STATE OF DELAWARE

ALL-HAZARD MITIGATION PLAN

Revised August, 2018

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Note - This annex contains sensitive data and has been classified For Official Use Only (FOUO). This annex will not be distributed with the Basic Plan. Requests for this annex are required in writing and subject to the approval of the DEMA Director. Contact the State Hazard Mitigation Officer for more information.

INTRODUCTION

This section provides a general introduction to the State of Delaware's All-Hazard Mitigation Plan. It is broken down into the following seven sub-sections:

- Purpose
- Scope
- Background
- A Practical Approach to Hazard Mitigation Planning
- Description of the Planning Process
- Assurances and Adoption
- Plan Updates

Purpose

The purpose of this plan is:

- To protect life, safety and property by reducing the potential for future damages and economic losses that result from natural and man-caused hazards;
- To meet the requirements of the Disaster Mitigation Act of 2000, and therefore qualify for additional grant funding in both the pre-disaster and post-disaster environment;
- To speed recovery and redevelopment following future disaster events;
- To demonstrate a firm local commitment to hazard mitigation principles; and
- To comply with both state and federal legislative requirements for local hazard mitigation plans.

Scope

This plan will focus on those hazards determined to be "high risk" and "moderate risk" in the State. Fortunately, Kent County, New Castle County, and Sussex County have developed hazard mitigation plans which complement the State plan. This allowed for the use of county- level risk assessments to evaluate statewide hazard vulnerability. In addition, conducting county-level capability assessments enables state officials to identify existing strengths and potential weaknesses that the state addresses in the plan. The ability to provide state-level assistance is evaluated relative to the findings of the State *Capability Assessment*. Finally, the ability to review proposed county-level mitigation actions will help state officials to craft more meaningful policies, while identifying potential mitigation projects.

Background

Natural hazards, such as floods, tornadoes, hurricanes and severe winter storms, are a part of the world around us. Their occurrence is natural and inevitable, and there is little we can do to control their force and intensity. Human-caused hazards can be caused by technological accidents or acts of terrorism. The State of Delaware faces a variety of natural hazards, including flooding, tornadoes, ice storms, tropical systems, and earthquakes. Human-caused hazards include technological accidents, railroad spills, and industrial chemical releases. Although not a direct hazard, future conditions, such as climate change and sea level rise, can increase the adverse effects of both severe storm and flood events. These hazards are discussed in detail in Section 4.1 - Hazard Identification.

Through hazard mitigation planning, we can minimize the impact of natural and human-caused hazards on people and the built environment. Through proper planning and the implementation of policies and projects identified in the Plan, we can reduce the likelihood that these events will result in disasters. This document, titled the "**State of Delaware All-Hazard Mitigation Plan**" (Henceforth referred to as the "Plan"), is a logical, information-driven process that systematically identifies and guides the implementation of specific actions and the creation of policies designed to make Delaware safer from the threat of natural and human-caused hazards including terrorism.

INTRODUCTION

"Hazard mitigation" is a technical term for reducing risks to people and property from natural and human-caused hazards. It includes both structural measures, such as protecting buildings and infrastructure from the forces of nature, technological accidents and acts of terrorism, and non-structural measures, such as natural resource protection and wise floodplain management. Actions may be targeted to protect existing development, or could be designed to protect future development as well. It is widely accepted that the most effective mitigation measures are implemented at the local government level, where decisions on the regulation and control of development are ultimately made.

The easiest way a community can get serious about hazard mitigation is through the development and adoption of a local hazard mitigation plan. A mitigation plan will ensure that measures to reduce the present and future vulnerability of a community are thoroughly considered before, during and after the next disaster strikes. A hazard mitigation plan is designed to help decision makers guide actions based on accurate information.

A Practical Approach to Hazard Mitigation Planning

The plan is designed to be both *strategic* — providing a long-term vision of how the State will address natural and human-caused hazards, and *functional* — guiding the day-to-day decisions of State officials. In addition to the identification and prioritization of possible projects, emphasis has been placed on the use of broad policy goals and more refined objectives and actions to assist Delaware to become less vulnerable to the damaging forces of nature, technological hazards, and acts of terrorism, while improving the economic, social, and environmental health of the State. The concept of multi-objective planning is emphasized throughout this document, identifying ways to link hazard mitigation policies and programs with complimentary State goals related to housing, economic development, recreational opportunities, transportation improvements, environmental quality, and public health and safety.

Mitigation planning offers many benefits, including:

- Saving lives and property;
- Saving money;
- Speeding up recovery following disasters;
- Reducing future vulnerability through wise development and post-disaster recovery and reconstruction;
- Expediting the receipt of pre-disaster and post-disaster grant funding; and
- Demonstrating a firm commitment to improving community health and safety.

More importantly, mitigation planning has the potential to produce long-term benefits by breaking the repetitive cycle of disaster loss. It has been estimated that, on average, every one dollar ($1) spent on hazard mitigation provides the nation approximately six dollars ($6) in future benefits. A core assumption of hazard mitigation is that a pre-disaster investment significantly reduces the demand for post-disaster assistance. Further, the adoption of mitigation practices enables local residents, businesses and industries to more quickly recover from a disaster, getting the economy back on track sooner and with less interruption.

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health and natural features, and enhancing recreational opportunities.

The State is vulnerable to a variety of natural and human-caused hazards. These hazards threaten loss of life and property of this State. Hazards, including coastal and inland flooding, tornado and hurricane force winds, earthquakes, winter storms, droughts, hazardous material spills, nuclear, biological, or chemical releases, and acts of terrorism have the potential to inflict vast economic losses and personal hardship. Hazard vulnerability continues to rise as coastal development increases and population continues to increase across the State, particularly in the southern coastal area. However, decisions made today can affect the degree to which hazard vulnerability changes over time.

INTRODUCTION

Hazard mitigation planning and effective disaster preparedness are the most effective instruments to diminish losses by reducing the impact of disasters upon people and property. Although mitigation efforts will not eliminate all disasters, the State shall endeavor to be prepared as much as possible for a disaster. The Delaware Emergency Management Agency (DEMA) has been designated as the State's coordinating agency for disaster preparedness, emergency response and disaster recovery assistance. DEMA has been tasked with coordinating the state's disaster mitigation efforts through the State Hazard Mitigation Program (SHMP).

This plan represents the efforts of State and local agencies to reduce the impact of identified hazards. The catalyst for this plan was the series of presidential disaster declarations through 2016. The Disaster Mitigation Act of 2000 provided an additional impetus to enhance our plan in order to comply with new requirements and receive additional post-disaster mitigation funds, should a presidentially-declared disaster strike. The Plan demonstrates the State's commitment to build upon past work and develop a comprehensive all-hazard mitigation program that helps us achievable our mitigation goals and objectives.

Description of the Planning Process

The State of Delaware utilized the planning process guidance provided in the Federal Emergency Management Agency (FEMA) Comprehensive Preparedness Guide (CPG 101) to revise the State All-Hazards Mitigation Plan. The planning process includes the following six steps:

1. Form a Collaborative Planning Team
2. Understand the Situation
3. Determine Goals and Objectives
4. Plan Development
5. Plan Preparation, Review, and Approval
6. Plan Implementation

Below is a brief introduction to the steps and how they correlate to the sections of the State Plan. Section 2 of the plan gives more detail on the steps and how the planning process was used for the 2018 revision.

Step 1, Form a Collaborative Planning Team - *Section 2 Planning Process*, identifies and list the agencies and members of the Collaborative Planning Team and details how the Planning Process used. The section also covers how the whole community was engaged in the revision of the State Plan for 2018.

Step 2, Understand the Situation - *Section 3 Community Profile* includes narrative descriptions on community characteristics, such as the State's geographic, economic and demographic profiles, and discusses future development trends and implications for hazard vulnerability. *Section 4.1 and 4.2, Hazard Identification and Vulnerability Assessment* describes and analyzes the natural and human-caused hazards, including terrorism and other man-made hazards, and includes an analysis of natural hazard vulnerabilities. Finally, a comprehensive understanding of the situation includes assessing the State's vulnerabilities and identifying gaps in the State's capabilities.

Step 3, Determine Goals and Objectives – following the identification of hazards and vulnerabilities, *Section 5: Capabilities Assessment,* this assesses Delaware's capabilities, which lead to a thorough review/revision of the established goals, and objectives and the validation of mitigation activities that will facilitate risk reduction efforts.

Step 4, Plan Development - Plan development included reviewing all Mitigation Plan requirements and reviewing the various sections for changes and updates. Since the 2013 update, additional Federal requirement have been instituted to include Threat Hazard Identification and Risk Analysis (THIRA) and Future Conditions such as climate changes and sea level rise.

Step 5, Plan Preparation, Review, and Approval - The planning teams will be conducting section updates and reviews throughout the update process. A draft of the whole plan will be consolidated and provided to the Mitigation Council for review prior to forwarding to FEMA.

Step 6, Plan Implementation and Maintenance - Section 7 describes the administrative manner, in which the plan will be implemented, reviewed, revised, and maintained. Specific activities include describing the schedule for plan updates.

Assurances & Adoption

The State All-Hazard Mitigation Plan enhances and supports the Delaware Emergency Operations Plan (DEOP), revised in June 2017, and as such, is to be considered an annex to this plan. Additionally, the SHMP supports the variety of other emergency operations and support plans developed by the State to address potential emergencies that might impact the State of Delaware.

This plan has been adopted by the State of Delaware under the authority granted to the State in Title 20, Chapter 31 of the Delaware Code relating to civil defense and emergency management.

This document has been developed to be in accordance with current rules and regulations governing mitigation planning. The State of Delaware will continue to monitor all relevant federal and state legislation that impacts disaster mitigation activities, and adjust the plan as necessary to ensure compliance with any relevant statutes and policies. The plan shall be routinely monitored and updated every five (5) years as required by FEMA, to maintain compliance with the following legislation:

A. Delaware General Statutes, Title 20, Chapter 31, Emergency Management.
B. The Robert T. Stafford Disaster Relief and Emergency Assistance Act Disaster Mitigation Act as amended by the Disaster Mitigation Act of 2000 (Public Law 106-390 – October 30, 2000).
C. Post-Katrina Emergency Management Reform Act of 2006.

Plan Updates

2007 Plan Update
The 2007 update to this section added a statement reaffirming the State of Delaware's commitment to the mitigation process and philosophies espoused in DMA2K and other relevant legislation.

2010 Plan Update
This section was reviewed. Added information explaining the status of Executive Order 38.

2013 Plan Update
This section was reviewed and contains mostly minor edits. Added a reference to climate change and sea level rise in the "Background" section. Removed any reference to the Executive Order 38. Added in a reference to the Post-Katrina Emergency Management Reform Act of 2006.

2018 Plan Update
This section was revised and updated to include the Six Steps in the Planning Process listed in the FEMA Comprehensive Preparedness Guide (CPG) 101. Changes were also made to reflect the Federal requirement to update the Plan every five (5) years, instead of three (3). Deleted information regarding northern Delaware population growth along I-95 corridor and updated it to reflect the population growth in the State's southern coastal area.

PLANNING PROCESS

Section 2

This section describes the planning process undertaken by the State of Delaware in preparation for the 2018 update of the State All-Hazard Mitigation Plan. Specific topics include:

- Overview of Hazard Mitigation Planning
- Coordination Among Agencies
- The Planning Process
- State and Federal Mitigation Program Coordination
- Local Mitigation Plan Coordination
- Plan Updates

Overview of Hazard Mitigation Planning

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

Mitigation planning offers many benefits, including:

- Saving lives and property;
- Saving money;
- Speeding recovery following disasters;
- Reducing future vulnerability through wise development and post-disaster recovery and reconstruction;
- Expediting the receipt of pre-disaster and post-disaster grant funding; and
- Demonstrating a firm commitment to improving community health and safety.

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

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health and enhancing recreational opportunities. In addition to the identification and prioritization of possible mitigation projects, emphasis has been placed on alternatives that will assist Delaware in becoming less vulnerable to the damaging forces of nature, technological and terrorist hazards, while improving the economic, social and environmental health of the State.

Coordination Among Agencies

S2. Does the plan describe how the state coordinated with other agencies and stakeholders? [44 CFR §§201.4(b) and (c)(1)]

State Hazard Mitigation Council

The State Hazard Mitigation Council (SHMC) made up of public representatives, private citizens, business and organizations was brought together to work with DEMA and provide input at key stages of the process. Efforts to involve State agencies and public organizations that might have a role in the implementation of the mitigation action or polices included invitations to attend meetings and serve on the Council, coordination with functional experts, obtaining progress or summary reports, conducting strategy meetings, and opportunities for input and comment on all draft deliverables.

Although many State agencies are involved in hazard mitigation, the Delaware Emergency Management Agency (DEMA) has been assigned the leadership role in the area of disaster mitigation. Hazard mitigation efforts for the State are coordinated by the State Hazard Mitigation Officer (SHMO). The SHMO together with selected staff from each department forms the core of the State Hazard Mitigation Council (SHMC). Personnel from other State agencies are included on the Council and are requested to provide advice in the development, review, and implementation of hazard mitigation projects and plans as required. ***Table 2-1*** shows the agencies represented on the State Mitigation Council.

Department/Organization	Division
Department of Safety & Homeland Security	Delaware Emergency Management Agency Delaware State Police
Department of Natural Resources and Environmental Control (DNREC)	Division of Waste and Hazardous Substances Division of Air Quality Division of Parks & Recreation Division of Water Resources Division of Watershed Stewardship • Dam Safety • NFIP Coordinator • Floodplain Management Delaware Coastal Programs
Department of Transportation (DelDOT)	Homeland Security and Resilience & Sustainability Planning
Department of Health & Social Services	Division of Public Health Division of Social Services
Department of Agriculture	
Department of Education	
Department of Insurance	
Department of State	Division of Historical & Cultural Affairs Delaware Real Estate Commission
Delaware National Guard	
Delaware River & Bay Authority	
Delaware State Housing Authority	
State Fire Prevention Commission	State Fire School
Governor's Office	Office of Management & Budget • State Planning Office • Facilities Management

University of Delaware	State Climatologist Disaster Research Center IPA/Delaware League of Local Governments Marine Advisory Service
Delaware Geological Survey	
New Castle County	
Kent County	
Sussex County	
American Red Cross	
U. S. Army Corps of Engineers	
American Society of Industrial Security	Delaware Chapter

The Planning Team

In Delaware, the State Hazard Mitigation Council serves as official planning team for Mitigation planning. However, a wide variety of personnel have provided significant input into the past revisions and the 2018 plan update. Table 2- 2 provides a list of personnel, their agency, and their contribution to the 2018 plan update.

Name	Agency	Type of Contributions
AJ Schall	Department of Safety & Homeland Security	Direction, guidance, plan review and editing
Tony Lee	Department of Safety & Homeland Security	Coordination and guidance
Paige Fitzgerald	Department of Safety & Homeland Security	Coordination, plan review, and editing
Arnie Cookson	Department of Safety & Homeland Security	Community Profile, Critical Facilities
Willie Patrick	Department of Safety & Homeland Security	HazMat and Terrorism information
Lori Sherwood	Department of Safety & Homeland Security	Research, Capability Assessment plans and programs
Wilbert Hayes	Department of Safety & Homeland Security	Radiological data review and HazMat data review
Arthur D. Paul	Department of Safety & Homeland Security	Planning team lead, research, drafting updates, editing, and finalizing the plan
Gerald Pepper	Department of Safety & Homeland Security	Terrorism information review
Mike Powell	Dept. of Natural Resources and Environmental Control	Plan Review, Repetitive Loss, HIRA and strategy inputs
Greg Williams	Dept. of Natural Resources and Environmental Control	Plan review, Repetitive Loss
Virgil Holmes	Dept. of Natural Resources and Environmental Control	Community profile
Jennifer DeMooy	Dept. of Natural Resources and Environmental Control	Sea Level Rise

Janice Shute	Dept. of Natural Resources and Environmental Control	Dam/levee HIRA data
Jamie Bethard	Dept. of Natural Resources and Environmental Control	HazMat Data
Dwayne Day	Department of Transportation	Plan review, and mitigation action updates
Silvana Croope	Department of Transportation	Plan review, and mitigation action updates
Tim Sexton	Department of Health and Social Services	Mitigation Strategy review and update
Linda Popels	Department of Health and Social Services	HIRA review and update data
Ruth Campbell	Department of Health and Social Services	Coordination
Tim Cooper	Department of Health and Social Services	HIRA review and update
Shawn L. Foster	Department of Health and Social Services	HIRA review and update
Kyle Hoyd	Department of Agriculture	HIRA review and update, wildfire information
Connie Holland	State Planning Office	Community Profile, HIRA & strategy review
Miriam Pamilio	State Planning Office	Community Profile, HIRA & strategy review
Serena Fletcher	Department of State	Community Profile, library information
James Pennewell	Department of Education	Community Profile, education information
Garland Pennington	Delaware National Guard	Coordination, HIRA review
CSM Michael Fields	Delaware National Guard	Strategy review and update
Robert Young	Delaware River & Bay Authority	Coordination, Strategy review and update
Karen Horton	Delaware State Housing Authority	Coordination
Susan Givens	State Fire Prevention Commission	Fire Information for the HIRA
Mark Seifert	University of Delaware	Coordination, HIRA and Mitigation Action Review
Kevin Brinson	University of Delaware	Climatology and DEOS

John Callahan	Delaware Geological Survey	Climate and Weather
Dan Leathers	University of Delaware	Climate Data
Jim Richmond	American Red Cross	Coordination, Review
Jason F. Miller	U. S. Army Corps of Engineers	Coordination, Review
Joseph Bucovetsky	Federal Emergency Mgmt Agency	Update Guidance
Mathew McCullough	Federal Emergency Mgmt Agency	Update Guidance
Joe Miketta	National Weather Service	Coordination
David Carpenter	New Castle County	County Coordination, Review
Joe Thomas	Sussex County	County Coordination, Review
Colin Faulkner	Kent County	County Coordination, Review

PLANNING PROCESS

The Planning Process

Does the plan describe the planning process used to develop the plan? Does the plan describe how the state coordinated with other agencies and stakeholders? [44 CFR §§201.4(b) and (c)(1)]

The State Hazard Mitigation Plan Update Kickoff meeting was held on February 24, 2017 at the State Emergency Operations Center and there were approximately 26 attendees. The State Hazard Mitigation Officer, Arthur D. Paul started the meeting with a welcome and introductions. Delaware Emergency Management Agency (DEMA) Director A. J. Schall welcomed attendees and made some opening comments.

The purpose of the meeting was to kick-off the process of updating the State All-Hazard Mitigation Plan. The State had a comprehensive plan that was approved by FEMA in August 2013 and required updating by August 2018. While the plan is well written, it still needs to be thoroughly reviewed to ensure that all requirements are met prior to FEMA approval.

The State of Delaware utilized the planning process guidance provided in the Federal Emergency Management Agency (FEMA) Comprehensive Preparedness Guide (CPG 101) to revise the State All-Hazards Mitigation Plan. The Six Steps in the Planning Process are pictured below:

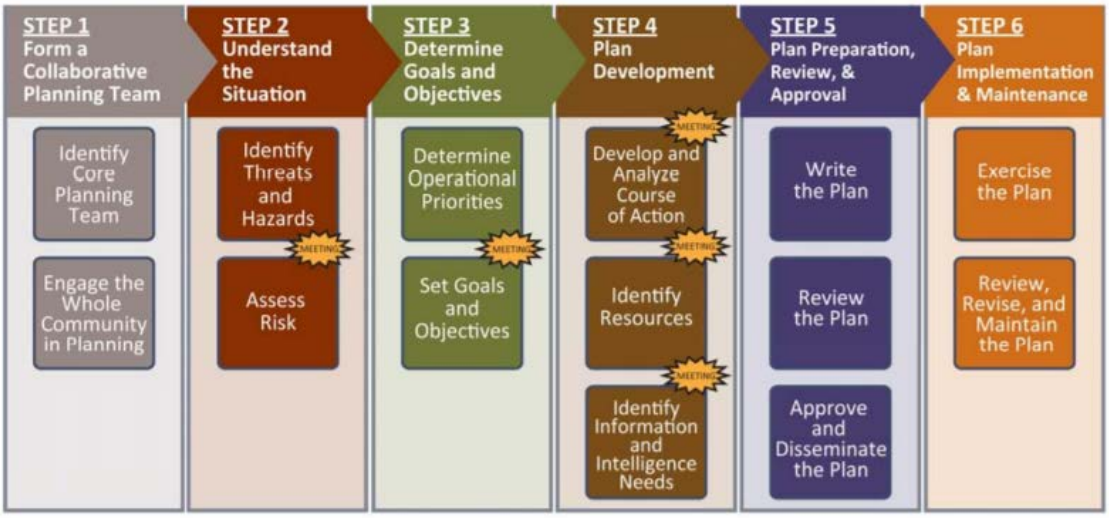


Figure 2-1 *FEMA's Six Planning Steps*

The six planning steps from the Guide were matched to a timeline which depicts the actions and activities that were used to update the plan (see *Figure 2-2*). FEMA requires that the plan describe the planning process and include documents used in updating the plan. The plan must also describe State coordination with other agencies and stakeholders; all meetings were documented and coordinated statewide through Delaware's three counties, Kent, New Castle, and Sussex.

Step 1 - Collaborative Planning Team ***April - September 2017***

Forming a Collaborative Planning Team is the first step in the planning process. Delaware has an established planning team through the State Hazard Mitigation Council (SHMC), as discussed in the previous section. However for the purposes of the 2018 update, Delaware established smaller sub-teams to address specific areas and sections of the plan. The idea was to ensure we utilized our resources in the most effective and efficient manner.

According to the CPG 101: *"Experiences and lessons learned indicate that operational planning is best performed by a small team.....Case studies and research reinforce this concept by pointing out the common thread found in successful operations is that participating organizations have understood and accepted their roles."*

Planning sub-teams were established to include functional experts and stakeholders with experience, related to the Delaware's hazards and threats. The Planning Committee had a teleconference in September 11, 2017 and there were 21 participants. The primary purpose of the teleconference was to finalize the Sub-teams and Team Leaders, cover team responsibilities, and to review plan update requirements. The planning sub-teams met and teleconferenced to review and re-rank Delaware's hazards based on the past five years (see Annex F: Supporting Documents). Sub-team members volunteered and were solicited for the following sub-teams and leads:

- Natural Hazards (Nat Haz) - Kevin Brinson-UD, Michael Powell-DNREC
- Public Health & Safety - Linda Popels-DHSS/DPH, Ron Bounds-DIAC, and Will Hayes-DEMA
- Coordination and Review - Art Paul, Damaris Slawik, Lori Sherwood-DEMA
- Mitigation Strategy and Actions - Art Paul –DEMA

Step 2 - Understand the Situation ***August - December 2017***

According to CPG 101, identifying threats, hazards, and assessing risk/vulnerabilities, helps the planning team decide what hazards or threats merit special attention. This is an important and key step in the planning process. The primary purpose of the teleconference was to finalize the Sub-teams and Team Leaders, cover team responsibilities, and to review plan update requirements. The sub-teams had telephone conferences and meetings to assign areas of responsibilities and sections for reviewing.

Hazard Identification - Section 4.1 provides a general description of the hazards from a general/national perspective and from a Delaware historical perspective. Federal and State analyses that include data about historical incidents within the jurisdictions provide valuable information for identifying hazards. In addition to experiences and inputs of all stakeholders. This section required updating of the hazards that have impacted Delaware since the August 2013 revision and the hazards needed to be re-ranked based on the activities of the past five years. This section was updated to include human-caused and technological hazards; previously located in Annex G, which was "For Official Use Only" (FOUO).

The Mitigation Plan Update Sub-Team Workshop was held October 27, 2017, there were approximately 26 attendees at the meeting. The meeting began with a discussion of the planning process and timeline to complete the 2018 plan. The primary purpose was to give the Sub-Teams a chance to meet face to face and continue the process of revising the hazard identification section. The Sub-Teams had separate break-out sessions for coordination and review of guidance and update requirements.

Representatives from University of Delaware discussed Vulnerability Assessment. The Sub-Teams reviewed FEMA guidance, assigned sections of the plan, identified missing stakeholders, validated “Hazard Rankings”, and discussed consolidating/reorganizing hazards. FEMA and University of Delaware team members swapped out of each session to answer questions from team members. Then the Sub-Team Committee gathered for an overview of their sessions.

The University of Delaware (UD) was contracted to perform Vulnerability Assessment--Section 4.2--which provides an overview and analysis of natural hazard vulnerabilities to include risk and loss assessments. The mapping and assessment portion was revised using HAZUS-MH, FEMA's loss estimation software.

The outcomes of the hazard Identification and the vulnerability assessment were used to identify gaps, determine operational priorities, and to determine a strategies, goals and objectives, which is the next step in the planning process.

Step 3 - Determine Goals and Objectives ***January - March 2018***

According to CPG 101 Goals are broad, general statements that indicate the intended solution to identified problems. Objectives are more specific and identifiable actions. The August 2013 revision of the Plan contained five goals and each contained several objectives. The planning team reviewed the goals and objectives for validity and to ensure that all vulnerabilities and gaps in capabilities were addressed thru mitigation actions, Section 6.2.

PLANNING PROCESS

The mitigation strategy, goals, and objectives, form the basis for action in Delaware's Mitigation Program. Members of the planning team will used their understanding of the situation, gained from the hazard identification and vulnerability assessment, to identify gaps in Delaware's capabilities and to revise the state's goals, objectives, and mitigation actions accordingly.

Step 4 - Plan Development ***January - March 2018***

The Plan Development Step includes, analyze course of action, identify resources, and information and intelligence needs. The step also included a thorough review of plan requirements to include new items such as Threat Hazard Identification and Risk Analysis (THIRA) and future conditions; such as climate change and sea level rise. THIRA topics relevant to Mitigation were included in the Capability Section of the plan. We worked closely with the THIRA planning team and FEMA to avoid duplication of efforts and to ensure that requirements are met. Additionally, future conditions considerations were included for each applicable hazard that was identified in the Hazard Identification Section, 4.1.

The mitigation actions form the basis for action in Delaware's Mitigation Program. Members of the planning team will used their understanding of the situation, gained from the hazard identification and vulnerability assessment, to identify gaps in Delaware's capabilities and to revise the state's goals, objectives, and mitigation actions accordingly.

Step 5 - Plan Preparation, Review & Approval ***April - May 2018***

The Natural Hazard and Public Health and Safety, sub-teams reviewed and updated sections of the plan and the Coordination and Review sub-team collected, prepared, reviewed, and standardized sub-team inputs. The Plan was vetted thru DEMAs Planning Sections and management. A draft of the entire plan was consolidated and provided to the Mitigation Council for review prior to forwarding to FEMA. Following FEMAs review and our corrections, we will receive an Approval Pending Adoption (APA) letter. Once the APA letter is received, the plan will be forwarded to the Governor for approval.

Step 6 - Plan Implementation & Maintenance ***June - August 2018***

Once the Governor adopted the plan it was forwarded to FEMA for final approval. Maintenance of the plan will include annual reports to the State Hazard Mitigation Council. The reports will detail the latest legislative requirements or changes and information on projects and programmatic activity.

For a more detailed discussion of each meeting/teleconference, or for more information on the planning process, please refer to Annex E: Supporting documents.

Figure 2-2 All-Hazards Mitigation Plan Update Timeline

Public Involvement

The State Hazard Mitigation Council (SHMC) provides oversight of States Mitigation program and the SHMC meeting are open to the public and are advertised on the State Calendar. Citizens are invited and have attended the meeting. A fundamental component of this planning process involves public participation. Individual citizen and community-based input provides the entire planning team with a greater understanding of local concerns and ensures a higher degree of mitigation success by developing community "buy-in" from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the natural hazards present in their community and take personal steps to reduce their potential impact. Public awareness is a key component of an overall mitigation strategy aimed at making a home, neighborhood, school, business, or city safer from the potential effects of natural and human-caused hazards.

