is reserved.

32 For an explanation of what "emergency" and exigency" mean, see PDAT Manual, pg 68.

33 Before utilizing this exception, Applicants should review their solicitation and the publicizing of their solicitation to ensure that it was not inadvertently drafted in a manner to reduce or eliminate competition, which resulted in the receipt of one or no proposals. If this is found to be the case, the Applicant should revise the solicitation and re-publicize the solicitation in order to resolve the competitive concerns.

7. **Contracting with Small and Minority Businesses, Women's Business Enterprises, and Labor Surplus Area Firms**

a. Has the NFE taken the following affirmative steps[34] to assure that minority businesses, women's business enterprises, and labor surplus area firms are used[35] when possible? § 200.321 **Yes No N/A (document)** i. Placing qualified small and minority businesses and women's business enterprises on solicitation lists? **Yes No N/A (document)**

ii. Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources? **Yes No N/A – no potential sources (document)** iii. Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses,[36] and women's business enterprises? **Yes No N/A – not economically feasible (document)**

iv. Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises? **Yes No N/A – the requirement does not permit (document)**

v. Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce **Yes No N/A – not appropriate (document)**

vi. Requiring the prime contractor, if subcontracts are to be let, to take the affirmative steps listed above? **Yes No N/A – no subcontracts will be let (document)**

34 The following affirmative steps are non-exclusive; while these steps must be taken, additional steps, as determined by the NFE, local, state, or tribal government regulations or procedures, may also be taken.

35 Collectively referred to as "socioeconomic contractors" or "socioeconomic contracting," this requirement does not impose an obligation to set aside either the solicitation or award of a contract to these types of firms; this requirement only imposes an obligation to carry out and document the six identified affirmative steps. Failure to do so has been frequently identified as a justification to de-obligate funding by the Department of Homeland Security (DHS), Office of Inspector General (OIG).

36 This is not the same as breaking a single project down into smaller components in order to circumvent the micro-purchase or small purchase thresholds to utilize their streamlined acquisition procedures (e.g. "project splitting.")

8. **Contract cost and price**

a. If the contract amount (including contract modifications) exceeds $150,000, did the NFE perform a cost or price analysis? § 200.323(a) **Yes No N/A**

b. Did the NFE negotiate profit as a separate element of the price for each contract in which there is no price competition and in all cases where cost analysis is performed? § 200.323(b) **Yes No N/A**

c. Is the contract a "cost plus a percentage of cost" or "percentage of construction cost" [37] contract? [Note: This form of contract is prohibited under the Federal procurement standards and is ineligible for FEMA reimbursement] **Yes No**

9. **Bonding requirements for construction or facility improvement contracts exceeding $150,000**

a. [Note: For construction or facility improvement contracts or subcontracts exceeding the Simplified Acquisition Threshold (i.e, $150,000), the Federal 13 awarding agency or pass-through entity may accept the bonding policy and requirements of the nonFederal entity provided that the Federal awarding agency or pass-through entity has made a determination that the Federal interest is adequately protected.]

b. If such a determination (see above) has not been made, does the procurement include the following? **Yes No N/A** i. A bid guarantee from each bidder equivalent to five percent of the bid price? **Yes No N/A** 1. The "bid guarantee" must consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of the bid, execute such contractual documents as may be required within the time specified.

ii. A performance bond on the part of the contractor for 100 percent of the contract price? **Yes No N/A** 1. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.

iii. A payment bond on the part of the contractor for 100 percent of the contract price. **Yes No N/A** 1. A "payment bond" is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

37 This type of contract is separate and distinct from cost plus fixed fee, cost plus incentive fee, and cost plus award fee type contracts, which are permissible and used to incentivize contractors to perform to a higher standard of quality, lower cost, or faster performance. Cost plus percentage of cost contracts on the other hand provide none of these incentives; instead, there is a reverse incentive for the contractor to increase its costs as the higher its costs go, the more profit it earns, as its potential earnings are uncapped. The following characteristics are suggestive of a prohibited cost plus percentage of cost contract: (1) payment is on a predetermined percentage rate; (2) the predetermined percentage rate is applied to actual performance costs; (3) the contractor's entitlement is uncertain at the time of contracting; and (4) the contractor's entitlement increases commensurately with increased performance costs.

END OF CHECKLIST

Appendix G **Monitoring Risk Formula** (Excel version located on hdrive)

| | | |

| | | |

Appendix H Equipment Sampling Methodology

Determine threshold for equipment within the jurisdiction from listing housed on Hdrive Monitoring folder.

Develop excel workbook lists of total population from expenditure lists for the affected awards. Add columns to capture serial/asset tag #s and physical location. Add a column for date inspected. Add the serials and locations from the equipment audit report. Provide the list to Subgrantee to verify equipment, serial and locations listed. Have them return the verified listing.

When the verified listing is returned, create a tab within workbook to summarize total population.

If the population total is less than $750,000 a 100% review will be conducted.

For populations greater than $750,000 up to $1,500,000 a 75% review will be conducted.

Populations over $1,500,000 through $3,000,000 a 50% review will be conducted.

Populations over $3,000,000 will be conducted at 25% review.

100% review of all items of controlled equipment will be performed for every Subgrantee and all areas of compliance with the Executive Order will be addressed.

Select the populations from equipment lists for each award and create a separate sheet entitled Inspections. Add column for award name and enter next to each item. Sort this listing by physical location. Provide listing to jurisdiction and coordinate inspection dates with various locations.

On completion of monitoring visit update any changed information obtained during the inspections on the individual award sheets and file under the monitoring folder for the jurisdiction under h drive GMEFS.

Appendix I Monitoring Schedule (excel version located in Hdrive Monitoring folder)

CY17 Monitoring Schedule		2/15/2017				
Preparedness and HMEP Awards						
Calendar Year	Dates Performed/Scheduled	Agency/ Jurisdiction	Period Covered	Items Addressed/ Visit Purpose	Awaiting Info/Docs	Date completed
2017		Allegany				
2017		Annapolis				
2017		Anne Arundel				
2017	1/1/17-2/15/17	Balto City	2009-2016	single audit inventory CAP equipment disposition	final resolution of questioned costs due 2/15/17	
2017		Balto County				
2017		Calvert				
2017		Caroline				
2017		Carroll				
2017	2/6/2017	Cecil		memagms and grants management training		
2017		Charles				
2017		Dorchester				
2017		Frederick				
2017		Garrett				
2017		Harford				
2017	2016 reschedule to 2017 due to flooding	Howard				
2017		Kent				
2017		Montgomery				
2017		Ocean City				
2017		PG				
2017		Queen Anne				
2017		Saint Mary's				
2017		Somerset				
2017		Talbot				
2017		Washington				
2017	1/31/2017	Wicomico	2009-2016	Equipment Inspection, MEMAGMS training and grant compliance with 2CFR	Revised Records retention and purchasing manuals	2/15/2017
2017	January	Worcester	2009-2016		sent request 12/30/16	
2017	Desk Review	BMC				
2017	March	MIEMSS	2009-2016		sent request 2/8/17	
2017	Desk Review	MSP				
2017	1/1/2017	MEMA		Revise templates for 2cfr, develop risk and monitoring schedule update sop with cklist for hmep; add hmep to memgms; add hmgp to memagms		
Hazard Mitigation Awards						
Project #	Dates	Sub-grantee Name	Project Completion Date	Project Title	Disaster	
4	1/10/2017	Ocean City	10/12/14	Town of Ocean City FM Emergency Advisory Radio System	MD-4034	
3	1/10/2017	Ocean City	01/10/14	Ocean City Portable Variable Message Signs	MD-4034 and MD-4170	
8	Toni	Garrett	08/22/14	Garrett County - Government Mobile Warning Signs	MD-4034	
11	Toni	Garrett	08/31/14	Garrett County -Technology and Communications Center	MD-4034	
9	Toni	Oakland	08/01/14	Town of Oakland VFD Generator	MD-4034	
13	Wilson	Baltimore	09/02/15	Bowleys Quarters VFD Generator	MD-4038	
14	Wilson	Bel Air,	12/17/2015	Town of Bel Air WW System Generators	MD-4038	
4	Wilson	Ridge	07/15/15	Ridge Volunteer Fire Department	MD-4075	
8	Toni	Frostburg	10/23/15	Frostburg Water System Generator	MD-4075	
11	Toni	Wicomico	09/18/14	Wicomico County EOC/911 Generat	MD-4075	2/13/2017
12	Toni	Frostburg	9/15/2015	Savage Pumping Station Generator	MD-4075	
7	Wilson	Baltimore	11/18/15	Woodlawn Volunteer Fire Department Backup Generator	MD-4091	
10	Wilson	Carroll	11/02/15	Carroll County, Union Bridge Fire Company Generator	MD-4091	
	Toni	Allegany	4/20/2015	Allegany County Mass Dialing Platform/Reverse 911	MD-4038	
	Toni	Washington	5/20/2015	Hagerstown Flood Warning Gates	MD-1875	
	Toni	Garrett	4/20/2015	Garrett County Variable Message Signs (VMS)	MD-4091	

Appendix J HMEP Administration Check List and Forms

Pre-award phase

_____ Jan.-Feb. of the Federal Fiscal Year: Review Notice of Funding Opportunity (NOFO) and Grants.gov posting by the Pipeline and Hazardous Materials Safety Administration (PHMSA) of Department of Transportation (DOT)

_____ Review any "Related Documents" in Grants.gov, which may include an "Expenditures Guide"

_____ Create solicitation letters to eligible applicants, and send for upper management review and approval.

_____ Once approved for release by upper management, solicitation letters are to be sent to eligible applicants, with the attaching program narrative template, budget detail template, and Expenditures Guide

_____ Receive applications, keeping both hard and electronic copies of letters/communication from jurisdictions that both request and decline HMEP funds. . File electronic copies of the letters in the HMEP Folder under the FY of the award "H:\ADMINISTRATION\Director of Administration\GRANTS". File hard copies into the correct FY HMEP binder.

_____ When completing Year 1 applications, check Grantsolutions.gov link on Grants.gov page for any additional documents to be submitted through Grants.gov.

_____ When submitting Year 2/3 applications, send out revised solicitation letters in February to eligible entities, then update contact information (any responsible parties). Year 2/3 applications are due at the end of June and must be submitted through HMEP.Grants@dot.gov. The Year 2/3, awards are awarded via amendment in Grantsolutions.gov.

_____ Prepare FMIS budget for MEMA retained funding. (Any management & administration costs)

_____ Compile Applications and send to SERC. Must send sub-grantee applications to SERC during each yearly application for funding allocation recommendations.

_____ MEMA reviews SERC allocation, reviewing eligibility and cost allowability.

_____ May have PHMSA review electronic application package before submission through HMEP.Grants@dot.gov

_____ Submit complete application through Grants.gov, and wait for PHMSA response

_____ May/June: Deadline for applications to PHMSA

Award Phase

_____ September: Grants awarded.

_____Once awarded, electronically sign Grant Agreement, and file electronically and physically. File electronic copies of the Grant Agreement in the HMEP Folder under the FY of the award "H:\ADMINISTRATION\Director of Administration\GRANTS". File hard copies into the correct FY HMEP binder.

_____ Inform External Outreach Branch Manager of Award Date and Amount for press release.

_____ Supply approved MEMA FMIS budget to Finance.

_____ Supply sub-award information to Finance.

_____ Finance builds workbook in shared drive. This is located at "H:\ADMINISTRATION\Fiscal Services\Grants" in the FFY of the award.

_____ Read through PHMSA Grant Agreement and update MEMAs Memorandum of Agreement (MOA) with necessary changes. Previous MOAs may be found in "H:\ADMINISTRATION\Director of Administration\GRANTS" in the HMEP folder under the previous FY.

_____ Send MEMA MOAs to Director of Administration for legal review.

_____ Once approved, get MEMA MOA's signed by Director, then send out MEMA MOA's to be signed by the sub-grantee. Receive sub-grantee signed MOAs, upload into shared drive under the HMEP folder in the correct FY, then file MOA into the HMEP binder.

_____ Before the end of each calendar quarter, send reminders to sub-grantees for Quarterly Status Reports (QSR) and reimbursements. Reimbursements may not be requested every quarter; however QSRs and SF 425s are due two weeks after the end of the calendar quarter.

_____ For sub-grantees reimbursements, enter information – dates, amounts, reason, and details – into "reimbursement request report." This will be submitted to PHMSA with the SF 270.

_____ Submit MEMA reimbursement approval cover page, sub-grantee SF270, SF425, and all supporting documentation to Finance.

_____ File reimbursement into HMEP binder. File all files electronically including supporting documents, QSR, SF 270, and SF 425 into the HMEP folder under the correct FY in the shared drive.

_____ When all sub-grantees reimbursements for the quarter have been processed, create

MEMA's statewide SF270. (1. Fill out top boxes with the correct info. Ex. Making sure grant # is current and reflects any extensions) (2. Fill out Line A, (Use Finance Workbook Expenditures total) Line F, (Finance Workbook Match Total) Line G, (Finance Workbook Expenditures) Line H, (Previous 270 Line G), Line I should match reimbursement request report.

_____ On DELPHI (http://einvoice.esc.gov/ Go to "eInvoicing Access"), attach completed reimbursement request report and submit SF270 to PHMSA.

_____ Submit mid-year program performance report (PPR), due 30 days after March 31 report to PHMSA via email, HMEP.grants@dot.gov

_____ Whenever a re-scope request is necessary (whenever there is a change in projects that PHMSA had approved – details in Terms and Conditions), go to https://hazmatgrants.phmsa.dot.gov/activity_request.asp, and fill out necessary information and submit

Close-Out Instructions

_____ Be cognizant of the performance period of award; liquidation period is 30 days after the end of the performance period

_____ Ensure Finance and Grants have matching records of reimbursements

_____ When submitting the final reimbursement, statewide SF 270, to PHMSA, must check the Final box in Section 1B on the SF 270

_____ Submit final program performance report, due 90 days after December 31 report to PHMSA

PHMSA Grant

Reimbursement Request Identification of Requested

Receip Identificatio	Receip Dat	Amoun	Matc	Categor	Activit	Activity	Matc		Associate Projec	Location Applicatio
	Tota	**$ -**	**$ -**					**$**		

FEDERAL FINANCIAL REPORT

(Follow form instructions)

1. Federal Agency and Organizational Element to Which Report is Submitted	2. Federal Grant or Other Identifying Number Assigned by Federal Agency (To report multiple grants, use FFR Attachment) HM-HMP-0546-16-01-00	Page 1 of pages
3. Recipient Organization (Name and complete address including Zip code)		

4a. DUNS Number	4b. EIN	5. Recipient Account Number or Identifying Number (To report multiple grants, use FFR Attachment)	6. Report Type ☐ Quarterly ☐ Semi-Annual ☐ Annual ☐ Final	7. Basis of Accounting ☐ Cash ☐ Accrual

8. Project/Grant Period From: (Month, Day, Year) To: (Month, Day, Year)	9. Reporting Period End Date (Month, Day, Year)

10. **Transactions**	Cumulative
(Use lines a-c for single or multiple grant reporting)	
Federal Cash (To report multiple grants, also use FFR Attachment):	
a. Cash Receipts	
b. Cash Disbursements	
c. Cash on Hand (line a minus b)	
(Use lines d-o for single grant reporting)	
Federal Expenditures and Unobligated Balance:	
d. Total Federal funds authorized	
e. Federal share of expenditures	
f. Federal share of unliquidated obligations	
g. Total Federal share (sum of lines e and f)	
h. Unobligated balance of Federal funds (line d minus g)	
Recipient Share:	
i. Total recipient share required	
j. Recipient share of expenditures	
k. Remaining recipient share to be provided (line i minus j)	
Program Income:	
l. Total Federal program income earned	
m. Program income expended in accordance with the deduction alternative	

n. Program income expended in accordance with the addition alternative							
o. Unexpended program income (line l minus line m or line n)							
	a. Type	b. Rate	c. Period From	Period To	d. Base	e. Amount Charged	f. Federal Share
11. Indirect Expense							
				g. Totals:			
12. *Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation:*							
13. Certification: By signing this report, I certify that it is true, complete, and accurate to the best of my knowledge. I am aware that any false, fictitious, or fraudulent information may subject me to criminal, civil, or administrative penalities. (U.S. Code, Title 218, Section 1001)							
a. Typed or Printed Name and Title of Authorized Certifying Official						c. Telephone (Area code, number and extension)	
						d. Email address	
b. Signature of Authorized Certifying Official						e. Date Report Submitted (Month, Day, Year)	
						14. Agency use only:	

Standard Form 425
OMB Approval Number: 0348-0061
Expiration Date: 10/31/2011

REQUEST FOR ADVANCE OR REIMBURSEMENT

(See instructions on back)

OMB APPROVAL NO. 0348-0004

PAGE ____ OF ____ PAGES

1. TYPE OF PAYMENT REQUESTED
a. "X" one or both boxes: ☐ ADVANCE ☑ REIMBURSEMENT
b. "X" the applicable box: ☐ FINAL ☑ PARTIAL

2. BASIS OF REQUEST: ☑ CASH ☐ ACCRUAL

3. FEDERAL SPONSORING AGENCY AND ORGANIZATIONAL ELEMENT TO WHICH THIS REPORT IS SUBMITTED

4. FEDERAL GRANT OR OTHER IDENTIFYING NUMBER ASSIGNED BY FEDERAL AGENCY

5. PARTIAL PAYMENT REQUEST NUMBER FOR THIS REQUEST

6. EMPLOYER IDENTIFICATION NUMBER

7. RECIPIENT'S ACCOUNT NUMBER OR IDENTIFYING NUMBER

8. PERIOD COVERED BY THIS REQUEST
FROM *(month, day, year)*
TO *(month, day, year)*

9. RECIPIENT ORGANIZATION

Name:

Number and Street:

City, State and ZIP Code:

10. PAYEE *(Where check is to be sent if different than item 9)*

Name:

Number and Street:

City, State and ZIP Code:

11. COMPUTATION OF AMOUNT OF REIMBURSEMENTS/ADVANCES REQUESTED

PROGRAMS/FUNCTIONS/ACTIVITIES ►	(a)	(b)	(c)	TOTAL
a. Total program outlays to date *(As of date)*	$	$	$	$ 0.00
b. *Less:* Cumulative program income				0.00
c. Net program outlays *(Line a minus line b)*	0.00	0.00	0.00	0.00
d. Estimated net cash outlays for advance period				0.00
e. Total *(Sum of lines c & d)*	0.00	0.00	0.00	0.00
f. Non-Federal share of amount on line e				0.00
g. Federal share of amount on line e				0.00
h. Federal payments previously requested				0.00
i. Federal share now requested *(Line g minus line h)*	0.00	0.00	0.00	0.00
j. Advances required by month, when requested by Federal grantor agency for use in making prescheduled advances — 1st month				0.00
2nd month				0.00
3rd month				0.00

12. ALTERNATE COMPUTATION FOR ADVANCES ONLY

a. Estimated Federal cash outlays that will be made during period covered by the advance	$
b. *Less:* Estimated balance of Federal cash on hand as of beginning of advance period	
c. Amount requested *(Line a minus line b)*	$ 0.00

AUTHORIZED FOR LOCAL REPRODUCTION

(Continued on Reverse)

13. CERTIFICATION		
I certify that to the best of my knowledge and belief the data on the reverse are correct and that all outlays were made in accordance with the grant conditions or other agreement and that payment is due and has not been previously requested.	SIGNATURE OR AUTHORIZED CERTIFYING OFFICIAL	DATE REQUEST SUBMITTED
	TYPED OR PRINTED NAME AND TITLE	TELEPHONE (AREA CODE, NUMBER, EXTENSION)

This space for agency use

Public reporting burden for this collection of information is estimated to average 60 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0004), Washington, DC 20503.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

INSTRUCTIONS

Please type or print legibly. Items 1, 3, 5, 9, 10, 11e, 11f, 11g, 11i, 12 and 13 are self-explanatory; specific instructions for other items are as follows:

Item	*Entry*
2	Indicate whether request is prepared on cash or accrued expenditure basis. All requests for advances shall be prepared on a cash basis.
4	Enter the Federal grant number, or other identifying number assigned by the Federal sponsoring agency. If the advance or reimbursement is for more than one grant or other agreement, insert N/A; then, show the aggregate amounts. On a separate sheet, list each grant or agreement number and the Federal share of outlays made against the grant or agreement.
6	Enter the employer identification number assigned by the U.S. Internal Revenue Service, or the FICE (institution) code if requested by the Federal agency.
7	This space is reserved for an account number or other identifying number that may be assigned by the recipient.
8	Enter the month, day, and year for the beginning and ending of the period covered in this request. If the request is for an advance or for both an advance and reimbursement, show the period that the advance will cover. If the request is for reimbursement, show the period for which the reimbursement is requested.
Note:	The Federal sponsoring agencies have the option of requiring recipients to complete items 11 or 12, but not both. Item 12 should be used when only a minimum amount of information is needed to make an advance and outlay information contained in item 11 can be obtained in a timely manner from other reports.
11	The purpose of the vertical columns (a), (b), and (c) is to provide space for separate cost breakdowns when a project has been planned and budgeted by program, function, or activity. If additional columns are needed, use as many additional forms as needed and indicate page number in space provided in upper right; however, the summary totals of all programs, functions, or activities should be shown in the "total" column on the first page.
11a	Enter in "as of date," the month, day, and year of the ending of the accounting period to which this amount applies. Enter program outlays to date (net of refunds, rebates, and discounts), in the appropriate columns. For requests prepared on a cash basis, outlays are the sum of actual cash disbursements for goods and services, the amount of indirect expenses charged, the value of in-kind contributions applied, and the amount of cash advances and payments made to subcontractors and subrecipients. For requests prepared on an accrued expenditure basis, outlays are the sum of the actual cash disbursements, the amount of indirect expenses incurred, and the net increase (or decrease) in the amounts owed by the recipient for goods and other property received and for services performed by employees, contracts, subgrantees and other payees.
11b	Enter the cumulative cash income received to date, if requests are prepared on a cash basis. For requests prepared on an accrued expenditure basis, enter the cumulative income earned to date. Under either basis, enter only the amount applicable to program income that was required to be used for the project or program by the terms of the grant or other agreement.
11d	Only when making requests for advance payments, enter the total estimated amount of cash outlays that will be made during the period covered by the advance.
13	Complete the certification before submitting this request.

OMB Control Number: 2137-0586
Expiration Date: 06/30/2019

HAZARDOUS MATERIALS EMERGENCY PREPAREDNESS (HMEP) GRANT PROGRAM

PERFORMANCE REPORT

Mid-year Report ☐

Final Report ☐

Fiscal Year 2016

Persons are not required to respond to the collection of information herein unless a currently valid OMB control number is displayed. (5 CFR §§ 1320.5(b)(2) and §1320.6(a)(2))

Planning activities funded by the Hazardous Materials Emergency Preparedness Planning and Training Grant will be used to develop, improve, and carryout emergency plans under the Emergency Planning and Community Right-To-Know Act of 1986 (42 U.S.C. 11001 et seq.), see 49 U.S.C. 5116(a). Emergency responders who receive training under the HMEP training grant will have the ability to protect nearby persons, property, and the environment from the effects of accidents or incidents involving the transportation of hazardous material in accordance with existing regulations or National Fire Protection Association standards for competence of responders to accidents and incidents involving hazardous materials see 49 U.S.C 5116(b).

PROGRESS REPORT

The following format must be used by each Hazardous Materials Emergency Preparedness (HMEP) grantee to provide mid-year and final progress reports. A single report will cover both planning and training, as applicable. Each report should include activity attributable to the reporting cycle.

Mid-year progress reports must provide information on activities occurring during the first half of the grant year cycle ending March 31st and are due no later than April 30th.

Final progress reports must provide information on activities occurring during the entire grant year ending September 30th and are due no later than December 29th.

I. IDENTIFYING INFORMATION

A. Name of Recipient (Enter the information shown in Item 1 on the Grant Agreement cover page):

_____

B. HMEP Agreement Number (Enter the information shown in Item 2 on the Grant Agreement cover page):

_____

C. Performance Period or Grant Year (Enter the information shown in Item 5 on the Grant Agreement cover page):

_____

D. Name and Title of Point of Contact: _____

E. E-Mail Address and Telephone Number of Point of Contact: _____

II. REPORT OF PROGRESS

Provide a brief summary in the space provided of what was accomplished under the HMEP grant award during the reporting period or grant year for both planning and training, as applicable.

1. Please provide a narrative detailing how planning and training goals and objectives for the HMEP grant were achieved during this performance period.

2. Please provide a brief description of any issues or delays that impacted the HMEP grant recipient's ability to utilize or administer its HMEP award.

3. If 50% or less of your HMEP grant award has been expended to date (mid-year), or less than 100% of your HMEP grant award has been expended to date (year-end), please briefly describe the reason for the unexpended balance and how your agency plans to resolve the balance before the end of the performance period.

4. Please provide a narrative detailing how the State or Tribe, through the use of HMEP planning and training funds, is better able to handle accidents and incidents involving the transport of hazardous materials.

5. Planning sub-grantee information for reporting period. Please complete the table below.

LEPC Name (Region or District)	Sub-Award Amount ($)	Amount Expended During Reporting Period ($)	Current Award Balance ($)	Activities Performed/Planned by LEPC/Region	Mode of Transport (air, water, highway, and/or rail)	Type of Hazmat (if applicable)	Status; (Completed, In Progress, Not Started). *Indicate Completion Date If Status is In-progress or Not Started*

6. What is the total number of public sector emergency responders in the following training categories?

Training	Number of Public Sector Emergency Responders
Initial/Refresher	
Awareness	
Operational	
Specialist	
Technician	

7. What is the number of emergency response teams with a HAZMAT specialty unit that receive HMEP planning funds? ☐

8. Training Activities during this reporting period. **Please complete the table below.**

	Training Type (e.g., Awareness, Operations, Specialist, Technician)	Number Trained	Equipment Used (if applicable)	Supplies Used (if applicable)	Actual Cost	Start Date/ End Date	Outcome	Expected Output
Initial Training								
Refresher Training								

This page left blank intentionally

APPENDIX G

Local Jurisdiction Plan Reporting

This page left blank intentionally

Appendix G: Local Jurisdiction Plan Reporting

Plans and ordinances, including zoning ordinances, subdivision and land development ordinances, floodplain management ordinances, comprehensive plans, etc., assist with minimizing impacts of hazards through preventive measures Additionally, emergency plans such as Continuity of Operations Plans (COOPs), Emergency Operations Plans (EOPs), and Disaster Recovery Plans (DRPs) play a critical role in preparing jurisdictions to respond to and recover from hazards. Preparedness and planning measures are important hazard mitigation efforts for county and local communities to focus on, as they offer cost-effective means for reducing the probability of future losses to residents, property, or the environment.

The table below provides a detailed breakdown of all emergency and hazard mitigation-related planning products for each county and jurisdiction within the state. While some local jurisdictions, such as Annapolis, Baltimore City, and Ocean City, are required to develop plans independent of their county, most municipal jurisdictions may adopt the county Hazard Mitigation Plan as their local plan. For tracking purposes, the 10 counties that voluntarily reported plans and ordinances within their local municipal jurisdictions are listed in the table below.

Note: Eight counties did not self-report any planning products, so desktop research was conducted to identify any "public-facing" plans that were available on the jurisdictions' websites.

The following acronyms are used to populate the table below:

- HMP – Hazard Mitigation Plan
- FMP – Flood Mitigation Plan
- EAP – Emergency Action Plan
- EOP – Emergency Operations Plan
- GIP – Green Infrastructure Plans
- DRP – Disaster Recovery Plan
- DP3 – Disaster Preparedness and Planning Project (Baltimore City only)
- NFP – Nuisance Flooding Plan
- COOP – Continuity of Operations Plan
- Comp Plan – Comprehensive Plan

Note: An "X" indicates that the plan exists, but no further details were provided. The year is provided where available, and any relevant comments have been included if they were provided by the jurisdiction.

Existing Jurisdictional Planning Mechanisms

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
State of Maryland	Update in progress				2015						
Western Region											
Allegany County	2018		2020					2014			
Garrett County	2018				2017			2018			
Washington County	2017		2012		2012	2017	2020	2012			
Hagerstown					2015		2020	2015			
Boonsboro					2012		2020	2012			
Smithsburg					2013		2020	2013			
Hancock					2011		2020	2011			
Funkstown							2020	2012			
Sharpsburg							2020	2012			
Keedysville							2020	2012			
Williamsport							2020	2012			
Central Region											
City of Annapolis	2018	2023	2016		2020	2014	2020	2020		2020	
Anne Arundel County	2020		2015	2005 adopted in County Code	2018	2021 in progress	2018	2021 in progress	2002 2021 in progress	2020	
Highland Beach	2020										

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Baltimore City	X (DP3)		X	X	X	In progress	X	X	X Green Network Plan	10/2020	EAP for reservoirs/ dams
Baltimore County	2014				2019			2020		2020	
Carroll County	Update in progress	Part of HMP	Yes – under revision, target completion late fall	N/A	2017	Yes – Draft	Yes – Draft	2019	No	N/A	
Freedom Area								Yes – 2018			
Harford County	2017		2016						2018		
Howard County	2018	2018	2016		2019	2019	2020		2018		
Frederick County	2016							2010			
Town of Thurmont	2017 with Frederick County		1992		2016			In progress; target date 4/2021			EAP – Hunting Creek Dam – 2018
Montgomery County	2018				2017		2009	2			
Prince George's County	Update in progress		2016		2020 EOP & DRP				7/2016	01/2021	
City of Bowie					2016						
City of Laurel	2017		Update in progress		2019		2019; update in progress			Starting process	

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Southern Region											
Calvert County	07/2018	10/2020			01/2019		03/2020	08/2019		10/2020	REP – 05/2019
Chesapeake Beach			11/1991					02/2020			
North Beach			10/2014								
Charles County	X				X		X			X	
La Plata	X									X	
Indian Head	X									X	
Port Tobacco	X									X	
St. Mary's County	12/2017		11/11/2014		2019		Updating	3/23/2010	N/A		
Lower Eastern Shore Region											
Dorchester County	2017	2017	2015	2017	Draft		Draft	1996; under update		2017 Part of FMP	
Somerset County	2017			2014						2019	
Town of Ocean City	2017		2015		2013			2017		2020	
Wicomico County	Update in progress				Annual update		2020 Annual update	2017		2020	CCTA 2019
Worcester County	Update in progress 10/2020	Need updated		Need updated	2015	Need updated	Need updated	Need updated	Need updated	10/1/20	

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Upper Eastern Shore Region											
Caroline County	2019	None	2014 (amended 2015)	Follows State	2017	New plan in progress	20	2010 Next update exp. 2022	Within Comp Plan	Draft under review (2020)	
Denton	2010 Updated exp 2022-2025										
Greensboro	2010 Updated exp 2022-2025										
Federalsburg	2009 Updated exp 2022-2025										
Henderson	2009 Updated exp 2022-2025										
Hillsboro	2009 Updated exp 2022-2025										
Goldsboro	2009 Updated exp 2022-2025										

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Marydel	2009 Updated exp 2022-2025										
Preston	2012 Updated exp 2022-2025										
Ridgely	2009 Updated exp 2022-2025										
Templeville	2009 Updated exp 2022-2025										
Cecil County	2022				2017		2019	2010	2019	2020	
Cecilton								2010			
Chesapeake City	Adopted County	2015						2009			
Charlestown	Adopted County							2008			
Elkton		2014						2010			
North East								2012			
Perryville	Adopted County	2014						2014			

Jurisdiction	HMP	FMP	Floodplain Ordinance	Critical Areas Plan	EOP	DRP	COOP	Comp Plan	GIP	NFP	Other
Port Deposit	Adopted County							2019			
Rising Sun	Adopted County		2013					2018			
Kent County	Update in progress;				2009, update in progress exp. 2021		2016; ongoing with updates expected post-COVID			2019	
Queen Anne's County	2019	Medium priority in the QAC HMP (page 15-8)	2014 (corresponding map update)	1996 (Update in progress)	2016		In progress	2010 (Update in progress)	GI data layer held by MD DNR	2020	2016 Sea Level Rise/Vuln Plan and 2019 Debris Mgmt Plan
Talbot County	Update in progress				2014		2012	2016	Update in progress		
Oxford		2016	2016	2017				Update in progress			

This page left blank intentionally

APPENDIX H

State Assets Maps

This page left blank intentionally

State Asset Loss Estimate Methodology

As identified in Section 3.4, state asset loss estimation calculations are based on the highest hazards impacting the facilities, i.e. hazards determined high-risk, in each jurisdiction. See Section 3.22 – 3.26.2 of the HIRA for ranking methodology and data used in calculating the high-risk jurisdictions for each hazard. The process that was used for each jurisdiction and hazard to develop a total estimated loss associated with the state or historic assets in that county for the specific hazard is as follows:

1. Confirm which hazards were previously determined to be high-risk (or medium-high risk for the Coastal and Wildfire hazards)
2. Using ESRI ArcGIS Pro, the geospatial layers were overlayed, and an intersection was taken using the following layers:
    a. Hazard Extent - In the case where geographic data was not localized for hazards like storm, wind, and extreme temperatures, etc., the entire jurisdiction at high-risk was considered.
    b. County (jurisdictional boundaries)
    c. Critical Facilities
3. Based on the intersection, the number of assets that fell within the jurisdiction boundaries and hazard extent for the high-risk (or medium-high) hazards were considered.
4. The associated value of the assets from the previous step was then calculated

The graphic below shows how this intersection works out. The numbers on the Wind Hazard map correspond to the County maps that have assets potentially impacted by the hazard. This methodology was repeated for each hazard as appropriate.

This page left blank intentionally

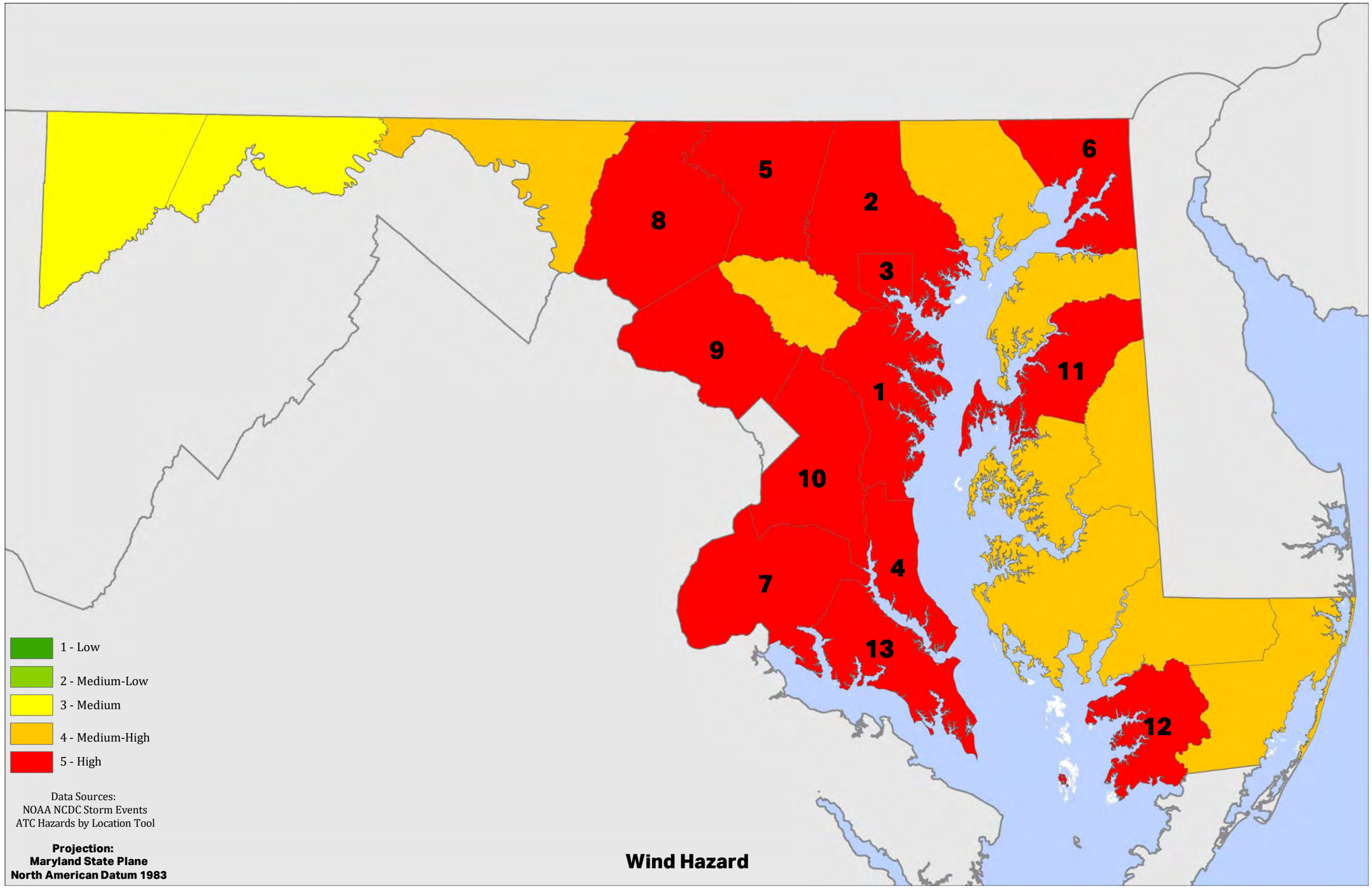
State Asset Loss Estimates for High-Hazard Ranking Counties

State of Maryland

Hazard Mitigation Plan 2021

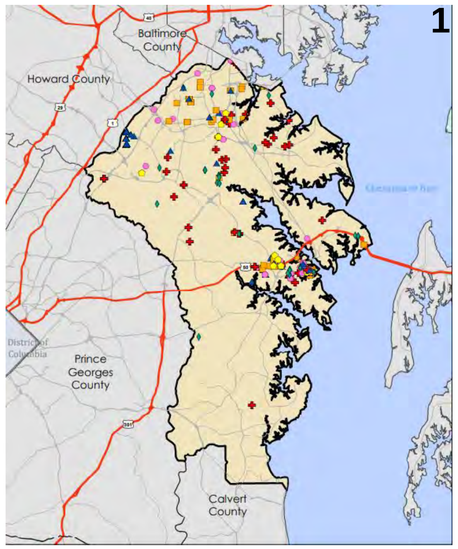
Hazard Identification & Risk Assessment

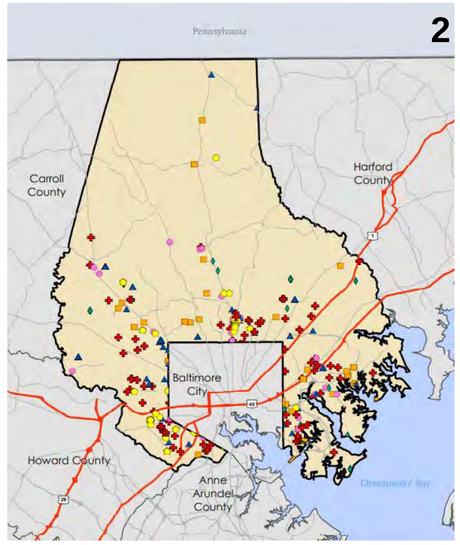
These maps show risk levels assessed for significant hazards. Parameters used to create the Hazard Ranking and Risk Maps for each hazard are explained in the Hazard Assessment and

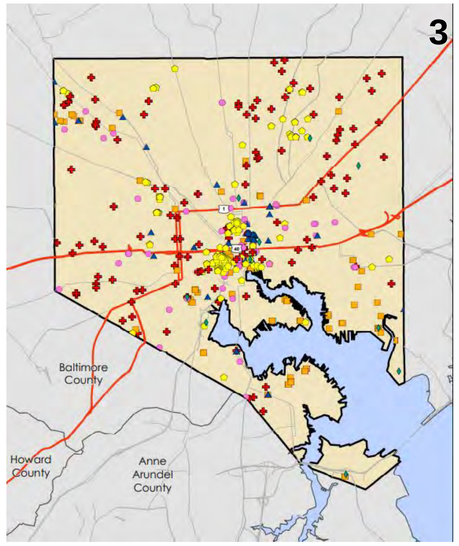


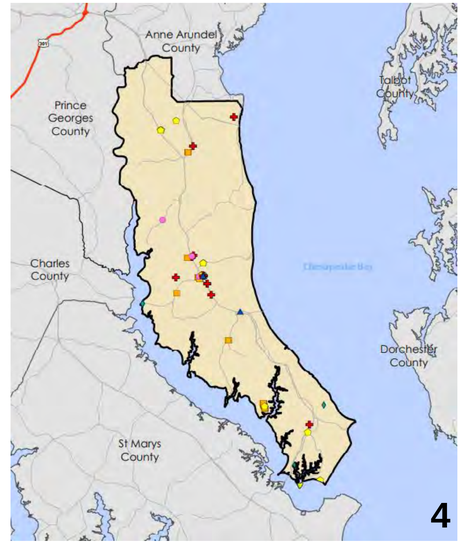
Maryland
EMERGENCY MANAGEMENT AGENCY

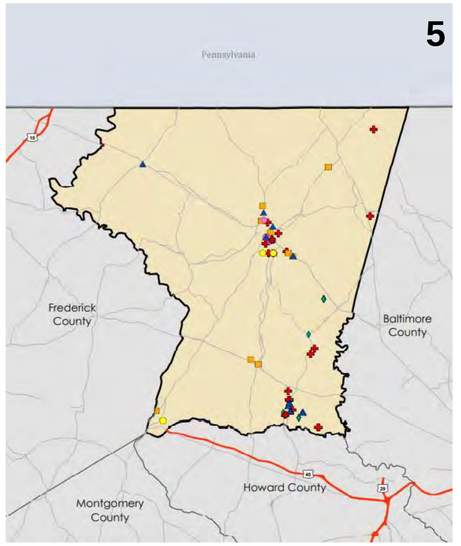
AECOM

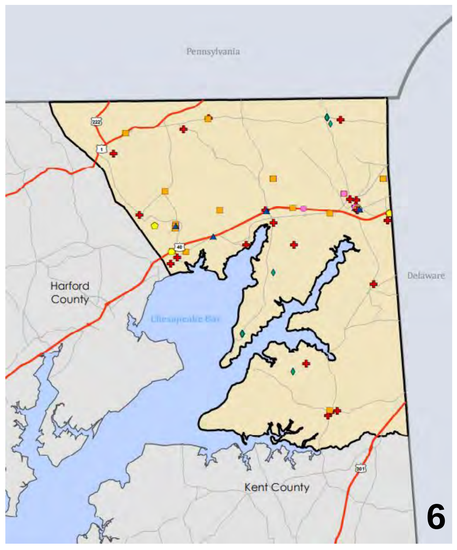


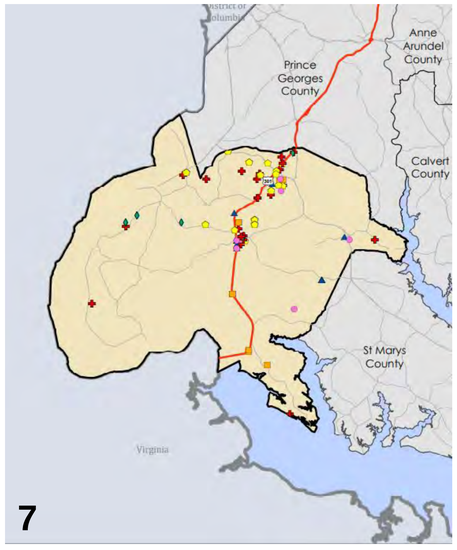


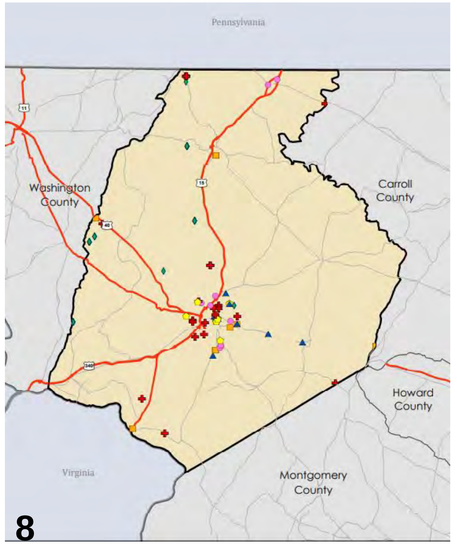


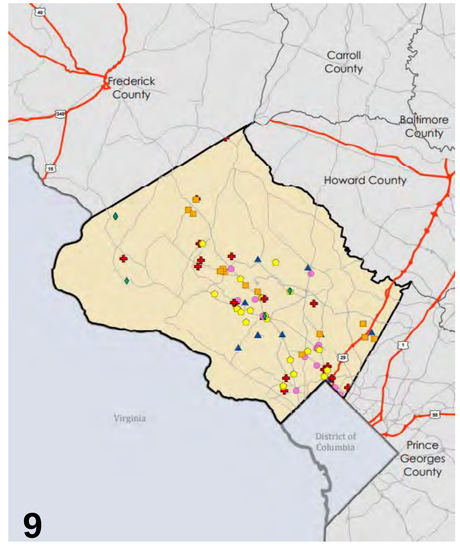


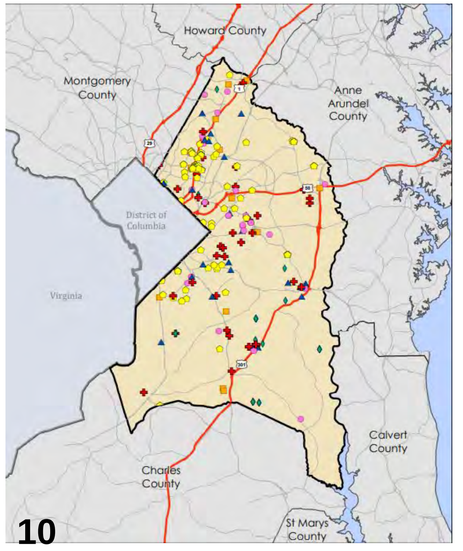


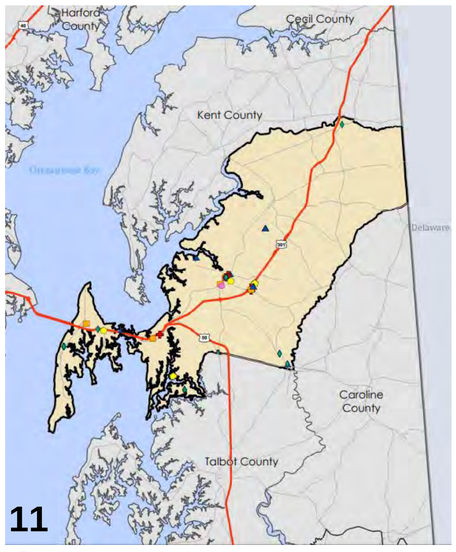


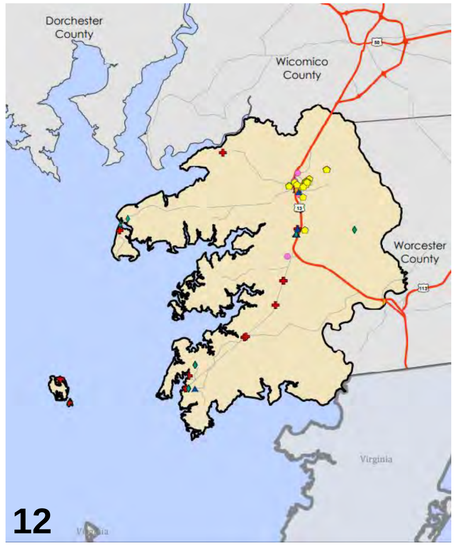


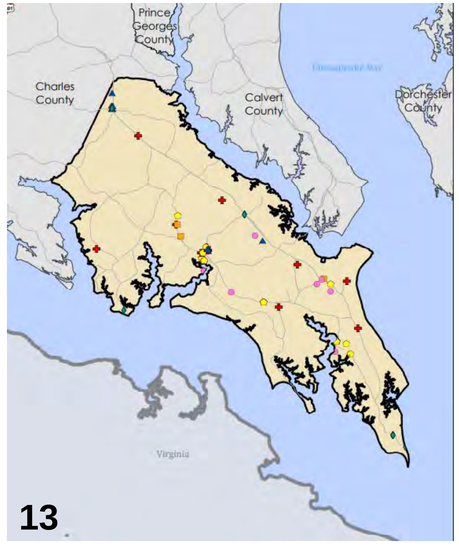












The state assets counted toward each hazard loss estimate is a reflection of the total assets within the high-risk ranked counties as seen above.

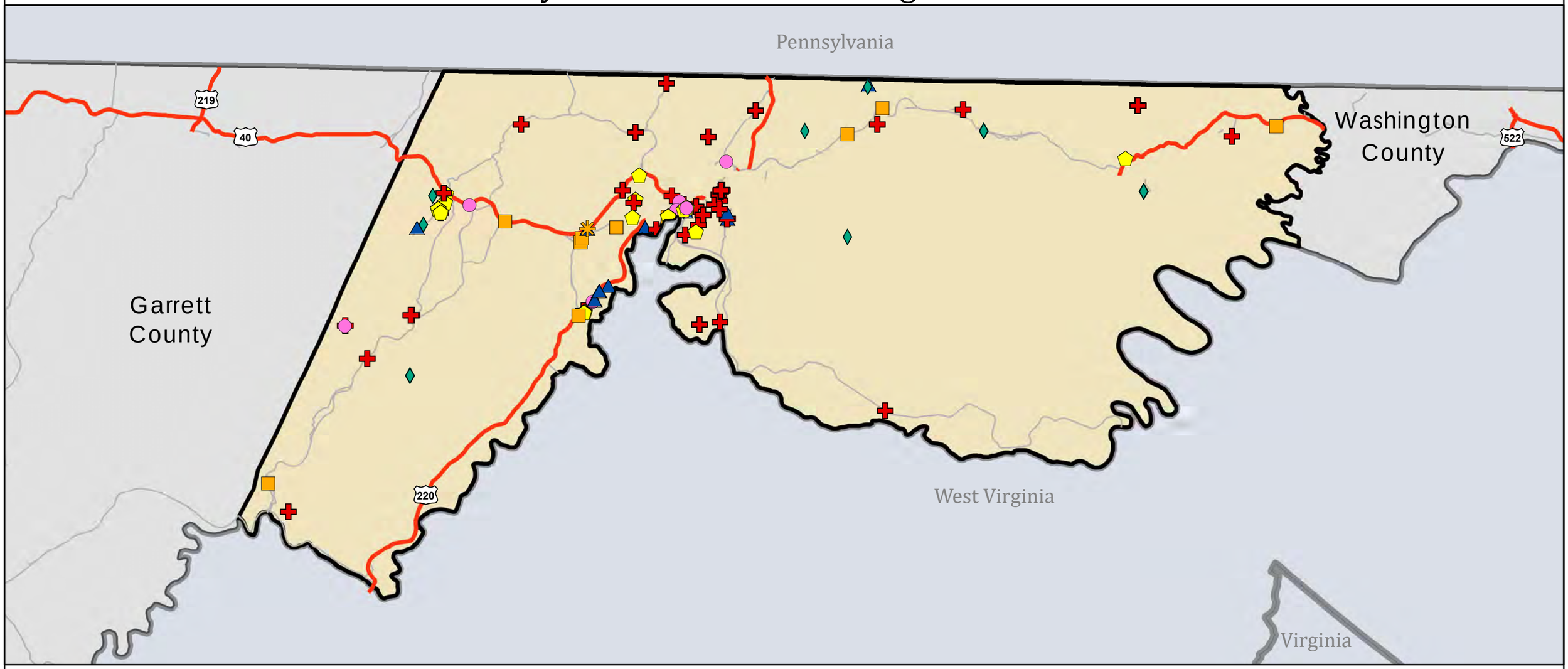
Appendix H - Table of State Assets - 2021

Jurisdiction	Administration	Corrections	Department of Natural Resources	Education	Environment	Fire/ Police	Health Related	Historic	Judicial/ Legal	Military	Social Services	Transportation	Utility/ Infrastructure	Total State Assets	Total Built in or Prior to 1965	% of State Assets 50 yrs. Or Older
Allegany	17	41	46	70	2	4	51	8	6	7	22	25	1	300	57	19%
Anne Arundel	27	119	127	9	7	5	78	0	36	5	30	84	2	529	158	30%
City of Annapolis	98	2	36	8	4	4	4	0	38	2	4	4	28	232	42	18%
Baltimore	31	29	168	91	6	21	146	0	16	69	100	68	0	745	378	51%
Baltimore City	99	75	1	300	9	1	81	0	27	6	96	171	1	867	233	27%
Calvert	11	1	6	33	0	3	11	0	5	3	1	16	42	132	50	38%
Caroline	48	1	106	3	0	1	5	0	3	0	3	255	0	425	97	23%
Carroll	11	29	24	3	27	3	101	0	5	1	9	22	0	235	102	43%
Cecil	11	1	203	6	2	5	21	0	3	2	3	35	0	292	151	52%
Charles	11	6	55	35	1	1	8	0	7	3	14	12	0	153	40	26%
Dorchester	5	1	13	49	1	1	24	0	4	5	3	3	0	109	13	12%
Frederick	13	2	86	21	2	3	12	0	7	2	27	22	0	197	75	38%
Garrett	8	1	171	31	1	3	25	0	3	0	45	9	0	297	121	41%
Harford	14	3	100	15	3	2	13	0	10	28	9	23	0	220	82	37%
Howard	23	55	206	20	2	11	23	0	8	2	4	15	0	369	156	42%
Kent	7	1	6	2	0	0	12	0	3	1	5	3	0	40	5	13%
Montgomery	20	4	85	23	3	2	12	0	10	2	13	18	0	192	58	30%
Prince George's	39	6	80	393	5	7	23	0	14	7	42	12	0	628	261	42%
Queen Anne's	6	8	32	32	1	4	5	0	3	1	0	5	1	98	22	22%
Somerset	15	1	108	65	2	3	9	97	5	9	7	3	0	324	149	46%
St. Mary's	8	63	58	99	1	1	17	0	6	1	0	11	0	265	56	21%
Talbot	8	1	19	4	5	3	9	0	6	1	2	9	0	67	10	15%
Washington	20	69	96	19	5	3	45	0	5	45	16	12	0	335	121	36%
Wicomico	22	8	14	84	1	4	40	0	7	4	10	2	1	197	61	31%
Worcester	8	2	85	2	0	2	11	7	3	0	1	4	0	125	33	26%
Ocean City	0	0	0	0	0	0	0	0	4	0	2	2	0	8	0	0%
TOTAL	**580**	**529**	**1931**	**1417**	**90**	**97**	**786**	**112**	**244**	**206**	**468**	**845**	**76**	**7381**	**2531**	**34%**

This page left blank intentionally

Allegany County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Allegany County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

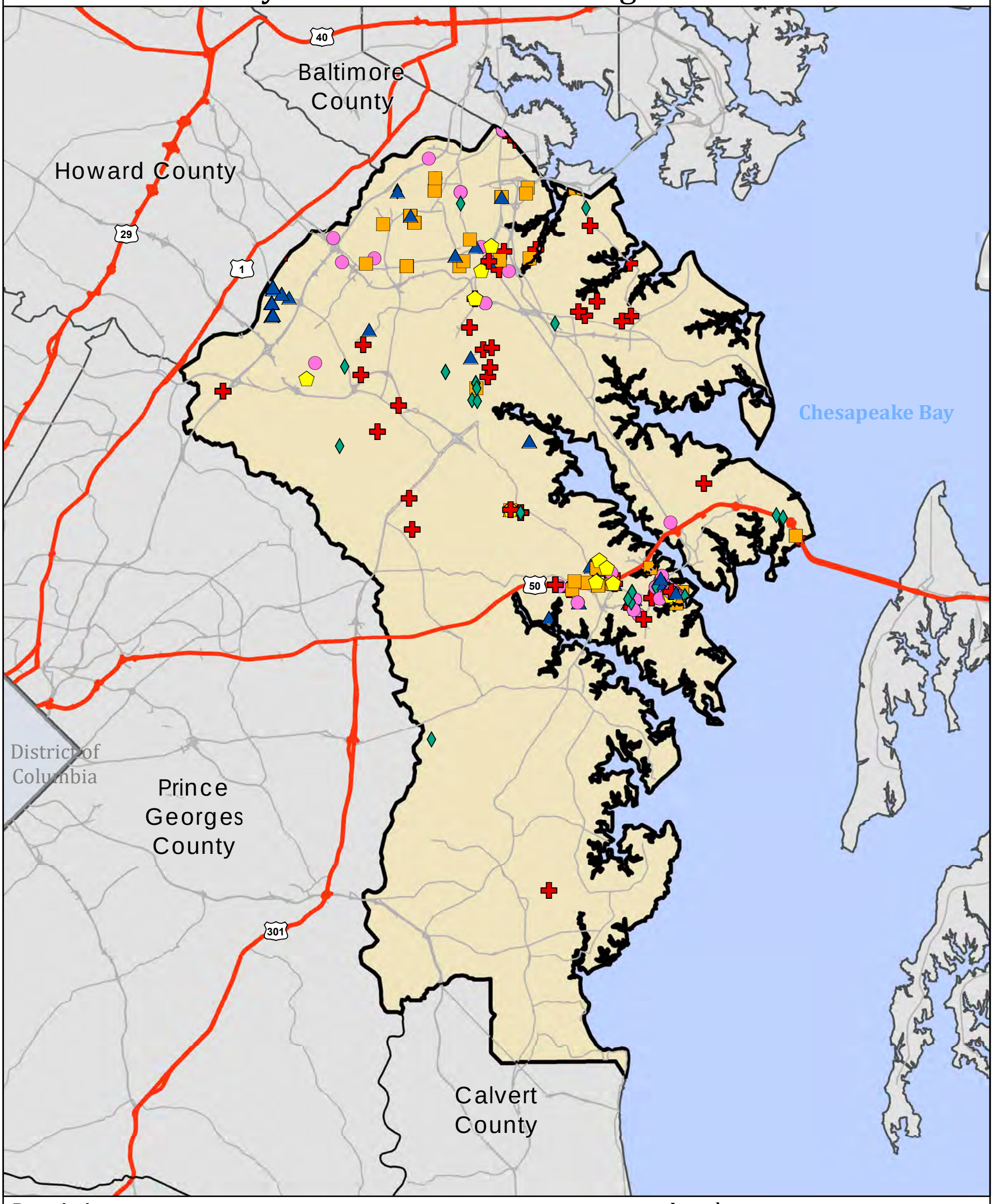
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Anne Arundel County State Assets

Maryland 2021 Hazard Mitigation Plan



Description:

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Anne Arundel County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

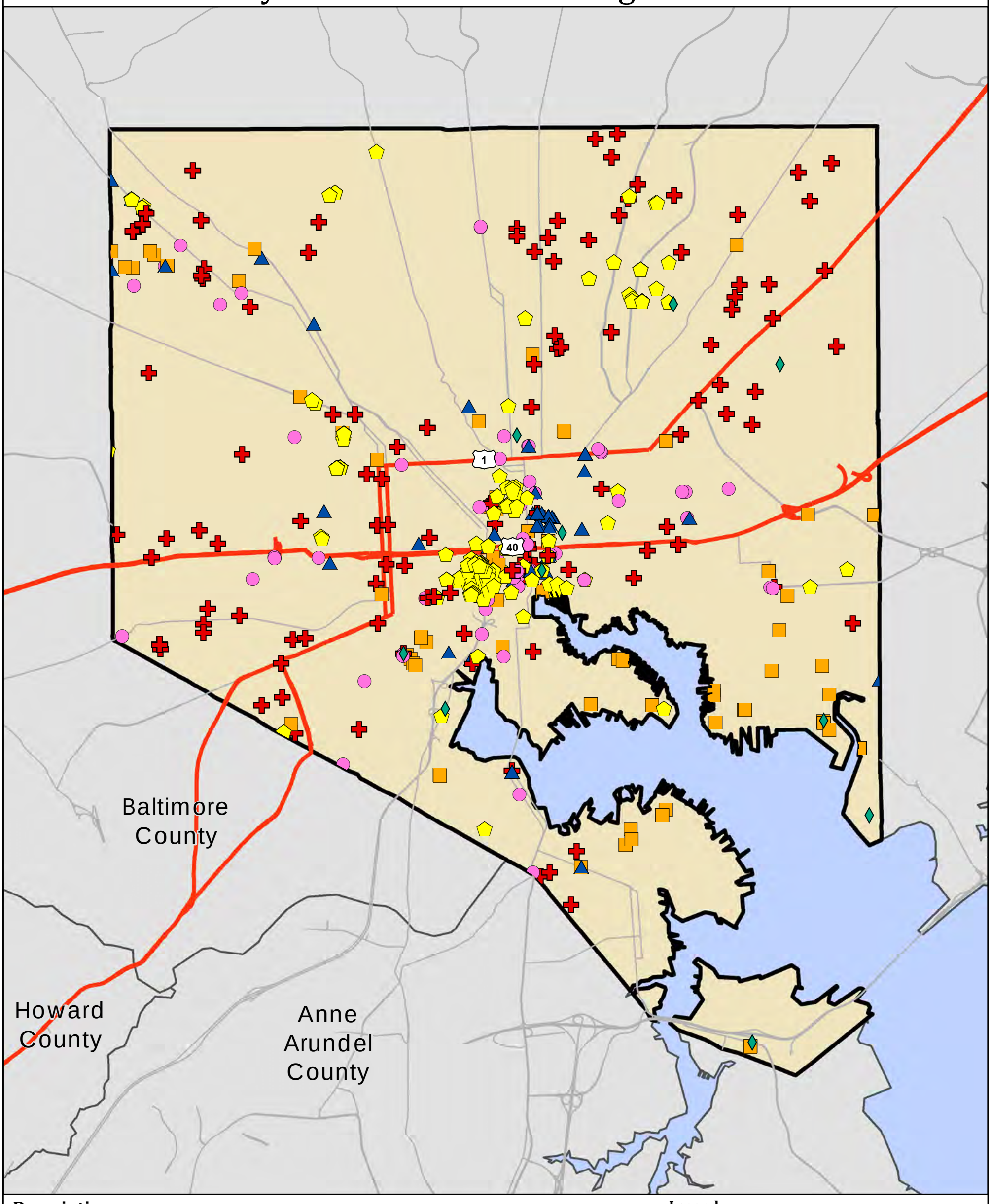
0 1 2 4 6 8 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Baltimore City State Assets

Maryland 2021 Hazard Mitigation Plan



Description:

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Baltimore City
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

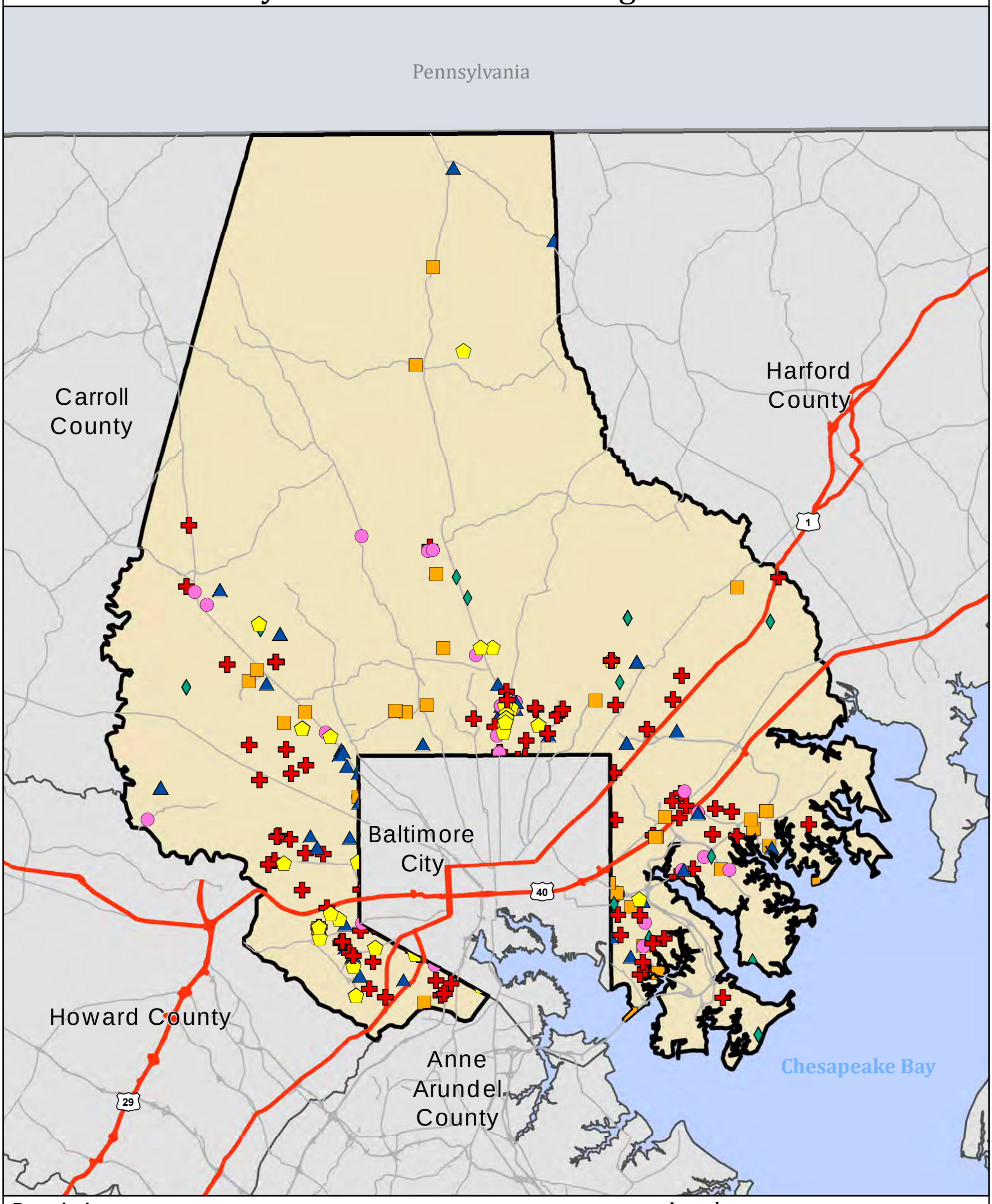
0 0.375 0.75 1.5 2.25 3 Miles

AECOM

Maryland Emergency Management Agency

Baltimore County State Assets

Maryland 2021 Hazard Mitigation Plan



Description:

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Baltimore County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

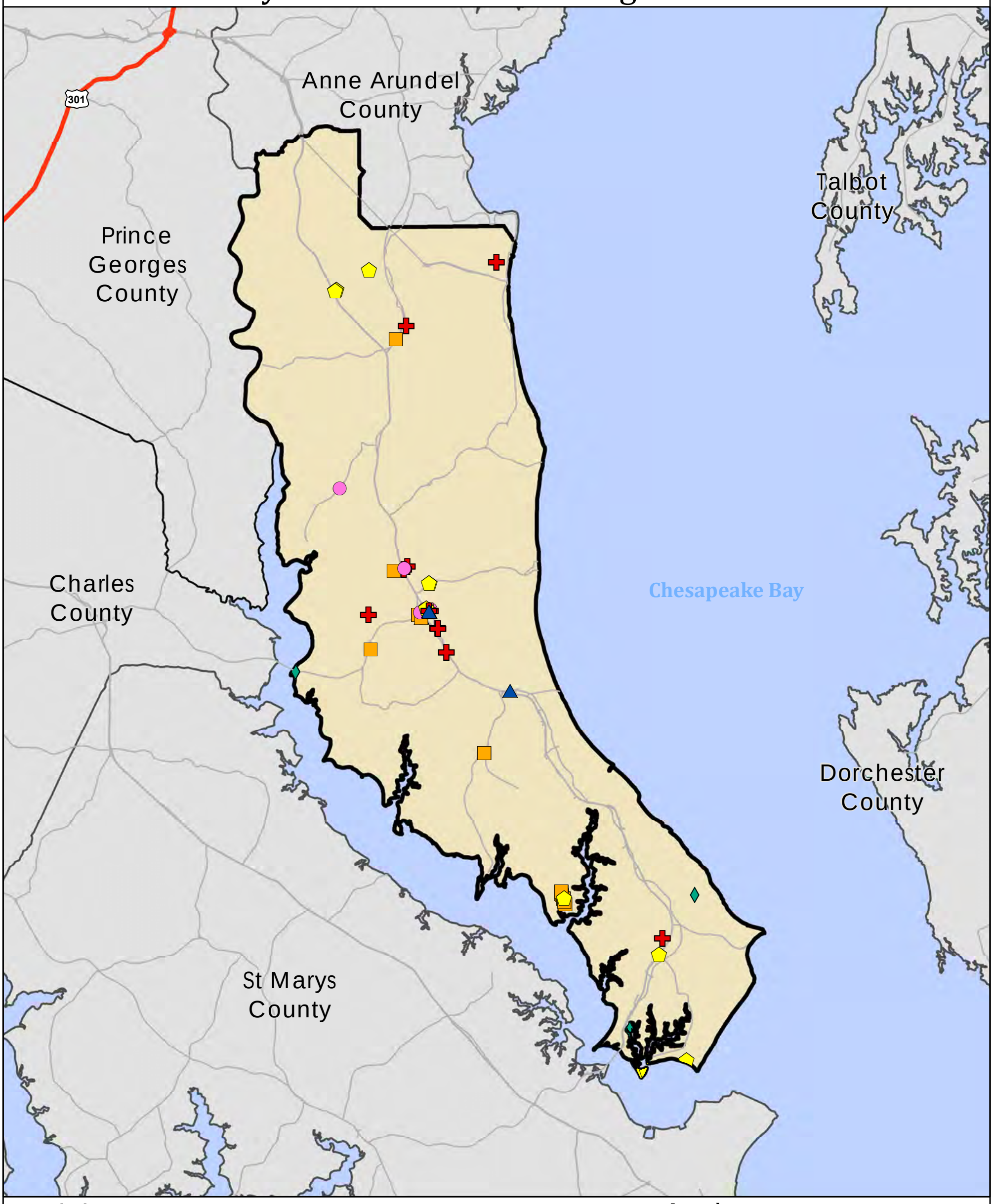
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Calvert County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Calvert County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

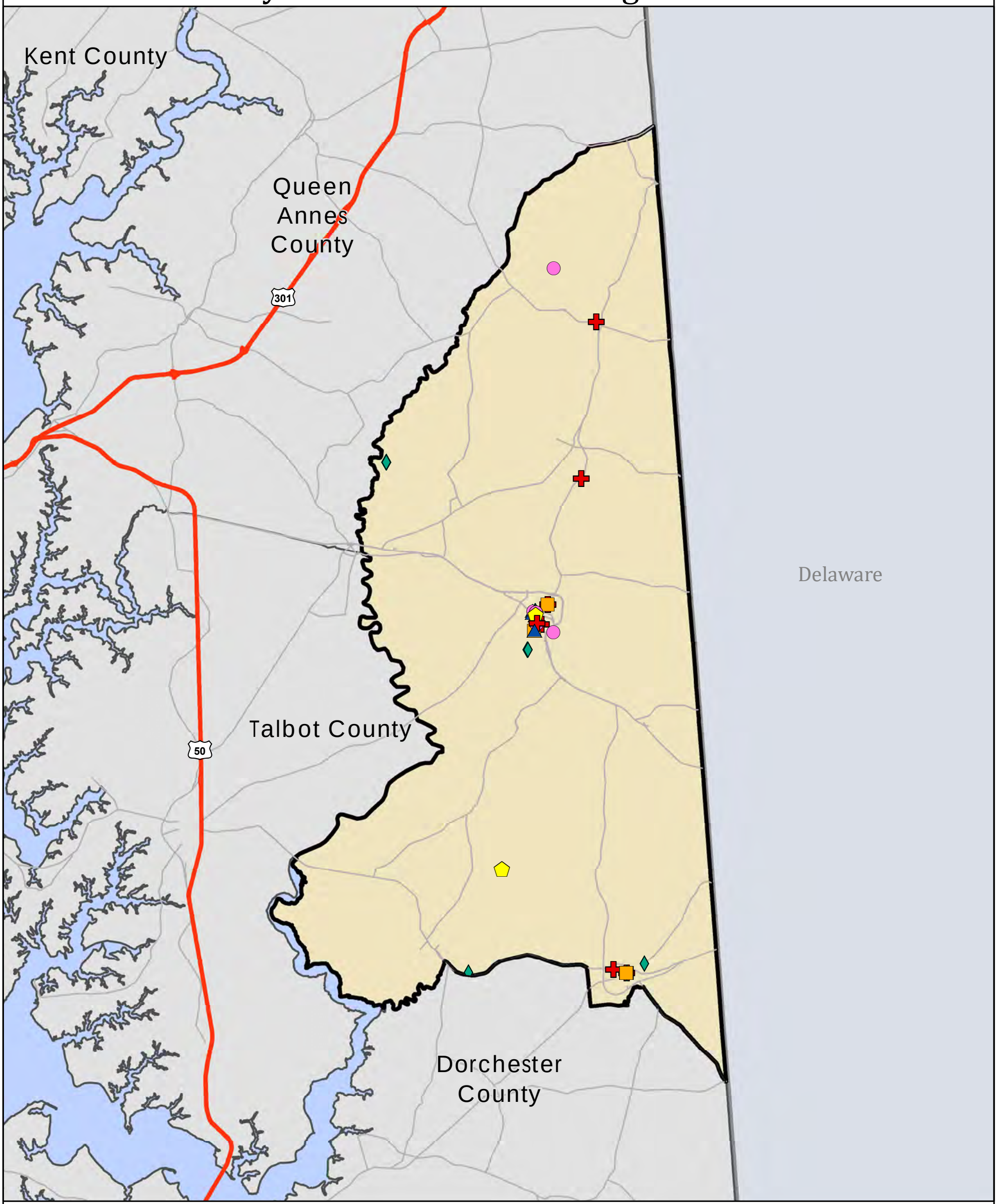
0 0.75 1.5 3 4.5 6 Miles

AECOM

Maryland Emergency Management Agency

Caroline County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Caroline County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

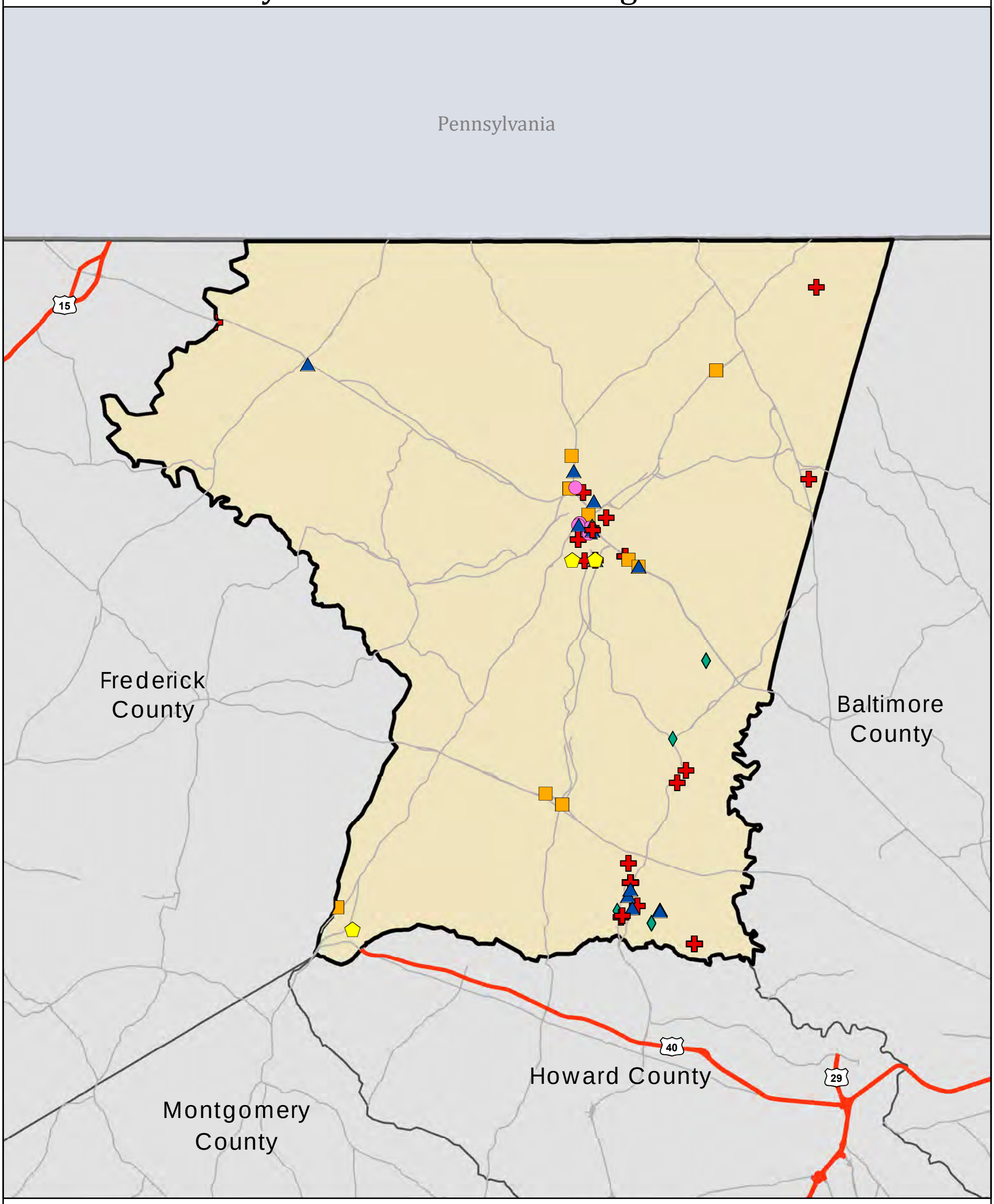
0 1 2 4 6 8 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Carroll County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Carroll County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

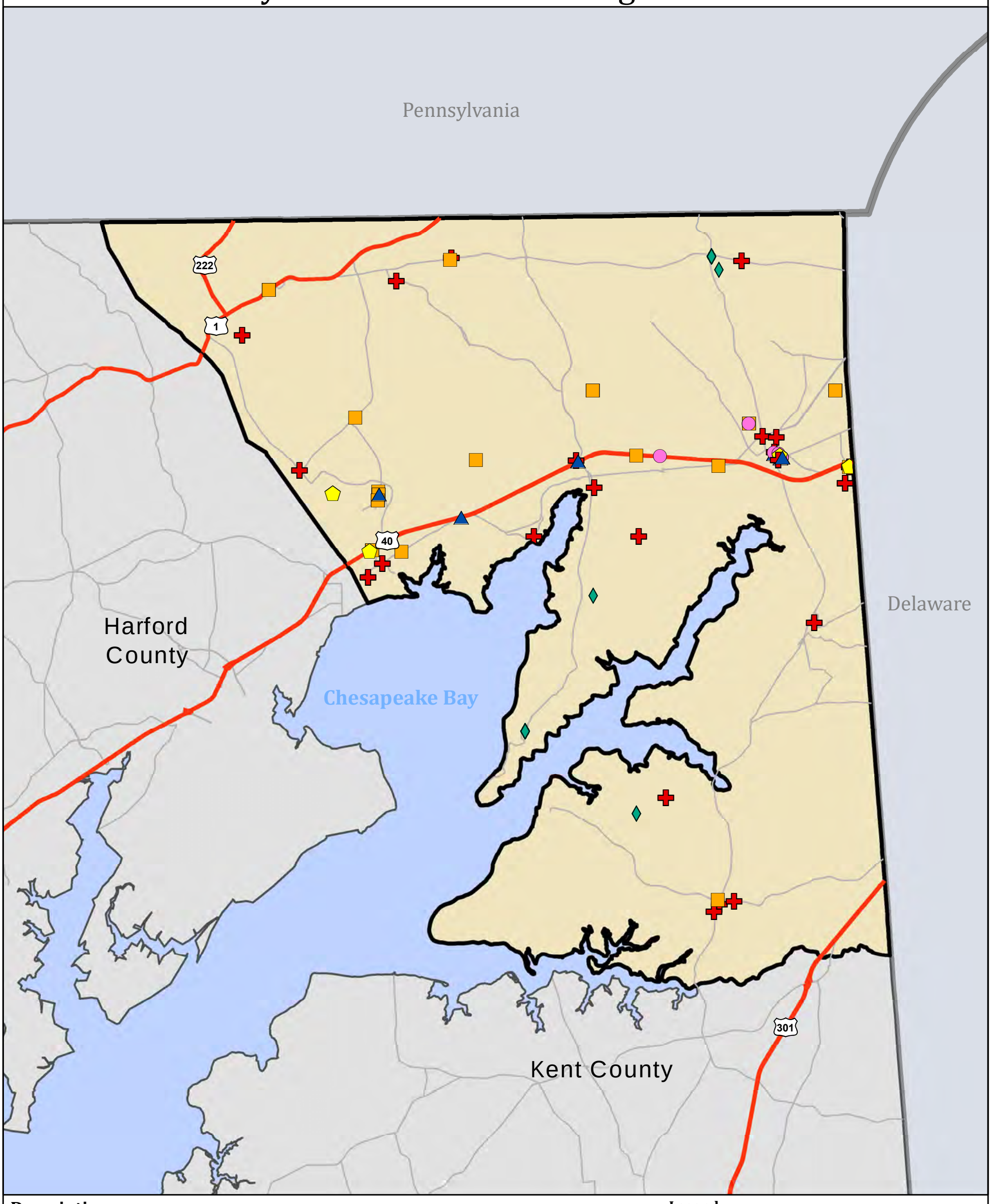
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Cecil County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Cecil County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

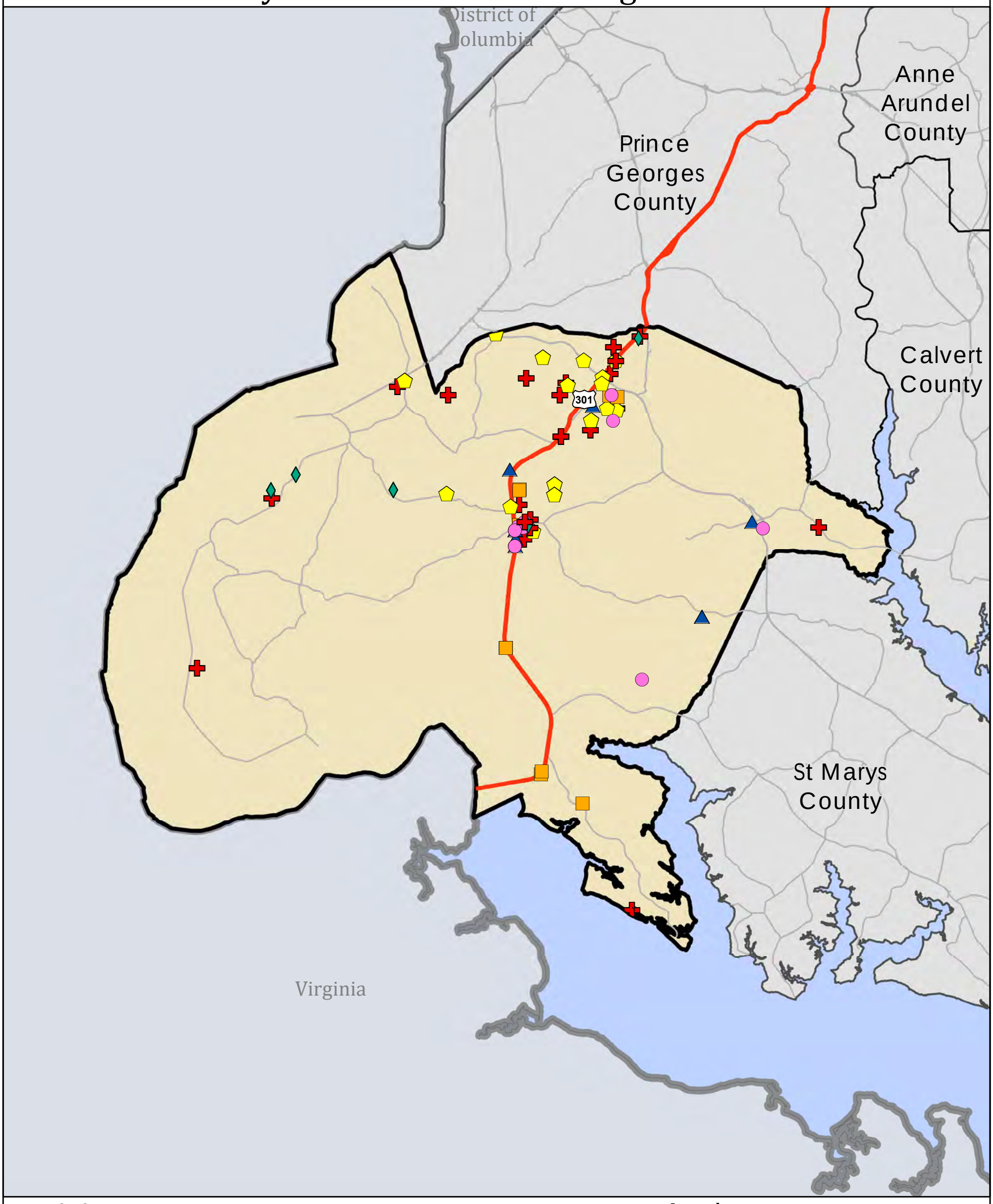
0 0.75 1.5 3 4.5 6 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Charles County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Charles County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

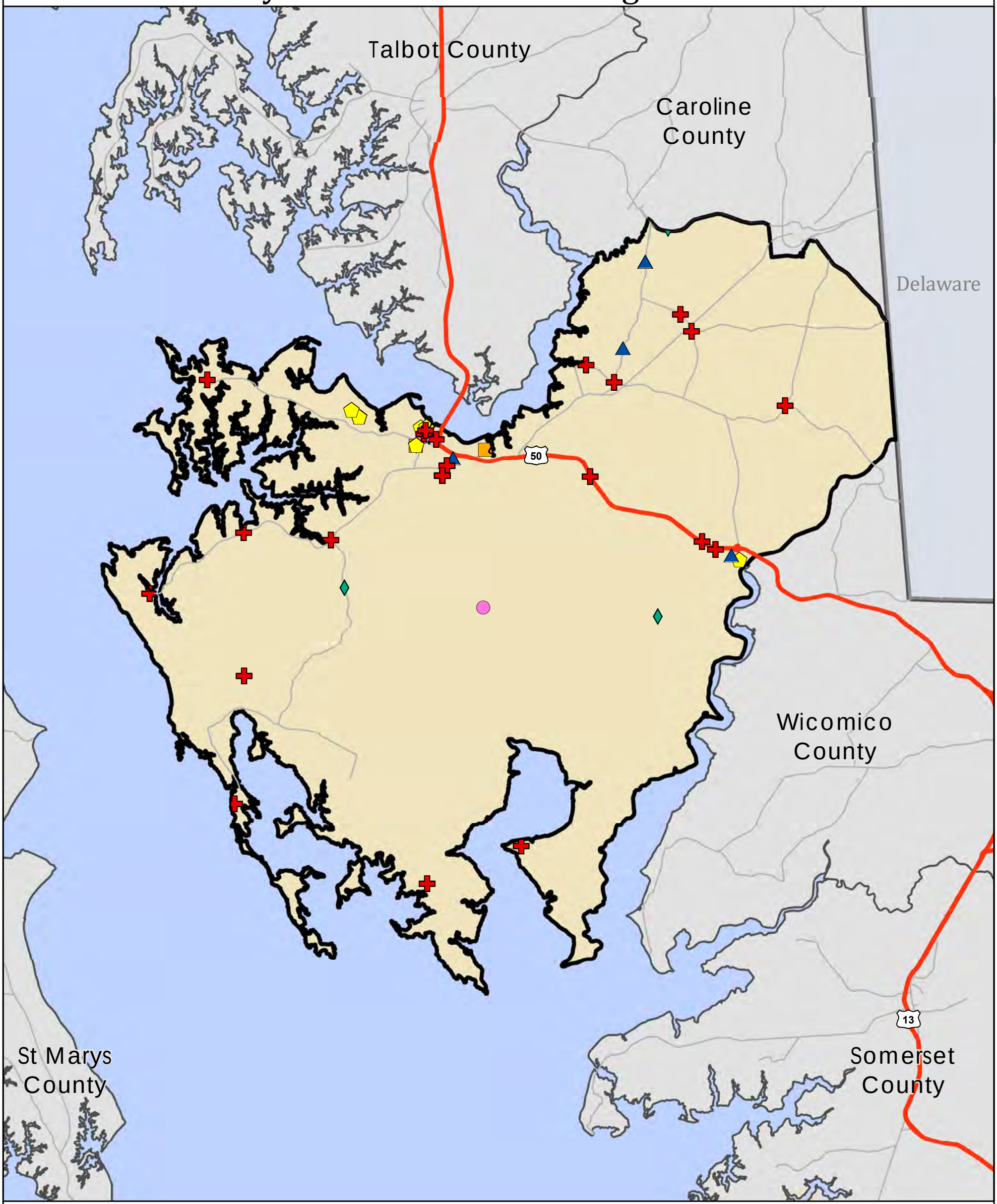
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Dorchester County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Dorchester County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

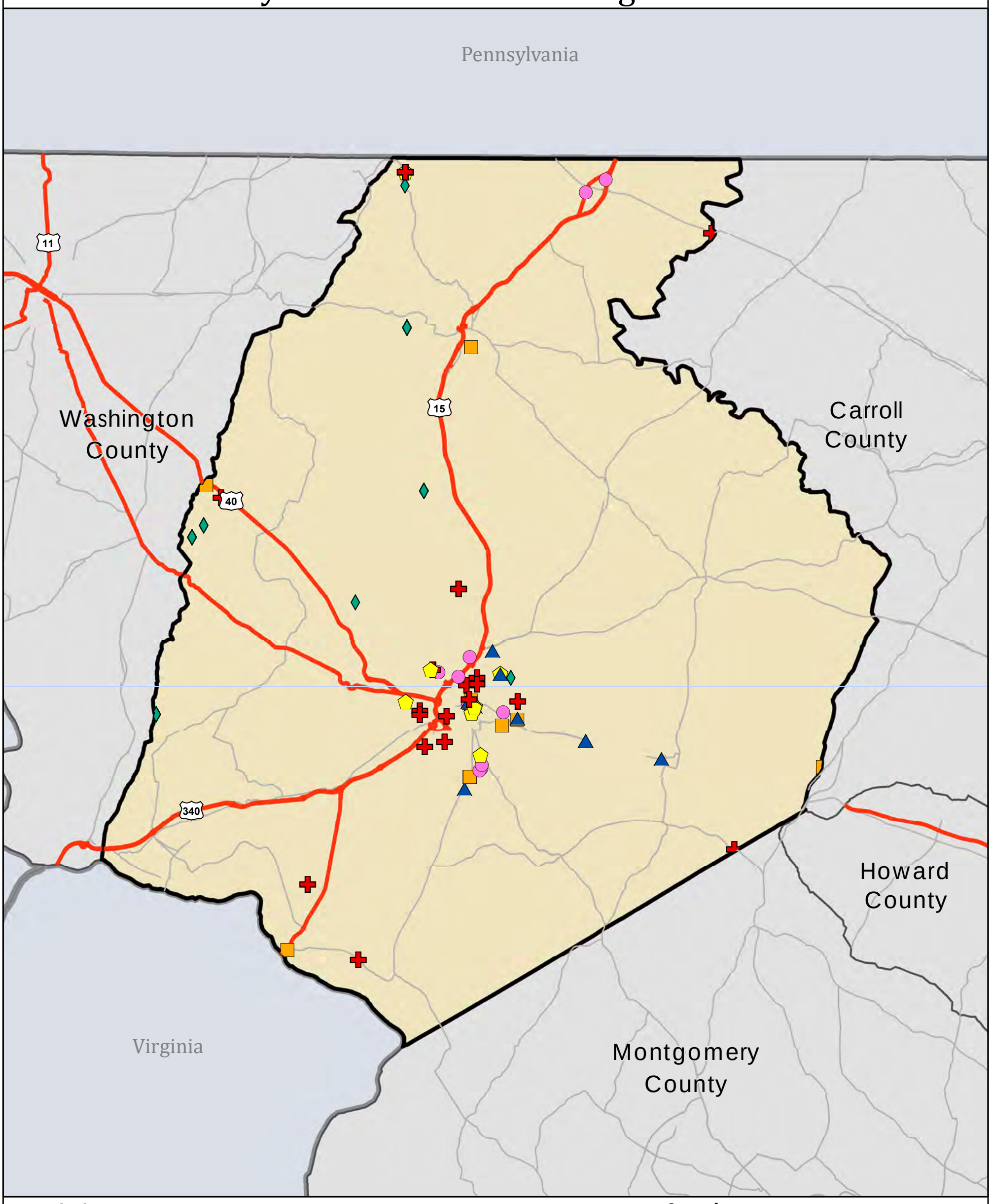
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Frederick County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Frederick County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

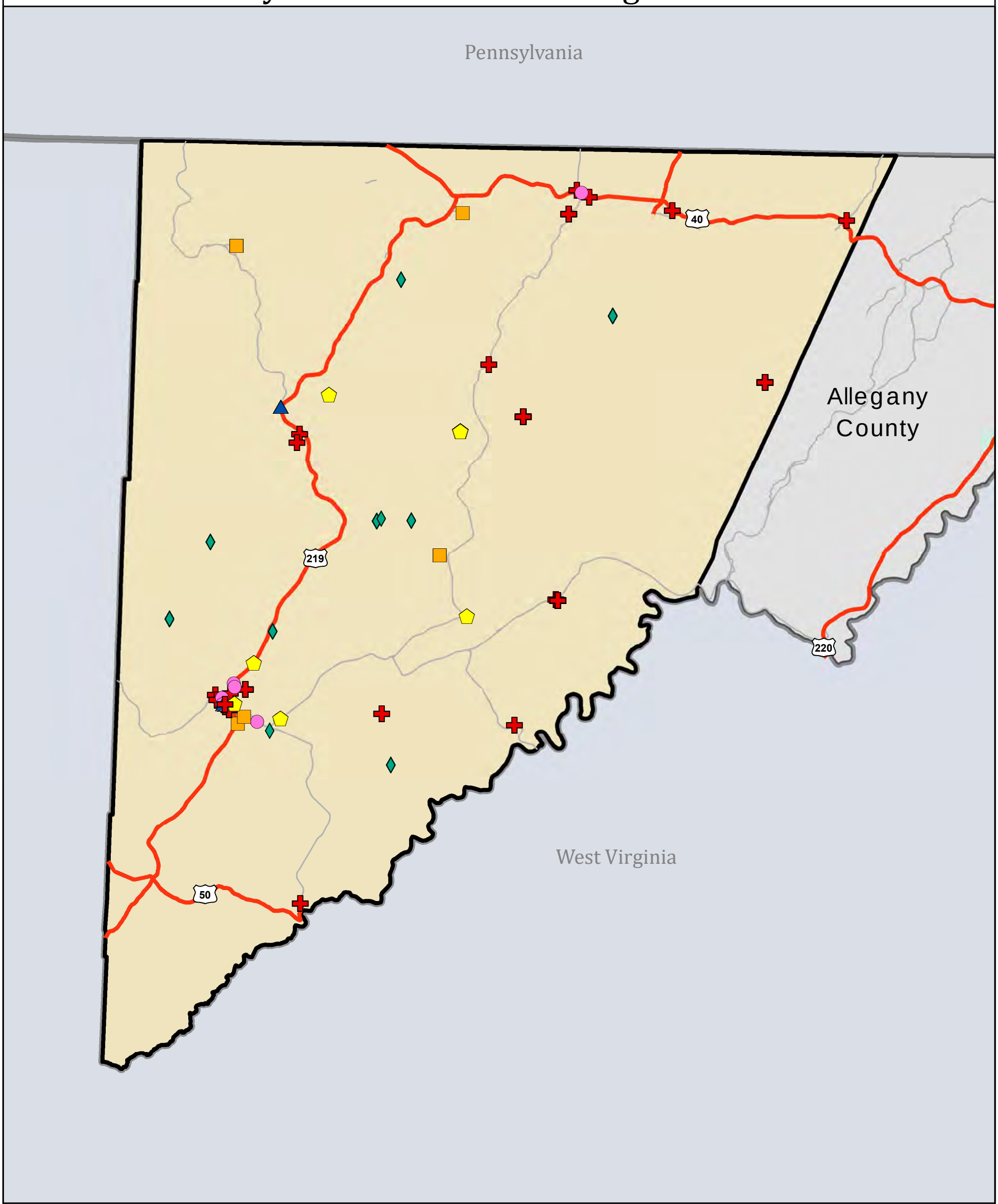
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Garrett County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Garrett County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

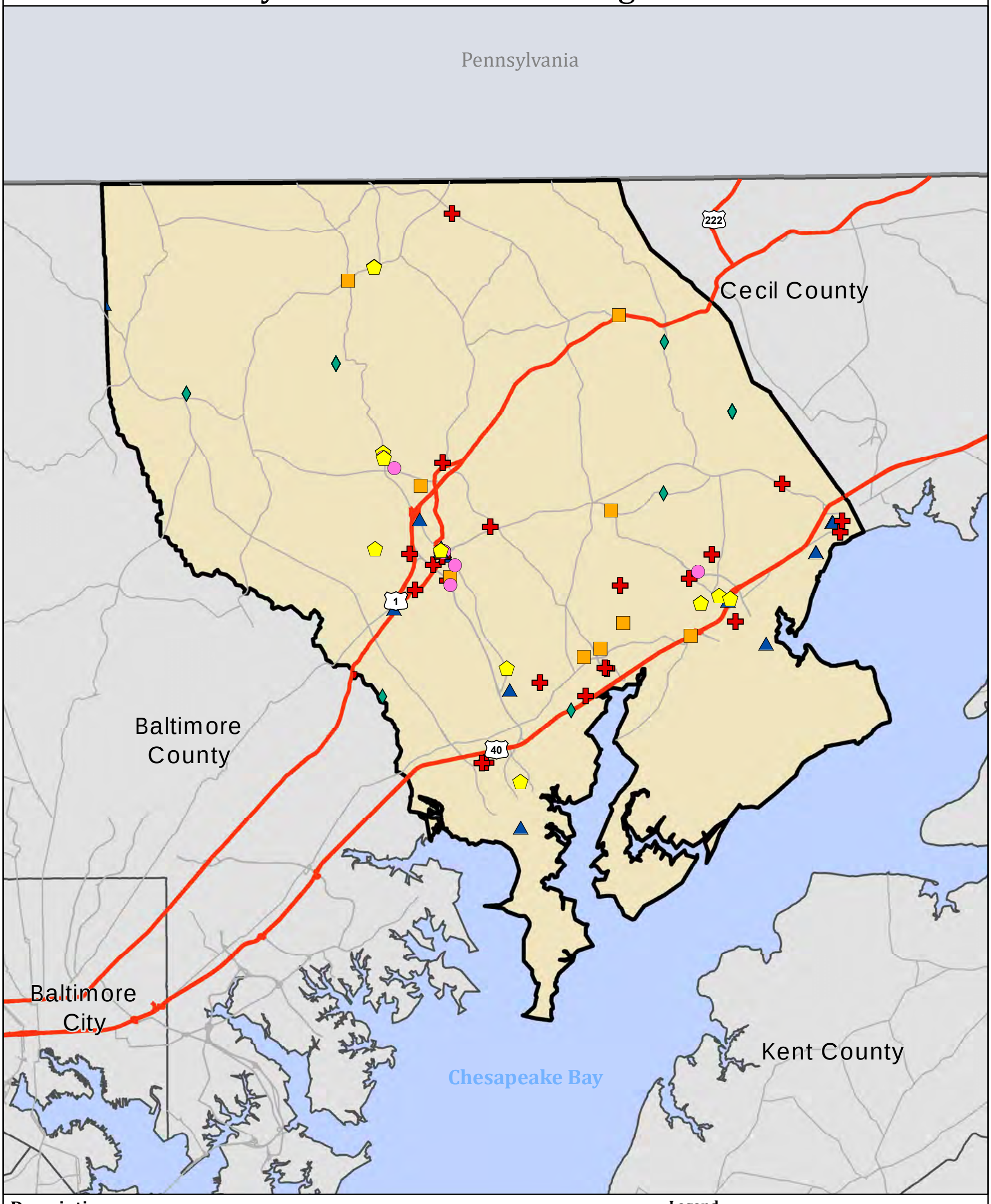
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Harford County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Harford County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

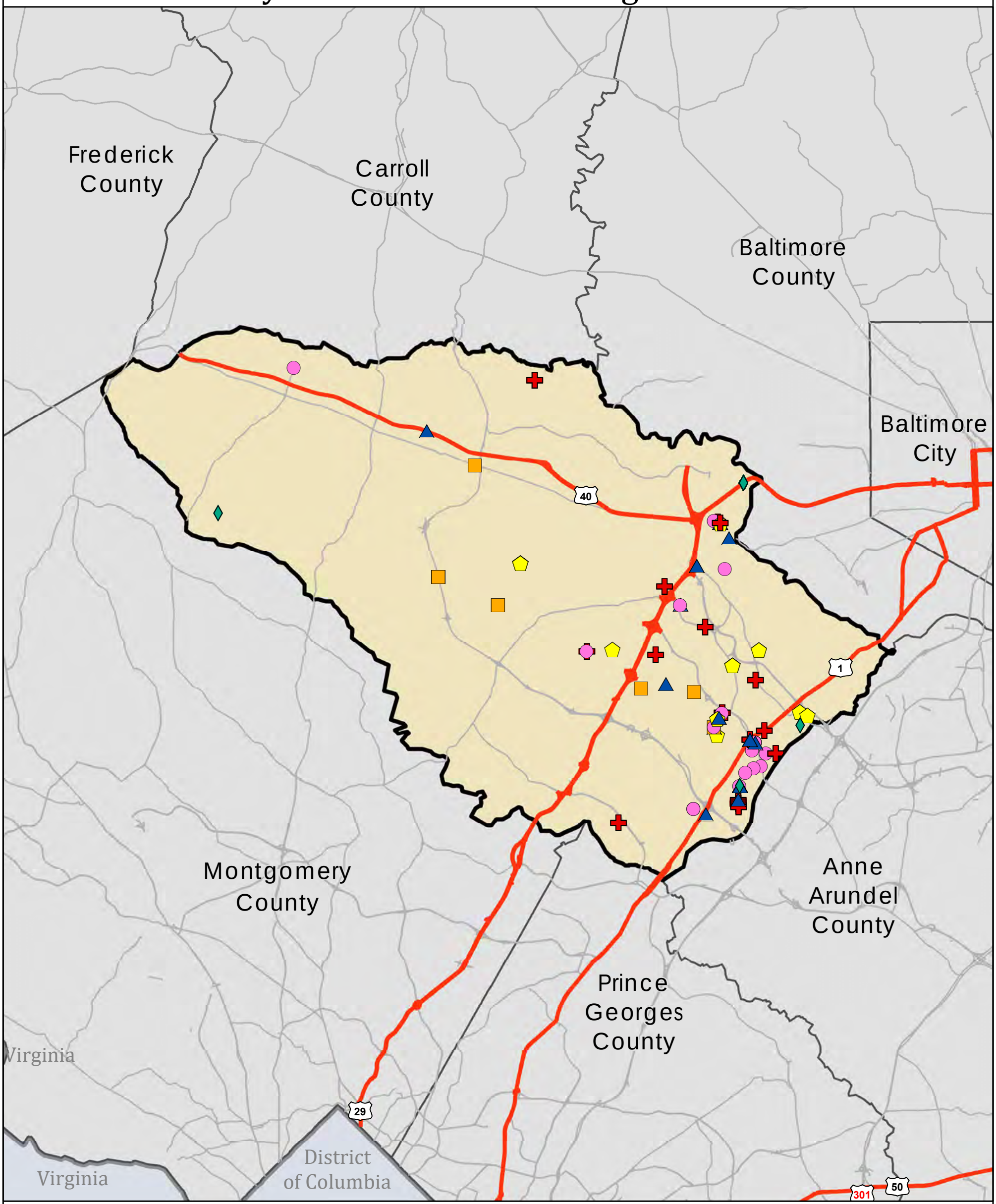
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Howard County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Howard County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

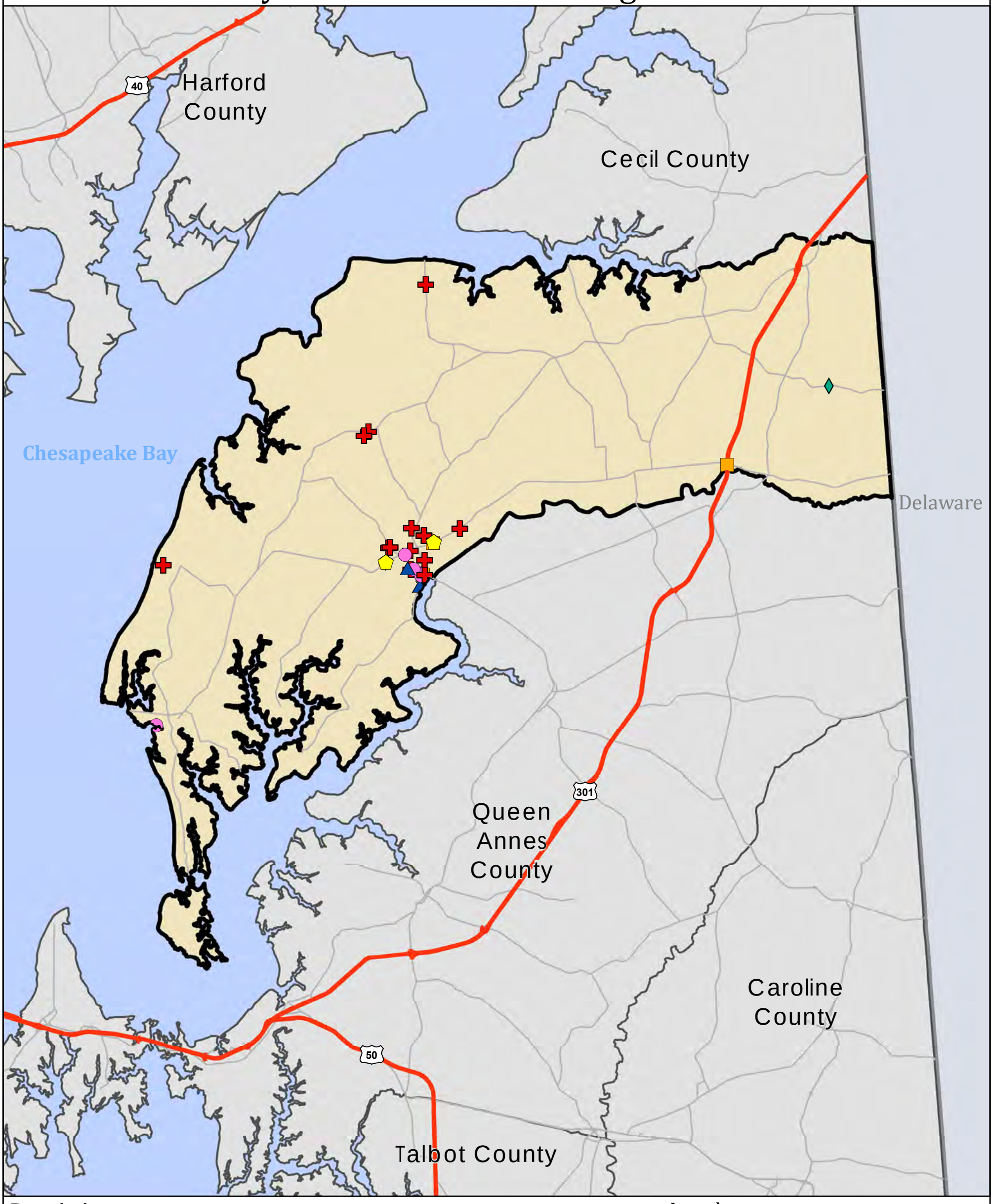
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Kent County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Kent County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

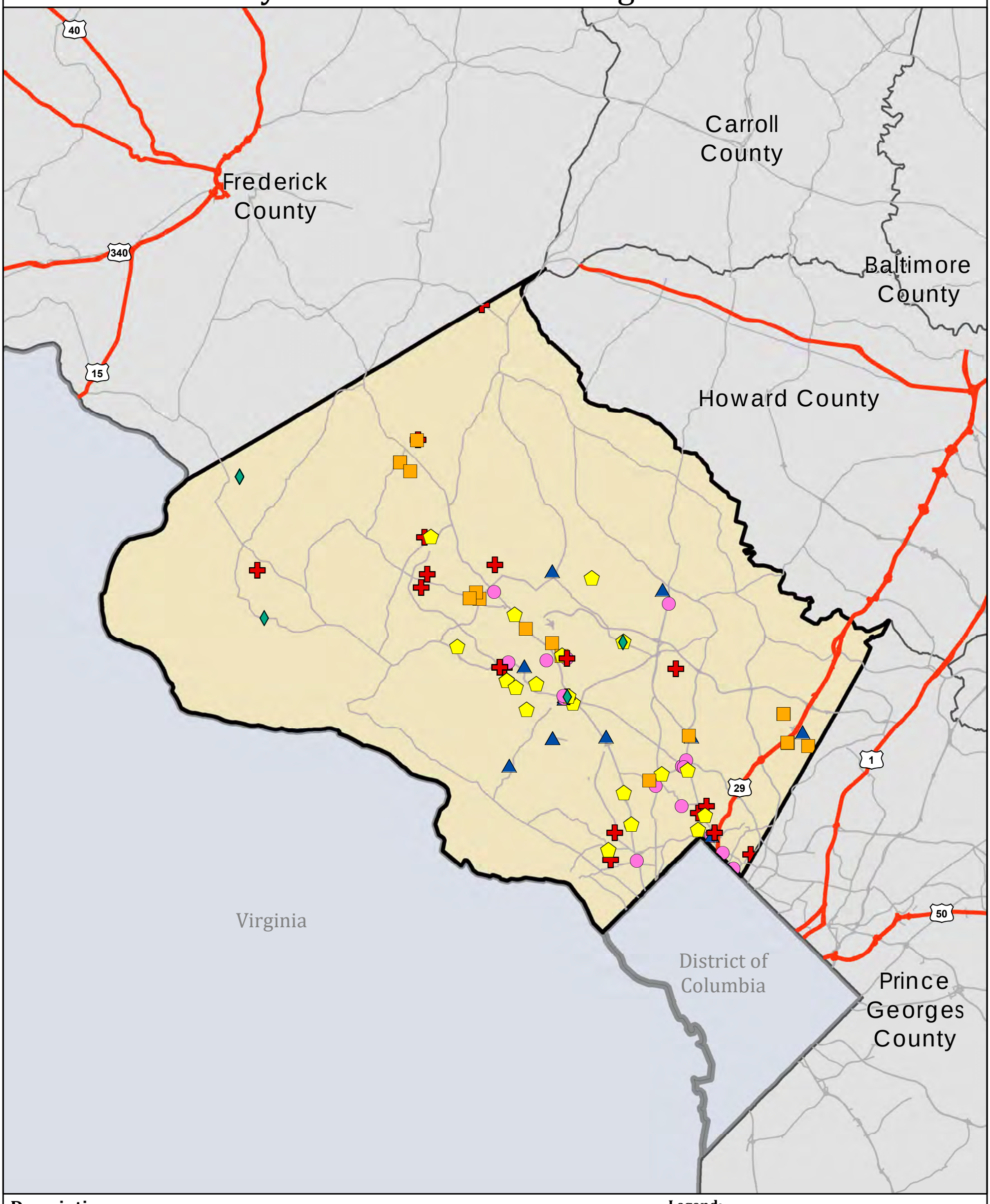
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Montgomery County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Montgomery County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

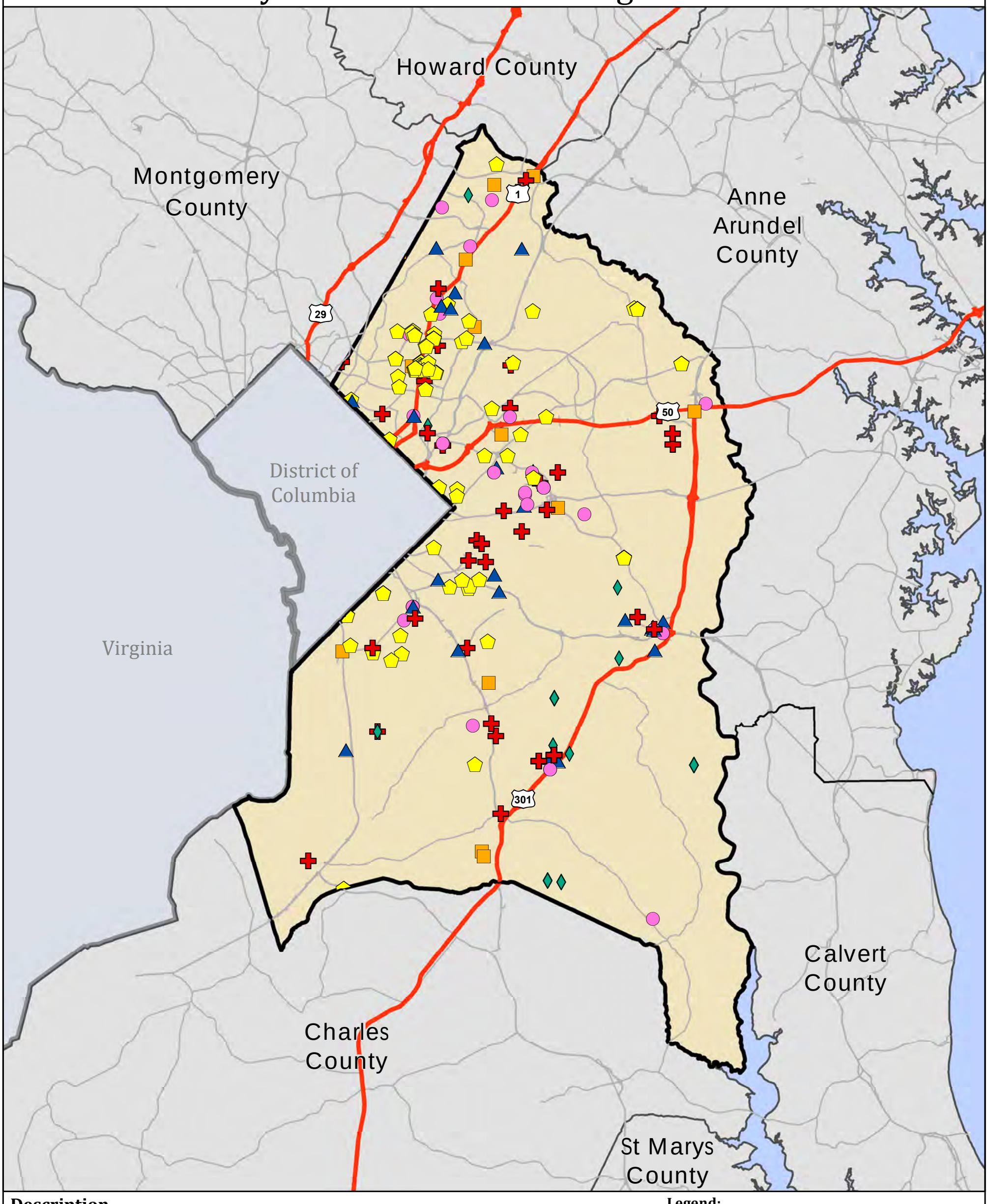
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Prince Georges County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Prince Georges County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

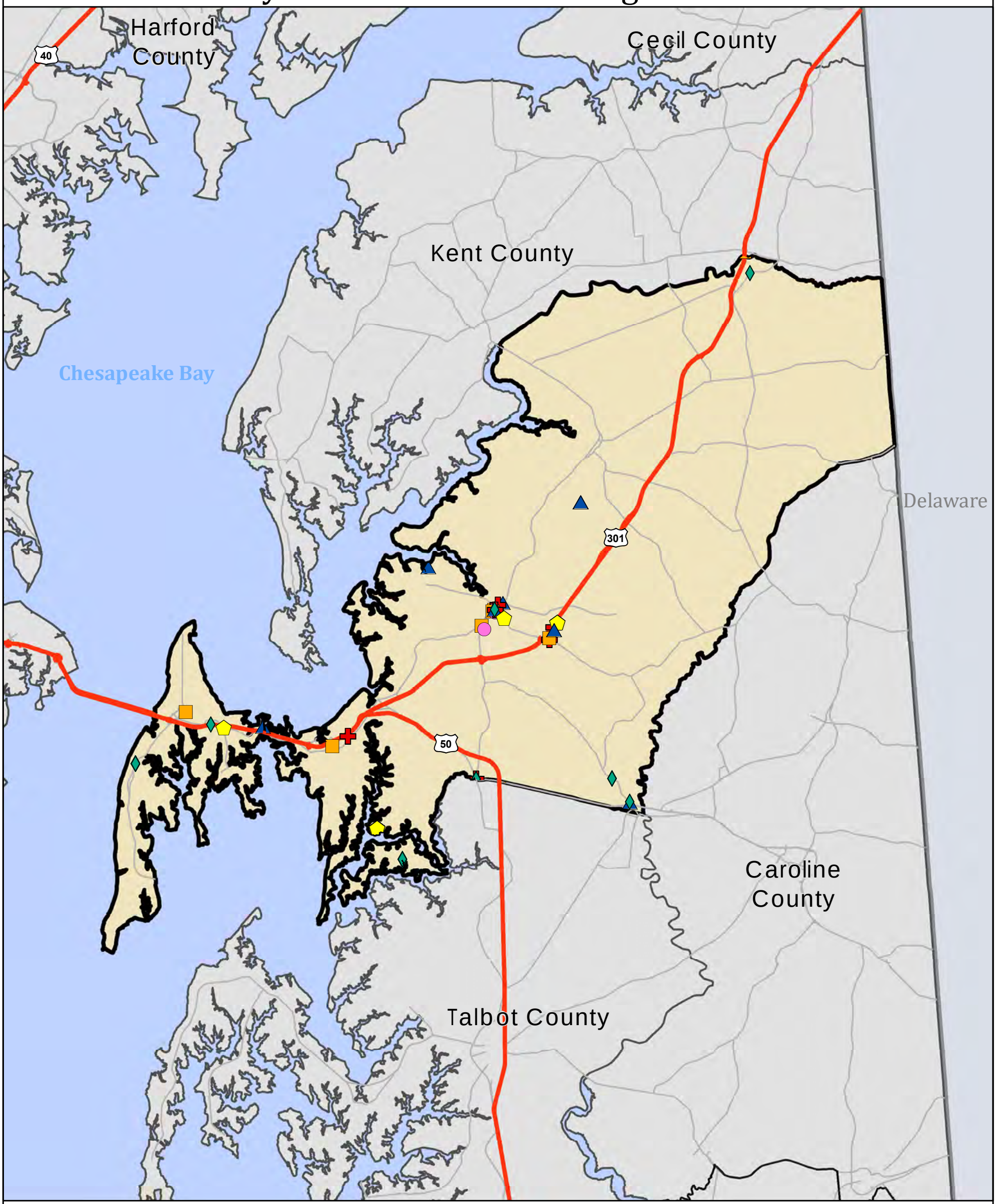
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Queen Annes County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Queen Annes County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

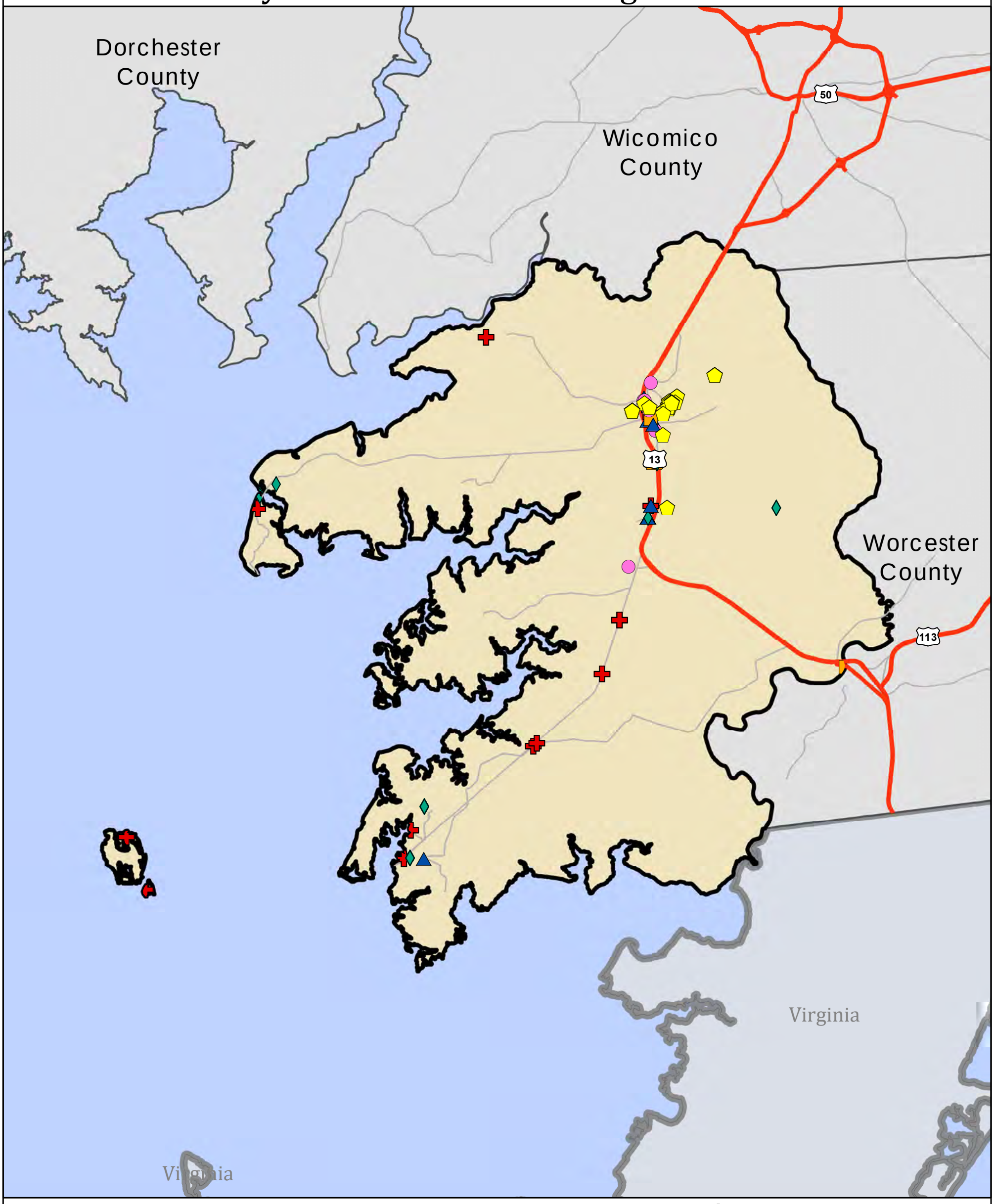
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Somerset County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Somerset County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

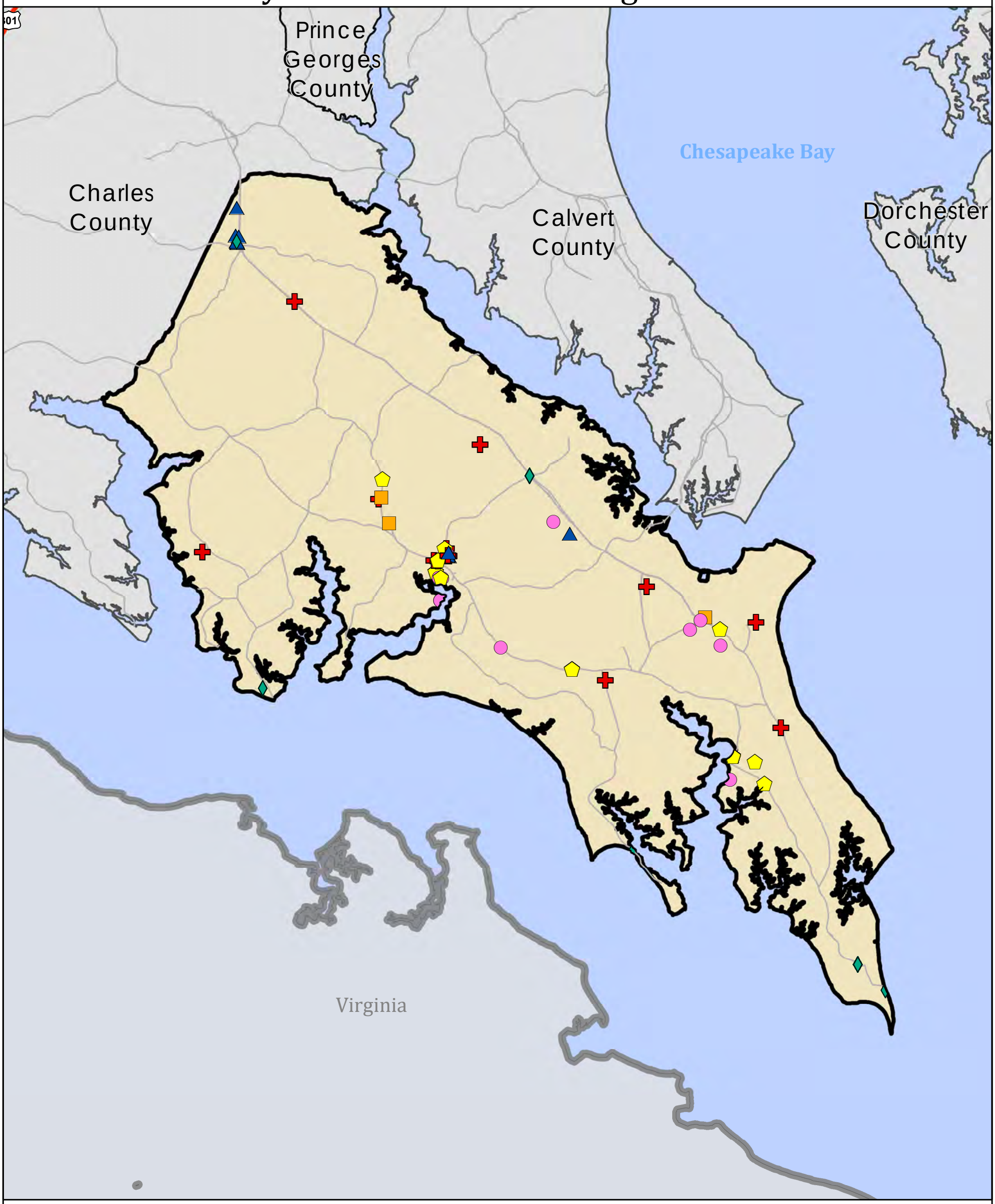
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

St Marys County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- St Marys County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Talbot County State Assets

Maryland 2021 Hazard Mitigation Plan

Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Talbot County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

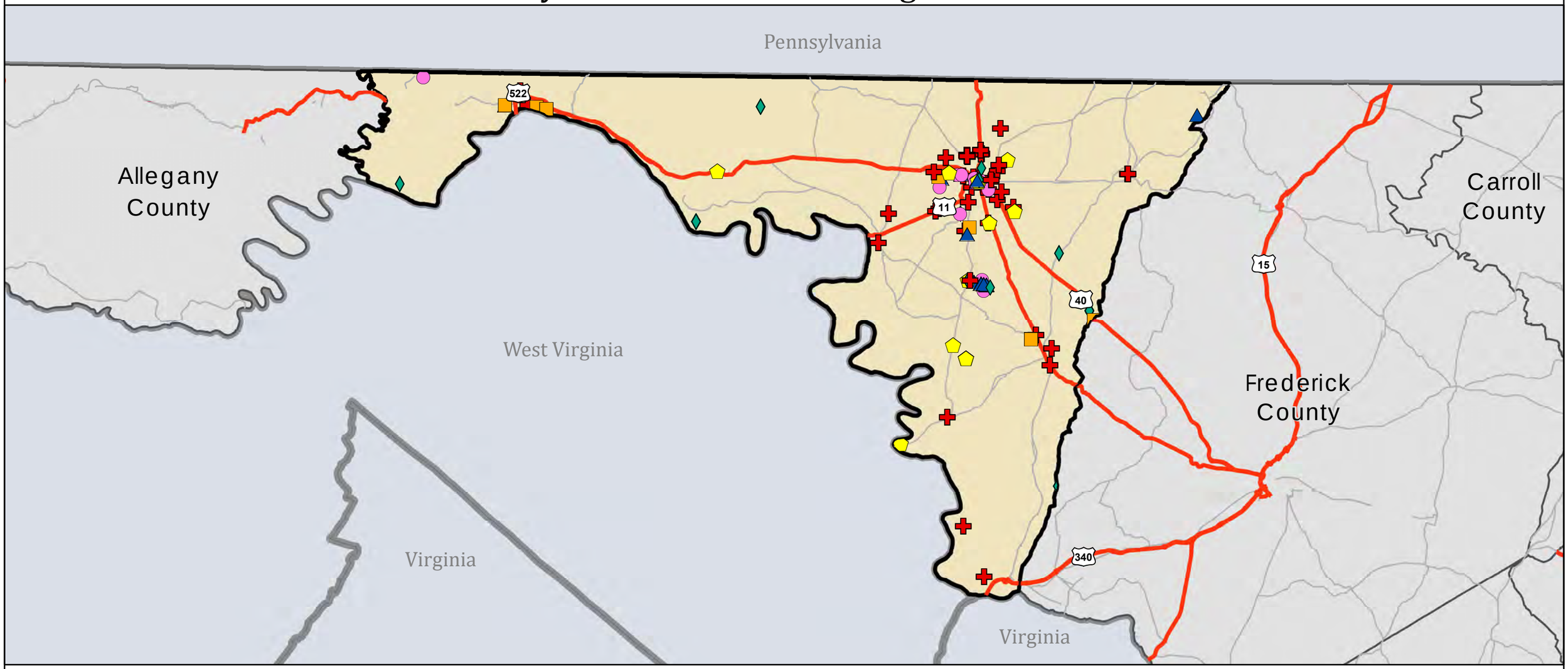
0 0.75 1.5 3 4.5 6 Miles

AECOM

Maryland Emergency Management Agency

Washington County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure
- Maryland Routes
- US Routes
- Maryland Counties
- Washington County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

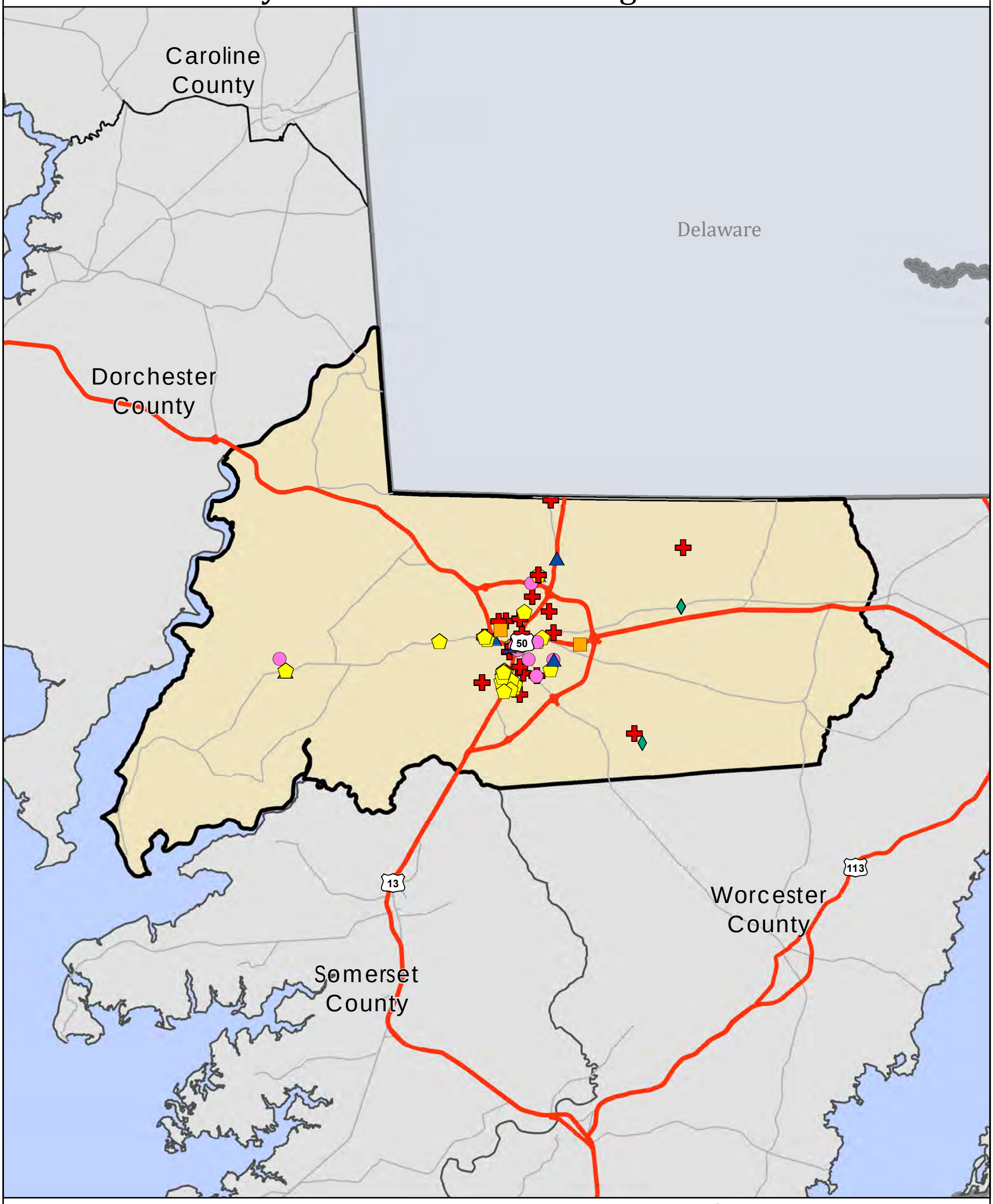
0 1.5 3 6 9 12 Miles

AECOM

Maryland Emergency Management Agency

Wicomico County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Wicomico County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

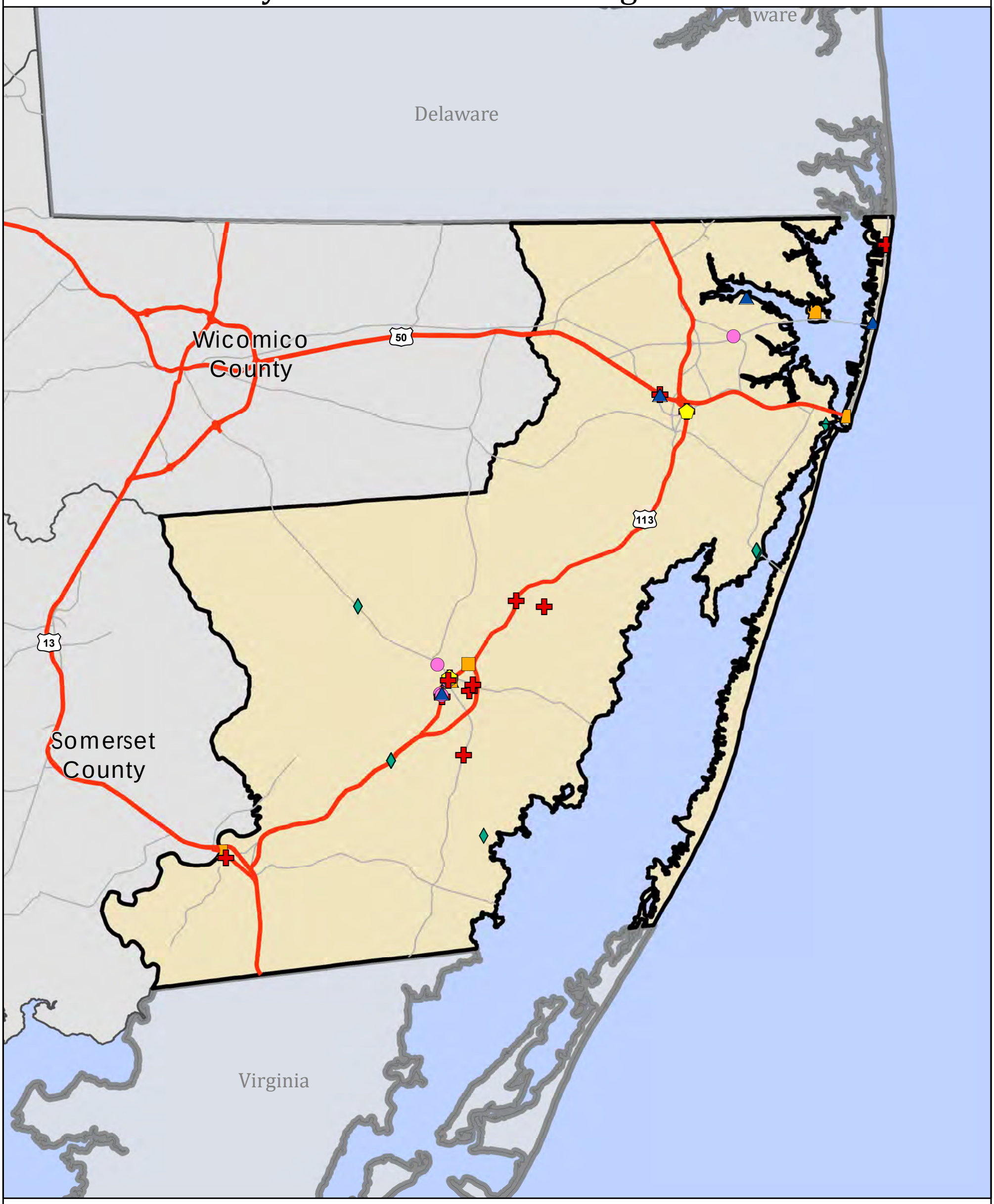
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Worcester County State Assets

Maryland 2021 Hazard Mitigation Plan



Description

State Assets are state owned/operated facilities. In total there are 7,621 state assets identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of State Assets Included:

- *Administrative*
- *Law Enforcement: Correctional, Fire & Police Dept., Judicial/Legal, Military*
- *Environmental: Environmental, Dept. of Natural Resources*
- *Educational: Educational, Historical*
- *Health: Health, Social Services*
- *Transportation/Infrastructure: Airports, Transportation, Utility/Infrastructure*

Legend:

Asset Type

- Administrative
- Law Enforcement
- Environmental
- Educational
- Health
- Transportation/ Infrastructure

- Maryland Routes
- US Routes
- Maryland Counties
- Worcester County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

APPENDIX I

Critical Facilities Maps

This page left blank intentionally

Critical Facility Loss Estimate Methodology

As identified in Section 3.4, critical facility loss estimation calculations are based on the highest hazards impacting the facilities, i.e. hazards determined high-risk, in each jurisdiction. See Section 3.22 – 3.26.2 of the HIRA for ranking methodology and data used in calculating the high-risk jurisdictions for each hazard. The process that was used for each jurisdiction and hazard to develop a total estimated loss associated with critical facilities in that county for the specific hazard is as follows:

1. Confirm which hazards were previously determined to be high-risk (or medium-high risk for the Coastal and Wildfire hazards)
2. Using ESRI ArcGIS Pro, the geospatial layers were overlayed, and an intersection was taken using the following layers:
   a. Hazard Extent - In the case where geographic data was not localized for hazards like storm, wind, and extreme temperatures, etc., the entire jurisdiction at high-risk was considered.
   b. County (jurisdictional boundaries)
   c. Critical Facilities
3. Based on the intersection, the number of critical facilities that fell within the jurisdiction boundaries and hazard extent for the high-risk hazards were considered.
4. The associated value of the critical facilities from the previous step was then calculated.

The graphic below shows how this intersection works out. The numbers on the Wind Hazard map correspond to the County maps that have facilities potentially impacted by the hazard. This methodology was repeated for each hazard as appropriate.

Following the graphic, the remainder of this Section provides the Critical Facilities database table and the individual jurisdictional maps showing the locations of the facilities in each.

This page left blank intentionally

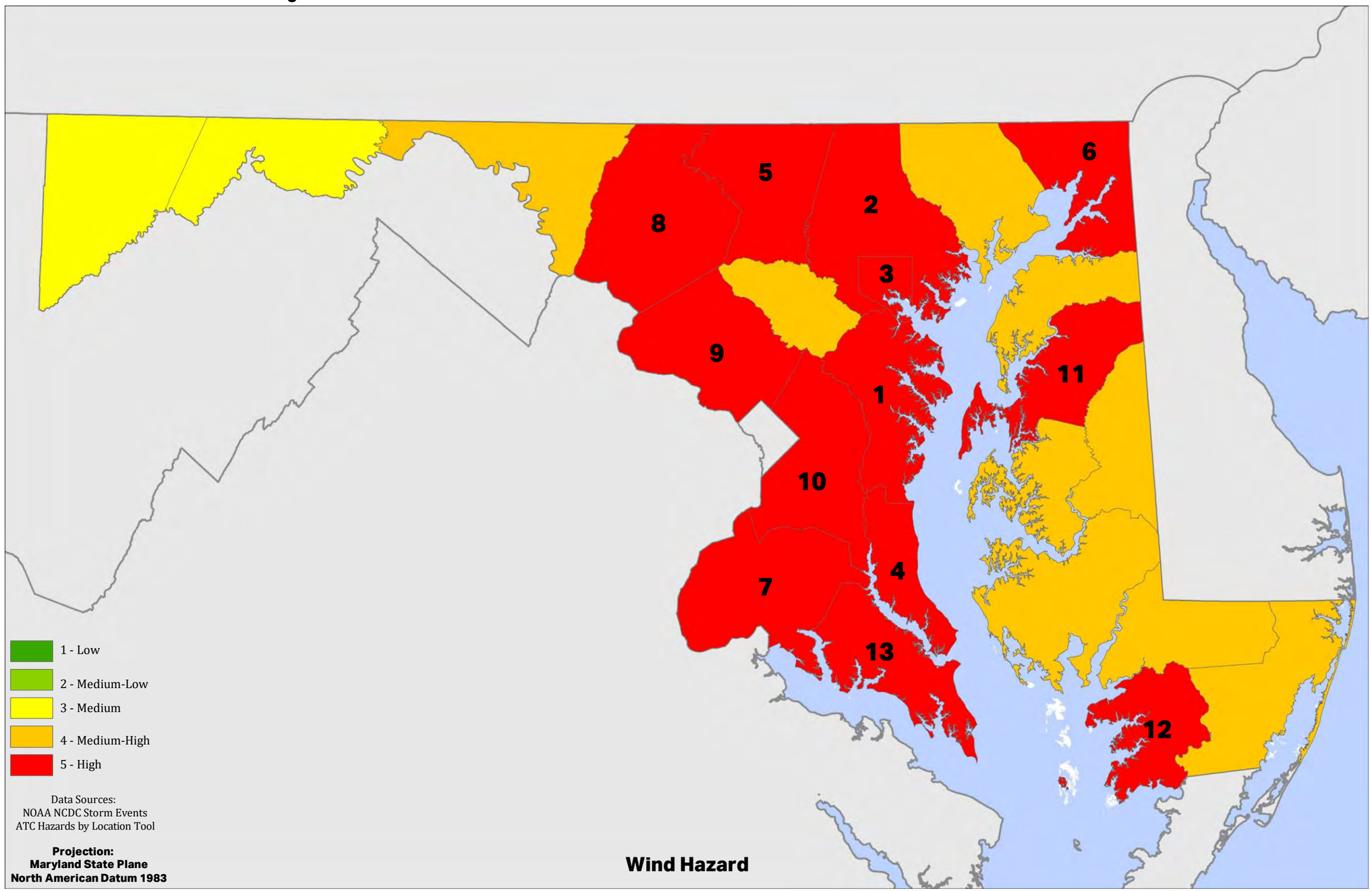
Critical Facility Loss Estimates for High-Hazard Ranking Counties

State of Maryland

Hazard Mitigation Plan 2021

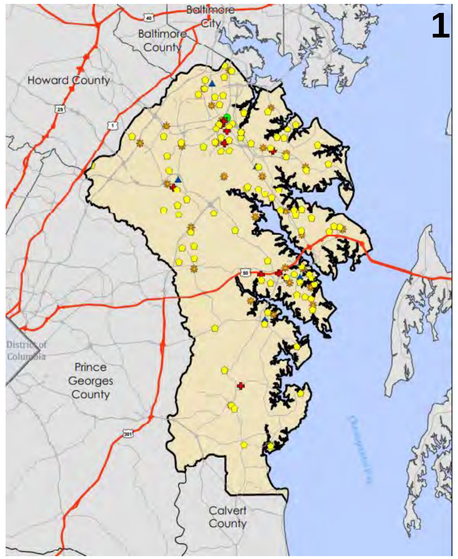
Hazard Identification & Risk Assessment

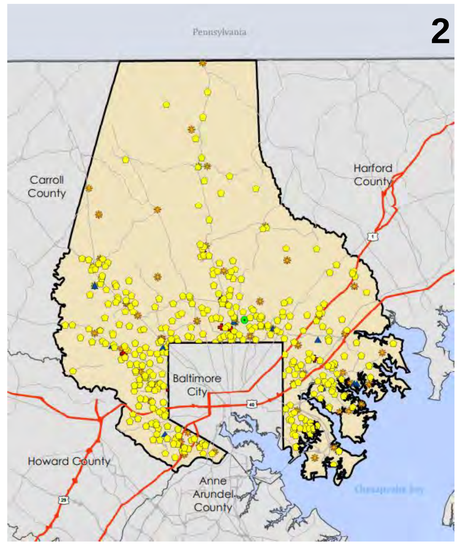
These maps show risk levels assessed for significant hazards. Parameters used to create the Hazard Ranking and Risk Maps for each hazard are explained in the Hazard Assessment and

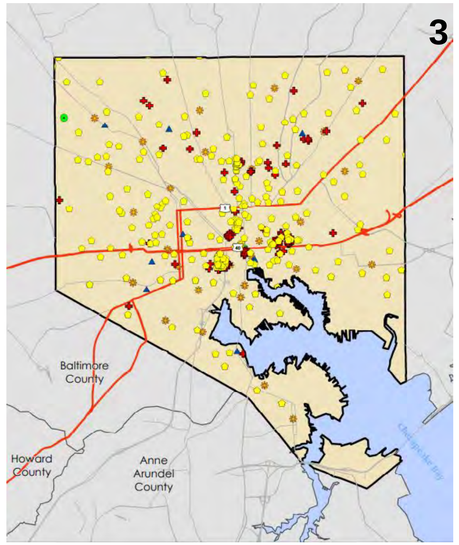


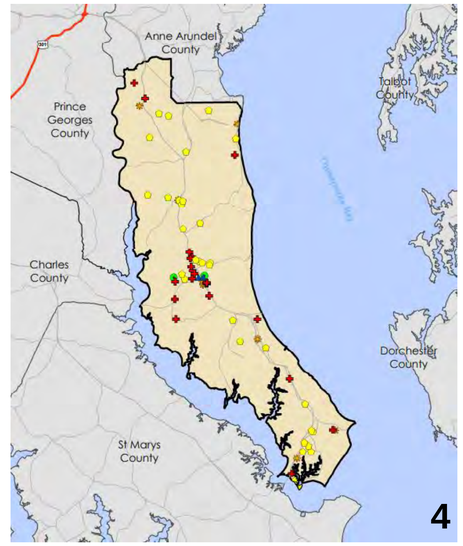
Maryland
EMERGENCY MANAGEMENT AGENCY

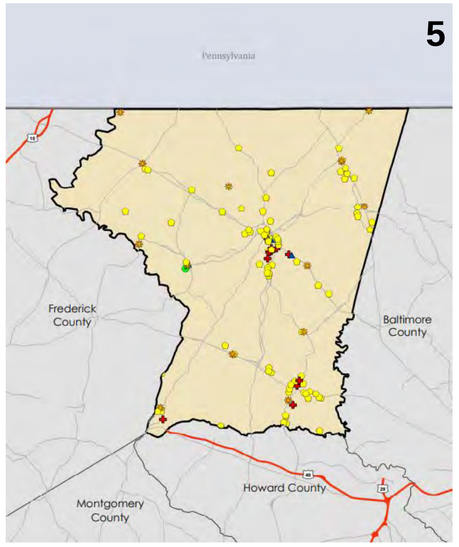
AECOM

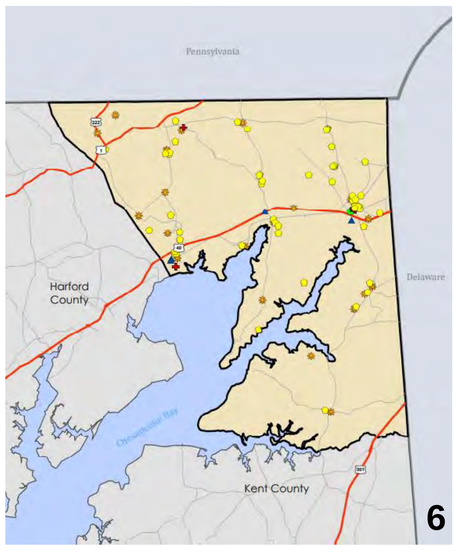


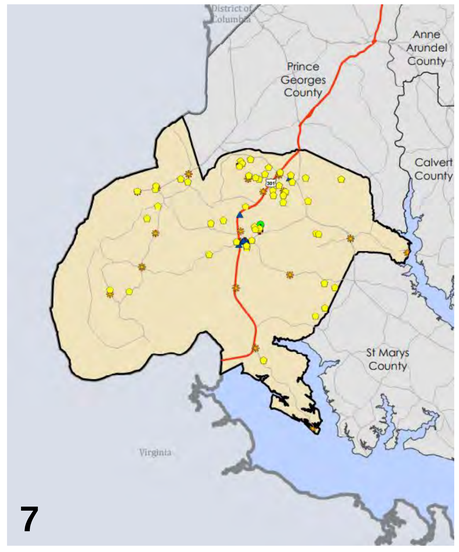


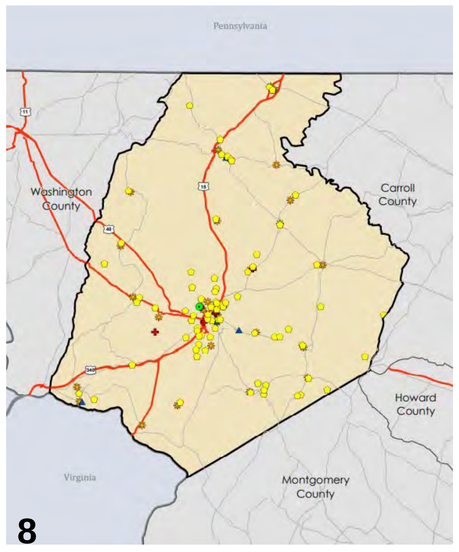


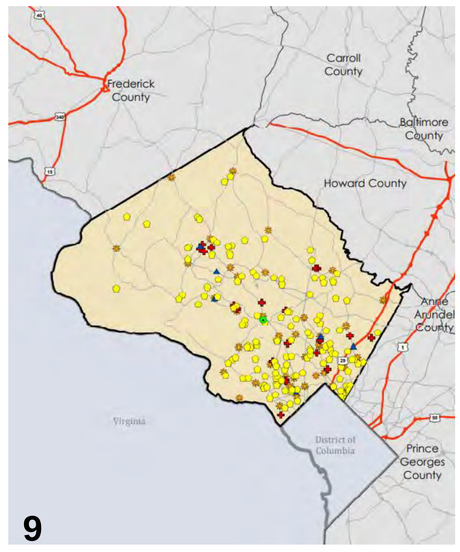


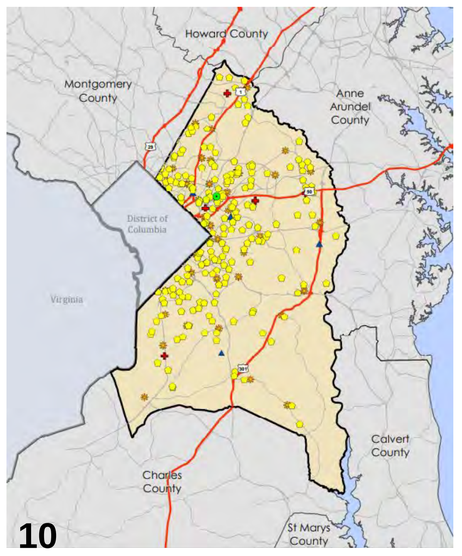


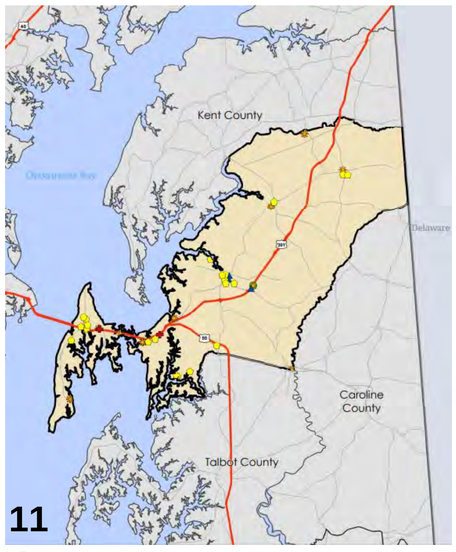


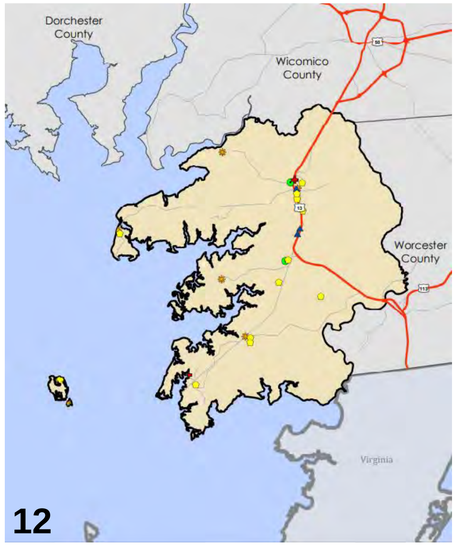


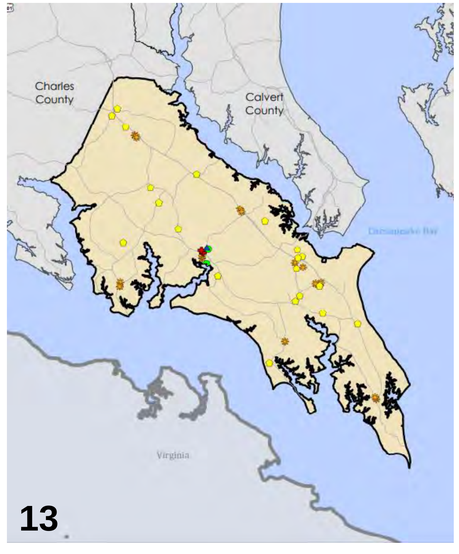












The critical facilities counted toward each hazard loss estimate is a reflection of the total facilities within the high-risk ranked counties as seen above.

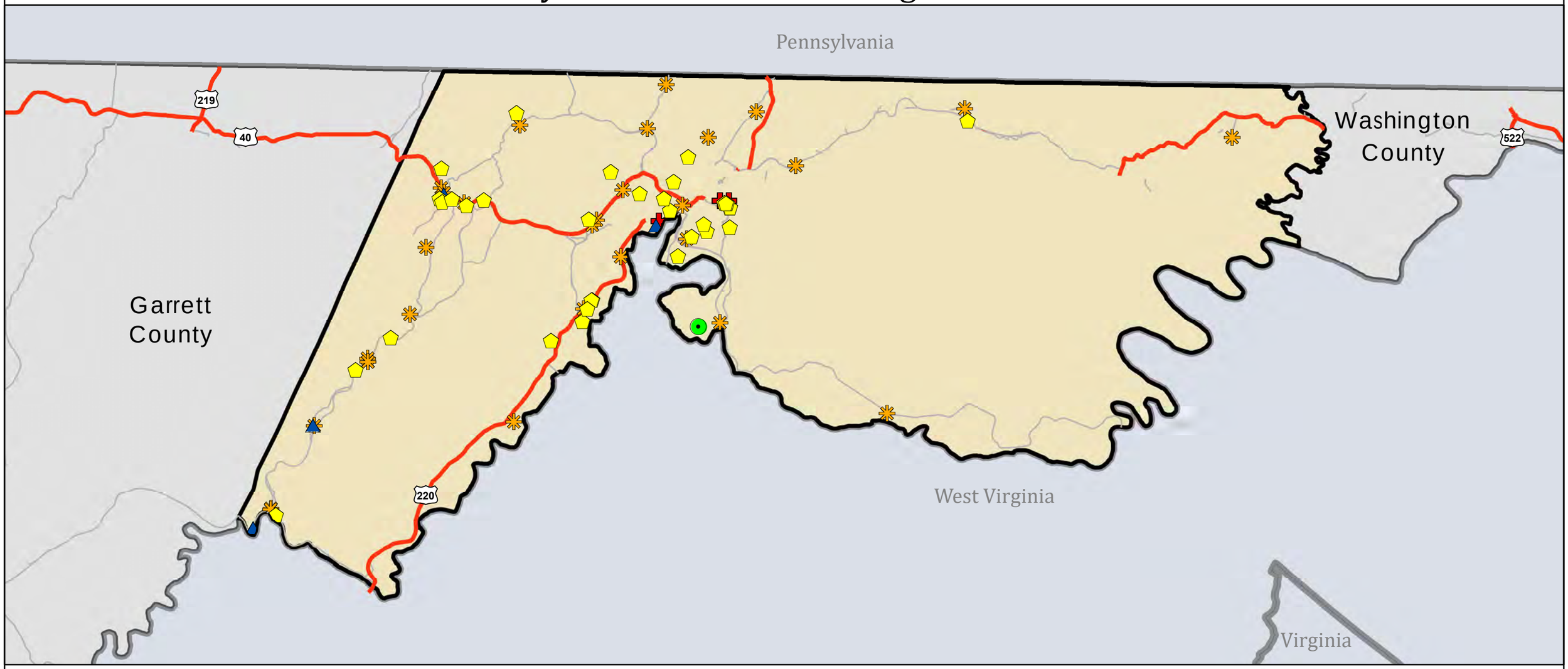
Appendix I - Table of Critical Facilities - 2021

Jurisdiction	EOC	Fire	Medical	Police	School	Total Critical Facilites	Total Built in or Prior to 1965	% of Critical Facilities 50 yrs. Or older
Allegany	1	29	3	4	33	70	43	61%
Anne Arundel	0	30	7	4	73	114	32	28%
City of Annapolis	1	2	4	1	17	25	8	32%
Baltimore	1	58	4	14	350	427	106	25%
Baltimore City	2	40	103	11	301	457	228	50%
Calvert	2	8	22	2	39	73	18	25%
Caroline	2	7	9	4	9	31	13	42%
Carroll	2	14	12	1	86	115	38	33%
Cecil	1	21	10	4	55	91	41	45%
Charles	1	18	3	6	52	80	22	28%
Dorchester	1	15	26	5	15	62	30	48%
Frederick	2	30	8	4	77	121	41	34%
Garrett	1	4	1	0	13	19	9	47%
Harford	2	28	8	9	69	116	28	24%
Howard	1	5	1	0	28	35	6	17%
Kent	1	7	4	2	11	25	11	44%
Montgomery	2	39	25	6	149	221	65	29%
Prince George's	2	39	6	4	200	251	25	10%
Queen Anne's	1	16	5	3	24	49	26	53%
Somerset	2	7	2	3	12	26	19	73%
St. Mary's	2	16	3	1	21	43	10	23%
Talbot	1	7	10	6	21	45	15	33%
Washington	2	23	3	6	53	87	37	43%
Wicomico	1	13	4	6	42	66	31	47%
Worcester	0	0	0	0	0	0	0	0%
Ocean City	1	5	0	1	2	9	2	22%
TOTAL	**35**	**481**	**283**	**107**	**1752**	**2658**	**904**	**34%**

This page left blank intentionally

Allegany County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of critical facilities included: EOC, Fire, Medical, Police, and School

Legend:
Facility Type

- EOC
- Fire
- Medical
- Police
- School
- Maryland Routes
- US Routes
- Maryland Counties
- Allegany County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

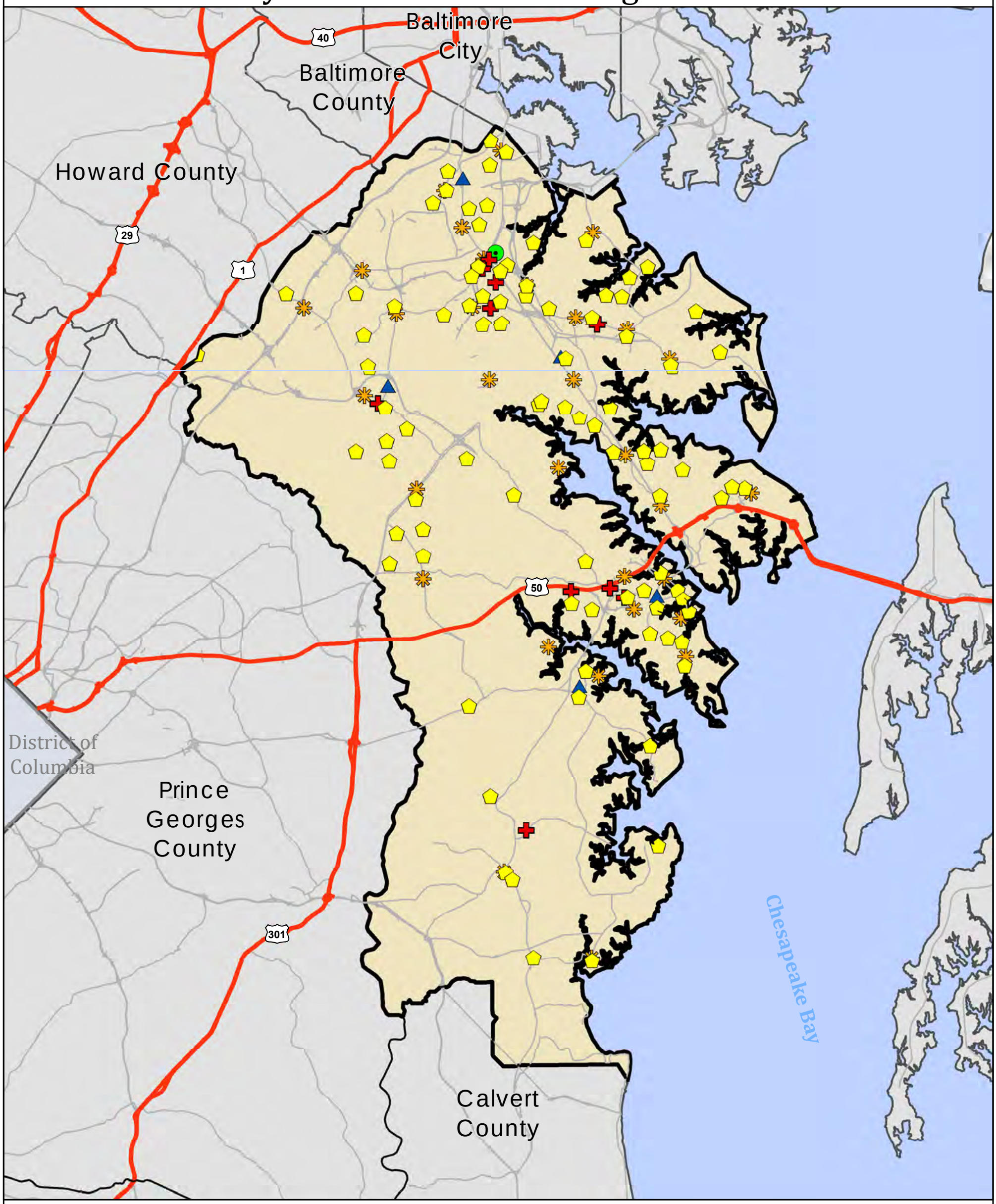
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Anne Arundel County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Anne Arundel County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

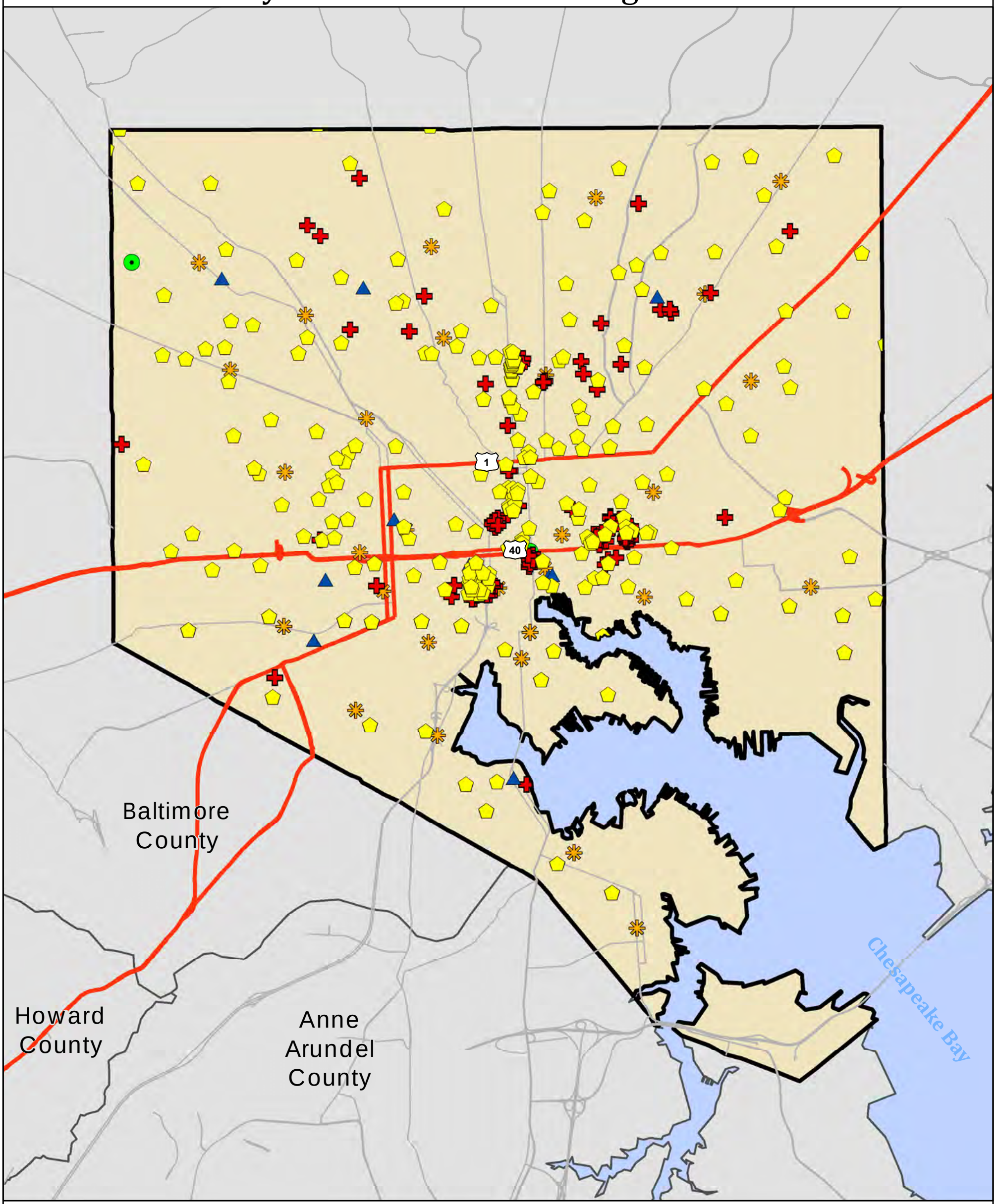
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Baltimore City Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Baltimore City
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

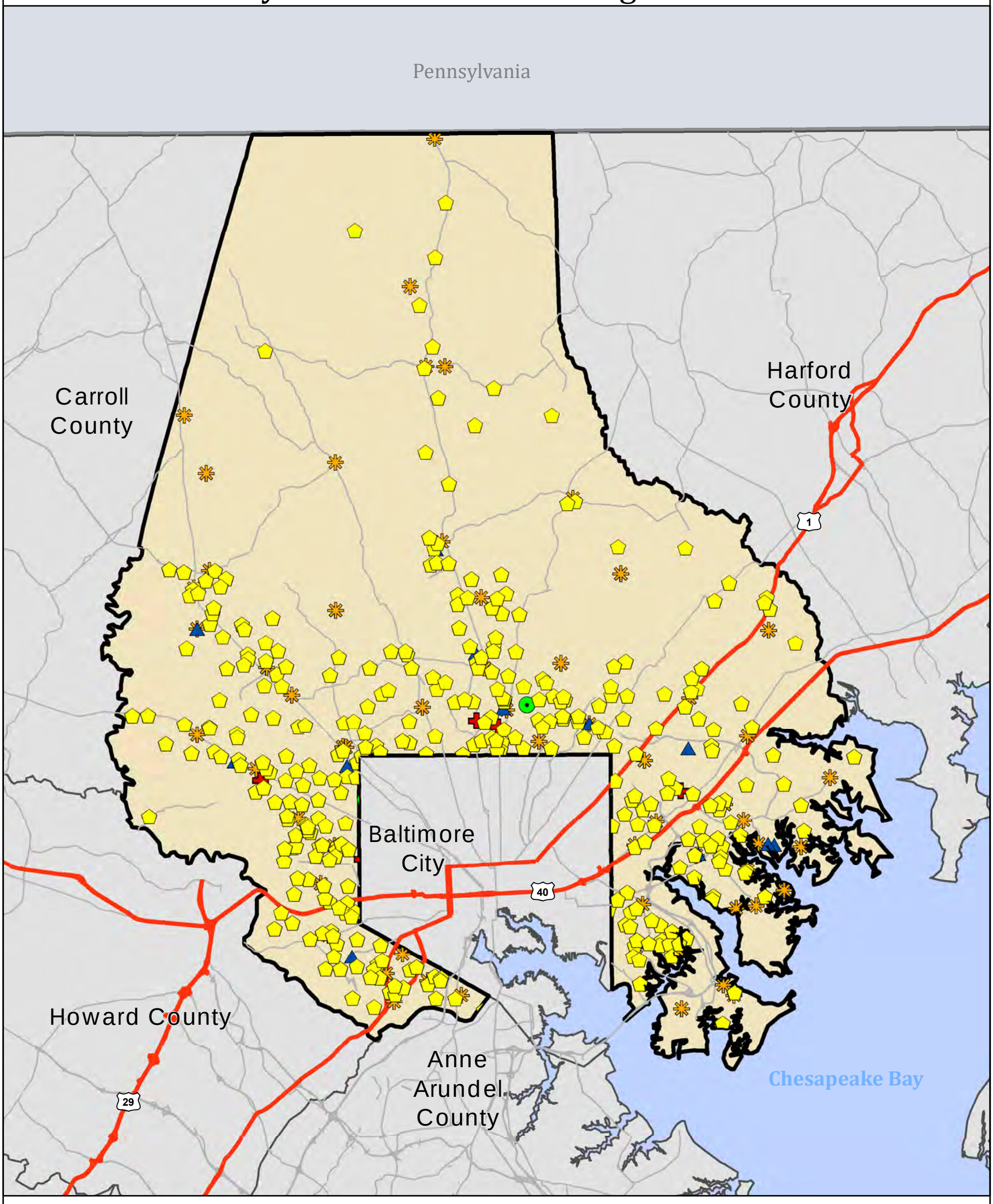
0 0.375 0.75 1.5 2.25 3 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Baltimore County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Baltimore County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

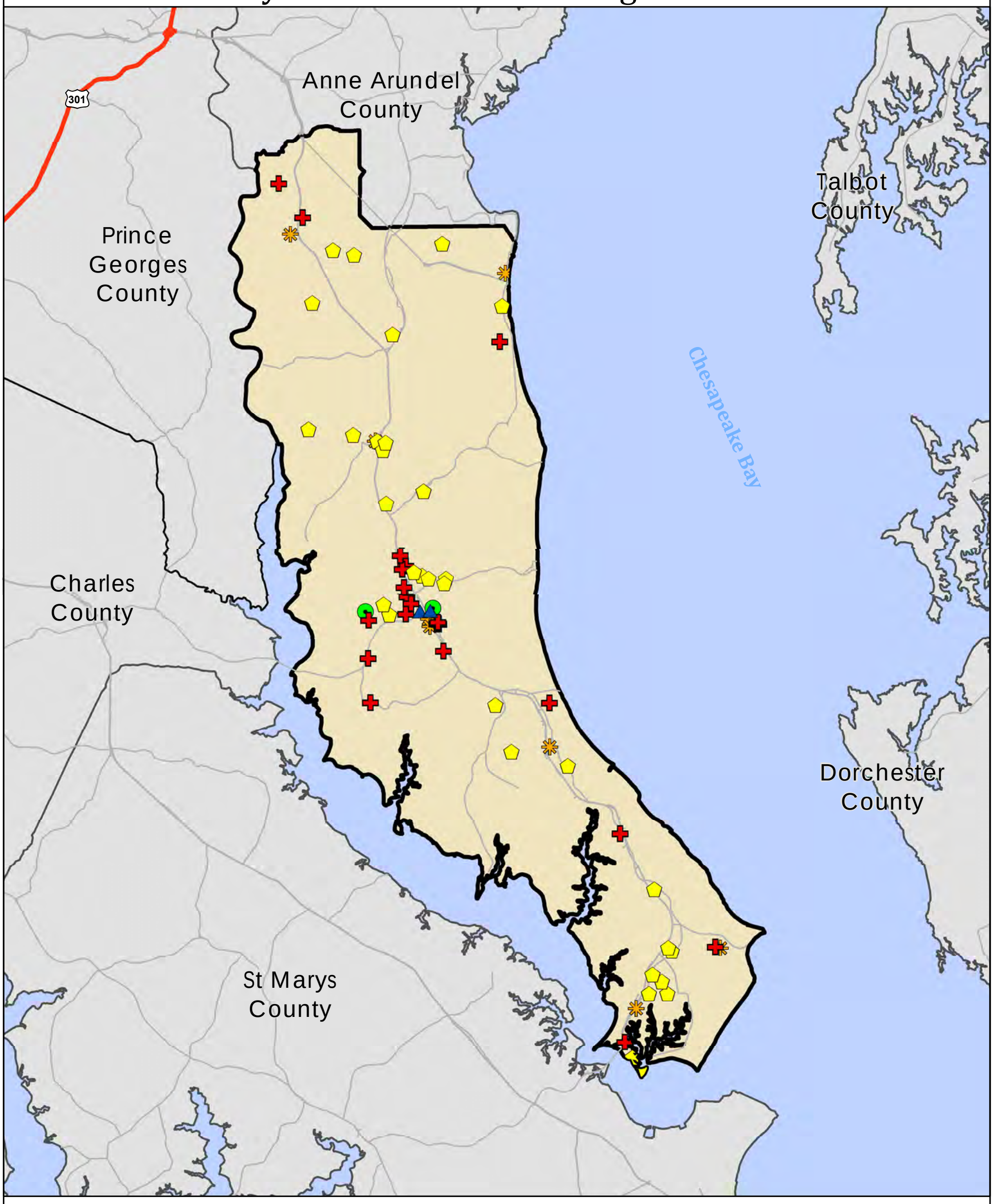
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Calvert County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Calvert County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

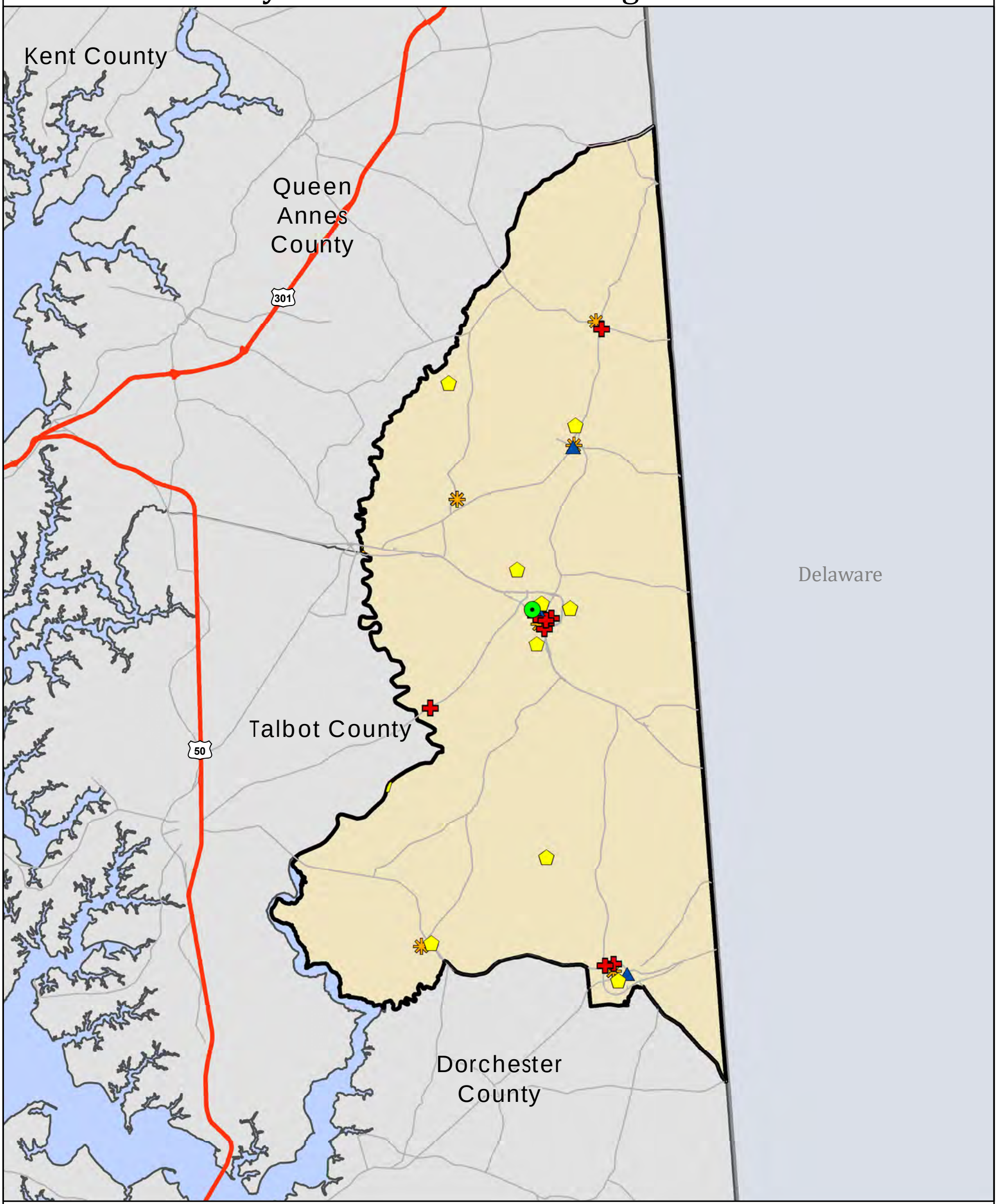
0 0.75 1.5 3 4.5 6 Miles

AECOM

Maryland Emergency Management Agency

Caroline County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Caroline County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

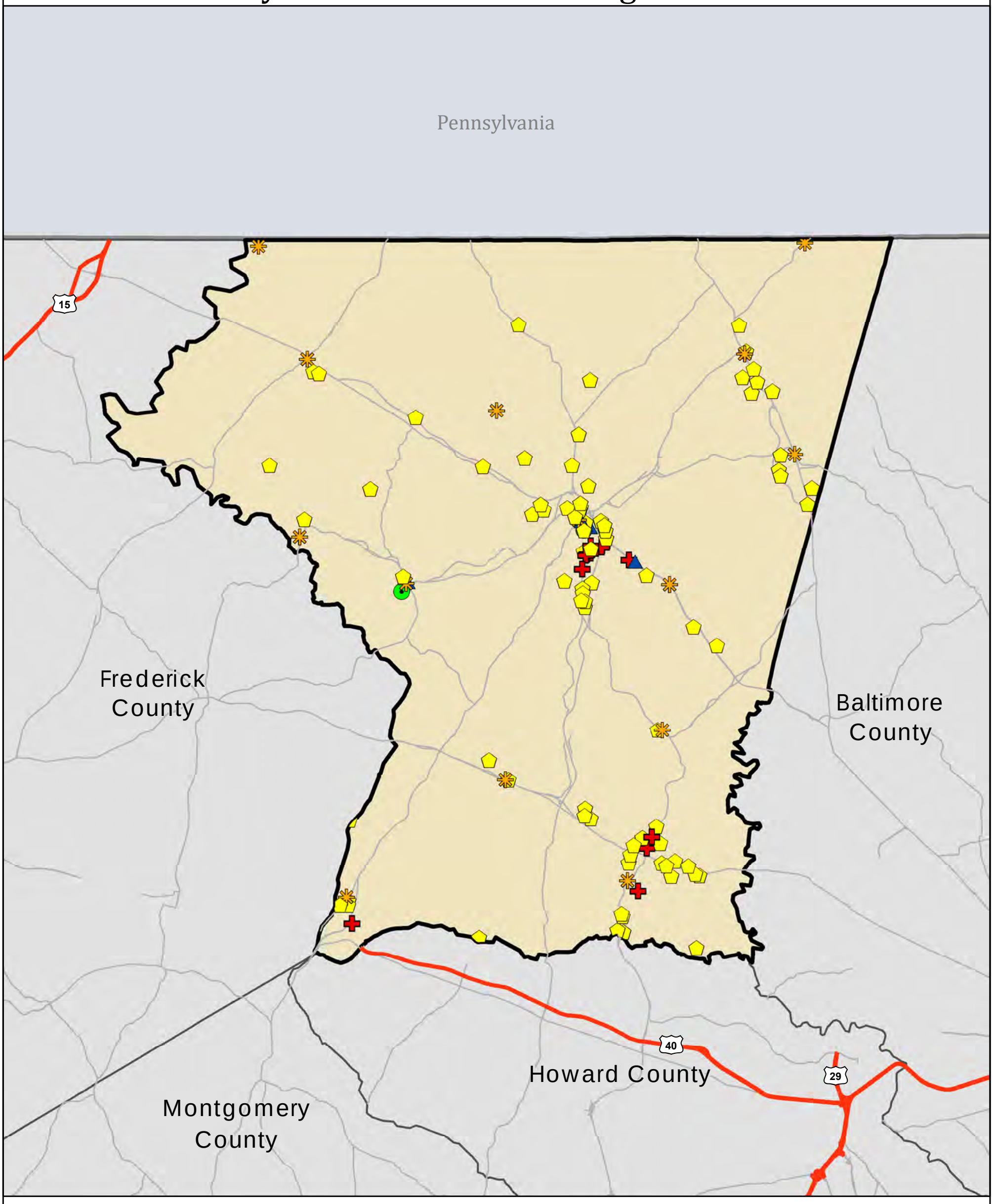
0 1 2 4 6 8 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Carroll County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Carroll County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