Public input was sought using three methods: 1) public meetings, 2) website access, and 3) newspaper advertisement campaign. A county-level public meeting was held following the second planning workshop. The public meetings were held to present the findings of the risk and capability assessments and garner input regarding hazard concerns and possible mitigation actions that could be included in the Plan, including both policies and projects. In many cases, citizens can provide intimate details of problematic hazards, particularly those that have directly affected them.

The updated plan will be public facing and will be available on DEMAs website; with the exception of "For Official Use Only" or sensitive information. The plan currently has two restricted annexes that are not available to the public. Information made available to the public will be closely scrutinized by the planning team.

How other Stakeholders were Involved

A range of stakeholders were involved in the mitigation planning process. Stakeholder involvement was encouraged through the use of multiple planning workshops, public meetings, press releases, public notices and the notification of stakeholder groups.

For example, the county-level risk assessments were used as the basis for the State-level risk assessment. In addition, county level mitigation plans, which included participating municipalities, developed joint plan goals and objectives. Specific mitigation actions were developed on an individual county and municipal level. In many cases, counties, and municipal governments agreed to adopt regional mitigation actions that crossed jurisdictional boundaries.

The coordination of State and local plans also facilitated the assistance of several State agencies, including DEMA, the State Historic Preservation Office, the University of Delaware, Office of State Planning, Department of Natural Resources and Environmental Control (almost all divisions), Delaware Geological Survey, Delaware Department of Transportation and the Delaware National Guard.

The Preparation of this Plan

Planning sub-teams were established to facilitate the preparation of the 2018 Plan. The Sub-Teams included functional experts and stakeholders with experience, related to the Delaware's hazards and threats. The three Sub-Teams were: Natural Hazards, Public Health & Safety, Coordination and Review. The Planning Committee had a teleconference in September 11, 2017 and there were 21 participants. The primary purpose of the teleconference was to finalize the Sub-teams and Team Leaders, cover team responsibilities, and to review plan update requirements. The planning sub-teams met and teleconferenced to review and re-rank Delaware's hazards based on the past five years. The Planning Sub-Teams were instrumental in providing input to the State Plan sections listed below. See Annex F: Supporting Documents, for more information on the Sup-Team activities.

The *Community Profile*, located in Section 3, describes the general makeup of the State, including prevalent geographic, demographic, and economic characteristics. In addition, building characteristics and land use patterns are discussed. This baseline information provides a snapshot of statewide planning and thereby assists the counties and municipal officials in recognizing those factors that ultimately play a role in describing local

vulnerabilities to natural, technological and terrorist hazards.

The *Hazard Analysis/Risk Assessment/Vulnerability Assessment*, found in Section 4 of the plan, describes and analyzes the natural, human-caused, and technological hazards present in the State of Delaware. The analysis utilizes historical data on past hazard occurrences, and establishes hazard profiles and a hazard risk ranking based upon hazard frequency, magnitude and impact. The FEMA HAZUS-MH® loss estimation methodology, combined with the use of existing historical hazard data, was used to conduct the *Risk Assessment*. This information on hazard risk is critical when communities must determine the most appropriate mitigation actions for their community to pursue and implement. The findings of the *Risk Assessment* enable communities to prioritize and focus their efforts on those structures or planning areas facing the greatest risk.

The *Capability Assessment*, found in Section 5, provides a comprehensive examination of the State's capacity to implement meaningful mitigation strategies and identifies existing opportunities for program enhancement. Capabilities addressed in this section include staff and organizational capability, technical capability, policy and program capability, fiscal capability, legal authority and political willpower. Information was obtained through the use of detailed questionnaires and the analysis of existing plans, ordinances and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses or conflicts in programs or activities that may hinder mitigation efforts, or to identify those activities that can be built upon in establishing a successful community hazard mitigation program.

The *Community Profile*, *Risk Assessment*, and *Capability Assessment* form the basis for determining the goals and objectives for the plan. Each of these three background studies help set the stage for developing, adopting and implementing a meaningful *Mitigation Strategy*, found in Section 6, that consists of specific mitigation goals and objectives, and their attendant actions and implementation mechanisms. This process is designed to result in a plan that is both strategic (through the identification of long-term goals) and functional (through mid-range objectives and short-term actions).

Following the completion of the *Mitigation Strategy*, State agencies and stakeholders concentrated on designing measures to ensure the Plan's continuous implementation, and adopted evaluation procedures to ensure that the Plan is routinely updated. These measures are discussed in the *Plan Maintenance Procedures* found in Section 7 of the Plan.

State and Federal Mitigation Program Coordination

Hazard mitigation planning efforts in Delaware are integrated through a combination of federal, State, local, and non-government plans, programs, and initiatives. Legal requirements in the Disaster Mitigation Act of 2000, policy guidance from the various federal mitigation programs, Delaware State law, the Delaware Emergency Operations Plan, Executive Order 15, local Hazard Mitigation Plans, and business partnerships all add to the framework for integration.

Federal Integration

The Pre-Disaster Mitigation Grant Program (PDM), Hazard Mitigation Grant Program (HMGP), and Public Assistance (PA) programs are administered through the Delaware Emergency Management Agency (DEMA). The National Flood Insurance Program (NFIP) and Flood Mitigation Programs (FMA) are coordinated through the Delaware Department of Natural Resources and Environmental Control (DNREC). These programs are used to implement the integrated planning process and implement mitigation measures through funding sources and policy. The HMGP, FMA, and PDM are currently used to fund State and local planning efforts and the implementation of the mitigation strategies identified in this plan.

Local Mitigation Plan Coordination

Local Funding and Technical Assistance

A description of the State process to support, through funding and technical assistance, the development of local mitigation plans. 44 CFR 201.4(c)(4)(i)

Hazard Mitigation Grant Program (HMGP) funding is authorized for projects located within the State and is not restricted to the counties receiving the Presidential Disaster Declaration. Initially, project priority may be targeted to the affected county for the type of hazard experienced. The approved project does not have to be damaged as a result of the disaster. Projects may not be retroactively funded. The State of Delaware has used funding from Disaster 4037 and Disaster 4090 to assist with the updates of their three County Hazard Mitigation Plans.

Although many State agencies are involved in hazard mitigation, DEMA has been assigned the lead role in the area of disaster mitigation. The specific duties are defined in the State Mitigation Programs Administrative Plan. Hazard mitigation efforts for the State are coordinated by the State Hazard Mitigation Officer (SHMO). The SHMO together with selected staff from each department forms the core of the SHMC. Personnel from other State agencies are included in the Council and are requested to provide advice in the development, review, and implementation of hazard mitigation projects and plans as required.

The Delaware Emergency Management Agency (DEMA) Natural Hazards Section has been actively involved in the update of its three Counties Hazard Mitigation Plans. The Natural Hazards Section has participated in county plan updates through meeting attendance, review of drafts, and has provided technical assistance whenever and wherever possible. The Delaware Local governments (city, town and county) have the primary task for identifying hazards in their communities and should take appropriate action to mitigate their consequences.

An effective mitigation program requires actions on the cause of the emergency (hazard), the population affected by the emergency, and the interaction between the hazard and the people. To implement a fully developed hazard mitigation program in Delaware, all technical support agencies may be asked to offer technical assistance and guidance to local communities in assessing their risk, planning, and designing mitigation measures to reduce the risk. Hazard Vulnerability studies as well as Flood Mitigation Plans, local Risk Assessments, Capability Assessments, and Mitigation Strategies have been completed for New Castle, Kent, and Sussex Counties; the City of Wilmington mitigation efforts are addressed in the New Castle County Plan. DEMA provides technical assistance to the counties during the planning process to identify, evaluate, and prioritize local projects that are cost-effective, environmentally sound, and technically feasible, that also contribute to and are aligned with mitigation actions identified by the state.

DEMA has provided (and will continue to provide) technical assistance to the counties and the University of Delaware in the development of their hazard mitigation plans. Both local and state mitigation planning cycles are defined in five year increments to ensure consistency in planning review and update processes. The timeline for coordination is as follows:

ACTIVITY	TIME before plan adoption
Identify necessary project funding	24 months
Application Development	20 months
Contract planning support (as needed)	16 months
Kick-off Meeting for planning partners	14 months
County First Draft Review	7 months
DEMA Review	6 months
FEMA 1st Review	5 months
County incorporates DEMA & FEMA feedback	3.5 months
FEMA Adoption Pending Approval letter	3 months
County Adoption of plan	2 months
Final FEMA Approval	1 months

The agency assisted all three counties in their update of their local mitigation plans. The SHMO attended local planning meetings, provided guidance on the update requirements, Severe Repetitive Loss and Repetitive Loss data, as well as information gathered by summer interns on local mitigation accomplishments. The State of Delaware has placed a special emphasis on communities with Repetitive Loss and Severe Repetitive Loss properties when it comes to prioritizing projects and planning grants as well as technical assistance for plan development. DEMA submitted a planning application through the Pre-Disaster Mitigation program to help fund the local updates. The SHMO also assisted the University of Delaware in the development of their mitigation plan.

Local Plan Development

Local jurisdictions in Delaware address some hazards in the planning and development process, primarily through the use of building codes and land use and zoning ordinances. In preparation of a mitigation plan, the local government is required to survey and study such matters as use and preservation of land, characteristics and conditions of existing development, natural resources, surface water, geology, environmental and economic factors, existing public facilities, drainage, flood control and flood damage prevention measures, among others. The variety of ordinances and regulations used by the three counties and the various jurisdictions throughout the State can be found in Section 5.

In general terms, these plans have been effective at preventing damages during major flooding, for example. The State experiences flash flooding several times a year due to heavy rains, and suffers very little damage (relatively speaking) as a result of the prohibition of development in areas prone to flooding.

Having functional local mitigation plans is essential to the success of the State's ability to implement cost effective and feasible mitigation projects. Local plans are required to be updated on a 5 year basis. Communities actively seeking funding to mitigate, especially if funding is to be geared towards Repetitive Loss or Severe Repetitive Loss properties will be given a higher priority towards their plan updates.

Local Plan Integration

A description of the State process and timeframe by which local plans will be reviewed, coordinated, and linked to the State Mitigation Plan. 44 CFR 201.4(c)(4)(ii)

In 2003, the State chose to simultaneously develop Disaster Mitigation Act-compliant mitigation plans at the State and county level. This approach facilitated the integration of the planning processes. However, since 2003, the County and State plans have changed and they are no longer updated simultaneously.

Nonetheless, local plans undergo a comprehensive review and evaluation process every five years by the State Hazard Mitigation Council under the authority of the Governor's Executive Order #15 and DEMA policy to determine whether there have been any significant changes in the State necessitating changes in the types of mitigation actions proposed.

The Counties were actively involved in the 2018 revision of the State Plan update and portions of the County Mitigation plans (hazard identification and risk/vulnerability assessment) were used to perform the Vulnerability Assessment of the 2018 State Plan.

Interagency Plan Integration

Because the State of Delaware is so small, many of the state-local planning processes are integrated and well-coordinated. Additionally, the State provides many of the governmental functions that in most other states are provided by local government (i.e., public health services). This eliminates much of the "disconnect" that exists among the various entities with planning and mitigation responsibilities that occur in other states.

As an example, the State of Delaware is responsible for approximately 90% of the paved roadways in the state (most states own less than 20% of the paved roads within their respective boundaries). Planning to ensure roads meet environmental requirements is part and parcel of all but the most basic local development processes. The State owns neighborhood roads, for example, and subdivision planning is carried out in conjunction with State land use guidelines and in coordination with reviews from the NFIP Program Manager and other relevant/interested parties. More information on this subject can be found in Section 5.

Prioritizing Local Assistance

Criteria for prioritizing communities and local jurisdictions that would receive planning and project grants under available funding programs which should include 1) Consideration for communities with highest risks, 2) Repetitive loss properties, and 3) The most intense development pressures. [For] non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs. 44 CFR 201.4(c)(4)(iii)

The State Hazard Mitigation Council will solicit and prioritize projects and support applicants in obtaining Hazard Mitigation Grants to implement prioritized projects.

Hazard Mitigation Grant Program (HMGP) funding is authorized for projects located within the State and is not restricted to the counties receiving Presidential Disaster Declarations. Initially, project priority may be targeted to the affected county for the type of hazard which occurred.

The Hazard Mitigation Administrative Plan (Appendix D) details the minimum project criteria. To be eligible for the Hazard Mitigation Grant Program, a project must be in conformance with the local and State Hazard Mitigation Plans:

- Be in conformance with local and State hazard mitigation plans
- Have a beneficial impact upon the designated disaster area. (Note: The designated disaster area comprises those counties designated in the disaster declaration as eligible for HMGP funds. Disaster declarations in Delaware include verbiage that makes HMGP funds available statewide)
- Be in conformance with 44 CFR part 9, Floodplain Management and Protection of Wetlands, 44 CFR part 10, Environmental Considerations, and Executive Orders;
- Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster; Benefit Cost Analysis will be developed per FEMA standards.
- Not be eligible under another federal program or grant.

Projects may be of any nature that will result in protection to public or private property. Eligible projects include, but are not limited to:

- Structural hazard control or protection projects;
- Construction activities that will result in protection from hazards;
- Retrofitting of facilities;
- Property acquisition, relocation, elevation as defined in §206.434(d);
- Development of State or local mitigation standards;
- Development of comprehensive hazard mitigation programs with implementation as an essential component;
- Development or improvement of warning systems.

Examples of projects which have been highly prioritized by Delaware's State Hazard Mitigation Council in prior disasters include:

- Non-structural shoreline flood/storm protection projects;
- Relocation/acquisition/elevation of flood prone structures;
- Education/training programs aimed at reducing hazards;
- Equipment purchases which directly reduce losses or hazard;
- Improvements to public utilities which reduce future losses;
- Planning activities that directly reduce losses or hazard;
- Outreach projects that can reasonably be expected to reduce losses or hazards.

Once HMGP applications are submitted, the State Hazard Mitigation Council (SHMC) may be tasked to review and prioritize the applications if funds are limited. When the SHMC is tasked, proposed projects should be reviewed by the SHMC Policy Group and representatives from the Advisory Group who have the project specific expertise to critically evaluate those projects being considered. Projects that are selected by the SHMC for funding will be sent to FEMA Region III with a request for funding.

When required, the SHMC will review project proposals, and propose a list of projects to be funded. The specific selection criterion is provided in the “Applicant Evaluation Sheet” in Appendix C. If a project is withdrawn by the applicant or rejected by FEMA, the SHMC may approve funding for an alternate project from the initial list or solicit and review additional projects.

When the SHMC selects proposed projects for funding, it is the responsibility of the applicant to provide all relevant project information in a timely manner. Applicants shall have 90 days from the time at which they are notified that their proposed project has been approved to send all application information necessary to apply to FEMA for funding. This includes project description, discussion of alternatives, cost breakdown, damage prevention estimates, and requests for letters of project concurrence from environmental agencies. If, after 90 days from the date of notification, such information has not been provided to the SHMO, the SHMC may select another project from the initial list of draft projects or solicit new ones. However, at the discretion of the SHMC, the applicant may be granted a time extension to provide necessary information.

DEMA has provided (and will continue to provide) technical assistance to the counties and the University of Delaware in the development of their hazard mitigation plans. The agency assisted all three counties in their update of their local mitigation plans. The SHMO attended all local planning meetings, provided guidance on the update requirements, Severe Repetitive Loss and Repetitive Loss data, as well as information gathered by summer interns on local mitigation accomplishments. The State of Delaware has placed a special emphasis on communities with Repetitive Loss and Severe Repetitive Loss properties when it comes to prioritizing projects and planning grants as well as technical assistance for plan development. DEMA submitted a planning application through the Pre-Disaster Mitigation program to help fund the local updates. The SHMO also assisted the University of Delaware in the development of their mitigation plan.

The counties are authorized to use pass-thru funds from the EMPG and other federal emergency management programs to develop and enhance their hazard mitigation plans, provided the work is included in the “scope of work” submitted and approved by DEMA. The DEMA staff is available to the locals to support any mitigation planning activities they wish to pursue, and the agency provides information and assistance as necessary to help them achieve those goals when requested.

Plan Updates

Note Regarding 2007 Plan Update
The 2007 update to this section addressed changes in composition to the State Hazard Mitigation Council, explained the 2007 update process, and modified information regarding the integration process.

Note Regarding 2010 Plan Update
The 2010 update added a section covering the 2010 update. Specified personnel involved in the update process and their contribution.

Note Regarding 2013 Plan Update
The 2013 update added a section covering the 2013 update. Specified personnel involved in the update process and their contribution.

Note Regarding 2018 Plan Update
The 2018 update added a section covering the 2018 update. Updated the planning process to align with FEMA CPG 101 Six Step Planning Process. Update Planning Team and included information on Planning Sub-teams and the people involved in the update process. Changed all references to Executive Order 38 to Executive Order 15.

COMMUNITY PROFILE

This section provides a general overview of the State of Delaware. It is broken down into the following six sections:

- Geography and the Environment;
- Population and Demographics;
- Infrastructure and Land Use;
- Employment and Industry;
- Disaster Declarations; and
- Plan Updates.

Geography and the Environment

Introduction

Delaware, one of the Mid-Atlantic States of the United States, occupies part of the peninsula between Delaware Bay and Chesapeake Bay, and was one of the thirteen original states. Delawareans played a major role in the events that occurred during and after the American Revolution (1775-1783), and on December 7, 1787, Delaware became the first state to ratify the Constitution of the United States.

Delaware is divided into three counties: New Castle, Kent, and Sussex. Historically, industrialized New Castle County has contrasted with the other two counties, which have been predominantly agricultural areas. Today approximately 60% of the population lives in New Castle County, the northernmost county. Wilmington, the state's largest city, with more than with more than 70,000 people, is located in New Castle County. Dover, located in Kent County in the center of the state, is Delaware's capital.

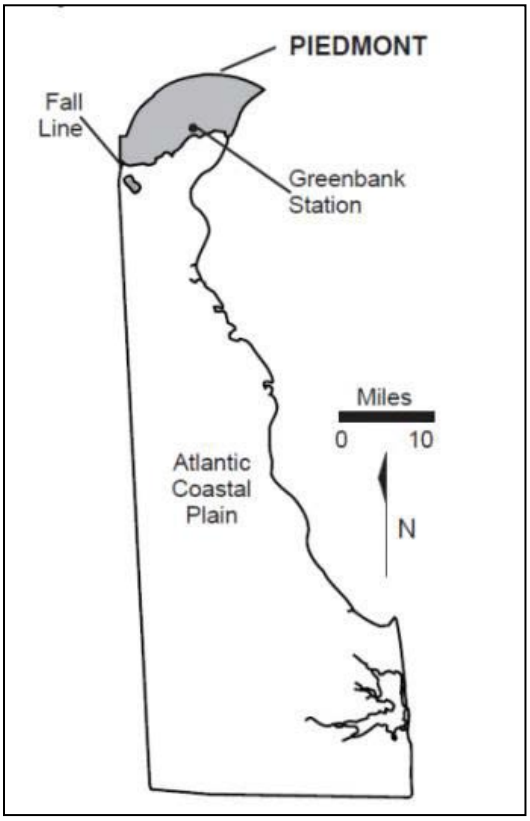
The history of Wilmington and of the state's early large-scale industrial growth is, to a great extent, the history of the famous du Pont family and E. I. du Pont de Nemours and Company, one of the world's largest chemical companies. Delaware is primarily an industrial state. Most of the manufacturing industries are located in New Castle County, although a number of industrial plants have been established in the two southern counties. For the most part, the south primarily remains an agricultural area, and farmers produce a wide range of products for such urban markets as Washington, D.C., Philadelphia, Baltimore, and New York City.

The people of Delaware commonly denote the parts of their state as either "north of the canal," meaning in the industrialized and more densely inhabited region around Wilmington, or "south of the canal," meaning Delaware's more rural and less densely populated region that makes up the southern half of New Castle County and all of Kent and Sussex Counties. The canal, referred to as the Chesapeake and Delaware Canal, effectively bisects New Castle County.

The state's name is derived from the name of Thomas West, 3rd Baron De La Warr, Virginia's first colonial governor. In 1610 Sir Samuel Argall, sailing for Virginia, sighted what is now called Cape Henlopen in Delaware Bay. Argall named it Cape De La Warr in honor of the governor. Although the cape itself was later renamed, the name *Delaware* came to be applied to the Delaware River and Delaware Bay and later to the land along the western shore of the bay and the river. Delaware's official nickname is the First State, which commemorates Delaware's early ratification of the U.S. Constitution. Delaware is also known as the Diamond State, because its value, like that of a diamond, is said to be out of all proportion to its small size. Another nickname, the Blue Hen State, dates from the American Revolution when the fighting spirit of the Delaware First Regiment was compared with that of their mascots, a brood of gamecocks reared by a famous blue hen. The blue hen was later designated the official state bird. Delaware is the second smallest state of the Union, covering only 6,206 sq km (2,396 sq mi), including 184 sq km (71 sq mi) of inland water and 961 sq km (371 sq mi) of coastal water over which it has jurisdiction. Only Rhode Island is smaller. Located in the eastern section of the Delmarva Peninsula, between Delaware Bay and Chesapeake Bay, Delaware is 154 km (96 mi) from north to south and varies from 14 to 56 km (9 to 35 mi) east to west. The state is a low-lying area. With an average elevation of only 18 m (60 ft), it ranks as the lowest state in the nation.

Delaware is vulnerable to the effects of climate change. Climate change is defined by the U.S. Environmental Protection Agency as any significant change in the measures of climate lasting for a long period of time, including major changes is temperature, precipitation, and wind patterns. Challenges posed by changing conditions include extreme temperatures, heavier precipitation, and sea level rise, according to the Delaware Department of Resources and Environmental Control. Due to the state being a low-lying area, it is particularly vulnerable to the threat of sea level rise.

Natural Resources



Delaware can be divided into two major regions, or physiographic provinces, each of which is part of a larger physiographic division of the eastern United States. The two regions are the Piedmont and the Coastal Plain. The Piedmont, which is part of the larger Appalachian Region, extends through Delaware into Maryland and Pennsylvania and forms only a small section of Delaware. The Coastal Plain occupies the rest of the state as well as much of the coastal area of neighboring states. The boundary between Delaware's two natural regions is marked by the Fall Line, the zone where streams pass from the more ancient and harder rock of the Central Appalachian Piedmont to the more easily eroded unconsolidated sediments (gravel, sand, silt and clay), of the Coastal Plain.

The Piedmont in Delaware lies north of the Christina River, roughly trending Delaware route 2, and consists of fertile river valleys and rolling wooded hills. The highest point, on the border with Pennsylvania, is 137 m (448 ft) above sea level, and few other hills rise above 122 m (400 ft).

The Coastal Plain in Delaware is characterized by flat topography which is part of the wide sandy plain that stretches along the eastern coast of the United States. The Great Cypress Swamp lies in the southern part of the Coastal Plain. Other coastal swamps and marshes, which are flooded at high tide, occupy

the lower courses of many of the major river valleys. A ridge of well-drained land runs the entire length of the Coastal Plain in Delaware. It forms the topographic divide between rivers flowing eastward into Delaware Bay and westward into Chesapeake Bay. Delaware's best farmlands lie on or near the low ridge. Nearly all of the state's coastal plain is less than 18 m (60 ft) above sea level.

A major natural resource in Delaware, water, is found in extensive aquifer systems within the relatively flat Coastal Plain. As a result, Delaware has an abundant supply of good quality water that is capable of supporting current as well as future demands related to economic development, public, commercial, domestic, and agricultural use.

Rivers, Bays, Lakes and Ponds

Delaware has more than 2,500 miles of rivers and streams, and 2,954 acres of lakes and ponds. Delaware borders the estuary of the Delaware River, which is considered to be the state's principal waterway. The wide, lower portion of the estuary is called Delaware Bay. In northeastern Delaware, Delaware's boundary with New Jersey extends to the 1934 mean low water line of the Delaware River along the New Jersey shore, so that the river lies almost entirely in Delaware. In northern Delaware, rivers flowing into the Delaware River include the Christina and its tributary, Brandywine Creek, which join the Delaware River to form the Port of Wilmington, a major shipping port. Other rivers flowing into Delaware Bay include the Appoquinimink, Smyrna, and Saint Jones rivers in central Delaware, and the Murderkill, Mispillion and Broadkill rivers, which enter the bay in southern Delaware. The Nanticoke River is the principal river in southwestern Delaware and flow southwestward across Maryland into Chesapeake Bay. There are many other smaller rivers and streams in the state.

Except for the Delaware River, most of the major rivers in the state are navigable only by small craft. Oceangoing vessels and barges can navigate Delaware Bay and the Delaware River to Wilmington and other ports farther upriver. The Chesapeake and Delaware Canal extends across the northern part of the state to link Delaware Bay and Chesapeake Bay. The canal forms part of the Intracoastal Waterway.

In colonial times the small waterfalls that occur where Brandywine Creek and other tributaries of the Christina River flow over the Fall Line provided waterpower for Delaware's flour mills and other factories.

There are no large lakes in Delaware. However, there are numerous small lakes and ponds, which are often used for fishing and other recreational activities.

Coastlines

The state's ocean coastline is only 45 km (28 mi) long.

The shoreline, which includes all bays and inlets, is 613 km (381 mi) long. The Delaware Bay and Atlantic coast sustain one of the longest marshes and associated freshwater ecosystems along the Atlantic coast.

Extensive saltwater marshes are found along the shores of the Delaware River and Delaware Bay. By contrast, south of Cape Henlopen the seacoast is fringed by sand dunes and long sandy barrier beaches. Indian River Inlet, which allows small vessels to reach the shallow lagoons behind the coast, is the only break in the barrier beaches. Behind the barrier beaches are Rehoboth Bay, Indian River Bay and Little Assawoman Bay.

Climate and Temperature

Delaware has generally hot and humid summers and mild winters. In July, average daytime temperatures are usually in the upper 20°s to lower 30°sC (80°sF) or even higher. But because summer nights tend to be cooler than the days, July averages are about 24°C (about 75°F). In addition, onshore sea breezes can reduce daytime temperatures along the coast by 3 to 6 Celsius degrees (5 to 10 Fahrenheit degrees). January averages range from -1°C (31°F) at Newark, in the north, to 3°C (38°F) at Bridgeville, in Sussex County. Nearly

three-fifths of Delaware's days are classified as sunny. Precipitation (rainfall and snowfall) in Delaware is evenly distributed throughout the year, with slightly more in June and July than in any other month. Most of the state receives between 1,020 and 1,170 mm (40 and 46 in) a year. Severe droughts are uncommon. Thunderstorms occur frequently in summer, and in winter there is generally light snowfall.

Growing Season and Soils

The growing season, which is the period between the last killing frost in the spring and the first killing frost in the fall, is generally between 170 and 200 days long. Destructive frosts seldom occur later than the end of April or before the middle of October.

Delaware has predominantly gray-brown soils, called Ultisols that range in texture from coarse sands to loams. These soils have in many areas been cultivated for as long as 200 years, now require heavy applications of fertilizer when cultivated.

Plant Species

Prior to European settlement, most of Delaware was covered by forest. However, much of the original tree cover was cut for timber, fuel, and agricultural purposes in the 17th and 18th centuries. Today 31 percent of the state remains forested, although nearly all existing forests have been harvested for timber at some time in the past. The principal deciduous trees include oak, hickory, beech, maple, gums, and ash. Loblolly pine , found chiefly in the southern part of the state, is the principal conifer. In the sandy coastal areas are found pitch pine, loblolly pine, red cedar, and bayberry. The bald cypress, common in the South, has its northernmost stand in North America in the Great Cypress Swamp, where Atlantic white cedar and other trees can also be found.

Wild flowers are found in great abundance between early spring and late fall. Common wild flowers include the crocus, violet, azalea, honeysuckle, pink lady's slipper, and aster. The water lily is common in freshwater lakes and ponds throughout the state. The hibiscus grows in salt marshes, and the swamp magnolia along the coast. The blossom of the peach tree is the state flower of Delaware.

Wildlife Species

The white-tailed deer is the only large game animal found in Delaware today. Other animals found here include the fox, raccoon, chipmunk, rabbit, mole, muskrat, mink, otter, and some beaver.