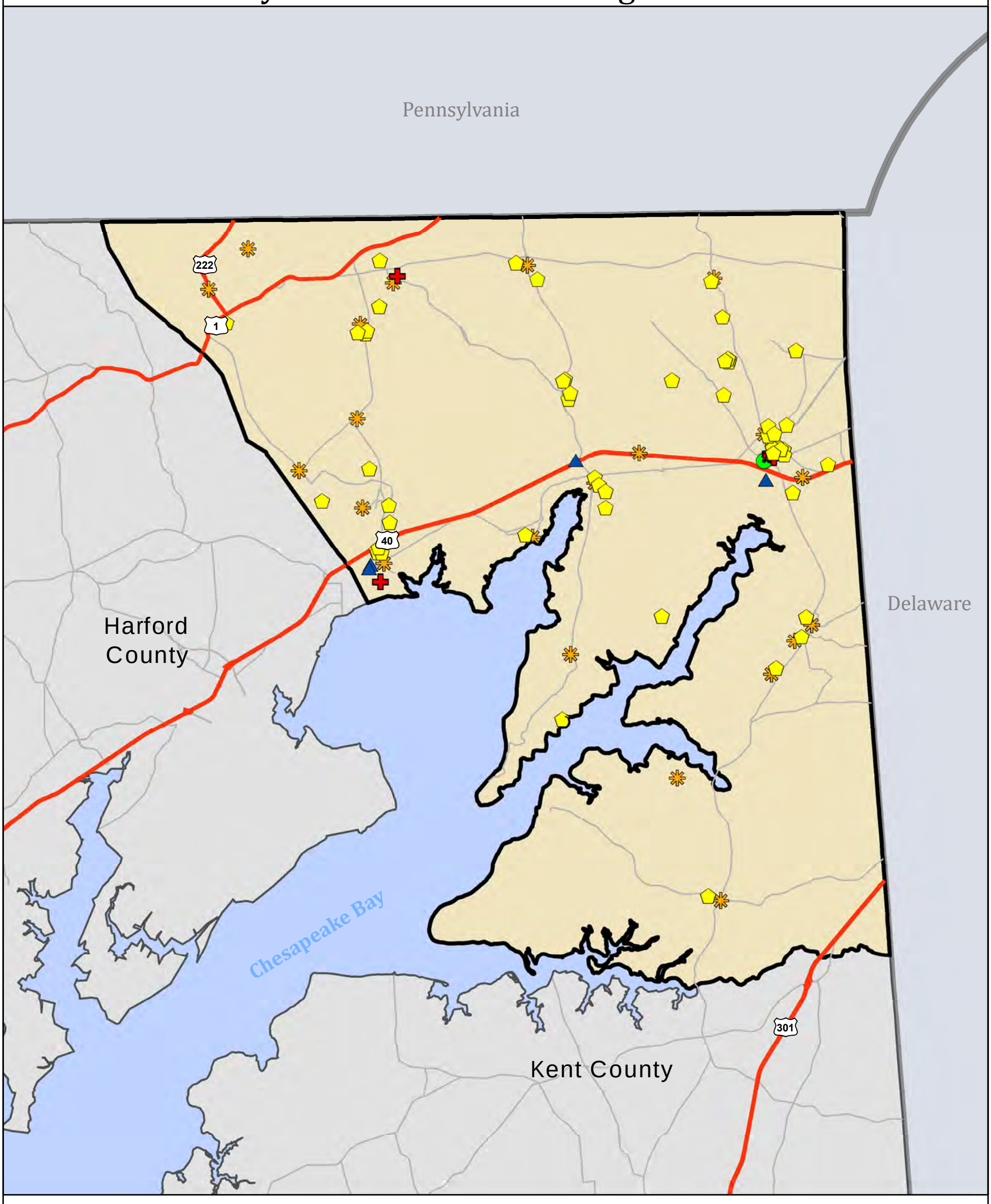
0 1 2 4 6 8 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Cecil County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Cecil County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

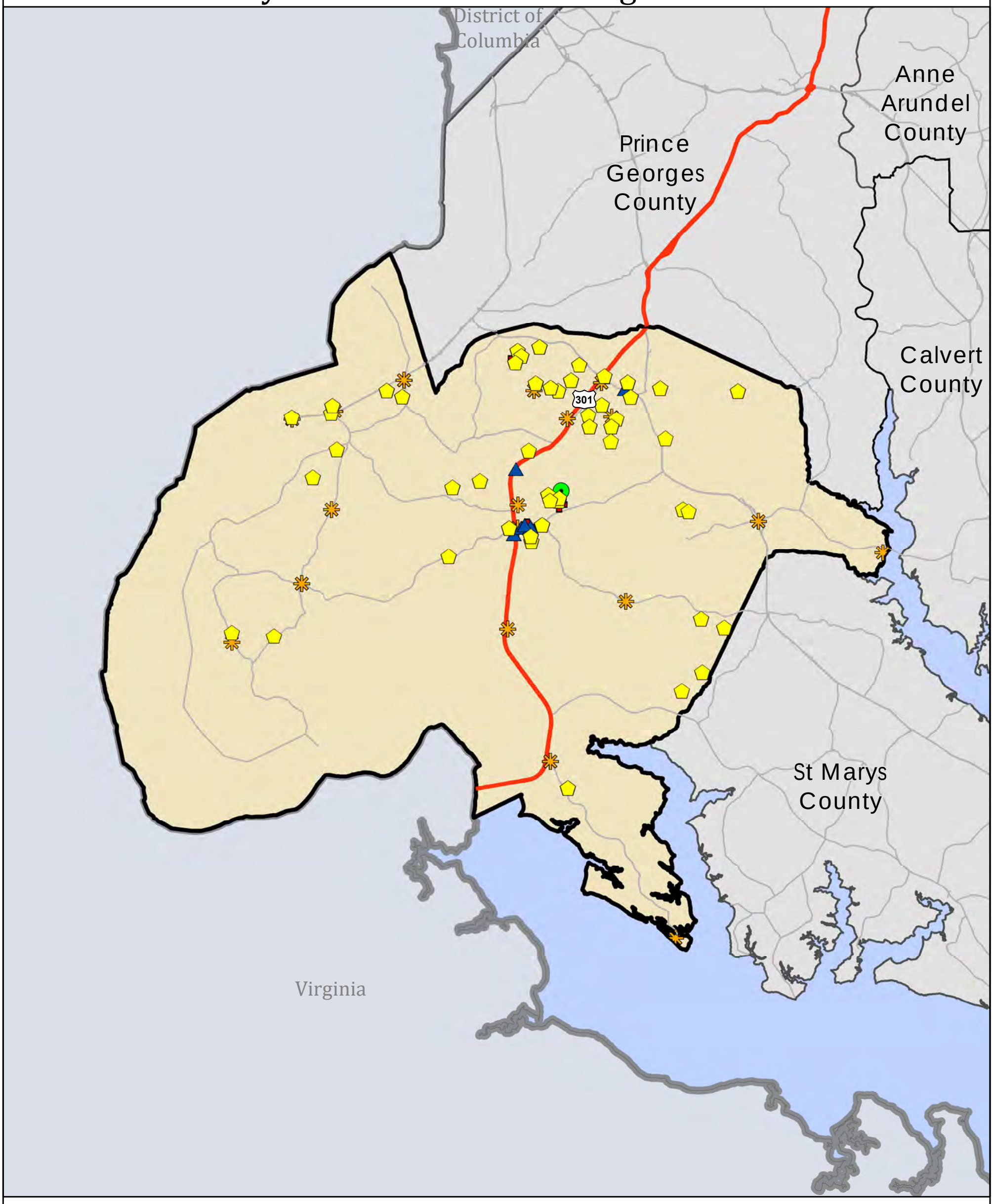
0 0.75 1.5 3 4.5 6 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Charles County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:
Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Charles County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

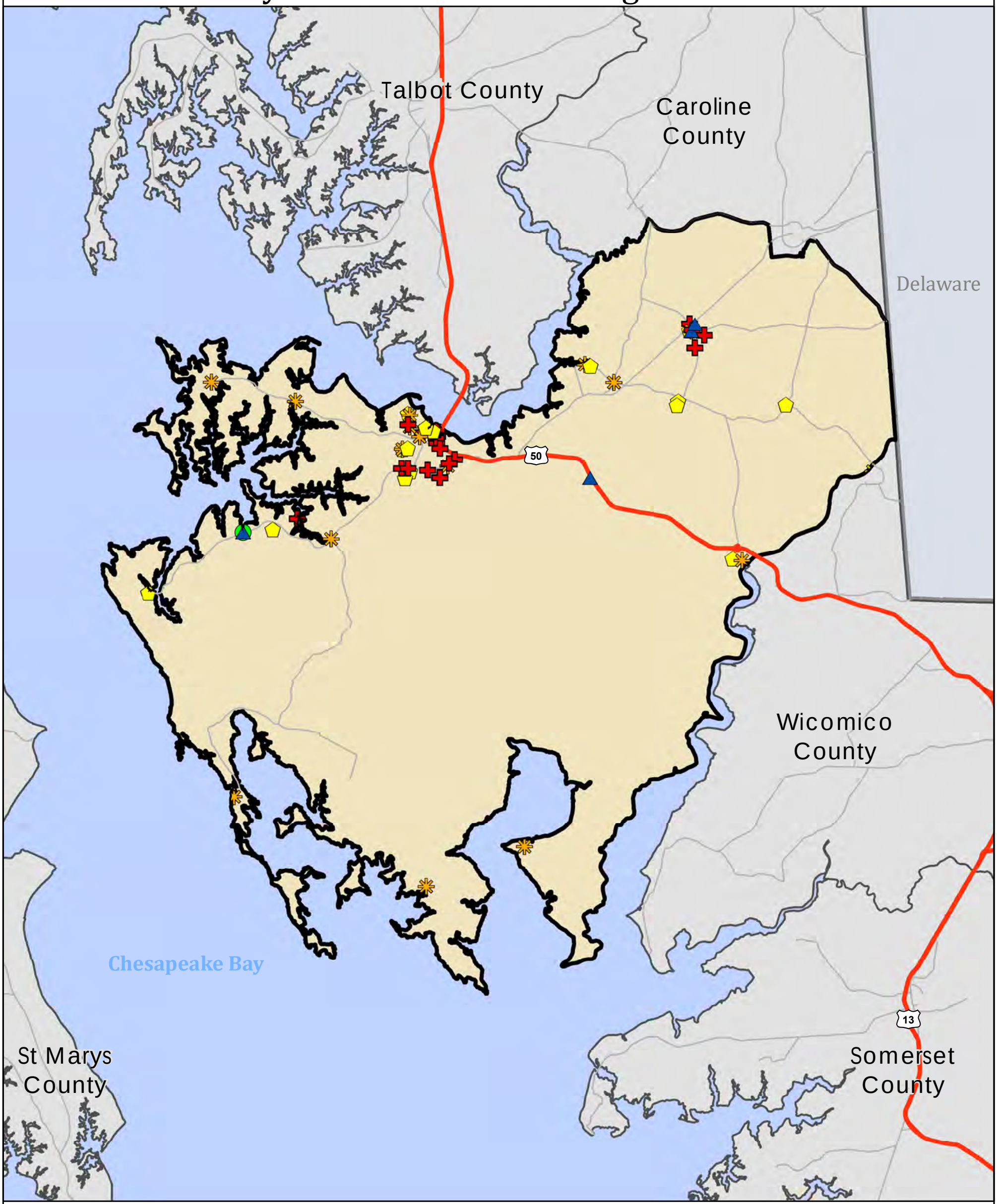
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Dorchester County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Dorchester County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

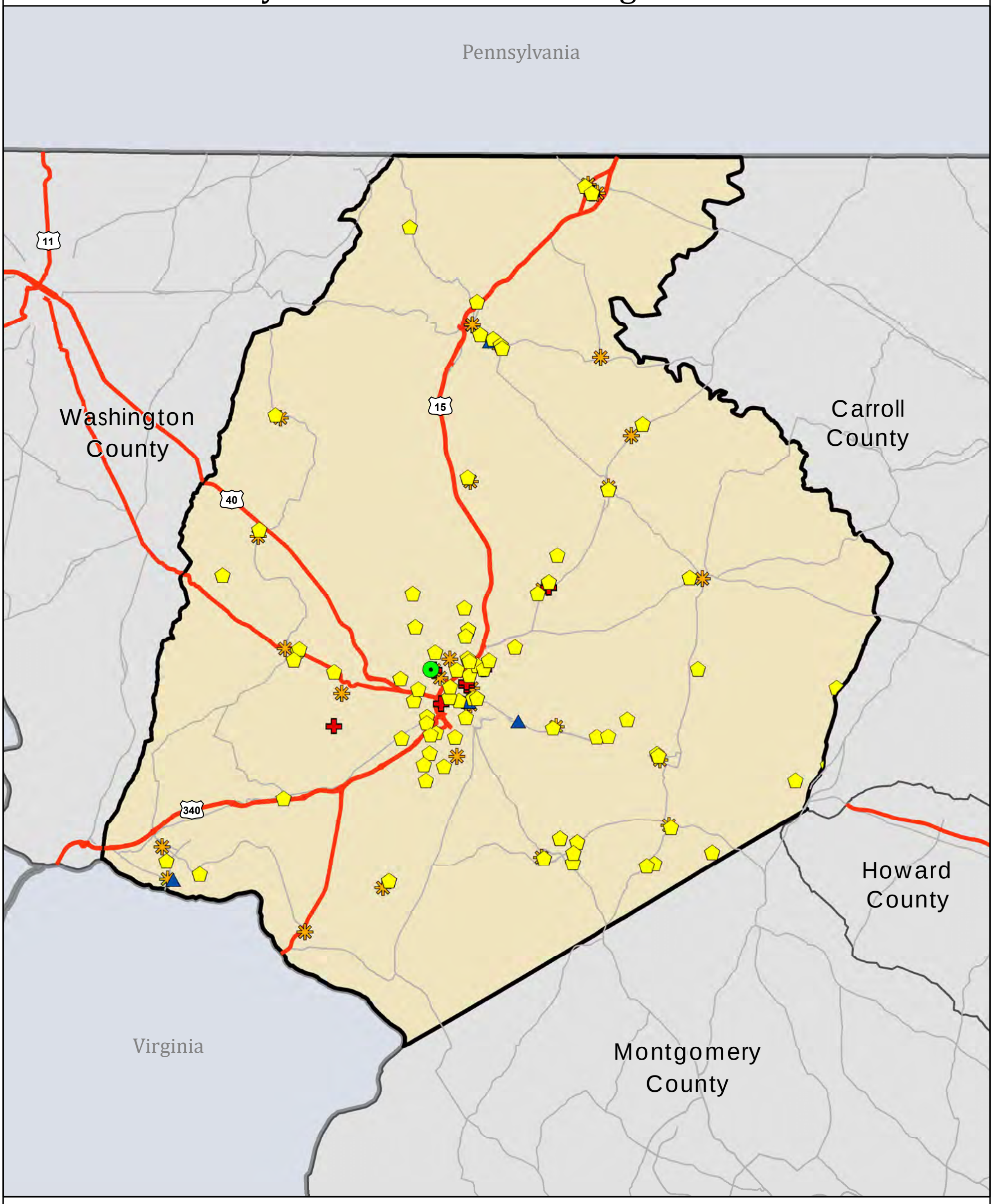
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Frederick County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Frederick County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

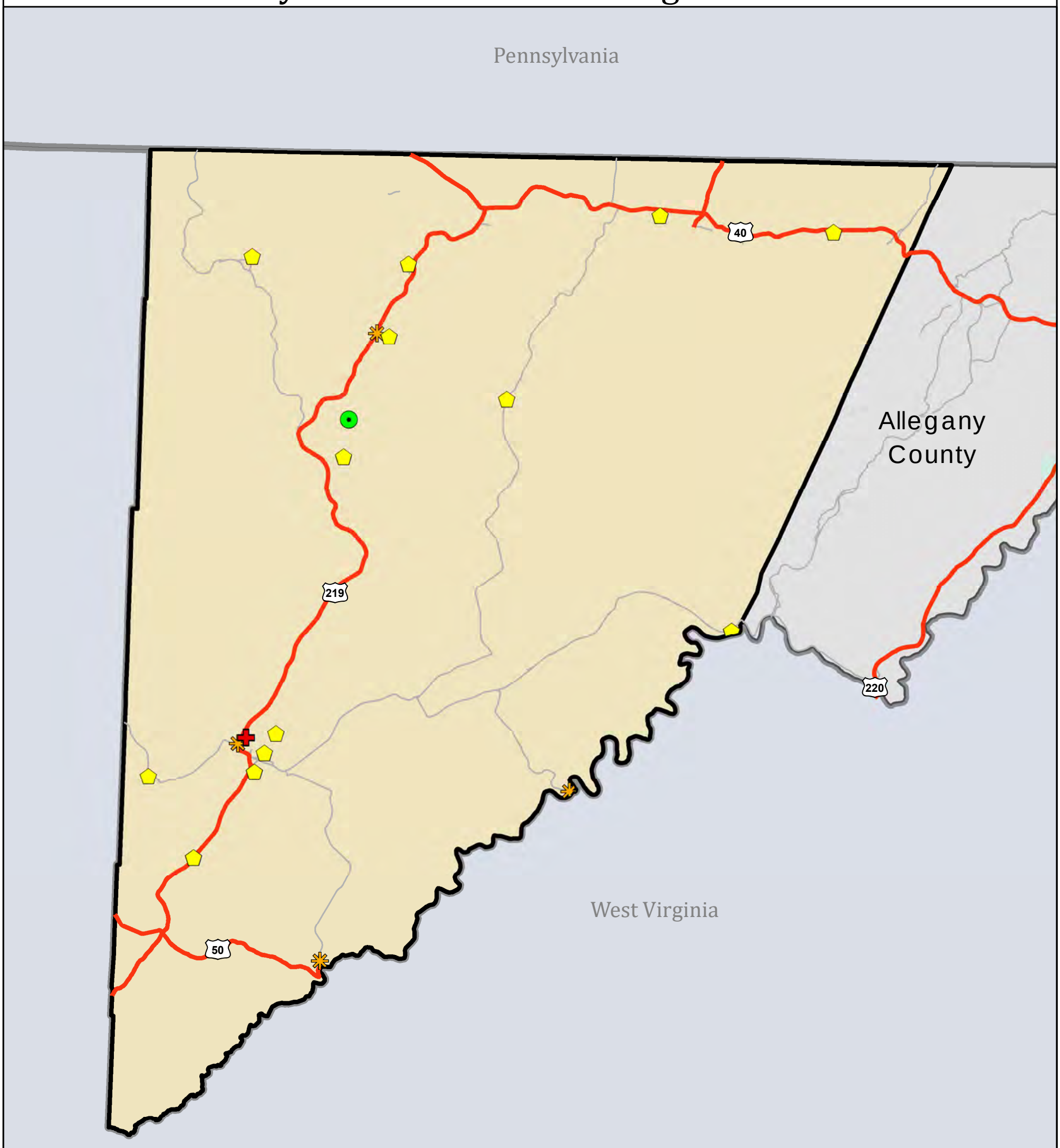
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Garrett County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School
- Maryland Routes
- US Routes
- Maryland Counties
- Garrett County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

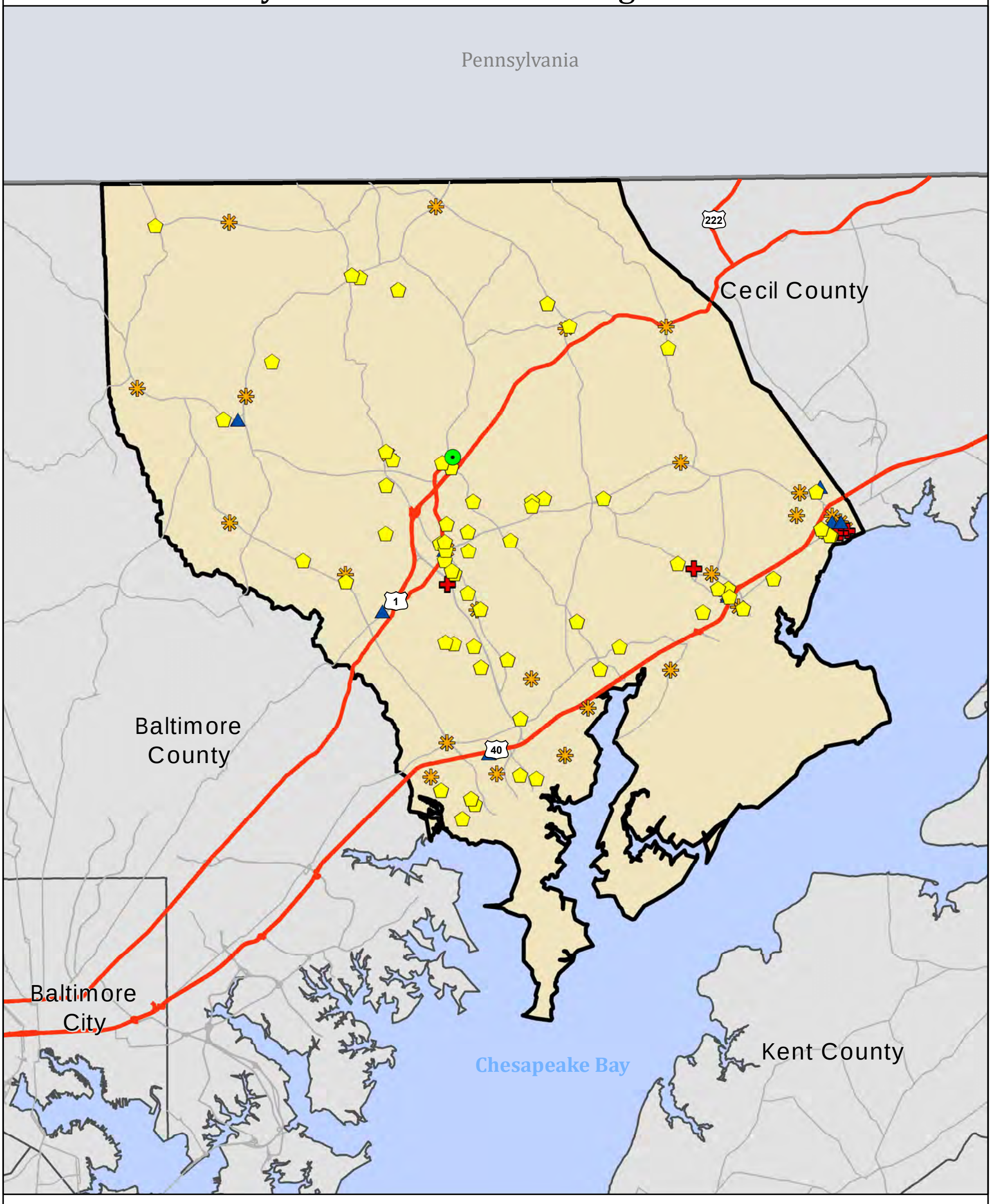
0 1 2 4 6 8 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Harford County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Harford County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

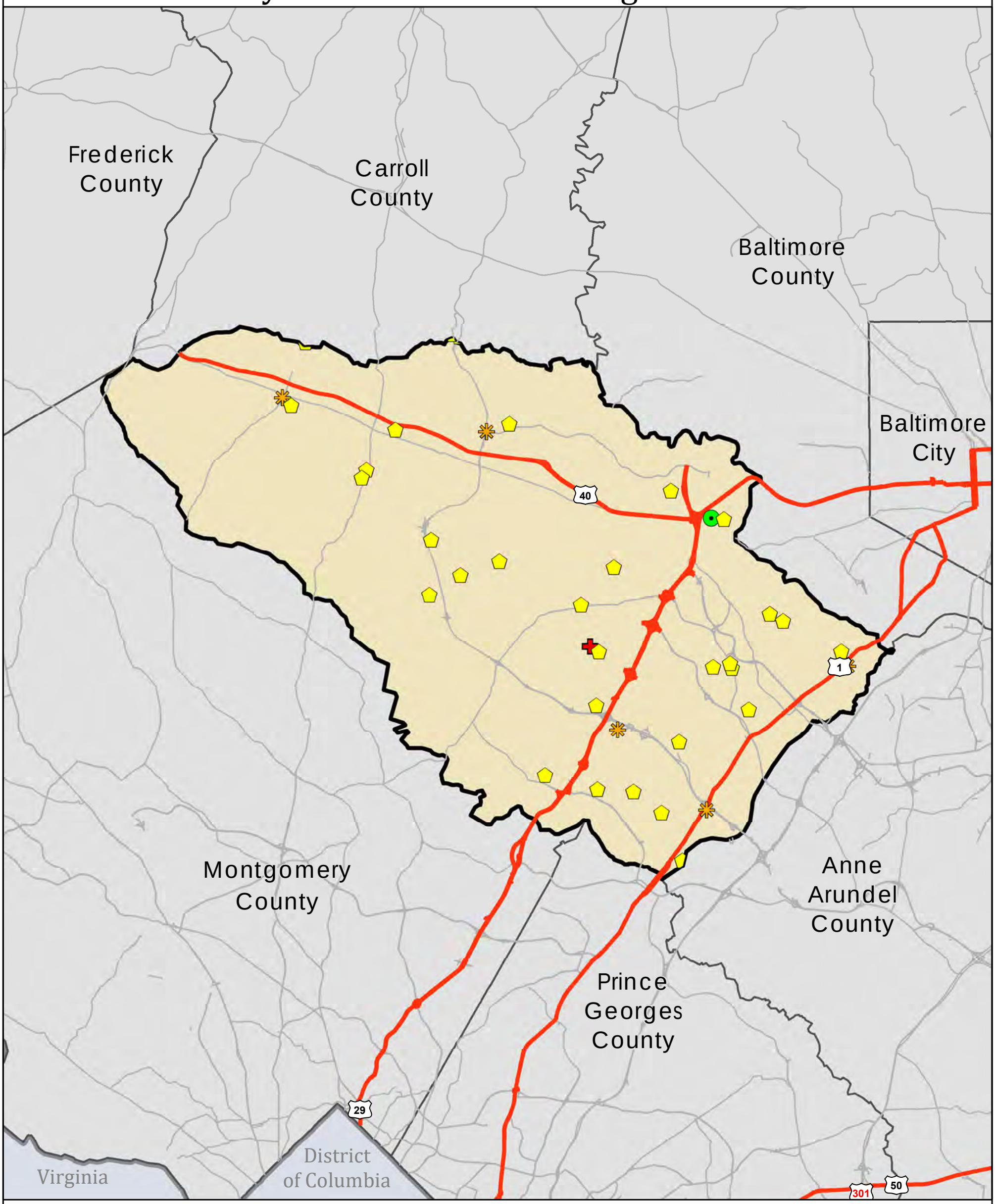
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Howard County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Howard County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

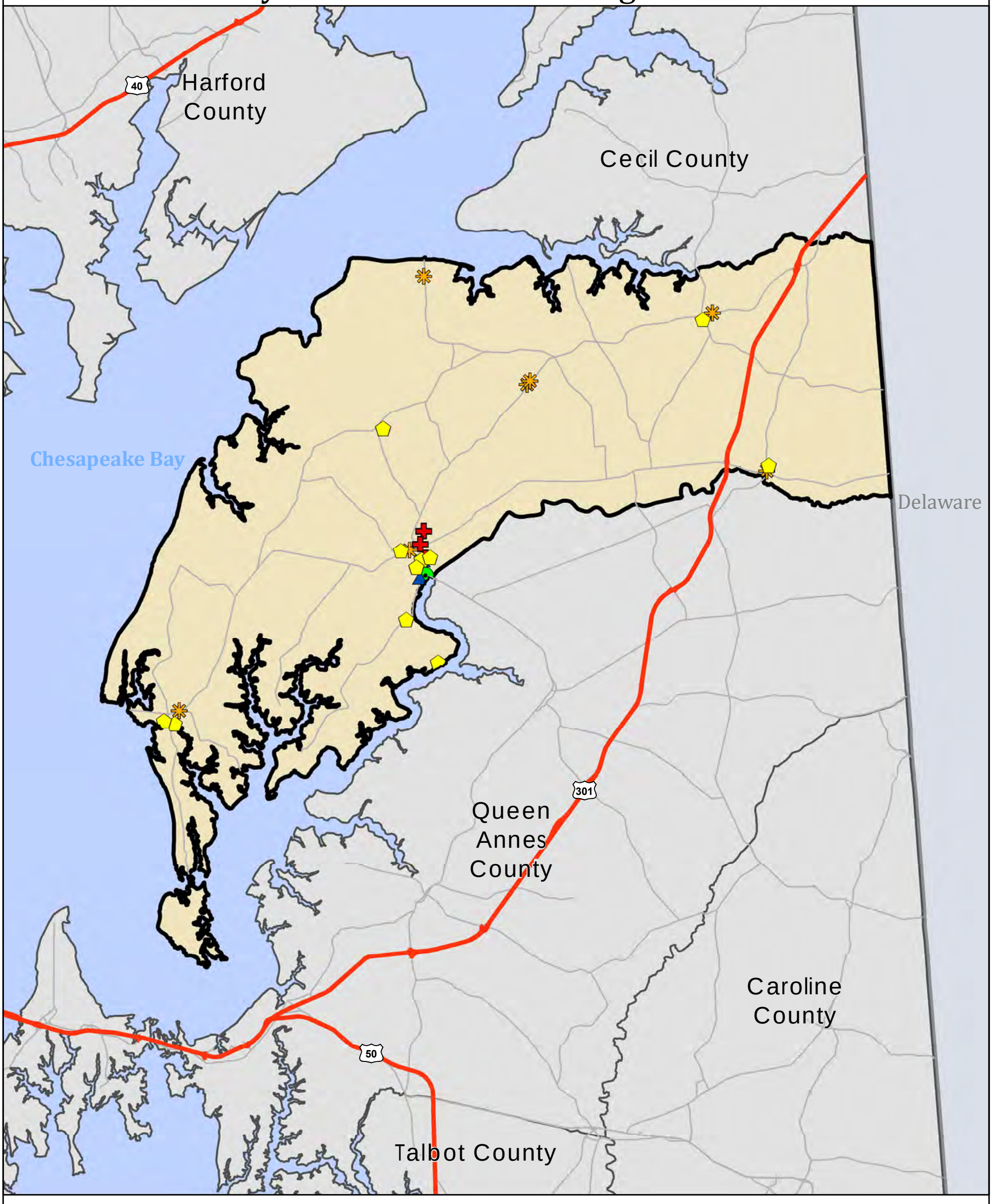
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Kent County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Kent County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

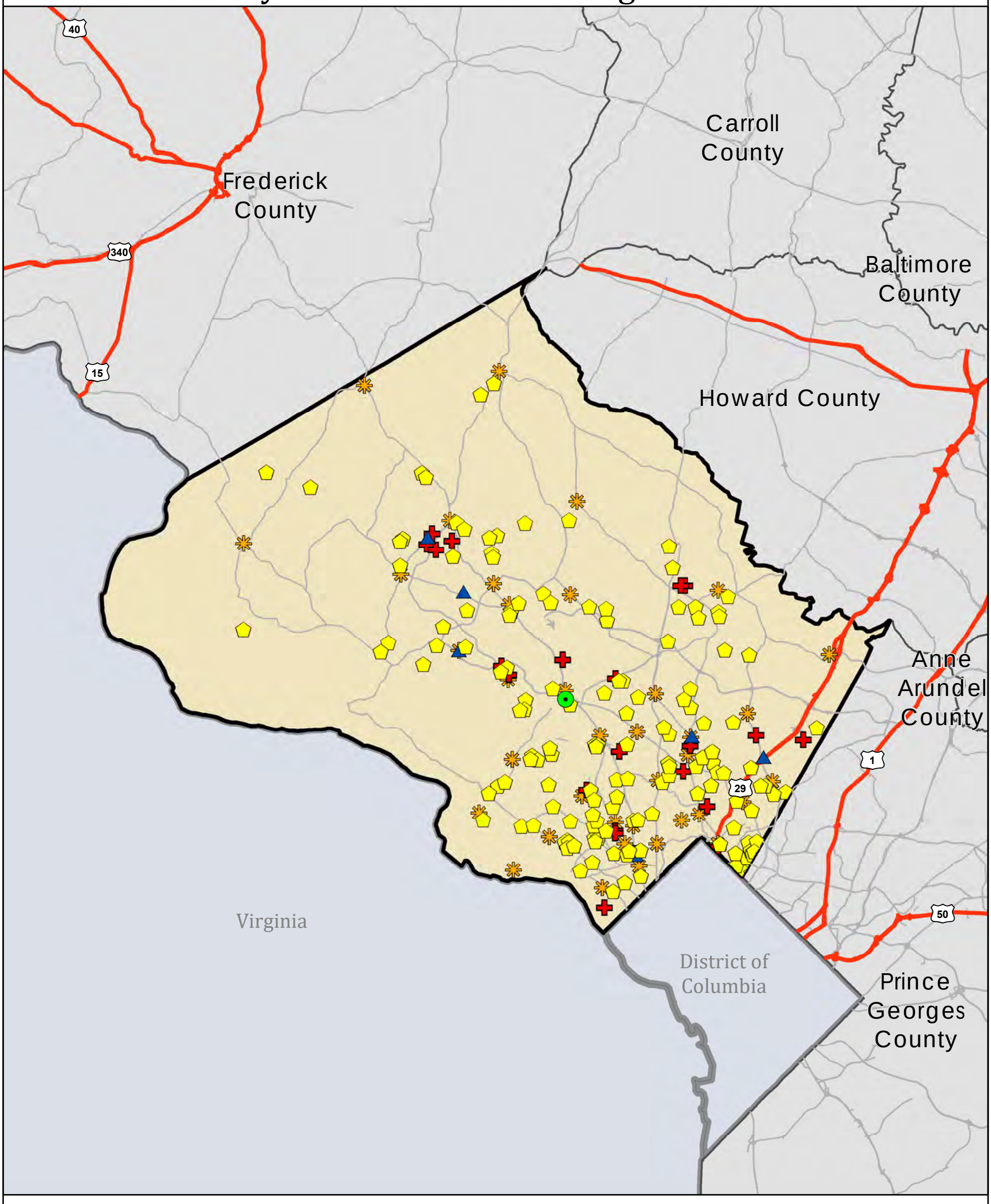
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

Montgomery County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:
Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Montgomery County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

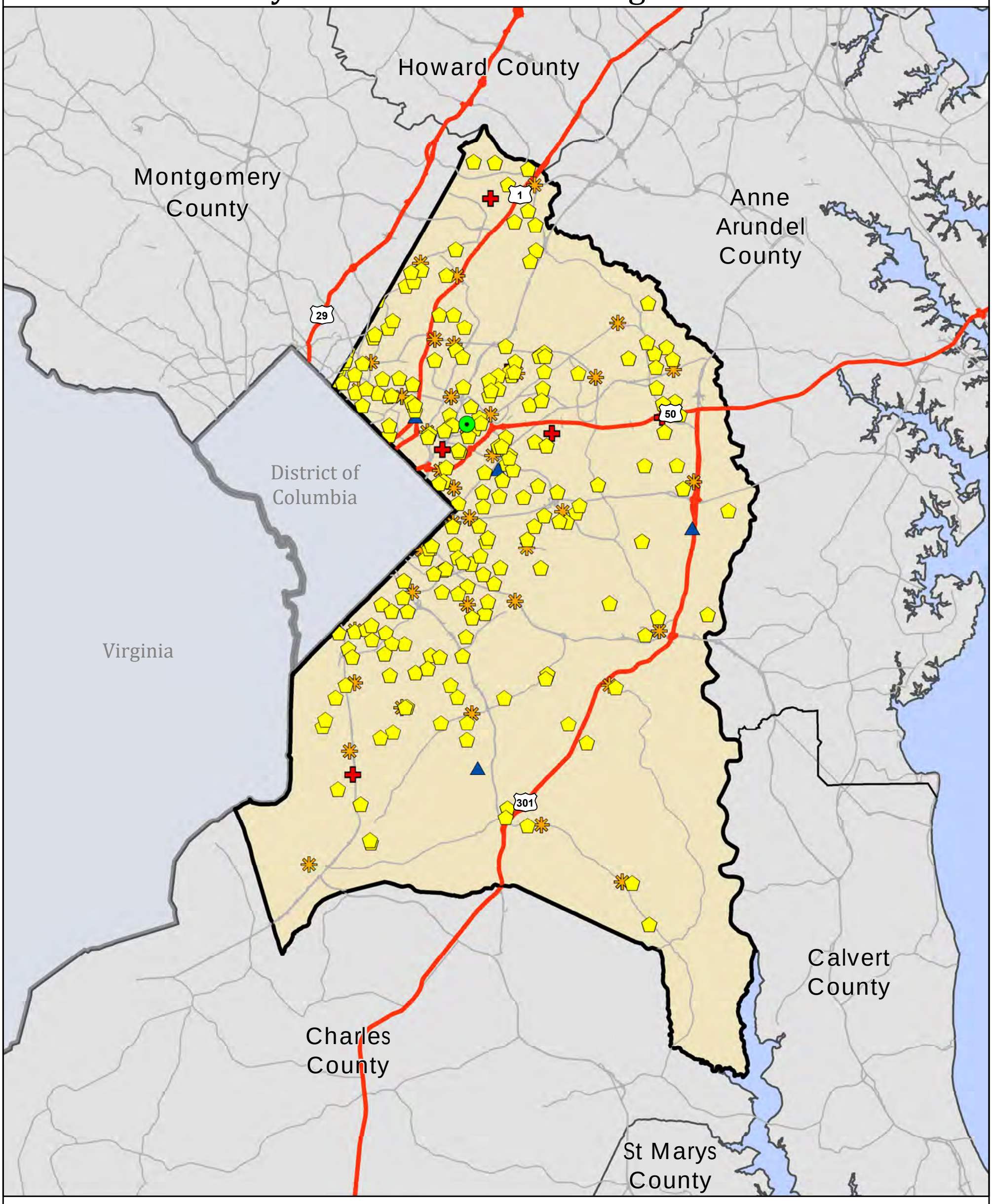
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Prince George's County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Prince Georges County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

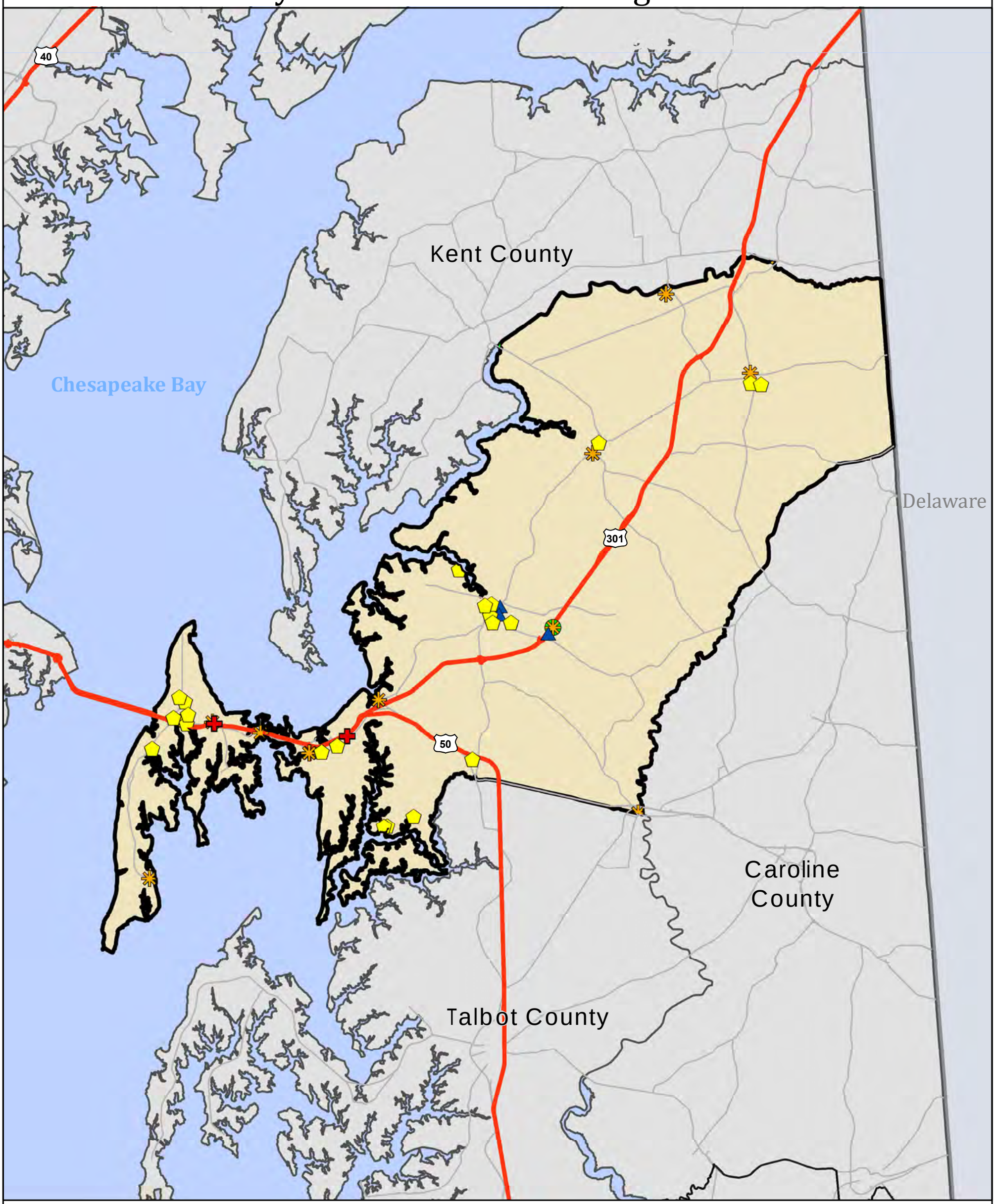
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Queen Anne's County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Queen Annes County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

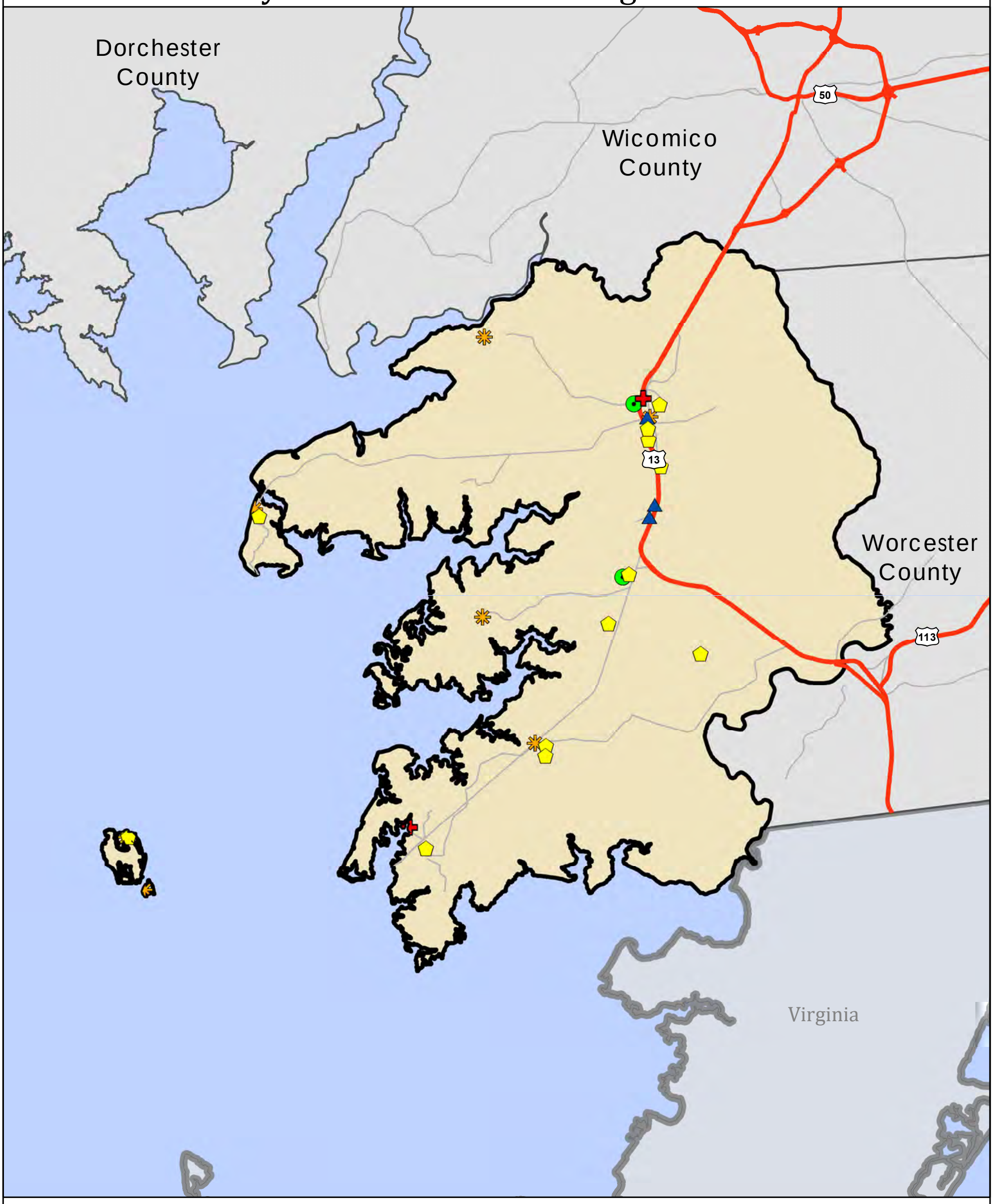
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Somerset County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Somerset County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

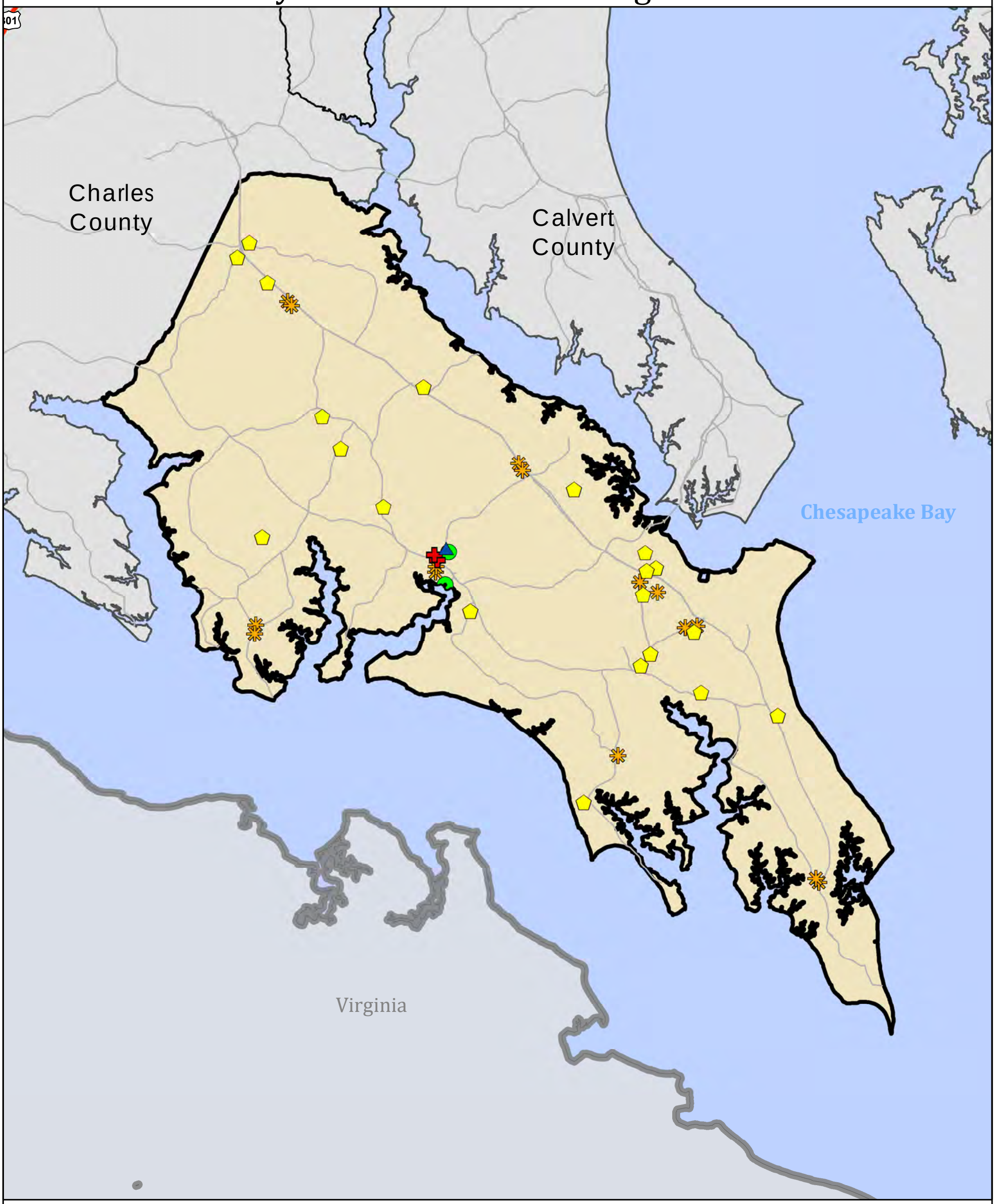
0 1 2 4 6 8 Miles

AECOM

Maryland Emergency Management Agency

St Mary's County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:
Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- St Marys County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

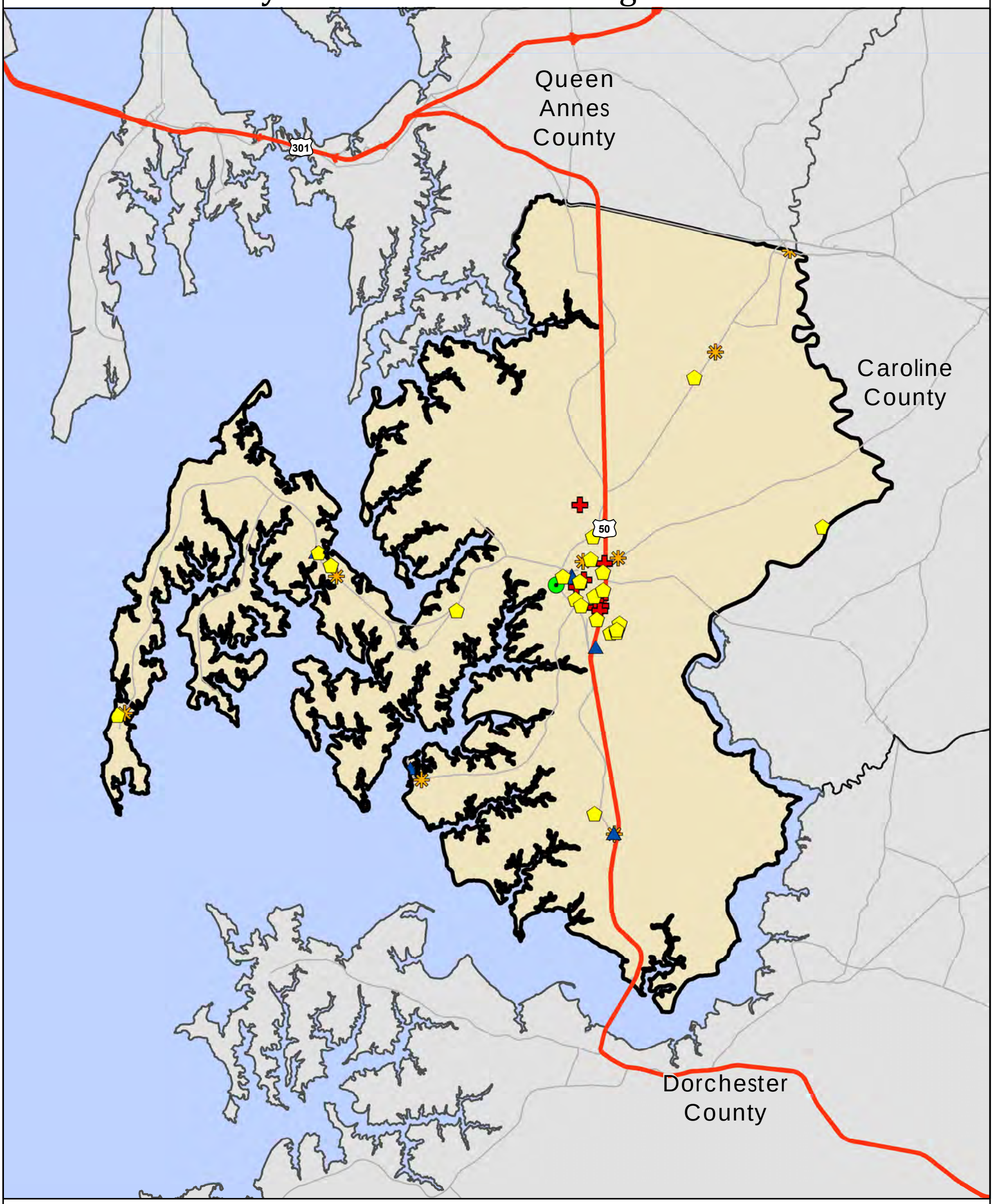
0 1 2 4 6 8 Miles

AECOM

Maryland
EMERGENCY MANAGEMENT AGENCY

Talbot County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Talbot County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

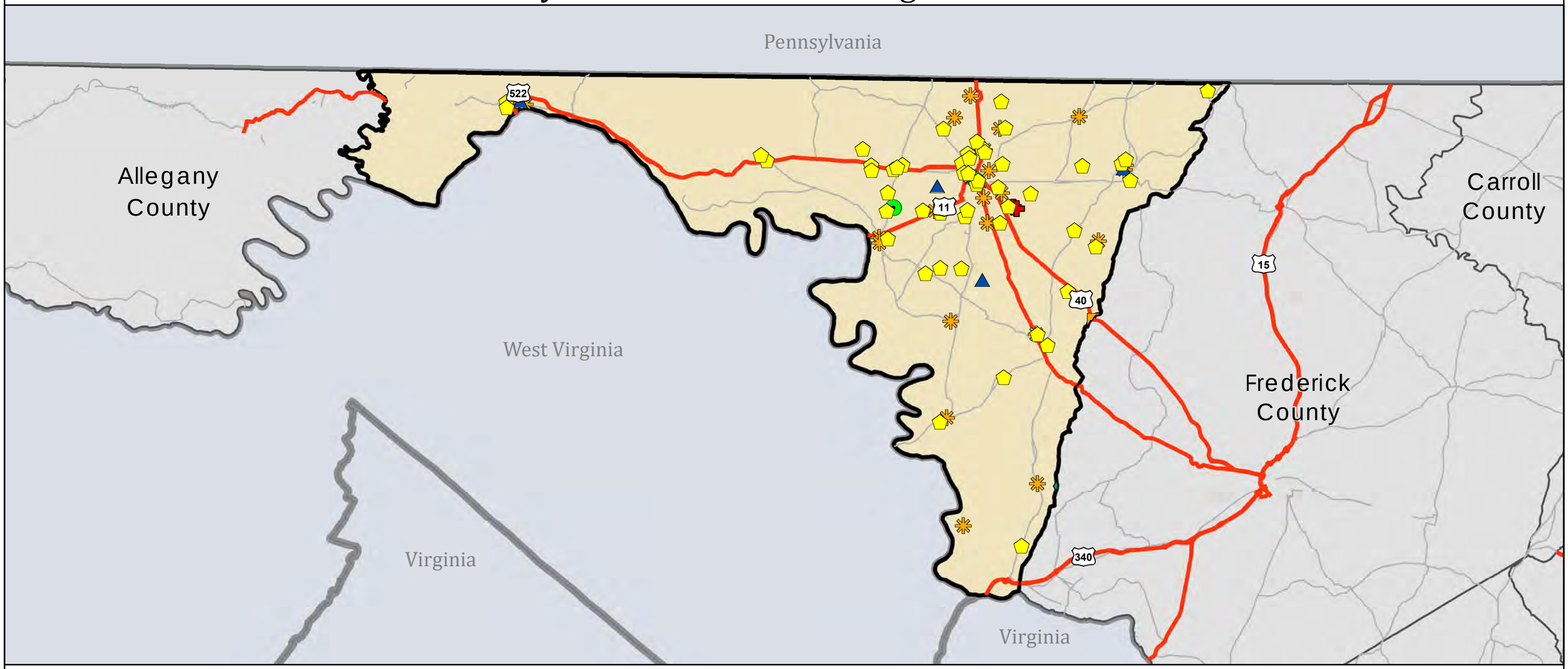
0 0.75 1.5 3 4.5 6 Miles

AECOM

Maryland Emergency Management Agency

Washington County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of critical facilities included: EOC, Fire, Medical, Police, and School

Legend:
Facility Type

- EOC
- Fire
- Medical
- Police
- School
- Maryland Routes
- US Routes
- Maryland Counties
- Washington County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

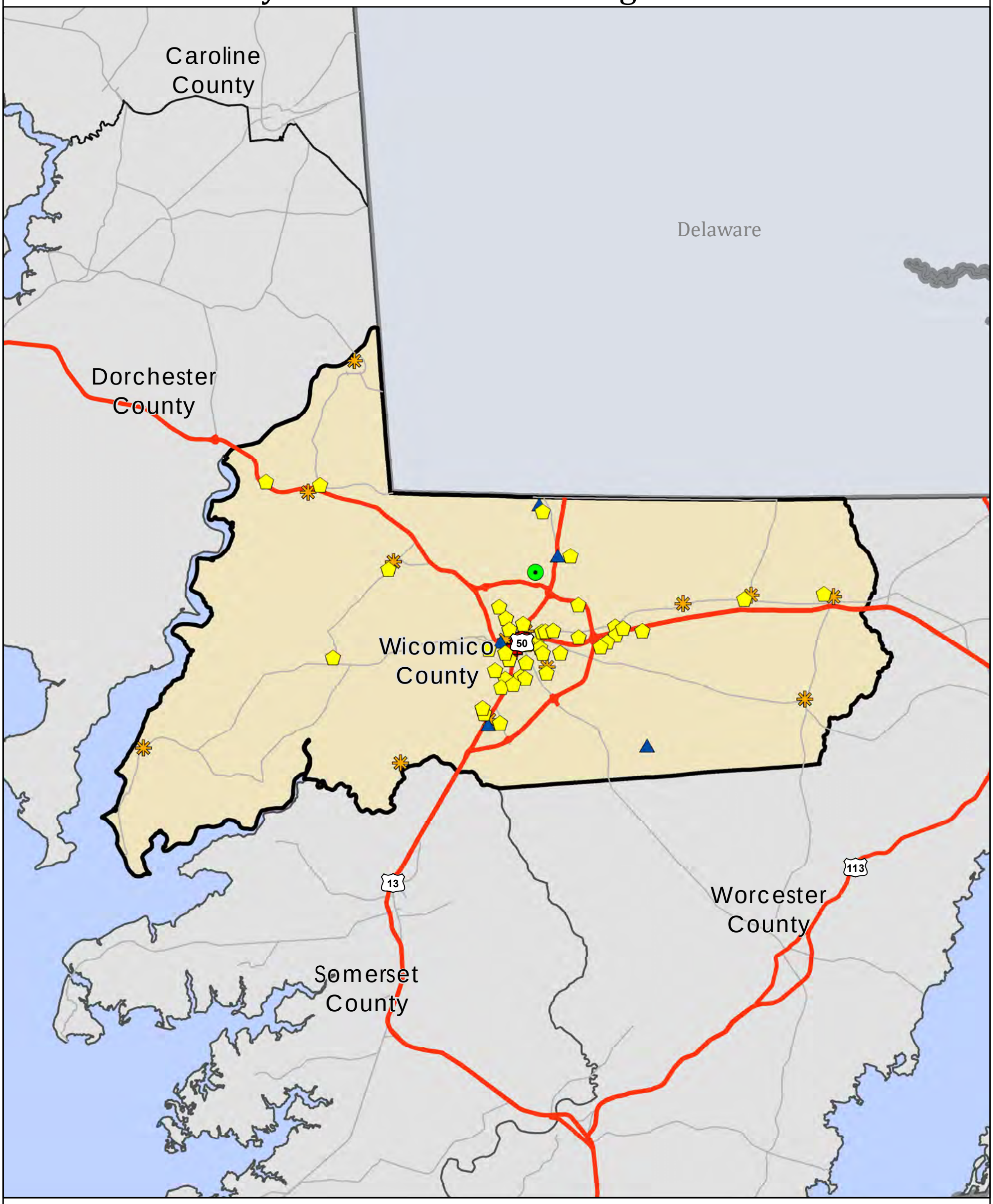
0 1.5 3 6 9 12 Miles

AECOM

Maryland Emergency Management Agency

Wicomico County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Wicomico County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

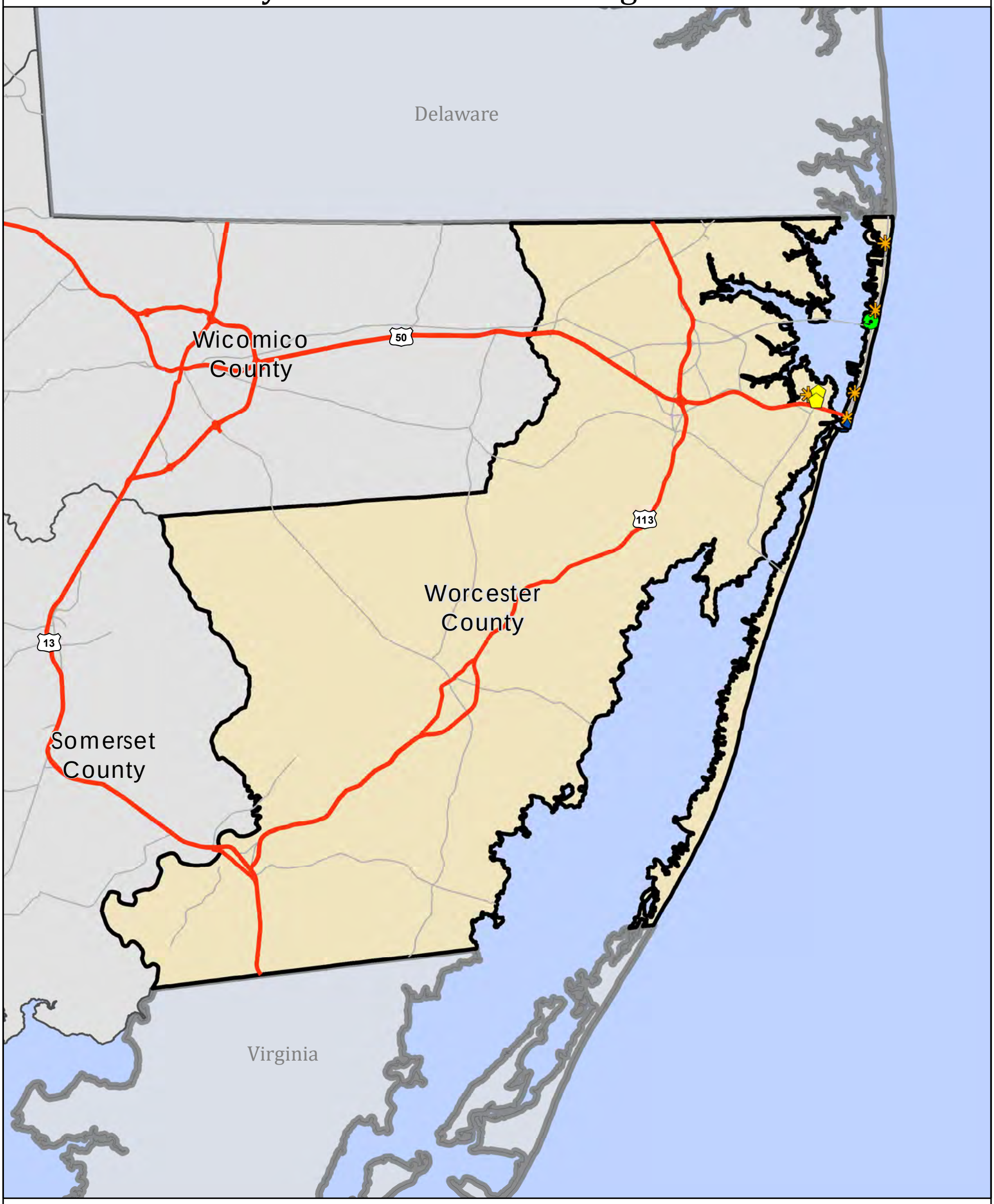
0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

Worcester County Critical Facilities

Maryland 2021 Hazard Mitigation Plan



Description:

Critical Facility refers to structures that the state has determined must continue to operate before, during, and after an emergency and/or disaster. In total there are 2,639 critical facilities identified. When available, location information is provided for each point such as address, city, state, zip, and latitude and longitude coordinates.

Based on this information this data was imported and geolocated into ArcGIS. Building information is also included (when available) such as building value, contents value, number of stories, and year built. Analyses within this plan use this data in unison with various hazard information.

Types of Critical Facilities Included: EOC, Fire, Medical, Police, and School.

Legend:

Facility Type

- EOC
- Fire
- Medical
- Police
- School

- Maryland Routes
- US Routes
- Maryland Counties
- Worcester County
- Surrounding States

Projection:
Maryland State Plane
North American Datum 1983

Data Sources:
2020 MD Critical Facility Database
2020 MD State Asset Database
SHA State & County Boundaries
ESRI State Boundaries

0 1.25 2.5 5 7.5 10 Miles

AECOM

Maryland Emergency Management Agency

APPENDIX J

Risk Assessment Data

This page left blank intentionally

Appendix J - Risk Assessment Data

The following tables were developed and utilized for the Section 3 Risk Assessment, as well as the additional Vulnerability Assessment. Please note that these may not be fully formatted, as they are raw data. Excel or other raw data files may be provided in addition as backup to this information.

Table J-1: Hazards and Timeframe

HAZARDS & TIMEFRAME – MARCH 2021				
Hazard	**NCDC Data**	**Earliest Record Date**	**Latest Record Date**	**Recording Period Length (years)**
Coastal	Hurricane Storm Surge/Tide Tropical Storm Coastal Flood Tropical Depression	3/13/1993	4/30/2020	27
Flood	Flash Flood Flood Heavy Rain	3/4/1993	4/30/2020	27
Winter Storm	Blizzard Heavy Snow Ice Storm Sleet/Freezing Rain Winter Storm Winter Weather Freezing Fog Cold/Wind Chill Frost/Freeze Lake-Effect Snow	1/9/1993	4/22/2020	27
Wind	High Wind Strong Wind Thunderstorm Wind	5/30/1956	4/30/2020	64
Tornado	Funnel Cloud Tornado Waterspout	8/11/1950	4/13/2020	70
Thunderstorm	Hail Lightning	7/16/1956	4/30/2020	64

HAZARDS & TIMEFRAME – MARCH 2021				
Hazard	**NCDC Data**	**Earliest Record Date**	**Latest Record Date**	**Recording Period Length (years)**
Wildfire	Forest Fire Wildfire National Reporting System	1/1/1998	12/31/2015	18
Drought	Drought	1/1/1995	4/30/2020	25
Soil Movement	Subsidence Landslides Karst Sinkholes	N/A	N/A	N/A
Public Health Emergencies	Pandemics Opioid Crisis	2016	2019	3
Dam Failures	Dam Incidents Hazard Ranked Dams	5/5/2016	10/1/2018	4
Extreme Temperatures	Extreme Cold/Wind Chill Excessive Heat	7/25/2016	7/21/2019	4
Human-Caused Hazards & Threats	Terrorism Hazmat Incidents Cyber Security	1/4/2016	8/3/2020	5

Table J-2: Population Detail – March 2021

Population – March 2021					
County	**2020 Population Estimates**	**2020 Population Vulnerability**	**2020 Population Density**	**Ranking**	**County Area (Sq. Mile)**
Allegany	70,416	1.164948703	163.8690751	1	429.7089
Anne Arundel	579,234	9.582735413	1,385.290807	3	418.1317
Baltimore	827,370	13.687849467	1,362.61946	3	607.1908
Calvert	92,525	1.530715728	425.660435	2	217.3681
Caroline	33,406	0.552662411	102.9545738	1	324.4732
Carroll	168,447	2.786754631	372.3373921	2	452.4042
Cecil	102,855	1.701613253	285.8383104	2	359.8363
Charles	163,257	2.700892274	285.2881007	2	572.2531
Dorchester	31,929	0.528227209	56.10704709	1	569.0729
Frederick	259,547	4.293895435	388.9670845	2	667.2724
Garrett	29,014	0.480002012	44.22777533	1	656.0131
Harford	255,441	4.225966564	570.070098	3	448.087
Howard	325,690	5.388152451	1,284.560856	3	253.5419
Kent	19,422	0.321313816	68.25154183	1	284.565
Montgomery	1,050,688	17.382379324	2,075.644648	4	506.1984
Prince George's	909,327	15.043730245	1,827.899883	3	497.4709
Queen Anne's	49,586	0.820341206	132.1659642	1	375.1798
St. Mary's	113,510	1.877887515	310.5901075	2	365.4656
Somerset	25,616	0.423786156	81.7200514	1	313.4604
Talbot	37,181	0.615115282	136.0204018	1	273.3487
Washington	151,049	2.498925480	323.0272591	2	467.6045
Wicomico	103,609	1.714087283	271.1750754	2	382.0742
Worcester	52,276	0.864844046	110.1294858	1	474.6776
City of Baltimore	593,490	9.818583923	7,317.298706	4	81.1078
City of Annapolis	39,223	0.648897736	5,854.179104	4	6.7
Ocean City	6,944	0.114880195	1,509.565217	3	4.6
Totals	**6,091,052**				**10,007.8065**

Table J-2: Injuries and Deaths from Hazards – Coastal, Drought, Floods, and Thunderstorms

INJURIES & DEATHS – MARCH 2021								
	Coastal		Drought		Flood		Thunderstorm	
County	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries
Allegany	0	0	0	0	0	0	0	0
Anne Arundel	1	2	2	0	2	2	2	22
Baltimore	2	4	2	0	2	36	1	4
Calvert	1	2	0	0	0	0	1	1
Caroline	0	1	0	0	0	1	0	1
Carroll	0	0	0	0	0	0	0	12
Cecil	0	0	1	0	0	5	0	4
Charles	1	2	0	0	0	0	1	0
Dorchester	0	0	0	0	0	0	0	0
Frederick	0	0	1	0	8	1	2	5
Garrett	0	0	0	0	0	0	0	4
Harford	1	2	0	0	2	17	1	14
Howard	0	0	0	0	4	2	0	0
Kent	0	1	0	0	0	0	0	8
Montgomery	0	0	1	2	1	5	1	4
Prince George's	1	2	2	0	0	6	1	5
Queen Anne's	1	1	0	0	0	2	0	0
St. Mary's	1	2	0	0	0	0	0	0
Somerset	0	0	0	0	0	0	0	0
Talbot	0	1	0	0	0	0	0	6
Washington	0	0	0	0	0	0	0	1
Wicomico	0	0	0	0	0	0	1	1
Worcester	0	0	0	0	0	0	0	1
City of Baltimore	1	2	4	0	5	4	2	1

Table J-3: Injuries and Deaths from Hazards – Tornadoes, Wildfires, Wind, and Winter Storms

INJURIES & DEATHS – MARCH 2021								
	Tornado		Wildfire		Wind		Winter Storm	
County	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries
Allegany	0	6	0	1	0	5	6	167
Anne Arundel	0	1	0	3	2	27	6	166
Baltimore	1	66	0	0	2	32	15	332
Calvert	2	2	0	0	0	7	5	161
Caroline	0	0	0	0	0	0	0	0
Carroll	0	3	0	0	2	31	8	166
Cecil	0	2	0	0	2	8	0	0
Charles	1	122	0	0	1	5	4	165
Dorchester	1	16	0	0	0	2	0	0
Frederick	0	1	0	1	1	13	7	166
Garrett	1	12	0	0	0	0	0	0
Harford	0	12	0	0	0	10	8	166
Howard	1	2	0	1	0	15	8	166
Kent	0	0	0	0	0	2	0	0
Montgomery	0	1	0	0	2	13	8	166
Prince George's	2	60	0	0	1	13	6	166
Queen Anne's	1	0	0	0	0	4	1	1
St. Mary's	0	4	0	0	0	12	4	161
Somerset	0	0	0	0	0	4	0	0
Talbot	0	0	0	0	0	0	2	0
Washington	0	1	0	0	0	9	7	166
Wicomico	0	2	0	0	0	0	0	0
Worcester	0	0	0	0	0	0	0	0
City of Baltimore	0	5	0	0	1	30	20	168

Table J-4: Injuries and Deaths from Hazards – Dam Failures, Extreme Temperatures, Human-Caused, Public Health, and Soil Movement

Injuries & Deaths – March 2021										
	Dam Failures		Extreme Temperatures		Human-Caused Hazards		Public Health Emergencies		Soil Movement	
County	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries
Allegany	0	0	0	0	0	1	147	0	0	0
Anne Arundel	0	0	1	0	0	0	768	0	0	0
Baltimore	0	0	0	0	0	1	1,296	0	0	0
Calvert	0	0	0	0	0	0	102	0	0	0
Caroline	0	0	0	0	0	0	35	0	0	0
Carroll	0	0	0	0	0	0	214	0	0	0
Cecil	0	0	0	0	0	0	196	0	0	0
Charles	0	0	0	0	0	0	115	0	0	0
Dorchester	0	0	0	0	0	0	31	0	0	0
Frederick	0	0	1	0	0	1	275	0	0	0
Garrett	0	0	0	0	0	0	13	0	0	0
Harford	0	0	0	0	0	0	332	0	0	0
Howard	0	0	0	0	0	0	157	0	0	0
Kent	0	0	0	0	0	0	20	0	0	0
Montgomery	0	0	1	0	0	0	325	0	0	0
Prince George's	0	0	0	0	0	0	426	0	0	0
Queen Anne's	0	0	0	0	0	0	39	0	0	0

Injuries & Deaths – March 2021										
	Dam Failures		Extreme Temperatures		Human-Caused Hazards		Public Health Emergencies		Soil Movement	
County	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries	Deaths	Injuries
St. Mary's	0	0	0	0	0	0	26	0	0	0
Somerset	0	0	0	0	0	0	104	0	0	0
Talbot	0	0	0	0	0	0	41	0	0	0
Washington	0	0	0	0	0	4	277	0	0	0
Wicomico	0	0	0	0	0	0	131	0	0	0
Worcester	0	0	0	0	0	0	59	0	0	0
City of Baltimore	0	0	8	0	0	1	2,985	0	0	0

Table J-5: Property and Crop Damage Due to Hazards – Coastal and Drought

Property & Crop Damage – March 2021								
	COASTAL UPDATE		COASTAL RANKING		DROUGHT UPDATE		DROUGHT RANKING	
County	2020 CPI Property Damage	2020 CPI Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	0	0	1	1	0	0	1	1
Anne Arundel	10.521 m	0	3	1	0	1.801 m	1	3
Baltimore	728.385 m	88.448 k	4	2	0	6.331 m	1	4
Calvert	27.504 m	17.258 k	4	1	0	1.801 m	1	3
Caroline	2.025 m	0	2	1	0	0	1	1
Carroll	88.448 k	0	1	1	0	6.040 m	1	4
Cecil	2.089 m	0	2	1	0	0	1	1
Charles	15.839 m	26.966 k	3	1	0	1.801 m	1	3
Dorchester	4.577 m	9.103 m	2	4	0	2.157 m	1	4
Frederick	8.629 k	0	1	1	0	26.825 m	1	4
Garrett	0	0	1	1	0	0	1	1
Harford	26.058 m	88.448 k	4	2	0	4.487 m	1	4
Howard	892.038 k	0	2	1	0	5.004 m	1	4
Kent	19.008 m	0	3	1	0	0	1	1
Montgomery	535.007 k	0	2	1	0	7.938 m	1	4
Prince George's	7.764 m	35.595 k	3	1	0	1.801 m	1	3
Queen Anne's	67.289 m	0	4	1	0	0	1	1

Property & Crop Damage – March 2021								
	COASTAL UPDATE		COASTAL RANKING		DROUGHT UPDATE		DROUGHT RANKING	
County	2020 CPI Property Damage	2020 CPI Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
St. Mary's	161.394 m	88.448 k	4	2	0	1.801 m	1	3
Somerset	10.577 m	2.677 m	3	4	0	2.157 m	1	4
Talbot	2.230 m	0	2	1	0	0	1	1
Washington	0	0	1	1	0	22.834 m	1	4
Wicomico	1.427 m	1.891 m	2	3	0	2.157 m	1	4
Worcester	19.148 m	1.820 m	3	3	0	0	1	1
City of Baltimore	450.931 m	0	4	1	0	1.801 m	1	3

Table J-6: Property and Crop Damage Due to Hazards – Flood and Thunderstorms

Property & Crop Damage – March 2021								
	FLOOD UPDATE		FLOOD RANKING		THUNDERSTORM UPDATE		THUNDERSTORM RANKING	
County	2020 CPI Property Damage	2020 CPI Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	18.262 m	44.224 k	3	1	115.414 k	10.786 k	1	1
Anne Arundel	10.296 m	0	3	1	1.548 m	0	2	1
Baltimore	14.453 m	0	3	1	1.144 m	10.786 k	2	1
Calvert	959.600 k	0	2	1	270.739 k	0	1	1
Caroline	15.010 m	1.802 m	3	3	117.572 k	0	1	1
Carroll	3.153 m	0	2	1	429.300 k	16.179 k	1	1
Cecil	12.708 m	0	3	1	729.163 k	0	2	1
Charles	540.783 k	0	2	1	167.189 k	53.932 k	1	2
Dorchester	44.305 m	0	4	1	23.730 k	0	1	1
Frederick	39.245 m	0	4	1	1.519 m	16.179 k	2	1
Garrett	6.168 m	1.000 k	3	1	6.471 k	0	1	1
Harford	39.744 m	0	4	1	912.532 k	539.322 k	2	3
Howard	490.783 k	0	1	1	1.016 m	1.078 k	2	1
Kent	4.015 m	0	2	1	28.044 k	5.393 k	1	1
Montgomery	3.995 m	276.132 k	2	2	6.913 m	16.179 k	3	1
Prince George's	7.549 m	0	3	1	762.601 k	1.078 k	2	1

Property & Crop Damage – March 2021								
	FLOOD UPDATE		FLOOD RANKING		THUNDERSTORM UPDATE		THUNDERSTORM RANKING	
County	2020 CPI Property Damage	2020 CPI Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Queen Anne's	10.459 m	0	3	1	68.503 k	0	1	1
St. Mary's	1.758 m	0	2	1	735.006 k	0	2	1
Somerset	0	0	1	1	3.235 k	0	1	1
Talbot	10.842 m	0	3	1	1.307 m	0	2	1
Washington	36.435 m	88.448 k	4	2	173.661 k	6.471 k	1	1
Wicomico	70.000 k	0	1	1	118.257 k	0	1	1
Worcester	508.629 k	0	2	1	33.235 k	0	1	1
City of Baltimore	6.376 m	0	3	1	37.752 k	0	1	1

Table J-7: Property and Crop Damage Due to Hazards – Tornadoes and Wildfire

Property & Crop Damage – March 2021								
	TORNADO UPDATE		TORNADO RANKING		WILDFIRE UPDATE		WILDFIRE RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	5.735 m	318.200 k	3	2	31.296k	0	1	1
Anne Arundel	7.681 m	0	3	1	12.9k	0	1	1
Baltimore	39.722 m	8.629 k	4	1	2.495k	0	1	1
Calvert	12.244 m	5.393 k	3	1	4.418k	0	1	1
Caroline	404.491 k	0	1	1	9.114k	0	1	1
Carroll	10.584 m	21.572 k	3	1	2.450k	0	1	1
Cecil	3.618 m	0	2	1	19.191k	0	1	1
Charles	126.388 m	10.786 k	4	1	44.638k	0	1	1
Dorchester	6.192 m	0	3	1	20.590k	0	1	1
Frederick	2.720 m	53.932 k	2	2	18.882k	0	1	1
Garrett	2.786 m	0	2	1	3.853k	0	1	1
Harford	6.689 m	15.101 k	3	1	5.913k	0	1	1
Howard	4.312 m	0	2	1	7.294k	0	1	1
Kent	542.558 k	0	2	1	2.337k	0	1	1
Montgomery	5.282 m	43.145 k	3	1	5.189k	0	1	1
Prince George's	119.947 m	6.471 k	4	1	8.194k	0	1	1
Queen Anne's	567.366 k	0	2	1	4.154k	0	1	1

Property & Crop Damage – March 2021								
	TORNADO UPDATE		TORNADO RANKING		WILDFIRE UPDATE		WILDFIRE RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
St. Mary's	4.454 m	22.651 k	2	1	10.210k	0	1	1
Somerset	73.347 k	0	1	1	116.544k	0	2	1
Talbot	81.976 k	0	1	1	4.813k	0	1	1
Washington	1.745 m	102.471 k	2	2	2.493k	0	1	1
Wicomico	893.459 k	0	2	1	8.599k	0	1	1
Worcester	387.806 k	0	1	1	5.329k	0	1	1
City of Baltimore	215.728 k	0	1	1	.405K	0	1	1

Table J-8: Property and Crop Damage Due to Hazards – Wind and Winter Storms

Property & Crop Damage – March 2021								
	WIND UPDATE		WIND RANKING		WINTER STORM UPDATE		WINTER STORM RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	572.737 k	8.629 k	2	1	26.966 k	0	1	1
Anne Arundel	5.389 m	19.415 k	3	1	2.346 m	0	2	1
Baltimore	4.230 m	12.943 k	2	1	1.798 m	32.359 k	2	1
Calvert	2.171 m	61.482 k	2	2	10.786 k	0	1	1
Caroline	813.297 k	1.078 k	2	1	215.728 k	0	1	1
Carroll	1.710 m	134.830 k	2	2	186.605 k	53.932 k	1	2
Cecil	2.591 m	1.078 k	2	1	1.456 m	0	2	1
Charles	1.375 m	92.763 k	2	2	5.393 k	0	1	1
Dorchester	2.871 m	0	2	1	0	0	1	1
Frederick	2.534 m	191.998 k	2	2	302.020 k	136.987 k	1	2
Garrett	1.471 m	0	2	1	391.840 k	0	1	1
Harford	1.235 m	24.808 k	2	1	73.347 k	0	1	1
Howard	1.924 m	24.808 k	2	1	688.174 k	53.932 k	2	2
Kent	757.208 k	1.078 k	2	1	134.830 k	0	1	1
Montgomery	14.191 m	61.482 k	3	2	3.176 m	80.898 k	2	2
Prince George's	5.308 m	18.336 k	3	1	1.175 m	108.943 k	2	2

Property & Crop Damage – March 2021								
	WIND UPDATE		WIND RANKING		WINTER STORM UPDATE		WINTER STORM RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Queen Anne's	1.914 m	1.078 k	2	1	345.166 k	0	1	1
St. Mary's	5.082 m	105.707 k	3	2	16.179 k	0	1	1
Somerset	1.515 m	0	2	1	0	0	1	1
Talbot	644.881 k	1.088 k	2	1	431.457 k	0	1	1
Washington	2.240 m	170.425 k	2	2	37.752 k	1.084 m	1	3
Wicomico	1.460 m	0	2	1	5.393 m	0	3	1
Worcester	4.304 m	0	2	1	21.572 k	0	1	1
City of Baltimore	1.238 m	3.235 k	2	1	1.731 m	0	2	1

Table J-9: Property and Crop Damage Due to Hazards – Soil Movement and Public Health

Property & Crop Damage – March 2021								
	SOIL MOVEMENT UPDATE		SOIL MOVEMENT RANKING		PUBLIC HEALTH EMERGENCIES UPDATE		PUBLIC HEALTH EMERGENCIES RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	0	0	1	1	0	0	1	1
Anne Arundel	0	0	1	1	0	0	1	1
Baltimore	0	0	1	1	0	0	1	1
Calvert	0	0	1	1	0	0	1	1
Caroline	0	0	1	1	0	0	1	1
Carroll	0	0	1	1	0	0	1	1
Cecil	0	0	1	1	0	0	1	1
Charles	0	0	1	1	0	0	1	1
Dorchester	0	0	1	1	0	0	1	1
Frederick	0	0	1	1	0	0	1	1
Garrett	0	0	1	1	0	0	1	1
Harford	0	0	1	1	0	0	1	1
Howard	0	0	1	1	0	0	1	1
Kent	0	0	1	1	0	0	1	1
Montgomery	0	0	1	1	0	0	1	1
Prince George's	0	0	1	1	0	0	1	1

Property & Crop Damage – March 2021								
	SOIL MOVEMENT UPDATE		SOIL MOVEMENT RANKING		PUBLIC HEALTH EMERGENCIES UPDATE		PUBLIC HEALTH EMERGENCIES RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Queen Anne's	0	0	1	1	0	0	1	1
St. Mary's	0	0	1	1	0	0	1	1
Somerset	0	0	1	1	0	0	1	1
Talbot	0	0	1	1	0	0	1	1
Washington	0	0	1	1	0	0	1	1
Wicomico	0	0	1	1	0	0	1	1
Worcester	0	0	1	1	0	0	1	1
City of Baltimore	0	0	1	1	0	0	1	1

Table J-10: Property and Crop Damage Due to Hazards – Dam Failures and Extreme Temperatures

Property & Crop Damage – March 2021								
	DAM FAILURES UPDATE		DAM FAILURES RANKING		EXTREME TEMPERATURES UPDATE		EXTREME TEMPERATURES RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	0	0	1	1	0	0	1	1
Anne Arundel	0	0	1	1	0	0	1	1
Baltimore	0	0	1	1	0	0	1	1
Calvert	0	0	1	1	0	0	1	1
Caroline	0	0	1	1	0	0	1	1
Carroll	0	0	1	1	0	0	1	1
Cecil	0	0	1	1	0	0	1	1
Charles	0	0	1	1	0	0	1	1
Dorchester	0	0	1	1	0	0	1	1
Frederick	0	0	1	1	0	0	1	1
Garrett	0	0	1	1	0	0	1	1
Harford	0	0	1	1	0	0	1	1
Howard	0	0	1	1	0	0	1	1
Kent	0	0	1	1	0	0	1	1
Montgomery	0	0	1	1	0	0	1	1
Prince George's	0	0	1	1	0	0	1	1

Property & Crop Damage – March 2021								
	DAM FAILURES UPDATE		DAM FAILURES RANKING		EXTREME TEMPERATURES UPDATE		EXTREME TEMPERATURES RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Queen Anne's	0	0	1	1	0	0	1	1
St. Mary's	0	0	1	1	0	0	1	1
Somerset	0	0	1	1	0	0	1	1
Talbot	0	0	1	1	0	0	1	1
Washington	0	0	1	1	0	0	1	1
Wicomico	0	0	1	1	0	0	1	1
Worcester	0	0	1	1	0	0	1	1
City of Baltimore	0	0	1	1	0	0	1	1

Table J-11: Property and Crop Damage Due to Hazards – Human-Caused

Property & Crop Damage – March 2021				
	HUMAN-CAUSED HAZARDS UPDATE		HUMAN-CAUSED HAZARDS RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Allegany	167.500 k	0	1	1
Anne Arundel	99.950 k	0	1	1
Baltimore	51.500 k	0	1	1
Calvert	0	0	1	1
Caroline	137.694 k	0	1	1
Carroll	341.910 k	0	1	1
Cecil	18.005 k	0	1	1
Charles	0	0	1	1
Dorchester	0	0	1	1
Frederick	51.268 k	0	1	1
Garrett	0	0	1	1
Harford	3.022 k	0	1	1
Howard	187.200 k	0	1	1
Kent	0	0	1	1
Montgomery	6.515 k	0	1	1
Prince George's	123.248 k	0	1	1
Queen Anne's	50.000 k	0	1	1
St. Mary's	0	0	1	1

Property & Crop Damage – March 2021				
	HUMAN-CAUSED HAZARDS UPDATE		HUMAN-CAUSED HAZARDS RANKING	
County	2020 Actual Property Damage	2020 Actual Crop Damage	Property Damage	Crop Damage
Somerset	0	0	1	1
Talbot	0	0	1	1
Washington	68.020 k	0	1	1
Wicomico	140.300 k	0	1	1
Worcester	10.000 k	0	1	1
City of Baltimore	354.218 k	0	1	1

Data Sources: NCDC, MDS (Wildfire), USDOT (Human-Caused Hazards)
CPI - Consumer Price Index
k = Thousands of Dollars
m = Millions of Dollars

Table J-12: Geographic Extent of Damage – Coastal, Drought, Flood, Thunderstorms, Tornadoes, Wildfire, and Wind

Geographic Extent – March 2021							
	COASTAL	DROUGHT	FLOOD	THUNDERSTORM	TORNADO	WILDFIRE	WIND
County	% of Coastal Land Area	% Crop from 2012 Agriculture Census	% in 100-yr Flood Zone (A, AE, AO, & VE)	2"> Hail and Lightning Events with Injuries/Deaths	SVRGIS (intensity & frequency)	MD Forestry % in High & Med-High Risk	ASCE Wind Design Speed
Allegany	0.00%	0.46%	0.01%	1	2	8.782492509	116
Anne Arundel	64.00%	4.81%	8.69%	4	4	2.593485505	120
Baltimore	15.00%	10.02%	5.11%	2	4	1.716134497	120
Calvert	93.00%	7.86%	6.26%	2	3	7.056891403	121
Caroline	37.00%	61.64%	7.18%	2	1	0.101973929	123
Carroll	0.00%	26.29%	5.64%	3	4	0.28735403	119
Cecil	59.00%	26.16%	8.15%	2	3	2.154480663	121
Charles	63.00%	6.84%	10.58%	2	4	6.389977313	119
Dorchester	98.00%	30.60%	51.64%	1	2	0.012462	123
Frederick	0.00%	24.17%	7.07%	2	4	2.567998421	118
Garrett	0.00%	2.21%	3.70%	1	3	8.893589387	116
Harford	4.00%	15.10%	10.20%	3	4	1.408375667	120
Howard	0.00%	8.76%	5.58%	1	3	0.997371437	119
Kent	87.00%	67.46%	8.36%	2	1	0	121
Montgomery	0.00%	10.56%	7.98%	4	4	0.322174948	119
Prince George's	7.00%	3.79%	10.36%	3	4	2.66949766	120

Geographic Extent – March 2021							
	COASTAL	DROUGHT	FLOOD	THUNDERSTORM	TORNADO	WILDFIRE	WIND
County	% of Coastal Land Area	% Crop from 2012 Agriculture Census	% in 100-yr Flood Zone (A, AE, AO, & VE)	2"> Hail and Lightning Events with Injuries/Deaths	SVRGIS (intensity & frequency)	MD Forestry % in High & Med-High Risk	ASCE Wind Design Speed
Queen Anne's	74.00%	60.50%	5.99%	1	2	0	121
St. Mary's	81.00%	16.91%	9.17%	2	4	6.627036634	122
Somerset	96.00%	22.27%	48.79%	1	1	0.467411766	126
Talbot	Pending	58.74%	10.53%	2	1	0	122
Washington	0.00%	19.31%	7.50%	2	2	3.662942533	118
Wicomico	49.00%	27.58%	15.54%	1	1	2.047613933	126
Worcester	54.00%	28.88%	20.10%	1	2	3.904144725	131
Baltimore City	38.00%	0.04%	4.52%	2	1	0	120

Table J-13: Geographic Extent of Damage – Winter Storms, Dam Failures, Extreme Temperatures, Human-Caused, Public Health, and Soil Movement

Geographic Extent – March 2021						
	WINTER STORM	DAM FAILURES	EXTREME TEMPERATURES	HUMAN-CAUSED HAZARDS	PUBLIC HEALTH	SOIL MOVEMENT
County	Average Snowfall Total (in inches)	High Hazard Dams	Excessive Heat & Extreme Cold Events	Hazmat Events	Low Median Income Areas	% Karst
Allegany	4	1	3	12	$59,300.00	42.98%
Anne Arundel	2	13	6	67	$101,000.00	0
Baltimore	3	7	5	219	$101,000.00	19.39%
Calvert	1	10	3	3	$121,300.00	0
Caroline	2	2	0	3	$62,500.00	0
Carroll	3	7	2	4	$101,000.00	13.13%
Cecil	2	10	2	18	$90,100.00	0
Charles	1	3	2	2	$121,300.00	0
Dorchester	1	0	0	12	$65,500.00	0
Frederick	3	8	2	17	$121,300.00	16.33%
Garrett	4	1	3	0	$60,400.00	66.32%
Harford	3	11	3	8	$101,000.00	6.18%
Howard	3	24	5	66	$101,000.00	0
Kent	2	3	0	0	$75,700.00	0
Montgomery	3	18	5	45	$121,300.00	6.03%
Prince George's	2	16	5	245	$121,300.00	0

Geographic Extent – March 2021						
	WINTER STORM	DAM FAILURES	EXTREME TEMPERATURES	HUMAN-CAUSED HAZARDS	PUBLIC HEALTH	SOIL MOVEMENT
County	Average Snowfall Total (in inches)	High Hazard Dams	Excessive Heat & Extreme Cold Events	Hazmat Events	Low Median Income Areas	% Karst
Queen Anne's	2	3	0	2	$101,000.00	0
St. Mary's	1	3	2	0	$101,700.00	0
Somerset	1	0	0	0	$49,800.00	0
Talbot	1	0	0	5	$80,100.00	0
Washington	3	4	3	559	$75,300.00	61.84%
Wicomico	1	2	0	14	$65,600.00	0
Worcester	1	0	0	1	$72,600.00	0
Baltimore City	3	2	0	43	$101,000.00	5.84%

Table J-14: Number of Hazard Events – Coastal, Drought, Flood, and Thunderstorms

Events – March 2021								
	COASTAL		DROUGHT		FLOOD		THUNDERSTORM	
County	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized
Allegany	1	0.04	1	0.04	69	2.55	39	0.61
Anne Arundel	56	2.07	21	0.83	123	4.54	108	1.69
Baltimore	20	0.74	23	0.91	164	6.06	116	1.82
Calvert	17	0.63	17	0.67	46	1.70	52	0.82
Caroline	9	0.33	76	3.01	63	2.33	21	0.33
Carroll	2	0.07	11	0.44	87	3.21	72	1.13
Cecil	5	0.18	70	2.77	103	3.80	44	0.69
Charles	10	0.37	20	0.79	52	1.92	84	1.32
Dorchester	21	0.78	2	0.08	30	1.11	27	0.42
Frederick	3	0.11	16	0.63	153	5.65	90	1.41
Garrett	1	0.04	2	0.08	66	2.44	41	0.64
Harford	9	0.33	16	0.63	89	3.29	81	1.27
Howard	2	0.07	19	0.75	92	3.40	44	0.69
Kent	10	0.37	77	3.05	57	2.10	30	0.47
Montgomery	2	0.07	21	0.83	175	6.46	168	2.64
Prince George's	3	0.11	20	0.79	119	4.39	98	1.54
Queen Anne's	11	0.41	77	3.05	77	2.84	22	0.35
St. Mary's	61	2.25	15	0.59	81	2.99	71	1.11
Somerset	15	0.55	7	0.28	24	0.89	22	0.35
Talbot	11	0.41	75	2.97	66	2.44	36	0.56

Events – March 2021								
	COASTAL		DROUGHT		FLOOD		THUNDERSTORM	
County	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized
Washington	1	0.04	17	0.67	80	2.95	90	1.41
Wicomico	11	0.41	2	0.08	35	1.29	34	0.53
Worcester	26	0.96	1	0.04	49	1.81	32	0.50
Baltimore City	18	0.66	23	0.91	69	2.55	23	0.36

Table J-15: Number of Hazard Events – Tornadoes, Wildfires, Wind, and Winter Storms

Events – March 2021								
	TORNADO		WILDFIRE		WIND		WINTER STORM	
County	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized
Allegany	9	0.13	459	25.5	206	3.22	354	12.99
Anne Arundel	22	0.32	193	10.7222222	438	6.85	160	5.87
Baltimore	25	0.36	377	20.9444444	455	7.12	318	11.67
Calvert	19	0.27	403	22.3888889	239	3.74	110	4.04
Caroline	8	0.11	454	25.2222222	251	3.93	130	4.77
Carroll	20	0.29	118	6.55555556	320	5.01	232	8.51
Cecil	20	0.29	448	24.8888889	388	6.07	179	6.57
Charles	30	0.43	1114	61.8888889	159	2.49	132	4.84
Dorchester	13	0.19	726	40.3333333	350	5.48	78	2.86
Frederick	36	0.52	486	27	240	3.75	249	9.14
Garrett	11	0.16	265	14.7222222	220	3.44	218	8.00
Harford	29	0.42	422	23.4444444	328	5.13	215	7.89
Howard	16	0.23	111	6.16666667	317	4.96	193	7.08
Kent	7	0.10	125	6.94444444	402	6.29	143	5.25
Montgomery	27	0.39	226	12.5555556	535	8.37	210	7.71
Prince George's	29	0.42	166	9.22222222	327	5.12	161	5.91
Queen Anne's	13	0.19	292	16.2222222	223	3.49	143	5.25
St. Mary's	26	0.37	576	32	66	1.03	105	3.85
Somerset	5	0.07	250	13.8888889	266	4.16	69	2.53
Talbot	13	0.19	392	21.7777778	254	3.97	128	4.70

Events – March 2021								
	TORNADO		WILDFIRE		WIND		WINTER STORM	
County	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized
Washington	14	0.20	398	22.1111111	164	2.57	230	8.44
Wicomico	10	0.14	527	29.2777778	112	1.75	76	2.79
Worcester	15	0.22	168	9.33333333	158	2.47	102	3.74
Baltimore City	5	0.07	24	1.33333333	168	2.63	175	6.42

Table J-16: Number of Hazard Events – Dam Failures, Extreme Temperatures, Human-Caused, Public Health, and Soil Movement

Events – March 2021										
	DAM FAILURES		EXTREME TEMPS		HUMAN-CAUSED HAZARDS		PUBLIC HEALTH		SOIL MOVEMENT	
County	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized
Allegany	0	0.00	3	0.80	12	2.67	147	49.00	0	0.00
Anne Arundel	0	0.00	6	0.13	67	14.89	768	256.00	0	0.00
Baltimore	0	0.00	5	0.11	219	48.67	1296	432.00	0	0.00
Calvert	0	0.00	3	0.07	3	0.67	102	34.00	0	0.00
Caroline	0	0.00	0	0.00	3	0.67	35	11.67	0	0.00
Carroll	2	0.51	2	0.04	4	0.89	214	71.33	0	0.00
Cecil	1	0.26	2	0.04	18	4.00	196	65.33	0	0.00
Charles	0	0.00	2	0.04	2	0.44	115	38.33	0	0.00
Dorchester	0	0.00	0	0.00	12	2.67	31	10.33	0	0.00
Frederick	2	0.51	2	0.04	17	3.78	275	91.67	0	0.00
Garrett	0	0.00	3	0.07	0	0.00	13	4.33	0	0.00
Harford	2	0.51	3	0.07	8	1.78	332	110.67	0	0.00
Howard	1	0.26	5	0.11	66	14.67	157	52.33	0	0.00
Kent	0	0.00	0	0.00	0	0.00	20	6.67	0	0.00
Montgomery	1	0.26	5	0.11	45	10.00	325	108.33	0	0.00
Prince George's	1	0.26	5	0.11	245	54.44	426	142.00	0	0.00

Events – March 2021										
	DAM FAILURES		EXTREME TEMPS		HUMAN-CAUSED HAZARDS		PUBLIC HEALTH		SOIL MOVEMENT	
County	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized	Event Total	Annualized
Queen Anne's	0	0.00	0	0.00	2	0.44	39	13.00	0	0.00
St. Mary's	1	0.26	2	0.04	0	0.00	26	8.67	0	0.00
Somerset	0	0.00	0	0.00	0	0.00	104	34.67	0	0.00
Talbot	0	0.00	0	0.00	5	1.11	41	13.67	0	0.00
Washington	1	0.26	3	0.07	559	124.22	277	92.33	0	0.00
Wicomico	6	1.53	0	0.00	14	3.11	131	43.67	0	0.00
Worcester	1	0.26	0	0.00	1	0.22	59	19.67	0	0.00
Baltimore City	1	0.26	0	0.00	43	9.56	2985	995.00	0	0.00

Overall and Local Hazard Rankings

The following tables are the result of jurisdictional ranking of hazards (based on local plan information) as well as the overall risk assessment rankings as determined by our methodology.

Following the local rankings tables, the Overall State Rankings and Methodology Tables are presented. The information in these tables is graphically represented by the maps in Appendix K, as well as in Section 3 of the 2021 State Hazard Mitigation Plan.

Table J-17: Local Rankings Per Hazard – Coastal, Draught, Flood, Thunderstorms, Tornadoes, Wildfire, Wind, and Winter Storms – 2021

Local Rankings – March 2021									
County	**Year**	**COASTAL**	**DROUGHT**	**FLOOD**	**THUNDERSTORM**	**TORNADO**	**WILDFIRE**	**WIND**	**WINTER STORM**
Allegany	2018	1	3	5	4	3	3	3	4
Anne Arundel	2018	4	3	5	5	5	1	0	5
Baltimore	2016*	5	3	5	4	3	3	3	4
Calvert	2017	5	1	5	4	4	0	5	3
Caroline	2019	3	3	5	3	3	0	3	3
Carroll	2016*	2	5	3	0	3	0	0	5
Cecil	2015	1	3	5	5	1	1	0	5
Charles	2018	3	1	5	5	5	1	5	3
Dorchester	2017	5	3	4	4	3	3	4	4
Frederick	2017	3	3	5	3	5	3	5	5
Garrett	2018	2	2	5	4	3	3	4	5
Harford	2016*	2	5	3	4	4	0	4	3
Howard	2018	4	4	5	3	3	1	3	5
Kent	2020	4	1	4	5	2	1	4	3
Montgomery	2019	3	3	3	5	3	3	5	3
Prince George's	2017	4	2	5	4	5	1	4	4
Queen Anne's	2018	5	5	5	1	1	3	5	3
St. Mary's	2017	5	3	5	4	4	3	4	5
Somerset	2017	5	4	5	4	2	3	4	3

Local Rankings – March 2021									
County	**Year**	**COASTAL**	**DROUGHT**	**FLOOD**	**THUNDERSTORM**	**TORNADO**	**WILDFIRE**	**WIND**	**WINTER STORM**
Talbot	2017	5	3	5	4	3	3	0	5
Washington	2017	3	1	3	3	3	4	3	2
Wicomico	2016	4	3	3	3	3	3	4	4
Worcester	2020	5	3	4	3	3	4	4	2
Baltimore City	2018	3	3	5	3	3	0	5	5
City of Annapolis	2018	5	1	5	2	1	0	2	3
Ocean City	2017	5	0	3	3	2	1	4	3

Note: * Denotes outdated Local Plan
Ranking Scale – High-5, Medium-High-4, Medium-3, Medium-Low-2, Low-1, Not Ranked-0

Table J-18: Local Rankings Per Hazard – Soil Movement, Public Health, Dam Failures, Extreme Temperatures, and Human-Caused – 2021

Local Rankings – March 2021						
County	**Year**	**SOIL MOVEMENT**	**PUBLIC HEALTH EMERGENCIES**	**DAM FAILURES**	**EXTREME TEMPS**	**HUMAN-CAUSED HAZARDS**
Allegany	2018	3	2	0	4	4
Anne Arundel	2018	5	0	1	3	0
Baltimore	2016*	2	1	3	3	5
Calvert	2017	1	0	1	5	1
Caroline	2019	4	3	0	3	0
Carroll	2016*	4	0	3	0	0
Cecil	2015	1	0	1	3	3
Charles	2018	1	5	3	5	3
Dorchester	2017	0	2	1	4	2
Frederick	2017	3	0	1	3	0
Garrett	2018	4	4	3	1	3
Harford	2016*	0	0	0	0	0
Howard	2018	0	0	0	0	0
Kent	2020	1	5	0	4	0
Montgomery	2019	1	0	0	3	0
Prince George's	2017	2	0	3	3	0
Queen Anne's	2018	0	0	0	5	0
St. Mary's	2017	0	0	0	0	0
Somerset	2017	0	5	0	4	4

Local Rankings – March 2021						
County	**Year**	**SOIL MOVEMENT**	**PUBLIC HEALTH EMERGENCIES**	**DAM FAILURES**	**EXTREME TEMPS**	**HUMAN-CAUSED HAZARDS**
Talbot	2017	0	0	0	3	0
Washington	2017	1	1	0	2	3
Wicomico	2016	2	3	3	3	0
Worcester	2020	0	0	0	3	2
Baltimore City	2018	2	0	2	5	0
City of Annapolis	2018	0	0	0	1	0
Ocean City	2017	0	0	0	0	0

Note: * Denotes outdated Local Plan
Ranking Scale – High-5, Medium-High-4, Medium-3, Medium-Low-2, Low-1, Not Ranked-0

Table J-19: Ranking Scales– March 2021

Score	Population Vulnerability Geometrical Interval	Population Density Geometrical Interval	Annualized Events	Annualized Events - Coastal, Dam Failures & Extreme Temps	Annualized Events - Flood	Annualized Events - Human Caused Hazards	Annualized Events - Public Health Crisis	Injuries/ Deaths	Property Damage	Crop Damage
1	0.00	0	0	0	0	< 0.5	< 12	None	0.00	0.00
2	0.85	174.7392	0.11	0.11	1.50	2	40	Injury	500 k	50 k
3	2.25	546.3805	1.01	0.50	2.30	10	100	N/A	5 m	501 k
4	6.12	1919.7552	2.51	1.00	3.50	> 10	> 100	Death	> 20 m	> 2 m

Overall Score

(>=) Hazard Risk Score	*Rank*
0	Low
10.5	Medium-Low
14.5	Medium
18.5	Medium-High
23	High

No Local Plan Ranking Score

(>=) Hazard Risk Score	*Rank*
0	Low
6	Medium-Low
10	Medium
14	Medium-High
18	High

Overall Risk Factors & Score March 2021		
WEIGHTING		
Population Vulnerability	*PV*	**0.5**
Population Density	*PN*	**0.5**
Injuries	*IN*	**1**
Deaths	*DT*	**1**
Property Damage (Annualized)	*PD*	**1**
Crop Damage (Annualized)	*CD*	**1**
Geographic Extent (Hazard Dependent)	*GE*	**1.5**
Events (Annualized)	*EV*	**1**
Local Plan Ranking	*LOCAL*	**1.5**

NOTE: For values represented as zero (*highlighted in gray*) under LP (Local Plan), the "No Local Plan Ranking Score' was utilized.

Overall Score

(>=)	*Hazard Risk Score Rank*
0	Low
10.5	Medium-Low
14.5	Medium
18.5	Medium-High
23	High

No Local Plan Ranking Score

(>=)	*Hazard Risk Score Rank*
0	Low
6	Medium-Low
10	Medium
14	Medium-High
18	High

Table J-20: Overall Ranking: Coastal – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		COASTAL								
County	FIPS	PV	PN	Cst_IN	Cst_DT	Cst_PD	Cst_CD	Cst_GE	Cst_EV	Cst_Local	Cst_RS	Cst_Rank
Allegany	24001	2	1	1	1	1	1	1	1	1	9.5	Low
Anne Arundel	24003	4	3	2	4	3	1	3	4	4	28	High
Baltimore	24005	4	3	2	4	4	2	1	3	5	27.5	High
Calvert	24009	2	2	2	4	4	1	4	3	5	29.5	High
Caroline	24011	1	1	2	1	2	1	2	2	3	16.5	Medium
Carroll	24013	3	2	1	1	1	1	1	1	2	12	Medium-Low
Cecil	24015	2	2	1	1	2	1	3	2	1	15	Medium
Charles	24017	3	2	2	4	3	1	3	2	3	23.5	High
Dorchester	24019	1	1	1	1	2	4	4	3	5	25.5	High
Frederick	24021	3	2	1	1	1	1	1	2	3	14.5	Medium
Garrett	24023	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
Harford	24025	3	3	2	4	4	2	1	2	2	21.5	Medium-High
Howard	24027	3	3	1	1	2	1	1	1	4	16.5	Medium
Kent	24029	1	1	2	1	3	1	4	2	4	22	Medium-High
Montgomery	24031	4	4	1	1	2	1	1	1	3	16	Medium
Prince George's	24033	4	3	2	4	3	1	1	2	4	23	High
Queen Anne's	24035	1	1	2	4	4	1	3	2	5	26	High
St. Mary's	24037	2	2	2	4	4	2	4	4	5	31.5	High
Somerset	24039	1	1	1	1	3	4	4	3	5	26.5	High
Talbot	24041	1	1	2	1	2	1	3	2	5	21	Medium-High

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		COASTAL								
County	FIPS	PV	PN	Cst_IN	Cst_DT	Cst_PD	Cst_CD	Cst_GE	Cst_EV	Cst_Local	Cst_RS	Cst_Rank
Washington	24043	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
Wicomico	24045	2	2	1	1	2	3	2	2	4	20	Medium-High
Worcester	24047	2	1	1	1	3	3	3	3	5	24.5	High
City of Baltimore	24510	4	4	2	4	4	1	2	3	3	25.5	High

Table J-21: Overall Ranking: Drought – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		DROUGHT								
County	FIPS	PV	PN	Drt_IN	Drt_DT	Drt_PD	Drt_CD	Drt_GE	Drt_EV	Drt_Local	Drt_RS	Drt_Rank
Allegany	24001	2	1	1	1	1	1	1	1	3	12.5	Medium-Low
Anne Arundel	24003	4	3	1	4	1	3	1	2	3	20.5	Medium-High
Baltimore	24005	4	3	1	4	1	4	2	2	3	23	High
Calvert	24009	2	2	1	1	1	3	2	2	1	14.5	Medium
Caroline	24011	1	1	1	1	1	1	4	4	3	19.5	Medium-High
Carroll	24013	3	2	1	1	1	4	3	2	5	23.5	High
Cecil	24015	2	2	1	4	1	1	3	4	3	22	Medium-High
Charles	24017	3	2	1	1	1	3	2	2	1	15	Medium
Dorchester	24019	1	1	1	1	1	4	4	1	3	19.5	Medium-High
Frederick	24021	3	2	1	4	1	4	3	2	3	23.5	High
Garrett	24023	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
Harford	24025	3	3	1	1	1	4	3	2	5	24	High
Howard	24027	3	3	1	1	1	4	2	2	4	21	Medium-High
Kent	24029	1	1	1	1	1	1	4	4	1	16.5	Medium
Montgomery	24031	4	4	2	4	1	4	2	2	3	24.5	High
Prince George's	24033	4	3	1	4	1	3	1	2	2	19	Medium-High
Queen Anne's	24035	1	1	1	1	1	1	4	4	5	22.5	Medium-High
St. Mary's	24037	2	2	1	1	1	3	3	2	3	19	Medium-High
Somerset	24039	1	1	1	1	1	4	3	2	4	20.5	Medium-High
Talbot	24041	1	1	1	1	1	1	4	4	3	19.5	Medium-High

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		DROUGHT								
County	FIPS	PV	PN	Drt_IN	Drt_DT	Drt_PD	Drt_CD	Drt_GE	Drt_EV	Drt_Local	Drt_RS	Drt_Rank
Washington	24043	3	2	1	1	1	4	3	2	1	17.5	Medium
Wicomico	24045	2	2	1	1	1	4	3	1	3	19	Medium-High
Worcester	24047	2	1	1	1	1	1	3	1	3	15.5	Medium
City of Baltimore	24510	4	4	1	4	1	3	1	2	3	21	Medium-High

Table J-22: Overall Ranking: Flood – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		FLOOD								
County	FIPS	PV	PN	Fld_IN	Fld_DT	Fld_PD	Fld_CD	Fld_GE	Fld_EV	Fld_Local	Fld_RS	Fld_Rank
Allegany	24001	2	1	1	1	3	1	1	3	5	19.5	Medium-High
Anne Arundel	24003	4	3	2	4	3	1	1	4	5	26.5	High
Baltimore	24005	4	3	2	4	3	1	1	4	5	26.5	High
Calvert	24009	2	2	1	1	2	1	1	2	5	18	Medium
Caroline	24011	1	1	2	1	3	3	1	3	5	22	Medium-High
Carroll	24013	3	2	1	1	2	1	1	3	3	16.5	Medium
Cecil	24015	2	2	2	1	3	1	1	4	5	22	Medium-High
Charles	24017	3	2	1	1	2	1	2	2	5	20	Medium-High
Dorchester	24019	1	1	1	1	4	1	4	1	4	21	Medium-High
Frederick	24021	3	2	2	4	4	1	1	4	5	26.5	High
Garrett	24023	1	1	1	1	3	1	1	3	5	19	Medium-High
Harford	24025	3	3	2	4	4	1	2	3	3	24.5	High
Howard	24027	3	3	2	4	1	1	1	3	5	23	High
Kent	24029	1	1	1	1	2	1	1	2	4	15.5	Medium
Montgomery	24031	4	4	2	4	2	2	1	4	3	24	High
Prince George's	24033	4	3	2	1	3	1	2	4	5	25	High
Queen Anne's	24035	1	1	2	1	3	1	1	3	5	20	Medium-High
St. Mary's	24037	2	2	1	1	2	1	1	3	5	19	Medium-High
Somerset	24039	1	1	1	1	1	1	4	1	5	19.5	Medium-High
Talbot	24041	1	1	1	1	3	1	2	3	5	20.5	Medium-High

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		FLOOD								
County	FIPS	PV	PN	Fld_IN	Fld_DT	Fld_PD	Fld_CD	Fld_GE	Fld_EV	Fld_Local	Fld_RS	Fld_Rank
Washington	24043	3	2	1	1	4	2	1	3	3	19.5	Medium-High
Wicomico	24045	2	2	1	1	1	1	2	1	3	14.5	Medium
Worcester	24047	2	1	1	1	2	1	3	2	4	19	Medium-High
City of Baltimore	24510	4	4	2	4	3	1	1	3	5	26	High

Table J-23: Overall Ranking: Thunderstorm – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		THUNDERSTORM								
County	FIPS	PV	PN	TS_IN	TS_DT	TS_PD	TS_CD	TS_GE	TS_EV	TS_Local	TS_RS	TS_Rank
Allegany	24001	2	1	1	1	1	1	1	2	4	15	Medium
Anne Arundel	24003	4	3	2	4	2	1	4	3	5	29	High
Baltimore	24005	4	3	2	4	2	1	2	3	4	24.5	High
Calvert	24009	2	2	2	4	1	1	2	2	4	21	Medium-High
Caroline	24011	1	1	2	1	1	1	2	2	3	15.5	Medium
Carroll	24013	3	2	2	1	1	1	3	3	0	15	Medium-High
Cecil	24015	2	2	2	1	2	1	2	2	5	20.5	Medium-High
Charles	24017	3	2	1	4	1	2	2	3	5	24	High
Dorchester	24019	1	1	1	1	1	1	1	2	4	14.5	Medium
Frederick	24021	3	2	2	4	2	1	2	3	3	22	Medium-High
Garrett	24023	1	1	2	1	1	1	1	2	4	15.5	Medium
Harford	24025	3	3	2	4	2	3	3	3	4	27.5	High
Howard	24027	3	3	1	1	2	1	1	2	3	16	Medium
Kent	24029	1	1	2	1	1	1	2	2	5	18.5	Medium-High
Montgomery	24031	4	4	2	4	3	1	4	4	5	31.5	High
Prince George's	24033	4	3	2	4	2	1	3	3	4	26	High
Queen Anne's	24035	1	1	1	1	1	1	1	2	1	10	Low
St. Mary's	24037	2	2	1	1	2	1	2	3	4	19	Medium-High
Somerset	24039	1	1	1	1	1	1	1	2	4	14.5	Medium
Talbot	24041	1	1	2	1	2	1	2	2	4	18	Medium

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		THUNDERSTORM								
County	FIPS	PV	PN	TS_IN	TS_DT	TS_PD	TS_CD	TS_GE	TS_EV	TS_Local	TS_RS	TS_Rank
Washington	**24043**	3	2	2	1	1	1	2	3	3	18	**Medium**
Wicomico	**24045**	2	2	2	4	1	1	1	2	3	18	**Medium**
Worcester	**24047**	2	1	2	1	1	1	1	2	3	14.5	**Medium**
City of Baltimore	**24510**	4	4	2	4	1	1	2	2	3	21.5	**Medium-High**

Table J-24: Overall Ranking: Tornado – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		TORNADO								
County	FIPS	PV	PN	Trn_IN	Trn_DT	Trn_PD	Trn_CD	Trn_GE	Trn_EV	Trn_Local	Trn_RS	Trn_Rank
Allegany	24001	2	1	2	1	3	2	2	2	3	19	Medium-High
Anne Arundel	24003	4	3	2	1	3	1	4	2	5	26	High
Baltimore	24005	4	3	2	4	4	1	4	2	3	27	High
Calvert	24009	2	2	2	4	3	1	3	2	4	24.5	High
Caroline	24011	1	1	1	1	1	1	1	2	3	13	Medium-Low
Carroll	24013	3	2	2	1	3	1	4	2	3	22	Medium-High
Cecil	24015	2	2	2	1	2	1	3	2	1	16	Medium
Charles	24017	3	2	2	4	4	1	4	2	5	29	High
Dorchester	24019	1	1	2	4	3	1	2	2	3	20.5	Medium-High
Frederick	24021	3	2	2	1	2	2	4	2	5	25	High
Garrett	24023	1	1	2	4	2	1	3	2	3	21	Medium-High
Harford	24025	3	3	2	1	3	1	4	2	4	24	High
Howard	24027	3	3	2	4	2	1	3	2	3	23	High
Kent	24029	1	1	1	1	2	1	1	1	2	11.5	Medium-Low
Montgomery	24031	4	4	2	1	3	1	4	2	3	23.5	High
Prince George's	24033	4	3	2	4	4	1	4	2	5	30	High
Queen Anne's	24035	1	1	1	4	2	1	2	2	1	15.5	Medium
St. Mary's	24037	2	2	2	1	2	1	4	2	4	22	Medium-High
Somerset	24039	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
Talbot	24041	1	1	1	1	1	1	1	2	3	13	Medium-Low

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		TORNADO								
County	FIPS	PV	PN	Trn_IN	Trn_DT	Trn_PD	Trn_CD	Trn_GE	Trn_EV	Trn_Local	Trn_RS	Trn_Rank
Washington	24043	3	2	2	1	2	2	2	2	3	19	Medium-High
Wicomico	24045	2	2	2	1	2	1	1	2	3	16	Medium
Worcester	24047	2	1	1	1	1	1	2	2	3	15	Medium
City of Baltimore	24510	4	4	2	1	1	1	1	1	3	16	Medium

Table J-25: Overall Ranking: Wildfire – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		WILDFIRE								
County	FIPS	PV	PN	Wf_IN	Wf_DT	Wf_PD	Wf_CD	Wf_GE	Wf_EV	Wf_Local	Wf_RS	Wf_Rank
Allegany	24001	2	1	2	1	1	1	4	4	3	21	Medium-High
Anne Arundel	24003	4	3	2	1	1	1	3	4	0	17	Medium-High
Baltimore	24005	4	3	1	1	1	1	2	4	3	19	Medium-High
Calvert	24009	2	2	1	1	1	1	4	4	5	23.5	High
Caroline	24011	1	1	1	1	1	1	1	4	2	13.5	Medium-Low
Carroll	24013	3	2	1	1	1	1	1	4	0	12	Medium-Low
Cecil	24015	2	2	1	1	1	1	2	4	0	13	Medium
Charles	24017	3	2	1	1	1	1	4	4	1	18	Medium
Dorchester	24019	1	1	1	1	1	1	1	4	3	15	Medium
Frederick	24021	3	2	2	1	1	1	3	4	3	20.5	Medium-High
Garrett	24023	1	1	1	1	1	1	4	4	3	19.5	Medium-High
Harford	24025	3	3	1	1	1	1	2	4	0	14	Medium
Howard	24027	3	3	2	1	1	1	2	4	1	16.5	Medium
Kent	24029	1	1	1	1	1	1	1	4	3	15	Medium
Montgomery	24031	4	4	1	1	1	1	1	4	3	18	Medium
Prince George's	24033	4	3	1	1	1	1	3	4	3	20.5	Medium-High
Queen Anne's	24035	1	1	1	1	1	1	1	4	3	15	Medium
St. Mary's	24037	2	2	1	1	1	1	4	4	1	17.5	Medium
Somerset	24039	1	1	1	1	2	1	2	4	3	17.5	Medium
Talbot	24041	1	1	1	1	1	1	1	4	3	15	Medium

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		WILDFIRE								
County	FIPS	PV	PN	Wf_IN	Wf_DT	Wf_PD	Wf_CD	Wf_GE	Wf_EV	Wf_Local	Wf_RS	Wf_Rank
Washington	24043	3	2	1	1	1	1	3	4	2	18	Medium
Wicomico	24045	2	2	1	1	1	1	2	4	3	17.5	Medium
Worcester	24047	2	1	1	1	1	1	4	4	3	20	Medium-High
City of Baltimore	24510	4	4	1	1	1	1	1	3	0	12.5	Medium-Low

Table J-26: Overall Ranking: Wind – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		WIND								
County	FIPS	PV	PN	Wd_IN	Wd_DT	Wd_PD	Wd_CD	Wd_GE	Wd_EV	Wd_Local	Wd_RS	Wd_Rank
Allegany	24001	2	1	2	1	2	1	1	4	3	17.5	Medium
Anne Arundel	24003	4	3	2	4	3	1	2	4	0	20.5	High
Baltimore	24005	4	3	2	4	2	1	2	4	3	24	High
Calvert	24009	2	2	2	1	2	2	3	4	5	25	High
Caroline	24011	1	1	1	1	2	1	3	4	3	19	Medium-High
Carroll	24013	3	2	2	4	2	2	2	4	0	19.5	High
Cecil	24015	2	2	2	4	2	1	3	4	0	19.5	High
Charles	24017	3	2	2	4	2	2	2	3	5	26	High
Dorchester	24019	1	1	2	1	2	1	3	4	4	21.5	Medium-High
Frederick	24021	3	2	2	4	2	2	2	4	5	27	High
Garrett	24023	1	1	1	1	2	1	1	4	4	17.5	Medium
Harford	24025	3	3	2	1	2	1	2	4	4	22	Medium-High
Howard	24027	3	3	2	1	2	1	2	4	3	20.5	Medium-High
Kent	24029	1	1	2	1	2	1	3	4	4	21.5	Medium-High
Montgomery	24031	4	4	2	4	3	2	2	4	5	29.5	High
Prince George's	24033	4	3	2	4	3	1	2	4	4	26.5	High
Queen Anne's	24035	1	1	2	1	2	1	3	4	5	23	High
St. Mary's	24037	2	2	2	1	3	2	3	3	4	23.5	High
Somerset	24039	1	1	2	1	2	1	4	4	4	23	High
Talbot	24041	1	1	1	1	2	1	3	4	0	14.5	Medium-High

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		WIND								
County	FIPS	PV	PN	Wd_IN	Wd_DT	Wd_PD	Wd_CD	Wd_GE	Wd_EV	Wd_Local	Wd_RS	Wd_Rank
Washington	24043	3	2	2	1	2	2	2	4	3	21	Medium-High
Wicomico	24045	2	2	1	1	2	1	4	3	4	22	Medium-High
Worcester	24047	2	1	1	1	2	1	4	3	4	21.5	Medium-High
City of Baltimore	24510	4	4	2	4	2	1	2	4	5	27.5	High

Table J-27: Overall Ranking: Winter Storm – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		WINTER STORM								
County	FIPS	PV	PN	WW_IN	WW_DT	WW_PD	WW_CD	WW_GE	WW_EV	WW_Local	WW_RS	WW_Rank
Allegany	24001	2	1	2	4	1	1	4	4	4	25.5	High
Anne Arundel	24003	4	3	2	4	2	1	1	4	5	25.5	High
Baltimore	24005	4	3	2	4	2	1	2	4	4	25.5	High
Calvert	24009	2	2	2	4	1	1	1	4	3	20	Medium-High
Caroline	24011	1	1	1	1	1	1	1	4	3	15	Medium
Carroll	24013	3	2	2	4	1	2	2	4	5	26	High
Cecil	24015	2	2	1	1	2	1	1	4	5	20	Medium-High
Charles	24017	3	2	2	4	1	1	1	4	3	20.5	Medium-High
Dorchester	24019	1	1	1	1	1	1	1	4	4	16.5	Medium
Frederick	24021	3	2	2	4	1	2	2	4	5	26	High
Garrett	24023	1	1	1	1	1	1	4	4	5	22.5	Medium-High
Harford	24025	3	3	2	4	1	1	1	4	3	21	Medium-High
Howard	24027	3	3	2	4	2	2	4	4	5	30.5	High
Kent	24029	1	1	1	1	1	1	1	4	3	15	Medium
Montgomery	24031	4	4	2	4	2	2	2	4	3	25.5	High
Prince George's	24033	4	3	2	4	2	2	4	4	4	29.5	High
Queen Anne's	24035	1	1	2	4	1	1	1	4	3	19	Medium-High
St. Mary's	24037	2	2	2	4	1	1	1	4	5	23	High
Somerset	24039	1	1	1	1	1	1	1	4	3	15	Medium
Talbot	24041	1	1	1	4	1	1	1	4	5	21	Medium-High

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		WINTER STORM								
County	FIPS	PV	PN	WW_IN	WW_DT	WW_PD	WW_CD	WW_GE	WW_EV	WW_Local	WW_RS	WW_Rank
Washington	24043	3	2	2	4	1	3	2	4	2	22.5	Medium-High
Wicomico	24045	2	2	1	1	3	1	1	4	4	19.5	Medium-High
Worcester	24047	2	1	1	1	1	1	1	4	2	14	Medium-Low
City of Baltimore	24510	4	4	2	4	2	1	1	4	5	26	High

Table J-28: Overall Ranking: Soil Movement – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		SOIL MOVEMENT								
County	FIPS	PV	PN	SM_IN	SM_DT	SM_PD	SM_CD	SM_GE	SM_EV	SM_Local	SM_RS	SM_Rank
Allegany	24001	2	1	1	1	1	1	4	1	3	17	Medium
Anne Arundel	24003	4	3	1	1	1	1	1	1	5	17.5	Medium
Baltimore	24005	4	3	1	1	1	1	3	1	2	16	Medium
Calvert	24009	2	2	1	1	1	1	1	1	1	10	Low
Caroline	24011	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
Carroll	24013	3	2	1	1	1	1	3	1	4	18	Medium
Cecil	24015	2	2	1	1	1	1	1	1	1	10	Low
Charles	24017	3	2	1	1	1	1	1	1	1	10.5	Medium-Low
Dorchester	24019	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Frederick	24021	3	2	1	1	1	1	3	1	3	16.5	Medium
Garrett	24023	1	1	1	1	1	1	4	1	4	18	Medium
Harford	24025	3	3	1	1	1	1	2	1	0	11	Medium
Howard	24027	3	3	1	1	1	1	1	1	0	9.5	Medium-Low
Kent	24029	1	1	1	1	1	1	1	1	1	9	Medium-Low
Montgomery	24031	4	4	1	1	1	1	2	1	1	13.5	Medium-Low
Prince George's	24033	4	3	1	1	1	1	1	1	2	13	Medium-Low
Queen Anne's	24035	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
St. Mary's	24037	2	2	1	1	1	1	1	1	0	8.5	Medium-Low
Somerset	24039	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Talbot	24041	1	1	1	1	1	1	1	1	0	7.5	Medium-Low

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		SOIL MOVEMENT								
County	FIPS	PV	PN	SM_IN	SM_DT	SM_PD	SM_CD	SM_GE	SM_EV	SM_Local	SM_RS	SM_Rank
Washington	24043	3	2	1	1	1	1	4	1	1	15	Medium
Wicomico	24045	2	2	1	1	1	1	1	1	2	11.5	Medium-Low
Worcester	24047	2	1	1	1	1	1	1	1	0	8	Medium-Low
City of Baltimore	24510	4	4	1	1	1	1	2	1	2	15	Medium

Table J-29: Overall Ranking: Public Health Emergencies – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		PUBLIC HEALTH EMERGENCIES								
County	FIPS	PV	PN	PH_IN	PH_DT	PH_PD	PH_CD	PH_GE	PH_EV	PH_Local	PH_RS	PH_Rank
Allegany	24001	2	1	1	4	1	1	4	3	2	20.5	Medium-High
Anne Arundel	24003	2	1	1	4	1	1	1	4	0	16	Medium-High
Baltimore	24005	4	3	1	4	1	1	1	4	1	17.5	Medium
Calvert	24009	4	3	1	4	1	1	1	2	0	12.5	Medium
Caroline	24011	2	2	1	4	1	1	4	1	3	19.5	Medium-High
Carroll	24013	1	1	1	4	1	1	1	3	0	14	Medium-High
Cecil	24015	3	2	1	4	1	1	2	3	0	15	Medium-High
Charles	24017	2	2	1	4	1	1	1	2	5	20.5	Medium-High
Dorchester	24019	3	2	1	4	1	1	3	1	2	16.5	Medium
Frederick	24021	1	1	1	4	1	1	1	3	0	14	Medium-High
Garrett	24023	3	2	1	4	1	1	4	1	4	21	Medium-High
Harford	24025	1	1	1	4	1	1	1	4	0	15.5	Medium-High
Howard	24027	3	3	1	4	1	1	1	3	0	14.5	Medium-High
Kent	24029	3	3	1	4	1	1	3	1	5	21	Medium-High
Montgomery	24031	1	1	1	4	1	1	1	4	0	16.5	Medium-High
Prince George's	24033	4	4	1	4	1	1	1	4	0	16	Medium-High
Queen Anne's	24035	4	3	1	4	1	1	1	2	0	11.5	Medium
St. Mary's	24037	1	1	1	4	1	1	1	1	0	11.5	Medium
Somerset	24039	2	2	1	4	1	1	4	2	5	23.5	High
Talbot	24041	1	1	1	4	1	1	2	2	0	13	Medium

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		PUBLIC HEALTH EMERGENCIES								
County	FIPS	PV	PN	PH_IN	PH_DT	PH_PD	PH_CD	PH_GE	PH_EV	PH_Local	PH_RS	PH_Rank
Washington	**24043**	1	1	1	4	1	1	3	3	1	18.5	**Medium-High**
Wicomico	**24045**	3	2	1	4	1	1	3	3	3	21	**Medium-High**
Worcester	**24047**	2	2	1	4	1	1	3	2	0	15	**Medium-High**
City of Baltimore	**24510**	2	1	1	4	1	1	1	4	0	16.5	**Medium-High**

Table J-30: Overall Ranking: Dam Failures – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		DAM FAILURES								
County	FIPS	PV	PN	DF_IN	DF_DT	DF_PD	DF_CD	DF_GE	DF_EV	DF_Local	DF_RS	DF_Rank
Allegany	24001	2	1	1	1	1	1	1	1	0	8	Medium-Low
Anne Arundel	24003	4	3	1	1	1	1	3	1	1	14.5	Medium
Baltimore	24005	4	3	1	1	1	1	2	1	3	16	Medium
Calvert	24009	2	2	1	1	1	1	2	1	1	11.5	Medium-Low
Caroline	24011	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Carroll	24013	3	2	1	1	1	1	2	3	3	17	Medium
Cecil	24015	2	2	1	1	1	1	2	2	1	12.5	Medium-Low
Charles	24017	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
Dorchester	24019	1	1	1	1	1	1	1	1	1	9	Low
Frederick	24021	3	2	1	1	1	1	2	3	1	14	Medium-Low
Garrett	24023	1	1	1	1	1	1	1	1	3	12	Medium-Low
Harford	24025	3	3	1	1	1	1	2	3	0	13	Medium
Howard	24027	3	3	1	1	1	1	4	2	0	15	Medium-High
Kent	24029	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Montgomery	24031	4	4	1	1	1	1	3	2	0	14.5	Medium-High
Prince George's	24033	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Queen Anne's	24035	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
St. Mary's	24037	2	2	1	1	1	1	1	2	0	9.5	Medium-Low
Somerset	24039	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Talbot	24041	1	1	1	1	1	1	1	1	0	7.5	Medium-Low

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		DAM FAILURES								
County	FIPS	PV	PN	DF_IN	DF_DT	DF_PD	DF_CD	DF_GE	DF_EV	DF_Local	DF_RS	DF_Rank
Washington	24043	3	2	1	1	1	1	1	2	0	10	Medium
Wicomico	24045	2	2	1	1	1	1	1	4	3	16	Medium
Worcester	24047	2	1	1	1	1	1	1	2	0	9	Medium-Low
City of Baltimore	24510	4	4	1	1	1	1	1	2	2	14.5	Medium

Table J-31: Overall Ranking: Extreme Temperatures – March 2021

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		EXTREME TEMPERATURES								
County	FIPS	PV	PN	ET_IN	ET_DT	ET_PD	ET_CD	ET_GE	ET_EV	ET_Local	ET_RS	ET_Rank
Allegany	24001	2	1	1	1	1	1	2	3	4	17.5	Medium
Anne Arundel	24003	4	3	1	4	1	1	4	2	3	23	High
Baltimore	24005	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Calvert	24009	2	2	1	1	1	1	2	1	5	17.5	Medium
Caroline	24011	1	1	1	1	1	1	1	1	3	12	Medium-Low
Carroll	24013	3	2	1	1	1	1	2	1	0	10.5	Medium
Cecil	24015	2	2	1	1	1	1	2	1	3	14.5	Medium
Charles	24017	3	2	1	1	1	1	2	1	5	18	Medium
Dorchester	24019	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
Frederick	24021	3	2	1	4	1	1	2	1	3	18	Medium
Garrett	24023	1	1	1	1	1	1	2	1	1	10.5	Medium-Low
Harford	24025	3	3	1	1	1	1	2	1	0	11	Medium
Howard	24027	3	3	1	1	1	1	3	2	0	13.5	Medium
Kent	24029	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
Montgomery	24031	4	4	1	4	1	1	3	2	3	22	Medium-High
Prince George's	24033	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Queen Anne's	24035	1	1	1	1	1	1	1	1	5	15	Medium
St. Mary's	24037	2	2	1	1	1	1	2	1	0	10	Medium
Somerset	24039	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
Talbot	24041	1	1	1	1	1	1	1	1	3	12	Medium-Low

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		EXTREME TEMPERATURES								
County	FIPS	PV	PN	ET_IN	ET_DT	ET_PD	ET_CD	ET_GE	ET_EV	ET_Local	ET_RS	ET_Rank
Washington	24043	3	2	1	1	1	1	2	1	2	13.5	Medium-Low
Wicomico	24045	2	2	1	1	1	1	1	1	3	13	Medium-Low
Worcester	24047	2	1	1	1	1	1	1	1	3	12.5	Medium-Low
City of Baltimore	24510	4	4	1	4	1	1	1	1	5	21	Medium-High

Table J-32: Overall Ranking: Extreme Temperatures – March 2021

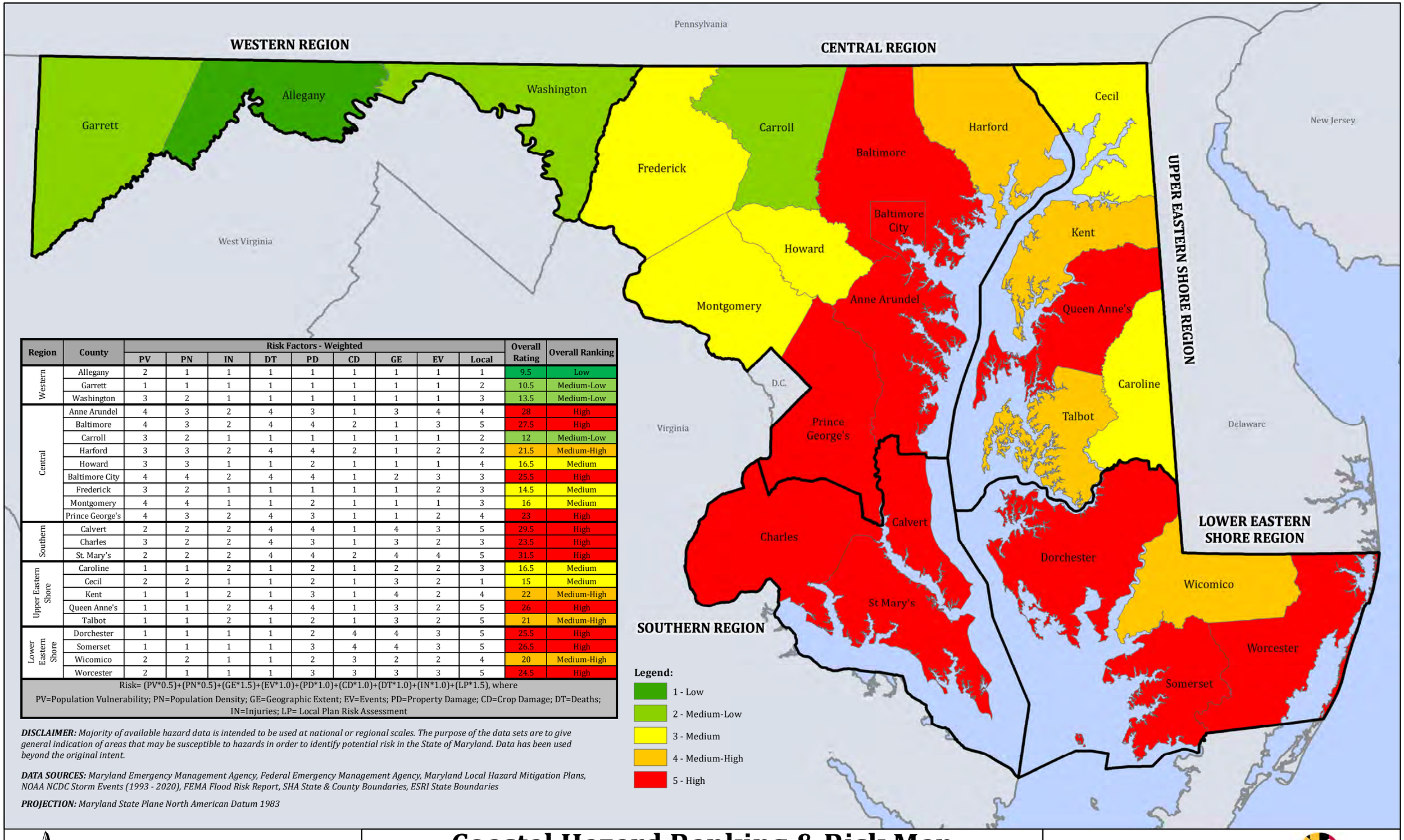
Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		HUMAN-CAUSED HAZARDS & THREATS								
County	FIPS	PV	PN	HC_IN	HC_DT	HC_PD	HC_CD	HC_GE	HC_EV	HC_Local	HC_RS	HC_Rank
Allegany	24001	2	1	1	1	1	1	2	3	4	17.5	Medium
Anne Arundel	24003	4	3	1	1	1	1	4	4	0	17.5	Medium-High
Baltimore	24005	4	3	1	1	1	1	4	4	5	25	High
Calvert	24009	2	2	1	1	1	1	1	2	1	11	Medium-Low
Caroline	24011	1	1	1	1	1	1	1	2	0	8.5	Medium-Low
Carroll	24013	3	2	1	1	1	1	2	2	0	11.5	Medium
Cecil	24015	2	2	1	1	1	1	3	3	3	18	Medium
Charles	24017	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
Dorchester	24019	1	1	1	1	1	1	2	3	2	14	Medium-Low
Frederick	24021	3	2	1	1	1	1	3	3	0	14	Medium-High
Garrett	24023	1	1	1	1	1	1	1	1	3	12	Medium-Low
Harford	24025	3	3	1	1	1	1	2	2	0	12	Medium
Howard	24027	3	3	1	1	1	1	4	4	0	17	Medium-High
Kent	24029	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Montgomery	24031	4	4	1	1	1	1	3	3	0	15.5	Medium-High
Prince George's	24033	4	3	1	1	1	1	4	4	0	17.5	Medium-High
Queen Anne's	24035	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
St. Mary's	24037	2	2	1	1	1	1	1	1	0	8.5	Medium-Low
Somerset	24039	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
Talbot	24041	1	1	1	1	1	1	2	2	0	10	Medium

Overall Ranking – March 2021												
(SORTED BY FIPS CODE)		POPULATION		HUMAN-CAUSED HAZARDS & THREATS								
County	FIPS	PV	PN	HC_IN	HC_DT	HC_PD	HC_CD	HC_GE	HC_EV	HC_Local	HC_RS	HC_Rank
Washington	24043	3	2	1	1	1	1	4	4	3	21	Medium-High
Wicomico	24045	2	2	1	1	1	1	3	3	0	13.5	Medium
Worcester	24047	2	1	1	1	1	1	1	1	2	11	Medium-Low
City of Baltimore	24510	4	4	1	1	1	1	3	3	0	15.5	Medium-High

APPENDIX K

Risk Assessment Mapping

This page left blank intentionally



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	1	9.5	Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
Central	Anne Arundel	4	3	2	4	3	1	3	4	4	28	High
	Baltimore	4	3	2	4	4	2	1	3	5	27.5	High
	Carroll	3	2	1	1	1	1	1	1	2	12	Medium-Low
	Harford	3	3	2	4	4	2	1	2	2	21.5	Medium-High
	Howard	3	3	1	1	2	1	1	1	4	16.5	Medium
	Baltimore City	4	4	2	4	4	1	2	3	3	25.5	High
	Frederick	3	2	1	1	1	1	1	2	3	14.5	Medium
	Montgomery	4	4	1	1	2	1	1	1	3	16	Medium
	Prince George's	4	3	2	4	3	1	1	2	4	23	High
Southern	Calvert	2	2	2	4	4	1	4	3	5	29.5	High
	Charles	3	2	2	4	3	1	3	2	3	23.5	High
	St. Mary's	2	2	2	4	4	2	4	4	5	31.5	High
Upper Eastern Shore	Caroline	1	1	2	1	2	1	2	2	3	16.5	Medium
	Cecil	2	2	1	1	2	1	3	2	1	15	Medium
	Kent	1	1	2	1	3	1	4	2	4	22	Medium-High
	Queen Anne's	1	1	2	4	4	1	3	2	5	26	High
	Talbot	1	1	2	1	2	1	3	2	5	21	Medium-High
Lower Eastern Shore	Dorchester	1	1	1	1	2	4	4	3	5	25.5	High
	Somerset	1	1	1	1	3	4	4	3	5	26.5	High
	Wicomico	2	2	1	1	2	3	2	2	4	20	Medium-High
	Worcester	2	1	1	1	3	3	3	3	5	24.5	High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA Flood Risk Report, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

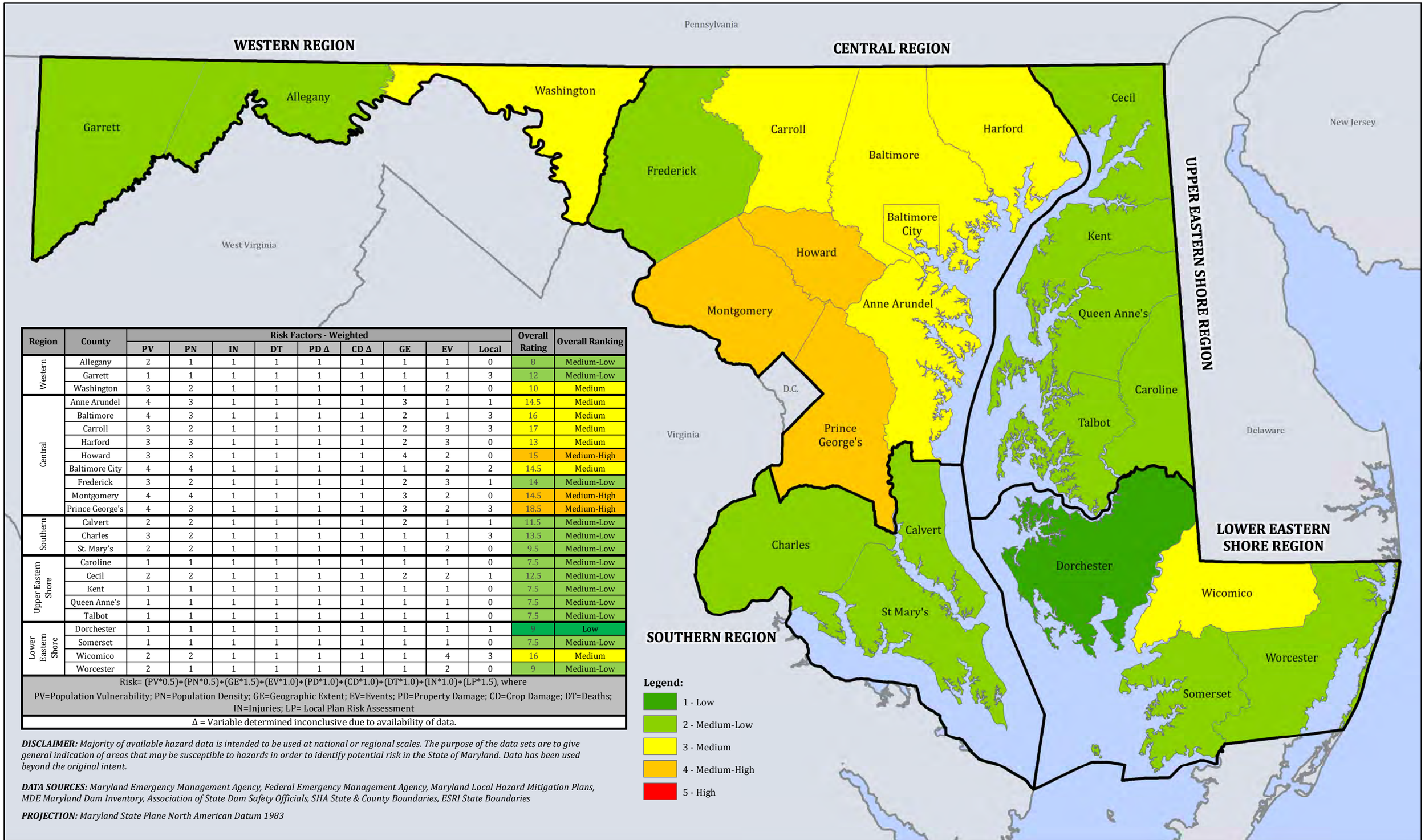
0 5 10 20 30 Miles

Coastal Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	0	8	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	1	1	1	1	1	2	0	10	Medium
Central	Anne Arundel	4	3	1	1	1	1	3	1	1	14.5	Medium
	Baltimore	4	3	1	1	1	1	2	1	3	16	Medium
	Carroll	3	2	1	1	1	1	2	3	3	17	Medium
	Harford	3	3	1	1	1	1	2	3	0	13	Medium
	Howard	3	3	1	1	1	1	4	2	0	15	Medium-High
	Baltimore City	4	4	1	1	1	1	1	2	2	14.5	Medium
	Frederick	3	2	1	1	1	1	2	3	1	14	Medium-Low
	Montgomery	4	4	1	1	1	1	3	2	0	14.5	Medium-High
	Prince George's	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Southern	Calvert	2	2	1	1	1	1	2	1	1	11.5	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	2	0	9.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Cecil	2	2	1	1	1	1	2	2	1	12.5	Medium-Low
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	1	9	Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	4	3	16	Medium
	Worcester	2	1	1	1	1	1	1	2	0	9	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

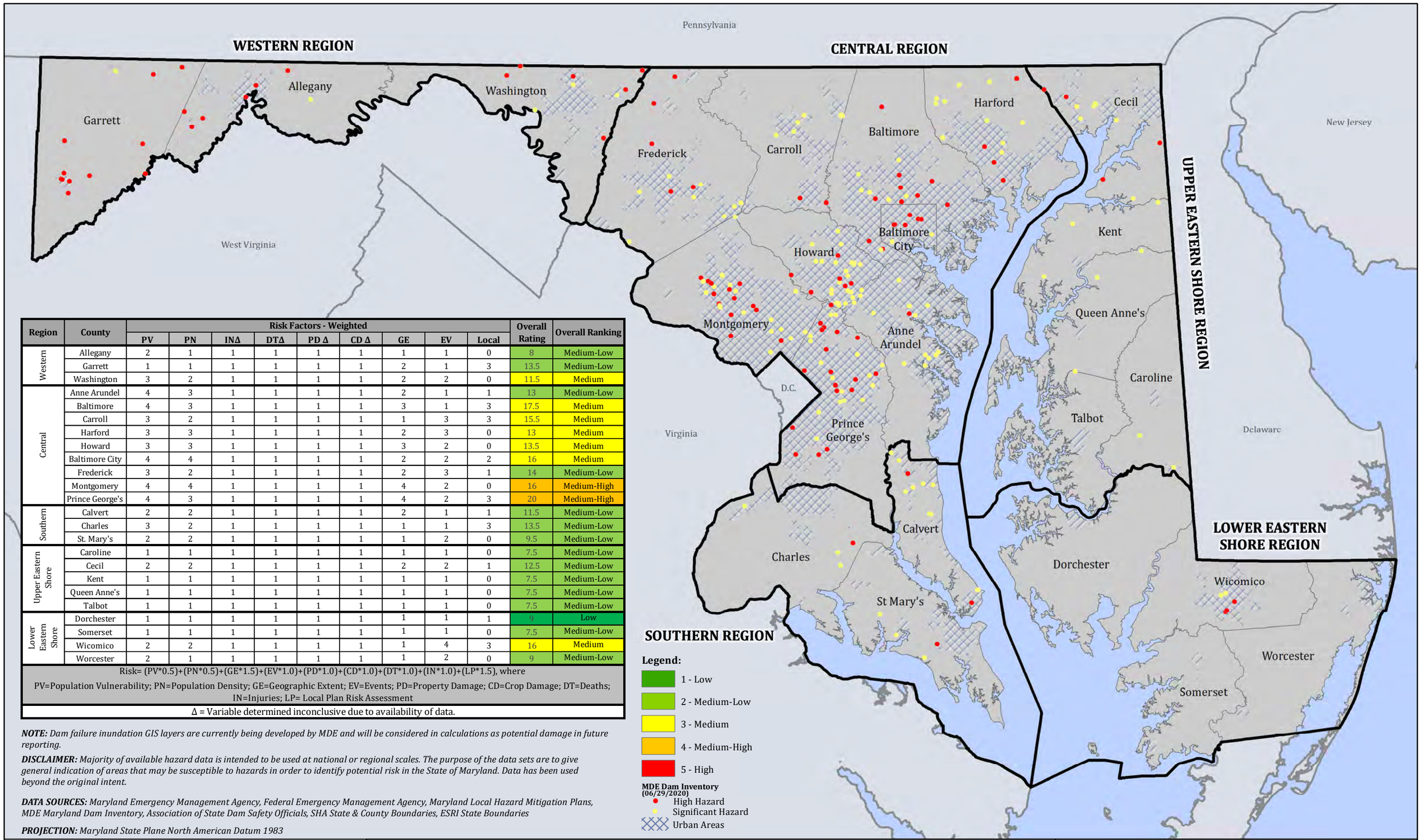
0 5 10 20 30 Miles

Dam Failure Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	INΔ	DTΔ	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	0	8	Medium-Low
	Garrett	1	1	1	1	1	1	2	1	3	13.5	Medium-Low
	Washington	3	2	1	1	1	1	2	2	0	11.5	Medium
Central	Anne Arundel	4	3	1	1	1	1	2	1	1	13	Medium-Low
	Baltimore	4	3	1	1	1	1	3	1	3	17.5	Medium
	Carroll	3	2	1	1	1	1	1	3	3	15.5	Medium
	Harford	3	3	1	1	1	1	2	3	0	13	Medium
	Howard	3	3	1	1	1	1	3	2	0	13.5	Medium
	Baltimore City	4	4	1	1	1	1	2	2	2	16	Medium
	Frederick	3	2	1	1	1	1	2	3	1	14	Medium-Low
	Montgomery	4	4	1	1	1	1	4	2	0	16	Medium-High
	Prince George's	4	3	1	1	1	1	4	2	3	20	Medium-High
Southern	Calvert	2	2	1	1	1	1	2	1	1	11.5	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	2	0	9.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Cecil	2	2	1	1	1	1	2	2	1	12.5	Medium-Low
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	1	9	Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	4	3	16	Medium
	Worcester	2	1	1	1	1	1	1	2	0	9	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

NOTE: *Dam failure inundation GIS layers are currently being developed by MDE and will be considered in calculations as potential damage in future reporting.*

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

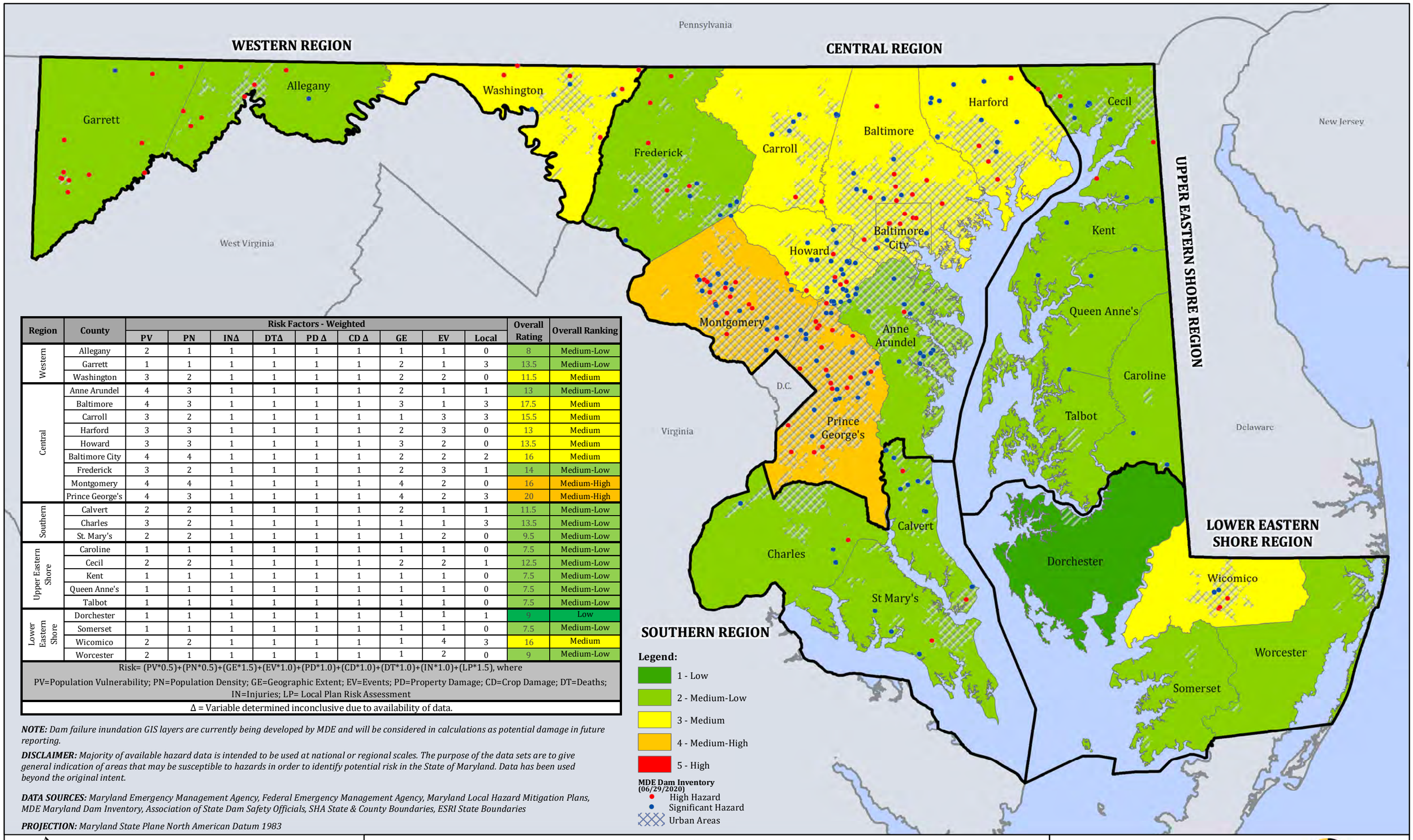
0 5 10 20 30 Miles

Dam Failure Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	INΔ	DTΔ	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	0	8	Medium-Low
	Garrett	1	1	1	1	1	1	2	1	3	13.5	Medium-Low
	Washington	3	2	1	1	1	1	2	2	0	11.5	Medium
Central	Anne Arundel	4	3	1	1	1	1	2	1	1	13	Medium-Low
	Baltimore	4	3	1	1	1	1	3	1	3	17.5	Medium
	Carroll	3	2	1	1	1	1	1	3	3	15.5	Medium
	Harford	3	3	1	1	1	1	2	3	0	13	Medium
	Howard	3	3	1	1	1	1	3	2	0	13.5	Medium
	Baltimore City	4	4	1	1	1	1	2	2	2	16	Medium
	Frederick	3	2	1	1	1	1	2	3	1	14	Medium-Low
	Montgomery	4	4	1	1	1	1	4	2	0	16	Medium-High
	Prince George's	4	3	1	1	1	1	4	2	3	20	Medium-High
Southern	Calvert	2	2	1	1	1	1	2	1	1	11.5	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	2	0	9.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Cecil	2	2	1	1	1	1	2	2	1	12.5	Medium-Low
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	1	9	Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	4	3	16	Medium
	Worcester	2	1	1	1	1	1	1	2	0	9	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

NOTE: *Dam failure inundation GIS layers are currently being developed by MDE and will be considered in calculations as potential damage in future reporting.*

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, MDE Maryland Dam Inventory, Association of State Dam Safety Officials, SHA State & County Boundaries, ESRI State Boundaries*

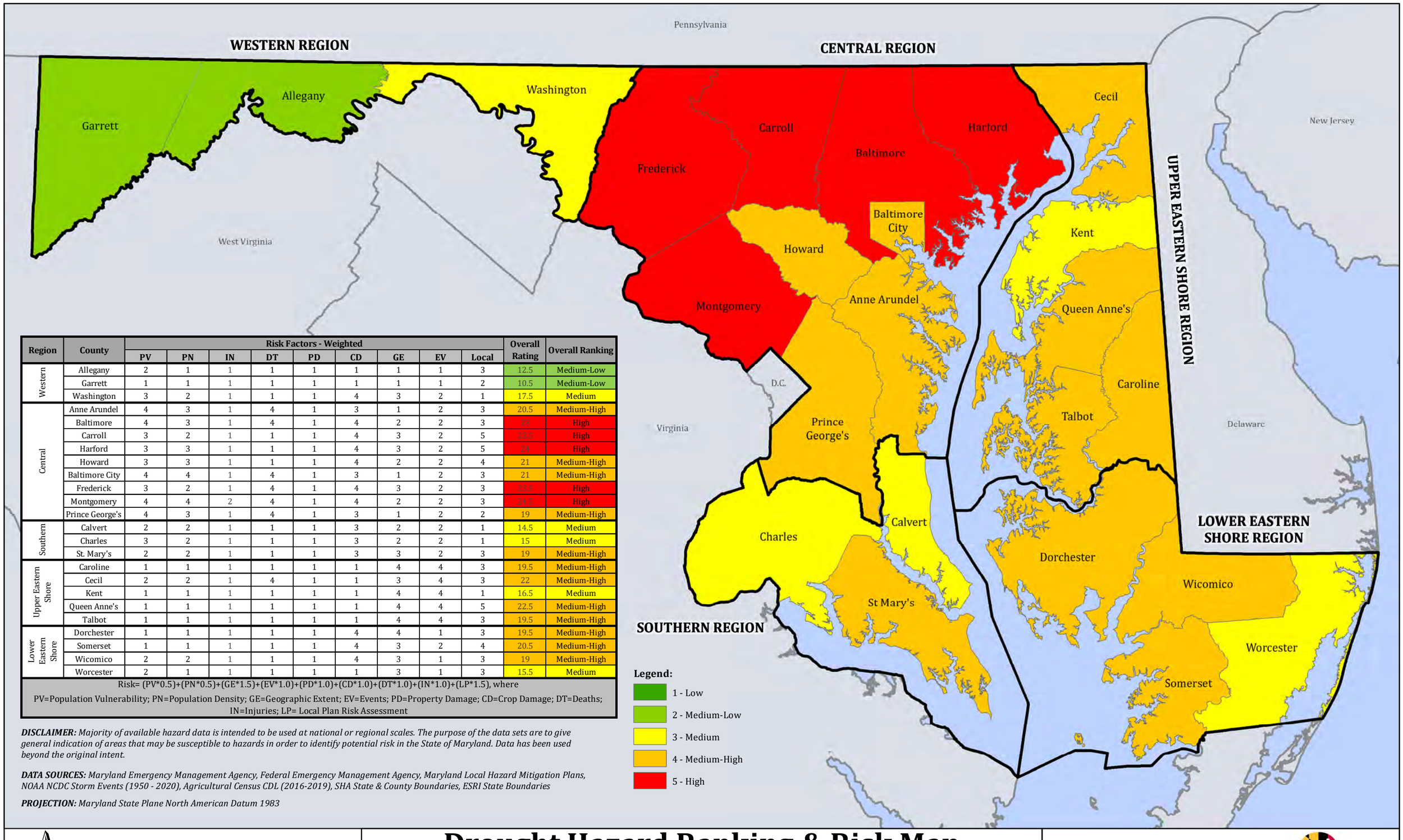
PROJECTION: *Maryland State Plane North American Datum 1983*

Dam Failure Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	1	3	12.5	Medium-Low
	Garrett	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Washington	3	2	1	1	1	4	3	2	1	17.5	Medium
Central	Anne Arundel	4	3	1	4	1	3	1	2	3	20.5	Medium-High
	Baltimore	4	3	1	4	1	4	2	2	3	23	High
	Carroll	3	2	1	1	1	4	3	2	5	23.5	High
	Harford	3	3	1	1	1	4	3	2	5	24	High
	Howard	3	3	1	1	1	4	2	2	4	21	Medium-High
	Baltimore City	4	4	1	4	1	3	1	2	3	21	Medium-High
	Frederick	3	2	1	4	1	4	3	2	3	23.5	High
	Montgomery	4	4	2	4	1	4	2	2	3	24.5	High
	Prince George's	4	3	1	4	1	3	1	2	2	19	Medium-High
Southern	Calvert	2	2	1	1	1	3	2	2	1	14.5	Medium
	Charles	3	2	1	1	1	3	2	2	1	15	Medium
	St. Mary's	2	2	1	1	1	3	3	2	3	19	Medium-High
Upper Eastern Shore	Caroline	1	1	1	1	1	1	4	4	3	19.5	Medium-High
	Cecil	2	2	1	4	1	1	3	4	3	22	Medium-High
	Kent	1	1	1	1	1	1	4	4	1	16.5	Medium
	Queen Anne's	1	1	1	1	1	1	4	4	5	22.5	Medium-High
	Talbot	1	1	1	1	1	1	4	4	3	19.5	Medium-High
Lower Eastern Shore	Dorchester	1	1	1	1	1	4	4	1	3	19.5	Medium-High
	Somerset	1	1	1	1	1	4	3	2	4	20.5	Medium-High
	Wicomico	2	2	1	1	1	4	3	1	3	19	Medium-High
	Worcester	2	1	1	1	1	1	3	1	3	15.5	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Agricultural Census CDL (2016-2019), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

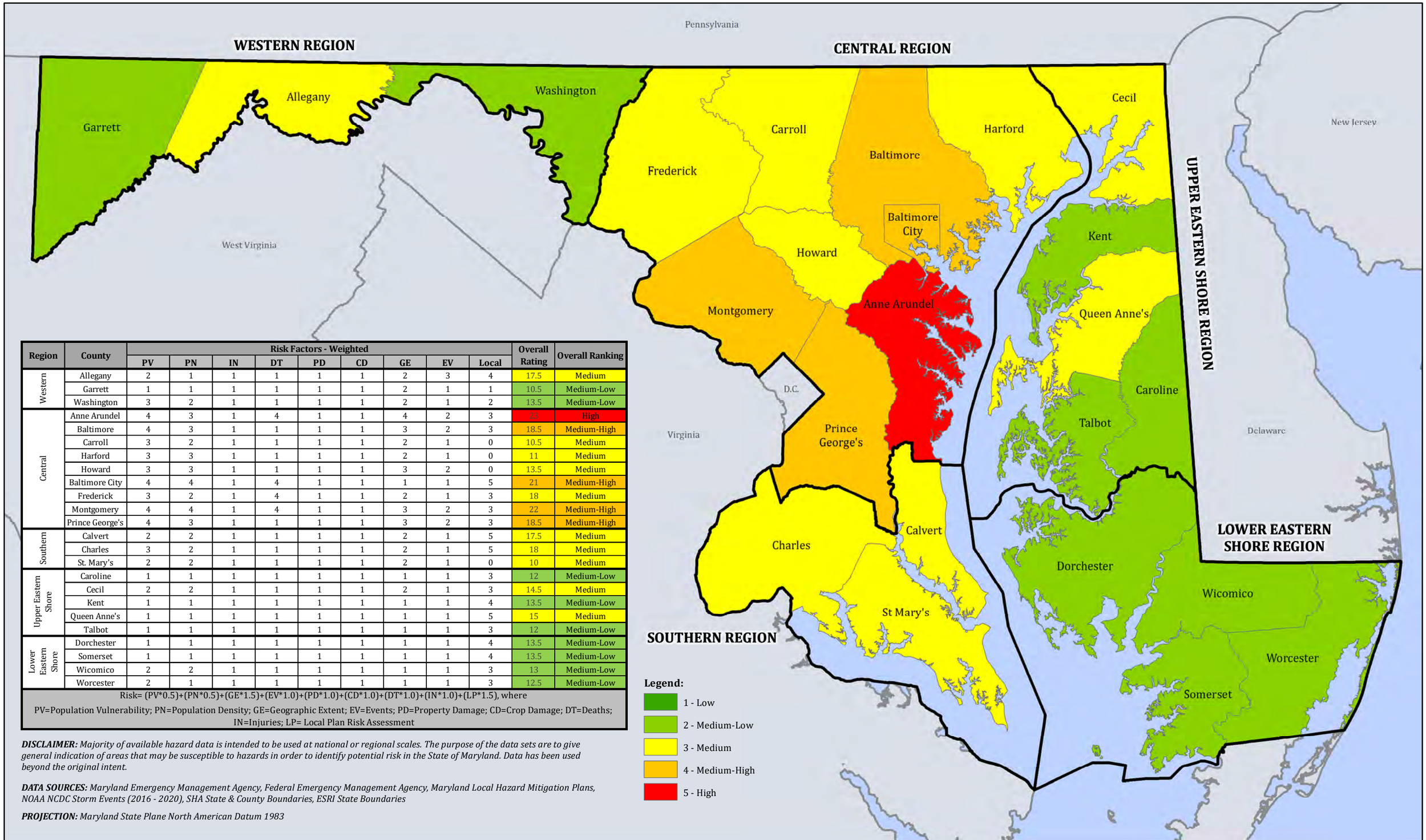
0 5 10 20 30 Miles

Drought Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2020

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	2	3	4	17.5	Medium
	Garrett	1	1	1	1	1	1	2	1	1	10.5	Medium-Low
	Washington	3	2	1	1	1	1	2	1	2	13.5	Medium-Low
Central	Anne Arundel	4	3	1	4	1	1	4	2	3	24	High
	Baltimore	4	3	1	1	1	1	3	2	3	18.5	Medium-High
	Carroll	3	2	1	1	1	1	2	1	0	10.5	Medium
	Harford	3	3	1	1	1	1	2	1	0	11	Medium
	Howard	3	3	1	1	1	1	3	2	0	13.5	Medium
	Baltimore City	4	4	1	4	1	1	1	1	5	21	Medium-High
	Frederick	3	2	1	4	1	1	2	1	3	18	Medium
	Montgomery	4	4	1	4	1	1	3	2	3	22	Medium-High
	Prince George's	4	3	1	1	1	1	3	2	3	18.5	Medium-High
Southern	Calvert	2	2	1	1	1	1	2	1	5	17.5	Medium
	Charles	3	2	1	1	1	1	2	1	5	18	Medium
	St. Mary's	2	2	1	1	1	1	2	1	0	10	Medium
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Cecil	2	2	1	1	1	1	2	1	3	14.5	Medium
	Kent	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	5	15	Medium
	Talbot	1	1	1	1	1	1	1	1	3	12	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	1	3	13	Medium-Low
	Worcester	2	1	1	1	1	1	1	1	3	12.5	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

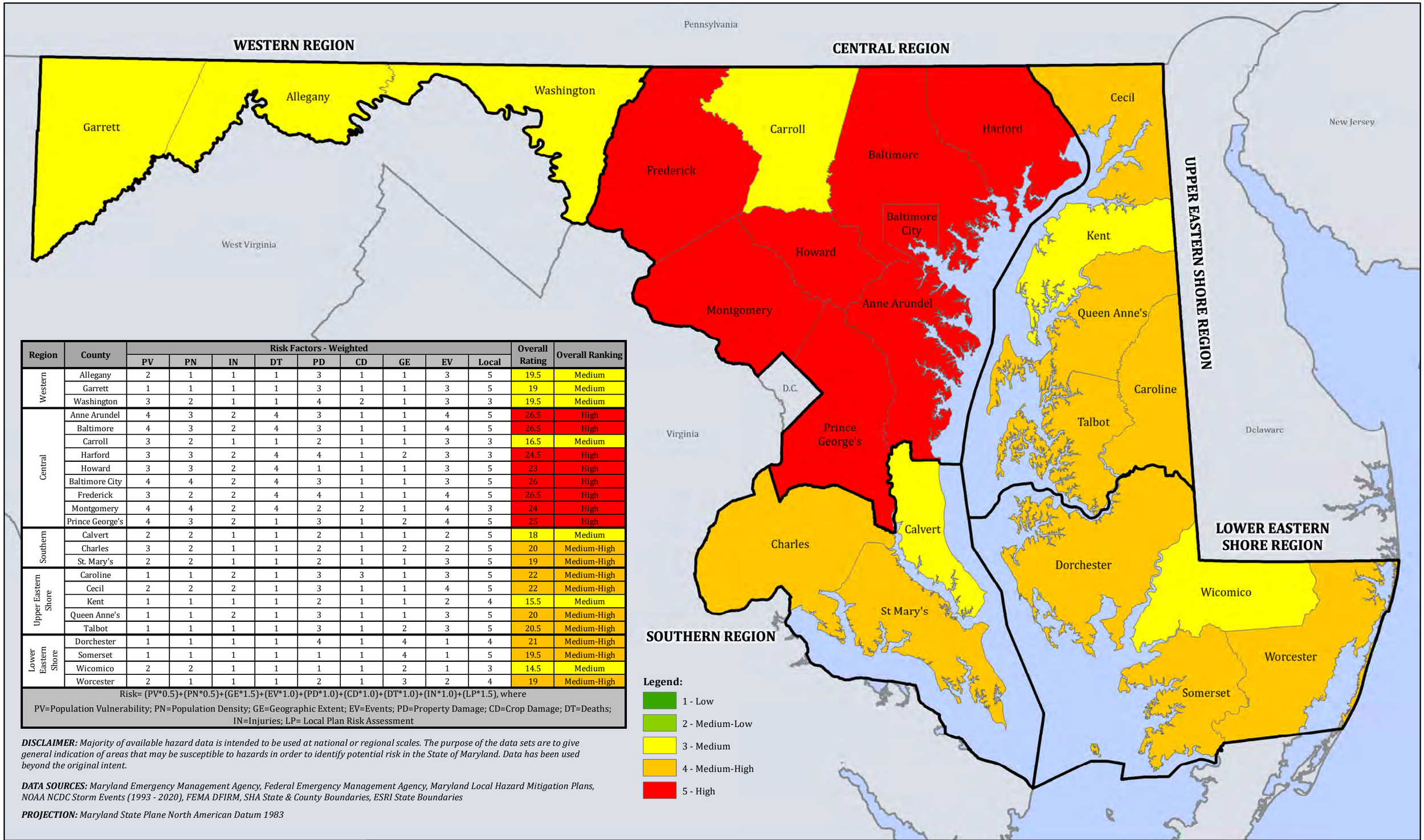
0 5 10 20 30 Miles

Extreme Temperatures Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	3	1	1	3	5	19.5	Medium
	Garrett	1	1	1	1	3	1	1	3	5	19	Medium
	Washington	3	2	1	1	4	2	1	3	3	19.5	Medium
Central	Anne Arundel	4	3	2	4	3	1	1	4	5	26.5	High
	Baltimore	4	3	2	4	3	1	1	4	5	26.5	High
	Carroll	3	2	1	1	2	1	1	3	3	16.5	Medium
	Harford	3	3	2	4	4	1	2	3	3	24.5	High
	Howard	3	3	2	4	1	1	1	3	5	23	High
	Baltimore City	4	4	2	4	3	1	1	3	5	26	High
	Frederick	3	2	2	4	4	1	1	4	5	26.5	High
	Montgomery	4	4	2	4	2	2	1	4	3	24	High
	Prince George's	4	3	2	1	3	1	2	4	5	25	High
Southern	Calvert	2	2	1	1	2	1	1	2	5	18	Medium
	Charles	3	2	1	1	2	1	2	2	5	20	Medium-High
	St. Mary's	2	2	1	1	2	1	1	3	5	19	Medium-High
Upper Eastern Shore	Caroline	1	1	2	1	3	3	1	3	5	22	Medium-High
	Cecil	2	2	2	1	3	1	1	4	5	22	Medium-High
	Kent	1	1	1	1	2	1	1	2	4	15.5	Medium
	Queen Anne's	1	1	2	1	3	1	1	3	5	20	Medium-High
	Talbot	1	1	1	1	3	1	2	3	5	20.5	Medium-High
Lower Eastern Shore	Dorchester	1	1	1	1	4	1	4	1	4	21	Medium-High
	Somerset	1	1	1	1	1	1	4	1	5	19.5	Medium-High
	Wicomico	2	2	1	1	1	1	2	1	3	14.5	Medium
	Worcester	2	1	1	1	2	1	3	2	4	19	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), FEMA DFIRM, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

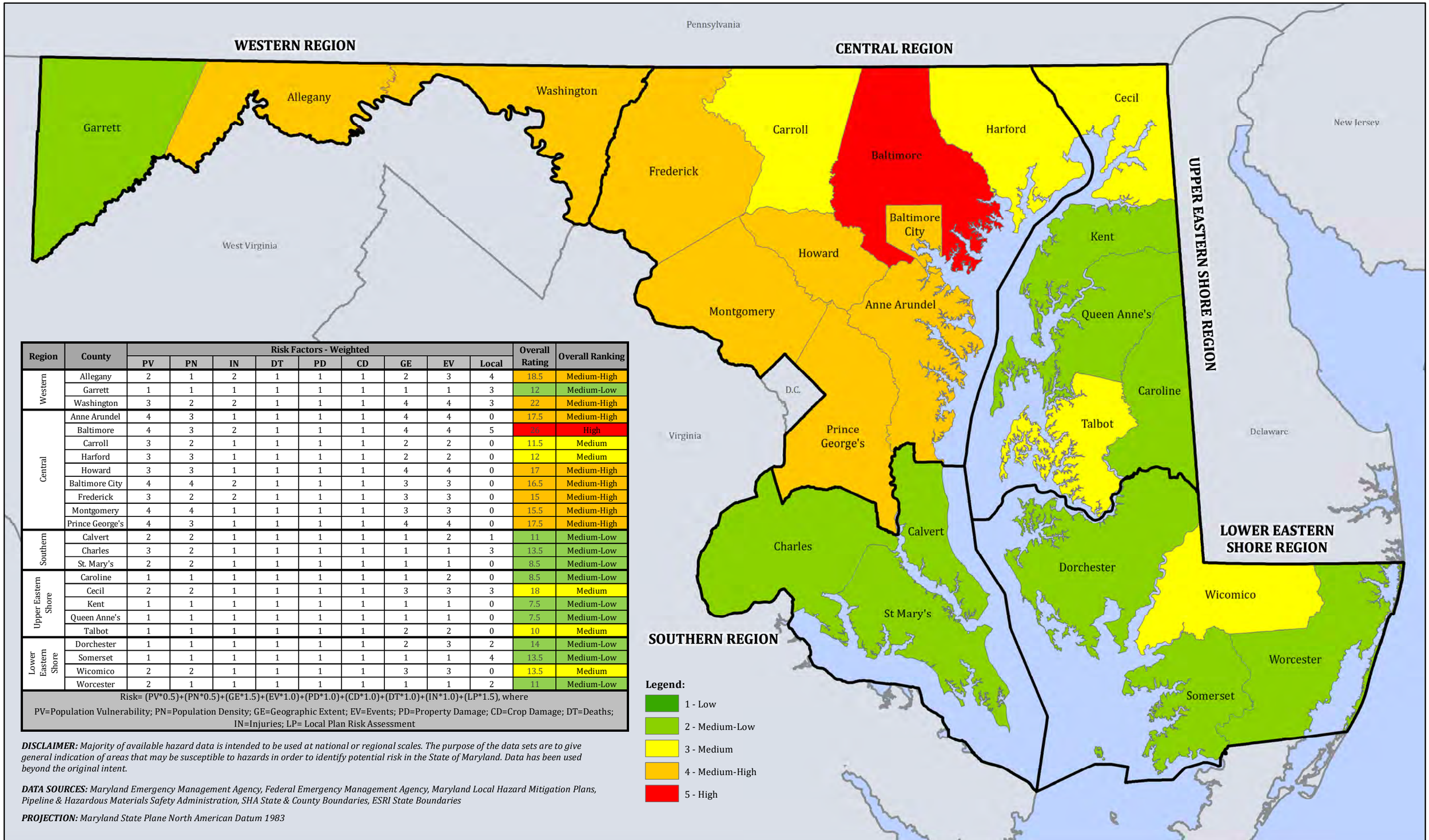
0 5 10 20 30 Miles

Flood Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	2	3	4	18.5	Medium-High
	Garrett	1	1	1	1	1	1	1	1	3	12	Medium-Low
	Washington	3	2	2	1	1	1	4	4	3	22	Medium-High
Central	Anne Arundel	4	3	1	1	1	1	4	4	0	17.5	Medium-High
	Baltimore	4	3	2	1	1	1	4	4	5	26	High
	Carroll	3	2	1	1	1	1	2	2	0	11.5	Medium
	Harford	3	3	1	1	1	1	2	2	0	12	Medium
	Howard	3	3	1	1	1	1	4	4	0	17	Medium-High
	Baltimore City	4	4	2	1	1	1	3	3	0	16.5	Medium-High
	Frederick	3	2	2	1	1	1	3	3	0	15	Medium-High
	Montgomery	4	4	1	1	1	1	3	3	0	15.5	Medium-High
	Prince George's	4	3	1	1	1	1	4	4	0	17.5	Medium-High
Southern	Calvert	2	2	1	1	1	1	1	2	1	11	Medium-Low
	Charles	3	2	1	1	1	1	1	1	3	13.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	1	0	8.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	2	0	8.5	Medium-Low
	Cecil	2	2	1	1	1	1	3	3	3	18	Medium
	Kent	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	2	2	0	10	Medium
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	2	3	2	14	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Wicomico	2	2	1	1	1	1	3	3	0	13.5	Medium
	Worcester	2	1	1	1	1	1	1	1	2	11	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Pipeline & Hazardous Materials Safety Administration, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 5 10 20 30 Miles

Human Caused Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT	PD Δ	CD Δ	GE	EV	Local		
Western	Allegany	2	1	1	4	1	1	4	3	2	20.5	Medium-High
	Garrett	1	1	1	4	1	1	4	1	4	21	Medium-High
	Washington	3	2	1	4	1	1	3	3	1	18.5	Medium-High
Central	Anne Arundel	4	3	1	4	1	1	1	4	0	16	Medium-High
	Baltimore	4	3	1	4	1	1	1	4	1	17.5	Medium
	Carroll	3	2	1	4	1	1	1	3	0	14	Medium-High
	Harford	3	3	1	4	1	1	1	4	0	15.5	Medium-High
	Howard	3	3	1	4	1	1	1	3	0	14.5	Medium-High
	Baltimore City	4	4	1	4	1	1	1	4	0	16.5	Medium-High
	Frederick	3	2	1	4	1	1	1	3	0	14	Medium-High
	Montgomery	4	4	1	4	1	1	1	4	0	16.5	Medium-High
	Prince George's	4	3	1	4	1	1	1	4	0	16	Medium-High
Southern	Calvert	2	2	1	4	1	1	1	2	0	12.5	Medium
	Charles	3	2	1	4	1	1	1	2	5	20.5	Medium-High
	St. Mary's	2	2	1	4	1	1	1	1	0	11.5	Medium
Upper Eastern Shore	Caroline	1	1	1	4	1	1	4	1	3	19.5	Medium-High
	Cecil	2	2	1	4	1	1	2	3	0	15	Medium-High
	Kent	1	1	1	4	1	1	3	1	5	21	Medium-High
	Queen Anne's	1	1	1	4	1	1	1	2	0	11.5	Medium
	Talbot	1	1	1	4	1	1	2	2	0	13	Medium
Lower Eastern Shore	Dorchester	1	1	1	4	1	1	3	1	2	16.5	Medium
	Somerset	1	1	1	4	1	1	4	2	5	23.5	High
	Wicomico	2	2	1	4	1	1	3	3	3	21	Medium-High
	Worcester	2	1	1	4	1	1	3	2	0	15	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

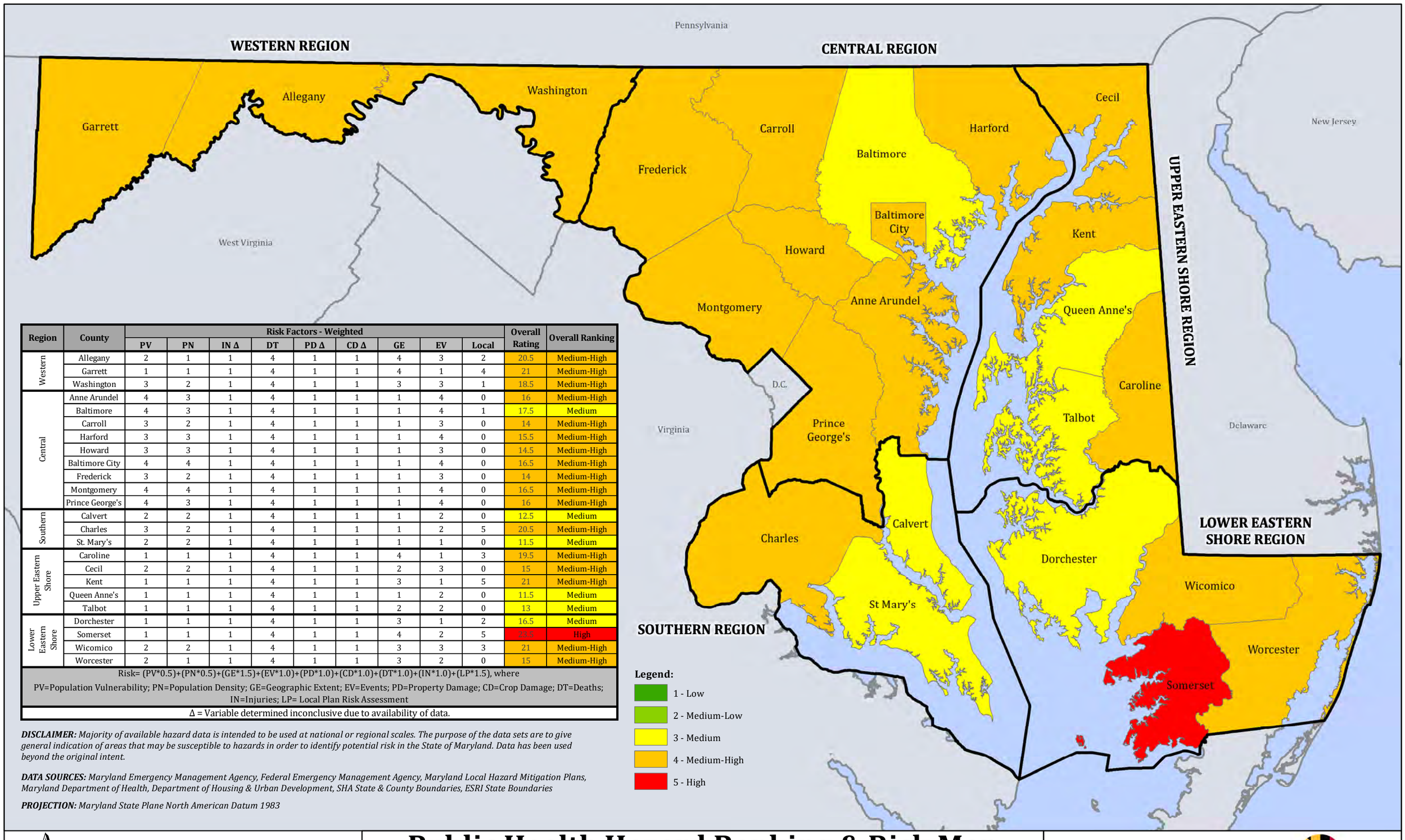
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Health, Department of Housing & Urban Development, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*



0 5 10 20 30 Miles

Public Health Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN Δ	DT Δ	PD Δ	CD Δ	GE	EV Δ	Local		
Western	Allegany	2	1	1	1	1	1	4	1	3	17	Medium
	Garrett	1	1	1	1	1	1	4	1	4	18	Medium
	Washington	3	2	1	1	1	1	4	1	1	15	Medium
Central	Anne Arundel	4	3	1	1	1	1	1	1	5	17.5	Medium
	Baltimore	4	3	1	1	1	1	3	1	2	16	Medium
	Carroll	3	2	1	1	1	1	3	1	4	18	Medium
	Harford	3	3	1	1	1	1	2	1	0	11	Medium
	Howard	3	3	1	1	1	1	1	1	0	9.5	Medium-Low
	Baltimore City	4	4	1	1	1	1	2	1	2	15	Medium
	Frederick	3	2	1	1	1	1	3	1	3	16.5	Medium
	Montgomery	4	4	1	1	1	1	2	1	1	13.5	Medium-Low
	Prince George's	4	3	1	1	1	1	1	1	2	13	Medium-Low
Southern	Calvert	2	2	1	1	1	1	1	1	1	10	Low
	Charles	3	2	1	1	1	1	1	1	1	10.5	Medium-Low
	St. Mary's	2	2	1	1	1	1	1	1	0	8.5	Medium-Low
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	1	4	13.5	Medium-Low
	Cecil	2	2	1	1	1	1	1	1	1	10	Low
	Kent	1	1	1	1	1	1	1	1	1	9	Low
	Queen Anne's	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Talbot	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Somerset	1	1	1	1	1	1	1	1	0	7.5	Medium-Low
	Wicomico	2	2	1	1	1	1	1	1	2	11.5	Medium-Low
	Worcester	2	1	1	1	1	1	1	1	0	8	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

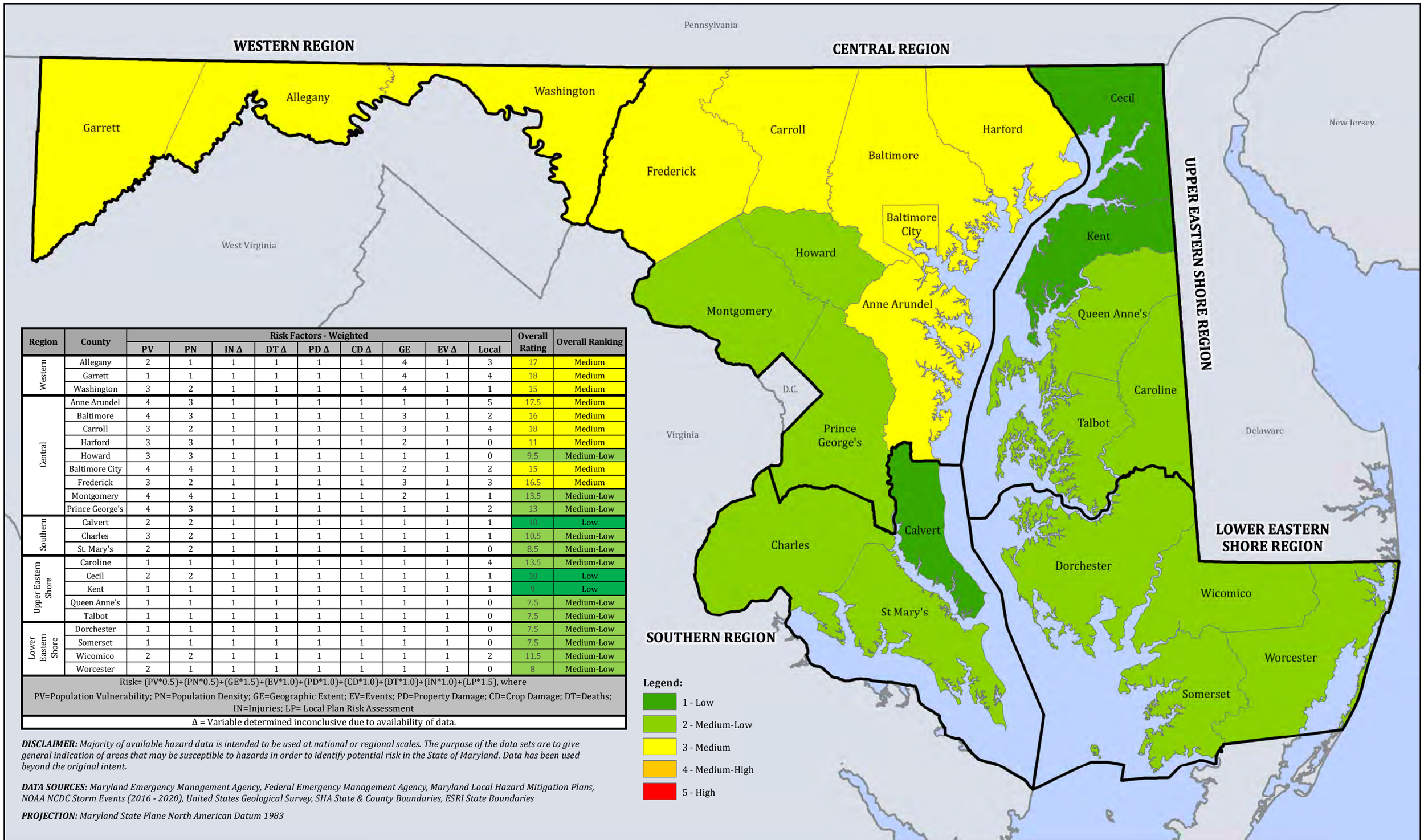
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Variable determined inconclusive due to availability of data.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (2016 - 2020), United States Geological Survey, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*



0 5 10 20 30 Miles

Soil Movement Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	1	1	1	1	1	2	4	15	Medium
	Garrett	1	1	2	1	1	1	1	2	4	15.5	Medium
	Washington	3	2	2	1	1	1	2	3	3	18	Medium
Central	Anne Arundel	4	3	2	4	2	1	4	3	5	29	High
	Baltimore	4	3	2	4	2	1	2	3	4	24.5	High
	Carroll	3	2	2	1	1	1	3	3	0	15	Medium-High
	Harford	3	3	2	4	2	3	3	3	4	27.5	High
	Howard	3	3	1	1	2	1	1	2	3	16	Medium
	Baltimore City	4	4	2	4	1	1	2	2	3	21.5	Medium-High
	Frederick	3	2	2	4	2	1	2	3	3	22	Medium-High
	Montgomery	4	4	2	4	3	1	4	4	5	31.5	High
	Prince George's	4	3	2	4	2	1	3	3	4	26	High
Southern	Calvert	2	2	2	4	1	1	2	2	4	21	Medium-High
	Charles	3	2	1	4	1	2	2	3	5	24	High
	St. Mary's	2	2	1	1	2	1	2	3	4	19	Medium-High
Upper Eastern Shore	Caroline	1	1	2	1	1	1	2	2	3	15.5	Medium
	Cecil	2	2	2	1	2	1	2	2	5	20.5	Medium-High
	Kent	1	1	2	1	1	1	2	2	5	18.5	Medium-High
	Queen Anne's	1	1	1	1	1	1	1	2	1	10	Low
	Talbot	1	1	2	1	2	1	2	2	4	18	Medium
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	2	4	14.5	Medium
	Somerset	1	1	1	1	1	1	1	2	4	14.5	Medium
	Wicomico	2	2	2	4	1	1	1	2	3	18	Medium
	Worcester	2	1	2	1	1	1	1	2	3	14.5	Medium

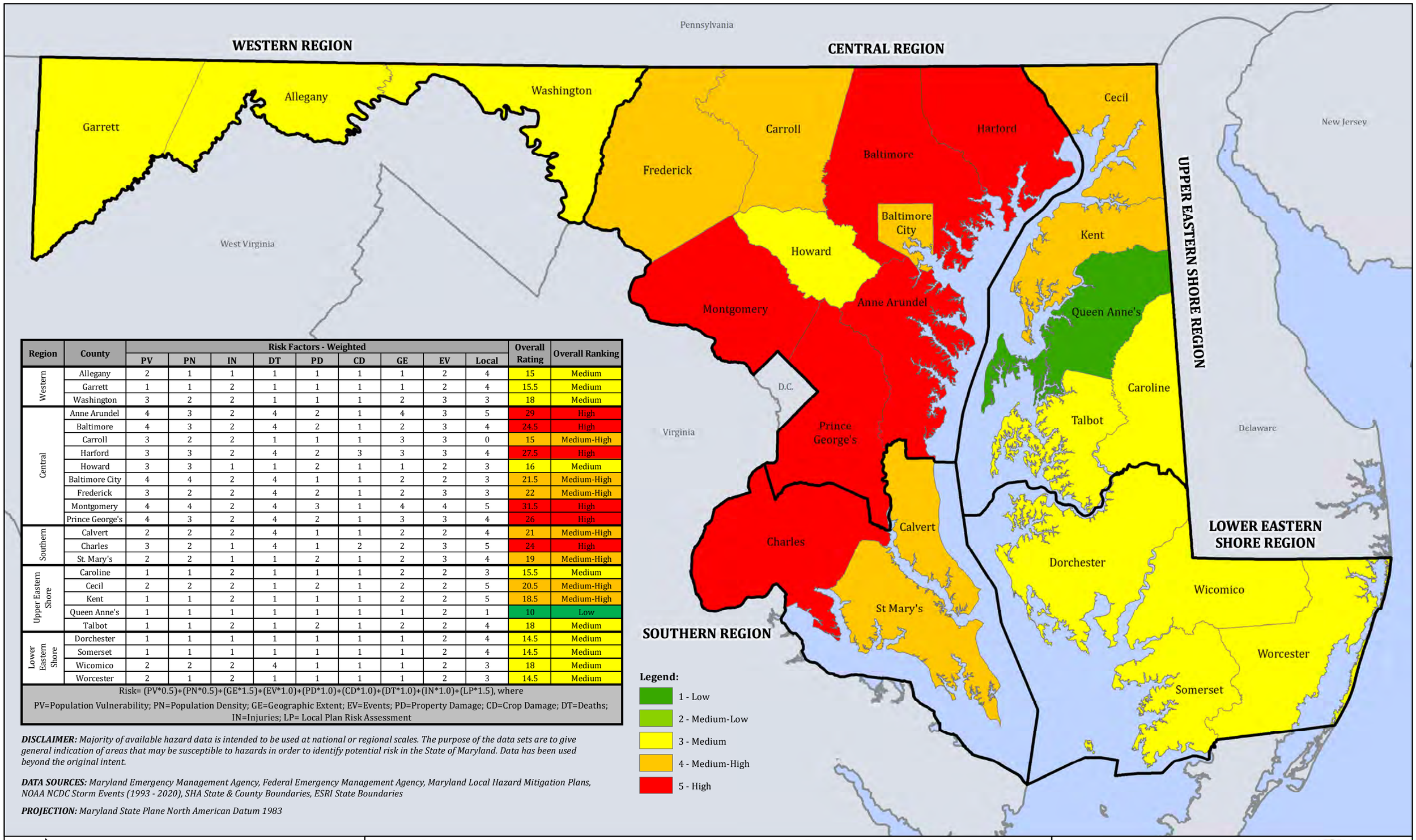
Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

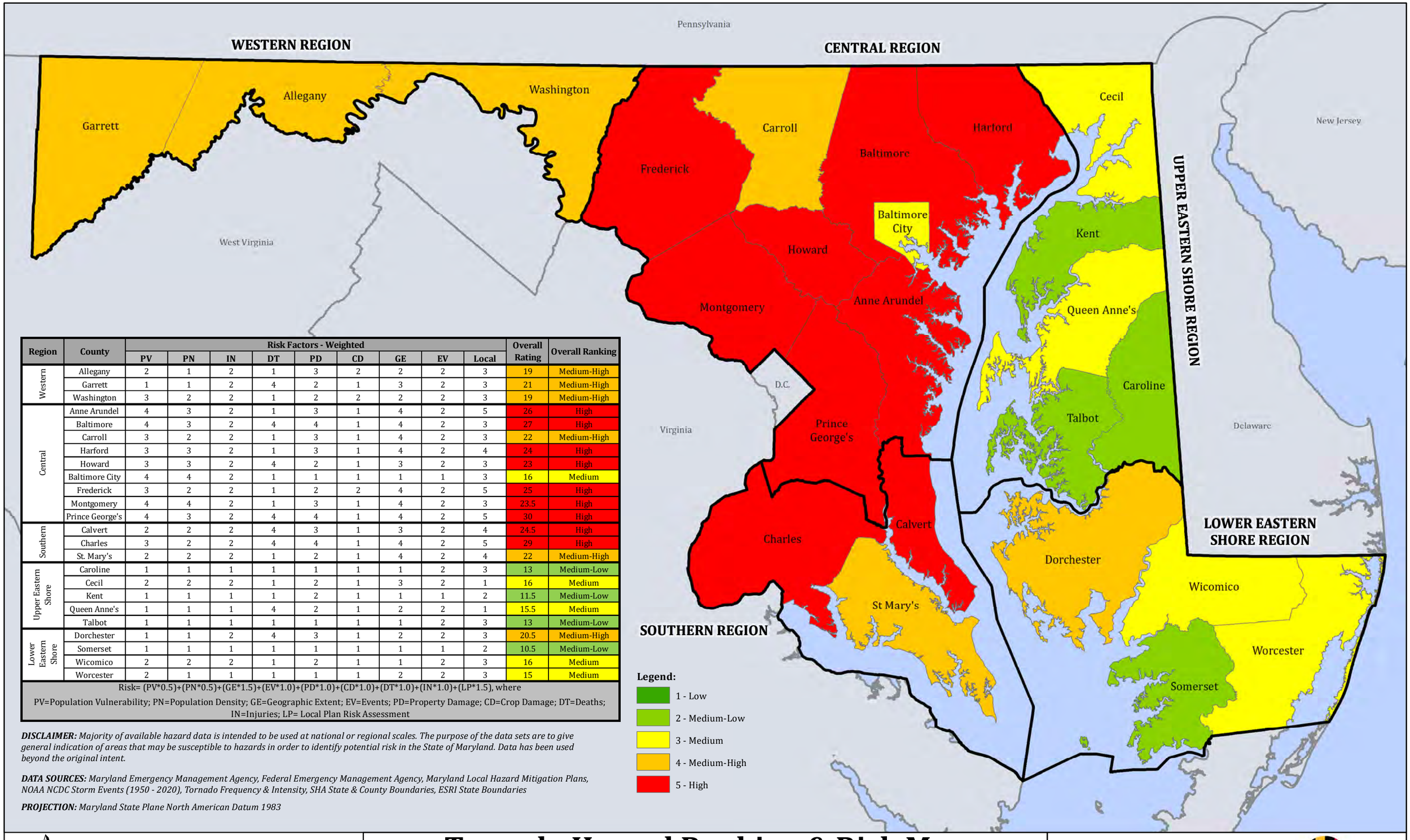


Thunderstorm Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	3	2	2	2	3	19	Medium-High
	Garrett	1	1	2	4	2	1	3	2	3	21	Medium-High
	Washington	3	2	2	1	2	2	2	2	3	19	Medium-High
Central	Anne Arundel	4	3	2	1	3	1	4	2	5	26	High
	Baltimore	4	3	2	4	4	1	4	2	3	27	High
	Carroll	3	2	2	1	3	1	4	2	3	22	Medium-High
	Harford	3	3	2	1	3	1	4	2	4	24	High
	Howard	3	3	2	4	2	1	3	2	3	23	High
	Baltimore City	4	4	2	1	1	1	1	1	3	16	Medium
	Frederick	3	2	2	1	2	2	4	2	5	25	High
	Montgomery	4	4	2	1	3	1	4	2	3	23.5	High
	Prince George's	4	3	2	4	4	1	4	2	5	30	High
Southern	Calvert	2	2	2	4	3	1	3	2	4	24.5	High
	Charles	3	2	2	4	4	1	4	2	5	29	High
	St. Mary's	2	2	2	1	2	1	4	2	4	22	Medium-High
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	2	3	13	Medium-Low
	Cecil	2	2	2	1	2	1	3	2	1	16	Medium
	Kent	1	1	1	1	2	1	1	1	2	11.5	Medium-Low
	Queen Anne's	1	1	1	4	2	1	2	2	1	15.5	Medium
	Talbot	1	1	1	1	1	1	1	2	3	13	Medium-Low
Lower Eastern Shore	Dorchester	1	1	2	4	3	1	2	2	3	20.5	Medium-High
	Somerset	1	1	1	1	1	1	1	1	2	10.5	Medium-Low
	Wicomico	2	2	2	1	2	1	1	2	3	16	Medium
	Worcester	2	1	1	1	1	1	2	2	3	15	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), Tornado Frequency & Intensity, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

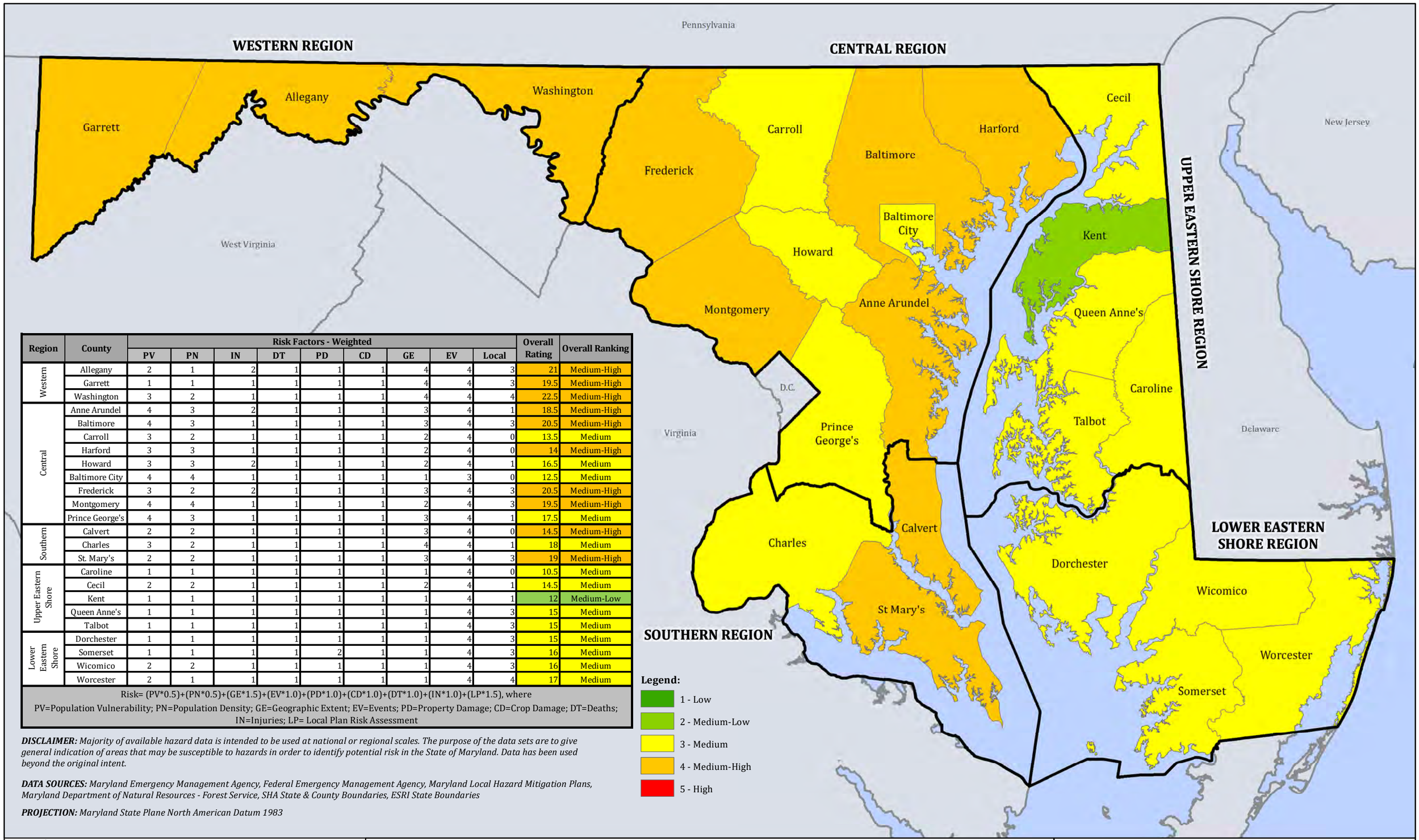
0 5 10 20 30 Miles

Tornado Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency



Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	1	1	4	4	3	21	Medium-High
	Garrett	1	1	1	1	1	1	4	4	3	19.5	Medium-High
	Washington	3	2	1	1	1	1	4	4	4	22.5	Medium-High
Central	Anne Arundel	4	3	2	1	1	1	3	4	1	18.5	Medium-High
	Baltimore	4	3	1	1	1	1	3	4	3	20.5	Medium-High
	Carroll	3	2	1	1	1	1	2	4	0	13.5	Medium
	Harford	3	3	1	1	1	1	2	4	0	14	Medium-High
	Howard	3	3	2	1	1	1	2	4	1	16.5	Medium
	Baltimore City	4	4	1	1	1	1	1	3	0	12.5	Medium
	Frederick	3	2	2	1	1	1	3	4	3	20.5	Medium-High
	Montgomery	4	4	1	1	1	1	2	4	3	19.5	Medium-High
	Prince George's	4	3	1	1	1	1	3	4	1	17.5	Medium
Southern	Calvert	2	2	1	1	1	1	3	4	0	14.5	Medium-High
	Charles	3	2	1	1	1	1	4	4	1	18	Medium
	St. Mary's	2	2	1	1	1	1	3	4	3	19	Medium-High
Upper Eastern Shore	Caroline	1	1	1	1	1	1	1	4	0	10.5	Medium
	Cecil	2	2	1	1	1	1	2	4	1	14.5	Medium
	Kent	1	1	1	1	1	1	1	4	1	12	Medium-Low
	Queen Anne's	1	1	1	1	1	1	1	4	3	15	Medium
	Talbot	1	1	1	1	1	1	1	4	3	15	Medium
Lower Eastern Shore	Dorchester	1	1	1	1	1	1	1	4	3	15	Medium
	Somerset	1	1	1	1	2	1	1	4	3	16	Medium
	Wicomico	2	2	1	1	1	1	1	4	3	16	Medium
	Worcester	2	1	1	1	1	1	1	4	4	17	Medium

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, Maryland Department of Natural Resources - Forest Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*

0 5 10 20 30 Miles

Wildfire Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland EMERGENCY MANAGEMENT AGENCY

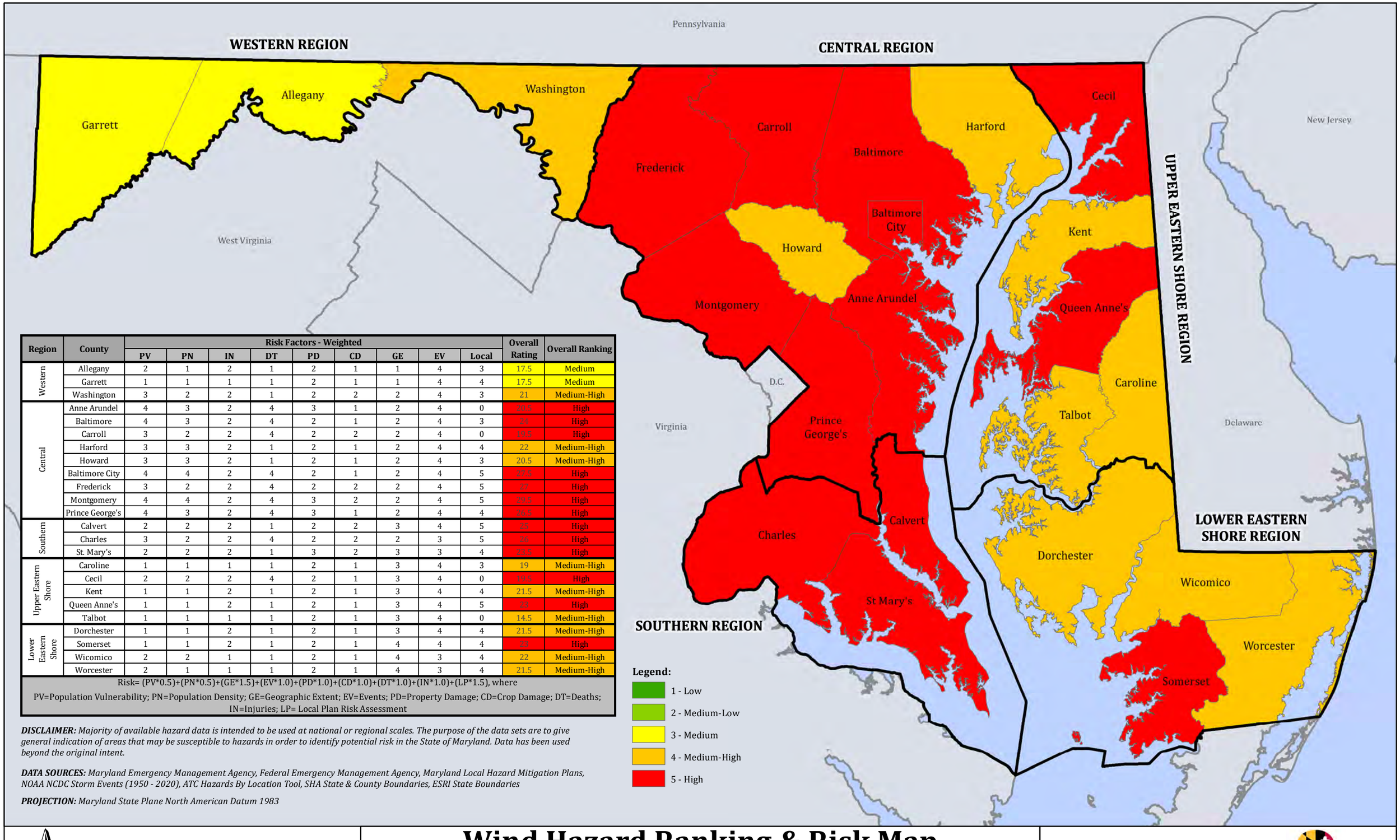
Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	1	2	1	1	4	3	17.5	Medium
	Garrett	1	1	1	1	2	1	1	4	4	17.5	Medium
	Washington	3	2	2	1	2	2	2	4	3	21	Medium-High
Central	Anne Arundel	4	3	2	4	3	1	2	4	0	20.5	High
	Baltimore	4	3	2	4	2	1	2	4	3	24	High
	Carroll	3	2	2	4	2	2	2	4	0	19.5	High
	Harford	3	3	2	1	2	1	2	4	4	22	Medium-High
	Howard	3	3	2	1	2	1	2	4	3	20.5	Medium-High
	Baltimore City	4	4	2	4	2	1	2	4	5	27.5	High
	Frederick	3	2	2	4	2	2	2	4	5	27	High
	Montgomery	4	4	2	4	3	2	2	4	5	29.5	High
	Prince George's	4	3	2	4	3	1	2	4	4	26.5	High
Southern	Calvert	2	2	2	1	2	2	3	4	5	25	High
	Charles	3	2	2	4	2	2	2	3	5	26	High
	St. Mary's	2	2	2	1	3	2	3	3	4	23.5	High
Upper Eastern Shore	Caroline	1	1	1	1	2	1	3	4	3	19	Medium-High
	Cecil	2	2	2	4	2	1	3	4	0	19.5	High
	Kent	1	1	2	1	2	1	3	4	4	21.5	Medium-High
	Queen Anne's	1	1	2	1	2	1	3	4	5	23	High
	Talbot	1	1	1	1	2	1	3	4	0	14.5	Medium-High
Lower Eastern Shore	Dorchester	1	1	2	1	2	1	3	4	4	21.5	Medium-High
	Somerset	1	1	2	1	2	1	4	4	4	23	High
	Wicomico	2	2	1	1	2	1	4	3	4	22	Medium-High
	Worcester	2	1	1	1	2	1	4	3	4	21.5	Medium-High

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1950 - 2020), ATC Hazards By Location Tool, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*



Wind Hazard Ranking & Risk Map

State of Maryland Hazard Mitigation Plan 2021

AECOM

Maryland Emergency Management Agency

Region	County	Risk Factors - Weighted									Overall Rating	Overall Ranking
		PV	PN	IN	DT	PD	CD	GE	EV	Local		
Western	Allegany	2	1	2	4	1	1	4	4	4	25.5	High
	Garrett	1	1	1	1	1	1	4	4	5	22.5	Medium-High
	Washington	3	2	2	4	1	3	2	4	2	22.5	Medium-High
Central	Anne Arundel	4	3	2	4	2	1	1	4	5	25.5	High
	Baltimore	4	3	2	4	2	1	2	4	4	25.5	High
	Carroll	3	2	2	4	1	2	2	4	5	26	High
	Harford	3	3	2	4	1	1	1	4	3	21	Medium-High
	Howard	3	3	2	4	2	2	4	4	5	30.5	High
	Baltimore City	4	4	2	4	2	1	1	4	5	26	High
	Frederick	3	2	2	4	1	2	2	4	5	26	High
	Montgomery	4	4	2	4	2	2	2	4	3	25.5	High
	Prince George's	4	3	2	4	2	2	4	4	4	29.5	High
Southern	Calvert Δ	2	2	2	4	1	1	1	4	3	20	Medium-High
	Charles Δ	3	2	2	4	1	1	1	4	3	20.5	Medium-High
	St. Mary's	2	2	2	4	1	1	1	4	5	23	High
Upper Eastern Shore	Caroline Δ	1	1	1	1	1	1	1	4	3	15	Medium
	Cecil	2	2	1	1	2	1	1	4	5	20	Medium-High
	Kent Δ	1	1	1	1	1	1	1	4	3	15	Medium
	Queen Anne's	1	1	2	4	1	1	1	4	3	19	Medium-High
	Talbot	1	1	1	4	1	1	1	4	5	21	Medium-High
Lower Eastern Shore	Dorchester Δ	1	1	1	1	1	1	1	4	4	16.5	Medium
	Somerset Δ	1	1	1	1	1	1	1	4	3	15	Medium
	Wicomico	2	2	1	1	3	1	1	4	4	19.5	Medium-High
	Worcester Δ	2	1	1	1	1	1	1	4	2	14	Medium-Low

Risk= (PV*0.5)+(PN*0.5)+(GE*1.5)+(EV*1.0)+(PD*1.0)+(CD*1.0)+(DT*1.0)+(IN*1.0)+(LP*1.5), where

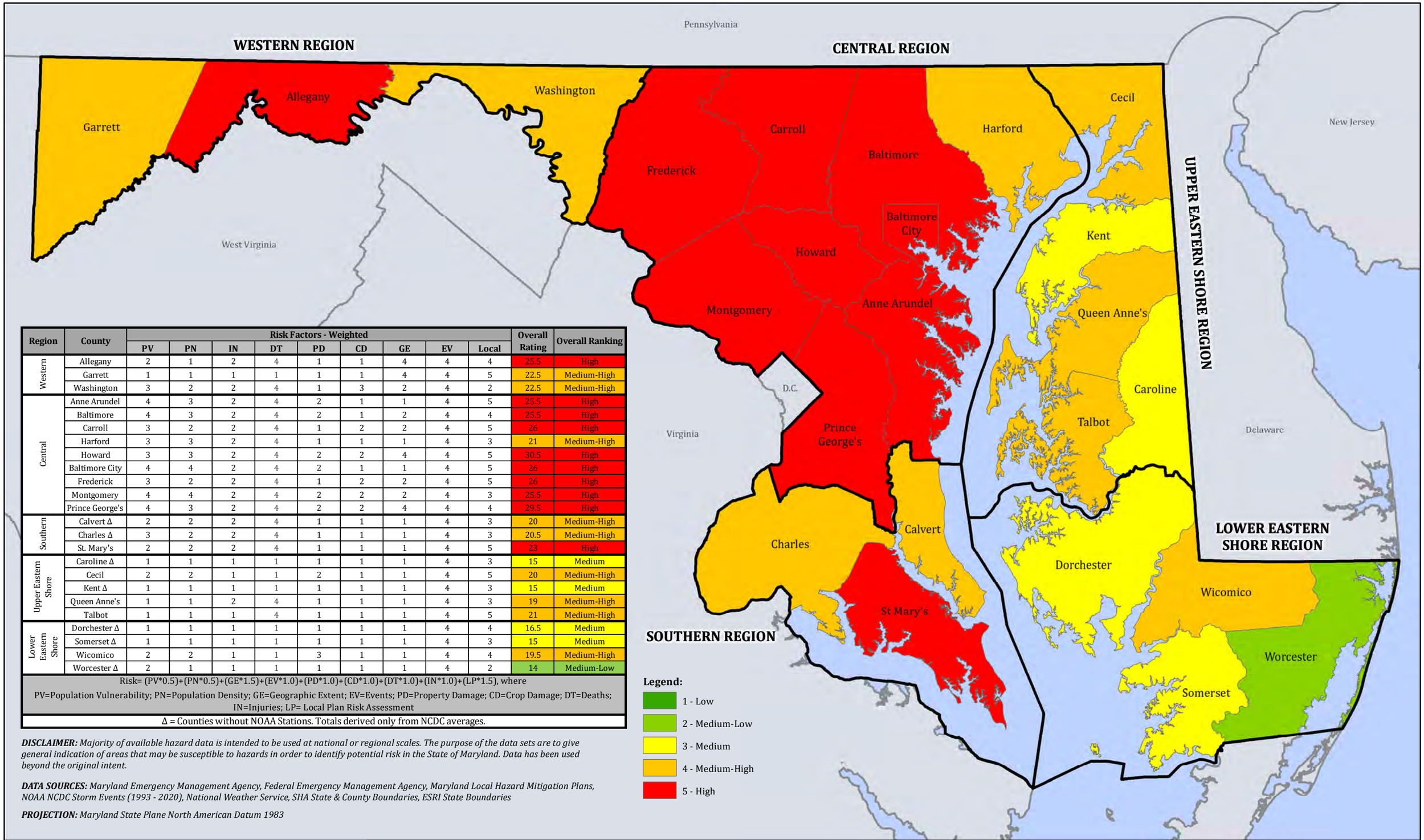
PV=Population Vulnerability; PN=Population Density; GE=Geographic Extent; EV=Events; PD=Property Damage; CD=Crop Damage; DT=Deaths; IN=Injuries; LP= Local Plan Risk Assessment

Δ = Counties without NOAA Stations. Totals derived only from NCDC averages.

DISCLAIMER: *Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland. Data has been used beyond the original intent.*

DATA SOURCES: *Maryland Emergency Management Agency, Federal Emergency Management Agency, Maryland Local Hazard Mitigation Plans, NOAA NCDC Storm Events (1993 - 2020), National Weather Service, SHA State & County Boundaries, ESRI State Boundaries*

PROJECTION: *Maryland State Plane North American Datum 1983*



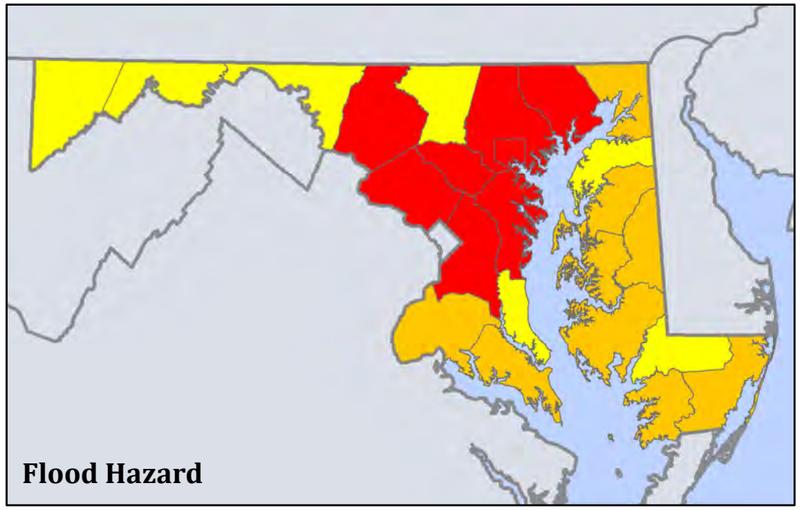
0 5 10 20 30 Miles

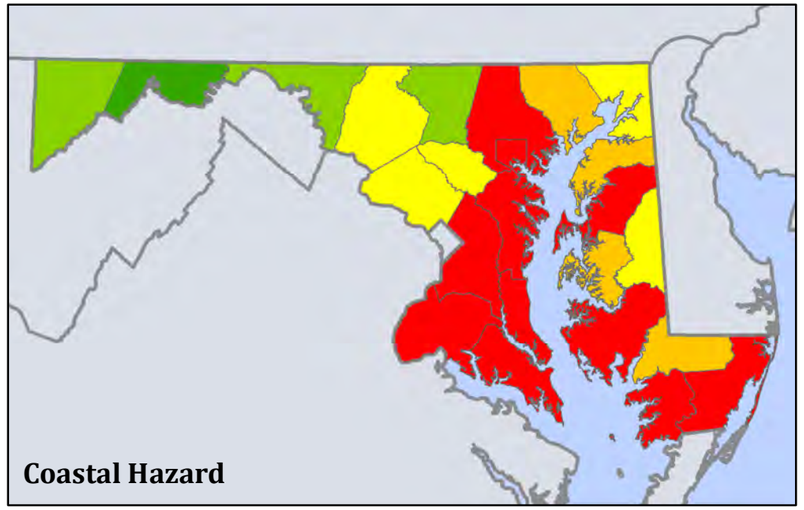
Winter Storm Hazard Ranking & Risk Map

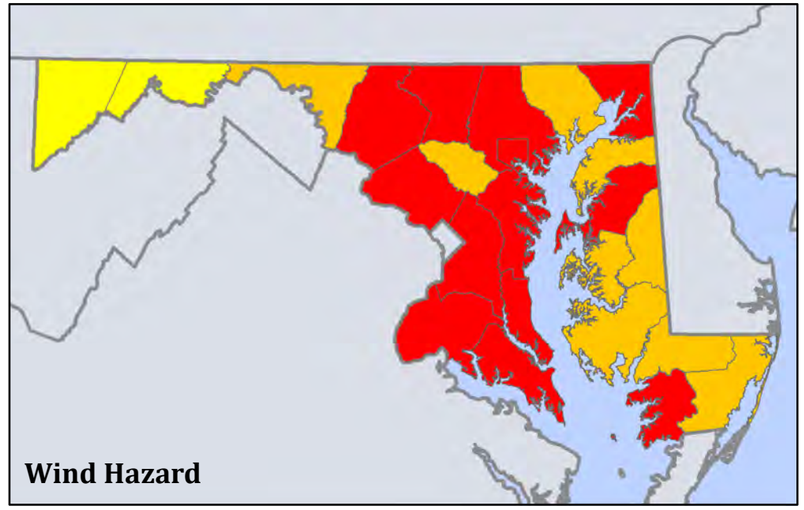
State of Maryland Hazard Mitigation Plan 2021

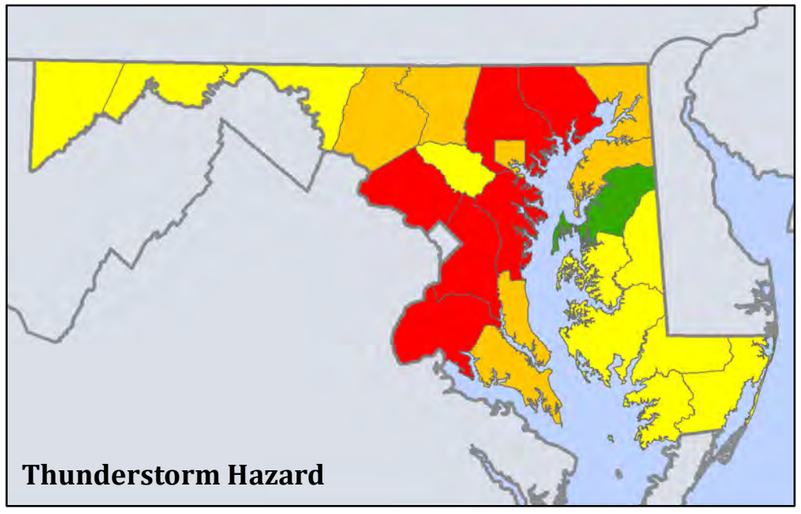
AECOM

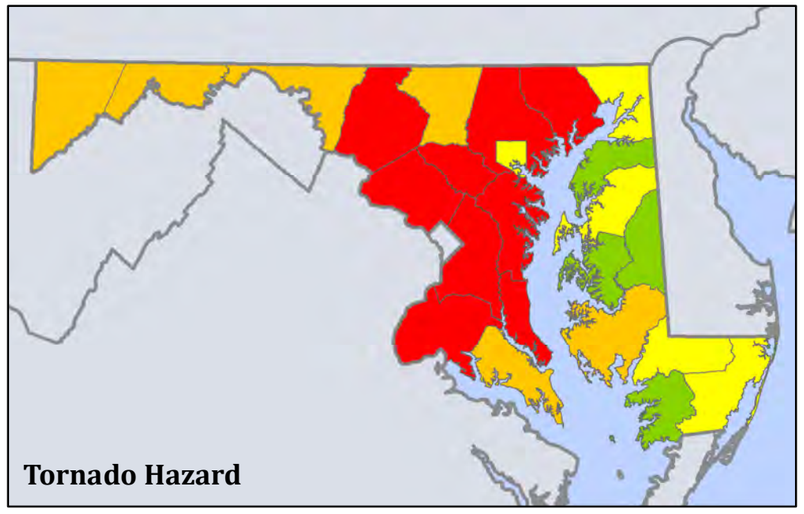
Maryland Emergency Management Agency

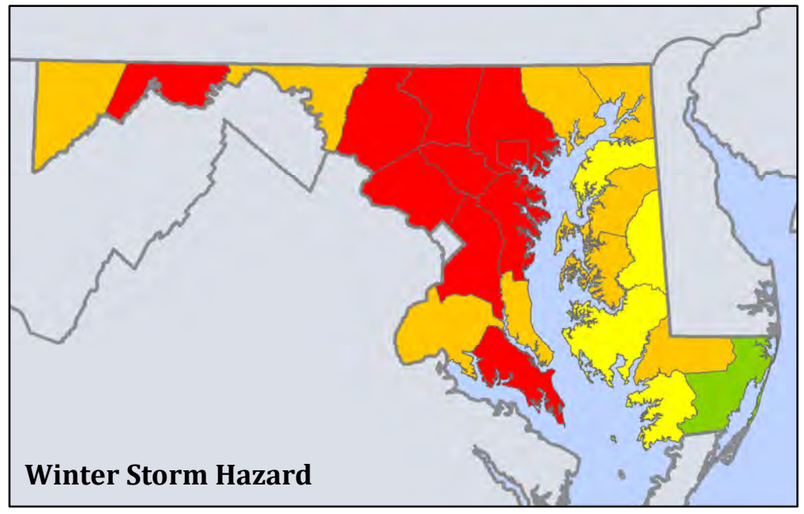


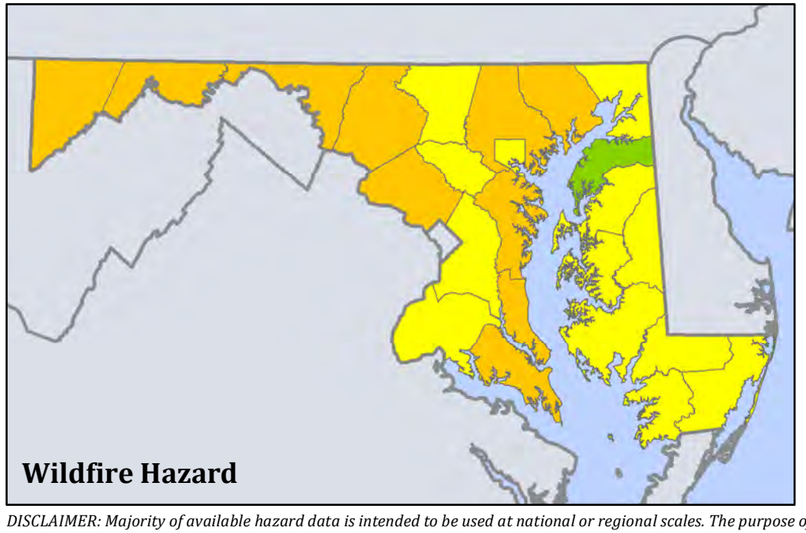












Hazard Ranking Risk Maps

State of Maryland
Hazard Mitigation Plan 2021

Hazard Identification & Risk Assessment

These maps show risk levels assessed for significant hazards. Parameters used to create the Hazard Ranking and Risk Maps for each hazard are explained in the Hazard Assessment and Ranking Methodology section of this report.

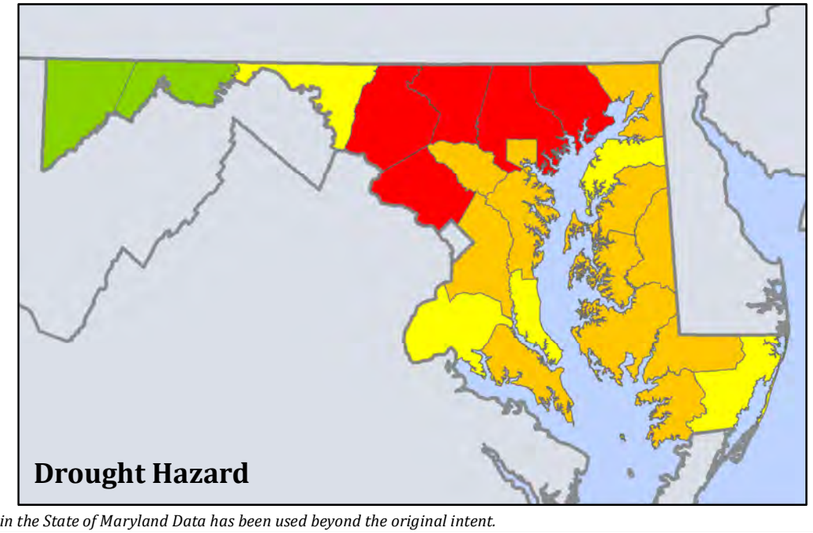
Data Sources:
NOAA NCDC Storm Events (All Hazards)
FEMA DFIRM (Flood Hazard)
FEMA Coastal Risk Map (Coastal Hazard)
ASCE Design Wind Speeds (Wind Hazard)
USDA-NSSA Cropland Data Layer (Drought Hazard)
Maryland Dept. of Natural Resources - Forest Service (Wildfire Hazard)
US Census Bureau

Projection:
Maryland State Plane
North American Datum 1983

Legend:
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High

Maryland
EMERGENCY MANAGEMENT AGENCY

AECOM



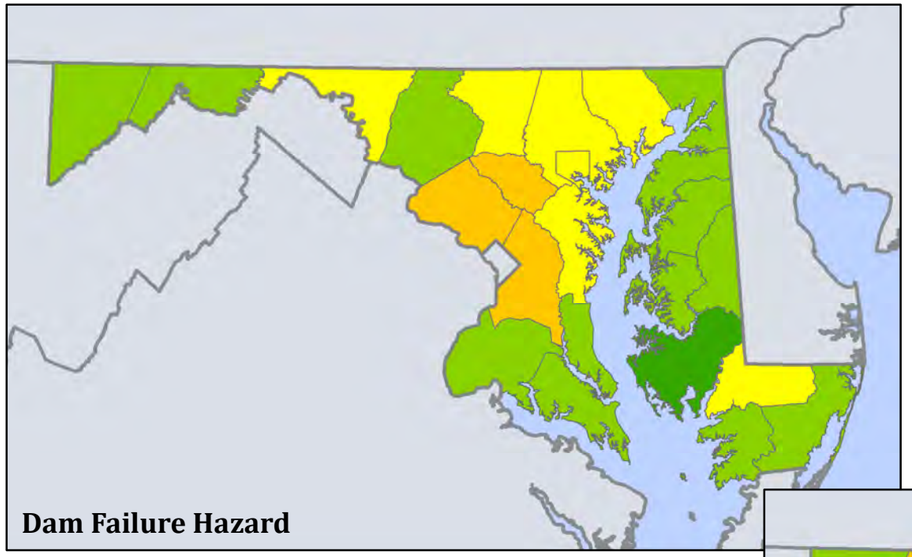
DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland Data has been used beyond the original intent.

Hazard Ranking Risk Maps

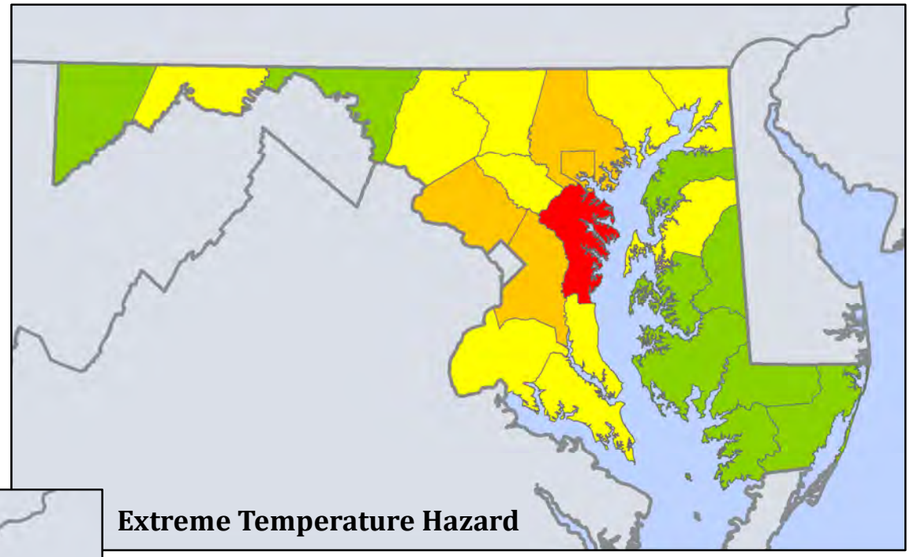
State of Maryland
Hazard Mitigation Plan 2021

Hazard Identification & Risk Assessment

These maps show risk levels assessed for significant hazards. Parameters used to create the Hazard Ranking and Risk Maps for each hazard are explained in the Hazard Assessment and Ranking Methodology section of this report.



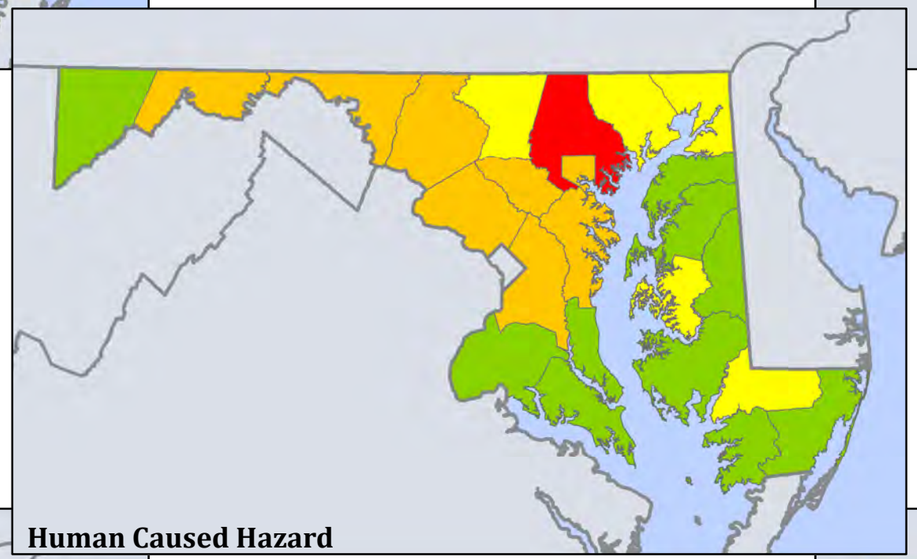
Dam Failure Hazard



Extreme Temperature Hazard

Legend:

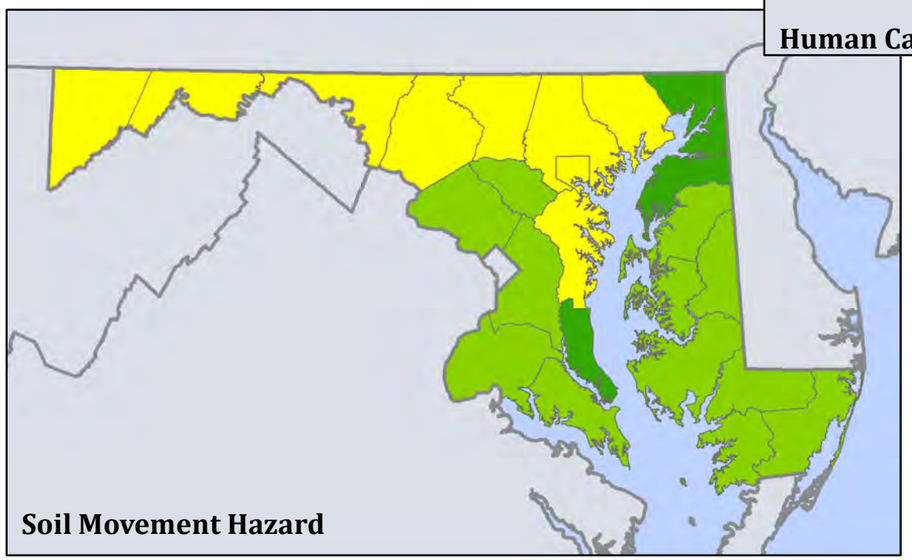
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High



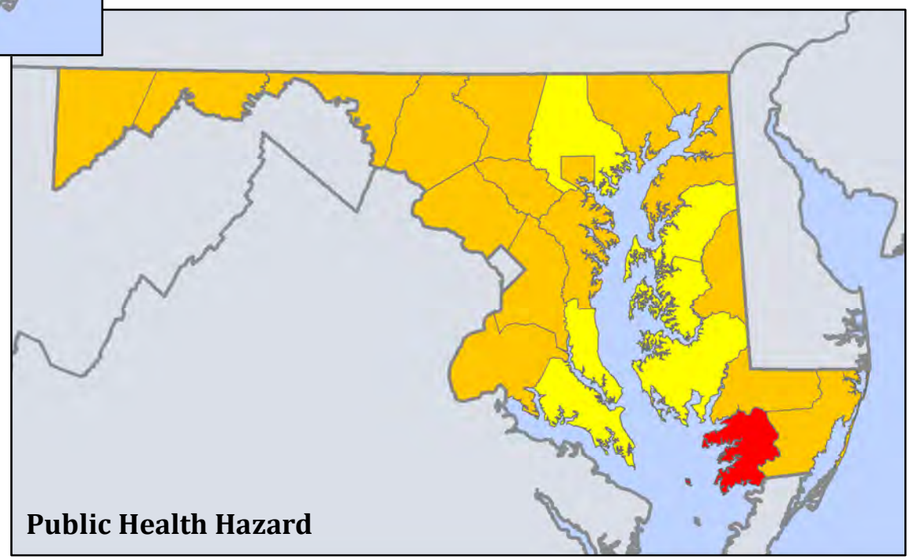
Human Caused Hazard

Maryland
EMERGENCY MANAGEMENT AGENCY

AECOM



Soil Movement Hazard



Public Health Hazard

Data Sources:
NOAA NCDC Storm Events (All Hazards)
Association of State Dam Safety Officials (Dam Hazard)
MDE Maryland Dam Inventory (Dam Hazard)
Pipeline & Hazardous Materials Safety Administration (Human Caused Hazard)
United States Geological Survey (Soil Movement Hazard)
Maryland Department of Health (Public Health Hazard)
Department of Housing & Urban Development (Public Health Hazard)
US Census Bureau

Projection:
Maryland State Plane
North American Datum 1983

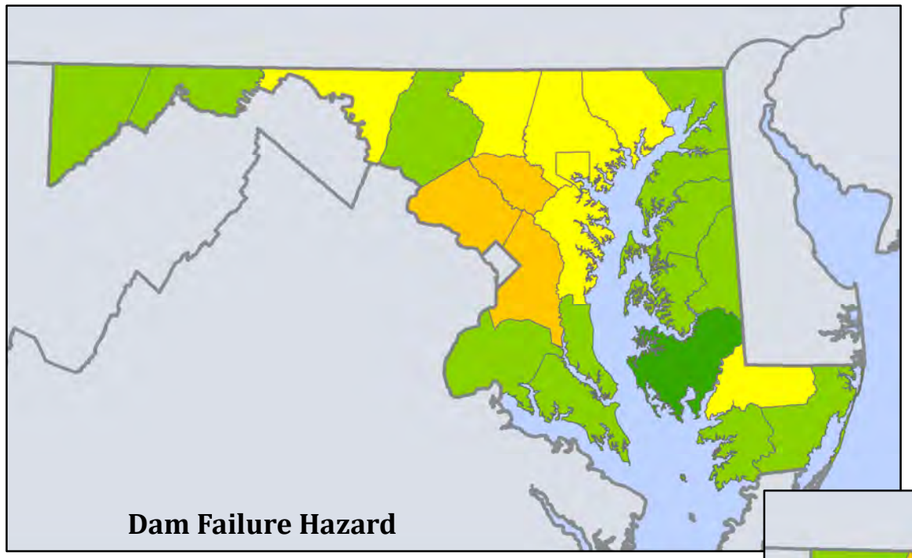
DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland Data has been used beyond the original intent.

Hazard Ranking Risk Maps

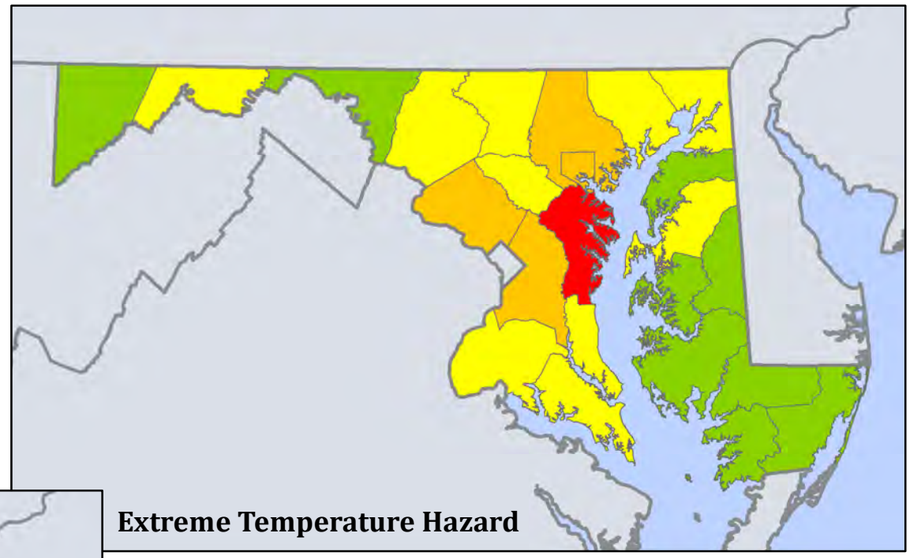
State of Maryland
Hazard Mitigation Plan 2021

Hazard Identification & Risk Assessment

These maps show risk levels assessed for significant hazards. Parameters used to create the Hazard Ranking and Risk Maps for each hazard are explained in the Hazard Assessment and Ranking Methodology section of this report.



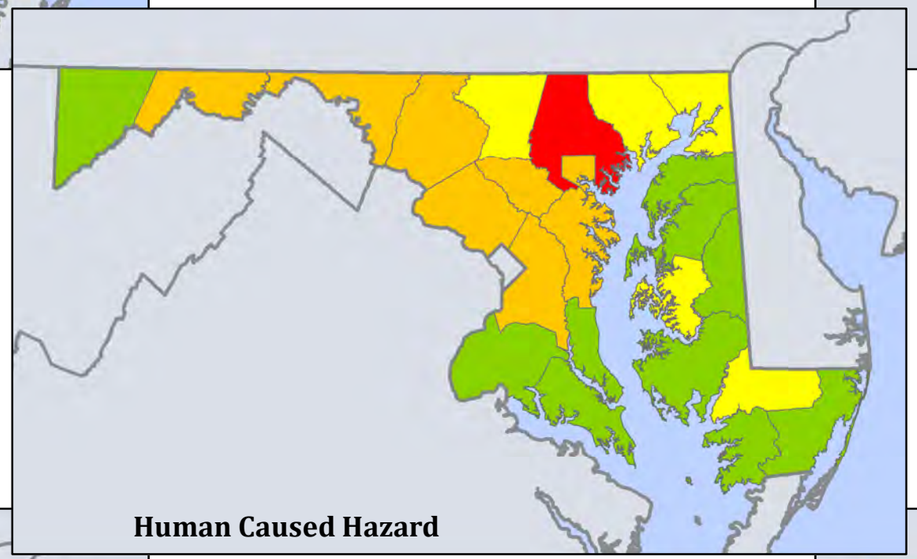
Dam Failure Hazard



Extreme Temperature Hazard

Legend:

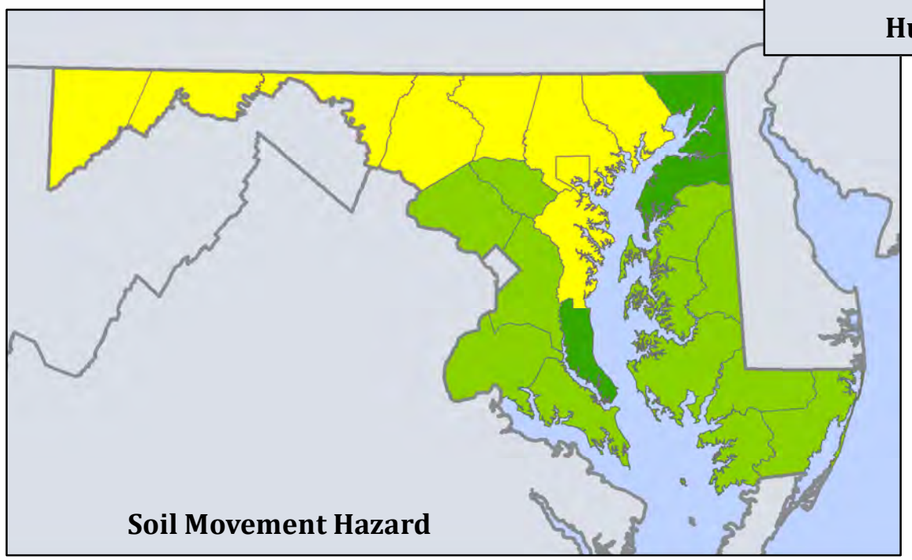
- 1 - Low
- 2 - Medium-Low
- 3 - Medium
- 4 - Medium-High
- 5 - High



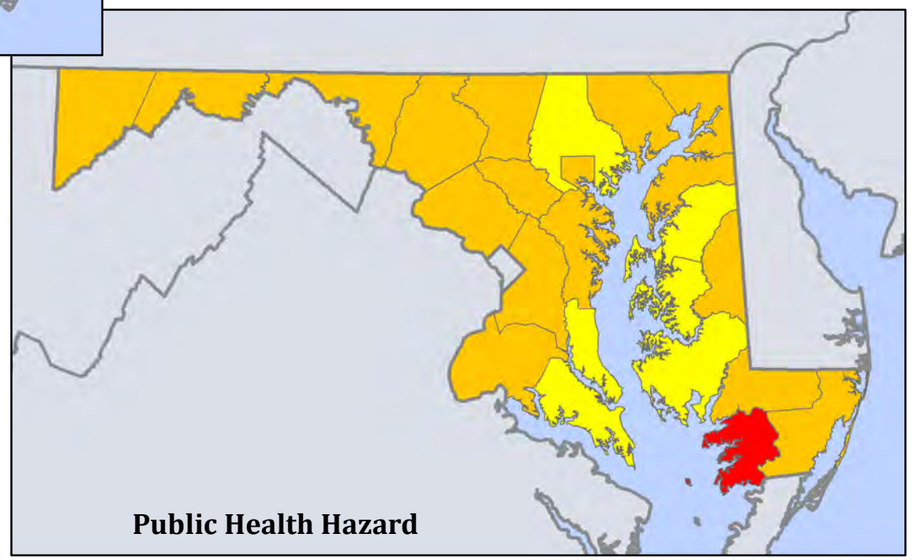
Human Caused Hazard

Maryland
EMERGENCY MANAGEMENT AGENCY

AECOM



Soil Movement Hazard



Public Health Hazard

Data Sources:
NOAA NCDC Storm Events (All Hazards)
Association of State Dam Safety Officials (Dam Hazard)
MDE Maryland Dam Inventory (Dam Hazard)
Pipeline & Hazardous Materials Safety Administration (Human Caused Hazard)
United States Geological Survey (Soil Movement Hazard)
Maryland Department of Health (Public Health Hazard)
Department of Housing & Urban Development (Public Health Hazard)
US Census Bureau

Projection:
Maryland State Plane
North American Datum 1983

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards in order to identify potential risk in the State of Maryland Data has been used beyond the original intent.

APPENDIX L

Flood Risk Reports

This page left blank intentionally

Source: https://www.youtube.com/watch?v=-tA--mbz8GY

STATE OF MARYLAND

FLOOD RISK REPORT

ALLEGANY COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Allegany County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Allegany County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Allegany County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 5

d. Related Resources 6

2 Flood Risk Analysis 9

a. Overview 9

b. Analysis of Risk 10

i. Flood Depth and Analysis Grids 10

ii. Flood Risk Assessments 11

iii. Areas of Mitigation Interest 13

3 Flood Risk Analysis Results 25

a. Allegany County, Maryland Flood Risk Project Area Summary 26

i. Overview 26

ii. Flood Risk Results 26

iii. Flood Risk Maps 36

b. Communities 37

i. Allegay County (Unincorporated Area) (CID 240001) 37

ii. Town of Barton Summary (CID 240002) 41

iii. City of Cumberland (CID 240003) 44

iv. Town of Lonaconing (CID 240005)....48
v. Town of Midland (CID 240006)....51
vi. Town of Westernport (CID 240007)....54
4 Actions To Reduce Flood Risk....57
a. Types of Mitigation Actions....57
i. Local Plans and Regulations....57
ii. Structure and Infrastructure Projects....58
iii. Natural Systems Protection Activities....58
iv. Education and Awareness Activities....59
b. Identifying Specific Actions for Your Community....60
c. Mitigation Programs and Assistance....61
i. FEMA Mitigation Programs and Assistance....62
ii. Additional Mitigation Programs and Assistance....63
5 Acronyms And Definitions....64
a. Acronyms....64
b. Definitions....66
6 Additional Resources....70

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Allegany County Essential Facilities 14

Table 2: USACE National Inventory of Dams – Allegany County, MD 15

Table 3: Flood Risk Assessment – Community Overview 26

Table 4: Allegany County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood 27

Table 5: Allegany County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 27

Table 6: Allegany County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 28

Table 7: Allegany County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood 30

Table 8: Allegany County, Maryland – Building & Content Loss Estimates Summary for 1%-Annual-Chance Flood (Essential Facilities in Riverine Areas) 30

Table 9: Allegany County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood 31

Table 10: Allegany County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine Areas) 32

Table 11: Allegany County, Maryland – Areas of Mitigation Interest 33

Table 12: Allegany County, Maryland – High-Risk Areas 34

Table 13: Allegany County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 38

Table 14: Allegany County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 39

Table 15: Town of Barton – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 42

Table 16: Town of Barton – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 42

Table 17: City of Cumberland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 45

Table 18: City of Cumberland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 46

Table 19: Town of Lonaconing – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 49

Table 20: Town of Lonaconing – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 49

Table 21: Town of Midland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 52

Table 22: Town of Midland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 52

Table 23: Town of Westernport – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 55

Table 24: Town of Westernport – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 55

Table 25: Mitigation Actions for Areas of Mitigation Interest 59

Table 26: FEMA Hazard Mitigation Assistance Programs 62

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Intersection of Routes 36 and 40 (Motor City)
Source: Times News

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur, as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Intersection of Routes 220 and 53 (Cresaptown)
Source: Times News & Allegany County Department of Emergency Services

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Appendix A of this FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: Western Maryland Scenic Railroad Tracks
Source: Times News & Allegany County Department of Emergency Services

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 29 to 31.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (forthcoming effective date on April 3, 2020), provided by FEMA Region III and Maryland Department of the Environment.
- MD Property View – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of March 2016), acquired through the Maryland Department of Planning – http://planning.maryland.gov/OurProducts/.
  Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordiances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructured after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Allegany County GIS Office – http://gov.allconet.org/217/Digital-Data *(Limited Distribution; data available by purchase/ request).*
- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identified five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.
- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Section 2 - Subsection ii Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).
- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that

identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

The *2018 Allegany County Hazard Mitigation Plan Update* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

Please note that the information in this FRR may be reviewed for inclusion during the update of the Allegany County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website developed by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Emergency Action Plans.** Emergency Action Plans (EPA) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to

show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

Nine (9) dams are located within Allegany County, four (4) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Allegany County, MD,* on page 15 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.
- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Oldtown Toll Bridge; Source: Times-News
Bottom Photo: Jones Farm; Source: Ripple Effects Drone Services

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

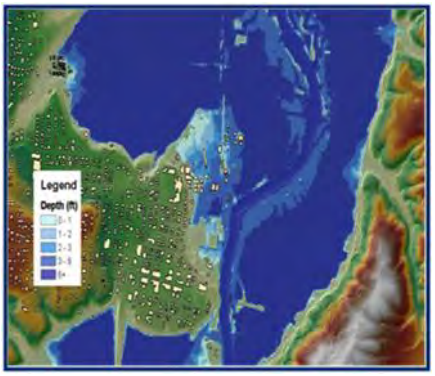
b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

i. Flood Depth and Analysis Grids

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county. This grid communicates flood depth as a function of the difference between the calculated water surface elevation and the ground.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region
- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

Percent Loss: These percentages express losses for assets divided by their total value (building and contents).

- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

  Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the

floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 78 essential facilities located within Allegany County with a total estimated building value of $630,230,100.

Table 1: Allegany County Essential Facilities

Facility Type	Number of Structure	Estimated Building Value
Emergency Operations Center (EOC)	1	$916,300
Fire/Rescue Stations	28	$17,023,100
Hospital & Medical Clinics	7	$19,650,900
Police Stations	6	$ 225,250,500
Schools (K-12 & Colleges)	36	$367,389,300
Total	**78**	**$630,230,100**

Source: Updated 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

Figure 2.4

An essential facility, Corriganville Volunteer Fire Department, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: Corriganville VFD Facebook Page

High-Risk Areas

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of six (6) high risk areas were identified within Allegany County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Rocky Gap Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: View of gorge over spillway- Picture of Rocky Gap State Park, View from Visitor Center.
Source: TripAdvisor

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, nine (9) dams are located in Allegany County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Allegany County, MD

Name	Owner Type	Purpose	River	Emergency Action Plan (EAP)
Barton Reservoir	Local Government	Water Supply, Debris Control	Butcher Run	No
Don Pleasants Dam	Private	Recreation	Bear Hollow Creek	Yes
Dry Run Detention Dam and Culvert	Local Government	Flood Control	Wills Creek-TR	No
Industrial Dam	Local Government	Flood Control	North Branch, Potomac River	No
Lonaconing Reservoir	Public Utility	Water Supply	Jackson Run	Yes
Midland-Gilmore Reservoir	Public Utility	Water Supply	Elk Lick Run	Yes

Newpage Westvaco Dam	Private	Water Supply	Potomac River	No
Rocky Gap Dam	State	Water Supply, Recreation	Rocky Gap Run	Yes
Roeder Farm Pond	Private	Recreation, Fire Protection, Stock, Or Small Fish Pond, Fish and Wildlife Pond	Town Creek-TR	No
Koontz Run Reservoir Tanks	Public Utility	Water Supply	Koontz Run	Yes

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

This dam failure caused flooding that damaged several homes and vehicles.

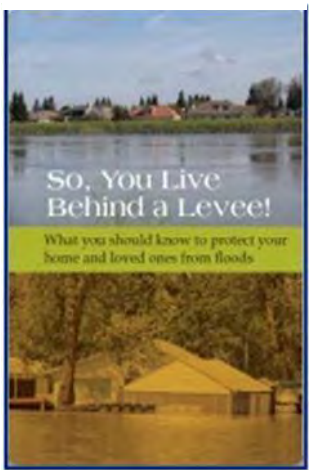
  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.

- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

Levees

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance

flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

There are two (2) accredited levees located within Allegany County; Wills Creek and Upper Potomac Industrial Park. Acccording to US Army Corps of Engineers, the Cumberland Flood Damage Reduction System, located along the left bank of Wills Creek and along the left bank of the North Branch Potomac River, provides flood risk reduction for the City of Cumberland. The system contains levee embankment, floodwall, closure structures, pump stations, and drainage structures. Following completion of a Freeboard Modification Project in December 2017, the Upper Potomac Industrial Park Levee meet all Section 65.10 requirements for Levee Accreditation.

Figure 2.8

Wills Creek at flood stage as it passes through the levee located in the City of Cumberland. Note damages can be more extensive due to high velocity flood flows than if the levee was not there.

Top Photo: Leveed Area within the City of Cumberland
Source: National Levee Database-Interactive Map
Bottom Photo: Wills Creek - Levee in the City of Cumberland on May 5, 2017
Source: WCBC Radio

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.

- Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
- A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**
    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
    - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
    - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
    - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Figure 2.9

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of November 30, 2017, a total of twenty-one (21) FEMA Designated Repetitive Loss Properties were within Allegany County; 20 residential and 1 commercial structures. Ten (10) of the properties are located within the municipalities while the remaining eleven (11) properties are located within the unincorporated portions of Allegany County. There are no Severe Repetitive Loss (SRL) properties within Allegany County.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
  - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
  - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.10

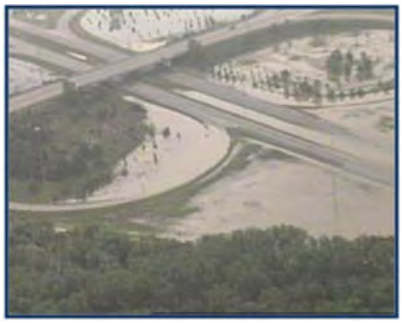
Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
  - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  Figure 2.11

  When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  The *2018 Allegany County Hazard Mitigation Plan Update* provided a listing of repetitive flood locations based on frequent complients provided by the Department of Public Works – County Roads Division. The listing of repetitive flooding issues is within Chapter 16 Mitigation Strategies on Table 16.2 of the Plan Update. A total of 11 repetitive flood locations were identifed in the unincorporated areas of the County, while 17 were identified within the incorporated areas of the County.

- **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
  - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
  - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 25.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  - **Reasons why areas of significant riverine erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine erosion can undercut structures and roads, causing instability and possible collapse.

- Landslides and mudslides are a result of erosion
- Approximately one-third of the nation's streams experience severe erosion problems

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Allegany County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Allegany County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Allegany County (Unincorporated Areas)	240001	41,156	408.5	Y	N/A	Y
Town of Barton	240002	457	0.2	Y	N/A	Y
City of Cumberland	240003	20,859	10.1	Y	N/A	Y
Town of Lonaconing	240005	1,214	0.4	Y	N/A	Y
Town of Midland	240006	446	0.2	Y	N/A	Y
Town of Westernport	240007	1,888	0.9	Y	N/A	Y

Note: The City of Frostburg and Town of Luke are not included in this report since they have no UDFs within the regulatory 1-percent-annual-chance floodplains, or Special Flood Hazard Areas (SFHAs).

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Allegany County, Maryland's Flood Risk Project incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur. Note that

minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 4: Allegany County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Allegany County Unincorporated Areas	41,156	499	$22,100,000	$537	84%
Town of Barton	457	4	$60,000	$131	< 1%
City of Cumberland	20,859	3	$20,000	$1	< 1%
City of Frostburg	9,002	0	$0	$0	0%
Town of Lonaconing	1,214	51	$2,090,000	$1,647	8%
Town of Luke	65	0	$0	$0	0%
Town of Midland	446	13	$80,000	$179	< 1%
Town of Westernport	1,888	37	$2,050,000	$1,059	8%
Total	**75,087**	**607**	**$26,400,000**	**$350**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Allegany County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	476	$39,400,000	40%	$5,500,000	14%
Commercial Building & Contents	81	$33,300,000	34%	$7,800,000	23%
Other Building & Contents	50	$25,300,000	26%	$7,700,000	30%
Total Building & Contents[3]	607	$98,000,000	100%	$21,000,000	21%
Business Disruption[4]	N/A	N/A	N/A	$5,400,000	N/A
TOTAL[5]	**607**	**$98,000,000**	**100%**	**$26,400,000**	**27%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Allegany County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	33	5%	$7,800,000	$200,000	$20,000	$0	0%
1 - 10%	260	43%	$29,800,000	$100,000	$1,400,000	$10,000	7%
10 - 20%	126	21%	$14,300,000	$100,000	$2,000,000	$20,000	10%
20 - 30%	63	10%	$13,500,000	$200,000	$3,300,000	$50,000	16%
30 - 40%	40	7%	$19,700,000	$500,000	$7,200,000	$200,000	34%
40 - 50%	29	5%	$4,800,000	$200,000	$2,200,000	$80,000	11%
50% or More	56	9%	$8,100,000	$100,000	$4,800,000	$90,000	23%
TOTAL	**607**	**100%**	**$98,000,000**	**$200,000**	**$20,920,000**	**$30,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables represent countywide information within the Allegany County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Allegany County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 7. The list of essential facilities at-risk is provided on page 31.

Table 7: Allegany County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood

Type	Estimated Building Value	Total Essential Facilities	1% (100-yr) Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$916,300	1	$0	0
Fire Station	$17,023,100	28	$80,074	6
Hospital	$19,650,900	7	$0	0
Police Station	$225,250,500	6	$0	0
School	$367,389,300	36	$619,045	2
TOTAL	**$630,230,100**	**78**	**$699,119**	**8**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Table 8: Allegany County, Maryland – Building & Content Loss Estimates Summary for 1%-Annual-Chance Flood (Essential Facilities in Riverine Areas)

Type	Total 1% (100-yr) Dollar Losses (Building & Content)	Total Building Loss	Building Loss Percentage of Total	Total Content Loss	Content Loss Percentage of Total
Fire Station	$382,886	$80,073	21%	$302,813	79%
School	$4,930,499	$619,045	13%	$4,311,454	87%
TOTAL	**$5,313,385**	**$699,118**	**N/A**	**$4,614,267**	**N/A**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Allegany County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; • Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Allegany County contains 326 state assets. However, none of these state assets are at-risk to the 1-percent-annual-chance flood event.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
  - The model estimates that a total of 14,669 tons of debris will be generated. Of the total amount, Finishes comprises 29% of the total, Structure comprises 39% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 587 truckloads (@25 tons/truck) to remove the debris generated by the flood.

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

Table 9: Allegany County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	4,266	29%	170
Structure	5,689	39%	228
Foundation	4,714	32%	189
TOTAL	**14,669**	**100%**	**587**

Source: Hazus 3.1: Flood Modual – Allegany County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**
  - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 651 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 794 people (out of a total population of 75,087) will seek temporary shelter in public shelters.

Table 10: Allegany County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	651	1,952	794

Source: Hazus 3.1: Flood Modual – Allegany County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 11: Allegany County, Maryland – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	8	Depth grids, Emergency Management Dept.
High-Risk Areas	6	NFHL, Census Blocks, UDFs
Levee	7	NFHL
Repetitive Flood Issues	29	Emergency Management Dept., Local Public Works – Roads Division, Municipalities
Repetitive Loss Properties	21	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database.

At-Risk Essential Facilities

Results from the 1-percent-annual-chance flood event analysis indicate eight (8) essential facilities are at-risk. These facilities include six (6) fire/rescue stations and two (2) schools. Two (2) facilities, Flintstone Elementary School and Calvary Christian Academy, were determined to a have a flood depth exceeding 5 feet of water. Flood depths for each facility is provided below along with the identified facilities.

- Tri Towns Rescue Squad, Westernport – 2.4'
- Potomac Fire Company #2 – 2.0'
- Corriganville Volunteer Fire Department – 3.8'
- Georges Creek Ambulance Service – 4.1'
- Midland Fire Company – 1.5'
- Baltimore Pike Volunteer Fire Department – 1.1'
- Flintstone Elementary School – 5.9'
- Calvary Christian Academy – 7.1'

A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

High-Risk Areas

Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 12: Allegany County, Maryland – High-Risk Areas

High-Risk Area	Location *(and Flooding Source(s))*	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Westernport *(Georges Creek, North Branch Potomac River)*	137	3	32	$1,600,000	6%
Area 2	North Branch Potomac / Mexico Farms *(North Branch Potomac River)*	237	2	35	$640,000	2%
Area 3	Lonaconing *(Georges Creek, Jackson Run)*	392	13	61	$2,500,000	10%
Area 4	Cresaptown *(Warrior Run)*	193	6	14	$1,900,000	7%
Area 5	Flintstone *(Flintstone Creek)*	41	4	10	$3,500,000	13%
Area 6	Narrows Park / La Vale *(Wills Creek, Braddock Run)*	160	12	44	$9,600,000	37%
Total for High-Risk Areas		**1160**	**40**	**196**	**$19,700,000**	**75%**

Levees

There are 2 accredited levees systems within Allegany County which have been demonstrated and certified to provide protection against the 1-percent-annual-chance floodplain.

- **Wills Creek (Cumberland)**

  After the extensive damage to the City of Cumberland caused by the 1936 and 1942 floods, the U.S. Army Corps of Engineers undertook a comprehensive flood protection system, including 1.6 miles of channel improvements along Wills Creek, 1.7 miles of channel improvements along the North Branch Potomac River, and levees/floodwalls. Based on As-Built Drawings titled "Local Flood Protection Project, Cumberland, Maryland and Ridgeley, West Virginia, Wills Creek Channel Improvement" (1959), this flood protection system is designed to protect against discharges 28% greater than the March 1936 flood (Reference 16). This system was demonstrated to meet all Section 65.10 requirements for Levee Accreditation in 2013.

- **Upper Potomac Industrial Park**

Following the completion of a Freeboard Modification Project in December 2017, the Upper Potomac Industrial Park Levee was demonstrated to meet all Section 65.10 requirements for Levee Accreditation in March 2018.

Within Allegany County, there are also multiple levees that have not been demonstrated by the communities or levee owner(s) to meet the requirements of 44 CFR Part 65.10 of the NFIP regulations as they relate to the levee's capacity to provide 1% percent annual chance flood protection. Following the 1996 floods on Georges Creek, a multi-agency flood mitigation project was completed, including bridge/roadway improvements, stream restoration, property acquisition, and sewer line relocation. Other non-accredited flood protection measures include the Neff Run system, the Lonaconing Floodwall system, the Paper Mill floodwall in Luke, and the Westernport Floodwalls project.

J Repetitive Flood Issues

Reviewing the repetitive flood locations and issues identified on Table 16.2 in the *2018 Allegany County Hazard Mitigation Plan Update*, several repetitive flood locations were found to be within high risk areas listed in Table 12 of this report.

The following high-risk areas containing identified repetitive flood locations are provided below, as well as, the associated flood issue.

- **High-Risk Area 1 – Westernport**
  - Washington Street – Road Elevation Issue
  - Main Street – Road Elevation and SWM Issues
  - Church Street – Road Elevation and SWM Issues
  - Route 135 (State Road) – Road Elevation and SWM Issues

  A total of 33 at-risk structures are located within the High-Risk Area 1, all of which are located along one of the identified repetitive flood locations. At-risk structure types vary from residential to commercial with flood loss estimations ranging as high as over $100,000. The map depicting this area is within Appendix A.

- **High-Risk Area 3 – Lonaconing**
  - Intersection of Island and Union Street – Road Elevation Issue
  - Railroad Street – Road Elevation Issue

A cluster of at-risk structures, a total of nine (9), are located along the identified repetitive flood locations. The structures types at these locations consist commercial and residential structures. Flood loss estimations for these at-risk structures range between $10,000 to $50,000. The map depicting this area is within Appendix A.

- **Repetitive Loss Properties (RLP)**

Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. As of November 30, 2017, a total of twenty-one (21) FEMA Designated Repetitive Loss Properties were within Allegany County; 20 residential and 1 commercial structures. Ten (10) of the properties are located within the municipalities while the remaining eleven (11) properties are located within the unincorporated portions of Allegany County. There are no Severe Repetitive Loss (SRL) properties within Allegany County. According to the 2017 Plan, the 21 repetitive loss properties were reviewed and recommended for inclusion on the flood buyout waiting list. Furthermore, one (1) repetitive loss propery identified is an Essential Facilities, Flintstone Elementary Schools. The Flintstone Elementary School is located within the 1-percent-annual-chance flood event and has a projected flood depth of 5.9 feet. This Essential Facility is located within High Risk Area 5.

iii. Flood Risk Maps

The Flood Risk Maps for Allegany County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Allegany County (Unincorporated Areas) Summary (CID 240001)

The following pages include Flood Risk data for the Allegany County (Unincorporated Areas).

Overview

Allegany County (Unincorporated Areas) is located in western Maryland. It is bordered by Garrett County, Maryland to the west, Somerset, Bedford and Fulton Counties, Pennsylvania, to the north, Washington County, Maryland to the east, and Mineral, Hampshire, and Morgan Counties, West Virginia, to the south. The major flooding sources in Allegany County are the Potomac River and the North Branch Potomac River, Georges Creek, Evitts Creek, Town Creek, and Fifteenmile Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Allegany County (Unincorporated Areas)	240001	41,156	408.5	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 4, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 217 policies totaling approximately $39,813,100
- NFIP-recognized repetitive loss properties = 6
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Allegany County (Unincorporated Area) that are located within the Allegany County, Maryland Riverine Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report

provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Allegany County (Unincorporated Areas) flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 13. Additionally, Table 14 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 13: Allegany County (Unincorporated Areas)– Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	415	$32,800,000	41%	$4,100,000	13.0%
Commercial Building & Contents	52	$28,600,000	36%	$6,700,000	23.0%
Other Building & Contents	32	$18,800,000	23%	$6,300,000	34.0%
Total Building & Contents[3]	499	$80,200,000	100%	$17,100,000	21.0%
Business Disruption[4]	N/A	N/A	N/A	$5,000,000	N/A
TOTAL[5]	**499**	**$80,200,000**	**100%**	**$22,100,000**	**28.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 14: Allegany County (Unincorporated Areas)– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	23	5%	$5,700,000	$200,000	$10,000	$0	0%
1 - 10%	225	45%	$26,300,000	$100,000	$1,300,000	$10,000	8%
10 - 20%	100	20%	$11,100,000	$100,000	$1,500,000	$20,000	9%
20 - 30%	51	10%	$10,800,000	$200,000	$2,700,000	$50,000	16%
30 - 40%	29	6%	$14,900,000	$500,000	$5,500,000	$200,000	32%
40 - 50%	23	5%	$4,400,000	$200,000	$2,000,000	$90,000	12%
50% or More	48	10%	$6,900,000	$100,000	$4,000,000	$80,000	24%
TOTAL	**499**	**100%**	**$80,100,000**	**$200,000**	**$17,010,000**	**$30,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Allegany County (Unincorporated Area)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Barton Summary (CID 240002)

The following pages include Flood Risk data for the Town of Barton.

Overview

The Town of Barton lies in Western Maryland within Allegany County. The area of the County known as the Georges Creek Region is located in the westernmost portion of Allegany County with the Town of Barton located in the southern portion of that Region. The Town of Barton's primary source of surface water is Jackson Run, however, the mainstem of Georges Creek, as well as Butcher Run, flow through the Town of Barton.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Barton	240002	457	0.2	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 4, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 2 policies totaling approximately $390,000
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Barton that are located within the Allegany County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Barton's riverine flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 15. Additionally, Table 16 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 15: Town of Barton – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	1	$90,000	9%	$0	0.0%
Commercial Building & Contents	1	$400,000	40%	$0	0.0%
Other Building & Contents	2	$500,000	51%	$60,000	12.0%
Total Building & Contents[3]	4	$990,000	100%	$60,000	6.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**4**	**$990,000**	**100%**	**$60,000**	**6.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 16: Town of Barton – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	25%	$400,000	$400,000	$0	$0	0%
1 - 10%	2	50%	$500,000	$300,000	$20,000	$10,000	33%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	1	25%	$90,000	$90,000	$40,000	$40,000	67%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**4**	**100%**	**$990,000**	**$200,000**	**$60,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Barton

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. City of Cumberland Summary (CID 240003)

The following pages include Flood Risk data for the City of Cumberland.

Overview

The City of Cumberland is located in Western Maryland, just north of the West Virginia State Boundary. The major flooding sources in Cumberland, Wills Creek and North Branch, have both had flood protection works completed causing flooding to be localized and minor.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
City of Cumberland	240003	20,859	10.1	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 4, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 20 policies totaling approximately $4,585,600
- NFIP-recognized repetitive loss properties = 5
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the City of Cumberland that are located within the Allegany County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The City of Cumberland flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 17.

Additionally, Table 18 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

As noted in the Areas of Mitigation Interest section of the countywide results, there is a levee system in the City of Cumberland that includes portions of Wills Creek and North Branch Potomac River. This system was accredited in 2013 to provide protection from the 1-percent-annual-chance flood. As such, there are roughly 71 buildings with a combined improvement value of $ 22,270,900 that are within the flood zone designation 'X Protected by Levee' and are NOT determined in this report to experience losses during the 1-percent-annual-chance flood event.

Table 17: City of Cumberland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	1	$30,000	50%	$20,000	67.0%
Commercial Building & Contents	2	$30,000	50%	$0	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	3	$60,000	100%	$20,000	33.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**3**	**$60,000**	**100%**	**$20,000**	**33.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 18: City of Cumberland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	1	33%	$10,000	$10,000	$0	$0	0%
10 - 20%	1	33%	$20,000	$20,000	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	1	33%	$30,000	$30,000	$20,000	$20,000	100%
TOTAL	**3**	**100%**	**$60,000**	**$20,000**	**$20,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the City of Cumberland

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. Town of Lonaconing Summary (CID 240005)

The following pages include Flood Risk data for the Town of Lonaconing.

Overview

The Town of Lonaconing is located in Allegany County along the Georges Creek Valley, approximately 16 miles west of Cumberland. Major flooding sources include Georges Creek, Jackson Run, and Koontz Run. Nichols Run flows through the southern portion of Lonaconing as well.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Lonaconing	240005	1,214	0.4	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 4, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 23 policies totaling approximately $3,898,600
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Lonaconing that are located within the Allegany County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Lonaconing flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 19. Additionally, Table 20

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 19: Town of Lonaconing – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	41	$5,000,000	63%	$1,300,000	26.0%
Commercial Building & Contents	6	$600,000	8%	$60,000	10.0%
Other Building & Contents	4	$2,400,000	30%	$700,000	29.0%
Total Building & Contents[3]	51	$8,000,000	100%	$2,060,000	26.0%
Business Disruption[4]	N/A	N/A	N/A	$30,000	N/A
TOTAL[5]	**51**	**$8,000,000**	**100%**	**$2,090,000**	**26.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 20: Town of Lonaconing – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	2%	$50,000	$50,000	$0	$0	0%
1 - 10%	18	35%	$1,300,000	$70,000	$60,000	$0	3%
10 - 20%	13	25%	$1,000,000	$80,000	$100,000	$10,000	5%
20 - 30%	8	16%	$2,400,000	$300,000	$500,000	$60,000	27%
30 - 40%	5	10%	$2,900,000	$600,000	$1,000,000	$200,000	53%
40 - 50%	3	6%	$40,000	$10,000	$20,000	$10,000	1%
50% or More	3	6%	$400,000	$100,000	$200,000	$70,000	11%
TOTAL	**51**	**100%**	**$8,090,000**	**$200,000**	**$1,880,000**	**$40,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Lonaconing

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

v. Town of Midland Summary (CID 240006)

The following pages include Flood Risk data for the Town of Midland.

Overview

The Town of Midland is located in western Allegany County, west of Cumberland and along the Georges Creek Valley. Major flooding sources include Georges Creek and Neff Run.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Midland	240006	446	0.2	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 4, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 19 policies totaling approximately $1,819,000
- NFIP-recognized repetitive loss properties = 1
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Midland that are located within the Allegany County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Midland's riverine flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 21. Additionally, Table 22 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 21: Town of Midland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	10	$900,000	38%	$60,000	7.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	3	$1,500,000	63%	$20,000	1.0%
Total Building & Contents[3]	13	$2,400,000	100%	$80,000	3.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**13**	**$2,400,000**	**100%**	**$80,000**	**3.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 22: Town of Midland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	3	23%	$1,200,000	$400,000	$0	$0	0%
1 - 10%	8	62%	$1,100,000	$100,000	$50,000	$10,000	63%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	2	15%	$100,000	$50,000	$30,000	$20,000	38%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**13**	**100%**	**$2,400,000**	**$200,000**	**$80,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Midland

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

vi. Town of Westernport Summary (CID 240007)

The following pages include Flood Risk data for the Town of Westernport.

Overview

The Town of Westernport is located in western Maryland at the southwestern tip of Allegany County in an area known as "Tritowns" which is comprised of Luke, Westernport, and Piedmont. Westernport is also located along the Georges Creek Valley. Principal flooding sources are Georges Creek and North Branch Potomac River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Westernport	240007	1,888	0.9	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 4, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 29 policies totaling approximately $4,212,200
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Westernport that are located within the Allegany County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Westernport flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 23. Additionally, Table 24 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 23: Town of Westernport – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss
Residential Building & Contents	8	$500,000	8%	$50,000	10.0%
Commercial Building & Contents	20	$3,700,000	59%	$1,000,000	27.0%
Other Building & Contents	9	$2,100,000	33%	$700,000	33.0%
Total Building & Contents[3]	37	$6,300,000	100%	$1,750,000	28.0%
Business Disruption[4]	N/A	N/A	N/A	$300,000	N/A
TOTAL[5]	**37**	**$6,300,000**	**100%**	**$2,050,000**	**33.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 24: Town of Westernport – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	5	14%	$400,000	$80,000	$0	$0	0%
1 - 10%	6	16%	$500,000	$80,000	$30,000	$10,000	2%
10 - 20%	12	32%	$2,200,000	$200,000	$400,000	$30,000	23%
20 - 30%	4	11%	$300,000	$80,000	$80,000	$20,000	5%
30 - 40%	4	11%	$1,800,000	$500,000	$600,000	$200,000	35%
40 - 50%	2	5%	$300,000	$200,000	$100,000	$50,000	6%
50% or More	4	11%	$900,000	$200,000	$500,000	$100,000	29%
TOTAL	**37**	**100%**	**$6,400,000**	**$200,000**	**$1,710,000**	**$50,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Westernport

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with a forthcoming effective date on April 3, 2020), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations
- Open space preservation

- Building codes
- Participation in the NFIP Community Rating System (CRS)
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and their natural functions. Examples include:

- Wetland protection
- Habitat protection

- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 25 below identifies possible mitigation actions for each AoMI to consider.

Table 25: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***

AoMI	Possible Actions to Reduce Flood Risk
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	• ***2018 Allegany County Flood Buy-out Listing*** o ***58 flood-prone properties acquired and demolished*** *2018 Allegany County Hazard Mitigation Plan Update*
	• ***Road Mitigation Projects Completed*** o ***8 repetitive flooding Issues mitigated*** *2018 Allegany County Hazard Mitigation Plan Update*

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?

- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The *2018 Allegany County Hazard Mitigation Plan Update – Chapter 16 Mitigation Strategies* identifies and prioritizes mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 26 below.

Table 26: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact

information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood

corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential Facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) as amended, https://www.fema.gov/media-library-data/1490360363533a531e65a3e1e63b8b2cfb7d3da7a785c/Stafford_ActselectHSA2016

FEMA, *Presidential and Emergency Declarations by State*, https://www.fema.gov/disasters

FEMA, Digital Flood Insurance Rate Maps (DFIRMS), https://www.fema.gov/msc

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,*
coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Western Region Representative:
Amy C. M. Stonebreaker, Planner, Floodplain Manager
Allegany County Office of Land Development Services
701 Kelly Road, Cumberland, MD 21502
https://gov.allconet.org/227/Land-Development-Services

Allegany County Department of Emergency Services
11400 PPG Road SE, Cumberland, MD 21502
https://gov.allconet.org/168/Emergency-Services

Allegany County Department of Planning and Growth
701 Kelly Road, Cumberland, MD 21502
https://gov.allconet.org/271/Planning-Growth

Allegany County Department of Public Works
701 Kelly Road, Cumberland, MD 21502
https://gov.allconet.org/228/Public-Works

Allegany County Geographic Information Systems (GIS)
701 Kelly Road, Cumberland, MD 21502
https://gov.allconet.org/214/Geographic-Information-Systems-GIS

This page left blank intentionally

Source: https://www.youtube.com/watch?v=-tA--mbz8GY

STATE OF MARYLAND

FLOOD RISK REPORT

ALLEGANY COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Allegany County, Maryland – Countywide Flood Risk Map (FRM)

Allegany County, Maryland – High Risk Area 1: Westernport (Georges Creek, North Branch Potomac River) – Dollar Losses

Allegany County, Maryland – High Risk Area 1: Westernport (Georges Creek, North Branch Potomac River) – Percent Losses

Allegany County, Maryland – High Risk Area 2: North Branch Potomac / Mexico Farms (North Branch Potomac River) – Dollar Losses

Allegany County, Maryland – High Risk Area 2: North Branch Potomac / Mexico Farms (North Branch Potomac River) – Percent Losses

Allegany County, Maryland – High Risk Area 3: Lonaconing (Georges Creek, Jackson Run) – Dollar Losses

Allegany County, Maryland – High Risk Area 3: Lonaconing (Georges Creek, Jackson Run) – Percent Losses

Allegany County, Maryland – High Risk Area 4: Cresaptown (Warrior Run) – Dollar Losses

Allegany County, Maryland – High Risk Area 4: Cresaptown (Warrior Run) – Percent Losses

Allegany County, Maryland – High Risk Area 5: Flintstone (Flintstone Creek) – Dollar Losses

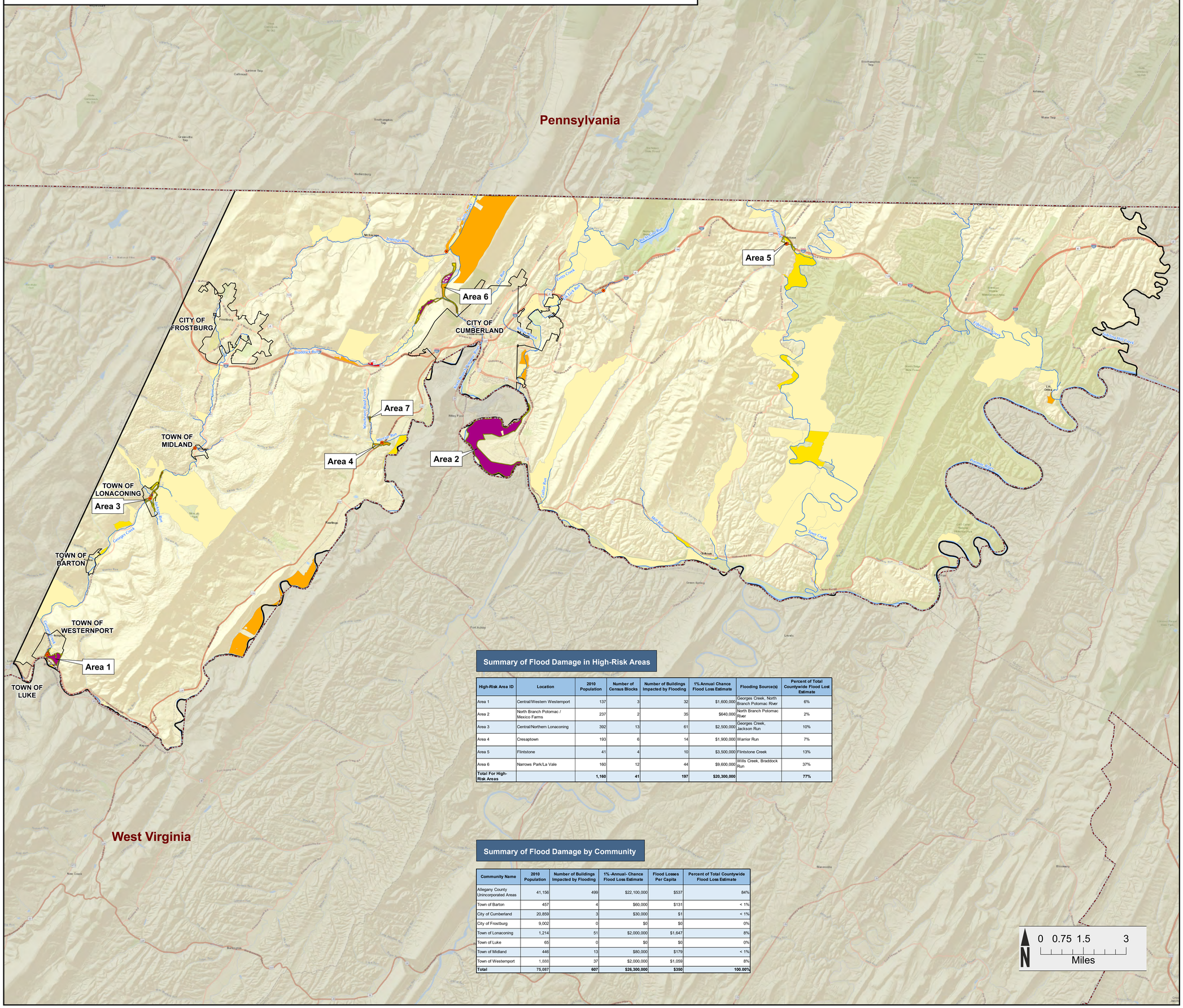
Allegany County, Maryland – High Risk Area 5: Flintstone (Flintstone Creek) – Percent Losses

Allegany County, Maryland – High Risk Area 6: Narrows Park / La Vale (Wills Creek, Braddock Run) – Dollar Losses

Allegany County, Maryland – High Risk Area 6: Narrows Park / La Vale (Wills Creek, Braddock Run) – Percent Losses

Allegany County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Allegany County, Maryland

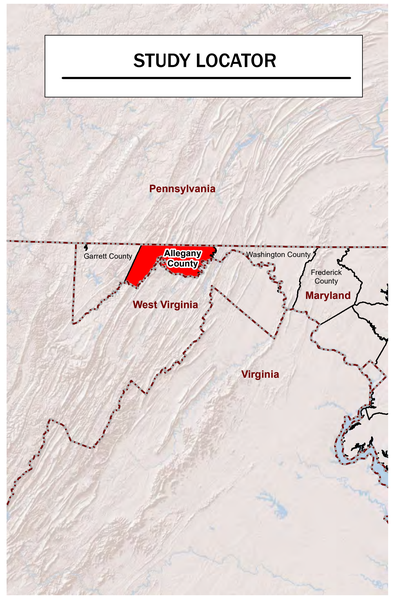


Summary of Flood Damage in High-Risk Areas

High-Risk Area ID	Location	2010 Population	Number of Census Blocks	Number of Buildings Impacted by Flooding	1% Annual Chance Flood Loss Estimate	Flooding Source(s)	Percent of Total Countywide Flood Lost Estimate
Area 1	Central/Western Westernport	137	3	32	$1,600,000	Georges Creek, North Branch Potomac River	6%
Area 2	North Branch Potomac / Mexico Farms	237	2	35	$640,000	North Branch Potomac River	2%
Area 3	Central/Northern Lonaconing	392	13	61	$2,500,000	Georges Creek, Jackson Run	10%
Area 4	Cresaptown	193	6	14	$1,900,000	Warrior Run	7%
Area 5	Flintstone	41	4	10	$3,500,000	Flintstone Creek	13%
Area 6	Narrows Park/La Vale	160	12	44	$9,600,000	Wills Creek, Braddock Run	37%
Total For High-Risk Areas		**1,160**	**41**	**197**	**$20,300,000**		**77%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Buildings Impacted by Flooding	1%-Annual- Chance Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Allegany County Unincorporated Areas	41,156	499	$22,100,000	$537	84%
Town of Barton	457	4	$60,000	$131	< 1%
City of Cumberland	20,859	3	$30,000	$1	< 1%
City of Frostburg	9,002	0	$0	$0	0%
Town of Lonaconing	1,214	51	$2,000,000	$1,647	8%
Town of Luke	65	0	$0	$0	0%
Town of Midland	446	13	$80,000	$179	< 1%
Town of Westernport	1,888	37	$2,000,000	$1,059	8%
Total	75,087	**607**	**$26,300,000**	**$350**	**100.00%**



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area* (Area 1)

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk Essential Facility

N

0 0.75 1.5 3

Miles

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

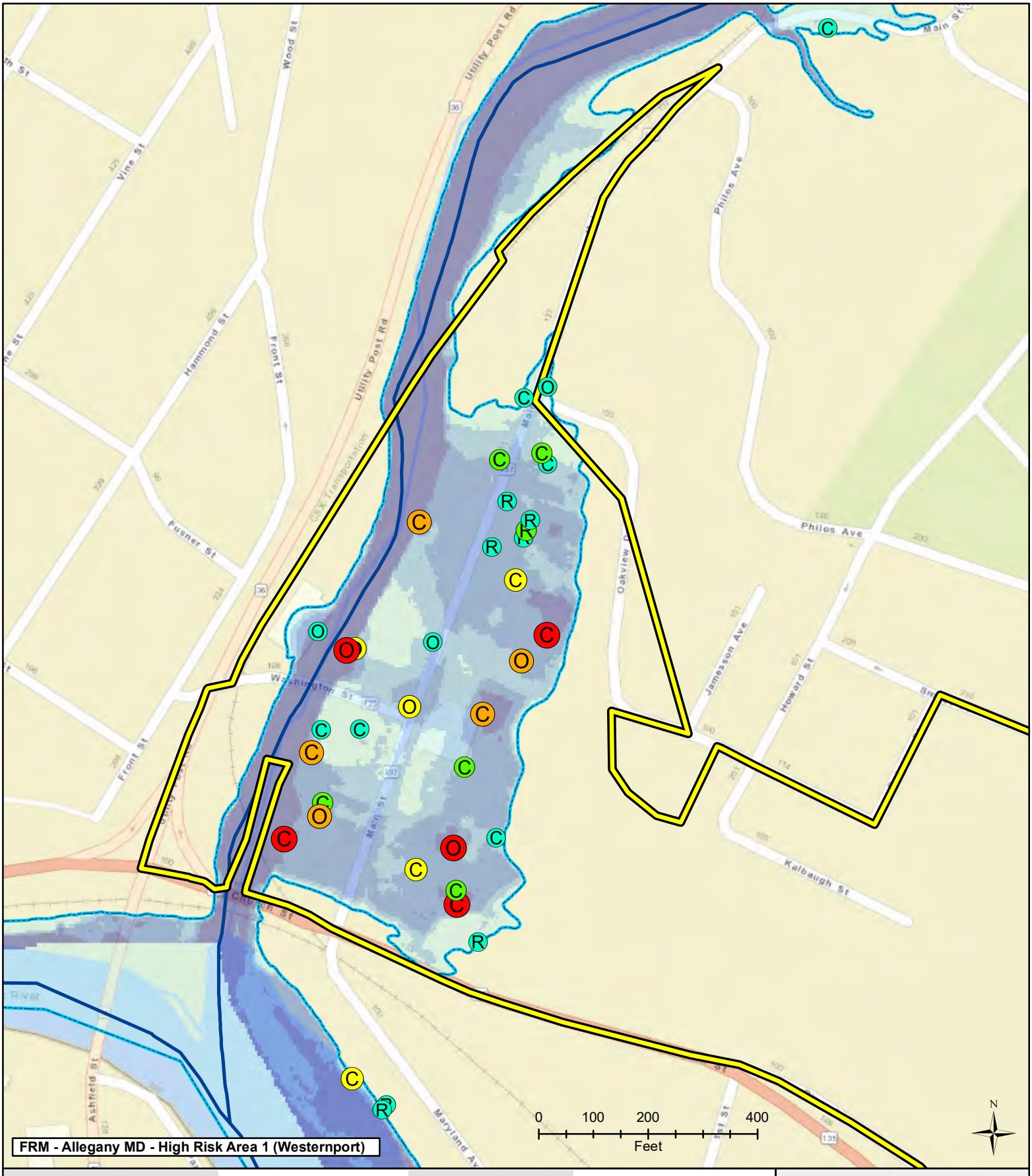
Allegany County and Incorporated Areas, MD

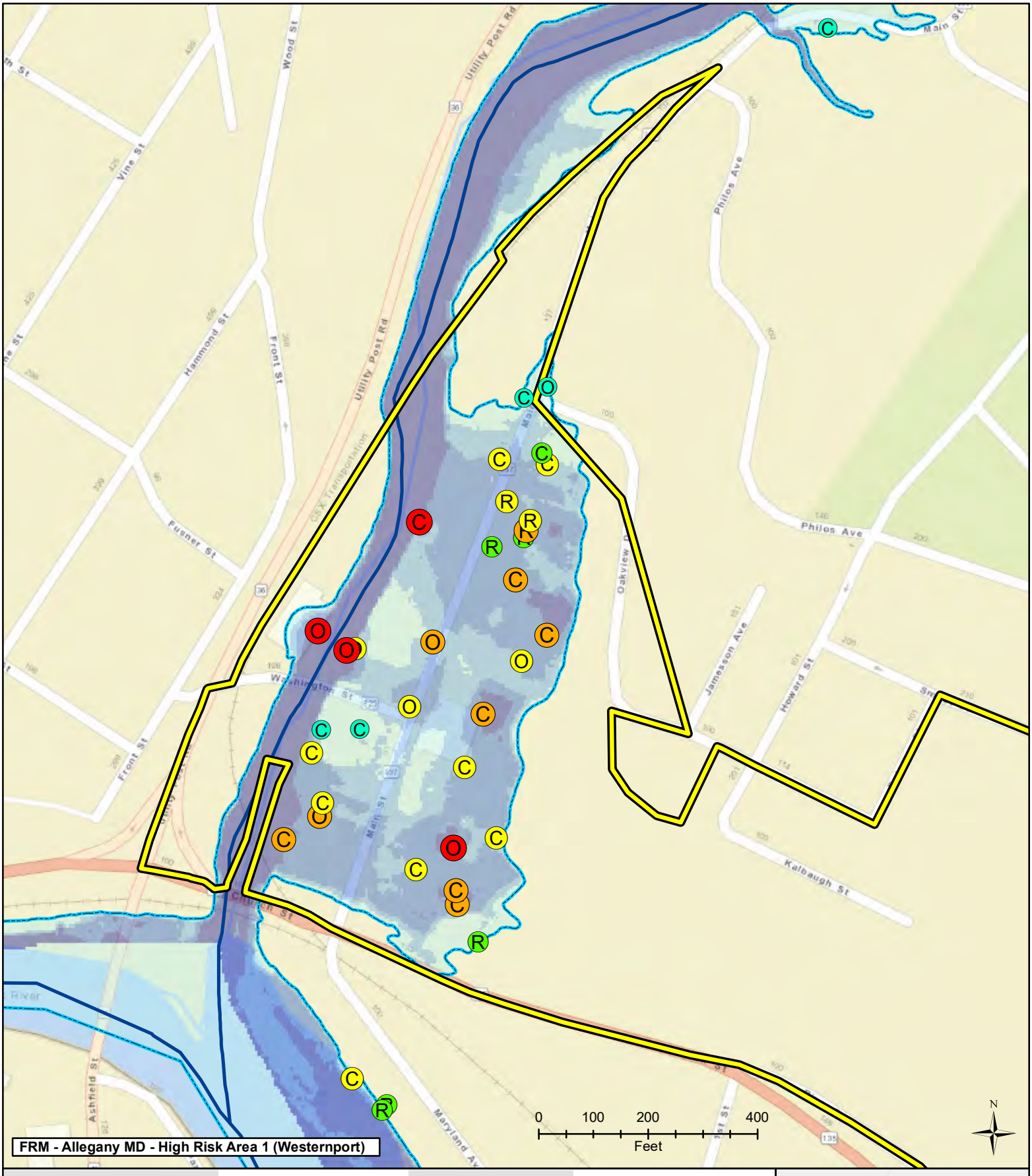
MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Allegany County, MD.

RELEASE DATE
12/31/2019


FRM - Allegany MD - High Risk Area 1 (Westernport)
0 100 200 400
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Allegany County
WEST



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

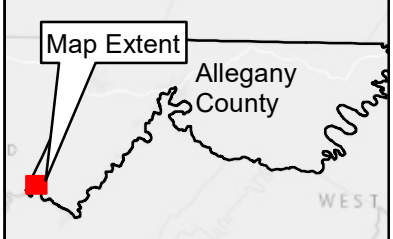
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

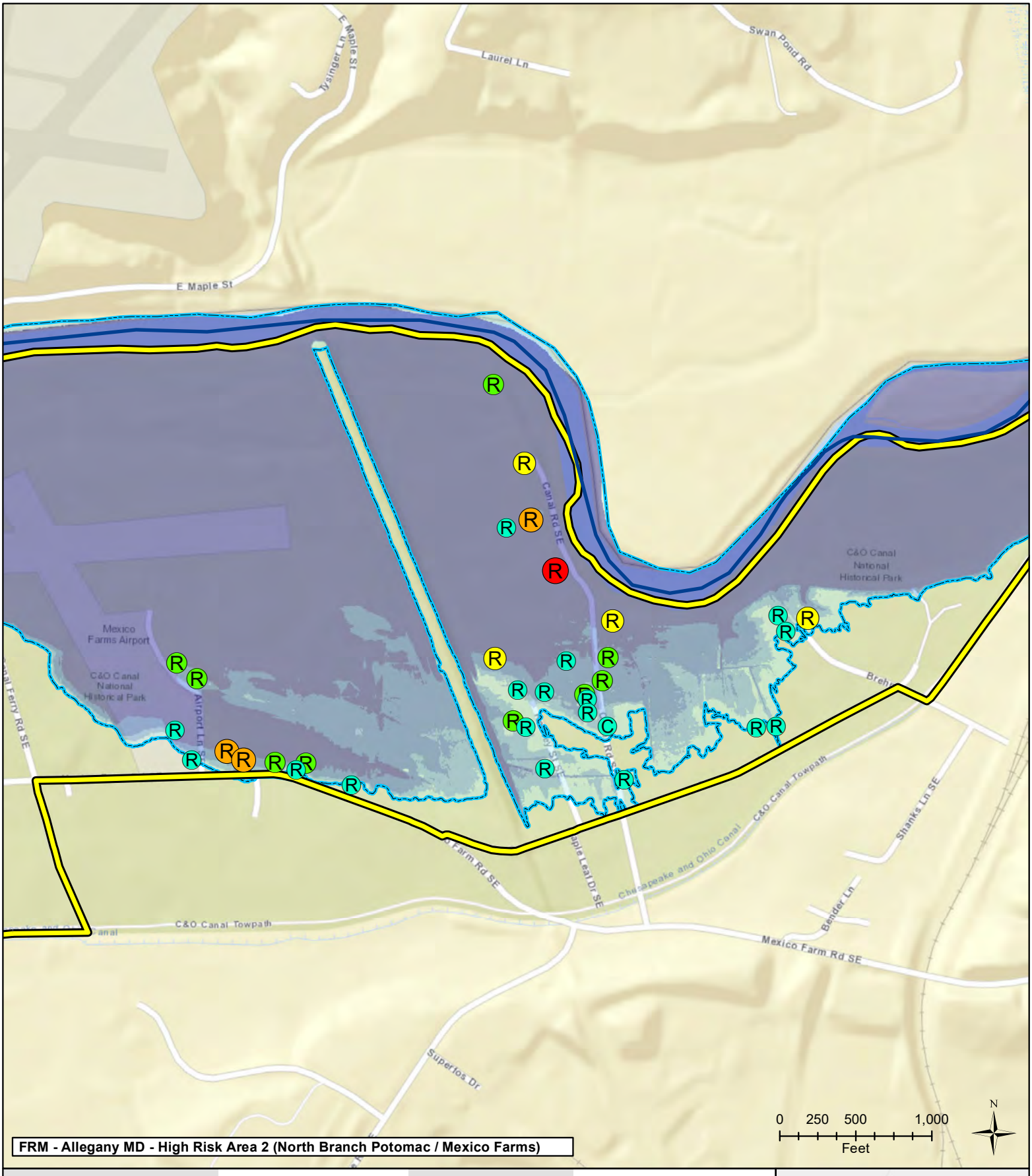
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More





FRM - Allegany MD - High Risk Area 2 (North Branch Potomac / Mexico Farms)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

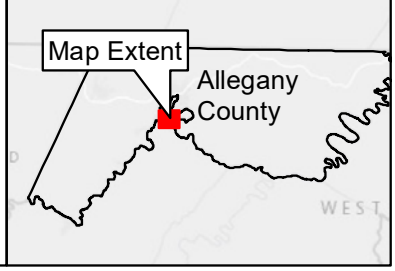
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

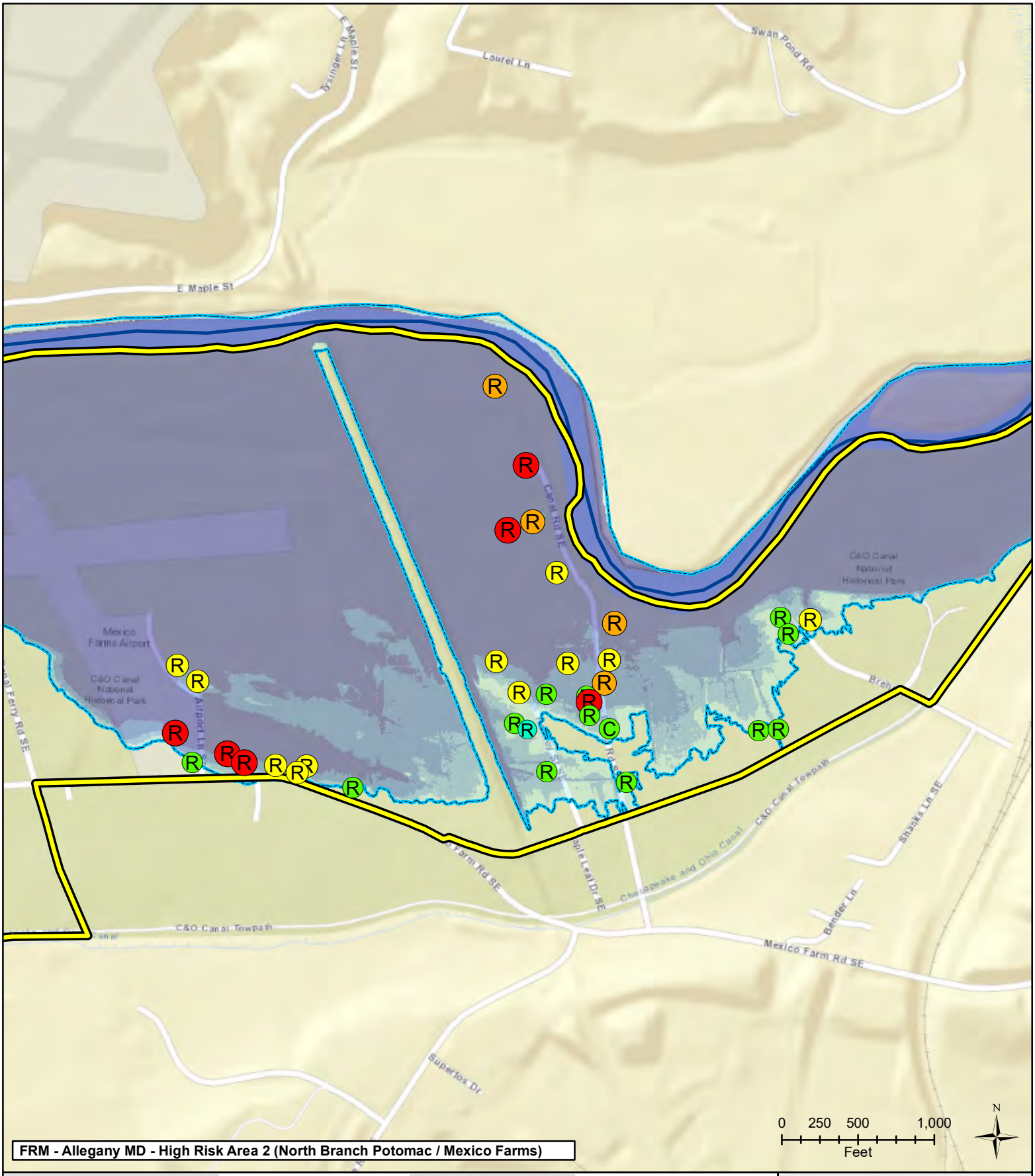
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Allegany MD - High Risk Area 2 (North Branch Potomac / Mexico Farms)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

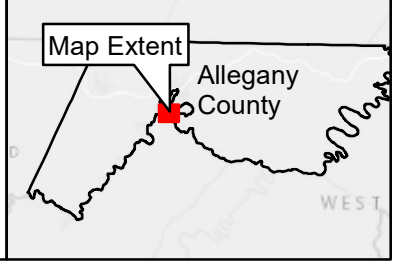
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

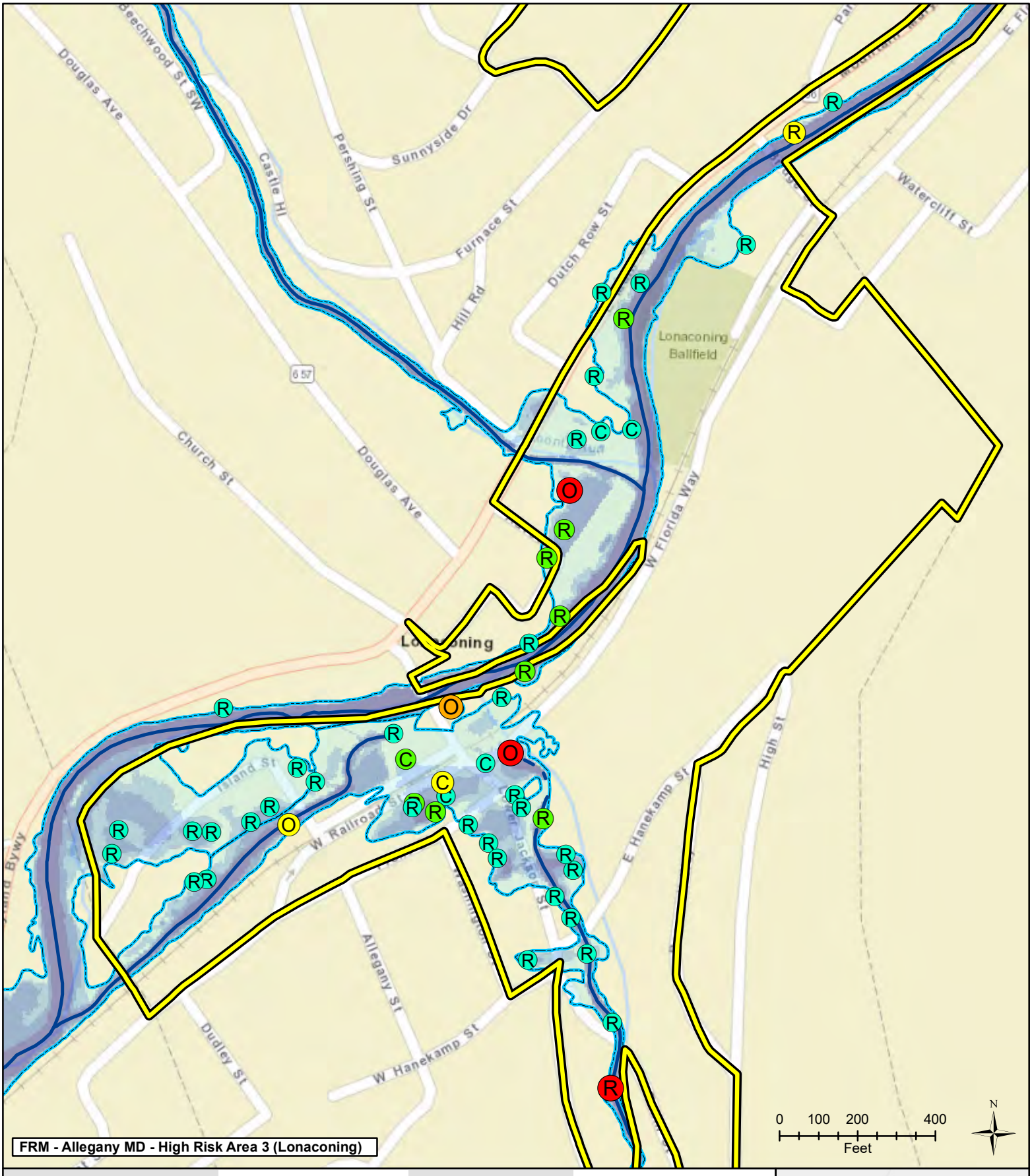
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

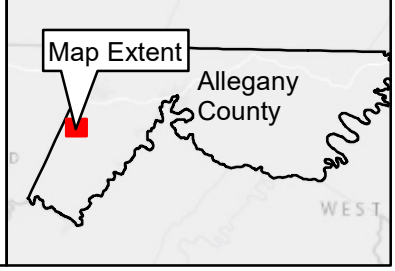
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

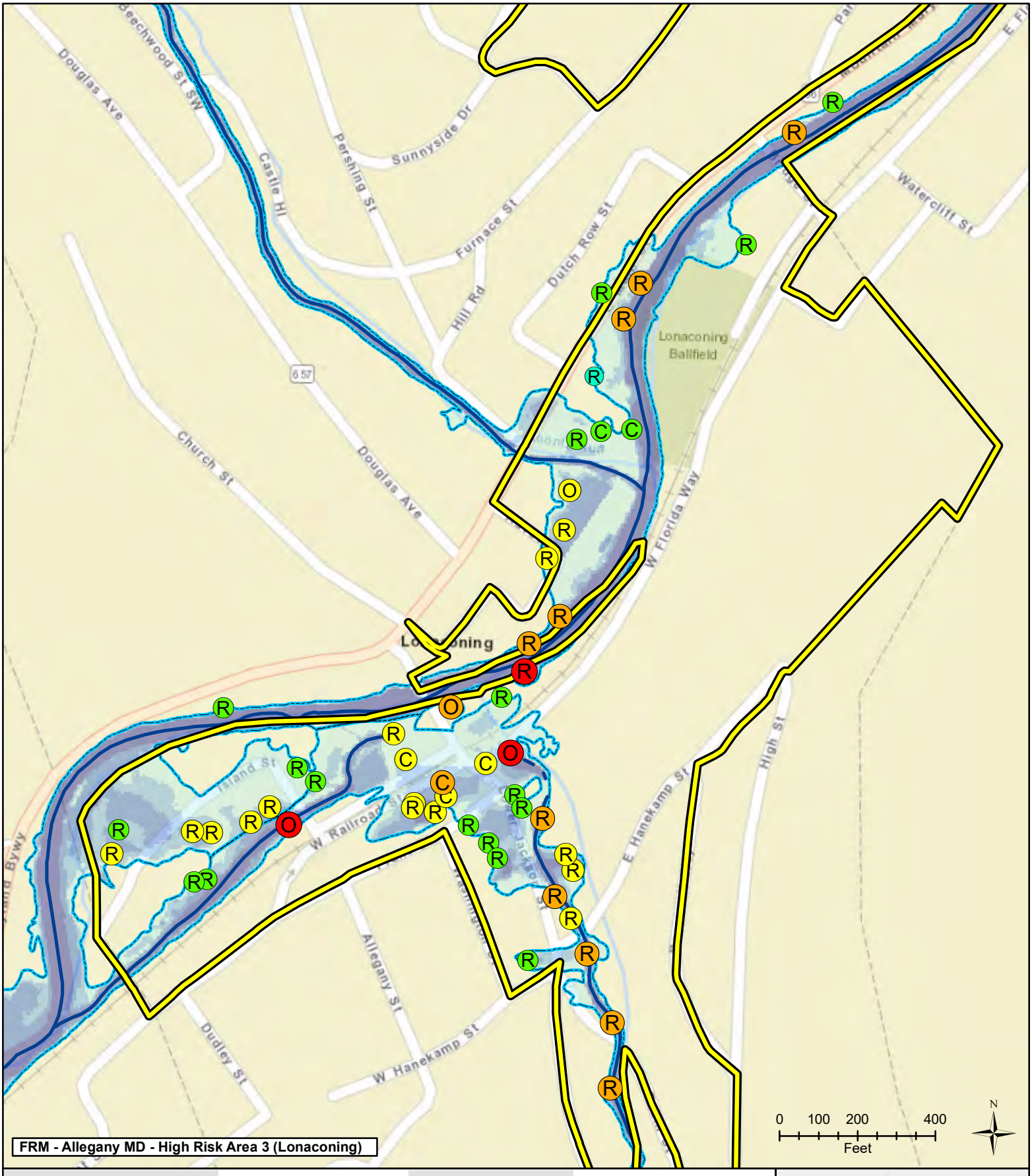
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

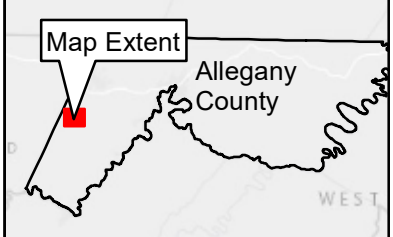
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

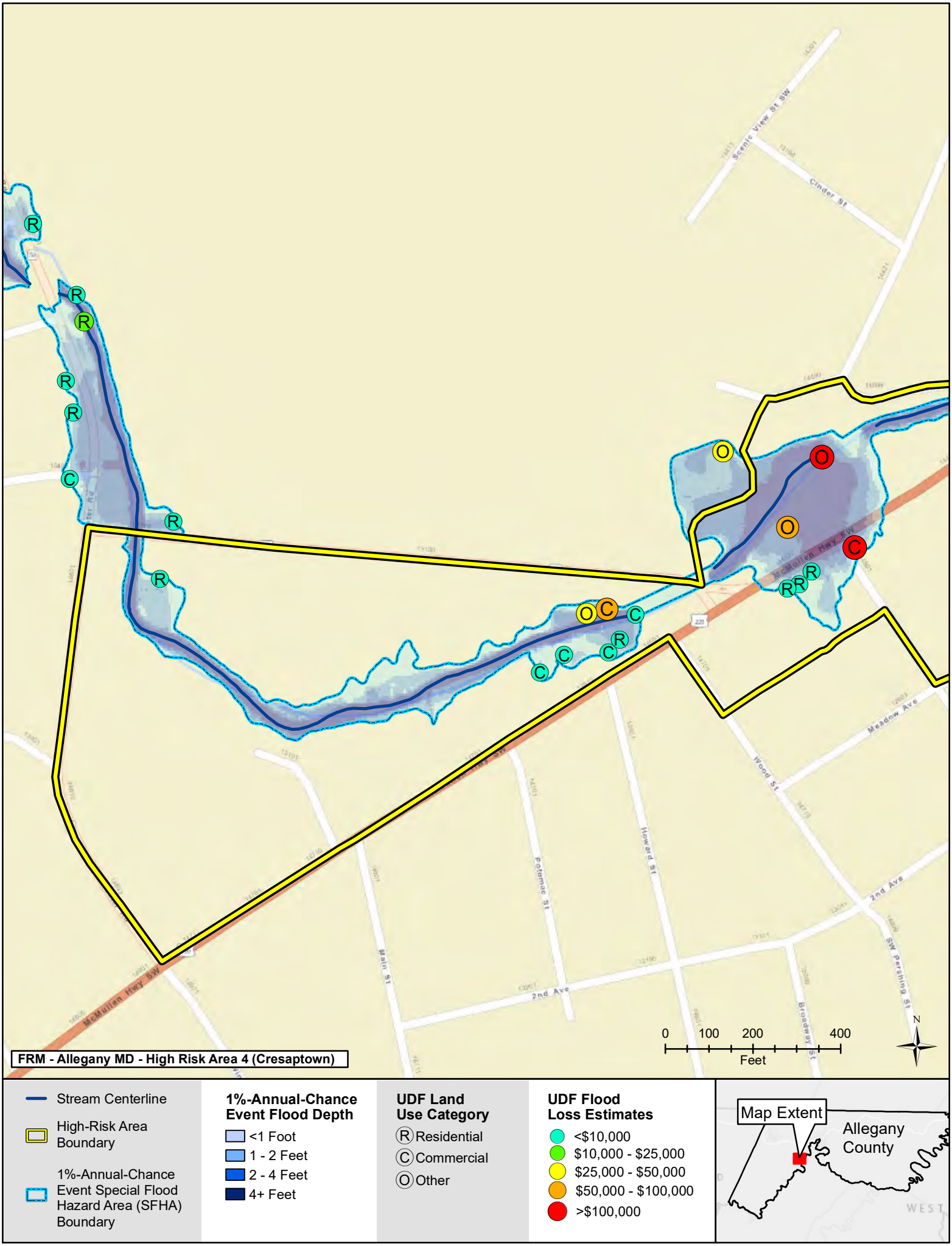
UDF Land Use Category

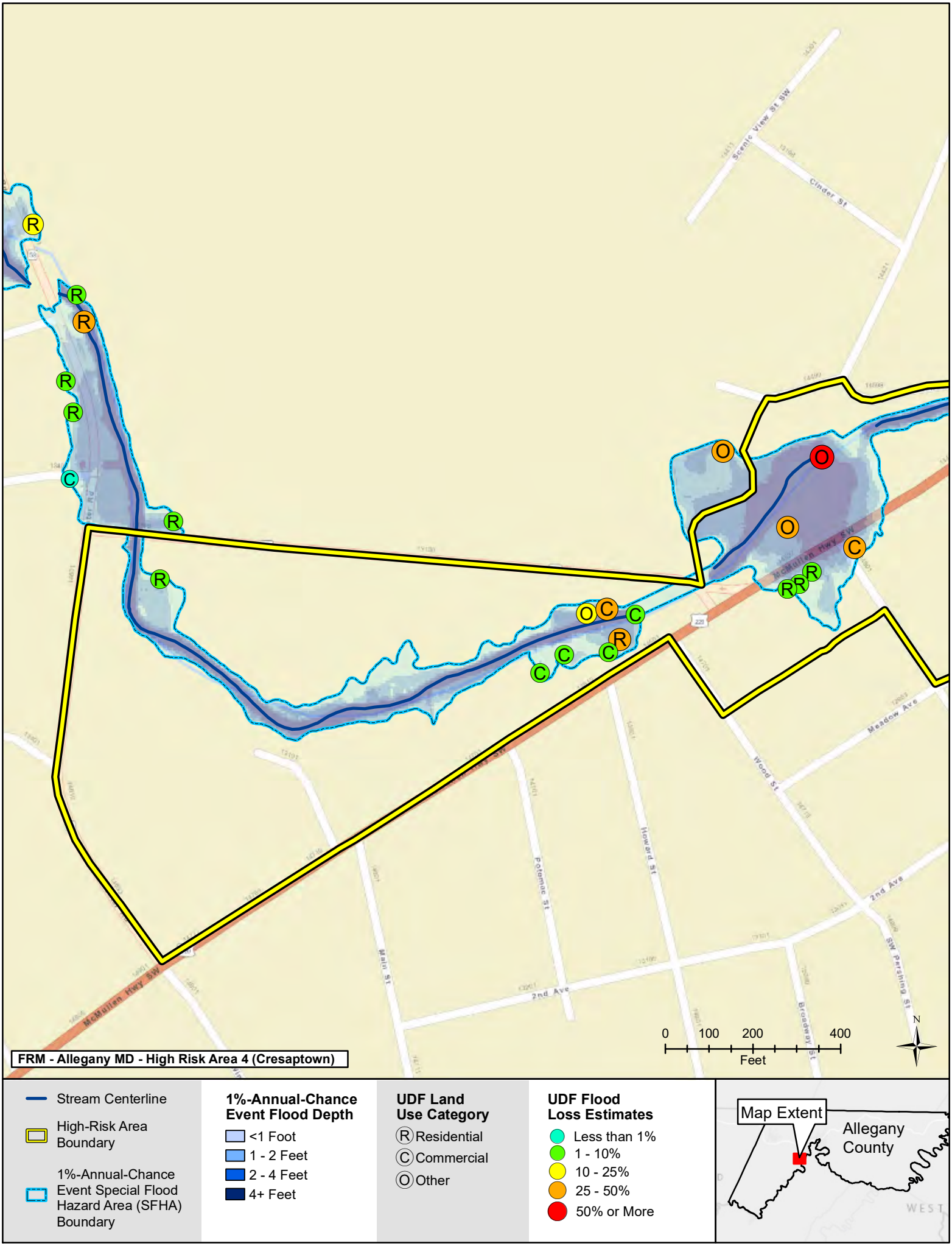
- (R) Residential
- (C) Commercial
- (O) Other

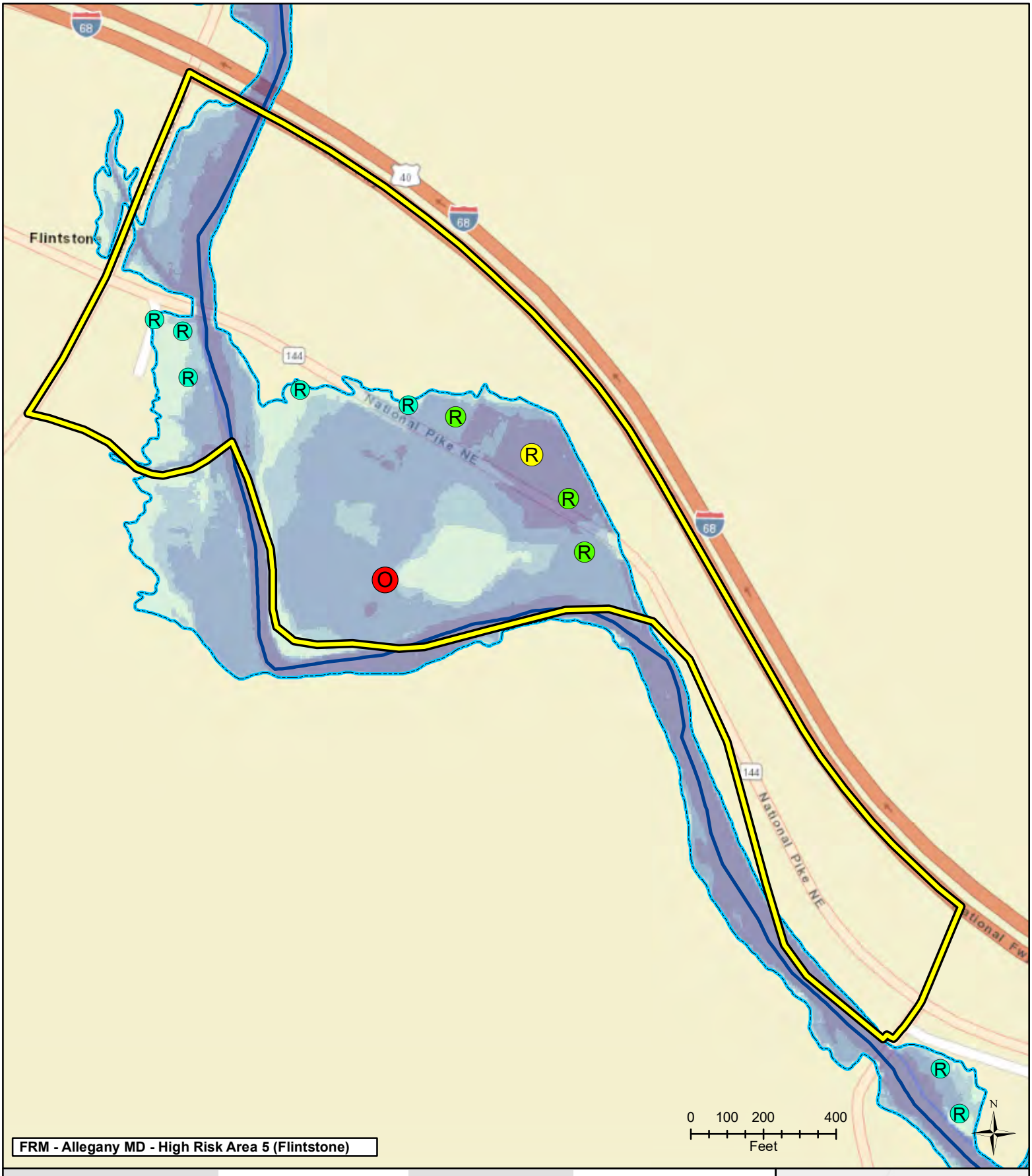
UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




FRM - Allegany MD - High Risk Area 4 (Cresaptown)
0
100
200
400
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Allegany County
WEST
McMullen Hwy SW
Scenic View St SW
Cinder St
Meadow Ave
Wood St
Howard St
Potomac St
Main St
2nd Ave
SW Pershing St
Broadway St


Scenic View St SW
Cinder St
McMullen Hwy SW
Meadow Ave
Wood St
Howard St
Potomac St
Main St
2nd Ave
SW Pershing St
Broadway St
0
100
200
400
Feet
N
FRM - Allegany MD - High Risk Area 4 (Cresaptown)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Allegany County
WEST



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

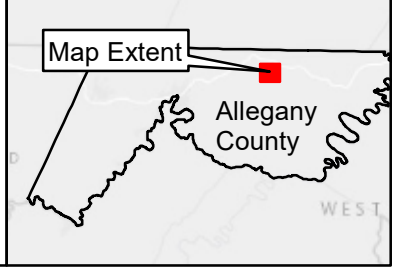
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

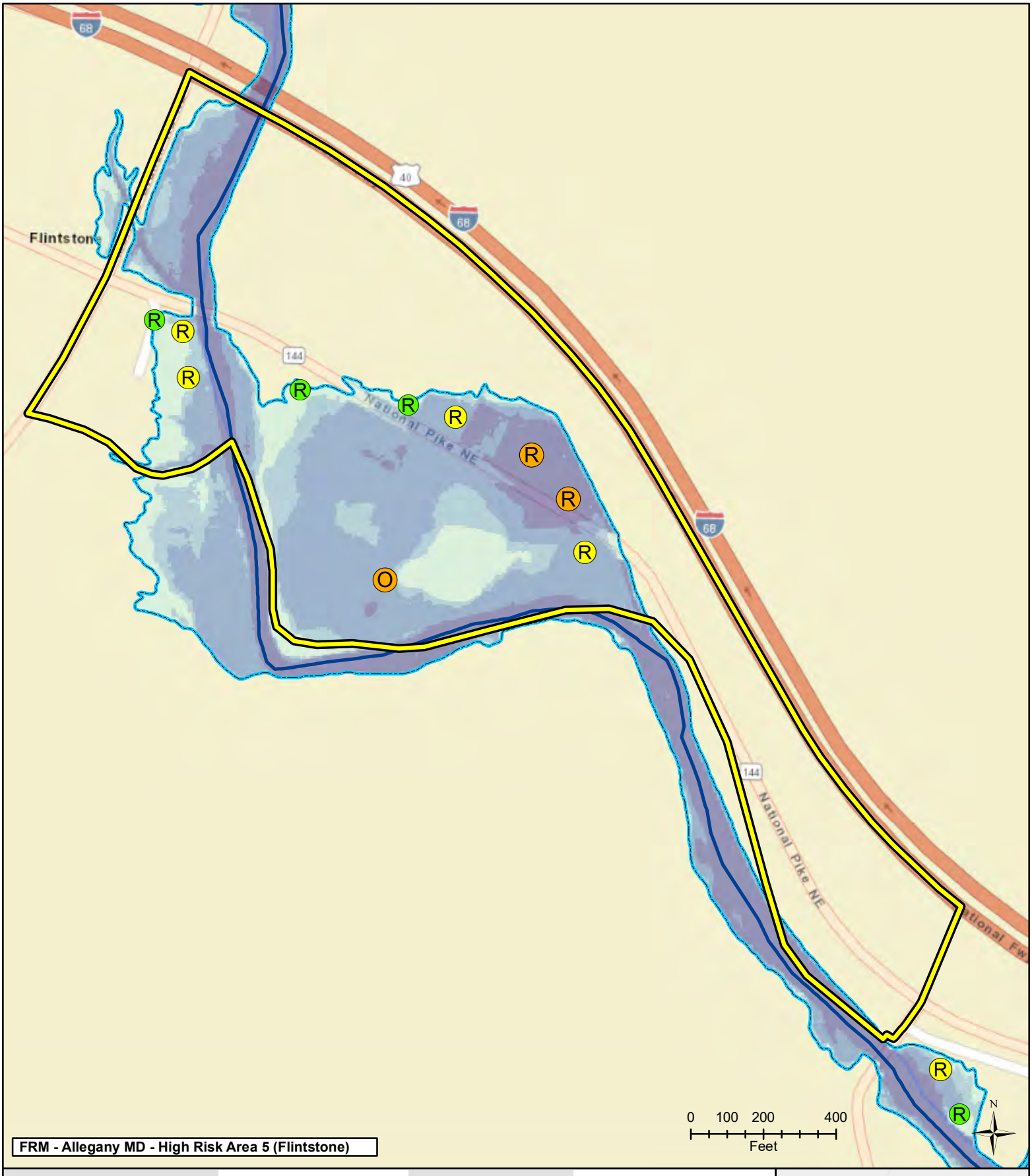
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Allegany MD - High Risk Area 5 (Flintstone)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

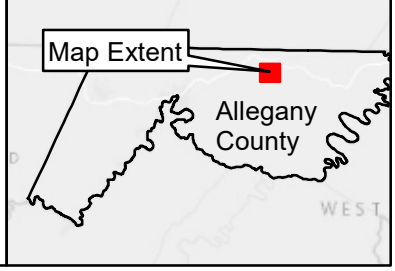
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

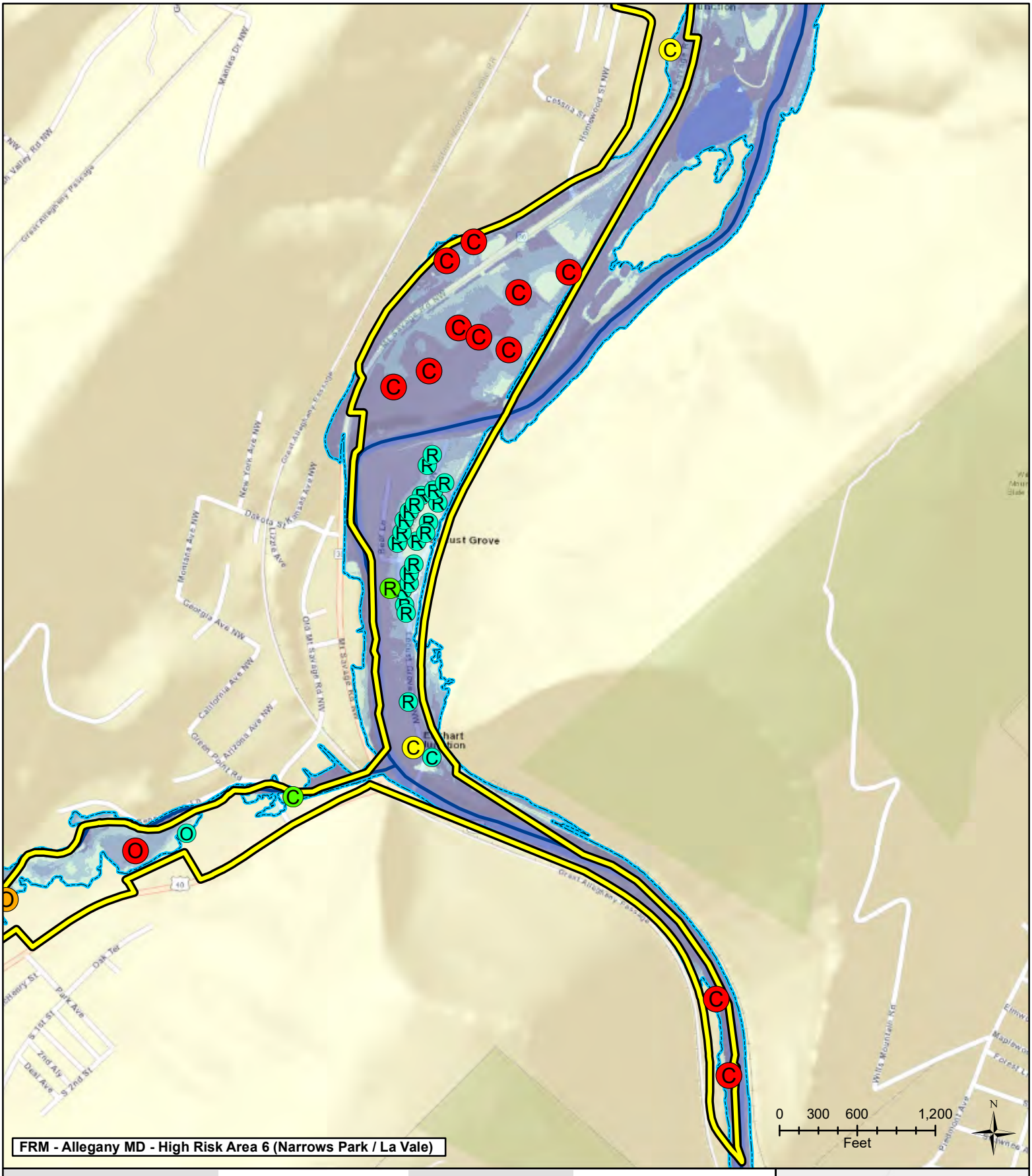
UDF Land Use Category

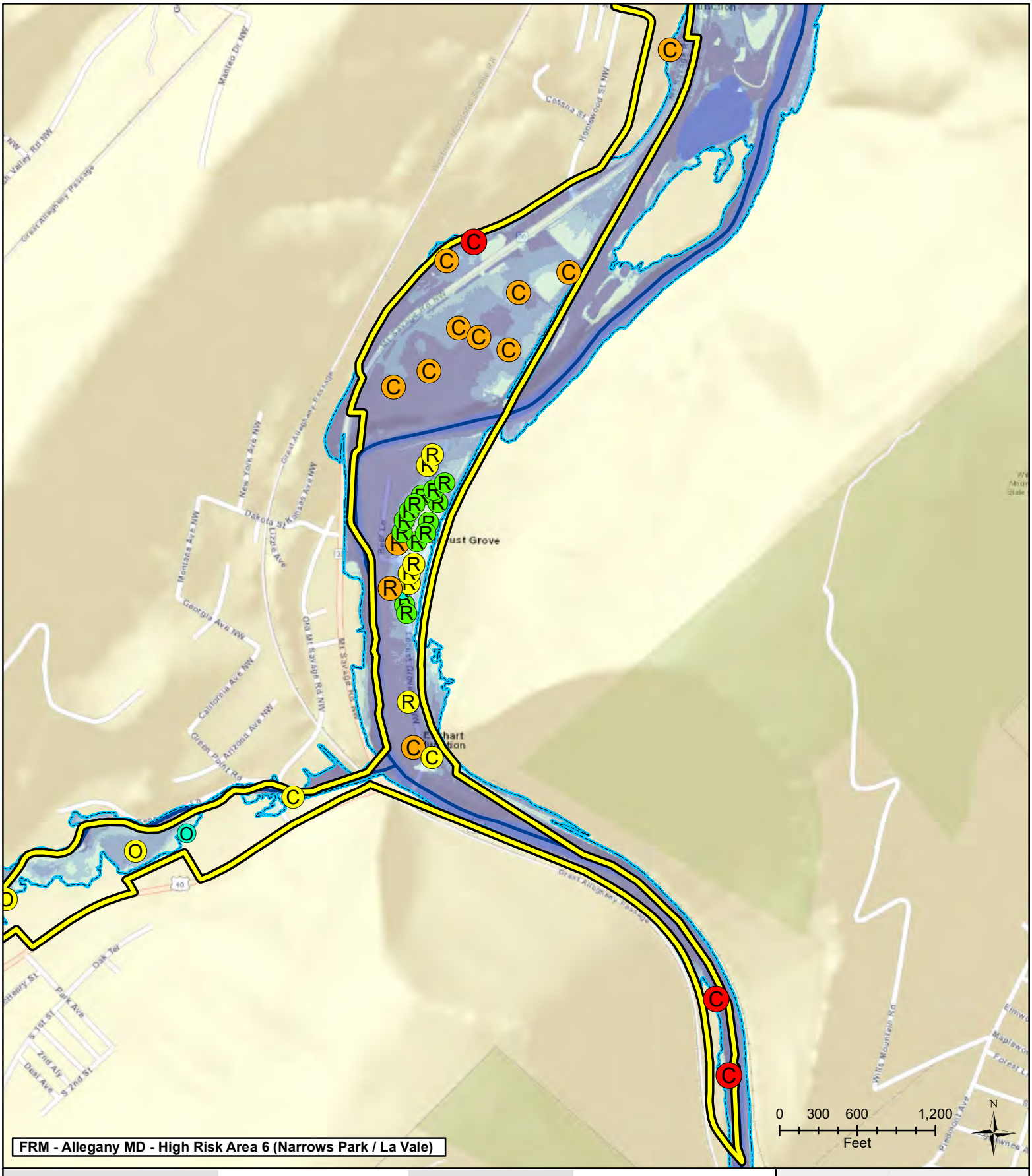
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




FRM - Allegany MD - High Risk Area 6 (Narrows Park / La Vale)
0 300 600 1,200
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Allegany County


FRM - Allegany MD - High Risk Area 6 (Narrows Park / La Vale)
0 300 600 1,200
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Allegany County

FRM - Allegany MD - Essential Facilities At-Risk to 1-Percent-Annual-Chance Flood Event

- Stream Centerline
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

Allegany County & Municipalities

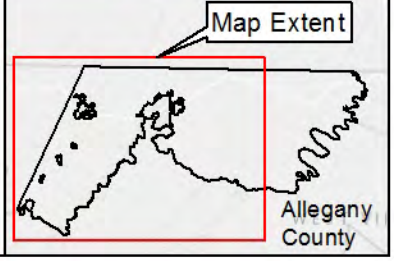
- Unincorporated & Incorporated Areas

Essential Facility Types At-Risk

- Fire
- Fire/Rescue
- School

Essential Facility Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000



This page left blank intentionally

Source: https://www.aacounty.org/index.html

STATE OF MARYLAND

FLOOD RISK REPORT

ANNE ARUNDEL COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Anne Arundel County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Anne Arundel County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Anne Arundel County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis for the county as a whole and for individual communities, with calculations of total flood damages by land use (occupancy type) and a summary of damage severity for buildings impacted by flooding. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership -http://www.resiliencypartnership.com - have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 5

d. Related Resources 7

2 Flood Risk Analysis 11

a. Overview 11

b. Analysis of Risk 12

i. Flood Depth and Analysis Grids 12

ii. Flood Risk Assessments 13

iii. Areas of Mitigation Interest 15

3 Flood Risk Analysis Results 27

a. Anne Arundel County, MD Flood Risk Project Area Summary 28

i. Overview 28

ii. Flood Risk Results 28

iii. Flood Risk Maps 37

b. Communities 38

i. Anne Arundel County (Unincorporated Areas) (CID 240008) 38

ii. City of Annapolis Summary (CID 240009) 41

iii. Town of Highland Beach (CID 240161) 44

4 Actions To Reduce Flood Risk....48

a. Types of Mitigation Actions....48

i. Local Plans and Regulations....48

ii. Structure and Infrastructure Projects....49

iii. Natural Systems Protection Activities....50

iv. Education and Awareness Activities....50

b. Identifying Specific Actions for Your Community....52

c. Mitigation Programs and Assistance....53

i. FEMA Mitigation Programs and Assistance....53

ii. Additional Mitigation Programs and Assistance....54

5 Acronyms And Definitions....55

a. Acronyms....55

b. Definitions....57

6 Additional Resources....61

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Anne Arundel County Essential Facilities....16

Table 2: USACE National Inventory of Dams – Anne Arundel County, MD....18

Table 3: Flood Risk Assessment – Community Overview....28

Table 4: Anne Arundel County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....29

Table 5: Anne Arundel County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....29

Table 6: Anne Arundel County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....30

Table 7: Anne Arundel County, Maryland – Degree of Damage Summary for the 1%-Annual-Chance Flood (Government Facilities in Riverine and Coastal Areas)....31

Table 8: Anne Arundel County, Maryland – Building & Content Loss Estimates Summary for the 1%-Annual-Chance Flood (State Assets in Riverine and Coastal Areas)....32

Table 9: Anne Arundel County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine Areas)....33

Table 10: Anne Arundel County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Riverine Areas)....34

Table 11: Anne Arundel County, Maryland – Types of Mitigation Interest....35

Table 12: Anne Arundel County, Maryland – High-Risk Areas....36

Table 13: Anne Arundel County (Unincorporated Areas) – Estimated Losses by Occupancy Type for 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....39

Table 14: Anne Arundel County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....40

Table 15: Anne Arundel County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 40

Table 16: City of Annapolis – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 43

Table 17: City of Annapolis – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 43

Table 18: Town of Highland Beach – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 46

Table 19: Town of Highland Beach – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 46

Table 20: Mitigation Actions for Areas of Mitigation Interest 50

Table 21: FEMA Hazard Mitigation Assistance Programs 53

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Compromise Street in Annapolis
Source: The Baltimore Sun

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Dock Street, Annapolis
Source: The Baltimore Sun

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: The water rises on Hammonds Ferry Road near Snyder's Willow Grove Restaurant in Linthicum, a reoccurring problem in Anne Arundel County.

Source: Capital Gazette

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future

land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

> Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 34-35.
>
> Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.
>
> In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic (H&H) modeling), floodplain boundaries, and flood depths based on regulatory FIRM updates and published in the FEMA National Flood Hazard Layer (NFHL), including:
  - Anne Arundel County Map Modernization Study – October 16, 2012
    - Restudy of all riverine flood hazards
  - Anne Arundel County Coastal Physical Map Revision (PMR) – February 18, 2015
    - Restudy of all coastal flood hazards
  - Letter of Map Revision (LOMR) – September 5, 2017
    - LOMR 17-03-0502P was prepared to revised Tributary No. 1 to Towsers Branch near Crain Highway / Route 3.
- Non-regulatory coastal flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were previously developed in conjunction with the Anne Arundel County Coastal PMR, effective February 18, 2015. These products were published to the FEMA Map Service Center on September 9, 2015 and have been leveraged as part of this countywide assessment.

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of January 2017), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/.
  Note that first floor elevations are *not* specified within this dataset but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordinances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructed after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Anne Arundel County Office of Information Technology, Geographic Information Services (OIT GIS) - https://www.aacounty.org/departments/oit/gis/ *(Limited Distribution; data available by purchase/ request)*.

- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.

- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Subsection ii: Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

  The Anne Arundel County Hazard Mitigation Plan was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

  Please note that the information in this FRR may be reviewed for inclusion during the update of the Anne Arundel County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.
- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.
- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.
- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

Anne Arundel County participates in the Maryland Emergency Mangement Know Your Zone program. This program is designed to m ake evacuations for residents easier to understand and act upon during predicted storm surge or tidal flooding events.

Figure 1.6

TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk, Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Anne Arundel County evacuation zones can be found at: http://mema.maryland.gov/Pages/know-your-zone-md.aspx.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  Anne Arundel County conducted a study with the Maryland Department of Natural Resources (DNR) on potential sea level rise impacts and to develop adaptation strategies for the County. The *2011 Sea Level Rise Strategic Plan – Anne Arundel County* provides a summary on key findings from the vulnerability assessment, identifies major planning issues for the County as related to sea level rise, and provides recommends for future actions to protect resources and minimize impacts.

- **Emergency Action Plans.** Emergency Action Plans (EAP) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

  Twenty-one (21) dams are located within Anne Arundel County, ten (10) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Anne Arundel County, MD,* on page 18 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  As noted in Section 1 of this report, a previously completed *Flood Risk Report - Anne Arundel County, Maryland Coastal Study*, developed by FEMA using Hazus Version 2.2, was released on September 9, 2015. This report provides coastal flood risk information, such as estimated coastal flood losses for the 1-percent-annual-chance flood event. The Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Flooding in Waysons Corner
Source: YouTube – Pilgrim
https://www.youtube.com/watch?v=vtKzAdXWxpo
Bottom Photo: Flooding at the historic African American cemetery in Broadneck, in Anne Arundel County.
Source: The Baltimore Sun

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

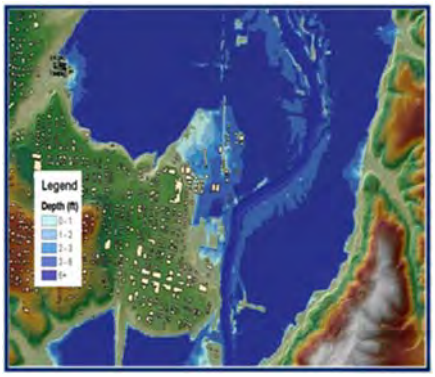
State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood depth is a function of the difference between

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

the calculated water surface elevation (including overland wave propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and regulatory FIRM updates for each study type were separately performed.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This include direct building losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income,

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

rental income, wage, and direct output losses, as well as relocation costs.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Figure 2.4

One of Anne Arundel County's essential facilities includes the Fire Company 7 - Arundel Volunteer Fire Company.

Photo Source: *https://www.aacounty.org/locations-and-directions*

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 161 essential facilities located within Anne Arundel County with a total estimated building value of $1,250,886,700.

Table 1: Anne Arundel County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	1	$2,272,400
Fire/Rescue Stations	31	$6,5783,100
Hospital & Medical Clinics	11	$88,236,000
Police Stations	5	$12,083,100
Schools (K-12 & Colleges)	113	$1,082,512,100
Total	**161**	**$1,250,886,700**

Source: Updated 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

  High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  A total of 7 high risk areas were identified within Anne Arundel County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

  A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Lake Waterford Park) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

  Figure 2.5

  Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

  Photo: Lake Waterford Park
  Source: The Baltimore Sun
  http://digitaledition.baltimoresun.com/tribune/article_popover.aspx?guid=6d9383c9-1985-447d-8c07-

  While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

  According to the USACE National Inventory of Dams, twenty-one (21) dams are located in Anne Arundel County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Anne Arundel County, MD

Name	Owner Type	Purpose	River	Emergency Action Plan (EAP)
South River Colony Parcel A SWM Lake	Local Government	Flood Control	Glebe Creek-TR	No
Riva Trace Community Pond	Private	Recreation	South River -TR	Yes
Lake of the Pines (Tarnans Branch Crossing)	Local Government	Recreation	Tarnans Branch	Yes
Heritage Harbour (Mastline Drive)	Private	Recreation	South River-TR	No
Annapolis Reservoir	Local Government	Recreation	Broad Creek-TR	Yes
Annapolis Mall SWM Pond	Local Government	Flood Control	Offstream-Weems Creek	No
Windgate SWM Dam 3 (Burtons Cove Way)	Private	Flood Control	Offstream-Weems Creek	Yes
Saefern Dam	Private	Recreation	Clements Creek-TR	No
Crofton Farms Regional SWM Pond	Local Government	Flood Control	Towsers Branch -TR	No
Chartwell Country Club Dam	Private	Irrigation	Severn River-TR	Yes
Shipleys Choice Section II SWM Dam	Local Government	Flood Control	Severn River-TR-Bear Branch	Yes
Park Retreat SWM Pond	Local Government	-	Magothy River-TR	No
Shipleys Crossing North Dam 2	Private	-	Marley Creek-TR	Yes
Shipleys Crossing North Dam	Private	-	Marley Creek-TR	Yes
Lake Allen Dam	Federal	Recreation	Midway Branch	No
Burba Lake Dam	Federal	Fire Protection, Stock, Or Small Fish Pond	-	Yes
Seven Oaks SWM Dam	Private	Flood Control	Jackson Run, TR-Severn Run	No
Russett Center Upper Dam/Pond #2 (Ridgemere Crossing)	Local Government	Flood Control	Little Patuxent River-TR	No
Russett Center Lower Dam/Pond #1	Local Government	Flood Control	Little Patuxent River-TR	No
Jessup Prison Dam	State	Flood Control	Dorsey Run-TR	Yes
Cristal Global Hawkins Point Plant Settling Basins	Private	-	Offstream-Patapsco River	No

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**

  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.

Figure 2.6

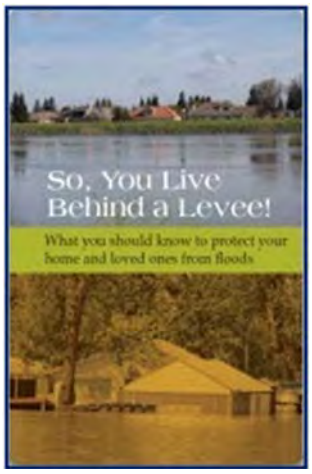
This dam failure caused flooding that damaged several homes and vehicles.

  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.
  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
  - When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
  - For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1%-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of residual risk.

Acccording to US Army Corps of Engineers, National Levee Database, there are no levees located within Anne Arundel County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

  - **Reasons coastal structures are considered AoMIs:**
    - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.

- Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
- As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**
    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
    - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
    - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
    - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

  Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

  Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

  As of August 2016, a total of eighty-nine (89) FEMA Designated Repetitive Loss Properties were within Anne Arundel County; There are eighty-four (84) repetitive loss properties located in the unincorporated area of Anne Arundel County and five (5) repetitive loss properties identified within the City of Annapolis. There is a total of seven (7) severe repetitive loss structures located within Anne Arundel County.

  Figure 2.8

  Clusters of past flood insurance claims can show where there is a repetitive flood problem.

  - **Reasons past claim hotspots are considered AoMIs:**
    - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
    - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
    - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

  Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

  Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

  Figure 2.9

  Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

  - **Reasons Areas of Significant Land Use Change are considered AoMIs:**
    - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
    - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
    - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

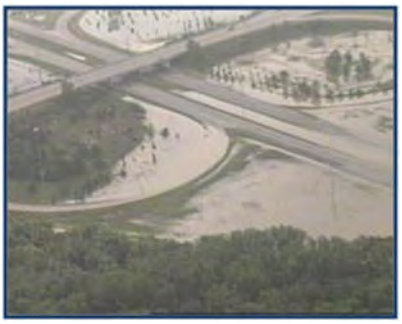
- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate

routes are available, risks may be reduced, including risks to life and economic loss.

- **Reasons overtopped roads are considered AoMIs:**
  - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
  - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

Figure 2.10



When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

- **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
  - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
  - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 18.

- **Reasons areas of mitigation success are considered AoMIs:**
  - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
  - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
  - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
    - Landslides and mudslides are a result of erosion
    - Approximately one-third of the nation's streams experience severe erosion problems
    - Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
    - Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Anne Arundel County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Anne Arundel County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Anne Arundel County (Unincorporated Areas)	240008	499,166	579.81	Y	N/A	Y
City of Annapolis	240009	38,394	8.11	Y	N/A	Y
Town of Highland Beach	240161	96	0.08	Y	N/A	Y

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Anne Arundel County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that countywide summary results represent totals for both coastal and riverine flooding. Separate information for coastal and riverine flood losses are presented, where applicable, for individual communities under Section 3, Subsection b.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Table 4: Anne Arundel County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Anne Arundel County (Unincorporated Areas)	499,166	2,160	$88,000,000	$176	84%
City of Annapolis	38,394	109	$16,810,000	$438	16%
Town of Highland Beach	96	7	$200,000	$2,083	< 1%
Total	**537,656**	**2,276**	**$105,010,000**	**$195**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Anne Arundel County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	2,122	$659,900,000	81%	$58,200,000	9.0%
Commercial Building & Contents	135	$138,100,000	17%	$28,400,000	21.0%
Other Building & Contents	19	$21,300,000	3%	$3,400,000	16.0%
Total Building & Contents[3]	2,276	$819,300,000	100%	$90,000,000	11.0%
Business Disruption[4]	N/A	N/A	N/A	$15,000,000	N/A
TOTAL[5]	**2,276**	**$819,300,000**	**100%**	**$105,000,000**	**13.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Anne Arundel County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	543	24%	$230,400,000	$400,000	$80,000	$0	0%
1 - 10%	635	28%	$234,200,000	$400,000	$14,300,000	$20,000	16%
10 - 20%	647	28%	$213,300,000	$300,000	$30,500,000	$50,000	34%
20 - 30%	338	15%	$77,800,000	$200,000	$19,100,000	$60,000	21%
30 - 40%	74	3%	$31,100,000	$400,000	$10,700,000	$100,000	12%
40 - 50%	26	1%	$27,400,000	$1,100,000	$12,400,000	$500,000	14%
50% or More	13	1%	$5,100,000	$400,000	$2,900,000	$200,000	3%
TOTAL	**2,276**	**100%**	**$819,300,000**	**$400,000**	**$89,980,000**	**$40,000**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables represent information within the Anne Arundel County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (based on the county's latest effective NFHL data, dated September 5, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Anne Arundel County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential essential facility flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, however, no essential facilities in Anne Arundel County are at-risk to the 1-percent-annual-chance flood event.

While there are no essential facilities at-risk, there are several government facilities at-risk to the 1-percent-annual-chance flood event. The list of government facilities at-risk is provided on page 36.

Table 7: Anne Arundel County, Maryland – Degree of Damage Summary for the 1%-Annual-Chance Flood (Government Facilities in Riverine and Coastal Areas)

Type	Estimated Building Value	Total Government Facilities	1% (100-yr) Dollar Losses (Building Value)
Government	$ 4,200,100	10	$1,851,905
TOTAL	**$4,200,100**	**10**	**$1,851,905**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Anne Arundel County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Anne Arundel County contains 652 state assets. Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 8.

Table 8: Anne Arundel County, Maryland – Building & Content Loss Estimates Summary for the 1%-Annual-Chance Flood (State Assets in Riverine and Coastal Areas)

Type	Total 1% (100-yr) Dollar Losses (Building & Content)	Total Building Loss	Building Loss Percentage of Total	Total Content Loss	Content Loss Percentage of Total
Utility/Infrastructure	$36,984,000	$9,537,000	26%	$27,447,000	74%
Department of Natural Resources	$113,796,000	$44,036,000	39%	$69,760,000	61%
TOTAL	**$150,780,000**	**$53,573,000**	**N/A**	**$97,207,000**	**N/A**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored in the 'Area of Mitigation Interest' (S_AOMI_Ar) layer of the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
  - The model estimates that a total of 23,302 tons of debris will be generated. Of the total amount, Finishes comprises 60% of the total, Structure comprises 22% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 932 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 9: Anne Arundel County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	14,087	60%	564
Structure	5,034	22%	201
Foundation	4,181	18%	167
TOTAL	**23,302**	**100%**	**932**

Source: Hazus 3.1: Flood Modual – Anne Arundel County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**
    - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 3,167 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 5,260 people (out of a total population of 537,656) will seek temporary shelter in public shelters.

Table 10: Anne Arundel County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Riverine Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	3,167	9,501	5,260

Source: Hazus 3.1: Flood Modual – Anne Arundel County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 11: Anne Arundel County, Maryland - Types of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Government Facilities	10	Depth grids, UDFs
At-Risk State Assets	2	Dept grids, MEMA
High-Risk Areas	7	Depth grids, UDFs, Loss estimates
Repetitive Loss Properties	89	FEMA NFIP/MDE Community Assistance Program Manager

- **At-Risk Government Facilities:**
  - Results from the 1-percent-annual-chance flood event analysis indicate ten (10) government facilities are at-risk; eight (8) facilities are Anne Arundel County facilities, and two (2) are City of Annapolis facilities. Flood depths for each facility is provided below along with the identified facilities.
    - City of Annapolis Facilities
      Sewage Pumping Plant: 1 Shipwright Street, Annapolis – 3.5′
      Water Works: Defense Highway, Annapolis – 1.0′
    - Anne Arundel Public Works Facilities
      Holly Avenue, Shady Side – 0.5′
      Pumping Station: 936 Main Street, Deale – 2.3′
      Recreation Area: 1788 Dorsey Road, Hanover – 2.3′
      Recreation Area: 4550 Sands Road, Harwood – 8.1′
      Freshwater Pumping Station, Crofton – 5.7′
      Clark Station: Burns Crossing Road, Severn – 0.7′
      Tipton Airport, Fort Mead – 4.0′
      Freshwater Pumping Station, Severn Run State Park, Severn – 1.0′
- **At-Risk State Assets:**
  - Results from the 1-percent-annual-chance flood event analysis indicate two (2) state assets are at-risk. These facilities include one (1) Utility/Infrastructure facilities and one (1) Department of Natural Resources facility. Flood depths for each facility is provided below along with the identified facilities.
    - Utility/Infrastructure Facility
      - Museum: 77 Main Street, Annapolis – 1.5′
    - Department of Natural Resources Facilities
      - H. J. Elser- Burtis Property: 69 Prince George Street, Annapolis – 3.7′

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 12: Anne Arundel County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Bayside Beach / Hines Ponds	660	30	160	$4,497,287	4%
Area 2	Oyster Harbor / Thomas Point / Arundel on the Bay	828	44	145	$3,215,582	3%
Area 3	Selby-on-the-Bay	2,288	69	237	$7,573,186	7%
Area 4	South Creek / Avalon Shores	1,225	37	171	$2,958,350	3%
Area 5	Cedarhurst / Columbia Beach	815	37	212	$2,551,218	2%
Area 6	Deale / Franklin Manor	1,632	55	237	$4,081,586	4%
Area 7	Holland Point / Bay Front Ave	302	6	76	$1,319,411	1%
Total for High-Risk Areas		**7,750**	**278**	**1,238**	**$26,196,620**	**25%**

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of eighty-nine (89) FEMA Designated Repetitive Loss Properties have been identified in the unincorporated portions of Anne Arundel County and the City of Annapolis. A total of seventy-six (76) single family homes, two (2) condos, and six (6) commercial structures are within the unincorporated areas of the County. Six (6) of these structures are severe repetitive loss properties.

  According to the *2018 City of Annapolis Hazard Mitigation Plan*, there are currently five (5) repetitive loss properties identified within the City of Annapolis; four (4) repetitive loss properties and one (1) severe repetitive

loss property. The RL properties are located within Ward 1 (three (3) properties) and Ward 8 (two (2) properties). These properties consist of two (2) marinas, one (1) social club, one (1) shopping center, and one (1) apartment building. Three (3) repetitive loss properties are within the Historic District of Annapolis.

Due to sensitivity of public disclosure for flood insurance claims, Repetitive and Severe Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

iii. Flood Risk Maps

The Flood Risk Maps for Anne Arundel County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Anne Arundel County (Unincorporated Areas) Summary (CID 240008)

The following pages include Flood Risk data for the Anne Arundel County (Unincorporated Areas).

Overview

The Anne Arundel County (Unincorporated Areas) is located is central Maryland and consists of 579.81 square miles. It is bordered by Baltimore County and Baltimore City to the north, Howard County to the northwest, Prince George's County to the west, Calvert County to the south, and the Chesapeake Bay to the east.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Anne Arundel County (Unincorporated Areas)	240008	499,166	579.81	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires 2023
- Past Federal Disaster Declarations for flooding = 4
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 5,391 policies totaling approximately $1,541,431,600
- NFIP-recognized repetitive loss properties = 84
- NFIP-recognized severe repetitive loss properties = 6

Data provided below only includes areas in the Anne Arundel County (Unincorporated Areas) that are located within the Anne Arundel County, Maryland Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Anne Arundel County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event (for both riverine and coastal flood hazards), along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Loss estimates for the 1-percent-annual-chance flood were calculated using Hazus-MH, and the results by occupancy type are presented in Table 13. Then, Tables 14 and 15 show the severity of damage to buildings from flooding for riverine and coastal areas. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 13: Anne Arundel County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	2,052	$598,700,000	83%	$49,800,000	8.0%
Riverine	*136*	*$28,600,000*	*29%*	*$2,800,000*	*10.0%*
Coastal	*1916*	*$570,100,000*	*91%*	*$47,000,000*	*8.0%*
Commercial Building & Contents	90	$101,700,000	14%	$22,800,000	22.0%
Riverine	*27*	*$49,100,000*	*50%*	*$8,900,000*	*18.0%*
Coastal	*63*	*$52,600,000*	*8%*	*$13,800,000*	*26.0%*
Other Building & Contents	18	$21,300,000	3%	$3,400,000	16.0%
Riverine	*14*	*$20,800,000*	*21%*	*$3,300,000*	*16.0%*
Coastal	*4*	*$400,000*	*0%*	*$100,000*	*25.0%*
Total Building & Contents[3]	**2,160**	**$721,700,000**	**100%**	**$76,000,000**	**11.0%**
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	$3,800,000	N/A
Business Disruption[4] *(Coastal)*				$8,300,000	
TOTAL[5]	**2,160**	**$721,700,000**	**100%**	**$88,000,000**	**12.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 14: Anne Arundel County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	23	13%	$17,100,000	$700,000	$40,000	$0	0%
1 - 10%	81	46%	$46,200,000	$600,000	$3,000,000	$40,000	20%
10 - 20%	29	16%	$8,600,000	$300,000	$1,200,000	$40,000	8%
20 - 30%	10	6%	$2,400,000	$200,000	$600,000	$60,000	4%
30 - 40%	16	9%	$6,700,000	$400,000	$2,200,000	$100,000	15%
40 - 50%	9	5%	$15,900,000	$1,800,000	$7,100,000	$800,000	47%
50% or More	9	5%	$1,600,000	$200,000	$900,000	$100,000	6%
TOTAL	**177**	**100%**	**$98,500,000**	**$600,000**	**$15,040,000**	**$80,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Anne Arundel County (Unincorporated Areas)

Table 15: Anne Arundel County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	496	25%	$193,900,000	$400,000	$30,000	$0	0%
1 - 10%	519	26%	$173,400,000	$300,000	$10,400,000	$20,000	17%
10 - 20%	592	30%	$159,400,000	$300,000	$21,900,000	$40,000	36%
20 - 30%	304	15%	$65,200,000	$200,000	$16,000,000	$50,000	26%
30 - 40%	54	3%	$19,300,000	$400,000	$6,800,000	$100,000	11%
40 - 50%	15	1%	$9,600,000	$600,000	$4,500,000	$300,000	7%
50% or More	3	0%	$2,300,000	$800,000	$1,400,000	$500,000	2%
TOTAL	**1,983**	**100%**	**$623,100,000**	**$300,000**	**$61,030,000**	**$30,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Anne Arundel County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (based on the county's latest effective NFHL data, dated September 5, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. City of Annapolis Summary (CID 240009)

The following pages include Flood Risk data for the City of Annapolis.

Overview

The City of Annapolis is in eastern Anne Arundel County. It consists of 8.11 square miles along State Highway 450. The primary flooding source in the city is the Chesapeake Bay.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
City of Annapolis	240009	38,394	8.11	Y	N/A	Y

- Participating in the City Hazard Mitigation Plan which expires March 18, 2023
- Past Federal Disaster Declarations for flooding = 4
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 487 policies totaling approximately $147,188,000
- NFIP-recognized repetitive loss properties = 4
- NFIP-recognized severe repetitive loss properties = 1

Data provided below only includes areas in the City of Annapolis that are located within the Anne Arundel County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The City of Annapolis flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Annapolis, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 16. Additionally, Table 17

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: City of Annapolis – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	63	$59,400,000	62%	$8,200,000	14.0%
Commercial Building & Contents	45	$36,300,000	38%	$5,600,000	15.0%
Other Building & Contents	1	$20,000	0%	$10,000	50.0%
Total Building & Contents[3]	109	$95,720,000	100%	$13,810,000	14.0%
Business Disruption[4]	N/A	N/A	N/A	$3,000,000	N/A
TOTAL[5]	**109**	**$95,720,000**	**100%**	**$16,810,000**	**18.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: City of Annapolis – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	23	21%	$18,800,000	$800,000	$10,000	$0	0%
1 - 10%	32	29%	$14,000,000	$400,000	$800,000	$30,000	6%
10 - 20%	23	21%	$44,600,000	$1,900,000	$7,300,000	$300,000	53%
20 - 30%	24	22%	$10,200,000	$400,000	$2,500,000	$100,000	18%
30 - 40%	4	4%	$5,100,000	$1,300,000	$1,700,000	$400,000	12%
40 - 50%	2	2%	$1,900,000	$1,000,000	$900,000	$500,000	7%
50% or More	1	1%	$1,200,000	$1,200,000	$600,000	$600,000	4%
TOTAL	**109**	**100%**	**$95,800,000**	**$900,000**	**$13,810,000**	**$100,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the City of Annapolis.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against coastal 1-percent-annual-chance floodplain boundaries (based on the county's latest effective NFHL data, dated September 5, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Highland Beach Summary (CID 240161)

The following pages include Flood Risk data for the Town of Highland Beach.

Overview

The Town of Highland Beach is in eastern Anne Arundel County. It consists of 0.08 square miles near State Highway 450. The primary flooding source in the town is the Chesapeake Bay.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Highland Beach	240161	96	0.08	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires 2023
- Past Federal Disaster Declarations for flooding = 4
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 13 policies totaling approximately $4,305,300
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Highland Beach that are located within the Anne Arundel County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Highland Beach flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Annapolis, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 18: Town of Highland Beach – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	7	$1,900,000	100%	$200,000	11.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	7	$1,900,000	100%	$200,000	11.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**7**	**$1,900,000**	**100%**	**$200,000**	**11.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Highland Beach – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	14%	$600,000	$600,000	$0	$0	0%
1 - 10%	3	43%	$500,000	$200,000	$40,000	$10,000	29%
10 - 20%	3	43%	$800,000	$300,000	$100,000	$30,000	71%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**7**	**100%**	**$1,900,000**	**$300,000**	**$140,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Highland Beach.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against coastal 1-percent-annual-chance floodplain boundaries (based on the county's latest effective NFHL data, dated September 5, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Participation in the NFIP Community Rating System (CRS)
- Building codes
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 20 below identifies possible mitigation actions for each AoMI to consider.