Among the wide variety of birds found in Delaware are the robin, Carolina wren, starling, boat-tailed grackle, wood thrush, purple grackle, catbird, cardinal, tufted titmouse, blue jay, and ruby-throated hummingbird. There are also a number of species of warbler, woodpecker, vireo, and sparrow in the state. The woodcock, snipe, quail, mourning dove, and pheasant are the principal game birds. Shore and water birds include the great blue heron, snowy egret, black duck, blue-winged teal, and species of sandpipers, gulls, and terns.

The snapping turtle is common in the swamps. Snakes include the hognose snake, the blackrat snake, the garter snake, and the copperhead, the only poisonous snake in the state. Crabs and clams are gathered in Delaware Bay, although their numbers are drastically reduced from former years, while oysters have been almost eliminated by a combination of diseases. Bass, perch, pike, trout, and other game fish are common in many lakes, ponds, and smaller streams in the state. Other fish include sturgeon, catfish, and drumfish.

Conservation and Air Quality

Delaware's Department of Natural Resources and Environmental Control (DNREC) is responsible for the conservation of soil and water and the management of fish and wildlife, parks, water resources, air quality, and waste disposal. The preservation of wetlands and other fragile lands is a priority. State park acreage has risen from about 2,100 hectares (about 5,300 acres) in the early 1970s to more than 10,000 hectares (about 26,000 acres) in 2016. The possible loss of its remaining open space is one of the state's most serious environmental issues. According to the 2016 Annual Air Quality Report, "all pollutants except ozone are below the national air quality standards." Over the last ten years, trends in ambient concentrations of the criteria pollutants have been either level or declining."

Since 1970, lead has been virtually eliminated from the air, and levels of soot, dust, and other particulate matter have fallen. Concentrations of carbon monoxide, sulfur, and some organic chemicals have also declined.

Because ozone is the pollutant of primary concern, the state requires vehicle emission inspections. To help reduce vehicle emissions, service stations are required to sell highly combustible gasoline in summer. In 1990 Delaware and five nearby states concluded an agreement to coordinate strategies for the control of ozone and certain other pollutants.

Waste Management

Delaware waste management systems are protective of human health and the environment and encourage waste reduction and recycling whenever possible. The majority of solid waste generated in the state is managed by the Delaware Solid Waste Authority (DSWA) in one of their three state approved landfills. The majority of hazardous waste generated in the state is shipped out of state to approved treatment and disposal facilities. Waste management in the state is regulated under strict rules which track the waste from generation to appropriate disposal facilities. Delaware also has a Hazardous Substance Cleanup program that remediates any historical releases of hazardous substances to the environment.

Water Quality

As recently as 1975, Delaware routinely experienced serious water pollution and public health problems as a result of the discharge of untreated sewage and wastes. Since then, as a result of voluntary efforts, regulatory actions, and significant private and public investments in wastewater treatment facilities, localized improvements in water quality have been achieved. The need for additional cleanup and pollution prevention continues. The focus of water quality management has shifted from point source discharges (end-of-pipe) to decreased stream flows and nonpoint source problems, such as urban and agricultural runoff, erosion, and sedimentation. Unaddressed, these problems lead to poor habitat conditions for fish and other aquatic life, decreased enjoyment of our surface waters for recreation, and unhealthy conditions for those surface waters upon which we rely for drinking water supply and other domestic uses.

Delaware's waters have been classified using a rating system called for in the Federal Clean Water Act. The classification system is keyed to a management program designed to protect uses of the waters (referred to as "designated uses") for such purposes as drinking water supply, recreation, and the propagation of fish, aquatic life and wildlife. These designated uses serve as Delaware's water quality goals for specific watersheds. In order to protect those uses, a comprehensive set of chemical, biological, and habitat standards have been promulgated. Designated uses and standards are embodied in the State of Delaware Surface Water Quality Standards.

The Department of Natural Resources and Environmental Control has found that approximately 85% of Delaware's rivers and streams do not fully support the swimming use and approximately 94% do not fully support the fish and wildlife use. Most of these waters do not meet the standards because of nonpoint source pollution impacts.

Ponds and lakes in Delaware exhibit many of the same problems as rivers and streams. However, ponds and lakes also serve as "catch basins" for a variety of pollutants that are washed from the land and the air into these waterbodies. Two indicators which show the tendency for lakes and ponds to accumulate pollutants are fish consumption advisories due to toxic substances in the fish, and the extent of nutrient enrichment. Nutrient enrichment can lead to excessive weed and algae growth, reduced water clarity, and decreases in population of aquatic life and wildlife. The Department has found that approximately 44% of Delaware's fresh water ponds and lakes do not fully support the swimming use and approximately 89% do not fully support the fish and wildlife use.

Government

The present constitution of Delaware, which was adopted in 1897, has been amended many times. It is the fourth constitution in the history of the state. The first constitution, adopted in 1776, created "The Delaware State" with a president as chief executive. It was replaced in 1792 by a constitution that established the basic form of the present state government. The third constitution, adopted in 1831, made a number of changes in the judiciary. In each case the constitution was written by a constitutional convention and put into effect without being submitted to a popular vote. In order to become law, a proposed amendment must receive a two-thirds vote of approval from each house of the state legislature in two successive sessions, with an election intervening.

The current chief executive of the state is Democratic Governor John Carney, who is elected for a term of four years and may serve only two terms. Other executive officers are the lieutenant governor, attorney general, insurance commissioner, auditor of accounts, and treasurer, who are elected to serve four-year terms. The governor appoints the secretary of state, various commissioners and judges, and some of the administrative officers. The governor has the power to veto proposed legislation. A three-fifths majority vote in each house of the state legislature is required to override the governor's veto.

The state legislature, called the General Assembly, meets annually at Dover. It consists of a Senate and a House of Representatives. The senate has 21 members, who are elected for four-year terms, and the house of representatives has 41 members, who are elected for two-year terms.

The state judicial system includes a supreme court, a superior court, and a court of chancery. The Supreme Court is made up of a chief justice and four associate justices. The justices and all state judges are appointed by the governor, with the consent of the senate, for 12-year terms. Lower courts include a court of common pleas in each county in the state, as well as family courts, municipal courts, and magistrates' courts.

Delaware is divided into three counties: New Castle, Kent, and Sussex. New Castle County is administered by an elected council headed by an elected president. Sussex County is administered by an elected council, with one council member serving as president. Kent County is administered by an elected board of commissioners called the levy court. The counties are subdivided into hundreds, which are old English political subdivisions with no government of their own and little significance.

Most of the cities and towns in Delaware, including Wilmington, have the mayor and council form of municipal government. Some are governed by a council and manager. Delaware elects one representative and two senators to the Congress of the United States. In presidential elections the state has three electoral votes.

Political and Economic Development

Republican Governor Russell W. Peterson, Jr. (1969-1973), reorganized the executive branch of state government during his term. Its former collection of nearly 100 semi-independent commissions was replaced by ten executive departments, each directed by a cabinet secretary appointed by the governor with legislative consent. The governor persuaded the legislature to adopt a Coastal Zone Act designed to prevent the environmental degradation of Delaware's extensive bay, river, and ocean coastline by new industry or refineries.

In the 1970s northern Delaware's previously strong economic development slowed. The cost of maintaining the state's education, transportation, and welfare programs threatened to overwhelm the tax base and to drive some industries from the state. In response to this challenge, Governor Pierre S. du Pont IV reduced state spending and encouraged the legislature to adopt the Financial Center Development Act of 1981. By relaxing regulations on interest rates that banks may charge their customers, the act attracted more than a dozen out-of-state banks to locate their credit card operations in the First State. The banks' large new buildings now dominate Wilmington, where they employ thousands of workers.

In the mid-1980s Delaware's personal income tax rates were reduced four times in four years. Yet government revenues and employment continued to grow and construction boomed as more businesses and credit-card operations flocked to the state. The banks maintained high employment in the state in spite of downsizing (shrinking of the workforce), which by the early 1990s had become commonplace among the state's mature chemical corporations. Another source of economic health in Delaware is its legal profession. Delaware is the corporate home of hundreds of major and minor corporations that take advantage of Delaware's unrestrictive incorporation law and its state and federal courts, which are highly experienced in corporate law. In 1988, when many American businesses faced hostile corporate takeovers, the legislature enacted a law that made Delaware even more attractive. The law made it difficult to accomplish such a takeover of a Delaware corporation, because the would-be acquirer must capture 85 percent of the corporation's stock in a single transaction or wait three years before proceeding.

Delaware achieved a healthy economy in the 1990s. Democratic governor Thomas Carper, who served from 1993 to 2001, took an active approach to creating and preserving jobs. He was succeeded by Democrat Ruth Ann Minner, who became Delaware's first female governor. Minner pledged to address urban sprawl in the state and to improve education. However, the state continued to be troubled by an unusually high infant mortality rate that bespeaks the persistence of poverty, especially among racial minorities[1] [T]To address this issue, Governor Minner formed the Infant Mortality Task Force in 2004. The persistent efforts of Governor Minner to reduce the mortality rate has paid off. According to the Center for Disease Control, infant mortality in Delaware currently stands at almost eight in 1,000 live births, which is down from 2005, when infant mortality was at 9.3 deaths in 1,000 live births. "

Population and Demographics

According to the State Planning Office, in 2017, the population of Delaware is 961,939, putting Delaware 45th among the 50 states. This represented an increase of 7.13 percent over the 2010 census figure of 897,934. Despite its comparatively small population, Delaware has a high average density of 460.8 persons per square mile, as of the latest Census in 20
10 Whites make up the largest share of Delaware's residents, representing 70.1 percent of the population. Blacks are 22.6 percent of the population, Hispanic or Latino are 9.2 percent of the population, Asians 4.0 percent, Native Americans 0.1 percent, and those of mixed heritage or not reporting race 2.6 percent. Hawaiians and other Pacific Islanders are 0.1 percent of the population. Most of the population lived in urban areas in 2017.

[1] *Source of most of Delaware's geographic environmental information was contributed by Carol E. Hoffecker, B.A., M.A., PhD. Richards Professor of History, University of Delaware. Author of Delaware: A Bicentennial History and Delaware. The First State, and Charles A. Stansfield, B.S., M.S., PhD Professor of Geography, Rowan College of New Jersey, Author of New Hersey: A geography and coauthor of New Jersey, Yesterday and Today.*

The earliest settlers, who arrived in the 17th century, were mainly Swedes, but there were also Finns, Dutch, and a few English and French. The total population in the region in the middle of the 17th century was probably less than 1,000. Most Delawareans trace their ancestry back to later immigrants. The British were the most numerous in the late 17th and 18th centuries and included settlers of English, Scottish, Irish, and Welsh extraction. French settlers arrived in the 1790s. In the middle of the 19th century, immigrants from Ireland and Germany found work in the factories that were being set up in northern Delaware. Toward the end of the 19th century they were followed by Italians, Poles, Jews, and Ukrainians. Blacks are descended mainly from Africans who were brought to Delaware as slaves during the 17th and 18th centuries.

In 2016, of the total households, numbering 426,149 units, the median household income was $61,017 in Delaware statewide. The median per capita income average was $31,118 statewide. According to the Department of Labor, as of December of 2017, the State of Delaware had an unemployment rate of 4.6 percent, above the national average of 4.1 percent. According to the latest figures from the Office of State Planning Coordination from a five year study of 2011 to 2015, the number of families in poverty statewide averages 8.2 percent, well below the national average of 11.3 percent.

Race Relations

Race relations have been a great concern in Delaware. The state's public schools were segregated by race under the constitution of 1897 and remained so until after the Supreme Court of the United States struck down racial segregation in its 1954 decision, *Brown* v. *Board of Education* (*see* Segregation in the United States). Two of the cases that were merged in that historic decision, *Bulah* v. *Gebhart* and *Belton* v. *Gebhart,* involved Delaware plaintiffs. Integration proceeded smoothly in most parts of the state except Milford, where diehard segregationists succeeded in having the public schools shut down for a year. *Deacto* segregation—racial imbalance of schools caused by residence patterns—continued to be a problem into the 1970s and beyond. In 1978 a federal court decree affecting Wilmington and its surrounding suburbs (*Evans* v. *Buchanan*) mandated the busing of children to achieve racial balance in the schools. In 1995 a federal judge ended mandatory busing when it was found that the goals of integration had been achieved.

Segregated housing was also practiced throughout the state until the federal government passed legislation to end it in 1968. In that year Wilmington, like many other American cities, experienced rioting following the assassination of Martin Luther King, Jr. The governor, Charles L. Terry, Jr., called out the National Guard to keep order and, over the protests of the city's mayor, kept it on patrol until his successor took office in January 1969.

Infrastructure and Land Use

Delaware's Infrastructure

Natural Infrastructure

Delaware's natural infrastructure provides innumerable services that the residents of the state depend on. Ecosystem services include provisioning services, such as food, water, timber, and fiber, and regulating services that affect climate, floods, disease, waste, and water quality. (Millennium Ecosystem Assessment, 2005)

There are various examples of natural infrastructure throughout the state and they all provide their own unique benefits. Wetlands provide surface water retention, shoreline stabilization, and preservation of wildlife habitats. Forests protect groundwater quality and support groundwater recharge. Beaches and dunes provide a first line of defense against storm waves and tides and vegetated dunes can buffer storm surge. (Delaware Climate Change Impact Assessment p. 9-4, 2014)

Man-Made Infrastructure

Delaware's main center of transportation and commerce, the Port of Wilmington, lies on the Christina River near its junction with the Delaware River. Wilmington serves large oceangoing vessels and carries on an extensive trade through its municipal marine terminal with New York City and other U.S. ports as well as with foreign ports. Wilmington is the largest port-of-discharge for bananas in the world. The port is also important in both import and export of automobiles. The chief commercial waterways are the Delaware River, Delaware Bay, and the Chesapeake and Delaware Canal.

The Delaware Department of Transportation is responsible for maintaining approximately 90 percent of roads, much higher than the national average of 20 percent. (2017 Report on State Planning Issues) By the end of 2016, Delaware had 6,427 miles of public roads, according to the Federal Highway Performance Monitoring System**.** Wilmington is the focal point of several major federal highways. The Delaware Memorial Bridge, which spans the Delaware River near Wilmington, was opened in 1951. Traffic volume grew so heavy (the bridge connects the Delaware and New Jersey turnpikes) that a second, twin span was opened in 1968. A ferry offers year-round service between Lewes, Delaware, and Cape May, New Jersey. Construction is underway for New U.S. Route 301, a project designed to lessen truck traffic on local roads, and is scheduled to be completed in December of 2018

Railroad transportation is available in New Castle County. Passenger Rail Service is offered by Amtrak, the Southeastern Pennsylvania Transportation Authority (SEPTA), and the Wilmington & Western Railroad. Freight railway is provided by CSX Transportation and Norfolk Southern Railway. (Delaware Climate Change Impact Assessment p. 9-8, 2014) Delaware is served by approximately 240 miles of railroads, according to the most recent update of the Delaware State Rail Plan.

There are several public airports located in Wilmington, Dover, and Georgetown. For commercial air travelers, the northern Delaware area is also served by a major international airport in Philadelphia and the central and southern Delaware area is also served by the international airport in Baltimore (Delaware Climate Change Impact Assessment p. 9-8, 2014). In addition, Dover Air Force Base is one of the most important military air cargo terminals on the East Coast.

Manufacturing

In 2013, some 6.1 percent of the non-farm workforce of Delaware was employed in manufacturing industries. The principal industry is the chemical industry, which in 1996 generated two-fifths of all income produced by industry. Chemical products manufactured in the state include paints and varnishes, dyes, cloth and cloth finishes, and synthetic fibers. Other industrial activities include pharmaceuticals, food processing and the manufacture of paper products, instruments, rubber and plastic goods, fabricated metal products, machinery, and transportation equipment. There are also several petroleum refineries and printing and publishing firms in the state. Most industrial plants are located in northern New Castle County, in the Wilmington area.

The chemical industry in Delaware dates from 1802, when Eleuthère Irénée du Pont, a French immigrant, built the state's first gunpowder mill on Brandywine Creek near Wilmington. From those early beginnings, the E. I. du Pont de Nemours and Company grew into one of the top chemical companies in the United States. The home office and the research laboratories of the company now dominate the city and suburbs of Wilmington. There are a number of other chemical companies with headquarters in Delaware, the largest being Hercules and Atlas, which split off from the Du Pont Company after an antitrust suit in 1912.
The manufacture of textiles and leather products was formerly a major economic activity, but it is now of only minor significance. The textile industry began in the late 18th century, when Jacob Broom built the state's first cotton mill on Brandywine Creek. Leather making is also one of the state's oldest industries. Buckskin and chamois leather were manufactured in Wilmington as early as 1732.

Principal Cities

Delaware's largest city is Wilmington, which according to the U.S. Census Bureau, had an estimated population of 71,442 as of July 2016. Wilmington was the site of the first permanent settlement by Europeans during the colonial era and is today the chief center of manufacturing, commercial, and transportation activities in the state. Wilmington is also the state's foremost cultural center.

Dover, the state capital, serves as an administrative and commercial center. Tourism is also important to the city, which is noted for its many buildings of historic interest. Dover's population was estimated at 37,786, according to2016 Census data. Newark, with a population of 33,398 according to 2016 Census data, is an industrial city in New Castle County and the seat of the University of Delaware. Milford, with a population of 10,979 according to 2016 Census data, is a trade center for farms in southern Delaware. Seaford is an industrial community on the Nanticoke River in Sussex County. Lewes is one of the oldest ports on the East Coast. New Castle, site of William Penn's first landing in North America, is a quaint river town south of Wilmington. Its historic courthouse and cobblestone streets attract many visitors each year.

Agriculture

Over 40 percent of Delaware land is in agriculture according to the Delaware Department of Agriculture and the National Agricultural Statistics Service. In 2015 there were 2,500 farms in Delaware with the average farm size being 200 acres. According to the US Department of Agriculture, there was over 500,000 acres of operated farmland in 2017.

The sale of livestock and livestock products accounts for nearly 79 percent of total farm income, according to the Delaware Department of Agriculture. According to the US Department of Agriculture Research Office, broilers are the most valuable agriculture product in Delaware. Corn and soybeans are also among the top agriculture products in the State.

Dairy farms are numerous in northern sections of the state and are a major source of fresh milk for Wilmington, Philadelphia, and other large cities in the East. Hogs and beef cattle, which are fed partly on surplus milk and milk wastes, are also raised.

Soybeans and corn are grown throughout the state, and represent the leading crops in terms of sales. Wheat is raised on many farms in northern and central Delaware. Potatoes are a specialty crop on farms in southern Delaware, and together with peas are the most valuable vegetable crops. In addition, a variety of truck and fruit crops are produced in the state. Apples and peaches are the important orchard crops.

Commercial fishing crews and chartered boats working out of Lewes and other lower Delaware ports catch saltwater fish in Delaware Bay and the Atlantic Ocean. Clams and crabs are dredged. According to the National Marine fisheries service of the National Oceanographic and Atmospheric Administration, Delaware's commercial fishing industry was valued at just over 10 million dollars in 2016..

Many farmers retain small woodlots on their property. The wood is used to make boxes and crates and other wood products. Some fine woods, for use as veneers in good-quality furniture, are also cut. Holly, which is fashioned into wreaths and decorations for the Christmas season, is also grown.

Education and Cultural Institutions

Although the general assembly created a public school fund in 1796, no use was made of it until 1817 and 1818, when $1,000 was allocated to each county for the education of poor children. In 1829 the legislature passed "An Act for the Establishment of Free Schools." Under the terms of the act, Delaware was divided into school districts, which were empowered to raise funds that would be matched, up to $300, by state funds. However, no district was compelled to raise money or to open a school.

Delaware now has a modern school system. The seven members of the state board of education are appointed by the governor and confirmed by the state senate. Six of the members serve six year terms; the seventh serves at the pleasure of the governor. The state secretary of education is appointed by the governor, approved by the state senate, and serves at the pleasure of the governor. School attendance in Delaware is compulsory for all children from the ages of 5 to 16. According to the Delaware Department of Education, the state has 226 public schools, with 137,217students and 9,506 teachers.

According to the Delaware Department of Education for the 2015-2016 school year, Delaware spent over $13,450on each student's education. According to a 2012-2016 study by the U.S. Census Bureau, 88.8 percent of persons older than 25 in Delaware had a high school diploma, compared to an average of 87percent for the nation as a whole.

The first state institution of higher education, Newark College (now the University of Delaware, at Newark) was founded in 1833. Delaware has 3 public and 5 private institutions of higher education. Among the most notable of these schools, besides the University of Delaware, are Delaware State University and Wesley College, both in Dover; Goldey-Beacom College and Widener University School of Law, both in Wilmington; and Wilmington University in New Castle. Collectively, the higher education system has over 41,500 undergraduate and 8,000 graduate students annually.

Delaware has 37 public tax-supported libraries. All public library buildings offer free wireless Internet access and have computers available to the public to use regularly and in the event of a disaster to apply for FEMA assistance and communicate with family. The Wilmington Public Library, which dates from the 18th century, is the oldest library in Delaware. Coastal libraries prone to flooding include the Lewes Public Library in Lewes, Rehoboth Beach Public Library in Rehoboth Beach, and South Coastal Public Library in Bethany Beach. Outstanding libraries devoted to the history of Delaware include the Corbit- Calloway Memorial Library in Odessa, the Delaware Public Archives in Dover, and the library of the Historical Society of Delaware in Wilmington. Institutions with notable collections that participate in the Delaware Heritage Collection or the Delaware Library Catalog include Barratt's Chapel and Museum in Frederica, the Fort Delaware Society in Delaware City and the Old Swedes Foundation in Wilmington.

Located on the former country estate of Henry Francis du Pont, the Winterthur Museum, Garden, and Library in Winterthur has exhibits of furniture and household goods of the period from 1640 to 1840. The museum is open to the public for guided tours. Other important museums include the museum of the Historical Society and the Delaware Art Museum, both in Wilmington; the Delaware State Museums, in Dover; and the Delaware Museum of Natural History, in Wilmington. The Hagley Museum, in Wilmington, is a museum of American industrial history. The Zwaanendael Museum, in Lewes, was built by the state in 1931 to mark the 300th anniversary of the Dutch settlement in 1631.

It is believed that the first newspaper in the state was the Wilmington *Courant,* which was published for six months in 1762. The oldest continuously published newspaper is the *Delaware Gazette,* which continues today as the *Daily News Journal.* One of Delaware's most notable publications was the former weekly newspaper entitled *The Blue Hen's Chicken.* It was published and edited in the mid-19th century by Francis Vincent, who used the newspaper to advocate programs of civil rights, labor reform, and public service. There are 2 daily newspapers published in the state. The Wilmington *News Journal,* which is the state's largest newspaper in circulation, has daily statewide circulation. The *Delaware State News* is published daily in Dover.

Delaware has 8 AM and 27 FM radio stations. Several cable television systems operate in the state. The state's first radio station, WDEL, in Wilmington, began operations in 1922.

Wilmington supports a symphony orchestra and a professional theater. The Grand Opera House, in

Wilmington, is home to Opera Delaware and presents a year-round program of classical concerts and dance. Community theater groups are also maintained in Newark, Dover, and elsewhere.

Recreation and Places of Interest

Although it is a small state, Delaware has numerous recreational facilities and is noted for its historic sites and buildings. Facilities for swimming, boating, and other water sports are located at numerous places along the coast, and camping, hiking, and picnicking are popular pastimes in the state parks and forests. There are no national parks or national forests.

Among Delaware's 16 state parks is Fort Delaware State Park, on Pea Patch Island in the Delaware River and accessible by boat from Delaware City. The huge granite fort was a Union stronghold during the Civil War. Bellevue State Park, in Wilmington, once was the estate of the du Pont family and features the Bellevue mansion. Also near Wilmington is Brandywine Creek, with its towering tulip trees, rolling hills, and wildflower meadows framed by gray stone walls. Cape Henlopen State Park, east of Lewes on the Atlantic shore, includes a fishing pier stretching into Delaware Bay and the Seaside Nature Center, popular with bird-watchers. Delaware Seashore State Park, south of Dewey Beach, includes 10 km (6 mi) of ocean and bay shoreline. Trap Pond State Park, east of Laurel, encompasses part of the Great Cypress Swamp that is home to the unique bald cypress trees. There are three state forests in Delaware. Among them are Blackbird State Forest and Taber State Forest, while Redden State Forest in the southern part of the state is the largest. Many regions of the state have been set aside as wildlife preserves, fishing sites, and public beaches. Prime Hook National Wildlife Refuge is located around Broadkill Beach, while near Dover is Bombay Hook National Wildlife Refuge.

Fort Christina, in Wilmington, marks the site where Swedish pioneers landed in 1638 to establish the first permanent European settlement in Delaware. The John Dickinson Plantation, built in 1740, was once the home of the American patriot John Dickinson. It is one of several early American buildings in the historic Dover area. The former state capitol in Dover, dating from about 1790, is one of the oldest capitols in the country. The structure faces the historic Green, which appears today almost as it did in 1717, the year Dover and the Green were laid out. The historic Court House in New Castle, which dates from the early 1730s, is one of the oldest existing public buildings in the United States. Its cupola served as the focus from which surveyors drew the arc forming Delaware's northern border.

The Amstel House Museum depicts 18th-century life in New Castle. Another popular New Castle attraction is the George Read II House, a classic Federal style mansion. The De Vries Monument near Lewes marks the approximate site of the former Zwaanendael (Swanendael), Delaware's short-lived first community, which was founded in 1631. Several of these sites were designated as part of the First State National Monument under the National Park System.

Among Delaware's many historic churches is Old Swedes Church and Hendrickson House Museum, in Wilmington, which has been in use since its completion in 1698. Barratt's Chapel in Frederica, Christ Episcopal Church near Laurel, and Old Drawyers' Presbyterian Church near Odessa were built between 1770 and 1780. Immanuel Episcopal Church in New Castle was built early in the 18th century, as was the recently restored Presbyterian Church there. Prince George's Chapel in Dagsboro was built in 1757. Fenwick Island Lighthouse, which began operation in 1859, was decommissioned in 1978 and now is operated by the state as an attraction. The Wilmington and Western Railroad operates a steam train through the scenic Red Clay Valley.

Colors abound at the Great Delaware Kite Festival at Cape Henlopen, held in late April. Early in May many historic private homes in Dover are opened to the public during Old Dover Days. The Delaware State Fair, held in July in Harrington, is a true agricultural fair, featuring a mixture of livestock and farm equipment. A Day in Old Newcastle is held annually in May. Nanticoke Pow Wow draws eastern Native Americans to the September festival which includes ceremonial dances, storytelling, and Native American food and crafts. The

Delaware Decoy Festival and Carving Championship, held in Odessa in October, focuses on the skill of crafting decoys used in duck hunting. Christmas parades are held in several communities in early December, and a candlelight tour of historic homes is held in NewCastle.

Employment and Industry

According to the Delaware Economic Development Office, Delaware has the strongest state economy in the region and remains an above average performer in comparison to the national economy. With lower than average unemployment (4.3%), as compared to the national average (4.7%), afair and equitable tax system, and a well-trained workforce, the state's economic climate has shown dramatic improvement since the early 1980s, partially in response to stable fiscal policies, careful debt management, conservative spending programs, and personal income tax reductions. Despite the recent downturn in the economy, Delaware's economy appears more resilient than other States in the region and nationally.

Economic Activities

Delaware is a small but prosperous state, the economy of which benefits from the large urban markets nearby. During much of the 19th and 20th centuries, manufacturing was the state's leading economic activity. In the late 1990s, however, the finance sector provided the greatest share of the state's economy, with many people employed in commerce, service industries, or government agencies as well. Partly because of Delaware's relatively lenient corporate-tax laws, many businesses are incorporated in the state even though virtually all their activities are carried on elsewhere.

According to the Delaware Department of Labor, Delaware's labor force totaled 456,200 in December of 2017. Education and health services comprised 17.5 percent of the workforce, government workers 14.6 percent, retail trade represented 11.7 percent, the finance and insurance sector totaled 9.3 percent, 8.2 percent in accommodation and food services, and 5.8 percent in professional, scientific, and engineering services... In 2017, 11.2 percent of Delaware's workers were unionized according to the Bureau of Labor Statistics.

According to the U.S. Census Bureau, the median value of owner-occupied housing units in Delaware as of July 2016 was $233,100 compared to the national average of $184,700.

The State of Delaware sustains a diversified economy, with most employment being concentrated in the education, health, and social services sector.

Delaware's largest employer is state government with over 14,000employees in 2016.

Disaster Declarations

Because disaster declarations are made at the county level, the City of Wilmington's disasters are declared under New Castle County. Since 1962, the state of Delaware has had 16 disaster declarations and five Federal Emergency Declarations (shown in **Table 3-2**). Two (2) of these disaster declarations occurred within one week of each other in 2003 (Tropical Storm Henri and Hurricane Isabel).

Recent disasters in the state of Delaware include:

Presidents' Day Snow Storm
EM-3183 (March 20, 2003)
Declared Counties: New Castle, Kent, Sussex

On March 20, 2003 the President declared that an emergency existed in the State of Delaware. This declaration was based on emergency measures performed to save lives and protect public health and safety resulting from snow on February 14-19, 2003. The State of Delaware experienced the impact of two back-to-back winter storm systems over the Presidents' Day weekend. All three Delaware counties were severely impacted by these winter storms receiving up to 24 inches of snowfall in New Castle County, 27 inches in Kent County, and 20 inches in Sussex County.

Hurricane Isabel

DR-1494 (September 20, 2003)
Declared Counties: New Castle, Kent, Sussex

On September 20, 2003, the President declared that a major disaster existed in the State of Delaware. This declaration was based on damage resulting from Hurricane Isabel which impacted the State of Delaware on September 18, 2003. Hurricane Isabel resulted in: loss of electric power to 250,000 customers; seven shelters being activated; public schools and state and county government offices being closed; sixty-two roads and two major bridges being closed due to flooding, trees and/or downed wires; five communities being inundated with floodwaters; and numerous homes and businesses being damaged or destroyed.

Tropical Storm Henri
DR-1495 (September 23, 2003)
Declared Counties: New Castle

On September 23, 2003 the President declared that a major disaster existed in the State of Delaware. This declaration was based on damage resulting from Tropical Storm Henri which severely impacted New Castle County, Delaware on September 15, 2003. As a result of a stationary line of thunderstorms, extremely heavy rain fell which caused catastrophic flash flooding in numerous areas of New Castle County. During a 14-hour period, a total of 8-10 inches of rainfall fell with 6-8 inches falling during a 3- hour period. The Red Clay Creek in New Castle County was the hardest hit with stream gages reporting a new “flood of record” exceeding levels seen in 1999 with Hurricane Floyd. The Wooddale gage on Red Clay Creek crested at 17.3 feet. The previous record crest was 13.9 feet in September 1999 as a result of Hurricane Floyd. As a result of the extremely heavy rainfall and flooding, approximately 100 residents were evacuated from residential areas and many were sheltered at the Brandywine Springs Elementary School. The flash flooding caused extensive damage to numerous roadways and bridges, which resulted in their closure. Seven (7) Wilmington and Western Railroad Bridges were washed out. In addition, there were approximately 15 hazardous material responses involving hazardous material spills into the Red Clay Creek.

Hurricane Jeanne
DR-1572 (November 15, 2004)
Declared Counties: New Castle

On November 15, 2004 the President declared that a major disaster existed in the State of Delaware. This declaration was based on damage which severely impacted New Castle County, Delaware resulting from severe storms, tornadoes, and flooding from the remnants of Hurricane Jeanne on September 28 – October 2, 2004. As a result of severe thunderstorms with heavy rain (3” to 8”), catastrophic flash flooding occurred in numerous areas of New Castle County. One thunderstorm spawned an F2 tornado in the Wilmington Manor area with a path 5 miles long, 150 yards wide and maximum winds of 130 mph. This tornado produced significant damage to infrastructure at the New Castle County Airport and Elsmere area. Remnants of Hurricane Jeanne resulted in: 12,000 customers without power; one shelter being activated; public schools in New Castle County being closed; 40 roads being closed due to flooding, trees and downed power lines; 70 residential areas being impacted by tornado activity and/or inundated with floodwaters; 12 businesses sustaining major damage and 2 being destroyed; and sudden rising flood waters causing a severe public health hazard in 59 sub-divisions.

Hurricane Katrina
EM-3262 (September 30, 2005)
Declared Counties: New Castle, Kent, Sussex

On September 30, 2005, the President declared that an emergency existed in the State of Delaware. This declaration was based on emergency measures performed to save lives and protect public health and safety due to the emergency conditions resulting from the influx of evacuees from areas struck by Hurricane Katrina beginning on August 29, 2005. This severe weather disaster caused considerable human suffering and extensive damage in the states of Alabama, Florida, Louisiana, and Mississippi. A significant number of citizens living in the impacted states were displaced and required short and long- term recovery assistance. An estimated 300+ individuals self evacuated to Delaware. Of this number, West End Neighborhood House, a

private non-profit organization, provided short term interim housing to 7 families early in the process and the Delaware State Housing Authority, a branch of state government, provided long term interim housing to the above 7 families plus 10 additional families.

Sussex County Flooding
DR-1654 (July 5, 2006)
Declared Counties: Sussex

On July 5, 2006 the President declared that a major disaster existed in the State of Delaware. This declaration was based on damage resulting from severe storms and flooding which severely impacted portions of Sussex County, Delaware beginning on June 23, 2006. A stationary front stalled over the northeast, including Delaware, and led to extremely heavy rainfall (8"-15"), and flooding. The areas of Seaford and Blades, Delaware were particularly hard hit. The heavy rainfall and subsequent flooding resulted in severe damage to roadways, bridges and buildings in the general area impacted by the storms. The Sussex County Flooding resulted in: 794 customers without power; activation of one shelter; summer school for most public schools in Sussex County being cancelled on Monday June 26th due to flooded road conditions; 39 roads being affected or damaged due to flooding, downed trees, downed wires; 15 roads experiencing road failure; 4 communities being inundated with floodwaters; numerous homes and businesses being damaged or destroyed; and evacuations and rescues of those in need.

Severe Winter Storm
DR-1896 (March 31, 2010)
Declared Counties: New Castle, Kent, Sussex

On March 31, 2010 the President declared that a major disaster existed in the State of Delaware. This declaration was based on damage resulting from the Severe Winter Storms and Snowstorms which impacted the State of Delaware February 5-11, 2010. The Middle Atlantic area was impacted by a strong Nor'easter from Friday evening February 5th through Saturday February 6th. A low pressure system organized along the Gulf Coast and tracked northeastward through the Southeastern States. With heavy snow bands that developed across the region, snowfall rates of 1 to 2 inches per hour extended into portions of Delmarva. Wilmington recorded its highest snowfall ever for any single event with 25.5 inches. Strong gusty winds were also recorded. Some of the higher wind gusts included 61 mph measured in Lewes and 60 mph at Georgetown. A second powerful Nor'easter impacted the Mid Atlantic region in less than a week from Tuesday February 9th to Wednesday February 10th. Low pressure developed near the Texas Gulf Coast and tracked into the Ohio Valley during Tuesday. As this low tracked eastward, it gradually transferred its energy to another area of low pressure which organized along the Carolina coast late Tuesday evening. During Wednesday February 10th, this low intensified rapidly just east of the New Jersey coast. Heavy snow occurred in two bursts across the region. The first round of snow pushed through Tuesday evening and into the early morning hours of Wednesday. Some mixing with sleet and rain occurred with this initial burst of snow, especially from the Delmarva northward through central New Jersey and southeastern Pennsylvania. Snowfall rates of 1 to 2 inches per hour occurred from portions of the Delmarva. An area of 12 to 18 inch accumulations were measured across much of western New Jersey and down into the northern Delmarva. Snowfall amounts of 8 to 12 inches were tallied from the southern Delmarva northward through eastern New Jersey. Total snow accumulations were not as high for Delaware beaches due to sleet and rain mixing in for a longer period of time. Wind gusts of 40 mph or greater were also measured at Dover and Wilmington.

Hurricane Irene
EM-3336 (August 28, 2011)
Declared Counties: New Castle, Kent, and Sussex

On August 28, 2011, the President declared that an emergency exists in the State of Delaware. This declaration was based on emergency measures performed to save lives and protect public health and safety resulting from Hurricane Irene beginning on August 25, 2011 and continuing through August 31, 2011. Hurricane Irene maintained Category 1 strength as the eye of the storm passed within 27 miles of the Delaware coast, producing continuous tropical storm force winds, tornadoes, and record flooding. The State sustained a storm surge of 2.98 feet on top of an astronomical high tide, with a tidal level of 8.2 feet inundating low lying coastal areas.

Excessive rainfall caused record flooding on the Christina River, Brandywine River, and near record flooding on the Red and White Clay Rivers in New Castle County. Rainfall totals ranged from 7.47 inches in Sussex County, to 8.81 inches in Kent County and 8.34 inches in New Castle County. Hurricane Irene resulted in 51,000 customers losing power at the peak of the storm, and causing mandatory evacuations of approximately 80,000 to 100,000 tourists and residents, including special populations. State highway officials reported over 200 roads under water, and 7 bridges sustaining structural damage. Thirty seven (37) homes and businesses sustained major damage or were destroyed, as well as 6 state maintained beaches sustaining extensive damage such as beach erosion and dune breaches. There were also 2 fatalities associated with the hurricane.

Hurricane Irene
DR-4037 (September 30, 2011) Declared
Counties: Kent and Sussex

On September 30, 2011, the President declared that a major disaster exists in the State of Delaware. This declaration was based on damage resulting from Hurricane Irene, during the period of August 25-31, 2011. This major disaster declaration was declared after damage assessments were conducted and it was determined that Kent and Sussex counties had sustained extensive enough permanent damage to qualify for a major disaster declaration.

Hurricane Sandy
EM-3357 (October 29, 2012)
Declared Counties: Kent and Sussex

On October 29, 2012, the President declared that an emergency exists in the State of Delaware. This declaration was based on emergency measures performed to save lives and protect public health and safety resulting from Hurricane Sandy beginning on October 27, 2012, and continuing. Hurricane Sandy transitioned from a tropical to extra-tropical event that delivered high winds, serious coastal erosion and coastal flooding, storm surge, and heavy rains. The eye of the storm traveled within ten miles of Delaware. The State sustained a storm surge of 5.06 feet on top of an astronomical high tide, with a tidal level of 9.1 feet, inundating low lying coastal areas. Rainfall totals ranged from 6.42 - 10.20 inches in Sussex County, from 7.57 – 9.14 inches in Kent County, and 4.60 – 8.33 inches in New Castle County. The state also experienced maximum wind gusts of 67 mph.

Hurricane Sandy
DR-4090 (November 16, 2012)
Declared Counties: Kent and Sussex

On November 16, 2012, the President declared that a major disaster exists in the State of Delaware. This declaration was based on damage resulting from Hurricane Sandy during the period of October 27 to November 8, 2012. Hurricane Sandy resulted in approximately 45,000 customers without power at the peak of the storm, mandatory evacuations of over 35 communities and flood prone areas, including special populations beginning on October 27th, seven shelters being opened and schools remaining closed through the duration of the event. State highway officials reported numerous roads under water and sustaining structural damage, along with several bridges. In addition, in excess of 40,000 tons of sand had to be removed from Route 1 which runs along the coast in Sussex County. There was extensive damage to 6 state maintained beaches resulting in severe beach erosion and dune breaches as well as extensive damage to 5 dikes in New Castle County. Hurricane Sandy also resulted in 19 homes or businesses sustaining major damage or being destroyed.

Winter Storm Jonas
DR-4265-DE (March 10, 2016)
Declared Counties: Sussex

From January 22-23, 2016 a historic nor'easter produced large snowfall totals, damaging winds, and substantial coastal flooding across the entire State of Delaware. Winds from the storm, combined with high astronomical tides, produced particularly significant tidal flooding along sections of the Delaware coastline. Several near-record peak storm-tide elevations were recorded at U.S. Geological Survey (USGS) continuous-record tide

gages, comparable with the record levels set during the 1962 Ash Wednesday Storm. During the event over 50 residents had to be evacuated, 1,000's of homes lost power due to flooded substations, multiple major roadways were flooded throughout Sussex County, and moderate to major erosion took place along the virtually all of Delaware's ocean and bay-side beaches.

Table 3-2
Presidential Disaster Declarations for the State of Delaware, 1962–2017
NC = New Castle County, K = Kent County, S = Sussex County

Event	Declaration Date	Type of Assistance	Declaration Number	Affected Counties
Delaware Severe Storms, High Tides, Flooding	03/09/1962	Public Assistance	DR-126	NC, K, S
Water Shortage	08/15/1965	Individual Assistance Public Assistance	DR-207	NC, K
Severe Coastal Storm	02/06/1992	Public Assistance	DR-933	K
Severe Coastal Storm and Flooding	01/15/1993	Public Assistance	DR-976	S
Severe Snowfall and Winter Storm	03/18/1993	Public Assistance	EM-3111	NC
Severe Ice Storms and Flooding	03/16/1994	Public Assistance	DR-1017	K, S
Blizzard of ‘96 (Severe Snow Storm)	01/12/1996	Public Assistance	DR-1082	NC, K, S
Severe Winter Storms, High Winds, and Flooding	02/13/1998	Public Assistance	DR-1205	S
Hurricane Floyd	09/21/1999	Individual Assistance Public Assistance	DR-1297	NC
Severe Snowstorm	3/20/2003	Emergency Assistance	EM-3183	NC, K, S
Hurricane Isabel	09/20/2003	Individual Assistance Public Assistance	DR-1494	NC, K, S
Tropical Storm Henri	09/23/2003	Individual Assistance Public Assistance	DR-1495	NC
Hurricane Jeanne	11/15/2004	Public Assistance	DR-1572	NC
Hurricane Katrina	9/30/2005	Public Assistance	EM-3263	NC, K, S
Severe Flooding	7/5/2006	Public Assistance	DR-1654	S
Severe Winter Storm	3/31/10	Public Assistance	DR-1896	NC, K, S
Hurricane Irene	8/28/2011	Emergency Assistance	EM-3336	NC, K, S
Hurricane Irene	9/30/2011	Public Assistance	DR-4037	K, S
Hurricane Sandy	10/29/2012	Emergency Assistance	EM-3357	K, S
Hurricane Sandy	11/16/2012	Public Assistance	DR-4090	K, S
Severe Winter Storm	1/22/2016	Public Assistance	DR-4265	S

Source: Federal Emergency Management Agency

Plan Updates

Note Regarding 2007 Plan Update
For the 2007 update to the State Hazard Mitigation Plan, Section was updated to reflect new demographical information, including updated population and household figures, income figures, etc., and to reflect some minor modification to governmental structure and administrative regulations. Additionally, information about specific disasters that have occurred in Delaware since the 2004 Plan was published has been provided.

Note Regarding 2010 Plan Update
For the 2010 update, the entire section was reviewed and updated as inputs were received. All five functional areas were updated with changes.

Note Regarding 2013 Plan Update
For the 2013 update, the entire section was reviewed and updated as inputs were received. All five functional areas were updated with changes. Statistical data from the 2010 Census Report were incorporated into this section. A new section was added, “Plan Updates” to track the changes from plan revision to revision

Note Regarding 2018 Plan Update
For the 2018 update, the entire section was reviewed and updated as inputs were received. All five functional areas were updated with changes. Updated statistical data was incorporated into this section. This 2018 Plan Update section was added to track changes from plan revision to revision.

S3. Does the risk assessment include an overview of the type and location of all natural hazards that can affect the state? [44 CFR §201.4(c)(2)(i)]

S4. Does the risk assessment provide an overview of the probabilities of future hazard events? [44 CFR §201.4(c)(2)(i)]

Delaware and its communities are vulnerable to a wide array of natural hazards that threaten life and property. This section provides an overview of the natural hazards and the human-caused and technological hazards.

Natural Hazard

- Coastal Flooding
- Storms (Nor'easters)
- Hurricanes
- Winter Precipitation
- Coastal Erosion
- Inland Flooding
- Severe Thunderstorms
- Extreme Heat
- Extreme Cold
- Tornadoes
- Dam/Levee Failure
- Drought
- Wildfire
- Earthquakes, Landslides and Sinkholes
- Tsunamis

Human-Caused / Technological

- Public Health Incidents
  - Animal / Crop / Plant Disease
  - Human Disease Incident
  - Pandemic Human Disease
  - Mass Casualties Incident
- Terrorism
- Hazardous Materials (HazMat)
- Transportation/Infrastructure Incidents
- Other Incidents

Coastal Flooding

Many of the coastal storms mentioned above caused significant amounts of flooding along Delaware's coastal regions. Coastal Flooding is the component/risk hazard of coastal storms most likely to cause significant damage and loss of life. Delaware experiences flooding all along its coastline. In Sussex County, coastal flooding is experienced from the ocean side with waves and surge battering the beach dunes as well as high tide and wind-driven flooding from the reverse side in all the communities surrounding the Inland Bays. In Kent County, coastal flooding occurs along the Delaware Bay shore line from waves originating within the Bay and surge propagating up the tributaries, flooding the surrounding marsh. Southern New Castle County has similar environments as Kent County does, however, Northern New Castle County, the urban coastal areas and ports of Wilmington are exposed to coastal flooding as well as flooding from precipitation runoff.

Storm surge is technically defined as a dome of water caused by the winds and central low pressure of a storm system. The faster the winds, deeper the low pressure (more intense), and the longer the fetch (e.g., the distance over the ocean which winds travel), the larger the surge will be. The majority of the surge is caused by the wind field. In both tropical and mid-latitude cyclones, the winds spin counterclockwise around a low pressure center, causing surge amounts to be largest in the front right quadrant of a storm system or ahead of the frontal boundary.

The total water level experienced during a flood event from a storm, called the storm tide, is comprised of storm surge along with the height of the tides, waves, and freshwater input from precipitation runoff. In practice, however, it is common to compute storm surge as simply the difference between the storm tide and the astronomical-only tides, represented simply as storm tide = surge + tides. Although simple to compute, it is important to note that surge amounts computed in this way includes influences from wave setup and wave run up, freshwater input, and other factors.

Additionally, storm surge heights and associated waves are dependent upon the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas.

Table 4.1-1
Summary of NOAA Coastal Flooding Events by County in the State of Delaware, (08/01/1950 – 06/30/2017)

County	No. of Events	No. of Days with Event	Total Property Damage Recorded	Deaths	Injuries
Kent	20	20	$726,000	0	0
New Castle	16	16	$2,400,000	0	0
Sussex	73	45	$51,586,000	0	5
TOTAL	**109**	**60**	**$54,712,000**	**0**	**5**

Source: NCEI Storms Events Database, https://www.ncdc.noaa.gov/stormevents/

On average, water levels observed at National Ocean Service (NOS) Lewes tide gauge are highest in late summer/early fall and at a minimum in mid-winter. The difference between the max and min throughout the year is about 0.17 m, or about 0.55 ft. Thus, storms and high tides that occur during late summer/early fall, primarily hurricane season, have a higher platform of water for surge and waves to build on.

Impacts of flooding include road closures and evacuations due to high water, infrastructure damage to roads and buildings, impacts to water supplies due to contamination, and emergency response can cause significant disruption in commercial activities and public services, or causing water logged properties near the shoreline, adjacent to a back bay or marsh, or along a tributary.

Effects of Sea Level Rise on Coastal Flooding

Coastal flooding will be exacerbated by rising seas that have been occurring globally. Global mean sea levels have risen approximately 8 inches in the past 100 years. According to the International Panel on Climate Change's (IPCC) 5th report for Policy Makers, glacier mass loss and ocean thermal expansion from warming together explain about 75% of the observed global mean sea level rise (high confidence) since the early 1970s. Over the period 1993 to 2010, global mean sea level rise is, with high confidence, consistent with the sum of the observed contributions from ocean thermal expansion due to warming (1.1 [0.8 to 1.4] mm yr–1), from changes in glaciers (0.76 [0.39 to 1.13] mm yr–1), Greenland ice sheet (0.33 [0.25 to 0.41] mm yr–1), Antarctic ice sheet (0.27 [0.16 to 0.38] mm yr–1), and land water storage (0.38 [0.26 to 0.49] mm yr–1). The sum of these contributions is 2.8 [2.3 to 3.4] mm yr–1. [1]

Sea level rise around Delaware has been observed at twice the amount as the global mean sea level rise. Figure 4.1-1 shows the linear rate of sea-level rise at Lewes to be 3.42 mm/yr, which equates to about 0.400 m / 15.7 inches since 1900 through 2016. This is about twice the rate, and therefore twice the amount, of global mean sea-level rise observed since 1900. Along with global mean sea-level rise resulting from the ocean thermal expansion and melting of the land-based ice sheets, additional processes in this region add positively to the increase of sea level relative to the land surface, such as 1) geologic land subsidence due to the glacial isostatic adjustment from the Laurentide ice sheet during the last Ice Age; 2) changing nearby ocean circulation patterns; and 3) gravitational effects from melting ice sheets of Greenland and Antarctica. Due to these multiple factors contributing to the relative sea-level rise, this region has become known as a hotspot for potential damage and vulnerability to sea-level rise. [2]

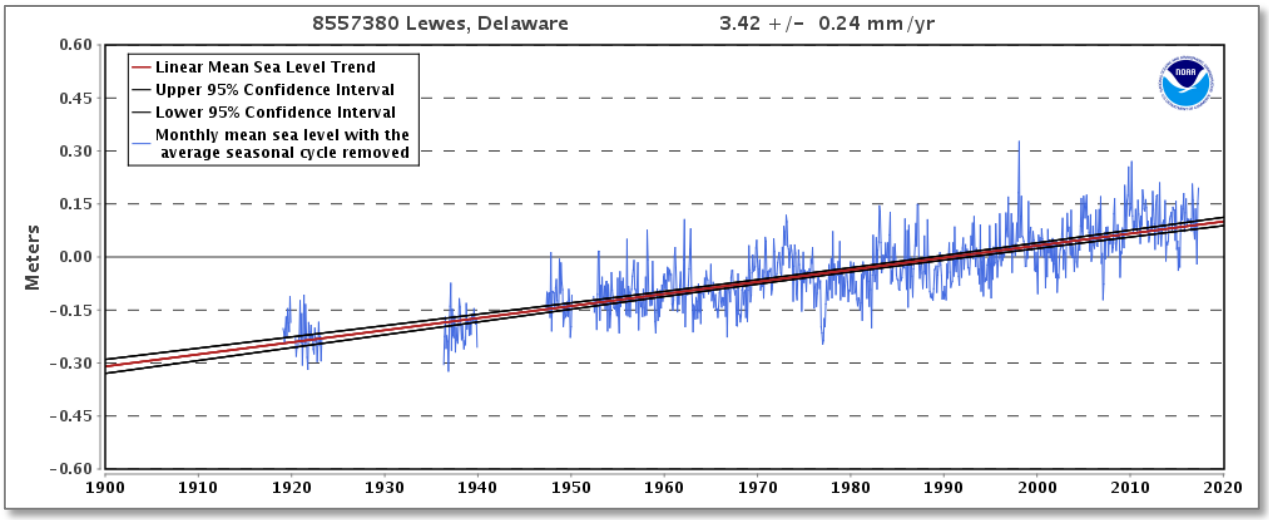


Figure 4.1-1. *Monthly mean sea level for NOAA Lewes tide station from 1919 through 2016. Linear MSL trend and 95% confidence interval shown in red and black, respectively. Data referenced to NTDE 1983-2001 MSL. Source: NOAA CO-OPS Tides and Currents SLR Trends website.*

Extreme Coastal Flooding

Extreme coastal flooding is generally the term used for moderate to high levels of flooding that accompany storms. Major damage and loss of life caused by extreme flooding is one of the most prominent threats facing Delaware today. Significant flood events can occur from many types of meteorological environments/events, such as mid-latitude storms approaching Delaware from the west, mid-latitude or tropical systems coming up the US East Coast, or from prolonged, strong offshore winds that may develop from a stalled pressure system in the Atlantic Ocean.

Listed in Table 4.1-2 below are the top events observed at the NOAA tide gauges at Lewes and Reedy Point. Only events that reached the NWS Major and Moderate Coastal Flood Advisory level for each gauge were included in this table. These levels are important, as they determine when the NWS issues coastal flood warnings for portions of Delaware. Moderate coastal flood advisory level at the NOAA Lewes tide gauge is 7.0 ft MLLW (4.4 ft NAVD88) and 8.0 ft MLLW (5.4 ft NAVD88) for Major. Moderate coastal flood advisory level at the NOAA Reedy Point tide gauge is 8.2 ft MLLW (5.2 ft NAVD88) and 9.2 ft MLLW (6.2 ft NAVD88) for Major[3]. Shaded events in Table 4.1-2 represent events at the Major flood advisory level.

Table 4.1-2 *List of moderate and major tidal flooding events for Lewes and Reedy Point, Delaware. Source: NOAA*

NOAA Lewes (1919 – 2017)				NOAA Reedy Point (1956 – 2017)			
Date/Time	MLLW (ft)	NAVD88 (ft)	Storm type	Date/Time	MLLW (ft)	NAVD88 (ft)	Storm type
1/23/2016 13:24	6.63	9.26	Mid-Lat	4/17/2011 2:42	6.27	9.24	Mid-Lat
3/7/1962 2:00	6.59	9.22	Mid-Lat	12/21/2012 10:54	6.21	9.18	H1 Sandy
1/4/1992 13:06	6.12	8.75	Mid-Lat	10/30/2012 5:42	6.13	9.10	Mid-Lat
10/29/2012 13:24	6.06	8.69	H1 Sandy	10/25/1980 17:06	5.91	8.88	Mid-Lat
1/28/1998 14:36	5.99	8.62	Mid-Lat	9/19/2003 9:18	5.69	8.66	H2 Isabel
2/5/1998 8:06	5.86	8.49	Mid-Lat	12/11/1992 16:42	5.36	8.33	Mid-Lat
9/27/1985 12:42	5.40	8.03	H2 Gloria	5/12/2008 10:06	5.36	8.33	Mid-Lat
3/3/1994 5:06	5.35	7.98	Mid-Lat	11/28/1993 15:00	5.31	8.28	Mid-Lat
8/28/2011 0:00	5.35	7.98	H2 Irene	5/1/2014 4:48	5.27	8.24	Mid-Lat

10/25/1980 14:18	5.31	7.94	Mid-Lat
3/29/1984 11:42	5.27	7.90	Mid-Lat
1/8/1996 3:30	5.21	7.84	Mid-Lat
12/12/1992 15:18	5.18	7.81	Mid-Lat
11/13/2009 10:54	5.12	7.75	Mid-Lat
5/12/2008 7:06	5.09	7.72	Mid-Lat
10/29/2011 15:24	5.05	7.68	Mid-Lat
10/22/1961 12:00	4.99	7.62	Mid-Lat
10/14/1977 14:00	4.98	7.61	Mid-Lat
2/17/2003 13:42	4.93	7.56	Mid-Lat
10/31/1991 20:00	4.91	7.54	Mid-Lat
10/2/2015 16:48	4.91	7.54	Mid-Lat
11/14/1997 13:00	4.79	7.42	Mid-Lat
11/3/1962 17:00	4.79	7.42	Mid-Lat
10/7/2006 13:18	4.75	7.38	Mid-Lat
1/25/2000 17:06	4.73	7.36	Mid-Lat
1/2/1987 15:42	4.72	7.35	Mid-Lat
10/17/2009 12:30	4.71	7.34	TS Kyle
10/8/1996 22:30	4.70	7.33	Josephine
12/22/1972 15:00	4.69	7.32	Mid-Lat
6/5/2012 1:30	4.67	7.30	Mid-Lat
3/6/2013 20:48	4.63	7.26	Mid-Lat
2/9/2016 14:00	4.61	7.24	Mid-Lat
1/13/1964 13:00	4.59	7.22	Mid-Lat
12/9/1973 12:00	4.59	7.22	Mid-Lat
9/20/2017 1:00	4.58	7.21	H1 Jose
9/26/1992 0:42	4.56	7.19	TS Danielle
5/26/2005 2:54	4.56	7.19	Mid-Lat
1/24/2016 2:06	4.54	7.17	Mid-Lat
12/19/2009 15:36	4.50	7.13	Mid-Lat
1/31/2006 14:54	4.50	7.13	Mid-Lat
11/10/1969 14:00	4.49	7.12	Mid-Lat
2/24/1998 11:48	4.47	7.10	Mid-Lat
12/9/2014 15:06	4.42	7.05	Mid-Lat
11/15/1981 16:06	4.40	7.03	Mid-Lat
1/3/2003 13:54	4.40	7.03	Mid-Lat
12/2/1986 13:42	4.39	7.02	Mid-Lat
10/19/1989 17:00	4.39	7.02	Mid-Lat
9/30/2016 0:48	4.38	7.01	Mid-Lat

Peak water level data values for each storm listed (also called the storm tide) were taken directly from the observed datasets retrieved from the NOAA CO-OPS website. All data were obtained from NOAA High/Low data product, except for data from Lewes prior to 6/1/1979, which was obtained from the hourly time series. These values may not match exactly, albeit will be very close to, storm tide values published from NOAA through other avenues as several different methods are employed, depending on the case, to determine peak water levels during a high tide or storm event.