Table 20: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***

AoMI	Possible Actions to Reduce Flood Risk
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	• ***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The Anne Arundel County Hazard Mitigation Plan Update and the 2018 City of Annapolis Hazard Mitigation Plan Chapter 12 New Mitigation, Goals, Objectives and Actions are valuable places to identify and prioritize possible mitigation actions. These plans include mitigation actions that were developed, reviewed,

and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 21 below.

Table 21: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses

funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally-recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,*
coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Central Region Representative:
Michel Ney Sheffer, GISP, CFM
Data Services Division - Assistant Division Chief
Office of Planning and Preliminary Engineering
MD State Highway Administration
msheffer@sha.state.md.us

Anne Arundel County Office of Emergency Management
Henry L. Hein Public Service Building
7480 Baltimore and Annapolis Blvd., Glen Burnie, MD 21061
https://www.aacounty.org/departments/office-of-emergency-management/

Anne Arundel County Office of Planning and Zoning
2664 Riva Road, Annapolis, MD 21401
https://www.aacounty.org/departments/planning-and-zoning/index.html

Anne Arundel County Department of Public Works
2662 Riva Road, Annapolis, MD 21401
https://www.aacounty.org/departments/public-works/

Anne Arundel County Office of Information Technology,
Geographic Information Services (OIT GIS)
44 Calvert Street, Annapolis, MD 21401
https://www.aacounty.org/departments/oit/gis/

Source: https://www.aacounty.org/index.html

STATE OF MARYLAND

FLOOD RISK REPORT

ANNE ARUNDEL COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Anne Arundel County, Maryland - Countywide Flood Risk Map (FRM)

Anne Arundel County, Maryland – High Risk Area 1: Bayside Beach / Hines Ponds – Dollar Losses

Anne Arundel County, Maryland – High Risk Area 1: Bayside Beach / Hines Ponds – Percent Losses

Anne Arundel County, Maryland – High Risk Area 2: Oyster Harbor / Thomas Point / Arundel on the Bay – Dollar Losses

Anne Arundel County, Maryland – High Risk Area 2: Oyster Harbor / Thoams Point / Arundel on the Bay – Percent Losses

Anne Arundel County, Maryland – High Risk Area 3: Selby-on-the-Bay – Dollar Losses

Anne Arundel County, Maryland – High Risk Area 3: Selby-on-the-Bay – Percent Losses

Anne Arundel County, Maryland – High Risk Area 4: South Creek / Avalon Shores – Dollar Losses

Anne Arundel County, Maryland – High Risk Area 4: South Creek / Avalon Shores – Percent Losses

Anne Arundel County, Maryland – High Risk Area 5: Cedarhurst / Columbia Beach – Dollar Losses

Anne Arundel County, Maryland – High Risk Area 5: Cedarhurst / Columbia Beach – Percent Losses

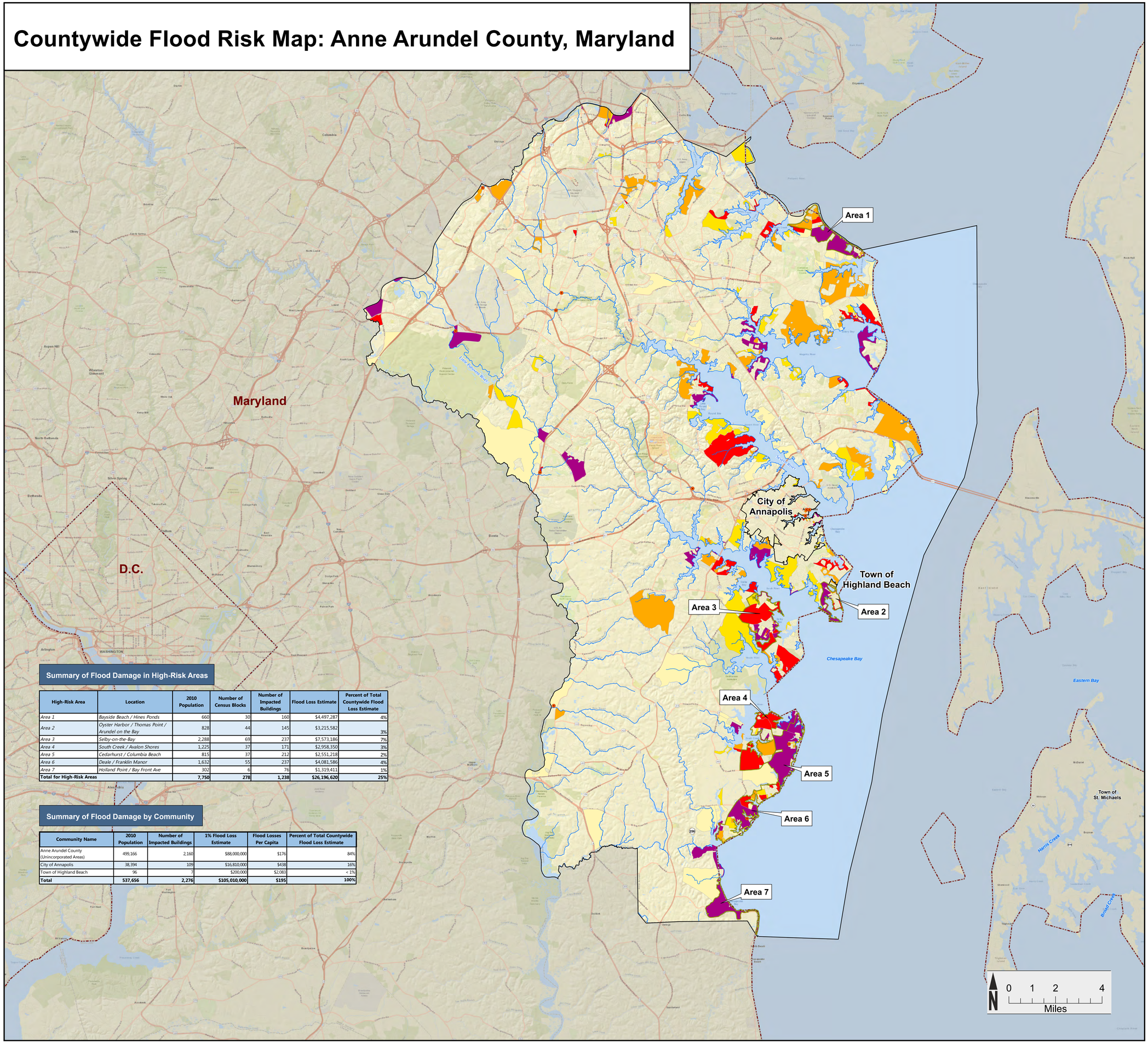
Anne Arundel County, Maryland – High-Risk Area 6: Deale / Franklin Manor – Dollar Losses

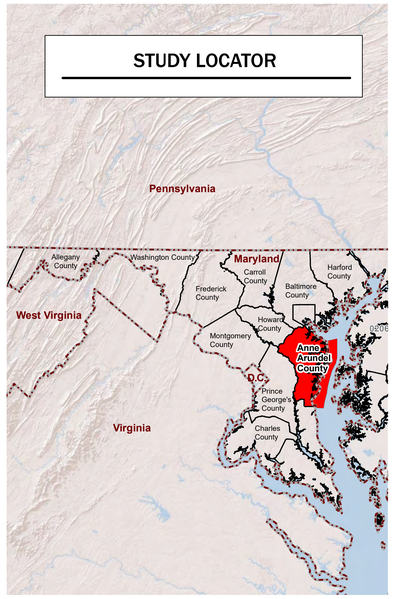
Anne Arundel County, Maryland – High Risk Area 6: Deale / Franklin Manor – Percent Losses

Anne Arundel County, Maryland – High Risk Area 7: Holland Point / Bay Front Ave – Dollar Losses

Anne Arundel County, Maryland – High Risk Area 7: Holland Point / Bay Front Ave – Percent Losses

Countywide Flood Risk Map: Anne Arundel County, Maryland





Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	*Bayside Beach / Hines Ponds*	660	30	160	$4,497,287	4%
Area 2	*Oyster Harbor / Thomas Point / Arundel on the Bay*	828	44	145	$3,215,582	3%
Area 3	*Selby-on-the-Bay*	2,288	69	237	$7,573,186	7%
Area 4	*South Creek / Avalon Shores*	1,225	37	171	$2,958,350	3%
Area 5	*Cedarhurst / Columbia Beach*	815	37	212	$2,551,218	2%
Area 6	*Deale / Franklin Manor*	1,632	55	237	$4,081,586	4%
Area 7	*Holland Point / Bay Front Ave*	302	6	76	$1,319,411	1%
Total for High-Risk Areas		**7,750**	**278**	**1,238**	**$26,196,620**	**25%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Anne Arundel County (Unincorporated Areas)	499,166	2,160	$88,000,000	$176	84%
City of Annapolis	38,394	109	$16,810,000	$438	16%
Town of Highland Beach	96	7	$200,000	$2,083	< 1%
Total	**537,656**	**2,276**	**$105,010,000**	**$195**	**100%**

MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area* (Area 1)

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk State Asset or Essential Facility

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

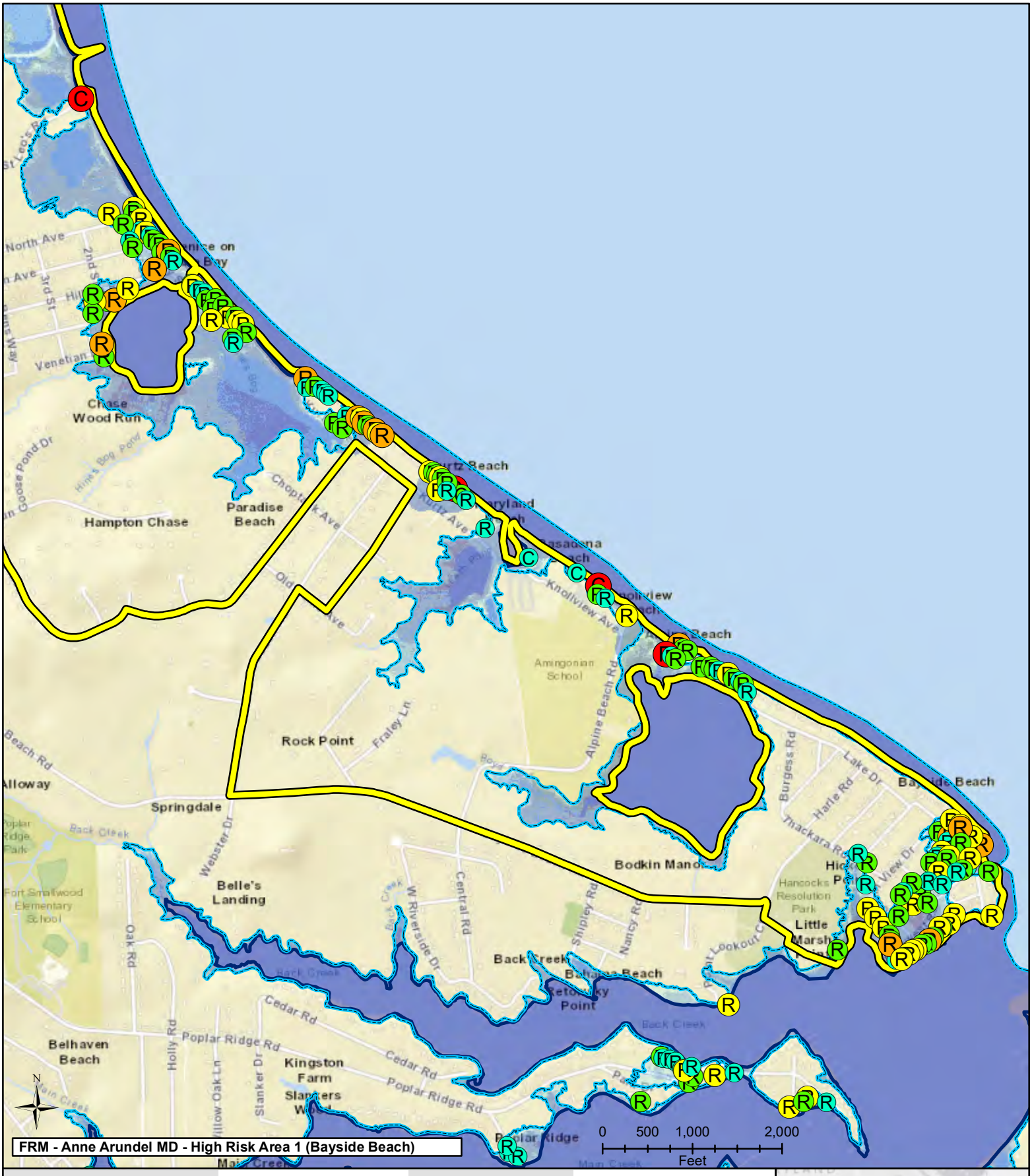
Anne Arundel County and Incorporated Areas, MD

MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Anne Arundel County, MD.

RELEASE DATE
12/31/2019



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

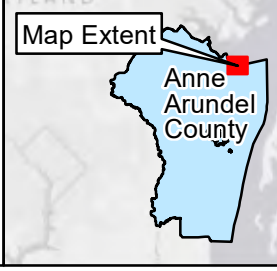
UDF Land Use Category

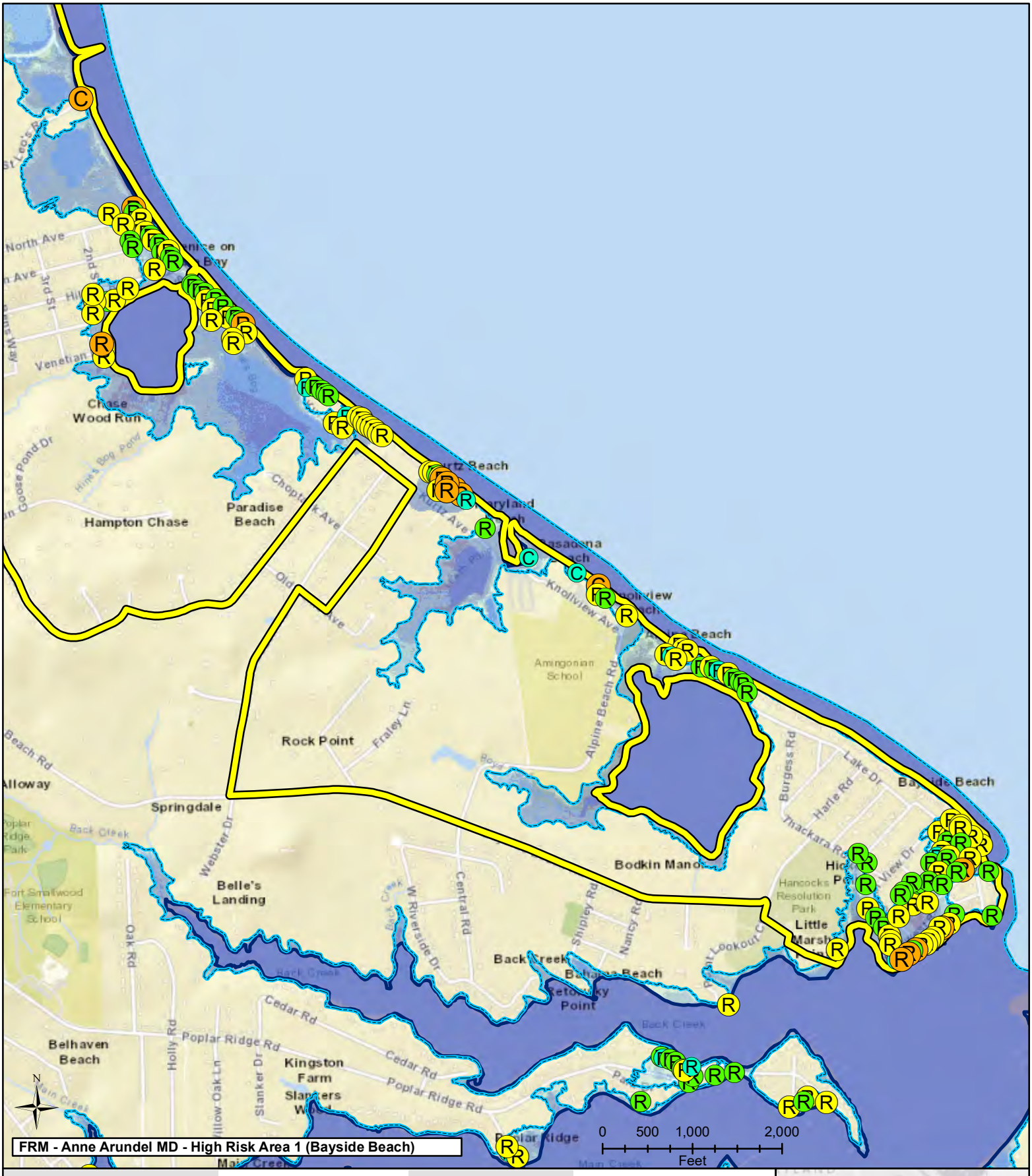
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000

Map Extent





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

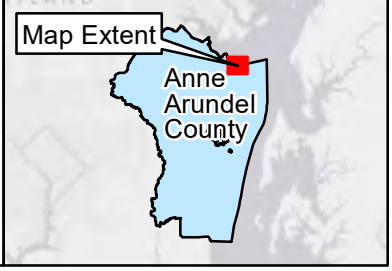
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

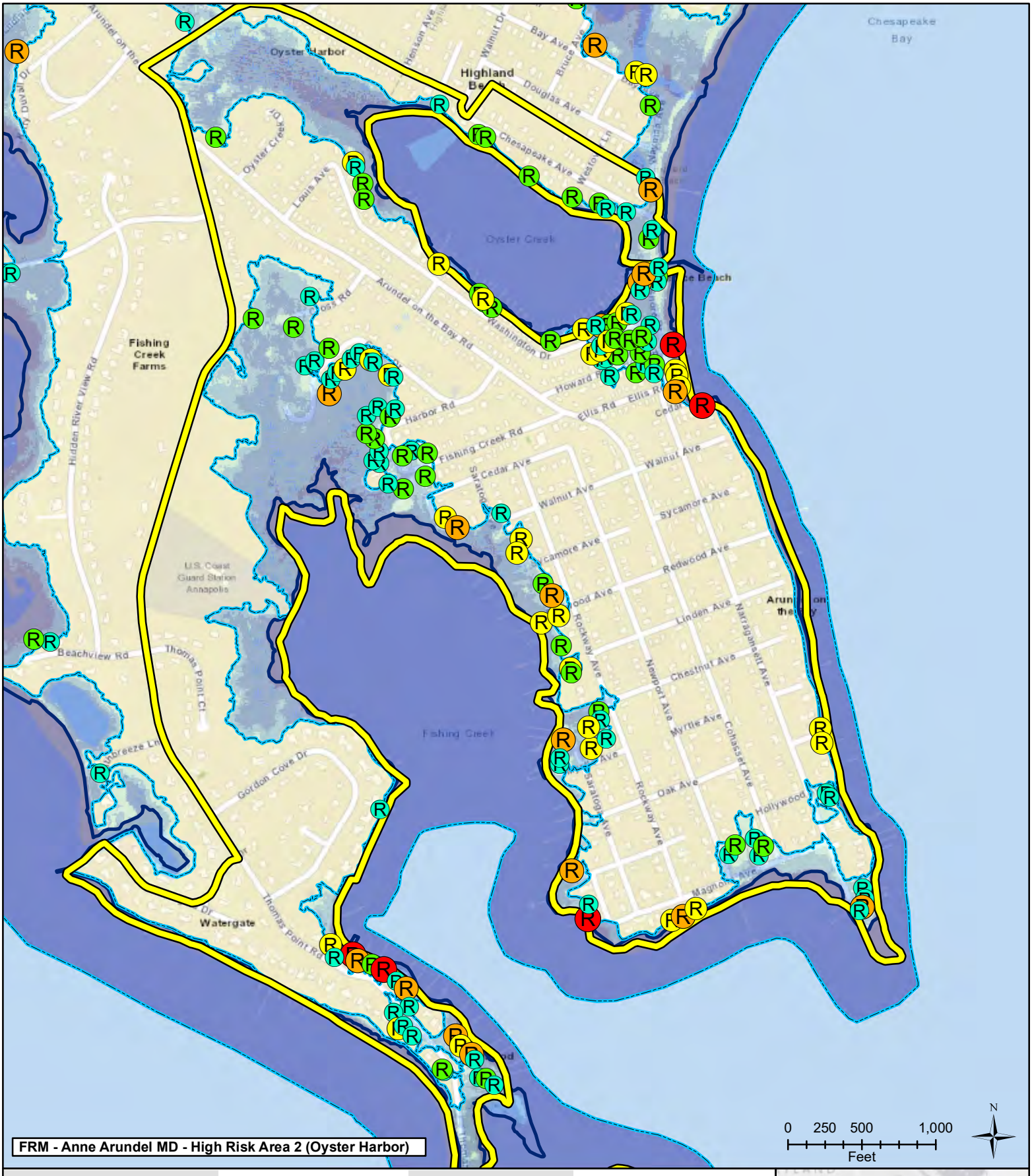
UDF Land Use Category

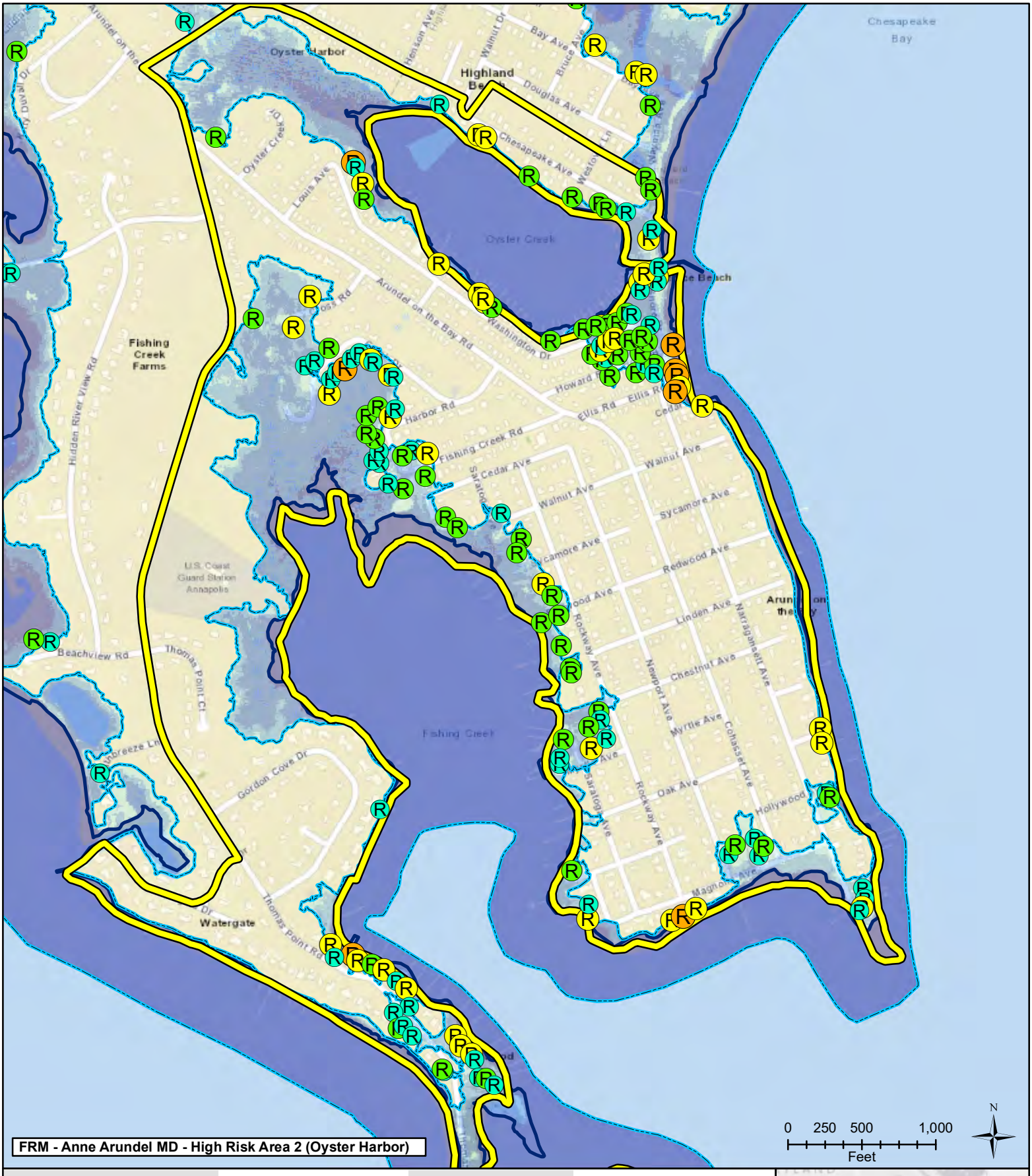
- (R) Residential
- (C) Commercial
- (O) Other

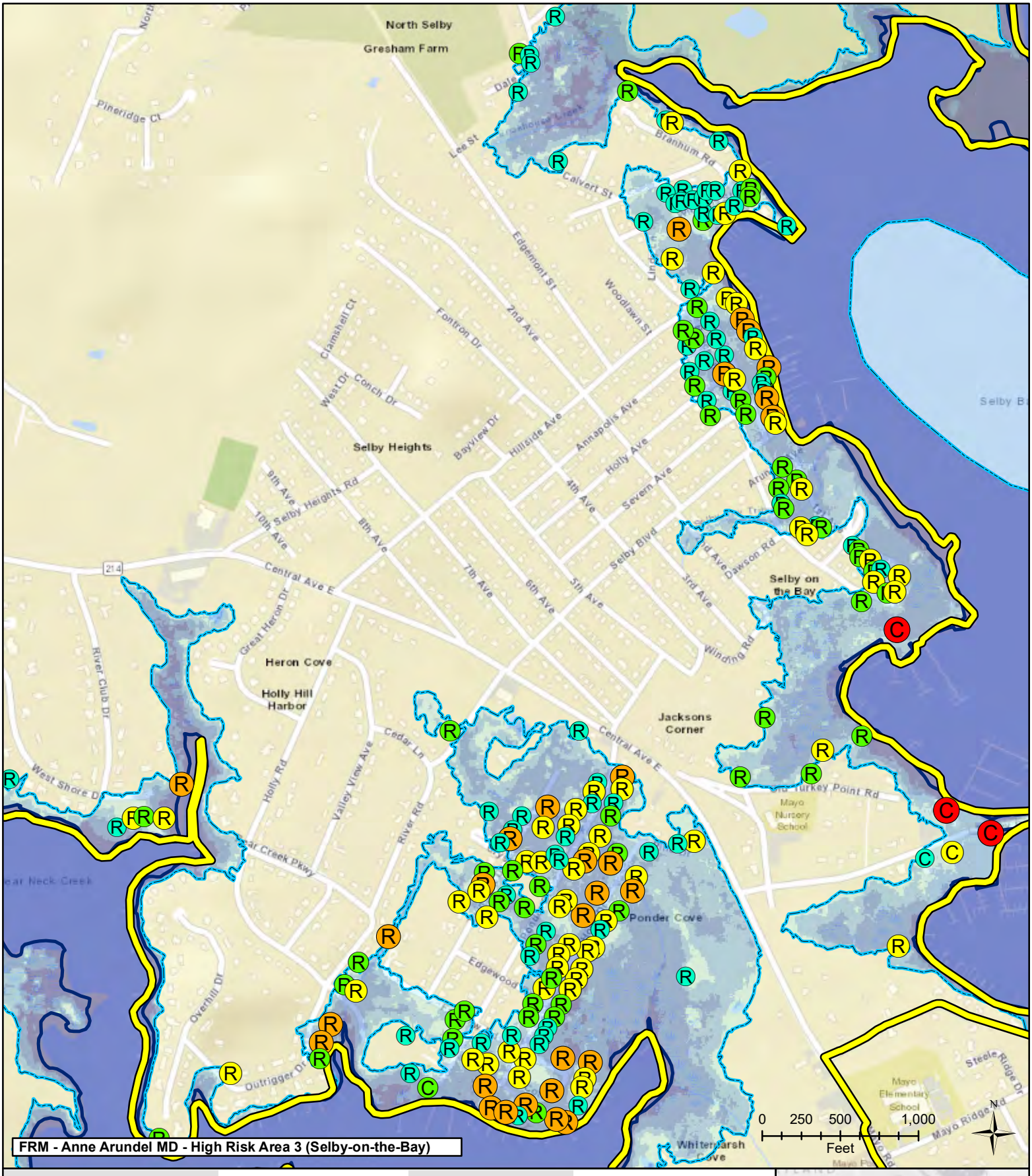
UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Chesapeake Bay
Oyster Harbor
Highland Beach
Oyster Creek
Fishing Creek Farms
Arundel on the Bay Rd
Fishing Creek
Watergate
U.S. Coast Guard Station Annapolis
Beachview Rd
Thomas Point Rd
Gordon Cove Dr
Fishing Creek Rd
Harbor Rd
Walnut Ave
Sycamore Ave
Redwood Ave
Linden Ave
Chestnut Ave
Oak Ave
Hollywood Ave
Magnolia Ave
Rockway Ave
Newport Ave
Myrtle Ave
Conasset Ave
Narragansett Ave
Saratoga Ave
Howard Ave
Ellis Rd
Washington Dr
Chesapeake Ave
Bay Ave
Douglas Ave
Louis Ave
Hillsmere Dr
Hidden River View Rd
Thomas Point Ct
Breeze Ln
Cedar Ave
Saratoga Ave
Oyster Cove Dr
Oyster Creek Dr
Walnut Dr
Henson Ave
Bruce Ave
Weston Ave
Newton Ave
Loss Rd
Arundel on the Bay Rd
Washington Dr
Howard Ave
Ellis Rd
Cedar Ave
Fishing Creek Rd
Harbor Rd
Walnut Ave
Sycamore Ave
Redwood Ave
Linden Ave
Chestnut Ave
Oak Ave
Hollywood Ave
Magnolia Ave
Rockway Ave
Newport Ave
Myrtle Ave
Conasset Ave
Narragansett Ave
Saratoga Ave
Thomas Point Rd
Gordon Cove Dr
Thomas Point Ct
Breeze Ln
Beachview Rd
Hidden River View Rd
Oyster Creek Dr
Louis Ave
Hillsmere Dr
Henson Ave
Walnut Dr
Bay Ave
Douglas Ave
Bruce Ave
Weston Ave
Newton Ave
Chesapeake Ave
Oyster Cove Dr
Watergate Dr
Thomas Point


Chesapeake Bay
Oyster Harbor
Highland Beach
Oyster Creek
Fishing Creek Farms
Arundel on the Bay Rd
Harbor Rd
Fishing Creek Rd
Ellis Rd
Howard
Cedar Ave
Walnut Ave
Sycamore Ave
Redwood Ave
Linden Ave
Chestnut Ave
Oak Ave
Hollywood
Rockway Ave
Newport Ave
Myrtle Ave
Conasset Ave
Narragansett Ave
Saratoga Ave
Fishing Creek
U.S. Coast Guard Station Annapolis
Beachview Rd
Thomas Point Ct
Gordon Cove Dr
Thomas Point Rd
Watergate
Hidden River View Rd
Oyster Creek Dr
Louis Ave
Bay Ave
Douglas Ave
Chesapeake Ave
Washington Dr
Ellis Rd
Cedar Ave
Saratoga Ave
Rockway Ave
Magnolia Ave
FRM - Anne Arundel MD - High Risk Area 2 (Oyster Harbor)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Anne Arundel County
Map Extent



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

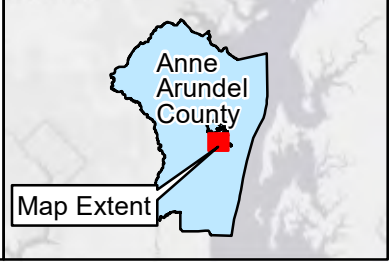
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

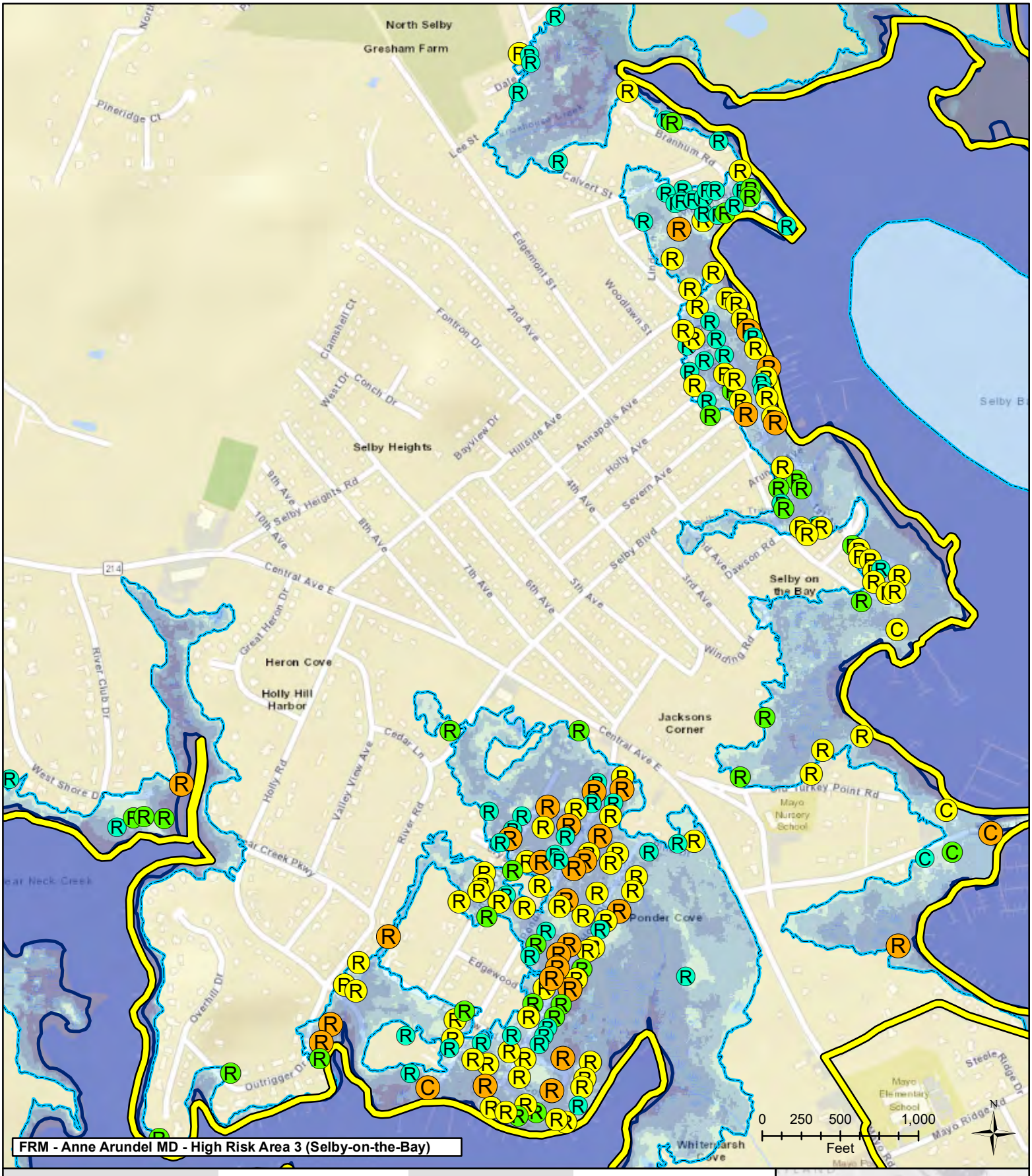
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

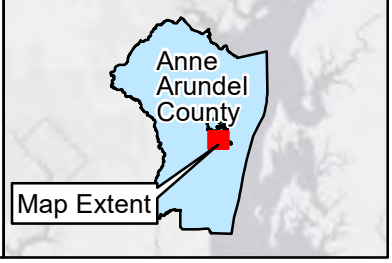
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

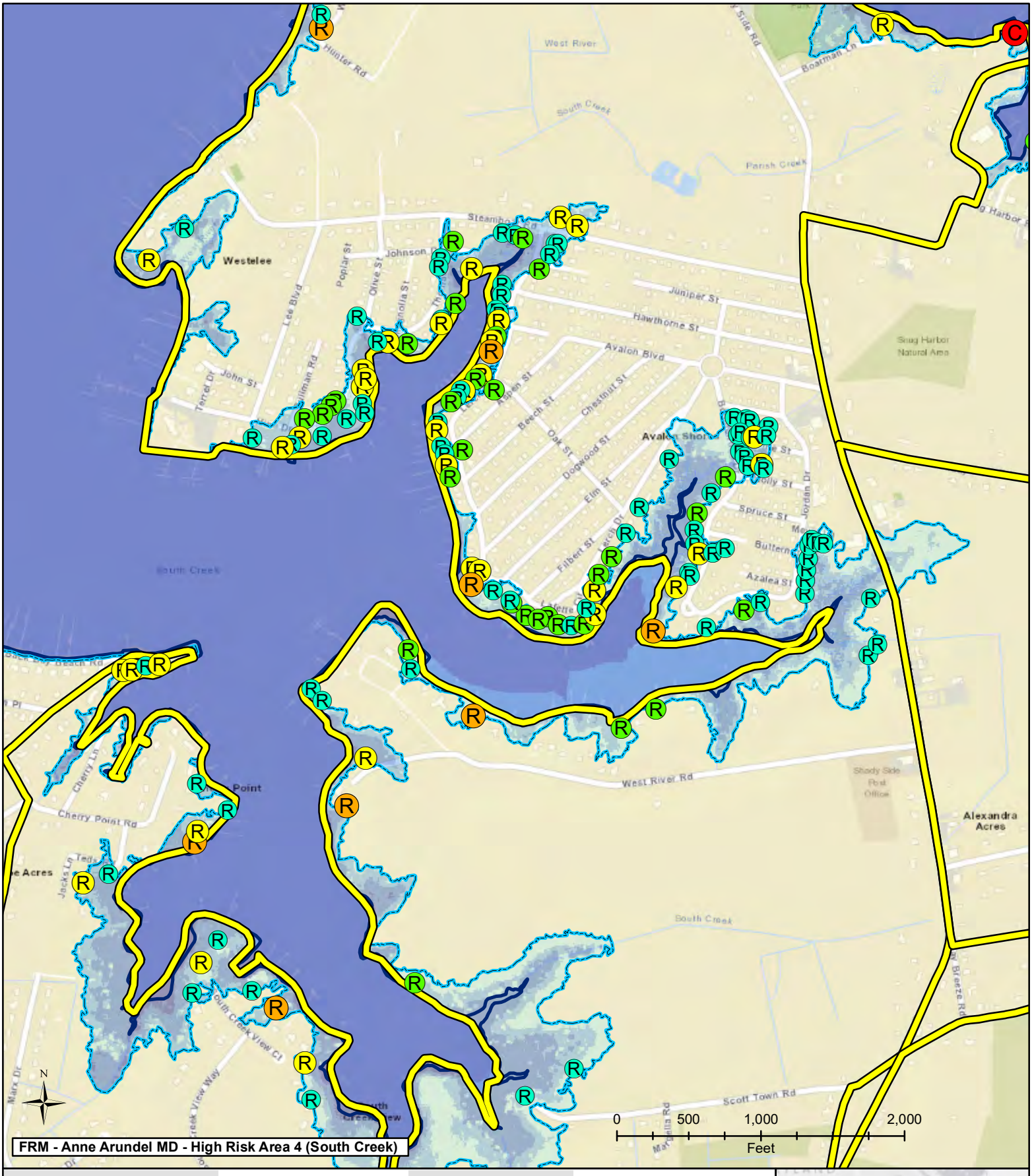
UDF Land Use Category

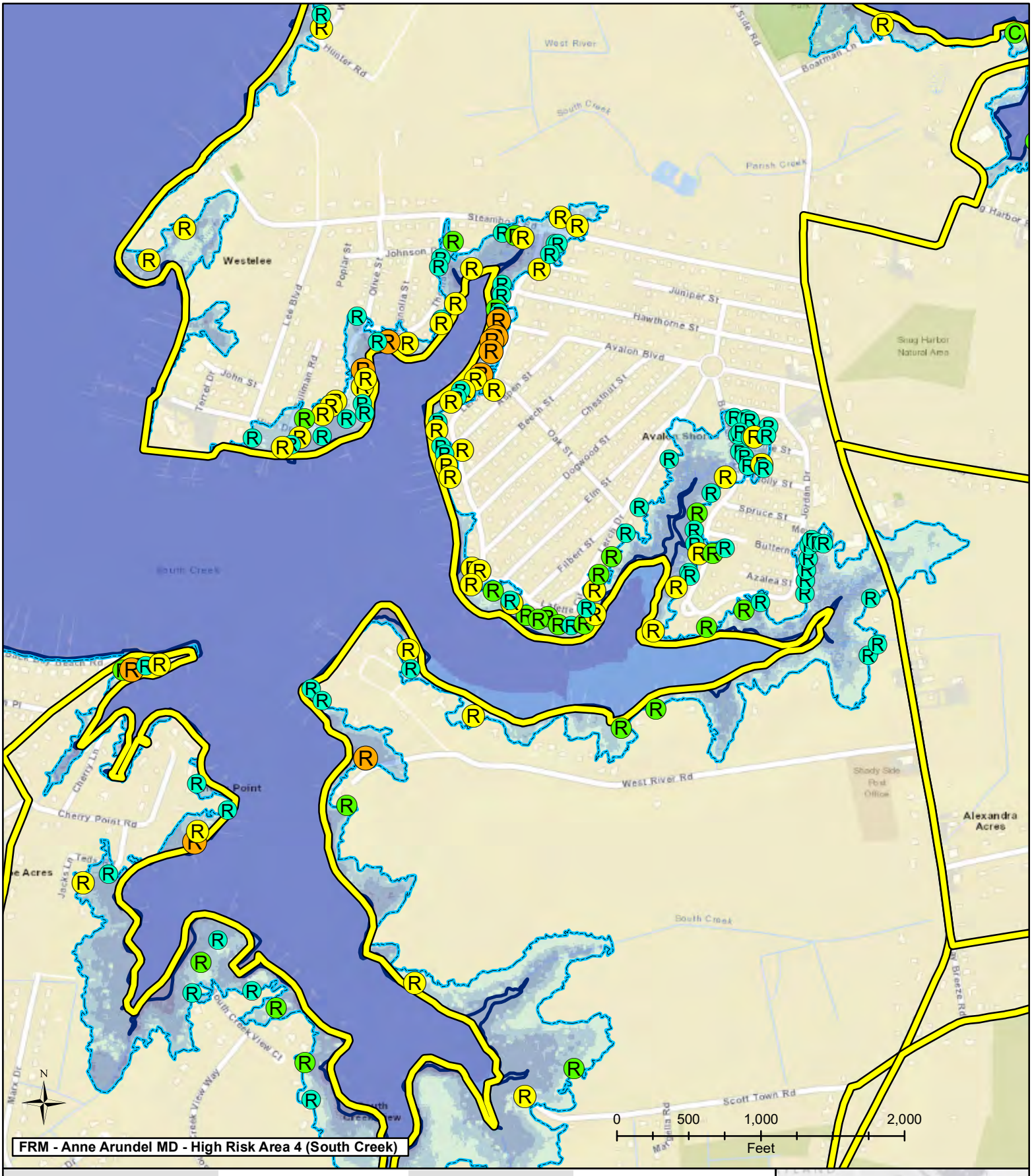
- (R) Residential
- (C) Commercial
- (O) Other

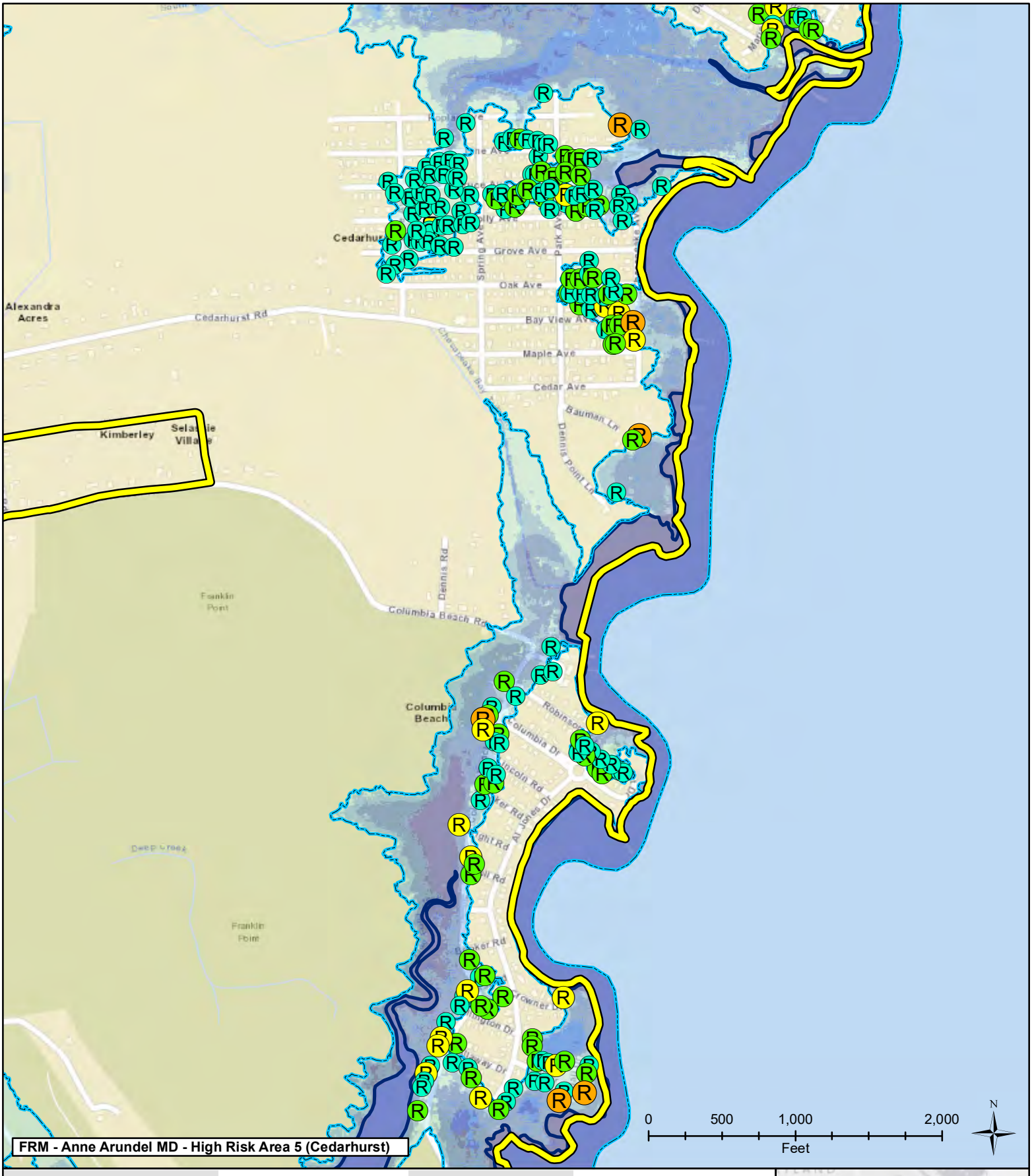
UDF Flood Loss Estimates

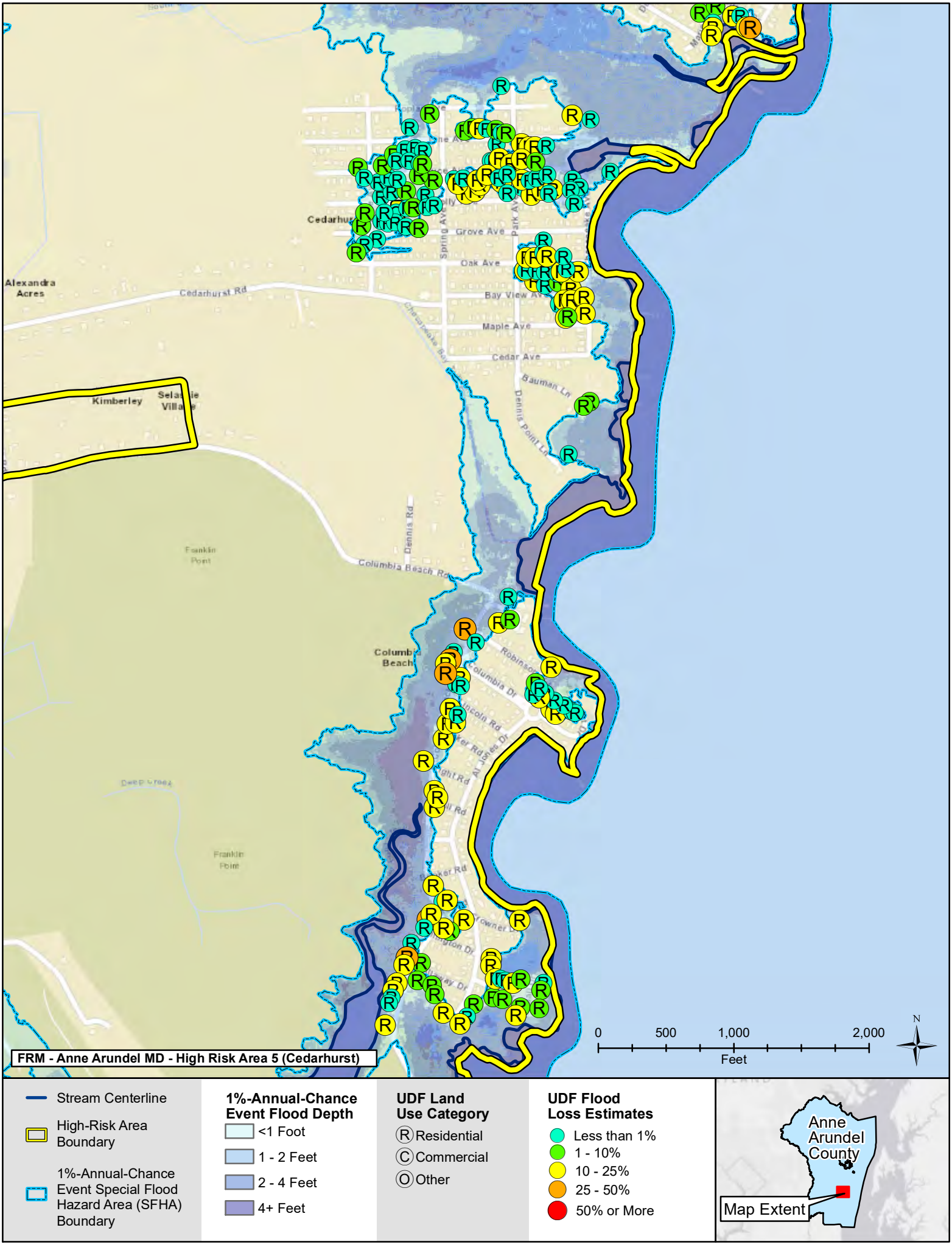
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More

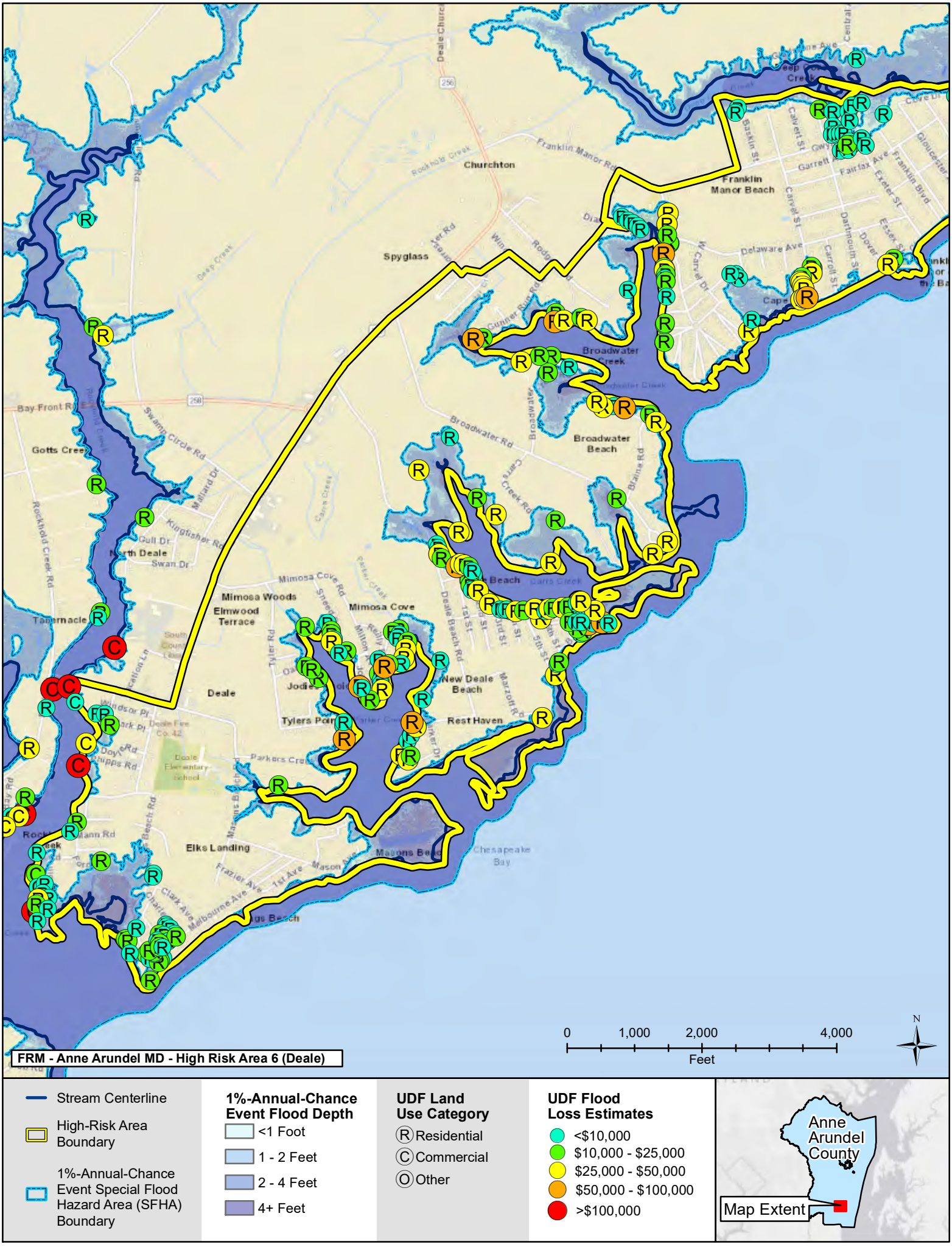


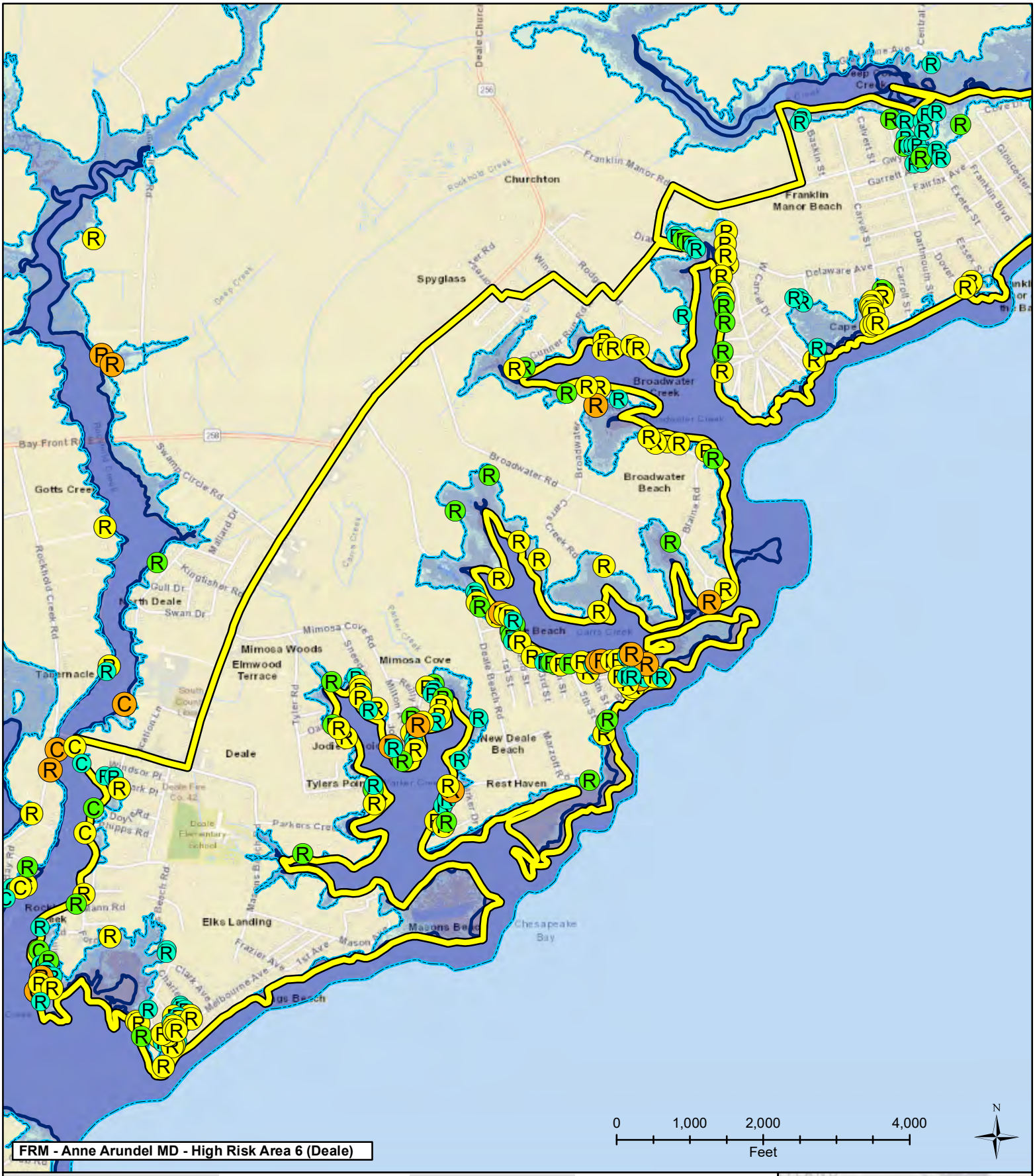

West River
Hunter Rd
Westelee
Steamboat Rd
Johnson
Poplar St
Olive St
Lee Blvd
Juniper St
Hawthorne St
Avalon Blvd
Spruce St
Butternut St
Azalea St
Dogwood St
Elm St
Beech St
Oak St
Chestnut St
Aspen St
Filbert St
Jordan Dr
Boatman Ln
Parish Creek
Snug Harbor Natural Area
South Creek
West River Rd
Point
Cherry Point Rd
Alexandra Acres
Shady Side Post Office
Scott Town Rd
South Creek View Ct
South Creek View Way
Mark Dr
Mac Della Rd
Bleeze Rd
N
0
500
1,000
2,000
Feet
FRM - Anne Arundel MD - High Risk Area 4 (South Creek)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Anne Arundel County
Map Extent

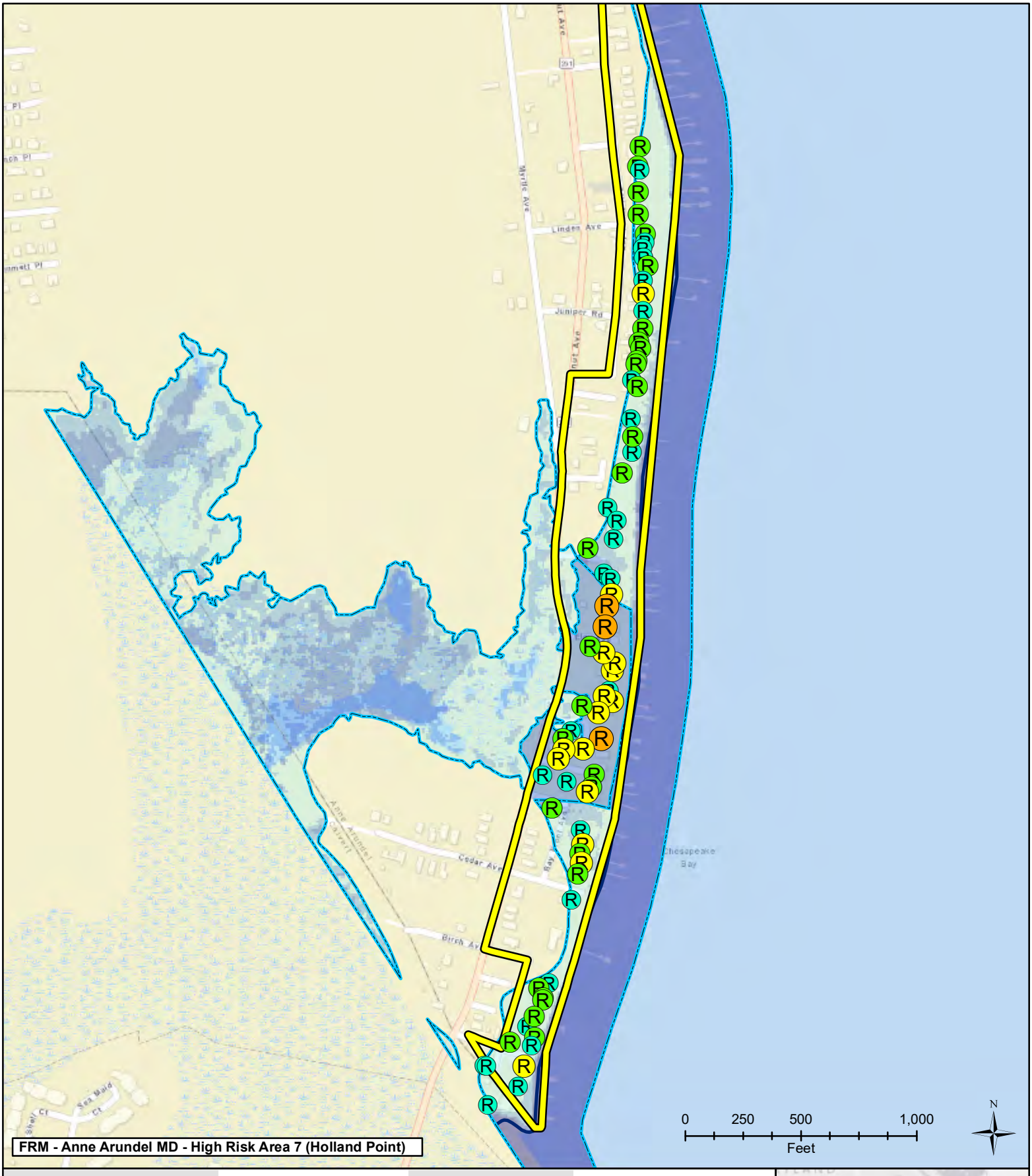

West River
Hunter Rd
South Creek
Parish Creek
Boardman Ln
Westelee
Poplar St
Johnson
Olive St
Lee Blvd
Juniper St
Hawthorne St
Avalon Blvd
Chestnut St
Beech St
Oak St
Dogwood St
Elm St
Spruce St
Azalea St
Jordan Dr
Filbert St
Laurel Dr
Terral Dr
John St
Aspen St
Snug Harbor Natural Area
Point
Cherry Point Rd
West River Rd
Shady Side Post Office
Alexandra Acres
South Creek View Ct
South Creek View Way
Scott Town Rd
Marcella Rd
0
500
1,000
2,000
Feet
N
FRM - Anne Arundel MD - High Risk Area 4 (South Creek)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Anne Arundel County
Map Extent

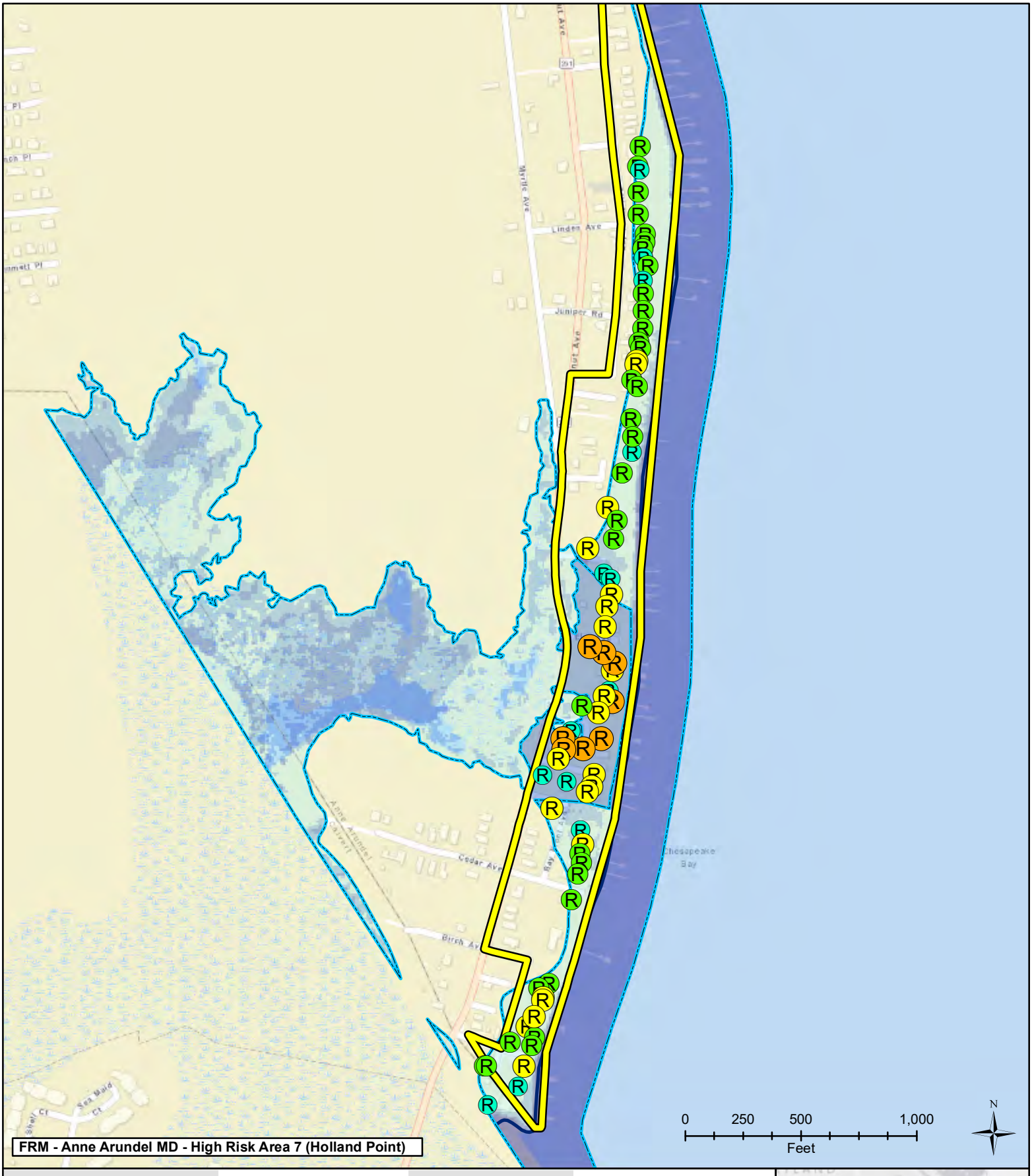

Cedarhurst
Alexandra Acres
Cedarhurst Rd
Grove Ave
Oak Ave
Bay View Ave
Maple Ave
Cedar Ave
Bauman Ln
Dennis Point Ln
Spring Ave
Park Ave
Kimberley
Franklin Point
Dennis Rd
Columbia Beach Rd
Columbia Beach
Columbia Dr
Lincoln Rd
Robinson Rd
Deep Creek
Franklin Point
FRM - Anne Arundel MD - High Risk Area 5 (Cedarhurst)
0
500
1,000
2,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Anne Arundel County
Map Extent


Alexandra Acres
Cedarhurst Rd
Grove Ave
Oak Ave
Bay View Ave
Maple Ave
Cedar Ave
Bauman Ln
Dennis Point Ln
Dennis Rd
Columbia Beach Rd
Columbia Dr
Lincoln Rd
Kimberley
Franklin Point
0
500
1,000
2,000
Feet
N
FRM - Anne Arundel MD - High Risk Area 5 (Cedarhurst)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Anne Arundel County
Map Extent


Churchton
Franklin Manor Beach
Spyglass
Broadwater Creek
Broadwater Beach
Gotts Cree
North Deale
Mimosa Woods
Elmwood Terrace
Mimosa Cove
Deale
New Deale Beach
Tylers Point
Rest Haven
Elks Landing
Masons Beach
Chesapeake Bay
Franklin Manor Rd
Broadwater Rd
Mimosa Cove Rd
Deale Beach Rd
Delaware Ave
Bay Front Rd
Swann Circle Rd
Kingfisher Rd
Gull Dr
Swan Dr
Rockhold Creek Rd
Tyler Rd
Parkers Creek
Frazier Ave
1st Ave
Mason Rd
Clark Ave
Melbourne Ave
Beach Rd
Marzolf Rd
Blaine Rd
Carrs Creek
Gunner Run Rd
Rockhold Creek
Deep Creek
Parkers Creek
Carrs Creek
Tabernacle
Jodies
FRM - Anne Arundel MD - High Risk Area 6 (Deale)
0
1,000
2,000
4,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Anne Arundel County
Map Extent


Churchton
Franklin Manor Beach
Spyglass
Broadwater Creek
Broadwater Beach
Gotts Cree
North Deale
Mimosa Woods
Elmwood Terrace
Mimosa Cove
Deale
New Deale Beach
Rest Haven
Tylers Point
Elks Landing
Masons Beach
Chesapeake Bay
Franklin Manor Rd
Broadwater Rd
Bay Front Rd
Swann Circle Rd
Mimosa Cove Rd
Deale Beach Rd
Delaware Ave
Garrett Ave
Fairfax Ave
Exeter St
Dover St
Carroll St
Dartmouth St
Frazier Ave
1st Ave
Mason Ave
Clark Ave
Melbourne Ave
Parkers Creek
Rockhold Creek
Deep Creek
Carrs Creek
Gunner Run Creek
Schooler Creek
Parker Creek
Rockhold Creek Rd
Beach Rd
Tyler Rd
Blaine Rd
Carrs Creek Rd
Dover Rd
Shupps Rd
Windsor Pl
Kingfisher Rd
Gull Dr
Swan Dr
Mallard Dr
Calhoun Ln
Deale Church Rd
Deale Fire Co. 42
Deale Elementary School
Tabernacle
Cape
FRM - Anne Arundel MD - High Risk Area 6 (Deale)
0
1,000
2,000
4,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Anne Arundel County
Map Extent


Linden Ave
Juniper Rd
Cedar Ave
Birch Ave
Chesapeake Bay
0
250
500
1,000
Feet
N
FRM - Anne Arundel MD - High Risk Area 7 (Holland Point)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Anne Arundel County
Map Extent



FRM - Anne Arundel MD - High Risk Area 7 (Holland Point)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

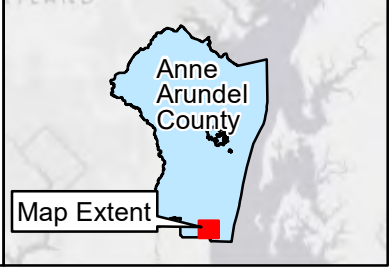
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More



This page left blank intentionally

Source: https://www. Myeasternshoremd.com

STATE OF MARYLAND

FLOOD RISK REPORT

CAROLINE COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Caroline County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Caroline County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Caroline County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 5

d. Related Resources 6

2 Flood Risk Analysis 11

a. Overview 11

b. Analysis of Risk 12

i. Flood Depth and Analysis Grids 12

ii. Flood Risk Assessments 13

iii. Areas of Mitigation Interest 15

3 Flood Risk Analysis Results 27

a. Caroline County, MD Flood Risk Project Area Summary 28

i. Overview 28

ii. Flood Risk Results 28

iii. Flood Risk Maps 37

b. Communities 38

i. Caroline County (Unincorporated Areas) (CID 240001) 38

ii. Town of Denton Summary (CID 240002) 42

iii. Town of Federalsburg (CID 240003) 45

iv. Town of Greensboro (CID 240005) 48

4 Actions To Reduce Flood Risk.....51

a. Types of Mitigation Actions.....51

i. Local Plans and Regulations.....51

ii. Structure and Infrastructure Projects.....52

iii. Natural Systems Protection Activities.....53

iv. Education and Awareness Activities.....53

b. Identifying Specific Actions for Your Community.....55

c. Mitigation Programs and Assistance.....56

i. FEMA Mitigation Programs and Assistance.....56

ii. Additional Mitigation Programs and Assistance.....57

5 Acronyms And Definitions.....58

a. Acronyms.....58

b. Definitions.....60

6 Additional Resources.....64

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Caroline County Essential Facilities....16

Table 2: USACE National Inventory of Dams – Caroline County, MD....18

Table 3: Flood Risk Assessment – Caroline County, MD & Communities....28

Table 4: Caroline County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....29

Table 5: Caroline County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....30

Table 6: Caroline County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....30

Table 7: Caroline County, Maryland – Essential Facilities Summary for Riverine and Coastal Areas....32

Table 8: Caroline County, Maryland – Building & Content Loss Estimate Summary for the 1%-Annual-Chance Flood (Essential Facilities in Riverine & Coastal Areas)....32

Table 9: Caroline County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)....34

Table 10: Caroline County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)....35

Table 11: Caroline County, Maryland – Types of Mitigation Interest....35

Table 12: Caroline County, Maryland – High-Risk Areas....36

Table 13: Caroline County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)....39

Table 14: Caroline County (Unincorporated Area) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....40

Table 15: Caroline County (Unincorporated Area) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)....40

Table 16: Town of Denton – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....43

Table 17: Town of Denton – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....43

Table 18: Town of Federalsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....46

Table 19: Town of Federalsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....46

Table 20: Town of Greeensboro – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....49

Table 21: Town of Greeensboro – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)....49

Table 22: Mitigation Actions for Areas of Mitigation Interest....54

Table 23: FEMA Hazard Mitigation Assistance Programs....57

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Choptank River floods G. Daniel Crouse Memorial Park in Denton. Source: MyEasternShoreMD

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Greensboro Fairgrounds
Source: The Democrat Star

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: Long Swamp Road, Federalsburg June 2006 Flood
Source: https://www.carolinemd.org/227/Road-or-Bridge-Closures

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 32 to 34.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.
- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (effective date January 16, 2015), provided by FEMA Region III and Maryland Department of the Environment. In conjunction with this regulatory FIRM update, non-regulatory flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were previously developed for coastal flood hazards in Caroline County, and have been leveraged as part of this countywide flood risk assessment.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of June 2016), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/. Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordiances). Instead, based on trends in residential

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructured after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Caroline County Project Management & GIS Office – https://www.carolinemd.org/Directory.aspx?did=18 *(Limited Distribution; data available by purchase/ request).*

- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.

- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Section 2 - Subsection ii Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be

identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

  The *2019 Caroline County Hazard Mitigation Plan Update* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

  Please note that the information in this FRR may be reviewed for inclusion during the update of the Caroline County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the

potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

  Caroline County encourage residents to " Stay in Touch." According to the Department of Emergency Services' Emergency Preparedness webpage, "In order to be prepared citizens must "Stay In Touch." This means plugging in to various media and keeping up to date on what is happening. Check all types of media – websites, newspapers, radio, TV, e-

Figure 1.6

Caroline County's Hurricane Evacuation Zone Map.

Source: www.knowyourzonemd.com

mails, mobile and land phones – for national and local information. During an emergency, the Emergency Services office provides information on shelter openings and evacuation orders. The Department of Emergency Services (DES) utilizes social media to provide updates on breaking. Please visit DES Facebook and Twitter pages; access is on the DES home page."

In addition, a small protion of Caroline County is within the Maryland Emergency Management Agency's "Know Your Zone" evacuation initiative. Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk, Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Caroline County evacuation zones can be found at www.knowyourzonemd.com.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore was developed in January 2019 to provides local government leaders and staff with data, analyses, policy options, and implementation guidance. A *Caroline County Coastal Flood Vulnerability Study* (https://www.eslc.org/wp-content/uploads/docs/coastal-resilience/regional-sea-level-rise-study-2019.pdf) was completed and incldued in the Appendix of the document. According to the sudy, the goal was to model the potential damage to buildings and their contents from severe periodic coastal flooding events, both today and in the future using a value for predicted sea level change.

- **Emergency Action Plans.** Emergency Action Plans (EPA) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans

specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

Seven (7) dams are located within Caroline County, two (2) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Caroline County, MD,* on page 18 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  The *Flood Risk Report Caroline County, Maryland Coastal Study*, developed by FEMA using Hazus Version 2.2, was released on July 17, 2015. This report provides estimated coastal flood losses for the 1-percent-annual-chance flood event, and has been leveraged as part of this enhanced countywide flood risk assessment. The 2015 Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Floodwaters in Federalsburg
Source: https://www.carolinemd.org/312/Weather-Information
Bottom Photo: Federalsburg Marina after the 25 June 2006 Flood
Source: Caroline County Emergency Services

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

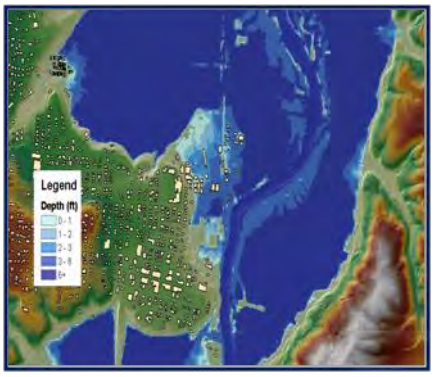
State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

depth is a function of the difference between the calculated water surface elevation (including overland wave propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and data development for each study type were performed by different mapping partners.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses

include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Figure 2.4

An essential facility, Federalsburg Police Department, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: Google Maps

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 37 essential facilities located within Caroline County with a total esitmated building value of $95,711,000.00.

Table 1: Caroline County Essential Facilities

Facility Type	Number of Structure	Estimated Building Value
Emergency Operations Center (EOC)	2	$3,548,000
Fire/Rescue Stations	12	$5,394,000
Hospital & Medical Clinics	5	$18,222,000
Police Stations	5	$2,190,000
Schools (K-12 & Colleges)	13	$66,357,000
Total	**37**	**$3,548,000**

Source: 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations.

Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 4 high risk areas were identified within Caroline County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Tuckahoe State Park Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: Tuckahoe State Park Dam
Source: https://dnr.maryland.gov/fisheries/Pages/hotspots/tuckahoe.aspx

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, seven (7) dams are located in Caroline County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Caroline County, MD

Name	Owner Type	Purpose	River	EAP Last Revision Date
Tuckahoe State Park Dam (Crouse Mill Road)	State	Recreation	Tuckahoe Creek	No
Lake Bonnie	Private	Recreation	Broadway Branch	No
Scull Farm Pond	Private	Recreation	Tuckahoe Creek-TR	No
Williston Mill Dam (MD 617 Old Harmony Road)	Private	Recreation	Mill Creek	No
Nagels Mill Pond	Private	Recreation	Nagels Pond	Yes
Smithville Dam (Possum Hill Road)	State	Recreation	TR-Smithville Ditch	No
Chambers Lake	Local Government	Recreation	Tanyard Branch	Yes

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

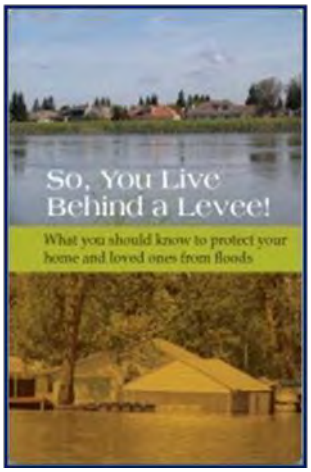
This dam failure caused flooding that damaged several homes and vehicles.

- A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
- For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are

erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

Acccording to US Army Corps of Engineers, National Levee Database, there are no levees located within Caroline County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly

maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

  - **Reasons coastal structures are considered AoMIs:**
    - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
    - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
    - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

- **Reasons stream flow constrictions are considered AoMIs:**
  - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
  - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
  - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
  - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Figure 2.8

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of December 2018, one (1) FEMA Designated Repetitive Loss Properties was within Caroline County. This residential property is located in Greensboro. There are no non-residential repetitive loss structures located in Caroline County. There are no Severe Repetitive Loss (SRL) properties within Caroline County.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of

mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.

- Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
- Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.9

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

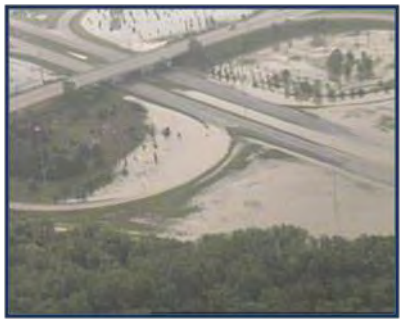
- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.

- Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  Figure 2.10

  When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  The *2019 Caroline County Hazard Mitigation Plan* provided a listing of repetitive flood locations identified by the Hazard Mitigation Planning Committee. The listing of repetitive flooding issues is within Chapter 4 Riverine Flooding on Table 4.13 of the Plan. A total of 53 repetitive flood locations were identifed in the unincorporated areas of the County and municipalities.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**

- So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
- To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 25.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.

- Landslides and mudslides are a result of erosion
- Approximately one-third of the nation's streams experience severe erosion problems
- Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
- Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Caroline County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Caroline County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Caroline County, MD & Communities

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Caroline County (Unincorporated Areas)	240130	20,788	317.44	Y	08	Y
Town of Denton	240104	4,418	5.50	Y	N/A	Y
Town of Federalsburg	240013	2,739	1.99	Y	N/A	Y
Town of Greensboro	240014	1,931	1.07	Y	N/A	Y

Note: The Towns of Goldsboro, Henderson, Hillsboro, Marydel, Preston, Ridgely and Templeville are not included in this report since they have no buildings within the 1-percent-annual-chance Special Flood Hazard Areas (SFHAs).

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Caroline County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that countywide summary results represent totals for both coastal and riverine flooding. Separate information for coastal and riverine flood losses are presented, where applicable, for individual communities under Section 3, Subsection b.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1 (Riverine) and version 2.2 (Coastal), and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Table 4: Caroline County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Caroline County (Unincorporated Areas)	20,788	113	$3,000,000	$144	16%
Town of Denton	4,418	2	$40,000	$9	< 1%
Town of Federalsburg	2,739	235	$14,900,000	$5,440	81%
Town of Goldsboro	246	0	$0	$0	0%
Town of Greensboro	1,931	36	$560,000	$290	3%
Town of Henderson	146	0	$0	$0	0%
Town of Hillsboro	161	0	$0	$0	0%
Town of Marydel	141	0	$0	$0	0%
Town of Preston	719	0	$0	$0	0%
Town of Ridgely	1,639	0	$0	$0	0%
Town of Templeville	138	0	$0	$0	0%
Total	**33,066**	**386**	**$18,500,000**	**$559**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Caroline County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	288	$35,500,000	51%	$4,700,000	13.0%
Commercial Building & Contents	65	$17,200,000	25%	$5,400,000	31.0%
Other Building & Contents	33	$17,000,000	24%	$5,800,000	34.0%
Total Building & Contents[3]	386	$69,700,000	100%	$15,900,000	23.0%
Business Disruption[4]	N/A	N/A	N/A	$2,600,000	N/A
TOTAL[5]	**386**	**$69,700,000**	**100%**	**$18,500,000**	**27.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Caroline County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	31	8%	$7,900,000	$300,000	$10,000	$0	0%
1 - 10%	64	17%	$10,500,000	$200,000	$500,000	$10,000	3%
10 - 20%	138	36%	$16,300,000	$100,000	$2,300,000	$20,000	14%
20 - 30%	68	18%	$11,200,000	$200,000	$2,800,000	$40,000	18%
30 - 40%	40	10%	$9,800,000	$200,000	$3,400,000	$90,000	21%
40 - 50%	28	7%	$6,300,000	$200,000	$2,800,000	$100,000	18%
50% or More	17	4%	$7,600,000	$400,000	$4,100,000	$200,000	26%
TOTAL	**386**	**100%**	**$69,600,000**	**$200,000**	**$15,910,000**	**$40,000**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables onrepresent information within the Caroline County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Caroline County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 7. The list of essential facilities impacted by the 1-percent-annual-chance flood event is listed on page 35.

Table 7: Caroline County, Maryland – Essential Facilities Summary for Riverine and Coastal Areas

Type	Estimated Building Value	Total Essential Facilities	1% Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$3,548,000	2	$0	0
Fire Station	$5,394,000	12	$0	0
Hospital	$18,222,000	5	$0	0
Police Station	$2,190,000	5	$52,010	1
School	$66,357,000	13	$0	0
TOTAL	**$95,711,000**	**37**	**$52,010**	**1**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored in the 'Area of Mitigation Interest' (S_AOMI_Ar) layer of the Flood Risk Database.

Table 8: Caroline County, Maryland – Building & Content Loss Estimate Summary for the 1%-Annual-Chance Flood (Essential Facilities in Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss % of Total	Total Content Loss	Content Loss % of Total
Fire Station	$141,170	$52,010	37%	$89,160	63%
TOTAL	**$141,170**	**$52,010**	**N/A**	**$89,160**	**N/A**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored in the 'Area of Mitigation Interest' (S_AOMI_Ar) layer of the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Caroline County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Caroline County contains 115 state assets. However, none of these state assets are at-risk to the 1-percent-annual-chance flood event.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
    - The model estimates that a total of 2,215 tons of debris will be generated. Of the total amount, Finishes comprises 62% of the total, Structure comprises 17% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 89 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 9: Caroline County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	1,377	62%	55
Structure	366	17%	15
Foundation	472	21%	19
TOTAL	**2,215**	**100%**	**89**

Source: Hazus 3.1: Flood Modual – Caroline County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**

- Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 360 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 614 people (out of a total population of 33,066) will seek temporary shelter in public shelters.

Table 10: Caroline County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	360	1,080	614

Source: Hazus 3.1: Flood Modual – Caroline County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 11: Types of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	1	Depth grids, Emergency Management Dept.
High-Risk Areas	4	Depth grids, UDFs, Loss estimates
Repetitive Flood Issues	53	Hazard Mitigation Planning Committee
Repetitive Loss Properties	1	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database, except where noted.

- **At-Risk Essential Facilities:**
  - Results from the 1-percent-annual-chance flood event analysis indicate one (1) essential facility are at-risk, the Federalsburg Police Station. The flood depth for this facility is provided below.
    - Federalsburg Police Station, Federalsburg – 2.0'

A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 12: Caroline County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Federalsburg	682	25	237	$15,069,805	81%
Area 2	Greensboro / Mill St	557	13	46	$701,869	4%
Area 3	Choptank Wetlands Preserve / Little Creek	175	9	21	$207,357	1%
Area 4	Choptank / Maryland Ave / Main St	73	7	19	$777,206	4%
Total for High-Risk Areas		**1,414**	**47**	**304**	**$15,979,031**	**86%**

- **Repetitive Flood Issues**

  Reviewing the repetitive flooded roadways and issues identified in the *2019 Caroline County Hazard Mitigation Plan Update,* several repetitive flood locations were found to be within high risk areas listed in Table 13 of this report. However, because the spatial extents are not fully defined, repetitive flooded roads are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. One (1) FEMA Designated Repetitive Loss Property was identified in the Town of Greensboro. Due to sensitivity of public disclosure for flood insurance claims, Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

iii. Flood Risk Maps

The Flood Risk Maps for Caroline County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Caroline County (Unincorporated Areas) Summary (CID 240130A)

The following pages include Flood Risk data for the Caroline County (Unincorporated Areas).

Overview

The Caroline County (Unincorporated Areas) is located in eastern Maryland and consists of 317.44 square miles. It is bordered by Queen Anne's County to the north and northwest, Talbot County to the west, Dorchester County to the south, and the State of Delaware to the east.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Caroline County (Unincorporated Areas)	240130	23,978	317.44	Y	08	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 105 policies totaling approximately $45,961,500.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Caroline County (Unincorporated Areas) that are located within the Caroline County, Maryland Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Caroline County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood (for both riverine and coastal flood hazards), along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 13. Then, Tables 14 and 15 shows the severity of damage to buildings from flooding for riverine and coastal areas. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 13: Caroline County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	95	$15,600,000	72%	$1,400,000	9.0%
Riverine	*38*	*$5,700,000*	*55%*	*$600,000*	*11.0%*
Coastal	*57*	*$9,900,000*	*88%*	*$800,000*	*8.0%*
Commercial Building & Contents	10	$2,600,000	12%	$800,000	31.0%
Riverine	*7*	*$1,700,000*	*16%*	*$500,000*	*29.0%*
Coastal	*3*	*$900,000*	*8%*	*$300,000*	*33.0%*
Other Building & Contents	8	$3,400,000	16%	$400,000	12.0%
Riverine	*6*	*$3,000,000*	*29%*	*$300,000*	*10.0%*
Coastal	*2*	*$400,000*	*4%*	*$200,000*	*50.0%*
Total Building & Contents[3]	**113**	**$21,600,000**	**100%**	**$2,600,000**	**12.0%**
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	*$200,000*	N/A
Business Disruption[4] *(Coastal)*				*$200,000*	
TOTAL[5]	**113**	**$21,600,000**	**100%**	**$3,000,000**	**14.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

The figures in these tables only represent information within the Caroline County (Unincorporated Areas)

Table 14: Caroline County (Unincorporated Area)– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	12	24%	$3,300,000	$300,000	$0	$0	0%
1 - 10%	12	24%	$3,200,000	$300,000	$100,000	$10,000	8%
10 - 20%	10	20%	$1,100,000	$100,000	$200,000	$20,000	16%
20 - 30%	4	8%	$500,000	$100,000	$100,000	$30,000	8%
30 - 40%	7	14%	$1,900,000	$300,000	$700,000	$100,000	56%
40 - 50%	3	6%	$300,000	$100,000	$100,000	$30,000	8%
50% or More	3	6%	$90,000	$30,000	$60,000	$20,000	5%
TOTAL	**51**	**100%**	**$10,390,000**	**$200,000**	**$1,260,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Caroline County (Unincorporated Areas)

Table 15: Caroline County (Unincorporated Area)– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	15	24%	$3,700,000	$200,000	$0	$0	0%
1 - 10%	13	21%	$2,400,000	$200,000	$100,000	$10,000	8%
10 - 20%	16	26%	$2,600,000	$200,000	$400,000	$30,000	31%
20 - 30%	12	19%	$1,200,000	$100,000	$300,000	$30,000	23%
30 - 40%	4	6%	$1,100,000	$300,000	$400,000	$100,000	31%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	2	3%	$200,000	$100,000	$80,000	$40,000	6%
TOTAL	**62**	**100%**	**$11,200,000**	**$200,000**	**$1,280,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Caroline County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Denton Summary (CID 240104A)

The following pages include Flood Risk data for the Town of Denton.

Overview

The Town of Denton is in central Caroline County. It consists of 5.50 square miles along State Highway 404. The primary flooding sources in the town are Choptank River, Watts Creek, Tributary No. 4 to Choptank River, and Tributary No. 7 to Choptank River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Denton	240104	4,418	5.50	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 4 policies totaling approximately $1,330,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Denton that are located within the Caroline County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Denton flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Denton, so only riverine flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 16. Additionally, Table 17 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: Town of Denton – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	1	$300,000	100%	$40,000	13.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$0	0%	$0	0.0%
Total Building & Contents[3]	2	$300,000	100%	$40,000	13.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**2**	**$300,000**	**100%**	**$40,000**	**13.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: Town of Denton – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	0	0%	$0	$0	$0	$0	0%
10 - 20%	1	50%	$300,000	$300,000	$40,000	$40,000	100%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	1	50%	<$5,000	$0	<$5,000	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**2**	**100%**	**$300,000**	**$200,000**	**$40,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Denton.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Federalsburg Summary (CID 240013)

The following pages include Flood Risk data for the Town of Federalsburg.

Overview

The Town of Federalsburg is in southern Caroline County, with small portions of the town in Dorchester County. It consists of 1.99 square miles along State Highway 318. The primary flooding sources in the town are Marshy Hope Creek, Tanyard Branch, Tributary No. 1 to Marshy Hope Creek, and Miles Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Federalsburg	240013	2,739	1.99	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 55 policies totaling approximately $10,031,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Federalsburg that are located within the Caroline County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Federalsburg flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Federalsburg, and no UDFs are present in the portions of Federalsburg in Dorchester County, so only riverine flood loss estimates within Caroline County are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 18: Town of Federalsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	161	$15,700,000	36%	$2,800,000	18.0%
Commercial Building & Contents	55	$14,600,000	34%	$4,600,000	32.0%
Other Building & Contents	19	$12,900,000	30%	$5,300,000	41.0%
Total Building & Contents[3]	235	$43,200,000	100%	$12,700,000	29.0%
Business Disruption[4]	N/A	N/A	N/A	$2,200,000	N/A
TOTAL[5]	**235**	**$43,200,000**	**100%**	**$14,900,000**	**34.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Federalsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	0%	$100,000	$100,000	$0	$0	0%
1 - 10%	30	13%	$3,500,000	$100,000	$200,000	$10,000	2%
10 - 20%	98	42%	$10,800,000	$100,000	$1,600,000	$20,000	12%
20 - 30%	49	21%	$9,300,000	$200,000	$2,300,000	$50,000	18%
30 - 40%	25	11%	$6,600,000	$300,000	$2,200,000	$90,000	17%
40 - 50%	21	9%	$5,700,000	$300,000	$2,600,000	$100,000	20%
50% or More	11	5%	$7,400,000	$700,000	$4,000,000	$400,000	31%
TOTAL	**235**	**100%**	**$43,400,000**	**$200,000**	**$12,900,000**	**$50,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Federalsburg.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. Town of Greensboro Summary (CID 240014A)

The following pages include Flood Risk data for the Town of Greensboro.

Overview

The Town of Greensboro is in northern Caroline County. It consists of 1.07 square miles along State Highway 480. The primary flooding sources in the town are Choptank River and Forge Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Greensboro	240014	1,931	1.07	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires June 10, 2024
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 21 policies totaling approximately $4,252,200.00
- NFIP-recognized repetitive loss properties = 1 Single Family Home
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Greensboro that are located within the Caroline County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Greensboro flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Greensboro, so only riverine flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 20. Additionally, Table 21 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 20: Town of Greensboro – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	31	$3,800,000	84%	$500,000	13.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	5	$700,000	16%	$50,000	7.0%
Total Building & Contents[3]	36	$4,500,000	100%	$550,000	12.0%
Business Disruption[4]	N/A	N/A	N/A	$10,000	N/A
TOTAL[5]	**36**	**$4,500,000**	**100%**	**$560,000**	**12.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 21: Town of Greensboro – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	3	8%	$800,000	$300,000	$0	$0	0%
1 - 10%	9	25%	$1,500,000	$200,000	$80,000	$10,000	16%
10 - 20%	13	36%	$1,500,000	$100,000	$200,000	$20,000	40%
20 - 30%	3	8%	$200,000	$70,000	$70,000	$20,000	14%
30 - 40%	3	8%	$200,000	$70,000	$50,000	$20,000	10%
40 - 50%	4	11%	$200,000	$50,000	$100,000	$30,000	20%
50% or More	1	3%	$0	$0	$0	$0	0%
TOTAL	**36**	**100%**	**$4,400,000**	**$100,000**	**$500,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Greensboro.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date January 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Building codes
- Participation in the NFIP Community Rating System (CRS)
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 22 below identifies possible mitigation actions for each AoMI to consider.

Table 22: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***

AoMI	Possible Actions to Reduce Flood Risk
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?
- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?

- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

Your local Hazard Mitigation Plan is a valuable place to identify and prioritize possible mitigation actions. The plan includes a mitigation strategy with mitigation actions that were developed through a public and open process. You can then add to or modify those actions based on what is learned during the course of the Risk MAP project and the information provided within this FRR.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 23 below.

Table 23: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.
FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Room 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Caroline County Department of Emergency Services
9391 Double Hills Road Denton, MD 21629
https://www.carolinemd.org/181/Emergency-Services

Caroline County Department of Planning and Codes
403 South 7th Street, Suite 210, Denton, MD 21629
https://www.carolinemd.org/138/Planning-Codes

Caroline County Department of Public Works
520 Wilmuth Street, Denton, MD 21629
https://www.carolinemd.org/139/Public-Works

Caroline County Department of Planning and Codes –GIS & Programming
403 South 7th Street, Suite 210, Denton, MD 21629
https://www.dorchestercountymd.com/planning-zoning/maps-gis-data/

This page left blank intentionally

Source: https://www. Myeasternshoremd.com

STATE OF MARYLAND

FLOOD RISK REPORT

CAROLINE COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Caroline County, Maryland – Countywide Flood Risk Map (FRM)

Caroline County, Maryland – High Risk Area 1: Federalsburg – Dollar Losses

Caroline County, Maryland – High Risk Area 1: Federalsburg – Percent Losses

Caroline County, Maryland – High Risk Area 2: Greensboro / Mill St – Dollar Losses

Caroline County, Maryland – High Risk Area 2: Greensboro / Mill St – Percent Losses

Caroline County, Maryland – High Risk Area 3: Choptank Wetlands Preserve / Little Creek – Dollar Losses

Caroline County, Maryland – High Risk Area 3: Choptank Wetlands Preserve / Little Creek – Percent Losses

Caroline County, Maryland – High Risk Area 4: Choptank / Maryland Ave / Main St – Dollar Losses

Caroline County, Maryland – High Risk Area 4: Choptank / Maryland Ave / Main St – Percent Losses

Caroline County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Caroline County, Maryland

Town of Templeville
Town of Marydel
Town of Henderson
Town of Goldsboro
Town of Greensboro
Area 2
Town of Ridgely
Town of Hillsboro
Town of Denton
Area 3
Town of Preston
Area 4
Town of Federalsburg
Area 1

Eastern Bay

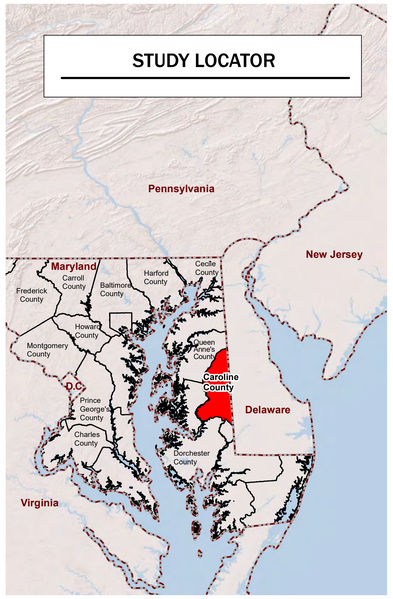
Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	*Federalsburg*	*682*	*25*	*237*	*$15,069,805*	*81%*
Area 2	*Greensboro / Mill St*	*557*	*13*	*46*	*$701,869*	*4%*
Area 3	*Choptank Wetlands Preserve / Little Creek*	*175*	*9*	*21*	*$207,357*	*1%*
Area 4	*Choptank / Maryland Ave / Main St*	*73*	*7*	*19*	*$777,206*	*4%*
Total for High-Risk Areas		**1,414**	**47**	**304**	**$15,979,031**	**86%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Caroline County (Unincorporated Areas)	20,788	113	$3,000,000	$144	16%
Town of Denton	4,418	2	$40,000	$9	< 1%
Town of Federalsburg	2,739	235	$14,900,000	$5,440	81%
Town of Goldsboro	246	0	$0	$0	0%
Town of Greensboro	1,931	36	$560,000	$290	3%
Town of Henderson	146	0	$0	$0	0%
Town of Hillsboro	161	0	$0	$0	0%
Town of Marydel	141	0	$0	$0	0%
Town of Preston	719	0	$0	$0	0%
Town of Ridgely	1,639	0	$0	$0	0%
Town of Templeville	138	0	$0	$0	0%
Total	**33,066**	**386**	**$18,500,000**	**$47,927**	**100%**

N
0 0.75 1.5 3
Miles



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area*

Area 1

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk Essential Facility

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

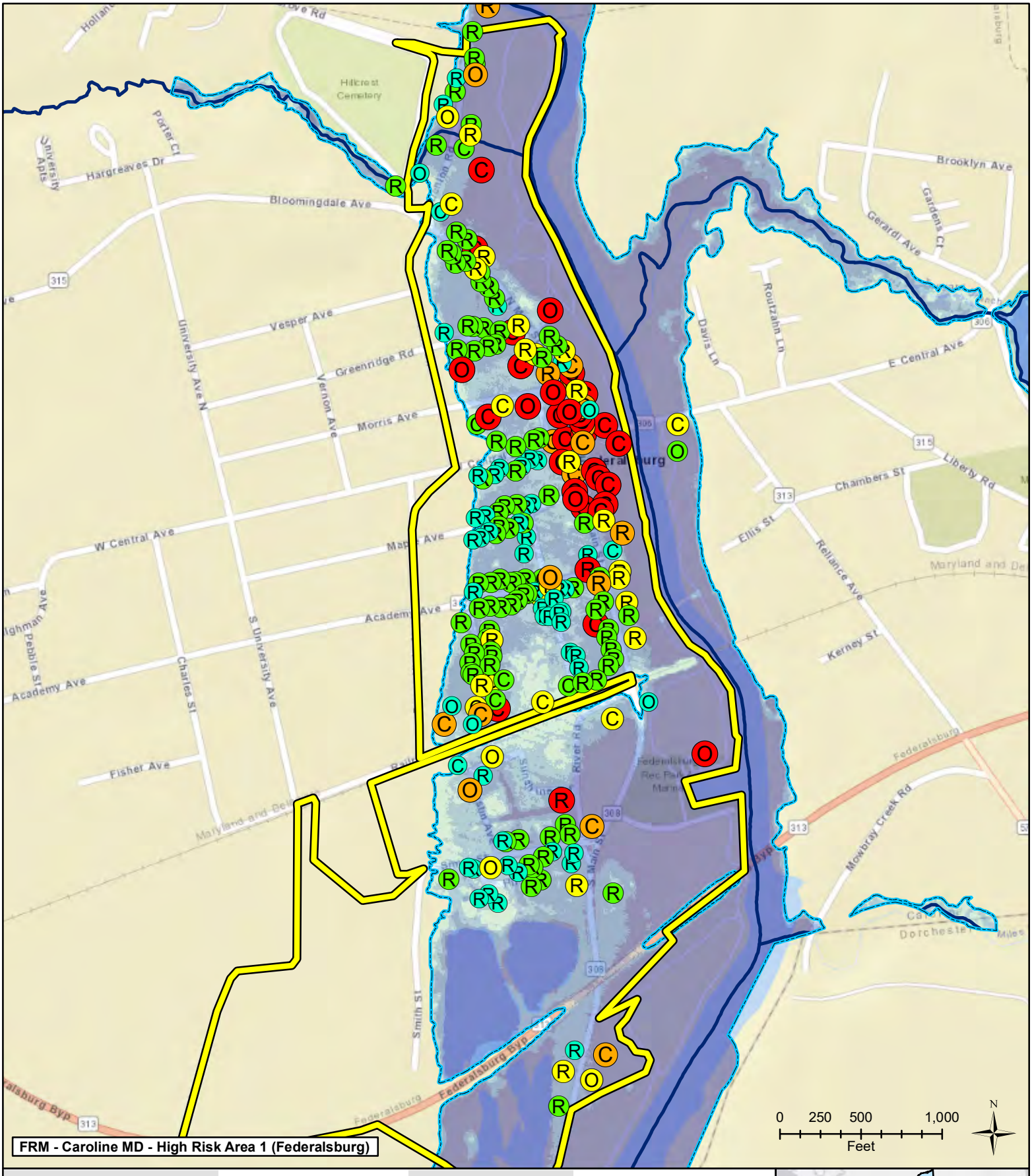
Caroline County and Incorporated Areas, MD

MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Caroline County, MD.

RELEASE DATE
12/31/2019



- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

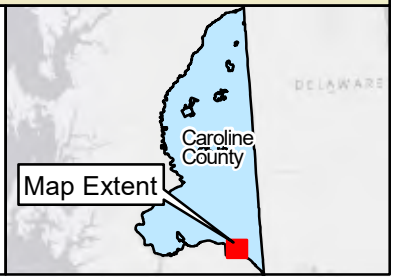
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

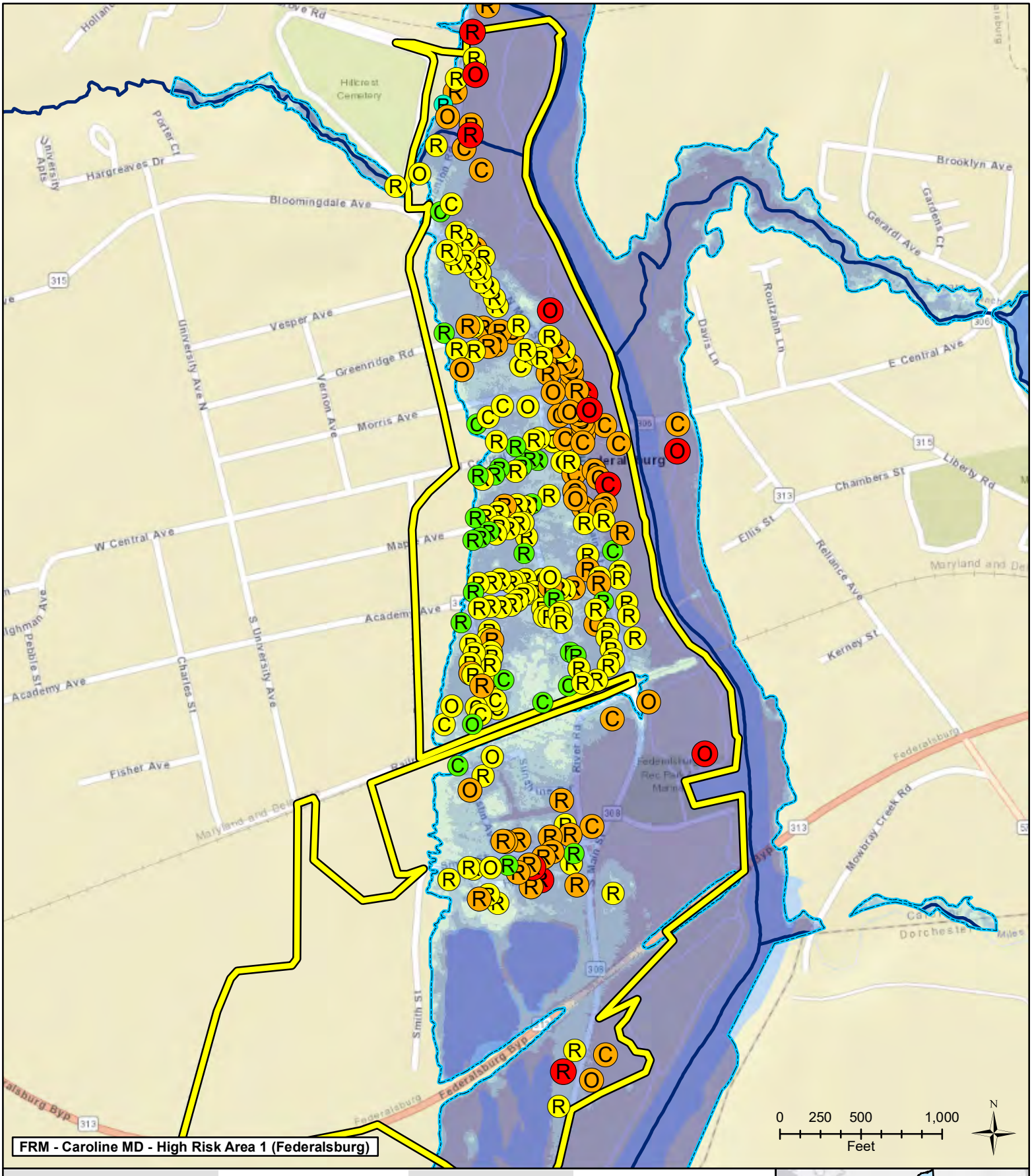
UDF Land Use Category

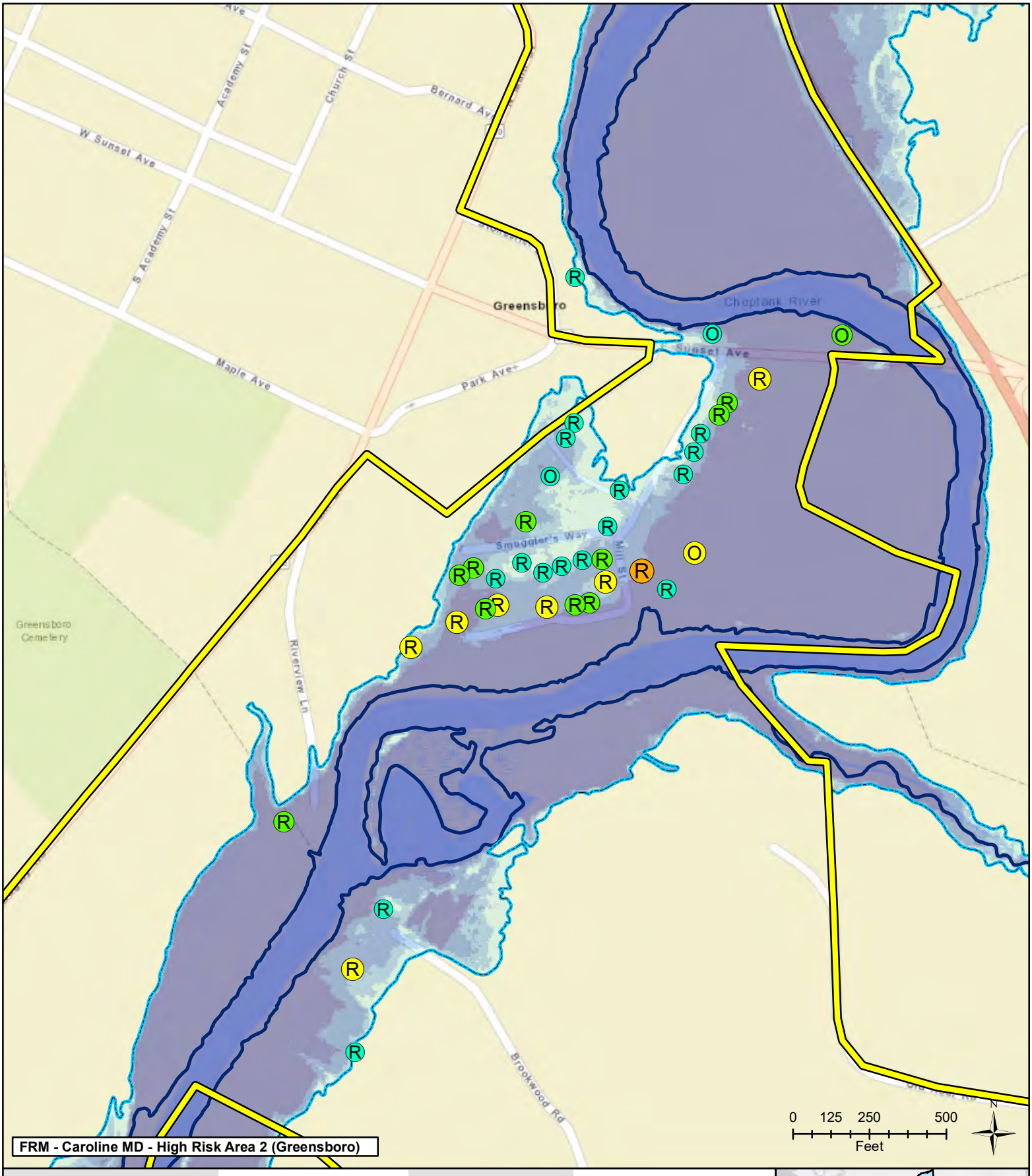
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000




Hillcrest Cemetery
Hargreaves Dr
Porter Ct
University Apts
Bloomingdale Ave
Vesper Ave
Greenridge Rd
Morris Ave
University Ave N
Vernon Ave
W Central Ave
Academy Ave
S University Ave
Charles St
Fisher Ave
Pebble St
Brooklyn Ave
Gardens Ct
Gerardi Ave
Routzahn Ln
Davis Ln
E Central Ave
Chambers St
Liberty Rd
Ellis St
Reliance Ave
Kerney St
Federalsburg
Mowbray Creek Rd
Federalsburg Byp
Smith St
Main St
River Rd
Maryland and Delaware
315
313
308
306
0 250 500 1,000
Feet
N
FRM - Caroline MD - High Risk Area 1 (Federalsburg)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Caroline County
Map Extent



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

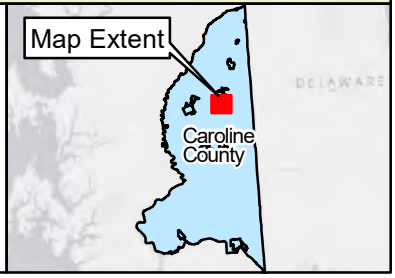
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

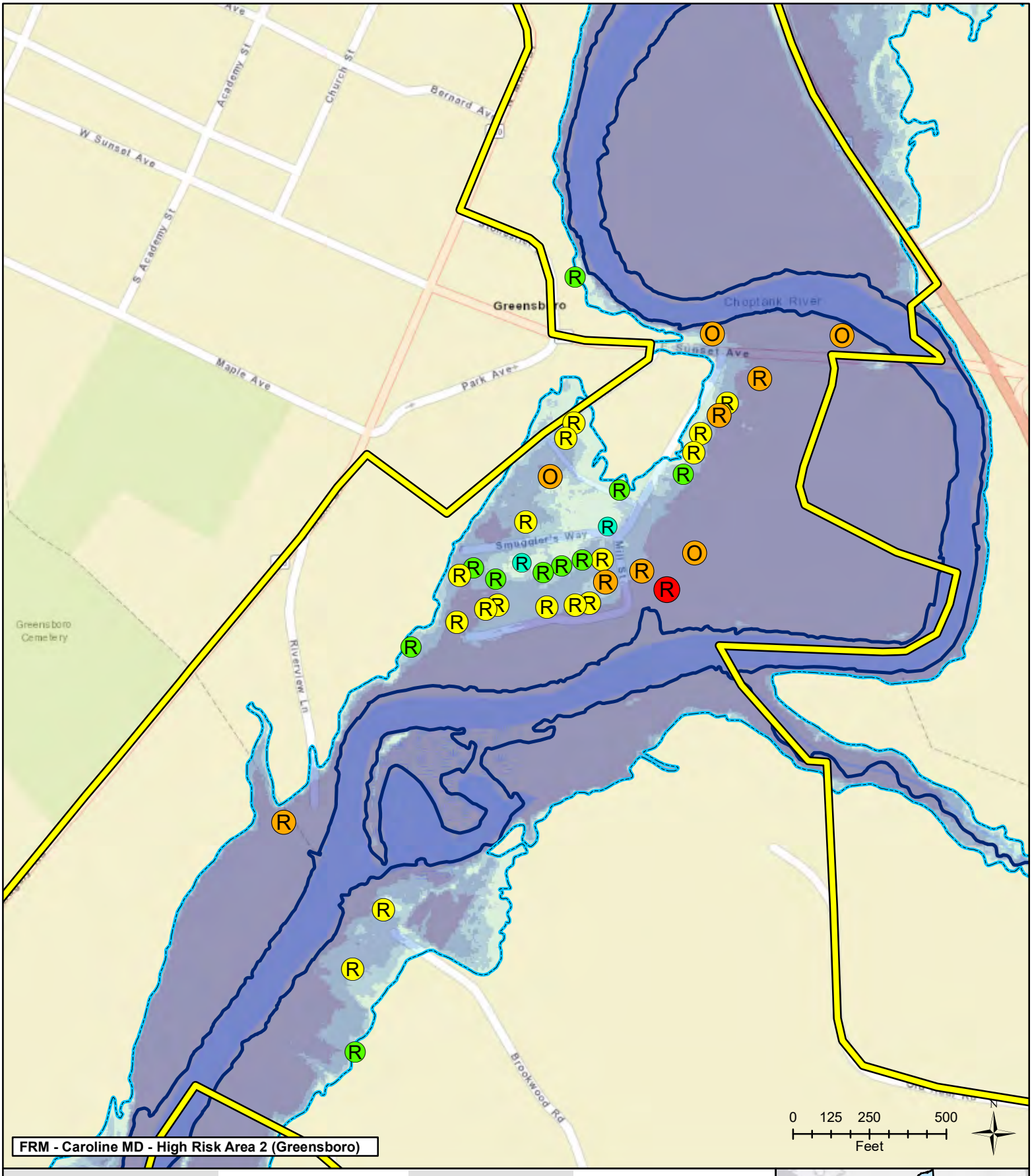
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Caroline MD - High Risk Area 2 (Greensboro)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

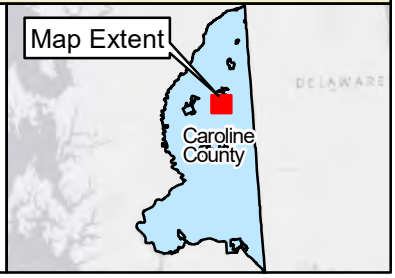
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

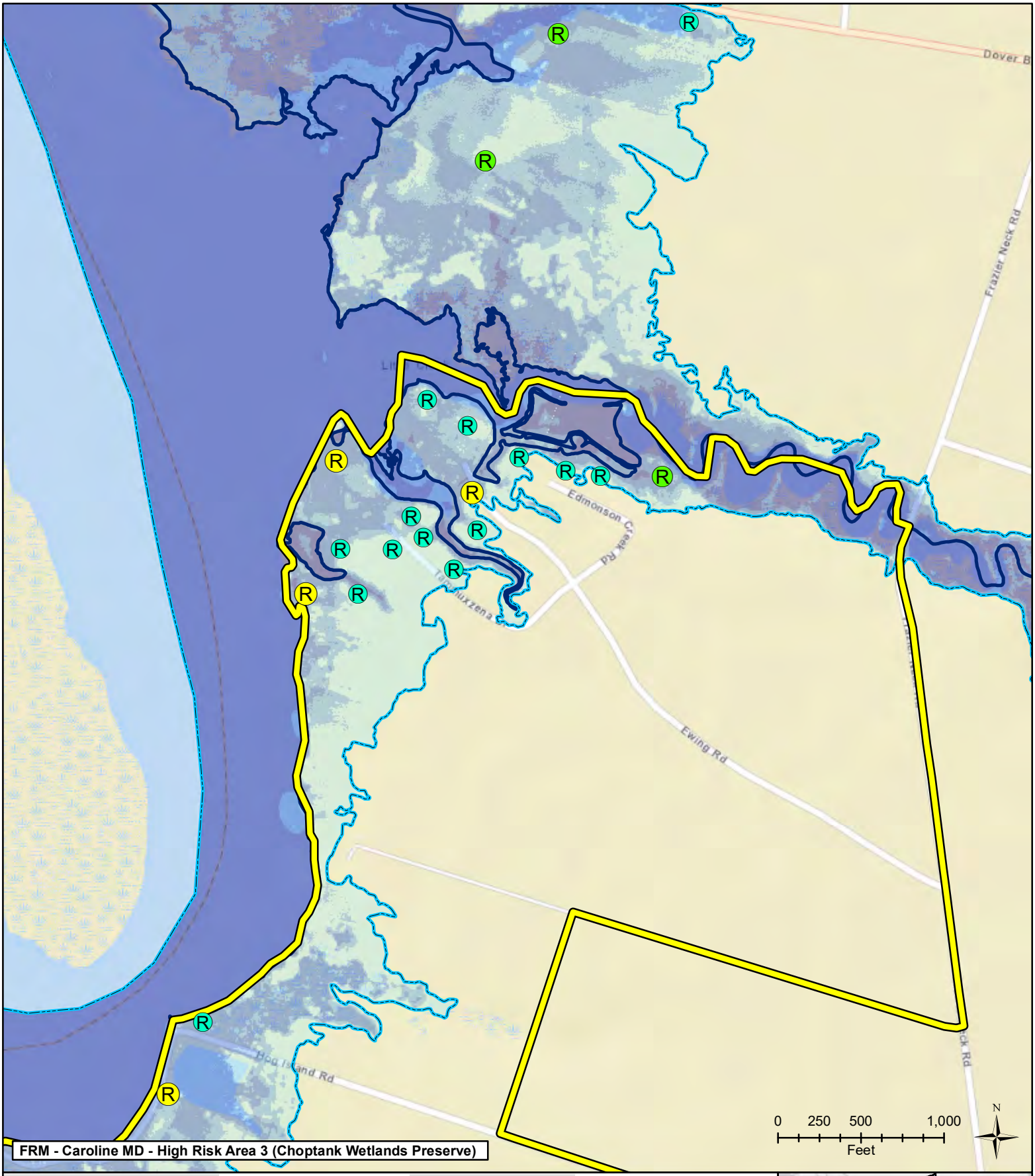
UDF Land Use Category

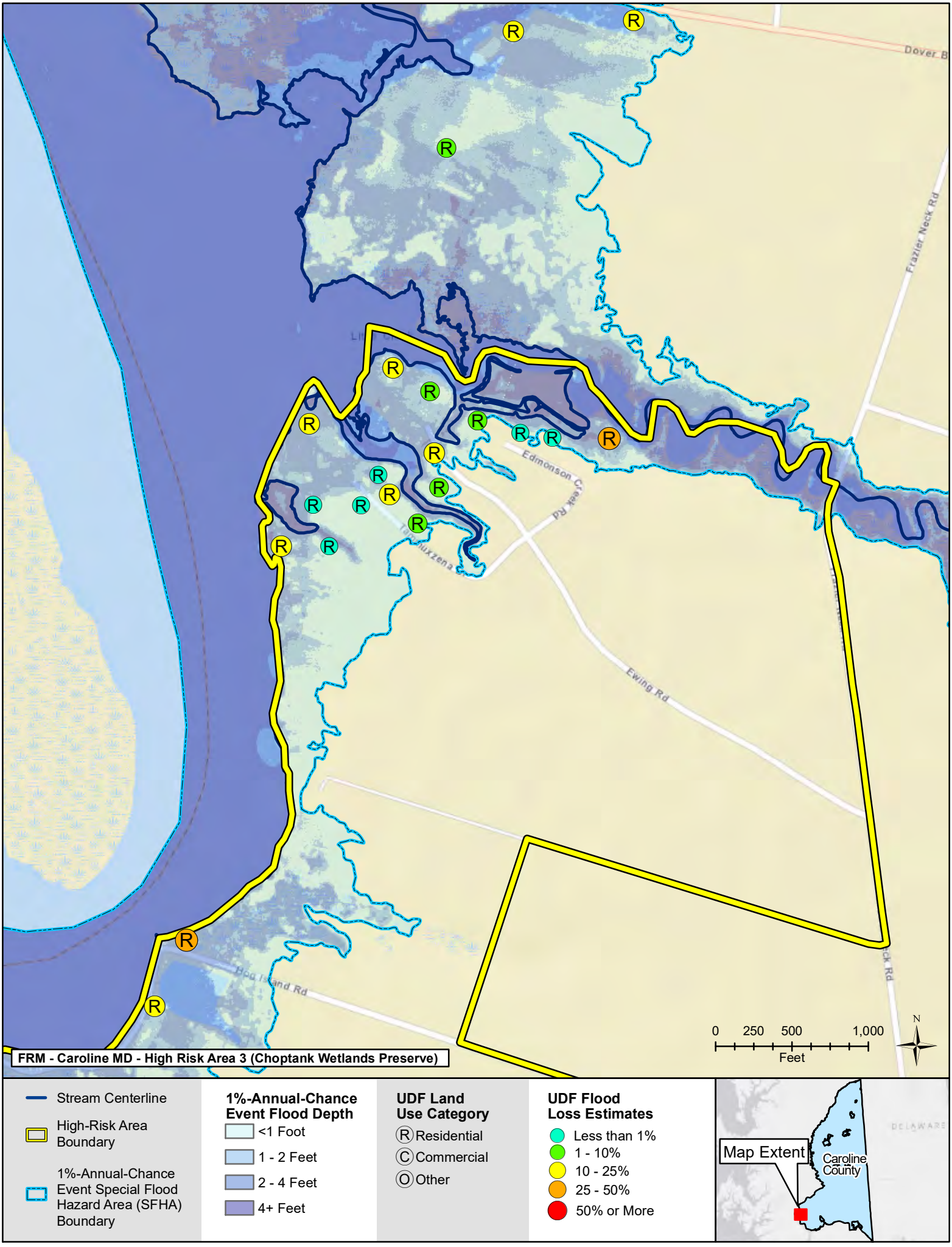
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More

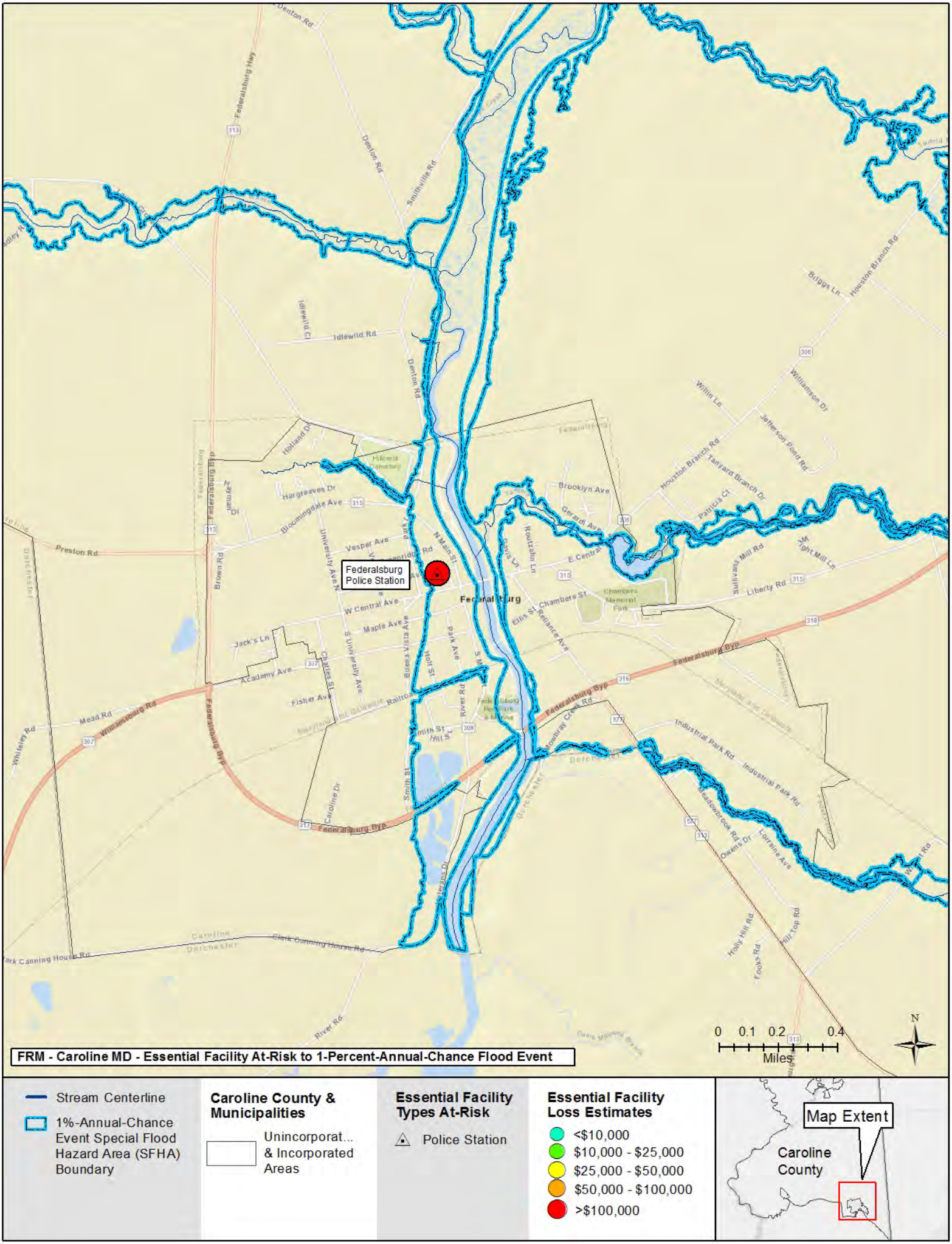



Dover B
Frazier Neck Rd
Edmonson Creek Rd
Ewing Rd
Hog Island Rd
0 250 500 1,000
Feet
N
FRM - Caroline MD - High Risk Area 3 (Choptank Wetlands Preserve)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Caroline County
DELAWARE


Dover B
Frazier Neck Rd
Edmonson Creek Rd
Ewing Rd
Hog Island Rd
0 250 500 1,000
Feet
N
FRM - Caroline MD - High Risk Area 3 (Choptank Wetlands Preserve)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Caroline County
DELAWARE

Poplar Neck Rd
Choptank Rd
Choptank Rd
Choptank Main St
Myrtle Ave
0
250
500
1,000
Feet
N
FRM - Caroline MD - High Risk Area 4 (Choptank)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Caroline County
DELAWARE

Poplar Neck Rd
Choptank Rd
Choptank Rd
Choptank Main St
Myrtle Ave
O
C
C
C
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
0
250
500
1,000
Feet
N
FRM - Caroline MD - High Risk Area 4 (Choptank)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Caroline County
DELAWARE


Federalsburg Police Station
Federalsburg
Denton Rd
Federalsburg Hwy
Idlewild Rd
Preston Rd
Brown Rd
Vesper Ave
N Main St
W Central Ave
Maple Ave
Jack's Ln
Academy Ave
Fisher Ave
Mead Rd
Williamsburg Rd
Whiteley Rd
Federalsburg Byp
Hargreaves Dr
Bloomingdale Ave
Holland Dr
Brooklyn Ave
Houston Branch Rd
Briggs Ln
Williamson Dr
Jefferson Point Rd
Tanyard Branch Dr
Patricia Ct
Gerardi Ave
E Central
Liberty Rd
Sullivans Mill Rd
Tight Mill Ln
Chambers St
Elks St
Reliance Ave
Routzahn Ln
Industrial Park Rd
Meadowbrook Rd
Owens Dr
Loraine Ave
Holly Hill Rd
Hill Top Rd
Fooks Rd
Clark Canning House Rd
River Rd
Caroline Dr
Smith St
Hill St
Park Ave
Buena Vista Ave
S University Ave
Charles St
Railroad
Crowbray Creek Rd
Smithville Rd
Idlewild Ct
Dorchester
Caroline
0 0.1 0.2 0.4
Miles
N
FRM - Caroline MD - Essential Facility At-Risk to 1-Percent-Annual-Chance Flood Event
Stream Centerline
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
Caroline County & Municipalities
Unincorporat... & Incorporated Areas
Essential Facility Types At-Risk
Police Station
Essential Facility Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Caroline County

This page left blank intentionally

Source: https://www.http://charlescounty.wusa9.com/photo-gallery/news/70013-photos-flooding-dmv#image24

STATE OF MARYLAND

FLOOD RISK REPORT

CHARLES COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Charles County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Charles County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Charles County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis for the county as a whole and for individual communities, with calculations of total flood damages by land use (occupancy type) and a summary of damage severity for buildings impacted by flooding. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 5

d. Related Resources 6

2 Flood Risk Analysis 11

a. Overview 11

b. Analysis of Risk 12

i. Flood Depth and Analysis Grids 12

ii. Flood Risk Assessments 13

iii. Areas of Mitigation Interest 15

3 Flood Risk Analysis Results 27

a. Charles County, MD Flood Risk Project Area Summary 28

i. Overview 28

ii. Flood Risk Results 29

iii. Flood Risk Maps 37

4 Actions To Reduce Flood Risk 38

a. Types of Mitigation Actions 38

i. Local Plans and Regulations 38

ii. Structure and Infrastructure Projects 39

iii. Natural Systems Protection Activities 40

iv. Education and Awareness Activities 40
b. Identifying Specific Actions for Your Community 42
c. Mitigation Programs and Assistance 43
i. FEMA Mitigation Programs and Assistance 43
ii. Additional Mitigation Programs and Assistance 44
5 Acronyms And Definitions 45
a. Acronyms 45
b. Definitions 47
6 Additional Resources 51

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Charles County Essential Facilities 16

Table 2: USACE National Inventory of Dams – Charles County, MD 18

Table 3: Flood Risk Assessment – Community Overview 28

Table 4: Charles County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 5: Charles County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 30

Table 6: Charles County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 31

Table 7: Charles County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 31

Table 8: Charles County, Maryland – Government Facilities Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas) 31

Table 9: Charles County, Maryland – State Assets Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas) 32

Table 10: Charles County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas) 33

Table 11: Charles County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas) 34

Table 12: Charles County, Maryland – Areas of Mitigation Interest 34

Table 13: Charles County, Maryland – High-Risk Areas 35

Table 14: Mitigation Actions for Areas of Mitigation Interest 41

Table 20: FEMA Hazard Mitigation Assistance Programs 44

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: heavy rains temporarily closed roads around Charles County
Source: SoMDNews - John Filer, Charles County Emergency Services

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to

humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: July 2019 - Flash flooding in many neighborhoods in northern Charles County, including flood-prone Pinefield
Source: SoMdNews
Photo by: Eric Stern

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: July 2019 - Heavy rains temporarily closed roads around Charles County
Source: SoMdNews
Photo by: John Filer, Charles County Emergency Services

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future

land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 31 to 33.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on two regulatory FIRM updates published in the FEMA National Flood Hazard Layer (NFHL), including:
  - Charles County Map Modernization Study – September 4, 2013
    - Restudy of all riverine flood hazards
  - Charles County Coastal Physical Map Revision (PMR) – May 4, 2015
    - Restudy of all coastal flood hazards
- Non-regulatory coastal flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were previously developed in conjunction with the Charles County Coastal PMR, effective May 4, 2015. These products were published to the FEMA Map Service Center on November 4, 2015 and have been leveraged as part of this countywide assessment.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of December 2017), acquired through the Maryland Deparment of

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

Planning – http://planning.maryland.gov/OurProducts/. Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordinances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructed after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Charles County Department of Planning and Growth Management – https://www.charlescountymd.gov/pgm/planning/pgm-maps *(Limited Distribution; data available by purchase/ request).*
- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.
- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. *Subsection ii: Flood Risk Assessments*, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance

floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The 2016 State of Maryland Hazard Mitigation Plan was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

  The 2018 Charles County Hazard Mitigation Plan Update was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

  Please note that the information in this FRR may be reviewed for inclusion during the update of the Charles County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in

Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

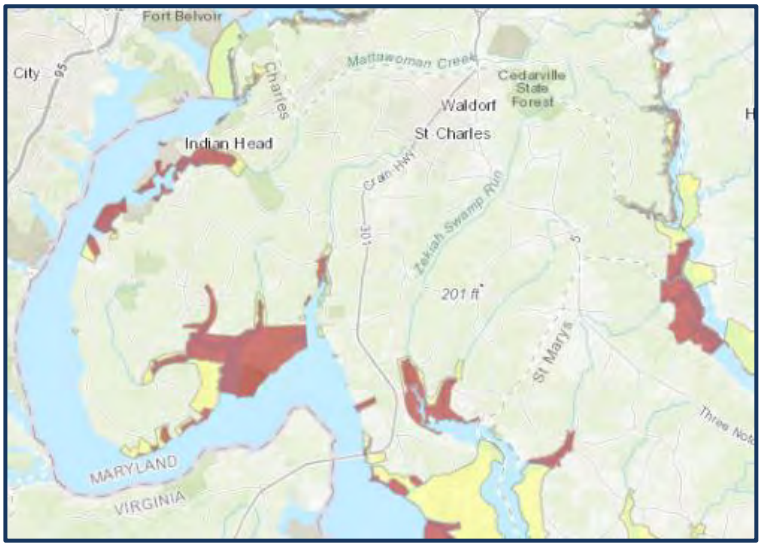
TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

Charles County in coordination with the State of Maryland and the U.S. Army Corp of Engineers updated the county's the Evacuation Zones. Therefore, Charles County now participates in the "Know Your Zone" evacuation initiative as part of Maryland's Hurricane Evacuation Study.

Figure 1.6



Charles County's Hurricane Evacuation Zone Map.

Source: www.knowyourzonemd.com

Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk, Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Charles County evacuation zones can be found at https://mema.maryland.gov/Pages/know-your-zone-md.aspx.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.
- **Emergency Action Plans.** Emergency Action Plans (EAP) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of

the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

Six (6) dams are located within Charles County, three (3) of which have Emergency Action Plans. Table 1, *USACE National Inventory of Dams – Charles County, MD,* on page 14 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  The *Flood Risk Report Charles County, Maryland Coastal Study*, developed by FEMA, was released on November 4, 2015. This report provides coastal flood risk information, such as estimated coastal flood losses for the 1-percent-annual-chance flood event. The Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

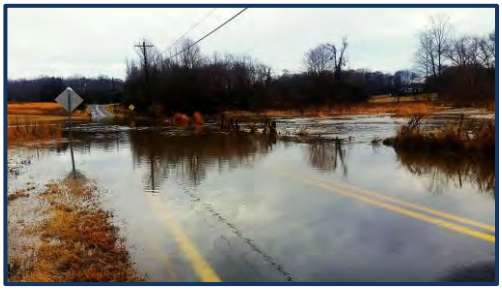
a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

Figure 2.1



Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Flooding down in Bryans Road, MD
Source: https://twitter.com/miketfox5/status/962859220780683265
Photo: Mermanda Eldridge
Bottom Photo: Flooding on Fenwick Rd in Bryans Road MD.
Source: Facebook – SOMDWXNEWS

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

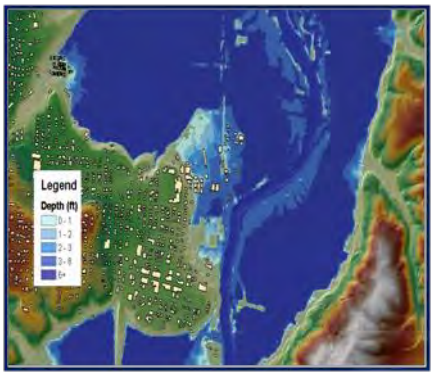
- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood depth is a function of the difference between the calculated water surface elevation (including

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

overland wvae propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and regulatory FIRM updates for each study type were separately performed.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Figure 2.4

Example of an essential facility, Waldorf Volunteer Fire Department.

Photo Source: Waldorf VFD Facebook Page

Essential facilities, sometimes called "critical facilities," are those w hose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 88 essential facilities located within Charles County with a total esitmated building value of $671,086,100.

Table 1: Charles County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	1	$6,744,000
Fire/Rescue Stations	18	$23,372,500
Hospital & Medical Clinics	3	$17,854,600
Police Stations	7	$49,097,400
Schools (K-12 & Colleges)	59	$574,017,600
Total	**88**	**$671,086,100**

Source: 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations.

Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 5 high risk areas were identified within Charles County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: View of Gilbert Run Dam
Source: YouTube – Tom Shelton

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Gilbert Run Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, six (6) dams are located in Charles County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Charles County, MD

Name	Owner Type	Purpose	River	EAP Last Revision Date
Myrtle Grove Lake	State	Recreation	Mattawoman Creek-TR	No
Westlake Village Lake 3	Private	Recreation	Piney Branch	No
Mc Allister Pond No. 1	Private	Irrigation	Kerrick Swamp-TR	No
Gilbert Run Dam 2 (Wheatley)	Local Government	Recreation	Wheatley Run	Yes
Gilbert Run Dam 1 (Trinity Church)	Local Government	Flood Control	Church Run	Yes
Gilbert Run Dam 3 (Jameson Dam)	Local Government	Flood Control	Gilbert Run	Yes

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

This dam failure caused flooding that damaged several homes and vehicles.

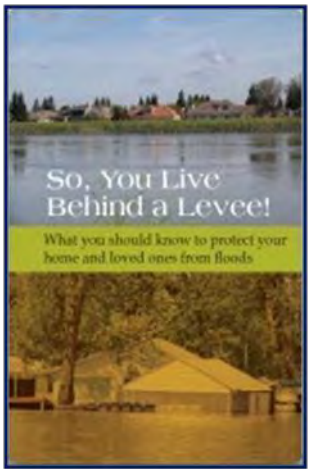
  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.

- For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

According to US Army Corps of Engineers, National Levee Database, there are no levees located within Charles County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

  - **Reasons coastal structures are considered AoMIs:**
    - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
    - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
    - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**
    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.

- These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
- If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
- Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

  Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Figure 2.8

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of August 2018, a total of twenty-seven (27) repetitive loss properties were within Charles County. These properties consist of six (6) non-residential and twenty-one (21) single-family structures. All properties are located within the unincorporated portions of the County. 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.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.

- Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
- Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.9

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

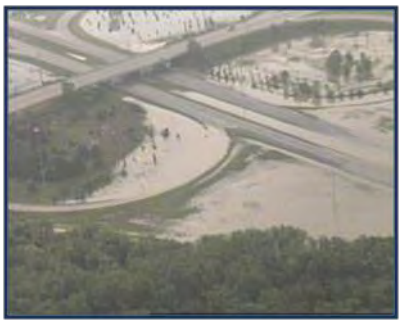
- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.

Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  Figure 2.10

  When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
    - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
    - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 19.

  - **Reasons areas of mitigation success are considered AoMIs:**

    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine erosion are considered AoMIs:**

    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
    - Landslides and mudslides are a result of erosion
    - Approximately one-third of the nation's streams experience severe erosion problems

- Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
- Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Charles County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Charles County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Population	Total Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Charles County (Unincorporated Areas)	240089	133,941	634.13	Y	N/A	Y
Town of Indian Head	240091	3,844	1.23	Y	N/A	Y
Town of La Plata	240092	8,753	7.48	Y	N/A	Y

Note that, although the Towns of Indian Head and La Plata have mapped flood hazards, neither community has UDFs within the regulatory 1-percent-annual-chance floodplain, so no estimated flood losses to report for either community.

Additionally, the Village of Port Tobacco is not identified as a distinct incorporated community on effective FEMA products, so in this report, it is not distinguished from the surrounding Unincorporated Areas of Charles County. And lastly, specific building information is not available for the Indian Head Naval Support Facility (a large federal property), so loss estimates have not been analyzed for that location as part of this countywide flood risk assessment.

Therefore, the countywide flood risk summary in this section reflects the estimated losses and flooding within Charles County (Unincorporated Areas); and separate summaries for individual communities are not applicable.

The information below provides an overview of the Charles County (Unincorporated Areas) floodplain management program information as of the date of this publication:

- Participating in the County Multi-Hazard Mitigation Plan which expires December 10, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 664 policies totaling approximately $189,231,600
- NFIP-recognized repetitive loss properties = 20
- NFIP-recognized severe repetitive loss properties = 1

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Charles County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1 (Riverine) and version 2.2 (Coastal), and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5 (with distinction between riverine and coastal losses).

Tables 6 and 7 show the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood, for riverine and coastal flooding, respectively.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 4: Charles County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Charles County (Unincorporated Areas)	133,941	409	$13,160,000	$98	100%
Town of Indian Head	3,844	0	$0	$0	0%
Town of La Plata	8,753	0	$0	$0	0%
Total	**146,538**	**409**	**$13,160,000**	**$90**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Charles County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	381	$60,500,000	79%	$8,600,000	14.0%
Riverine	*92*	*$17,900,000*	*81%*	*$3,300,000*	*18.0%*
Coastal	*289*	*$42,600,000*	*78%*	*$5,300,000*	*12.0%*
Commercial Building & Contents	22	$15,900,000	21%	$4,300,000	27.0%
Riverine	*5*	*$3,700,000*	*17%*	*$300,000*	*8.0%*
Coastal	*17*	*$12,300,000*	*22%*	*$3,900,000*	*32.0%*
Other Building & Contents	6	$400,000	1%	$60,000	15.0%
Riverine	*5*	*$400,000*	*2%*	*$50,000*	*13.0%*
Coastal	*1*	*$20,000*	*0%*	*$10,000*	*50.0%*
Total Building & Contents[3]	**409**	**$76,800,000**	**100%**	**$12,960,000**	**17.0%**
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	*$70,000*	N/A
Business Disruption[4] *(Coastal)*				*$100,000*	
TOTAL[5]	**409**	**$76,800,000**	**100%**	**$13,160,000**	**17.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Charles County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	6	6%	$2,400,000	$400,000	$0	$0	0%
1 - 10%	28	27%	$5,800,000	$200,000	$300,000	$10,000	8%
10 - 20%	27	26%	$6,700,000	$200,000	$1,000,000	$40,000	28%
20 - 30%	19	19%	$3,200,000	$200,000	$800,000	$40,000	22%
30 - 40%	10	10%	$2,100,000	$200,000	$700,000	$70,000	19%
40 - 50%	7	7%	$1,200,000	$200,000	$500,000	$70,000	14%
50% or More	5	5%	$600,000	$100,000	$300,000	$60,000	8%
TOTAL	**102**	**100%**	**$22,000,000**	**$200,000**	**$3,600,000**	**$40,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 7: Charles County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	50	16%	$15,700,000	$300,000	$0	$0	0%
1 - 10%	27	9%	$8,000,000	$300,000	$500,000	$20,000	5%
10 - 20%	63	21%	$11,500,000	$200,000	$1,700,000	$30,000	18%
20 - 30%	54	18%	$8,400,000	$200,000	$2,100,000	$40,000	22%
30 - 40%	29	9%	$4,500,000	$200,000	$1,500,000	$50,000	16%
40 - 50%	6	2%	$2,500,000	$400,000	$1,100,000	$200,000	12%
50% or More	78	25%	$4,400,000	$60,000	$2,500,000	$30,000	27%
TOTAL	**307**	**100%**	**$55,000,000**	**$200,000**	**$9,400,000**	**$30,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables represent information within the Charles County, Maryland Flood Risk Assessment Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature

class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with an effective date May 4, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Charles County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and

schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential essential facility flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, however, no essential facilities in Charles County are at-risk to the 1-percent-annual-chance flood event.

While there are no essential facilities at-risk, there are two (2) government facilities at-risk to the 1-percent-annual-chance flood event. The list of government facilities at-risk is provided on page 33.

Table 8: Charles County, Maryland – Government Facilities Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas)

Type	Estimated Building Value	Total Essential Facilities Impacted by 1% Flood	1% Dollar Losses (Building & Content Value)
Government	$ 7,400	2	< $ 1,000
TOTAL	**$7,400**	**2**	**< $ 1,000**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Charles County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Charles County contains 165 state assets. Potential flood losses for the 1-percent-annual-chance

flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 9.

Table 9: Charles County, Maryland – State Assets Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas)

Type	Estimated Building Value	Total Essential Facilities Impacted by 1% Flood	1% (100-yr) Dollar Losses (Building & Content Value)
DNR Facility	$ 10,500	1	$ 0
TOTAL	**$10,500**	**1**	**$ 0**

Source: 2016 State of Maryland State Assets Database & Hazus analysis (Version 3.1) results stored in the 'Area of Mitigation Interest' (S_AOMI_Ar) layer of the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
  - The model estimates that a total of 2,934 tons of debris will be generated. Of the total amount, Finishes comprises 59% of the total, Structure comprises 23% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 117 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 10: Charles County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	1,731	59%	69
Structure	677	23%	27
Foundation	527	18%	21
TOTAL	**2,934**	**100%**	**117**

Source: Hazus 3.1: Flood Modual – Charles County Study Area/ General Building Stock

Projected Shelter Needs

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**
    - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 498 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 632 people (out of a total population of 146,551) will seek temporary shelter in public shelters.

Table 11: Charles County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	498	1,493	632

Source: Hazus 3.1: Flood Modual – Charles County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 12: Charles County, Maryland – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Government Facilities	2	Depth grids, Emergency Management Dept.
At-Risk State Assets	1	Dept grids, MEMA
High-Risk Areas	5	NFHL, Census Blocks, UDFs
Repetitive Loss Properties	21	FEMA NFIP/MDE Community Assistance Program Manager

- **At-Risk Government Facilities**

  Results from the 1-percent-annual-chance flood event analysis indicate two (2) essential facilities are at-risk; both police stations. Flood depths for each facility is provided below along with the identified facilities.

  - Zekiah Pumping Station– 9.9'
    3945 Leonardtown Road, Waldorf
  - St. Charles - Smallwood Village Pumping Station – 0.3'
    Saint Charles Industrial Park Subdivision

- **At-Risk State Assets:**

  Results from the 1-percent-annual-chance flood event analysis indicate one (1) state asset is at-risk. The structure is owned by the Department of Natural Resources and is located within the Mallow Bay Park at 1450 Wilson Landing Road, Nanjemo.

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created

by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 13: Charles County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Pinefield	275	2	36	$2,095,436	16%
Area 2	Port Tobacco	442	6	104	$2,420,999	19%
Area 3	West La Plata	90	2	14	$353,823	3%
Area 4	Rocky Point/Cobb Island	1,182	59	97	$3,298,608	25%
Area 5	Swan Point	1,035	18	62	$984,931	8%
Total for High-Risk Areas		**3,024**	**87**	**313**	**$9,153,796**	**70%**

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of 21 FEMA Designated Repetitive Loss Properties have been identified in the unincorporated portions of Charles County. In addition, one (1) of these properties is a Severe Repetitive Loss Property. Due to sensitivity of public disclosure for flood insurance claims, Repetitive and Severe Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

iii. Flood Risk Maps

The Flood Risk Maps for Charles County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Participation in the NFIP Community Rating System (CRS)
- Building codes
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 14 below identifies possible mitigation actions for each AoMI to consider.

Table 14: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***

AoMI	Possible Actions to Reduce Flood Risk
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?

- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The 2018 Charles County Hazard Mitigation Plan Update – Chapter 6 Mitigation Strategy identifies and prioritizes mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 20 below.

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

Table 15: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

FEMA's HMA grants are awarded to eligible states, federally-recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.
FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,*
coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Room 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Charles County Department of Emergency Services
10425 Audie Lane, La Plata, MD 20646
https://www.charlescountymd.gov/es/em/emergency-management

Charles County Department of Planning and Growth Management
200 Baltimore St., La Plata, MD 20646
https://www.charlescountymd.gov/pgm/planning/planning

Charles County Department of Public Works
10430 Audie La., La Plata, MD 20646
https://www.charlescountymd.gov/pw/welcome

Charles County Geographic Information Systems (GIS)
200 Baltimore St., La Plata, MD 20646
https://www.charlescountymd.gov/pgm/planning/pgm-maps

This page left blank intentionally

Source: https://www.http://charlescounty.wusa9.com/photo-gallery/news/70013-photos-flooding-dmv#image24

STATE OF MARYLAND

FLOOD RISK REPORT

CHARLES COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Charles County, Maryland – Countywide Flood Risk Map (FRM)

Charles County, Maryland – High Risk Area 1: Pinefield – Dollar Losses

Charles County, Maryland – High Risk Area 1: Pinefield – Percent Losses

Charles County, Maryland – High Risk Area 2: Port Tobacco – Dollar Losses

Charles County, Maryland – High Risk Area 2: Port Tobacco – Percent Losses

Charles County, Maryland – High Risk Area 3: West La Plata – Dollar Losses

Charles County, Maryland – High Risk Area 3: West La Plata – Percent Losses

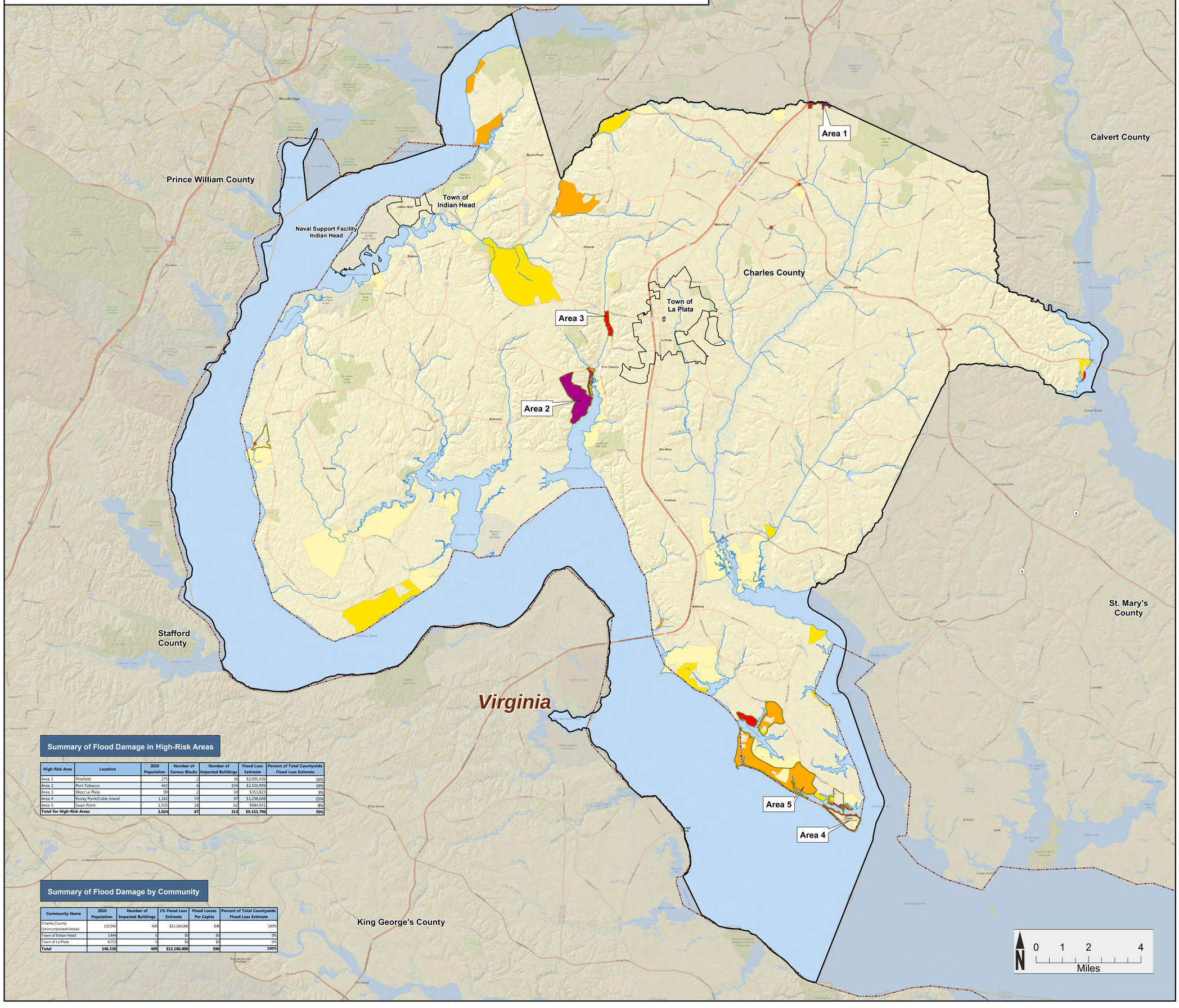
Charles County, Maryland – High Risk Area 4: Rocky Point – Dollar Losses

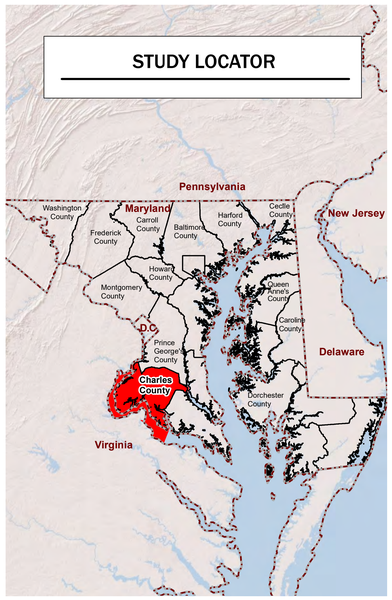
Charles County, Maryland – High Risk Area 4: Rocky Point – Percent Losses

Charles County, Maryland – High Risk Area 5: Swan Point – Dollar Losses

Charles County, Maryland – High Risk Area 5: Swan Point – Percent Losses

Countywide Flood Risk Map: Charles County, Maryland





MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area*

Area 1

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk State Asset or Essential Facility

Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Pinefield	275	2	36	$2,095,436	16%
Area 2	Port Tobacco	442	6	104	$2,420,999	19%
Area 3	West La Plata	90	2	14	$353,823	3%
Area 4	Rocky Point/Cobb Island	1,182	59	97	$3,298,608	25%
Area 5	Swan Point	1,035	18	62	$984,931	8%
Total for High-Risk Areas		**3,024**	**87**	**313**	**$9,153,796**	**70%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Charles County (Unincorporated Areas)	133,941	409	$13,160,000	$98	100%
Town of Indian Head	3,844	0	$0	$0	0%
Town of La Plata	8,753	0	$0	$0	0%
Total	**146,538**	**409**	**$13,160,000**	**$90**	**100%**

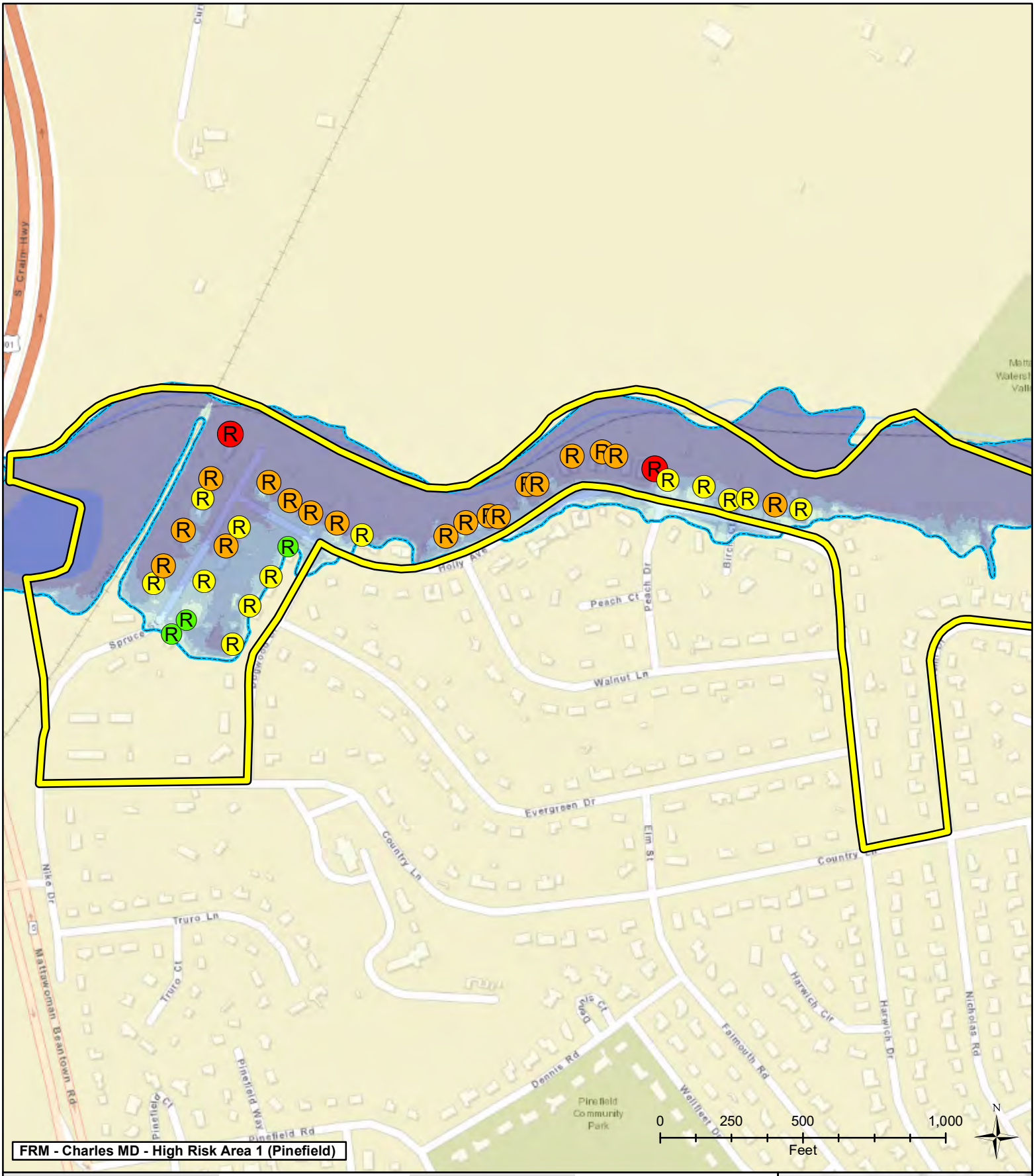
Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

Charles County and Incorporated Areas, MD

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Charles County, MD.

RELEASE DATE
12/31/2019



FRM - Charles MD - High Risk Area 1 (Pinefield)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

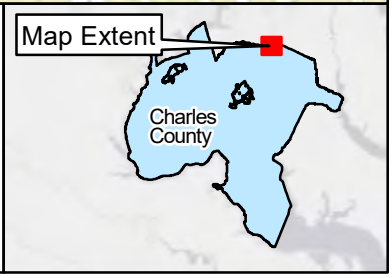
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

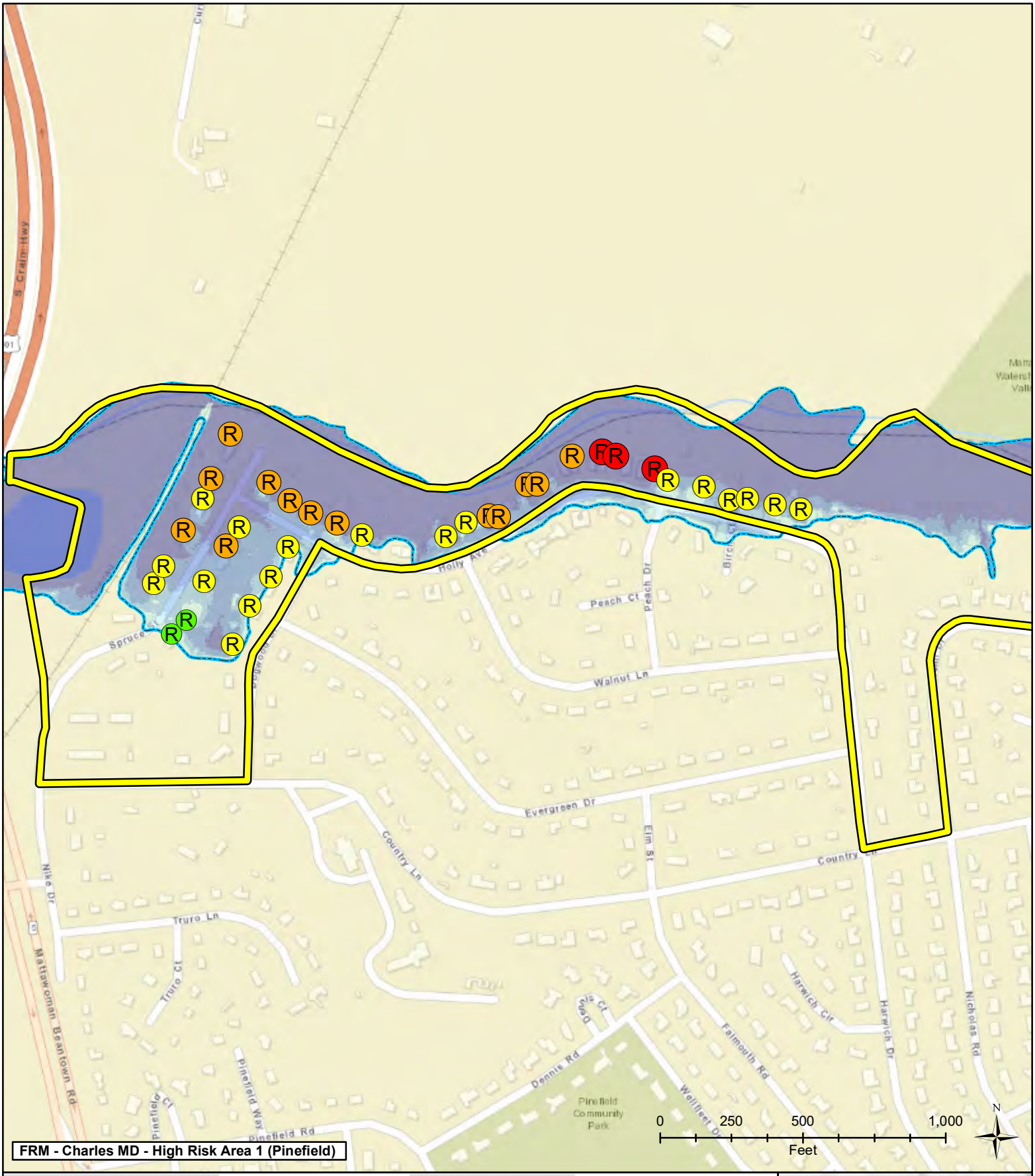
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Charles MD - High Risk Area 1 (Pinefield)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

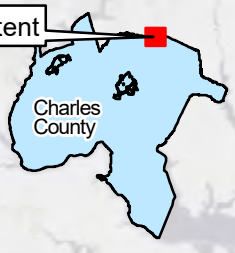
UDF Land Use Category

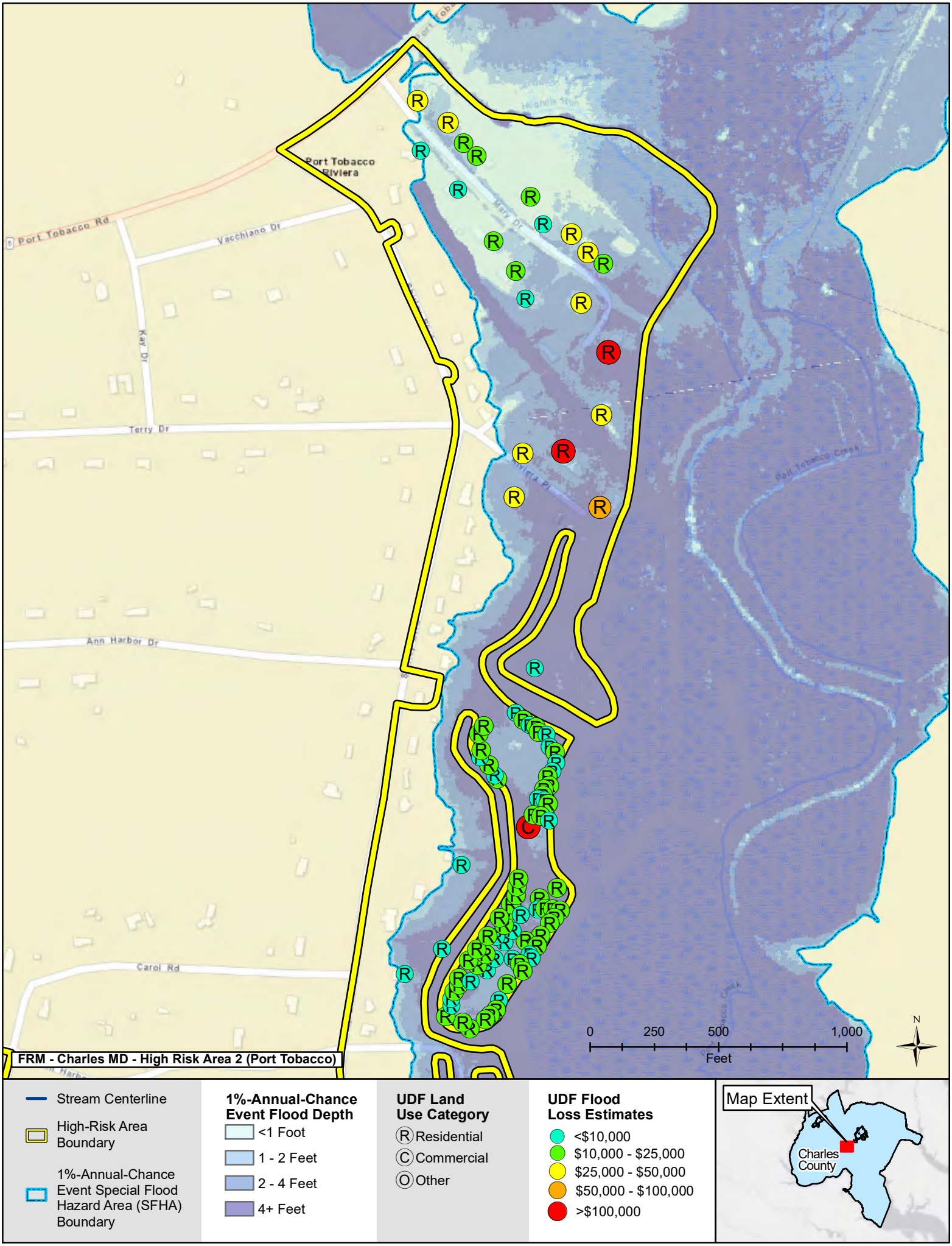
- (R) Residential
- (C) Commercial
- (O) Other

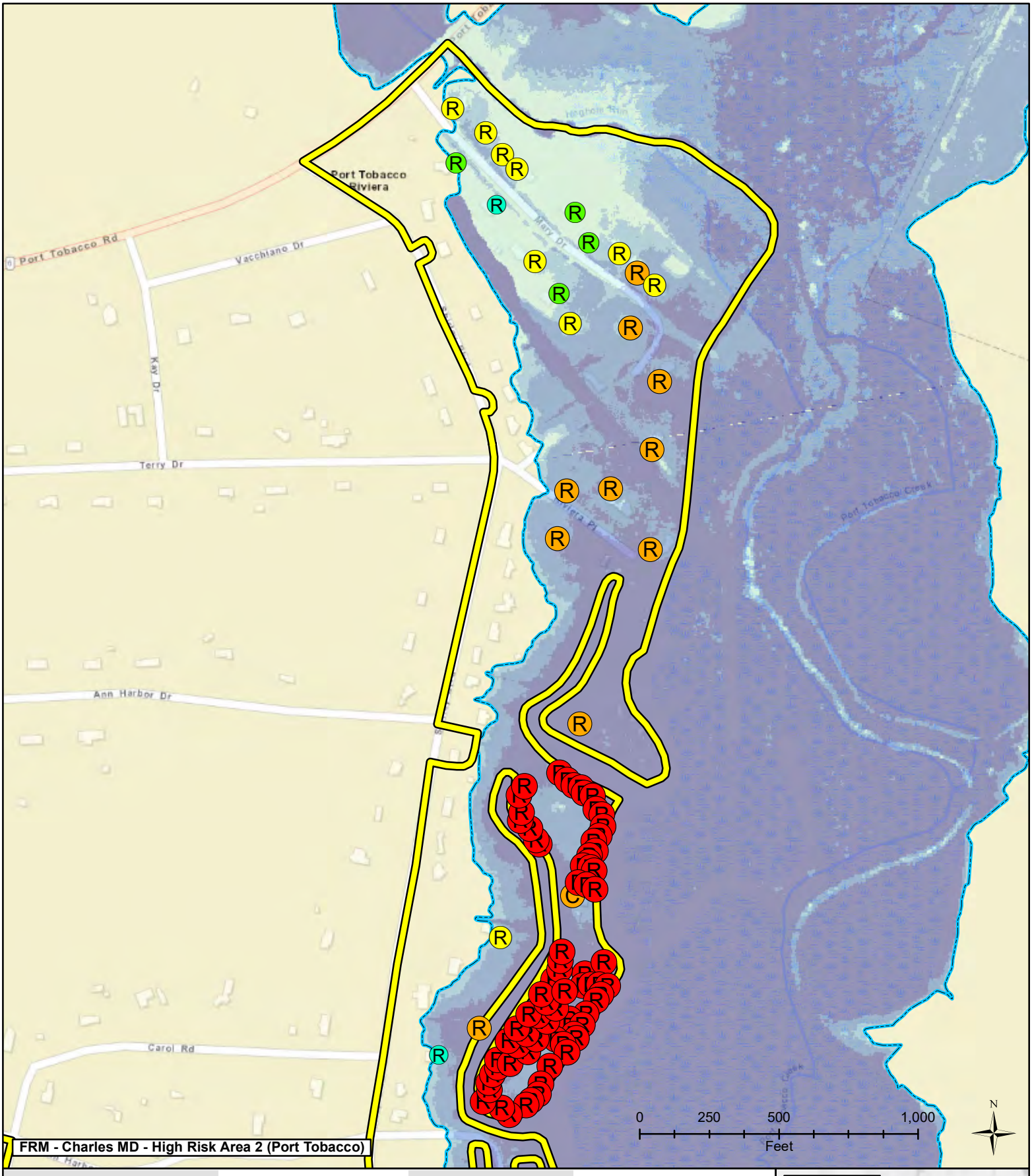
UDF Flood Loss Estimates

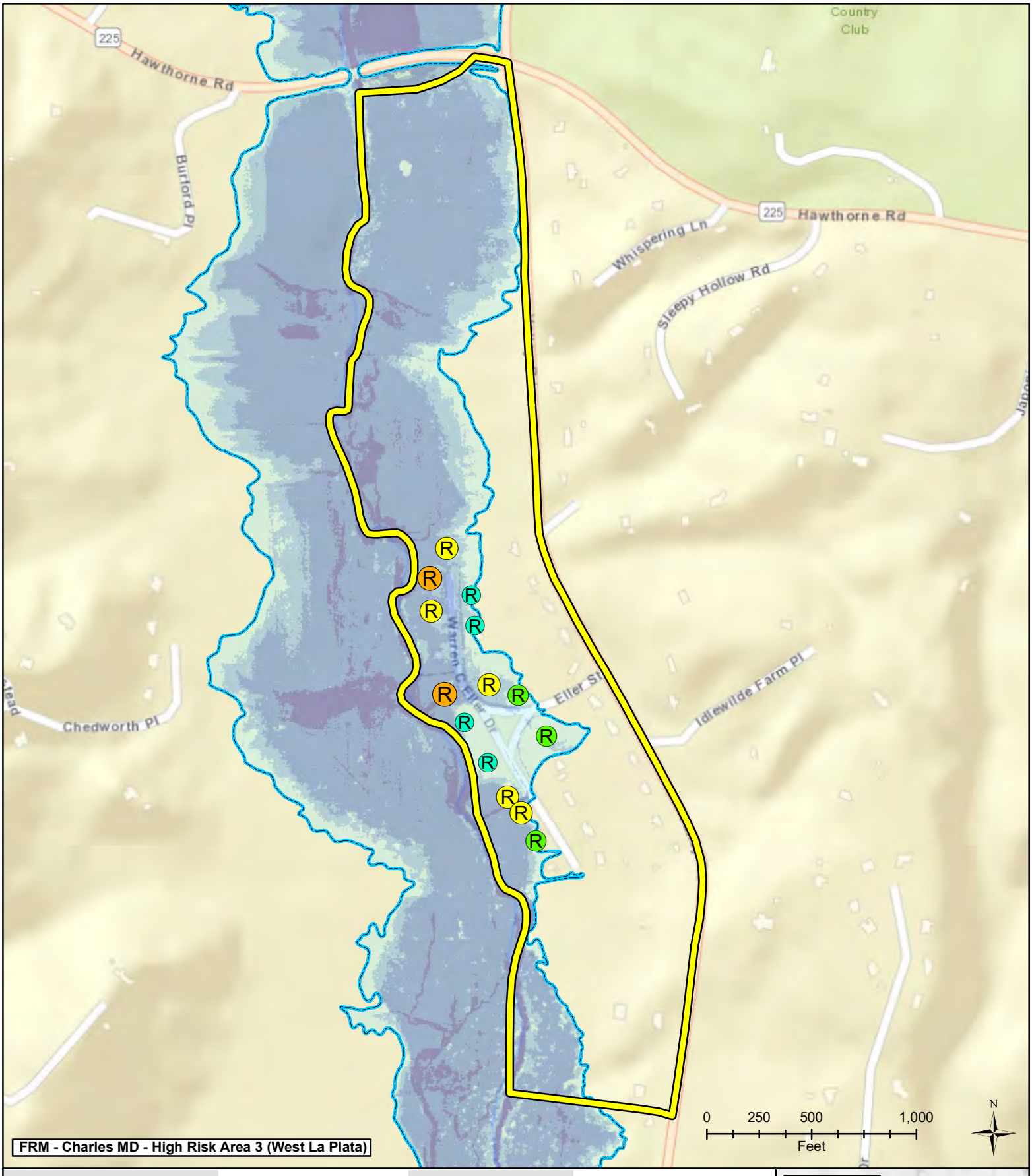
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More

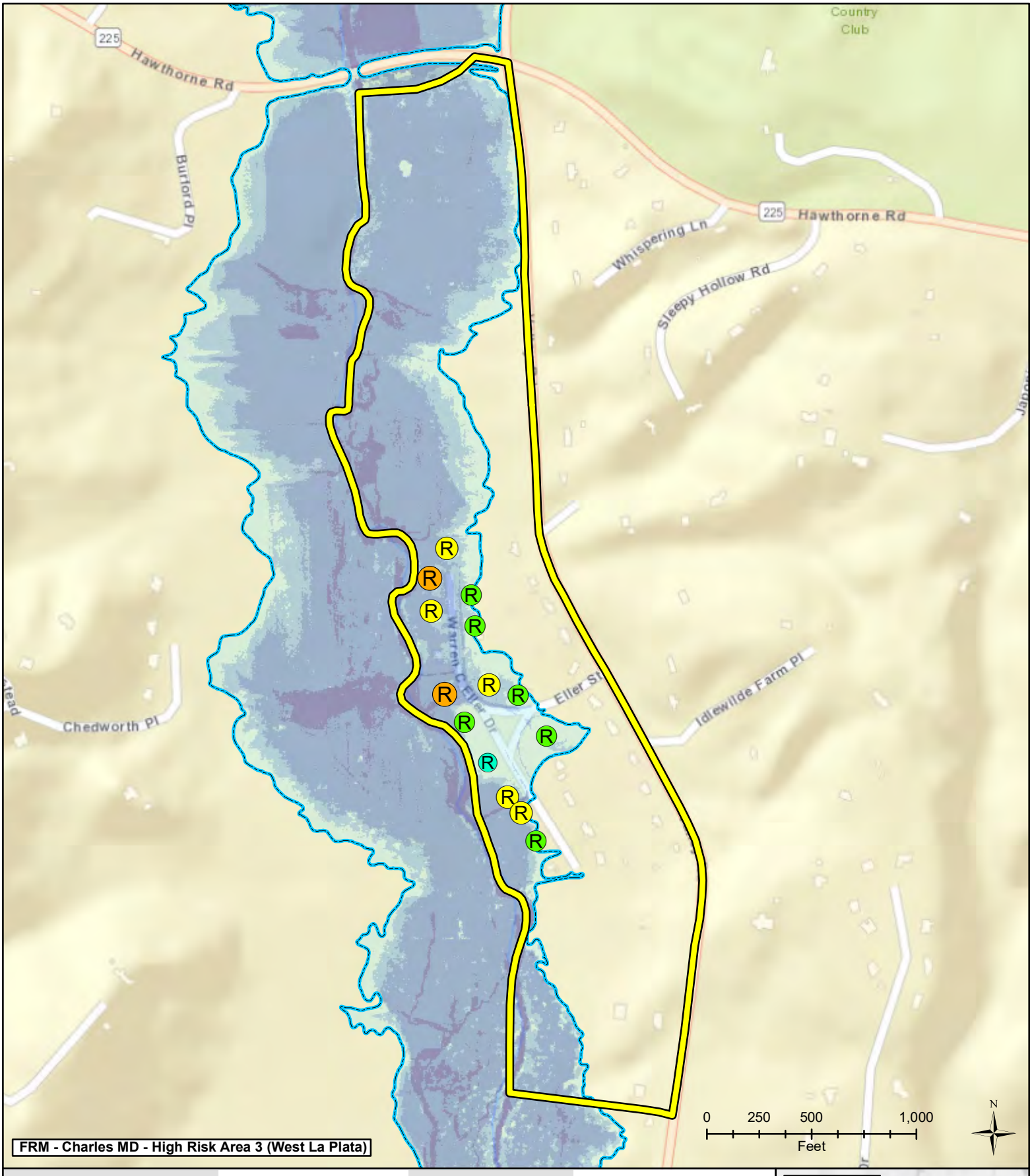
Map Extent

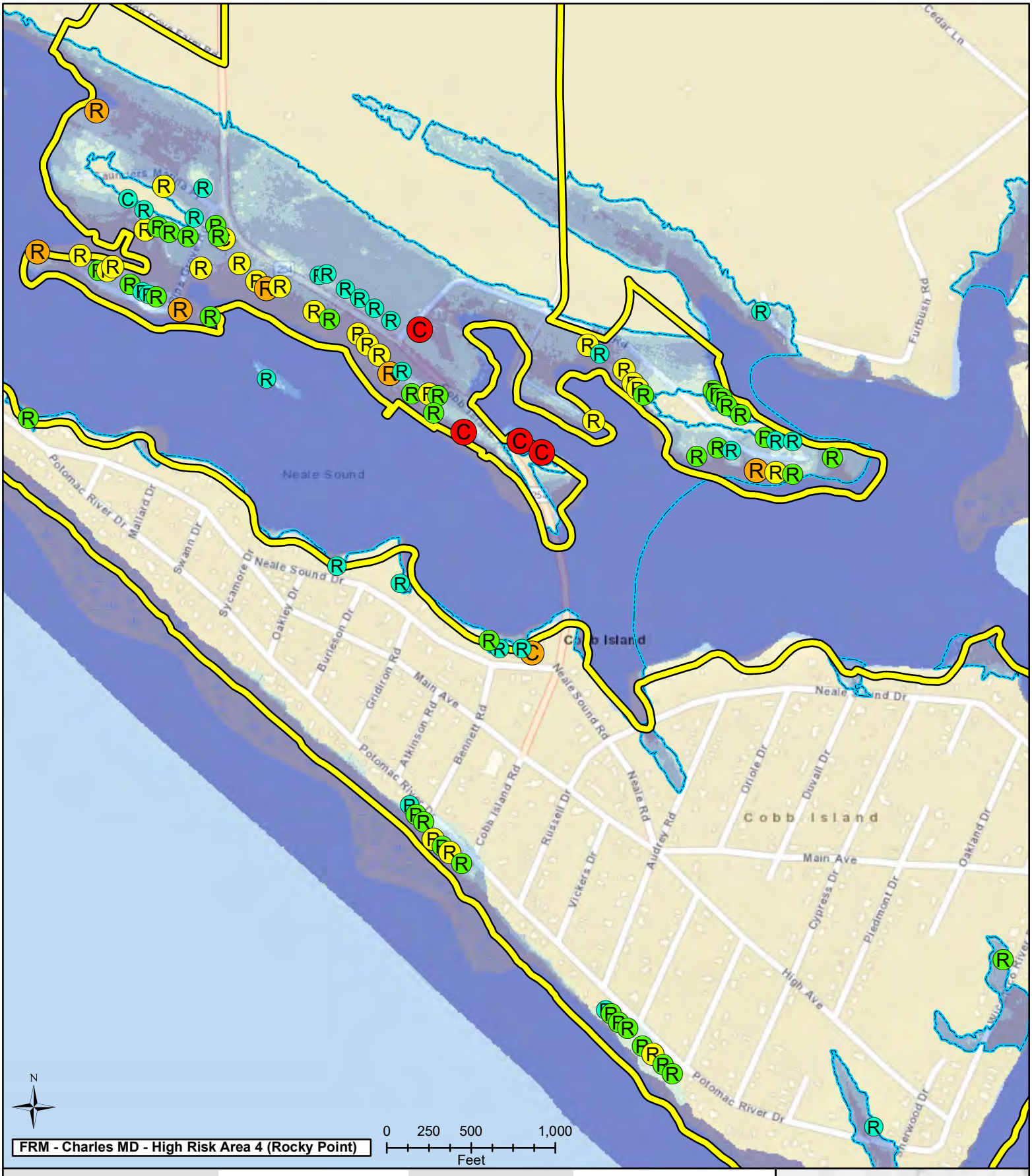


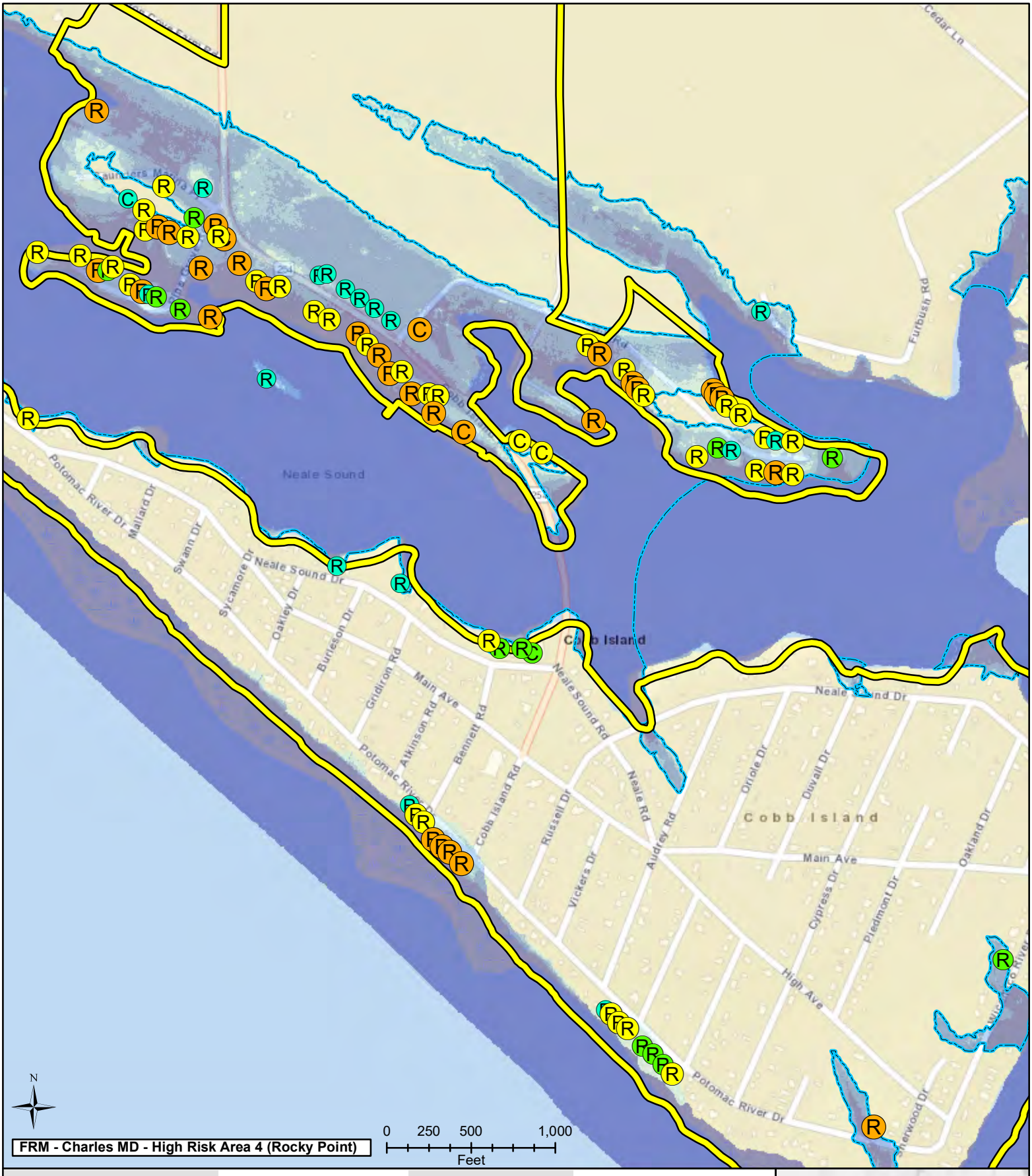

Port Tobacco Riviera
Port Tobacco Rd
Vacchiano Dr
Kay Dr
Terry Dr
Ann Harbor Dr
Carol Rd
Mary Dr
Riviera Pl
Port Tobacco Creek
FRM - Charles MD - High Risk Area 2 (Port Tobacco)
0
250
500
1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Charles County

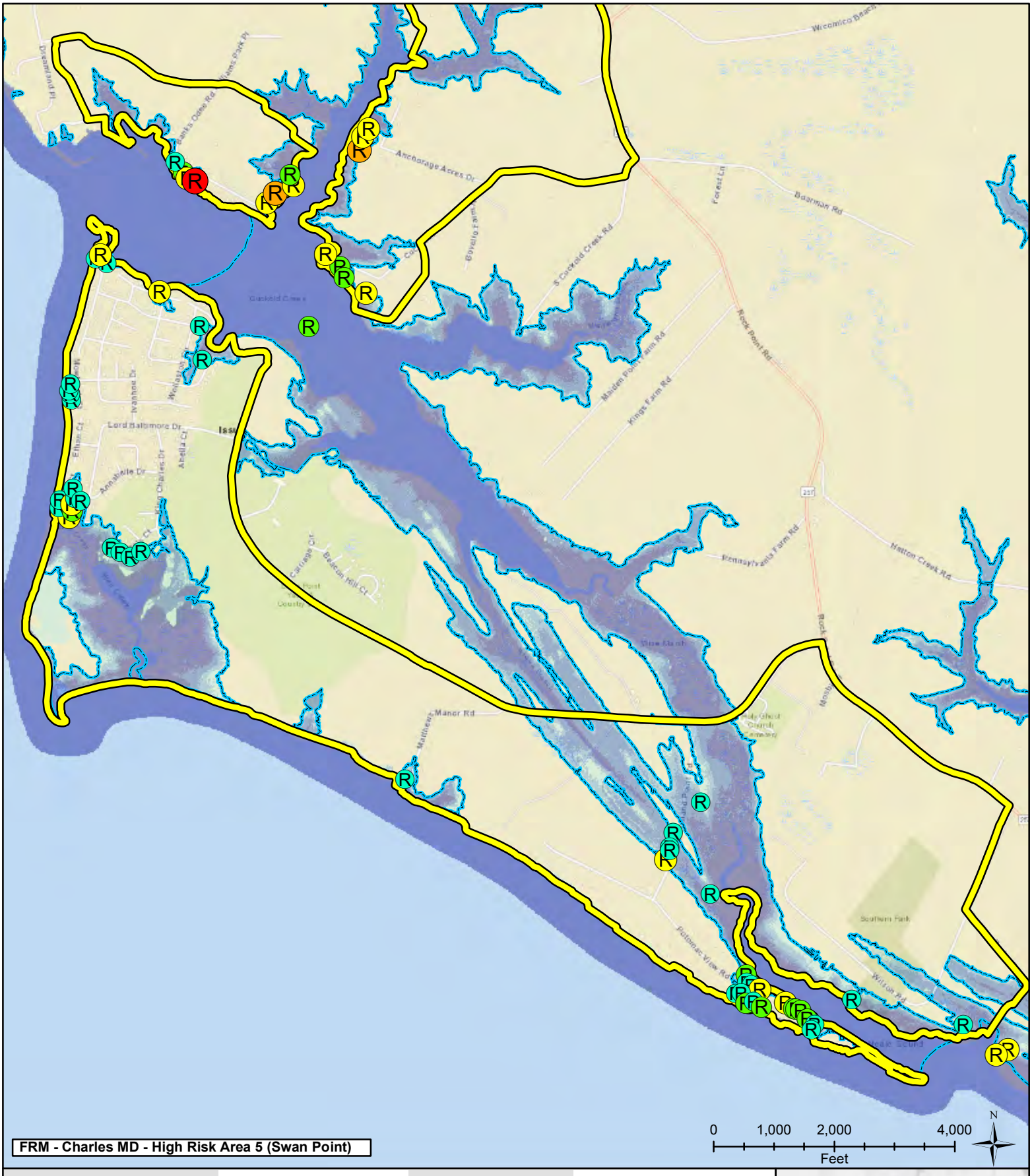

Port Tobacco Riviera
Port Tobacco Rd
Vacchiano Dr
Mary Dr
Key Dr
Terry Dr
Riviera Pl
Port Tobacco Creek
Ann Harbor Dr
Carol Rd
0
250
500
1,000
Feet
N
FRM - Charles MD - High Risk Area 2 (Port Tobacco)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Charles County


Country Club
225
Hawthorne Rd
Burford Pl
225
Hawthorne Rd
Whispering Ln
Sleepy Hollow Rd
Warren C Eller Dr
Eller St
Idlewilde Farm Pl
Chedworth Pl
FRM - Charles MD - High Risk Area 3 (West La Plata)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Charles County


Country Club
225
Hawthorne Rd
Burford Pl
Whispering Ln
225
Hawthorne Rd
Sleepy Hollow Rd
Eller St
Idlewilde Farm Pl
Chedworth Pl
0
250
500
1,000
Feet
N
FRM - Charles MD - High Risk Area 3 (West La Plata)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Charles County


Neale Sound
Cobb Island
Cobb Island
Potomac River Dr
Mallard Dr
Swann Dr
Sycamore Dr
Neale Sound Dr
Oakley Dr
Burleson Dr
Gridiron Rd
Main Ave
Atkinson Rd
Bennett Rd
Cobb Island Rd
Neale Sound Rd
Russell Dr
Vickers Dr
Audrey Rd
Neale Rd
Oriole Dr
Duvall Dr
Cypress Dr
Piedmont Dr
Oakland Dr
High Ave
Furbush Rd
Cedar Ln
N
0 250 500 1,000
Feet
FRM - Charles MD - High Risk Area 4 (Rocky Point)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Charles County
Map Extent


Neale Sound
Cobb Island
Cobb Island
Neale Sound Rd
Neale Sound Dr
Potomac River Dr
Mallard Dr
Swann Dr
Sycamore Dr
Oakley Dr
Burleson Dr
Gridiron Rd
Main Ave
Atkinson Rd
Bennett Rd
Cobb Island Rd
Russell Dr
Vickers Dr
Audrey Rd
Neale Rd
Oriole Dr
Duvall Dr
Cypress Dr
Piedmont Dr
Oakland Dr
High Ave
Furbush Rd
Cedar Ln
N
0 250 500 1,000
Feet
FRM - Charles MD - High Risk Area 4 (Rocky Point)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Charles County
Map Extent



FRM - Charles MD - High Risk Area 5 (Swan Point)

0 1,000 2,000 4,000
Feet

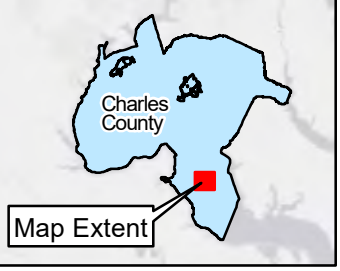
N

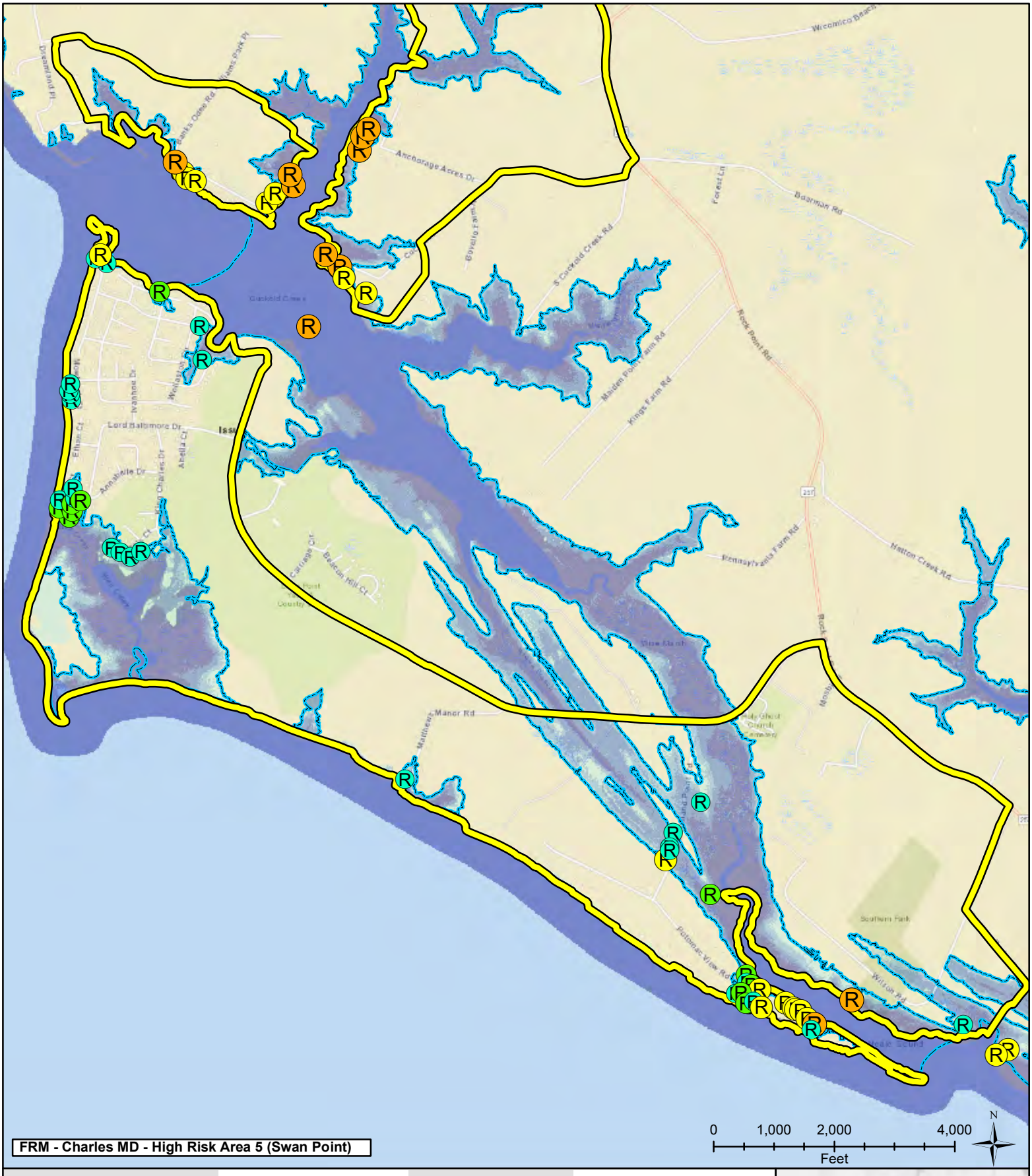
- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates
- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Charles MD - High Risk Area 5 (Swan Point)

0 1,000 2,000 4,000
Feet

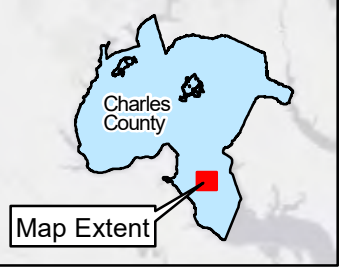
N

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More



Source: http://www.dorchestercountymd.com/planning-zoning/floodplain-information/

STATE OF MARYLAND

FLOOD RISK REPORT

DORCHESTER COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Dorchester County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Dorchester County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Dorchester County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 4

d. Related Resources 6

2 Flood Risk Analysis 11

a. Overview 11

b. Analysis of Risk 12

i. Flood Depth and Analysis Grids 12

ii. Flood Risk Assessments 13

iii. Areas of Mitigation Interest 15

3 Flood Risk Analysis Results 27

a. Dorchester County, MD Flood Risk Project Area Summary 28

i. Overview 28

ii. Flood Risk Results 28

iii. Flood Risk Maps 38

b. Communities 39

i. Dorchester County (Unincorporated Area) (CID 240001) 39

ii. City of Cambridge (CID 240003) 43

iii. Town of Church Creek (CID 240005) 46

iv. Town of Eldorado (CID 240006).....49
v. Town of Galestown (CID 240007).....52
vi. Town of Hurlock (CID 240008).....55
vii. Town of Secretary (CID 240009).....58
viii. Town of Vienna (CID 240010).....61
4 Actions To Reduce Flood Risk.....64
a. Types of Mitigation Actions.....64
i. Local Plans and Regulations.....64
ii. Structure and Infrastructure Projects.....65
iii. Natural Systems Protection Activities.....66
iv. Education and Awareness Activities.....66
b. Identifying Specific Actions for Your Community.....68
c. Mitigation Programs and Assistance.....69
i. FEMA Mitigation Programs and Assistance.....69
ii. Additional Mitigation Programs and Assistance.....70
5 Acronyms And Definitions.....71
a. Acronyms.....71
b. Definitions.....73
6 Additional Resources.....77

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Dorchester County Essential Facilities 16

Table 2: USACE National Inventory of Dams – Dorchester County, MD 18

Table 3: Flood Risk Assessment – Community Overview 28

Table 4: Dorchester County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 5: Dorchester County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 6: Dorchester County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 30

Table 7: Dorchester County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas) 32

Table 8: Dorchester County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas) 32

Table 9: Dorchester County, Maryland – State Assets Estimated Loss Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas) 33

Table 10: Dorchester County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas) 34

Table 11: Dorchester County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas) 35

Table 12: Dorchester County – Areas of Mitigation Interest 35

Table 13: Dorchester County, Maryland – High-Risk Areas 37

Table 14: Dorchester County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 40

Table 15a: Dorchester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 41

Table 15b: Dorchester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 41

Table 16: City of Cambridge – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 44

Table 17: City of Cambridge – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 44

Table 18: Town of Church Creek – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 47

Table 19: Town of Church Creek – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 47

Table 20: Town of Eldorado – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 50

Table 21: Town of Eldorado – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 50

Table 22: Town of Galestown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 53

Table 23: Town of Galestown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 53

Table 24: Town of Hurlock – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 56

Table 25: Town of Hurlock – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 56

Table 26: Town of Secretary – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 59

Table 27: Town of Secretary – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 59

Table 28: Town of Vienna – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 62

Table 29: Town of Vienna – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 62

Table 30: Mitigation Actions for Areas of Mitigation Interest 67

Table 31: FEMA Hazard Mitigation Assistance Programs 70

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Spring high tide on Wingate Bishops Head Road, Wingate
Source: WaterMovesUs.com

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Water Street, Cambridge
Source: www.chesapeakequarterly.net

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Appendix A of this FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: This washout caused the closure of Egypt Road near Cambridge after Hurricane Irene near Cambridge

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 33 and 34.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk

- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on regulatory FIRM updates and published in the FEMA National Flood Hazard Layer (NFHL), including:
    - Dorchester County Map Modernization Study – May 24, 2011
        - Restudy of all riverine flood hazards
    - Dorchester County Coastal Physical Map Revision (PMR) – March 16, 2015
        - Restudy of all coastal flood hazards
- Non-regulatory coastal flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were previously developed in conjunction with the Dorchester County Coastal PMR, effective March 16, 2015. These products were published to the FEMA Map Service Center on January 20, 2016 and have been leveraged as part of this countywide assessment.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of February 2015), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/.
  Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordinances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructed after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Dorchester County Planning and Zoning - GIS Office – https://www.dorchestercountymd.com/planning-zoning/maps-gis-data/ *(Limited Distribution; data available by purchase/ request)*
- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.
- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. *Subsection ii: Flood Risk Assessments*, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).
- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that

identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

The *2017 Dorchester County Hazard Mitigation Plan Update* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

Please note that the information in this FRR may be reviewed for inclusion during the update of the Dorchester County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.
- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.
- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the

Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

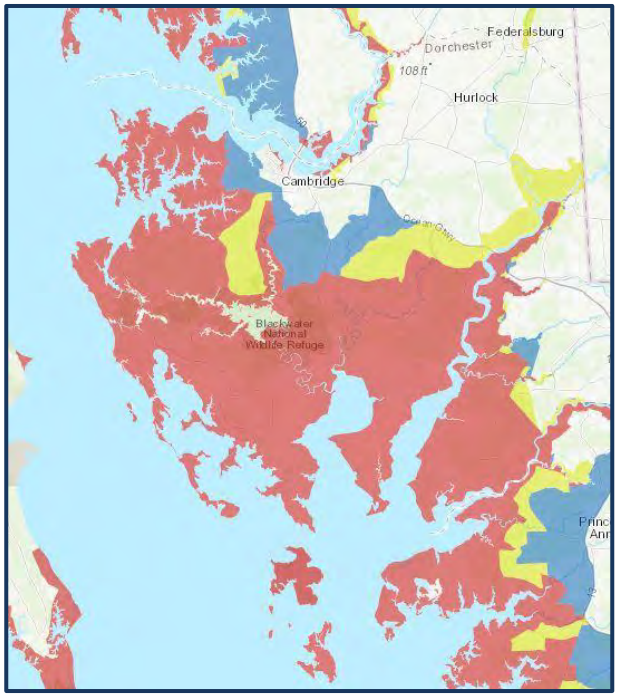
- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational p rocedures for responding to hurricane threats.