At the Lewes tide gauge since 1919, there have been 48 events where water levels reached to the Moderate (41 events) and Major (7 events) flood advisory levels. Of the 48, 41 (85%) events were due to mid-latitude cyclones (including nor'easters) and 7 (15%) due to tropical systems. At the Reedy Point tide gauge since 1956, there have been only 9 events that reached into Moderate (8 events) and Major (1 event) flood advisory categories. Of the 9, 7 (78%) events were due to mid-latitude cyclones (including nor'easters) and 2 (22%) due to tropical systems.

Effects of Sea Level Rise on Extreme Coastal Flooding

According to the Fourth National Climate Assessment climate science special report released in 2017, assuming storm characteristics do not change, sea level rise will increase the frequency and extent of extreme flooding associated with coastal storms, such as hurricanes and nor'easters (very high confidence). A projected increase in the intensity of hurricanes in the North Atlantic (medium confidence) could increase the probability of extreme flooding along most of the U.S. Atlantic and Gulf Coast states beyond what would be projected based solely on relative sea level rise. However, there is low confidence in the projected increase in frequency of intense Atlantic hurricanes, and the associated flood risk amplification, and flood effects could be offset or amplified by such factors, such as changes in overall storm frequency or tracks.

Shallow/Minor Coastal Flooding

Major or extreme flooding due to coastal storms is not the only type of coastal flooding hazard to affect coastal communities. Shallow tidal flooding can also be a primary concern to Delaware citizens. Broadly defined, shallow tidal flooding begins when the water level reaches a point to cause a disruption to typical everyday life. Sometimes, this type of flooding is also called minor flooding or nuisance flooding, and most often numerically defined as when the observed water level exceeds the NWS Minor Coastal Flood Advisory level. Small vertical increases in sea level can cause large increases in horizontal extent in low, flat, open areas such as much of the Delaware coastal plain region. Shallow tidal flooding will reach further inland, and in areas not protected, can cause water on the road surface making the road impassable, can cause significant disruption in commercial activities and public services, or causing water logged properties near the shoreline, adjacent to a back bay or marsh, or along a tributary.

Table 4.1-3 *Data observed at NOAA Lewes tide gauge. Note the exponential increase in the number of days where the water levels from at least one high tide crosses over the NWS Minor Coastal Flood Advisory threshold. The NWS Minor Coastal Flood Advisory threshold at Lewes tide gauge is 6.0 ft / 1.83 m above MLLW, or 0.41 m / 1.35 ft above MHHW Source: Sweet and Park (2014)* https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2014EF000272

Decadal Time Period	Total number of days with coastal flooding greater than NWS Minor Threshold	Mean number of days per year with coastal flooding greater than NWS Minor Threshold
1955-1964	47	4.7
1965-1974	61	6.1
1975-1984	47	4.7
1985-1994	69	6.9
1995-2004	105	10.5
2015-2014	214	21.4

Effects of Sea-Level Rise on Shallow Tidal Flooding

Shallow tidal flooding has increased due to sea-level rise in the past, and it is also expected to increase at a faster rate in the future due to sea-level rise. As sea levels rise, the mean high tide level approaches the minor coastal flood advisory threshold. As that happens, a significantly larger number of high tides will therefore be above that level. Figure 4.1-2 displays the projected number of days experiencing shallow tidal flooding under sea-level rise caused by two greenhouse gas emissions scenarios.[4] The higher emissions scenario

corresponds to the IPCC RCP8.5 "business as usual" scenarios, while the lower emissions scenario corresponds to a reduced emissions scenario midway through the 21st century (RCP4.5). Furthermore, the recent Fourth National Climate Assessment Climate Science Special Report (2017) states:

> *"As sea levels have risen, the number of tidal floods each year that cause minor impacts (also called "nuisance floods") have increased 5- to 10-fold since the 1960s in several U.S. coastal cities (very high confidence). Rates of increase are accelerating in over 25 Atlantic and Gulf Coast cities (very high confidence). Tidal flooding will continue increasing in depth, frequency, and extent this century (very high confidence)."*

Thus sea-level rise due to climate change is a significant future consideration for Delaware as it relates to impacts from coastal flooding of all kinds.

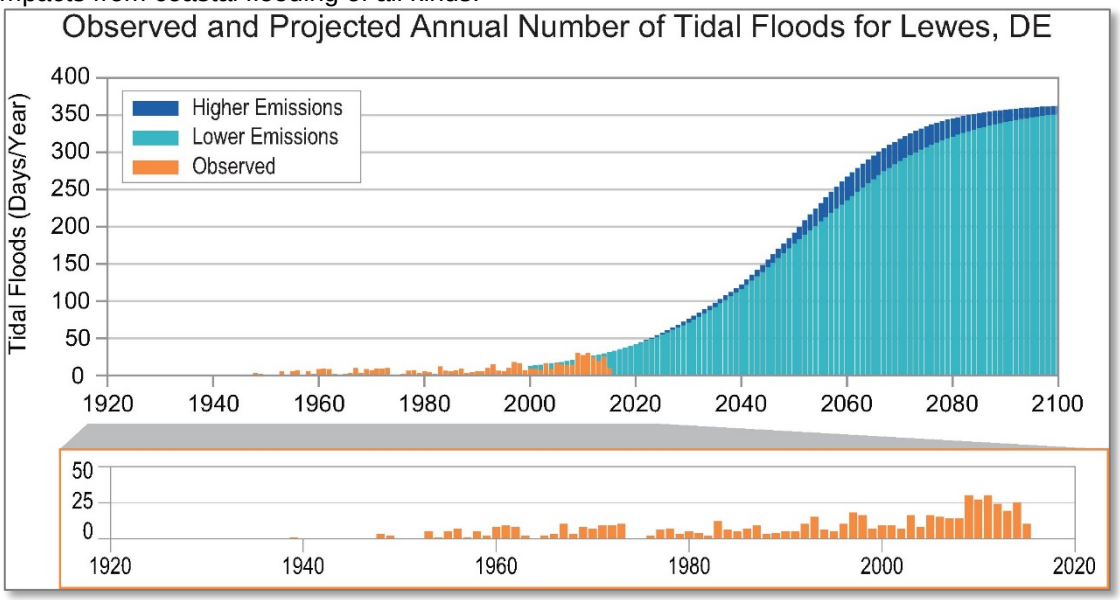


Figure 4.1-2. *Observed and projected tidal floods in Lewes, DE from 1920 until 2100 based on various greenhouse gas emissions scenarios from the 5th IPCC Assessment Report (2014). Source: Delaware State Summary for 4th National Climate Assessment.*

Coastal Storms

Coastal storm is a generic term used to describe a large area of low atmospheric pressure, with counter-clockwise flowing winds (in the northern hemisphere), moving along the coastal areas of a large landmass. In the mid-Atlantic region of the United States, coastal storms generally fall into one of two categories as either a mid-latitude cyclone, or a tropical cyclone. Mid-latitude cyclones are typically the larger of the storm types, deriving their energy from contrasting cold/dry and warm/moist air masses. In combination with a strong area of high atmospheric pressure to the north, these storms can bring very strong northeasterly winds to Delaware and heavy precipitation. As they move along the coast they are often referred to as "nor'easters" due to the prevailing wind direction (winds blow from the northeast). Tropical cyclones (e.g. tropical storms and hurricanes) are smaller in size, but often stronger areas of low atmospheric pressure. They derive their energy from atmospheric moisture and are often associated with very high wind speeds and copious amounts of precipitation. Each type of storm brings similar impacts to coastal areas, which may include high winds, storm surge, coastal flooding, heavy precipitation, inland flooding, and in the winter, frozen precipitation. Mid-latitude cyclones are by far the most frequent coastal storm type along the mid-Atlantic coast. Although tropical cyclones occur far less frequently than mid-latitude cyclones, they are often stronger systems leading to increased impacts to coastal areas. Combined, these storms are arguably the most important weather-related hazard that affects Delaware. Impacts of coastal storms include road closures due to flooding, potential evacuation of homes, disruptions to the power grid due to downed trees and power lines caused by high winds, closed beaches due to rip current risks, and potentially significant emergency response, such as emergency services response, activation of shelters, and sometimes state of emergency declarations.

Mid-Latitude Cyclones:

In a study conducted at the University of Delaware, 2309 coastal storms were documented along the mid-Atlantic coast during the period 1945 – 2016. Of these, approximately 96% were mid-latitude cyclones. Coastal storms occur all months of the year, but generally peak during the late winter and early spring months (Fig. 4-3a). Their intensity can vary, as can their impact to coastal areas. There have been no long-term trends in the frequency of coastal storms since 1945, but there was a period with lower frequencies from approximately 1970 through the early 1990s (Fig. 4-3b).

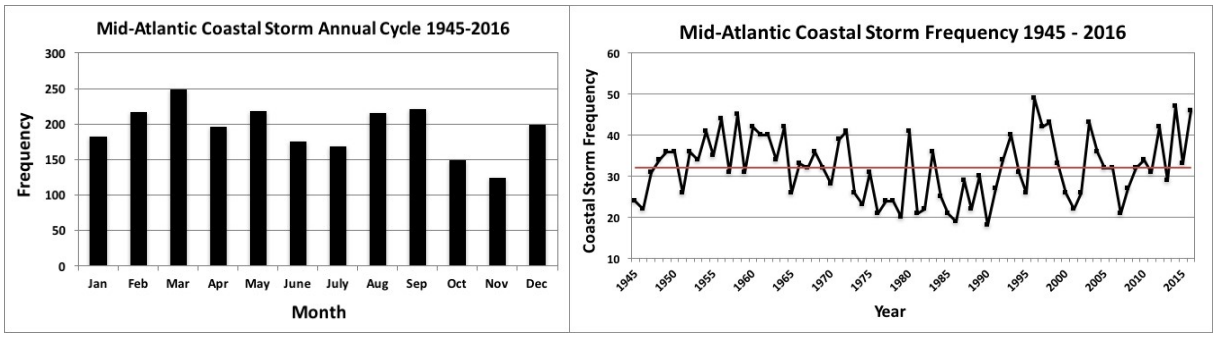


Fig 4.1-3. *(a) Annual cycle of the frequency of mid-Atlantic coastal storms, and (b) frequency of storms each year 1945 – 2016.*

Notable Mid-Latitude Cyclones

March 1962

On March 5, 1962, the combination of strong high pressure over eastern Canada, and a developing low-pressure system off the coast of the Southeast United States signaled the beginning of one of the most intense coastal storms events on record for the mid-Atlantic. Over the next 72-hours coastal Delaware was subjected to record setting winds and tidal flooding. The strong high pressure over eastern Canada blocked the forward progress of the low-pressure system moving up the coast, causing it to remain nearly stationary for three days. The intense pressure gradient between the two systems resulted in strong easterly and northeasterly winds along the Delaware coast, pushing water toward the shoreline. This resulted in life-threatening tidal levels for five tidal cycles. The estimated damage in 1962 dollars was approximately 90 million dollars (over 600 million today). In Delaware, seven fatalities and the loss of hundreds of residences has made this the costliest mid-latitude cyclone on record.

January 1992

A developing low-pressure system off of the southeast coast of the United States moved toward the northwest on January 3, 1992, reaching the coast south of Delaware on January 4. Its northwest movement was the result of the surface low-pressure being “pulled” to the west by a strong upper-level trough moving through the Southeast United States. As the storm center came onshore just south of Delaware, the strongest winds and tidal anomalies covered the Delmarva Peninsula, causing flooding along both the Delaware Bay and the Inland Bays. The coastal flooding was enhanced due to the storm making landfall near the time of high tide, during the highest tidal cycles of the month associated with a new moon. The storm resulted in both Kent and Sussex counties receiving federal disaster area declarations. Significant damage was widespread along the coast including beach erosion, damage to coastal dunes and destruction of a portion of the boardwalk in both Rehoboth and Bethany Beaches.

May 2008 (Mother’s Day Storm)

An area of low pressure, centered over the Illinois/Indiana border on May 11, 2008, moved quickly eastward and redeveloped off the North Carolina coast. The storm moved northeast and was centered over the southern Delmarva Peninsula by May 12. The placement of the storm to the south of Delaware resulted in the initiation of strong northeast winds that persisted throughout the day on the 12th. These strong onshore winds, coupled with high astronomical tides, resulted in significant coastal flooding along the Delaware Bay coast of Delaware. Winds reached 68 mph in Lewes, 60 mph in Dover and 48 mph in Wilmington. The high tidal levels required evacuations in a number of Delaware Bay towns, the closing of several coastal roadways and a fatality at sea.

Tropical Cyclones

All tropical cyclones moving within 200 miles of Lewes, DE were documented for the period 1851 – 2017. During that period 203 tropical cyclones were found to have moved through this region. Tropical cyclones occur primarily in the late summer and autumn seasons (Fig 4.1-4a), peaking during the month of September. On average, only one tropical cyclone will move this close to Delaware in any given year. However, this number is quite variable from one year to the next. The number of storms each decade since 1851 is shown in Figure 4.1-4b.

There is a tendency for a peak in the number of storms on a roughly 60-year cycle (decade of the 1880s, 1940s, 2000s). Several notable hurricanes have impacted Delaware since the turn of the century including Isabelle (2003), Irene (2011) and Sandy (2012). The picture to the right is flooding from Hurricane Gloria along Route 1 in 1985.

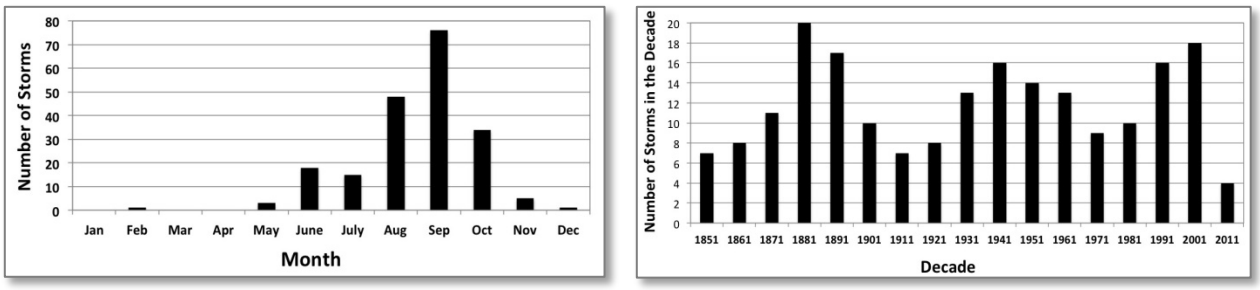


***Fig 4.1-4. (a)** Annual cycle of tropical cyclones moving within 200 miles of Lewes and **(b)** decadal frequency of tropical cyclones moving within 200 miles of Lewes.*

Hurricanes

Hurricane Isabel (2003)

Isabel developed as a tropical storm September 6 about 600 miles west of the Southern Cape Verde Islands. The following day the storm was upgraded to a hurricane and within five days Isabel became the first Category 5 hurricane in the Atlantic since Hurricane Mitch in 1998. Isabel made landfall along the U.S. East Coast on September 18 as a Category 2 storm. Seven federal disaster declarations were issued as a result of Isabel, including the State of Delaware. Isabel may become best known for the wide-spread power outages it caused. Two days after Isabel lashed Delaware with wind and rain, approximately 60,000 of Conectiv's 280,000 customers were without power. About 28,000 customers were without power in the company's New Castle County region (which also includes Cecil and Harford counties in Maryland). A spokesperson for the power company said that trees falling across power lines caused most of the outages.

Hurricane Irene (2011)

Hurricane Irene maintained Category 1 strength as the eye of the storm passed within 27 miles of the Delaware coast, producing continuous tropical storm force winds, tornadoes, and record flooding. The State sustained a storm surge of 2.98 feet on top of an astronomical high tide, with a tidal level of 8.2 feet inundating low lying coastal areas. Excessive rainfall caused record flooding on the Christina River, Brandywine River, and near record flooding on the Red and White Clay Rivers in New Castle County. Rainfall totals ranged from 7.47 inches in Sussex County, to 8.81 inches in Kent County and 8.34 inches in New Castle County. Hurricane Irene resulted in 51,000 customers losing power at the peak of the storm, and causing mandatory evacuations of approximately 80,000 to 100,000 tourists and residents, including special populations. State highway officials reported over 200 roads under water, and 7 bridges sustaining structural damage. Thirty-seven (37) homes and businesses sustained major damage or were destroyed, as well as 6 state maintained beaches sustaining extensive damage such as beach erosion and dune breaches. There were also 2 fatalities associated with the hurricane.

Hurricane Sandy (2012)

Hurricane Sandy (2012) Hurricane Sandy transitioned from a tropical to extra-tropical event that delivered high winds, serious coastal erosion and coastal flooding, storm surge, and heavy rains. The eye of the storm traveled within ten miles of Delaware. The State sustained a storm surge of 5.06 feet on top of an astronomical high tide, with a tidal level of 9.1 feet, inundating low lying coastal areas. Rainfall totals ranged from 6.42 - 10.20 inches in Sussex County, from 7.57 – 9.14 inches in Kent County, and 4.60 – 8.33 inches in New Castle County. The state also experienced maximum wind gusts of 67 mph. Hurricane Sandy resulted in approximately 45,000 customers without power at the peak of the storm, mandatory evacuations of over 35 communities and flood prone areas, including special populations beginning on October 27th, seven shelters being opened and schools remaining closed through the duration of the event. State highway officials reported numerous roads under water and sustaining structural damage, along with several bridges. In addition, in excess of 40,000 tons of sand had to be removed from Route 1, which runs along the coast in Sussex County. There was extensive damage to 6 State maintained beaches resulting in severe beach erosion and dune breaches as well as extensive damage to 5 dikes in New Castle County. Hurricane Sandy also resulted in 19 homes or businesses sustaining major damage or being destroyed.

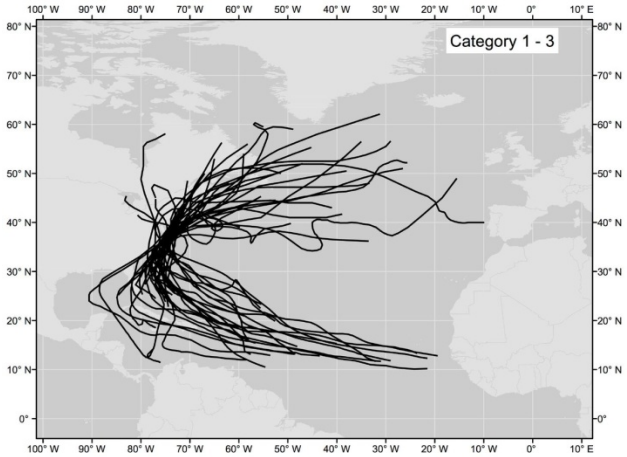


Figure 4.1-5 *Tracks of all Hurricanes (Category 1 to 3) that have come within 200 nautical miles of Lewes, DE from 1851 until 2014. Source: Delaware State Climate Office.*

Winter Precipitation

Winter precipitation consists of snow, sleet, and freezing rain. Winter precipitation is often accompanied by low temperatures and can have heavy and/or blowing snow, which can severely impair visibility and make driving conditions extremely hazardous. Icing from sleet and freezing rain is of particular concern, as even small accumulations of ice can cause a significant hazard.

Significant icing events can be especially devastating to power lines and trees, affecting power and communications to thousands of homes in a single event. Even small accumulations of ice can cause an extreme hazard to motorists and pedestrians by making roads and sidewalks extremely treacherous.

Snowstorm in Georgetown, DE in February 2010 (Photo courtesy: preparede.org)

Winter Precipitation in Delaware

Winter precipitation constitutes a significant statewide hazard in Delaware between October and April. Annually averaged snow in Delaware can range from approximately 20 inches in New Castle County to 13 to 15 inches in Kent and Sussex counties. However, annual variability of snowfall in Delaware is large and can range from as little as a trace of snow in 1997-1998 to 72 inches in 2009-2010. According to the National Climatic Data Center, the geographic area of the State of Delaware experienced 183 distinct winter storm events (heavy snow, ice, sleet, and blizzard) from January 1, 1996 through April of 2017 (see **Table 4.1-10**). In recent history, the three most powerful and costly storms to affect Delaware were the Blizzard of 1996, a storm over President's Day Weekend 2003 (which deposited nearly two feet of snow in many places), and the three storms during the winter of 2009-2010 – the snowiest winter on record for Delaware. These winter storm events resulted in more than $15.3 million in property damage statewide, 5 deaths, and 70 reported injuries. Specific details of these events can be found in the corresponding county-level plan. The biggest adverse impacts will be to the power outages, disruption of communications, and road closures, which impact response and the delivery of critical services.

Table 4.1-4
Winter Storms in the State of Delaware

County	# of Recorded Winter Storm Events (01/01/1950 – 04/30/2017)	Total Property Damage Recorded	Deaths	Injuries
Kent	48	$3,650,000	0	5
New Castle	65	$5,350,000	4	60
Sussex	70	$6,300,000	1	5
TOTAL	**183**	**$15,300,000**	**5**	**70**

Source: National Centers for Environmental Information Storms Database

Future Conditions for Winter Precipitation

According to climate change projections for Delaware in DNREC's Delaware Climate Change Impact Assessment (2014) Report, there could be a small, insignificant amount of winter precipitation (1 to 2% of annual snowfall) that falls as rain instead of snow due to anticipated warming during winter months. Given the magnitude, this effect should not have a significant effect on Delaware winters in the future. Overall, climate change projections do point to an increase in overall winter precipitation, but mainly in the form of more rain, not snow.

Coastal Erosion

Coastal Erosion is a general term used to describe a variety of shoreline changes such as changing beach topography, loss of sand from beaches or impacts to dunes. Coastal Erosion trends can generally be divided into two categories: long term shoreline change and storm-induced erosion. Most locations in Delaware are experiencing coastal erosion both as a long term trend and in response to storms. Impacts of coastal erosion include reduced resiliency to coastal storms, which makes homes, businesses, roads, and other types of infrastructure more susceptible to damage from coastal flooding during storm events. In addition, the beaches of Delaware are important to the state's tourism economy, thus loss of use or sub-optimal beach conditions resulting from coastal erosion can have a significant economic impact.

Causes of Coastal Erosion.

An underlying cause of coastal erosion is the rising sea level, which has been underway since the last glacial maximum over 20,000 years ago. This long term rising sea level trend generally causes the shorelines and barrier islands in Delaware to migrate landward and upward in elevation. This is also known as shoreline recession. Where lands have been developed, this inland migration of shorelines and beaches manifests as a narrowing of beaches and loss of sand dunes as the sea encroaches on structures. This long term trend of rising sea level can be seen as causing the long term recession rates listed below for locations throughout Delaware. See Table 4.1-6

Long Term Coastal Erosion in Lewes, Delaware: At this location the loss of sand in front of bayfront houses is a long term likely influenced by effects of the nearby Cape May Lewes Ferry Jetty (DNREC Photo)

Storm Impacts: To a large extent, this long term shoreline recession does not occur as a slow continuous process – it is also driven by storms. The impacts of storms on beaches and dunes are so significant that coastal erosion is often perceived as being attributable almost solely to storms. Storm impacts can be deceptive as much of the sand eroded from dunes and beaches is moved offshore during storms but still remains in the beach system and will likely return to the beach during calmer weather.

Sand Budgets: As shorelines have been developed, in many locations coastal structures have been built which impact the movement of sand. Examples of this are the jetties at Indian River Inlet and Roosevelt Inlet and groins in communities such as Rehoboth Beach. Most of the structures are intended to retain or slow the movement of sand. The success of these structures in slowing sand movement often has the effect of reducing the amount of sand reaching other sections of the coast. This effect is well documented. In some cases it can be an acceptable trade-off but it frequently has the effect in increasing the rate of shoreline recession on the "downdrift" shoreline.

Measuring Coastal Erosion

Delaware has a long history of monitoring coastal erosion most frequently through field surveys, and through the evaluation of aerial photography. Measuring coastal erosion is made difficult by its episodic nature. Taking shoreline location surveys at different times of the year, or before or after storms can make the interpretation of these surveys more difficult. In general, measuring long term coastal erosion requires numerous shoreline surveys taken over a long period of time, preferably during calm periods and at similar times of year. Measuring storm-induced coastal erosion requires surveys before and after a storm event, with care taken to account for the fact that some sand which is moved off the beach during a storm may return naturally in the calmer weeks and months which follow.

Measuring Erosion by Volume vs. Shoreline Location: Long term coastal erosion or shoreline recession is usually described by a rate of change of shoreline location such as "feet per year". Often change in the location of high tide line or low tide line is the feature that is used to generate this rate of change.

Responding to, or mitigating, shoreline erosion is often accomplished by adding sand back to beaches and dunes. This can be done by hauling sand, or by dredging sand from an offshore borrow site. Because these mitigation actions are typically measured by volume (i.e. cubic yard) it may often be most helpful to measure loss of sand, erosion or dune damage by volume. In fact, while popular accounts of storm induced beach erosion are often described by feet or meters of erosion, shoreline managers will want to determine the volume of sand lost from a particular beach system so that mitigation or repair projects may be planned. These determinations are typically done by performing a series of transect surveys of the dune, beach, and nearshore ocean bottom to estimate volumetric loss.

Storm Related Coastal Erosion in Bethany Beach Delaware: Following a severe extratropical coastal storm in November 2009. The pre-storm profile of the dune is evidenced by the wooden dune crossover profile. There appears to be over 50 feet of horizontal dune loss and significant beach erosion at this location. (DNREC Photo)

Long-Term coastal erosion rates at selected locations in Delaware:

Table 4.1-6 and 4.1-7 are provided as examples of rate of coastal recession in Delaware. Care should be taken in using data such as these because of the varying methods for calculating beach erosion and the wide range of rates over historic time periods. Many locations in Delaware, particularly along the Atlantic Ocean and certain Delaware Bay beaches in Kent and Sussex counties are undergoing periodic beach nourishment (addition of substantial quantities of sand). These management actions have significantly altered erosion trends. In many locations along the Atlantic Ocean coast, these management actions have resulted in the maintenance of more substantial dunes and wider beaches for the past 10-15 years than those which existed in previous decades.

The stabilization of beaches and dunes through beach nourishment does not mean that coastal erosion has been eliminated. These management actions are only successful for as long as they are undertaken. Shoreline recession will likely resume (possibly at an accelerated rate initially) once the infusion of sand into these beach systems is halted. In addition, beach nourishment is quite costly and is not being used at all locations for a variety of reasons, including the lack of economic justification in sparsely developed shorelines.