  Dorchester County participates in the "Know Your Zone" evacuation initiative as part of Maryland's Hurricane Evacuation Study. In the event that Dorchester County Department of Emergency Services issue evacuation orders, zones to be evacuated would be announced by various media outlets. Zones are designated A through C and provide

Figure 1.6



Dorchester County's Hurricane Evacuation Zone Map.

Source: www.knowyourzonemd.com

residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event.

The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk, Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Dorchester County evacuation zones can be found at www.knowyourzonemd.com.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  Since nearly 60% of the county lies in the 100-year floodplain, with most of that area being tidal floodplain and over 50% of the county's land area lies below elevation 4.9 feet above sea level, the *2008 Sea Level Rise: Technical Guidance For Dorchester County* was developed. The guidance identified four distinct planning strategies that need to be addressed when planning for the long-term implications of sea level rise. They are: Vulnerability and Impact Assessment; Long-Range and Comprehensive Planning; Codes, Regulations and Development Standards; and Public Education and Outreach.

  In addition, *Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore* was developed in January 2019 to provides local government leaders and staff with data, analyses, policy options, and implementation guidance. A *Dorchester County Coastal Flood Vulnerability Study* (https://www.eslc.org/wp-content/uploads/docs/coastal-resilience/regional-sea-level-rise-study-2019.pdf) was completed and included in the Appendix of the document. According to the study, the goal was to model the potential damage to buildings and their contents from severe periodic coastal flooding events, both today and in the future using a value for predicted sea level change.

- **Emergency Action Plans.** Emergency Action Plans (EPA) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

  Four (4) dams are located within Dorchester County, none have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Dorchester County, MD,* on page 18 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  As noted in Section 1 of this report, a previously completed *Flood Risk Report Dorchester County, Maryland Coastal Study* was developed by FEMA using Hazus Version 2.2 and released on January 20, 2016. This report provides coastal flood risk information, such as estimated coastal flood losses for the 1-percent-annual-chance flood event which have been leveraged for this countywide flood risk assessment. The Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Shorters Wharf
Source: Bay Journal
Bottom Photo: Hoopers Island as Hurricane Joaquin inches closer.
Source: MyEasternShoreMD.com

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

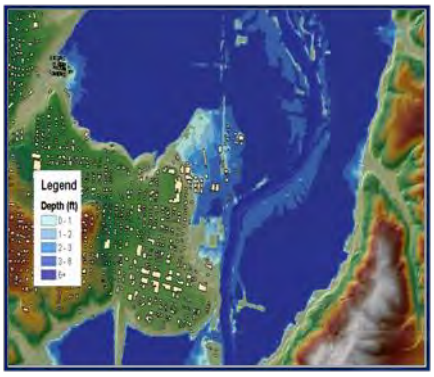
State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood depth

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

is a function of the difference between the calculated water surface elevation (including overland wave propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and regulatory FIRM updates for each study type were separately performed.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income,

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

rental income, wage, and direct output losses, as well as relocation costs.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 60 essential facilities located within Dorchester County with a total estimated building value of $212,432,000.

Figure 2.4

An essential facility, Madison Volunteer Fire Company, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: 2017 Dorchester County Hazard Mitigation Plan Update

Table 1: Dorchester County Essential Facilities

Facility Type	Number of Structure	Estimated Building Value
Emergency Operations Center (EOC)	1	$12,351,000
Fire/Rescue Stations	19	$14,844,000
Hospital & Medical Clinics	20	$61,892,000
Police Stations	2	$5,190,000
Schools (K-12 & Colleges)	18	$118,155,000
Total	**60**	**$212,432,000**

Source: 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

  High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  A total of 6 high risk areas were identified within Dorchester County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

  A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Galestown Millpond Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

  Figure 2.5

  Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

  Photo: Galestown Millpond Dam
  Source: YouTube: TweechizDrone
  Published on July 28, 2015
  https://www.youtube.com/watch?v=z7vwA3aE7B8

  While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

  According to the USACE National Inventory of Dams, four (4) dams are located in Dorchester County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Dorchester County, MD

Name	Owner Type	Purpose	River	Emergency Action Plan (EAP)
Cabin Creek Mill Dam	Private	Recreation	Cabin Creek	No
Hurlock Oxidation Ponds	Local Government	-	Offstream-Wrights Branch	No
Mill Creek Dam	Private	Recreation	Mill Creek	No
Galestown Millpond (Galestown-Reliance Road)	Local Government	Recreation	Gales Creek	No

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

that damaged several homes and vehicles.

  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.

- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

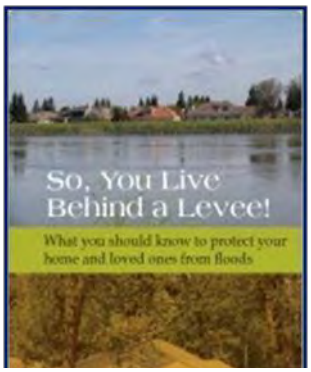


Figure 2.7

For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees

anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

Acccording to US Army Corps of Engineers, National Levee Database, there are no levees located within Dorchester County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses.

Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

- **Reasons coastal structures are considered AoMIs:**
  - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
  - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
  - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

- **Reasons stream flow constrictions are considered AoMIs:**
  - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.

- These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
- If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
- Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Figure 2.8

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of June 30, 2016, a total of forty-six (46) FEMA Designated Repetitive Loss Properties were within Dorchester County; 44 residential and 2 commercial structures. Eighteen (18) of the properties are located within the City of Cambridge while the remaining twenty-eight (28) properties are located within the unincorporated portions of Dorchester County. There are no Severe Repetitive Loss (SRL) properties within Dorchester County.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.

- Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
- Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.9

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
  - Open areas can allow wave energy to increase while densely developed areas and dense vegetation cover often obstruct waves. These

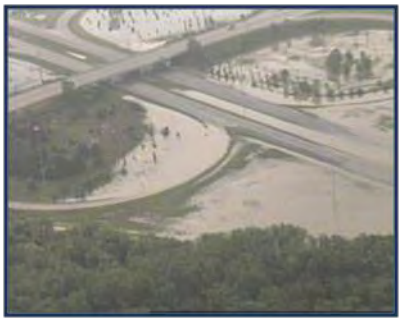
obstructions diminish the wave's potentially destructive forces in areas inland of the obstructions.

- Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

Figure 2.10



When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

- **Reasons overtopped roads are considered AoMIs:**
  - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
  - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

The *2017 Dorchester County Hazard Mitigation Plan Update* provided a listing of repetitive flood locations identified by the Hazard Mitigation Planning Committee. The listing of repetitive flooding issues is within Chapter 13 Mitigation Actions on Table 52 of the Plan Update. A total of 29 repetitive flood locations were identifed in the unincorporated areas of the County and municipalities.

- **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
  - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
  - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 32.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone

- Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
- Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
- Landslides and mudslides are a result of erosion
- Approximately one-third of the nation's streams experience severe erosion problems
- Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
- Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Dorchester County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Dorchester County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Dorchester County (Unincorporated Areas)	240026	16,612	964.99	Y	06	Y
City of Cambridge	240098	12,326	12.95	Y	N/A	Y
Town of Church Creek	240101	125	0.34	Y	N/A	Y
Town of Eldorado	240105	59	0.08	Y	N/A	Y
Town of Galestown	240106	138	0.26	Y	N/A	Y
Town of Hurlock	240112	2,092	2.89	Y	N/A	Y
Town of Secretary	240123	535	0.29	Y	N/A	Y
Town of Vienna	240127	271	0.76	Y	N/A	Y

Note: The Towns of Brookview and East New Market are not included in this report since they have no UDFs within the regulatory 1-percent-annual-chance Special Flood Hazard Areas (SFHAs). Additionally, Federalsburg (a multi-county community located in both Caroline and Dorchester Counties) has no UDFs or identified flood losses within Dorchester County and is therefore not included in this report. Flood risk analysis for Federalsburg is included in the Caroline County Flood Risk Project.

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Dorchester County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that countywide summary results represent totals for both coastal and riverine flooding. Separate information for coastal and riverine flood losses are presented, where applicable, for individual communities under Section 3, Subsection b.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 4: Dorchester County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Dorchester County (Unincorporated Areas)	16,612	2,274	$34,000,000	$2,047	92%
Town of Brookview	60	0	$0	$0	0%
City of Cambridge	12,326	126	$2,650,000	$215	7%
Town of Church Creek	125	7	$60,000	$480	< 1%
Town of East New Market	400	0	$0	$0	0%
Town of Eldorado	59	5	$20,000	$339	< 1%
Town of Galestown	138	2	$10,000	$72	< 1%
Town of Hurlock	2,092	4	$40,000	$19	< 1%
Town of Secretary	535	18	$90,000	$168	< 1%
Town of Vienna	271	4	$240,000	$886	< 1%
Total	**32,618**	**2,440**	**$37,110,000**	**$1,138**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Dorchester County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	2308	$441,100,000	91%	$30,000,000	7.0%
Commercial Building & Contents	57	$15,300,000	3%	$1,700,000	11.0%
Other Building & Contents	75	$27,900,000	6%	$4,100,000	15.0%
Total Building & Contents[3]	2440	$484,300,000	100%	$35,800,000	7.0%
Business Disruption[4]	N/A	N/A	N/A	$1,300,000	N/A
TOTAL[5]	**2440**	**$484,300,000**	**100%**	**$37,100,000**	**8.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Dorchester County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	617	25%	$239,200,000	$400,000	$20,000	$0	0%
1 - 10%	440	18%	$80,900,000	$200,000	$5,100,000	$10,000	14%
10 - 20%	806	33%	$107,400,000	$100,000	$14,600,000	$20,000	41%
20 - 30%	446	18%	$44,000,000	$100,000	$11,000,000	$20,000	31%
30 - 40%	59	2%	$6,500,000	$100,000	$2,100,000	$40,000	6%
40 - 50%	34	1%	$4,600,000	$100,000	$2,000,000	$60,000	6%
50% or More	38	2%	$1,700,000	$40,000	$1,000,000	$30,000	3%
TOTAL	**2440**	**100%**	**$484,300,000**	**$200,000**	**$35,820,000**	**$10,000**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Dorchester County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood

loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Dorchester County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 7. The list of essential facilities impacted by the 1-percent-annual-chance flood event is listed on page 35.

Table 7: Dorchester County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas)

Type	Estimated Building Value	Total Essential Facilities	1% (100-yr) Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$12,351,000	1	$0	0
Fire Station	$14,844,000	19	$55,552	6
Hospital	$61,892,000	20	$0	0
Police Station	$5,190,000	2	$0	0
School	$118,155,000	18	$0	0
TOTAL	**$212,432,000**	**60**	**$55,552**	**6**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Table 8: Dorchester County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss % of Total	Total Content Loss	Content Loss % of Total
Fire Station	$206,764	$55,552	27%	$151,212	73%
TOTAL	**$206,764**	**$55,552**	**N/A**	**$151,212**	**N/A**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Dorchester County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;

- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Dorchester County contains 174 state assets. Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 9.

Table 9: Dorchester County, Maryland – State Assets Estimated Loss Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss % of Total	Total Content Loss	Content Loss % of Total
MD Institute for Emergency Medical Services – Communications Engineering Services Facility	$2,604,000	$1,041,600	40%	$1,562,400	60%
Transportation Facility	$20,000	$10,000	50%	$10,000	50%
TOTAL	**$2,624,000**	**$1,051,600**	**N/A**	**$1,572,400**	**N/A**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

Debris Generation

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module

will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
    - The model estimates that a total of 7,828 tons of debris will be generated. Of the total amount, Finishes comprises 77% of the total, Structure comprises 9% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 313 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 10: Dorchester County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	5,992	77%	240
Structure	677	9%	27
Foundation	1,159	14%	46
TOTAL	**7,828**	**100%**	**313**

Source: Hazus 3.1: Flood Modual – Dorchester County Study Area/ General Building Stock

Projected Shelter Needs

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**

  - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 1,112 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 1,737 people (out of a total population of 32,618) will seek temporary shelter in public shelters.

Table 11: Dorchester County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Riverine and Coastal Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	1,112	3,336	1,737

Source: Hazus 3.1: Flood Modual – Dorchester County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 12: Dorchester County – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	6	Depth grids, Emergency Management Dept.
At-Risk State Assets	5	Dept grids, MEMA
High-Risk Areas	6	Depth grids, UDFs, Loss estimates
Repetitive Flood Issues	29	Local public works – Roads Division
Repetitive Loss Properties	58	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database.

- **At-Risk Essential Facilities:**

  Results from the 1-percent-annual-chance flood event analysis indicate six (6) essential facility are at-risk. These facilities include six (6) fire/rescue stations. Two (2) facilities, Hoopers Island Volunteer Fire Company and Lakes and Straits Fire Company, were determined to a have a flood depth

exceeding 2.5 feet of water. Flood depths for each facility is provided below along with the identified facilities.

- Taylors Island Volunteer Fire Company, Taylors Island – 1.1'
- Hoopers Island Volunteer Fire Company, Fishing Creek – 3.3'
- Lloyds Volunteer Fire Department, Cambridge – 1.2'
- Madison Volunteer Fire Company, Madison – 0.8'
- Station 500, Madison – 0.5'
- Lakes and Straits Fire Company, Wingate – 2.6'

A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

- **At-Risk State Assets:**

  Results from the 1-percent-annual-chance flood event analysis indicate five (5) state assets are at-risk. These facilities include four (4) MD Institute for Emergency Medical Services (MIEMSS) – Communications Engineering Services facilities that are leased for communication infrastructure and one (1) Transportation Facility.

  MIEMSS Communications Engineering Services work in a partnership arrangement with State and local jurisdictions to provide infrastructure that supports a public safety 700 MHz communications network. The microwave system provides point-to-point links between all of the usable existing and newly constructed communications towers. Connectivity to the county 9-1-1 Public Safety Answering Point (PSAP) centers is included. Monitoring of the network is primarily done by MIEMSS with access to the management system available to the county and state maintenance personnel.

  Flood depths for each facility is provided below along with the identified facilities.

  - MD Institute for Emergency Medical Services – Communications Engineering Services Facilities
    - Taylors Island Volunteer Fire Company, Taylors Island – 1.1'
    - Hoopers Island Volunteer Fire Company, Fishing Creek – 3.3'
    - Madison Volunteer Fire Company, Madison – 0.8'
    - Lakes and Straits Fire Company, Wingate – 2.6'

- Transportation Facility
  - Market Street Drawbridge – 5.0' (facility is elevated above water surface elevation)

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 13: Dorchester County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Hoopers Island	372	24	373	$7,015,801	19%
Area 2	Cambridge	457	20	116	$2,927,238	8%
Area 3	Neck District	973	175	448	$6,743,388	18%
Area 4	Bishops Head	364	64	343	$4,788,182	13%
Area 5	Town Point Neck	175	21	110	$1,615,177	4%
Area 6	Madison/Church Creek	796	69	345	$3,939,445	11%
Total for High-Risk Areas		**3,137**	**373**	**1,735**	**$27,029,231**	**73%**

- **Repetitive Flood Issues**

  Reviewing the repetitive flooded roadways locations and issues identified in Table 52 of the *2017 Dorchester County Hazard Mitigation Plan Update* several repetitive flood locations were found to be within high risk areas listed in Table 13 of this report. However, because the spatial extents of locations in Table 52 of the *2017 Dorchester County Hazard Mitigation Plan Update* are not fully defined, frequently flooded roadways are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of 58 FEMA Designated Repetitive Loss Properties have been identified in the unincorporated portions of Dorchester County and the City of Cambridge. According to the 2017 Plan, repetitive flooding occurs between the communities of Toddville and Crocheron due to road elevation issues. Several repetitive loss properties are also located in this vicinity and was designated as part of the repetitive loss area. Another area containing several critical and public facilities as well as repetitive loss properties and has been identified for repetitive flooding is the area between communities Honga and Hoopersville. Tidal flooding affects roadways in this area, which is concerning since these roadways are evacuation routes. Due to sensitivity of public disclosure for flood insurance claims, Repetitive and Severe Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

iii. Flood Risk Maps

The Flood Risk Maps for Dorchester County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Dorchester County (Unincorporated Areas) Summary (CID 240026)

The following pages include Flood Risk data for the Dorchester County (Unincorporated Areas).

Overview

The Dorchester County (Unincorporated Areas) is located is southeastern Maryland and consists of 964.99 square miles. It is bordered by Talbot and Caroline Counties to the north, the Chesapeake Bay to the west, Somerset County to the south, Wicomico County to the southeast, and the State of Delaware to the east.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Dorchester County (Unincorporated Areas)	240026	16,612	964.99	Y	06	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1,269 policies totaling approximately $311,778,400.00
- NFIP-recognized repetitive loss properties = 46
- NFIP-recognized severe repetitive loss properties = 1

Data provided below only includes areas in the Dorchester County (Unincorporated Areas) that are located within the Dorchester County, Maryland Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Dorchester County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 14. Additionally, Tables 15a and 15b (for riverine and coastal areas, respectively) show the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 14: Dorchester County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	2161	$410,600,000	93%	$28,300,000	7.0%
Riverine	4	$1,400,000	100%	$10,000	0.7%
Coastal	2157	$409,200,000	93%	$28,300,000	7.0%
Commercial Building & Contents	46	$11,600,000	3%	$1,000,000	9.0%
Riverine	0	$0	0%	$0	0.0%
Coastal	46	$11,600,000	3%	$1,000,000	9.0%
Other Building & Contents	67	$21,200,000	5%	$3,500,000	17.0%
Riverine	0	$0	0%	$0	0.0%
Coastal	67	$21,200,000	5%	$3,500,000	17.0%
Total Building & Contents[3]	2274	$443,400,000	100%	$32,800,000	7.0%
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	$0	N/A
Business Disruption[4] *(Coastal)*				$1,200,000	
TOTAL[5]	**2274**	**$443,400,000**	**100%**	**$34,000,000**	**8.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 15a: Dorchester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	50%	$1,100,000	$600,000	$0	$0	0%
1 - 10%	2	50%	$200,000	$100,000	$10,000	$10,000	100%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**4**	**100%**	**$1,300,000**	**$300,000**	**$10,000**	**$0**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 15b: Dorchester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	563	25%	$220,000,000	$400,000	$20,000	$0	0%
1 - 10%	391	17%	$72,100,000	$200,000	$4,500,000	$10,000	14%
10 - 20%	758	33%	$97,300,000	$100,000	$13,300,000	$20,000	41%
20 - 30%	430	19%	$40,600,000	$90,000	$10,200,000	$20,000	31%
30 - 40%	58	3%	$5,900,000	$100,000	$1,900,000	$30,000	6%
40 - 50%	32	1%	$4,300,000	$100,000	$1,800,000	$60,000	6%
50% or More	38	2%	$1,700,000	$40,000	$1,000,000	$30,000	3%
TOTAL	**2270**	**100%**	**$441,900,000**	**$200,000**	**$32,720,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within Dorchester County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature

class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. City of Cambridge Summary (CID 240098)

The following pages include Flood Risk data for the City of Cambridge.

Overview

The City of Cambridge is in northcentral Dorchester County. It consists of 12.95 square miles along US Highway 50. The primary flooding sources in the city are Little Blackwater Creek, Little Maple Dam Branch, and Choptank River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
City of Cambridge	240098	12,326	12.95	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 184 policies totaling approximately $44,174,900.00
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the City of Cambridge that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The City of Cambridge flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Cambridge, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: City of Cambridge – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	115	$25,900,000	73%	$1,500,000	6.0%
Commercial Building & Contents	7	$3,200,000	9%	$700,000	22.0%
Other Building & Contents	4	$6,200,000	18%	$400,000	6.0%
Total Building & Contents[3]	126	$35,300,000	100%	$2,600,000	7.0%
Business Disruption[4]	N/A	N/A	N/A	$50,000	N/A
TOTAL[5]	**126**	**$35,300,000**	**100%**	**$2,650,000**	**8.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: City of Cambridge – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	38	30%	$15,200,000	$400,000	$0	$0	0%
1 - 10%	35	28%	$6,900,000	$200,000	$500,000	$10,000	19%
10 - 20%	39	31%	$9,500,000	$200,000	$1,300,000	$30,000	48%
20 - 30%	13	10%	$3,100,000	$200,000	$700,000	$50,000	26%
30 - 40%	1	1%	$600,000	$600,000	$200,000	$200,000	7%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**126**	**100%**	**$35,300,000**	**$300,000**	**$2,700,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the City of Cambridge.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Church Creek Summary (CID 240101)

The following pages include Flood Risk data for the Town of Church Creek.

Overview

The Town of Church Creek is in northwestern Dorchester County. It consists of 0.34 square miles along State Highway 16. The primary flooding source in the town is Church Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Church Creek	240101	125	0.34	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 8 policies totaling approximately $2,100,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Church Creek that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Church Creek flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Church Creek, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 20. Additionally, Table 21 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 18: Town of Church Creek – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	6	$1,000,000	93%	$60,000	6.0%
Commercial Building & Contents	1	$80,000	7%	$0	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	7	$1,080,000	100%	$60,000	6.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**7**	**$1,080,000**	**100%**	**$60,000**	**6.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Church Creek – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	14%	$80,000	$80,000	$0	$0	0%
1 - 10%	6	86%	$1,000,000	$200,000	$60,000	$10,000	100%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**7**	**100%**	**$1,080,000**	**$200,000**	**$60,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Church Creek.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. Town of Eldorado Summary (CID 240105)

The following pages include Flood Risk data for the Town of Eldorado.

Overview

The Town of Eldorado is in northeastern Dorchester County. It consists of 0.08 square miles along State Highway 14. The primary flooding sources in the town are Mill Branch and Marshy Hope Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Eldorado	240105	59	0.08	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 9 policies totaling approximately $1,766,300.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Eldorado that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Eldorado flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Eldorado, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 22. Additionally, Table 23 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 20: Town of Eldorado – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	5	$400,000	100%	$20,000	5.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	5	$400,000	100%	$20,000	5.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**5**	**$400,000**	**100%**	**$20,000**	**5.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 21: Town of Eldorado – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	20%	$200,000	$200,000	$0	$0	0%
1 - 10%	3	60%	$200,000	$70,000	$10,000	$0	100%
10 - 20%	1	20%	$40,000	$40,000	<$5,000	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**5**	**100%**	**$440,000**	**$90,000**	**$10,000**	**$0**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Eldorado.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

v. Town of Galestown Summary (CID 240106)

The following pages include Flood Risk data for the Town of Galestown.

Overview

The Town of Galestown is in northeastern Dorchester County. It consists of 0.26 square miles near State Highway 313. The primary flooding sources in the town are Gale Creek and Nanticoke River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Galestown	240106	138	0.26	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1 policies totaling approximately $105,600.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Galestown that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Galestown flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 24. Additionally, Table 25 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 22: Town of Galestown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	1 *(Riverine)*	$80,000	89%	$10,000	13.0%
Commercial Building & Contents	1 *(Coastal)*	$10,000	11%	< $5,000	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	2	$90,000	100%	$10,000	11.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**2**	**$90,000**	**100%**	**$10,000**	**11.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 23: Town of Galestown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	1	50%	$80,000	$80,000	$10,000	$10,000	100%
10 - 20%	1	50%	$10,000	$10,000	< $5,000	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**2**	**100%**	**$90,000**	**$50,000**	**$10,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Galestown.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

vi. Town of Hurlock Summary (CID 240112)

The following pages include Flood Risk data for the Town of Hurlock.

Overview

The Town of Hurlock is in northeastern Dorchester County. It consists of 2.89 square miles along State Highway 392. The primary flooding source in the town is Wrights Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Hurlock	240112	2,092	2.89	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 10 policies totaling approximately $2,512,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Hurlock that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Hurlock flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no coastal flood losses are identified in Hurlock, so only riverine flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 26. Additionally, Table 27 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 24: Town of Hurlock – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	2	$100,000	20%	$20,000	20.0%
Commercial Building & Contents	2	$400,000	80%	$10,000	3.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	4	$500,000	100%	$30,000	6.0%
Business Disruption[4]	N/A	N/A	N/A	$10,000	N/A
TOTAL[5]	**4**	**$500,000**	**100%**	**$40,000**	**8.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 25: Town of Hurlock – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	2	50%	$400,000	$200,000	$10,000	$10,000	33%
10 - 20%	2	50%	$100,000	$50,000	$20,000	$10,000	67%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**4**	**100%**	**$500,000**	**$100,000**	**$30,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Hurlock.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

vii. Town of Secretary Summary (CID 240123)

The following pages include Flood Risk data for the Town of Secretary.

Overview

The Town of Secretary is in northeastern Dorchester County. It consists of 0.29 square miles along State Highway 14. The primary flooding source in the town is Warwick River

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Secretary	240123	535	0.29	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 24 policies totaling approximately $5,054,600.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Secretary that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Secretary flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Secretary, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 28. Additionally, Table 29 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 26: Town of Secretary – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	17	$2,900,000	97%	$50,000	2.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$100,000	3%	$20,000	20.0%
Total Building & Contents[3]	18	$3,000,000	100%	$70,000	2.0%
Business Disruption[4]	N/A	N/A	N/A	$20,000	N/A
TOTAL[5]	**18**	**$3,000,000**	**100%**	**$90,000**	**3.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 27: Town of Secretary – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	12	67%	$2,600,000	$200,000	$0	$0	0%
1 - 10%	0	0%	$0	$0	$0	$0	0%
10 - 20%	4	22%	$300,000	$80,000	$40,000	$10,000	57%
20 - 30%	2	11%	$100,000	$50,000	$30,000	$20,000	43%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**18**	**100%**	**$3,000,000**	**$200,000**	**$70,000**	**$0**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Secretary.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

viii. Town of Vienna Summary (CID 24012)

The following pages include Flood Risk data for the Town of Vienna.

Overview

The Town of Vienna is in eastern Dorchester County. It consists of 0.76 square miles near US Highway 50. The primary flooding source in the town is Nanticoke River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Vienna	240127	271	0.76	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which September 4, 2022
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 4 policies totaling approximately $980,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Vienna that are located within the Dorchester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Vienna flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Vienna, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 30. Additionally, Table 31 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 28: Town of Vienna – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	1	$200,000	33%	$40,000	20.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	3	$400,000	67%	$200,000	50.0%
Total Building & Contents[3]	4	$600,000	100%	$240,000	40.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**4**	**$600,000**	**100%**	**$240,000**	**40.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 29: Town of Vienna – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	0	0%	$0	$0	$0	$0	0%
10 - 20%	1	25%	$70,000	$70,000	$10,000	$10,000	4%
20 - 30%	1	25%	$200,000	$200,000	$40,000	$40,000	16%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	2	50%	$400,000	$200,000	$200,000	$100,000	80%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**4**	**100%**	**$670,000**	**$200,000**	**$250,000**	**$60,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Vienna.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date March 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Building codes
- Participation in the NFIP Community Rating System (CRS)
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 32 below identifies possible mitigation actions for each AoMI to consider.

Table 30: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***

AoMI	Possible Actions to Reduce Flood Risk
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	• ***2017 Dorchester County Floodprone Property Purchased*** o ***1 flood-prone property acquired through tax sale***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?

- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The *2017 Dorchester County Hazard Mitigation Plan Update* - Section 3 Mitigation Strategies, Chapter 13 Mitigation Actions, is a valuable place to identify and prioritize possible mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 33 below.

Table 31: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.
FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Suite 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Dorchester County Department of Emergency Services
829 Fieldcrest Road, Cambridge, MD 21613
https://www.dorchestercountymd.com/emergency-services-main/

Dorchester County Department of Planning and Zoning
501 Court Lane, Room 111, Cambridge, MD 21613
https://www.dorchestercountymd.com/planning-zoning/

Dorchester County Department of Public Works
5435 Handley Road, Cambridge, MD 21613
https://www.dorchestercountymd.com/departments/public-works-2/

Dorchester County Department of Planning and Zoning – Maps & GIS Data
501 Court Lane, Room 111, Cambridge, MD 21613
https://www.dorchestercountymd.com/planning-zoning/maps-gis-data/

This page left blank intentionally

Source: http://www.dorchestercountymd.com/planning-zoning/floodplain-information/

STATE OF MARYLAND

FLOOD RISK REPORT

DORCHESTER COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Dorchester County, Maryland – Countywide Flood Risk Map (FRM)

Dorchester County, Maryland – High Risk Area 1: Hoopers Island North – Dollar Losses

Dorchester County, Maryland – High Risk Area 1: Hoopers Island North – Percent Losses

Dorchester County, Maryland – High Risk Area 1: Hoopers Island South – Dollar Losses

Dorchester County, Maryland – High Risk Area 1: Hoopers Island South – Percent Losses

Dorchester County, Maryland – High Risk Area 2: Cambridge – Dollar Losses

Dorchester County, Maryland – High Risk Area 2: Cambridge – Percent Losses

Dorchester County, Maryland – High Risk Area 3: Neck District – Dollar Losses

Dorchester County, Maryland – High Risk Area 3: Neck District – Percent Losses

Dorchester County, Maryland – High Risk Area 4: Bishops Head – Dollar Losses

Dorchester County, Maryland – High Risk Area 4: Bishops Head – Percent Losses

Dorchester County, Maryland – High Risk Area 5: Two Point Neck – Dollar Losses

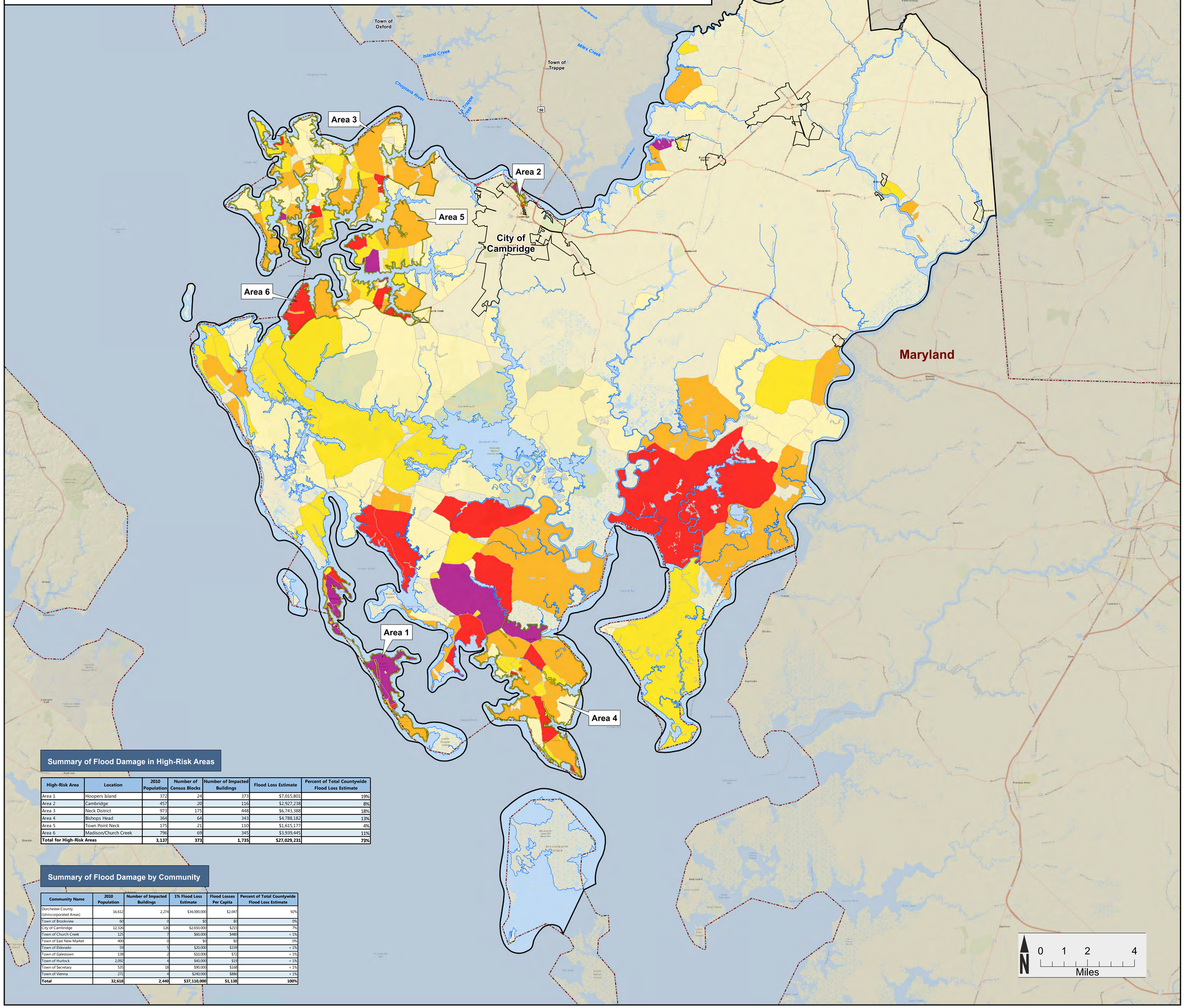
Dorchester County, Maryland – High Risk Area 5: Two Point Neck – Percent Losses

Dorchester County, Maryland – High Risk Area 6: Madison – Dollar Losses

Dorchester County, Maryland – High Risk Area 6: Madison – Percent Losses

Dorchester County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Dorchester County, Maryland

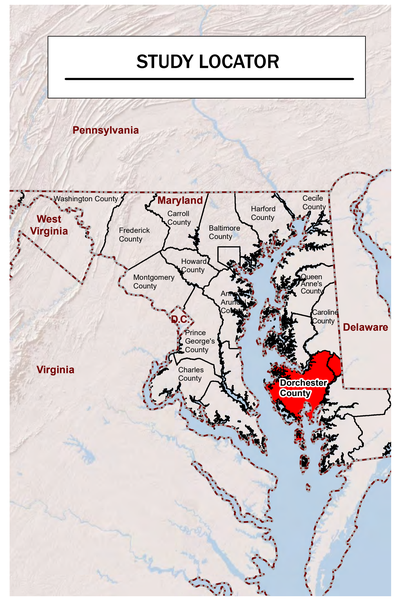


Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Hoopers Island	372	24	373	$7,015,801	19%
Area 2	Cambridge	457	20	116	$2,927,238	8%
Area 3	Neck District	973	175	448	$6,743,388	18%
Area 4	Bishops Head	364	64	343	$4,788,182	13%
Area 5	Town Point Neck	175	21	110	$1,615,177	4%
Area 6	Madison/Church Creek	796	69	345	$3,939,445	11%
Total for High-Risk Areas		**3,137**	**373**	**1,735**	**$27,029,231**	**73%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Dorchester County (Unincorporated Areas)	16,612	2,274	$34,000,000	$2,047	92%
Town of Brookview	60	0	$0	$0	0%
City of Cambridge	12,326	126	$2,650,000	$215	7%
Town of Church Creek	125	7	$60,000	$480	< 1%
Town of East New Market	400	0	$0	$0	0%
Town of Eldorado	59	5	$20,000	$339	< 1%
Town of Galestown	138	2	$10,000	$72	< 1%
Town of Hurlock	2,092	4	$40,000	$19	< 1%
Town of Secretary	535	18	$90,000	$168	< 1%
Town of Vienna	271	4	$240,000	$886	< 1%
Total	**32,618**	**2,440**	**$37,110,000**	**$1,138**	**100%**



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area* (Area 1)

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk State Asset or Essential Facility

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

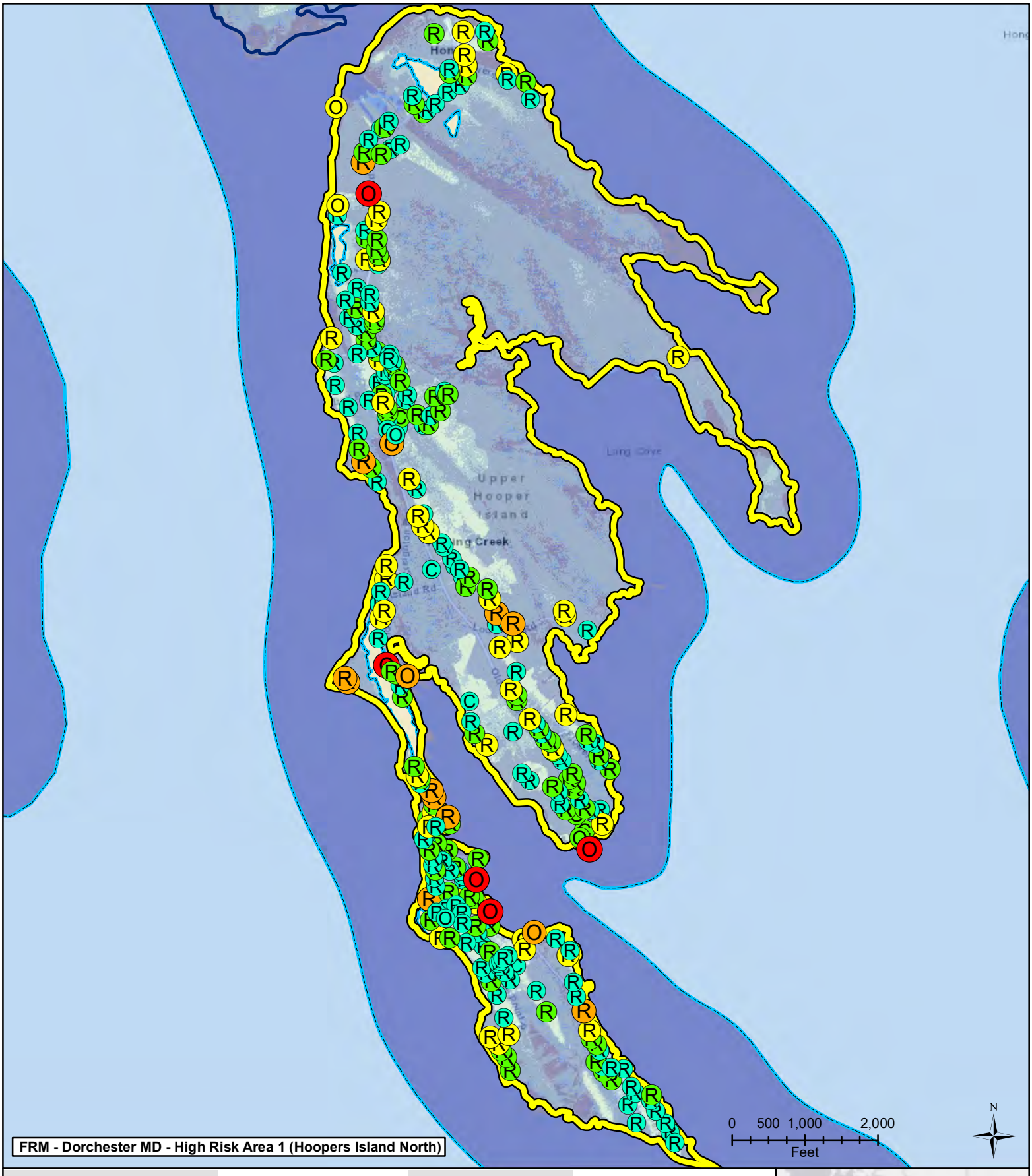
Dorchester County and Incorporated Areas, MD

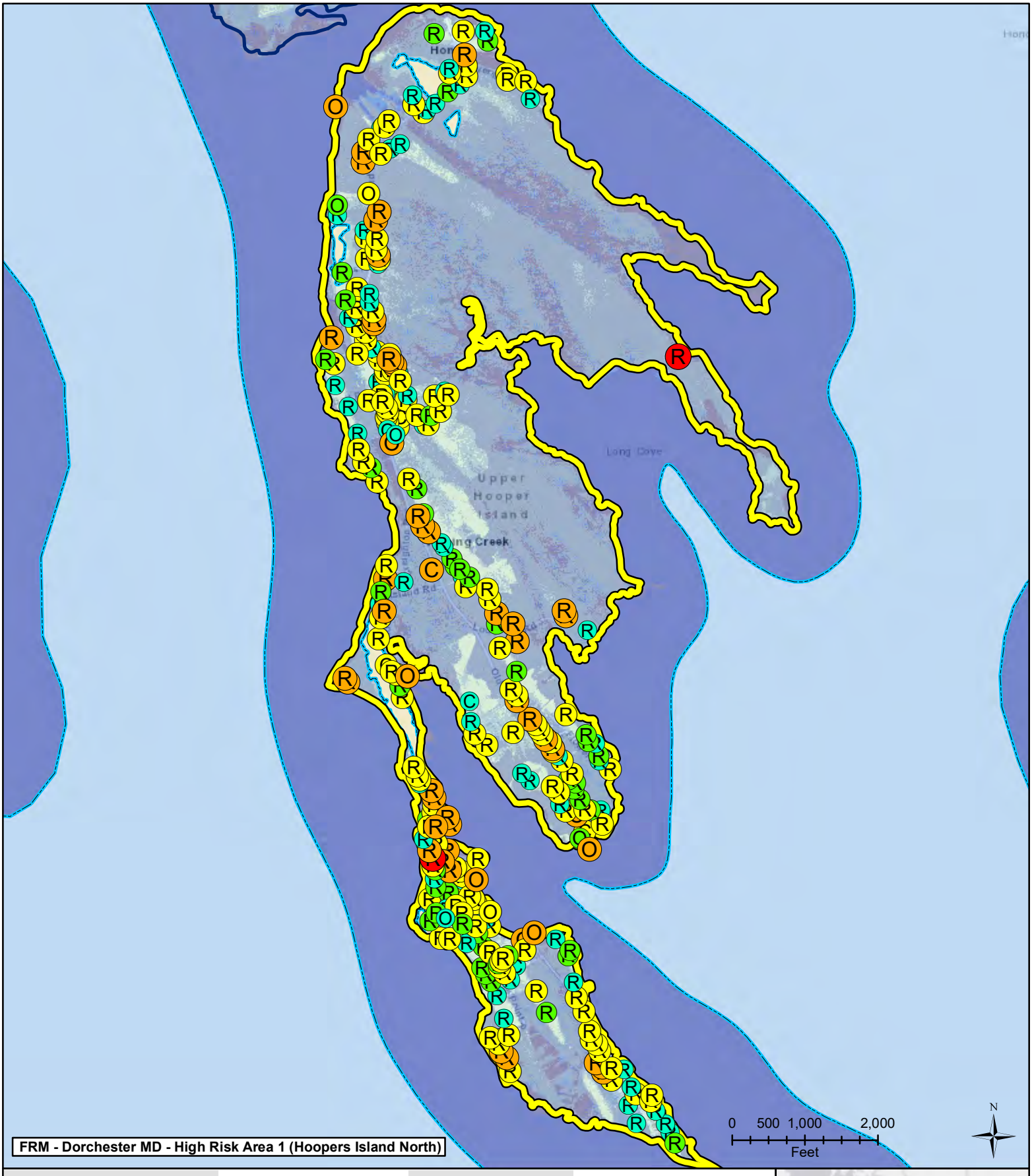
MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Dorchester County, MD.

RELEASE DATE
12/31/2019


Upper Hooper Island
Long Creek
0 500 1,000 2,000
Feet
N
FRM - Dorchester MD - High Risk Area 1 (Hoopers Island North)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Dorchester County
Map Extent



FRM - Dorchester MD - High Risk Area 1 (Hoopers Island North)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

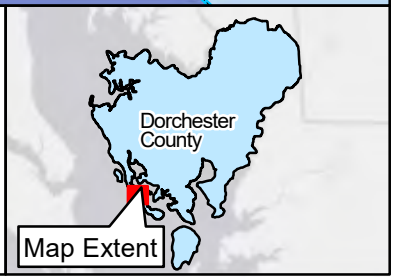
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

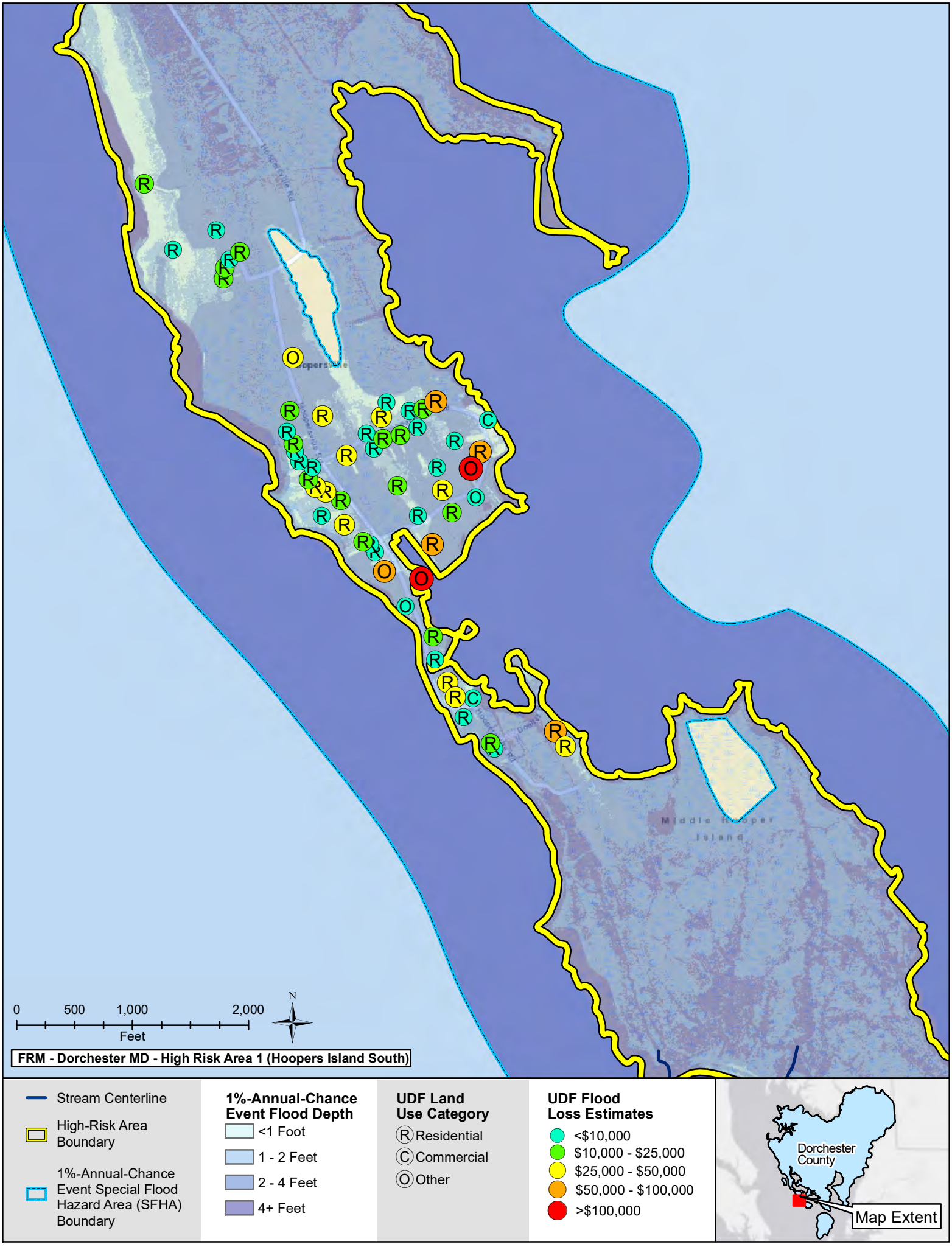
UDF Land Use Category

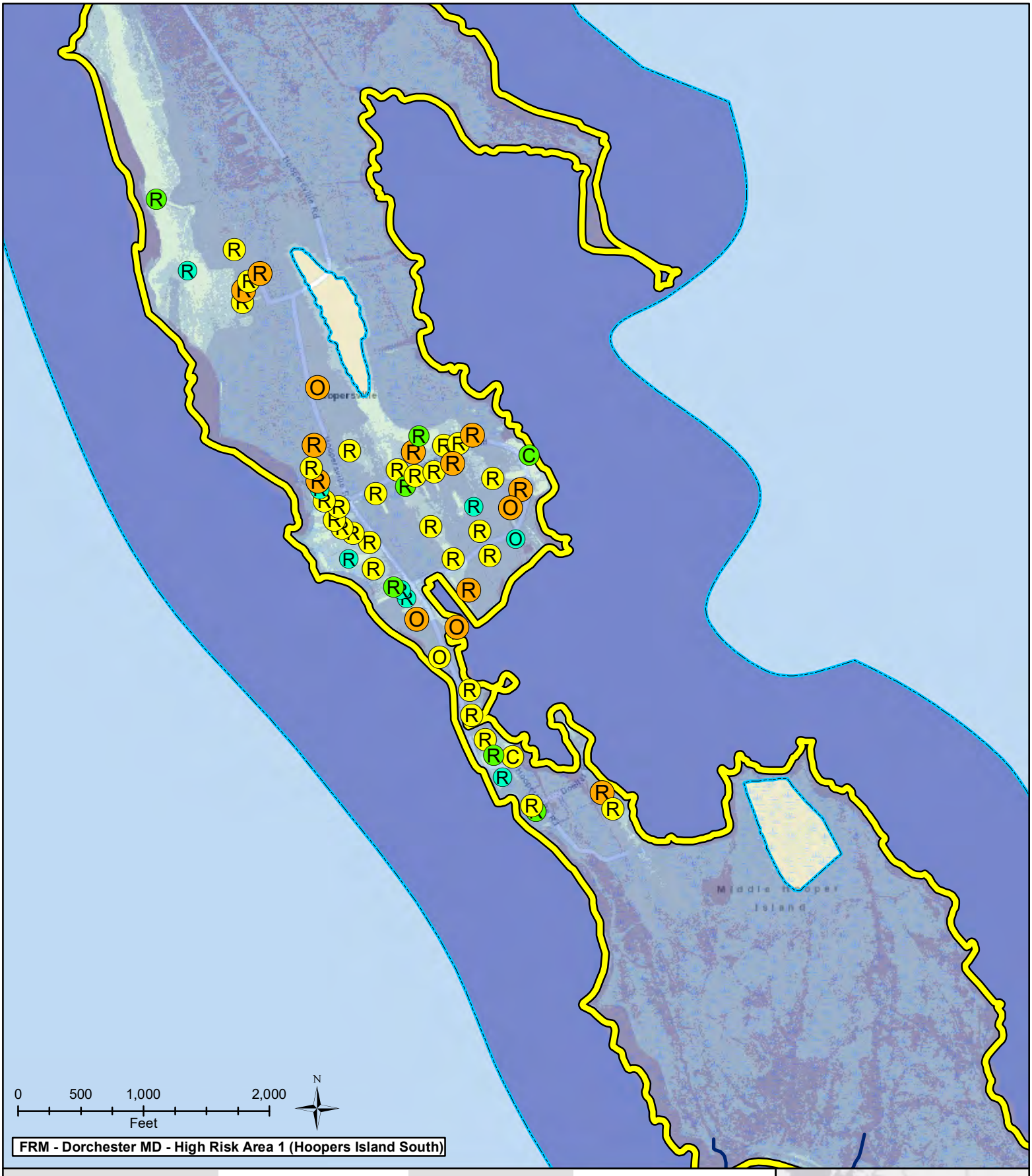
- (R) Residential
- (C) Commercial
- (O) Other

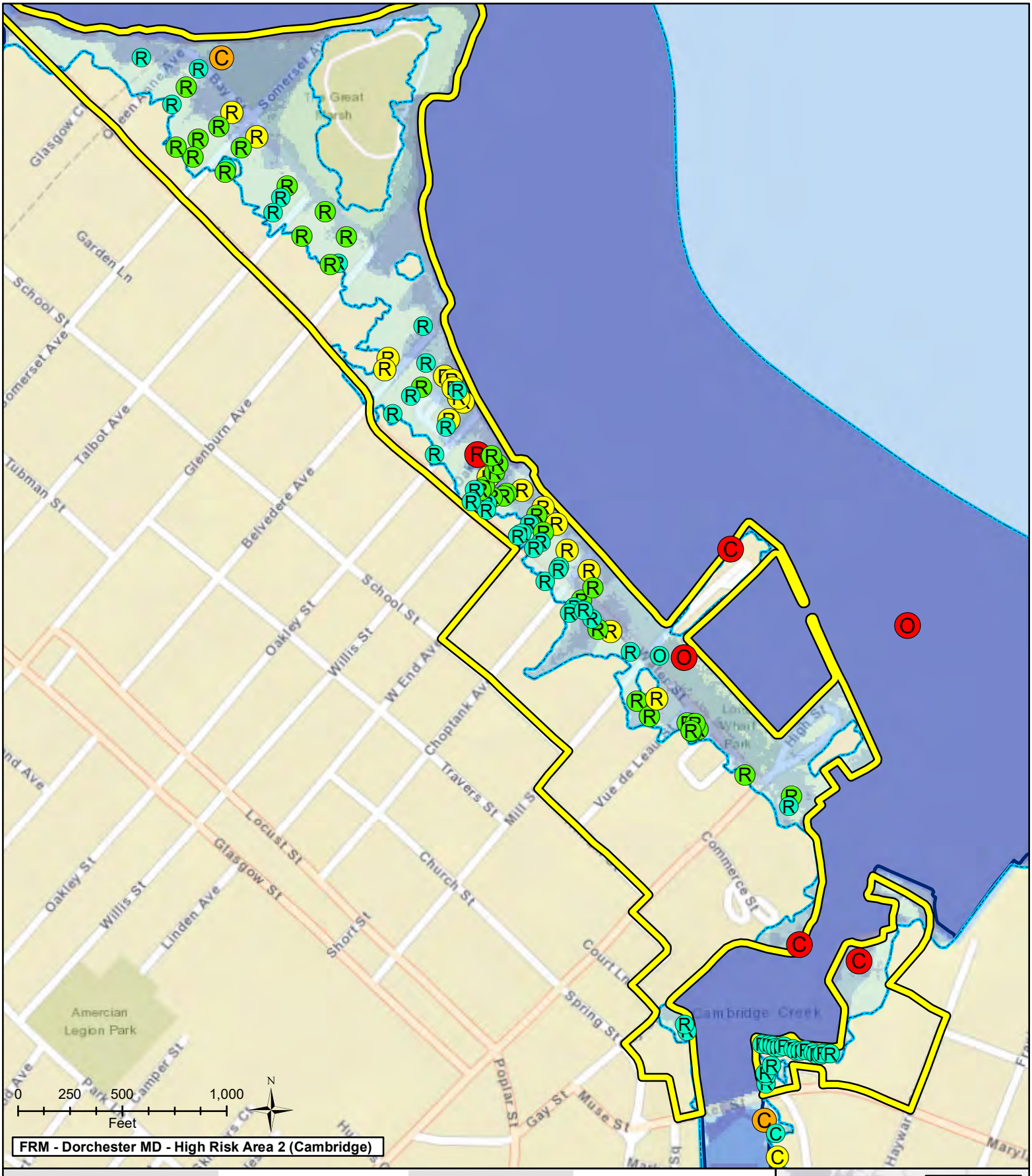
UDF Flood Loss Estimates

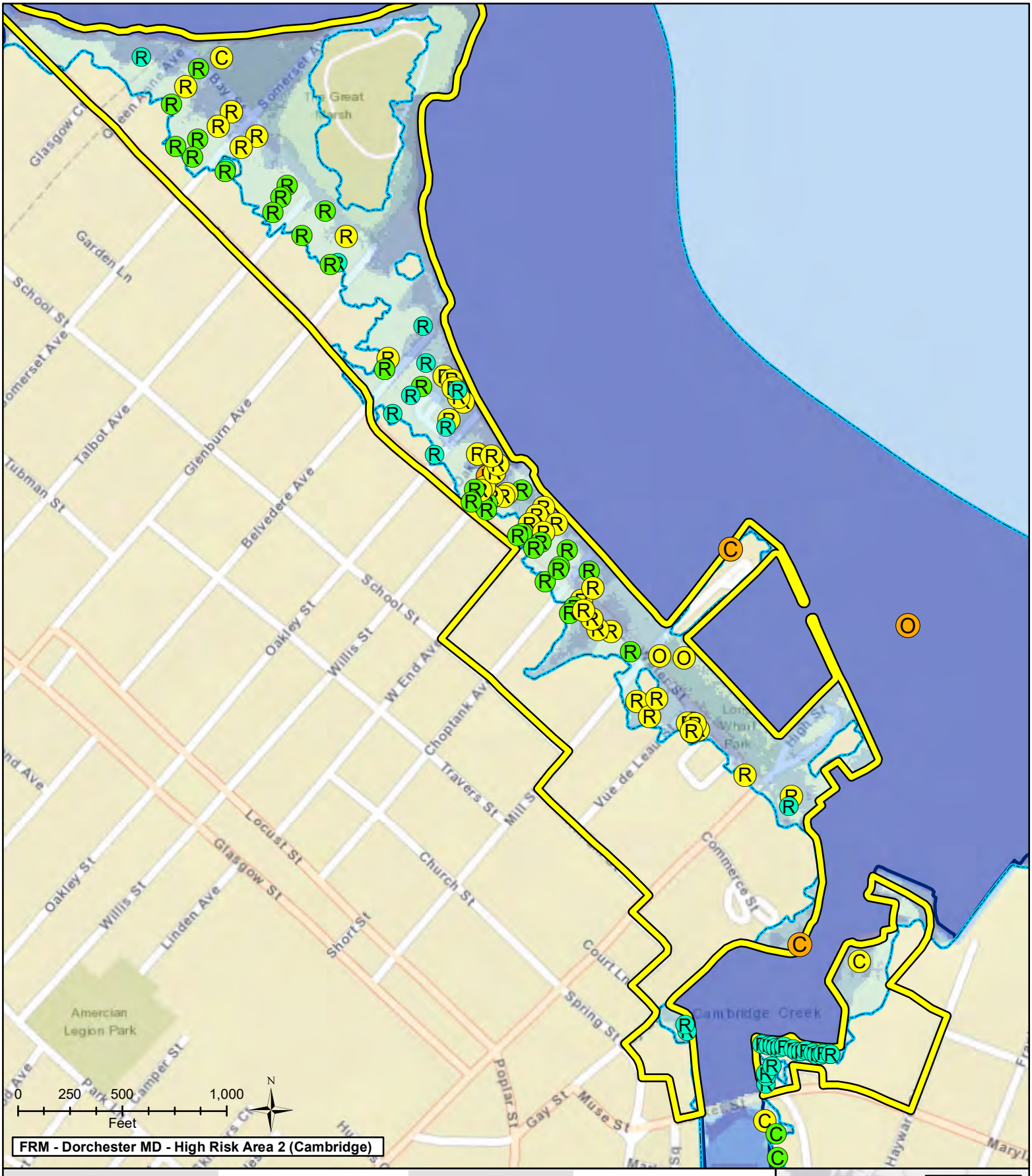
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More

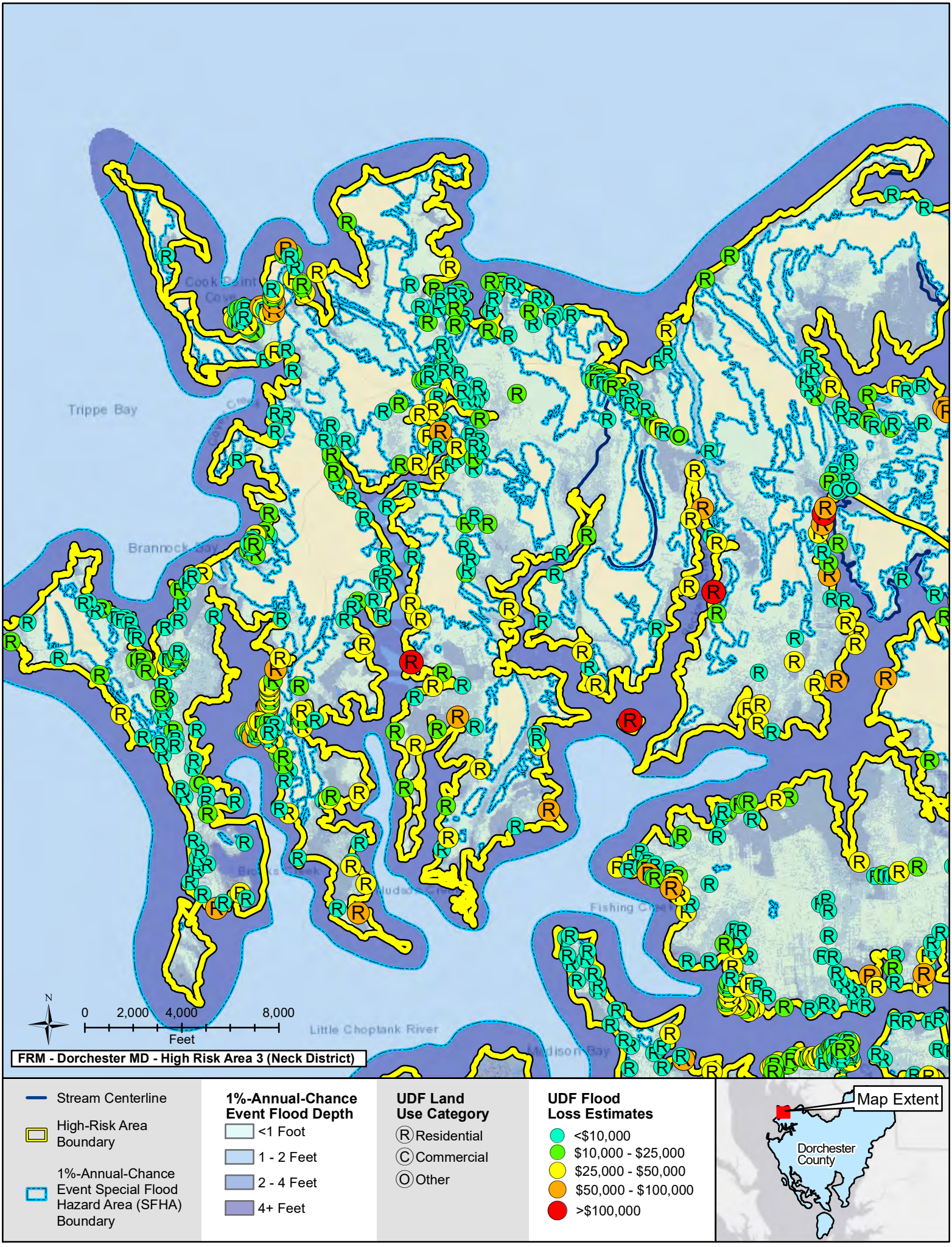


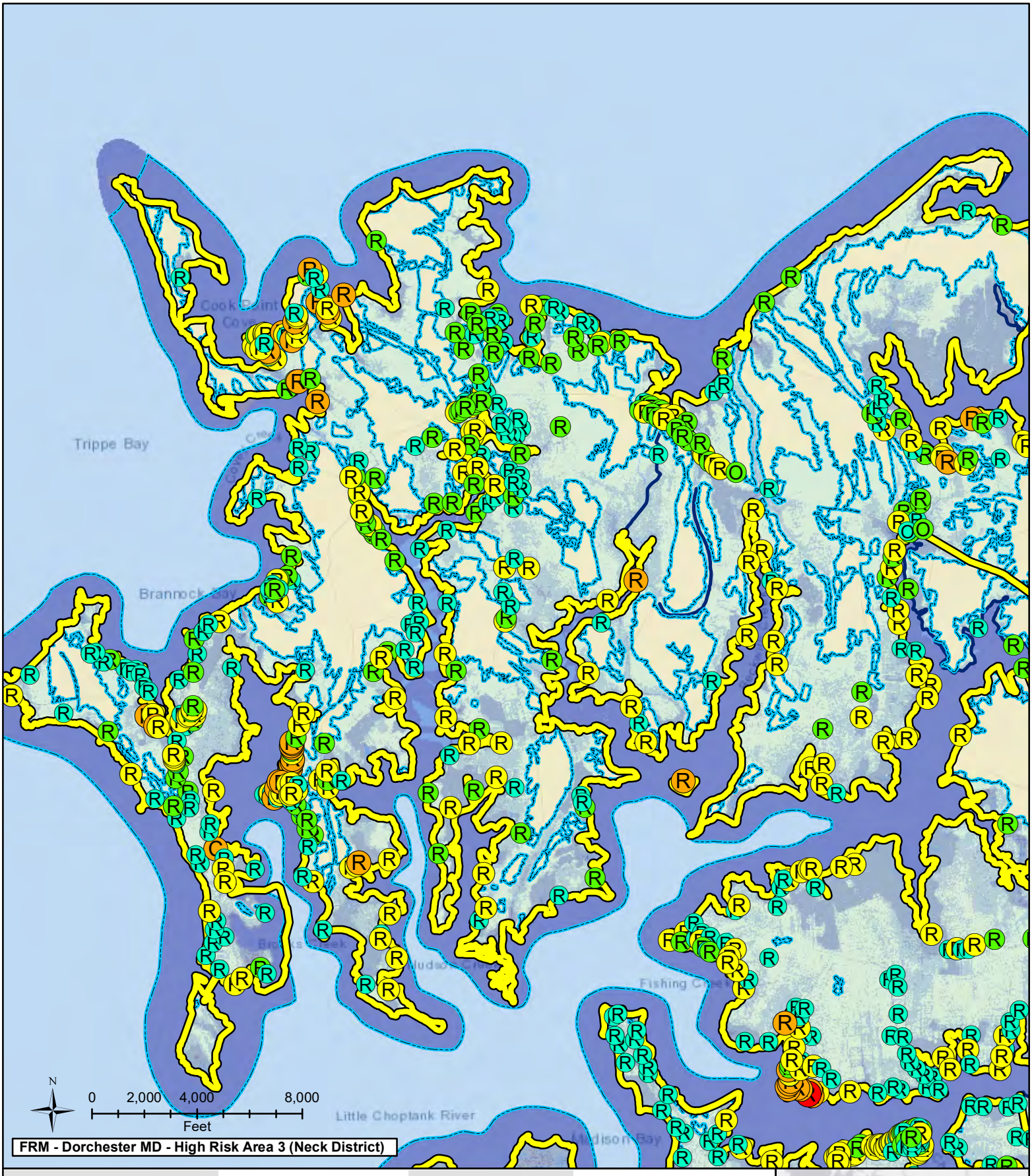

0
500
1,000
2,000
Feet
N
FRM - Dorchester MD - High Risk Area 1 (Hoopers Island South)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Dorchester County
Map Extent


0
500
1,000
2,000
Feet
N
FRM - Dorchester MD - High Risk Area 1 (Hoopers Island South)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Dorchester County
Map Extent


Garden Ln
School St
Somerset Ave
Talbot Ave
Glenburn Ave
Tubman St
Belvedere Ave
Oakley St
Willis St
W End Ave
Choptank Av
Travers St
Mill St
Vue de Leau
Locust St
Glasgow St
Church St
Linden Ave
Short St
Commerce St
Court Ln
Spring St
Poplar St
Gay St
Muse St
High St
Cambridge Creek
Amercian Legion Park
0 250 500 1,000
Feet
N
FRM - Dorchester MD - High Risk Area 2 (Cambridge)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Dorchester County


Garden Ln
School St
Somerset Ave
Talbot Ave
Glenburn Ave
Belvedere Ave
Tubman St
Oakley St
Willis St
W End Ave
Choptank Av
Travers St
Mill St
Vue de Leau
Commerce St
Locust St
Glasgow St
Church St
Linden Ave
Short St
Court Ln
Spring St
Poplar St
Gay St
Muse St
High St
Cambridge Creek
Amercian Legion Park
Park Ln
Camper St
The Great Marsh
0 250 500 1,000
Feet
N
FRM - Dorchester MD - High Risk Area 2 (Cambridge)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Dorchester County


Trippe Bay
Brannock Bay
Little Choptank River
Fishing Creek
Madison Bay
N
0
2,000
4,000
8,000
Feet
FRM - Dorchester MD - High Risk Area 3 (Neck District)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Dorchester County



FRM - Dorchester MD - High Risk Area 3 (Neck District)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

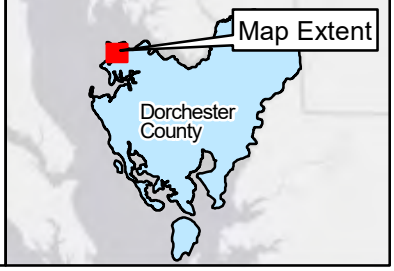
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

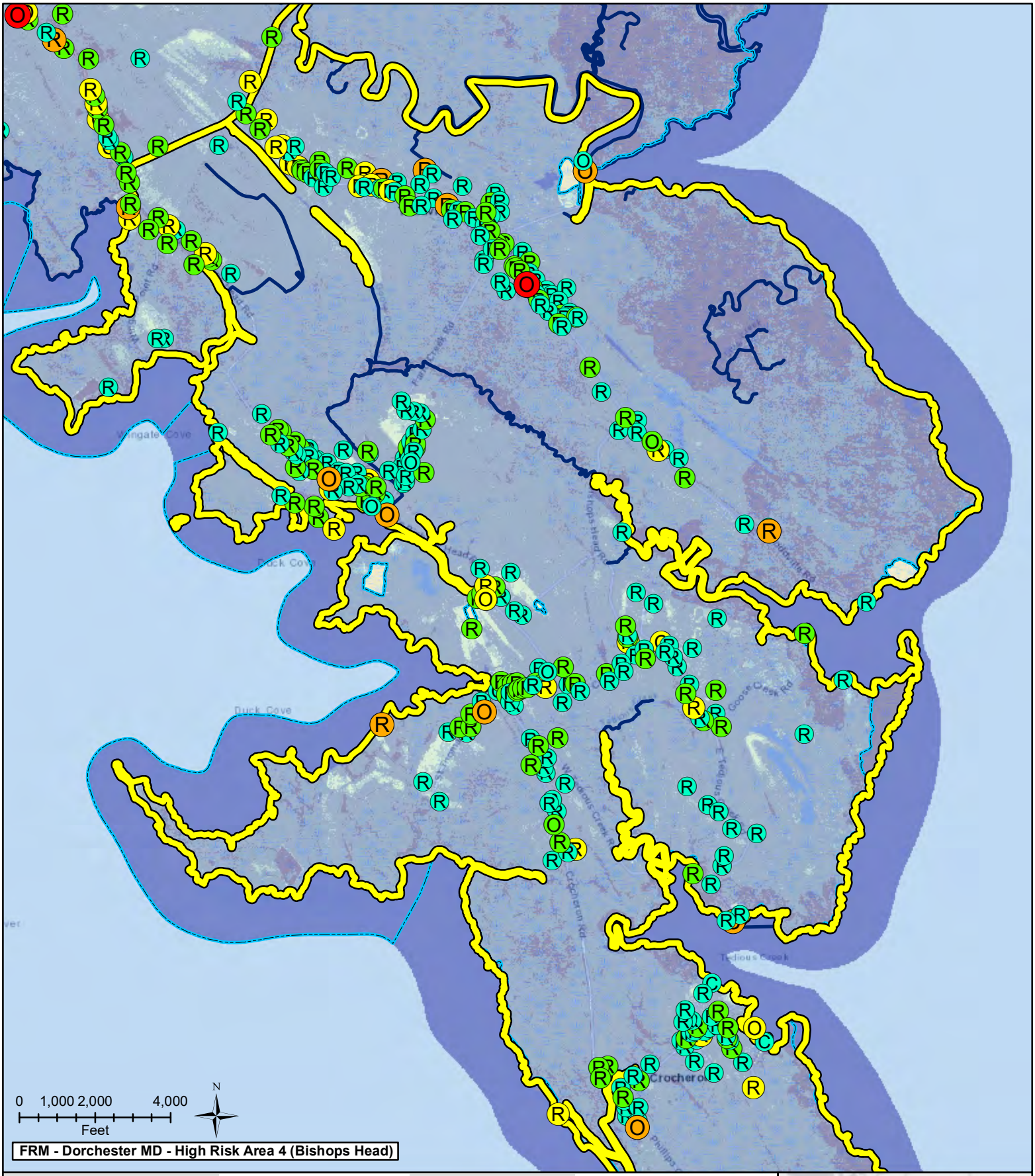
UDF Land Use Category

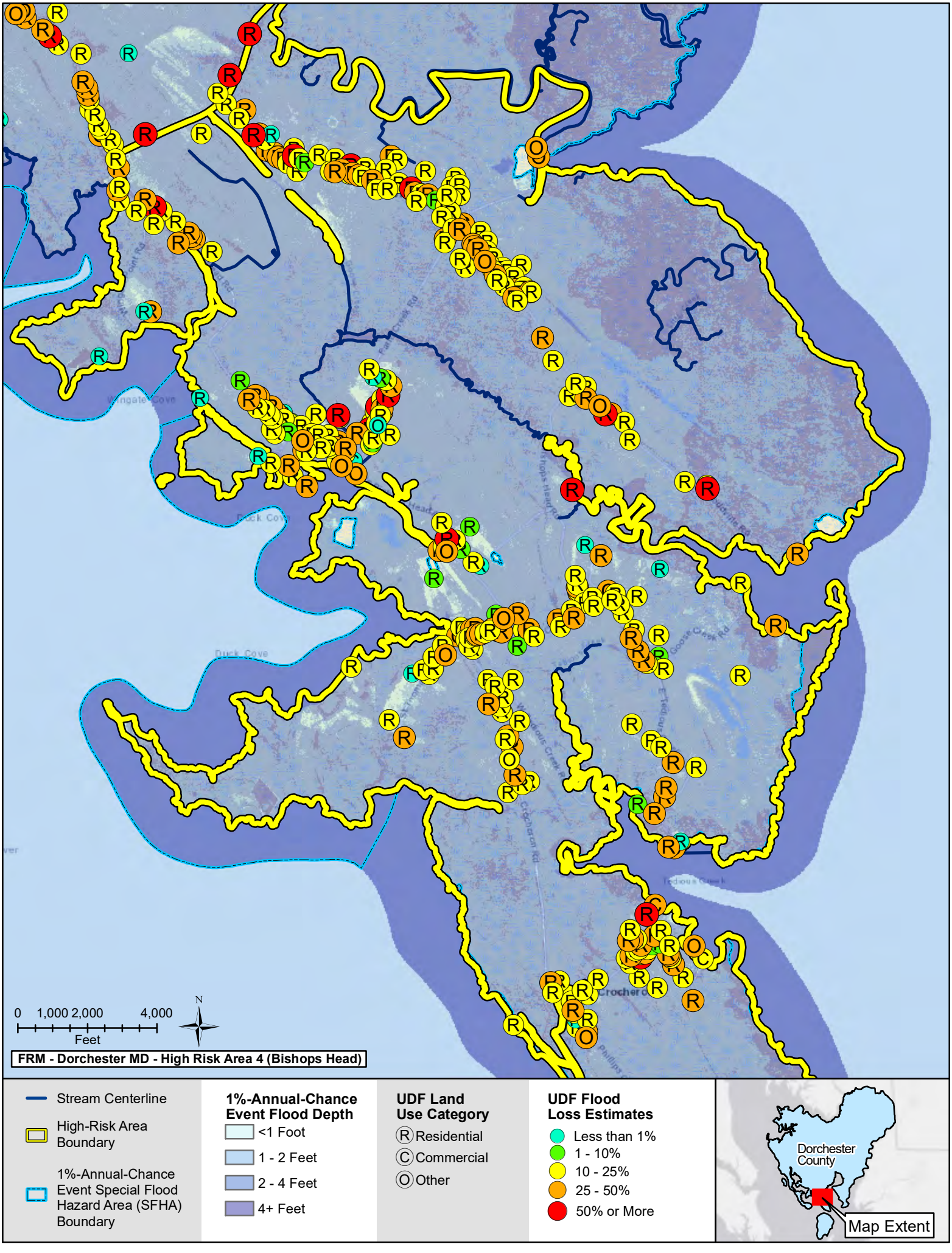
- (R) Residential
- (C) Commercial
- (O) Other

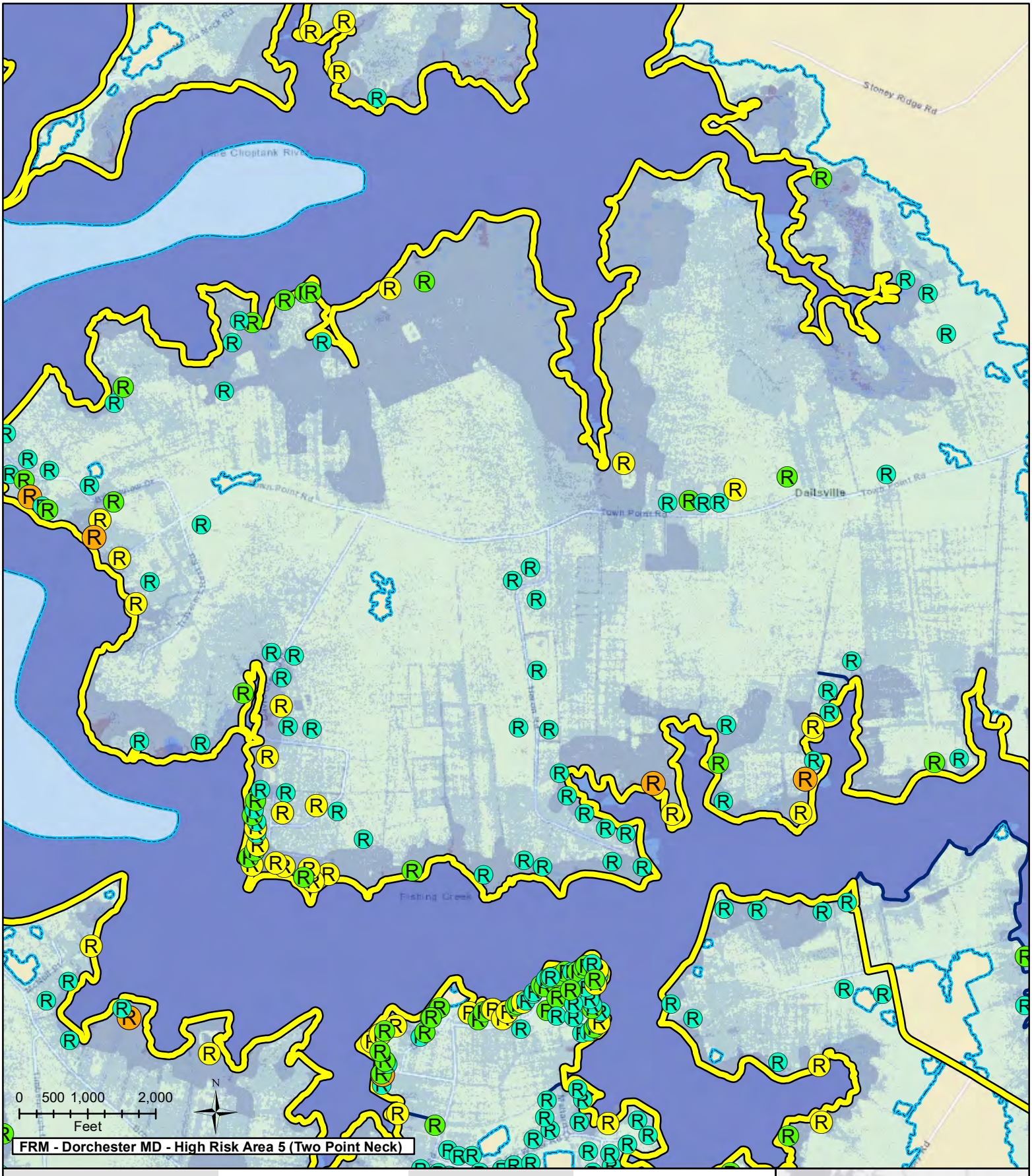
UDF Flood Loss Estimates

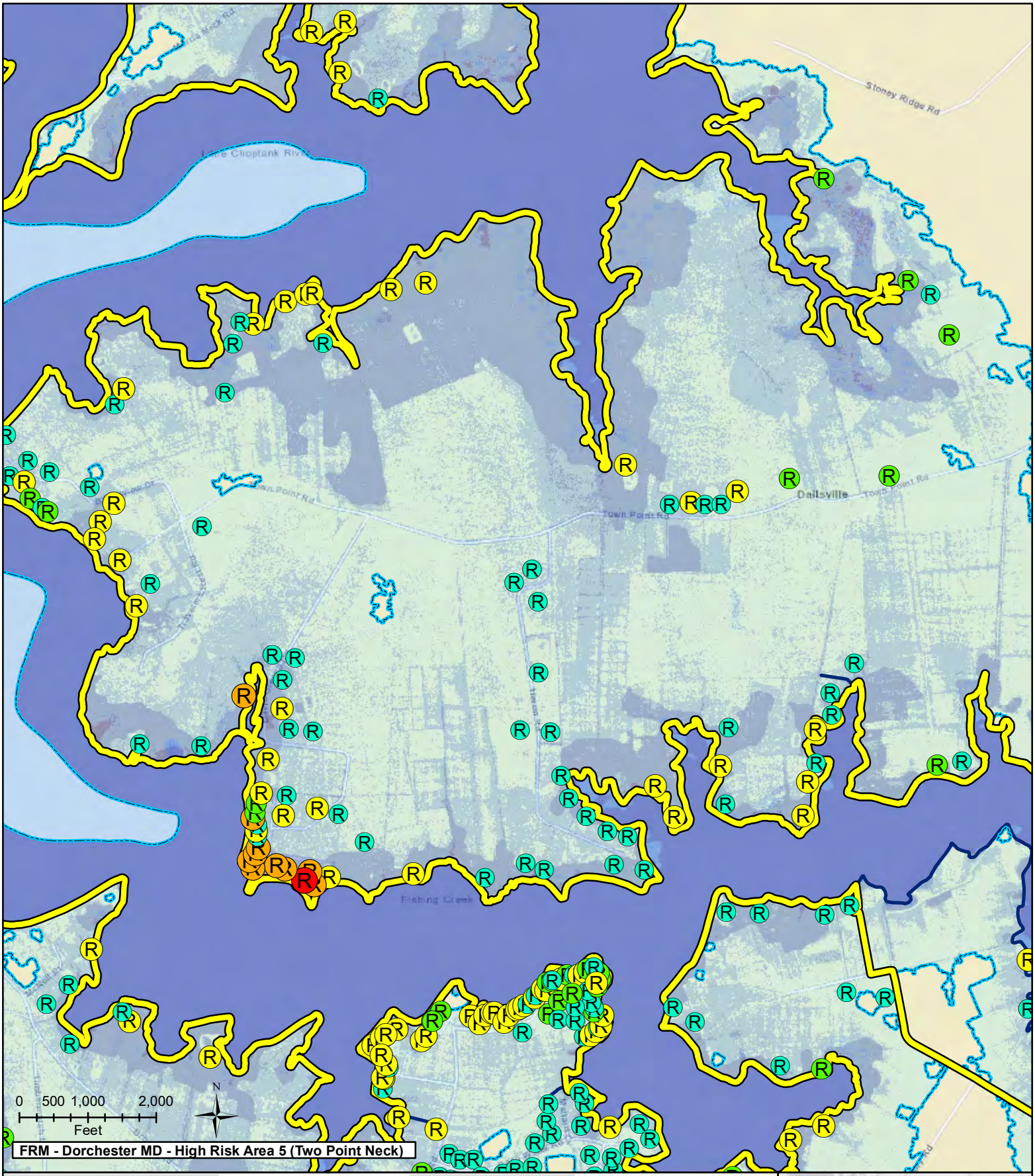
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




0 1,000 2,000 4,000
Feet
N
FRM - Dorchester MD - High Risk Area 4 (Bishops Head)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Dorchester County
Map Extent


0 1,000 2,000 4,000
Feet
N
FRM - Dorchester MD - High Risk Area 4 (Bishops Head)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Dorchester County
Map Extent


Stoney Ridge Rd
Lake Choptank River
Town Point Rd
Dailsville
Fishing Creek
0 500 1,000 2,000
Feet
N
FRM - Dorchester MD - High Risk Area 5 (Two Point Neck)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Dorchester County



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

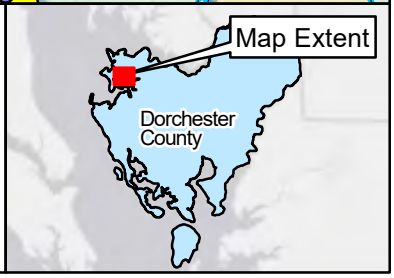
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

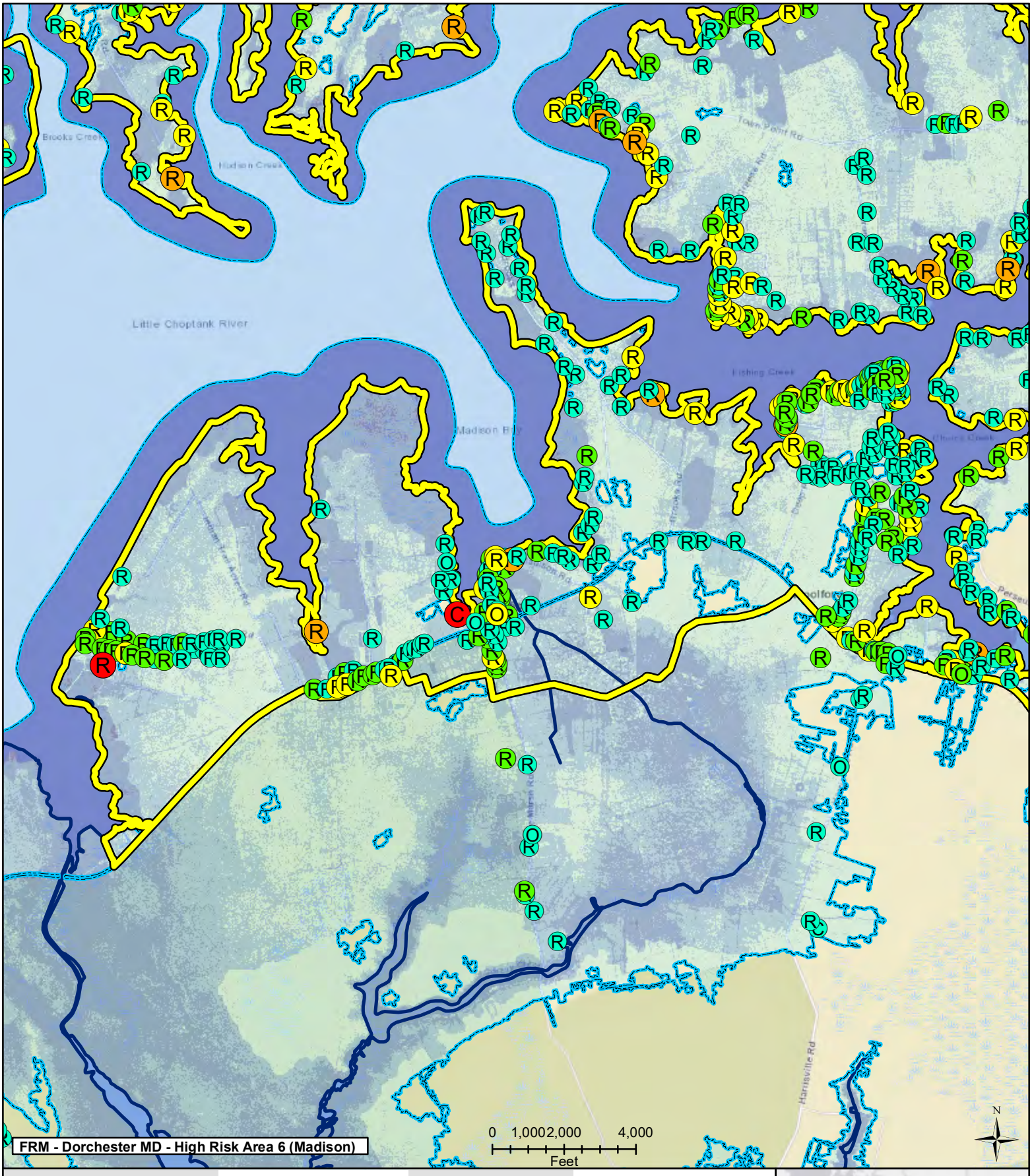
UDF Land Use Category

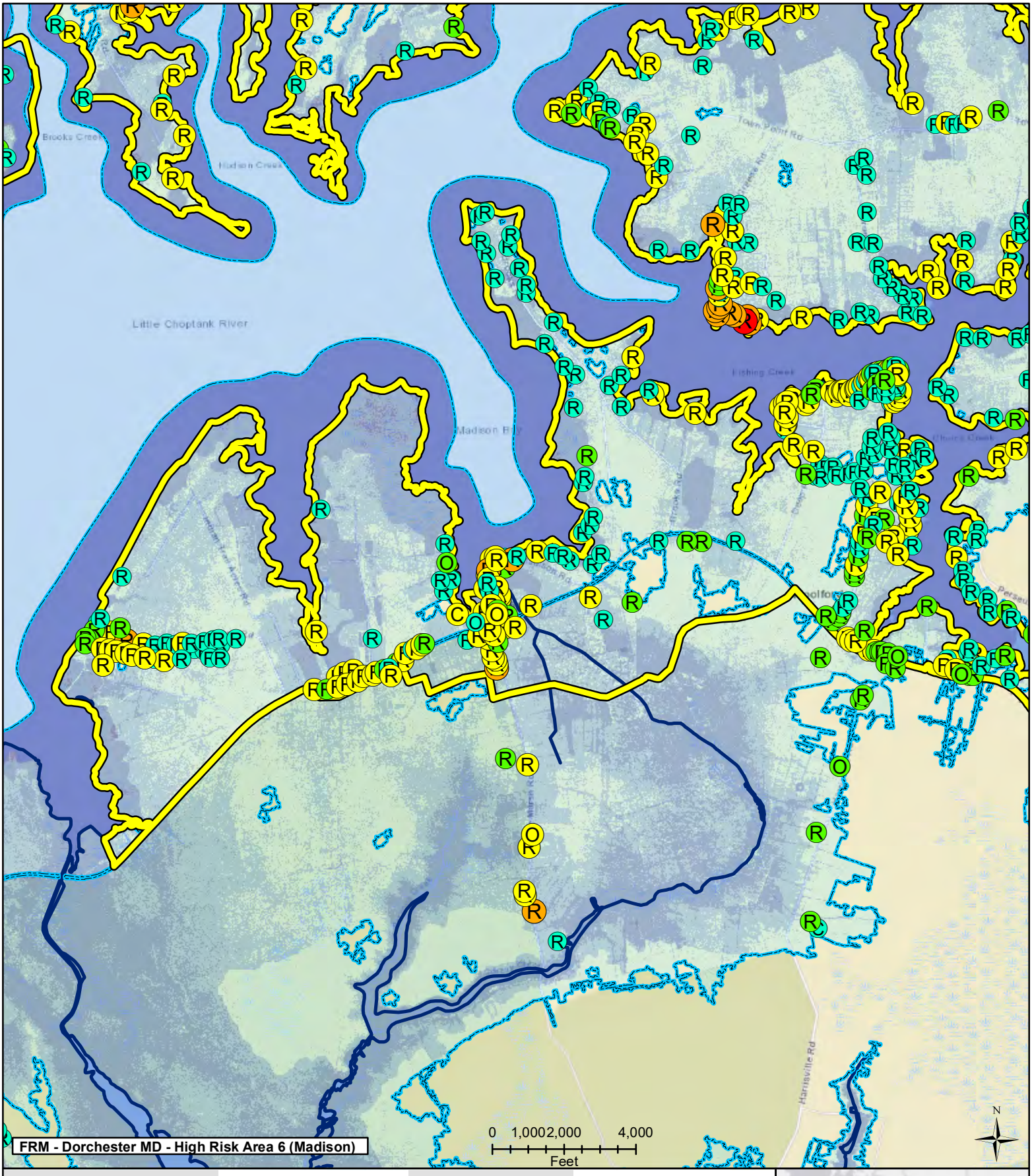
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Little Choptank River
Brooks Creek
Hudson Creek
Fishing Creek
Harrisville Rd
FRM - Dorchester MD - High Risk Area 6 (Madison)
0 1,000 2,000 4,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Dorchester County



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

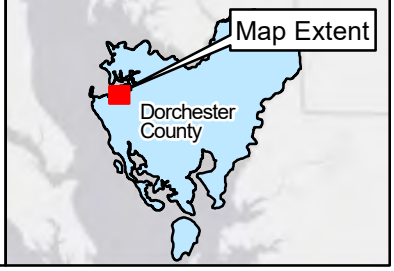
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

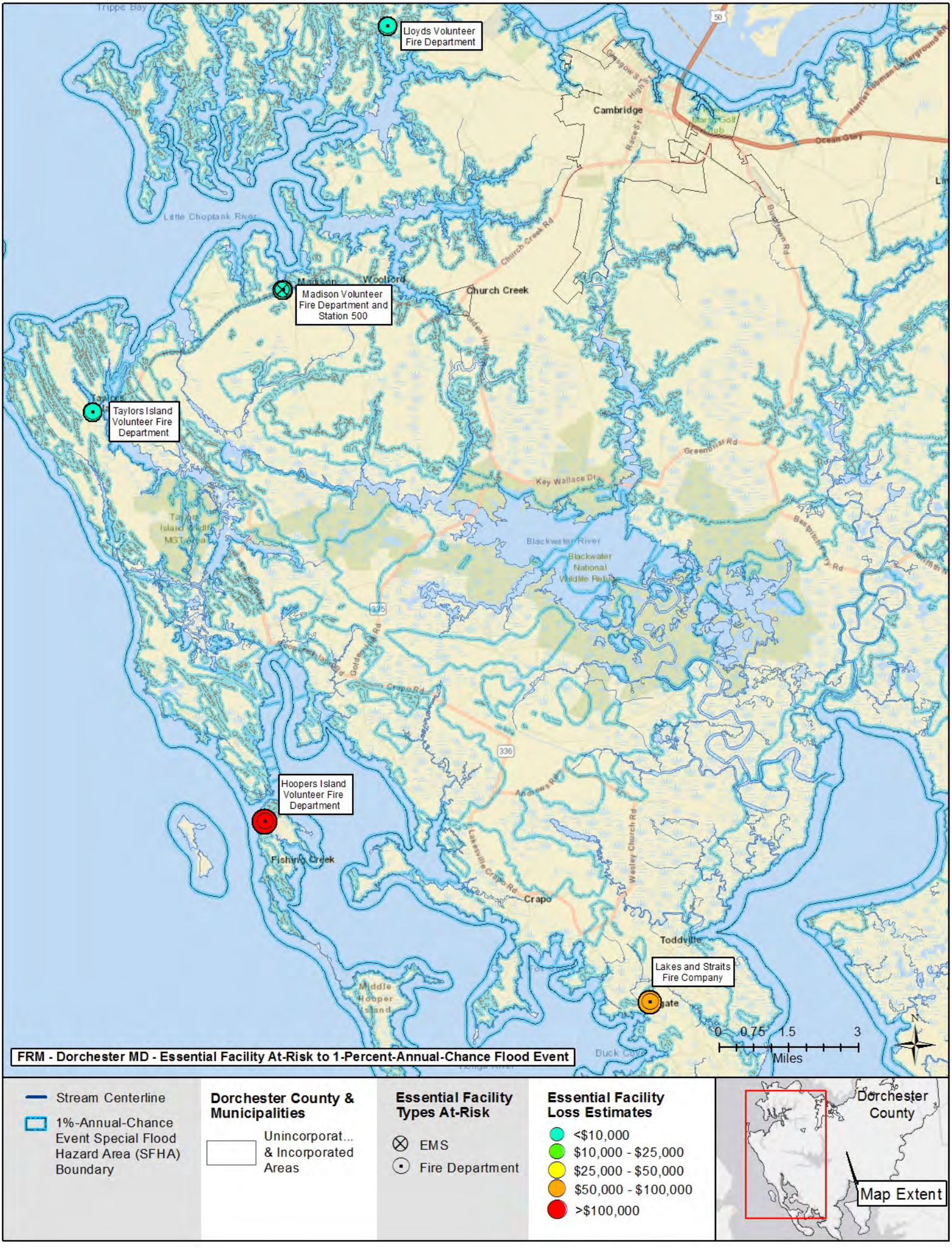
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Lloyds Volunteer Fire Department
Madison Volunteer Fire Department and Station 500
Taylors Island Volunteer Fire Department
Hoopers Island Volunteer Fire Department
Lakes and Straits Fire Company
Cambridge
Church Creek
Madison
Woolford
Fishing Creek
Crapo
Toddville
Blackwater River
Blackwater National Wildlife Refuge
Little Choptank River
Trippe Bay
Church Creek Rd
Key Wallace Dr
Greenbrier Rd
Crapo Rd
Andrews Rd
Wesley Church Rd
Lakesville Crapo Rd
Ocean Gtwy
Race St
Glasgow St
Bucktown Rd
Hoopers Island Rd
Golden Hill Rd
Middle Hooper Island
Duck Cove
50
375
336
0 0.75 1.5 3
Miles
N
FRM - Dorchester MD - Essential Facility At-Risk to 1-Percent-Annual-Chance Flood Event
Stream Centerline
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
Dorchester County & Municipalities
Unincorporat... & Incorporated Areas
Essential Facility Types At-Risk
EMS
Fire Department
Essential Facility Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Dorchester County
Map Extent

This page left blank intentionally

Source: https://en.wikipedia.org/wiki/Youghiogheny_River_Lake

STATE OF MARYLAND

FLOOD RISK REPORT

GARRETT COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Garrett County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State. Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland' commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping,

specifically essential facility and state asset loss estimation totals, for Garrett County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Garrett County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis for the county as a whole and for individual communities, with calculations of total flood damages by land use (occupancy type) and a summary of damage severity for buildings impacted by flooding. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 5

d. Related Resources 6

2 Flood Risk Analysis 9

a. Overview 9

b. Analysis of Risk 10

i. Flood Depth and Analysis Grids 10

ii. Flood Risk Assessments 11

iii. Areas of Mitigation Interest 13

3 Flood Risk Analysis Results 25

a. Garrett County, Maryland Flood Risk Project Area Summary 26

i. Overview 26

ii. Flood Risk Results 26

iii. Flood Risk Maps 34

b. Communities 35

i. Garrett County (Unincorporated Areas) (CID 240034) 35

ii. Town of Accident (CID 240093) 39

iii. Town of Friendsville (CID 240035).....42
iv. Town of Grantsville (CID 240165).....45
v. Town of Moutain Lake Park (CID 240038).....48
vi. Town of Oakland (CID 240039).....51
4 Actions To Reduce Flood Risk.....**54**
a. Types of Mitigation Actions.....54
i. Local Plans and Regulations.....54
ii. Structure and Infrastructure Projects.....55
iii. Natural Systems Protection Activities.....55
iv. Education and Awareness Activities.....56
b. Identifying Specific Actions for Your Community.....57
c. Mitigation Programs and Assistance.....58
i. FEMA Mitigation Programs and Assistance.....59
ii. Additional Mitigation Programs and Assistance.....60
5 Acronyms And Definitions.....**61**
a. Acronyms.....61
b. Definitions.....63
6 Additional Resources.....**67**

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Garrett County Essential Facilities 14

Table 2: USACE National Inventory of Dams – Garrett County, MD 16

Table 3: Flood Risk Assessment – Community Overview 26

Table 4: Garrett County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood 27

Table 5: Garrett County, Maryland – Estimated Losses by Occupany Type for the 1%-Annual-Chance Flood 27

Table 6: Garrett County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 28

Table 7: Garrett County, Maryland – At-Risk Government Facilities Summary for the 1%-Annual-Chance Flood 29

Table 8: Garrett County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood 31

Table 9: Garrett County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood 32

Table 10: Garrett County, Maryland – Areas of Mitigation Interest 32

Table 11: Garrett County, Maryland – High-Risk Areas 33

Table 12: Garrett County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 36

Table 13: Garrett County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 37

Table 14: Town of Accident – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 40

Table 15: Town of Accident – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 40

Table 16: Town of Friendsville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 43

Table 17: Town of Friendsville – E Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 43

Table 18: Town of Grantsville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 46

Table 19: Town of Grantsville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 46

Table 20: Town of Mountain Lake Park – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 49

Table 21: Town of Mountain Lake Park – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 49

Table 22: Town of Oakland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 52

Table 23: Town of Oakland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 52

Table 24: Mitigation Actions for Areas of Mitigation Interest 56

Table 25: FEMA Hazard Mitigation Assistance Programs 59

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: The Little Youghiogheny leaves its banks Friday in Oakland.
Source: The Garrett Republican

Figure 1.2

Which picture below shows more flood risk?

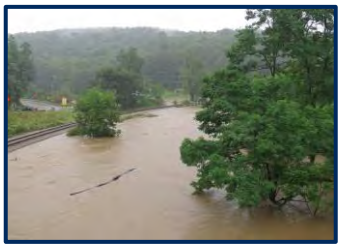
Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur, as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3



Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Gorman – Garrett County
Source: WCBC

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Appendix A of this FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

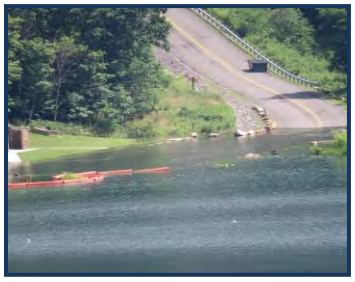
These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4



Vulnerability of infrastructure is another important consideration.

Photo: Jennings Randolph Lake
Source: WCBC

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example,

zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 30 and 31.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (dated October 2, 2013 and produced by FEMA Region III and Maryland Department of the Environment), as well as a subsequently issued Letter of Map Revision (Case Number 16-03-2576P), dated March 10, 2017, for a small portion of Savage River upstream of Westernport Road. Note that a small portion of the North Branch Potomac River in Garrett County (Unincorporated Areas) near the Town of Bayard, WV was revised in February 2019, based on new hydrologic and hydraulic analysis for the Town of Bayard Levee System. The analysis in this report predates the North Branch Potomac floodplain revision, and is determined to only impact 2 structures in Garrett County.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of October 2015), acquired through the Maryland Department of Planning – http://planning.maryland.gov/OurProducts/.
  Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordiances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructured after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Garrett County GIS Office – https://www.garrettcounty.org/planning-land-development/mapping-services. *(Limited Distribution; data available by purchase/ request).*

- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identified five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.

- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Section 2 - Subsection ii Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood

profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

  The *2018 Garrett County Hazard Mitigation Plan* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

  Please note that the information in this FRR may be reviewed for inclusion during the update of the Garrett County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation,

TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

- **Emergency Action Plans.** Emergency Action Plans (EAP) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

  Twenty-one (21) dams are located within Garrett County, twelve (12) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Garrett County, MD,* on page 15 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Gorman
Source: WCBC
Bottom Photo: Youghiogheny
Source: WCBC

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

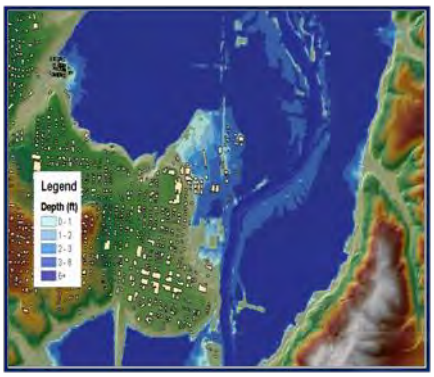
- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, flood depth and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains, based on the October 2013 Flood Insurance Rate Maps for Garrett

County and Incorporated Areas. This grid communicates flood depth as a function of the difference between the calculated water surface elevation and the ground.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region
- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from floods and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This include direct building losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

  Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other

areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

There are 51 essential facilities located within Garrett County with a total estimated building value of $215,484,000.

Table 1: Garrett County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	1	$5,546,000
Fire/Rescue Stations	15	$ 7,418,000
Hospital & Medical Clinics	9	$ 45,275,000
Police Stations	3	$ 10,042,000
Schools (K-12 & Colleges)	23	$ 147,203,000
Total	**51**	**$215,484,000**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored as the Essential Facilities Flood Risk Assessment Dataset in the Flood Risk Database.

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

Figure 2.4

One of Garrett County's essential facilities includes the Gorman Volunteer Fire Department.

Photo Source: GarrettCountyBusiness.com

- **High-Risk Areas**

  High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  A total of 10 high risk areas were identified within Garrett County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

  A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., New Germany State Park Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

  Figure 2.5

  Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

  Photo: New Germany State Park Dam
  Source: www.stateparks.com

  While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

  According to the USACE National Inventory of Dams, twenty-one (21) dams are located in Garrett County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Garrett County, MD

Name	Owner Type	Purpose	River	Emergency Action Plan (EAP)
Kemp Farm Pond	Private	Recreation	Youghiogheny River Lake-TR	No
Lake Louise	Private	Recreation	Puzzley Run	Yes
Meadow Run Dam	Private	Recreation	Meadow Run	Yes
Frostburg Reservoir	Local Government	Water Supply	Big Piney Run	Yes
Platter Farm Pond	Private	Recreation	Church Run	No
New Germany State Park Dam	State	Recreation	Poplar Lick Run	No
Bittinger Farm Pond	Private	Recreation	Little Savage River	No
Western Maryland 4H Center	State	Recreation	Pleasant Valley Run	No
Waterfront Greens Community Pond	Private	Recreation	Deep Creek Lake-TR	No
Little Youghiogheny Site #7	Local Government	Flood Control	Little Youghiogheny River	Yes
Adventure Sports Center Pond	Local Government	Recreation	Off stream-Fork Run	No
Deep Creek Dam	Private	Recreation	Deep Creek	Yes
Savage River Dam	State	Flood Control	Savage River	Yes
Piedmont Water Supple Intake Dam	Local Government	Water Supply	Savage River	No
Jennings Randolph Dam	Federal	Flood Control	North Branch Potomac River	Yes
Herrington Manor	State	Recreation	Herrington Run	No
Little Youghiogheny Site #2	Local Government	Flood Control	Cherry Glade Run	Yes
Little Youghiogheny Site #1	Local Government	Flood Control	Cherry Glade Run	Yes
Little Youghiogheny Site #3	Local Government	Flood Control	Wilson Run	Yes
Little Youghiogheny Site #6 (Broadford)	Local Government	Water Supply	Broad Food Run	Yes
Little Youghiogheny Site #5	Local Government	Flood Control	Landons Dam Run	Yes

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

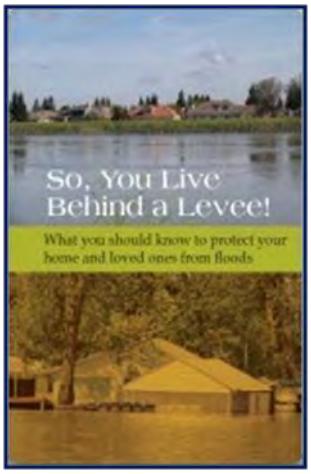
- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

This dam failure caused flooding that damaged several homes and vehicles.

  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
  - When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
  - For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

Figure 2.8

Top Photo: Leveed Area within the Town of Kitzmiller.
Source: National Levee Database-Interactive Map

The Kitzmiller flood risk management system (FRMS) is part of the Kitzmiller federally authorized and constructed flood risk management project (FRMP) located in Garrett County, Maryland, and Mineral County, West Virginia, along both banks of the North Fork Potomac River in the vicinity of Kitzmiller, Maryland. The project includes two systems: Kitzmiller and Blaine. The project was originally designed to provide flood risk management for a discharge of 52,000 cubic feet per second (cfs) on the North Branch of the Potomac River. Both systems are operated and maintained locally by the Town of Kitzmiller.

The biggest risk to people behind the levee would be a break in the levee caused by flood water flowing over the top of the levee. The levee has been loaded up to 87% of the levee height in 1985 with minor erosion concerns noted that have been repaired. The levee embankment consists of fine grained materials but will experience short loading duration. There are approximately 181 people within the leveed area with short egress routes to high ground. Further information on inspections and assessment of the Kitzmiller Levee is available at the National Levee Database:

https://levees.sec.usace.army.mil/#/levees/system/2305180002/summary

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a

widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.

- A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**

    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
    - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
    - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
    - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Figure 2.9

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of January 16, 2018, a total of seventeen (17) FEMA Designated Repetitive Loss Properties and one (1) Severe Repetitive Loss Property were within Garrett County. One (1) repetitive loss property is located witin the Town of Friendsville, while the remaining sixteent (16) are located in the unincorporated areas of the County.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
  - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
  - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

  Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

  Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

  Figure 2.10

  Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

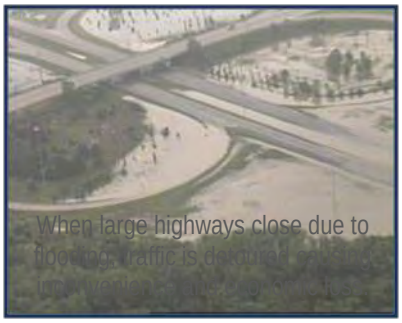
  - **Reasons Areas of Significant Land Use Change are considered AoMIs:**
    - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
    - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
    - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

- **Reasons overtopped roads are considered AoMIs:**
  - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
  - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

Figure 2.11



- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  The *2018 Garrett County Hazard Mitigation Plan Update* provided a listing of repetitive flood locations was provided by the Department of Public Works – Roads Division. The listing of repetitive flooding issues is within Chapter 6 Riverine Flooding on Table 22 of the Plan Update. A total of 20 repetitive flood locations were identifed in the unincorporated areas of the County, while 11 were identifed within the incorporated areas of the County.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
    - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
    - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural

measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 25.

- **Reasons areas of mitigation success are considered AoMIs:**
  - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
  - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
  - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  - **Reasons why areas of significant riverine erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine erosion can undercut structures and roads, causing instability and possible collapse.
    - Landslides and mudslides are a result of erosion
    - Approximately one-third of the nation's streams experience severe erosion problems

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Garrett County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Garrett County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Garrett County (Unincorporated Areas)	240034	29,859	653.83	Y	N/A	Y
Town of Accident	240093	325	0.61	Y	N/A	Y
Town of Friendsville	240035	491	0.91	Y	N/A	Y
Town of Grantsville	240165	766	0.98	Y	N/A	Y
Town of Mountain Lake Park	240038	2,092	2.01	Y	N/A	Y
Town of Oakland	240039	1,925	2.72	Y	N/A	Y

Note: The Towns of Deer Park, Kitzmiller and Loch Lyn Heights were not included in this report since they had no UDFs within Special Flood Hazard Areas (SFHAs).

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Garrett County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Refined flood loss estimates and loss ratios for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Additional information and data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

Table 4: Garrett County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Garrett County (Unincorporated Areas)	29,859	231	$3,200,000	$107	51%
Town of Accident	325	5	$20,000	$62	< 1%
Town of Deer Park	399	0	$0	$0	0%
Town of Friendsville	491	55	$1,400,000	$2,851	22%
Town of Grantsville	766	6	$940,000	$1,227	15%
Town of Kitzmiller	321	0	$0	$0	0%
Town of Loch Lynn Heights	522	0	$0	$0	0%
Town of Mountain Lake Park	2,092	2	<$5,000	$0	< 1%
Town of Oakland	1,925	13	$700,000	$364	11%
Total	**36,700**	**312**	**$6,300,000**	**$172**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Garrett County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	277	$19,300,000	61%	$2,800,000	15.0%
Commercial Building & Contents	14	$5,100,000	16%	$1,500,000	29.0%
Other Building & Contents	21	$7,500,000	24%	$1,100,000	15.0%
Total Building & Contents[3]	312	$31,900,000	100%	$5,400,000	17.0%
Business Disruption[4]	N/A	N/A	N/A	$900,000	N/A
TOTAL[5]	**312**	**$31,900,000**	**100%**	**$6,300,000**	**20.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Garrett County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	23	7%	$3,400,000	$100,000	$10,000	$0	0%
1 - 10%	110	35%	$12,900,000	$100,000	$600,000	$10,000	11%
10 - 20%	71	23%	$4,700,000	$70,000	$700,000	$10,000	13%
20 - 30%	42	13%	$2,900,000	$70,000	$700,000	$20,000	13%
30 - 40%	23	7%	$3,900,000	$200,000	$1,300,000	$60,000	24%
40 - 50%	12	4%	$1,500,000	$100,000	$700,000	$60,000	13%
50% or More	31	10%	$2,700,000	$90,000	$1,500,000	$50,000	27%
TOTAL	**312**	**100%**	**$32,000,000**	**$100,000**	**$5,510,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables represent information for all jurisdictions within the Garrett County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).
- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Garrett County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential essential facility flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, however, no essential facilities in Garrett County are at-risk to the 1-percent-annual-chance flood event.

While there are no essential facilities at-risk, there are several government facilities at-risk to the 1-percent-annual-chance flood event. The list of government facilities at-risk is provided on page 32.

Table 7: Garrett County, Maryland – At-Risk Government Facilities Summary for the 1%-Annual-Chance Flood

Type	Estimated Building Value	Total Essential Facilities Impacted by 1% Flood	1% (100-yr) Dollar Losses (Building Value)
Government	$ 309,300	6	$ 18,676
TOTAL	**$309,300**	**6**	**$18,676**

Hazus analysis (Version 3.1) results stored as the User Defined Facilities (UDFs) Flood Risk Assessment Dataset in the Flood Risk Database

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within

Garrett County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Garrett County contains 319 state assets. However, none of these state assets are at-risk to the 1-percent-annual-chance flood event.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**

  The model estimates that a total of 1,836 tons of debris will be generated. Of the total amount, Finishes comprises 55% of the total, Structure comprises

19% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 73 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 8: Garrett County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	1,002	55%	40
Structure	353	19%	14
Foundation	481	26%	19
TOTAL	**1,836**	**100%**	**73**

Source: Hazus 3.1: Flood Modual – Garrett County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**

  Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 204 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 106 people (out of a total population of 30,097) will seek temporary shelter in public shelters.

Table 9: Garrett County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	204	613	106

Source: Hazus 3.1: Flood Modual – Garrett County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type, which are also included in the Areas of Mitigation Interest data layer (S_AOMI_Ar) of the FRD that accompanies this report.

Table 10: Garrett County, Maryland – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Government Facilities	6	Depth grids, UDFs
High-Risk Areas	10	NFHL, Census Blocks, UDFs
Levee	1	NFHL, National Levee Database
Repetitive Flood Issues	30	Emergency Management Dept., Local Public Works – Roads Division, Municipalities
Repetitive Loss Properties	18	FEMA NFIP/MDE Community Assistance Program Manager

- **At-Risk Government Facilities**

  Results from the 1-percent-annual-chance flood event analysis indicate six (6) government facilities are at-risk; three (3) facilities are Garrett County Department of Public Works facilities, one (1) Town of Oakland facility, one (1) Town of Friendsville facility, and one (1) Town of Accident facility. Flood depths for each facility is provided below along with the identified facilities.

  - Town of Oakland Facility – 3.4'
    Tom Park Lane, Oakland
  - Town of Friendsville Water Treatment Plant – 0.7'
    849 First Avenue, Friendsville
  - Town of Accident Water Pump Station – 0.5'
    South Main Street, Accident
  - Garrett County Public Works Facility – 3.6'
    West Ashby Ellis Road, Oakland

- Garrett County Public Works Facility – 2.0'
  338 Steyer Gorman Road, Gorman
- Garrett County Public Works Facility – 0.4'
  121 Owens Avenue, Bloomington

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 11: Garrett County, Maryland – High-Risk Areas

High-Risk Area	Location *(and Flooding Source(s))*	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Youghiogheny River / Snowy Creek Rd	207	11	39	$260,000	4%
Area 2	North Branch Potomac River / Steyer Gorman Rd	16	5	7	$70,000	1%
Area 3	E Oak St / S 1st St	18	3	7	$660,000	11%
Area 4	Youghiogheny River Lake / Bear Creek	122	13	49	$1,260,000	20%
Area 5	Mill Run / Mill Run Rd / Chet Kelly Rd	63	3	17	$100,000	2%
Area 6	Spiker Run / Casselman River / Bittinger Rd	17	2	6	$160,000	3%
Area 7	Bear Pen Rn / Savage Rvr Rd / Bear Pen Rn Natural Area	37	7	46	$500,000	8%
Area 8	Savage River / South Savage Mountain Natural Area	20	1	11	$340,000	6%
Area 9	South Fork Crabtree Creek / Swanton Rd	50	5	12	$150,000	2%
Area 10	North Branch Potomac River / Shallmar Rd	35	1	14	$40,000	1%
Total for High-Risk Areas		**585**	**51**	**208**	**$3,540,000**	**58%**

- **Levee**

  The Kitzmiller Levee is defined as Provisionally Accredited on the 2013 FIRMs for Garrett County. Based on that information, approximately 77 structures in Kitzmiller (with a combined property value of $10.7 million) are within an area of reduced flood risk due to the levee (and outside of the regulatory 1-percent-annual-chance floodplain). As a result, although some degree of risk is still present, no structures in Kitzmiller are analyzed herein for estimated loss based on the 1-percent annual chance event.

- **Repetitive Flood Issues**

  Based on frequently flooded roadways that are identified and ranked in Table 22 of the *2018 Garrett County Hazard Mitigation Plan Update*, several repetitive flood locations are found to be within high risk areas listed in Table 11 of this report, such as Shallmar Road along North Branch Potomac River. However, because the spatial extents of locations in Table 22 of the *2018 Garrett County Hazard Mitigation Plan Update* are not fully defined, frequently flooded roadways are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of seventeen (17) FEMA Designated Repetitive Loss Properties have been identified in the unincorporated portions of Garrett County and one (1) within the Town of Friendsville. Due to sensitivity of public disclosure for flood insurance claims, Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

iii. Flood Risk Maps

Flood Risk Maps for Garrett County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Garrett County (Unincorporated Areas) Summary (CID 240034)

The following pages include Flood Risk data for the Garrett County (Unincorporated Areas).

Overview

The Garrett County (Unincorporated Areas) is the western-most county in Maryland. It is bordered by the State of Pennsylvania to the north, the State of West Virginia to the west and south, and Allegany County, Maryland, to the east. Garrett County consists of 656 square miles located entirely within the Allegheny Plateau which is strongly dissected by a natural drainage pattern. Land character ranges from steep slopes to gently sloping and moderately sloping summits to valleys and floodplains. The county has over 76,000 acres of parks, lakes, and publicly accessible forestland.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Garrett County (Unincorporated Areas)	240034	29,859	653.83	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires December 2, 2023.
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 65 policies totaling approximately $13,452,800.00
- NFIP-recognized repetitive loss properties = 16 Single Family Homes
- NFIP-recognized severe repetitive loss properties = 1

Data provided below only includes areas in the Garrett County (Unincorporated Areas) that are located within the overall Garrett County, Maryland Riverine Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this

report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Garrett County (Unincorporated Areas) riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the regulatory 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates and loss ratios for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 12. Additionally, Table 13 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 12: Garrett County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	210	$14,000,000	65%	$1,900,000	14.0%
Commercial Building & Contents	6	$1,300,000	6%	$300,000	23.0%
Other Building & Contents	15	$6,300,000	29%	$700,000	11.0%
Total Building & Contents[3]	231	$21,600,000	100%	$2,900,000	13.0%
Business Disruption[4]	N/A	N/A	N/A	$300,000	N/A
TOTAL[5]	**231**	**$21,600,000**	**100%**	**$3,200,000**	**15.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 13: Garrett County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	16	7%	$2,300,000	$100,000	$0	$0	0%
1 - 10%	81	35%	$10,600,000	$100,000	$500,000	$10,000	16%
10 - 20%	56	24%	$3,500,000	$60,000	$500,000	$10,000	16%
20 - 30%	31	13%	$1,700,000	$50,000	$400,000	$10,000	13%
30 - 40%	18	8%	$1,300,000	$70,000	$500,000	$30,000	16%
40 - 50%	7	3%	$500,000	$70,000	$200,000	$30,000	6%
50% or More	22	10%	$1,800,000	$80,000	$1,000,000	$50,000	32%
TOTAL	**231**	**100%**	**$21,700,000**	**$90,000**	**$3,100,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Garrett County (Unincorporated Area)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).
- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Accident (CID 240093)

The following pages include Flood Risk data for the Town of Accident.

Overview

The Town of Accident is in the northwest quadrant of Garrett County. It consists of 0.5 square miles along US Highway 219. The primary flooding sources in the town include South Branch Bear Creek, and Tributary 1 to South Branch Bear Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Accident	240093	325	0.61	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires December 2, 2023.
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1 policies totaling approximately $70,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Accident that are located within the Garrett County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Accident's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 14. Additionally, Table 15

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 14: Town of Accident – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	4	$500,000	100%	$20,000	4.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$0	0%	$0	0.0%
Total Building & Contents[3]	5	$500,000	100%	$20,000	4.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**5**	**$500,000**	**100%**	**$20,000**	**4.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 15: Town of Accident – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	40%	$200,000	$100,000	$0	$0	0%
1 - 10%	3	60%	$300,000	$100,000	$20,000	$10,000	100%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**5**	**100%**	**$500,000**	**$100,000**	**$20,000**	**$0**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Accident

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Friendsville Summary (CID 240035)

The following pages include Flood Risk data for the Town of Friendsville.

Overview

The Town of Friendsville is in the northwest quadrant of Garrett County. It consists of 0.9 square miles along Interstate 68. The primary flooding sources in the town include Youghiogheny River (Lower Reach) and Bear Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Friendsville	240035	491	0.91	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires December 2, 2023.
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 14 policies totaling approximately $1,962,900.00
- NFIP-recognized repetitive loss properties = 1
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Friendsville that are located within the Garrett County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Friendsville's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates and loss ratios for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 16. Additionally, Table 17 shows the severity of damage to buildings from flooding

within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: Town of Friendsville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	49	$3,900,000	75%	$700,000	18.0%
Commercial Building & Contents	4	$800,000	15%	$300,000	38.0%
Other Building & Contents	2	$500,000	10%	$100,000	20.0%
Total Building & Contents[3]	55	$5,200,000	100%	$1,100,000	21.0%
Business Disruption[4]	N/A	N/A	N/A	$300,000	N/A
TOTAL[5]	**55**	**$5,200,000**	**100%**	**$1,400,000**	**27.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: Town of Friendsville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	4%	$200,000	$100,000	$0	$0	0%
1 - 10%	22	40%	$1,700,000	$80,000	$90,000	$0	8%
10 - 20%	13	24%	$1,000,000	$80,000	$200,000	$20,000	18%
20 - 30%	7	13%	$600,000	$90,000	$100,000	$10,000	9%
30 - 40%	3	5%	$600,000	$200,000	$200,000	$70,000	18%
40 - 50%	4	7%	$500,000	$100,000	$200,000	$50,000	18%
50% or More	4	7%	$500,000	$100,000	$300,000	$80,000	28%
TOTAL	**55**	**100%**	**$5,100,000**	**$90,000**	**$1,090,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Friendsville

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. Town of Grantsville Summary (CID 240165)

The following pages include Flood Risk data for the Town of Grantsville.

Overview

The Town of Grantsville is in northcentral Garrett County. It consists of 1 square miles along Interstate 68. The primary flooding source in the town is Casselman River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Grantsville	240165	766	0.98	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires December 2, 2023.
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1 policies totaling approximately $280,000.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Grantsville that are located within the Garrett County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Grantsville's riverine flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates and loss ratios for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19 shows the severity of damage to buildings from flooding

within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table18: Town of Grantsville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss
Residential Building & Contents	3	$200,000	8%	$50,000	25.0%
Commercial Building & Contents	2	$2,000,000	80%	$600,000	30.0%
Other Building & Contents	1	$300,000	12%	$200,000	67.0%
Total Building & Contents[3]	6	$2,500,000	100%	$850,000	34.0%
Business Disruption[4]	N/A	N/A	N/A	$90,000	N/A
TOTAL[5]	**6**	**$2,500,000**	**100%**	**$940,000**	**38.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Grantsville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	0	0%	$0	$0	$0	$0	0%
10 - 20%	1	17%	$70,000	$70,000	$10,000	$10,000	1%
20 - 30%	3	50%	$600,000	$200,000	$100,000	$30,000	12%
30 - 40%	1	17%	$1,600,000	$1,600,000	$500,000	$500,000	62%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	1	17%	$300,000	$300,000	$200,000	$200,000	25%
TOTAL	**6**	**100%**	**$2,570,000**	**$400,000**	**$810,000**	**$100,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Grantsville

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

v. Town of Mountain Lake Park Summary (CID 240038)

The following pages include Flood Risk data for the Town of Mountain Lake Park.

Overview

The Town of Mountain Lake Park is in the southwest quadrant of Garrett County. It consists of 2 square miles along State Highway 135. The primary flooding sources in the town include Little Youghiogheny River, Tributary No. 1 to Little Youghiogheny River, and Broad Ford Run.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Mountain Lake Park	240038	2,092	2.01	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires December 2, 2023.
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 0 policies totaling $0
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Mountain Lake Park that are located within the Garrett County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Mountain Lake Park's riverine flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates and loss ratios for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 20.

Additionally, Table 21 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 20: Town of Mountain Lake Park – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss
Residential Building & Contents	1	$100,000	50%	<$5,000	<1.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$100,000	50%	$0	0.0%
Total Building & Contents[3]	2	$200,000	100%	<$5,000	<1.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**2**	**$200,000**	**100%**	**<$5,000**	**<1.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 21: Town of Mountain Lake Park– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	50%	$100,000	$100,000	$0	$0	0%
1 - 10%	1	50%	$100,000	$100,000	<$5,000	$0	0%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**2**	**100%**	**$200,000**	**$100,000**	**<$5,000**	**$0**	**0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
The figures in these tables only represent information within the Town of Mountain Lake Park

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

vi. Town of Oakland Summary (CID 240039)

The following pages include Flood Risk data for the Town of Oakland.

Overview

The Town of Oakland is in the southwest quadrant of Garrett County. It consists of 2 square miles along US Highway 219. The primary flooding sources in the town include Little Youghiogheny River, Bradley Run, Tributary No. 2 to Little Youghiogheny River Wilson Run, and Cotton Run.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Oakland	240039	1,925	2.72	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires December 2, 2023.
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 7 policies totaling approximately $544,300.00
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Oakland that are located within the Garrett County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Oakland's riverine flood risk analysis incorporates newly modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates and loss ratios for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 22.

Additionally, Table 23 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 22: Town of Oakland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss
Residential Building & Contents	10	$500,000	28%	$100,000	20.0%
Commercial Building & Contents	2	$1,000,000	56%	$300,000	30.0%
Other Building & Contents	1	$300,000	17%	$100,000	33.0%
Total Building & Contents[3]	13	$1,800,000	100%	$500,000	28.0%
Business Disruption[4]	N/A	N/A	N/A	$200,000	N/A
TOTAL[5]	**13**	**$1,800,000**	**100%**	**$700,000**	**39.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 23: Town of Oakland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	15%	$600,000	$300,000	$0	$0	0%
1 - 10%	3	23%	$200,000	$70,000	$10,000	$0	2%
10 - 20%	1	8%	$100,000	$100,000	$20,000	$20,000	4%
20 - 30%	1	8%	$30,000	$30,000	$10,000	$10,000	2%
30 - 40%	1	8%	$300,000	$300,000	$100,000	$100,000	20%
40 - 50%	1	8%	$500,000	$500,000	$300,000	$300,000	59%
50% or More	4	31%	$100,000	$30,000	$70,000	$20,000	14%
TOTAL	**13**	**100%**	**$1,830,000**	**$100,000**	**$510,000**	**$40,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Oakland

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date October 2, 2013), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Building codes
- Participation in the NFIP Community Rating System (CRS)
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and their natural functions. Examples include:

- Wetland protection

- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 24 below identifies possible mitigation actions for each AoMI to consider.

Table 24: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***

AoMI	Possible Actions to Reduce Flood Risk
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	• ***2018 Garrett County Acquisitions*** o ***4 flood-prone properties acquired and demolished*** *2018 Garrett County Hazard Mitigation Plan Update*

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?

- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?
- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

The *2018 Garrett County Hazard Mitigation Plan* – Chapter 22 Mitigation Strategies identifies and prioritizes mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 25 below.

Table 25: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application

requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood

corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.
Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) as amended,
https://www.fema.gov/media-library-data/1490360363533a531e65a3e1e63b8b2cfb7d3da7a785c/Stafford_ActselectHSA2016

FEMA, *Presidential and Emergency Declarations by State*, https://www.fema.gov/disasters

FEMA, Digital Flood Insurance Rate Maps (DFIRMS), https://www.fema.gov/msc

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.
FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Western Region Representative:
Amy C. M. Stonebreaker, Planner, Floodplain Manager
Allegany County Office of Land Development Services
701 Kelly Road, Cumberland, MD 21502
https://gov.allconet.org/227/Land-Development-Services

Garrett County Department of Emergency Services
771 Airport Road, McHenry, MD 21541
https://www.garrettcounty.org/emergency-services

Garrett County Department of Planning and Land Management
Frederick A. Thayer III Courthouse - Administrative Building – Room 208
203 South Fourth Street, Oakland, MD 21550
https://www.garrettcounty.org/planning-land-development

Garrett County Department of Public Works
2008 Maryland Highway, Suite 2, Mt. Lake Park, MD 21550
https://www.garrettcounty.org/navigation/NDI=

Garrett County Department of Planning and Land Management – GIS Division
Frederick A. Thayer III Courthouse - Administrative Building – Room 208
203 South Fourth Street, Oakland, MD 21550
https://www.garrettcounty.org/planning-land-development/mapping-services

Source: https://en.wikipedia.org/wiki/Youghiogheny_River_Lake

STATE OF MARYLAND

FLOOD RISK REPORT

GARRETT COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Garrett County, Maryland – Countywide Flood Risk Map (FRM)

Garrett County, Maryland – High Risk Area 1: Youghiogheny River / Snowy Creek Rd – Dollar Losses

Garrett County, Maryland – High Risk Area 1 : Youghiogheny River / Snowy Creek Rd – Percent Losses

Garrett County, Maryland – High Risk Area 2: Steyer Gorman Rd / North Branch Potomac River – Dollar Losses

Garrett County, Maryland – High Risk Area 2: Steyer Gorman Rd / North Branch Potomac River – Percent Losses

Garrett County, Maryland – High Risk Area 3: E Oak St / S 1st St – Dollar Losses

Garrett County, Maryland – High Risk Area 3: E Oak St / S 1st St – Percent Losses

Garrett County, Maryland – High Risk Area 4: Bear Creek / Youghiogheny River Lake – Dollar Losses

Garrett County, Maryland – High Risk Area 4: Bear Creek / Youghiogheny River Creek – Percent Losses

Garrett County, Maryland – High Risk Area 5: Mill Run / Mill Run Rd / Chet Kelly Rd – Dollar Losses

Garrett County, Maryland – High Risk Area 5: Mill Run / Mill Run Rd / Chet Kelly Rd – Percent Losses

Garrett County, Maryland – High Risk Area 6: Spiker Run / Casselman River / Bittinger Rd – Dollar Losses

Garrett County, Maryland – High Risk Area 6: Spiker Run / Casselman River / Bittinger Rd – Percent Lossses

Garrett County, Maryland – High Risk Area 7: Bear Pen Run / Savage River Rd / Bear Pen Run Natural Area – Dollar Losses

Garrett County, Maryland – High Risk Area 7: Bear Pen Run / Savage River Rd / Bear Pen Run Natural Area – Percent Losses

Garrett County, Maryland – High Risk Area 8: Savage River / South Savage Mountain Natural Area – Dollar Losses

Garrett County, Maryland – High Risk Area 8: Savage River / South Savage Mountain Natural Area – Percent Losses

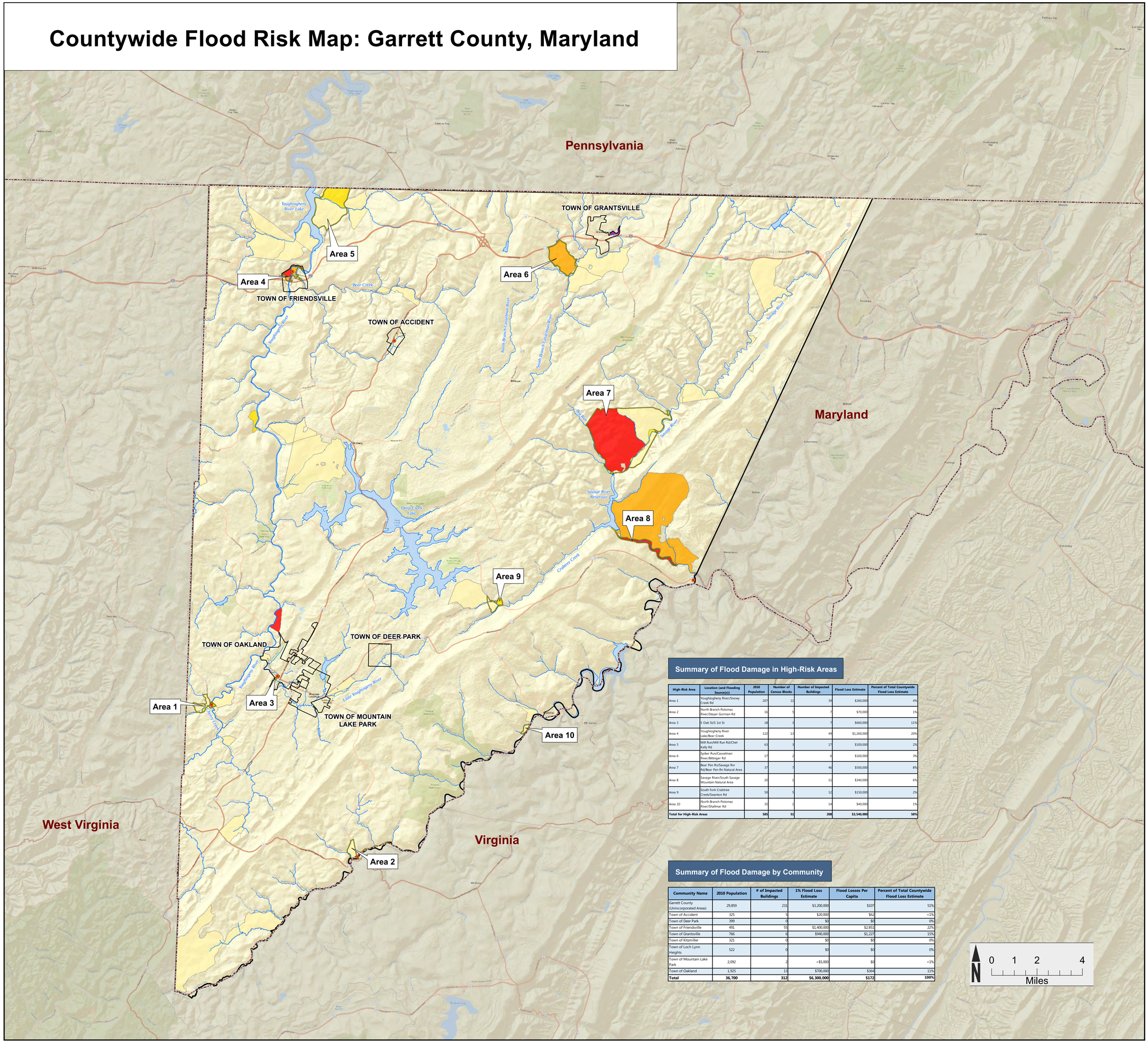
Garrett County, Maryland – High Risk Area 9: South Fork Crabtree Creek / Swanton Rd – Dollar Losses

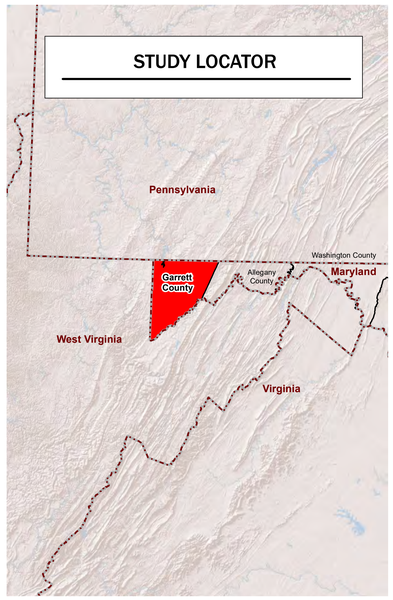
Garrett County, Maryland – High Risk Area 9: South Fork Crabtree Creek / Swanton Rd – Percent Losses

Garrett County, Maryland – High Risk Area 10: Shallmar Rd / North Branch Potomac River – Dollar Losses

Garrett County, Maryland – High Risk Area 10: Shallmar Rd / North Branch Potomac River – Percent Losses

Countywide Flood Risk Map: Garrett County, Maryland





MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area* (Area 1)

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk Government Facility

Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location (and Flooding Source(s))	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Youghiogheny River/Snowy Creek Rd	207	11	39	$260,000	4%
Area 2	North Branch Potomac River/Steyer Gorman Rd	16	9	7	$70,000	1%
Area 3	E Oak St/S 1st St	18	3	7	$660,000	11%
Area 4	Youghiogheny River Lake/Bear Creek	122	13	49	$1,260,000	20%
Area 5	Mill Run/Mill Run Rd/Chet Kelly Rd	63	3	17	$100,000	2%
Area 6	Spiker Run/Casselman River/Bittinger Rd	17	2	6	$160,000	3%
Area 7	Bear Pen Rn/Savage Rvr Rd/Bear Pen Rn Natural Area	37	7	46	$500,000	8%
Area 8	Savage River/South Savage Mountain Natural Area	20	1	11	$340,000	6%
Area 9	South Fork Crabtree Creek/Swanton Rd	50	5	12	$150,000	2%
Area 10	North Branch Potomac River/Shallmar Rd	35	1	14	$40,000	1%
Total for High-Risk Areas		**585**	**51**	**208**	**$3,540,000**	**58%**

Summary of Flood Damage by Community

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Garrett County (Unincorporated Areas)	29,859	231	$3,200,000	$107	51%
Town of Accident	325	5	$20,000	$62	<1%
Town of Deer Park	399	0	$0	$0	0%
Town of Friendsville	491	55	$1,400,000	$2,851	22%
Town of Grantsville	766	6	$940,000	$1,227	15%
Town of Kitzmiller	321	0	$0	$0	0%
Town of Loch Lynn Heights	522	0	$0	$0	0%
Town of Mountain Lake Park	2,092	2	<$5,000	$0	<1%
Town of Oakland	1,925	13	$700,000	$364	11%
Total	**36,700**	**312**	**$6,300,000**	**$172**	**100%**

N 0 1 2 4 Miles

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

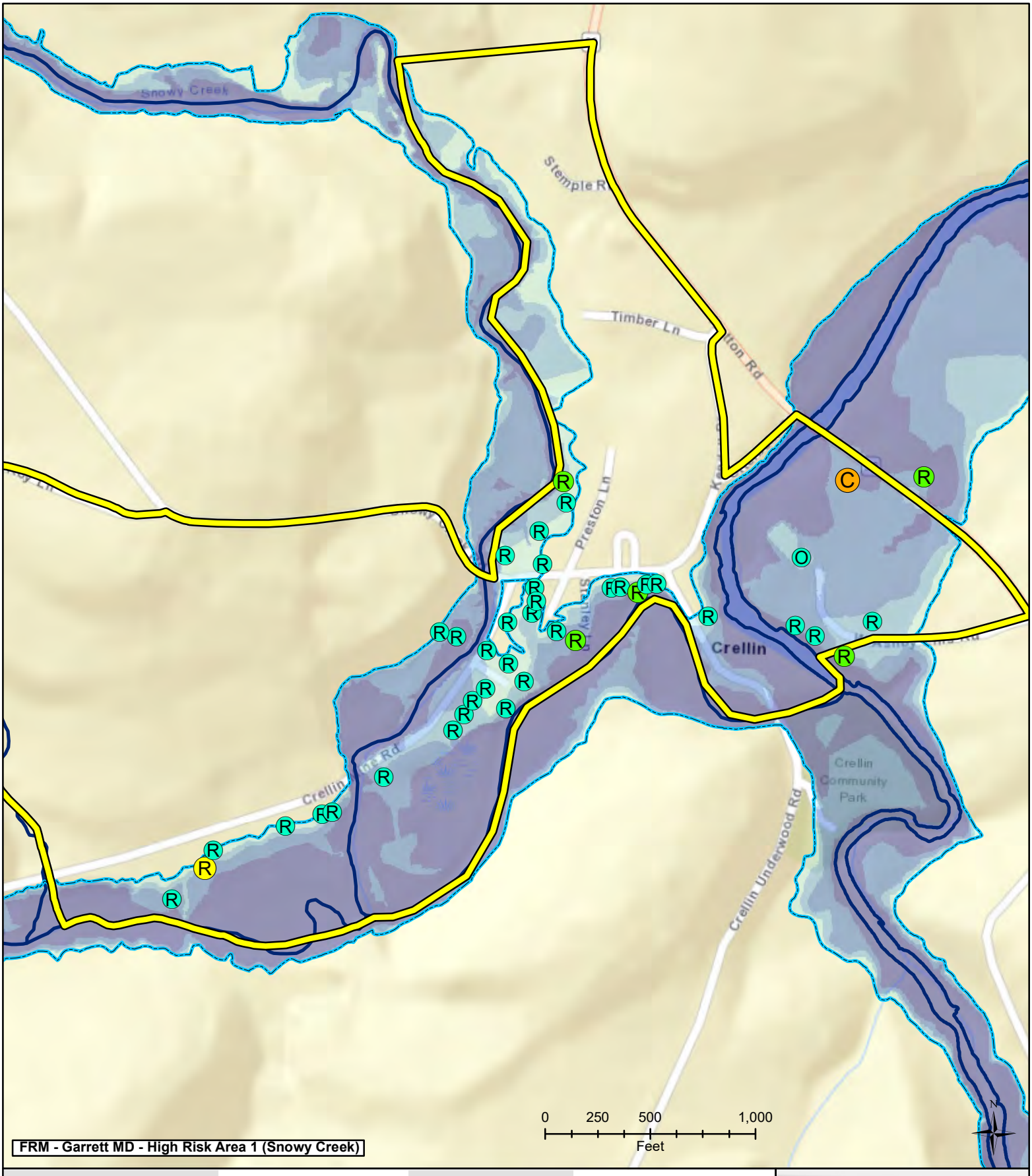
Garrett County and Incorporated Areas, MD

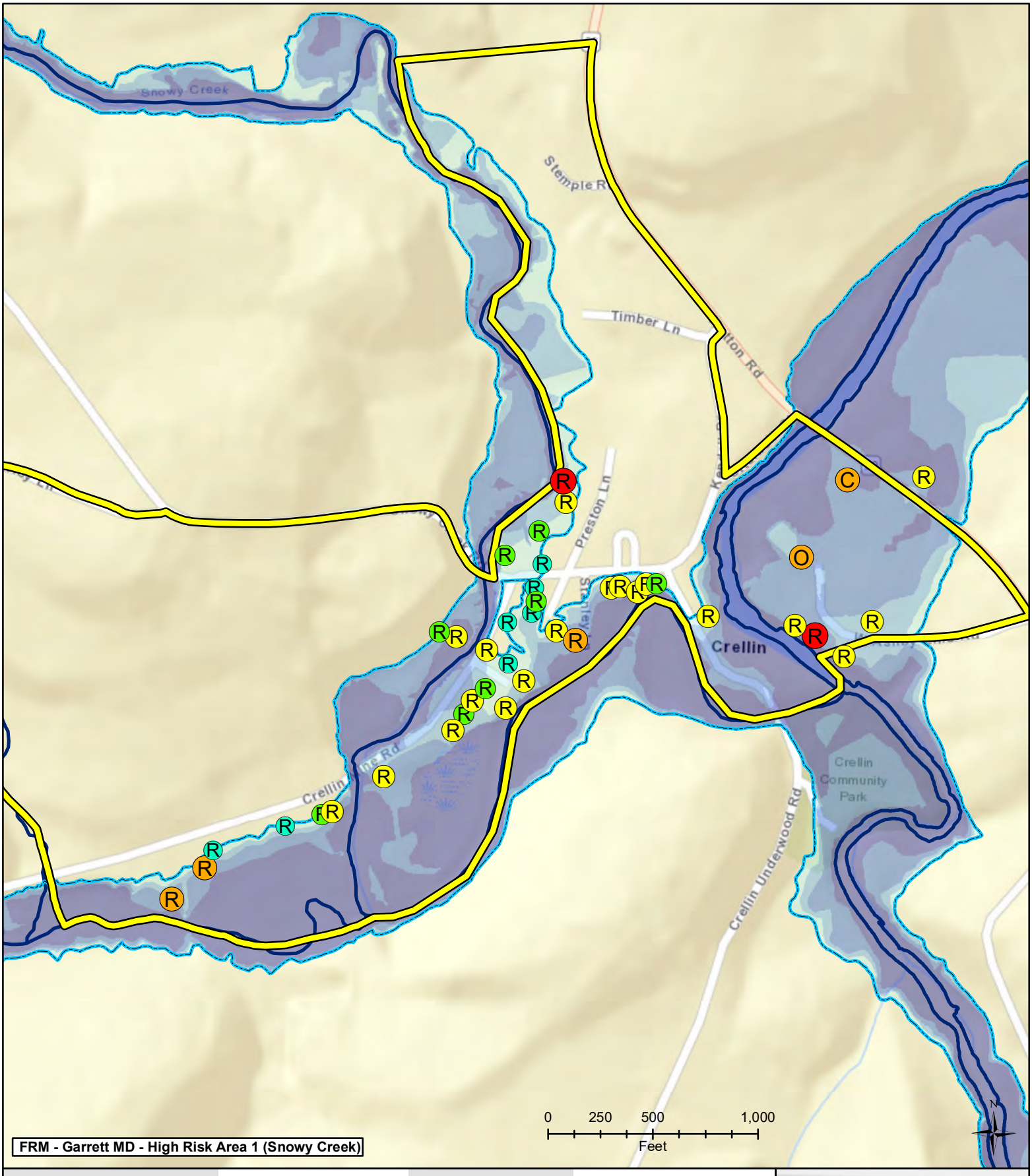
MARYLAND

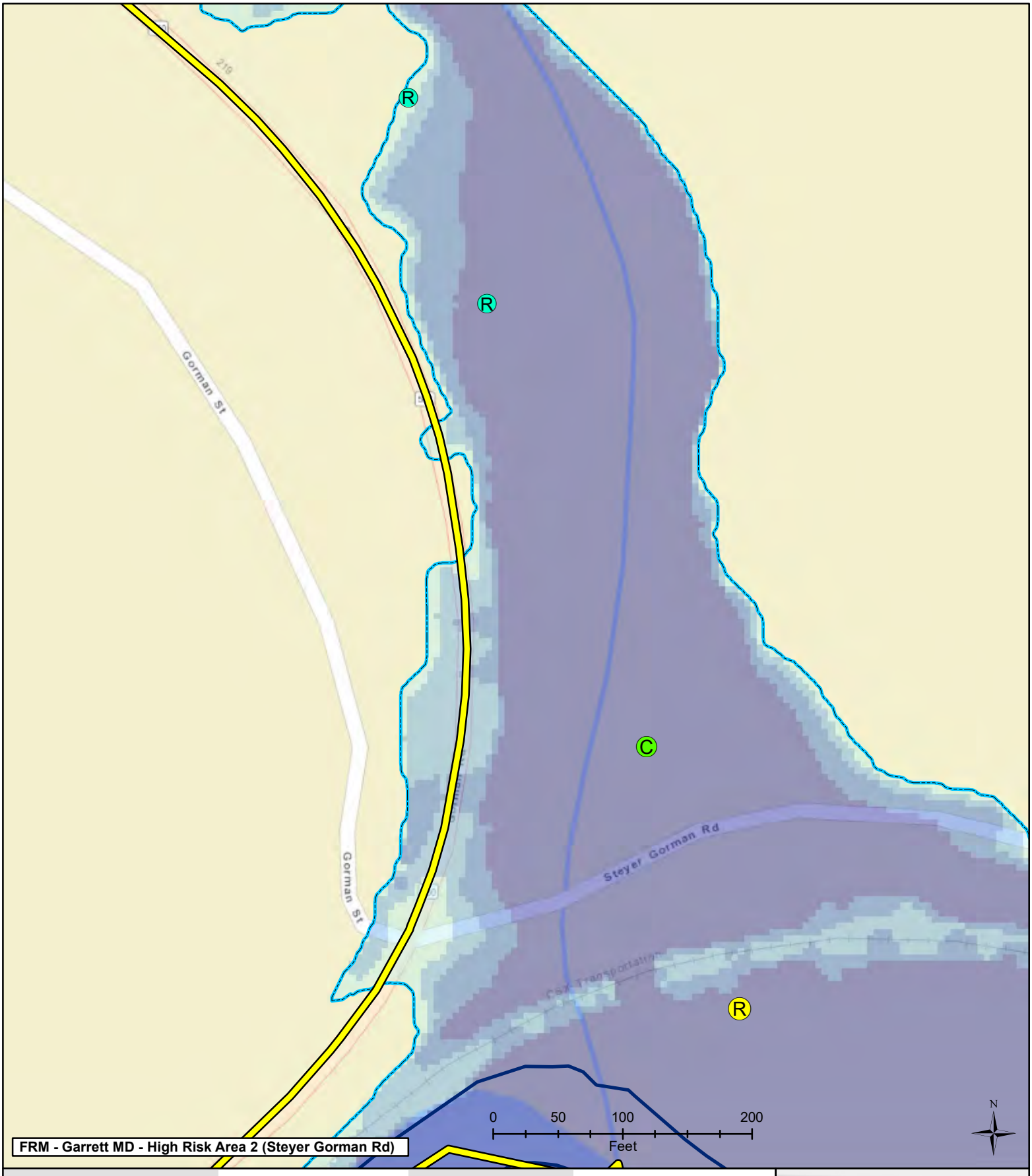
FEMA

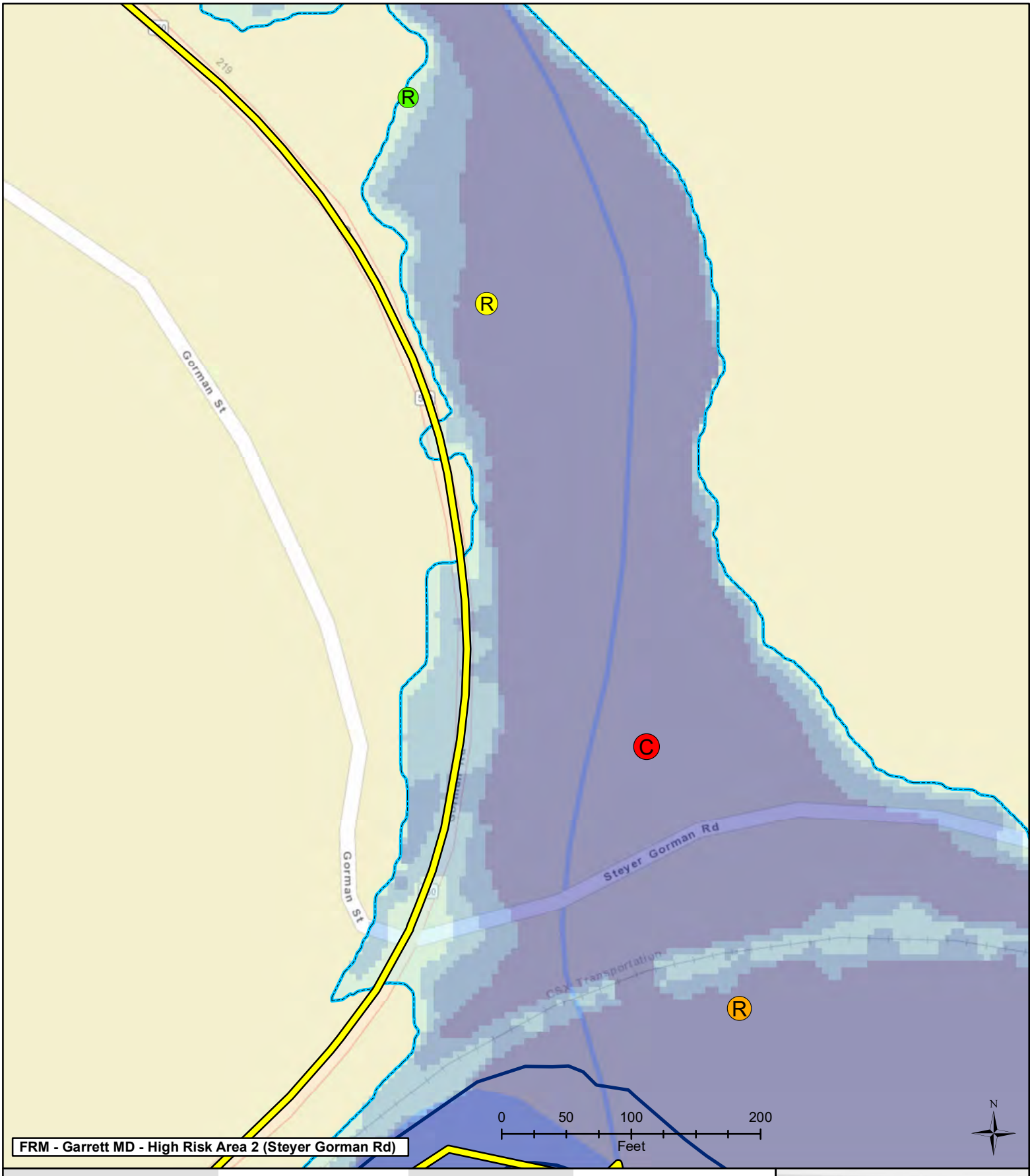
This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Garrett County, MD.

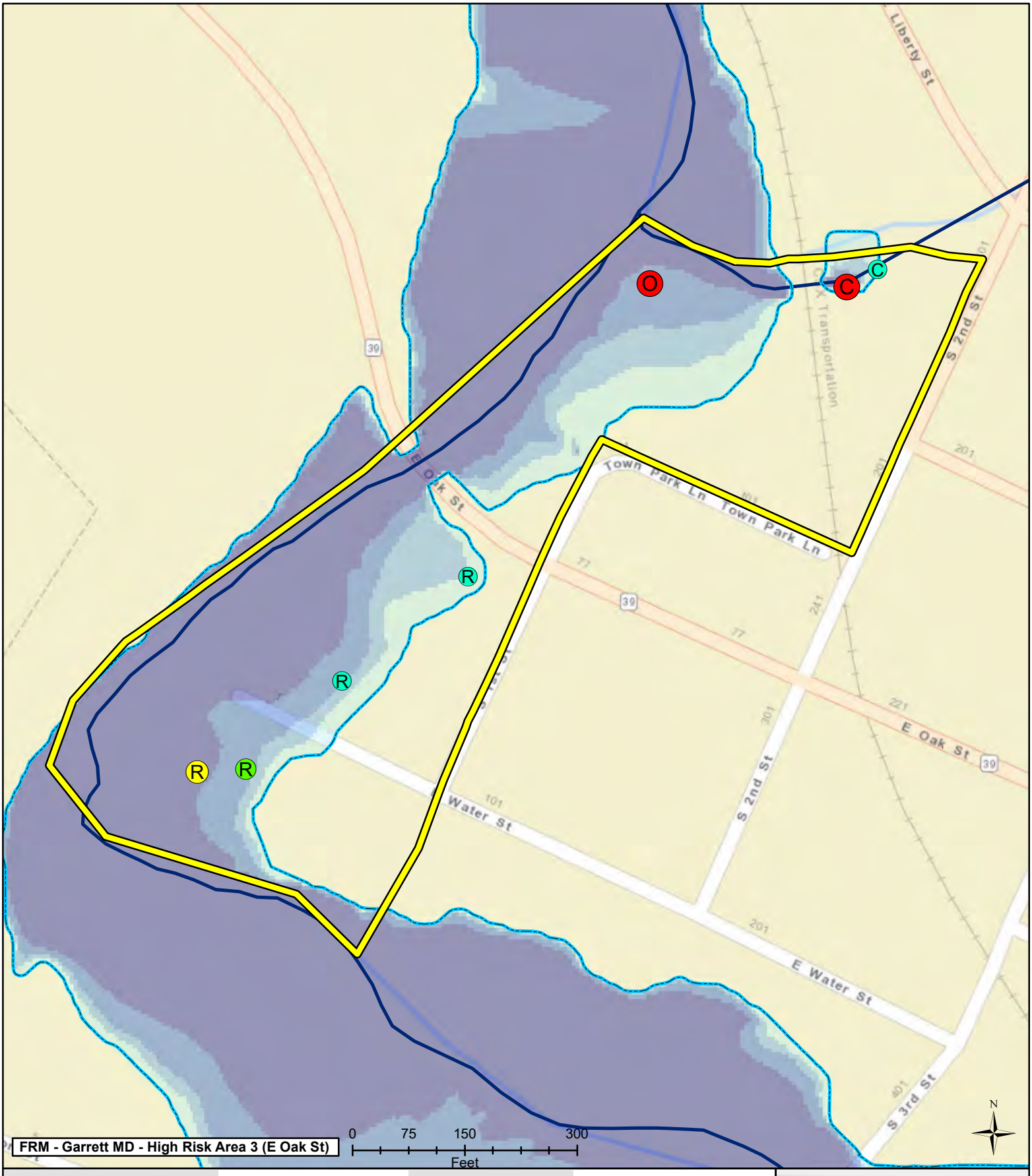
RELEASE DATE
12/31/2019

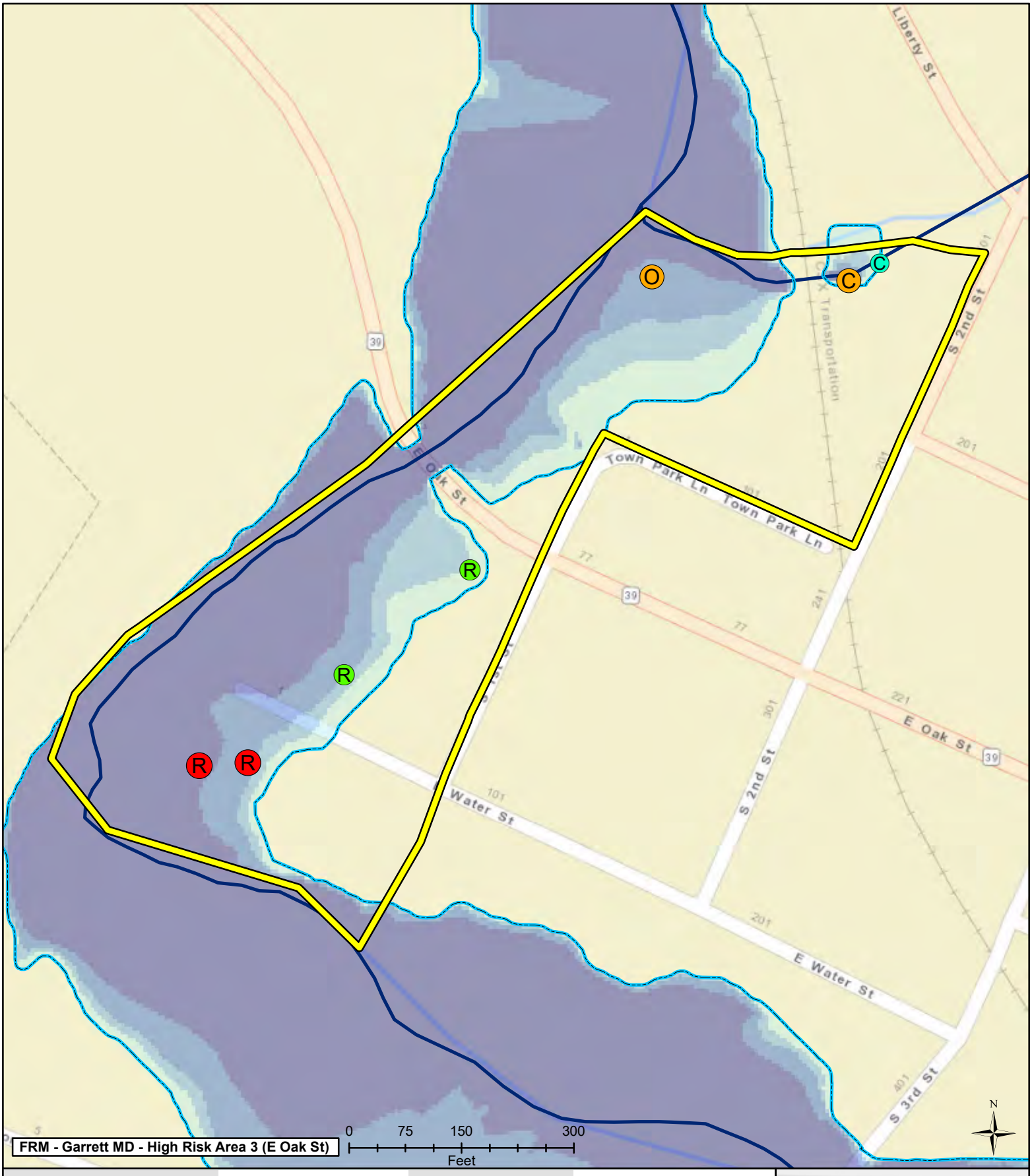

Snowy Creek
Stemple R
Timber Ln
Preston Ln
Crellin
Crellin Community Park
Crellin Underwood Rd
0
250
500
1,000
Feet
FRM - Garrett MD - High Risk Area 1 (Snowy Creek)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Garrett County
Map Extent


Snowy Creek
Stemple R
Timber Ln
Preston Ln
Crellin
Crellin Community Park
Crellin Underwood Rd
0
250
500
1,000
Feet
FRM - Garrett MD - High Risk Area 1 (Snowy Creek)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Garrett County
Map Extent


R
R
C
R
Gorman St
Gorman St
Steyer Gorman Rd
0
50
100
200
Feet
N
FRM - Garrett MD - High Risk Area 2 (Steyer Gorman Rd)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Garrett County
Map Extent


R
R
C
R
Gorman St
Gorman St
Steyer Gorman Rd
CSX Transportation
0
50
100
200
Feet
N
FRM - Garrett MD - High Risk Area 2 (Steyer Gorman Rd)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Garrett County
Map Extent


E Oak St
Water St
S 2nd St
S 3rd St
Town Park Ln
Liberty St
E Water St
O
C
C
R
R
R
R
FRM - Garrett MD - High Risk Area 3 (E Oak St)
0
75
150
300
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Garrett County



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

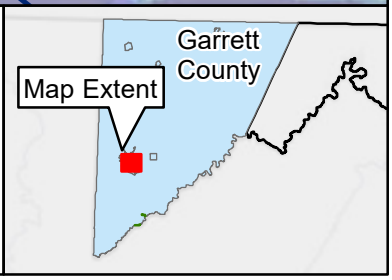
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

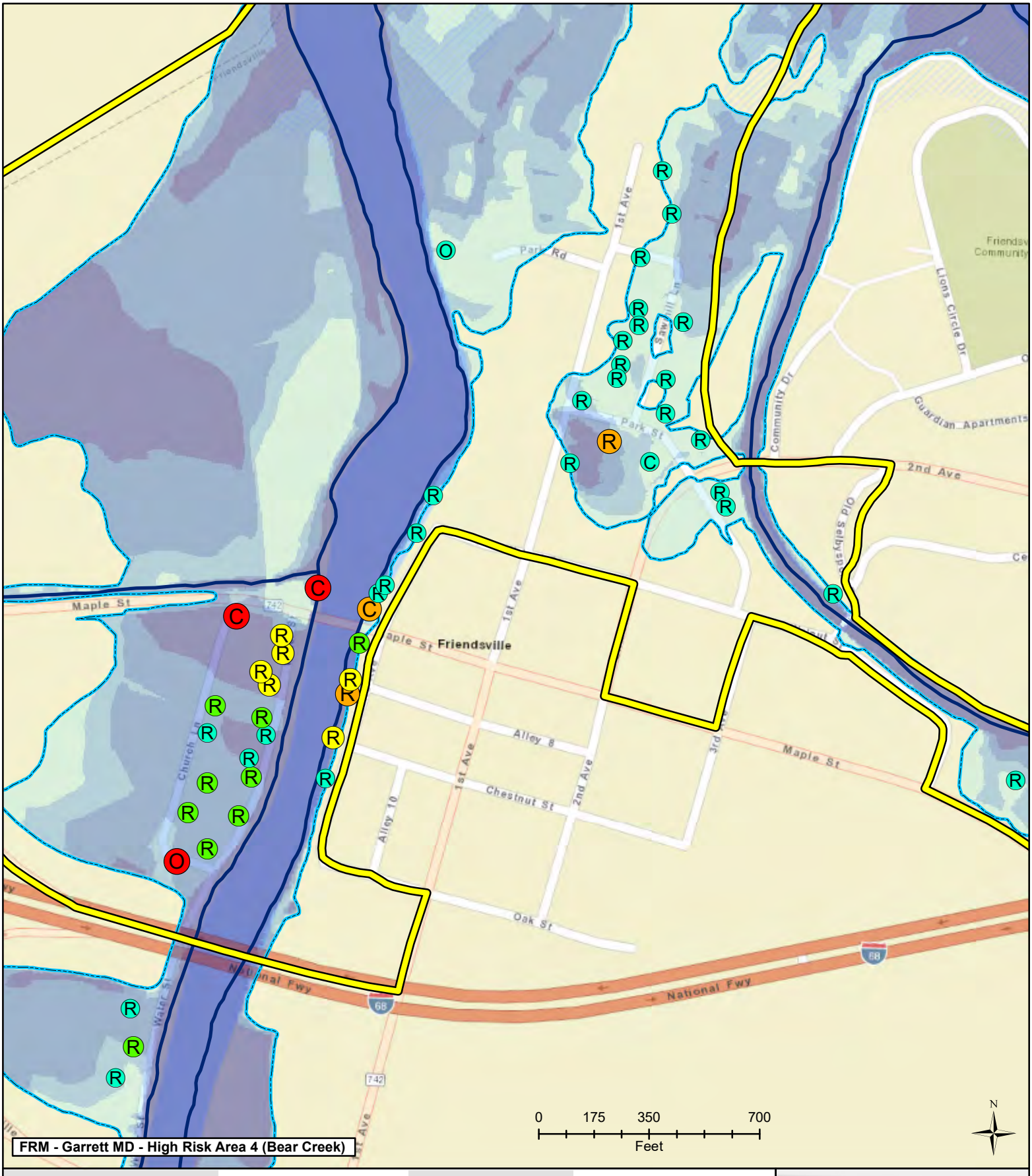
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

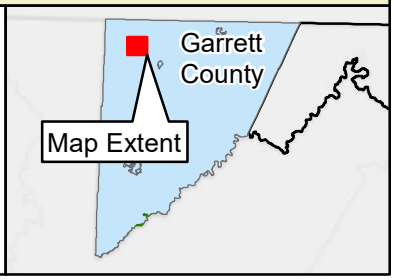
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

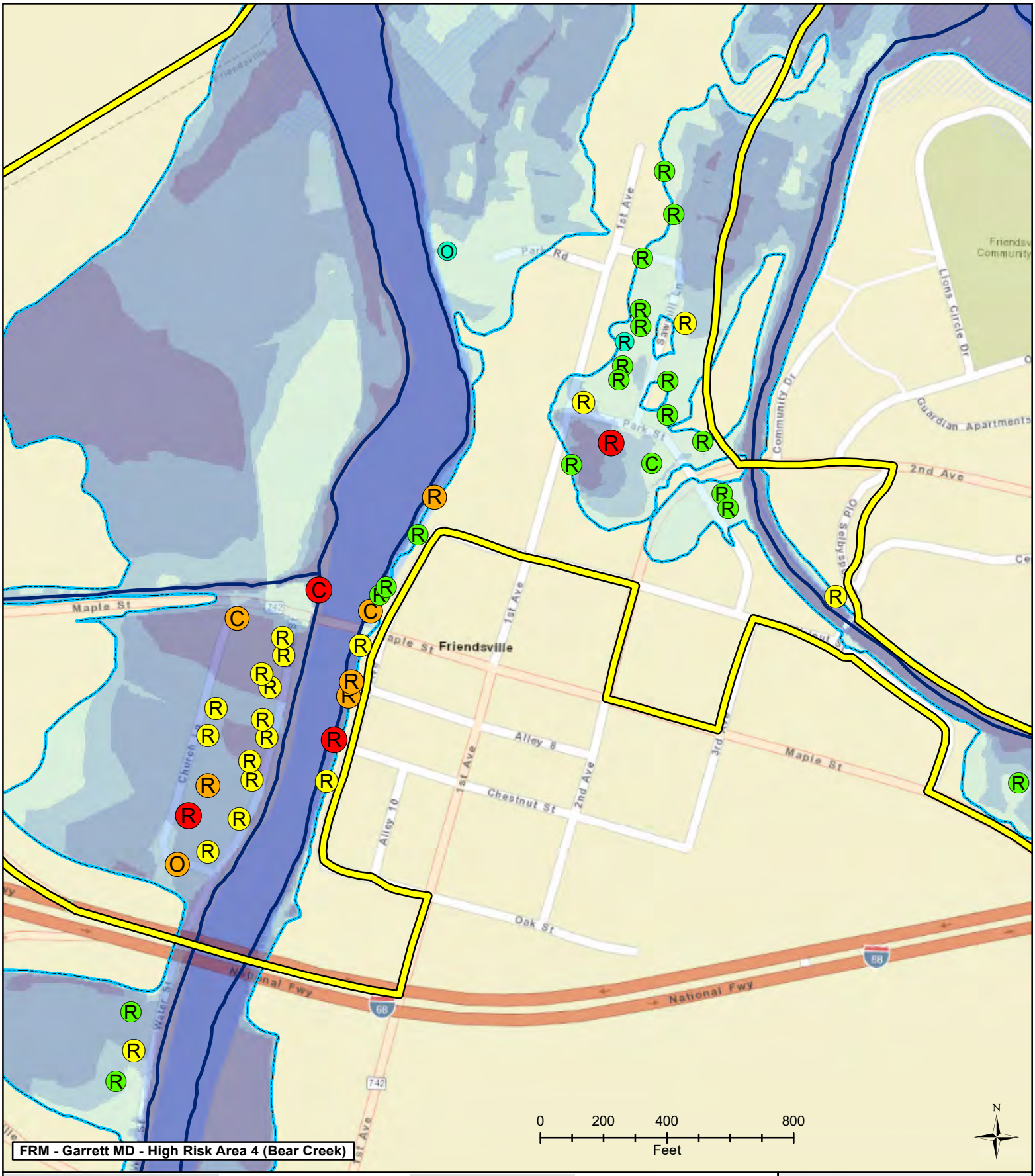
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

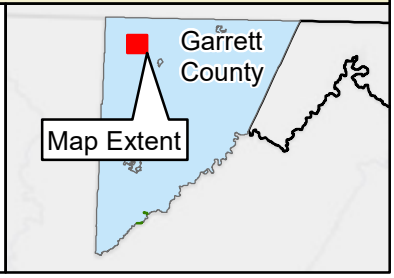
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category

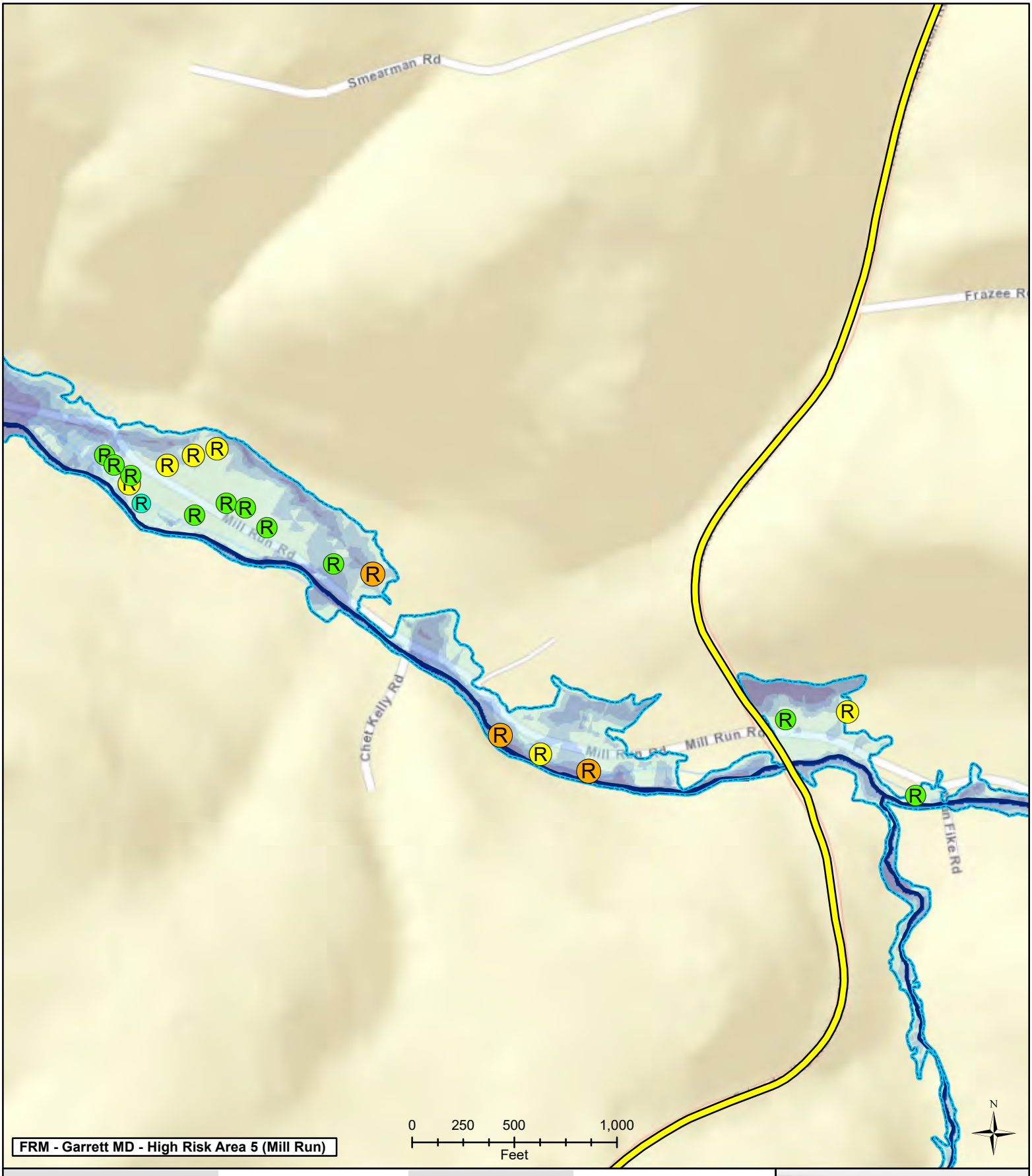
- (R) Residential
- (C) Commercial
- (O) Other

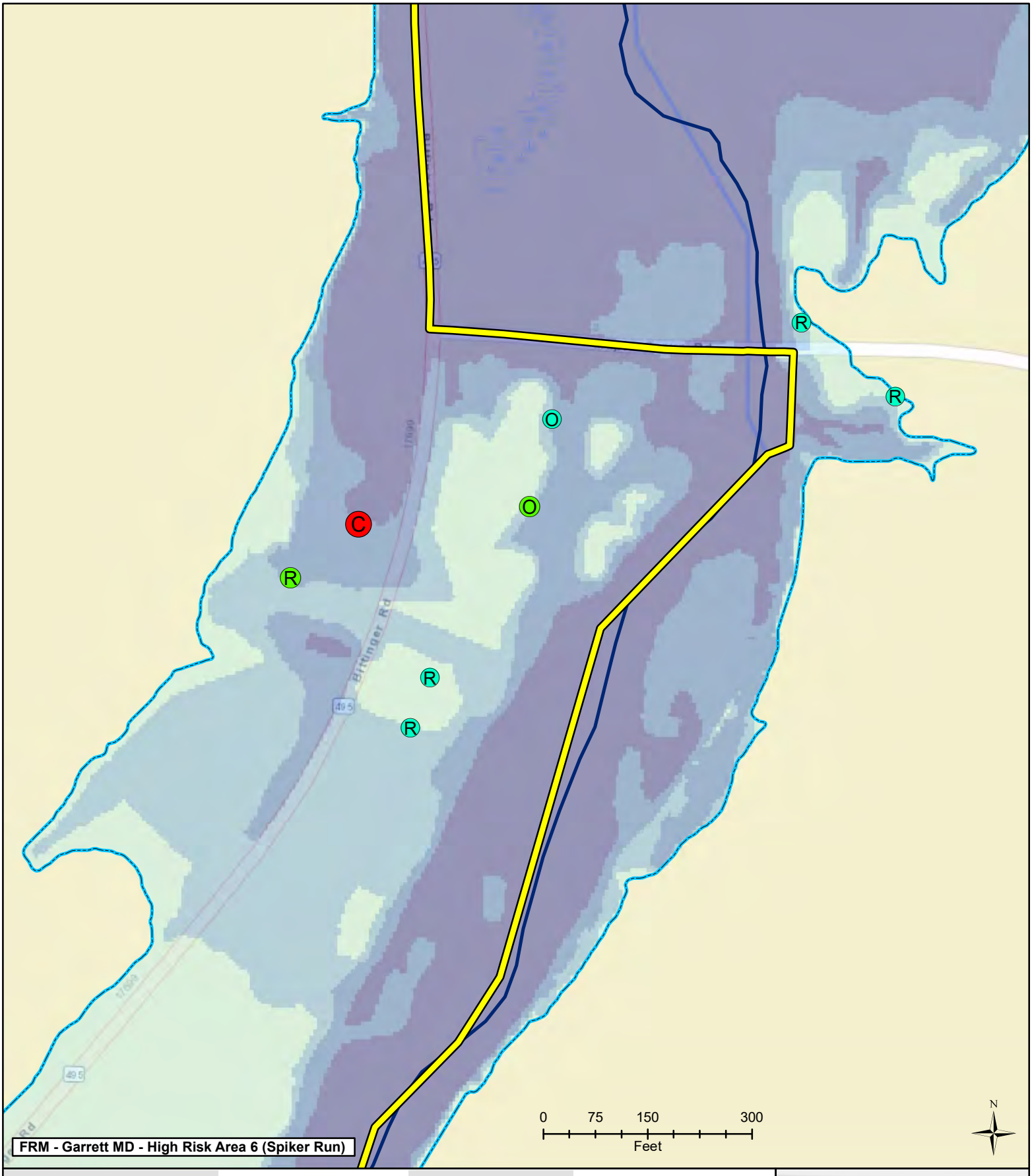
UDF Flood Loss Estimates

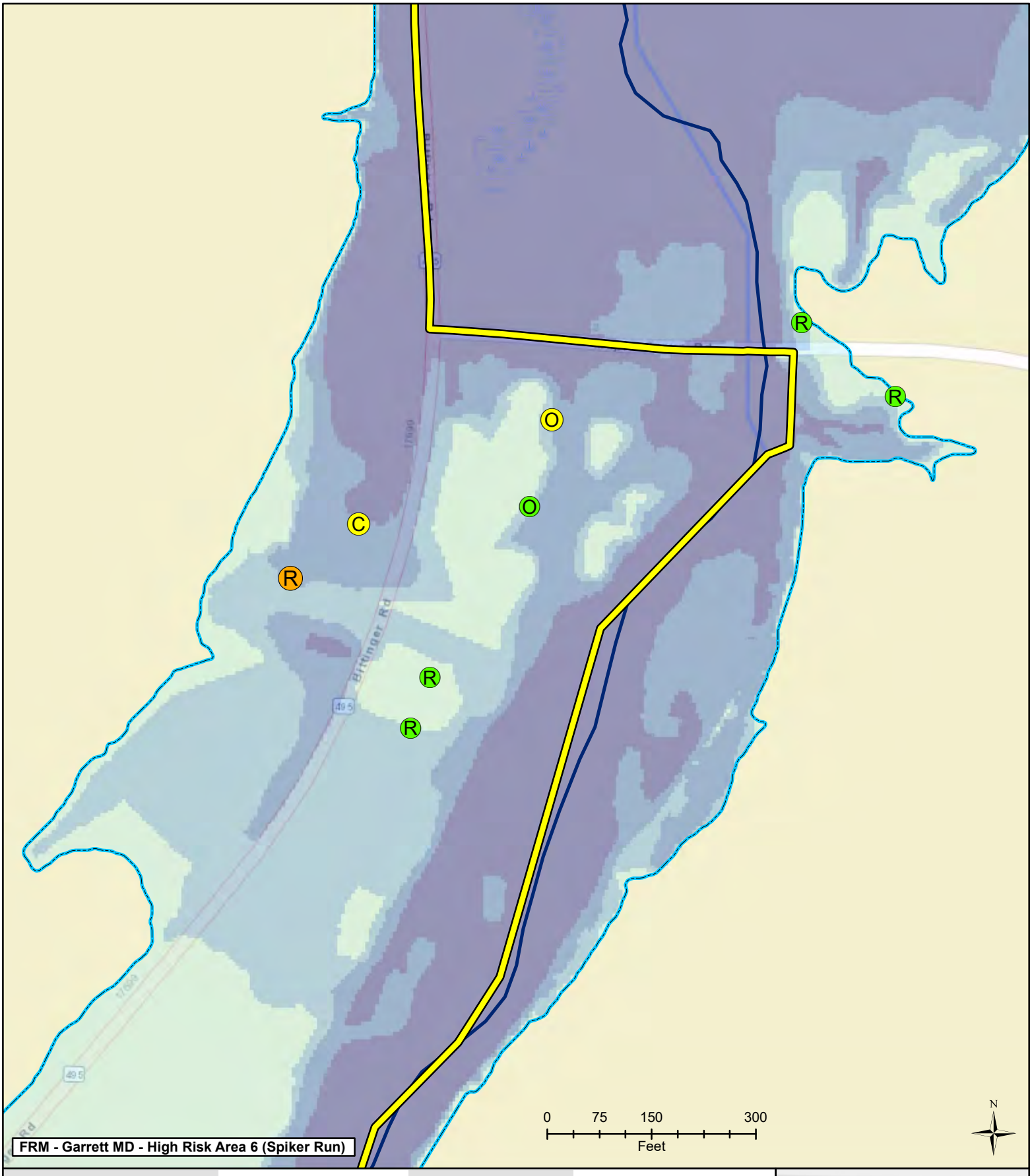
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More

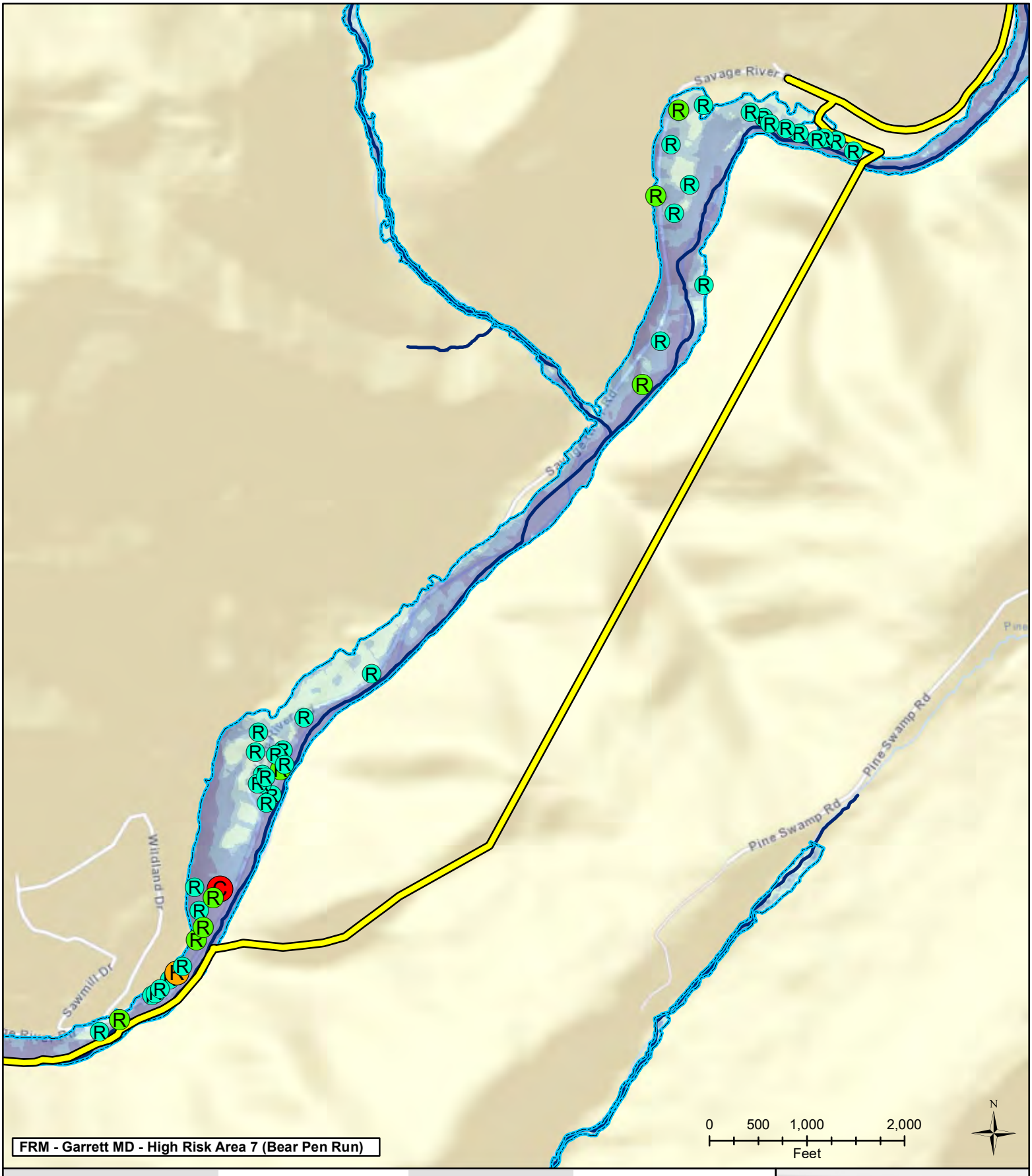


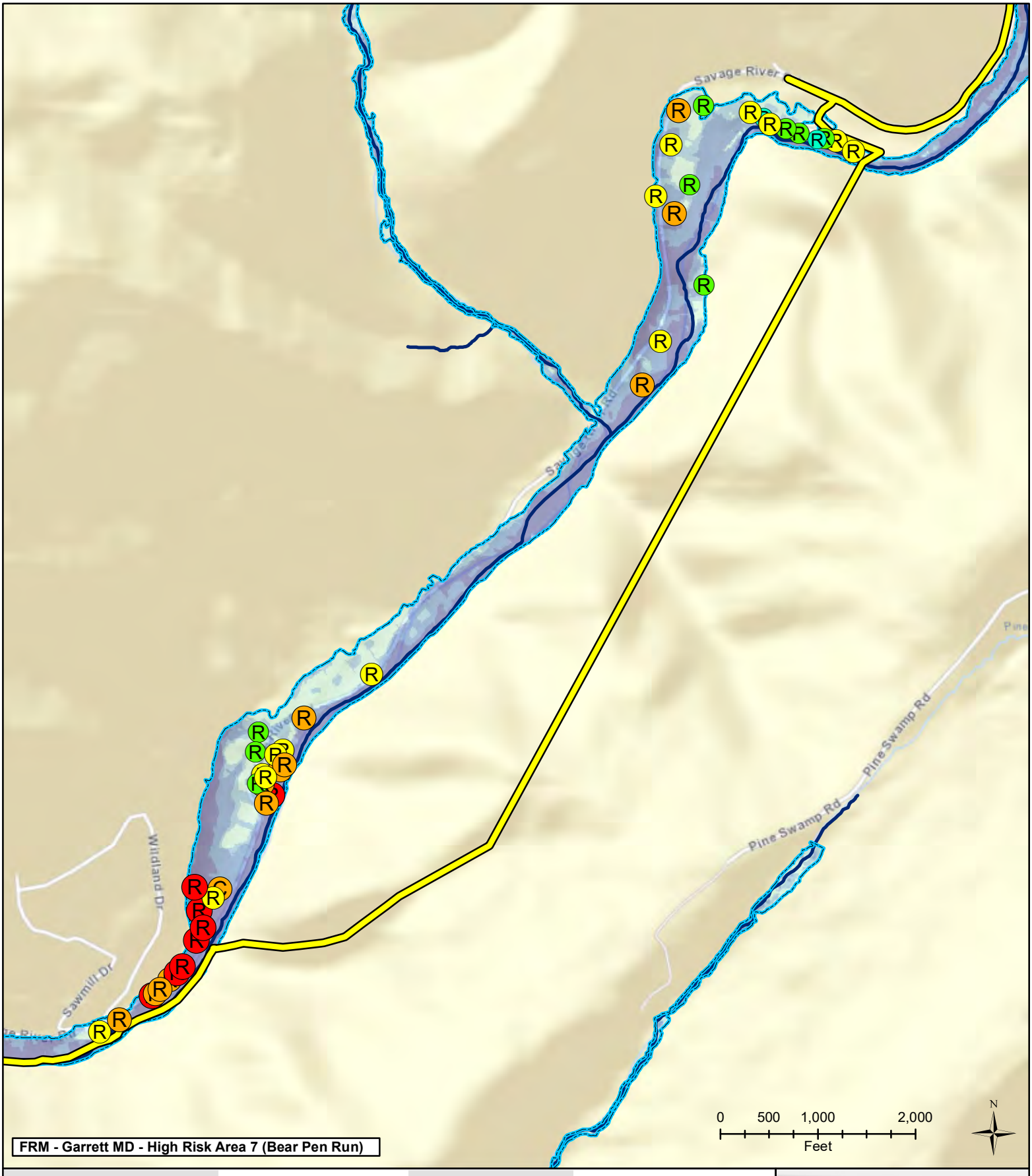
Smearman Rd
Frazee R
Mill Run Rd
Chet Kelly Rd
Mill Run Rd
Mill Run Rd
Fike Rd
R
0
250
500
1,000
Feet
N
FRM - Garrett MD - High Risk Area 5 (Mill Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Garrett County

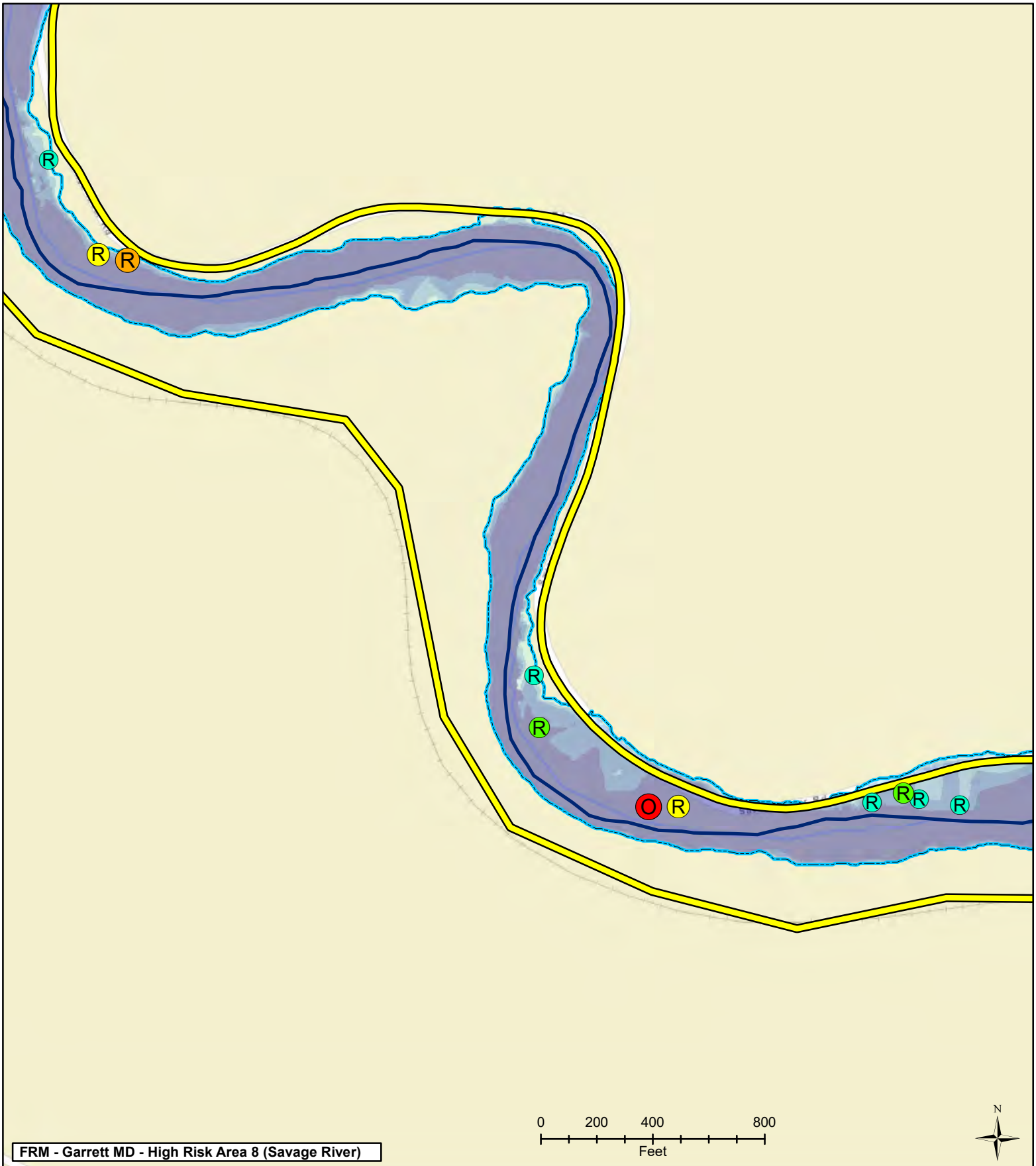

Smearman Rd
Frazee R
Mill Run Rd
Chet Kelly Rd
Mill Run Rd
Mill Run Rd
Fike Rd
R
C
O
0
250
500
1,000
Feet
N
FRM - Garrett MD - High Risk Area 5 (Mill Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Garrett County


R
R
O
O
C
R
R
R
Bittinger Rd
0
75
150
300
Feet
N
FRM - Garrett MD - High Risk Area 6 (Spiker Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Garrett County


R
R
O
O
C
R
R
R
Bittinger Rd
495
495
0
75
150
300
Feet
N
FRM - Garrett MD - High Risk Area 6 (Spiker Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Garrett County


Savage River
Pine Swamp Rd
Pine Swamp Rd
Sawmill Dr
Wildland Dr
FRM - Garrett MD - High Risk Area 7 (Bear Pen Run)
0
500
1,000
2,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Garrett County


Savage River
Pine Swamp Rd
Pine Swamp Rd
Sawmill Dr
Wildland Dr
0
500
1,000
2,000
Feet
N
FRM - Garrett MD - High Risk Area 7 (Bear Pen Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Garrett County



0 200 400 800
Feet

N

FRM - Garrett MD - High Risk Area 8 (Savage River)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

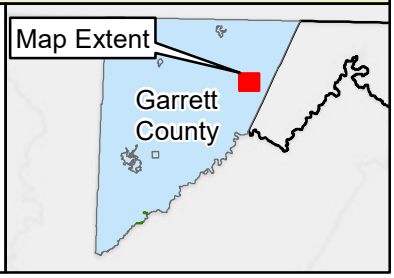
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

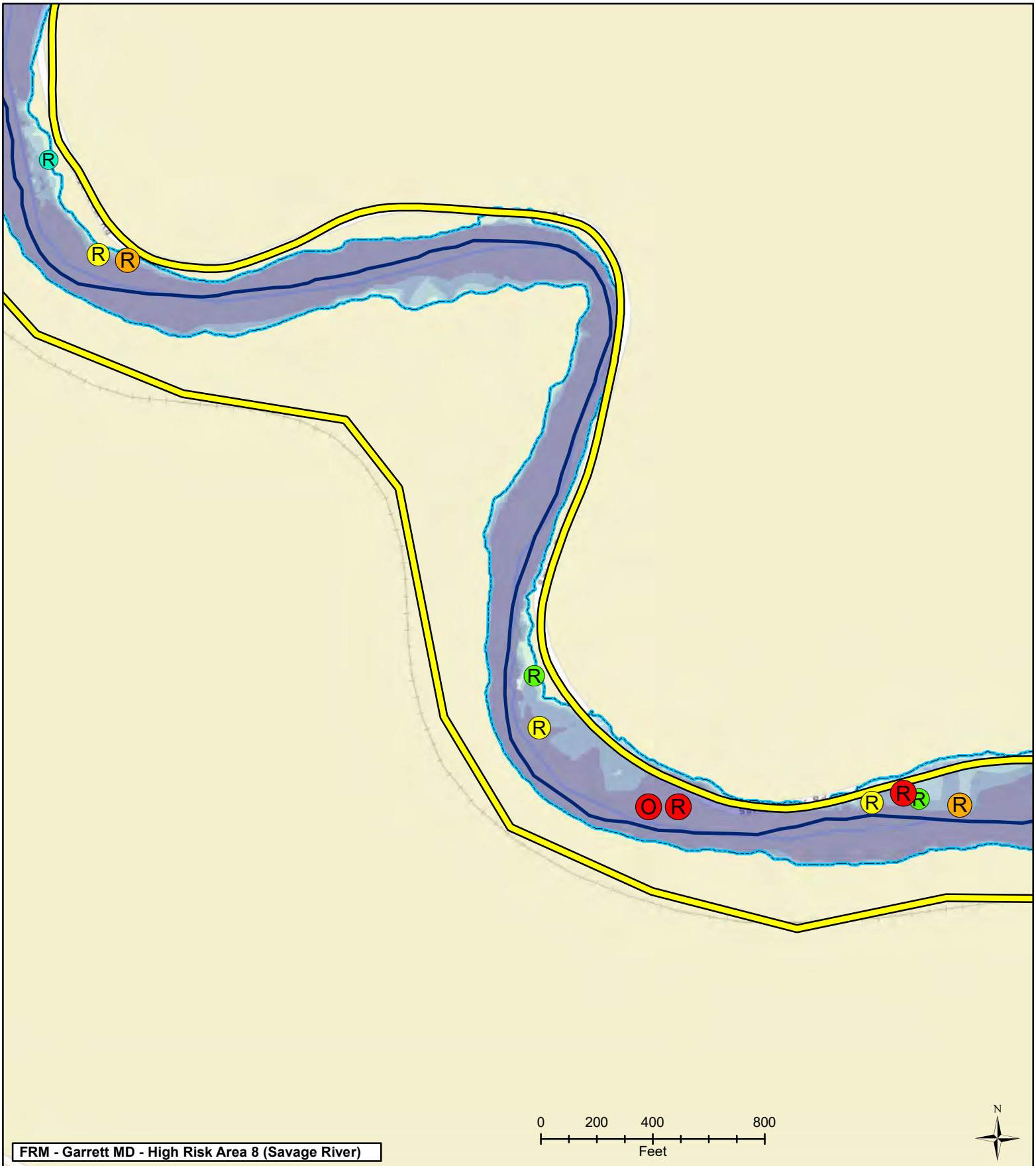
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Garrett MD - High Risk Area 8 (Savage River)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

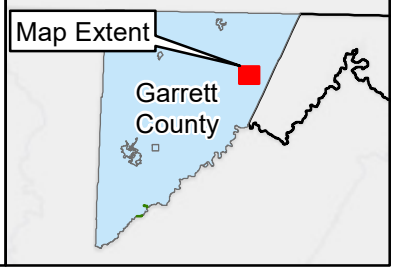
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More



FRM - Garrett MD - High Risk Area 9 (South Fork Crabtree Creek)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

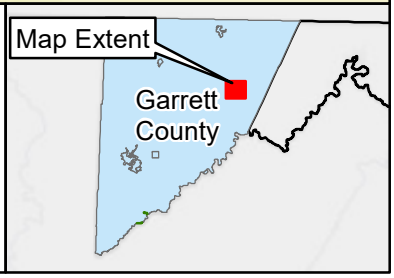
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

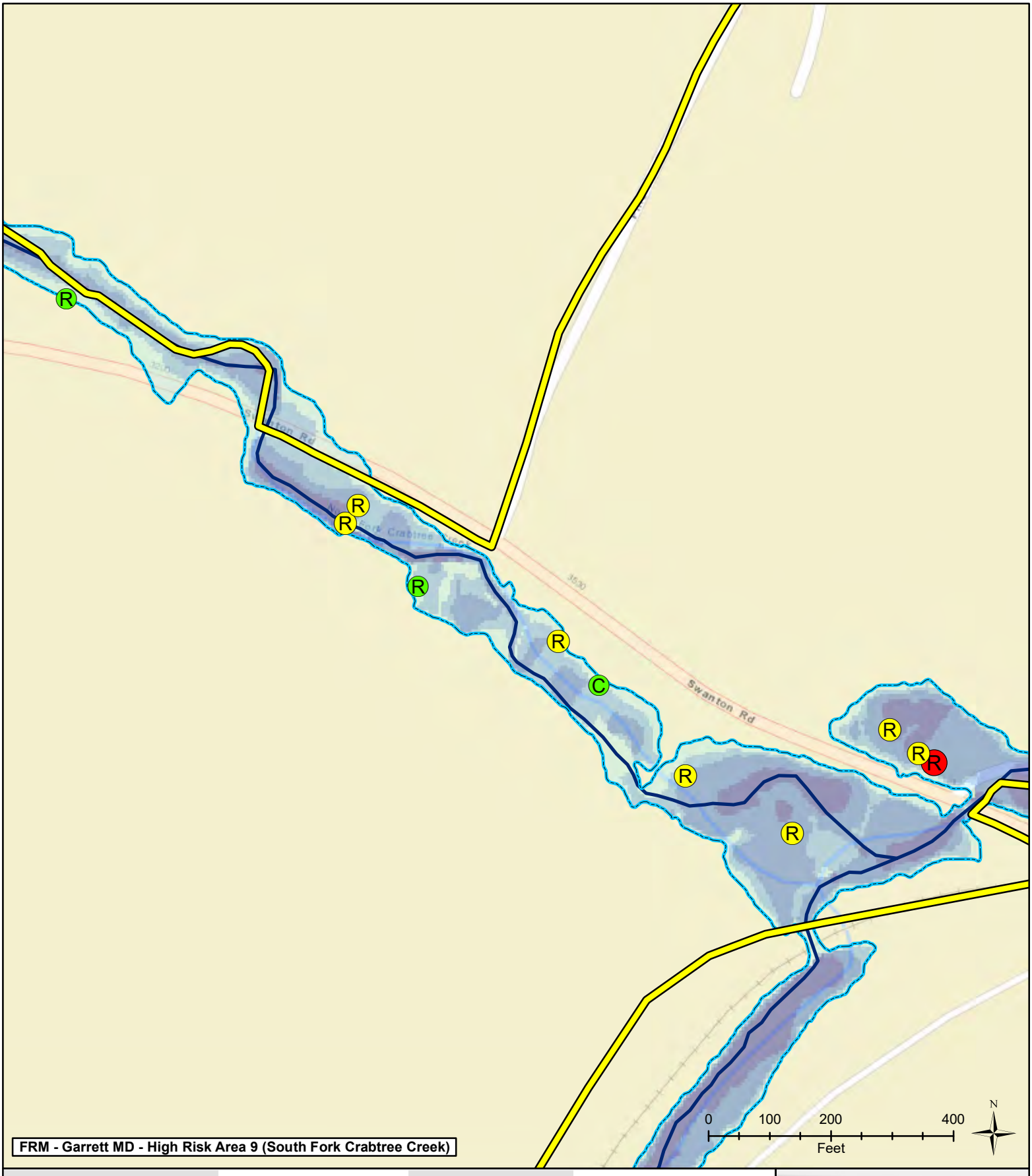
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Garrett MD - High Risk Area 9 (South Fork Crabtree Creek)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

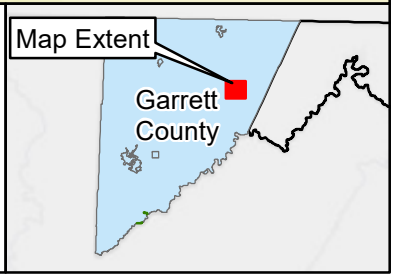
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

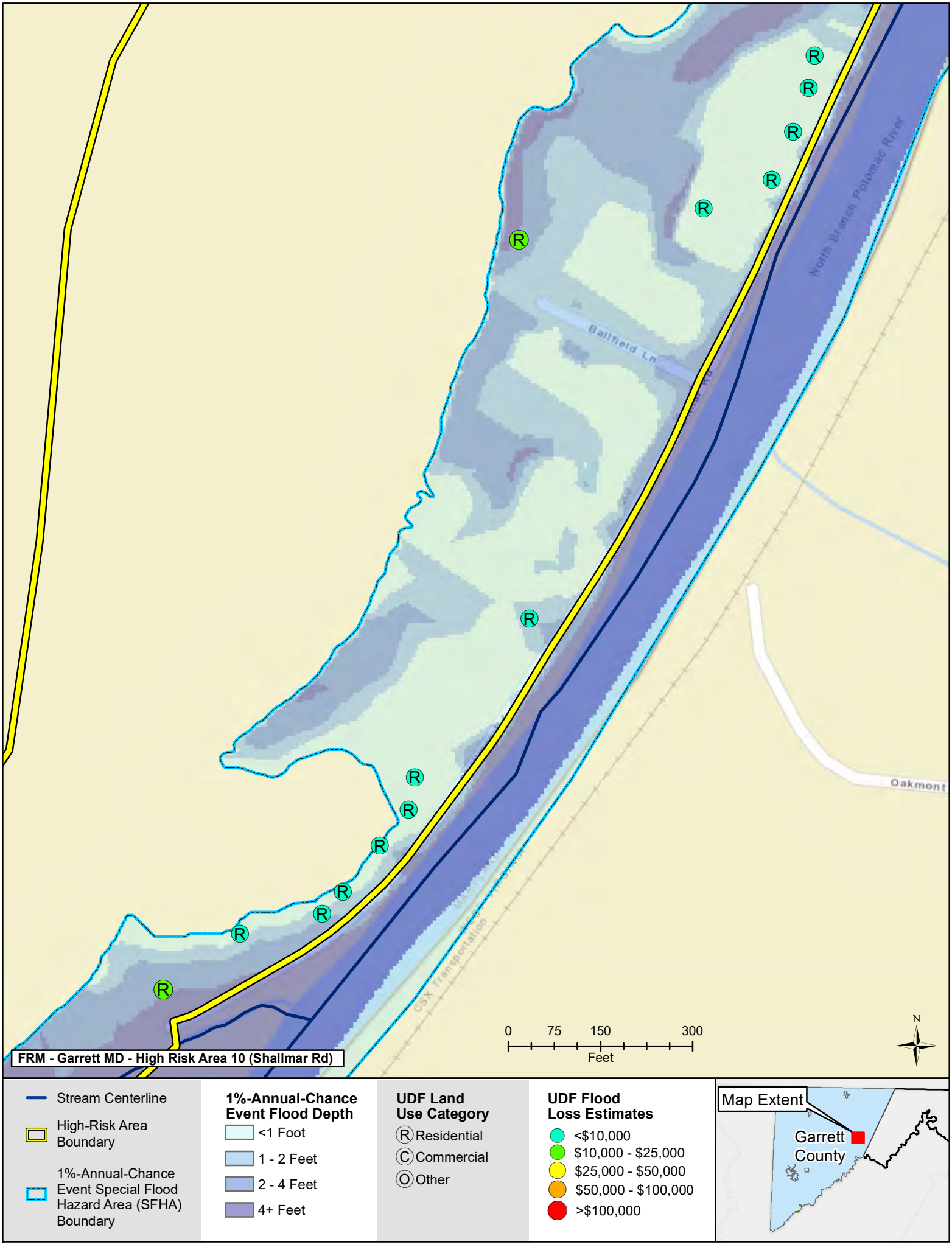
UDF Land Use Category

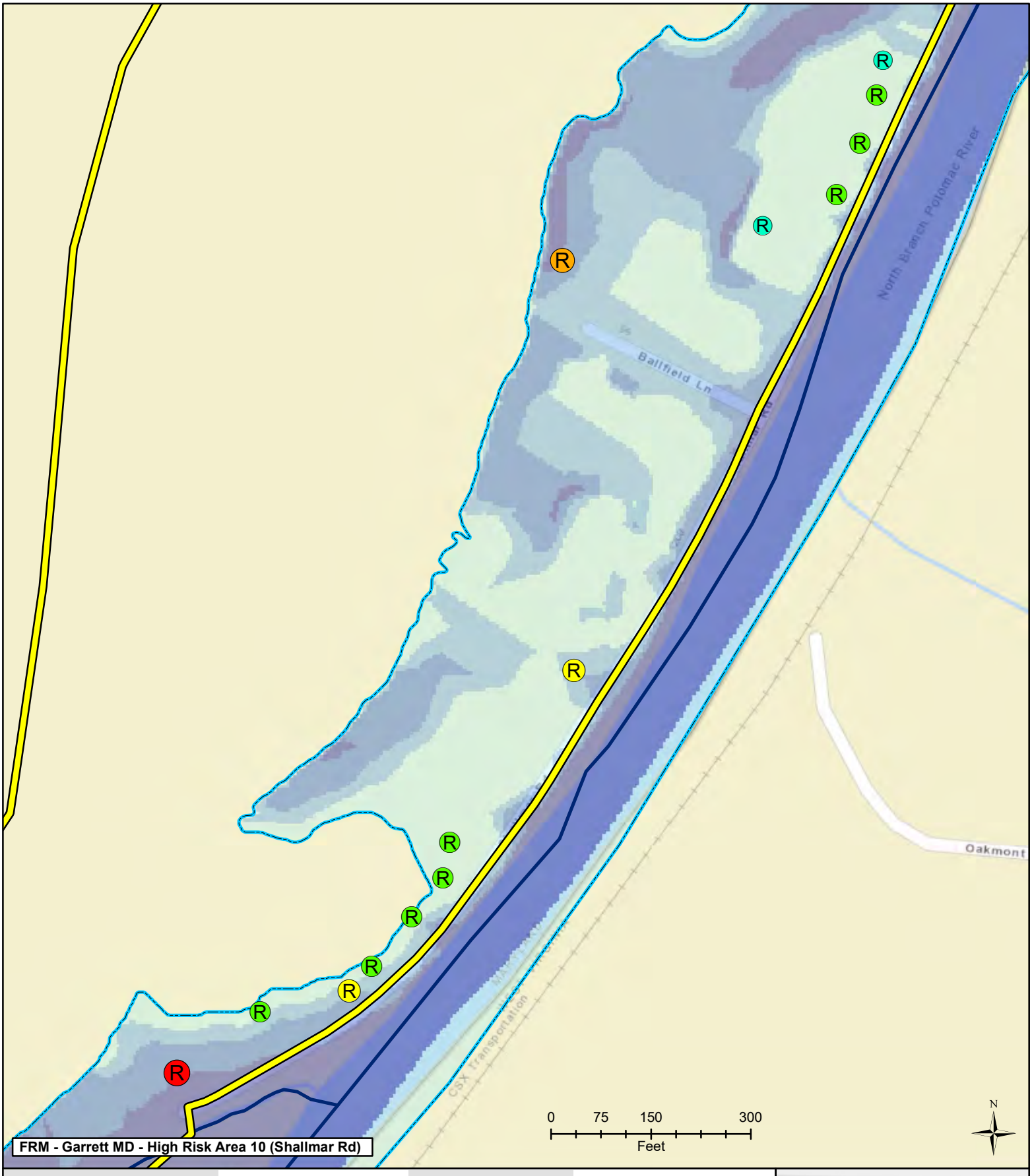
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




North Branch Potomac River
Ballfield Ln
Oakmont
CSX Transportation
R
0
75
150
300
Feet
N
FRM - Garrett MD - High Risk Area 10 (Shallmar Rd)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Garrett County


North Branch Potomac River
Ballfield Ln
Oakmont
CSX Transportation
R
0
75
150
300
Feet
N
FRM - Garrett MD - High Risk Area 10 (Shallmar Rd)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Garrett County

This page left blank intentionally

Source: https://www.MyEasternShore.com

STATE OF MARYLAND

FLOOD RISK REPORT

QUEEN ANNE'S COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Queen Anne's County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Queen Anne's County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Queen Anne's County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 4

d. Related Resources 6

2 Flood Risk Analysis 11

a. Overview 11

b. Analysis of Risk 12

i. Flood Depth and Analysis Grids 12

ii. Flood Risk Assessments 13

iii. Areas of Mitigation Interest 15

3 Flood Risk Analysis Results 27

a. Queen Anne's County, MD Flood Risk Project Area Summary 27

i. Overview 27

ii. Flood Risk Results 28

iii. Flood Risk Maps 37

b. Communities 38

i. Queen Anne's County (Unincorporated Area) (CID 240054) 38

ii. Town of Centreville Summary (CID 240056) 42

iii. Town of Queenstown (CID 240120) 46

4 Actions To Reduce Flood Risk....49

a. Types of Mitigation Actions....49

i. Local Plans and Regulations....49

ii. Structure and Infrastructure Projects....50

iii. Natural Systems Protection Activities....51

iv. Education and Awareness Activities....51

b. Identifying Specific Actions for Your Community....53

c. Mitigation Programs and Assistance....54

i. FEMA Mitigation Programs and Assistance....54

ii. Additional Mitigation Programs and Assistance....55

5 Acronyms And Definitions....56

a. Acronyms....56

b. Definitions....58

6 Additional Resources....62

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Queen Anne's County Essential Facilities 16

Table 2: USACE National Inventory of Dams – Queen Anne's County, MD 18

Table 3: Flood Risk Assessment – Community Overview 28

Table 4: Queen Anne's County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 5: Queen Anne's County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 6: Queen Anne's County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 30

Table 7: Queen Anne's County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas) 32

Table 8: Queen Anne's County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas) 32

Table 9: Queen Anne's County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood (Coastal & Riverine Areas) 34

Table 10: Queen Anne's County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Coastal & Riverine Areas) 35

Table 11: Queen Anne's County, Maryland – Areas of Mitigation Interest 35

Table 12: Queen Anne's County, Maryland – High-Risk Areas 36

Table 13: Queen Anne's County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 39

Table 14a: Queen Anne's County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 40

Table 14b: Queen Anne's County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas).....40

Table 15: Town of Centreville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 43

Table 16a: Town of Centreville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 44

Table 16b: Town of Centreville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 44

Table 17: Town of Queenstown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 47

Table 18: Town of Queenstown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 47

Table 19: Mitigation Actions for Areas of Mitigation Interest.....51

Table 20: FEMA Hazard Mitigation Assistance Programs 54

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Sandfield, near Millington, after Hurricane Irene inundated the community. Source: MyEasternShore.com

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: Sassafras Street in Millington on the Queen Anne's County side of town.

Source: MyEasternShore.com

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: Arrington Road – 10/29/2012, Source: Departments of Emergency Services & Public Works

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 33 to 35.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk

- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (effective November 5, 2014), provided by FEMA Region III and Maryland Department of the Environment.
- Non-regulatory coastal flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were previously developed in conjunction with the November 5, 2014 regulatory FIRM update. These products were published to the FEMA Map Service Center on June 30, 2015 and have been leveraged as part of this countywide assessment.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of October 2017), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/. Note that first floor elevations are not specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordinances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructed after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

- Building footprints, representing real-world locations for addressable structures, provided by Queen Anne's County Geographic Information Systems– https://www.qac.org/912/GIS-Data-Download *(Limited Distribution; data available by purchase/ request).*

- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.

- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Subsection ii: Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The 2016 State of Maryland Hazard Mitigation Plan was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

The 2018 Queen Anne's County Multi-Jurisdictional Hazard Mitigation Plan was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

Please note that the information in this FRR may be reviewed for inclusion during the update of the Queen Anne's County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

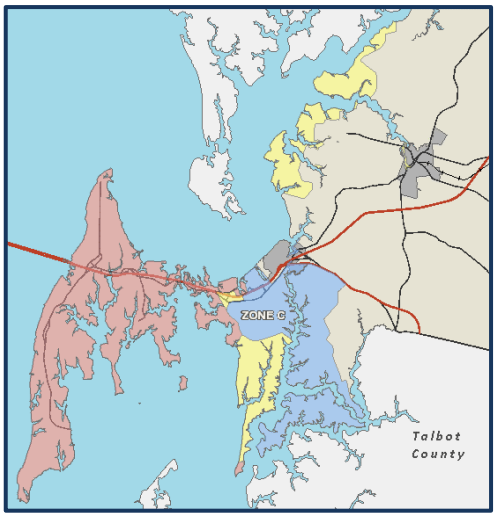
- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

  TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

  Queen Anne's County participates in the "Know Your Zone" evacuation initiative as part of Maryland's Hurricane Evacuation Study. Queen Anne's County Department of Emergency Services provides information about hurricane preparedness and "Know Your Zone" on their webpage: https://www.qac.org/1051/Hurricane-Preparedness.

  Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk,

Figure 1.6



Queen Anne's County's Hurricane Evacuation Zone Map.

Source:
https://gis.qac.org/qac272/Index.html?configBase=https://gis.qac.org/Geocortex/Essentials/REST/sites/QAC_Know_Your_Flood_Zone/viewers/QAC_Election_District_Viewer/virtualdirectory/Resources/Config/Default.

Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Queen Anne's County evacuation zones can be found at: https://gis.qac.org/qac272/Index.html?configBase=https://gis.qac.org/Geocortex/Essentials/REST/sites/QAC_Know_Your_Flood_Zone/viewers/QAC_Election_District_Viewer/virtualdirectory/Resources/Config/Default.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  In addition, *Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore* was developed in January 2019 to provides local government leaders and staff with data, analyses, policy options, and implementation guidance. A *Queen Anne's County Coastal Flood Vulnerability Study* (https://www.eslc.org/wp-content/uploads/docs/coastal-resilience/regional-sea-level-rise-study-2019.pdf) was completed and included in the Appendix of the document. According to the study, the goal was to model the potential damage to buildings and their contents from severe periodic coastal flooding events, both today and in the future using a value for predicted sea level change.

- **Emergency Action Plans.** Emergency Action Plans (EAP) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

  Nine (9) dams are located within Queen Anne's County, three (3) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Queen Anne's County, MD,* on page 18 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  As noted in Section 1 of this report, a previously completed *Flood Risk Report Queen Anne's County, Maryland Coastal Study* was developed by FEMA using Hazus Version 2.2 and released on June 30, 2015. This report provides coastal flood risk information, such as estimated coastal flood losses for the 1-percent-annual-chance flood event which have been leveraged for this countywide flood risk assessment. The Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Mears Point Marina on Kent Island
Source: MyEasternShoreMD.com
Bottom Photo: Centreville Wharf
Source:
https://www.qac.org/Facilities/Facility/Details/Centreville-Landing-119

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

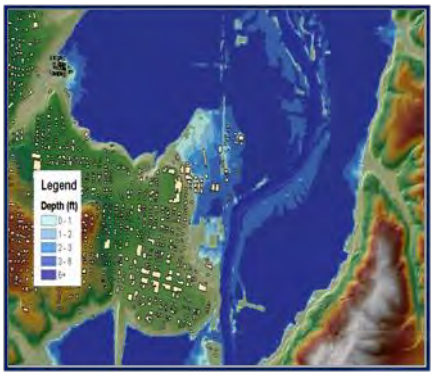
The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

i. Flood Depth and Analysis Grids

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood depth is a function of the difference between the

calculated water surface elevation (including overland wave propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and regulatory FIRM updates for each study type were separately performed.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Percent Loss:** These percentages express lossees for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

Figure 2.4

An essential facility, Centreville Police Department, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: https://www.centrevillepolice.org/welcome

There are 50 essential facilities located within Queen Anne's County with a total estimated building value of $380,753,600.

Table 1: Queen Anne's County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	1	$3,465,500
Fire/Rescue Stations	16	$41,661,700
Hospital & Medical Clinics	5	$29,042,700
Police Stations	5	$3,207,400
Schools (K-12 & Colleges)	23	$303,376,300
Total	**50**	**$380,753,600**

Source: 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations.

Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 5 high risk areas were identified within Queen Anne's County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Unicorn Branch Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: Unicorn Branch Dam
Source:
https://dnr.maryland.gov/fisheries/Pages/hatcheries/unicorn.aspx

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, nine (9) dams are located in Queen Anne's County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Queen Anne's County, MD

Name	Owner Type	Purpose	River	Emergency Action Plan (EAP)
Forman Branch Dam	Private	Irrigation	Foreman Branch	No
Unicorn Branch Dam	State	Recreation	Unicorn Branch	Yes
Jones Lake Dam	Private	Recreation	Sewell Branch	No
Boxers Rest Farm Pond	Private	Irrigation	Hambleton Creek	No
Owings Farm Pond	Private	Flood Control	Hambleton Creek	Yes
Mezick Farm Pond	Private	Fish and Wildlife Pond	Reed Creek	No
Claiborne Gooch	Private	Recreation	Island Creek	No
Wye Mills Dam	State	Recreation	Wye East River	Yes
Dodd Farm Pond	Private	Fish and Wildlife Pond	Wye East-TR	No

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

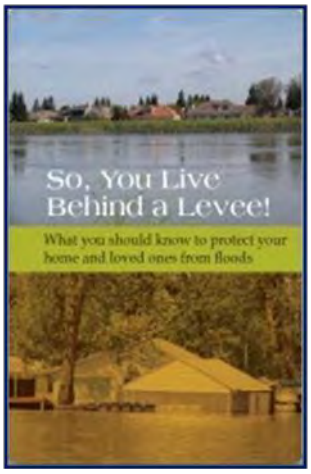
This dam failure caused flooding that damaged several homes and vehicles.

- A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
- For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are

erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

According to US Army Corps of Engineers, National Levee Database, there are no levees located within Queen Anne's County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly

maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

  - **Reasons coastal structures are considered AoMIs:**
    - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
    - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
    - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

- **Reasons stream flow constrictions are considered AoMIs:**
  - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
  - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
  - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
  - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Figure 2.8

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of August 2018, a total of thirty-five (35) repetitive loss properties were within Queen Anne's County. These properties consist of two (2) commercial, one (1) condo, and thirty-two (32) single-family structures. All properties are located within the unincorporated portions of the County, with the exception of one (1) repetitive loss property with is located within the Town of Centreville. There are no Severe Repetitive Loss (SRL) properties within Queen Anne's County.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
  - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
  - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.9

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

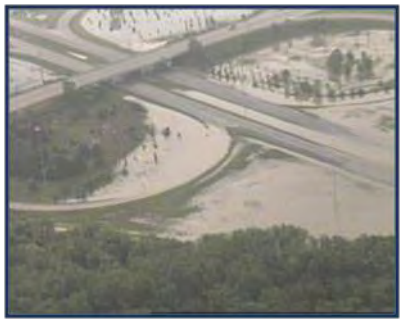
- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.

- Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
- Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

Figure 2.10



When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

The *2019 Queen Anne's County Multi-Jurisdictional Hazard Mitigation Plan* provided a listing of repetitive flood locations identified by the Department of Public Works and municipalities. The listing of repetitive flooding issues is within Chapter 15 Mitigation Strategies & Implementation on Table 15.4 of the

Plan. A total of eleven (11) repetitive flood locations were identifed in the unincorporated areas of the County and municipalities.

- **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
  - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
  - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 21.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

- **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
  - Riverine flood damage assessments generally consider inundation alone
  - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
  - Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
  - Landslides and mudslides are a result of erosion
  - Approximately one-third of the nation's streams experience severe erosion problems
  - Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
  - Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Queen Anne's County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Queen Anne's County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Queen Anne's County (Unincorporated Areas)	240054	40,485	503.98	Y	N/A	Y
Town of Church Hill	240057	745	0.72	Y	N/A	Y
Town of Queenstown	240120	664	1.69	Y	N/A	Y

Note: The Towns of Barclay, Church Hill, Millington, Queen Anne, Sudlersville, and Templeville were not included in this report since they had no UDFs, and accordingly no estimated flood loss for the 1-percent annual chance flood.

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

The Queen Anne's County, Maryland Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that countywide summary results represent totals for both coastal and riverine flooding. Separate information for coastal and riverine flood losses are presented, where applicable, for individual communities under Section 3, Subsection b.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 4: Queen Anne's County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Queen Anne's County (Unincorporated Areas)	40,485	987	$23,040,000	$569	99%
Town of Barclay	120	0	$0	$0	0%
Town of Centreville	4,285	19	$150,000	$35	< 1%
Town of Church Hill	745	0	$0	$0	0%
Town of Millington	642	0	$0	$0	0%
Town of Queen Anne	222	0	$0	$0	0%
Town of Queenstown	664	11	$200,000	$301	< 1%
Town of Sudlersville	497	0	$0	$0	0%
Town of Templeville	138	0	$0	$0	0%
Total	**47,798**	**1,017**	**$23,390,000**	**$489**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Queen Anne's County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	884	$234,500,000	79%	$12,500,000	5.0%
Commercial Building & Contents	124	$59,600,000	20%	$7,600,000	13.0%
Other Building & Contents	9	$900,000	0%	$40,000	4.0%
Total Building & Contents[3]	1017	$295,000,000	100%	$20,100,000	7.0%
Business Disruption[4]	N/A	N/A	N/A	$3,300,000	N/A
TOTAL[5]	**1017**	**$295,000,000**	**100%**	**$23,400,000**	**8.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Queen Anne's County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	451	47%	$150,600,000	$300,000	$10,000	$0	0%
1 - 10%	190	20%	$43,000,000	$200,000	$2,600,000	$10,000	13%
10 - 20%	213	22%	$54,600,000	$300,000	$7,400,000	$30,000	37%
20 - 30%	93	10%	$23,600,000	$300,000	$5,900,000	$60,000	30%
30 - 40%	8	1%	$1,500,000	$200,000	$500,000	$60,000	3%
40 - 50%	8	1%	$8,200,000	$1,000,000	$3,500,000	$400,000	18%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**963**	**100%**	**$281,500,000**	**$300,000**	**$19,910,000**	**$20,000**	**100%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Queen Anne's County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date November 5, 2014), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Queen Anne's County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 7. The list of essential facilities impacted by the 1-percent-annual-chance flood event is listed on page 35.

Table 7: Queen Anne's County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas)

Type	Estimated Building Value	Total Essential Facilities	1% (100-yr) Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$3,465,500	1	$0	0
Fire Station	$41,661,700	16	$0	0
Hospital	$29,042,700	5	$0	0
Police Station	$3,207,400	5	$42,336	2
School	$303,376,300	23	$0	0
TOTAL	**$380,753,600**	**50**	**$42,336**	**2**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Table 8: Queen Anne's County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss % of Total	Total Content Loss	Content Loss % of Total
Police Station	$48,736	$42,336	87%	$6,400	13%
TOTAL	**$48,736**	**$42,336**	**N/A**	**$6,400**	**N/A**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Queen Anne's County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Queen Anne's County contains 117 state assets. However, none of these state assets are at-risk to the 1-percent-annual-chance flood event.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
    - The model estimates that a total of 4,598 tons of debris will be generated. Of the total amount, Finishes comprises 77% of the total, Structure comprises 11% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 184 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 9: Queen Anne's County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood (Coastal & Riverine Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	3,553	77%	142
Structure	503	11%	20
Foundation	542	12%	22
TOTAL	**4,598**	**100%**	**184**

Source: Hazus 3.1: Flood Modual – Queen Anne's County Study Area/ General Building Stock

Projected Shelter Needs

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**
    - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 886 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 1,807 people (out of a total population of 47,798) will seek temporary shelter in public shelters.

Table 10: Queen Anne's County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood (Coastal & Riverine Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	886	2,658	1,807

Source: Hazus 3.1: Flood Modual – Queen Anne's County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 11: Queen Anne's County, Maryland – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	2	Depth grids, Emergency Management Dept.
High-Risk Areas	5	Depth grids, UDFs, Loss estimates
Repetitive Flood Issues	11	Local public works & municipalities
Repetitive Loss Properties	35	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database.

- **At-Risk Essential Facilities:**

  Results from the 1-percent-annual-chance flood event analysis indicate two (2) essential facilities are at-risk; both police stations. Flood depths for each facility is provided below along with the identified facilities.

  - Sheriff's Office – Kent Narrow Substation – 1.7'
  - Centreville Police Department – 0.5'

  A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 12: Queen Anne's County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Cloverfields	1,329	12	157	$1,411,834	6%
Area 2	Kingstown	484	18	50	$1,328,165	6%
Area 3	Romancoke	639	9	57	$1,179,556	5%
Area 4	Kent Narrows/Grasonville	3,133	42	274	$11,901,506	51%
Area 5	South Stevensville	2,496	37	223	$1,094,438	5%
Total for High-Risk Areas		**8,081**	**118**	**761**	**$16,915,499**	**72%**

- **Repetitive Flood Issues**

  Reviewing the repetitive flood locations and issues identified on Table 15.4 in the *2019 Queen Anne's County Multi-Jurisdictional Hazard Mitigation Plan,* several repetitive flood locations were found to be within high risk areas listed in Table 12 of this report. However, because the spatial extents of those listed locations are not fully defined, frequently flooded roadways are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of thirty-five (35) repetitive loss properties were within Queen Anne's County. These properties consist of two (2) commercial, one (1) condo, and thirty-tow (32) single-family structures. All properties are located within the unincorporated portions of the County, except for one (1) repetitive loss property with is located within the Town of Centreville. The Kent Island and Grasonville area contain the highest concentration of RLP's. Twenty-eight (28) RPL's are within this area of the County. The remaining repetitive loss properties are scattered along the Chester River and its tributaries.

iii. Flood Risk Maps

The Flood Risk Maps for Queen Anne's County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Queen Anne's County (Unincorporated Areas) Summary (CID 240054)

The following pages include Flood Risk data for the Queen Anne's County (Unincorporated Areas).

Overview

The Queen Anne's County (Unincorporated Areas) is located in eastern Maryland and consists of 503.98 square miles. It is bordered by Kent County to the north, the State of Delaware to the east, Caroline County to the southeast, Talbot County to the south, and the Chesapeake Bay to the west.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Queen Anne's County (Unincorporated Areas)	240054	40,485	503.98	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires May 27, 2024
- Past Federal Disaster Declarations for flooding = 0
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 2,265 policies totaling approximately $630,219,000
- NFIP-recognized repetitive loss properties = 34
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Queen Anne's County (Unincorporated Areas) that are located within the Queen Anne's County, Maryland Flood Risk Project, and do not necessarily represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Queen Anne's County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 13. Additionally, Tables 14a and 14b (for Riverine and Coastal Areas, respectively) show the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 13: Queen Anne's County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	861	$231,100,000	80%	$12,100,000	5.0%
Riverine	*172*	*$38,400,000*	*100%*	*$1,600,000*	*4.0%*
Coastal	*689*	*$192,700,000*	*76%*	*$10,500,000*	*5.0%*
Commercial Building & Contents	118	$58,400,000	20%	$7,600,000	13.0%
Riverine	*0*	*$0*	*0%*	*$0*	*0.0%*
Coastal	*118*	*$58,400,000*	*23%*	*$7,600,000*	*13.0%*
Other Building & Contents	8	$800,000	0%	$40,000	5.0%
Riverine	*0*	*$0*	*0%*	*$0*	*0.0%*
Coastal	*8*	*$800,000*	*0%*	*$40,000*	*5.0%*
Total Building & Contents[3]	987	$290,300,000	100%	$19,740,000	7.0%
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	$0	N/A
Business Disruption[4] *(Coastal)*				$3,300,000	
TOTAL[5]	**987**	**$290,300,000**	**100%**	**$23,040,000**	**8.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 14a: Queen Anne's County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	88	51%	$20,800,000	$200,000	$0	$0	0%
1 - 10%	38	22%	$8,600,000	$200,000	$400,000	$10,000	27%
10 - 20%	42	24%	$8,500,000	$200,000	$1,000,000	$20,000	67%
20 - 30%	4	2%	$600,000	$200,000	$100,000	$30,000	7%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**172**	**100%**	**$38,500,000**	**$200,000**	**$1,500,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 14b: Queen Anne's County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	407	50%	$141,100,000	$300,000	$10,000	$0	0%
1 - 10%	147	18%	$33,700,000	$200,000	$2,100,000	$10,000	12%
10 - 20%	159	20%	$44,600,000	$300,000	$6,200,000	$40,000	34%
20 - 30%	86	11%	$22,700,000	$300,000	$5,800,000	$70,000	32%
30 - 40%	6	1%	$1,500,000	$300,000	$500,000	$80,000	3%
40 - 50%	7	1%	$8,200,000	$1,200,000	$3,500,000	$500,000	19%
50% or More	3	0%	$100,000	$30,000	$80,000	$30,000	0%
TOTAL	**815**	**100%**	**$251,900,000**	**$300,000**	**$18,190,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within Queen Anne's County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature

class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date November 5, 2014), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Centreville Summary (CID 240056)

The following pages include Flood Risk data for the Town of Centreville.

Overview

The Town of Centreville is in central Queen Anne's County. It consists of 2.74 square miles along State Highway 213. The primary flooding sources in the city are Mill Stream Branch, Yellow Branch Stream, Three Bridges Branch, and Gravel Run.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Centreville	240056	4,285	2.74	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires May 27, 2024
- Past Federal Disaster Declarations for flooding = 0
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 24 policies totaling approximately $7,135,900
- NFIP-recognized repetitive loss properties = 1
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Centreville that are located within the Queen Anne's County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Centreville flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 15. Additionally, Tables 16a and 16b (for Riverine and Coastal Areas, respectively) show the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 15: Town of Centreville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	12	$1,700,000	60%	$100,000	6.0%
Riverine	*0*	*$0*	*0%*	*$0*	*0.0%*
Coastal	*12*	*$1,700,000*	*67%*	*$100,000*	*6.0%*
Commercial Building & Contents	6	$1,100,000	39%	$30,000	3.0%
Riverine	*1*	*$300,000*	*100%*	*$0*	*0.0%*
Coastal	*5*	*$800,000*	*32%*	*$30,000*	*4.0%*
Other Building & Contents	1	$30,000	1%	$0	0.0%
Riverine	*0*	*$0*	*0%*	*$0*	*0.0%*
Coastal	*1*	*$30,000*	*1%*	*$0*	*0.0%*
Total Building & Contents[3]	19	$2,830,000	100%	$130,000	5.0%
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	$0	N/A
Business Disruption[4] *(Coastal)*				$20,000	
TOTAL[5]	**19**	**$2,830,000**	**100%**	**$150,000**	**5.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 16a: Town of Centreville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	100%	$300,000	$300,000	$0	$0	$0
1 - 10%	0	0%	$0	$0	$0	$0	$0
10 - 20%	0	0%	$0	$0	$0	$0	$0
20 - 30%	0	0%	$0	$0	$0	$0	$0
30 - 40%	0	0%	$0	$0	$0	$0	$0
40 - 50%	0	0%	$0	$0	$0	$0	$0
50% or More	0	0%	$0	$0	$0	$0	$0
TOTAL	**1**	**100%**	**$300,000**	**$300,000**	**$0**	**$0**	**$0**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 16b: Town of Centreville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	5	28%	$1,500,000	$300,000	$0	$0	0%
1 - 10%	3	17%	$400,000	$100,000	$40,000	$10,000	31%
10 - 20%	6	33%	$500,000	$80,000	$70,000	$10,000	54%
20 - 30%	1	6%	$20,000	$20,000	$0	$0	0%
30 - 40%	2	11%	$70,000	$40,000	$20,000	$10,000	15%
40 - 50%	1	6%	$10,000	$10,000	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**18**	**100%**	**$2,500,000**	**$100,000**	**$130,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Centreville.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature

class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date November 5, 2014), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Queenstown (CID 240120)

The following pages include Flood Risk data for the Town of Queenstown.

Overview

The Town of Queenstown in southern Queen Anne's County. It consists of 1.69 square miles along US Highway 301. The primary flooding sources in the city are Queenstown Creek, Little Queenstown Creek, Chester River, Walsey Creek, and Wye River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Queenstown	240120	664	1.69	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires May 27, 2024
- Past Federal Disaster Declarations for flooding = 0
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1 policies totaling approximately $350,000
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Queenstown that are located within the Queen Anne's County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Queenstown flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that no riverine flood losses are identified in Queenstown, so only coastal flood loss estimates are presented.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 19. Additionally, Table 20 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 17: Town of Queenstown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	11	$1,700,000	100%	$200,000	12.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	11	$1,700,000	100%	$200,000	12.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**11**	**$1,700,000**	**100%**	**$200,000**	**12.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 18: Town of Queenstown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	9%	$200,000	$200,000	$0	$0	0%
1 - 10%	2	18%	$200,000	$100,000	$20,000	$10,000	7%
10 - 20%	6	55%	$1,100,000	$200,000	$200,000	$30,000	74%
20 - 30%	2	18%	$200,000	$100,000	$50,000	$30,000	19%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**11**	**100%**	**$1,700,000**	**$200,000**	**$270,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Queenstown.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date November 5, 2014), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Participation in the NFIP Community Rating System (CRS)
- Building codes
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 21 below identifies possible mitigation actions for each AoMI to consider.

Table 19: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***

AoMI	Possible Actions to Reduce Flood Risk
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	• ***2019 Queen Anne's County Repetitive Loss Properties Mitigated*** Four (4) of the RL properties listed had been mitigated through elevation projects

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The 2019 Queen Anne's County Multi-Jurisdictional Hazard Mitigation Plan, Chapter 15 New Mitigation Strategies & Implementation, is a valuable place to identify and prioritize possible mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning

committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 22 below.

Table 20: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also

subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.
FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Suite 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Queen Anne's County Department of Emergency Services
100 Communications Drive, Centreville, MD 21617
https://www.qac.org/325/Emergency-Services

Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Suite 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Queen Anne's County Department of Public Works
312 Safety Drive, Centreville, MD 21617
https://www.qac.org/364/Public-Works

Queen Anne's County Geographical Information Systems - Mapping
100 Communications Drive, Suite 100, Centreville, MD 21617
https://www.qac.org/227/Information-Technology

This page left blank intentionally

Source: https://www.MyEasternShore.com

STATE OF MARYLAND

FLOOD RISK REPORT

QUEEN ANNE'S COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Queen Anne's County, Maryland – Countywide Flood Risk Map (FRM)

Queen Anne's County, Maryland – High Risk Area 1: Cloverfields – Dollar Losses

Queen Anne's County, Maryland – High Risk Area 1: Cloverfields – Percent Losses

Queen Anne's County, Maryland – High Risk Area 2: Kingstown – Dollar Losses

Queen Anne's County, Maryland – High Risk Area 2: Kingstown – Percent Losses

Queen Anne's County, Maryland – High Risk Area 3: Romancoke – Dollar Losses

Queen Anne's County, Maryland – High Risk Area 3: Romancoke – Percent Losses

Queen Anne's County, Maryland – High Risk Area 4: Kent Narrows – Dollar Losses

Queen Anne's County, Maryland – High Risk Area 4: Kent Narrows – Percent Losses

Queen Anne's County, Maryland – High Risk Area 5: South Stevensville – Dollar Losses

Queen Anne's County, Maryland – High Risk Area 5: South Stevensville – Percent Losses

Queen Anne's County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Queen Anne's County, Maryland

Area 1

Area 2

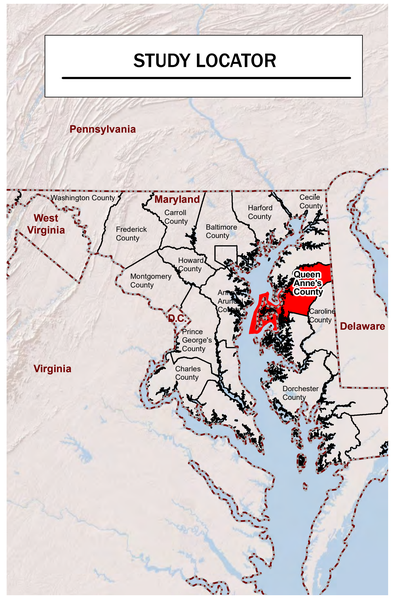
Area 3

Area 4

Area 5

Maryland

Town of St. Michaels



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area* (Area 1)

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk Essential Facility

Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Cloverfields	1,329	12	157	$1,411,834	6%
Area 2	Kingstown	484	18	50	$1,328,165	6%
Area 3	Romancoke	639	9	57	$1,179,556	5%
Area 4	Kent Narrows/Grasonville	3,133	42	274	$11,901,506	51%
Area 5	South Stevensville	2,496	37	223	$1,094,438	5%
Total for High-Risk Areas		**8,081**	**118**	**761**	**$16,915,499**	**72%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Queen Anne's County (Unincorporated Areas)	40,485	987	$23,040,000	$569	99%
Town of Barclay	120	0	$0	$0	0%
Town of Centreville	4,285	19	$150,000	$35	< 1%
Town of Church Hill	745	0	$0	$0	0%
Town of Millington	642	0	$0	$0	0%
Town of Queen Anne	222	0	$0	$0	0%
Town of Queenstown	664	11	$200,000	$301	< 1%
Town of Sudlersville	497	0	$0	$0	0%
Town of Templeville	138	0	$0	$0	0%
Total	**47,798**	**1,017**	**$23,390,000**	**$489**	**100%**

N

0 0.75 1.5 3

Miles

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

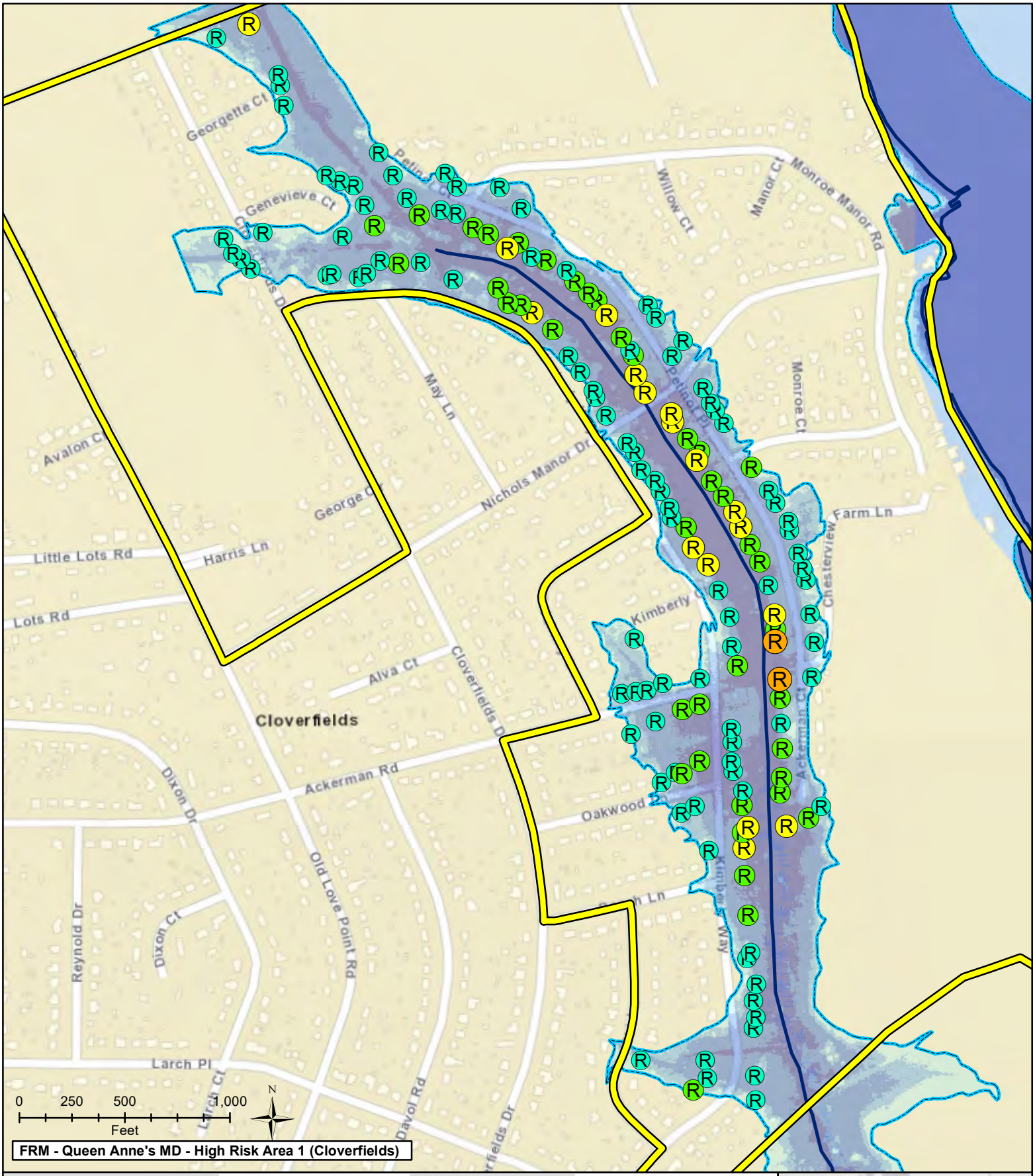
Queen Anne's County and Incorporated Areas, MD

MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Queen Anne's County, MD.

RELEASE DATE
12/31/2019



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

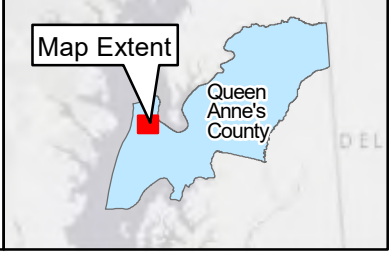
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

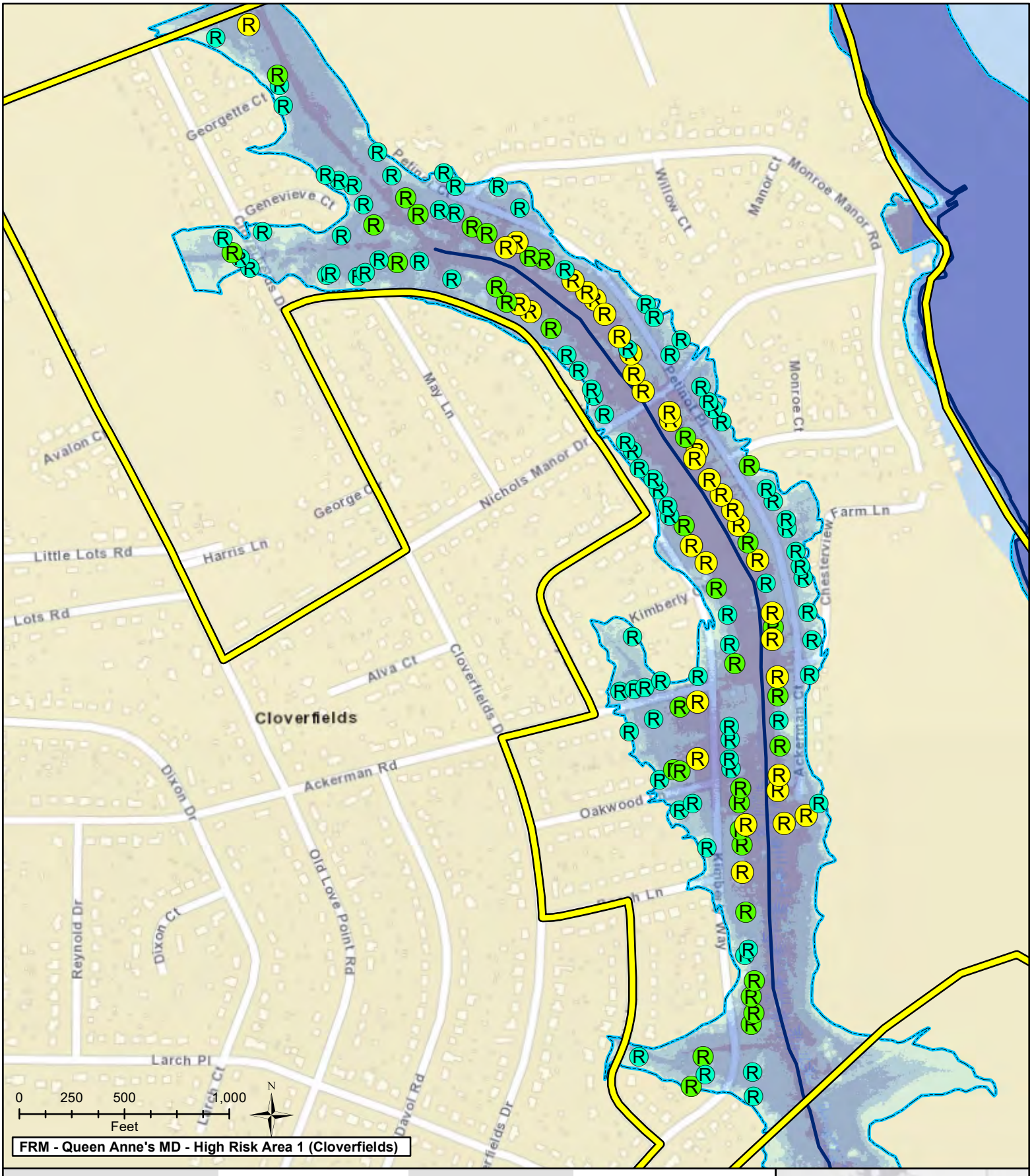
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

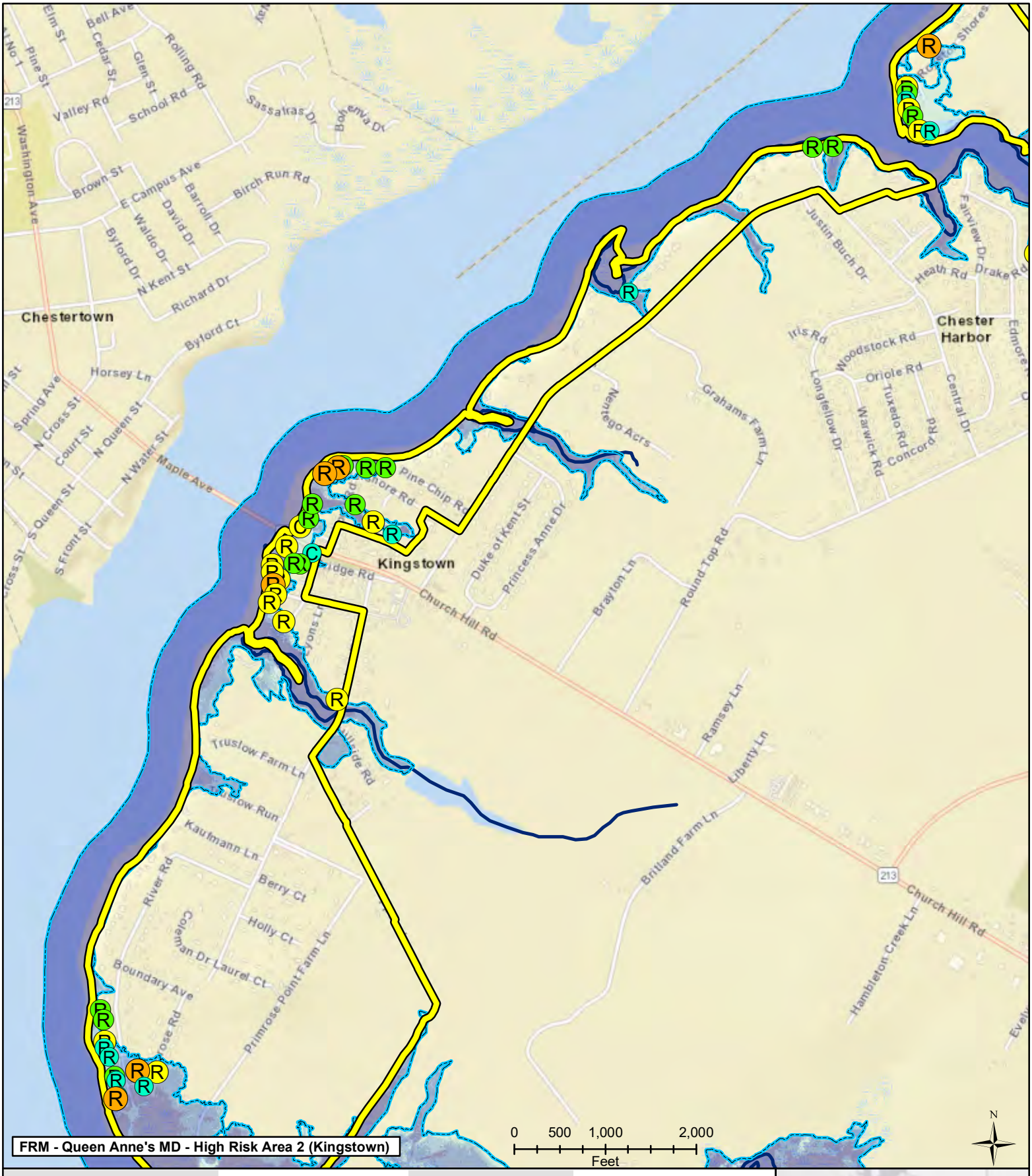
UDF Flood Loss Estimates

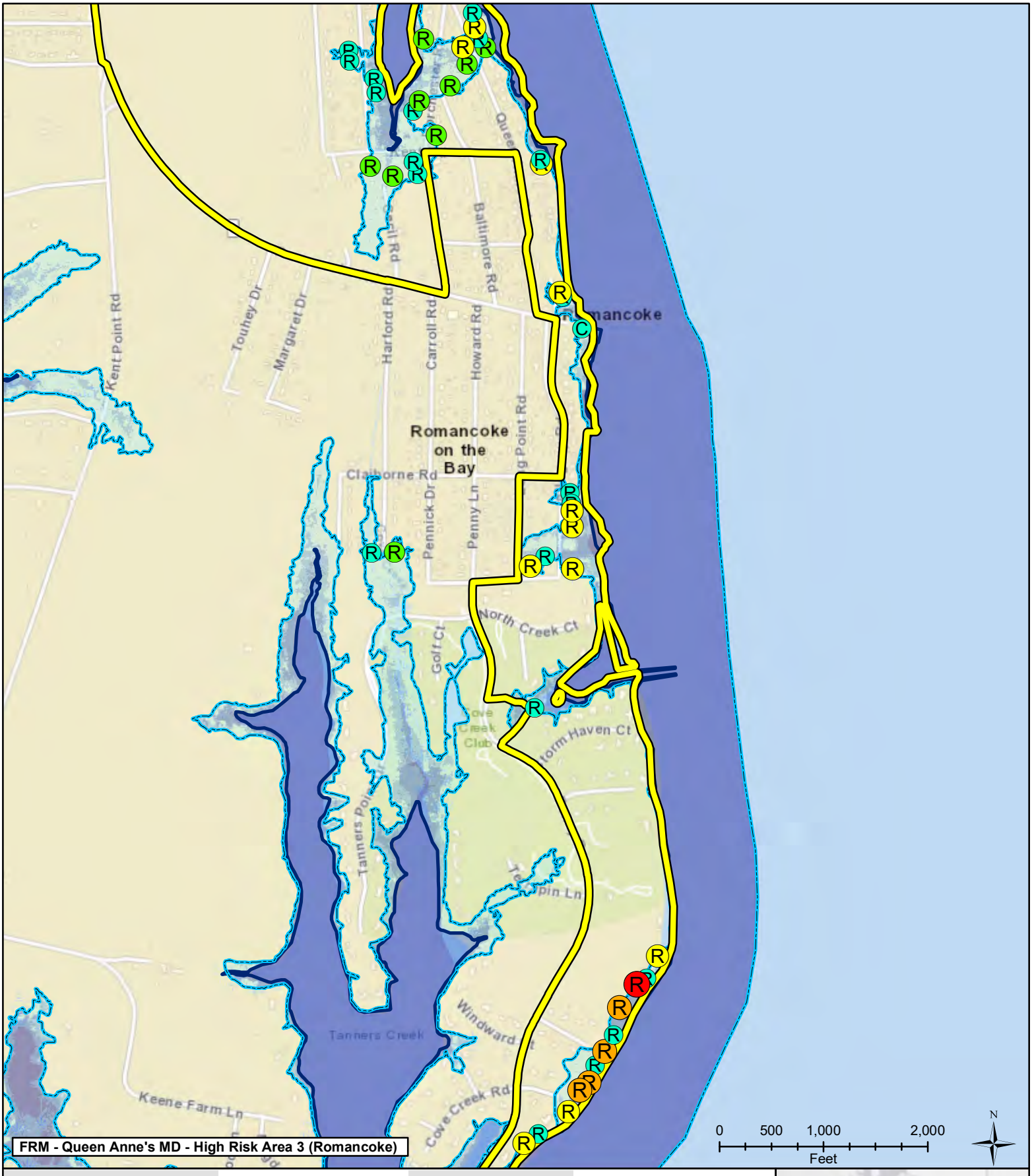
- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000




Georgette Ct
Genevieve Ct
Pellinni Ct
Willow Ct
Manor Ct
Monroe Manor Rd
Monroe Ct
Avalon Ct
May Ln
Nichols Manor Dr
George Ct
Little Lots Rd
Harris Ln
Lots Rd
Chesterview Farm Ln
Kimberly Ct
Alva Ct
Cloverfields Dr
Cloverfields
Ackerman Rd
Ackerman Ct
Oakwood Ln
Dixon Dr
Old Love Point Rd
Reynold Dr
Dixon Ct
Kingsley Way
Larch Pl
Larch Ct
Davol Rd
0 250 500 1,000
Feet
N
FRM - Queen Anne's MD - High Risk Area 1 (Cloverfields)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Queen Anne's County

Chestertown
Kingstown
Chester Harbor
Maple Ave
Church Hill Rd
Pine Chip Rd
Duke of Kent St
Princess Anne Dr
Grahams Farm Ln
Round Top Rd
Brayton Ln
Ramsey Ln
Liberty Ln
Britland Farm Ln
Hambleton Creek Ln
Truslow Farm Ln
Kaufmann Ln
Berry Ct
Holly Ct
Laurel Ct
Boundary Ave
Primrose Point Farm Ln
River Rd
Valley Rd
School Rd
Rolling Rd
Sassafras Dr
Bohemia Dr
Brown St
E Campus Ave
Birch Run Rd
Barroll Dr
David Dr
Waldo Dr
Byford Dr
N Kent St
Richard Dr
Byford Ct
Horsey Ln
Spring Ave
N Cross St
Court St
N Queen St
N Water St
S Queen St
S Front St
Washington Ave
Justin Buch Dr
Heath Rd
Drake Rd
Fairview Dr
Iris Rd
Woodstock Rd
Oriole Rd
Longfellow Dr
Warwick Rd
Tuxedo Rd
Concord Rd
Central Dr
Nemego Acres
FRM - Queen Anne's MD - High Risk Area 2 (Kingstown)
0 500 1,000 2,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Queen Anne's County


Chestertown
Kingstown
Chester Harbor
Valley Rd
School Rd
Sassafras Dr
Boxenva Dr
Brown St
E Campus Ave
Birch Run Rd
Barroll Dr
David Dr
Waldo Dr
Byford Dr
N Kent St
Richard Dr
Byford Ct
Horsey Ln
Spring Ave
N Cross St
Court St
N Queen St
N Water St
Maple Ave
S Queen St
S Front St
Washington Ave
Pine Chip Rd
Duke of Kent St
Princess Anne Dr
Church Hill Rd
Round Top Rd
Brayton Ln
Ramsey Ln
Liberty Ln
Britland Farm Ln
Hambleton Creek Ln
Truslow Farm Ln
Kaufmann Ln
River Rd
Berry Ct
Holly Ct
Laurel Ct
Boundary Ave
Primrose Point Farm Ln
Justin Buch Dr
Heath Rd
Drake Rd
Fairview Dr
Iris Rd
Woodstock Rd
Oriole Rd
Longfellow Dr
Warwick Rd
Tuxedo Rd
Concord Rd
Central Dr
Grahams Farm Ln
FRM - Queen Anne's MD - High Risk Area 2 (Kingstown)
0 500 1,000 2,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Queen Anne's County



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

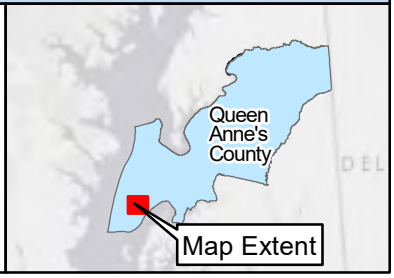
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

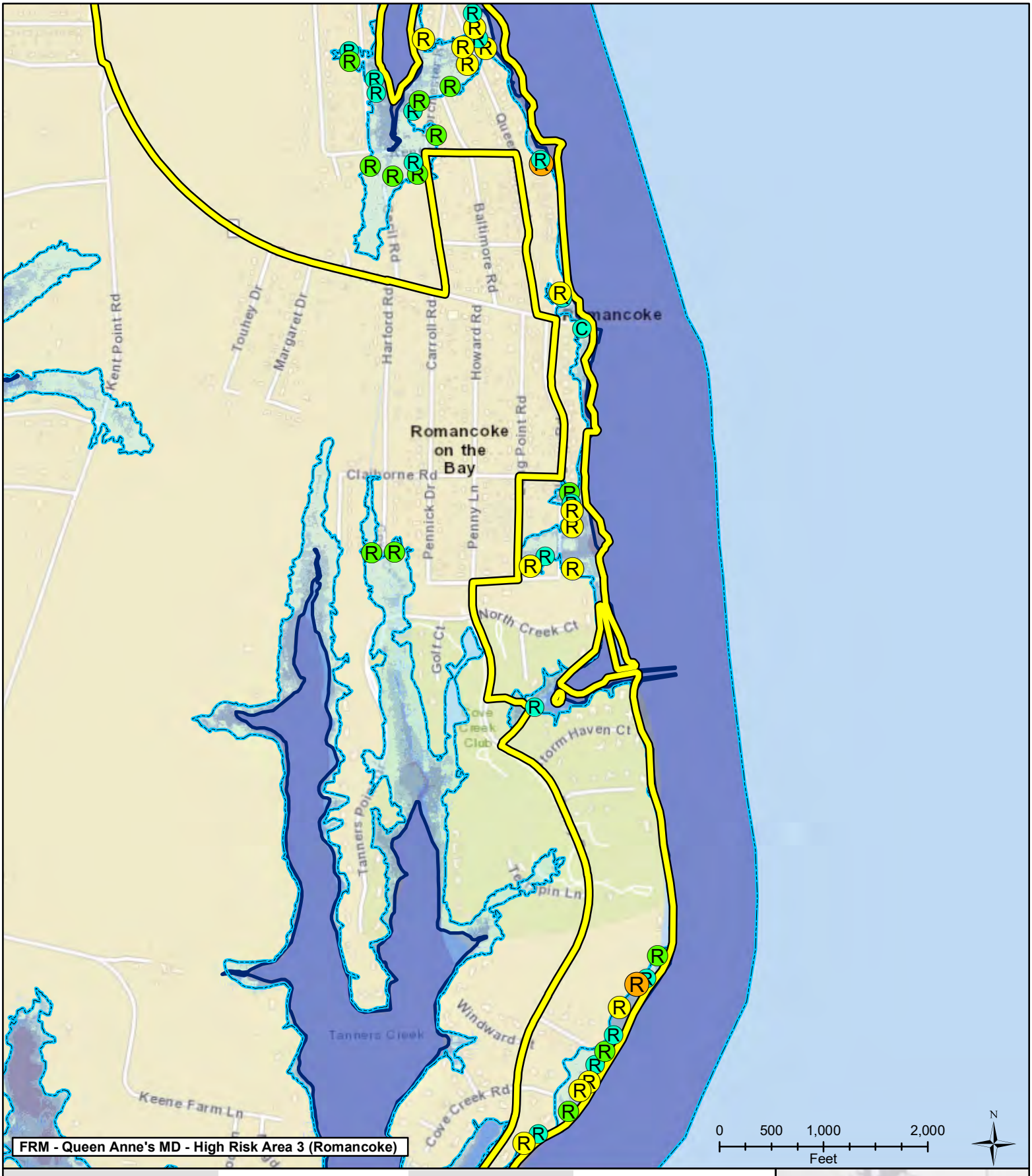
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

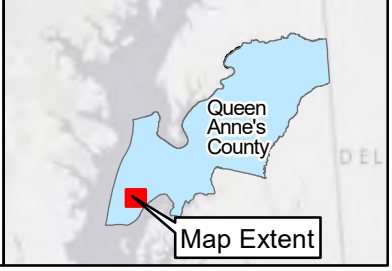
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

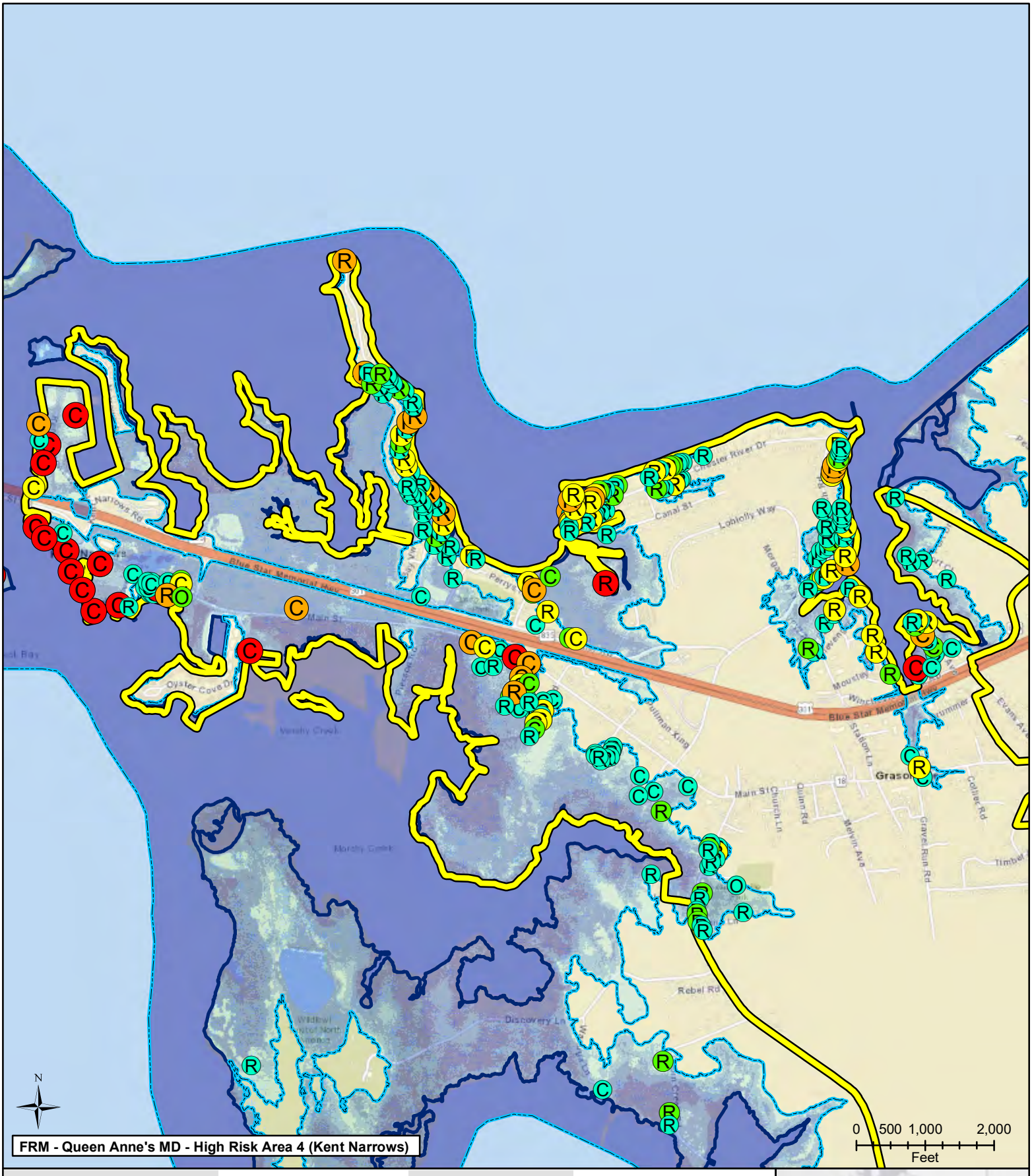
UDF Land Use Category

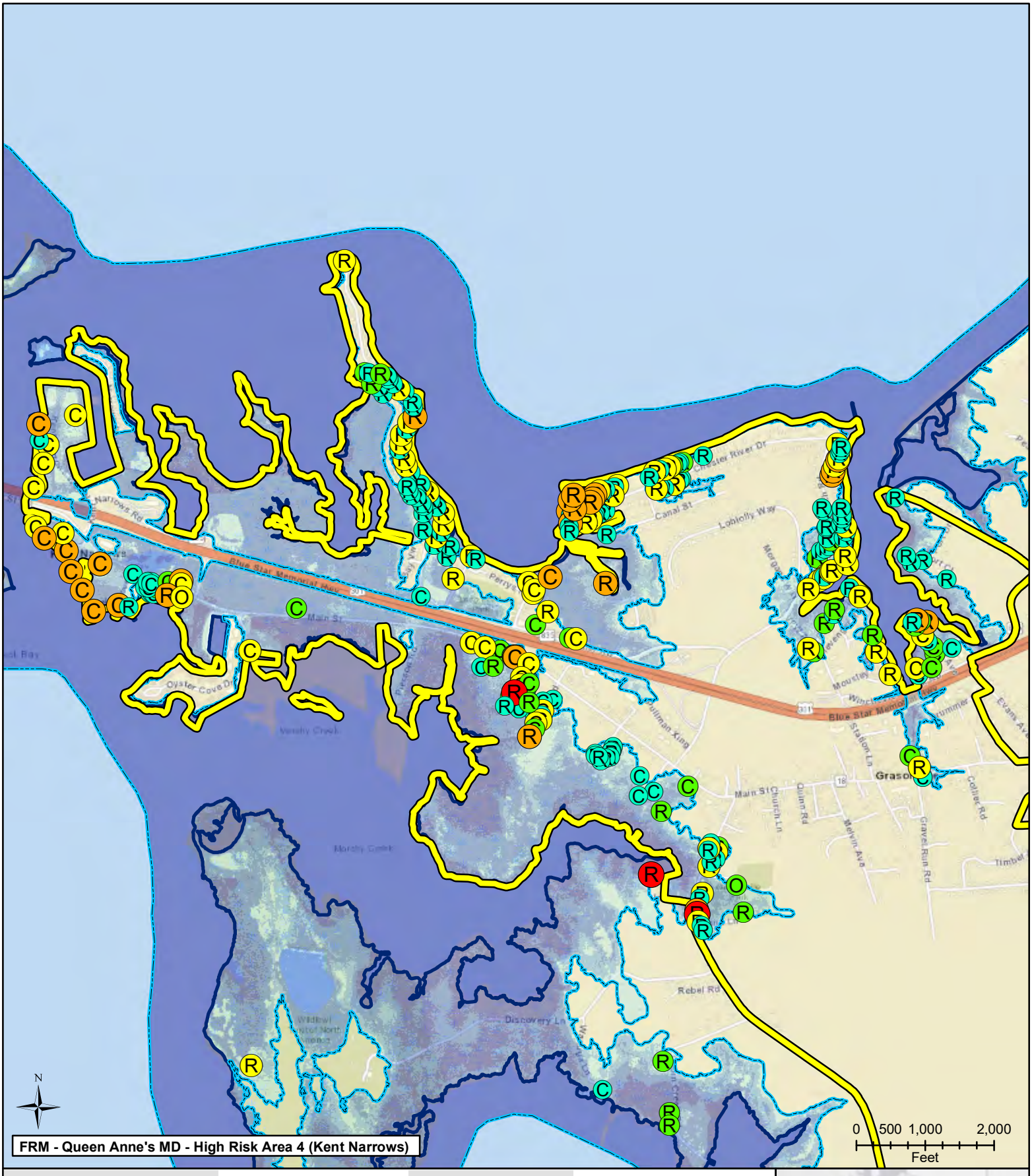
- (R) Residential
- (C) Commercial
- (O) Other

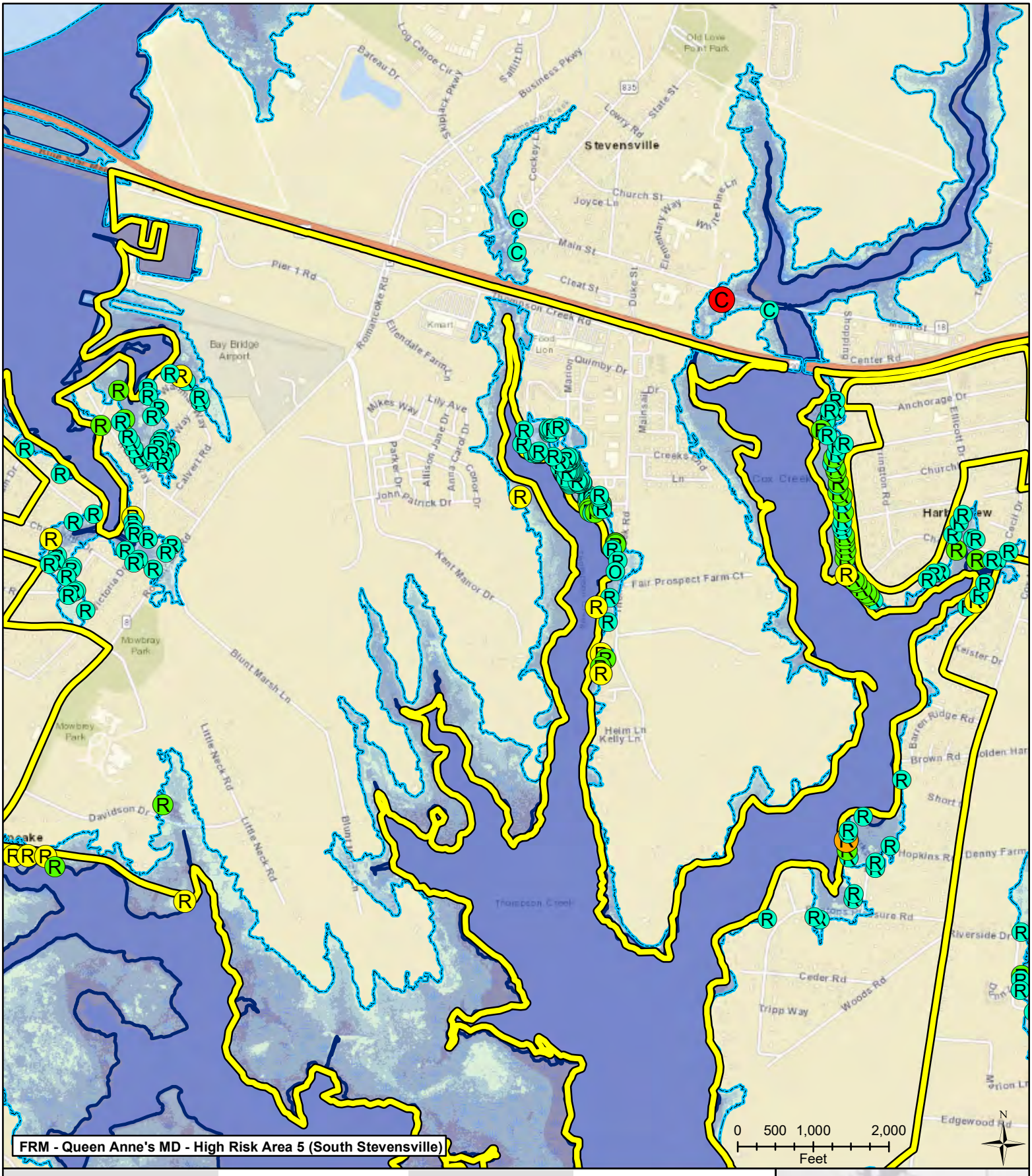
UDF Flood Loss Estimates

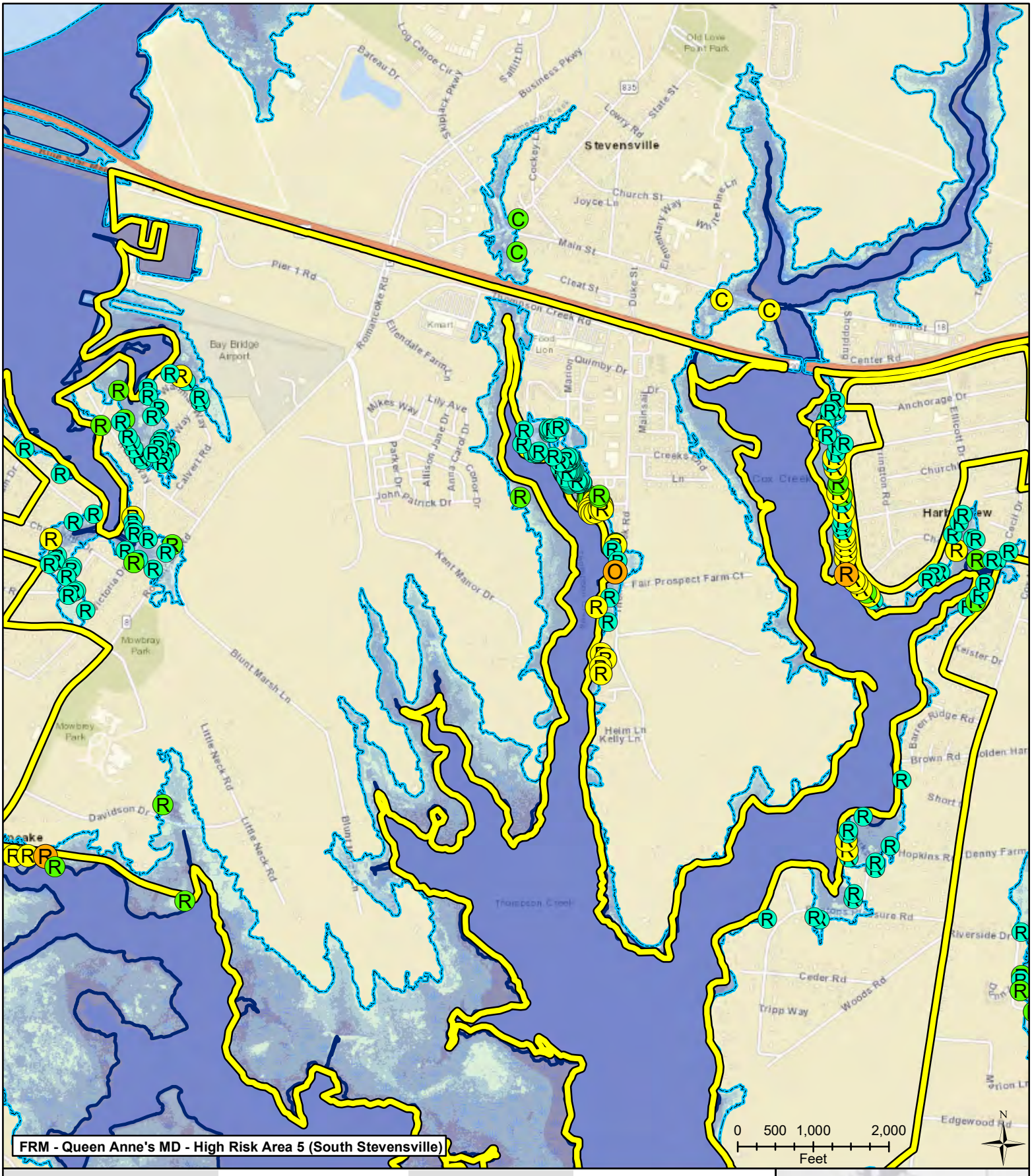
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More

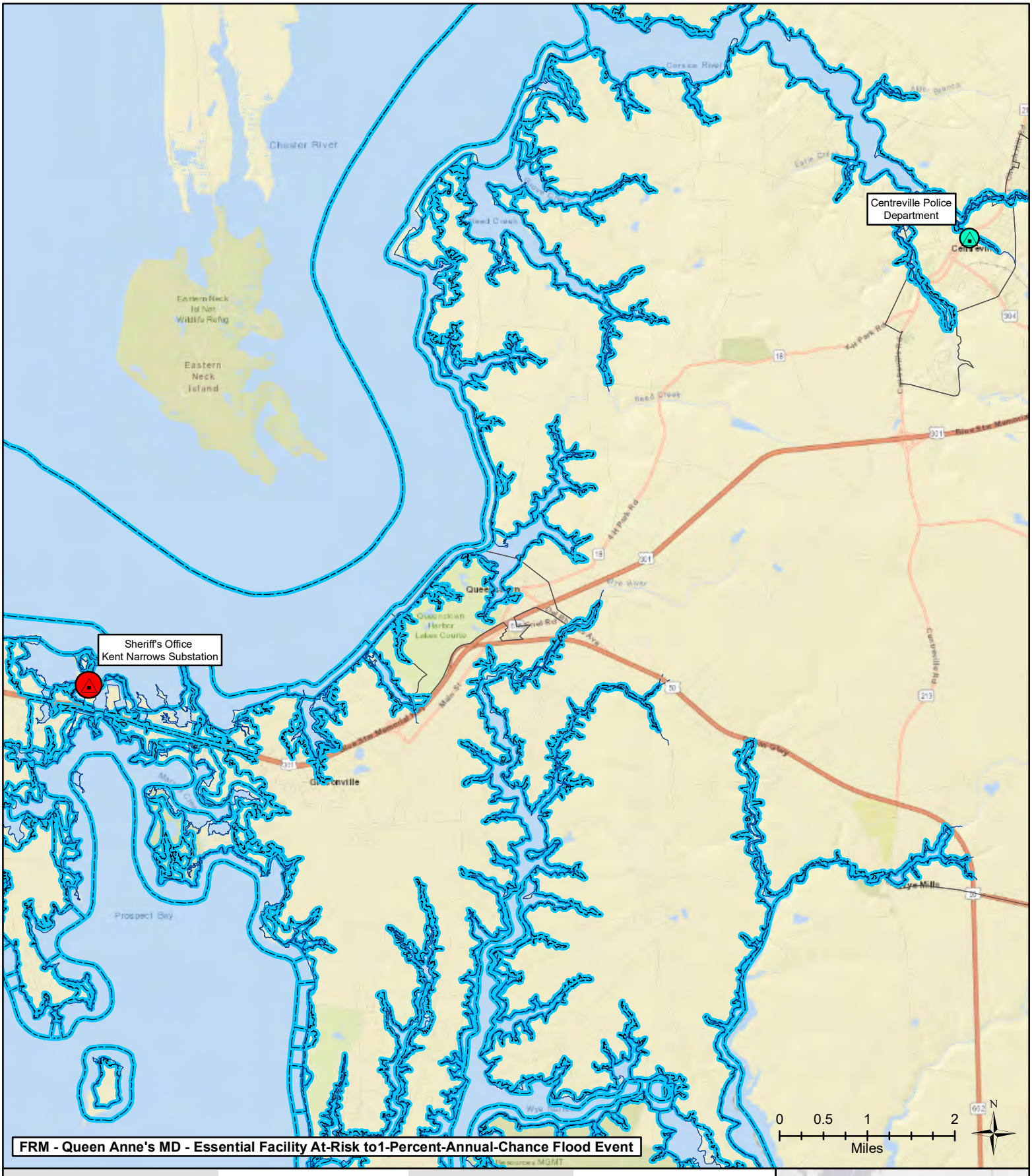



N
FRM - Queen Anne's MD - High Risk Area 4 (Kent Narrows)
0 500 1,000 2,000
Feet
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Queen Anne's County
Map Extent


N
FRM - Queen Anne's MD - High Risk Area 4 (Kent Narrows)
0 500 1,000 2,000
Feet
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Queen Anne's County
Map Extent


Stevensville
Bay Bridge Airport
Mowbray Park
Kmart
Food Lion
Old Love Point Park
Harbor View
Cox Creek
Thompson Creek
Bateau Dr
Log Canoe Cir
Skipjack Pkwy
Sailfish Dr
Business Pkwy
Lowry Rd
State St
Cockey Ln
Church St
Joyce Ln
Elementary Way
White Pine Ln
Main St
Cleat St
Pier 1 Rd
Romancoke Rd
Ellendale Farm Ln
Thompson Creek Rd
Marion Quimby Dr
Mainsail Dr
Creeks End Ln
Shopping Center Rd
Anchorage Dr
Ellicott Dr
Mikes Way
Lily Ave
Parker Dr
Allison Jane Dr
Anna Carol Dr
Conner Dr
John Patrick Dr
Calvert Rd
Kent Manor Dr
Fair Prospect Farm Ct
Blunt Marsh Ln
Little Neck Rd
Davidson Dr
Heim Ln
Kelly Ln
Barren Ridge Rd
Brown Rd
Hopkins Rd
Denny Farm
Riverside Dr
Cedar Rd
Tripp Way
Woods Rd
Edgewood Rd
Keister Dr
0 500 1,000 2,000
Feet
N
FRM - Queen Anne's MD - High Risk Area 5 (South Stevensville)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Queen Anne's County


Stevensville
Bay Bridge Airport
Mowbray Park
Harbor View
Pier 1 Rd
Main St
Cleat St
Church St
Center Rd
Lowry Rd
Romancoke Rd
Ellendale Farm Ln
Mikes Way
Lily Ave
Parker Dr
Allison Jane Dr
Anna Carol Dr
Conner Dr
John Patrick Dr
Kent Manor Dr
Fair Prospect Farm Ct
Blunt Marsh Ln
Little Neck Rd
Davidson Dr
Heim Ln
Kelly Ln
Brown Rd
Hopkins Rd
Cedar Rd
Tripp Way
Woods Rd
Riverside Dr
Edgewood Rd
Anchorage Dr
Creeks End Ln
Cox Creek
Thompson Creek
Bateau Dr
Log Canoe Circle
Skipjack Pkwy
Business Pkwy
Old Love Point Park
Duke St
Elementary Way
White Pine Ln
Quimby Dr
Mainsail Dr
Shopping Center Rd
Ellicott Dr
Keister Dr
Barren Ridge Rd
Denny Farm
Calvert Rd
Victoria Dr
Cockey Ln
Kmart
Food Lion
0 500 1,000 2,000
Feet
N
FRM - Queen Anne's MD - High Risk Area 5 (South Stevensville)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Queen Anne's County



FRM - Queen Anne's MD - Essential Facility At-Risk to1-Percent-Annual-Chance Flood Event

- Stream Centerline
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

Queen Anne's County & Municipalities

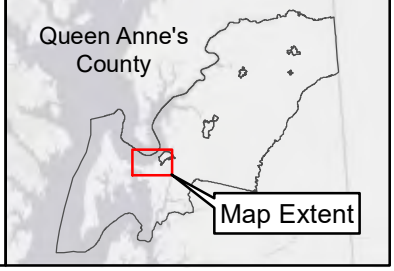
- Unincorporated & Incorporated Areas

Essential Facility Types At-Risk

- Police

Essential Facility Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000



This page left blank intentionally

Source: WBOC - http://www.wboc.com/story/41172290/crisfield-offers-assistance-during-flooding-comes-somerset-wicomico-areas-storm%2f402778002%2f/RK=2/RS=s50HP3a4JW2ANKTtpaOZIpdtirs-

STATE OF MARYLAND

FLOOD RISK REPORT

SOMERSET COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Somerset County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Somerset County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Somerset County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 4

d. Related Resources 6

2 Flood Risk Analysis 11

a. Overview 11

b. Analysis of Risk 12

i. Flood Depth and Analysis Grids 12

ii. Flood Risk Assessments 13

iii. Areas of Mitigation Interest 15

3 Flood Risk Analysis Results 27

a. Somerset County, MD Flood Risk Project Area Summary 28

i. Overview 28

ii. Flood Risk Results 28

iii. Flood Risk Maps 39

b. Communities 40

i. Somerset County (Unincorporated Area) (CID 240061) 40

ii. City of Crisfield Summary (CID 240062) 44

iii. Town of Princess Anne (CID 240063) 47

4 Actions To Reduce Flood Risk....50

a. Types of Mitigation Actions....50

i. Local Plans and Regulations....50

ii. Structure and Infrastructure Projects....51

iii. Natural Systems Protection Activities....52

iv. Education and Awareness Activities....52

b. Identifying Specific Actions for Your Community....54

c. Mitigation Programs and Assistance....55

i. FEMA Mitigation Programs and Assistance....55

ii. Additional Mitigation Programs and Assistance....56

5 Acronyms And Definitions....57

a. Acronyms....57

b. Definitions....59

6 Additional Resources....63

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Somerset County Essential Facilities 16

Table 2: Flood Risk Assessment – Community Overview 28

Table 3: Somerset County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 4: Somerset County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 29

Table 5: Somerset County, Maryland – Estimated Degree of Damage Summary for 1%-Annual-Chance Flood (UDFs in Coastal Areas) 30

Table 6: Somerset County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas) 32

Table 7: Somerset County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas) 32

Table 8: Somerset County, Maryland – State Assets Estimated Loss Summary for the 1%-Annual-Chance Flood (State Assets in Riverine and Coastal Areas) 33

Table 9: Somerset County, Maryland – Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas) 34

Table 10: Somerset County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas) 35

Table 11: Somerset County, Maryland – Types of Mitigation Interest 35

Table 12: Somerset County, Maryland – High-Risk Areas 38

Table 13: Somerset County (Unincorporated Area) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 41

Table 14: Somerset County (Unincorporated Area) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 42

Table 15: City of Crisfield – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 45

Table 16: City of Crisfield – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 45

Table 17: Town of Princess Anne – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 48

Table 18: Town of Princess Anne – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 48

Table 19: Mitigation Actions for Areas of Mitigation Interest 52

Table 20: FEMA Hazard Mitigation Assistance Programs 55

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Cafe Milano and much of downtown Crisfield was surrounded by floodwaters that rose 2-3 feet above normal during Wednesday morning high tide.
Source: DelMarva Now

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: City of Crisfield, October 2019
Source: https://www.wrde.com/story/41172290/crisfield-offers-assistance-during-flooding

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4

Vulnerability of infrastructure is another important consideration.

Photo: Cafe Milano and much of downtown Crisfield was surrounded by floodwaters that rose 2-3 feet above normal. March 2018 Source: https://www.delmarvanow.com/story/news/local/maryland/2018/03/07/flooding-comes-somerset-wicomico-areas-storm/402778002/

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future

land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 32 and 33.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.
- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (effective February 4, 2015), provided by FEMA Region III and Maryland Department of the Environment. In conjunction with that regulatory update, non-regulatory coastal flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were developed and published to the FEMA Map Service Center on May 4, 2016. Those non-regulatory coastal datasets have been leveraged as part of this countywide assessment.

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of October 2018), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/.
  Note that first floor elevations are *not* specified within this dataset but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordinances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the

community's initial FIRM) and 4' for Post-FIRM (constructed after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Somerset County Geographic Information Systems– https://www.somersetmd.us/departments/departments_-_n_-_z/planning_and_zoning/index.php *(Limited Distribution; data available by purchase/ request).*
- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.
- Hazus-MH Versions 2.2 and 3.1 – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. *Subsection ii: Flood Risk Assessments*, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).
- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that

identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

The *2017 Somerset County Hazard Mitigation Plan Update* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

Please note that the information in this FRR may be reviewed for inclusion during the update of the Somerset County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.
- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.
- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the

Mid-Atlantic Region predicted to potentially have some of the worst impacts of sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

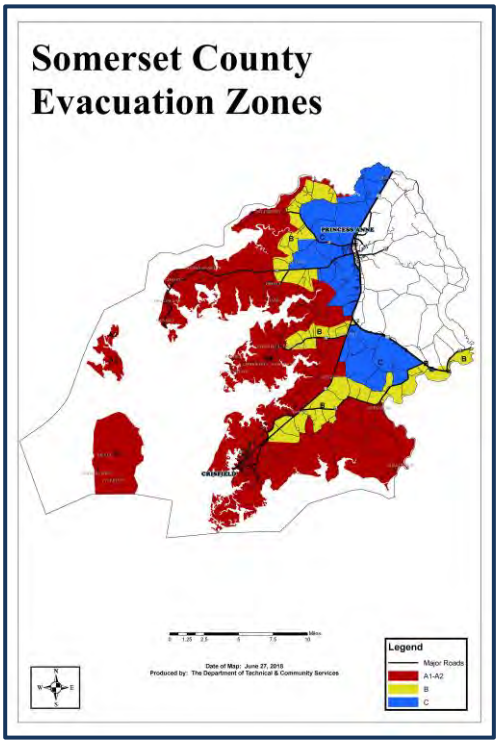
TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

  The Maryland Emergency Mangement Agency and Somerset County launched the Know Your Zone campaign on June 14, 2018, a program designed to make evacuations for residents easier to understand and act upon during predicted storm surge or tidal flooding events.

  Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to

Figure 1.6



least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in red, identifies the areas most at risk, Zone B, yellow, are areas with a moderate risk, and Zone C, blue, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario. A local map of the Somerset County evacuation zones can be found at: http://www.somerset911.org/Zones.html.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  Over the last 50 years, the County has experienced conditions that are now associated with the dynamic nature of coastal regions, the *2008 Somerset County, Maryland Rising Sea Level Guidance* was developed. The guidance identified four distinct planning strategies that need to be addressed when planning for the long-term implications of sea level rise. They are: Vulnerability and Impact Assessment; Long-Range and Comprehensive Planning; Codes, Regulations and Development Standards; and Public Education and Outreach.

- **Emergency Action Plans.** Emergency Action Plans (EAP) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

  According to the *USACE National Inventory of Dams – Somerset County, MD,* there are no dams located within the Somerset County.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what

happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

The *Flood Risk Report Somerset County, Maryland Coastal Study*, developed by FEMA using Hazus Version 2.2 and released on May 4, 2016, provides coastal flood risk information such as estimated coastal flood losses for the 1-percent-annual-chance flood event which have been leveraged for this countywide flood risk assessment. The Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Flooding in the City of Crisfield – October 2019.
Source: WBOC - http://www.wboc.com/story/41172290/crisfield-offers-assistance-during-flooding
Bottom Photo: Low-lying cornfields near the Chesapeake Bay are inundated with saltwater.
Source: The Atlantic - https://www.theatlantic.com/science/archive/2018/03/maryland-salt-farms/554663/

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

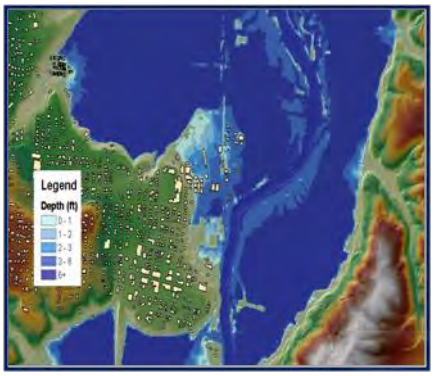
State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

flood depth is a function of the difference between the calculated water surface elevation (including overland wave propagation for coastal areas) and the ground.

Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and regulatory FIRM updates for each study type were separately performed.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region

- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

Figure 2.4

An essential facility, Crisfield Volunteer Fire Department, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: Maryland Emergency Management Agency

There are 49 essential facilities located within Somerset County with a total esitmated building value of $281,992,200.

Table 1: Somerset County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	3	$3,013,500
Fire/Rescue Stations	9	$2,505,100
Hospital & Medical Clinics	14	$34,941,200
Police Stations	8	$101,644,000
Schools (K-12 & Colleges)	15	$139,888,400
Total	**49**	**$281,992,200**

Source: Updated 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations.

Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 6 high risk areas were identified within Somerset County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, they are no dams located in Somerset County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

- **Reasons dams are considered AoMIs:**

Figure 2.6

This dam failure caused flooding that damaged several homes and vehicles.

  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.

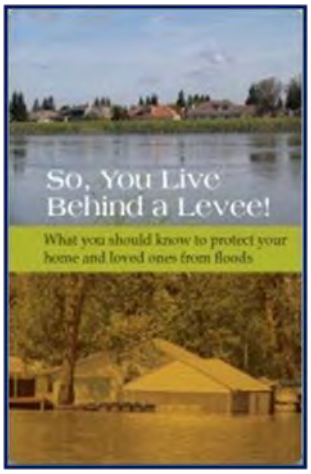
- Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.
- A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
- For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

Acccording to US Army Corps of Engineers, National Levee Database, there are no levees located within Somerset County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

- **Reasons coastal structures are considered AoMIs:**
  - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
  - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
  - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**
    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
    - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
    - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
    - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

  Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

  Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

  As of June 30, 2017, a total of fifty-three (53) FEMA Designated Repetitive Loss Properties were within Somerset County; three (3) commercial, three (3) condos, and forty-seven (47) single-family structures. There are thirty-seven (37) repetitive loss properties located in the unincorporated area of Somerset County. Additionally, one repetitive loss property is within the municipal boundaries of Princess Anne, while fifteen (15) are within the City of Crisfield. There are no severe repetitive loss structures located within Somerset County.

  - **Reasons past claim hotspots are considered AoMIs:**

    - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.

    - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.

    Figure 2.8

    Clusters of past flood insurance claims can show where there is a repetitive flood problem.

    - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

  Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

  Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

  Figure 2.9

  Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

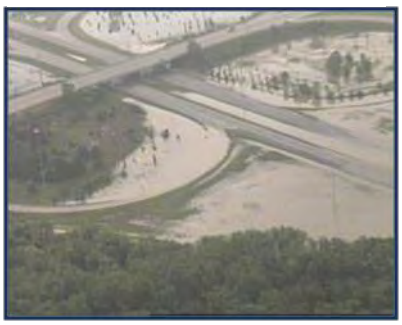
  - **Reasons Areas of Significant Land Use Change are considered AoMIs:**
    - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
    - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
    - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

- **Reasons overtopped roads are considered AoMIs:**
  - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
  - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

Figure 2.10



When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  The *2017 Somerset County Hazard Mitigation Plan Update* provided a listing of repetitive flood locations identified by the Department of Public Works. The listing of repetitive flooding issues is within *Appendix D Roads and Bridges of Concern* of the Plan Update. A total of 137 repetitive flood locations were identifed in the unincorporated areas of the County and municipalities.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
    - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
    - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural

measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. . A list of mitigation actions can be found in Section 4, Table 19.

- **Reasons areas of mitigation success are considered AoMIs:**
  - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
  - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
  - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
    - Landslides and mudslides are a result of erosion
    - Approximately one-third of the nation's streams experience severe erosion problems
    - Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
    - Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach

erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Somerset County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Somerset County, Maryland includes the following communities:

Table 2: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Somerset County (Unincorporated Areas)	240061	20,454	605.14	Y	N/A	Y
City of Crisfield	240062	2,726	3.17	Y	N/A	Y
Town of Princess Anne	240063	3,290	1.69	Y	N/A	Y

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

The Somerset County, Maryland Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Within Somerset County and Incorporated Areas, UDFs for riverine areas were analyzed, but no associated losses were identified. As a result, only coastal flood losses are presented, based on the leveraged UDFs from the May 2016 coastal flood risk products for Somerset County.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 2.2, and the results are summarized by community name in Table 3, and by land use occupancy type in Table 4. Table 5 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 3: Somerset County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Somerset County (Unincorporated Areas)	20,454	3,700	$53,000,000	$2,591	60%
City of Crisfield	2,726	1,075	$35,400,000	$12,986	40%
Town of Princess Anne	3,290	11	$110,000	$33	< 1%
Total	**26,470**	**4,786**	**$88,500,000**	**$3,343**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 4: Somerset County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	4,405	$424,400,000	71%	$57,600,000	14.0%
Commercial Building & Contents	217	$104,400,000	18%	$13,400,000	13.0%
Other Building & Contents	164	$65,600,000	11%	$11,800,000	18.0%
Total Building & Contents[3]	4,786	$594,400,000	100%	$82,800,000	14.0%
Business Disruption[4]	N/A	N/A	N/A	$5,700,000	N/A
TOTAL[5]	**4,786**	**$594,400,000**	**100%**	**$88,500,000**	**15.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 5: Somerset County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	683	14%	$154,300,000	$200,000	$60,000	$0	< 1%
1 - 10%	579	12%	$119,000,000	$200,000	$7,600,000	$10,000	9%
10 - 20%	1,621	34%	$157,700,000	$100,000	$23,200,000	$10,000	28%
20 - 30%	1,094	23%	$98,200,000	$90,000	$24,300,000	$20,000	29%
30 - 40%	389	8%	$39,000,000	$100,000	$12,900,000	$30,000	16%
40 - 50%	106	2%	$13,200,000	$100,000	$5,900,000	$60,000	7%
50% or More	314	7%	$13,100,000	$40,000	$8,800,000	$30,000	11%
TOTAL	**4,786**	**100%**	**$594,500,000**	**$100,000**	**$82,760,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the User Defined Facilities (UDFs) Flood Risk Assessment Dataset in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Somerset County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date February 4, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction*

Level

This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).
- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Somerset County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 6.

Results from the analysis concluded 16 Essential Facilities in Somerset County are at-risk to the 1-percent-annual-chance flood event. The list of essential facilities impacted by the 1-percent-annual-chance flood event is listed on page 35.

Table 6: Somerset County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas)

Type	Estimated Building Value	Total Essential Facilities	1% (100-yr) Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$3,013,500	3	$0	0
Fire Station	$2,505,100	9	$82,011	6
Hospital	$34,941,200	14	$1,499,573	4
Police Station	$101,644,000	8	$3,100	2
School	$139,888,400	15	$56,308	4
TOTAL	**$281,992,200**	**49**	**$1,640,992**	**16**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Table 7: Somerset County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas)

Type	Total 1% (100-yr) Dollar Losses (Building & Content)	Total Building Loss	Building Loss Percentage of Total	Total Content Loss	Content Loss Percentage of Total
Fire Station	$332,533	$82,011	25%	$250,523	75%
Hospital	$2,688,797	$1,499,573	56%	$1,189,224	44%
Police Station	$8,413	$3,100	37%	$5,314	63%
School	$361,810	$56,308	16%	$305,502	84%
TOTAL	**$3,391,554**	**$1,640,992**	**N/A**	**$1,750,562**	**N/A**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Somerset County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;

- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Somerset County contains 275 state assets. Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 8.

Table 8: Somerset County, Maryland – State Assets Estimated Loss Summary for the 1%-Annual-Chance Flood (State Assets in Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss Percentage of Total	Total Content Loss	Content Loss Percentage of Total
MD Institute for Emergency Medical Services – Communications Engineering Services Facility	$3,387,018	$1,859,642	55%	$1,527,376	45%
Department of Natural Resources Facility	$3,209,004	$693,037	22%	$2,515,967	78%
TOTAL	**$6,596,022**	**$2,552,679**	**N/A**	**$4,043,344**	**N/A**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis (Version 3.1) results stored as the State Assets Flood Risk Assessment Dataset in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall,

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
    - The model estimates that a total of 24,648 tons of debris will be generated. Of the total amount, Finishes comprises 71% of the total, Structure comprises 11% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 986 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 9: Somerset County, Maryland –Debris Generation Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	17,481	71%	699
Structure	2,721	11%	109
Foundation	4,446	18%	178
TOTAL	**24,648**	**100%**	**986**

Source: Hazus 3.1: Flood Modual – Somerset County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**

  - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 3,027 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 7,163 people (out of a total population of 26,470) will seek temporary shelter in public shelters.

Table 10: Somerset County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine and Coastal Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	3,027	9,080	7,163

Source: Hazus 3.1: Flood Modual – Somerset County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 11: Types of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	16	Depth grids, Emergency Management Dept.
At-Risk State Assets	9	Dept grids, MEMA
High-Risk Areas	6	Depth grids, UDFs, Loss estimates
Repetitive Flood Issues	137	Local public works – Roads Division
Repetitive Loss Properties	53	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database.

- **At-Risk Essential Facilities:**

  Results from the 1-percent-annual-chance flood event analysis indicate sixteen (16) essential facilities are at-risk; 6 fire stations, 4 medical facilities, 2 police stations, and 4 schools. Flood depths for each facility is provided below along with the identified facilities.

  - Lower Somerset Rescue and Fire Department – 1.5′
  - Crisfield Fire Department – 2.9′
  - Ewell Fire Department – 2.8′
  - Fairmount Fire Department – 1.3′
  - Mt. Vernon Fire Department – 0.5′
  - Tylerton Fire Department – 2.3′
  - McCready Health – 2.3′
  - Crisfield Clinic – 1.3′
  - Crisfield Pharmacy – 3.1′
  - Marion Pharmacy – 0.8′
  - Crisfield Police – 1.7′
  - DNR Police – 1.6′
  - Woodson Elementary School – 0.5′
  - Crisfield High School – 3.8′
  - Ewell Elementary School – 2.9′
  - Macedonia School – 3.9′

  A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

- **At-Risk State Assets:**

  Results from the 1-percent-annual-chance flood event analysis indicate nine (9) state assets are at-risk. These facilities include five (5) MD Institute for Emergency Medical Services (MIEMSS) – Communications Engineering Services facilities that are leased for communication infrastructure and four (4) Department of Natural Resources Facilities.

  MIEMSS Communications Engineering Services work in a partnership

arrangement with State and local jurisdictions to provide infrastructure that supports a public safety 700 MHz communications network. The microwave system provides point-to-point links between all of the usable existing and newly constructed communications towers. Connectivity to the county 9-1-1 Public Safety Answering Point (PSAP) centers is included. Monitoring of the network is primarily done by MIEMSS with access to the management system available to the county and state maintenance personnel.

Flood depths for each facility is provided below along with the identified facilities.

- MD Institute for Emergency Medical Services – Communications Engineering Services Facilities
  - Lower Somerset Rescue and Fire Department – 1.5′
  - McCready Health – 2.3′
  - Tylerton Fire Department – 2.3′
  - Ewell Fire Department – 2.8′
  - Crisfield Fire Department – 2.9′
- Department of Natural Resources Facilities
  - Crisfield Terminal - Office/Storage – 1.6′
  - Janes Island State Park – Various Park Structures – 2.6′
  - Sommers Cove Marina – Various Structures – 1.8′
  - Deal Island – Various Structures – 2.2′

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 12: Somerset County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Crisfield	5,617	330	2,586	$58,207,849	66%
Area 2	Deal Island	824	56	299	$2,657,678	3%
Area 3	Fairmount	555	39	354	$5,411,043	6%
Area 4	Mount Vernon	517	44	170	$2,078,285	2%
Area 5	Oriole	420	48	227	$4,709,302	5%
Area 6	Smith Island	276	25	287	$3,069,836	3%
Total for High-Risk Areas		**8,209**	**542**	**3,923**	**$76,133,993**	**86%**

- **Repetitive Flood Issues**

  Reviewing the repetitive flood locations and issues identified in Appendix A in the *2017 Somerset County Hazard Mitigation Plan Update* several repetitive flood locations were found to be within high risk areas listed in Table 12 of this report.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of fifty-three (53) FEMA Designated Repetitive Loss Properties have been identified in the unincorporated portions of Somerset County, City of Crisfield and Town of Princess Anne. According to the 2017 Plan, a concentration of repetitive loss properties is located in the community of the City of Crisfield. A cluster of twelve (12) repetitive loss properties are located in the northern portion of the City.

iii. Flood Risk Maps

The Flood Risk Maps for Somerset County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Somerset County (Unincorporated Area) Summary (CID 240061)

The following pages include Flood Risk data for the Somerset County (Unincorporated Areas).

Overview

The Somerset County (Unincorporated Areas) is located in southeastern Maryland and consists of 605.14 square miles. It is bordered by Dorchester County to the northwest, Wicomico County to the north, Worcester County to the east, and the State of Virginia to the south.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Somerset County (Unincorporated Areas)	240061	20,454	605.14	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 13, 2022
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1,280 policies totaling approximately $ 256,817,000
- NFIP-recognized repetitive loss properties = 37
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Somerset County (Unincorporated Areas) that are located within the Somerset County, Maryland Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

As noted in the countywide results section, UDFs for riverine areas in Somerset County were analyzed, but no associated losses were identified. As a result, only coastal flood losses are presented, based on the leveraged UDFs from the May 2016 coastal flood risk products for Somerset County.

Community Analyses and Flood Risk Results

The Somerset County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 13. Additionally, Table 14 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 13: Somerset County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	3,502	$325,100,000	90%	$45,800,000	14.0%
Commercial Building & Contents	90	$15,100,000	4%	$1,100,000	7.0%
Other Building & Contents	108	$21,900,000	6%	$5,000,000	23.0%
Total Building & Contents[3]	3,700	$362,100,000	100%	$51,900,000	14.0%
Business Disruption[4]	N/A	N/A	N/A	$1,100,000	N/A
TOTAL[5]	**3,700**	**$362,100,000**	**100%**	**$53,000,000**	**15.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 14: Somerset County (Unincorporated Areas)– Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	522	14%	$101,900,000	$200,000	$10,000	$0	< 1%
1 - 10%	488	13%	$60,900,000	$100,000	$3,600,000	$10,000	7%
10 - 20%	1,130	31%	$94,500,000	$80,000	$13,600,000	$10,000	26%
20 - 30%	860	23%	$65,100,000	$80,000	$16,200,000	$20,000	31%
30 - 40%	299	8%	$18,000,000	$60,000	$5,900,000	$20,000	11%
40 - 50%	88	2%	$8,600,000	$100,000	$3,800,000	$40,000	7%
50% or More	313	8%	$13,100,000	$40,000	$8,800,000	$30,000	17%
TOTAL	**3,700**	**100%**	**$362,100,000**	**$100,000**	**$51,910,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within Somerset County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date February 4, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. City of Crisfield (CID 240062)

The following pages include Flood Risk data for the City of Crisfield.

Overview

The City of Crisfield is in southern Somerset County. It consists of 3.17 square miles along State Highway 413. The primary flooding sources in the city are the Chesapeake Bay, Little Annemessex Creek, and Jenkins Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
City of Crisfield	240062	2,726	3.17	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 13. 2022
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 544 policies totaling approximately $95,924,000
- NFIP-recognized repetitive loss properties = 15
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the City of Crisfield that are located within the Somerset County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The City of Crisfield flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 15. Additionally, Table 16 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 15: City of Crisfield – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	896	$98,600,000	43%	$11,700,000	12.0%
Commercial Building & Contents	126	$89,300,000	39%	$12,300,000	14.0%
Other Building & Contents	53	$43,600,000	19%	$6,800,000	16.0%
Total Building & Contents[3]	1075	$231,500,000	100%	$30,800,000	13.0%
Business Disruption[4]	N/A	N/A	N/A	$4,600,000	N/A
TOTAL[5]	**1,075**	**$231,500,000**	**100%**	**$35,400,000**	**15.0%**

Source: Hazus analysis (Version 2.2) results stored as the User Defined Facilities Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 16: City of Crisfield – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	160	15%	$52,300,000	$300,000	$50,000	$0	0%
1 - 10%	89	8%	$57,700,000	$600,000	$4,000,000	$40,000	13%
10 - 20%	485	45%	$62,800,000	$100,000	$9,500,000	$20,000	31%
20 - 30%	234	22%	$33,100,000	$100,000	$8,200,000	$40,000	27%
30 - 40%	89	8%	$20,900,000	$200,000	$7,000,000	$80,000	23%
40 - 50%	18	2%	$4,600,000	$300,000	$2,100,000	$100,000	7%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**1,075**	**100%**	**$231,400,000**	**$200,000**	**$30,850,000**	**$30,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the User Defined Facilities Flood Risk Assessment Dataset in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the City of Crisfield.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date February 4, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Princess Anne Summary (CID 240063)

The following pages include Flood Risk data for the Town of Princess Anne.

Overview

The Town of Princess Anne is in northern Somerset County. It consists of 1.69 square miles along US Highway 13. The primary flooding sources in the town are Manokin River, Wesley Branch, and Loretta Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Princess Anne	240063	3,290	1.69	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires November 13, 2022
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 6 policies totaling approximately $1,314,200
- NFIP-recognized repetitive loss properties = 1
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Princess Anne that are located within the Somerset County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Princess Anne flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 17. Additionally, Table 18 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 17: Town of Princess Anne – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	7	$800,000	89%	$80,000	10.0%
Commercial Building & Contents	1	$50,000	6%	$20,000	40.0%
Other Building & Contents	3	$50,000	6%	$10,000	20.0%
Total Building & Contents[3]	11	$900,000	100%	$110,000	12.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**11**	**$900,000**	**100%**	**$110,000**	**12.0%**

Source: Hazus analysis (Version 2.2) results stored as the User Defined Facilities Flood Risk Assessment Dataset in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 18: Town of Princess Anne – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	9%	$10,000	$10,000	$0	$0	0%
1 - 10%	2	18%	$400,000	$200,000	$20,000	$10,000	18%
10 - 20%	6	55%	$400,000	$70,000	$70,000	$10,000	64%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	1	9%	$50,000	$50,000	$20,000	$20,000	18%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	1	9%	$0	$0	$0	$0	0%
TOTAL	**11**	**100%**	**$860,000**	**$80,000**	**$110,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the User Defined Facilities Flood Risk Assessment Dataset in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Princess Anne.

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against riverine and coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date February 4, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Participation in the NFIP Community Rating System (CRS)
- Building codes
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 19 below identifies possible mitigation actions for each AoMI to consider.

Table 19: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***

AoMI	Possible Actions to Reduce Flood Risk
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	• ***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The 2017 Somerset County Hazard Mitigation Plan Update Chapter 19 Mitigation Strategies is a valuable place to identify and prioritize possible mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a

stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 18 below.

Table 20: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also

subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

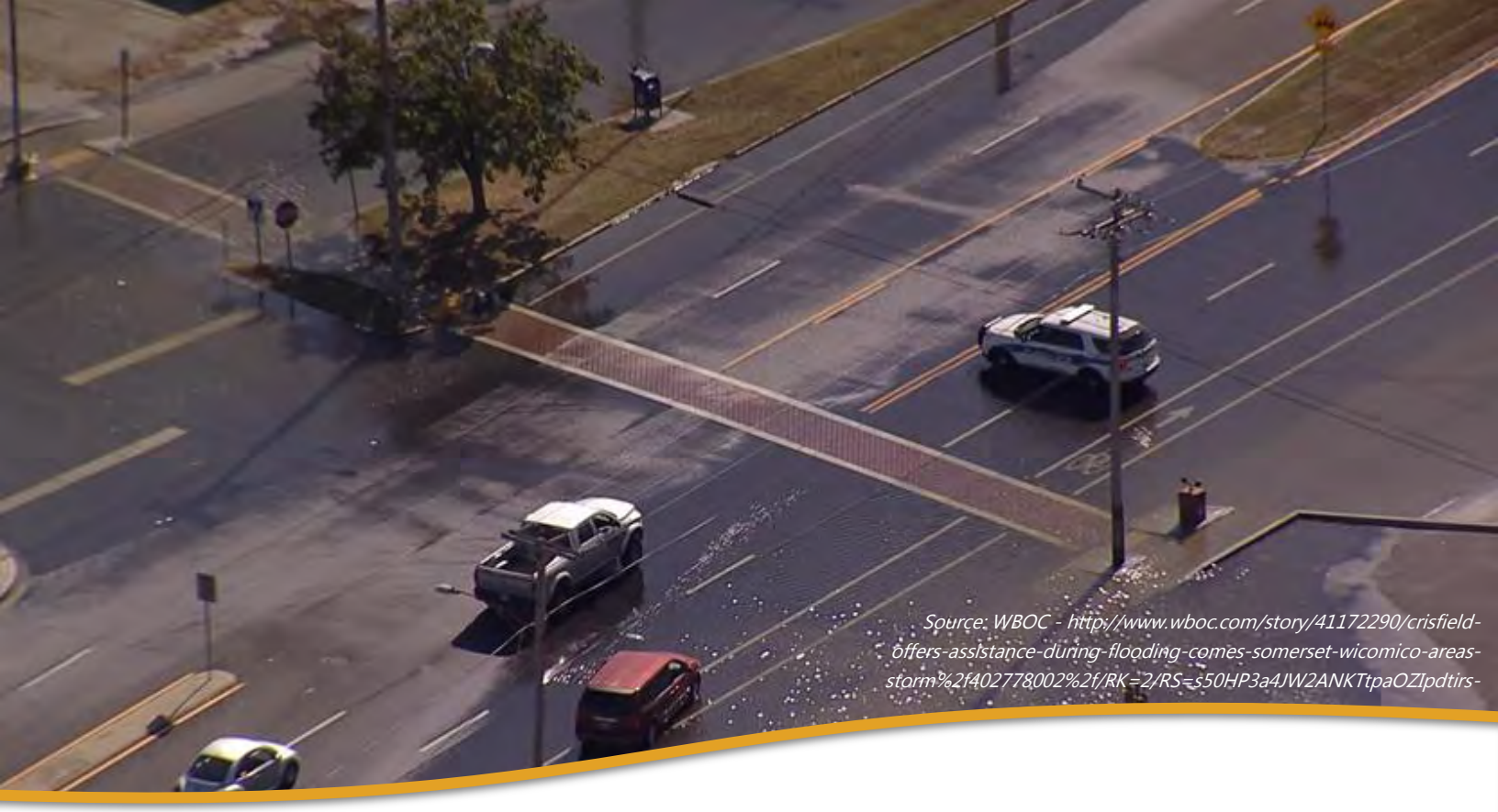
Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Room 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Somerset County Department of Emergency Services
11916 Somerset Avenue, Princess Anne, MD 21853
http://www.somerset911.org/

Somerset County Department of Planning and Zoning
11916 Somerset Avenue, Room 211, Princess Anne, MD 21853
https://www.somersetmd.us/departments_-_n_-_z/planning_&_zoning.php

Somerset County Department of Public Works
11916 Somerset Avenue, Room 210, Princess Anne, MD 21853
https://www.somersetmd.us/departments/departments_-_n_-_z/public_works/index.php

Somerset County Department of Planning and Zoning – Geographic Information Systems
11916 Somerset Avenue, Room 211, Princess Anne, MD 21853
https://www.somersetmd.us/departments/departments_-_n_-_z/planning_&_zoning.php



Source: WBOC - http://www.wboc.com/story/41172290/crisfield-offers-assistance-during-flooding-comes-somerset-wicomico-areas-storm%2f402778002%2f/RK=2/RS=s50HP3a4JW2ANKTtpaOZIpdtirs-

STATE OF MARYLAND

FLOOD RISK REPORT

SOMERSET COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Somerset County, Maryland – Countywide Flood Risk Map (FRM)

Somerset County, Maryland – High Risk Area 1: Crisfields – Dollar Losses

Somerset County, Maryland – High Risk Area 1: Crisfields – Percent Losses

Somerset County, Maryland – High Risk Area 2: Deal Island – Dollar Losses

Somerset County, Maryland – High Risk Area 2: Deal Island – Percent Losses

Somerset County, Maryland – High Risk Area 3: Fairmount – Dollar Losses

Somerset County, Maryland – High Risk Area 3: Fairmount – Percent Losses

Somerset County, Maryland – High Risk Area 4: Mount Vernon – Dollar Losses

Somerset County, Maryland – High Risk Area 4: Mount Vernon – Percent Losses

Somerset County, Maryland – High Risk Area 5: Oriole – Dollar Losses

Somerset County, Maryland – High Risk Area 5: Oriole – Percent Losses

Somerset County, Maryland – High Risk Area 6: Smith Island North – Dollar Losses

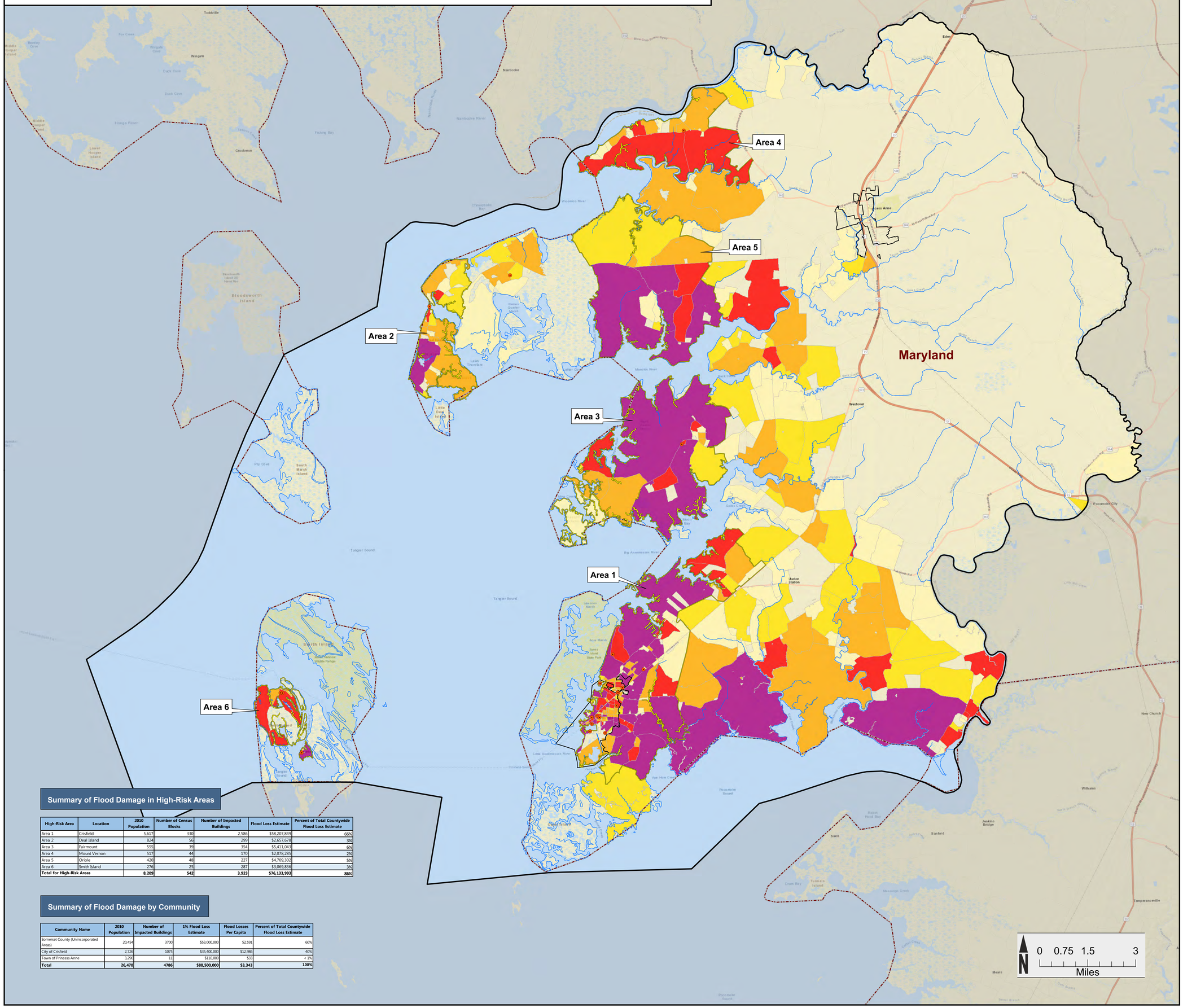
Somerset County, Maryland – High Risk Area 6: Smith Island North – Percent Losses

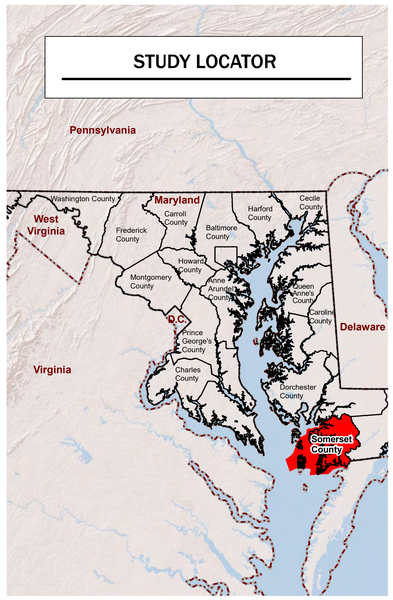
Somerset County, Maryland – High Risk Area 6: Smith Island South – Dollar Losses

Somerset County, Maryland – High Risk Area 6: Smith Island South – Percent Losses

Somerset County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Somerset County, Maryland





MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area*

Area 1

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk State Asset or Essential Facility

Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Crisfield	5,617	330	2,586	$58,207,849	66%
Area 2	Deal Island	824	56	299	$2,657,678	3%
Area 3	Fairmount	555	39	354	$5,411,043	6%
Area 4	Mount Vernon	517	44	170	$2,078,285	2%
Area 5	Oriole	420	48	227	$4,709,302	5%
Area 6	Smith Island	276	25	287	$3,069,836	3%
Total for High-Risk Areas		**8,209**	**542**	**3,923**	**$76,133,993**	**86%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Somerset County (Unincorporated Areas)	20,454	3700	$53,000,000	$2,591	60%
City of Crisfield	2,726	1075	$35,400,000	$12,986	40%
Town of Princess Anne	3,290	11	$110,000	$33	< 1%
Total	**26,470**	**4786**	**$88,500,000**	**$3,343**	**100%**

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

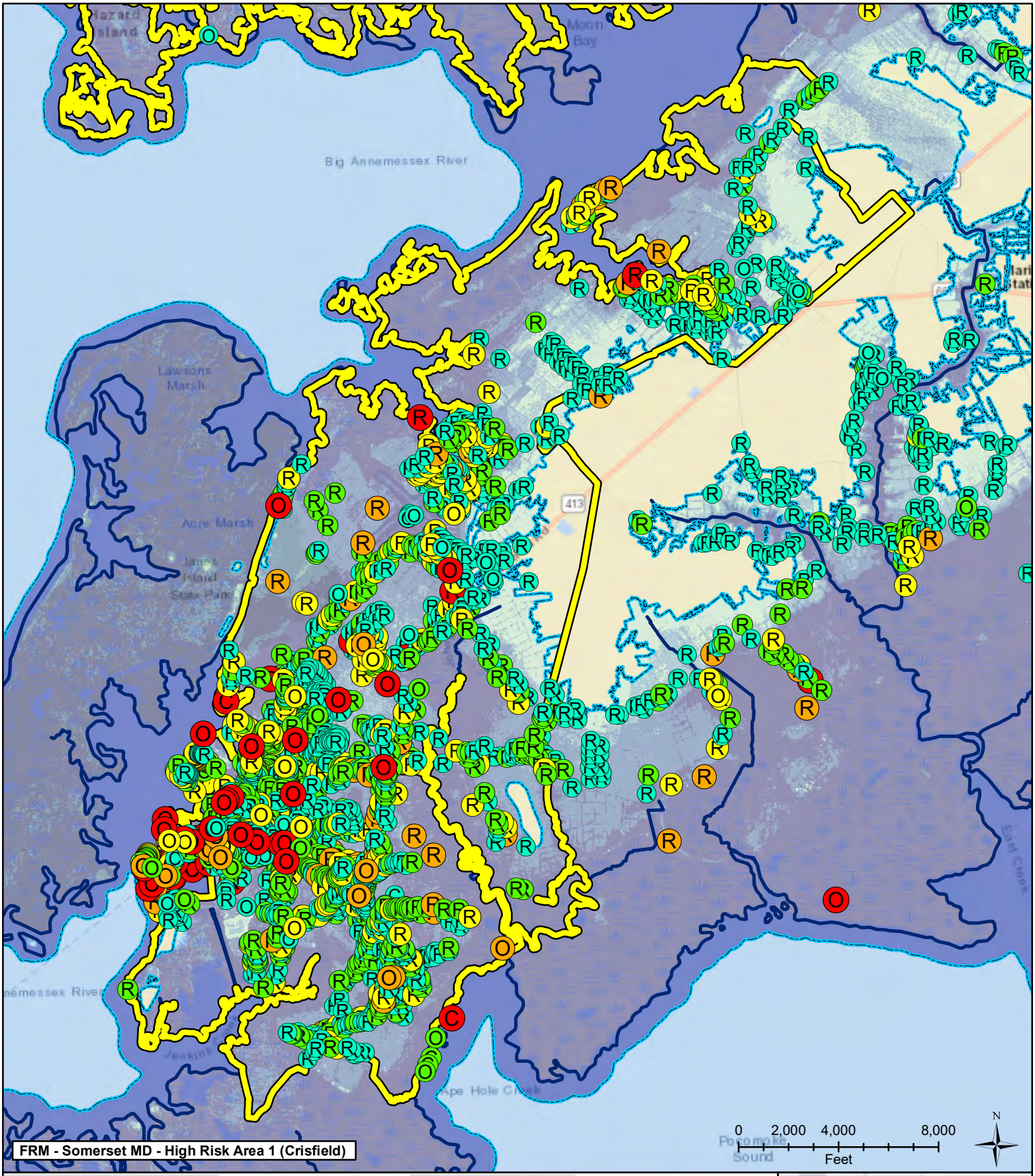
Somerset County and Incorporated Areas, MD

MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Somerset County, MD.