Table 4.1-5 *- Rate of Coastal Recession*

DELAWARE	Minimum Shoreline Change Rate (ft/yr)	Maximum Shoreline Change Rate (ft/yr)	Average Shoreline Recession Rate (ft/yr)
Woodland Beach	-2	-7	-4.5
Port Mahon	-9	-12	-10.5
Pickering Beach	-5	-5	-5
Bowers Beach	-2	-2	-2
South Bowers Beach	-8	-8	-8
Big Stone Beach	-5	-6	-5.5
Big Stone Beach to Mispillion Inlet	-10	-13	-11.5
Mispillion Inlet	-9	-11	-10
Slaughter Beach	-2	-2	-2
Slaughter Beach to Fowler	-1	-5	-3
Broadkill Beach	-3	-3	-3
Lewes Beach (near Roosevelt Inlet)	-3	-3	-3

Source: DNREC Delaware Bay Beach Economic Analysis

Table 4.1-6 – *Shoreline Recession Rate*

Reach	Length (ft)	Sub-Reach	Length (ft)	Long-Term Shoreline Recession Rate (ft/yr)
1. Fenwick Island	20,900	Unincorporated Fenwick	1,900	4.0
		Incorporated Fenwick	4,000	4.0
		Fenwick Island St. Park	3,600	4.0
		Fenwick Acres	600	4.0
		Uninc. Sussex County	2,800	4.0
		Fenwick Island St. Park	6,600	4.0
		York Beach	1,400	4.0
2. South Bethany	6,000	South Bethany	3,600	4.0
		South Bethany, N	500	4.0
		Middlesex	1,900	4.0
3. Sea Colony Unit	2,300	Sea Colony	2,300	4.0
4. Bethany Beach	5,100	Bethany Beach	5,100	4.0
5. North Bethany	22,500	Uninc. Sussex County	16,200	3.0
		Delaware Seashore St. Pk	6,300	2.0
Indian River Inlet				
6. Dewey Beach	36,100	Delaware Seashore St. Pk	26,900	2.0
		Indian/N Indian Beach	2,500	2.5
		Dewey Beach	5,700	2.0
		Silver Lake	1,000	1.5
7. Rehoboth Unit	11,500	Rehoboth (S. residential)	2,400	1.5
		Rehoboth (commerical)	3,800	2.0
		Rehoboth (Surf Ave)	1,900	2.5
		Henlopen Acres	1,300	3.5
		North Shores	2,100	4.0

Source: DNREC

Effects of Sea-Level Rise on Future Coastal Erosion

Coastal Erosion rates in Delaware are driven by many factors, but the rate of sea level rise may be the factor most directly related to the rate at which a shoreline will move. The Bruun rule states that shoreline erosion caused by sea level rise is a function of the average slope of the shoreface. Future increases in the rate of sea level rise would be expected to exacerbate coastal erosion on nearly all shorelines in Delaware. Delaware's "Beaches 2000" Report states that "many scientists now agree that an increase in the rate of sea level rise and, hence, an increase in the rate of shoreline migration will happen…"

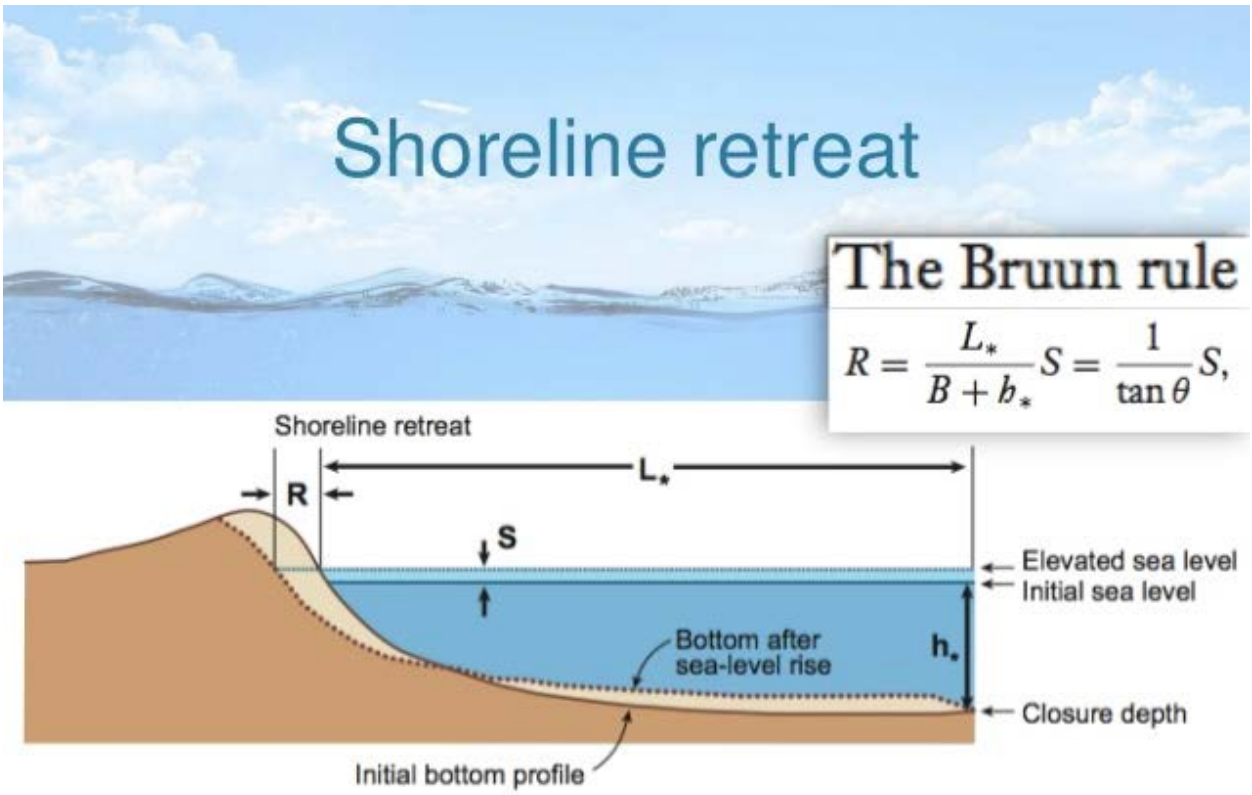


Figure 4.1-6

The Bruun rule of shoreline retreat (after Cooper & Pilkey 2004).

"Beaches 2000" further anticipates that "at some point in the future, the economic justification for a particular course of [erosion management] action considered optimal today will change because the local shoreline has changed due to sea level rise."

This outlook on coastal erosion has implications for hazard mitigation planning. Hazard mitigation strategies (such as lifting, flood proofing or otherwise retrofitting buildings or infrastructure adjacent to shorelines) which assume a continuation of current shoreline location trends into the future may significantly underestimate local risk factors. Increased sea level rise will likely lead to increased coastal erosion, beach and dune loss or migration and more severe storm impacts. Caution should be used in planning hazard mitigation activities in locations where future coastal changes, driven by factors such as accelerated sea level rise, could significantly increase future flood and wave damage risks.

Inland Flooding

Flooding is the most frequent and costly natural hazard in the United States, a hazard that has caused more than 10,000 deaths since 1900. Flooding is a major component in nearly 90 percent of all presidential disaster declarations involving natural hazards.

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

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

General floods are usually long-term events that may last for several days. The primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding (discussed further in this, Section 4.1) is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other large coastal storms. Urban flooding occurs where man-made development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.

Flash flooding events commonly occur from a dam or levee failure within minutes or hours of heavy amounts of rainfall, or from a sudden release of water held by an ice jam. Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms.

Impacts of inland flooding include road closures and evacuations due to high water, infrastructure damage to roads and buildings, impacts to water supplies due to contamination, and emergency response.

Flooding in Delaware

Although flash flooding occurs often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces. Flash flood waters move at very high speeds—"walls" of water can reach heights of 10 to 20 feet. Flash flood waters and the accompanying debris can uproot trees, roll boulders, destroy buildings, and obliterate bridges and roads.

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

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

Riverine and Flash Flooding Events in Delaware

According to the National Climatic Data Center, 232 days with riverine or flash flood events were reported in Delaware between January 1, 1950 and August 31, 2017. These events resulted in 4 deaths, 7 injuries and a total of nearly $29 million in property damage. **Tables 4.1-7** through **4.1-8** provide a breakdown of flood activity by county, presented under the subheadings of flash flooding and riverine flooding, differences mainly being how fast the waters rise. Because some events affected more than one county on the same day, the total number indicated by the tables below is slightly higher than the total number for the state provided above. Specific details of these events can be found in the corresponding county-level plan. Significant flash flooding events that have impacted people, property and the environment:

Table 4.1-7
Summary of Flash Flooding Events by County in the State of Delaware

County	Days with Recorded Flash Flooding Events (01/01/1950 – 08/31/2017)	Property Damage Recorded	Deaths	Injuries
Kent	24	$1,149,000	0	0
New Castle	88	$24,155,000	4	5
Sussex	38	$2,900.000	0	1
TOTAL	**128**	**$28,204,000**	**4**	**6**

Source: National Climatic Data Center, https://www.ncdc.noaa.gov/stormevents/

Significant riverine flooding events that have impacted people, property and the environment:

Table 4.1-8
Summary of Riverine Flooding Events by County in the State of Delaware

County	# of Days with Recorded Riverine Flooding Events (01/01/1950 08/31/2017)	Property Damage Recorded	Deaths	Injuries
Kent	10	$0	0	0
New Castle	83	$600,000	0	1
Sussex	28	$0	0	0
TOTAL	**104**	**$600,000**	**0**	**1**

Source: National Climatic Data Center, https://www.ncdc.noaa.gov/stormevents/

Notable Riverine or Flash Flood Events

Of the 232 flood events recorded by the National Climatic Data Center, a few events that have occurred in recent years are considered notable based on such criteria as magnitude, number of deaths, and amount of property damage. These events are detailed below:

September 16, 1999
Hurricane Floyd brought torrential rains and damaging winds on September 16, 1999. The hurricane caused widespread flash flooding as storm totals averaged around nine inches (10.58 inches in Sussex County). Most of this rain fell within a 12-hour period establishing a new State record. A total of $8 million in property damage was reported, along with two fatalities—the first hurricane-related deaths in the State since Hurricane Hazel in 1954. In addition, there were a number of injuries, at least two of which were serious. Overall, the event most heavily affected New Castle County.

August 11, 2001
Slow moving thunderstorms with torrential rains inundated southwestern Sussex County during the late afternoon of August 11, 2001. Doppler Radar storm total estimates reached 8.4 inches around Seaford. Aside from the far northeast and southeast part of the county, storm total estimates exceeded three (3) inches in the rest of the county. The torrents led to flooding of streams and the eventual dam failure of a 100-year-old dam on Hearns Pond. About a dozen municipal streets were closed because of the flooding including Delaware State Route 20. Damage was estimated at $1.1 million.

September, 2003
Torrential rains from Tropical Storm Henri, followed immediately by additional rain from Hurricane Isabel, led to massive flooding across the state, resulting in two disparate federal disaster declarations. During a 14-hour period, a total of 8-10 inches of rainfall fell with 6-8 inches falling during one 3-hour window. The Red Clay Creek in New Castle County was the hardest hit with stream gages reporting a new “flood of record” exceeding levels seen in 1999 with Hurricane Floyd. The Wooddale gage on Red Clay Creek crested at 17.3 feet, 9.8 feet above flood stage. The previous record crest was 13.9 feet in September 1999 as a result of Hurricane Floyd. As a result of the extremely heavy rainfall and flooding, hundreds of residents were evacuated from their homes. The flash flooding caused extensive damage to numerous roadways and bridges, which resulted in their closure. Seven (7) Wilmington and Western Railroad Bridges were washed out.

November 15, 2004
Hurricane Jeanne dumped heavy rain (3” to 8”) on New Castle County, resulting in catastrophic flash flooding and tornadoes that impacted over seventy residential areas. Forty roads were closed due to flooding, trees and downed power lines were everywhere, and rising flood waters created havoc in 59 sub-divisions.

July 5, 2006
A stationary front stalled over the northeast, including Delaware, and led to extremely heavy rainfall (8”- 15”), and flooding on June 25th 2006. The areas of Seaford and Blades were particularly hard hit. The heavy rainfall and subsequent flooding resulted in severe damage to roadways, bridges and buildings in the general area impacted by the storms. Public schools in Sussex County were cancelled on Monday June 26th due to flooded road conditions; 39 roads were damaged due to flooding, downed trees, downed wires; 15 roads experienced road failure; and 4 communities were inundated with floodwaters.

Figure 4.1-7 shows the largest peak discharges at the USGS stream gauge on the Brandywine River at Wilmington, DE. Information like this graph, as well as a table of recurrence intervals, and a Top 50 flood list are available for every long-term stream gauge in Delaware in Storm Books, created and maintained by the Delaware Geological Survey and the Delaware Environmental Monitoring and Analysis Center (DEMAC) at the University of Delaware. The books are used by hydrologists and technical experts during weather emergencies to provide guidance to state emergency management personnel during storm events.

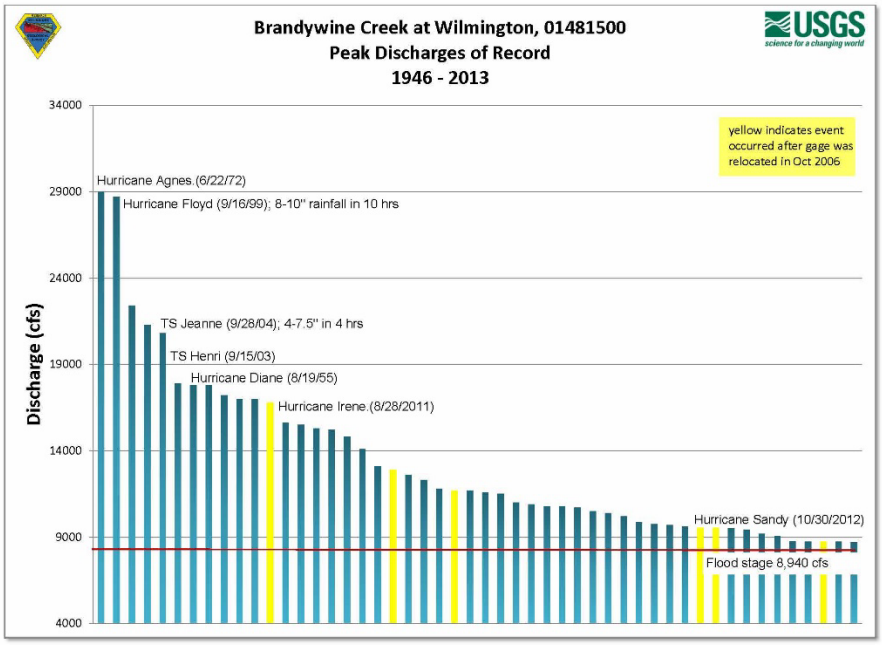


Figure 4.1-7 Peak discharges for the Brandywine Creek at Wilmington, DE USGS stream gauge for period 1946-2013.

Effects of Future Climate Change on Heavy Precipitation and Inland Flooding

Several prominent scientific studies, including the 4th National Climate Assessment Report (NCA4), have suggested that extreme precipitation events will increase in the future due to climate change. Figure 4.1-8 shows how this expected change is part of an overall potential regional increase in precipitation in the Northeast United States due to climate change.

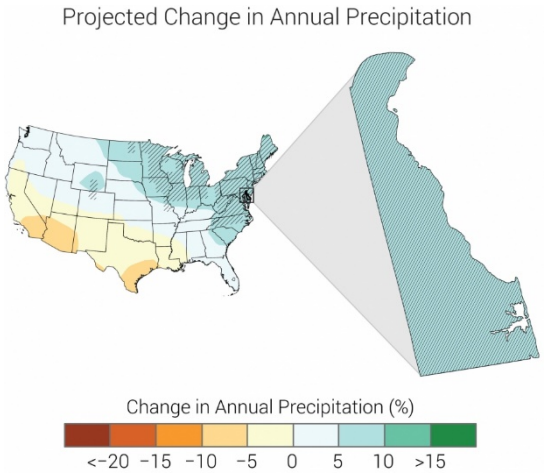


Figure 4.1-8 *Projected change in annual precipitation due to climate change. Source (Fourth National Climate Assessment State Report for Delaware)*

However, it's important to mention that the historical trend for Delaware shows very little change or trend in extreme precipitation events. Figure 4.1-9 shows the decadal time series for 1-day extreme precipitation events greater than 1, 2, 3, 4, and 5 inches for long-term climate monitoring stations in Delaware. The lack of any upward or downward trend suggests that precipitation is neither getting more or less extreme in Delaware, at least for the last 125 years, which is the observation period used in that study by the Delaware State Climate Office. However, climate model projections used in the NCA4 report are based on climate change, mainly temperature change, beyond anything experienced thus far in the observed climate record since 1895. Therefore, there is uncertainty in the prediction of increase in the frequency and duration of extreme precipitation in Delaware in the 21st Century, however, this potential change is the best available climate change information available. Also, there is a logical argument that increased temperature will increase the likelihood of extreme precipitation given that the atmosphere's ability to hold water vapor is directly related to the temperature of the atmosphere. Thus in a warmer climate, the atmosphere can hold greater amounts of water that can lead to heavier precipitation events. Obviously, with heavier precipitation, one would expect the potential for more frequent inland flooding. Another and perhaps more significant change that could affect the frequency and magnitude of future inland flooding is the urbanization of watersheds. Land surface changes in watersheds from natural to impervious surfaces increases the rate at which rainwater enters stream bodies, as water cannot be absorbed by impervious surfaces like it can by natural surfaces. Therefore, as watersheds become more urbanized in the coming decades, the flood frequency and magnitude along heavily urbanized streams and rivers will likely increase as well.

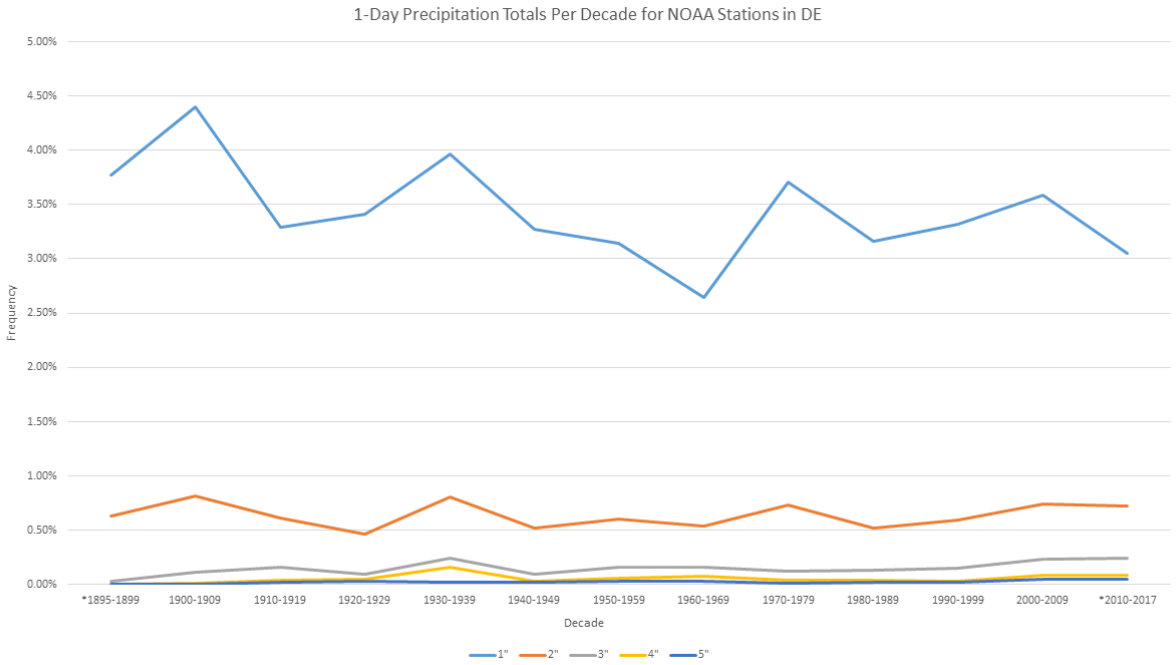


***Figure 4.1-9. 1**-Day Precipitation Frequencies by Decade for all long-term NOAA climate stations in Delaware. Source: Delaware State Climate Office.*

Severe Thunderstorms

The National Weather Service estimates that more than 100,000 thunderstorms occur each year across the United States, though only about 10 percent of these storms are classified as "severe." Although thunderstorms generally affect a small area when they occur, they can be very dangerous as by definition they contain lightning, and can also produce heavy rain, flash flooding, strong straight-line winds, large hail, and tornadoes. While thunderstorms can occur in all regions of the United States, they are most common along the Gulf coast and in Florida as atmospheric conditions in those regions are most suitable for their development. Effects of thunderstorms on emergency response include disruption to the power grid and road closures from downed trees and power lines, damage to homes and property from high winds and tornadoes, and crop losses and property damage from large hail.

On average, most of Delaware has over 30 days each year with thunderstorms (Fig. 4.1-10). To be classified as a "severe thunderstorm", the storm must produce either a tornado, straight-line winds greater than 58 mph, or hail greater than one inch in diameter. Impacts of severe thunderstorms would have many of the same impact as storms (page 6) to include the hazards associated lightning and large hail.

Severe weather reports associated with thunderstorms are recorded in the Storm Events Database at the National Center for Environmental Information (NCEI; https://www.ncdc.noaa.gov/stormevents/). Data has been collected in a consistent manner since 1996. It is important to note that this database covers only "reported" severe weather, and does not provide information on all the severe weather that may have occurred in a particular storm.

Lightning

All thunderstorms contain lightning, and therefore represent a danger to the public. According to the National Weather Service, over 90 people are killed and over 300 injured each year by lightning in the United States, along with several hundred million dollars in property damage. In addition, lightning is the primary cause of forest fires in many areas of the country. During the period 1996 through 2016 there were 125 reports of damage or injuries associated with lightning strikes across Delaware, according to the Storm Events Database. These events resulted in a reported loss of over six million dollars in property damage and eight injuries during the 21-year period.

Straight-Line Winds

Damaging straight-line winds are another major hazard associated with severe thunderstorms. Straight-line winds can reach speeds well in excess of 100 mph, and can cause significant damage, injury and loss of life. The terms downburst and microburst are often used to describe damaging straight-line winds. The difference between the two is simply in the size of the area affected (microburst is smaller) and in the duration of the damaging winds. Across Delaware, 447 straight-line wind reports have been recorded during the period 1996 through 2016. These resulted in reported property damages of nearly five million dollars, crop damage of over two-hundred thousand dollars, and two injuries.

Heavy Rainfall and Flash Flooding

Heavy rain, and the flash flooding situations that often follow, are the main cause of death from thunderstorms. Rainfall rates can be as high as several inches per hour, leading to flash flooding of streams and urban flooding situations. Delaware has seen 160 flash flooding events in the years 1996-2016. The majority of these were likely associated with convective rainfall, while others were the result of various processes associated with heavy rainfall or rapid snowmelt. These 160 events resulted in over $28 million in reported property damage, six injuries and four fatalities.

Large Hail

Large hail causes over one billion dollars in damage across the United States each year, much of which is done to crops. Hail can range in size from smaller than peas to larger than a softball. The largest hail stone recorded in the United States fell in Vivian, SD on July 23, 2010, measuring eight inches in diameter and weighing nearly two pounds. Large hail is rare across Delaware. However, in the period from 1950 through 2017 84 reports of large hail were documented, the largest being 2.5 inches in diameter (tennis ball sized) on May 22, 2014 in Brandywine Hundred in the Ballymeade development. Over 300 thousand dollars in crop damage was reported in Greenwood in Sussex County in June of 2009 from nickel sized hail. No injuries of fatalities have been recorded from hail in Delaware during the 67-year period of record.

Future Conditions of Severe Thunderstorms in Delaware

Climate projections lack specificity with respect to severe weather, as the severe weather typically occurs on weather scales much smaller than that which can be simulated in climate change simulations. Therefore, it is difficult to project changes in the frequency or magnitude of severe weather in the future.

Extreme Heat

While drought mostly impacts land and water resources, extreme heat can pose a significant risk, including loss of life, to humans, animals, and some plant species as well interruptions in service from electrical utilities due to added stress on grid infrastructure. Extreme heat can be defined as temperatures that hover 10 degrees or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity. Typically, extreme heat is categorized by the term 'heat wave', which is often considered a 3 day or longer period of maximum temperatures greater than or equal to 90°F. Elderly persons, young children, persons with respiratory difficulties, and those who are sick or overweight are more likely to become victims of extreme heat. Extreme heat in urban areas can create health concerns when stagnant atmospheric conditions trap pollutants and increase the rate of near-surface ozone formation, thus adding unhealthy air to excessively hot temperatures. In addition, the "urban heat island effect" can produce significantly higher nighttime temperatures because asphalt and concrete (which store heat longer) release heat more slowly than natural surfaces. In fact, a 2016 report from the United States Global Change Research Program cited several studies that support heat mortality being more closely related to higher nighttime temperatures than higher daytime temperatures. Thus extreme heat is not simply a daytime phenomenon, but can be important through the entire daily cycle. For Delaware, the National Weather Service documents over 88 instances of "excessive heat," "heat wave," or some other moniker that indicates high temperature extremes from 1996 through 2017. During these periods, 9 people died and another 64 suffered heat-related injuries.

For Delaware, extreme heat can affect any location, though urban areas tend to be affected more severely during heat waves because the nighttime temperatures tend to stay more elevated in urban areas than in rural areas. The deadliest heat wave since 1950 took place on July 4th – 6th, 1999. This event led to 4 deaths (two in New Castle County and two in Sussex County) and 5 heat-related injuries. In all cases, the deaths occurred in the interior of buildings without air conditioning. Temperatures soared over 100 degrees in Georgetown, DE on the 5th and approached that in every location of the state. Other effects from this heat wave were the loss of thousands of chickens in Sussex County at unknown damage/cost and extremely high demand on the electrical grid due to the need for round-the-clock air conditioning in most locations.

Effects of Climate Change on Extreme Heat

National Centers' for Environmental Information state climate summary for Delaware projects significant potential warming during the 21st century as a result of climate change. Figure 4.1-15 shows the projected change in average temperature for Delaware under two greenhouse gas (GHG) scenarios. The projected change in average temperature ranges from 3 °F in the lowest GHG emissions scenario to 13 °F in the highest GHG emissions scenario. This increase in the overall temperature regime for Delaware would result in increasing frequency and severity of excessive heat, which would only exacerbate the impacts of these hazards on Delaware's economy and population.

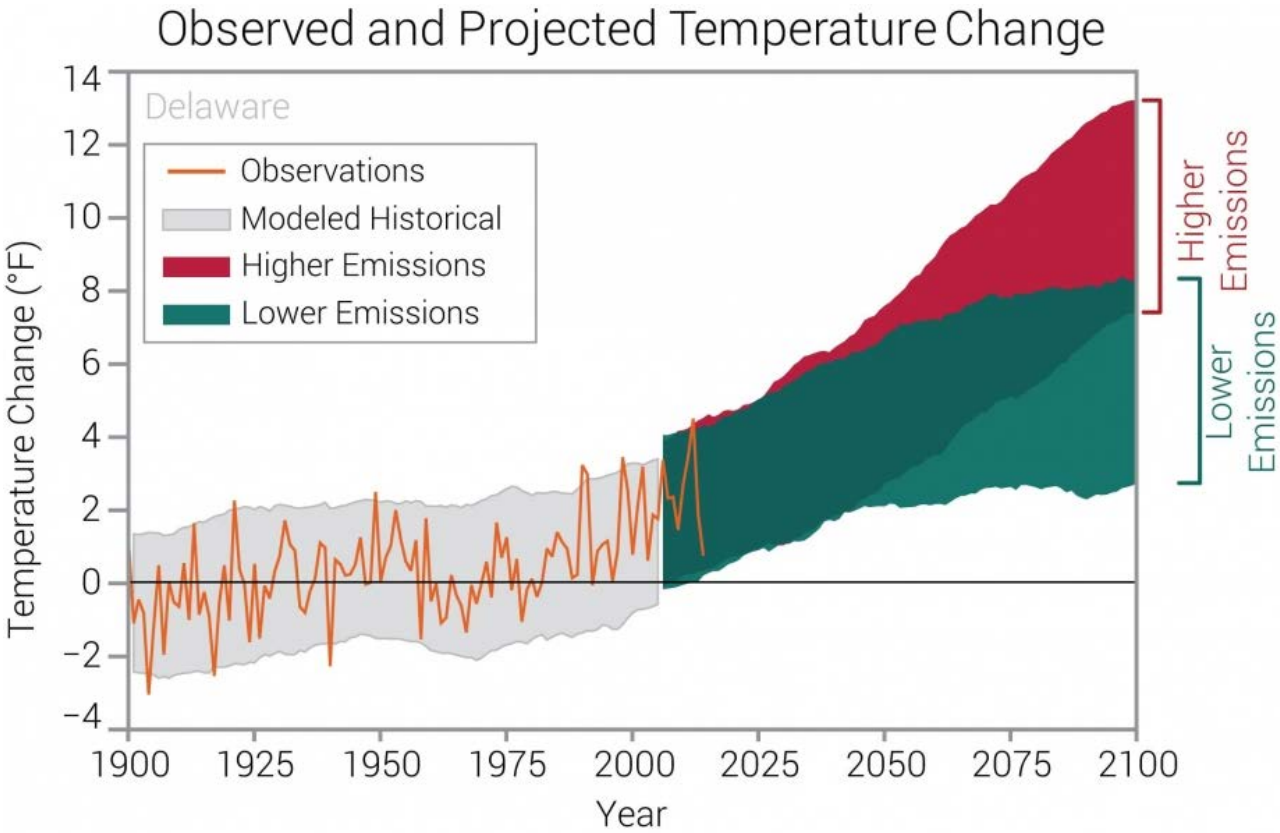


Figure 4.1-15. *Observed and Projected Average Temperature for Delaware. Source: National Centers for Environmental Information*

Extreme Cold

Extreme cold, particularly air temperatures below the freezing point (zero degrees Celsius (°C) or 32 degrees Fahrenheit (°F) can have a profound effect on humans, plants, and animals. Depending on the crop, agricultural production can be seriously affected when temperatures drop below the freezing point. Fruits and vegetables in particular are vulnerable to freezing temperatures, as they are often planted in the spring when late freezes can do the most damage. Freezing temperatures, and even temperatures above freezing up to 50 °F, can also pose a risk to humans and animals, as hypothermia and frostbite can set in within minutes of exposure. This impact on the health of humans and animals can exacerbated by the combination of wind and cold temperatures through a phenomenon called the wind chill effect. During this process, the wind acts to remove heat from the surface of the body, thus lowering the internal temperature of a person quicker than if the winds were calm. For instance, according to the National Weather Service's Wind Chill Chart (see **Table 4.1-9)**, an air temperature of 5 °F combined with a wind speed of 35 miles per hour (mph) can cause frostbite to set-in in 30 minutes. One extreme cold event documented for Delaware on February 6th 2007 killed 4 people, according to statistics from the National Center for Environmental Information.

Table 4.1-9. *Source: National Weather Service*

NWS Windchill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Future Conditions for Extreme Cold in Delaware

According to climate change projections for Delaware in DNREC's Delaware Climate Change Impact Assessment (2014) Report, wintertime temperatures are expected to moderate some under future climate conditions. On average, climate projections show Delaware experiencing 10 fewer days with minimum temperatures below 20 degrees F, which are currently averaging around 15 days per year. However, the variability in the climate change models is at least 10 days, therefore, it's difficult to say with certainty that Delaware will see 10 fewer extreme cold days by the end of the 21st century, though some downward trend is likely.

Tornadoes

The National Weather Service reports that nearly 1,200 tornadoes occur across the United States each year resulting in approximately 60 fatalities and 1,500 injuries. The strongest tornadoes can have rotating winds of more than 200 mph. The intensity of a tornado is determined from the estimated wind speeds and related damage using the "Enhanced Fujita Scale" (EF-Scale; Fig. 4.1-11). The Enhanced Fujita Scale gives increasing tornado intensities from EF-0 to EF-5 events. Tornadoes are rare across Delaware, with only 54 events from since 1950. The strongest of these events was an EF-2 storms with winds estimated at 130 mph that hit New Castle County on September 28, 2004. The eight events resulted in nearly $13.3 million in property damage and two deaths and 75 injuries. The only deadly tornado known to have occurred in Delaware, was on July 21, 1983 near Hartly, DE, where 2 people died and 9 were injured when the tornado struck several homes, including some mobile homes. A second notable tornado struck near the Woodland Beach/Smyrna Landing area on June 7, 1988, where 30 people were injured and 18 homes were destroyed.

Impacts of tornadoes expected to be severe to extensive localized damage to include: infrastructure damage to roads and buildings, slowed emergency response, road closures, localized disruption of communications and utilities.

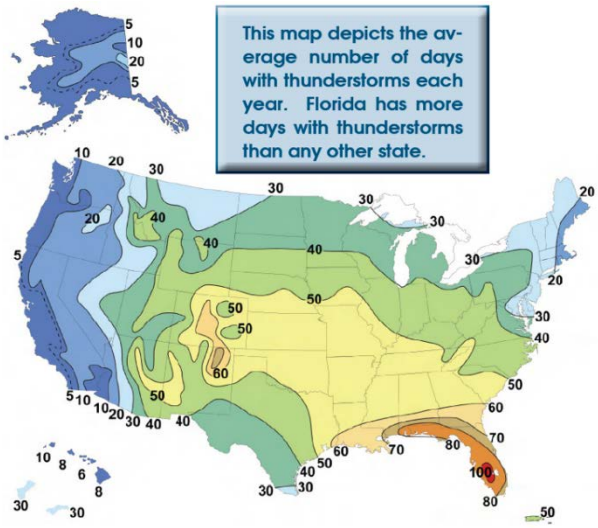


Fig 4.1-10. *The number of days with thunderstorms each year across the United States.*

EF- SCALE	
EF RATING	**3 Second Wind Gust (mph)**
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

Fig 4.1-11. *The Enhanced Fujita Scale for rating tornado intensity.*

Dam/Levee Failure

Dam Failure

A dam failure is the uncontrolled release of impounded water resulting in downstream flooding, and other impacts that can affect lives and property. These impacts include road failures and closures, evacuations of homes and businesses, and damage to utilities in the path of the resultant flood.

Dams are manmade structures that are constructed to hold back water and raise its level. The benefits of dams are numerous: they provide water for drinking, navigation, and agricultural irrigation. Dams also provide hydroelectric power, create lakes for fishing and recreation, and save lives by preventing or reducing floods. Dams are owned by state and local authorities, public utilities, federal agencies and are also privately owned. They are typically constructed of earth, rock, or concrete and come in all shapes and sizes. Dams can fail because water heights or flows exceed the capacity the structure was designed for (including flooding), or because the structure failed in some way. Structures fail for many reasons including lack of maintenance, erosion, seismic events, insufficient design, development or alteration of the floodplain, or improper construction. The primary causes of earthen dam failures are overtopping, piping failure, and foundation failure. Concrete/masonry dams usually fail from loss of a section or undermining. Concrete or masonry dams tend to fail suddenly, while earthen dams usually take longer to fail.

Failure of Hearns Pond dam near Seaford in Auaust 2001.

Though dams have many benefits, they also can pose a risk to communities if not designed, operated, and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and great property damage if development exists downstream of the dam. Aging infrastructure, new hydrologic information, and population growth in floodplain areas downstream from dams and near levees have resulted in an increased emphasis on safety, operation and maintenance.

In Delaware, the most notable dam failure was the Hearns Pond Dam failure on August 12, 2001 near Seaford, DE. Heavy rainfall on August 11th led to the eventual dam failure, with estimates of as much as 11+ inches of rainfall falling in the watershed above Hearns Pond in less than 24 hours. Following the dam's failure, water from the pond overtopped nearby Route 13A causing it to be flooded and closed. As water from the dam failure continued downstream, it emptied into Williams Pond, nearly overtopping its dam. Officials had to evacuate 15 patients from a nearby nursing home to the second floor in case the dam at Williams Pond failed. Damage from the dam failure was estimated to be around $1.1 million.

Dam Hazard Potential Classifications

FEMA utilizes a Hazard Potential Classification System for dams that categorizes them as Low, Significant, or High. This hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline interests. Dam hazard potential definitions, as contained in the Delaware Dam Safety Regulations, are as follows:

"Hazard potential" means the possible adverse incremental consequences that result from the release of water or stored contents due to failure of the dam or appurtenances. The hazard potential classification of a dam does not reflect in any way on the current condition of the dam and its appurtenant structures (e.g., safety, structural integrity, flood-routing capacity). "Low-hazard potential dam" means any dam whose failure or mis-operation is unlikely to cause loss of human life but may cause minor economic and/or environmental losses.

"Significant Hazard Potential Dam" shall mean any dam whose failure or mis-operation will cause possible loss of life, economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.

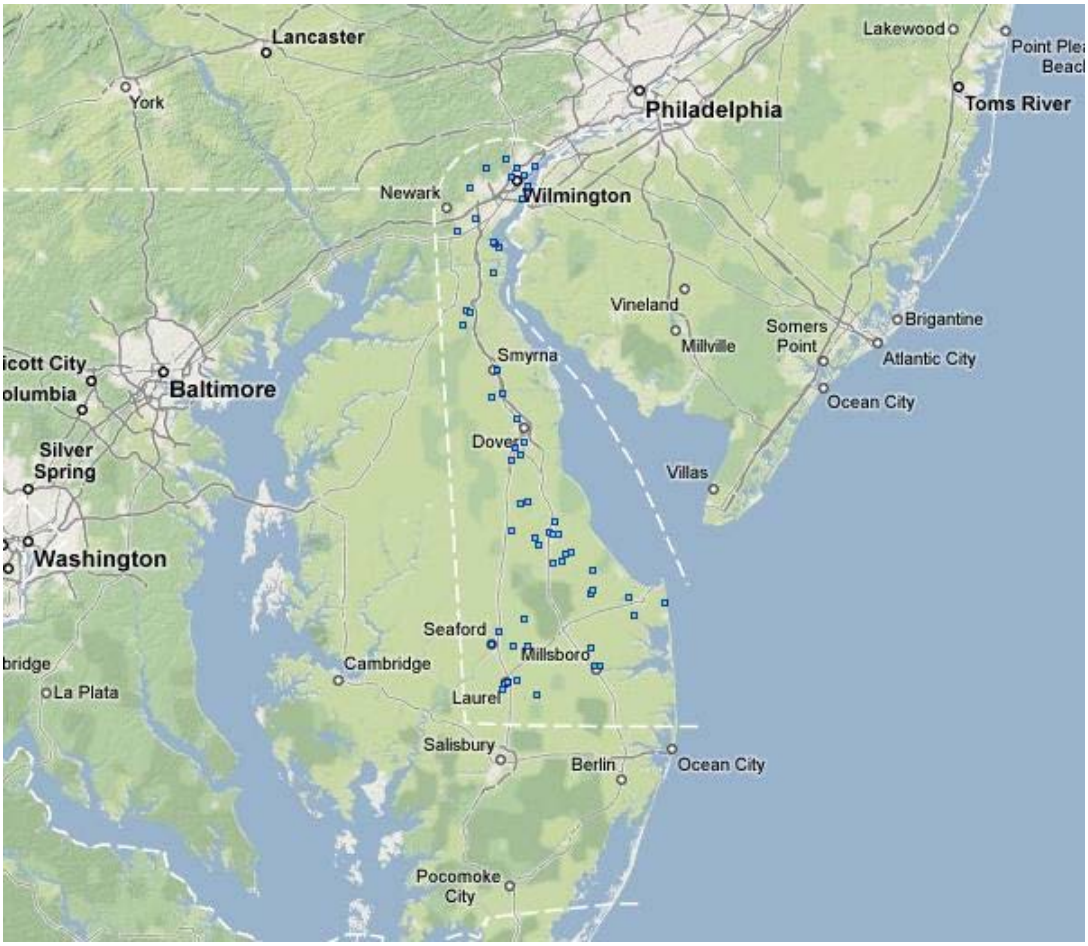
"High Hazard Potential Dam" shall mean any dam whose failure or mis-operation will cause probable loss of human life.

According to the National Inventory of Dams, there are 63 dams in the State of Delaware that are classified as having a High Hazard Potential (see **Table 4.1-9** for county dam hazard data—more specific information, such as location, owner and year built can be found in the corresponding county-level plan and **Figure 4.1-11** illustrates the NID location database). Nearly 85 percent of the dams within the State are classified as having a High or Significant Hazard Potential.

Table 4.1-9: County Dam Hazard Data

County	High Hazard	Significant Hazard	Low Hazard	Total Dams
Kent	18	1	2	21
New Castle	15	0	9	24
Sussex	30	5	3	38
TOTAL	**63**	**6**	**14**	**83**

Source: National Inventory of Dams, USACE



Source: National Inventory of Dams, USACE

Figure 4.1-11: *Delaware NID Dam Inventory Locations*

Levee Failure

A levee (also referred to as dike) failure or breach is a situation which causes the previously contained water to flood the land behind the levee due to the failure.

Levees are manmade embankments built to prevent the flooding or overflow of a river or sea. The primary purpose is to provide hurricane, storm, and flood protection relating to seasonal high water, storm surges, precipitation and other weather events. Levees are normally subject to water loading for only a few days or weeks during a year. If a levee breaks, scores of properties are quickly submerged in floodwaters and residents may become trapped by this rapidly rising water. The failure of dams and levees has the potential to place large numbers of people and great amounts of property in harm's way.

Gambacorta Dike in New Castle, DE

Delaware does have levees and many were originally built 400 years ago by European settlers. Five of the levees in New Castle County include the Buttonwood Dike, Broad Marsh Dike, Gambacorta Dike, Army Creek Dike and the Red Lion Dike. These five levees were rehabilitated in 2013-2014 to provide 10 storm protection plus freeboard. Buttonwood Dike, Broad Marsh Dike, Gambacorta Dike, Army Creek Dike are maintained by the City of New Castle and Red Lion Dike is maintained by DNREC.

Effects of Climate Change on Dam/Levee Failure

According the Fourth National Climate Assessment climate science special report released in 2017, heavy rainfall is increasing in intensity and frequency across the United States and globally and is expected to continue to increase. The largest observed changes in the United States have occurred in the Northeast. Due to the age of the dams/levees and increasing rainfall, design capacities that are considered deficient may increase and deterioration of the structures may be accelerated. More frequent intense events can damage or destroy dams/levees leading to failure and catastrophic flooding. Increasing development in areas affected by dam/levee flooding is also putting more people at risk. According the Fourth National Climate Assessment climate science special report released in 2017, global average sea levels are also expected to continue to rise and the incidence of daily tidal flooding is accelerating. These factors can also affect the design capacities of structures and the increasing salinity resulting from sea level rise may accelerate the deterioration of structures.

Drought

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

Droughts are frequently classified as one of following four types:

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

A USGS streamflow gaging station at the Ogeechee River near Eden, Georgia in July (Photo courtesy of the United State Geological Survey.

Meteorological droughts are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time. One common metric for defining meteorological drought is the Palmer Drought Severity Index (PDSI), which is typically used to define longer-term drought. Since 1950, Delaware has experienced 64 droughts of one month or longer (PDSI $\leq$ -2.0), with the longest drought lasting 18 months from February 2007 through August 2008. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Limited drought damage data are publicly available. However, to give some sense of the potential economic damage that drought can cause in Delaware, one drought defined in the NCEI storm database in the summer of 1999 caused $29.1 million, primarily due to crop losses in Sussex County. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. The last form of drought defined here, socio-economic drought, is the result of water shortages that limit the ability to supply water-dependent products in the marketplace. Examples of industries affected by this include car washes, landscaping industry, and at times heavy industry, which depends on the availability of water for cooling heavy machinery in the manufacture of products.

Surface and Groundwater Supplies

The Delaware Geological Survey (DGS) provides a monthly water conditions index (WCI) for northern New Castle County for water supply purposes. This index provides a relative index of the sufficiency of water supplies, both surface and groundwater, in northern New Castle County where the majority of Delaware's population resides. Figure 4.1-12 shows the monthly time series of WCI since 2014 relative to its historical maximum and minimum by month. Wet, normal, potential shortage, and shortage thresholds are defined for the WCI to aide State decision makers in issuing water restrictions during drought conditions. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

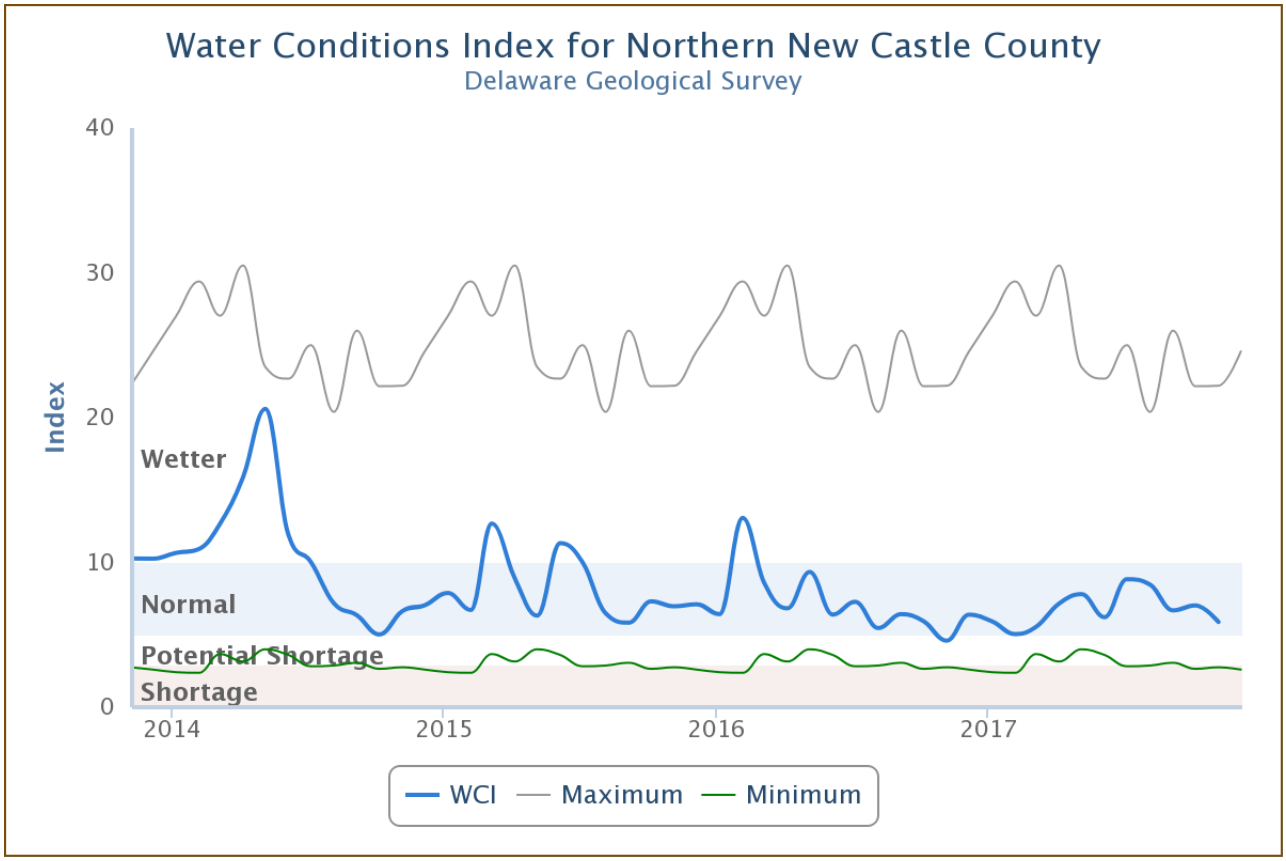


Figure 4.1-12. *Delaware Water Conditions Index since 2014.*

The U.S. Drought Monitor (USDM) summary map is produced weekly through a joint effort between the U.S. Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA), and the National Drought Mitigation Center (NDMC). The maps are used to identify general drought areas and label droughts by intensity, with D1 being the least intense and D4 being the most intense. Figure 4.1-13 provides historical Drought Monitor assessments for Delaware since 2000. Note the extent and duration of the drought in 2002, which is largely considered the worst drought in modern history in Delaware. This drought began in December of 2001 and did not relinquish for nearly one year, peaking in August 2002, with 100% of the state in D3 (extreme drought) or higher. From the NCEI Storm Events Database, the September 2002 drought report read:

"Delaware entered September with continuing drought conditions. Many daily, monthly and all time record low levels for streamflow and groundwater levels were being set and an outdoor burning ban was in effect. Lawn and garden businesses were suffering as homeowners held off on landscape designs and the grass became dormant. Landscapers were given temporary certificates of occupancy for limited watering of new landscaping. Shallow wells were going dry in Sussex County including older developments in Lewes and Rehoboth Beach. Governor Ruth Ann Minner's declared state of drought emergency for New Castle County north of the Chesapeake and Delaware Canal remained in effect. The drought emergency imposed mandatory restrictions in northern New Castle County. The governor also asked downstate residents to voluntarily reduce their water use. Heavy rain, especially in Sussex County, on September 1st initiated the return of normal precipitation. The heavy rain on the 1st permitted Wilmington to pump water from the Brandywine Creek back into the Hoopes Reservoir for emergency storage. The return of rain permitted the state to lift all environmental and general burning bans as of the 6th. The rain came too late to help most crops with the exception of late planted soybeans. Governor Ruth Ann Minner requested the U.S. Department of Agriculture Secretary Ann Venneman declare a crop disaster in Delaware. About eighty-five percent of farmers have losses of greater than 30 percent. Corn, soybeans, lima beans, snap beans and hay all sustained serious damage. It was expected to be the worst statewide vegetable harvest in 15 years. The mid month crop report showed that nearly 70 percent of the corn, sorghum range and pastures were either in poor or very poor condition. About half of the soybean crop was also in poor or very poor condition."

Damage totals from the Drought of 2002 are unknown, though between crop losses and effects on business in terms of lost revenue, it is estimated to be well into the millions. Other notable droughts identified by the USDM for Delaware include 2007-2008 and 2012.

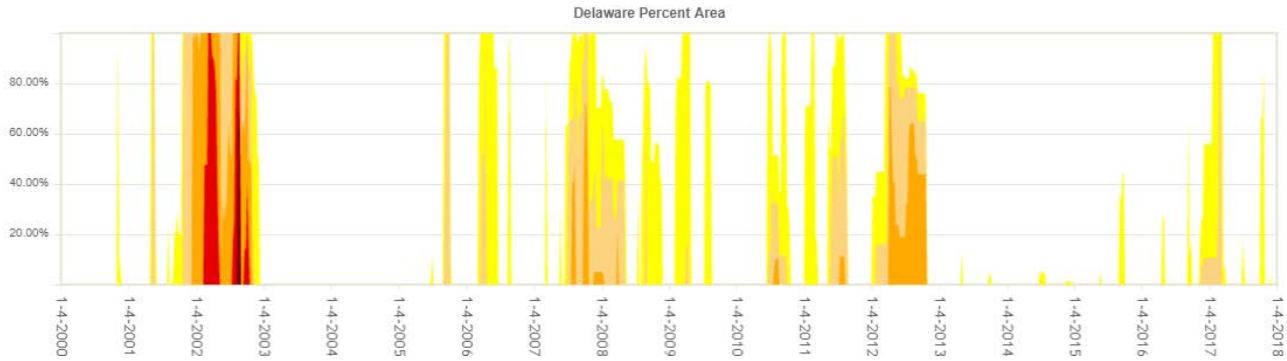


Figure 4.1-13. *U.S. Drought Monitor index values (D0-D4) since 2000. The Y-axis shows the percent area of Delaware covered by each drought category, while the X-axis displays the date/timeframe of the drought period.*

Effects of Climate Change on Drought

National Centers' for Environmental Information state climate summary for Delaware projects significant potential warming during the 21st century as a result of climate change. Figure 4.1-15 shows the projected change in average temperature for Delaware under two greenhouse gas (GHG) scenarios. The projected change in average temperature ranges from 3 °F in the lowest GHG emissions scenario to 13 °F in the highest GHG emissions scenario.[5] This increase in the overall temperature regime for Delaware would result in increasing frequency and severity of drought events and excessive heat, which would only exacerbate the impacts of these hazards on Delaware's economy and population.

Wildfire

A wildfire is any fire occurring in a wild land area (i.e., grassland, forest, brush land) except for fire under prescription.[1] Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

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

On Sunday, August 6, 2000, several forest fires converged near Sula, Montana, forming a firestorm that overran 100,000 acres and destroyed 10 homes. Temperatures in the flame front were estimated at more than 800 degrees. Note the elk, gathering near the East Fork of the Bitterroot River. (Photo by John McColgan/USFS

[1] Prescription burning, or a "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.

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

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

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

Wildfire in Delaware

According to the Delaware Fire Service, the greatest wildfire danger is in those marshes along the Delaware Bay that contain large expanses of the giant reed grass phragmites (Fig 4.1-14). One such example is the 1,400-acre fire that occurred at Prime Hook National Wildlife Refuge in 2002. Otherwise, the climate, forest types and terrain (flat, interspersed with cropland, ditches, roads, etc.) in Delaware generally do not promote large wildfires. Most of the wildfires within the State are small, surface fires that

are fairly easily extinguished and seldom do much environmental damage (Delaware Forest Service). However, there is one other area where extreme fire behavior can occur and that is in young loblolly pine plantations that grow throughout the state, five to fifteen years of age. During this period of growth in the plantation, tree crowns touch one another and natural lower limb pruning has not yet occurred. A surface fire in such an area can easily turn into an intense crown fire. With high temperatures and low relative humidity, wildfire in a young pine plantation has the capacity to become plume-dominated. If this occurs, the fire will develop an immense convection column capable of producing its own weather system. Such was the case with the Cross Keys Fire near Millsboro in the spring of 2005 that burned 168 acres and nearly entrapped several volunteer firefighters. While wildfires are not a common occurrence in Delaware, a changing climate may increase the risk of future incidences.

Impacts of Wildfires can be expected to cause severe to extensive localized damage depending on the extent of the fire and the duration. Impacts could be serious for local responders working within the impacted area and could result in the disruption of services and the need for evacuations.

Figure 4.1-14. *Delaware Wildfire Hazard Potential Map (Source: US Forest Service)*

Earthquakes, Landslides and Sinkholes

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

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

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (see Table 4.1-10). Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with a I corresponding to imperceptible events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in Table 4.1-11.

***Table 4.1-10**. Richter Scale of Earthquake Intensity. Source: United States Geological Survey*

Richter Magnitudes	Description	Mercalli Intensity
Less than 2.0	Micro	I
2.0 - 2.9	Minor	I to II
3.0 - 3.9		III to IV
4.0 - 4.9	Light	IV to VI
5.0 - 5.9	Moderate	VI to VII
6.0 - 6.9	Strong	VIII to X
7.0 - 7.9	Major	X or greater
8.0 – 8.9	Great	
9.0 or greater		

Table 4.1-11. *Modified Mercalli Intensity Scale for Earthquakes Source: United States Geological Survey*

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

Earthquakes in Delaware

According to the Delaware Geological Survey, 59 earthquakes have been recorded in the State of Delaware during a period from 1871 through 1985. The largest measured earthquake in Delaware was the Dover earthquake of November 30, 2017, which was measured as 4.1 on the Richter scale. The earthquake of October 9, 1871 was the previous strongest earthquake of record, reported to have had an intensity of VI to VII on the Modified Mercalli Intensity (MMI) scale in New Castle County; this event is estimated as 4.1 on the Richter scale. The lower end of the spectrum for Delaware consists of several earthquakes classified as I to II on the MMI scale, for instance the M1.7 earthquake documented in Newark in New Castle County on August 13, 2003. No damage estimates are currently available for these events, see table below 4.1-13.