RELEASE DATE
12/31/2019



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

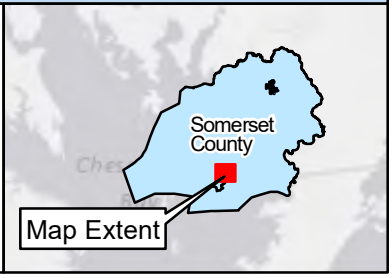
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

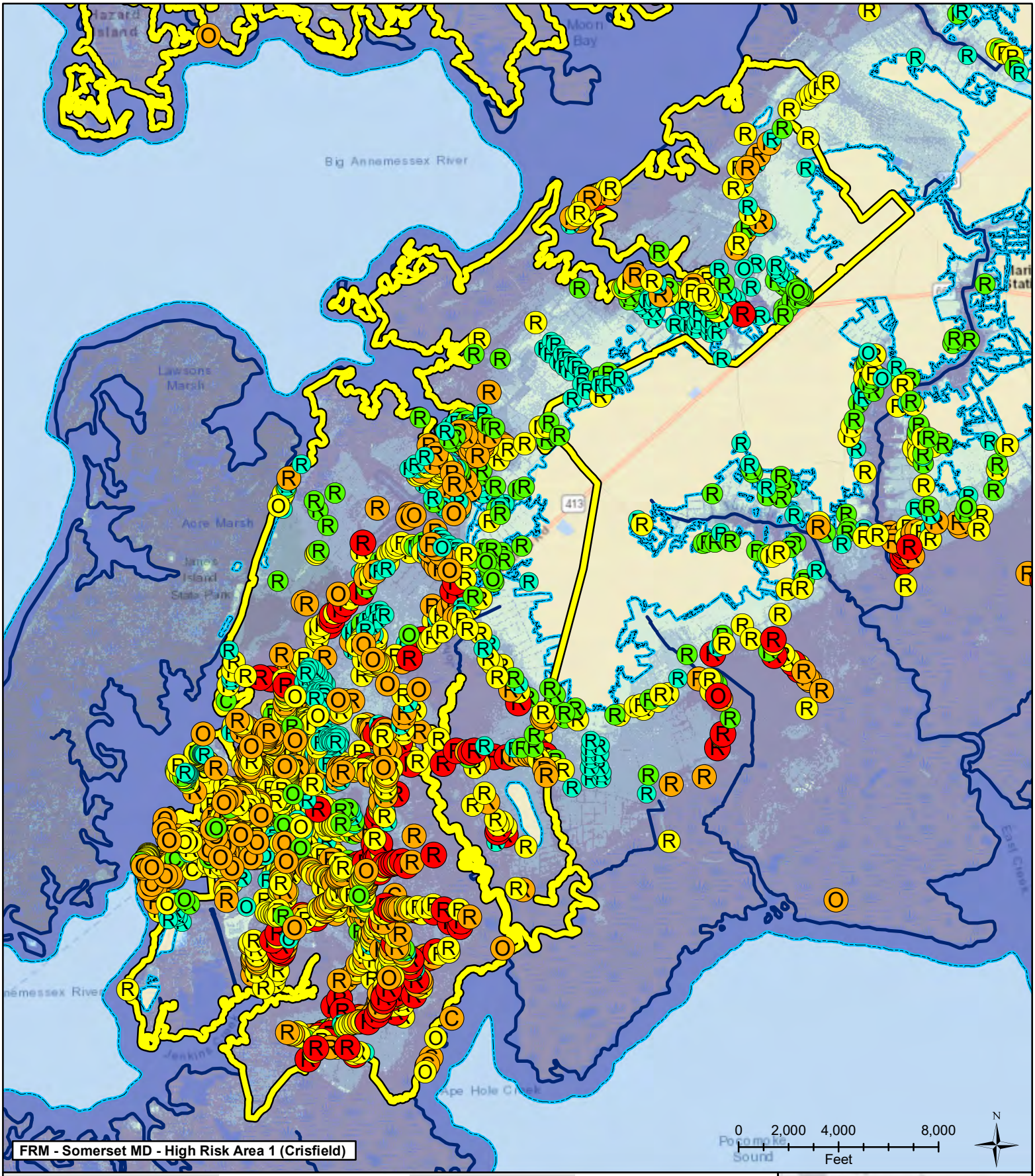
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

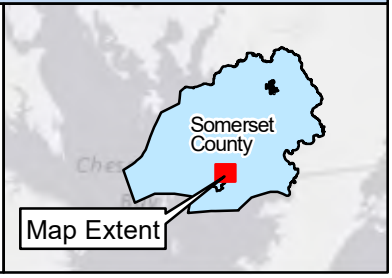
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

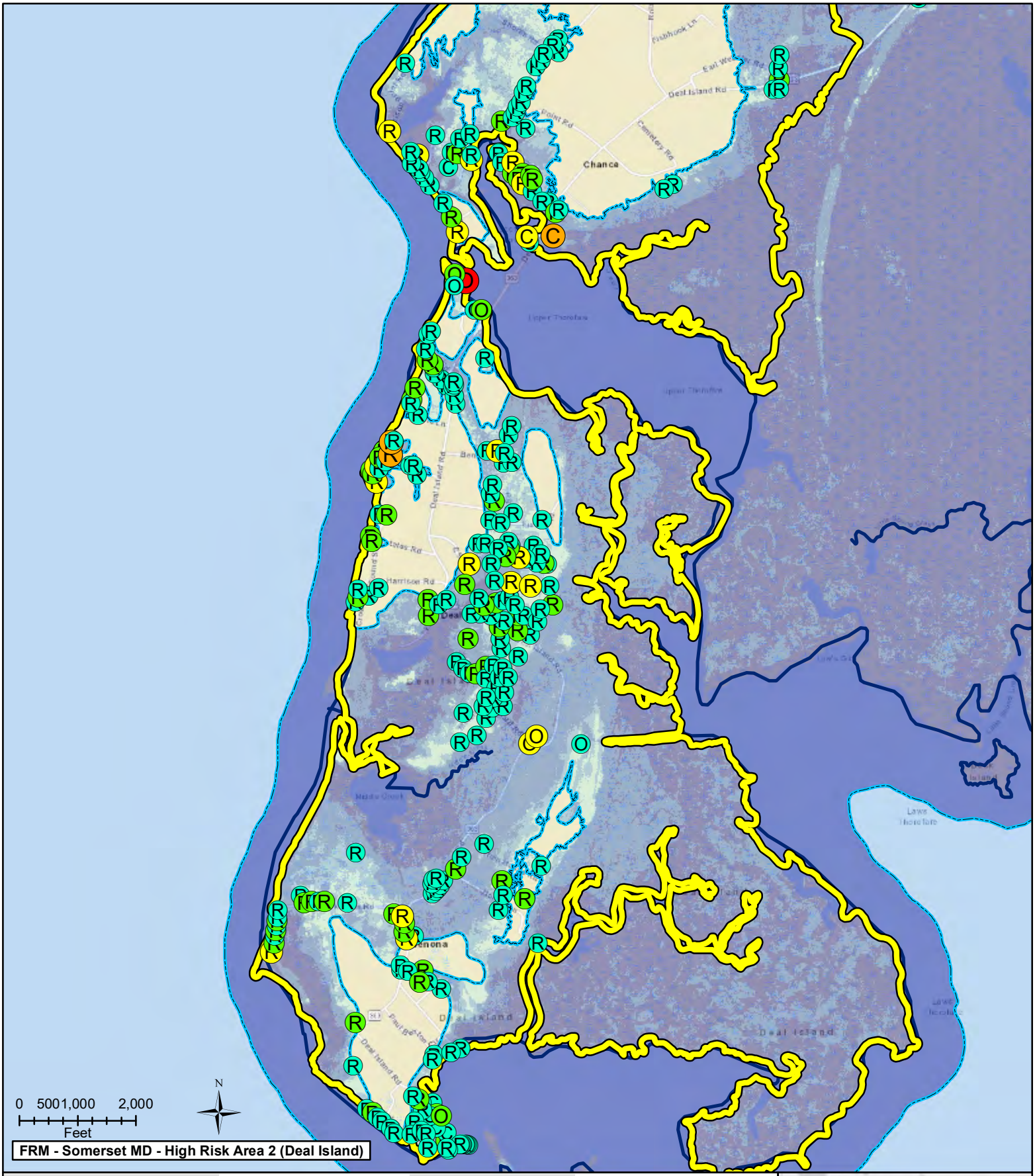
UDF Land Use Category

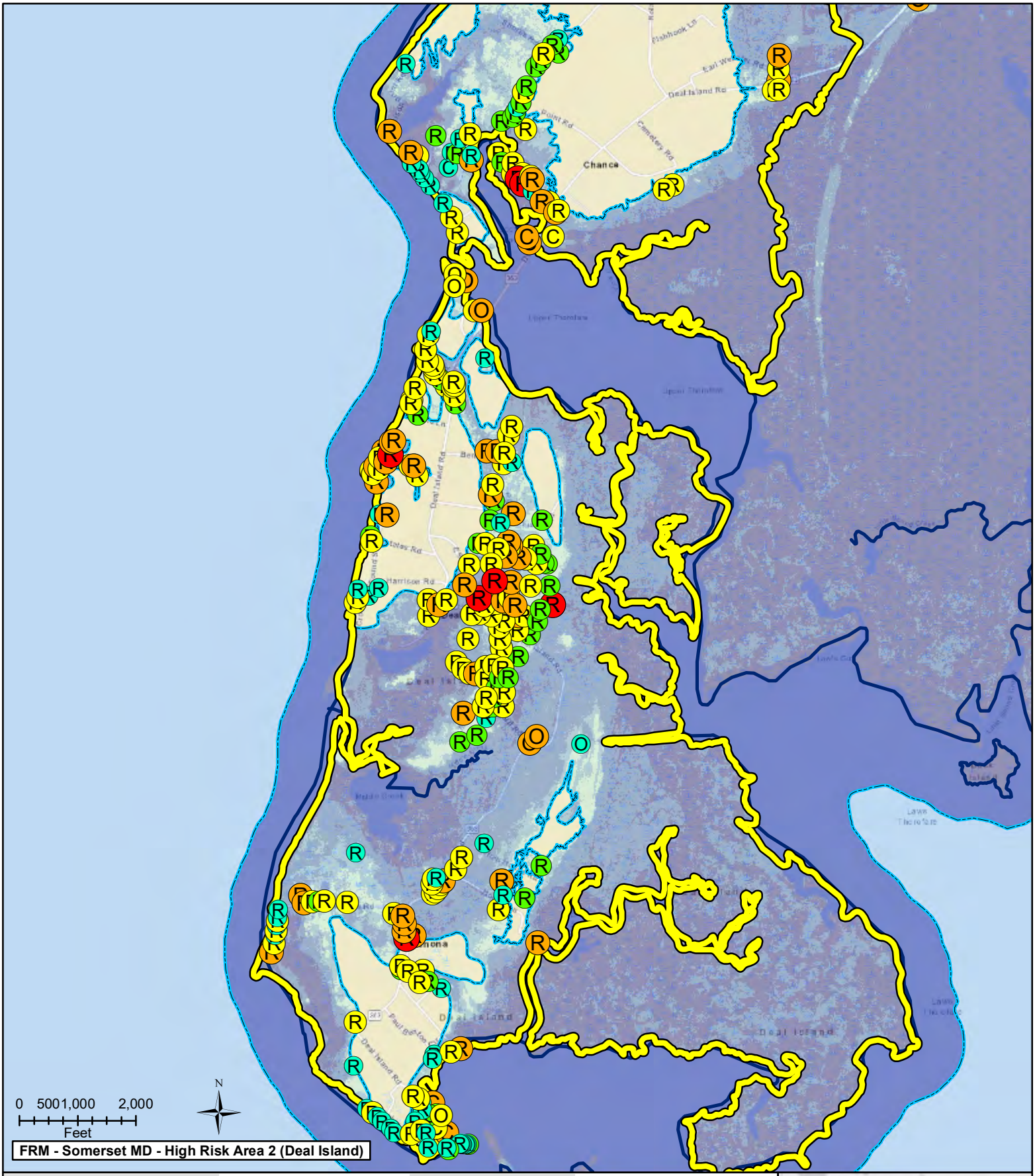
- (R) Residential
- (C) Commercial
- (O) Other

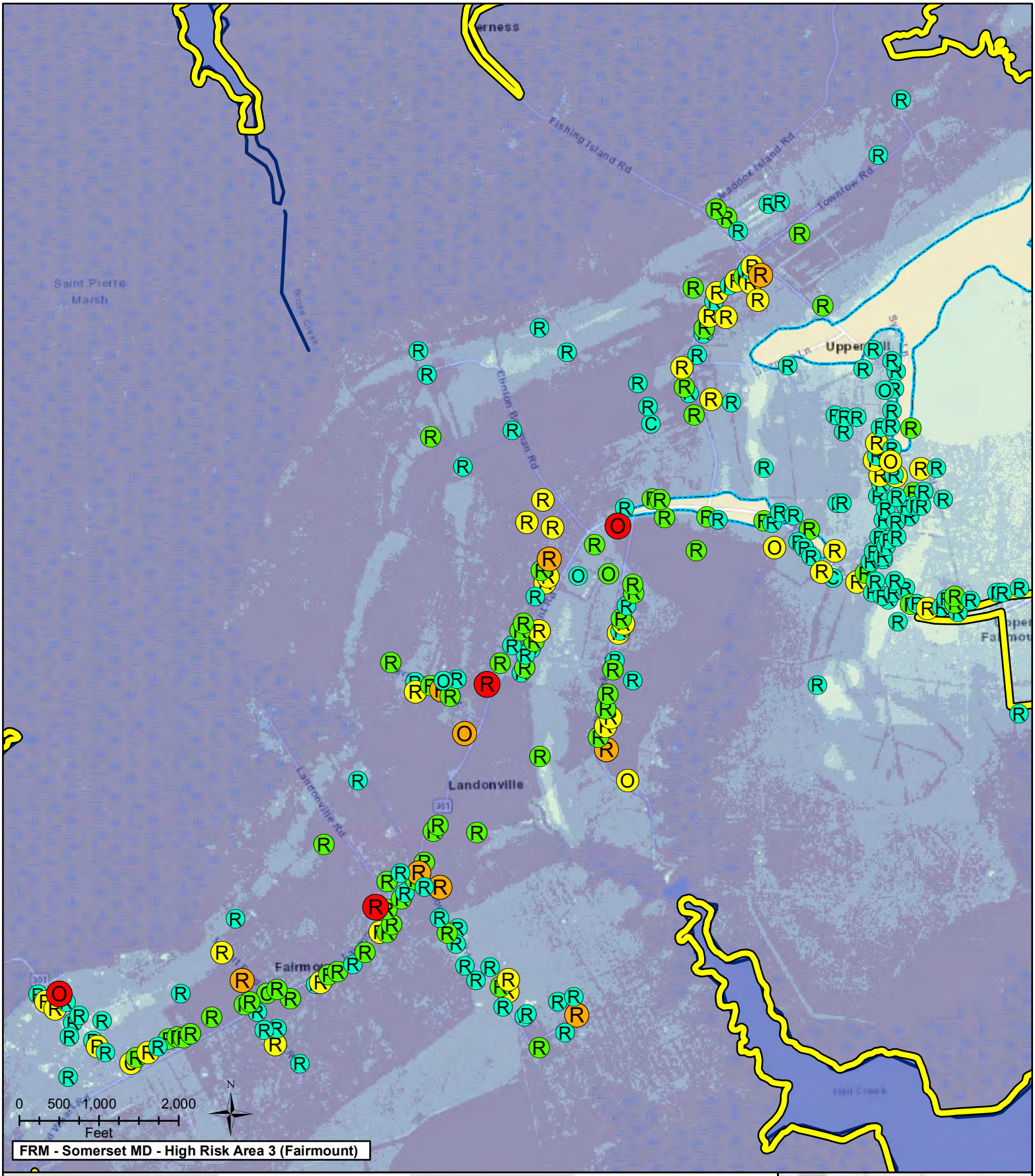
UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Chanca
Deal Island
Deal Island Rd
Harrison Rd
Laws Thorofare
Upper Thorofare
Nanticoke River
0 5001,000 2,000
Feet
N
FRM - Somerset MD - High Risk Area 2 (Deal Island)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Somerset County


Chance
Deal Island
Deal Island Rd
Fishhook Ln
Point Rd
Cemetery Rd
Harrison Rd
Tylers Rd
Deal Island Rd
Paul Bell Rd
Upper Thorofare
Lawes Thorofare
Monie Creek
Monie
0 5001,000 2,000
Feet
N
FRM - Somerset MD - High Risk Area 2 (Deal Island)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Somerset County



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

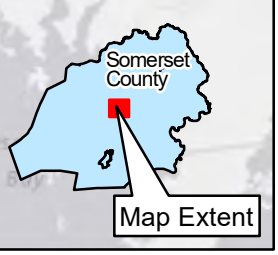
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

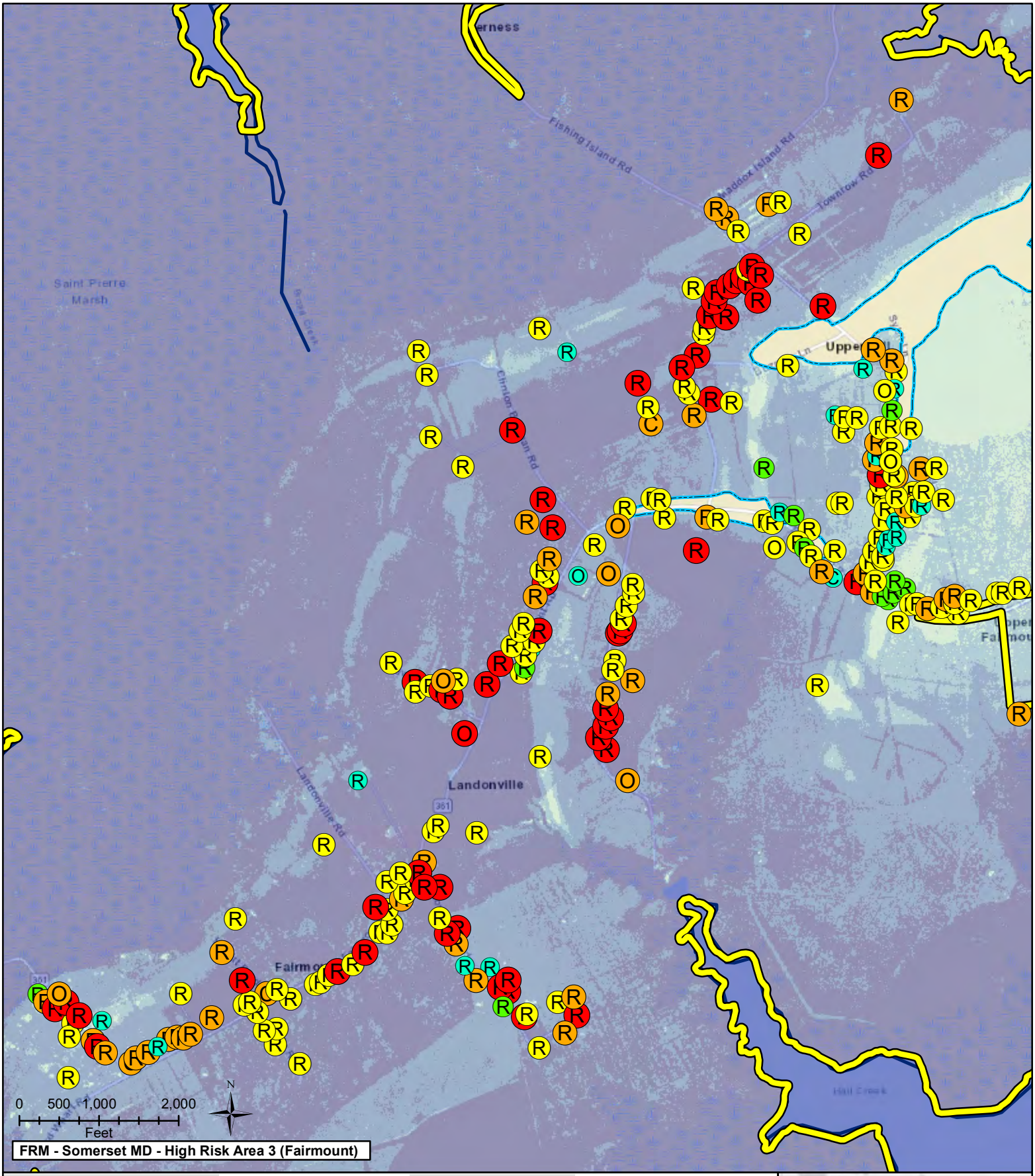
UDF Land Use Category

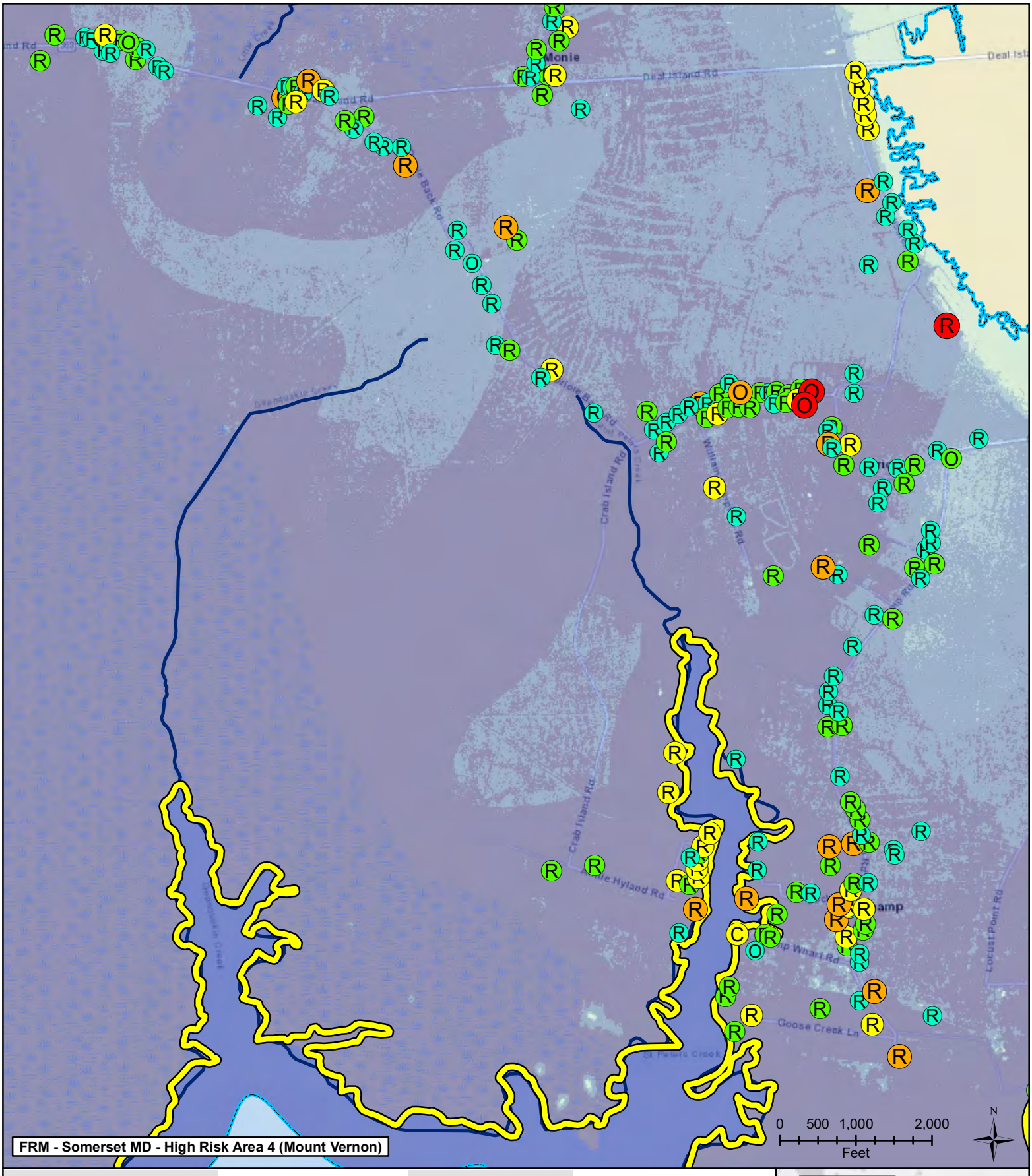
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000




Saint Pierre Marsh
Fishing Island Rd
Landonville
Landonville Rd
Fairmount
Hall Creek
0 500 1,000 2,000
Feet
N
FRM - Somerset MD - High Risk Area 3 (Fairmount)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Somerset County
Map Extent



FRM - Somerset MD - High Risk Area 4 (Mount Vernon)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

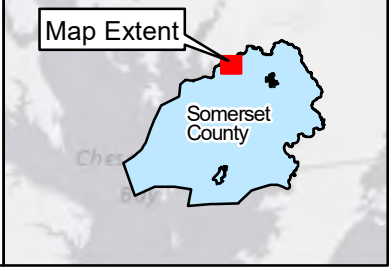
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

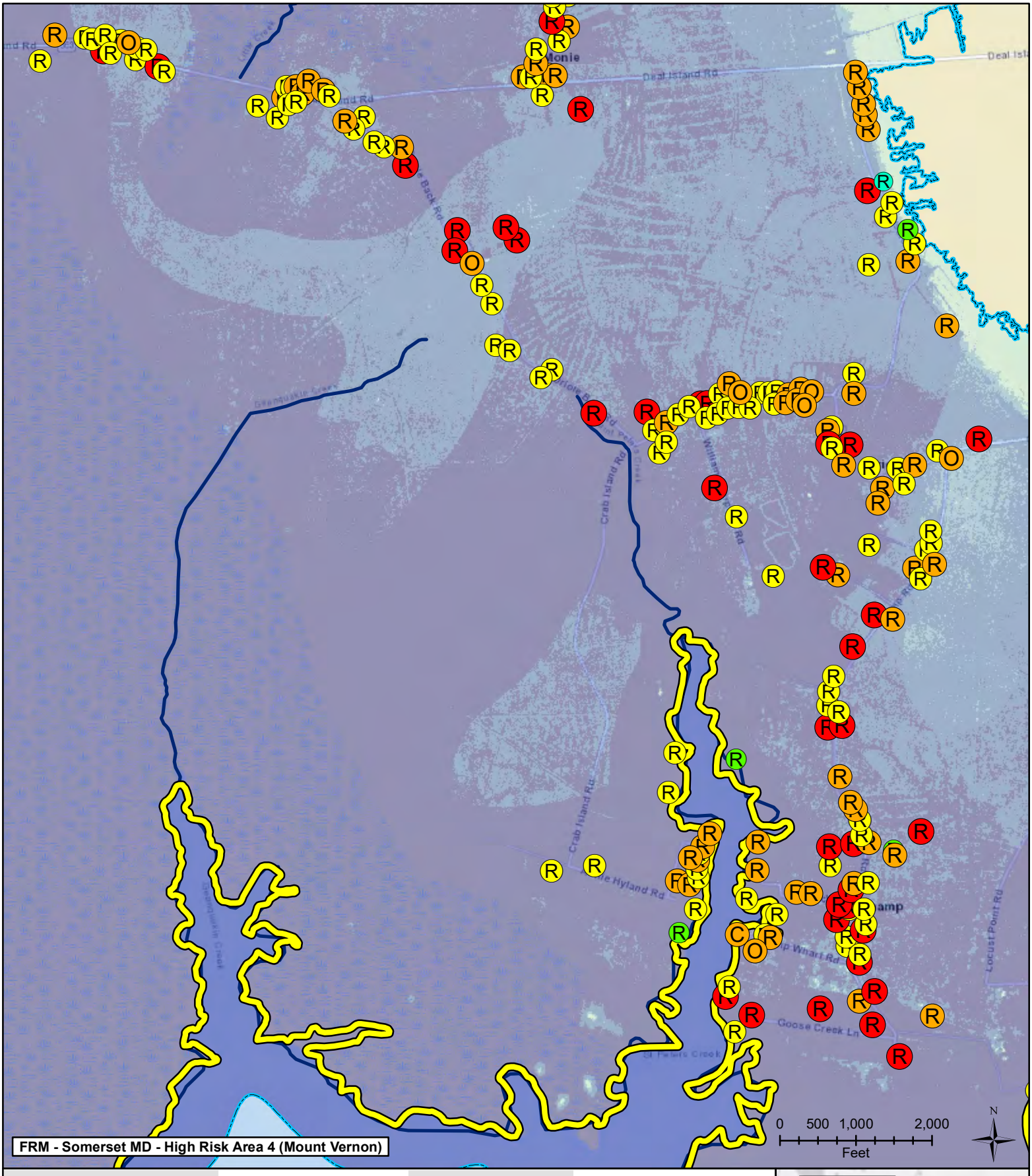
UDF Land Use Category

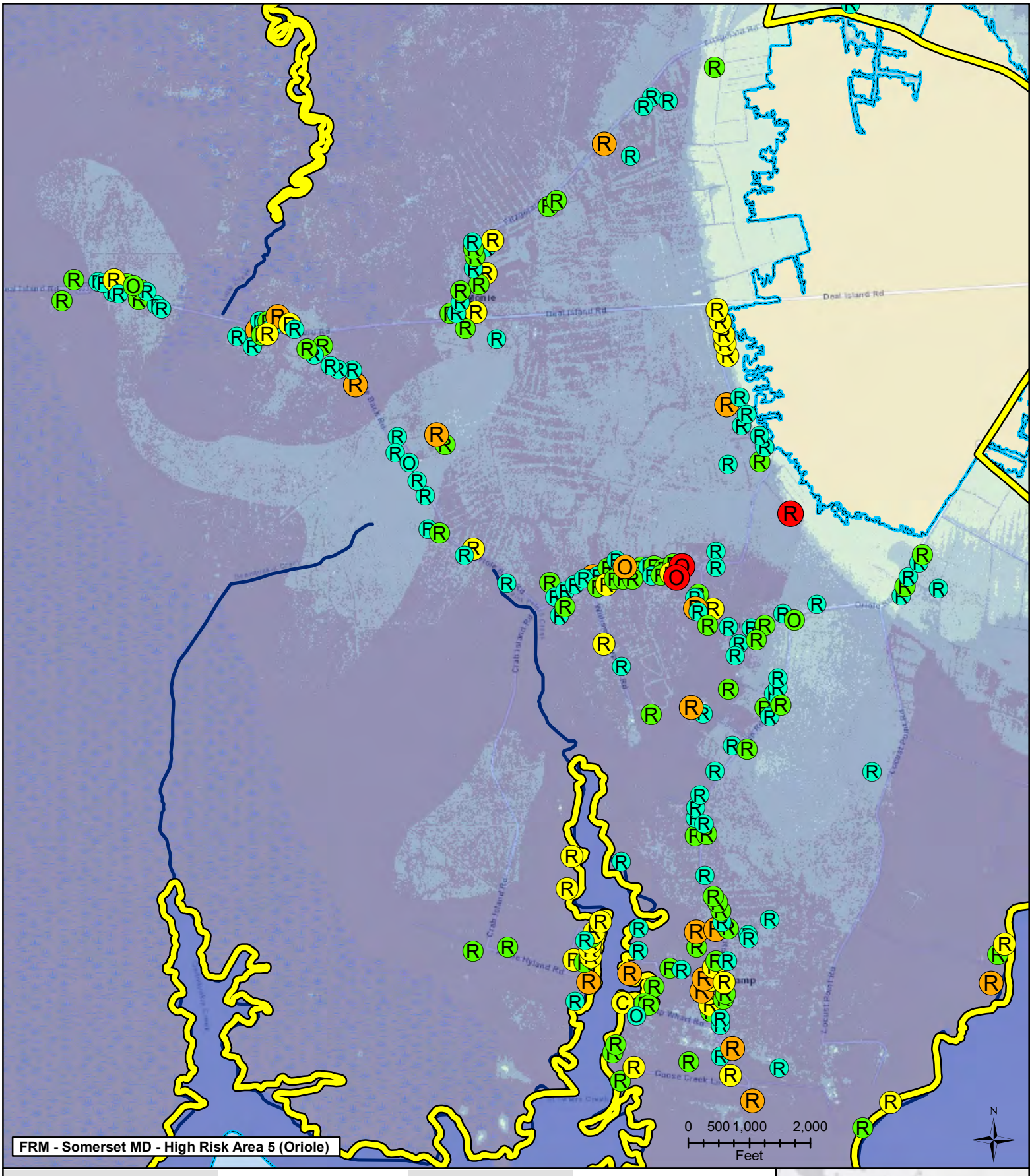
- (R) Residential
- (C) Commercial
- (O) Other

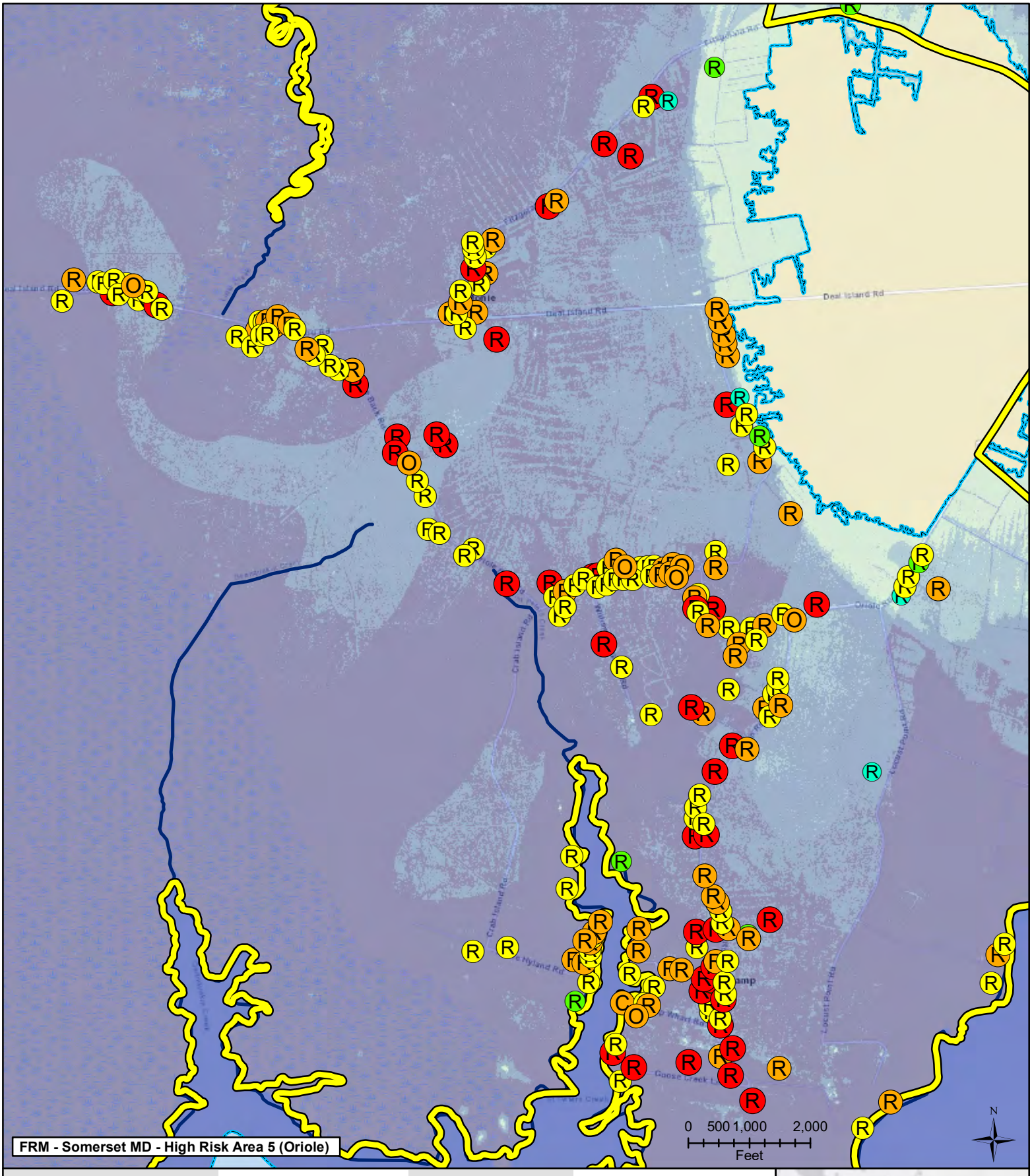
UDF Flood Loss Estimates

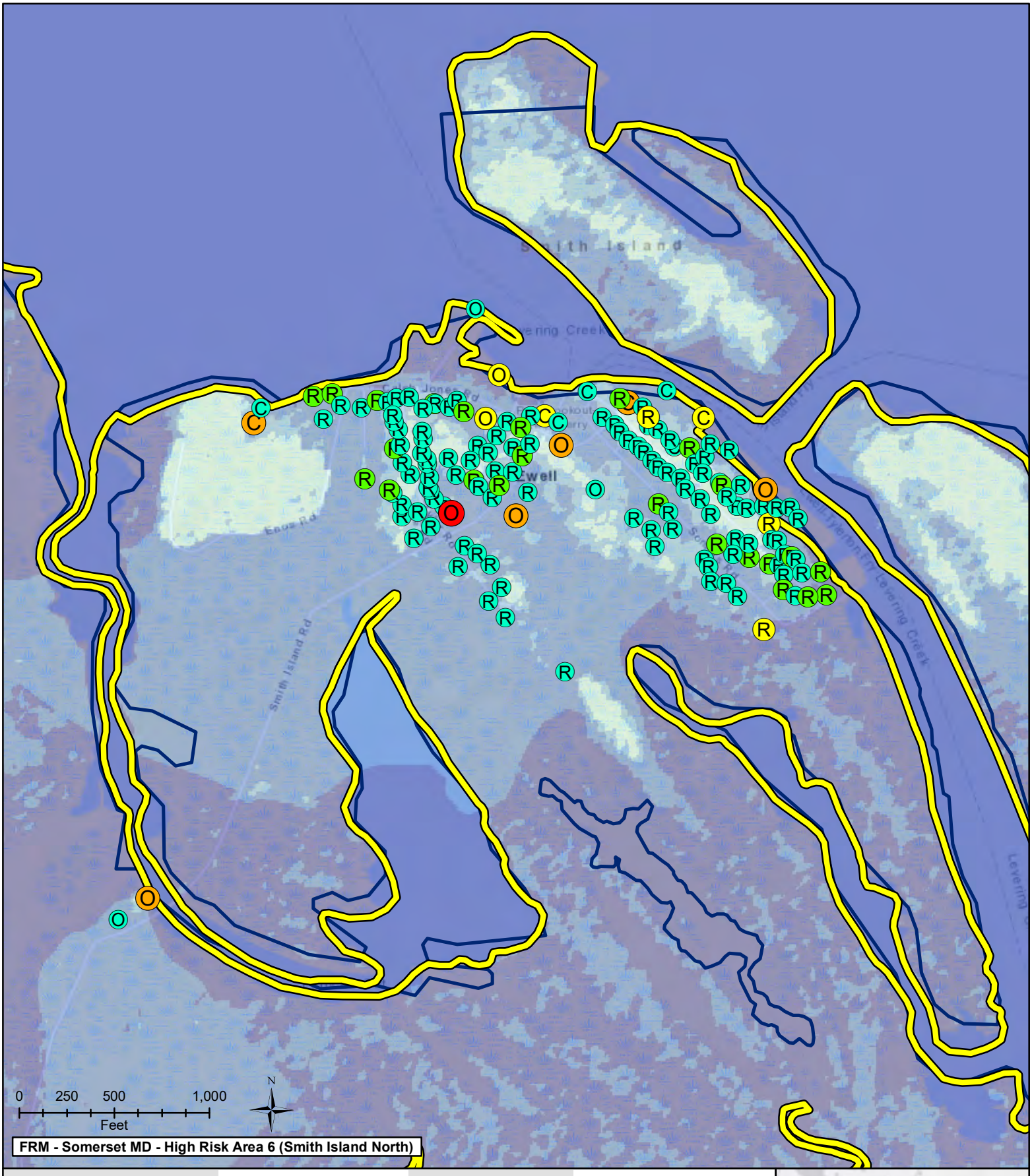
- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000




Deal Island Rd
Crab Island Rd
Goose Creek Ln
Locust Point Rd
0 500 1,000 2,000
Feet
N
FRM - Somerset MD - High Risk Area 4 (Mount Vernon)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Somerset County


FRM - Somerset MD - High Risk Area 5 (Oriole)
0 500 1,000 2,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Somerset County


FRM - Somerset MD - High Risk Area 5 (Oriole)
0 500 1,000 2,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Somerset County



FRM - Somerset MD - High Risk Area 6 (Smith Island North)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

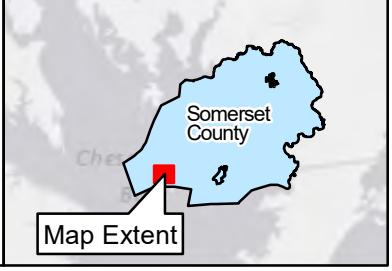
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

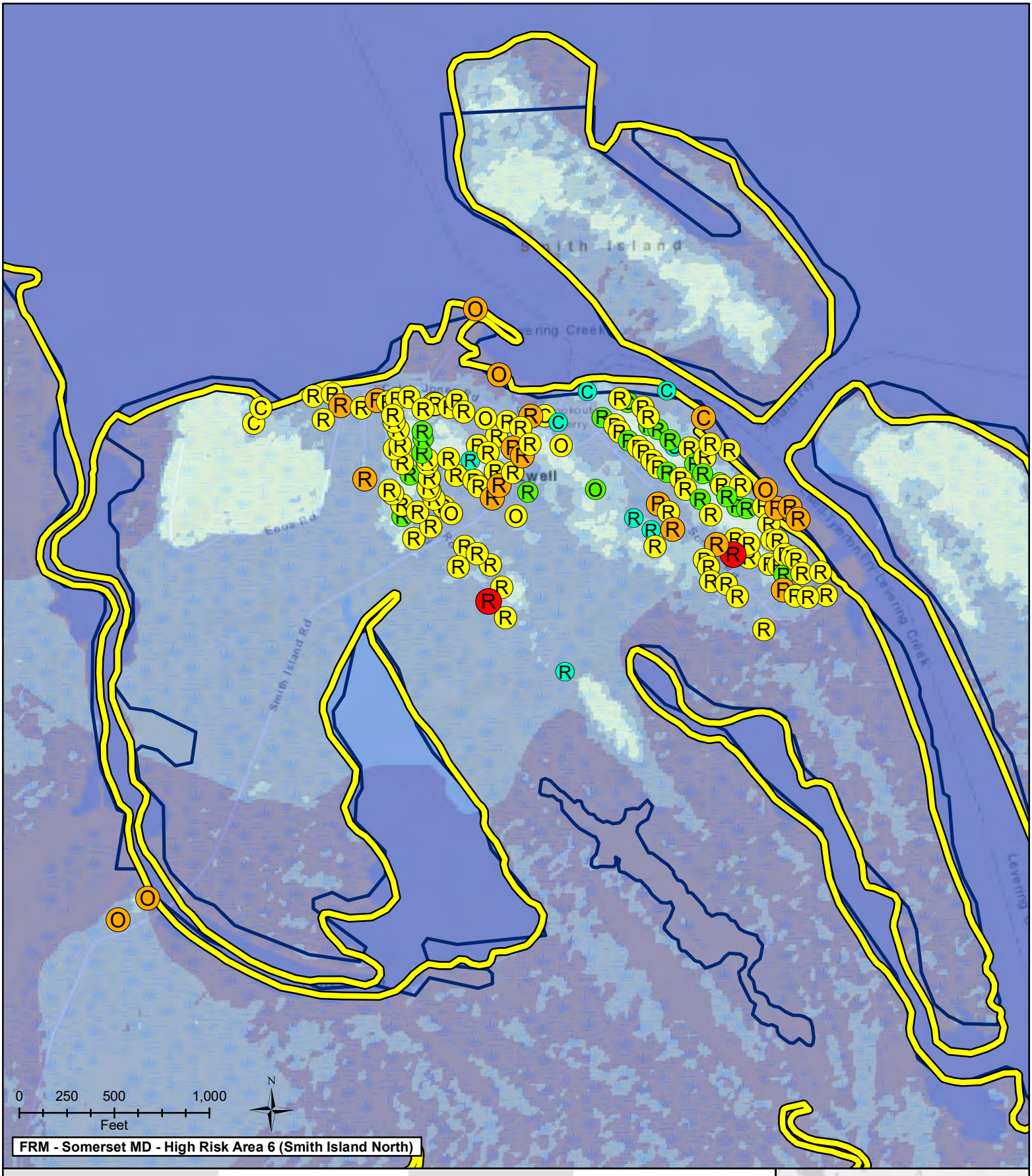
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Somerset MD - High Risk Area 6 (Smith Island North)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

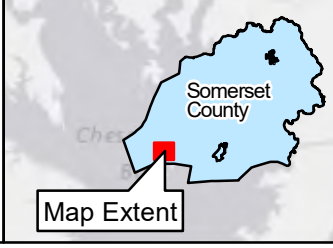
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

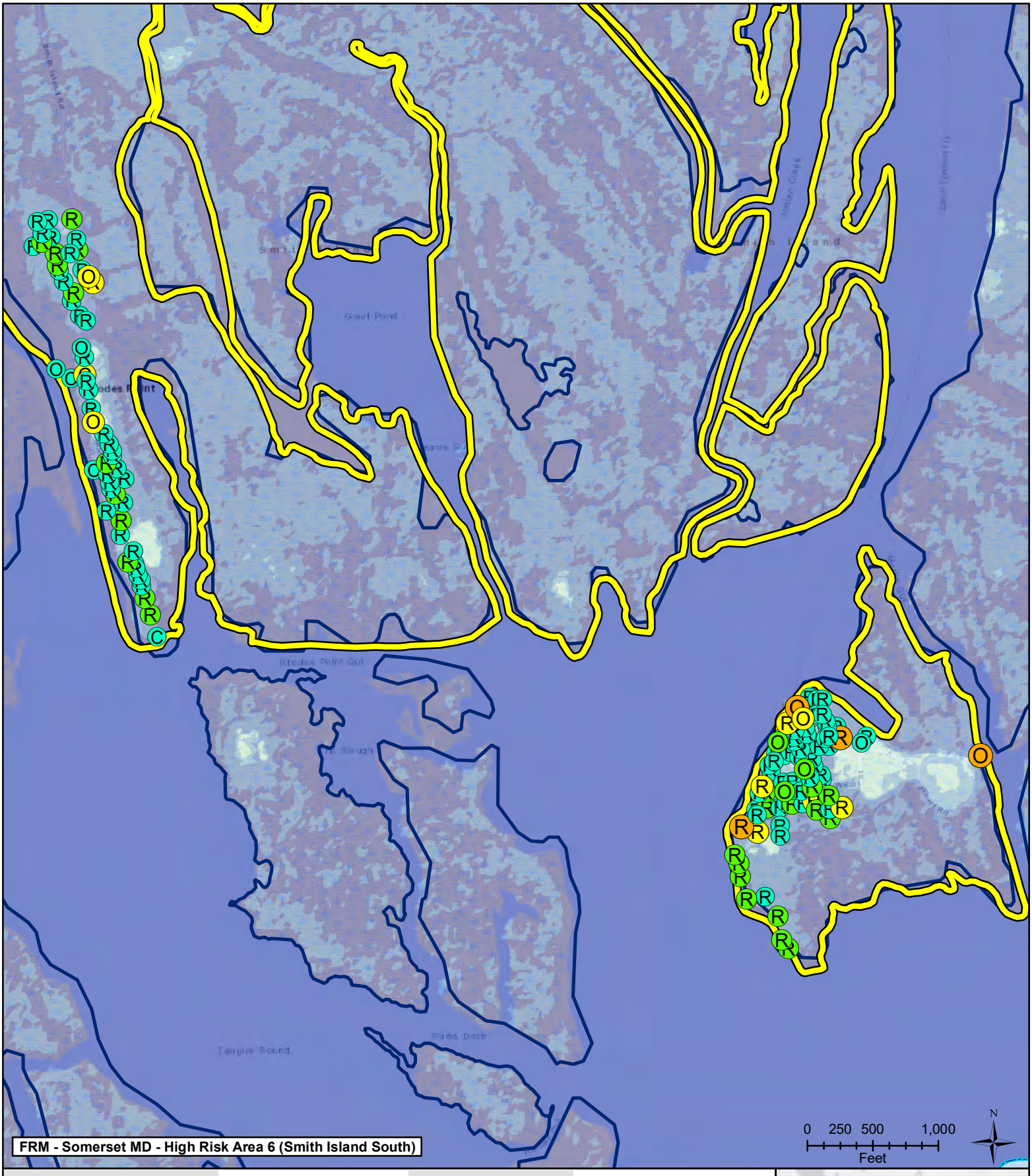
UDF Land Use Category

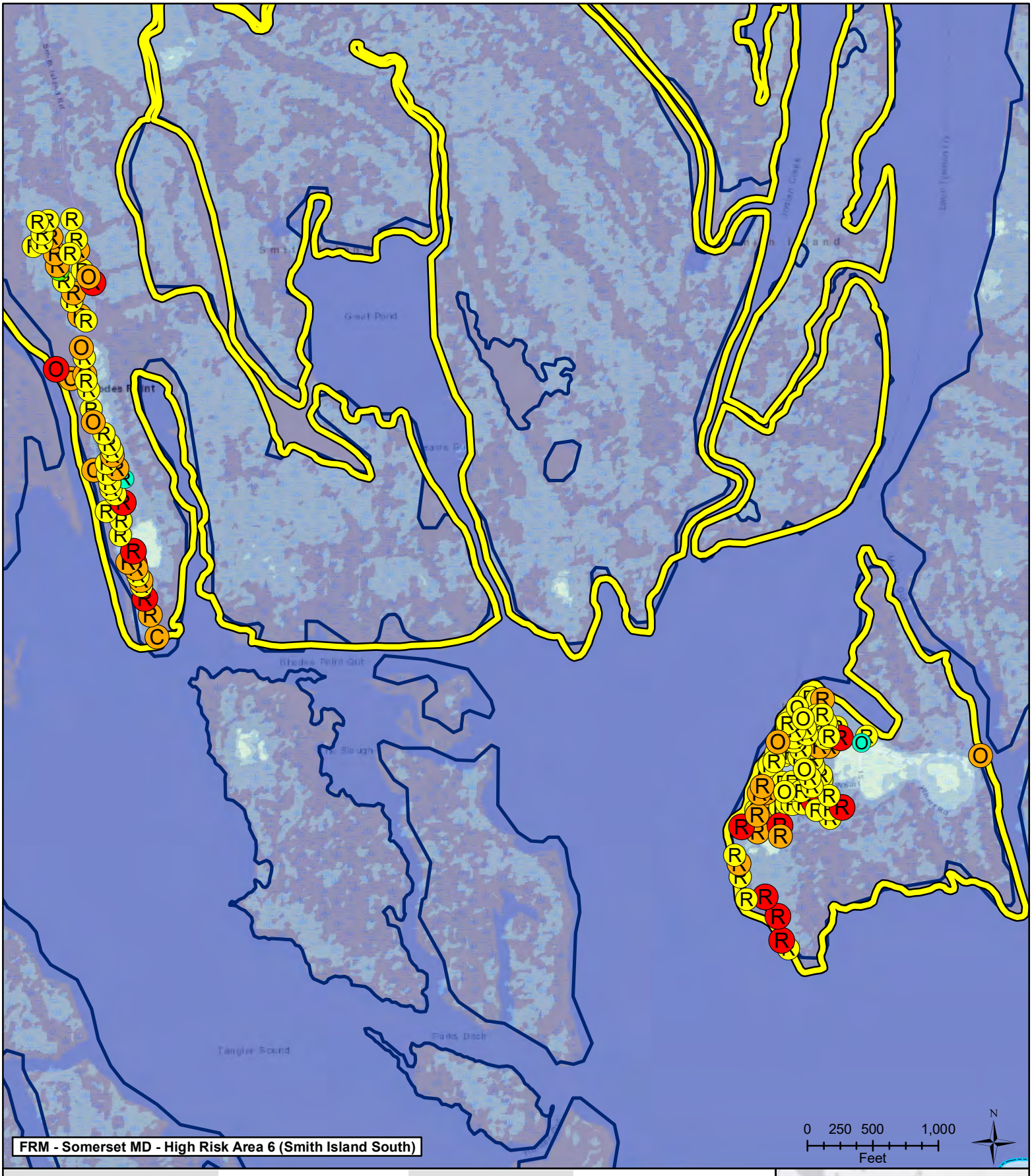
- (R) Residential
- (C) Commercial
- (O) Other

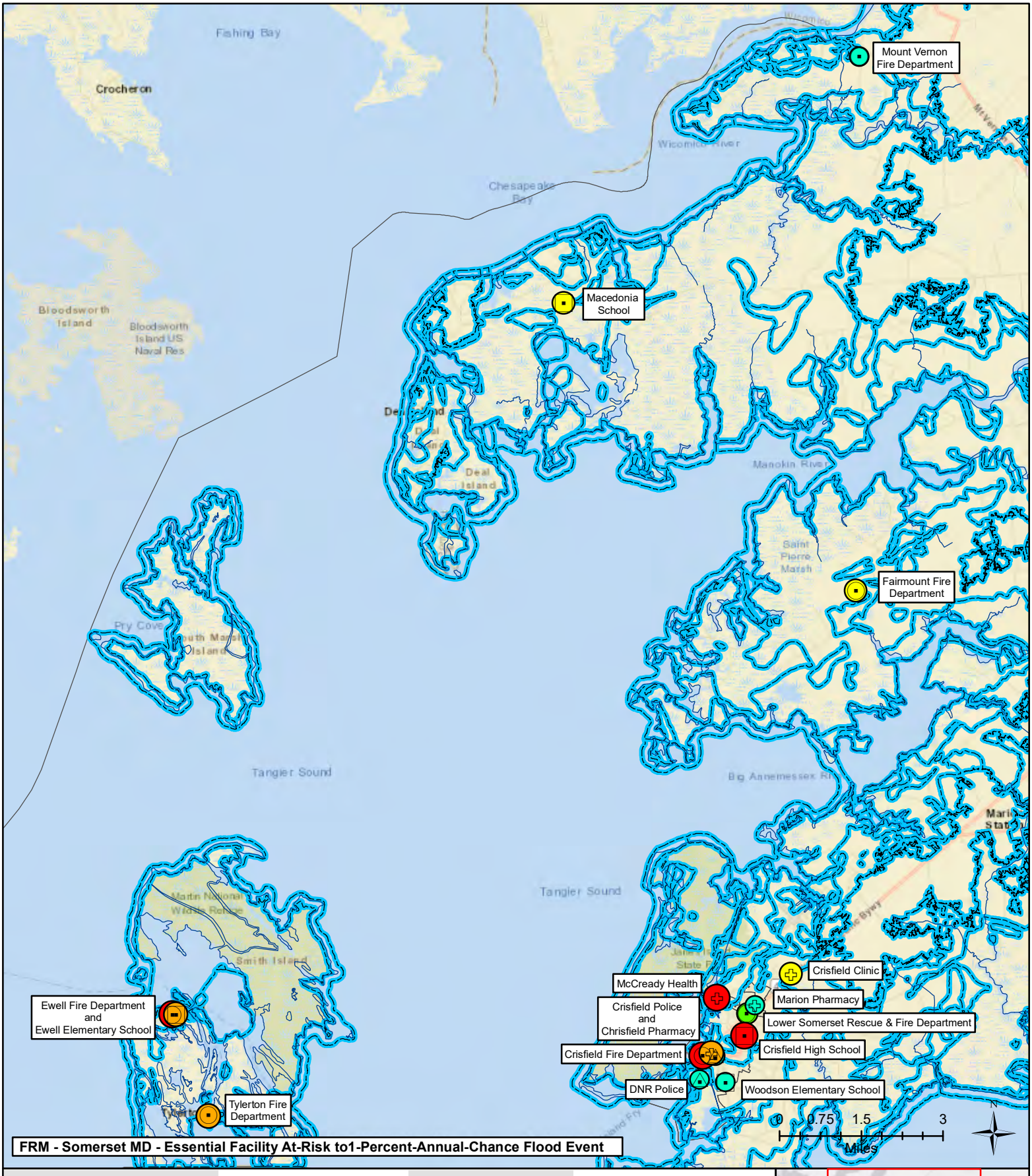
UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




FRM - Somerset MD - High Risk Area 6 (Smith Island South)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Somerset County
Map Extent


FRM - Somerset MD - High Risk Area 6 (Smith Island South)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
(R) Residential
(C) Commercial
(O) Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Somerset County
Map Extent


Fishing Bay
Crocheron
Bloodsworth Island
Bloodsworth Island US Naval Res
Wicomico River
Chesapeake Bay
Deal Island
Manokin River
Saint Pierre Marsh
Pry Cove
Tangier Sound
Big Annemessex R
Smith Island
Martin National Wildlife Refuge
Mount Vernon Fire Department
Macedonia School
Fairmount Fire Department
Crisfield Clinic
McCready Health
Marion Pharmacy
Crisfield Police and Chrisfield Pharmacy
Lower Somerset Rescue & Fire Department
Crisfield Fire Department
Crisfield High School
DNR Police
Woodson Elementary School
Ewell Fire Department and Ewell Elementary School
Tylerton Fire Department
0 0.75 1.5 3
Miles
FRM - Somerset MD - Essential Facility At-Risk to1-Percent-Annual-Chance Flood Event
Stream Centerline
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
Somerset County & Municipalities
Unincorporat... & Incorporated Areas
Essential Facility Types At-Risk
Fire
Medical
Police
School
Essential Facility Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Somerset County
Map Extent

This page left blank intentionally

Source: https://www.washingtonpost.com/news/capital-weather-gang/wp/2014/06/13/extreme-flooding-in-western-maryland-thursday-photos/?utm_term=.e5cf3b26cada

STATE OF MARYLAND

FLOOD RISK REPORT

WASHINGTON COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Washington County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Washington County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Washington County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis for the county as a whole and for individual communities, with calculations of total flood damages by land use (occupancy type) and a summary of damage severity for buildings impacted by flooding. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership -http://www.resiliencypartnership.com - have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Preface iii

Guidance on Using This Report iv

Table of Contents v

1 Introduction 1

a. About Flood Risk 1

i. Calculating Flood Risk 1

ii. Flood Risk Products 2

b. Uses of this Report 3

c. Sources of Data for Flood Risk Assessments 5

d. Related Resources 6

2 Flood Risk Analysis 9

a. Overview 9

b. Analysis of Risk 10

i. Flood Depth and Analysis Grids 10

ii. Flood Risk Assessments 11

iii. Areas of Mitigation Interest 13

3 Flood Risk Analysis Results 24

a. Washington County, Maryland Flood Risk Project Area Summary 25

i. Overview 25

ii. Flood Risk Results 25

iii. Flood Risk Maps 33

b. Communities 34

i. Washington County (Unincorporated Area) Summary (CID 240070) 34

ii. Town of Boonsboro (CID 240071) 38

iii. Town of Clear Spring (CID 240072) 41

iv. Town of Funkstown Summary (CID 240073).....44
v. City of Hagerstown Summary (CID 240074).....47
vi. Town of Hancock Summary (CID 240109).....50
vii. Town of Keedysville Summary (CID 240075).....53
viii. Town of Sharpsburg Summary (CID 240076).....56
ix. Town of Smithsburg Summary (CID 240124).....59
x. Town of Williamsport Summary (CID 240077).....62

4 Actions To Reduce Flood Risk 65

a. Types of Mitigation Actions.....65
i. Local Plans and Regulations.....65
ii. Structure and Infrastructure Projects.....66
iii. Natural Systems Protection Activities.....66
iv. Education and Awareness Activities.....67
b. Identifying Specific Actions for Your Community.....68
c. Mitigation Programs and Assistance.....69
i. FEMA Mitigation Programs and Assistance.....69
ii. Additional Mitigation Programs and Assistance.....70

5 Acronyms And Definitions 71

a. Acronyms.....71
b. Definitions.....73

6 Additional Resources 77

Appendix A (Map Collection) - Published as Separate, Accompanying Document

List of Tables

Table 1: Washington County Essential Facilities 14

Table 2: USACE National Inventory of Dams – Washington County, MD 16

Table 3: Flood Risk Assessment – Community Overview 25

Table 4: Washington County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood 26

Table 5: Washington County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 26

Table 6: Washington County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 27

Table 7: Washington County, Maryland – At-Risk Government Facilities Summary for the 1%-Annual-Chance Flood 28

Table 8: Washington County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood 30

Table 9: Washington County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood 31

Table 10: Washington County, Maryland – Areas of Mitigation Interest 31

Table 11: Washington County, Maryland – High-Risk Areas 33

Table 12: Washington County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 35

Table 13: Washington County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 36

Table 14: Town of Boonsboro – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 39

Table 15: Town of Boonsboro – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 39

Table 16: Town of Clear Spring – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 42

Table 17: Town of Clear Spring – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 42

Table 18: Town of Funkstown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 45

Table 19: Town of Funkstown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 45

Table 20: City of Hagerstown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 48

Table 21: City of Hagerstown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 48

Table 22: Town of Hancock – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood.....51

Table 23: Town of Hancock – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 51

Table 24: Town of Keedysville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 54

Table 25: Town of Keedysville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 54

Table 26: Town of Sharpsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 57

Table 27: Town of Sharpsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 57

Table 28: Town of Smithsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 60

Table 29: Town of Smithsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood 60

Table 30: Town of Williamsport – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood 63

Table 31: Town of Williamsport – Degree of Damage Summary for 1%-Annual-Chance Flood Event Refined Losses (UDFs in Riverine Areas) 63

Table 32: Mitigation Actions for Areas of Mitigation Interest 67

Table 33: FEMA Hazard Mitigation Assistance Program 70

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Motorist unsuccessfully try to drive in high standing water on Pennsylvania Avenue Source: Herald-Mail Media

Figure 1.2

Which picture below shows more flood risk?

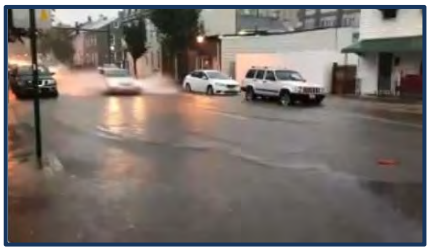
Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur, as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

Figure 1.3



Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: High water in Hagerstown near Mulberry and Washington Streets
Source: WUSA9 - Twitter

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Section 3 of the FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

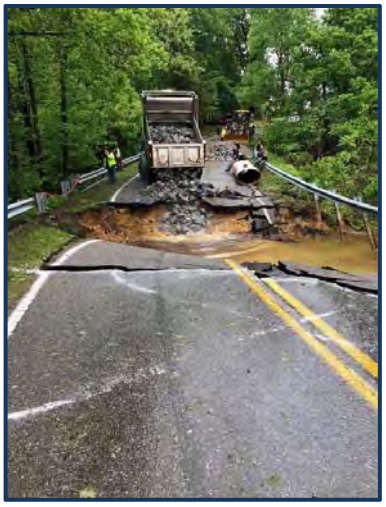
These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4



Vulnerability of infrastructure is another important consideration.

Photo: Road closures including this one, Chestnut Grove Road in Keedysville
Source: ABC7 - WJLA

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 30-32.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (effective August 15, 2017), provided by FEMA Region III and Maryland Department of the Environment.
- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of December 2017), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/. Note that first floor elevations are not specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordiances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

(constructured after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

- Building footprints, representing real-world locations for addressable structures, provided by Washington County GIS Office – https://www.washco-md.net/gis-home/ *(Limited Distribution; data available by purchase/ request).*
- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.
- Hazus-MH Version 3.1 (2016) – Hazus is a nationally applicable standardized software suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. Section 2 - Subsection ii Flood Risk Assessments, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).

- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

  The 2016 State of Maryland Hazard Mitigation Plan was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

  The *2017 Wasington County Multi-Jurisdictional Hazard Mitigation Plan* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

  Please note that the information in this FRR may be reviewed for inclusion during the update of the Washington County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website developed by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.

- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.

  TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Emergency Action Plans.** Emergency Action Plans (EPA) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should

take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

Eighteen (18) dams are located within Washington County, nine (9) of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Washington County, MD,* on page 15 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

  - **Washington County – Total Exposure in Floodplain (TEIF) Loss Estimation**

    A previous Hazus-based flood risk study for Washington County and Incorporated Areas, dated January 31, 2017 and available through the FEMA Map Service Center, was developed using different data inputs and loss estimation methodology (refered to as 'Total Exposure in Floodplain' or TEIF) than used in this enhanced countywide flood risk assessment. With TEIF, overall asset values and loss estimates for census blocks are refined (using building footprint locations and land use/land cover data to minimize or eliminate undeveloped portions of those census blocks) to provide an approximate value and relative comparison of potential flood loss.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Stream near Rohrersville
Source: Herald-Mail Media
Photo Source: Dan Dearth
Bottom Photo: Hagerstown flooding - 7/1/2014
Source: Herald-Mail Media
Photo Source: Tom Borum

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

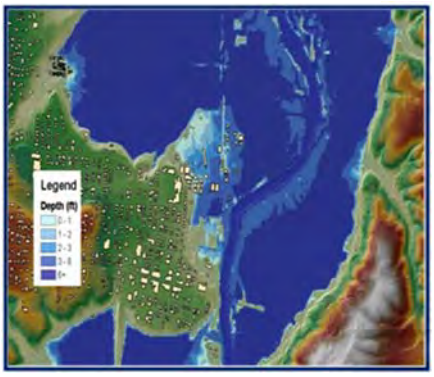
b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

i. Flood Depth and Analysis Grids

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, based on the August 2017 Flood Insurance Rate Maps for Washington County and Incorporated Areas. This grid communicates flood depth as a function of the difference between the calculated water surface elevation and the ground.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis, and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region
- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor, and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This include direct building losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

Figure 2.4

One of Washington County's essential facilities includes the Williamsport Volunteer Fire Department.

Photo Source: Williamsport VFD Facebook

There are 86 essential facilities located within Washington County with a total esitmated building value of $804,594,500.

Table 1: Washington County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	2	$3,904,200
Fire/Rescue Stations	22	$32,889,200
Hospital & Medical Clinics	3	$240,611,100
Police Stations	6	$76,333,900
Schools (K-12 & Colleges)	53	$450,856,100
Total	**86**	**$804,594,500**

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations.

Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 7 high risk areas were identified within Washington County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Rocky Gap Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: View of Blairs Valley Dam .
Source: http://www.switchfisher.com/

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, eighteen (18) dams are located in Washington County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Washington County, MD

Name	Owner Type	Purpose	River	EAP Last Revision Date
Lake Jenkins	State	Recreation	Potomac River-TR	No
Little Tonoloway Dam	Private	Recreation	Little Tonoloway Creek	No
Hancock Sewage Lagoon	Local Government	-	Offstream-Tonoloway Creek	No
Blairs Valley Dam	State	Recreation	Little Conococheague Creek	Yes
Kurt Sherman Dam (Upper Pond)	Private	Recreation	Offstream-Dry Run	Yes
Oliver Company (Lower Pond)	Private	Irrigation	Offstream-Dry Run	Yes
Potomac Dam #5	Federal	Fish and Wildlife Pond	Potomac River	Yes
Willson Water Treatment Plant Levee	Local Government	Flood Control	Offstream-Potomac River	No
Valley Mall Expansion SWM Dam	Private	-	Conococheague-TR-Semple Run	No
Hagerstown City Park Lake (Key Street)	Local Government	Recreation	Antietam Creek-TR	No
Cortland Manor SWM Dam	Private	Flood Control	Antietam Creek-TR	No
Hagerstown Municipal PWR Plant Dam	Private	Water Supply	Antietam Creek	No
Warner Gap Hollow Dam	Local Government	Water Supply	Warner Gap Hollow Creek	Yes
Smithsburg Reservoir	Local Government	Water Supply	Beaver Creek-OS	Yes
Lower Lake Royer	Local Government	Water Supply	Falls Creek-TR	Yes
Upper Lake Royer	Local Government	Water Supply	Falls Creek-TR	No
Greenbrier State Park Dam & Dike	State	Recreation	Little Beaver Creek-TR	Yes
Potomac River Dam #4	Federal	Hydroelectric	Potomac River	Yes

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

Figure 2.6

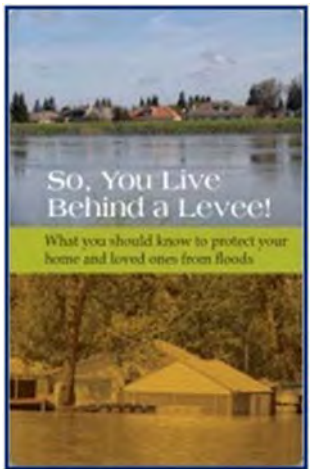
This dam failure caused flooding that damaged several homes and vehicles.

  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
  - When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
  - For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

According to US Army Corps of Engineers National Levee Database, there are no levees located within Washington County.

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

- **Reasons stream flow constrictions are considered AoMIs:**
  - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
  - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
  - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
  - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Figure 2.8

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

According to the *2017 Washington County Multi-Jurisdictional Hazard Mitigation Plan*, a total of forty-nine (49) FEMA Designated Repetitive Loss Properties and one (1) Severe Repetitive Loss Property were within Washington County. One (1) repetitive loss property is located witin unincorporated area of Washington County, while the remaining forty-nine (49) are located in the incorporated areas of the County.

- **Reasons past claim hotspots are considered AoMIs:**

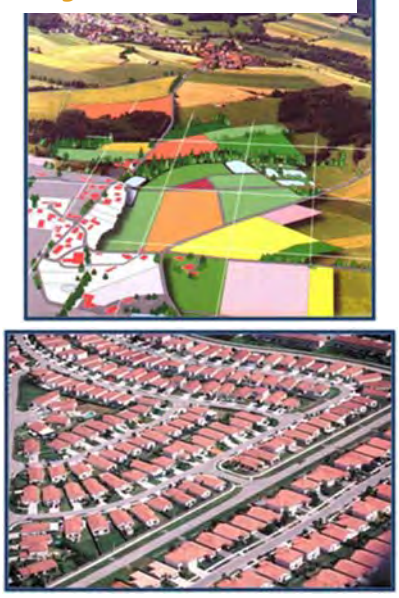
- A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
- Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
- Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.9



Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.

- Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
- Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  Figure 2.10

  When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  - **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
    - Further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).

- To create viable mitigation project applications to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 32.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  - **Reasons why areas of significant riverine erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations
    - Riverine erosion can undercut structures and roads, causing instability and possible collapse.
    - Landslides and mudslides are a result of erosion
    - Approx. 1/3 of the nation's streams experience severe erosion problems

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Washington County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Washington County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Washington County (Unincorporated Areas)	240070	94,656	436.38	Y	N/A	Y
Town of Boonsboro	240071	3,336	3.06	Y	N/A	Y
Town of Clear Spring	240072	358	0.12	Y	N/A	Y
Town of Funkstown	240073	904	0.37	Y	N/A	Y
City of Hagerstown	240074	39,662	12.16	Y	N/A	Y
Town of Hancock	240109	1,545	2.76	Y	N/A	Y
Town of Keedysville	240075	1,152	0.91	Y	N/A	Y
Town of Sharpsburg	240076	705	0.22	Y	N/A	Y
Town of Smithsburg	240124	2,975	1.04	Y	N/A	Y
Town of Williamsport	240077	2,137	0.98	Y	N/A	Y

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Washington County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 4: Washington County, Maryland – Estimated Losses by Community Name for the 1%-Annual-Chance Flood

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Washington County Unincorporated Areas	94,656	529	$41,300,000	$436	68%
Town of Boonsboro	3,336	6	$10,000	$3	< 1%
Town of Clear Spring	358	18	$230,000	$642	< 1%
Town of Funkstown	904	27	$1,840,000	$2,035	3%
City of Hagerstown	39,662	76	$7,000,000	$176	12%
Town of Hancock	1,545	45	$7,900,000	$5,113	13%
Town of Keedysville	1,152	4	$30,000	$26	< 1%
Town of Sharpsburg	705	13	$80,000	$113	< 1%
Town of Smithsburg	2,975	11	$50,000	$17	< 1%
Town of Williamsport	2,137	14	$2,200,000	$1,029	4%
Total	**147,420**	**743**	**$60,800,000**	**$412**	**100.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Washington County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	617	$76,500,000	37%	$12,200,000	16.0%
Commercial Building & Contents	72	$101,200,000	49%	$22,300,000	22.0%
Other Building & Contents	54	$26,800,000	13%	$9,500,000	35.0%
Total Building & Contents[3]	743	$204,500,000	100%	$44,000,000	22.0%
Business Disruption[4]	N/A	N/A	N/A	$16,800,000	N/A
TOTAL[5]	**743**	**$204,500,000**	**100%**	**$60,800,000**	**30.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Washington County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	50	7%	$31,400,000	$600,000	$20,000	$0	0%
1 - 10%	272	37%	$65,700,000	$200,000	$3,000,000	$10,000	7%
10 - 20%	130	17%	$26,100,000	$200,000	$4,000,000	$30,000	9%
20 - 30%	58	8%	$7,100,000	$100,000	$1,700,000	$30,000	4%
30 - 40%	44	6%	$20,100,000	$500,000	$7,400,000	$200,000	17%
40 - 50%	37	5%	$33,600,000	$900,000	$14,800,000	$400,000	34%
50% or More	152	20%	$20,500,000	$100,000	$13,000,000	$90,000	30%
TOTAL	**743**	**100%**	**$204,500,000**	**$300,000**	**$43,920,000**	**$60,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables represent countywide information for Washington County, Maryland

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).
- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Washington County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential essential facility flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, however, no essential facilities in Washington County are at-risk to the 1-percent-annual-chance flood event.

While there are no essential facilities at-risk, there are several government facilities at-risk to the 1-percent-annual-chance flood event. The list of government facilities at-risk is provided on pages 31 and 32.

Table 7: Washington County, Maryland – At-Risk Government Facilities Summary for the 1%-Annual-Chance Flood

Type	Estimated Building Value	Total Government Facilities	1% (100-yr) Dollar Losses (Building Value)
Government	$ 7,515,700	20	$ 739,912
TOTAL	**$7,515,700**	**20**	**$739,912**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database., with specially designated at-risk facilities also identified in the 'Areas of Mitigation Interest' Dataset (S_AOMI_Ar) in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Washington County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Washington County contains 367 state assets. However, none of these state assets are at-risk to the 1-percent-annual-chance flood event.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**

- The model estimates that a total of 4,667 tons of debris will be generated. Of the total amount, Finishes comprises 31% of the total, Structure comprises 37% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 587 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 8: Washington County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	4,544	31%	182
Structure	5,424	37%	217
Foundation	4,699	32%	188
TOTAL	**14,667**	**100%**	**587**

Source: Hazus 3.1: Flood Modual – Washington County Study Area/ General Building Stock

Projected Shelter Needs

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**

  Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 1,371 households will be displaced due to the flood. Displacement includes households evacuated from

within, or very near, to the inundated area. Of these, 1,618 people (out of a total population of 47,430) will seek temporary shelter in public shelters.

Table 9: Washington County, Maryland – Projected Shelter Needs Summary for the 1%-Annual-Chance Flood

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	1,371	4,112	1,618

Source: Hazus 3.1: Flood Modual – Washington County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 10: Washington County, Maryland – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Government Facilities	20	Depth grids, UDFs
Repetitive Loss Properties	18	FEMA NFIP/MDE Community Assistance Program Manager
High-Risk Areas	7	NFHL, Census Blocks, UDFs

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database.

- **At-Risk Government Facilities:**

  Results from the 1-percent-annual-chance flood event analysis indicate twenty (20) government facilities are at-risk; seven (7) facilities are Washington County Department of Public Works facilities and thirteen (13) are Municipal Public Works facilities. Flood depths for each facility is provided below along with the identified facilities.

  - Town of Boonsboro Public Works Facility – 1.4'
    South Main Street, Boonsboro
  - Town of Clear Spring Public Works Facility– 0.1'
    13081 Burnie Kinsell Drive, Clear Spring
  - Town of Funkstown Public Works Facilities
    East Oak Ridge Drive, Hagerstown – 8.9'
    Boonsboro Pike, Funkstown– 2.9'
    South High Street, Funkstown – 13.7'

- City of Hagerstown Public Works Facilities
  10802 Water Works Road, Williamsport – 8.8′
  1 Clean Water Circle, Hagerstown – 3.6′
  Jefferson Street, Hagerstown – 4.2′
- Town of Hancock Public Works Facility
  Creek Road, Hancock – 3.9′
- Town of Sharpsburg Public Works Facility
  South Church Street, Sharpsburg – 1.6′
- Town of Smithsburg Public Works Facility
  Henrietta Street, Smithsburg – 0.7′
- Town of Williamsport Public Works Facilities
  Lockwood Road, Williamsport – 21.3′
  North Conococheague Street, Williamsport – 9.3′
- Washington County Public Works Facilities
  Sandy Hook Road, Knoxville – 0.1′
  Sharpsburg Pike, Hagerstown – 5.5′
  16211 Wright Road, Williamsport – 1.3′
  16234 Elliott Parkway, Williamsport – 1.1′
  Rock Hill Road, Williamsport – 5.1′
  22523 Leitersburg Smithsburg Road, Smithsburg – 1.9′
  601 Northern Avenue, Hagerstown – 1.2′

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of forty-eight (48) FEMA Designated Repetitive Loss Properties and one (1) Severe Repetitive Loss Property have been identified in the incorporated portions of Washington County. One (1) FEMA Designated Repetitive Loss Property is within the unincorporated area of County. Due to sensitivity of public disclosure for flood insurance claims, Repetitive Loss Properties are only acknowledged herein, but are not captured within the Areas of Mitigation Interest layer of the FRD.

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

  Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 11: Washington County, Maryland – High-Risk Areas

High-Risk Area	Location and/or Flooding Source(s)	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Little Tonoloway Creek / Creek Rd	135	7	32	$7,060,196	12%
Area 2	Falling Waters Rd	237	5	47	$1,011,796	2%
Area 3	Millers Sawmill Rd	178	3	18	$736,588	1%
Area 4	E Oak Ridge Dr / Antietam Creek	249	7	27	$1,820,859	3%
Area 5	Jefferson Blvd / Greendale Dr	371	2	20	$1,185,143	2%
Area 6	Hamilton Run / E Magnolia Ave	345	6	35	$634,444	1%
Area 7	Marsh Run / Antietam Dr	74	3	23	$674,954	1%
Total for High-Risk Areas		**1,589**	**33**	**202**	**$13,123,981**	**22%**

iii. Flood Risk Maps

The Flood Risk Maps for Washington County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provides an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Washington County (Unincorporated Areas) Summary (CID 240070)

The following pages include Flood Risk data for the Washington County (Unincorporated Areas).

Overview

Washington County (Unincorporated Areas) is located in the western Maryland and consists of 436 square miles. It is bordered by Allegany County to the west, Fulton and Franklin County, Pennsylvania, to the north, Frederick County to the east, and Jefferson, Berkley, and Morgan County, West Virginia, and Loudoun County, Virginia, to the south.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Washington County (Unincorporated Areas)	240070	94,656	436.38	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 262 policies totaling approximately $65,598,100
- NFIP-recognized repetitive loss properties = 1 Single Family Homes
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Washington County (Unincorporated Areas) that are located within the Washington County, Maryland Riverine Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Washington County (Unincorporated Areas) riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 12. Additionally, Table 13 shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 12: Washington County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	469	$55,200,000	46%	$9,200,000	17.0%
Commercial Building & Contents	23	$50,400,000	42%	$14,500,000	29.0%
Other Building & Contents	37	$13,400,000	11%	$4,100,000	31.0%
Total Building & Contents[3]	529	$119,000,000	100%	$27,800,000	23.0%
Business Disruption[4]	N/A	N/A	N/A	$13,500,000	N/A
TOTAL[5]	**529**	**$119,000,000**	**100%**	**$41,300,000**	**35.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 13: Washington County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	35	7%	$9,600,000	$300,000	$0	$0	0%
1 - 10%	186	35%	$40,300,000	$200,000	$1,800,000	$10,000	6%
10 - 20%	84	16%	$15,900,000	$200,000	$2,500,000	$30,000	9%
20 - 30%	42	8%	$4,300,000	$100,000	$1,100,000	$30,000	4%
30 - 40%	27	5%	$8,900,000	$300,000	$3,100,000	$100,000	11%
40 - 50%	28	5%	$30,400,000	$1,100,000	$13,400,000	$500,000	48%
50% or More	127	24%	$9,600,000	$80,000	$6,100,000	$50,000	22%
TOTAL	**529**	**100%**	**$119,000,000**	**$200,000**	**$28,000,000**	**$50,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Washington County (Unincorporated Areas)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Boonsboro (CID 240071)

The following pages include Flood Risk data for the Town of Boonsboro.

Overview

The Town of Boonsboro is in southern Washington County. It consists of 3 square miles along US Highway 40 Alternate. The primary flooding sources in the town include Tributary No. 97, Tributary No. 98, and Branch B.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Boonsboro	240071	3,336	3.06	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 4 policies totaling approximately $1,130,000
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Boonsboro that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Boonsboro's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 14. Additionally, Table 15

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 14: Town of Boonsboro – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	4	$300,000	94%	$10,000	3.0%
Commercial Building & Contents	1	$10,000	3%	$0	0.0%
Other Building & Contents	1	$10,000	3%	$0	0.0%
Total Building & Contents[3]	6	$320,000	100%	$10,000	3.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**6**	**$320,000**	**100%**	**$10,000**	**3.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 15: Town of Boonsboro – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	5	83%	$300,000	$60,000	$10,000	$0	100%
10 - 20%	1	17%	$10,000	$10,000	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**6**	**100%**	**$310,000**	**$50,000**	**$10,000**	**$0**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Boonsboro

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Clear Spring (CID 240072)

The following pages include Flood Risk data for the Town of Clear Spring.

Overview

The Town of Clear Spring is in northcentral Washington County. It consists of 0.1 square miles along US Highway 40. The primary flooding source in the town is Toms Run 1.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Clear Spring	240072	358	0.12	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) =5 policies totaling approximately $1,290,000
- NFIP-recognized repetitive loss properties = 1 Single Family Home
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Clear Spring that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Clear Spring's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 16. Additionally, Table 17 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: Town of Clear Spring – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	14	$1,300,000	54%	$80,000	6.0%
Commercial Building & Contents	4	$1,100,000	46%	$90,000	8.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	18	$2,400,000	100%	$170,000	7.0%
Business Disruption[4]	N/A	N/A	N/A	$60,000	N/A
TOTAL[5]	**18**	**$2,400,000**	**100%**	**$230,000**	**10.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: Town of Clear Spring – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	6%	$300,000	$300,000	$0	$0	0%
1 - 10%	12	67%	$1,400,000	$100,000	$80,000	$10,000	50%
10 - 20%	5	28%	$600,000	$100,000	$80,000	$20,000	50%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**18**	**100%**	**$2,300,000**	**$100,000**	**$160,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Clear Spring

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. Town of Funkstown Summary (CID 240073)

The following pages include Flood Risk data for the Town of Funkstown.

Overview

The Town of Funkstown is in central Washington County. It consists of 0.4 square miles near the crossing of Interstate 70 and US Highway 40. The primary flooding source in the town is Antietam Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Funkstown	240073	904	0.37	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 11 policies totaling approximately $2,471,300
- NFIP-recognized repetitive loss properties = 2 Single Family Homes, 1 Non-residential
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Funkstown that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Funkstown's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 18: Town of Funkstown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	22	$3,100,000	53%	$400,000	13.0%
Commercial Building & Contents	2	$2,700,000	46%	$1,300,000	48.0%
Other Building & Contents	3	$100,000	2%	$60,000	60.0%
Total Building & Contents[3]	27	$5,900,000	100%	$1,760,000	30.0%
Business Disruption[4]	N/A	N/A	N/A	$80,000	N/A
TOTAL[5]	**27**	**$5,900,000**	**100%**	**$1,840,000**	**31.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Funkstown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	4%	$100,000	$100,000	$0	$0	0%
1 - 10%	8	30%	$1,000,000	$100,000	$50,000	$10,000	3%
10 - 20%	10	37%	$1,700,000	$200,000	$200,000	$20,000	12%
20 - 30%	4	15%	$700,000	$200,000	$200,000	$50,000	12%
30 - 40%	1	4%	$100,000	$100,000	$40,000	$40,000	2%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	3	11%	$2,400,000	$800,000	$1,200,000	$400,000	71%
TOTAL	**27**	**100%**	**$6,000,000**	**$200,000**	**$1,690,000**	**$60,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Funkstown

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

v. City of Hagerstown Summary (CID 240074)

The following pages include Flood Risk data for the City of Hagerstown.

Overview

The City of Hagerstown is in central Washington County. It consists of 12 square miles along Interstate 81. The primary flooding sources in the city include Antietam Creek, Hamilton Run, Tributary No. 78, and Tributary No. 29.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
City of Hagerstown	240074	39,662	12.16	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 42 policies totaling approximately $9,969,700
- NFIP-recognized repetitive loss properties = 4 Single Family Homes, 1 Non-residential
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the City of Hagerstown that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The City of Hagerstown's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 20. Additionally, Table 21

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 20: City of Hagerstown – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	60	$11,300,000	19%	$1,400,000	12.0%
Commercial Building & Contents	11	$36,800,000	63%	$1,300,000	4.0%
Other Building & Contents	5	$10,700,000	18%	$3,700,000	35.0%
Total Building & Contents[3]	76	$58,800,000	100%	$6,400,000	11.0%
Business Disruption[4]	N/A	N/A	N/A	$600,000	N/A
TOTAL[5]	**76**	**$58,800,000**	**100%**	**$7,000,000**	**12.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 21: City of Hagerstown – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	8	11%	$20,300,000	$2,500,000	$10,000	$0	0%
1 - 10%	37	49%	$20,000,000	$500,000	$1,000,000	$30,000	16%
10 - 20%	17	22%	$7,000,000	$400,000	$1,100,000	$60,000	17%
20 - 30%	5	7%	$1,100,000	$200,000	$300,000	$60,000	5%
30 - 40%	6	8%	$9,800,000	$1,600,000	$3,800,000	$600,000	59%
40 - 50%	3	4%	$500,000	$200,000	$200,000	$70,000	3%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**76**	**100%**	**$58,700,000**	**$800,000**	**$6,410,000**	**$80,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the City of Hagerstwon

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

vi. Town of Hancock Summary (CID 240109)

The following pages include Flood Risk data for the Town of Hancock.

Overview

The Town of Hancock is in western Washington County. It consists of 2.8 square miles near the crossing of Interstates 68 and 70. The primary flooding sources in the town include Little Tonoloway Creek, Chesapeake and Ohio Canal, and the Potomac River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Hancock	240109	1,545	2.76	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 8 policies totaling approximately $2,016,800
- NFIP-recognized repetitive loss properties = 3 Non-residential
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Hancock that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Hancock's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 22. Additionally, Table 23

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 22: Town of Hancock – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	15	$1,400,000	12%	$400,000	29.0%
Commercial Building & Contents	28	$9,900,000	83%	$5,000,000	51.0%
Other Building & Contents	2	$600,000	5%	$200,000	33.0%
Total Building & Contents[3]	45	$11,900,000	100%	$5,600,000	47.0%
Business Disruption[4]	N/A	N/A	N/A	$2,300,000	N/A
TOTAL[5]	**45**	**$11,900,000**	**100%**	**$7,900,000**	**66.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 23: Town of Hancock – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	4%	$800,000	$400,000	$0	$0	0%
1 - 10%	5	11%	$500,000	$100,000	$30,000	$10,000	1%
10 - 20%	5	11%	$400,000	$80,000	$60,000	$10,000	1%
20 - 30%	3	7%	$700,000	$200,000	$200,000	$70,000	4%
30 - 40%	8	18%	$1,000,000	$100,000	$300,000	$40,000	5%
40 - 50%	5	11%	$2,500,000	$500,000	$1,100,000	$200,000	19%
50% or More	17	38%	$5,900,000	$300,000	$4,000,000	$200,000	70%
TOTAL	**45**	**100%**	**$11,800,000**	**$300,000**	**$5,690,000**	**$100,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Hancock

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

vii. Town of Keedysville Summary (CID 240075)

The following pages include Flood Risk data for the Town of Keedysville.

Overview

The Town of Keedysville is in southern Washington County. It consists of 0.9 square miles along State Highway 34. The primary flooding sources in the town include Little Antietam Creek and Tributary No. 97.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Keedysville	240075	1,152	0.91	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 2 policies totaling approximately $420,000
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Keedysville that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Keedysville's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 24. Additionally, Table 25 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 24: Town of Keedysville – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	3	$300,000	94%	$30,000	10.0%
Commercial Building & Contents	1	$20,000	6%	$0	0.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	4	$320,000	100%	$30,000	9.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**4**	**$320,000**	**100%**	**$30,000**	**9.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 25: Town of Keedysville – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	1	25%	$100,000	$100,000	$10,000	$10,000	25%
10 - 20%	3	75%	$200,000	$70,000	$30,000	$10,000	75%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**4**	**100%**	**$300,000**	**$80,000**	**$40,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Keedysville

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

viii. Town of Sharpsburg Summary (CID 240076)

The following pages include Flood Risk data for the Town of Sharpsburg.

Overview

The Town of Sharpsburg is in southern Washington County. It consists of 0.2 square miles along State Highway 34. The primary flooding source in the town is Tributary No. 105.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Sharpsburg	240076	705	0.22	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 4 policies totaling approximately $860,500
- NFIP-recognized repetitive loss properties = 4 Single Family Homes
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Sharpsburg that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Sharpsburg's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 26. Additionally, Table 27 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 26: Town of Sharpsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	12	$1,400,000	99%	$80,000	6.0%
Commercial Building & Contents	0	$0	0%	$0	0.0%
Other Building & Contents	1	$10,000	1%	$0	0.0%
Total Building & Contents[3]	13	$1,410,000	100%	$80,000	6.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**13**	**$1,410,000**	**100%**	**$80,000**	**6.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 27: Town of Sharpsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	0	0%	$0	$0	$0	$0	0%
1 - 10%	9	69%	$1,200,000	$100,000	$50,000	$10,000	71%
10 - 20%	3	23%	$200,000	$70,000	$20,000	$10,000	29%
20 - 30%	1	8%	$10,000	$10,000	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**13**	**100%**	**$1,410,000**	**$100,000**	**$70,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Sharpsburg

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ix. Town of Smithsburg Summary (CID 240124)

The following pages include Flood Risk data for the Town of Smithsburg.

Overview

The Town of Smithsburg is in northeastern Washington County. It consists of 1 square mile along State Highway 77. The primary flooding sources in the town include Town Run, Grove Creek, and Beaver Creek.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Smithsburg	240124	2,975	1.04	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 3 policies totaling approximately $710,000
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Smithsburg that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Smithsburg's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1.2 of this report provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 28. Additionally, Table 29 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 28: Town of Smithsburg – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	9	$800,000	80%	$50,000	6.0%
Commercial Building & Contents	1	$200,000	20%	$0	0.0%
Other Building & Contents	1	$0	0%	$0	0.0%
Total Building & Contents[3]	11	$1,000,000	100%	$50,000	5.0%
Business Disruption[4]	N/A	N/A	N/A	$0	N/A
TOTAL[5]	**11**	**$1,000,000**	**100%**	**$50,000**	**5.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 29: Town of Smithsburg – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	18%	$200,000	$100,000	$0	$0	0%
1 - 10%	7	64%	$700,000	$100,000	$30,000	$0	60%
10 - 20%	2	18%	$200,000	$100,000	$20,000	$10,000	40%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**11**	**100%**	**$1,100,000**	**$100,000**	**$50,000**	**$0**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Smithsburg

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

x. Town of Williamsport Summary (CID 240077)

The following pages include Flood Risk data for the Town of Williamsport.

Overview

The Town of Williamsport is in central Washington County. It consists of 1 square mile along Interstate 81. The primary flooding sources in the town include C&O Canal, Conococheague Creek, Tributary No. 35, and Tributary No. 36.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Williamsport	240077	2,137	0.98	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires July 16, 2023
- Past Federal Disaster Declarations for flooding = 3
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 9 policies totaling approximately $1,593,700
- NFIP-recognized repetitive loss properties = 31 Single Family Homes, 1 Non-residential
- NFIP-recognized severe repetitive loss properties = 1 Single Family Home

Data provided below only includes areas in the Town of Williamsport that are located within the Washington County, Maryland Riverine Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Williamsport's riverine flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 30. Additionally, Table 31

shows the severity of damage to buildings from flooding within the community. Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 30: Town of Williamsport – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	9	$1,500,000	42%	$600,000	40.0%
Commercial Building & Contents	1	$60,000	2%	$0	0.0%
Other Building & Contents	4	$2,000,000	56%	$1,400,000	70.0%
Total Building & Contents[3]	14	$3,560,000	100%	$2,000,000	56.0%
Business Disruption[4]	N/A	N/A	N/A	$200,000	N/A
TOTAL[5]	**14**	**$3,560,000**	**100%**	**$2,200,000**	**62.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 31: Town of Williamsport – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	1	7%	$60,000	$60,000	$0	$0	0%
1 - 10%	2	14%	$200,000	$100,000	$10,000	$10,000	1%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	3	21%	$300,000	$100,000	$70,000	$20,000	4%
30 - 40%	2	14%	$300,000	$200,000	$100,000	$50,000	5%
40 - 50%	1	7%	$100,000	$100,000	$60,000	$60,000	3%
50% or More	5	36%	$2,600,000	$500,000	$1,700,000	$300,000	88%
TOTAL	**14**	**100%**	**$3,560,000**	**$300,000**	**$1,940,000**	**$100,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Williamsport

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the riverine 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective August 15, 2017), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1
Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations
- Building codes

- Participation in the NFIP Community Rating System (CRS)
- Open space preservation
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, and erosion, or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection

- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 32 below identifies possible mitigation actions for each AoMI to consider.

Table 32: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***

AoMI	Possible Actions to Reduce Flood Risk
Significant Land Use Changes	***Higher regulatory standard*** ***Stormwater BMPs*** ***Transfer of Development rights*** ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	***Elevation*** ***Creation of alternate routes*** ***Design as low water crossing***
Areas of Significant Riverine	***Relocation of buildings and infrastructure*** ***Regulations and planning*** ***Natural vegetation*** ***Erosion Control Structures*** ***Building Setbacks***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	***Identification of all flood hazard areas***
Areas of Mitigation Success	***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

The *2017 Washington County Multi-Jurisdictional Hazard Mitigation Plan* – Section 3.2 Project Implementation identifies and prioritizes mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 33 below.

Table 33: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress, and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting

data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,*
coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Western Region Representative:
Amy C. M. Stonebreaker, Planner, Floodplain Manager
Allegany County Office of Land Development Services
701 Kelly Road, Cumberland, MD 21502
https://gov.allconet.org/227/Land-Development-Services

Washington County Department of Emergency Services
16232 Elliott Parkway, Williamsport, MD 21795
https://www.washco-md.net/emergency-services/

Washington County Department of Planning and Zoning
Washington County Administration Complex
100 West Washington Street, Suite 2600, Hagerstown, MD 21740
https://www.washco-md.net/planning-zoning-2/

Washington County Department of Public Works
Washington County Administration Complex
100 West Washington Street, Suite 2400, Hagerstown, MD 21740
https://www.washco-md.net/public-works/

Washington County Department of Planning and Zoning – Maps & GIS/Spatial Data
Washington County Administration Complex
100 West Washington Street, Suite 2600, Hagerstown, MD 21740
https://www.washco-md.net/planning-zoning-2/planzone-maps-gis-spacial-data/

This page left blank intentionally

Source: https://www.washingtonpost.com/news/capital-weather-gang/wp/2014/06/13/extreme-flooding-in-western-maryland-thursday-photos/?utm_term=.e5cf3b26cada

STATE OF MARYLAND

FLOOD RISK REPORT

WASHINGTON COUNTY, MARYLAND

Appendix A

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Washington County, Maryland – Countywide Flood Risk Map (FRM)

Washington County, Maryland – High Risk Area 1: Little Tonoloway Creek / Creek Rd – Dollar Losses

Washington County, Maryland – High Risk Area 1: Little Tonoloway Creek / Creek Rd – Percent Losses

Washington County, Maryland – High Risk Area 2: Falling Waters Rd – Dollar Losses

Washington County, Maryland – High Risk Area 2: Falling Waters Rd – Percent Losses

Washington County, Maryland – High Risk Area 3: Millers Sawmill Rd – Dollar Losses

Washington County, Maryland – High Risk Area 3: Millers Sawmill Rd – Percent Losses

Washington County, Maryland – High Risk Area 4: Antietam Creek / E Oak Ridge Dr – Dollar Losses

Washington County, Maryland – High Risk Area 4: Antietam Creek / E Oak Ridge Dr – Percent Losses

Washington County, Maryland – High Risk Area 5: Jefferson Blvd / Greendale Dr – Dollar Losses

Washington County, Maryland – High Risk Area 5: Jefferson Blvd / Greendale Dr – Percent Losses

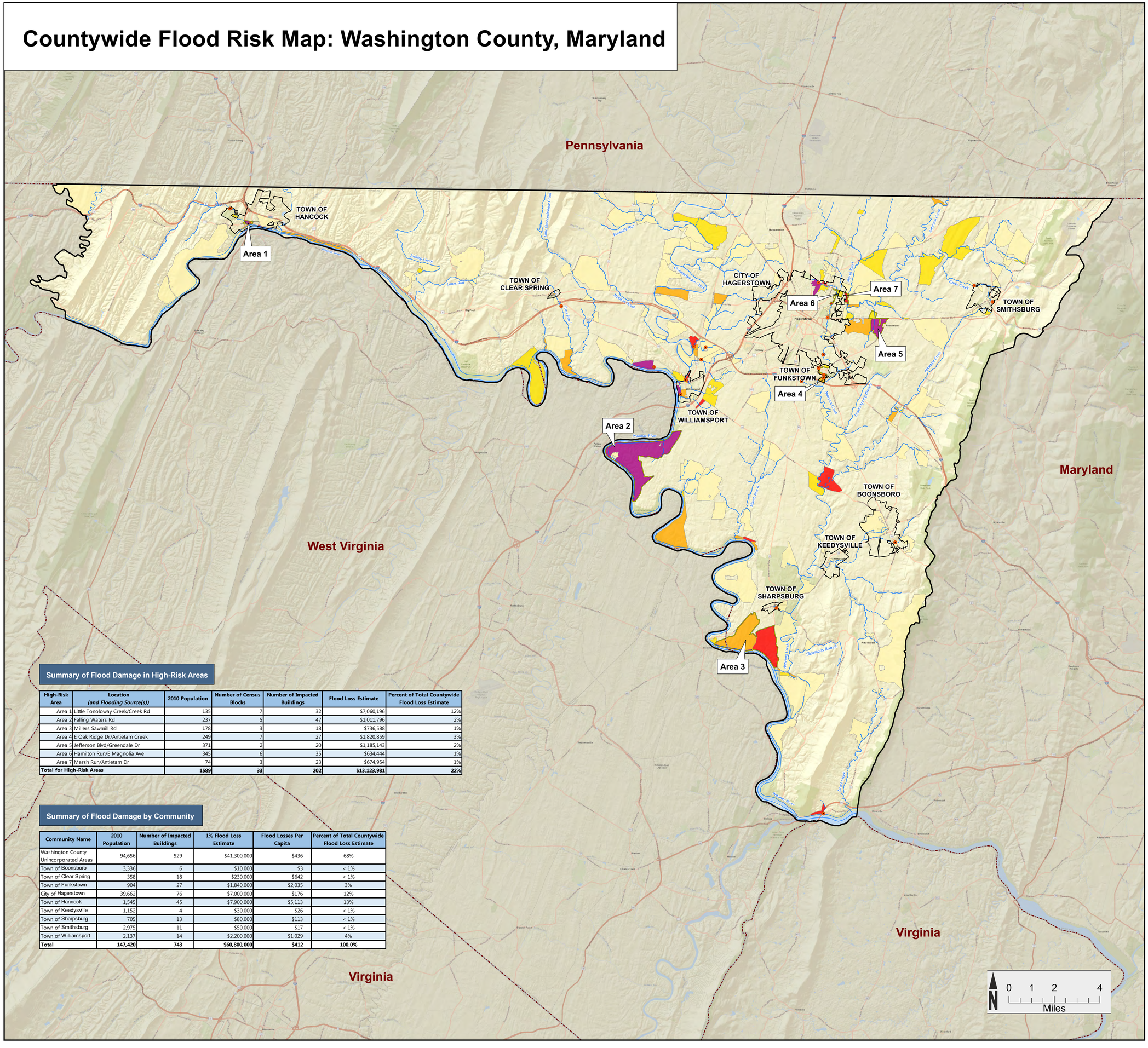
Washington County, Maryland – High Risk Area 6: Hamilton Run / E Magnolia Ave – Dollar Losses

Washington County, Maryland – High Risk Area 6: Hamilton Run / E Magnolia Ave – Percent Losses

Washington County, Maryland – High Risk Area 7: Marsh Run / Antietam Dr – Dollar Losses

Washington County, Maryland – High Risk Area 7: Marsh Run / Antietam Dr – Percent Losses

Countywide Flood Risk Map: Washington County, Maryland

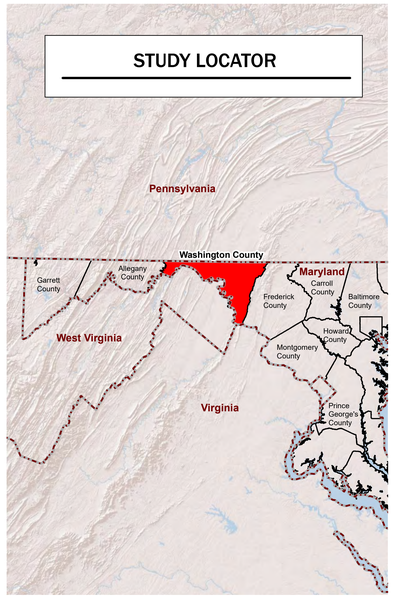


Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location *(and Flooding Source(s))*	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Little Tonoloway Creek/Creek Rd	135	7	32	$7,060,196	12%
Area 2	Falling Waters Rd	237	5	47	$1,011,796	2%
Area 3	Millers Sawmill Rd	178	3	18	$736,588	1%
Area 4	E Oak Ridge Dr/Antietam Creek	249	7	27	$1,820,859	3%
Area 5	Jefferson Blvd/Greendale Dr	371	2	20	$1,185,143	2%
Area 6	Hamilton Run/E Magnolia Ave	345	6	35	$634,444	1%
Area 7	Marsh Run/Antietam Dr	74	3	23	$674,954	1%
Total for High-Risk Areas		**1589**	**33**	**202**	**$13,123,981**	**22%**

Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Washington County Unincorporated Areas	94,656	529	$41,300,000	$436	68%
Town of Boonsboro	3,336	6	$10,000	$3	< 1%
Town of Clear Spring	358	18	$230,000	$642	< 1%
Town of Funkstown	904	27	$1,840,000	$2,035	3%
City of Hagerstown	39,662	76	$7,000,000	$176	12%
Town of Hancock	1,545	45	$7,900,000	$5,113	13%
Town of Keedysville	1,152	4	$30,000	$26	< 1%
Town of Sharpsburg	705	13	$80,000	$113	< 1%
Town of Smithsburg	2,975	11	$50,000	$17	< 1%
Town of Williamsport	2,137	14	$2,200,000	$1,029	4%
Total	**147,420**	**743**	**$60,800,000**	**$412**	**100.0%**



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area*

Area 1

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk Government Facilities

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

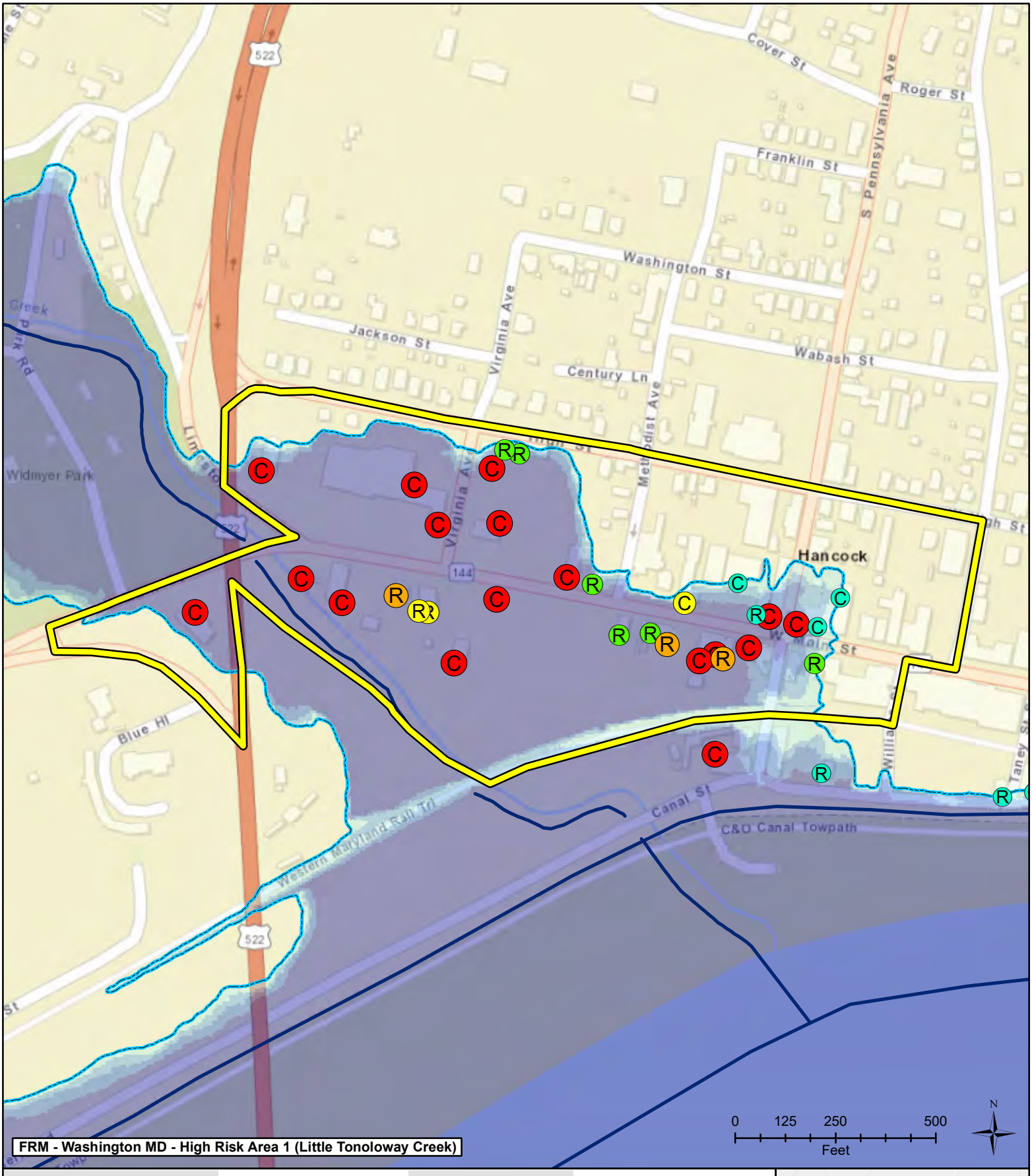
Washington County and Incorporated Areas, MD

MARYLAND

FEMA

This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Washington County, MD.

RELEASE DATE
12/31/2019



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

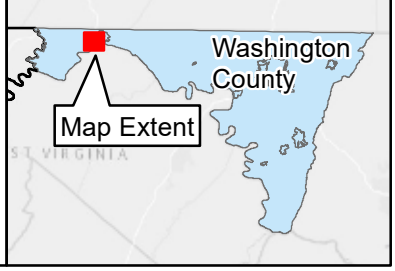
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

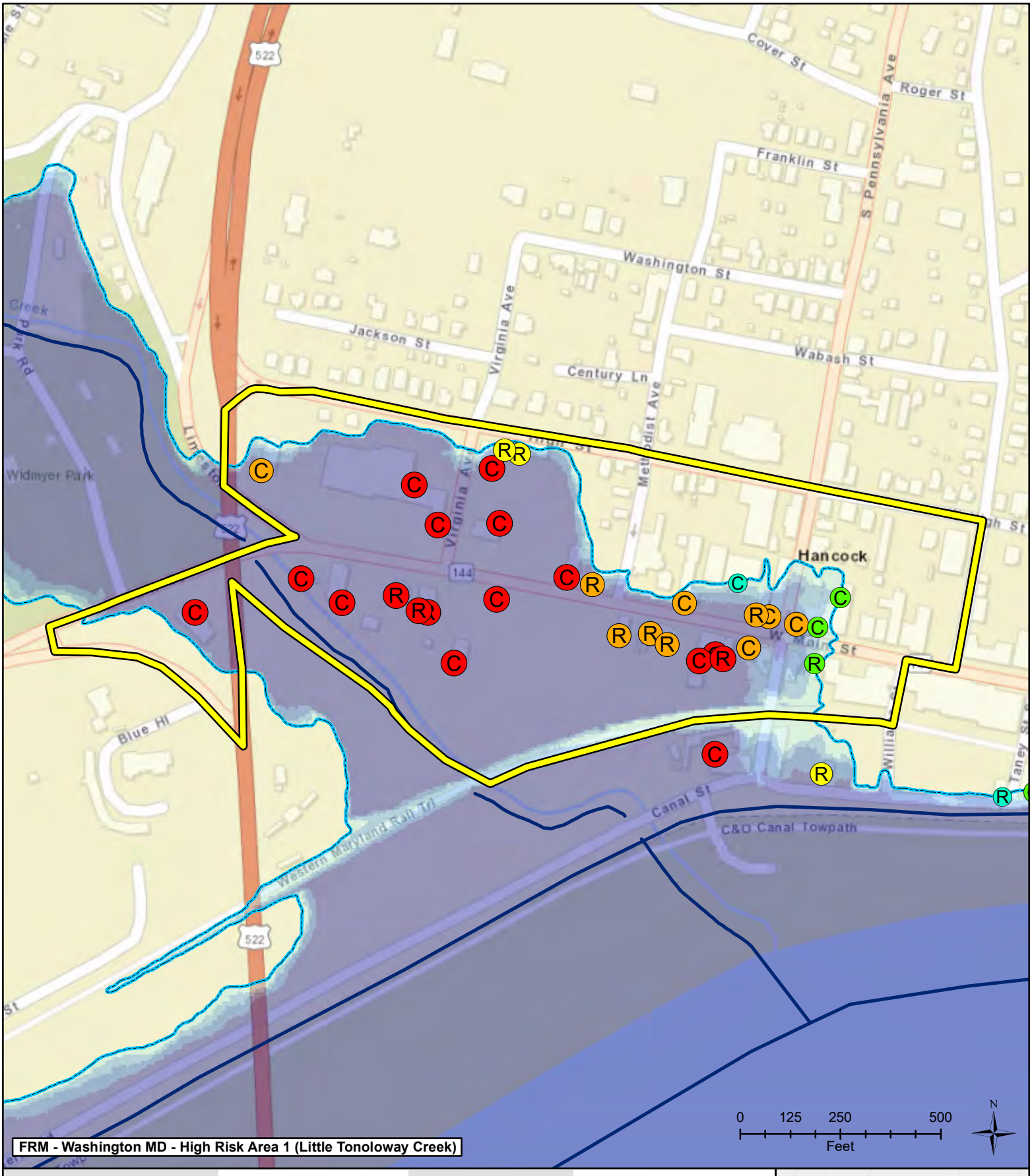
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

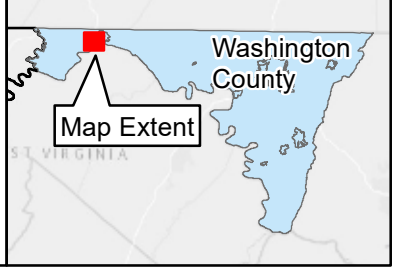
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

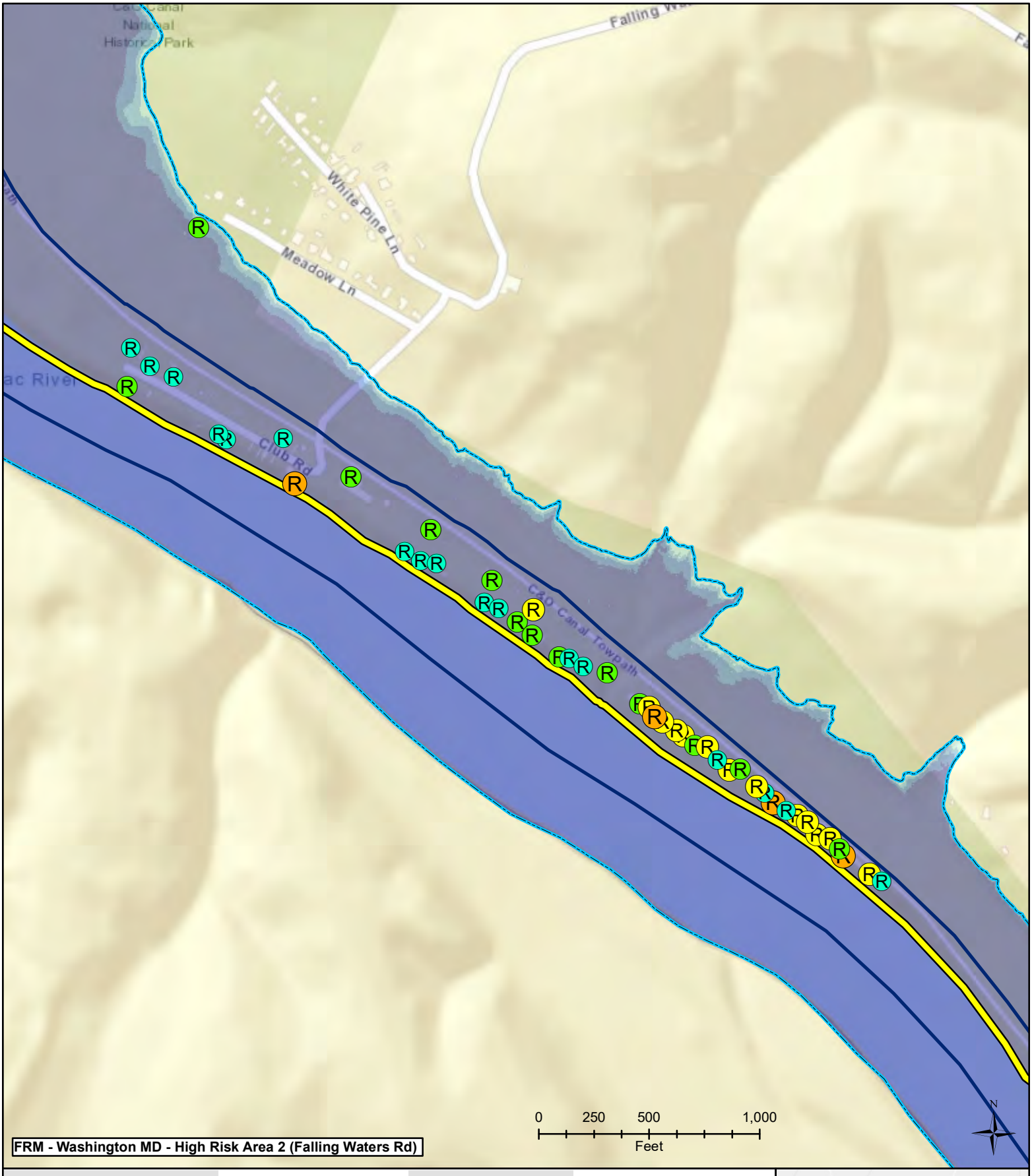
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More





FRM - Washington MD - High Risk Area 2 (Falling Waters Rd)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

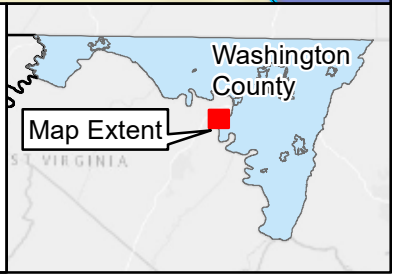
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

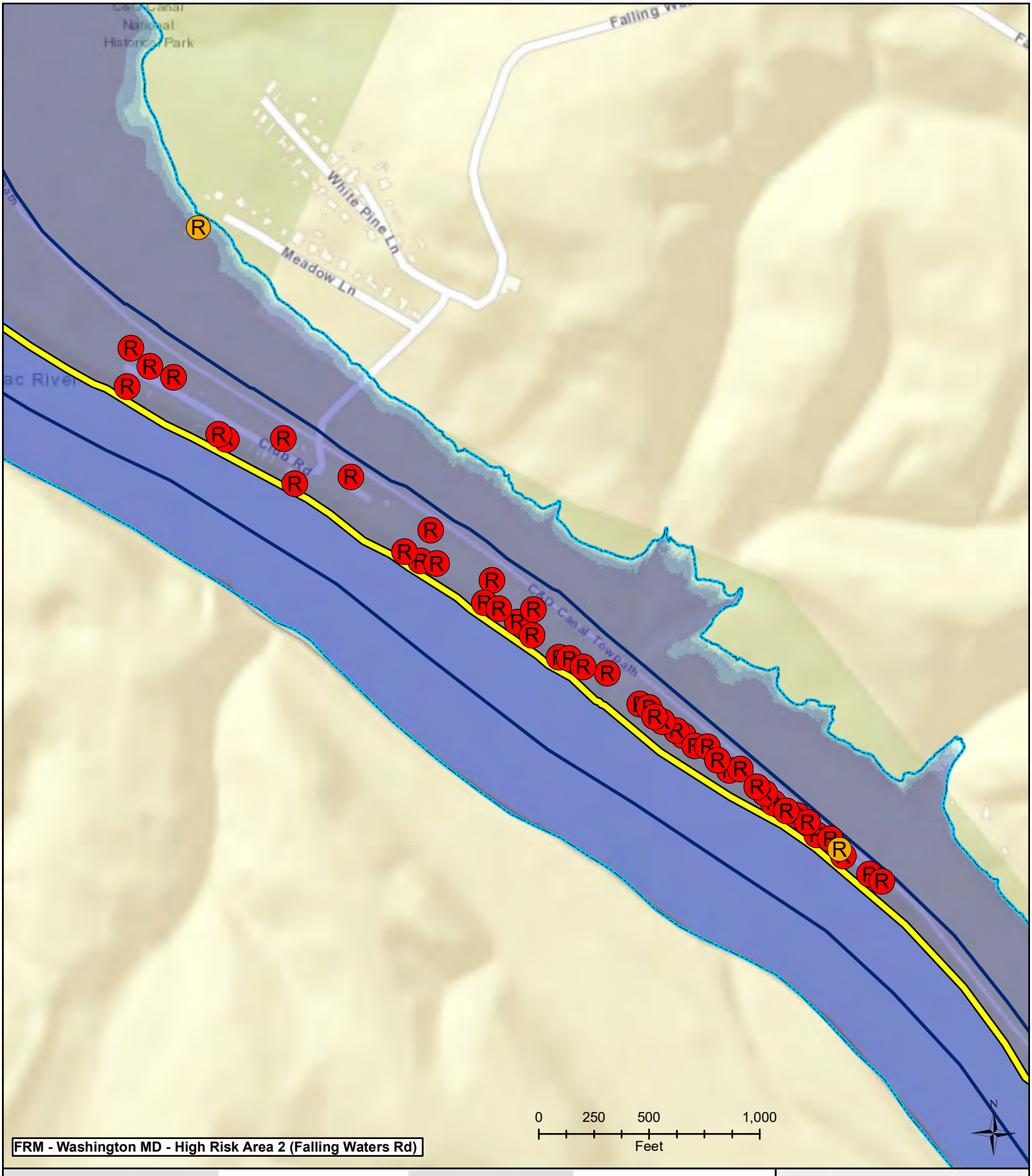
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Washington MD - High Risk Area 2 (Falling Waters Rd)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

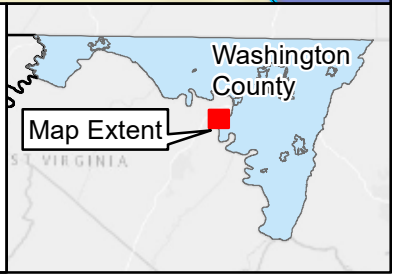
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

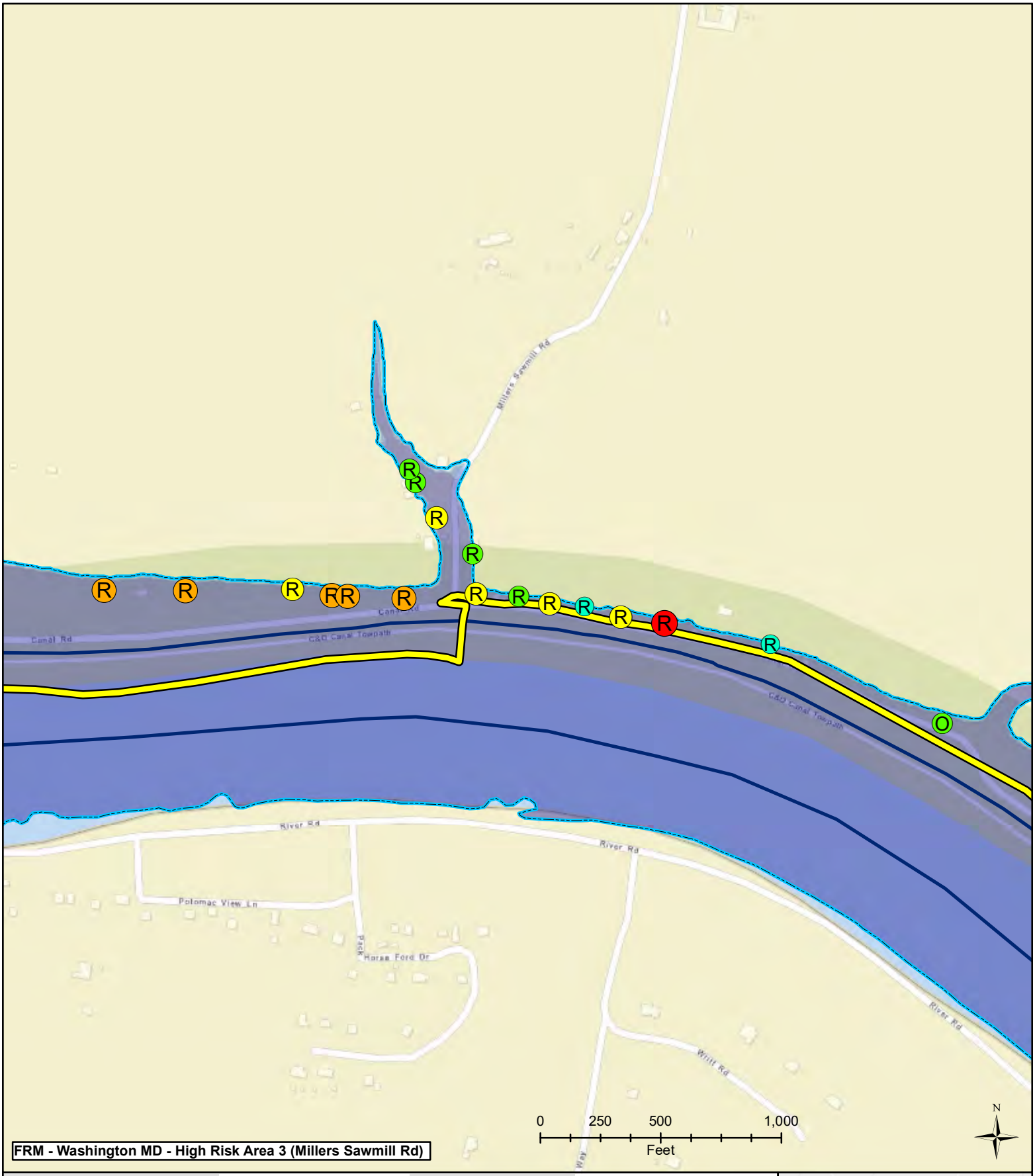
UDF Land Use Category

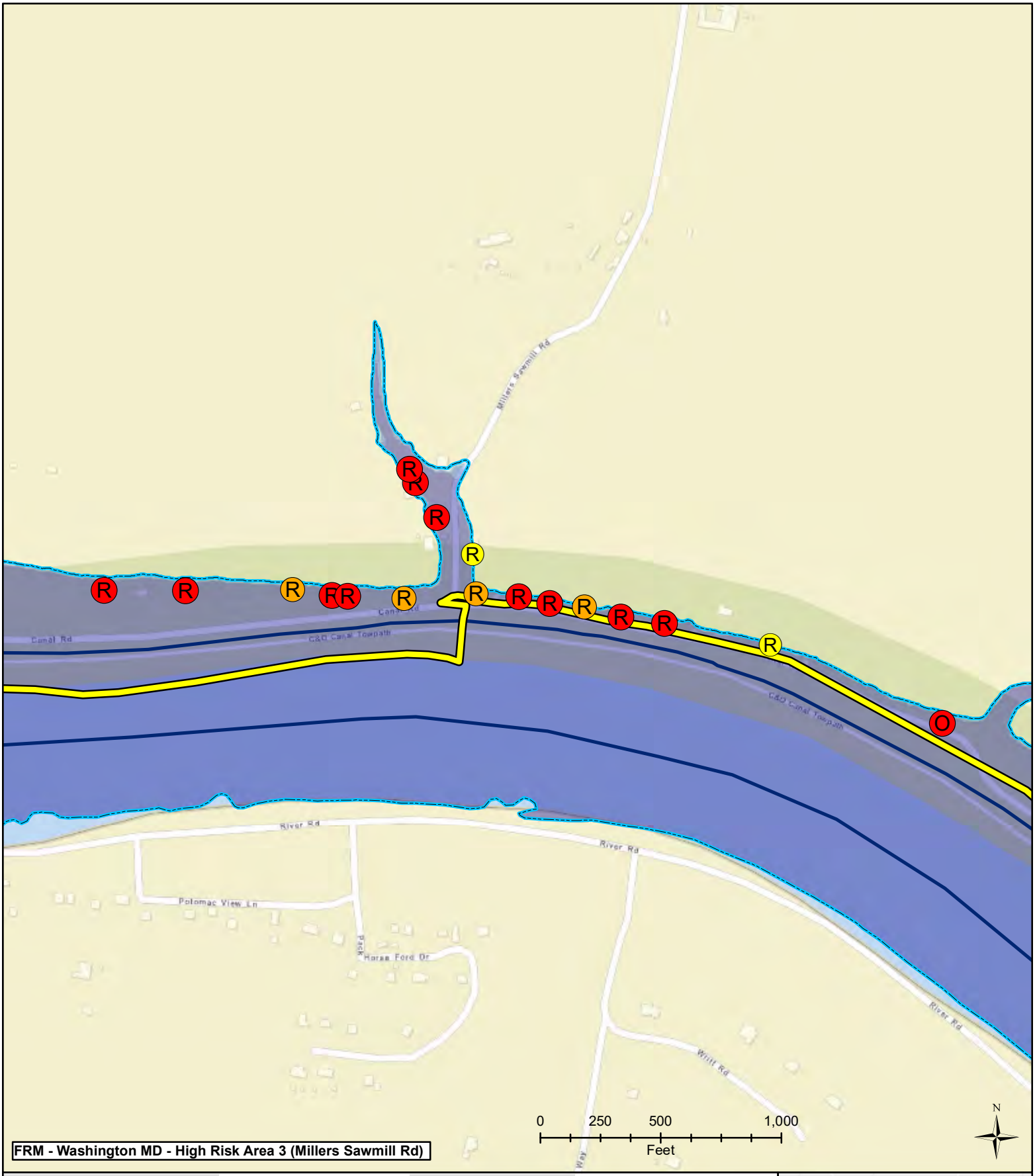
- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Millers Sawmill Rd
Canal Rd
C&O Canal Towpath
River Rd
Potomac View Ln
Horse Ford Dr
Wiltt Rd
0
250
500
1,000
Feet
N
FRM - Washington MD - High Risk Area 3 (Millers Sawmill Rd)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Washington County
Map Extent



FRM - Washington MD - High Risk Area 3 (Millers Sawmill Rd)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

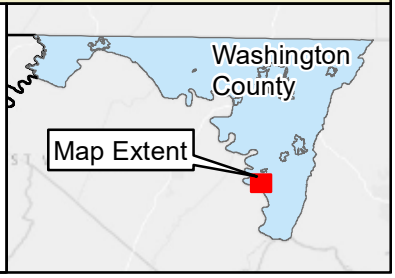
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More



Funkstown
W Baltimore St
Chestnut St
E Chestnut St
Baltimore St
W Maple St
E Maple St
W Cemetery St
E Cemetery St
N Antietam St
S Antietam St
N High St
S High St
Wye Oak Dr
W Poplar
Frederick R
40
0 125 250 500
Feet
N
FRM - Washington MD - High Risk Area 4 (Antietam Creek)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Washington County
Map Extent

FRM - Washington MD - High Risk Area 4 (Antietam Creek)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

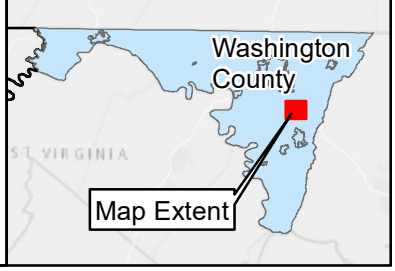
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

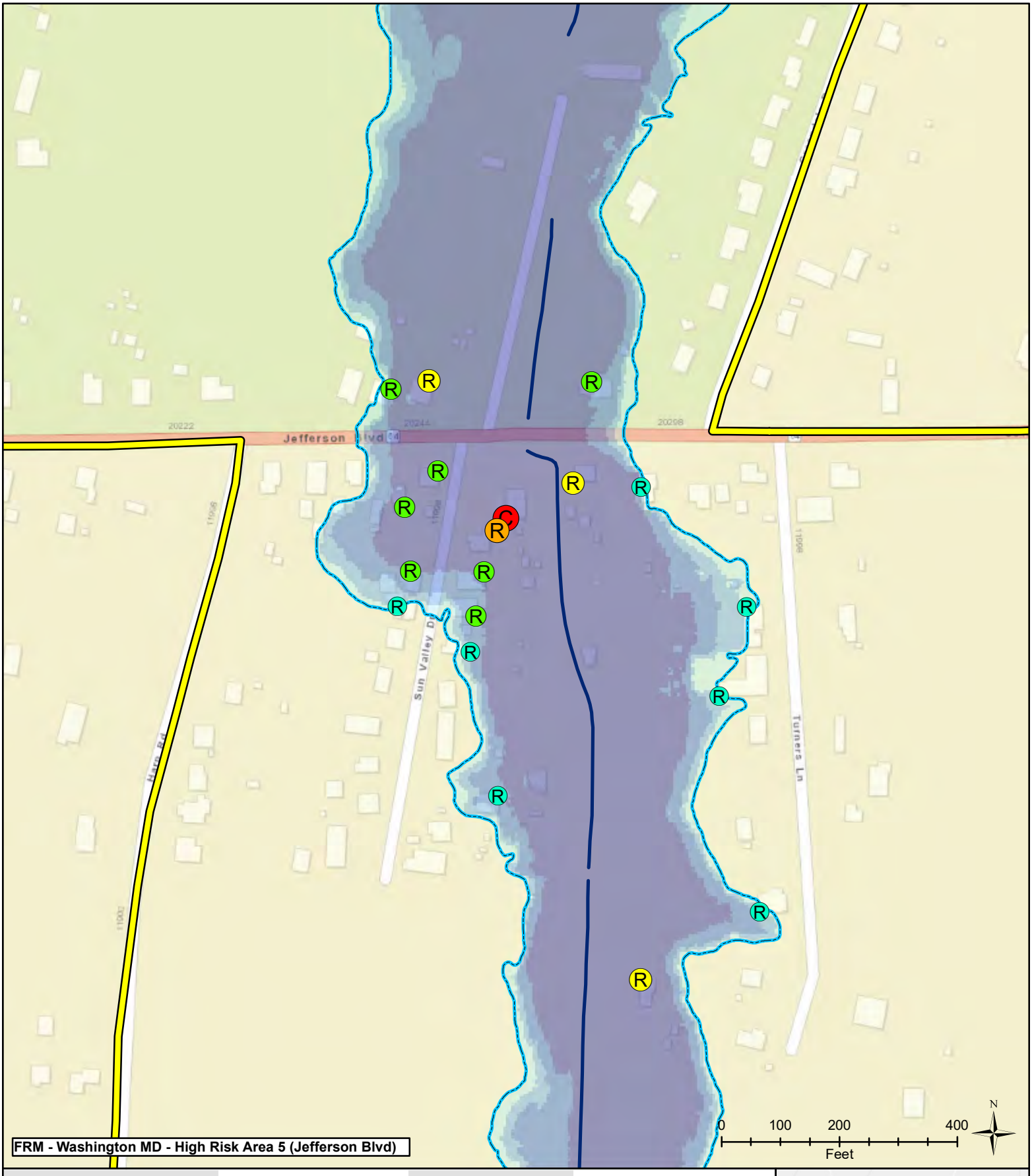
UDF Land Use Category

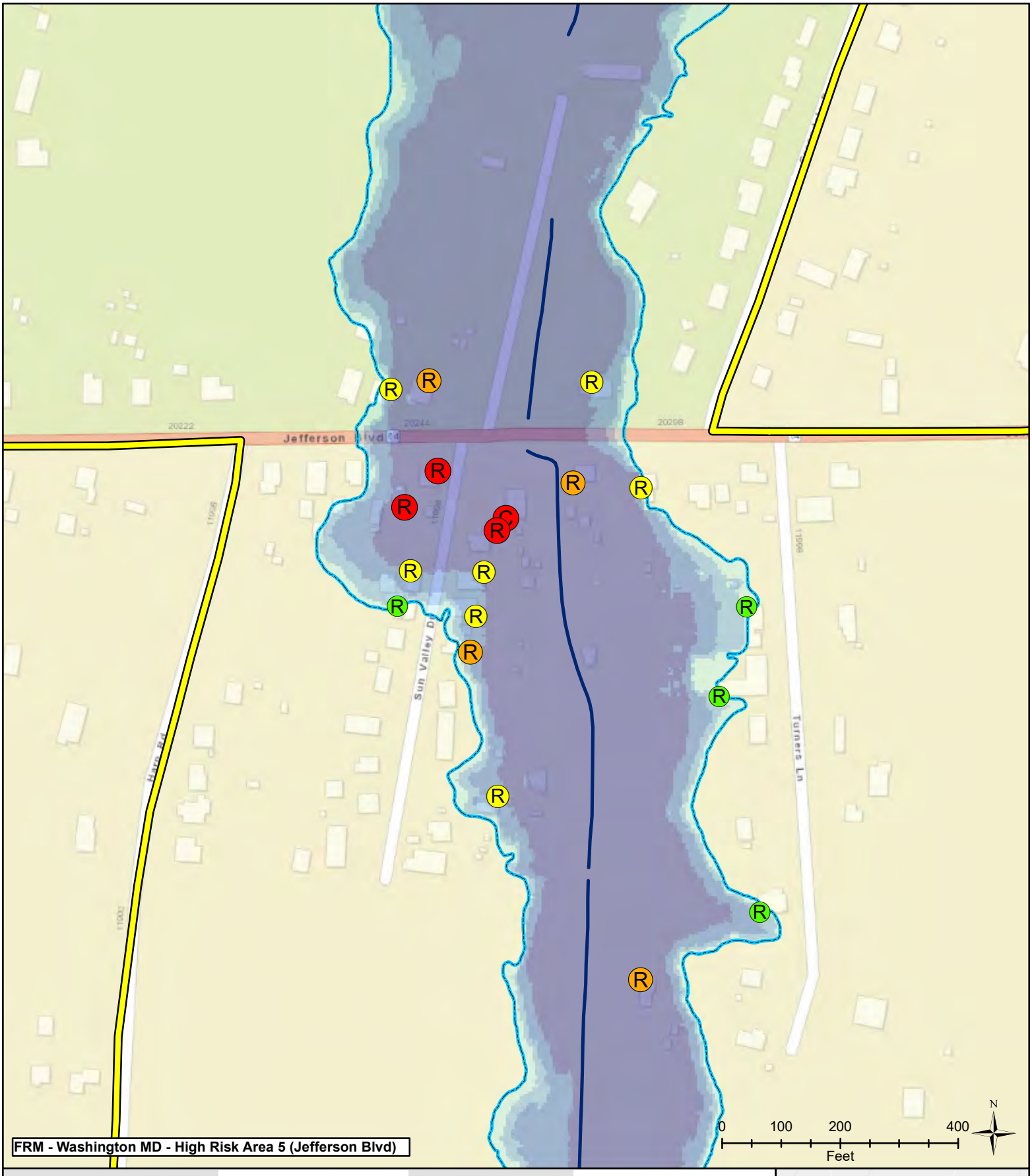
- (R) Residential
- (C) Commercial
- (O) Other

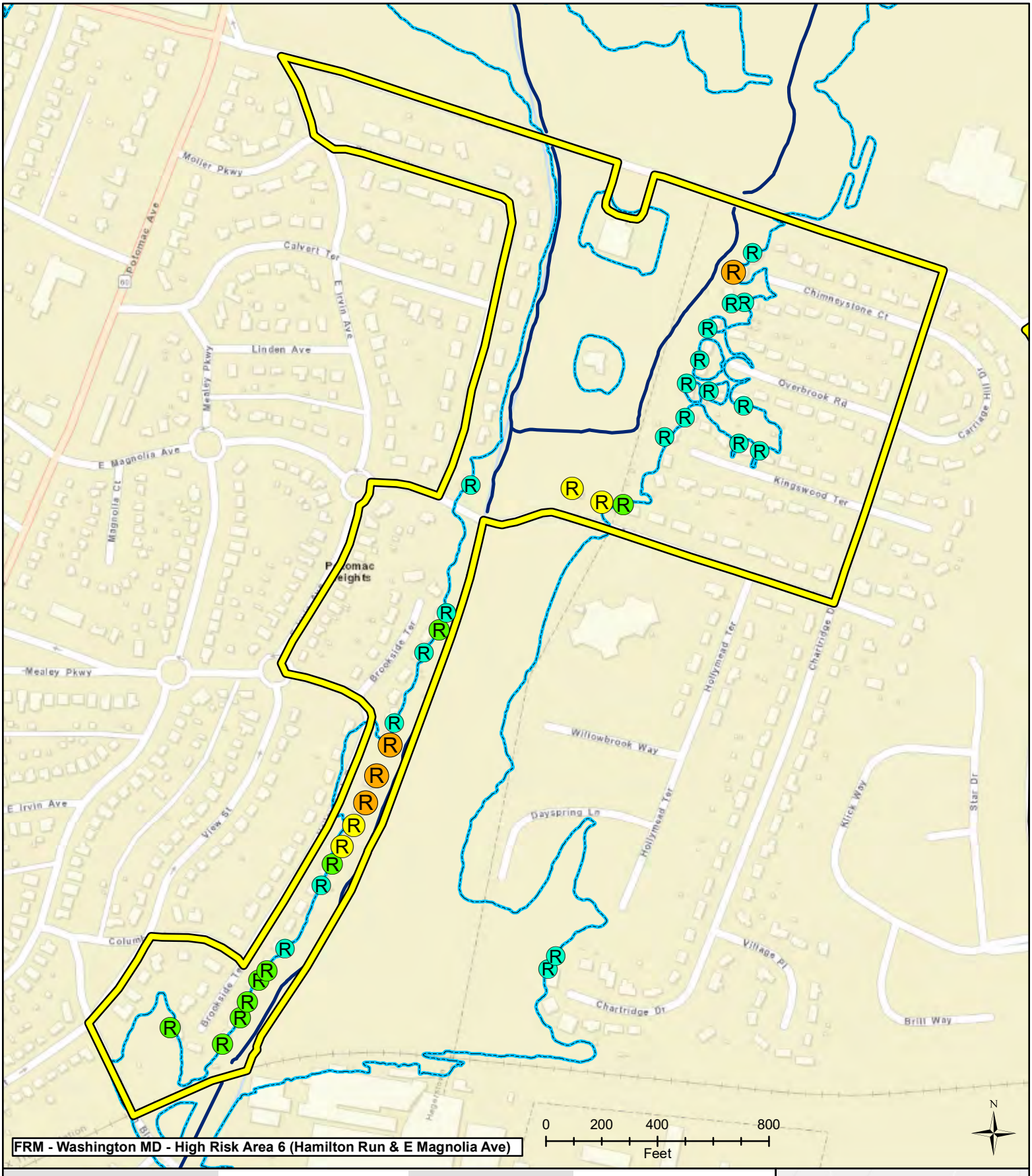
UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Jefferson Blvd
Sun Valley Dr
Turners Ln
FRM - Washington MD - High Risk Area 5 (Jefferson Blvd)
0
100
200
400
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Washington County
Map Extent


Jefferson Blvd
Sun Valley Dr
Turners Ln
0
100
200
400
Feet
N
FRM - Washington MD - High Risk Area 5 (Jefferson Blvd)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Washington County
Map Extent



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

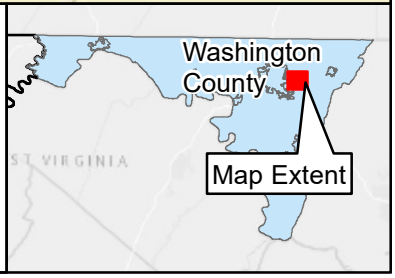
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

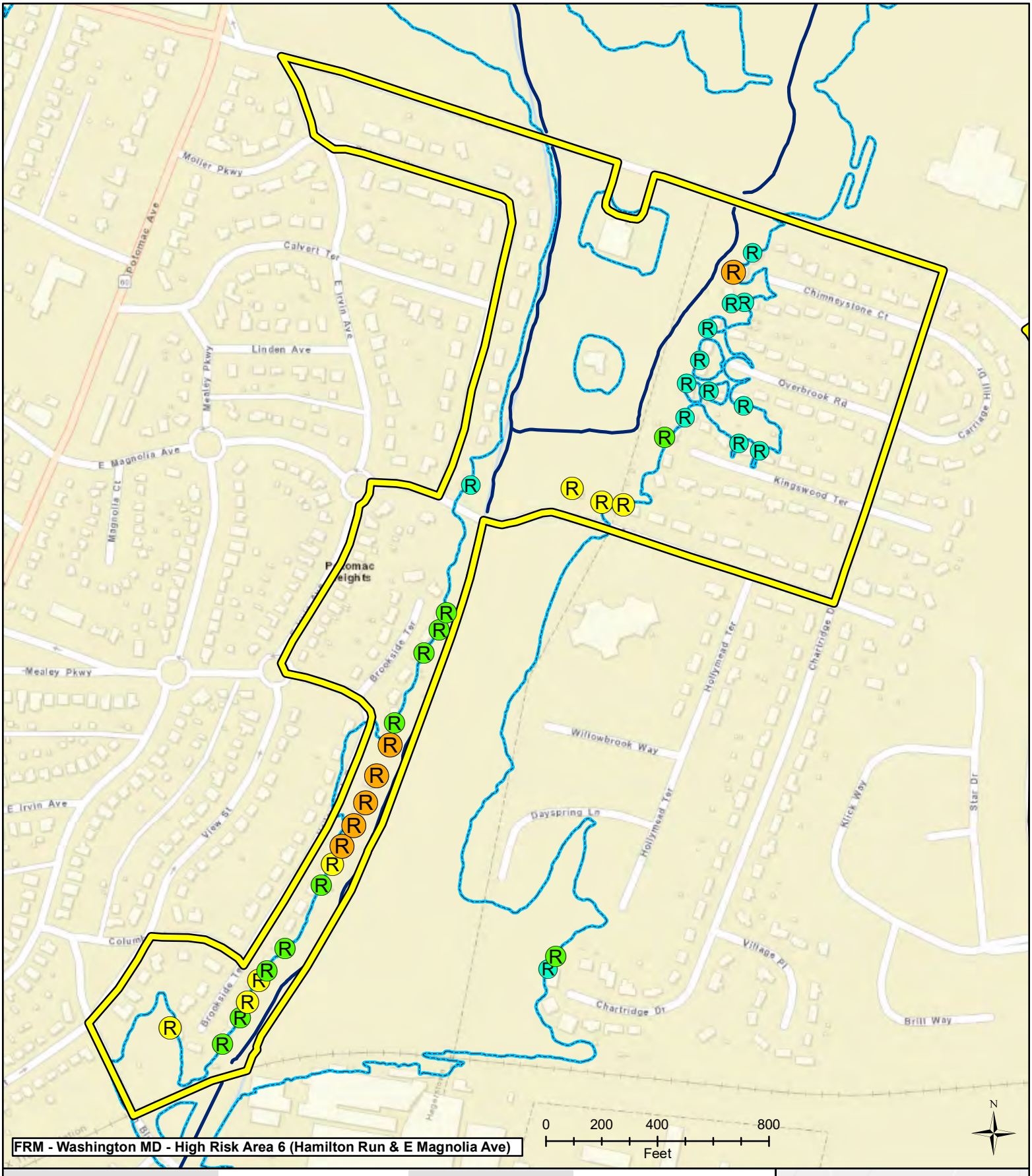
UDF Land Use Category

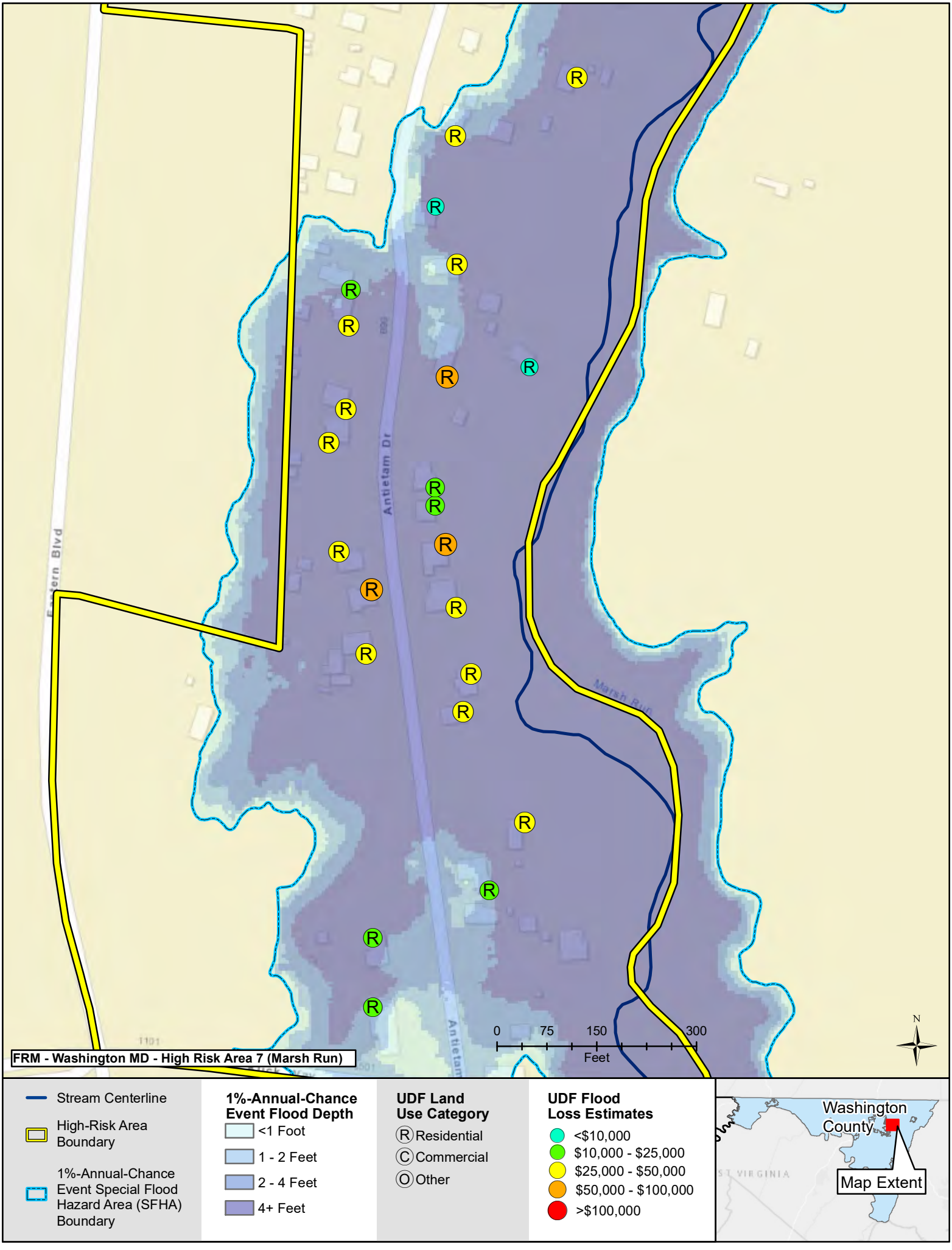
- (R) Residential
- (C) Commercial
- (O) Other

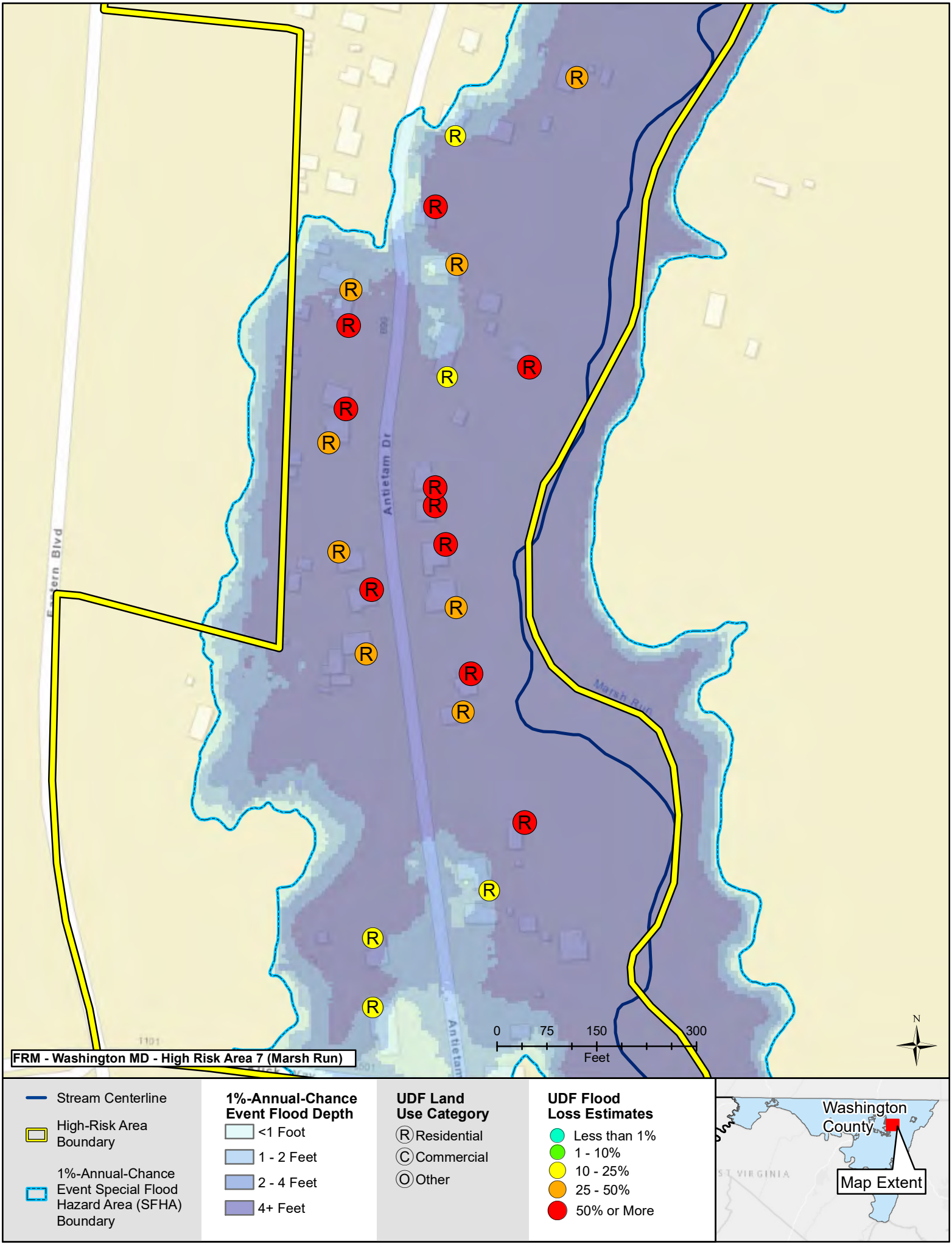
UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000




Moller Pkwy
Potomac Ave
Calvert Ter
E Irvin Ave
Linden Ave
Mealey Pkwy
E Magnolia Ave
Magnolia Ct
Potomac Heights
Brookside Ter
Mealey Pkwy
E Irvin Ave
View St
Columbia
Brookside Ter
Chimneystone Ct
Overbrook Rd
Carriage Hill Dr
Kingswood Ter
Hollymead Ter
Chartridge Dr
Willowbrook Way
Dayspring Ln
Hollymead Ter
Village Pl
Chartridge Dr
Klick Way
Star Dr
Brill Way
0
200
400
800
Feet
N
FRM - Washington MD - High Risk Area 6 (Hamilton Run & E Magnolia Ave)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Washington County
Map Extent


Antietam Dr
Marsh Run
0
75
150
300
Feet
N
FRM - Washington MD - High Risk Area 7 (Marsh Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Washington County
Map Extent


Antietam Dr
Marsh Run
0
75
150
300
Feet
N
FRM - Washington MD - High Risk Area 7 (Marsh Run)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Washington County
Map Extent

Source:
https://www.https://r.search.yahoo.com/_ylt=AwrE1xJKEJ1cJHIA5ClXNyoA;_ylu=X3oDMTEyY3VucDBuBGNvbG8DYm

STATE OF MARYLAND

FLOOD RISK REPORT

WORCESTER COUNTY, MARYLAND

REPORT NUMBER:
12/31/2019

FEMA

This page intentionally left blank.

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory Flood Risk information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire county (the Flood Risk Project area) as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Using the FEMA Flood Risk Report (FFR) template as a guide, a Maryland centric flood risk report has been produced for Worcester County, Maryland. Refined loss data provided within the **standard** FEMA FRR has been **expanded** to include additional facility types.

Standard - The standard FEMA FRR provides refined loss data results for the following facility types: Residential Building & Contents; Commercial Building & Contents; Other Building & Contents.

Expanded - In addition to the standard data results, the Maryland FRR includes refined losses for both essential facilities and state assets.

Both essential facilities and state assets, as defined and identified within the State of Maryland Hazard Mitigation Plan, have been integrated, producing loss estimations that were not previously available to the State.

Finally, an additional analysis was completed using the standard hazus run default data (census tract) HAZUS Version 3.1 for the purpose of generating **debris estimations** and **projected shelter needs**.

The development and publication of this new enhanced hazus data was a prioritized mitigation strategy for Maryland and will assist in risk ranking and decision-making. Maryland's

commitment to the completion of enhanced hazus analysis has resulted in additional data and mapping, specifically essential facility and state asset loss estimation totals, for Worcester County. This level of analysis will further assist in the determination of vulnerability and risk by indicating which area(s) contain the greatest number of at-risk essential facilities and/or the highest potential estimated losses, as well as those areas of the state with the highest state asset loss estimations. Finally, this FRR includes the information contained within the standard FEMA FFR, as well as new data tables and mapping products developed for the Maryland centric FRR project culminating in a robust analysis for improved decision-making and information sharing at both the State and local level.

Guidance on using this report

These Risk MAP products are intended to be used to assess the impacts of flooding in Worcester County, Maryland. The analysis was performed using FEMA's Hazus software (Version 3.1) and incorporates User Defined Facilities (UDFs) to improve the loss estimates for the 1% annual chance flood event. The UDFs were developed using local parcel, assessor, and building footprint data. The analysis also incorporates the impacts on critical facilities and expected debris and sheltering needs for the 1% annual chance flood event.

Sections 1 and **2** of this FRR provide an introduction and overview of the data, methodology, and potential uses for this flood risk assessment.

Section 3 then provides the results of this analysis, with calculations of total flood damages by land use and a count of buildings impacted by flooding within each community and in the county as a whole. In addition, **Section 3** provides estimates of how much debris is generated from flooding and how flooding may impact critical facilities.

Commonly, users of this report are encouraged to begin with Section 1 to familiarize themselves with the data and methodology for this flood risk assessment. Experienced users with a strong background in local hazard mitigation planning and emergency preparedness may wish skip to **Section 3** of this FRR.

The tabular and spatial data presented in this FRR are stored in an accompanying Flood Risk Database (FRD), which can be accessed using standard Geographic Information Systems (GIS) software. The FRD contains information about the depth of flooding and water surface elevations, flood loss estimations for individual buildings, impacts of flooding on critical facilities, and flood debris and loss estimations for census blocks within the county. Collectively, these products can be used to improve emergency and hazard mitigation planning in the county.

Please note that these Risk MAP Products were developed for the State of Maryland and funded by FEMA through a grant to the Maryland Emergency Management Agency (MEMA). Additional organizations within the Maryland Resiliency Partnership –http://www.resiliencypartnership.com – have been involved in the development of data and other products related to this report, which contains additional information and tables that are not typically part of standard FEMA Risk MAP Products. To see a full catalog of Risk MAP Products available for a specific county or community, please visit FEMA's Map Service Center Website (https://msc.fema.gov).

Table of Contents

Table of Contents

Preface.....iii

Guidance on Using This Report.....iv

Table of Contents.....v

1 Introduction.....1

a. About Flood Risk.....1

i. Calculating Flood Risk.....1

ii. Flood Risk Products.....2

b. Uses of this Report.....3

c. Sources of Data for Flood Risk Assessments.....4

d. Related Resources.....6

2 Flood Risk Analysis.....11

a. Overview.....11

b. Analysis of Risk.....11

i. Flood Depth and Analysis Grids.....12

ii. Flood Risk Assessments.....13

iii. Areas of Mitigation Interest.....15

3 Flood Risk Analysis Results.....27

a. Worcester County, Maryland Flood Risk Project Area Summary.....28

i. Overview.....28

ii. Flood Risk Results.....28

iii. Flood Risk Maps.....39

b. Communities.....40

i. Worcester County (Unincorporated Area) (CID 240001).....40

ii. Town of Berlin Summary (CID 240002).....44

iii. Town of Ocean City (CID 240003).....47

iv. City of Pocomoke (CID 240005)....50
v. Town of Snow Hill (CID 240006)....54
4 Actions To Reduce Flood Risk....57
a. Types of Mitigation Actions....57
i. Local Plans and Regulations....57
ii. Structure and Infrastructure Projects....58
iii. Natural Systems Protection Activities....59
iv. Education and Awareness Activities....59
b. Identifying Specific Actions for Your Community....61
c. Mitigation Programs and Assistance....62
i. FEMA Mitigation Programs and Assistance....62
ii. Additional Mitigation Programs and Assistance....63
5 Acronyms And Definitions....64
a. Acronyms....64
b. Definitions....66
6 Additional Resources....70

Appendix A (Map Collection) – Published as Separate, Accompanying Document

List of Tables

Table 1: Worcester County Essential Facilities 16

Table 2: USACE National Inventory of Dams – Worcester County, MD 17

Table 3: Flood Risk Assessment – Community Overview 28

Table 4: Worcester County, Maryland – Estimated Losses by Community Name for 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 5: Worcester County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 29

Table 6: Worcester County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine & Coastal Areas) 30

Table 7: Worcester County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas) 32

Table 8: Worcester County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas) 32

Table 9: Worcester County, Maryland – State Assets Estimated Loss Summary for the 1%-Annual-Chance Flood (State Assets in Riverine and Coastal Areas) 33

Table 10: Worcester County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas) 34

Table 11: Worcester County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine & Coastal Areas) 36

Table 12: Worcester County, Maryland – Areas of Mitigation Interest 36

Table 13: Worcester County, Maryland – High-Risk Areas 38

Table 14: Worcester County (Unincorporated Area) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 41

Table 15a: Worcester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 42

Table 15b: Worcester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 42

Table 16: Town of Berlin – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 45

Table 17: Town of Berlin – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 45

Table 18: Town of Ocean City – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 48

Table 19: Town of Ocean City – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 48

Table 20: City of Pocomoke – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas) 51

Table 21a: City of Pocomoke – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 52

Table 21b: City of Pocomoke – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas) 52

Table 22: Town of Snow Hill – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 55

Table 23: Town of Snow Hill – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas) 55

Table 24: Mitigation Actions for Areas of Mitigation Interest 59

Table 25: FEMA Hazard Mitigation Assistance Programs 62

1. Introduction

a. About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

i. Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

Figure 1.1

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

Photo: Flooding in North Ocean City in June 2018.
Source: The Chicago Tribune

Figure 1.2

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

ii. Flood Risk Products

Figure 1.3

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Photo: An Ocean Pines home's yard becomes a pond after torrential rains.

Source: Milt Savage photo; Delmarva now.

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA and the State of Maryland understand that flood risk is dynamic—that flooding does not stop at a line on a map—and that higher-level storm events and the impacts of Climate Change can result in flooding that exceeds the regulatory 1-percent-annual-chance floodplain. Nevertheless, the regulatory 1-percent-annual-chance flood is the common denominator for all studies in Maryland (whether coastal or riverine, or between studies using detailed or approximate methodologies) and is therefore used as the basis for the flood loss analysis in this report. Users are encouraged to utilize the related resources listed in this report, as well as any additional datasets that become available following the publication of these flood risk products:

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Maps (FRMs)**: The FRMs presented in Appendix A of this FRR show a variety of flood risk information in the project area. More background information about the data shown on the FRMs may be found in Section 2 and 3 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

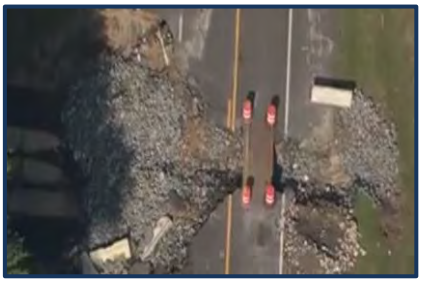
These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

b. Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Figure 1.4



Vulnerability of infrastructure is another important consideration.

Photo: Aerial of Route outside Snow Hill. Road washed out due to flooding in October 2016.

Source: Worcester County Twitter; WBOC

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Disaster Mitigation Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.

- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Data on Shelter and Debris Generation resulting from flood hazards modeled in this study on Pages 32 to 34.

Shelter needs may be added to the Mass Care and Sheltering Emergency Support Functions or annex of your local EOP.

In addition, debris generation results may be included within your debris management plan or annex of your local EOP.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Maps, and Flood Risk Report are "non-regulatory" Flood Risk products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

c. Sources of Data for Flood Risk Assessments

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk

- Information about where the risk is most severe

For this Flood Risk Project, the following sources of information were leveraged:

- New/revised engineering analyses (i.e. hydrologic and hydraulic modeling), floodplain boundaries, and flood depths based on a countywide regulatory FIRM update, (effective date July 16, 2015), provided by FEMA Region III and Maryland Department of the Environment. The 2015 countywide update included all coastal and riverine flooding locations.

  In conjunction with that regulatory update, non-regulatory coastal flood risk products (including a Hazus (Version 2.2) Analysis with User-Defined Facilities) were developed and published to the FEMA Map Service Center on December 30, 2015. Those non-regulatory coastal datasets have been leveraged as part of this countywide assessment. Subsequent to that coastal non-regulatory product development, three (3) Letters of Map Revision (case numbers 16-03-2683P, 17-03-0551P, and 18-03-1304P) were issued in 2017 and 2018 to revise coastal flood hazards in Ocean City based on refined topographic data and/or hydraulic analyses. Those Letters of Map Revision are not reflected in the previously completed coastal flood loss estimates that were leveraged for this project.

Figure 1.5

FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

- MDPropertyView – parcel-specific information containing assessed values, land use/occupancy categories, number of stories, etc. (as of March 2015), acquired through the Maryland Deparment of Planning – http://planning.maryland.gov/OurProducts/. Note that first floor elevations are *not* specified within this dataset, but are required values in the Hazus-MH data model. To account for unspecified first floor elevations, different alternative scenarios were tested, such as assigning a conservative estimate of 1' above grade to all residential properties (but which appeared to overestimate flood loss since many newer homes are partly elevated in accordance with contemporary building codes and local floodplain management ordiances). Instead, based on trends in residential housing across different decades (such as ranch-style homes constructed in the 1950s and 1960s), with support from observations using street-

view imagery, it was determined that 'Year Built' would be used as a proxy to assign first floor elevations for residential structures (1' for Pre-FIRM (constructed prior to the community's initial FIRM) and 4' for Post-FIRM (constructured after the community's initial FIRM)). Commercial and other non-residential structures were assigned 1' first floor elevations, regardless of year built.

Building footprints, representing real-world locations for addressable structures, provided by Worcester County GIS Office – http://www.co.worcester.md.us/departments/drp/gis. *(Limited Distribution; data available by purchase/ request).*

- Essential facilities as defined and identified within the State of Maryland Hazard Mitigation Plan. The State Plan identifed five (5) essential facility types, which include: Emergency Operation Centers (EOC), fire/EMS stations, hospital and medical clinics, police stations, and schools (K-12, colleges). The State of Maryland maintains an essential facility database.
- Hazus-MH Versions 2.2 and 3.1 – Hazus is a nationally applicable standardized softwore suite that contains models for estimating potential losses from floods and other natural disasters. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters. *Subsection ii: Flood Risk Assessments*, page 10 of this report, contains additional details about Hazus. Users can also find more information and download link at https://www.fema.gov/hazus.

d. Related Resources

For a more comprehensive picture of flood risk, FEMA and the State of Maryland recommend that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).
- **Flood or Multi-Hazard Mitigation Plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that

identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.

The *2016 State of Maryland Hazard Mitigation Plan* was reviewed and data pertaining to State Assets and Essential Facilities was incorporated into this report.

The *2019 Worcester County Multi-Jurisdictional Hazard Mitigation & Resilience Plan* was reviewed and information specific to high risk areas and areas of mitigation interest has been included in this report.

Please note that the information in this FRR may be reviewed for inclusion during the update of the Worcester County Hazard Mitigation Plan and flood mitigation assistance plan.

- **Maryland Flood Maps** (http://mdfloodmaps.net). A website provided by the State of Maryland providing information about flooding and maps showing floodplains in the state. The website allows users to download DFIRM data and flood models. The Maryland's Flood Map resources allows users to select their location on the map, the Flood Risk Application aids in determining their current flood risk based on Digital FIRMs (DFIRMs). The application also prompts users to launch a Flood Risk Guide, which helps users determine whether flood insurance is required or recommended for their property. Additionally, information on how to obtain and the benefits of having flood insurance is highlighted.
- **Maryland Resiliency Partnership** (http://www.resiliencypartnership.com). A collaboration of public agencies in Maryland working to support floodplain management, hazard mitigation, and climate and coastal resiliency. The partnership provides outreach, education, technical assistance, and funding to reduce the threat of natural hazards in the state. The website provides a list of federal and state grants available for hazard mitigation, upcoming events in Maryland that involve natural hazards, and a list of online sources to help planners and developers with hazard mitigation.
- **MDOT SHA Climate Change Vulnerability** (https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=86b5933d2d3e45ee8b9d8a5f03a7030c). MDOT SHA Climate Change Vulnerability is an ArcGIS Online (AGOL) web application which highlights sea level change and the potential impacts on Maryland's roadways, including roadway assets & infrastructure. The purpose of this application is to support MDOT SHA Senior Management, Leadership & Planning as they make efforts to avert and mitigate potential impacts of sea level rise that result from global climate change. With the Mid-Atlantic Region predicted to potentially have some of the worst impacts of

sea level change, MDOT SHA has prioritized and is now mitigating the potential impacts of baseline sea level change on roadway assets and infrastructure.

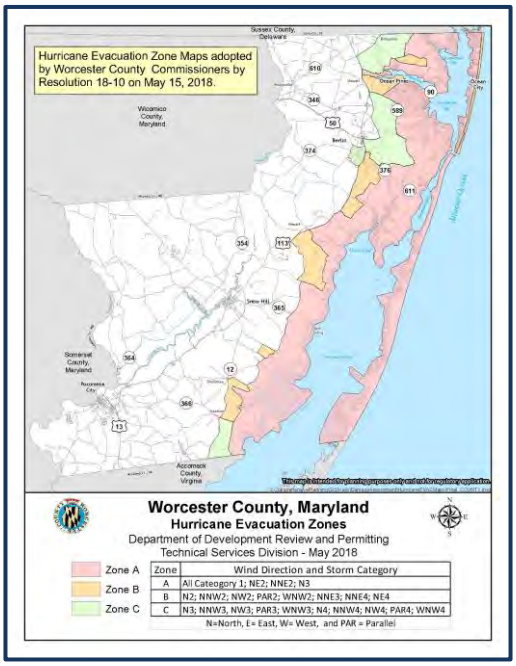
- **CoastSmart** (https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx). CoastSmart Communities is a program dedicated to assisting Maryland's coastal communities address short- and long-term coastal hazards, such as coastal flooding, storm surge, and sea level rise. CoastSmart connects local government staff and partners to essential information, tools, people, and trainings. The impacts of both short and long term hazards will be most intensely experienced within local communities; therefore require local action. CoastSmart provides resources to local government and communities to plan, prepare and increase resilience both short and long term.

> TIP: If evacuation routes are in high-hazard flood risk areas, know and follow the directions from local officials for community evacuation or seek high ground for localized flooding. If you do not evacuate before the flooding occurs or you are trapped by flash flooding, do not enter flooded areas or moving water either on foot or in a vehicle, including areas that appear to have only inches of water.

- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.

  Worcester County participates in the "Know Your Zone" evacuation initiative as part of Maryland's Hurricane Evacuation Study. In the event that Worcester County Emergency Services (WCES) issue evacuation orders, zones to be evacuated would be announced by both traditional media outlets, the County website, Facebook, and Twitter. Zones are designated A through C and provide residents with clarity on whether they should evacuate in an emergency or shelter at home, based on their physical street address and the nature of the emergency event. The three evacuation zones are from greatest to least risk of threat from wind speed, storm intensity, and storm surge. Zone A, in

Figure 1.5



Worcester County's Hurricane Evacuation Zone Map.

Source: *http://www.co.worcester.md.us/departments/emergency/evacuation-zones*

pink, identifies the areas most at risk, Zone B, orange, are areas with a moderate risk, and Zone C, green, are areas least at risk. Areas further inland that are not color coded are not expected to evacuate in any storm scenario.

- **Climate Change and Sea Level Rise Data and Maps.** Data and maps showing potential impacts from sea level rise provide a valuable resource for planning and risk communication purposes. By identifying areas that are most susceptible to rising sea levels, short- and long-term strategies can be developed to support coastal communities in their mitigation efforts. Various organizations, including NOAA and State and Local agencies, provide viewers, maps, and/or reports that help highlight low-lying coastal areas that would be inundated based on sea level rise scenarios.

  In order to plan responses to sea level rise impacts on the local communities and ecosystems within Worcester County, the *Sea Level Rise Response Strategy Worcester County, Maryland September 2008* was developed. The report presented several scenarios to assess the sea level rise impacts on Worcester County over the next century. The report also provided a prioritization of response options that considers which options would be useful despite uncertainties in the rate and range of sea level rise.

- **Emergency Action Plans.** Emergency Action Plans (EAP) are formal documents that identify potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life. The plans specify actions the dam owner should take to moderate or alleviate the identified problems at the dam. These plans usually contain inundation maps downstream of the dam to show emergency management authorities critical areas for action in case of an emergency. This report consulted available EAPs for those dams that were studied.

  Three (3) dams are located within Worcester County, none of which have Emergency Action Plans. Table 2, *USACE National Inventory of Dams – Worcester County, MD,* on page 17 provides additional details on each dam.

- **Hazus Flood Loss Estimation Reports** (https://msc.fema.gov). Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other

existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

The *Flood Risk Report Worcester County, Maryland Coastal Study*, developed by FEMA using Hazus Version 2.2 and released on December 30, 2015 provides coastal flood risk information such as estimated coastal flood losses for the 1-percent-annual-chance flood event which have been leveraged for this countywide flood risk assessment. The Coastal Flood Risk Report (FRR), Flood Risk Map (FRM) and Flood Risk Databases (FRD) can be found at: https://msc.fema.gov/portal/advanceSearch.

- **FEMA Map Service Center (MSC)** (https://msc.fema.gov). The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

2. Flood Risk Analysis

a. Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

Figure 2.1

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Top Photo: Water rushes off the road at the intersection of Rt.354 and Porters Crossing in Worcester County.
Source: Worcester County Twitter
Bottom Photo: A part of Queponco Rd outside of Snow Hill road was been closed due to impassable road conditions.
Source: Megan Raymond

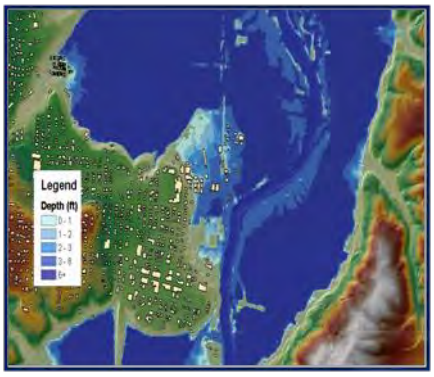
State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

b. Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area, including the following elements:

- Flood Depth Grids for 1 percent-annual chance Special Flood Hazard Areas (SFHAs)
- Flood Risk Assessments
- Areas of Mitigation Interest (where applicable)

Figure 2.2



Grid data can make flood mapping more informative, such as this flood depth grid showing relative depths of water in a scenario flood event.

i. Flood Depth and Analysis Grids

Grids are datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Flood Depth Grids:** Riverine Flood Depth Grids were created for all mapped 1-percent-annual-chance floodplains in the county, whereby flood depth is a function of the difference between the calculated water sufrace elevation (including overland wave propagation for coastal areas) and the ground.

  Note that separate flood depth grids are created for riverine and coastal flood hazards, as engineering analyses and floodplain mapping for the regulatory FIRM updates were separately performed for each study type.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

Depth grids form the basis for refined flood risk assessments and are used to calculate potential flood losses for display on the FRMs and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

ii. Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters. Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

Figure 2.3

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region
- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Scenario-Based Flood Loss Estimates:

Scenario-based flood losses have been calculated using Hazus (Version 3.1) for the 1-percent-annual-chance flood event. Flood losses were estimated in this 'refined' study using User Defined Facilities (UDFs), which were created using local parcel, assessor,

and building footprint data. Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels, and include the following:

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content losses.
- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.
- **Percent Loss:** These percentages express losses for assets divided by their total value (building and contents).
- **Essential Facility Losses:** Essential facilities are defined in Hazus as facilities which provide services to the community and should be functional after a flood, including schools, police stations, fire and EMS stations, medical facilities, and emergency operation centers. These facilities would otherwise be

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRMs can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

considered critical facilities for mitigation planning purposes. Estimated damages (in terms of loss of function) for essential facilities are determined on a site-specific basis according to latitude and longitude. For this report, Hazus calculates the types and numbers of essential facilities impacted.

iii. Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

This report and the FRM may include information that focuses on identifying Areas of Mitigation Interest that may be contributing (positively or negatively) to flooding and flood losses in the Flood Risk Project. AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest that may be identified in this Flood Risk Report, shown on the Flood Risk Map, and stored in the Flood Risk Database:

- **At-Risk Essential Facilities**

  Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

  There are 56 essential facilities located within Worcester County with a total esitmated building value of $264,796,700.

Table 1: Worcester County Essential Facilities

Facility Type	Number of Structures	Estimated Building Value
Emergency Operations Center (EOC)	1	$10,365,700
Fire/Rescue Stations	19	$12,764,800
Hospital & Medical Clinics	6	$35,401,700
Police Stations	7	$32,375,700
Schools (K-12 & Colleges)	23	$173,888,800
Total	**56**	**$264,796,700**

Source: Updated 2016 State of Maryland Critical Facility Database

- **Reasons at-risk essential facilities are considered AoMIs:**
  - Costly and specialized equipment may be damaged and need to be replaced.
  - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
  - Critical records and information stored at these facilities may be lost.

Figure 2.4

An essential facility, Ocean City Volunteer Fire Company, Station 2, was determined to be at-risk to the 1-percent-annual-chance flood event.

Photo Source: https://www.ocvfc.com/page/station-two

- **High-Risk Areas**

High-Risk Areas are places in the county that have a large amount of flood damage in a relatively small, concentrated area. High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

A total of 7 high risk areas were identified within Worcester County. These high-risk areas are discussed in Section 3 of this report. Maps depicting the location of high-risk areas are within Appendix A.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Big Millpond Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). "Dry dams," which are designed to contain water only during floods and do

not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Figure 2.5

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.

Photo: Big Millpond Dam
Source: Delmarva now

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

According to the USACE National Inventory of Dams, three (3) dams are located in Worcester County. Hazard classifications related to dams throughout Maryland are available through MDE's Dam Safety Division.

Table 2: USACE National Inventory of Dams – Worcester County, MD

Name	Owner Type	Purpose	River	Emergency Action Plan (EAP)
Big Millpond Dam	Local Government	Recreation	Little Mill Run	No
Pocomoke City Sewage Lagoon No. 1 (South Pond)	Local Government	-	Union Branch-OS	No
Pocomoke City Sewage Lagoon No. 2 (South Pond)	Local Government	-	Union Branch-OS	No

Source: USACE National Inventory of Dams - http://nid.usace.army.mil/cm_apex/f?p=838:7:0::NO

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.

Figure 2.6

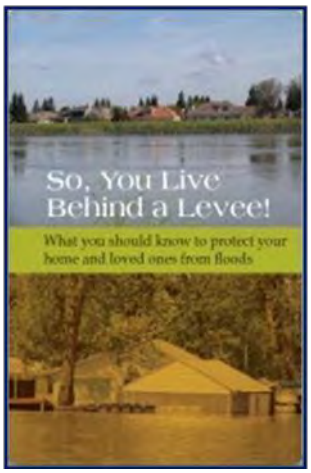
This dam failure caused flooding that damaged several homes and vehicles.

- Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.
- A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
- For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.
- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Figure 2.7



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

There is one (1) non-accedited levee located within Worcester County. Acccording to US Army Corps of Engineers, National Levee Database, the Atlantic Coast of Maryland Shoreline Protection project consists of a steel sheetpile bulkhead and placement of approximately 3.6 million cubic yards (CY) of sand along the Ocean City coastline. Specifically, this includes widening and raising the beach for 8.3 miles from 3rd Street to the Maryland-Delaware State Line with an additional 0.3 mile transition into Delaware, constructing a steel sheetpile bulkhead along the boardwalk for 1.5 miles from 4th Street to 27th Street, and constructing a vegetated sand dune for 6.9 miles from 27th Street to just beyond the Maryland-Delaware State Line.

Figure 2.8

Photo: Atlantic Coast of Maryland Shoreline Protection project
Source: National Levee Database-Interactive Map

- **Reasons levees are considered AoMIs:**
  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

  Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

  - **Reasons coastal structures are considered AoMIs:**
    - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
    - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.
    - As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**
    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.

- These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
- If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
- Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Figure 2.9

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

As of October 31, 2018, a total of sixty (60) FEMA Designated Repetitive Loss Properties were within Worcester County. Two (2) repetitive loss properties are located witin the Town of Ocean City, while the remaining 58 are located in the unincorporated areas of the County. Of the 58 repetitive loss properties, 2 properties are classified as severe repetitive loss properties.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
  - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with

inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.

- Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Figure 2.10

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

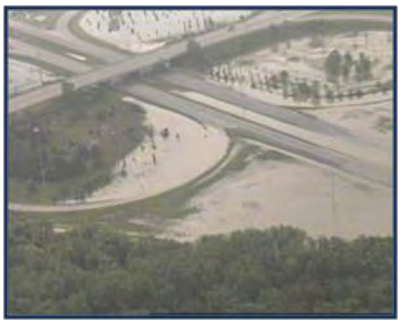
- **Reasons Areas of Significant Land Use Change are considered AoMIs:**

  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
  - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**

  Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

  Figure 2.11

  When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

  - **Reasons overtopped roads are considered AoMIs:**
    - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
    - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

  Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

  The *2019 Worcester County Multi-Jurisdictional Hazard Mitigation & Resilience Plan* provided a listing of repetitive flood locations identified by the Department of Public Works - County Roads Division. Also, a Fire District Survey Form was provided to the Worcester County Fire Districts to comment on roads impacting their communities. Four (4) Volunteer Fire Departments (Newark VFD, Snow Hill VFD, Stockton VFD, and Bishopville VFD) identified flood prone roads with their district. The listing of repetitive flooding issues is within Chapter 9 Mitigation Strategies on Table 9-1 of the Plan Update. A total of 73 repetitive flood locations were identifed in the unincorporated areas of the County and the Town of Snow Hill.

- **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
  - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
  - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

  Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. A list of mitigation actions can be found in Section 4, Table 25.

  - **Reasons areas of mitigation success are considered AoMIs:**
    - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
    - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
    - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

  Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

  Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

  - **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
    - Riverine flood damage assessments generally consider inundation alone
    - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations

- Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
- Landslides and mudslides are a result of erosion
- Approximately one-third of the nation's streams experience severe erosion problems
- Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
- Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

3. Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Depth Grids.** The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data.
- **Flood Risk Assessments.** A loss estimation of potential flood damages based on the 1-percent-annual-chance flood event.
- **Areas of Mitigation Interest.** A description of areas that may benefit from mitigation or additional risk analysis.
- **Flood Risk Maps (FRMs).** FRMs display base data (reflecting community boundaries, major roads, and stream lines) and potential flood risk assessment loss estimates; The FRMs include a countywide map of estimated flood losses by census block and summary tables for the entire project area, and a series of maps for High-Risk Areas (places in the county that have a large amount of flood damage in a concentrated area). High-Risk Areas are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas. This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

FRMs provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

a. Worcester County, Maryland Flood Risk Project Area Summary

i. Overview

This Flood Risk Assessment for Worcester County, Maryland includes the following communities:

Table 3: Flood Risk Assessment – Community Overview

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Worcester County Unincorporated Areas	240083	33,580	674.88	Y	N/A	Y
Town of Berlin	240141	4,485	3.42	Y	N/A	Y
Town of Ocean City	245207	7,102	9.58	Y	06	Y
City of Pocomoke City	240084	4,184	3.98	Y	N/A	Y
Town of Snow Hill	240086	2,103	3.14	Y	N/A	Y

Countywide results are provided in this section of the FRR, with subsequent summaries for each individual community.

ii. Flood Risk Results

User Defined Facilities Loss Estimations

Worcester County, Maryland's Flood Risk Project incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Note that countywide summary results represent totals for both coastal and riverine flooding. Separate information for coastal and riverine flood losses are presented, where applicable, for individual communities under Section 3, Subsection b.

Refined flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1 (riverine) and 2.2 (coastal), and the results are summarized by community name in Table 4, and by land use occupancy type in Table 5. Table 6 shows the severity of damage (within defined ranges) to buildings within the county from the 1-percent-annual-chance flood.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 4: Worcester County, Maryland – Estimated Losses by Community Name for 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Community Name	2010 Population	# of Impacted Buildings	1% Flood Loss Estimate[1]	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Worcester County (Unincorporated Areas)	33,580	3,774	$19,700,000	$587	42%
Town of Berlin	4,485	9	$130,000	$29	< 1%
Town of Ocean City	7,102	3,481	$19,500,000	$2,746	42%
City of Pocomoke	4,184	67	$2,200,000	$526	5%
Town of Snow Hill	2,103	76	$4,800,000	$2,282	10%
Total	**51,454**	**7,407**	**$46,500,000**	**$904**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 5: Worcester County, Maryland – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% Flood Percent Loss[2]
Residential Building & Contents	7,115	$1,368,400,000	81%	$30,600,000	2.0%
Commercial Building & Contents	220	$119,000,000	7%	$8,100,000	7.0%
Other Building & Contents	72	$199,900,000	12%	$6,500,000	3.0%
Total Building & Contents[3]	7,407	$1,687,300,000	100%	$45,200,000	3.0%
Business Disruption[4]	N/A	N/A	N/A	$1,300,000	N/A
TOTAL[5]	**7,407**	**$1,687,300,000**	**100%**	**$46,500,000**	**3.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 6: Worcester County, Maryland – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine & Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	4,776	64%	$1,340,100,000	$300,000	$200,000	$0	< 1%
1 - 10%	1,180	16%	$171,200,000	$100,000	$9,700,000	$10,000	21%
10 - 20%	901	12%	$107,300,000	$100,000	$15,100,000	$20,000	33%
20 - 30%	378	5%	$45,800,000	$100,000	$11,100,000	$30,000	25%
30 - 40%	73	1%	$12,400,000	$200,000	$4,200,000	$60,000	9%
40 - 50%	56	1%	$8,600,000	$200,000	$3,700,000	$70,000	8%
50% or More	43	1%	$1,800,000	$40,000	$1,200,000	$30,000	3%
TOTAL	**7,407**	**100%**	**$1,687,200,000**	**$200,000**	**$45,200,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).

[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Worcester County, Maryland Study

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, with an effective date July 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

Essential Facilities Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for essential facilities located within Worcester County. Essential facilities are those facilities that provide services to the community and should be functional after a flood. Essential facilities include emergency operations centers (EOC), hospitals, police stations, fire stations and schools. The damage for essential facilities is determined on a site-specific basis (i.e., the depth of flooding at the location of the facility).

Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 7. The list of essential facilities at-risk is provided on page 36.

Table 7: Worcester County, Maryland – Essential Facilities Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas)

Type	Estimated Building Value	Total Essential Facilities	1% (100-yr) Dollar Losses (Building Value)	Total Essential Facilities Impacted by 1% Flood
EOC	$10,365,700	1	$0	0
Fire Station	$12,764,800	19	$0	4
Hospital	$35,401,700	6	$34,432	1
Police Station	$32,375,700	7	$2,289	2
School	$173,888,800	23	$0	0
TOTAL	**$264,796,700**	**56**	**$36,721**	**7**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Table 8: Worcester County, Maryland – Essential Facilities Estimated Loss Summary for the 1%-Annual-Chance Flood (in Riverine and Coastal Areas)

Type	Total 1% Dollar Losses (Building & Content)	Total Building Loss	Building Loss Percentage of Total	Total Content Loss	Content Loss Percentage of Total
Fire Station*	$0	$0	0%	$0	0%
Hospital	$126,740	$34,432	27%	$92,308	73%
Police Station	$6,213	$2,289	37%	$3,924	63%
TOTAL	**$132,953**	**$36,721**	**N/A**	**$96,232**	**N/A**

Source: Updated 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

State Asset Loss Estimations

The Hazus flood model utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for state assets located within Worcester County. State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types:

- Administration;
- Corrections;
- Education;
- Fire/Police;
- Health Related;
- Judicial/Legal;
- Military;
- Transportation; and
- Utility/Infrastructure.

State assets include state-owned and/or operated facilities. Facilities were categorized based upon the State Agency that owns and/or operates the facility using the following facility types: Administration; Corrections; Department of Natural Resources; Education; Environmental; Fire/Police; Health Related; Historic; Judicial/Legal; Military; Social Services; Transportation; and Utility/Infrastructure.

According to the 2016 State of Maryland State Asset Database, Worcester County contains 271 state assets. Potential flood losses for the 1-percent-annual-chance flood event were calculated using Hazus-MH, version 3.1, and the results are presented in Table 9.

Table 9: Worcester County, Maryland – State Assets Estimated Loss Summary for the 1%-Annual-Chance Flood (State Assets in Riverine and Coastal Areas)

Type	Total 1% (100-yr) Dollar Losses (Building & Content)	Total Building Loss	Building Loss Percentage of Total	Total Content Loss	Content Loss Percentage of Total
Administrative Facility	$3,617,250	$482,300	13%	$3,134,950	87%
Educational Facility	$90,741	$13,559	15%	$77,182	85%
Judicial/Legal Facility	$1,969,877	$264,186	13%	$1,705,691	87%
Social Services	$242,717	$241,150	99%	$1,567	1%
Transportation Facility	$18,560	$2,560	14%	$16,000	86%
TOTAL	**$5,939,145**	**$1,003,755**	**N/A**	**$4,935,390**	**N/A**

Source: 2016 State of Maryland Critical Facility Database & Hazus analysis results stored as the State Assets Flood Risk Assessment Dataset in the Flood Risk Database.

Disclaimer: Hazus does compute loss estimates for structures exposed to the minimum flood depths of 0.1 feet. However, structural and content loss are dependent upon foundation type and/or the First Flood Elevations (FFE). Therefore, structures exposed to the minimum flood depths of 0.1 feet may have content loss only or both structural or content loss or neither.

Debris Generation

The HAZUS flood model debris estimation methodology evaluates building-related debris by major component, yet recognizes a fundamental difference in the type of debris generated, most flood-related debris are contents and finishes. Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The debris module will determine the expected amounts of debris generated within each census block. Output from this module is the debris weight (in tons).

The human, financial, environmental, and political costs associated with insufficient debris management planning can be devastating. Landfill capacities could become overwhelmed, roads could be damaged by debris hauling, adequate controls for debris disposed may not be in place, and general public health and safety hazard may become at-risk due to debris generation. Therefore, the debris generation results may be included within your debris management plan to ensure safe management and cleanup after an event.

- **Debris Generation from Flooding: The text below estimates the amount of debris generated in the county from the 1-percent-annual-chance flood event.**
    - The model estimates that a total of 9,901 tons of debris will be generated. Of the total amount, Finishes comprises 81% of the total, Structure comprises 6% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 396 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Table 10: Worcester County, Maryland – Debris Generation Summary for the 1%-Annual-Chance Flood (Riverine & Coastal Areas)

Debris Types	Total (tons)	Percentage of Total	Total Truckloads (@25 tons/truck)
Finishes	7,979	81%	319
Structure	601	6%	24
Foundation	1,320	13%	53
TOTAL	**9,901**	**100%**	**396**

Source: Hazus 3.1: Flood Modual – Worcester County Study Area/ General Building Stock

Projected Shelter Needs

Sheltering is defined as providing life-sustaining services in congregate facilities that provide a safe, sanitary, and secure environment for individuals and households displaced by disasters. The projected shelter estimates should be reviewed, and possibility used for planning purposes within the Emergency Support Function: Mass Sheltering.

The displaced population is based on the inundation area. Individuals and households will be displaced from their homes when the home has suffered little or no damage either because they were evacuated (i.e., a warning was issued) or there is no physical access to the property because of flooded roadways. Those displaced persons using shelters will most likely be individuals with lower incomes and those who do not have family and friends within the immediate area. Consequently, modification factors for flood are based primarily on income. Age plays a secondary role in that there are some individuals who will seek shelter even though they have the financial means of finding their own shelter. These will usually be younger, less established families and elderly families.

- **Projected Shelter Needs from Flooding: The text below estimates the projected shelter needs for the county from the 1-percent-annual-chance flood event.**
    - Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,363 households will be displaced due to the flood. Displacement includes households evacuated from within, or very near, to the inundated area. Of these, 4,894 people (out of a total population of 51,454) will seek temporary shelter in public shelters.

Table 11: Worcester County, Maryland – Projected Shelter Needs Summary for 1%-Annual-Chance Flood Event (Riverine & Coastal Areas)

Projected Shelter Needs	Total Number of Households Affected	Displaced Population	Population in need of Temporary Shelter
Sheltering	2,363	7,088	4,894

Source: Hazus 3.1: Flood Modual – Worcester County Study Area/ General Building Stock

Areas of Mitigation Interest

Section 2, Subsection b-iii Areas of Mitigation Interest of the FRR, provides more information regarding areas of mitigation interest, how they are defined for this analysis, and potential mitigation actions that could be considered for each type. The table below summarizes the number of areas of mitigation interest by type.

Table 12: Worcester County, Maryland – Areas of Mitigation Interest

Type of Mitigation Interest	Number of Occurrences	Data Source
At-Risk Essential Facilities	7	Depth grids, Emergency Management Dept.
At-Risk State Assets	8	Dept grids, MEMA
High-Risk Areas	7	NFHL, Census Blocks, UDFs
Repetitive Flood Issues	73	Emergency Management Dept., Local Public Works – Roads Division, Municipalities
Repetitive Loss Properties	60	FEMA NFIP/MDE Community Assistance Program Manager

Areas of Mitigation Interest are stored in the S_AOMI_Ar feature class of the Flood Risk Database.

- **At-Risk Essential Facilities**

  Results from the 1-percent-annual-chance flood event analysis indicate seven (7) essential facilities are at-risk; 4 fire stations, 1 medical facilities, and 2 police stations. Flood depths for each facility is provided below along with the identified facilities.

  - Ocean City VFC No 3 – 0.5'
  - Ocean City Fire Co Station 2 – 1.0'
  - Ocean City VFC Station 4 – 0.5'
  - Ocean City VFC Headquarters – 0.5'
  - Your Doc's In – 1.3'
  - Snow Hill Police Department – 0.9'
  - Ocean City Beach Patrol – 1.6'

A map depicting Essential Facilities at-risk to the 1-percent-annual-chance flood event is within Appendix A.

- **At-Risk State Assets:**

  Results from the 1-percent-annual-chance flood event analysis indicate eight (8) state assets are at-risk. These facilities include two (2) Administrative facilities that are leased, one (1) Education facility, leased, two (2) Judicial/Legal facilities, one (1) Social Services facility and two (2) Transportation facilities.

  Flood depths for each facility is provided below along with the identified facilities.

  - Administrative Facilities
    - Department of Agriculture, Snow Hill – 3.5'
    - Department of Human Resources, Snow Hill – 3.5'
  - Education Facility
    - Worcester UMD Office, Snow Hill – 4.0'
  - Judicial/Legal Facility
    - District Court, Snow Hill – 3.5'
    - Public Defender, Snow Hill – 1.8'
  - Social Services
    - Department of Juvenile Justice, Snow Hill – 3.5'
  - Transportation Facility
    - Drawbridge Tender House Bridge 23007 – 11.8' (facility is elevated above water surface elevation)
    - Drawbridge Tender House Bridge 23004 – 7.5' (facility is elevated above water surface elevation)

- **High-Risk Areas**

  Places in the county that have a large amount of flood damage in a concentrated area have been defined as High-Risk Areas. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

Maps for each high-risk area are compiled in Appendix A of this Flood Risk Report.

Table 13: Worcester County, Maryland – High-Risk Areas

High-Risk Area	Location	2010 Pop.	# of Census Blocks	# of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Ocean City	7,205	750	3,572	$19,599,801	42%
Area 2	Ocean Pines	7,225	139	1,927	$4,085,167	9%
Area 3	Cape Isle of Wight	935	23	417	$2,320,678	5%
Area 4	Bayside	330	37	184	$1,172,852	3%
Area 5	Snow Hill	379	33	100	$5,404,419	12%
Area 6	Captain's Hill	746	20	148	$1,077,991	2%
Area 7	West Ocean City	275	30	127	$1,925,840	4%
Area 8	Pokomoke City	582	32	89	$2,259,761	5%
Total for High-Risk Areas		**17,677**	**1,064**	**6,564**	**$37,846,509**	**81%**

- **Repetitive Flood Issues**

  Reviewing the repetitive flood locations and issues identified on Table 9-1 in the *2019 Worcester County Multi-Jurisdictional Hazard Mitigation & Resilience Plan*, several repetitive flood locations were found to be within high risk areas listed in Table 13 of this report.

- **Repetitive Loss Properties (RLP)**

  Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. One indicator is claims through the NFIP. A total of 58 FEMA Designated Repetitive Loss Properties have been identified in the unincorporated portions of Worcester County. Two areas containing a high concentration of RPLs have been identified, Snug Harbor and Ocean Pines. Snug Harbor contains 19 RLP and 2 Severe Repetitive Loss Properties with a total of 1,217,183.60 in loss, while Ocean Pines has 14 RLPs with a total of 254,660.85 in loss. Both Ocean Pines and Snug Harbor are high risk areas for Worcester County.

iii. Flood Risk Maps

The Flood Risk Maps for Worcester County, Maryland are included in Appendix A of this Flood Risk Report. In addition to the countywide map which presents the full Flood Risk Project area and summary tables, additional maps for High-Risk Areas are provided. For each High-Risk Area, buildings that are within the regulatory 1-percent-annual-chance flood hazard are distinguished by land use (as Residential, Commercial, or Other) and loss estimates for those buildings are presented within defined ranges based on dollar value and, separately, as percentages (where flood loss is divided by the value of the building and its contents).

b. Communities

The following section provide an overview of the community's floodplain management program as of the date of this publication, as well as a summary of the community's flood risk calculations.

i. Worcester County (Unincorporated Areas) Summary (CID 240083)

The following pages include Flood Risk data for the Worcester County (Unincorporated Areas).

Overview

The Worcester County (Unincorporated Areas) is located in southeastern Maryland and consists of 674.88 square miles. It is bordered by Wicomico County to the northwest, Somerset County to the west, the State of Virginia to the South, and the Atlantic Ocean to the east, and the State of Delaware to the north.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Worcester County (Unincorporated Areas)	240083	33,580	674.88	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires January 20, 2020
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 5,312 policies totaling approximately $1,554,183,000
- NFIP-recognized repetitive loss properties = 56
- NFIP-recognized severe repetitive loss properties = 2

Data provided below only includes areas in the Worcester County (Unincorporated Areas) that are located within the Worcester County, Maryland Flood Risk Project, and do not represent countywide totals. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Worcester County (Unincorporated Areas) flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance

flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 14. Additionally, Tables 15a and 15b (for riverine and coastal flooding locations, respectively) show the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 14: Worcester County (Unincorporated Areas) – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	3693	$828,900,000	93%	$14,400,000	2.0%
Riverine	86	$9,900,000	42%	$1,000,000	10.0%
Coastal	3607	$819,000,000	94%	$13,400,000	2.0%
Commercial Building & Contents	52	$25,300,000	3%	$2,000,000	8.0%
Riverine	9	$4,800,000	21%	$700,000	15.0%
Coastal	43	$20,500,000	2%	$1,200,000	6.0%
Other Building & Contents	29	$39,100,000	4%	$2,500,000	6.0%
Riverine	17	$8,700,000	37%	$900,000	10.0%
Coastal	12	$30,400,000	3%	$1,600,000	5.0%
Total Building & Contents[3]	3774	$893,300,000	100%	$18,900,000	2.0%
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	$800,000	N/A
Business Disruption[4] *(Coastal)*					
TOTAL[5]	**3774**	**$893,300,000**	**100%**	**$19,700,000**	**2.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 15a: Worcester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	18	16%	$4,300,000	$200,000	$0	$0	0%
1 - 10%	37	33%	$7,600,000	$200,000	$300,000	$10,000	11%
10 - 20%	28	25%	$6,500,000	$200,000	$1,000,000	$40,000	38%
20 - 30%	12	11%	$3,200,000	$300,000	$800,000	$70,000	30%
30 - 40%	12	11%	$1,300,000	$100,000	$400,000	$30,000	15%
40 - 50%	3	3%	$100,000	$30,000	$50,000	$20,000	2%
50% or More	2	2%	$200,000	$100,000	$100,000	$50,000	4%
TOTAL	**112**	**100%**	**$23,200,000**	**$200,000**	**$2,650,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 15b: Worcester County (Unincorporated Areas) – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2593	71%	$725,500,000	$300,000	$20,000	$0	0%
1 - 10%	423	12%	$79,300,000	$200,000	$4,500,000	$10,000	28%
10 - 20%	384	10%	$44,000,000	$100,000	$6,100,000	$20,000	38%
20 - 30%	213	6%	$16,800,000	$80,000	$4,000,000	$20,000	25%
30 - 40%	23	1%	$3,500,000	$200,000	$1,200,000	$50,000	7%
40 - 50%	19	1%	$700,000	$40,000	$300,000	$20,000	2%
50% or More	7	0%	$200,000	$30,000	$100,000	$10,000	1%
TOTAL	**3662**	**100%**	**$870,000,000**	**$200,000**	**$16,220,000**	**$0**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Worcester County (Unincorporated Area)

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this

feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date on July 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

ii. Town of Berlin Summary (CID 240141)

The following pages include Flood Risk data for the Town of Berlin.

Overview

The Town of Berlin is in northern Worcester County. It consists of 3.42 square miles along US Highway 113. The primary flooding sources in the town are Kitts Branch, Hudson Branch, Bottle Branch, and Tributary No. 3 to Kitts Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Berlin	240141	4,485	3.42	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires January 20, 2020
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) =90 policies totaling approximately $24,946,300
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Berlin that are located within the Worcester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Berlin's flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 16. Additionally, Table 17 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 16: Town of Berlin – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	6	$1,000,000	23%	$0	0.0%
Commercial Building & Contents	3	$3,300,000	77%	$70,000	2.0%
Other Building & Contents	0	$0	0%	$0	0.0%
Total Building & Contents[3]	9	$4,300,000	100%	$70,000	2.0%
Business Disruption[4]	N/A	N/A	N/A	$60,000	N/A
TOTAL[5]	**9**	**$4,300,000**	**100%**	**$130,000**	**3.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 17: Town of Berlin – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	6	67%	$3,500,000	$600,000	$0	$0	0%
1 - 10%	3	33%	$700,000	$200,000	$70,000	$20,000	100%
10 - 20%	0	0%	$0	$0	$0	$0	0%
20 - 30%	0	0%	$0	$0	$0	$0	0%
30 - 40%	0	0%	$0	$0	$0	$0	0%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**9**	**100%**	**$4,200,000**	**$500,000**	**$70,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Berlin

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date on July 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iii. Town of Ocean City Summary (CID 245207)

The following pages include Flood Risk data for the Town of Ocean City.

Overview

The Town of Ocean City is in northeastern Worcester County. It consists of 9.58 square miles along State Highway 528. The primary flooding sources in the town are Isle of Wight Bay, Assawoman Bay, and the Atlantic Ocean.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Ocean City	245207	7,102	9.58	Y	06	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires April 30, 2022
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 26,000 policies totaling approximately $5,089,192,700
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Ocean City that are located within the Worcester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Ocean City's flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 18. Additionally, Table 19 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 18: Town of Ocean City – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	3307	$528,000,000	75%	$15,100,000	3.0%
Commercial Building & Contents	143	$76,400,000	11%	$3,300,000	4.0%
Other Building & Contents	31	$100,700,000	14%	$800,000	0.8%
Total Building & Contents[3]	3481	$705,100,000	100%	$19,200,000	3.0%
Business Disruption[4]	N/A	N/A	N/A	$300,000	N/A
TOTAL[5]	**3481**	**$705,100,000**	**100%**	**$19,500,000**	**3.0%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 19: Town of Ocean City – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2143	62%	$552,600,000	$300,000	$60,000	$0	0%
1 - 10%	677	19%	$78,800,000	$100,000	$4,600,000	$10,000	24%
10 - 20%	440	13%	$50,700,000	$100,000	$7,300,000	$20,000	38%
20 - 30%	129	4%	$13,500,000	$100,000	$3,300,000	$30,000	17%
30 - 40%	27	1%	$4,100,000	$200,000	$1,400,000	$50,000	7%
40 - 50%	31	1%	$3,900,000	$100,000	$1,600,000	$50,000	8%
50% or More	34	1%	$1,400,000	$40,000	$900,000	$30,000	5%
TOTAL	**3481**	**100%**	**$705,000,000**	**$200,000**	**$19,160,000**	**$10,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Ocean City

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date on July 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

iv. City of Pocomoke City Summary (CID 240084)

The following pages include Flood Risk data for the City of Pocomoke City.

Overview

The City of Pocomoke City is in southwestern Worcester County. It consists of 3.98 square miles along US Highway 13. The primary flooding sources in the town are Pocomoke River, Pilchard Creek, Town Branch, Union Branch, Wagram Creek, and Beaverdam Branch.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
City of Pocomoke City	240084	4,184	3.98	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires January 20, 2020
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 0 policies totaling approximately $0
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the City of Pocomoke that are located within the Worcester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The City of Pocomoke City flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 20. Additionally, Table 21 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 20: City of Pocomoke City – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine and Coastal Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	54	$5,500,000	9%	$500,000	9.0%
Riverine	*13*	*$2,000,000*	*43%*	*$200,000*	*10.0%*
Coastal	*41*	*$3,500,000*	*6%*	*$200,000*	*6.0%*
Commercial Building & Contents	7	$4,800,000	8%	$1,000,000	21.0%
Riverine	*1*	*$2,700,000*	*57%*	*$900,000*	*33.0%*
Coastal	*6*	*$2,100,000*	*4%*	*$100,000*	*5.0%*
Other Building & Contents	6	$52,800,000	84%	$700,000	1.0%
Riverine	*0*	*$0*	*0%*	*$0*	*0.0%*
Coastal	*6*	*$52,800,000*	*90%*	*$700,000*	*1.0%*
Total Building & Contents[3]	67	$63,100,000	100%	$2,200,000	3.0%
Business Disruption[4] *(Riverine)*	N/A	N/A	N/A	$0	N/A
Business Disruption[4] *(Coastal)*				$0	
TOTAL[5]	**67**	**$63,100,000**	**100%**	**$2,200,000**	**3.0%**

Source: Hazus (Version 3.1 [Riverine] and 2.2 [Coastal]) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 21a: City of Pocomoke City – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	2	14%	$400,000	$200,000	$0	$0	0%
1 - 10%	2	14%	$400,000	$200,000	$30,000	$20,000	3%
10 - 20%	4	29%	$600,000	$200,000	$70,000	$20,000	6%
20 - 30%	5	36%	$600,000	$100,000	$100,000	$20,000	9%
30 - 40%	1	7%	$2,700,000	$2,700,000	$900,000	$900,000	82%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**14**	**100%**	**$4,700,000**	**$300,000**	**$1,100,000**	**$80,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

Table 21b: City of Pocomoke City – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Coastal Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	8	15%	$52,000,000	$6,500,000	$100,000	$10,000	10%
1 - 10%	25	47%	$2,500,000	$100,000	$100,000	$0	10%
10 - 20%	11	21%	$800,000	$70,000	$90,000	$10,000	9%
20 - 30%	7	13%	$2,800,000	$400,000	$600,000	$90,000	61%
30 - 40%	2	4%	$300,000	$200,000	$100,000	$50,000	10%
40 - 50%	0	0%	$0	$0	$0	$0	0%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**53**	**100%**	**$58,400,000**	**$1,100,000**	**$990,000**	**$20,000**	**100%**

Source: Hazus analysis (Version 2.2) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the City of Pocomoke

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use

classifications. The data was evaluated against the 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date on July 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

v. Town of Snow Hill Summary (CID 240086)

The following pages include Flood Risk data for the Town of Snow Hill.

Overview

The Town of Snow Hill is in central Worcester County. It consists of 3.14 square miles along US Highway 113. The primary flooding sources in the town are Pocomoke River, Purnell Branch, Tributary No. 5 to Pocomoke River, and Tributary No. 6 to Pocomoke River.

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Total Community Land Area (sq mi)	NFIP	CRS Rating	Mitigation Plan
Town of Snow Hill	240086	2,103	3.14	Y	N/A	Y

- Participating in the County Multi-Hazard Mitigation Plan which expires January 20, 2020
- Past Federal Disaster Declarations for flooding = 1
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 29 policies totaling approximately $7,995,100
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Snow Hill that are located within the Worcester County, Maryland Flood Risk Project. Sections 1 and 2 of this report provide more information regarding the source and methodology used to develop the information presented below.

Community Analyses and Flood Risk Results

The Town of Snow Hill flood risk analysis incorporates modeled floodplain boundaries and flood depths for the 1-percent-annual-chance flood event, along with User Defined Facilities (UDFs) developed from local parcel, assessor, and building footprint data. Section 1, Subsection b. Uses of this Report, provides additional details on these data sources.

Flood loss estimates for the 1-percent-annual-chance flood event were calculated using Hazus-MH, and the results are presented in Table 22. Additionally, Table 23 shows the severity of damage to buildings from flooding within the community.

Note that minor differences between values in these tables may result from rounding and aggregation under different categories.

Table 22: Town of Snow Hill – Estimated Losses by Occupancy Type for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Type	# of Impacted Buildings	Inventory Estimated Value	% of Total	1% Flood Dollar Losses[1]	1% (100-yr) Percent Loss[2]
Residential Building & Contents	55	$5,000,000	23%	$500,000	10.0%
Commercial Building & Contents	15	$9,300,000	43%	$1,800,000	19.0%
Other Building & Contents	6	$7,300,000	34%	$2,400,000	33.0%
Total Building & Contents[3]	76	$21,600,000	100%	$4,700,000	22.0%
Business Disruption[4]	N/A	N/A	N/A	$100,000	N/A
TOTAL[5]	**76**	**$21,600,000**	**100%**	**$4,800,000**	**22.0%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Percent Loss = Dollar Losses ÷ Estimated Value. Percentages are rounded to the nearest integer.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption

Table 23: Town of Snow Hill – Estimated Degree of Damage Summary for the 1%-Annual-Chance Flood (UDFs in Riverine Areas)

Degree of Damage[1]	Building Count	% of Building Count	Value of Buildings and Contents[2]	Average Value *(per Building)*	Total Damage[2]	Average Damage *(per Building)*	% of Total Damage
Less than 1%	6	8%	$1,700,000	$300,000	$0	$0	0%
1 - 10%	13	17%	$2,000,000	$200,000	$100,000	$10,000	2%
10 - 20%	34	45%	$4,700,000	$100,000	$600,000	$20,000	13%
20 - 30%	12	16%	$8,900,000	$700,000	$2,200,000	$200,000	47%
30 - 40%	8	11%	$400,000	$50,000	$100,000	$10,000	2%
40 - 50%	3	4%	$3,800,000	$1,300,000	$1,700,000	$600,000	36%
50% or More	0	0%	$0	$0	$0	$0	0%
TOTAL	**76**	**100%**	**$21,500,000**	**$300,000**	**$4,700,000**	**$60,000**	**100%**

Source: Hazus analysis (Version 3.1) results stored as the 'Flood Risk at Structure' Dataset (S_FRAS_PT) in the Flood Risk Database.

[1] Degree of Damage is the estimated financial loss to a building and its contents from flooding as a percentage of the total assessed value of the building and its contents (without consideration of estimated business disruption).
[2] Value and damages shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.

The figures in these tables only represent information within the Town of Snow Hill

The following data layers provided within the FRD were developed for this Flood Risk Project and should be used to further analyze potential losses and areas where they are likely to occur.

- **S_FRAS_Pt** – *Flood Risk Assessment Results at the Structure Level*

  This point feature class contains building location and inventory data for site-specific risk assessments. State and local data was leveraged for this feature class, including building footprints, structure values, and land use classifications. The data was evaluated against the 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective date on July 16, 2015), and for buildings that are within the regulatory 1-percent-annual-chance floodplain, estimated loss calculations were performed in this 'Refined' study.

- **S_FRAC_UDF_Ar** – *Flood Risk Assessment Results at the Census Block Level*

  This polygon feature class contains 2010 census block geometries and population counts, along with the aggregated summary of site-specific loss estimates for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class). Note that the flood loss summary per census block is not based on the Hazus General Building Stock, which assumes uniform distribution of the local building inventory.

- **S_FRAP_UDF_Ar** – *Flood Risk Assessment Results at the Political Jurisdiction Level*

  This polygon feature class contains county and municipal boundaries as published in the FEMA National Flood Hazard Layer (for communities that participate in the NFIP), with aggregated site-specific loss estimates broken down by occupancy type (residential, commercial, and other) for buildings that are within the regulatory 1-percent-annual-chance floodplain (as reflected in the S_FRAS_Pt feature class).

- **L_DEG_DMG_UDF** – This table summarizes the expected degree of damage, per community, for buildings that are within the regulatory 1-percent-annual-chance floodplain. The degree of damage for each structure/property is a function of the asset value divided by the flood loss estimate determined using Hazus. Damages are then aggregated within defined ranges (such as 10 – 20%, 20 – 30%, and so forth).

- **UDF_Hazus_Input** – This table contains the original UDF information that was imported into Hazus in order to calculate flood losses.

4. Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Figure 4.1

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

a. Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

- Local plans and regulations,
- Structure and infrastructure projects,
- Natural systems protection, and
- Education and awareness activities.

i. Local Plans and Regulations

Preventative measures integrated into local plans and regulations can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations

- Open space preservation
- Building codes
- Participation in the NFIP Community Rating System (CRS)
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

ii. Structure and Infrastructure Projects

Structure protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Infrastructure projects such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

iii. Natural Systems Protection Activities

Natural systems protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Dune protection measures such as walkovers, sand fencing, and vegetation

iv. Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

In Section 3, specific Areas of Mitigation Interest were identified. Table 24 below identifies possible mitigation actions for each AoMI to consider.

Table 24: Mitigation Actions for Areas of Mitigation Interest

AoMI	Possible Actions to Reduce Flood Risk
Dams	• ***Engineering assessment*** • ***Dam upgrades and strengthening*** • ***Emergency Action Plan*** • ***Dam removal*** • ***Easement creation in impoundment and downstream inundation areas***

AoMI	Possible Actions to Reduce Flood Risk
Levees (accredited and non-accredited) and significant levee-like structures	• ***Generally same as dams above*** • ***Purchase of flood insurance for at-risk structures***
Coastal Structures • ***Jetties*** • ***Groins*** • ***Seawalls*** • ***Other structures***	• ***Increase coastal setbacks for construction*** • ***Habitat restoration programs*** • ***Wetland restoration and mitigation banking programs*** • ***Engineering assessment*** • ***Structure upgrades and strengthening*** • ***Emergency Action Plan*** • ***Structure removal***
Stream Flow Constrictions (Undersized culverts or bridge openings)	• ***Engineering analysis*** • ***Replacement of structure pre- and post-disaster***
Past Flood Insurance Claims and IA/PA Hot Spots	• ***Acquisition*** • ***Elevation*** • ***Relocation*** • ***Floodproofing***
Significant Land Use Changes	• ***Higher regulatory standard*** • ***Stormwater BMPs*** • ***Transfer of Development rights*** • ***Compensatory storage and equal conveyance standards***
Key Emergency Routes Overtopped During Frequent Flooding Events	• ***Elevation*** • ***Creation of alternate routes*** • ***Design as low water crossing***
Areas of Significant Riverine or Coastal Erosion	• ***Relocation of buildings and infrastructure*** • ***Regulations and planning*** • ***Natural vegetation*** • ***Erosion Control Structures*** • ***Building Setbacks*** • ***Beach Nourishment*** • ***Dune Construction*** • ***Dune Protection Activities***
Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM but Known to be Inundated	• ***Identification of all flood hazard areas***
Areas of Mitigation Success	***N/A***

b. Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

Refer to FEMA's "Local Mitigation Planning Handbook" for more information on practical approaches, tools, worksheets and local mitigation planning examples for how communities can engage in effective planning to reduce risk from natural hazards and disasters.

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?

"Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" provides a FEMA resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters.

- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

The *2019 Worcester County Multi-Jurisdictional Hazard Mitigation & Resilience Plan* – Chapter 9 Mitigation Strategies identifies and prioritizes mitigation actions. The plan includes mitigation actions that were developed, reviewed, and rated by a stakeholder planning committee. As a result, mitigation action items rated high were developed into potential mitigation projects.

c. Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Figure 4.2

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at https://www.fema.gov/hazard-mitigation-assistance.

i. FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 25 below.

Table 25: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA program focuses funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also

subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, federally recognized tribes, and territories (Applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

ii. Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5. Acronyms and Definitions

a. Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CID	Community Identification Number
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

b. Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Accredited Levee System – A levee system that FEMA has shown on a FIRM that is recognized as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood. This determination is based on the submittal of data and documentation as required by 44CFR65.10 of the NFIP regulations. The area landward of an accredited levee system is shown as Zone X (shaded) on the FIRM except for areas of residual flooding, such as ponding areas, which are shown as Special Flood Hazard Area (SFHA).

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

CFS – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the SFHA extending from offshore to the inland limit of a primary frontal dune along an open coast or any other area subject to high velocity wave action from storms or seismic sources.

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design Flood Event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.
Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding
water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. This is sometimes referred to as flood risk.

Flood-borne debris impact – Floodwater moving at a moderate or high velocity can carry flood-borne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. "Freeboard" tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the NFIP regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR65.10), Mapping of Areas Protected by Levee Systems, and is not shown on a FIRM as reducing the flood hazard posed by a 1-percent-annual-chance flood.

Primary frontal dune (PFD) – A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Provisionally Accredited Levee (PAL) – A designation for a levee system that FEMA has previously accredited with reducing the flood hazards associated with a 1-percent-annual-chance or greater flood on an effective FIRM, and for which FEMA is awaiting data and/or documentation that will demonstrate the levee system's compliance with the NFIP regulatory criteria cited at 44CFR65.10.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of, or produced by, a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual-chance or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6. Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA), www.floodsmart.gov

FEMA, www.fema.gov

FEMA, *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2003. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*,

FEMA 64. Washington, DC, April 2004.

FEMA, 2005. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007b. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007c. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007d. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007e. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007f. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007g. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008a. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009c. *Local Officials Guide for Coastal Construction,* FEMA P-762. Washington, DC, February 2009.

FEMA, 2009d. *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations,* FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010b. *Home Builder's Guide to Coastal Construction,* FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, Washington, DC, February 2013.

FEMA, 2013. *Local Mitigation Planning Handbook*, Washington, DC, March 2013.
USGS. *USGS National Assessment of Shoreline Change Project,* coastal.er.usgs.gov/shoreline-change/

FEMA, 2015. *Plan Integration: Linking Local Planning Efforts*, Washington, DC, July 2015.

MEMA, 2015. *State of Maryland Local Hazard Mitigation Plan Guidance*. Reisterstown, MD, 2015.

MEMA, 2016. *2016 State of Maryland Hazard Mitigation Plan*. Reisterstown, MD, August 2016.

FEMA, 2018. *Mitigation Planning and the Community Rating System Key Topics Bulletin*, Washington, DC, October 2018.

State and Local Government Websites

Maryland Environmental Service (MES)
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE)
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

Maryland Emergency Management Agency
5401 Rue Saint Lo Drive, Reisterstown, MD 21136
https://mema.maryland.gov/Pages/default.aspx

Maryland Department of Housing and Community Development
7800 Harkins Rd, Lanham, MD 20706
https://dhcd.maryland.gov/pages/default.aspx

Maryland Association of Floodplain and Stormwater Managers
www.mafsm.org

Eastern Region Representative:
Amy G. Moredock, Principal Planner
Queen Anne's County Department of Planning & Zoning
110 Vincit Street, Room 104, Centreville, MD 21617
https://www.qac.org/234/Planning-Zoning

Worcester County Department of Emergency Services
1 W. Market St. Room 1002, Snow Hill, MD 21863
http://www.co.worcester.md.us/departments/emergency

Worcester County Department Development Review & Permitting
1 W. Market St. Room 1002, Snow Hill, MD 21863
http://www.co.worcester.md.us/departments/drp

Worcester County Department of Public Works
6113 Timmons Road, Snow Hill, MD 21863
http://www.co.worcester.md.us/departments/publicworks

Worcester County Geographic Information Systems (GIS)
1 W. Market St. Room 1002, Snow Hill, MD 21863
http://www.co.worcester.md.us/departments/drp/gis

This page left blank intentionally

Source:
https://www.https://r.search.yahoo.com/_ylt=AwrE1xJKEJ1cJHIA5ClXNyoA;_ylu=X3oDMTEyY3VucDBuBGNvbG8DYm

STATE OF MARYLAND

FLOOD RISK REPORT

WORCHESTER COUNTY, MARYLAND

APPENDIX A

REPORT NUMBER:

12/31/2019

FEMA

This page intentionally left blank.

List of Flood Risk Maps

Worchester County, Maryland – Countywide Flood Risk Map (FRM)

Worchester County, Maryland – High Risk Area 1: Ocean City – Dollar Losses

Worchester County, Maryland – High Risk Area 1: Ocean City – Percent Losses

Worchester County, Maryland – High Risk Area 2: Ocean Pines – Dollar Losses

Worchester County, Maryland – High Risk Area 2: Ocean Pines – Percent Losses

Worchester County, Maryland – High Risk Area 3: Cape Isle of Wight – Dollar Losses

Worchester County, Maryland – High Risk Area 3: Cape Isle of Wight – Percent Losses

Worchester County, Maryland – High Risk Area 4: Bayside – Dollar Losses

Worchester County, Maryland – High Risk Area 4: Bayside – Percent Losses

Worchester County, Maryland – High Risk Area 5: Snow Hill – Dollar Losses

Worchester County, Maryland – High Risk Area 5: Snow Hill – Percent Losses

Worchester County, Maryland – High Risk Area 6: Captains Hill – Dollar Losses

Worchester County, Maryland – High Risk Area 6: Captains Hill – Percent Losses

Worchester County, Maryland – High Risk Area 7: West Ocean City – Dollar Losses

Worchester County, Maryland – High Risk Area 7: West Ocean City – Percent Losses

Worchester County, Maryland – High Risk Area 8: Pokomoke City – Dollar Losses

Worchester County, Maryland – High Risk Area 8: Pokomoke City – Percent Losses

Worchester County, Maryland – Essential Facilities At-Risk

Countywide Flood Risk Map: Worchester County, Maryland

Summary of Flood Damage in High-Risk Areas

High-Risk Area	Location	2010 Population	Number of Census Blocks	Number of Impacted Buildings	Flood Loss Estimate	Percent of Total Countywide Flood Loss Estimate
Area 1	Ocean City	7,205	750	3,572	$19,599,801	42%
Area 2	Ocean Pines	7,225	139	1,927	$4,085,167	9%
Area 3	Cape Isle of Wight	935	23	417	$2,320,678	5%
Area 4	Bayside	330	37	184	$1,172,852	3%
Area 5	Snow Hill	379	33	100	$5,404,419	12%
Area 6	Captain's Hill	746	20	148	$1,077,991	2%
Area 7	West Ocean City	275	30	127	$1,925,840	4%
Area 8	Pokomoke City	582	32	89	$2,259,761	5%
Total for High-Risk Areas		**17,677**	**1,064**	**6,564**	**$37,846,509**	**81%**

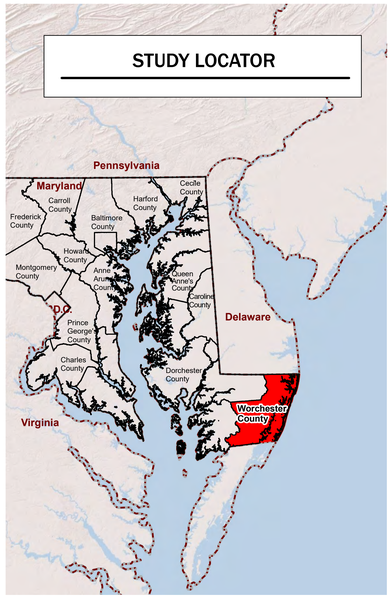
Summary of Flood Damage by Community

Community Name	2010 Population	Number of Impacted Buildings	1% Flood Loss Estimate	Flood Losses Per Capita	Percent of Total Countywide Flood Loss Estimate
Worcester County (Unincorporated Areas)	33,580	3,774	$19,700,000	$587	42%
Town of Berlin	4,485	9	$130,000	$29	< 1%
Town of Ocean City	7,102	3,481	$19,500,000	$2,746	42%
City of Pocomoke	4,184	67	$2,200,000	$526	5%
Town of Snow Hill	2,103	76	$4,800,000	$2,282	10%
Total	**51,454**	**7,407**	**$46,500,000**	**$904**	**100%**

Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Town of Ocean City
Town of Berlin
Town of Pokomoke

0 1 2 4
Miles

STUDY LOCATOR



MAP SYMBOLOGY

Base and Flood Data

- State Boundary
- Corporate Limits
- Rivers and Streams
- Coastal Surge Influenced Area

Riverine Flood Risk

Flood Loss Estimates by Census Block

- Very Low (<$50,000 damage)
- Low ($50,000-$100,000 damage)
- Medium ($100,000-$250,000 damage)
- High ($250,000-$500,000 damage)
- Very High (>$500,000 damage)
- High-Risk Area*

Area 1

*High-Risk Areas are places in the county that have a large amount of flood damage in a small area. They are created by grouping together adjacent Census Blocks with high flood loss estimations. Please note that significant flood damages can occur outside of the identified high-risk areas.

- At-Risk State Asset or Essential Facility

Risk Mapping, Assessment, and Planning (Risk MAP)

Countywide Flood Risk Map (FRM)

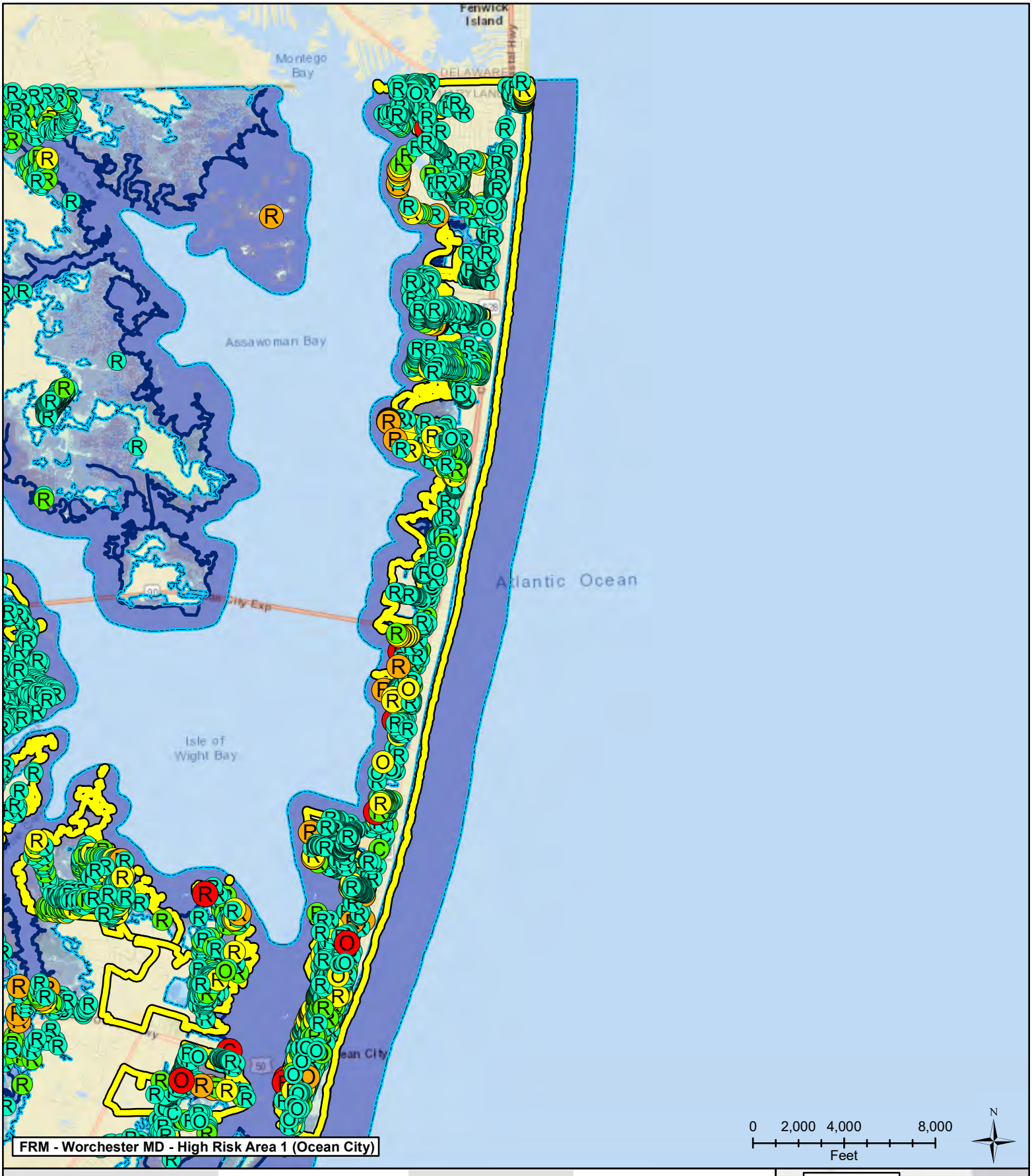
Worchester County and Incorporated Areas, MD

MARYLAND

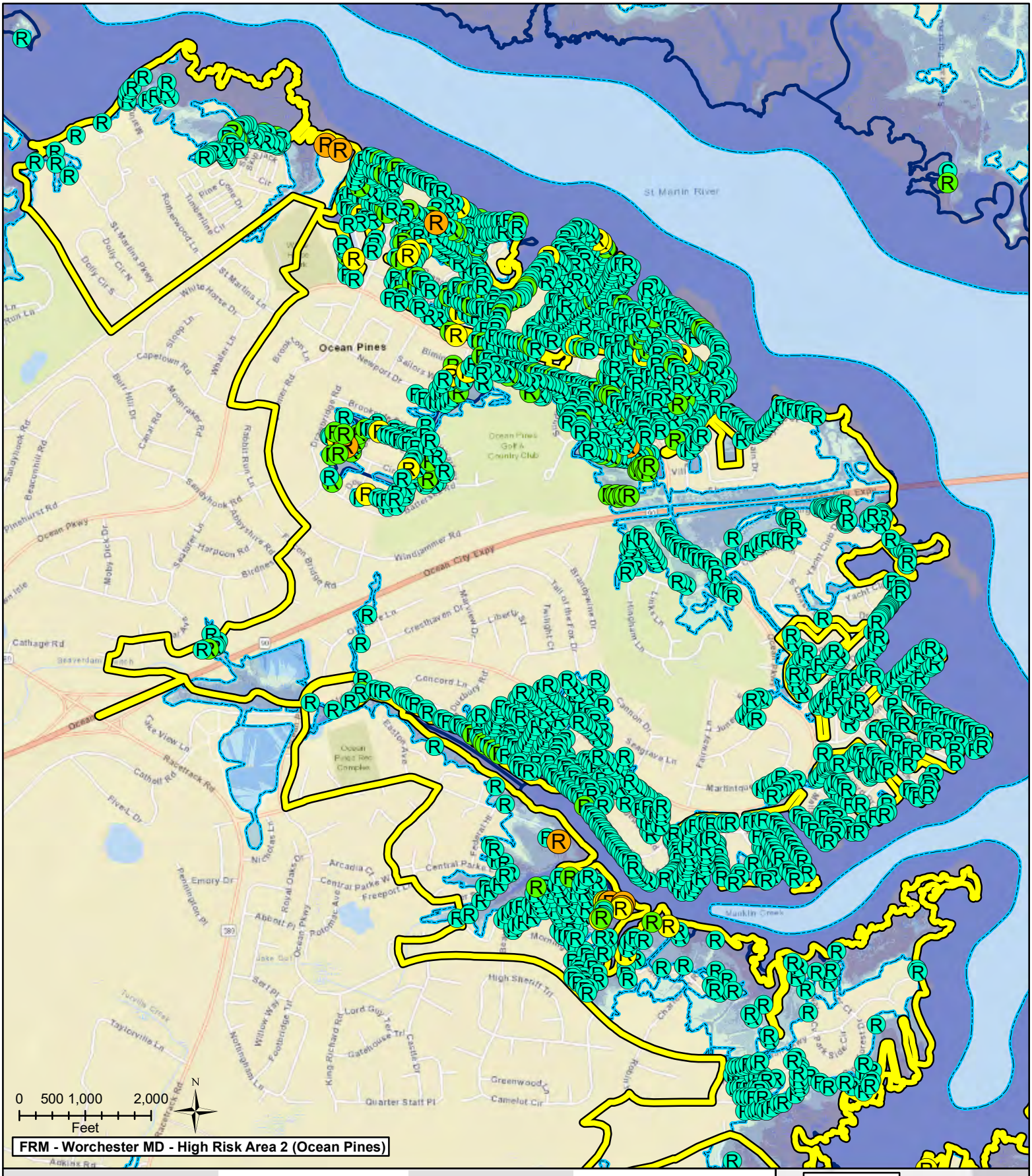
FEMA

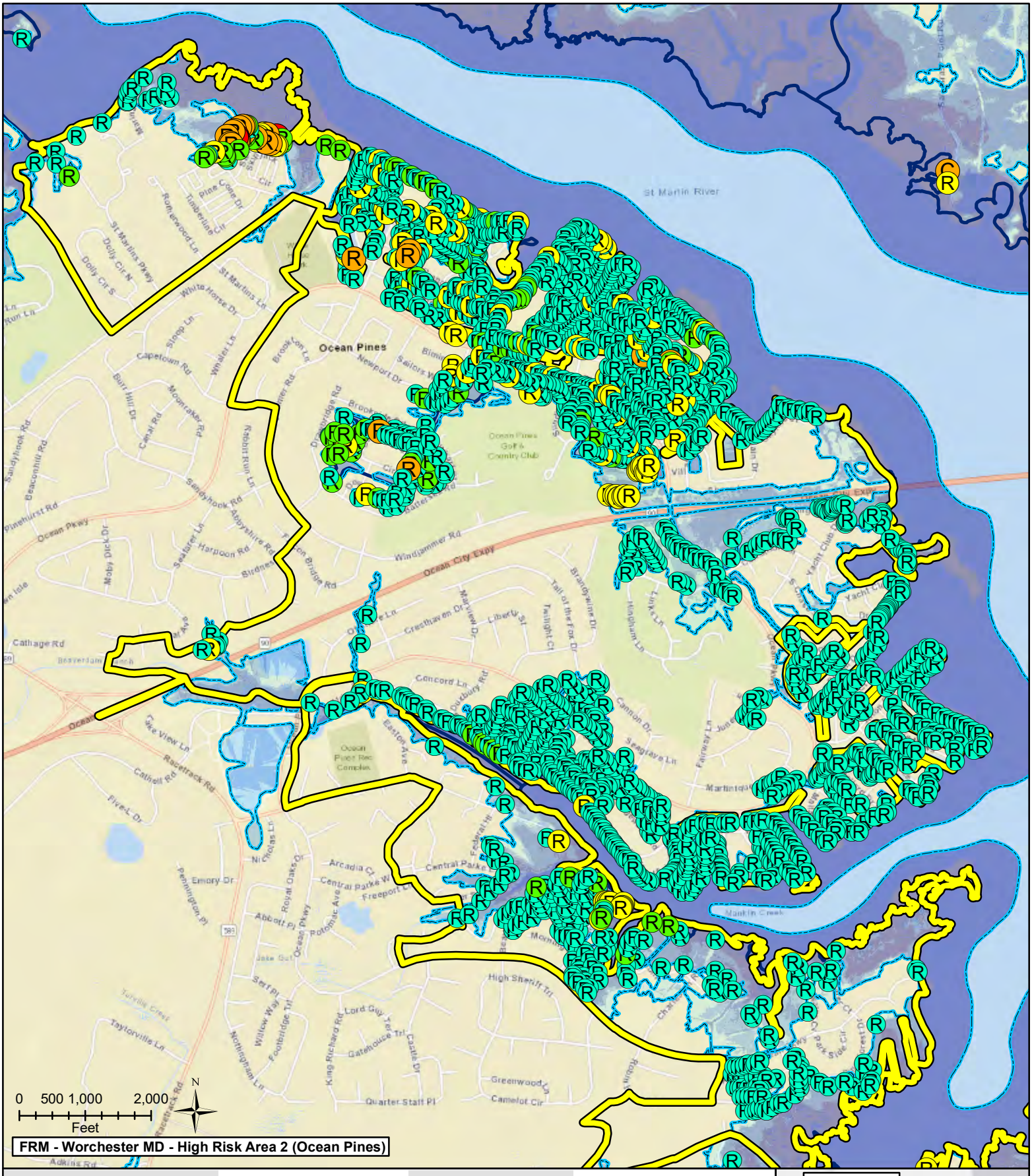
This Flood Risk Map has been prepared in conjunction with the Flood Risk Report and Flood Risk Database for Worchester County, MD.

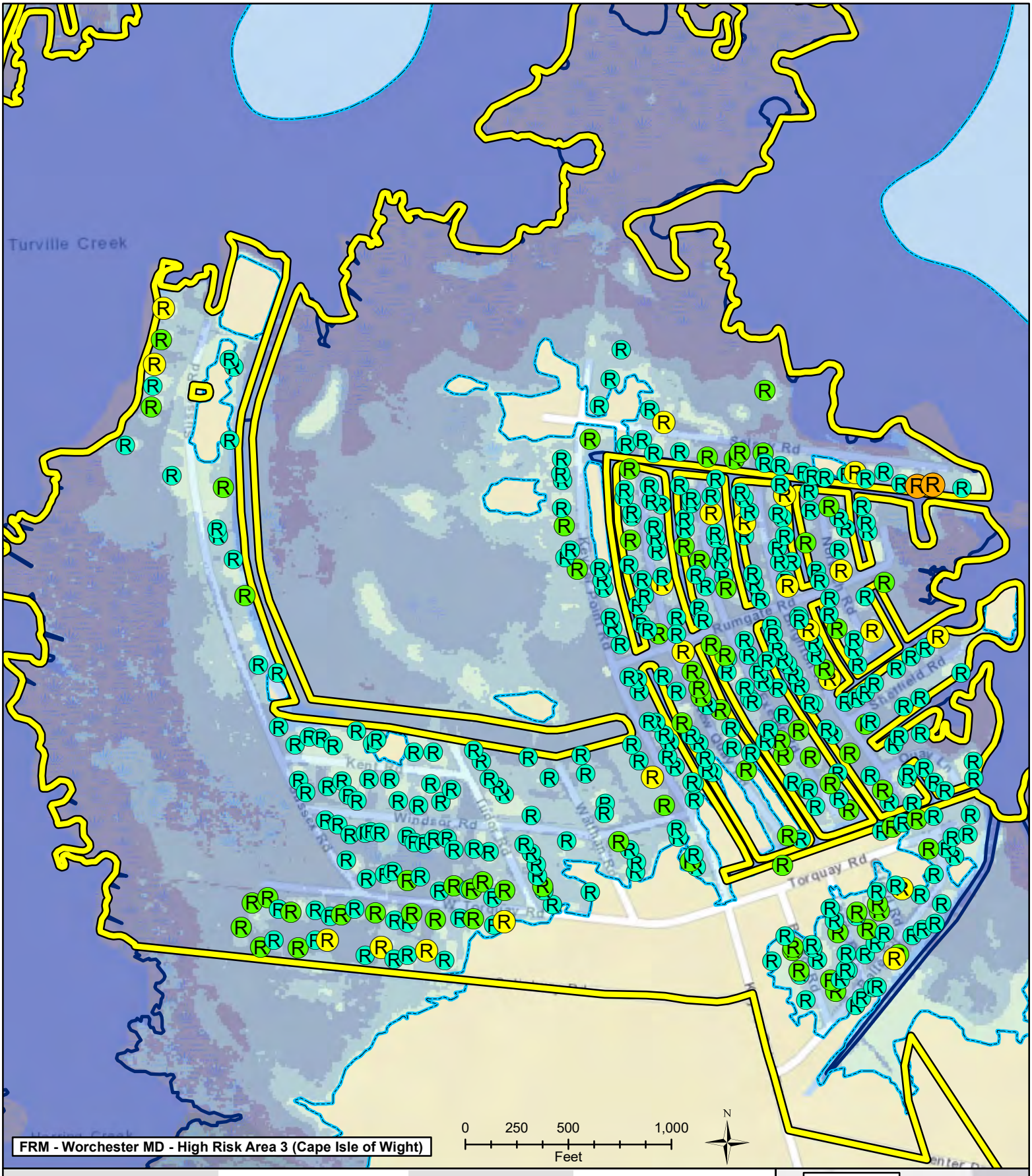
RELEASE DATE
12/31/2019

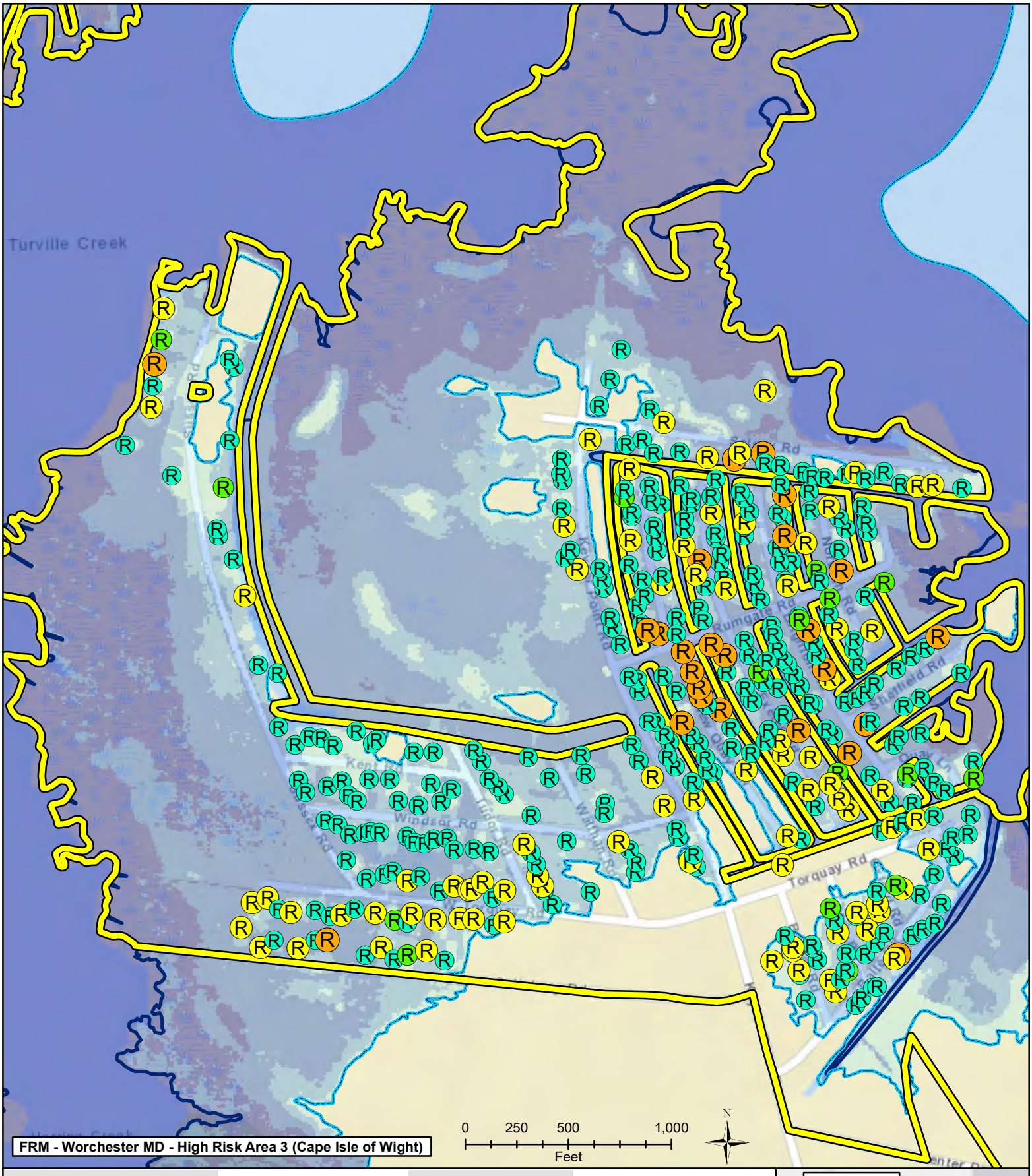

Fenwick Island
Montego Bay
Assawoman Bay
Atlantic Ocean
Isle of Wight Bay
Ocean City
FRM - Worchester MD - High Risk Area 1 (Ocean City)
0 2,000 4,000 8,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County

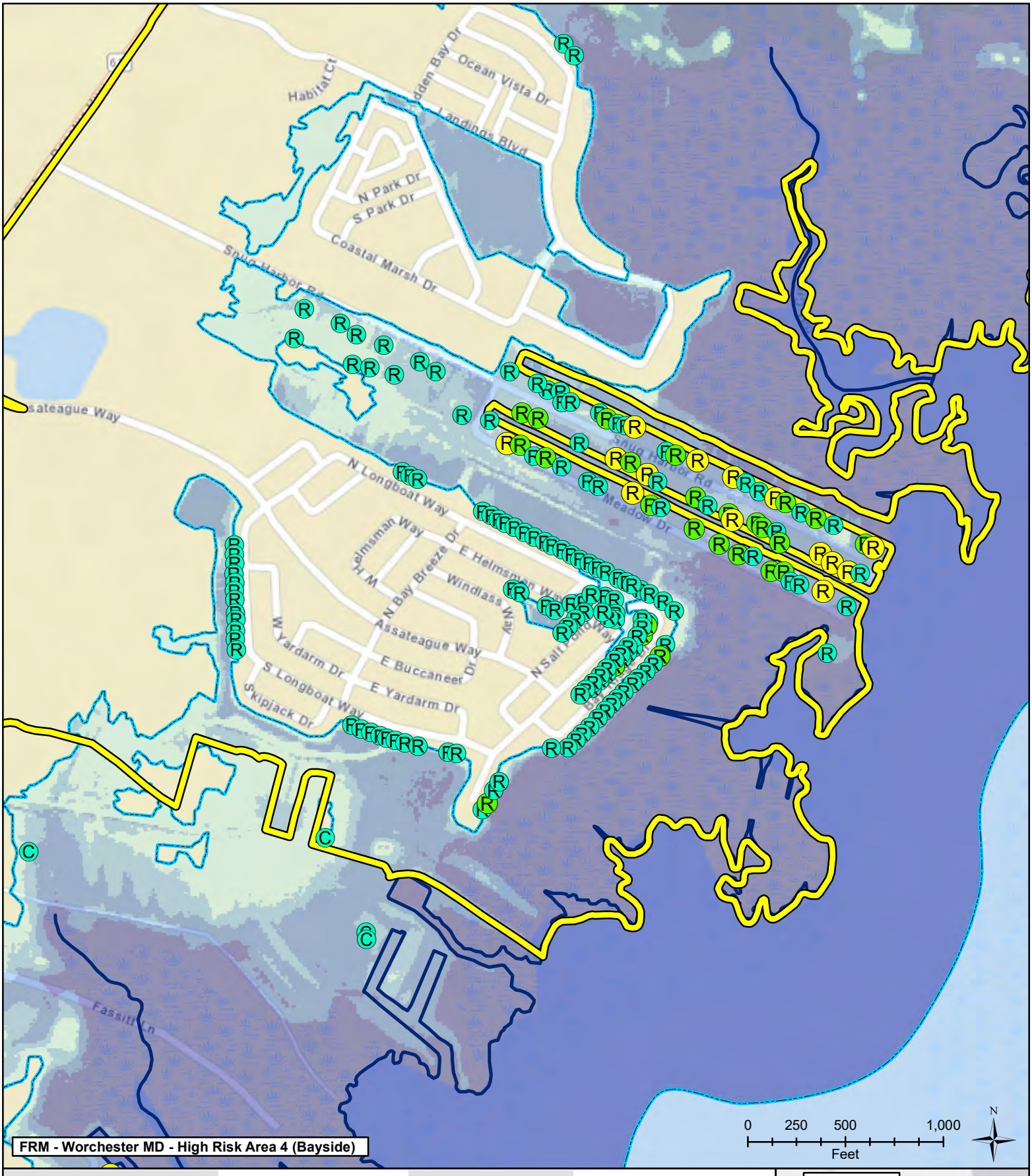
Fenwick Island
Montego Bay
Assawoman Bay
Atlantic Ocean
Isle of Wight Bay
Ocean City
FRM - Worchester MD - High Risk Area 1 (Ocean City)
0 2,000 4,000 8,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Worchester County

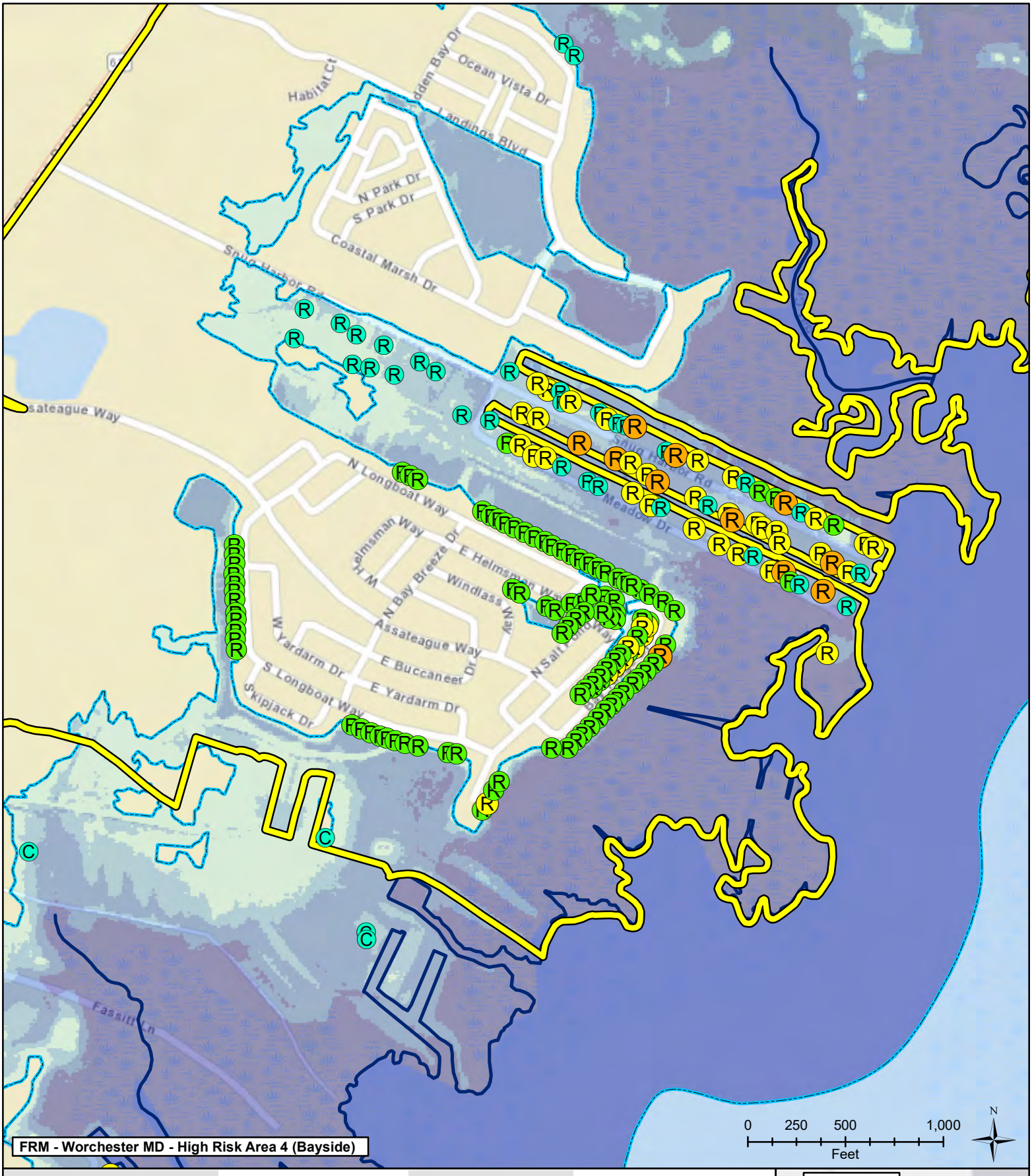

St Martin River
Ocean Pines
Ocean Pines Golf & Country Club
Ocean City Expy
Ocean Pkwy
Cathage Rd
Windjammer Rd
Concord Ln
Central Park Dr
Arcadia Ct
Emory Dr
Abbott Pl
Ocean Pkwy
Potomac Ave
Royal Oaks Dr
Nicholas Ln
Racetrack Rd
Cathell Rd
Five L Dr
Pennington Pl
Taylorville Ln
Willow Way
Footbridge Trl
Nottingham Ln
King Richard Rd
Lord Guy Ter
Gatehouse Trl
Castle Dr
Quarter Staff Pl
Greenwood Ln
Camelot Cir
High Sheriff Trl
Franklin Creek
Martinique
Cannon Dr
Sawgrave Ln
Fairway Ln
Easton Ave
Ocean Pines Rec Complex
Ocean Pines Golf & Country Club
Yacht Club Dr
Links Ln
Hingham Ln
Twilight Ct
Tall of the Fox Dr
Brandywine Dr
Liberty St
Crestwood Dr
Cresthaven Dr
Oakmont Ln
Sandyhook Rd
Abbeyshire Rd
Seaside Ln
Harpoon Rd
Moby Dick Dr
Rabbit Run Ln
Rum Island Bridge Rd
Birdnest Rd
Pinehurst Rd
Bearcenhill Rd
Sandyhook Rd
Moonraker Rd
Canal Rd
Butt Hill Dr
Capetown Rd
Whistler Ln
Sloop Ln
White Horse Dr
St Martins Ln
St Martins Pkwy
Dolly Cir N
Dolly Cir S
Pine Cone Dr
Timberline Cir
Rosewood Ln
Brookfield Rd
Brookfield Ln
Newport Dr
Sailors Way
Bimini Rd
Run Ln
Ln
Isle
0 500 1,000 2,000
Feet
N
FRM - Worchester MD - High Risk Area 2 (Ocean Pines)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County


St Martin River
Ocean Pines
Ocean City Expy
Ocean Pkwy
Cathage Rd
Racetrack Rd
Central Park Dr
Windjammer Rd
Concord Ln
Harpoon Rd
Sandyhook Rd
Abbott Pl
Ocean Pkwy
Potomac Ave
Arcadia Cir
Emory Dr
Taylorville Ln
Willow Way
Footbridge Trl
Lord Guy
Gatehouse Trl
Castle Dr
Quarter Staff Pl
Greenwood Cir
Camelot Cir
High Sheriff Trl
Manklin Creek
Ocean Pines Golf & Country Club
Ocean Pines Rec Complex
0 500 1,000 2,000
Feet
N
FRM - Worchester MD - High Risk Area 2 (Ocean Pines)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
(R) Residential
(C) Commercial
(O) Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Worchester County


Turville Creek
Rumgate Rd
Torquay Rd
Windsor Rd
FRM - Worchester MD - High Risk Area 3 (Cape Isle of Wight)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County


Turville Creek
Rumgate Rd
Torquay Rd
Windsor Rd
FRM - Worchester MD - High Risk Area 3 (Cape Isle of Wight)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
(R) Residential
(C) Commercial
(O) Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Worchester County


Habitat Ct
Ocean Vista Dr
Landings Blvd
N Park Dr
S Park Dr
Coastal Marsh Dr
Snug Harbor Rd
Assateague Way
N Longboat Way
Helmsman Way
E Helmsman Way
N Bay Breeze Dr
Windlass Way
Assateague Way
E Buccaneer Dr
W Yardarm Dr
E Yardarm Dr
S Longboat Way
Skipjack Dr
Meadow Dr
Fassitt Ln
FRM - Worchester MD - High Risk Area 4 (Bayside)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County



Stream Centerline

High-Risk Area Boundary

1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

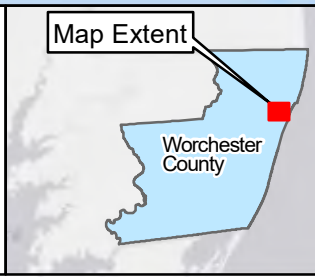
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

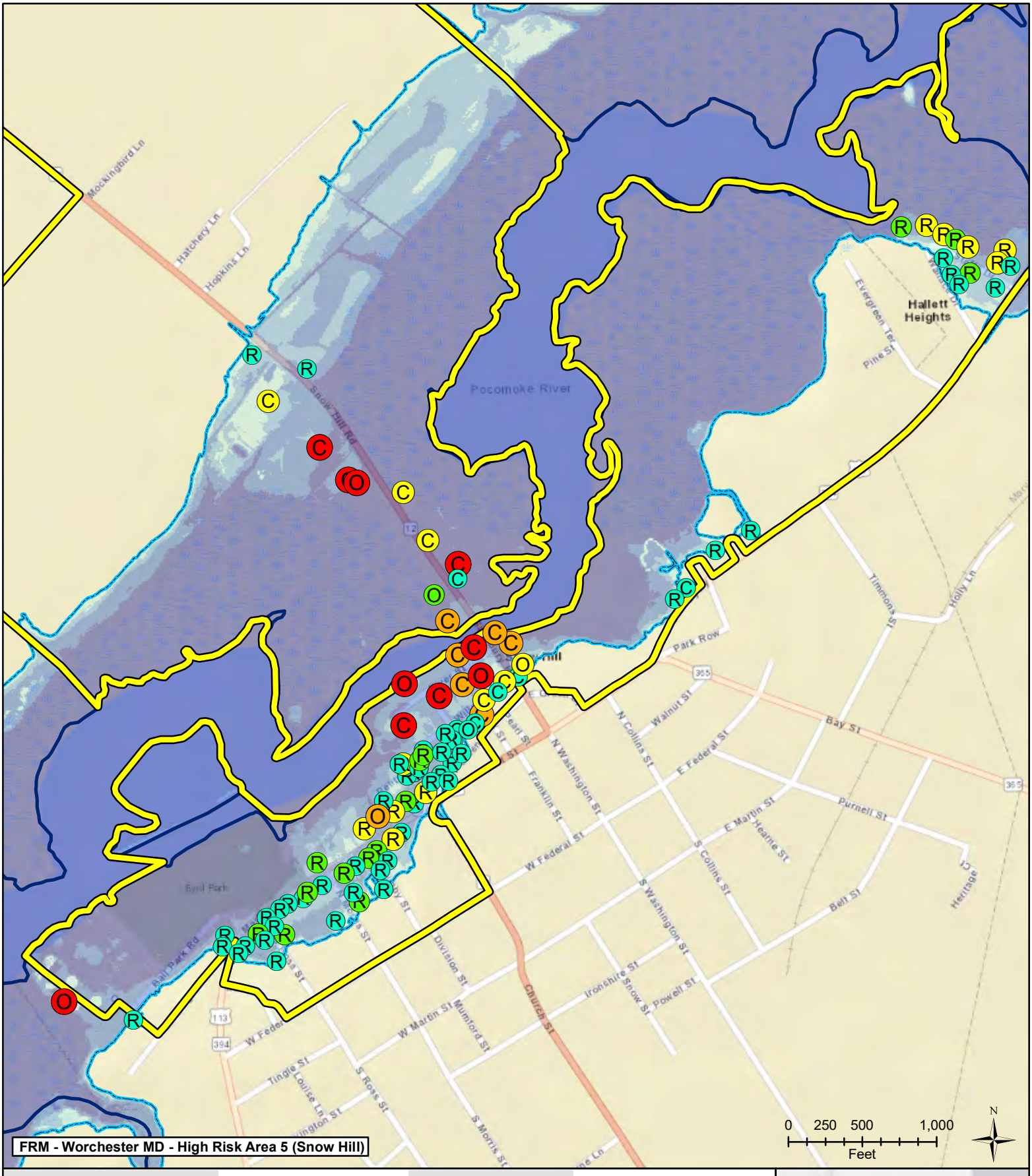
UDF Land Use Category

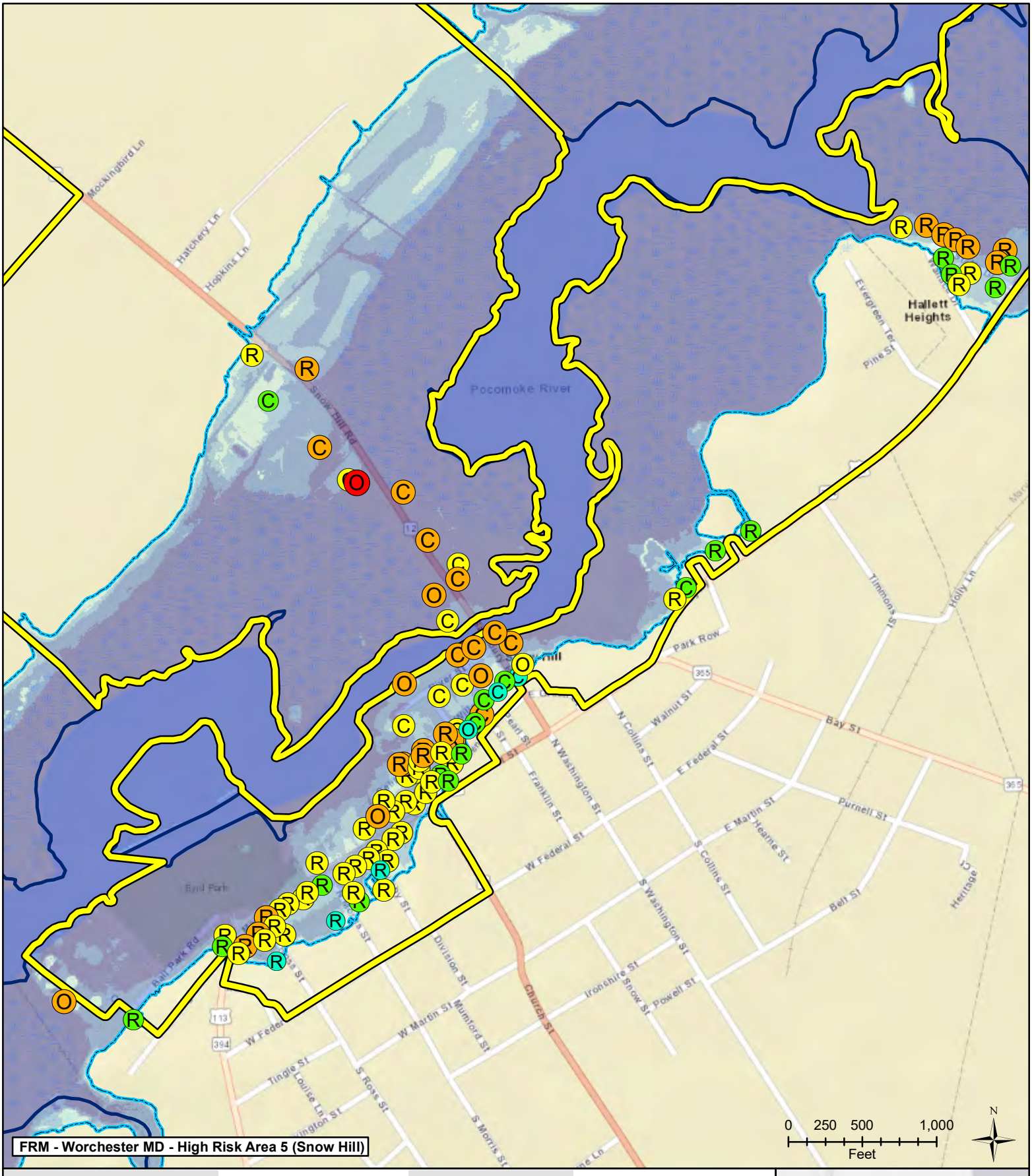
- (R) Residential
- (C) Commercial
- (O) Other

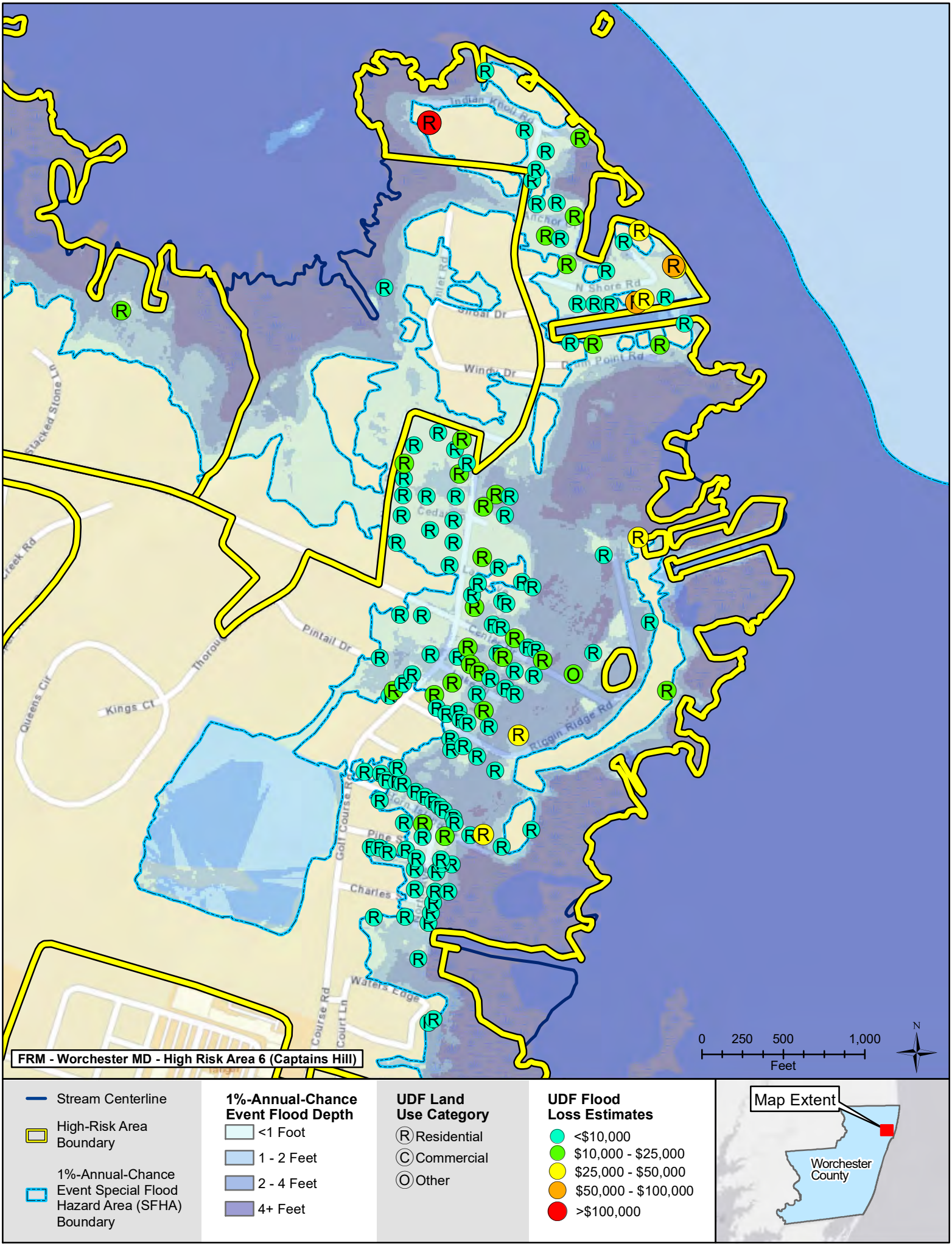
UDF Flood Loss Estimates

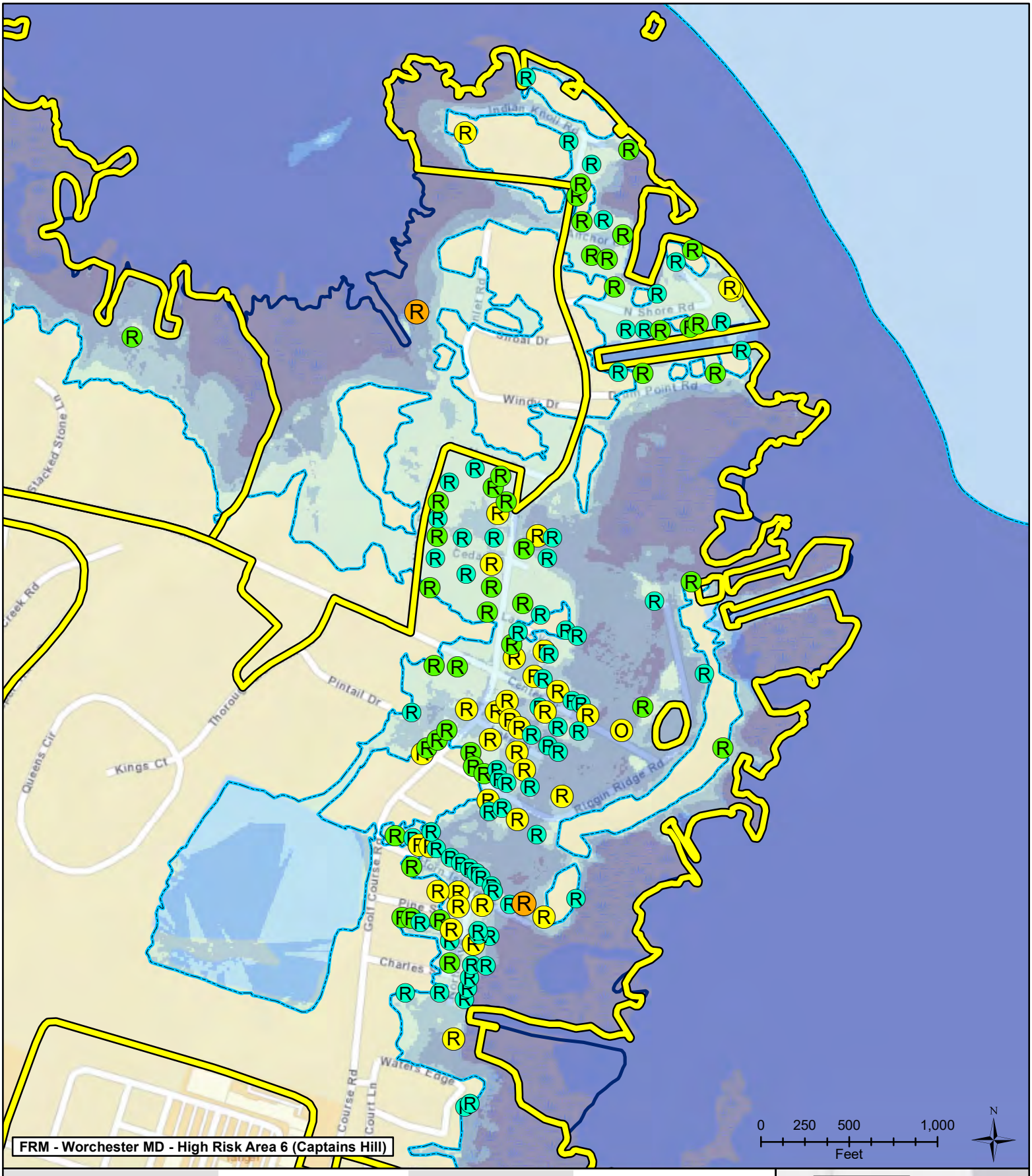
- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Pocomoke River
Hallett Heights
Mockingbird Ln
Hatchery Ln
Hopkins Ln
Snow Hill Rd
Park Row
Bay St
E Federal St
W Federal St
Purnell St
E Martin St
W Martin St
Walnut St
N Washington St
S Washington St
N Collins St
S Collins St
Franklin St
Hearne St
Church St
Division St
Mumford St
Ironshire St
Snow St
Powell St
Bell St
Timmons St
Holly Ln
Evergreen Ter
Pine St
Tingle St
S Rose St
S Morris St
Ball Park Rd
Byrd Park
FRM - Worchester MD - High Risk Area 5 (Snow Hill)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County


Pocomoke River
Hallett Heights
Snow Hill Rd
Mockingbird Ln
Hatchery Ln
Hopkins Ln
Park Row
Bay St
E Federal St
W Federal St
Purnell St
E Martin St
W Martin St
Church St
Walnut St
N Washington St
S Washington St
Franklin St
Division St
Mumford St
Ironshire St
Powell St
Bell St
Timmons St
Holly Ln
Pine St
Evergreen Ter
Ball Park Rd
Tingle St
S Rose St
S Morris St
Louise Ln
365
113
394
FRM - Worchester MD - High Risk Area 5 (Snow Hill)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Worchester County


FRM - Worchester MD - High Risk Area 6 (Captains Hill)
0 250 500 1,000
Feet
N
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
Residential
Commercial
Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County



FRM - Worchester MD - High Risk Area 6 (Captains Hill)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

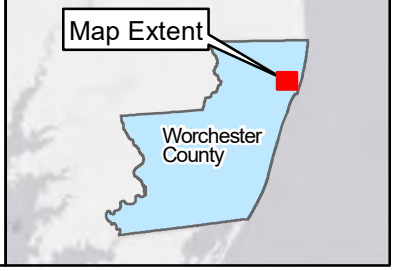
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

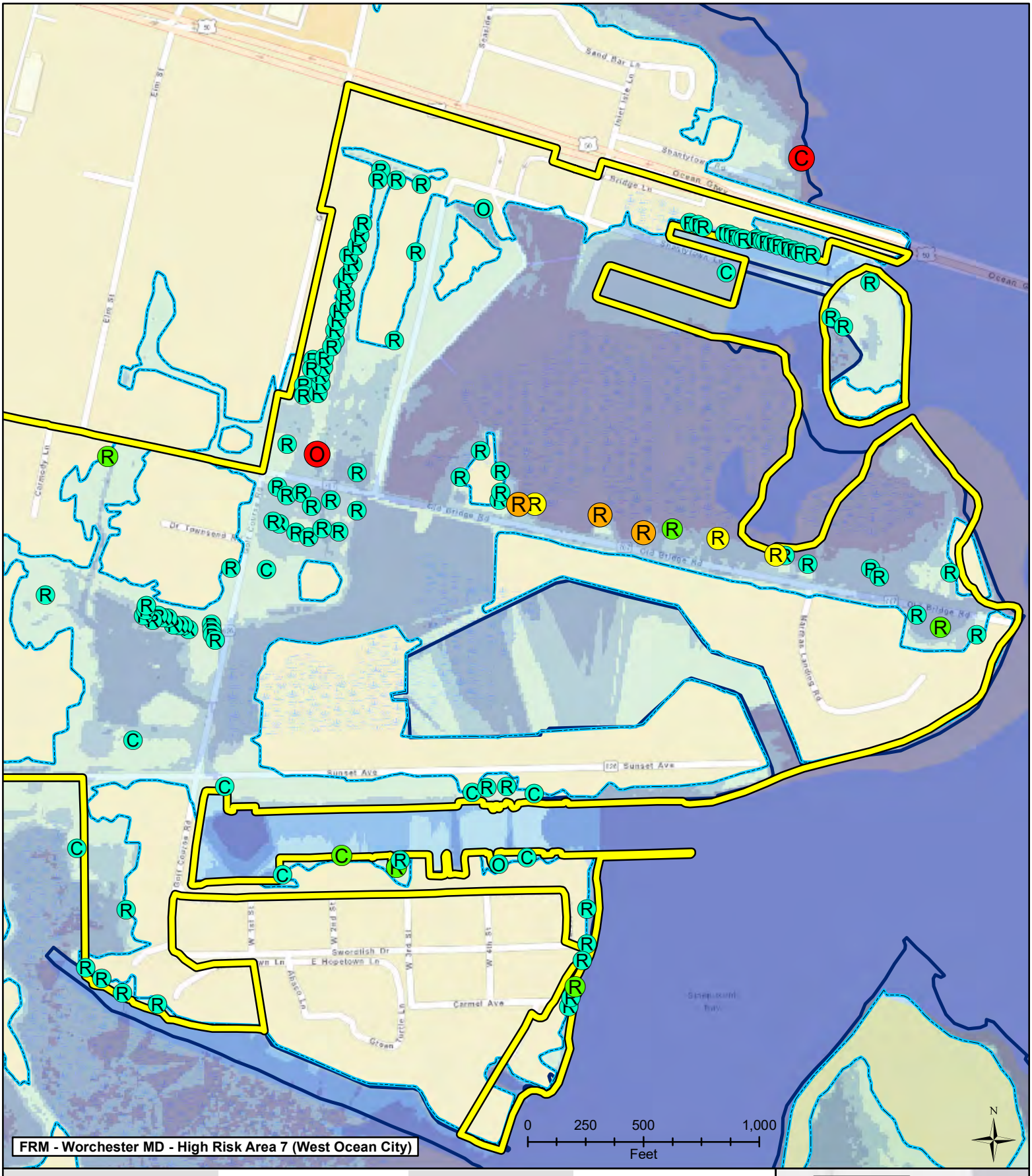
UDF Land Use Category

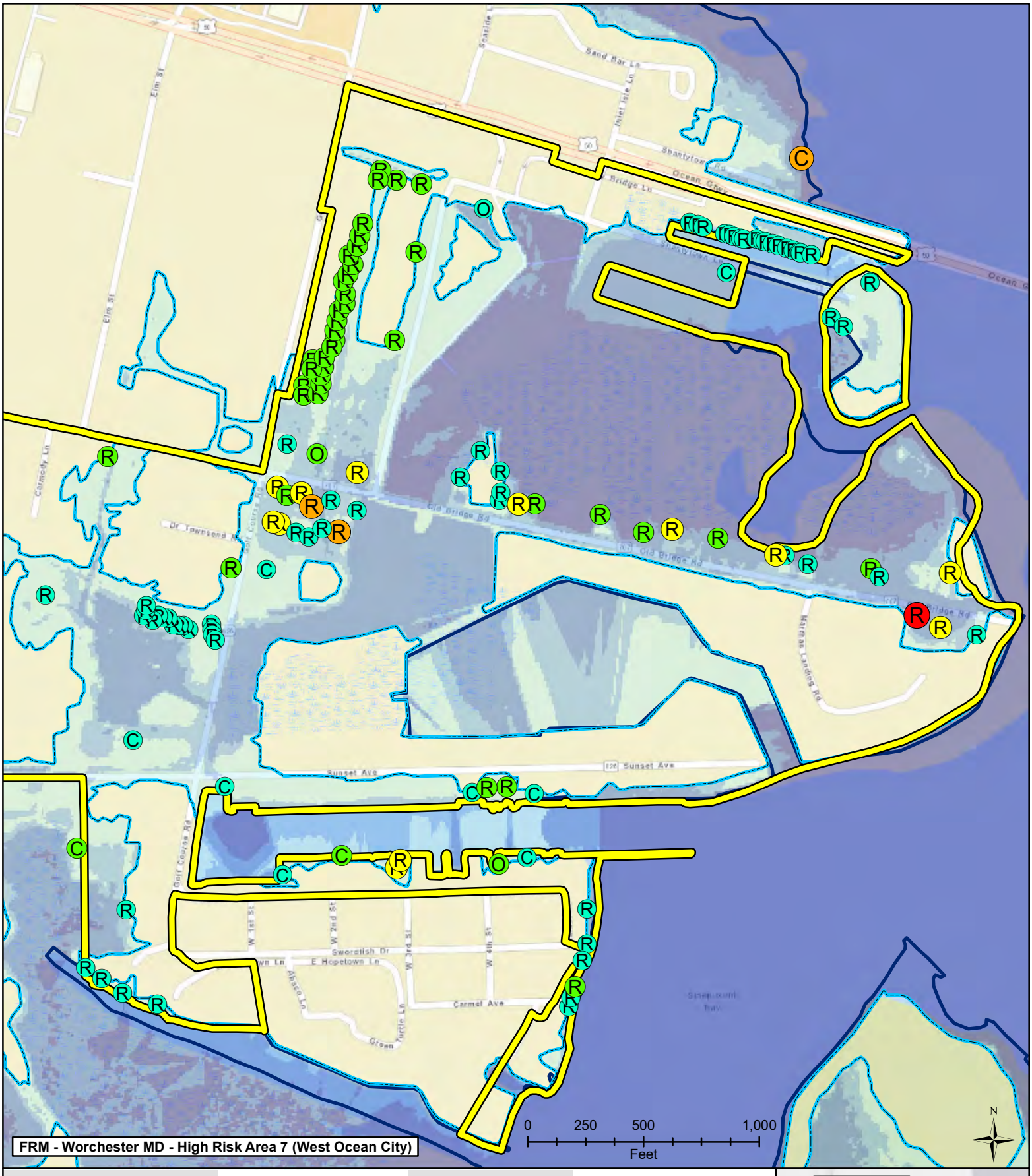
- (R) Residential
- (C) Commercial
- (O) Other

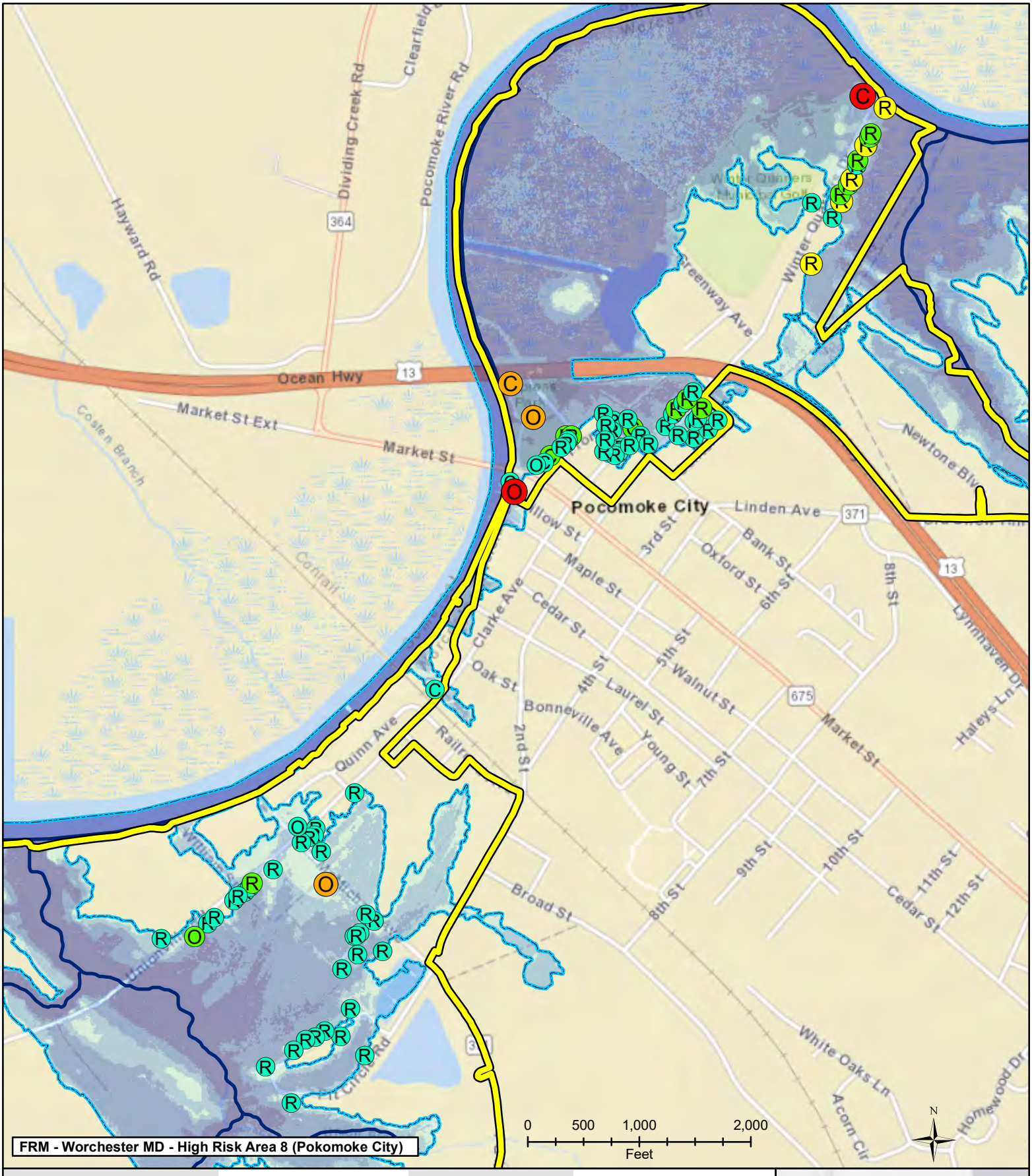
UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More




Sand Bar Ln
Inlet Isle Ln
Shantytown Rd
Ocean Gtwy
Bridge Ln
Elm St
Old Bridge Rd
Dr Townsend
Golf Course Rd
Sunset Ave
Marinas Landing Rd
Swordfish Dr
E Hopetown Ln
W 1st St
W 2nd St
W 3rd St
W 4th St
Carmel Ave
Abalone Ln
Green Turtle Ln
Colmedy Ln
Seaside
0
250
500
1,000
Feet
N
FRM - Worchester MD - High High Risk Area 7 (West Ocean City)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Map Extent
Worchester County


Sand Bar Ln
Inlet Isle Ln
Shantytown Rd
Ocean Gtwy
Bridge Ln
Elm St
Old Bridge Rd
Dr Townsend
Golf Course Rd
Sunset Ave
Sunset Ave
Narras Landing Rd
Swordfish Dr
E Hopetown Ln
Carmel Ave
W 1st St
W 2nd St
W 3rd St
W 4th St
Abalone Ln
Purple Ln
Green
0
250
500
1,000
Feet
N
FRM - Worchester MD - High High Risk Area 7 (West Ocean City)
Stream Centerline
High-Risk Area Boundary
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
1%-Annual-Chance Event Flood Depth
<1 Foot
1 - 2 Feet
2 - 4 Feet
4+ Feet
UDF Land Use Category
R Residential
C Commercial
O Other
UDF Flood Loss Estimates
Less than 1%
1 - 10%
10 - 25%
25 - 50%
50% or More
Map Extent
Worchester County



FRM - Worchester MD - High Risk Area 8 (Pokomoke City)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

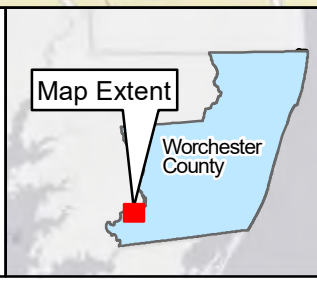
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

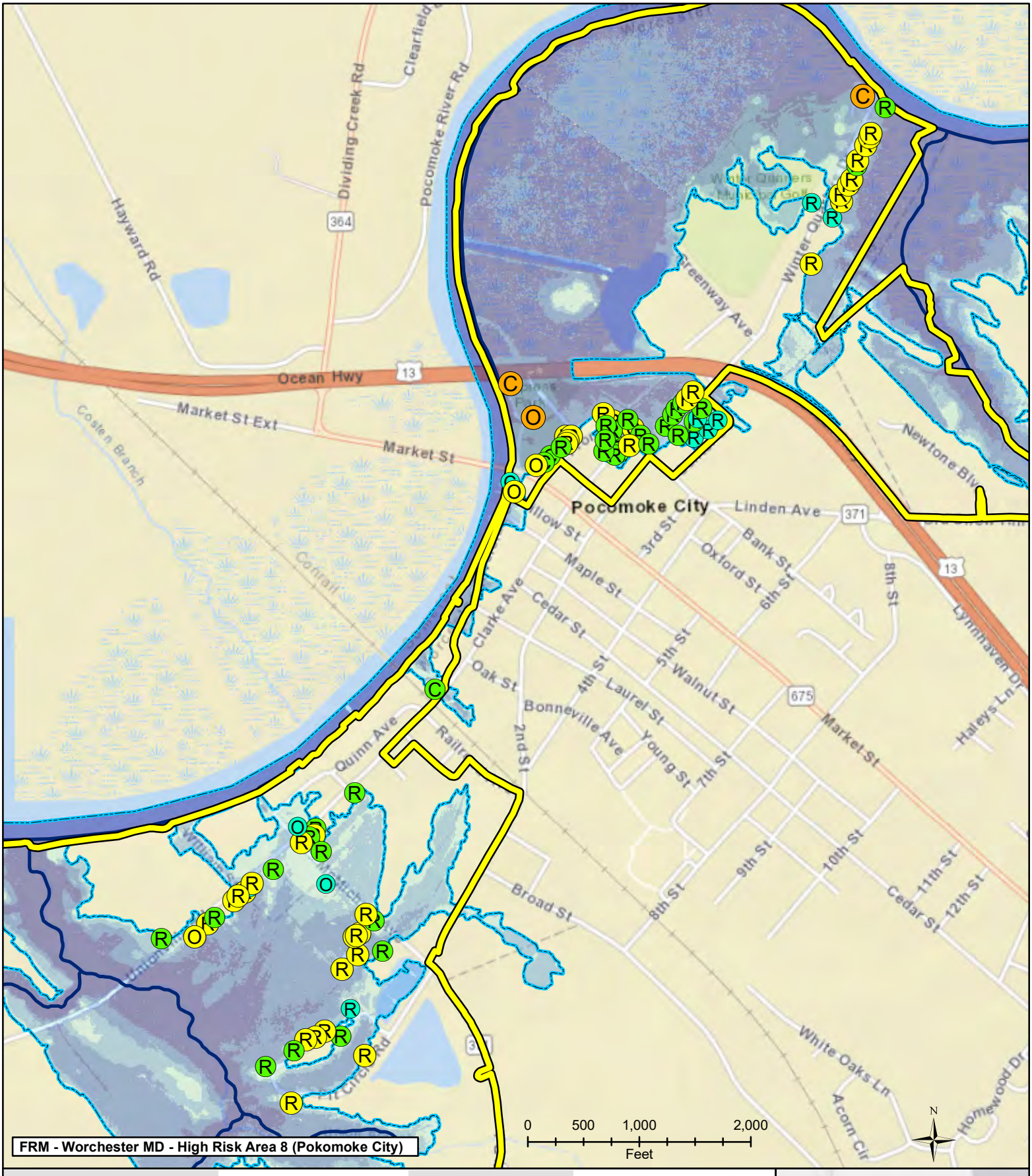
UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- <$10,000
- $10,000 - $25,000
- $25,000 - $50,000
- $50,000 - $100,000
- >$100,000





FRM - Worchester MD - High Risk Area 8 (Pokomoke City)

- Stream Centerline
- High-Risk Area Boundary
- 1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary

1%-Annual-Chance Event Flood Depth

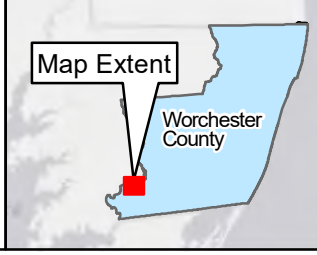
- <1 Foot
- 1 - 2 Feet
- 2 - 4 Feet
- 4+ Feet

UDF Land Use Category

- (R) Residential
- (C) Commercial
- (O) Other

UDF Flood Loss Estimates

- Less than 1%
- 1 - 10%
- 10 - 25%
- 25 - 50%
- 50% or More



Ocean City Volunteer Fire Company Station 4
Ocean City Volunteer Fire Company Station 3
Ocean City Volunteer Fire Company Headquarters
Your Doc's In
Ocean City Fire Company Station 2 and Beach Patrol
Snow Hill Police Department
Bishopville
Willards
Chaleyville
Showell
Ocean Pines
Berlin
Newark
Isle of Wight Bay
Sinepuxent Bay
DELAWARE
MARYLAND
0 0.75 1.5 3
Miles
N
FRM - Worcester MD - Essential Facility At-Risk to 1-Percent-Annual-Chance Flood Event
Stream Centerline
1%-Annual-Chance Event Special Flood Hazard Area (SFHA) Boundary
Worcester County & Municipalities
Unincorporat... & Incorporated Areas
Essential Facility Types At-Risk
Fire Department
Medical
Police
Essential Facility Loss Estimates
<$10,000
$10,000 - $25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Worcester County
Map Extent

This page left blank intentionally

Flood Risk Report

Talbot County, Maryland Coastal Study

County: Talbot

Community Names: Town of Easton*, Town of Oxford, Town of Queen Anne, Town of St. Michaels, Town of Trappe, Talbot County (Unincorporated Areas)*

State: Maryland

**This report only covers the area within the coastal region of this county.*

Report Number 001

08/03/2016

FEMA

RiskMAP

Increasing Resilience Together

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This Flood Risk Report (FRR) provides non-regulatory information to help local or tribal officials, floodplain managers, planners, emergency managers, and others better understand their flood risk, take steps to mitigate those risks, and communicate those risks to their citizens and local businesses.

Because flood risk often extends beyond community limits, the FRR provides flood risk data for the entire Flood Risk Project as well as for each individual community. This also emphasizes that flood risk reduction activities may impact areas beyond jurisdictional boundaries.

Flood risk is always changing, and there may be other studies, reports, or sources of information available that provide more comprehensive information. The FRR is not intended to be regulatory or the final authoritative source of all flood risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

Table of Contents

1 Introduction 1
1.1 About Flood Risk 1
1.1.1 Calculating Flood Risk 1
1.1.2 Flood Risk Products 2
1.2 Uses of this Report 2
1.3 Sources of Flood Risk Assessment Data Used 4
1.4 Related Resources 4
2 Flood Risk Analysis 7
2.1 Overview 7
2.2 Analysis of Risk 7
2.2.1 Changes Since Last FIRM 8
2.2.2 Flood Depth and Analysis Grids 8
2.2.3 Flood Risk Assessments 9
2.2.4 Areas of Mitigation Interest 11
3 Flood Risk Analysis Results 21
3.1 Flood Risk Map 23
3.2 Talbot County, Maryland Coastal Study Summary 25
3.2.1 Overview 25
3.2.2 Flood Risk Datasets 26
3.3 Communities 31
3.3.1 Town of Easton Summary (CID 240067) 31
3.3.2 Town of Oxford Summary (CID 240068) 37
3.3.3 Town of Queen Anne (CID 240059) 43
3.3.4 Town of St. Michaels Summary (CID 240069) 49
3.3.5 Town of Trappe Summary (CID 240108) 55
3.3.6 Talbot County (Unincorporated Areas) Summary (CID 240066) 61
4 Actions to Reduce Flood Risk 67
4.1 Types of Mitigation Actions 67
4.1.1 Preventative Measures 67
4.1.2 Property Protection Measures 68

4.1.3 Natural Resource Protection Activities 68
4.1.4 Structural Mitigation Projects 68
4.1.5 Public Education and Awareness Activities 69
4.1.6 Emergency Service Measures 69
4.2 Identifying Specific Actions for Your Community 69
4.3 Mitigation Programs and Assistance 70
4.3.1 FEMA Mitigation Programs and Assistance 71
4.3.2 Additional Mitigation Programs and Assistance 72
5 Acronyms and Definitions 73
5.1 Acronyms 73
5.2 Definitions 74
6 Additional Resources 79
7 Data Used to Develop Flood Risk Products 83

List of Tables

Table 3-1: Talbot County (Total Project Area): Estimated Potential Losses for Flood Event Scenarios 30
Table 3-2: Town of Easton (240067): Estimated Potential Losses for Flood Event Scenarios 35
Table 3-3: Town of Oxford (240068): Estimated Potential Losses for Flood Event Scenarios 41
Table 3-4: Town of Queen Anne (240059): Estimated Potential Losses for Flood Event Scenarios 47
Table 3-5: Town of St. Michaels (240069): Estimated Potential Losses for Flood Event Scenarios 53
Table 3-2: Town of Trappe (240108): Estimated Potential Losses for Flood Event Scenarios 59
Table 3-3: Talbot County (Unincorporated Areas) (240066): Estimated Potential Losses for Flood Event Scenarios 66
Table 4-1: FEMA Hazard Mitigation Assistance Programs 71

This page is intentionally left blank

FLOOD RISK REPORT

1 Introduction

1.1 About Flood Risk

Floods are naturally occurring phenomena that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops, and cause critical injuries or death.

Flooding is a natural part of our world and our communities. Flooding becomes a significant hazard, however, when it intersects with the built environment.

1.1.1 Calculating Flood Risk

It is not enough to simply identify where flooding may occur. Just because one knows where a flood occurs does not mean they know the **risk** of flooding. The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding. In other words:

Flood Risk = Probability x Consequences; where

- **Probability** = the likelihood of occurrence
- **Consequences** = the estimated impacts associated with the occurrence

The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or contributing engineering factors. Factors affecting the probability that a flood will impact an area range from changing weather patterns to the existence of mitigation projects. The ability to assess the probability of a flood and the level of accuracy for that assessment are also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans' activities within an area and how a flood impacts the natural and built environments.

Which picture below shows more flood risk?

Even if you assume that the flood in both pictures was the same probability—let's say a 10-percent-annual-chance flood—the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown in the bottom picture is higher.

1.1.2 Flood Risk Products

Through Risk MAP, FEMA provides communities with updated Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) Reports that focus on the probability of floods and that show where flooding may occur as well as the calculated 1-percent-annual-chance flood elevation. The 1-percent-annual-chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. FEMA understands that flood risk is dynamic—that flooding does not stop at a line on a map—and as such, provides the following flood risk products:

Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

- **Flood Risk Report (FRR)**: The FRR presents key risk analysis data for the Flood Risk Project.
- **Flood Risk Map (FRM)**: Like the example found in Section 3.1 of this document, the FRM shows a variety of flood risk information in the project area. More information about the data shown on the FRM may be found in Section 2 of this report.
- **Flood Risk Database (FRD)**: The FRD is in Geographic Information System (GIS) format and houses the flood risk data developed during the course of the flood risk analysis that can be used and updated by the community. After the Flood Risk Project is complete, this data can be used in many ways to visualize and communicate flood risk within the Flood Risk Project.

These Flood Risk Products provide flood risk information at both the Flood Risk Project level and community level (for those portions of each community within the Flood Risk Project). They demonstrate how decisions made within a Flood Risk Project can impact properties downstream, upstream, or both. Community-level information is particularly useful for mitigation planning and emergency management activities, which often occur at a local jurisdiction level.

1.2 Uses of this Report

The goal of this report is to help inform and enable communities and tribes to take action to reduce flood risk. Possible users of this report include:

Vulnerability of infrastructure is another important consideration.

- Local elected officials
- Floodplain managers
- Community planners
- Emergency managers
- Public works officials
- Other special interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the FRD, to:

- **Update local hazard mitigation plans.** As required by the 2000 Federal Stafford Act, local hazard mitigation plans must be updated at least every five (5) years. Summary information presented in Section 3 of this report and the FRM can be used to identify areas that may need additional focus when updating the risk assessment section of a local hazard mitigation plan. Information found in Section 4 pertains to the different mitigation techniques and programs and can be used to inform decisions related to the mitigation strategy of local plans.
- **Update community comprehensive plans.** Planners can use flood risk information in the development and/or update of comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high-hazard areas.
- **Update emergency operations and response plans.** Emergency managers can identify low-risk areas for potential evacuation and sheltering and can help first responders avoid areas of high-depth flood water. Risk assessment results may reveal vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.

Flooding along the Wabash River in Clark County, Illinois, contributed to a federal disaster declaration on June 24, 2008.

- **Develop hazard mitigation projects.** Local officials (e.g., planners and public works officials) can use flood risk information to re-evaluate and prioritize mitigation actions in local hazard mitigation plans.
- **Communicate flood risk.** Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about flood risks, changes since the last FIRM, and areas of mitigation interest. The report layout allows community information to be extracted in a fact sheet format.
- **Inform the modification of development standards.** Floodplain managers, planners, and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The Flood Risk Database, Flood Risk Map, and Flood Risk Report are “non-regulatory” products. They are available and intended for community use but are neither mandatory nor tied to the regulatory development and insurance requirements of the National Flood Insurance Program (NFIP). They may be used as regulatory products by communities if authorized by state and local enabling authorities.

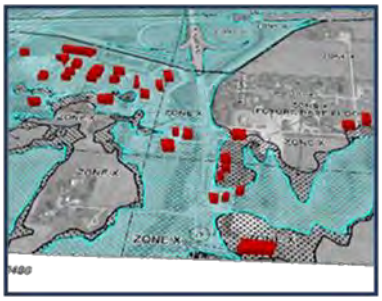
1.3 Sources of Flood Risk Assessment Data Used

To assess potential community losses, or the consequences portion of the "risk" equation, the following data is typically collected for analysis and inclusion in a Flood Risk Project:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about where the risk is most severe

For most Flood Risk Projects, FEMA uses the following sources of flood risk information to develop this report:

- Hazus-estimated flood loss information
- New engineering analyses (e.g., coastal, hydrologic, and/or hydraulic modeling) to develop new flood boundaries
- Locally supplied data (see Section 7 for a description)
- Sources identified during the Discovery process



FEMA data can be leveraged to identify and measure vulnerability by including local building information (i.e. building type). The examples above show various ways to display flooding intersecting with buildings.

1.4 Related Resources

For a more comprehensive picture of flood risk, FEMA recommends that state and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- **FIRMs and FIS Reports.** This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FIS Reports do not identify all floodplains in a Flood Risk Project. The FIS Report includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).
- **Hazus Flood Loss Estimation Reports.** Hazus can be used to generate reports, maps and tables on potential flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus can also run specialized risk assessments, such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the

National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other existing watershed reports may have a different focus, such as water quality, but may also contain flood risk and risk assessment information. See Section 6 for additional resources.

- **Flood or multi-hazard mitigation plans.** Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the Flood Risk Project.
- **Hurricane Evacuation Studies.** Produced through a joint effort by FEMA, NOAA, and USACE, Hurricane Evacuation Studies provide tools and information to the state and county emergency management offices to help determine who should evacuate during hurricane threats, and when those evacuations should occur. The information can be used to supplement or update hurricane evacuation plans and operational procedures for responding to hurricane threats.
- **FEMA Map Service Center (MSC).** The MSC has useful information, including fly sheets, phone numbers, data, etc. Letters of Map Change are also available through the MSC. The user can view FIRM databases and the National Flood Hazard Layer (NFHL) Database.

This page is intentionally left blank

2 Flood Risk Analysis

2.1 Overview

Flood hazard identification uses FIRMs, and FIS Reports identify where flooding can occur along with the probability and depth of that flooding. Flood risk assessment is the systematic approach to identifying how flooding impacts the environment. In hazard mitigation planning, flood risk assessments serve as the basis for mitigation strategies and actions by defining the hazard and enabling informed decision making. Fully assessing flood risk requires the following:

- Identifying the flooding source and determining the flood hazard occurrence probability
- Developing a complete profile of the flood hazard including historical occurrence and previous impacts
- Inventorying assets located in the identified flood hazard area
- Estimating potential future flood losses caused by exposure to the flood hazard area

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

Flood risk analyses are different methods used in flood risk assessment to help quantify and communicate flood risk. Flood risk analysis can be performed on a large scale (state, community) level and on a very small scale (parcel, census block). Advantages of large-scale flood risk analysis, especially at the watershed level, include identifying how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, flood risk analysis can provide actionable data to individual property owners so they can take appropriate mitigation steps.

2.2 Analysis of Risk

The FRR, FRM, and FRD contain a variety of flood risk analysis information and data to help describe and visualize flood risk within the project area. Depending on the scope of the Flood Risk Project for this project area, this information may include some or all of the following elements:

- Changes Since Last FIRM
- Flood Depth and Analysis Grids
- Flood Risk Assessments
- Areas of Mitigation Interest

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The flood risk analyses in the FRR, FRM, and FRD can inform the flood hazard portion of a community's or state's risk assessment. Further, data in the FRD can be used to develop information that meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

2.2.1 Changes Since Last FIRM

The Changes Since Last FIRM (CSLF) dataset, stored in the FRD and shown in Section 3 of this report, illustrates where changes to flood risk may have occurred since the last FIRM was published for the subject area. Communities can use this information to update their mitigation plans, specifically quantifying "what is at risk" and identifying possible mitigation activities.

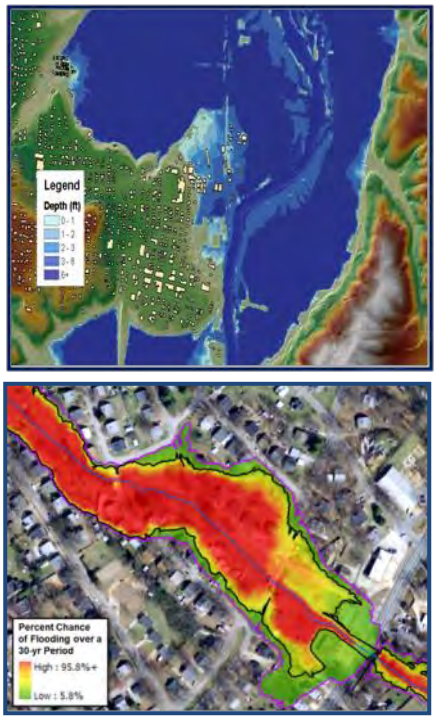
CSLF data can be used to communicate changes in the physical flood hazard area (size, location) as part of the release of new FIRMs. It can also be used in the development or update of hazard mitigation plans to describe changes in hazard as part of the hazard profile.

CSLF data is shown in the FRR, and underlying data is stored in the FRD.

The CSLF dataset identifies changes in the Special Flood Hazard Area (SFHA) and floodway boundary changes since the previous FIRM was developed. These datasets quantify land area increases and decreases to the SFHA and floodway, as well as areas where the flood zone designation has changed (e.g., Zone A to AE, AE to VE, shaded Zone X protected by levee to Zone AE for de-accredited levees).

The CSLF dataset is created in areas that were previously mapped using digital FIRMs. The CSLF dataset for this project area includes:

- **Floodplain and/or Floodway Boundary Changes**: Any changes to the existing floodplain or floodway boundaries are depicted in this dataset
- **Floodplain Designation Changes**: This includes changed floodplain designations (e.g., Zone A to Zone AE).



Grid data can make flood mapping more informative. The top image is a flood depth grid showing relative depths of water in a scenario flood event. The bottom image is a percent annual chance of flooding grid, which shows inundation areas of various frequency floods.

2.2.2 Flood Depth and Analysis Grids

Grids are FEMA datasets provided in the FRD to better describe the risk of the flood hazard. Much like the pixels in a photo or graphic, a grid is made up of square cells, where each grid cell stores a value representing a particular flood characteristic (elevation, depth, velocity, etc.) While the FIRM and FIS Report describe "what" is at risk by identifying the hazard areas, water surface, flood depth, and other analysis grids can help define "how bad" the risk is within those identified areas. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The Flood Depth and Analysis Grids provide an alternative way to visualize how a particular flood characteristic (depth, velocity, etc.) vary within the floodplain. Since they are derived from the engineering modeling results, they are typically associated with a particular frequency-based flooding event (e.g., 1-percent-annual-chance event). Grids provided in the FRD for this project area include the following:

- **Water Surface Elevation Grid:**

  This dataset represents the flood elevations calculated for the 1-percent-annual-chance flood event.

- **Flood Depth Grid:**

  Flood Depth Grids are created for each flood frequency calculated during the course of a Flood Risk Project. These grids communicate flood depth as a function of the difference between the calculated water surface elevation and the ground. Coastal flood depth grids are created for areas where the dominant wave hazard is overland wave propagation. The grid depicts the difference in elevation between the wave crest elevation, or BFE, and the ground. Coastal areas will typically only receive a depth grid for the 1-percent-annual-chance (base) flood for which overland wave propagation results are produced as a part of the FIS; however, approximate methods may be used to estimate wave crest elevations for other flood frequencies, if desired.

  Depth grids form the basis for refined flood risk assessments (as presented in a table in Section 3 of this report) and are used to calculate potential flood losses for display on the FRM and for tabular presentation in this report. Depth grids may also be used for a variety of ad-hoc risk visualization and mitigation initiatives.

Grid data can be used to communicate the variability of floodplains, such as where floodplains are particularly deep or hazardous, where residual risks lie behind levees, and where losses may be great after a flood event. For mitigation planning, grid data can inform the hazard profile and vulnerability analysis (what is at risk for different frequencies) and can be used for preliminary benefit-cost analysis screening. For floodplain management, higher regulatory standards can be developed in higher hazard flood prone areas (i.e., 10-percent-annual-chance floodplains or deep floodplains).

Grid data is stored in the FRD, and a list of available grid data is provided in the FRR.

2.2.3 Flood Risk Assessments

Flood risk assessment results reported in the FRR were developed using a FEMA flood loss estimation tool, Hazus. Hazus (www.fema.gov/Hazus) is a nationally-applicable and standardized risk assessment tool that estimates potential losses from earthquakes, floods, and hurricanes. It uses GIS technology to estimate physical, economic, and social impacts of disasters, Hazus can be used to help individuals and communities graphically visualize the areas where flood risk is highest. Some benefits of using Hazus include the following:

- Outputs that can enhance state and local mitigation plans and help screen for cost-effectiveness in FEMA mitigation grant programs
- Analysis refinement through updating inventory data and integrating data produced using other flood models
- Widely available support documents and networks (Hazus Users Groups)

Files from the FRD can be imported into Hazus to develop other risk assessment information including:

- Debris generated after a flood event
- Dollar loss of the agricultural products in a study region
- Utility system damages in the region
- Vehicle loss in the study region
- Damages and functionality of lifelines such as highway and rail bridges, potable water, and wastewater facilities

Hazus is a loss estimation methodology developed by FEMA for flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

Scenario-Based Flood Loss Estimates:

For the Average Annualized Loss (AAL) study, scenario-based flood losses have been calculated using Hazus (Version 2.1) for the 2-, 1-, 0.5-, and 0.2 percent-annual-chance flood events. For the 'refined' study, Hazus (Version 3.1) was used to calculate coastal flood losses for the 1-percent-annual-chance flood event. In this report, these losses are expressed in dollar amounts and are provided for the Coastal Flood Risk Project area only, even though results are shown at the local jurisdiction level.

Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from flood and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Flood loss estimates in this report are being provided at the project and community levels for multiple flood frequencies, and include the following:

Flood risk assessment data can be used in many ways to support local decision making and explanation of flood risk. For mitigation planning purposes, loss data can be used to help meet requirements to develop loss information for the hazard of flood. Also, the FRM can show where flood risk varies by geographic location. For emergency management, risk assessment data can help forecast losses based on predicted events, and resources can be assigned accordingly. Loss information can support floodplain management efforts, including those to adopt higher regulatory standards. Awareness of at-risk essential facilities and infrastructure also encourages mitigation actions to protect citizens from service disruption should flooding occur.

Flood risk assessment loss data is summarized in the FRR and on the FRM and stored in the FRD.

- **Residential Asset Loss**: These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss**: These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content and inventory losses.

- **Other Asset Loss**: This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content and inventory losses.
- **Business Disruption**: This includes the losses associated with the inability to operate a business due to the damage sustained during the flood. Losses include inventory, income, rental income, wage, and direct output losses, as well as relocation costs.
- **Annualized Losses**: Annualized losses are calculated using Hazus by taking losses from multiple events over different frequencies and expressing the long-term average by year. This factors in historic patterns of frequent smaller floods with infrequent but larger events to provide a balanced presentation of flood damage.
- **Loss Ratio:** The loss ratio expresses the scenario losses divided by the total building value for a local jurisdiction and can be a gage to determine overall community resilience as a result of a scenario event. For example, a loss ratio of 5 percent for a given scenario would indicate that a local jurisdiction would be more resilient and recover more easily from a given event, versus a loss ratio of 75 percent which would indicate widespread losses. An annualized loss ratio uses the annualized loss data as a basis for computing the ratio. Loss ratios are not computed for business disruption. These data are presented in the FRR.
- **Hazus Flood Risk Value:** On the FRM, flood risk is expressed in the following five categories: very low, low, medium, high, and very high for census blocks that have flood risk. It is based on the 1-percent-annual-chance total asset loss by census block.
- **Annualized Losses:** Annualized losses are calculated using Hazus by taking losses from mulitple events over different frequencies and expressing the long-term average by year. This factors in historic patterns of frequent smaller floods with infrequent but larger events to provide a balanced presentation of flood damage.

2.2.4 Areas of Mitigation Interest

Many factors contribute to flooding and flood losses. Some are natural, and some are not. In response to these risks, there has been a focus by the Federal government, State agencies, and local jurisdictions to mitigate properties against the impacts of flood hazards so that future losses and impacts can be reduced. An area identified as an Area of Mitigation Interest (AoMI) is an important element of defining a more comprehensive picture of flood risk and mitigation activity in a watershed, identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

AoMIs are identified through coordination with local stakeholders; through revised hydrologic and hydraulic and/or coastal analyses; by leveraging other studies or previous flood studies; from community mitigation plans, floodplain management plans, and local surveys; and from the mining of federal government databases (e.g., flood claims, disaster grants, and data from other agencies). Below is a list of the types of Areas of Mitigation Interest, however specific AoMIs were not identified as part of this project.

- **Dams**

A dam is a barrier built across a waterway for impounding water. Dams vary from impoundments that are hundreds of feet tall and contain thousands of acre-feet of water (e.g., Hoover Dam) to small dams that are a few feet high and contain only a few acre-feet of water (e.g., small residential pond). “Dry dams,” which are designed to contain water only during floods and do not impound water except for the purposes of flood control, include otherwise dry land behind the dam.

Dams vary in size and shape, the amount of water they impound, and their assigned hazard classification.
Whether or not an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

While most modern, large dams are highly engineered structures with components such as impervious cores and emergency spillways, most smaller and older dams are not. State dam safety programs emerged in the 1960s, and the first Federal Guidelines for Dam Safety were not prepared until 1979. By this time, the vast majority of dams in the United States had already been constructed.

- **Reasons dams are considered AoMIs:**
  - Many older dams were not built to any particular standard and thus may not withstand extreme rainfall events. Older dams in some parts of the country are made out of an assortment of materials. These structures may not have any capacity to release water and could be overtopped, which could result in catastrophic failure.
  - Dams may not always be regulated, given that the downstream risk may have changed since the dam was constructed or since the hazard classification was determined. Years after a dam is built, a house, subdivision, or other development may be constructed in the dam failure inundation zone downstream of the dam. Thus, a subsequent dam failure could result in downstream consequences, including property damage and the potential loss of life. Since these dams are not regulated, it is impossible to predict how safe they are.

This dam failure caused flooding that damaged several homes and vehicles.

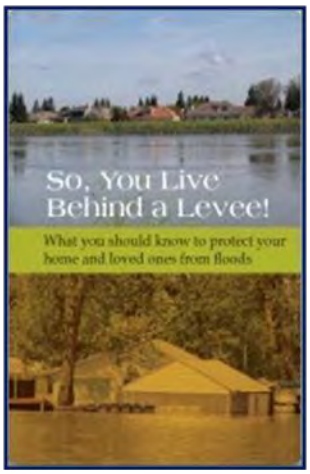
  - A significant dam failure risk is structural deficiencies associated with older dams that are not being adequately addressed today through needed inspection/maintenance practices.
  - For larger dams a flood easement may have been obtained on a property upstream or downstream of the dam. However, there may have been buildings constructed in violation of the flood easement.

- When a new dam is constructed, the placement of such a large volume of material in a floodplain area (if that is the dam location) will displace flood waters and can alter how the watercourse flows. This can result in flooding upstream, downstream, or both.
- For many dams, the dam failure inundation zone is not known. Not having knowledge of these risk areas could lead to unprotected development in these zones.

- **Levees**

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes. Soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

Similar to dams, levees have not been regulated in terms of safety and design standards until relatively recently. Many older levees were constructed in a variety of ways, from a farmer piling dirt along a stream to prevent nuisance flooding to levees made out of old mining spoil material. As engineered structures, levees are designed to a certain height and can fail if a flood event is greater than anticipated.



For more information about the risks associated with living behind levees, consult the publication "So, You Live Behind a Levee!" published by the American Society of Civil Engineers at http://content.asce.org/ASCELeveeGuide.html

A floodwall is a vertical wall that is built to reduce the flood hazard in a similar manner as a levee. Typically made of concrete or steel, floodwalls often are erected in urban locations where there is not enough room for a levee. Floodwalls are sometimes constructed on a levee crown to increase the levee's height.

Most new dams and levees are engineered to a certain design standard. If that design is exceeded, they could be overtopped and fail catastrophically, causing more damage than if the levee was not there in the first place. Few levees anywhere in the nation are built to more than a 1-percent-annual-chance flood, and the areas behind them are still at some risk for flooding. In some states, the flooding threat can extend up to 15 miles from a riverbank. Although the probability of flooding may be lower because a levee exists, risk is nonetheless still present. The American Society of Civil Engineers' publication "So, You Live Behind a Levee!" provides an in-depth explanation of levee and residual risk.

- **Reasons levees are considered AoMIs:**

Canal levee breaches as a result of Hurricane Katrina in New Orleans in 2005. Note damages can be more extensive due to high velocity flood flows than if the levee was not there.

  - Like dams, many levees in the United States were constructed using unknown techniques and materials. These levees have a higher failure rate than those that have been designed to today's standards.
  - A levee might not provide the flood risk reduction it once did as a result of flood risk changes over time. Flood risk can change due to a number of factors, including increased flood levels due to climate change or better estimates of flooding, development in the watershed increasing flood levels and settlement of the levee or floodwall, and sedimentation in the levee channel. Increased flood levels mean decreased reduction of the flood hazard. The lack of adequate maintenance over time will also reduce the capability of a levee to contain the flood levels for which it was originally designed.
  - Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity. Still, a widespread public perception of levees is that they will always provide protection. This perception may lead to not taking mitigation actions such as purchasing flood insurance.
  - A levee is a system that can fail due to its weakest point, and therefore maintenance is critical. Many levees in the United States are poorly maintained or not maintained at all. Maintenance also includes maintaining the drainage systems behind the levees so they can keep the protected area dry.

- **Coastal Structures**

Coastal structures, such as seawalls and revetments, are typically used to stabilize the shoreline to mitigate or prevent flood and/or erosion losses. Structures, such as jetties, groins and breakwaters, are constructed along naturally dynamic shorelines to alter the physical processes (e.g. sediment transport) for purposes that include reduction of long-term erosion rates, improvements to safe navigation (e.g., into ports), and reduction of erosive wave forces impacting a coast.

- **Reasons coastal structures are considered AoMIs:**
  - Coastal structures may provide flood or erosion protection for one site. However, they may also interrupt the sediment transport process, resulting in accelerated coastal erosion downdrift of the structure.
  - Coastal structures are typically designed to withstand the forces associated with extreme design conditions of waves and water levels. Adequate protection may not be provided if these conditions are exceeded.

- As with other infrastucture such as roads, bridges, and utilities, regular maintenance of shoreline protection structures is essential to ensure that they continue to provide the intended protection from flooding and erosion.

- **Stream Flow Constrictions**

  A stream flow constriction occurs when a human-made structure, such as a culvert or bridge, constricts the flow of a river or stream. The results of this constriction can be increased damage potential to the structure, an increase in velocity of flow through the structure, and the creation of significant ponding or backwater upstream of the structure. Regulatory standards regarding the proper opening size for a structure spanning a river or stream are not consistent and may be non-existent. Some local regulations require structures to pass a volume of water that corresponds to a certain size rain event; however, under sizing, these openings can result in flood damage to the structure itself. After a large flood event, it is not uncommon to have numerous bridges and culverts "washed out."

  - **Reasons stream flow constrictions are considered AoMIs:**
    - Stream flow constrictions can back water up on property upstream of the structure if not designed properly.
    - These structures can accelerate the flow through the structure causing downstream erosion if not properly mitigated. This erosion can affect the structure itself, causing undermining and failure.
    - If the constriction is a bridge or culvert, it can get washed out causing an area to become isolated and potentially more difficult to evacuate.
    - Washed-out culverts and associated debris can wash downstream and cause additional constrictions.

- **At-Risk Essential Facilities**

  Essential facilities, sometimes called "critical facilities," are those whose impairment during a flood could cause significant problems to individuals or communities. For example, when a community's wastewater treatment is flooded and shut down, not only do contaminants escape and flow into the floodwaters, but backflows of sewage can contaminate basements or other areas of the community. Similarly, when a facility such as a hospital is flooded, it can result in a significant hardship on the community not only during the event but long afterwards as well.

  - **Reasons at-risk essential facilities are considered AoMIs:**
    - Costly and specialized equipment may be damaged and need to be replaced.
    - Impairments to facilities such as fire stations may result in lengthy delays in responding and a focus on evacuating the facility itself.
    - Critical records and information stored at these facilities may be lost.

- **Past Flood Insurance Claims and Individual Assistance/Public Assistance Hotspots**

Assistance provided after flood events (flood insurance in any event and Individual Assistance [IA] or Public Assistance [PA] after declared disasters) occurs in flood affected areas. Understanding geographically where this assistance is being provided may indicate unique flood problems.

Clusters of past flood insurance claims can show where there is a repetitive flood problem.

Flood insurance claims are not always equally distributed in a community. Although estimates indicate that 20 to 50 percent of structures in identified flood hazard areas have flood insurance, clusters of past claims may indicate where there is a flood problem. However, clusters of past claims and/or areas where there are high payments under FEMA's IA or PA Programs may indicate areas of significant flood hazard.

- **Reasons past claim hotspots are considered AoMIs:**
  - A past claim hotspot may reflect an area of recent construction (large numbers of flood insurance policies as a result of a large number of mortgages) and an area where the as-built construction is not in accordance with local floodplain management regulations.
  - Sometimes clusters of past claims occur in subdivisions that were constructed before flood protection standards were in place, places with inadequate stormwater management systems, or in areas that may not have been identified as SFHAs.
  - Clusters of IA or PA claims may indicate areas where high flood insurance coverage or other mitigation actions are needed.

- **Areas of Significant Land Use Change**

  Development, whether it is a 100-lot subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas, thereby increasing flood hazards downstream.

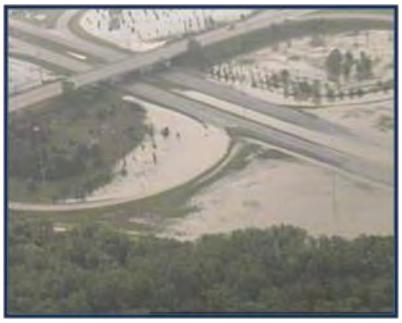
  Additionally, when development occurs, hard surfaces such as parking lots, buildings and driveways do not allow water to absorb into the ground, and more of the rainwater becomes runoff flowing directly into streams. As a result, the "peak flow" in a stream after a storm event will be higher and will occur faster. Without careful planning, major land use changes can affect the impervious area of a site and result in a significant increase in flood risk caused by streams that cannot handle the extra storm water runoff.

Changes in land use in areas vulnerable to coastal flooding may affect the severity of wave hazards. Wave energy dissipates as waves propagate through forested areas or areas with dense development while wave energy can increase in open areas such as agricultural fields or parking lots. Changes in land use can affect wave hazards beyond the immediate area of land use change.

Rooftops, pavements, patios, and driveways contribute to the impervious area in a watershed. This occurs in both urban areas and rural areas being developed.

- **Reasons Areas of Significant Land Use Change are considered AoMIs:**
  - Development in areas mapped SFHA reduces flood storage areas, which can make flooding worse at the development site and downstream of it.
  - Impervious surfaces speed up the water flowing in the streams, which can increase erosion and the danger that fast-flowing floodwaters pose to people and buildings.
  - Open areas can allow wave energy to increase while densely developed areas and dense vegetation cover often obstruct waves. These obstructions diminish the wave's potentially destructive forces in areas inland of the obstructions.
  - Rezoning flood-prone areas to high densities and/or higher intensity uses can result in more people and property at risk of flooding and flood damage.

- **Key Emergency Routes Overtopped During Frequent Flooding Events**



When large highways close due to flooding, traffic is detoured causing inconvenience and economic loss.

Roads are not always elevated above estimated flood levels, and present a significant flood risk to motorists during flooding events. When alternate routes are available, risks may be reduced, including risks to life and economic loss.

- **Reasons overtopped roads are considered AoMIs:**
  - Such areas, when identified, can be accounted for and incorporated into Emergency Action Plans.
  - Roads may be elevated or reinforced to reduce the risk of overtopping during flood events.

- **Drainage or Stormwater-Based Flood Hazard Areas, or Areas Not Identified as Floodprone on the FIRM But Known to Be Inundated**

Flood hazard areas exist everywhere. While FEMA maps many of these, others are not identified. Many of these areas may be located in communities with existing, older, and often inadequate stormwater management systems or in very rural areas. Other similar areas could be a result of complex or unique drainage characteristics. Even though they are not mapped, awareness of these areas is important so adequate planning and mitigation actions can be performed.

- **Reasons drainage or stormwater-based flood hazard areas or unidentified floodprone locations are considered AoMIs:**
  - So further investigation of such areas can occur and, based on scientific data, appropriate mitigation actions can result (i.e., land use and building standards).
  - To create viable mitigation project applications in order to reduce flood losses.

- **Areas of Mitigation Success**

Flood mitigation projects are powerful tools to communicate the concepts of mitigation and result in more resilient communities. Multiple agencies have undertaken flood hazard mitigation actions for decades. Both structural measures—those that result in flood control structures—and non-structural measures have been implemented in thousands of communities. An extensive list of mitigation actions can be found in Section 4.

- **Reasons areas of mitigation success are considered AoMIs:**
  - Mitigation successes identify those areas within the community that have experienced a reduction or elimination of flood risk.
  - Such areas are essential in demonstrating successful loss reduction measures and in educating citizens and officials on available flood hazard mitigation techniques.
  - Avoided losses can be calculated and shown.

- **Areas of Significant Riverine or Coastal Erosion**

Stream channels are shaped by a number of factors, including: degradation, aggradation, general scour, local scour, deposition, and lateral migration. Streams are constantly progressing towards a state of dynamic equilibrium involving water and sediment.

Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion is typically exasperated.

- **Reasons why areas of significant riverine or coastal erosion are considered AoMIs:**
  - Riverine flood damage assessments generally consider inundation alone
  - Bank erosion caused by within channel flows is not recognized as a significant hazard in Federal floodplain management regulations

- Riverine and coastal erosion can undercut structures and roads, causing instability and possible collapse.
- Landslides and mudslides are a result of erosion
- Approximately one-third of the nation's streams experience severe erosion problems
- Erosion of coastal barrier islands can result in breaches, washing out roads and cutting off access routes
- Erosion often occurs along beaches during storms, especially severe storms that stay offshore for long durations and result in ongoing "battering" of the shoreline from high winds and waves. As the beach erodes, vulnerable properties are placed at even greater risk to coastal flooding from later storm surge, high tides, and wave action.

- **Other**

  Other types of flood risk areas include drainage or stormwater-based flood hazard areas, or areas known to be inundated during storm events.

This page is intentionally left blank

3 Flood Risk Analysis Results

The following pages provide summary flood risk results for the Flood Risk Project as follows:

- **Flood Risk Map (FRM).** Within the Flood Risk Project the FRM displays base data reflecting community boundaries, major roads, and stream lines; potential losses for the refined 1-percent-annual-chance Coastal Flood Risk Study; new Flood Risk Project areas; and graphics and text that promote access and usage of additional data available through the FRD, FIRM, and National Flood Hazard Layer and viewers (desktop or FEMA website, etc.). This information can be used to assist in Flood Risk Project-level planning as well as for developing mitigation actions within each jurisdiction located within the Flood Risk Project.

The FRM provides a graphical overview of the Flood Risk Project which highlights areas of risk that should be noted, based on potential losses, exposed facilities, etc., based on data found in the FRD. Refer to the data in the FRD to conduct additional analyses.

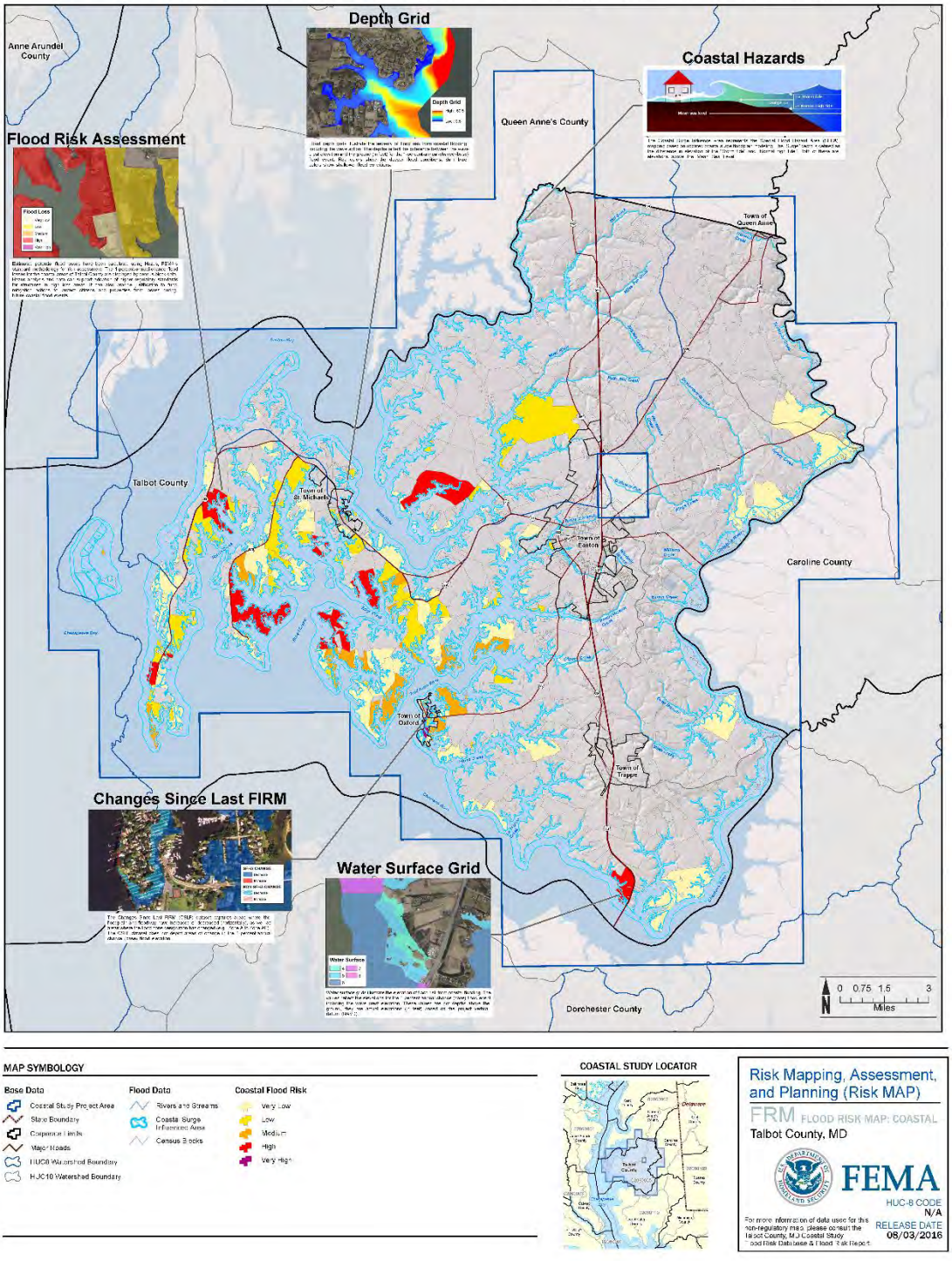
- **Flood Risk Project Summary.** Within the Flood Risk Project area, summary data for some or all of the following datasets are provided for the entire project area and also on a jurisdiction by jurisdiction basis:
    - **Changes Since Last FIRM (CSLF).** This is a summary of where the floodplain and flood zones have increased or decreased (only analyzed for areas that were previously mapped using digital FIRMs).
    - **Flood Depth and Analysis Grids.** A general discussion of the data provided in the FRD, including coastal analysis grids if furnished as part of the project.
    - **Flood Risk Assessments.** A loss estimation of potential flood damages from the 1-percent-annual-chance flood scenario.

This page is intentionally left blank

3.1 Flood Risk Map

The Flood Risk Map for this Flood Risk Project is shown below. In addition to this reduced version of the map, a full size version is available within the FRD.

Flood Risk Map: Talbot County, MD (Coastal) Effective 08/03/2016



This page left intentionally blank.

3.2 Talbot County, Maryland Coastal Study Summary

Talbot County is located in Eastern Maryland on the Eastern Shore of the Chesapeake Bay. It is bordered to the north by Queen Anne's County, to the south by Dorchester County, to the west by the Chesapeake Bay, and to the east by Caroline County. The county is mostly rural, but contains some higher-density development and commercial activity in the incorporated communities of Easton, Trappe, and St. Michaels. The county has 269 square miles of land area and a population of 37,782. Some of the major industries in Talbot County include agricultural activities such as soybean, corn, and poultry farming, and maritime activities like seafood processing and harvesting, sailing, and fishing.

Although Talbot County has a continental climate, temperature fluctuations over the year are moderated by the county's close proximity to the Chesapeake Bay and Atlantic Ocean. Temperatures in the county range from an average of 77˚F in summer to an average of 39°F in winter. In general, the terrain in Talbot County is fairly flat due to its location on the Atlantic Coastal Plain. Historically, coastal flooding problems in the county have largely been a result of impacts from tropical cyclones during the summer. Recent flooding events include Hurricane Isabel in 2003, Hurricane Irene in 2011, and Hurricane Sandy in 2012 (FEMA, 2014; U.S. Census Bureau, 2016; Talbot County Government, 2016).

3.2.1 Overview

Talbot County, located in Maryland, includes the following communities within the coastal region:

Community Name	CID	Total Community Population[1]	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Town of Easton	240067	15,945	86	10.6	92	Y	10	Y
Town of Oxford	240068	651	100	0.5	100	Y	10	Y
Town of Queen Anne	240059	98	100	0.1	100	Y	10	Y
Town of St. Michaels	240069	1,029	100	1.2	100	Y	10	Y
Town of Trappe	240108	1,077	100	2.8	100	Y	10	Y
Talbot County (Unincorporated Areas)	240066	18,982	98	253.8	98	Y	10	Y

[1]Population according to 2010 U.S. Census

Note: The Town of Queen Anne is a multi-county community that is included in its entirety in the Flood Insurance Study for Queen Anne's County and Incorporated Areas. The Town of Queen Anne has no mapped coastal flood risk hazards in Queen Anne's County and is therefore not included in the Coastal Flood Risk for Queen Anne's County.

Community-specific results are provided on subsequent pages. Data provided below and on subsequent pages only includes areas located within the Talbot County, Maryland Coastal Flood Risk Project and do not necessarily represent community-wide totals.

Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.2.2 Flood Risk Datasets

As a part of this Flood Risk Project, flood risk datasets were created for inclusion in the Flood Risk Database. Those datasets are summarized for this Flood Risk Project below:

- **Changes Since Last FIRM**
  - Special Flood Hazard Area (SFHA) boundaries within Talbot County were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:
    - Previous FIRM effective date: August 5, 2013
    - Revised Preliminary FIRM date: November 14, 2014
    - Current FIRM effective date: July 20, 2016
  - The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:
    - Increase: new area in the current effective FIRM compared to the previous effective FIRM.
    - Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
    - Net Change: calculated as ‘Increase’ minus ‘Decrease’.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for the county.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	67.8	5.6	25.5	-19.9
Within Floodway	<0.1	0	<0.1	>-0.1
Within CHHA (Zone VE or V)	13.0	4.7	4.9	-0.1

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- Evidence of actual flood losses can be one of the most compelling factors for increasing a community's flood risk awareness. Specific areas within each jurisdiction are detailed within the individual community summaries

- **Flood Depth and Analysis Grids**

  - The FRD contains datasets in the form of depth grids for the entire Flood Risk Project that can be used for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The data provided within the FRD should be used to further isolate areas where flood mitigation potential is high and may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation. Section 2 of the FRR provides general information regarding the development of and potential uses for this data. See the FRD for the following depth grid data:
    - Flood depth grid (1-percent-annual-chance flood event)
    - Water surface grid (1-percent-annual-chance flood event)

- **Flood Risk Results Information**

  - Talbot County, Maryland's coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.
  - The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

    National 2010 AAL Study Data

    This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses

from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

- **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
- **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.
- **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

Flood Risk Project Refined Data

This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

- **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.
- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this feature class, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective July 20, 2016), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (building + contents value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids

for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.

- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and contents losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.
- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-1: Talbot County (Total Project Area): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$303,400,000	89%	N/A	N/A	N/A	N/A	$18,700,000	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$32,100,000	9%	N/A	N/A	N/A	N/A	$7,000,000	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$5,200,000	2%	N/A	N/A	N/A	N/A	$900,000	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	**$340,700,000**	**100%**	**N/A**	**N/A**	**N/A**	**N/A**	**$26,600,000**	N/A	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$1,600,000	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	**$340,700,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$28,200,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$2,435,300,000	61%	N/A	N/A	$46,100,000	2%	$63,700,000	3%	$103,400,000	4%	$1,100,000	<1%
Commercial Building & Contents	$1,056,900,000	26%	N/A	N/A	$9,600,000	1%	$13,300,000	1%	$23,000,000	2%	$200,000	<1%
Other Building & Contents	$500,400,000	13%	N/A	N/A	$5,700,000	1%	$7,500,000	2%	$12,300,000	2%	$100,000	1%
Total Building & Contents[3]	**$3,992,500,000**	**100%**	**N/A**	**N/A**	**$61,400,000**	**2%**	**$84,500,000**	**2%**	**$138,600,000**	**3%**	**$1,400,000**	<1%
Business Disruption[4]	N/A	N/A	N/A	N/A	$2,000,000	N/A	$2,600,000	N/A	$4,200,000	N/A	$10,000	N/A
TOTAL[5]	**$3,992,500,000**	**N/A**	**N/A**	**N/A**	**$63,400,000**	**N/A**	**$87,100,000**	**N/A**	**$142,800,000**	**N/A**	**$1,400,000**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal Study

3.3 Communities

The following sections provide an overview of the community's floodplain management program as of the date of this publication, as well as summarize the flood risk analysis performed for each project area in Talbot County, Maryland.

3.3.1 Town of Easton Summary (CID 240067)

The following pages include Flood Risk data for the Town of Easton.

3.3.1.1 Overview

The Town of Easton is located on the Tred Avon River in the central part of Talbot County. In 2010, the city had a population of 15,945. Easton is the largest incorporated community in Talbot County and also acts as the county seat. U.S. Highway 50 is the major highway going through the town and connects it to other urban centers on Maryland's Eastern Shore. Easton has a dense and historic downtown with a large number of shops, restaurants, government buildings, and other businesses, which makes it an important center for commercial activity and tourism in Talbot County (U.S. Census Bureau, 2016; Town of Easton, 2010).

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Town of Easton	240067	15,945	86%	10.6	92%	Y	10	Y

- Participating in the Talbot County Hazard Mitigation Plan which expires December 19th, 2016.
- Past Federal Disaster Declarations for flooding = 6
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 102 policies totaling approximately $27,341,100
- NFIP-recognized repetitive loss properties = there are less than 5 properties (per Operational Standard 443 this is recorded as NULL in the FRD)
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Easton that are located within the Talbot County, Maryland Coastal Study Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.1.2 Community Analyses and Results

- **Changes Since Last FIRM**
  - Special Flood Hazard Area (SFHA) boundaries within the Town of Easton were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:
    - Previous FIRM effective date: August 5, 2013
    - Revised Preliminary FIRM date: November 14, 2014
    - Current FIRM effective date: July 20, 2016
  - The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:
    - Increase: new area in the current effective FIRM compared to the previous effective FIRM.
    - Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
    - Net Change: calculated as 'Increase' minus 'Decrease'.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for the Town of Easton.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.2	<0.1	0.1	>-0.1
Within Floodway	<0.1	0	<0.1	>-0.1
Within CHHA (Zone VE or V)	0	0	0	0

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grid (1-percent-annual-chance flood event)
    - Flood depth grid (1-percent-annual-chance flood event)

- Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results Information**

  - The Town of Easton's coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.

  - The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

    National 2010 AAL Study Data

    This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

    - **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
    - **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
    - **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.
    - **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

    Flood Risk Project Refined Data

    This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct

comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

- **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.
- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this feature class, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective July 20, 2016), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (building + contents value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.
- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and contents losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.
- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-2: Town of Easton (240067): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$0**	N/A	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$701,000,000	43%	N/A	N/A	$600,000	<1%	$700,000	<1%	$1,000,000	<1%	$10,000	<1%
Commercial Building & Contents	$698,100,000	43%	N/A	N/A	$500,000	<1%	$700,000	<1%	$1,100,000	<1%	$10,000	<1%
Other Building & Contents	$224,000,000	14%	N/A	N/A	$100,000	<1%	$200,000	<1%	$300,000	<1%	<$10,000	<1%
Total Building & Contents[3]	**$1,623,100,000**	**100%**	**N/A**	**N/A**	**$1,200,000**	**<1%**	**$1,600,000**	**<1%**	**$2,400,000**	**<1%**	**$20,000**	<1%
Business Disruption[4]	N/A	N/A	N/A	N/A	$30,000	N/A	$50,000	N/A	$100,000	N/A	$0	N/A
TOTAL[5]	**$1,623,100,000**	**N/A**	**N/A**	**N/A**	**$1,200,000**	**N/A**	**$1,600,000**	**N/A**	**$2,500,000**	**N/A**	**$20,000**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal Study

This page is intentionally left blank

3.3.2 Town of Oxford Summary (CID 240068)

The following pages include Flood Risk data for the Town of Oxford.

3.3.2.1 Overview

The Town of Oxford is located in Southwestern Talbot County where the Tred Avon River meets the Chesapeake Bay. In 2010, Oxford had a population of 651. The primary road going through the town is State Route 333, which connects it to the Town of Easton. The town's location on the Chesapeake Bay makes it a local center for maritime activity in Talbot County, and it attracts visitors and tourists who seek a quiet and charming small town away from the larger urban centers in the region (U.S. Census Bureau, 2016; Town of Oxford, 2016).

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Town of Oxford	240068	651	100%	0.5	100%	Y	10	Y

- Participating in the Talbot County Hazard Mitigation Plan which expires December 19th, 2016.
- Past Federal Disaster Declarations for flooding = 6
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 299 policies totaling approximately $80,175,000
- NFIP-recognized repetitive loss properties = 10
- NFIP-recognized severe repetitive loss properties = there are less than 5 properties (per Operational Standard 443 this is recorded as NULL in the FRD)

Data provided below only includes areas in the Town of Oxford that are located within the Talbot County, Maryland Coastal Study Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.2.2 Community Analyses and Results

- **Changes Since Last FIRM**
  - Special Flood Hazard Area (SFHA) boundaries within the Town of Oxford were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood

elevations in some areas and leveraged recently developed LiDAR-based topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:

  - Previous FIRM effective date: August 5, 2013
  - Revised Preliminary FIRM date: November 14, 2014
  - Current FIRM effective date: July 20, 2016
- The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:
  - Increase: new area in the current effective FIRM compared to the previous effective FIRM.
  - Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
  - Net Change: calculated as 'Increase' minus 'Decrease'.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for the Town of Oxford.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.3	<0.1	0.1	-0.1
Within Floodway	0	0	0	0
Within CHHA (Zone VE or V)	<0.1	<0.1	<0.1	>-0.1

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grid (1-percent-annual-chance flood event)
    - Flood depth grid (1-percent-annual-chance flood event)
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results Information**
  - The Town of Oxford's coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.
  - The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

    National 2010 AAL Study Data

    This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

    - **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
    - **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
    - **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.
    - **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

    Flood Risk Project Refined Data

    This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

- **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.
- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this feature class, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective July 20, 2016), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (building + contents value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.
- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and contents losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.
- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-3: Town of Oxford (240068): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$62,500,000	81%	N/A	N/A	N/A	N/A	$2,900,000	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$12,100,000	16%	N/A	N/A	N/A	N/A	$1,100,000	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$2,200,000	3%	N/A	N/A	N/A	N/A	$30,000	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	**$76,700,000**	**100%**	**N/A**	**N/A**	**N/A**	**N/A**	**$4,100,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$900,000	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	**$76,700,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$5,000,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$84,200,000	74%	N/A	N/A	$5,500,000	7%	$7,700,000	9%	$11,000,000	13%	$100,000	<1%
Commercial Building & Contents	$18,200,000	16%	N/A	N/A	$1,700,000	9%	$2,400,000	13%	$3,600,000	20%	$40,000	<1%
Other Building & Contents	$11,300,000	10%	N/A	N/A	$1,000,000	8%	$1,300,000	12%	$2,000,000	18%	$20,000	<1%
Total Building & Contents[3]	**$113,700,000**	**100%**	**N/A**	**N/A**	**$8,200,000**	**7%**	**$11,400,000**	**10%**	**$16,600,000**	**15%**	**$200,000**	**<1%**
Business Disruption[4]	N/A	N/A	N/A	N/A	$400,000	N/A	$500,000	N/A	$700,000	N/A	<$10,000	N/A
TOTAL[5]	**$113,700,000**	**N/A**	**N/A**	**N/A**	**$8,600,000**	**N/A**	**$11,900,000**	**N/A**	**$17,300,000**	**N/A**	**$200,000**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal Study

This page left intentionally blank.

3.3.3 Town of Queen Anne (CID 240059)

The following pages include Flood Risk data for the Town of Queen Anne.

3.3.3.1 Overview

The Town of Queen Anne is located in Northeastern Talbot County on Tuckahoe Creek. It is a multi-county community that is split between Queen Anne's and Talbot County. The major roads going through the Queen Anne include State Routes 303, 309, and 404, which all converge near the center of town. The town of Hillsboro, in Caroline County, is located adjacent to Queen Anne on the opposite side of Tuckahoe Creek (U.S. Census Bureau, 2016).

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Town of Queen Anne	240059	98	100%	0.1	100%	Y	10	Y

- Participating in the Talbot County Hazard Mitigation Plan which expires December 19th, 2016.
- Past Federal Disaster Declarations for flooding = 6
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = there are less than 5 properties (per Operational Standard 443 this is recorded as NULL in the FRD)0
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Queen Anne that are located within the Talbot County, Maryland Coastal Study Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.3.2 Community Analyses and Results

- **Changes Since Last FIRM**
  - Special Flood Hazard Area (SFHA) boundaries within the Town of Queen Anne were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based

topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:

- Previous FIRM effective date: September 27, 1985
- Preliminary FIRM date: September 28, 2012
- Current FIRM effective date: November 5, 2014

o The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:

- Increase: new area in the current effective FIRM compared to the previous effective FIRM.
- Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
- Net Change: calculated as 'Increase' minus 'Decrease'.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for the Town of Queen Anne.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0	0	0	0
Within Floodway	0	0	0	0
Within CHHA (Zone VE or V)	0	0	0	0

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**

o See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):

- Water surface elevation grid (1-percent-annual-chance flood event)
- Flood depth grid (1-percent-annual-chance flood event)

o Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results Information**

- The Town of Queen Anne's coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.
- The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

  National 2010 AAL Study Data

  This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

  - **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
  - **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
  - **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.
  - **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

  Flood Risk Project Refined Data

  This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

  - **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.

- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this feature class, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the Queen Anne's County, Maryland FIRM, effective November 5, 2014), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (building + contents value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.
- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and contents losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.
- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-4: Town of Queen Anne (240059): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$0**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$5,100,000	98%	N/A	N/A	$70,000	1%	$90,000	2%	$200,000	3%	<$10,000	<1%
Commercial Building & Contents	$100,000	2%	N/A	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
Other Building & Contents	$0	0%	N/A	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
Total Building & Contents[3]	**$5,200,000**	**100%**	**N/A**	**N/A**	**$70,000**	**1%**	**$90,000**	**2%**	**$200,000**	**3%**	**<$10,000**	**<1%**
Business Disruption[4]	N/A	N/A	N/A	N/A	$0	N/A	$0	N/A	$0	N/A	$0	N/A
TOTAL[5]	**$5,200,000**	**N/A**	**N/A**	**N/A**	**$70,000**	**N/A**	**$90,000**	**N/A**	**$200,000**	**N/A**	**<$10,000**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal Study

This page left intentionally blank.

3.3.4 Town of St. Michaels Summary (CID 240069)

The following pages include Flood Risk data for the Town of St. Michaels.

3.3.4.1 Overview

The Town of St. Michaels is located in Western Talbot County on the Miles River, which flows into the Chesapeake Bay. In 2010, St. Michaels had a population of 1,029. The primary road going through the town is State Route 333, which connects it to the Town of Easton and other urban centers on Maryland's Eastern Shore. For most of its history, the economy of St. Michaels was focused around the shipbuilding and seafood processing industries. In recent years, tourism has major industry in St. Michaels because of the town offers a wide variety of maritime activities for visitors and has vibrant waterfront and downtown areas. St. Michaels is also home to the Chesapeake Bay Maritime Museum (U.S. Census Bureau, 2016; St. Michaels Business Association, 2016).

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Town of St. Michaels	240069	1,029	100%	1.2	100%	Y	10	Y

- Participating in the Talbot County Hazard Mitigation Plan which expires December 19th, 2016.
- Past Federal Disaster Declarations for flooding = 6
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 178 policies totaling approximately $58,479,100
- NFIP-recognized repetitive loss properties = there are less than 5 properties (per Operational Standard 443 this is recorded as NULL in the FRD)
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of St. Michaels that are located within the Talbot County, Maryland Coastal Study Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.4.2 Community Analyses and Results

- **Changes Since Last FIRM**

- Special Flood Hazard Area (SFHA) boundaries within the Town of St. Michaels were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:
  - Previous FIRM effective date: August 5, 2013
  - Revised Preliminary FIRM date: November 14, 2014
  - Current FIRM effective date: July 20, 2016
- The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:
  - Increase: new area in the current effective FIRM compared to the previous effective FIRM.
  - Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
  - Net Change: calculated as 'Increase' minus 'Decrease'.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for the Town of St. Michaels.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0.1	0	0.2	-0.2
Within Floodway	0	0	0	0
Within CHHA (Zone VE or V)	0	0	0	0

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**
  - See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
    - Water surface elevation grid (1-percent-annual-chance flood event)
    - Flood depth grid (1-percent-annual-chance flood event)
  - Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The

FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results Information**
  - The Town of St. Michaels's coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.
  - The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

    National 2010 AAL Study Data

    This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

    - **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
    - **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
    - **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.
    - **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

    Flood Risk Project Refined Data

    This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current

population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

- **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.
- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this feature class, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective July 20, 2016), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (building + contents value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.
- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and contents losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.
- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-5: Town of St. Michaels (240069): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$15,200,000	49%	N/A	N/A	N/A	N/A	$1,500,000	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$13,200,000	42%	N/A	N/A	N/A	N/A	$4,900,000	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$2,600,000	8%	N/A	N/A	N/A	N/A	$900,000	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	**$31,100,000**	**100%**	**N/A**	**N/A**	**N/A**	**N/A**	**$7,200,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$100,000	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	**$31,100,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$7,400,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$94,800,000	46%	N/A	N/A	$1,400,000	1%	$2,000,000	2%	$3,700,000	4%	$30,000	<1%
Commercial Building & Contents	$87,800,000	43%	N/A	N/A	$2,100,000	2%	$2,900,000	3%	$6,200,000	7%	$60,000	<1%
Other Building & Contents	$21,900,000	11%	N/A	N/A	$100,000	<1%	$200,000	1%	$400,000	2%	<$10,000	<1%
Total Building & Contents[3]	**$204,500,000**	**100%**	**N/A**	**N/A**	**$3,600,000**	**2%**	**$5,100,000**	**3%**	**$10,300,000**	**5%**	**$90,000**	**<1%**
Business Disruption[4]	N/A	N/A	N/A	N/A	$300,000	N/A	$300,000	N/A	$700,000	N/A	<$10,000	N/A
TOTAL[5]	**$204,500,000**	**N/A**	**N/A**	**N/A**	**$3,900,000**	**N/A**	**$5,500,000**	**N/A**	**$11,000,000**	**N/A**	**$90,000**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal Study

This page is intentionally left blank

3.3.5 Town of Trappe Summary (CID 240108)

The following pages include Flood Risk data for the Town of Trappe.

3.3.5.1 Overview

The Town of Trappe is located in Southeastern Talbot County near La Trappe Creek. In 2010, Trappe had a population of 1,077. The primary road going through the town is U.S. Highway 50, which connects it to the City of Cambridge to the south and the Town of Easton to the north. Trappe was founded sometime between 1750 and 1760, although the town was not officially incorporated by the Maryland Genearal Assembly until 1856 (U.S. Census Bureau, 2016; Town of Trappe, 2016).

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Town of Trappe	240108	1,077	100%	2.8	100%	Y	10	Y

- Participating in the Talbot County Hazard Mitigation Plan which expires December 19th, 2016.
- Past Federal Disaster Declarations for flooding = 6
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 0 policies totaling $0
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in the Town of Trappe that are located within the Talbot County, Maryland Coastal Study Flood Risk Project, and do not necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.5.2 Community Analyses and Results

- **Changes Since Last FIRM**
  - Special Flood Hazard Area (SFHA) boundaries within the Town of Trappe were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based

topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:

- Previous FIRM effective date: August 5, 2013
- Revised Preliminary FIRM date: November 14, 2014
- Current FIRM effective date: July 20, 2016

o The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:

- Increase: new area in the current effective FIRM compared to the previous effective FIRM.
- Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
- Net Change: calculated as 'Increase' minus 'Decrease'.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for the Town of Trappe.

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	0	0	0	0
Within Floodway	0	0	0	0
Within CHHA (Zone VE or V)	0	0	0	0

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**

o See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):

- Water surface elevation grid (1-percent-annual-chance flood event)
- Flood depth grid (1-percent-annual-chance flood event)

o Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results Information**

- The Town of Trappe's coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.
- The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

National 2010 AAL Study Data

This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

- **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
- **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.
- **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

Flood Risk Project Refined Data

This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

- **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.

- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this feature class, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective July 20, 2016), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (building + contents value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.
- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and contents losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.
- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-6: Town of Trappe (240108): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$0	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	$0	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	$0	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	$0	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	$0	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$56,500,000	71%	N/A	N/A	<$10,000	<1%	<$10,000	<1%	<$10,000	<1%	$0	N/A
Commercial Building & Contents	$18,300,000	23%	N/A	N/A	<$10,000	<1%	<$10,000	<1%	<$10,000	<1%	$0	N/A
Other Building & Contents	$4,500,000	6%	N/A	N/A	<$10,000	<1%	<$10,000	<1%	<$10,000	<1%	$0	N/A
Total Building & Contents[3]	**$79,300,000**	**100%**	**N/A**	**N/A**	**<$10,000**	**<1%**	**<$10,000**	**<1%**	**<$10,000**	**<1%**	**$0**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	$0	N/A	$0	N/A	<$10,000	N/A	$0	N/A
TOTAL[5]	**$79,300,000**	**N/A**	**N/A**	**N/A**	**<$10,000**	**N/A**	**<$10,000**	**N/A**	**<$10,000**	**N/A**	**$0**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal Study

This page left intentionally blank.

3.3.6 Talbot County (Unincorporated Areas) Summary (CID 240066)

The following pages include Flood Risk data for Talbot County (Unincorporated Areas).

3.3.6.1 Overview

Talbot County is located in Eastern Maryland on the Eastern Shore of the Chesapeake Bay. It is bordered to the north by Queen Anne's County, to the south by Dorchester County, to the west by the Chesapeake Bay, and to the east by Caroline County. The county is mostly rural, but contains some higher-density development and commercial activity in the incorporated communities of Easton, Trappe, and St. Michaels. The county has 254 square miles of land area and a population of 18,982. Some of the major industries in Talbot County include agricultural activities such as soybean, corn, and poultry farming, and maritime activities like seafood processing and harvesting, sailing, and fishing.

Although Talbot County has a continental climate, temperature fluctuations over the year are moderated by the county's close proximity to the Chesapeake Bay and Atlantic Ocean. Temperatures in the county range from an average of 77˚F in summer to an average of 39°F in winter. In general, the terrain in Talbot County is fairly flat due to its location on the Atlantic Coastal Plain. Historically, coastal flooding problems in the county have largely been a result of impacts from tropical cyclones during the summer. Recent flooding events include Hurricane Isabel in 2003, Hurricane Irene in 2011, and Hurricane Sandy in 2012 (FEMA, 2014; U.S. Census Bureau, 2016; Talbot County Government, 2016).

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

Community Name	CID	Total Community Population	Percent of Population in County (Coastal)	Total Community Land Area (sq mi)	Percent of Land Area in County (Coastal)	NFIP	CRS Rating	Mitigation Plan
Talbot County (Unincorporated Areas)	240066	18,982	98%	253.8	98%	Y	10	Y

- Participating in the Talbot County Hazard Mitigation Plan which expires December 19th, 2016.
- Past Federal Disaster Declarations for flooding = 6
- National Flood Insurance Program (NFIP) policy coverage (policies/value) = 1,862 policies totaling approximately $568,033,500
- NFIP-recognized repetitive loss properties = 10
- NFIP-recognized severe repetitive loss properties = 0

Data provided below only includes areas in Talbot County (Unincorporated Areas) that are located within the Talbot County, Maryland Coastal Study Flood Risk Project, and do not

necessarily represent community-wide totals. Section 2 of the FRR provides more information regarding the source and methodology used to develop the information presented below. Datasets used toward the generation of results of this project are described in Section 7 of the FRR and are found in the FRD.

3.3.6.2 Community Analyses and Results

- **Changes Since Last FIRM**
  - Special Flood Hazard Area (SFHA) boundaries within Talbot County (Unincorporated Areas) were updated due to new engineering analysis performed within the Flood Risk Project. The updated modeling produced new flood zone areas and new base flood elevations in some areas and leveraged recently developed LiDAR-based topographic data. The data in this section reflects a comparison between the previous effective FIRM and the preliminary FIRM. The previously effective FIRM, preliminary FIRM, and current effective FIRM dates are listed below:
    - Previous FIRM effective date: August 5, 2013
    - Revised Preliminary FIRM date: November 14, 2014
    - Current FIRM effective date: July 20, 2016
  - The CSLF dataset includes the following information for areas within the Coastal Flood Risk Study:
    - Increase: new area in the current effective FIRM compared to the previous effective FIRM.
    - Decrease: loss of area in the current effective FIRM compared to the previous effective FIRM.
    - Net Change: calculated as 'Increase' minus 'Decrease'.

The table below summarizes the increases, decreases, and net change of SFHAs, Floodways, and Coastal High Hazard Areas (CHHAs) for Talbot County (Unincorporated Areas).

Area of Study	Total Area (mi^2)	Increase (mi^2)	Decrease (mi^2)	Net Change (mi^2)
Within SFHA	67.2	5.6	25.2	-19.6
Within Floodway	0	0	0	0
Within CHHA (Zone VE or V)	12.9	4.7	4.9	-0.1

Section 2 of the FRR provides more information regarding the source and methodology used to develop this table.

- **Flood Depth and Analysis Grids**

- See the FRD for the following depth and analysis grid data (Section 2 of the FRR provides general information regarding the development of and potential uses for this data):
  - Water surface elevation grid (1-percent-annual-chance flood event)
  - Flood depth grid (1-percent-annual-chance flood event)
- Additional information and data layers provided within the FRD should be used to further isolate these and other areas where flood mitigation potential is high. The FRD includes data which may be helpful in planning and implementing mitigation strategies. Properties located in areas expected to experience some depth of water should seriously consider mitigation options for implementation.

- **Flood Risk Results Information**
  - Talbot County's (Unincorporated Areas) coastal flood risk analysis incorporates results from a FEMA-performed Hazus analysis (Version 2.1 for 2010 AAL Study Data, Version 3.1 for Flood Risk Project Refined Data) which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were computed with state-level tax data (parcel centroids from the MD Department of Planning) and local building footprints provided by Talbot County to estimate loss ratios for the 1-percent-annual-chance flood scenario.
  - The following data layers provided within the FRD should be used to further analyze potential losses and areas where they are likely to occur.

    National 2010 AAL Study Data

    This set of features and tables in the FRD stores the default Hazus (Version 2.1) General Building Stock (GBS) inventory data (2000 census) and resulting losses from the FEMA National 2010 Average Annualized Loss (AAL) Study. These feature classes and data tables do not reflect any of the updates completed for this 'Refined' study.

    - **S_CenBlk_Ar_2000** – This feature class contains the default Hazus GBS inventory data (2000 census) by 2000 census blocks. It is broken down by occupancy type (residential, commercial and other) and also by loss type (building and contents).
    - **L_Exposure** – This table contains the default Hazus GBS inventory data (2000 census) by political area. It is broken down by occupancy type (residential, commercial, and other).
    - **L_RA_AAL** – This table contains the results, by 2000 census block, of the FEMA National 2010 Hazus Level 1 AAL study. Hazus was used to generate depth grids for the 2-, 1-, 0.5- and 0.2-percent-annual-chance return periods. The loss analysis was completed for each return period using the default Hazus GBS inventory data (2000 census) by census block. The return period losses were used to calculate the AAL values.

- **L_RA_Summary** – This table contains a summary of the L_RA_AAL losses by political area. The loss ratio values are the percentage of the L_RA_AAL losses per L_Exposure values.

Flood Risk Project Refined Data

This set of feature classes and tables in the FRD stores the updated Hazus (Version 3.1) User-Defined Facilities (UDF) inventory data and resulting losses for this 'Refined' study. The same political area geometries were used so direct comparisons to the National 2010 AAL Study can be made. In order to more accurately represent the coastal flood risk in the county based on the current population distribution, Hazus loss estimates using the refined data are summarized by 2010 census block boundaries.

- **S_CenBlk_Ar_2010** – This feature class contains 2010 census block geometries and population counts. It can be used to examine Hazus flood losses that are summarized in the L_RA_Refined table.
- **S_UDF_Pt** – This feature class contains location and inventory data for site-specific risk assessments. State and local data was obtained for this table, including building footprints, structure values and landuse classifications. The data was evaluated against the coastal 1-percent-annual-chance floodplain boundaries (presented on the countywide FIRM, effective July 20, 2016), and in areas where the actual building locations are contained in the SFHA, loss calculations were included in this 'Refined' study.
- **L_Exposure_Refined** – This table is an addition to the default database schema for this project. It contains a summary of S_UDF_Pt values (Building + Content value) by political area. It is broken down by occupancy type (residential, commercial, and other).
- **L_RA_Refined** – This table contains the results (by 2010 census block) of this flood risk study. Engineering models were used to generate depth grids for the 1-percent-annual-chance return period. The loss analysis was completed for the single return period using the updated Hazus UDF inventory data by 2010 census block. No AAL values were calculated since only a single return period losses were available.
- **L_RA_UDF_Refined** – This table is an addition to the default database schema for this project. It contains Hazus-estimated building and content losses for all structures in the S_UDF_Pt feature class.
- **L_RA_Summary_Refined_100yr** – This table is an addition to the default database schema specifically for this project. It contains a summary of the L_RA_Refined losses by political area. However, because the UDF inventory does not include all parcels within a census block, rather only parcels (and more specifically building footprints) which are located within the coastal SFHA, loss ratios for respective political areas would be skewed too high, and as a result, loss ratios are not presented in this Coastal Flood Risk Project.

- **UDF_Hazus_Input** – This table is an addition to the default database schema specifically for this project. It contains the original UDF table that was imported into Hazus in order to run loss calculations.

Table 3-7: Talbot County (Unincorporated Areas)(240066): Estimated Potential Losses for Flood Event Scenarios

Flood Risk Project Refined Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$225,700,000	97%	N/A	N/A	N/A	N/A	$14,300,000	N/A	N/A	N/A	N/A	N/A
Commercial Building & Contents	$6,800,000	3%	N/A	N/A	N/A	N/A	$1,000,000	N/A	N/A	N/A	N/A	N/A
Other Building & Contents	$500,000	<1%	N/A	N/A	N/A	N/A	$0	N/A	N/A	N/A	N/A	N/A
Total Building & Contents[3]	**$233,000,000**	**100%**	**N/A**	**N/A**	**N/A**	**N/A**	**$15,300,000**	N/A	**N/A**	**N/A**	**N/A**	**N/A**
Business Disruption[4]	N/A	N/A	N/A	N/A	N/A	N/A	$500,000	N/A	N/A	N/A	N/A	N/A
TOTAL[5]	**$233,000,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**$15,800,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

National 2010 AAL Study Losses[6]

Type	Inventory Estimated Value	% of Total	10% (10-Yr) Dollar Losses[1]	10% Loss Ratio[2]	2% (50-yr) Dollar Losses[1]	2% Loss Ratio[2]	1% (100-yr) Dollar Losses[1]	1% Loss Ratio[2]	0.2% (500-yr) Dollar Losses[1]	0.2% Loss Ratio[2]	Annualized Losses[1]($/yr)	Annualized Loss Ratio[2]
Residential Building & Contents	$1,493,700,000	76%	N/A	N/A	$38,500,000	3%	$53,200,000	4%	$87,500,000	6%	$1,000,000	<1%
Commercial Building & Contents	$234,400,000	12%	N/A	N/A	$5,300,000	2%	$7,200,000	3%	$12,000,000	5%	$70,000	<1%
Other Building & Contents	$238,700,000	12%	N/A	N/A	$4,500,000	2%	$5,900,000	2%	$9,600,000	4%	$70,000	<1%
Total Building & Contents[3]	**$1,966,800,000**	**100%**	**N/A**	**N/A**	**$48,300,000**	**2%**	**$66,300,000**	**3%**	**$109,200,000**	**6%**	**$1,100,000**	**<1%**
Business Disruption[4]	N/A	N/A	N/A	N/A	$1,300,000	N/A	$1,700,000	N/A	$2,700,000	N/A	$0	N/A
TOTAL[5]	**1,966,800,000**	**N/A**	**N/A**	**N/A**	**$49,600,000**	**N/A**	**$68,000,000**	**N/A**	**$111,900,000**	**N/A**	**$1,100,000**	**N/A**

[1]Losses shown are rounded to nearest $10,000 for values under $100,000 and to the nearest $100,000 for values over $100,000.
[2]Loss ratio = Dollar Losses ÷ Estimated Value. Loss Ratios are rounded to the nearest integer percent. Loss ratios were not calculated for the refined study because the analysis was restricted to parcels that were located in the coastal SFHA, which would result in highly skewed values.
[3]Total Building and Contents = Residential Building and Contents + Commercial Building and Contents + Other Building and Contents.
[4]Business Disruption = Inventory Loss + Relocation Cost + Income Loss + Rental Income Loss + Wage Loss + Direct Output Loss.
[5]Total = Total Building and Contents + Business Disruption
[6] Flood Risk Project Refined losses calculated using Hazus Version 3.1, National 2010 AAL Study losses calculated using Hazus Version 2.1.
The figures in this table only represent information within the Talbot County, Maryland Coastal S

4 Actions to Reduce Flood Risk

In order to fully leverage the Flood Risk Datasets and Products created for this Flood Risk Project, local stakeholders should consider many different flood risk mitigation tactics, including, but not limited the items shown in the sub-sections below.

Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

4.1 Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its flood risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Flood mitigation actions generally fall into the following categories:

4.1.1 Preventative Measures

Preventative measures are intended to keep flood hazards from getting worse. They can reduce future vulnerability to flooding, especially in areas where development has not yet occurred or where capital improvements have not been substantial. Examples include:

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations
- Open space preservation
- Building codes
- Floodplain development regulations
- Stormwater management

NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS: to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. (A Class 10 is not participating in the CRS and receives no discount.)

- Purchase development rights or conservation easements
- Participation in the NFIP Community Rating System (CRS)

4.1.2 Property Protection Measures

Property protection measures protect existing buildings by modifying the building to withstand floods, erosion, and waves or by removing buildings from hazardous locations. Examples include:

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

4.1.3 Natural Resource Protection Activities

Natural resource protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMP)
- Prevention of stream dumping activities (anti-litter campaigns)
- Improved forestry practices such as reforesting or selective timbering (extraction)
- Beach Nourishment
- Dune Construction
- Dune protection measures such as walkovers, sand fencing, and vegetation

4.1.4 Structural Mitigation Projects

Structural mitigation projects lessen the impact of floods by modifying the environmental natural progression of the flooding event. Structural protection such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk. Examples include:

- Reservoirs, retention, and detention basins

- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Seawalls, reventments, and bulkheads
- Groins, offshore breakwaters, and jetties

4.1.5 Public Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques they can use to reduce the flood risk to themselves and their property. Examples include:

- Readily available and readable updated maps
- Outreach projects
- Libraries
- Technical assistance
- Real estate disclosure
- Environmental education
- Risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

4.1.6 Emergency Service Measures

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

- Hazard warning system
- Emergency response plan
- COOP and COG planning
- Critical facilities protection
- Health and safety maintenance
- Post flood recovery planning

Refer to FEMA Mitigation Planning How To Guide #3 (FEMA 386-3) "Developing the Mitigation Plan - Identifying Mitigation Actions and Implementation Strategies" for more information on how to identify specific mitigation actions to address hazard risk in your community.

4.2 Identifying Specific Actions for Your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

- **Site characteristics.** Does the site present unique challenges (e.g., significant slopes or erosion potential)?
- **Flood characteristics.** Are the flood waters affecting the site fast or slow moving? Are there wave hazards? Is there debris associated with the flow? How deep is the flooding?
- **Social acceptance.** Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- **Technical feasibility.** Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?
- **Administrative feasibility.** Is there administrative capability to implement the mitigation action?
- **Legal.** Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.
- **Economic.** Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?
- **Environmental.** Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

FEMA in collaboration with the American Planning Association has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information, go to www.planning.org or http://www.fema.gov/library.

Your local Hazard Mitigation Plan is a valuable place to identify and prioritize possible mitigation actions. The plan includes a mitigation strategy with mitigation actions that were developed through a public and open process. You can then add to or modify those actions based on what is learned during the course of the Risk MAP project and the information provided within this FRR.

4.3 Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g., inclusion in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at http://www.fema.gov/government/grant/hma/index.shtm.

4.3.1 FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 4-1 below.

Table 4-1: FEMA Hazard Mitigation Assistance Programs

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards
Repetitive Flood Claims (RFC)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduce flood claims against the NFIP through flood mitigation; properties must be currently NFIP insured and have had at least one NFIP claim
Severe Repetitive Loss (SRL)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduce or eliminate the long-term risk of flood damage to SRL residential structures currently insured under the NFIP

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA, RFC, and SRL programs focus funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, tribes, and territories (applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website (www.fema.gov).

4.3.2 Additional Mitigation Programs and Assistance

Several additional agencies including USACE, Natural Resource Conservation Service (NRCS), U.S. Geological Survey (USGS), NOAA, and others have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are state-level sources of information and assistance, which vary among different states.

The Silver Jackets program, active in several states, is a partnership of USACE, FEMA, and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

5 Acronyms and Definitions

5.1 Acronyms

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio
AoMI	Areas of Mitigation Interest

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation
BMP	Best Management Practices

C

CFR	Code of Federal Regulations
CHHA	Coastal High Hazard Areas
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System
CSLF	Changes Since Last FIRM

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FLDWY	Floodway
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GBS	General Building Stock
GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

I

IA	Individual Assistance

M

MSC	Map Service Center

N

NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service

P

PA	Public Assistance
PDM	Pre-Disaster Mitigation

R

RFC	Repetitive Flood Claims
Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SRL	Severe Repetitive Loss

U

UDF	User-Defined Facilities
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

5.2 Definitions

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

Annualized Loss Ratio (ALR) – Expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area.

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from earth.

Cfs – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Coastal High Hazard Area (CHHA) – Portion of the floodplain subject to inundation by the 1-percent-annual or base flood and wave effects 3 feet or greater (mapped as VE Zones).

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – An artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus, essential facilities include hospitals, emergency operations centers, police stations, fire stations, and schools.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) Report – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. Sometimes referred to as flood vulnerability.

Flood vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. Sometimes referred to as flood risk.

Floodborne debris impact – Floodwater moving at a moderate or high velocity can carry floodborne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory) – The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – The portion of the SFHA that is outside of the floodway.

Freeboard – A factor of safety usually expressed in feet above a flood level for purposes of flood plain management. “Freeboard” tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed (44CFR§59.1).

Hazus – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds and storm surge, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Levee – A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (44CFR§59.1)

Loss ratio – Expresses loss as a fraction of the value of the local inventory (total value/loss).

Mudflow – Mudslide (i.e., mudflow) describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e., mudflow) may occur as a distinct phenomenon while a landslide is in progress, and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. (44CFR§59.1)

Primary frontal dune (PFD)—A continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

Probability (of flood) – The likelihood that a flood will occur in a given area.

Risk MAP – Risk Mapping, Assessment, and Planning, a FEMA strategy to work collaboratively with state, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the 1-percent-annual or base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater –Projected elevation that flood waters would assume, referenced to National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or other datum, in the absence of waves resulting from wind or seismic effects.

Stream Flow Constrictions – A point where a human-made structure constricts the flow of a river or stream.

6 Additional Resources

ASCE 7 – National design standard issued by the American Society of Civil Engineers (ASCE), *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the ASCE, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

ASCE, 2010. *So, You Live Behind a Levee!* Reston, VA.

FEMA

www.fema.gov

National Flood Insurance Program (NFIP), Federal Emergency Management Agency (FEMA)

www.floodsmart.gov

USGS National Assessment of Shoreline Change Project

http://coastal.er.usgs.gov/shoreline-change

FEMA Publications – available at www.fema.gov

FEMA, 1985. *Manufactured Home Installation in Flood Hazard Areas*, FEMA 85. Washington, DC, September 1985.

FEMA and the American Red Cross, 1992. *Repairing Your Flooded Home*, FEMA 234/ARC 4476. Washington, DC, August 1992.

FEMA, 1996. *Addressing Your Community's Flood Problems*, FEMA 309. Washington, DC, June 1996.

FEMA, 1998. *Homeowner's Guide to Retrofitting*, FEMA 312. Washington, DC, June 1998.

FEMA, 1999a. *Protecting Building Utilities from Flood Damage*, FEMA 348. Washington, DC, November 1999.

FEMA, 1999b. Riverine Erosion Hazard Areas Mapping Feasibility Study. Washington, DC, September 1999.

FEMA, 2000. *Above the Flood: Elevating Your Floodprone House,* FEMA 347. Washington, DC, May 2000.

FEMA, 2001. *Understanding Your Risks: Identifying Hazards and Estimating Losses*, FEMA 386-2. Washington, DC, August 2001.

FEMA, 2002a. *Getting Started: Building Support for Mitigation Planning*, FEMA 386-1. Washington, DC, September 2002.

FEMA, 2002b. *Integrating Manmade Hazards into Mitigation Planning*, FEMA 386-7. Washington, DC, September 2002.

FEMA, 2003a. *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies*, FEMA 386-3. Washington, DC, April 2003.

FEMA, 2003b. *Bringing the Plan to Life: Implementing the Hazard Mitigation Plan*, FEMA 386-4. Washington, DC, August 2003.

FEMA, 2003c. *Interim Guidance for State and Local Officials - Increased Cost of Compliance Coverage*, FEMA 301. Washington, DC, September 2003.

FEMA, 2004a. *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds*, FEMA 424. Washington, DC, January 2004.

FEMA, 2004b. *Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners*, FEMA 64. Washington, DC, April 2004.

FEMA, 2005a. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, FEMA 386-6. Washington, DC, May 2005.

FEMA, 2006a. *Multi-Jurisdictional Mitigation Planning*, FEMA 386-8. Washington, DC, August 2006.

FEMA, 2006b. *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*, FEMA 386-9. Washington, DC, August 2008.

FEMA, 2006c. "*Designing for Flood Levels Above the BFE," Hurricane Katrina Recovery Advisory 8, Hurricane Katrina in the Gulf Coast: Building Performance Observations, Recommendations, and Technical Guidance*, FEMA 549, Appendix E. Washington, DC, July 2006.

FEMA, 2007a. *Property Acquisition Handbook for Local Communities*, FEMA 317. Washington, DC, September 2007.

FEMA, 2007b. *Public Assistance Guide*, FEMA 322. Washington, DC, June 2007.

FEMA, 2007c. *Using Benefit-Cost Review in Mitigation Planning*, FEMA 386-5. Washington, DC, May 2007.

FEMA, 2007d. *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543. Washington, DC, January 2007.

FEMA, 2007e. *Selecting Appropriate Mitigation Measures for Floodprone Structures*, FEMA 551. Washington, DC, March 2007.

FEMA, 2007f. *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings,* FEMA 577. Washington, DC, June 2007.

FEMA, 2008. *Reducing Flood Losses Through the International Codes: Meeting the Requirements of the National Flood Insurance Program,* FEMA 9-0372, Third Edition. Washington, DC, December 2007.

FEMA, 2009a. Local Officials Guide for Coastal Construction, FEMA P-762. Washington, DC, February 2009.

FEMA, 2009b. Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations, FEMA P-550, Second Edition. Washington, DC, December 2009.

FEMA, 2010. Home Builder's Guide to Coastal Construction, FEMA P-499. Washington, DC, December 2010.

FEMA, 2011. Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas, Fourth Edition, FEMA P-55. Washington, DC, August 2011.

FEMA, 2013. *Flood Insurance Study, Talbot County, Maryland and Incorporated Areas*, Washington, D.C., August 5, 2013.

FEMA, 2014b. *Revised Preliminary Flood Insurance Study, Talbot County, Maryland and Incorporated Areas*, Washington, D.C., November 14, 2014.

FEMA, 2015a. FEMA Disaster Declarations
http://www.fema.gov/disasters

FEMA, 2015b. FEMA Community Information System
https://portal.fema.gov/famsVuWeb/home

FEMA, 2015c. FEMA Community Rating System (CRS) Communities and their Classes, May 2015, http://www.fema.gov/media-library-data/1424450651900d381a14283db10e28ae624543a9526ad/20_crs_508_apr2015.pdf

FEMA, 2016. *Flood Insurance Study, Talbot County, Maryland and Incorporated Areas*, Washington, D.C., July 20, 2016.

Community Websites

Talbot County Government, 2016. *Our History: Talbot County, http://www.talbotcountymd.gov/index.php?page=Talbot_County_History*

Town of Easton, 2010. *Economic Development, http://eastonmd.gov/PlanningZoning/2010_Comp_Plan/ECONOMIC_DEVELOPMENT.pdf*

Town of Oxford, 2016. *A Brief History of Oxford,* http://www.oxfordmd.net/history.html

St. Michaels Business Association, 2016. *St. Michaels History, http://www.stmichaelsmd.org/*

Town of Trappe, 2016. Town History, http://trappemd.net/town-history/

U.S. Census Bureau, 2016. State & County QuickFacts, *http://quickfacts.census.gov/*

Local Government Websites

Maryland Environmental Service (MES), 2016.
259 Najoles Road, Millersville, MD 21108
http://www.menv.com

Maryland Department of the Environment (MDE), 2016.
1800 Washington Boulevard, Baltimore, MD 21230
http://www.mde.state.md.us/Pages/Home.aspx

7 Data Used to Develop Flood Risk Products

GIS base map information was acquired from the following sources:

Engineering study information was leveraged from RAMPP with coordination from FEMA Region III and the United States Army Corps of Engineers (USACE).

A 10-foot resolution Digital Elevation Model (DEM) of Talbot County was used to create depth and water surface grids. This data was provided by Dewberry on August 4, 2015.

GIS basemap information was acquired from the DFIRM database, effective July 20, 2016. This dataset is available for download from the MSC.
https://msc.fema.gov

Additional datasets utilized in the project include the following:

- FEMA National 2010 Hazus Level 1 AAL Study
  Limited Distribution; database available upon request
- Hazus-MH Version 2.1 (2012)
  https://msc.fema.gov
- Hazus-MH Version 3.1 (2016)
  https://msc.fema.gov
- National Hydrography Dataset
  http://nhd.usgs.gov/
- U.S. Census Bureau, 2000 Hazus
  Dataset incorporated with Hazus-MH Version 2.1 software
- Maryland Department of Planning – parcel centroid dataset (as of February 2016)
  http://www.mdp.state.md.us/OurProducts/OurProducts.shtml
- Talbot County, Maryland GIS Services – Building Footprints (Acquired May 2016)
  Limited Distribution; database available upon request

APPENDIX M

Maryland Integrated Preparedness Programmatic Process & Assessment Cycle

This page left blank intentionally

Integrated Preparedness Programmatic Process and Assessment Cycle

MEMA's Preparedness Branch has developed the Maryland Integrated Preparedness Programmatic Process and Assessment Cycle, shown in full on the next page. As discussed in Section 6.1.4 of the plan narrative, this cycle provides the opportunity to further integrate hazard mitigation planning into the State's THIRA, SPR, and Integrated Preparedness Plan. This not only provides an opportunity to advance plan integration at the State level, but from a training perspective this provides an opportunity to formalize MEMA's local hazard mitigation planning in coordination with the activities of MEMA's Preparedness Branch.

This page left blank intentionally

Maryland Integrated Preparedness Programmatic Process & Assessment Cycle

Year 2/Year 3: Capability Reevaluation/ Update Baseline

Assess Current Capabilities/ Develop Baseline

Capability Targets Established

Capability Gaps Identified

Capability Prioritization

Identification of Preparedness Activities for Capability Sustainment/Development

THIRA Information Sources
- State Planning Scenarios Guide
- Hazard Mitigation Plan
- Statewide Threat Assessment

DHS/FEMA National Priorities

IPP
IPP serves as PMP against the SPR.

Sustaining, Refining & Building Capabilities

Validating Capabilities

Capability Status Review

Threat & Hazard Identification & Risk Assessment (THIRA)

3 Year THIRA Cycle

Stakeholder Preparedness Review (SPR)

Annual SPR Cycle

Integrated Preparedness Plan (IPP)

Identify Funding Requirements

Conduct Preparedness Activities
- Planning
- Organization
- Equipment
- Training
- Exercise
- Evaluation

After Action Reports (AAR)

Maryland State Preparedness Report (MDSPR)

Year 2

Year 3

Annual Integrated Preparedness Cycle

Maryland Preparedness Snapshot (MPS)

State Homeland Security Goals

Project Grant Funding
- EMPG
- UASI (Baltimore & NCR)
- SHSP
- Acquisition of Short-Term & Targeted Grant Programs

Consequence Management Operations
- Prevention
- Response
- Recovery

MDSPR
MDSPR serves as an annual QSR showing results of the projects identified in the IPP.

IPP Information Sources
- THIRA
- SPR
- Maryland Preparedness Snapshot
- DHS/FEMA National Priorities
- State Homeland Security Goals
- Disaster History
- After Action Reports (Incidents/Exercises)
- Corrective Actions Inventory
- EMAP Standards Assessment
- Emerging Threats & Hazards
- UASI Regional Requirements

THIRA Elements
- Threat & Hazard Identification
- 9 Threat & Hazard Scenarios
  - 3 – Natural Hazards
  - 3 – Technological Hazards
  - 3 – Human-Caused Threats
- Detail Impacts and Descriptions of Threats & Hazards
- 32 Core Capabilities Review
- Establish Capability Targets

SPR Elements
- Assess Current Capabilities
  - Lost/Decreased
  - Sustained
  - Built/Established
- Identify Capability Gaps
- Determine Gap Closure Activities
  - Preparedness (POETE)
  - Protection
  - Mitigation
- Describe Impacts of Funding Sources

IPP Elements
- Preparedness Priorities
- Integrated Preparedness Activities (POETEE)
- Program Reporting
- Multi-Year Schedule of Preparedness Activities

Capability Formulas
- **Capability Gap = Capability Target – Current Capability**
- **Capability Target = Capability + Timeframe Metric**
- **Current Capability = Capability Sustained (Beginning Capability – Capability Lost) + Capability Built**
- **Bridged Current Capability = Current Capability + Mutual Aid**

This page left blank intentionally