Future Conditions for Earthquakes

Future conditions for earthquakes are difficult to predict, as these are extremely rare in Delaware and have yet to cause any significant damage in past events. At this time, there is no physical process that suggests earthquakes in Delaware will be more or less frequent or more severe.

Table 4.1-12, *lists all recorded earthquakes for the period 1638 through 2017 along with their intensity and magnitude at the epicenter. For some events, the intensity appears as a range due to variations in distances across the impacted areas.*

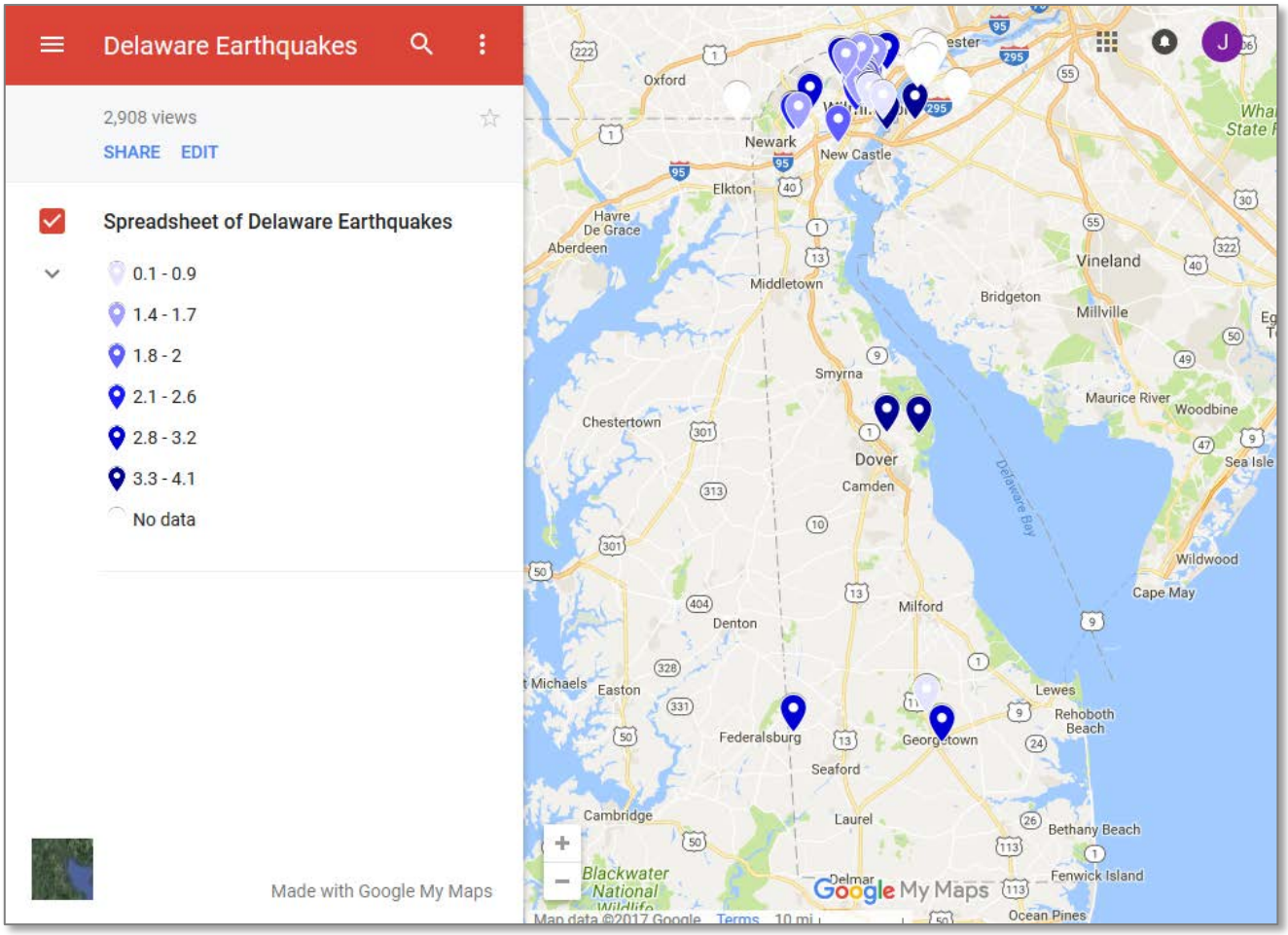


Table 4.1-13. *Recorded Earthquakes in the State of Delaware (1871-2018). Source: Delaware Geological Survey*

Date of Occurrence	Location(s) Reported to Have Been Affected/ Probable Epicenter	Notes	Magnitude (If Known)	Intensity (If Known)
October 9, 1871	Wilmington		4.1	VII
March 26, 1879	Dover (Kent County)		3.3	V
May 8, 1906	Seaford		3.0	IV
December 3, 1937	Georgetown		2.8	IV
July 14,1971	Southwest Wilmington		2.4	III-IV
January 8, 1944	Wilmington		3.2	V
December 29, 1971	Southwest Wilmington		2.6	IV-V
January 2, 1972	Southwest Wilmington		2.4	III-IV
January 3, 1972	Southwest Wilmington		2.4	III-IV
January 7, 1972	Southwest Wilmington		2.4	III-IV
January 22, 1972	Southwest Wilmington		2.4	III-IV
January 23, 1972	Southwest Wilmington		2.4	III-IV
January 23, 1972	Southwest Wilmington		2.4	III-IV
February 11, 1972	East-North-East Newark		3.2	V
February 11, 1972	Southwest Wilmington		2.9	III
August 14, 1972	Southwest Wilmington		2.4	III-IV
August 14, 1972	Southwest Wilmington		2.4	III-IV
November 26, 1972	Southwest Wilmington		2.4	III-IV
November 26, 1972	Southwest Wilmington		2.4	III-IV
February 28, 1973	Tri-State Area		3.8	V-VI
March 1, 1973		Aftershock		I
March 2, 1973	Claymont Area	Aftershock		I
March 2, 1973	Claymont Area	Aftershock		I
March 3, 1973	Claymont Area	Aftershock		I
March 3, 1973	Claymont Area	Aftershock		I
March 3, 1973	Claymont Area	Aftershock		I
March 4, 1973		Aftershock		I
July 10, 1973	Wilmington, Claymont		2.6	IV
April 28, 1974	Wilmington		2.5	V
February 10, 1977	Wilmington		2.6	V
June 5, 1977	Near Georgetown		0.1	
August 8, 1977	Near Georgetown		1.3	
February 25, 1980	Wilmington		1.0	I
November 17, 1983	Trolley Square, Wilmington		2.9	V
November 17, 1983	Trolley Square, Wilmington	Aftershock	2.0	
December 12, 1983	Northwest Wilmington		2.4	III-V
December 12, 1983		Possible aftershock	1.7	

January 19, 1984	Wilmington		2.5	IV
January 20, 1984	Wilmington		1.8	I-II
February 15, 1984	North Wilmington		1.5	I-II
October 11, 1985	North Wilmington		1.9	III-IV
October 20, 1985	Wilmington		1.7	III-IV
November 8, 1993	Wilmington		1.7	I-II
February 11, 1994	Wilmington		1.9	I
April 23, 1994	Wilmington		2.0	I-II
October 17, 1995	Wilmington		2.0	II
October 17, 1995	Wilmington		2.0	II-iii
December 20,1995	Wilmington		1.4	I-II
June 14, 1996	Wilmington		2.1	II-III
June 23, 1996	Wilmington		1.7	I-II
January 29, 1997	Wilmington		1.4	II
April 15, 1997	Wilmington		1.6	III-IV
March 15,1998	Wilmington		1.8	III
March 19,1998	Wilmington		1.7	III
March 19,1998	Wilmington		0.1	I-II
October 27, 1998	Near Montchanin		1.5	II
August 13, 2003	Near Newark		1.7	II
April 10, 2005	North Wilmington	Near Foulk and Naamans Road	1.2	I-II
November 30, 2017	Near Dover		4.1	

Landslides

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

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

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the

effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly.

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

In the United States, it is estimated that landslides cause up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year. However, in Delaware, no known landslide incident on any scale has caused damage to any property, though small landslides have been known to occur.

Sinkholes

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

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

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

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

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

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

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

Sinkholes were not known to exist in Delaware prior to 1978. Six have been found in Hockessin Valley since early 1978. Three developed during periods of above average precipitation in the spring of 1978 and in the fall to early winter of 1979. Limited evidence suggests that the other three sinkholes also formed during those weather conditions and time periods. Several other closed, topographic depressions in the Hockessin Valley have been identified as probable sinkholes.

Predicting where or when solution and collapse will occur is extremely difficult because of the complex subsurface drainage system and associated ground-water movement in the marble portion of the Hockessin Valley.

Low Risk Probability and Future Conditions for Landslides and Sinkholes

Sinkholes and landslides were not analyzed in more detail due to extremely low probability of loss of life or large property damage within the State of Delaware. Given this lack of predictability and infrequent occurrence in the past, it is currently impossible to predict whether landslides or sinkholes will become more or less common in Delaware in the future. Delaware has had no adverse effects (damages) ever documented that were due to a tsunami. Due to the relatively low probability of significant impacts, no further analysis or vulnerability assessment will be conducted for these hazards at this time.

Tsunamis

The word tsunami is Japanese and means "harbor wave." A tsunami is a series of great waves that are created by undersea disturbances such as earthquakes or volcanic eruptions. From the area of disturbance, tsunami waves will travel outward in all directions. Tsunamis can originate hundreds or even thousands of miles away from coastal areas and cause catastrophic damages and loss of life. Other impacts could include complete loss of infrastructure, particularly roads near coastal areas, sudden evacuations, assuming a tsunami warning is issued ahead of time, and extensive emergency response in the aftermath of a tsunami.

The time between wave crests may be five to 90 minutes and the open ocean wave speed may average 450 miles per hour. As tsunami waves approach shallow coastal waters, they appear normal size and the speed decreases until the waves near the shoreline, where they may grow to great height and crash into the shore. Rapid changes in the ocean water level may indicate that a tsunami is approaching. Most deaths during a tsunami are the result of drowning. Associated risks include flooding, polluted water supplies, and damaged gas lines.

According to the NOAA National Geophysical Data Center Global Historical Tsunami Database, there have been 2610 documented tsunami source events between 2000 BCE and present, (https://www.ngdc.noaa.gov/hazard/tsu_db.shtml), although not all of which resulted in measured wave run-up events, Fig 4.1-15. Of those that have affected the United States, approximately 12 tsunamis resulted in fatalities and 6 resulted in damages in excess of $1million. The deadliest tsunami in United States history struck Grand Isle, Louisiana, on November 19, 1867, killing 300 people. The deadliest tsunami in history worldwide was the Indian Ocean Tsunami that struck Indonesia on December 26, 2004, resulting from a 9.1 magnitude earthquake, ultimately killing approximately 230,000 people.

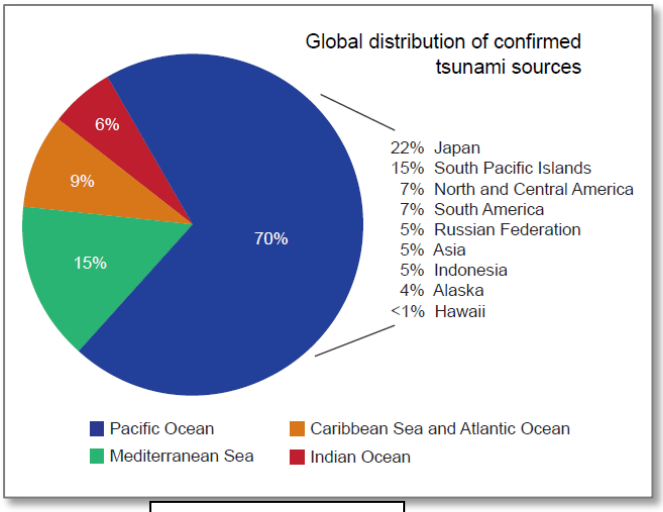


Figure 4.1-15.

In the United States, tsunamis have historically affected the West Coast, though historical evidence does show that tsunamis have affected the Eastern United States, including Delaware. Forty tsunamis and tsunami-like waves have been documented in the Eastern United States since 1600.

There has been a relatively low frequency of tsunamis in the Atlantic Ocean compared to the Pacific Ocean. The most famous Atlantic tsunami is the 1755 Lisbon tsunami that was generated by an earthquake on a fault offshore Portugal. The most noteworthy North America local tsunami is the 1929 M=7.3 Grand Banks earthquake near Newfoundland, Canada. This is a complex event; most, if not all, of the tsunami energy may have been triggered by landslide on the ocean floor. The maximum tsunami run-up from this event was 2-7 meters concentrated on the coast of Newfoundland, though it was recorded as far south as South Carolina. Like the Gulf Coast, there a couple of reports of small tsunamis from Caribbean earthquakes, all less than 1 meter.

However, the US National Tsunami Hazard Mitigation Program (NTHMP) has recently increased support for tsunami modelling for the US East Coast. Hazard risk is difficult on the US East Coast in part due to the lack of historical tsunami records and the uncertainty regarding the magnitude and return periods of potential large-scale events. Modeling that focused on the region surrounding Ocean City, MD included several populated coastal communities such as Lewes, DE, Rehoboth Beach, DE, Bethany Beach, DE, Ocean City, MD and Chincoteague, VA. The sources of the simulated tsunamis included earthquakes in the Puerto Rico Trench (M = 9.0 event) and in the Azores Convergence Zone (M = 8.6-9.0), the flank collapse of the Cumbre Vieja volcano (CVV), and several local (i.e., nearby to Ocean City region) submarine mass failures (SMF) landslides off the slope of the continental shelf. Due to the lack of historical data, it is not possible to predict what impacts climate change could have on tsunami risk in Delaware.

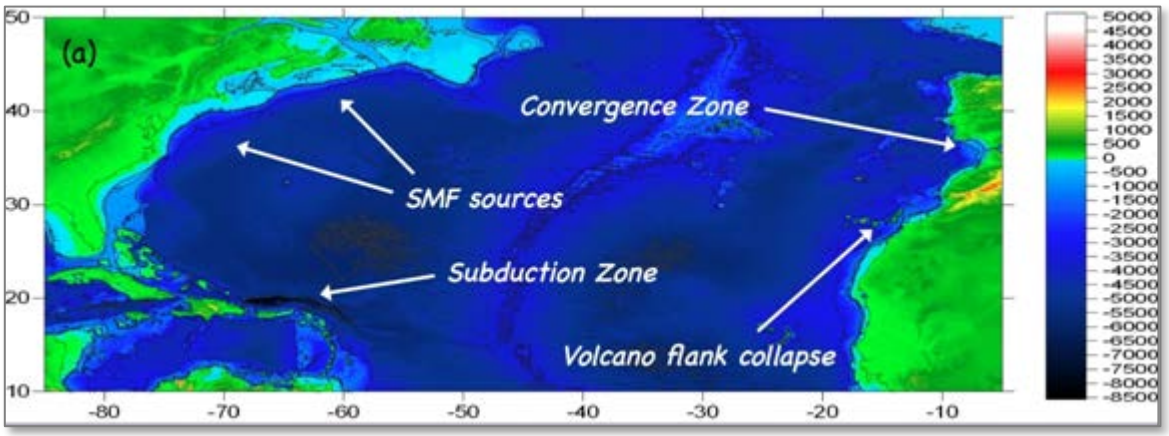


***Figure 4.1-16**. Map of potential Atlantic tsunami inducing areas.*

For each tsunami simulation resulting from these sources, the analysis mapped the furthest extent the tsunami would reach. The tsunami inundation line for each event was then combined to produce a worst case scenario that summarizes all events. The inundation line represents the maximum tsunami run up extent utilizing a number of extreme, yet scientifically realistic, tsunami sources. The map does not provide any further information about the return periods of the source events modelled.

Future Conditions for Tsunamis

Delaware has had no adverse effects (damages) ever documented that were due to a tsunami. Due to the relatively low probability of a tsunami significantly impacting the State of Delaware, no further analysis or vulnerability assessment will be conducted for this hazard at this time.

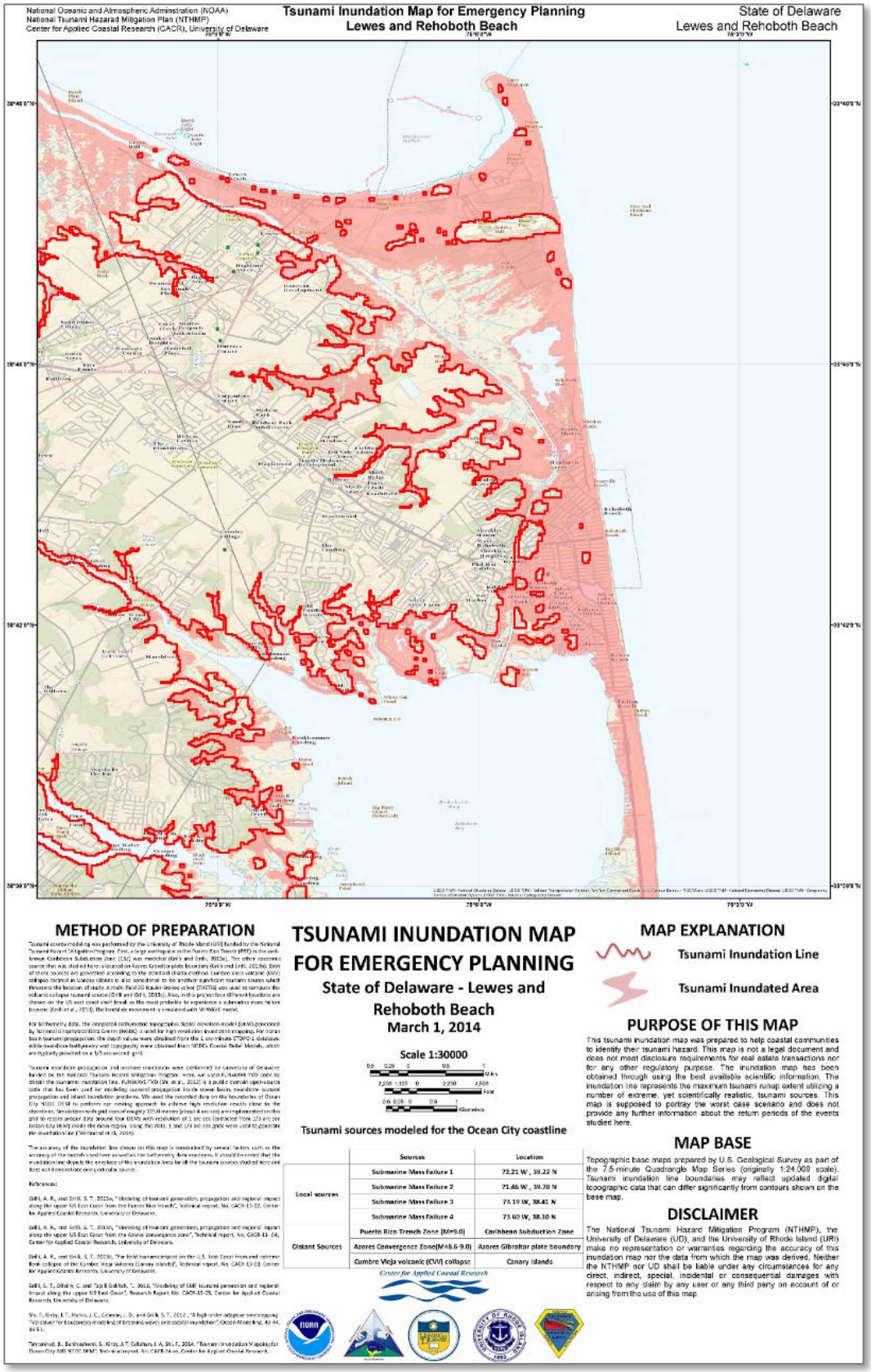


Figure 4.1-17*. Tsunami Inundation Map (DRAFT obtained from* https://www1.udel.edu/kirby/nthmp.html)

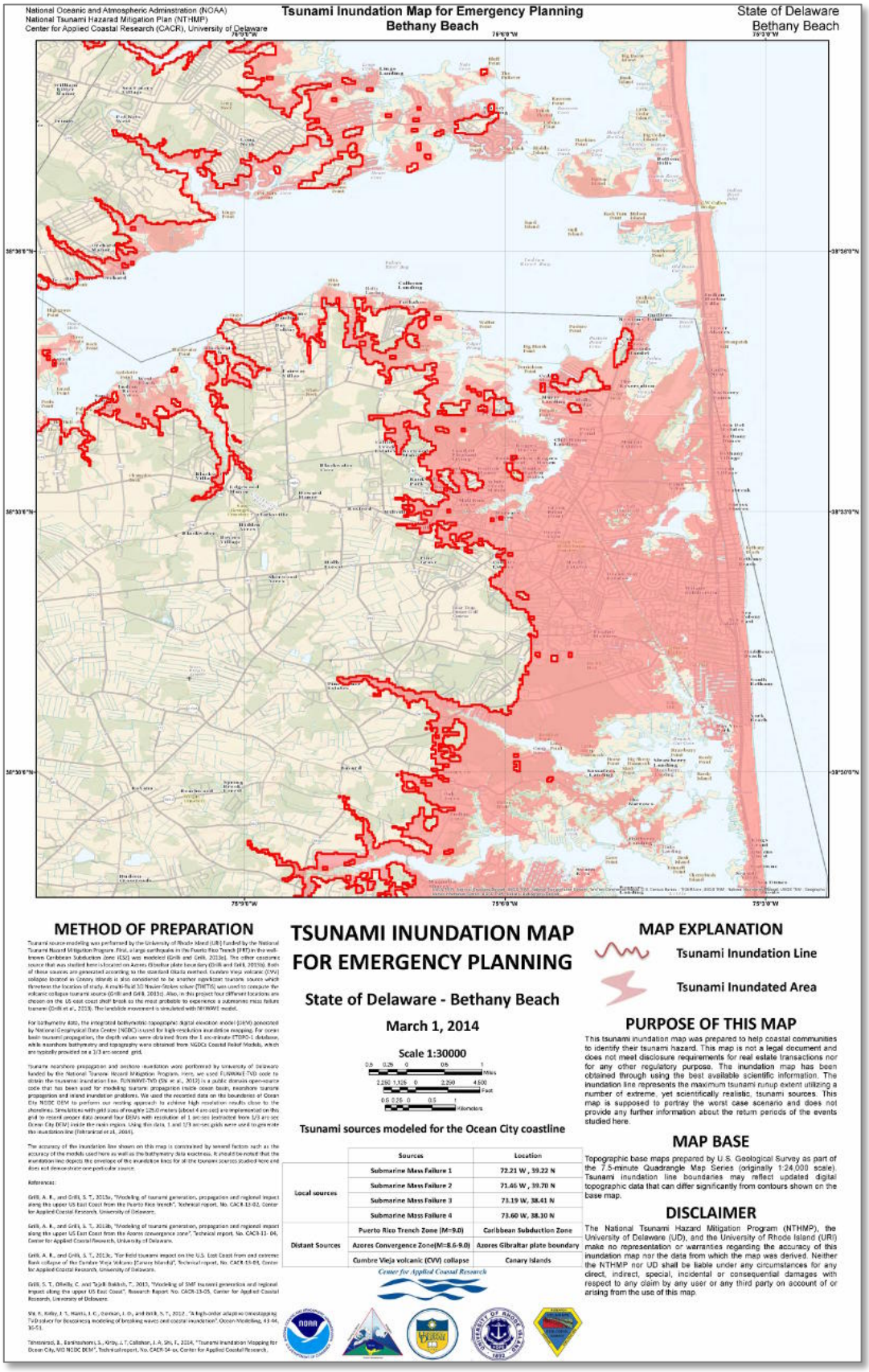


***Figure 4.1-18**. Tsunami Inundation Map (DRAFT obtained from* https://www1.udel.edu/kirby/nthmp.html)

Public Health Incidents

Animal/Crop/Plant Disease

An outbreak of disease that can be transmitted from animal to animal or plant to plant represents an animal/crop/plant disease. The disease outbreak will likely have a significant economic implication or public health impact. On the other hand, the crop/plant pest infestation will likely have severe economic implications, cause significant crop production losses, or significant environmental damage. The crop/plant pests may also have implications for public health. The introduction of some high consequence diseases may severely limit or eliminate the ability to move, slaughter, and export animals and animal products. The outbreak will have widespread economic and societal implications for the state. Response and recovery to infectious animal disease outbreaks will be lengthy, and many producers may never be able to return to business. There will be many indirect effects on the economy. In Delaware, where the poultry industry is essential to the state's economy, the detection of an infectious disease among poultry (i.e. avian influenza), could cause significant damage to the market.

Crop/plant pest infestations can cause widespread crop/plant loss and severe economic hardship on farmers and landowners and related businesses. Once infestation occurs, the pest may become endemic, causing repeated losses in subsequent growing years. Loss of production will affect all related industries, such as fuel, food, synthetics, processors, etc. Every year the Delaware Department of Agriculture conducts numerous animal disease investigations.

Human Disease Incident

An incident related to human disease is defined as a medical, health, or environmental threat to the general public (such as contamination, epidemics, and vector-borne diseases). Public health action to control infectious diseases in the 21st century is based on the 19th century discovery of microorganisms as the cause of many serious diseases (e.g., cholera and TB). Disease control in a population resulted from improvements in sanitation and hygiene, the discovery of antibiotics, and the implementation of universal childhood vaccination programs. Scientific and technologic advances played a major role in each of these areas and are the foundation for today's disease surveillance systems. The Centers for Disease Control and Prevention (CDC) established a National Notifiable Diseases Surveillance System that enables states and other jurisdictions to share infectious and non-infectious disease-related data. Reporting is mandated by state laws or regulations and should follow uniform reporting criteria (i.e. specific reporting timeframes, confirmatory testing, and clinical information). As of 2017, over eighty (80) infectious diseases were designated as notifiable at the national level. The list of notifiable diseases varies by state, and may include diseases that are reportable only at the state level.

The Delaware Division of Public Health (DPH), http://www.dhss.delaware.gov/dhss/dph/index.html, works to protect Delawareans from infectious disease threats through disease surveillance, investigation of suspect outbreaks, public education, and establishing partnerships with important stakeholders. Additionally, there are programs that guide community-based prevention planning, monitor current infectious disease trends, prevent transmission of infectious diseases, provide early detection and treatment for infected persons, and ensure access to health care for refugees in Delaware. In recent years, although there have been no major incidents of diseases with high percentages of loss of life or severe illness, emerging and re-emerging infectious diseases represent an ongoing threat.

While vaccines are available for many diseases, Delawareans remain vulnerable to other diseases known and unknown. Vaccine-preventable diseases have recently re-emerged as a public health threat, especially to infants and school-age children, due to anti-vaccination movements. This means that diseases that were previously declared as eliminated, such as measles, now represent a public health concern. On the other hand, antimicrobial resistance has been increasing in recent years. Patients that are infected with these resistant bacteria or viruses may have worse health outcomes, life-threatening infections, and increased health care costs. Another public health threat includes high consequence infectious diseases which represent a wide variety of diseases that could significantly impact communities and health care settings, such as diseases with high epidemic or pandemic potential (i.e. novel influenza), high person-to-person transmission rates (i.e. smallpox), or low-incidence and high death rates (i.e. rabies; viral hemorrhagic fevers). Moreover, the alarming increase in opioid abuse and injection drug use poses an increased risk for the transmission of blood-borne pathogens such as Hepatitis C and HIV.

Pandemic Human Disease

A pandemic human disease is defined as a disease that has spread around the world to many people. The word, “pandemic”, means that a disease has caused illness in a person on nearly every continent. Many diseases throughout the history of the world have been pandemic. Examples are HIV/AIDS and Influenza. A pandemic will have widespread economic and societal implications for the state. Response and recovery to a pandemic will likely be lengthy.

From 1900-2000, there were three (3) influenza pandemics, all about 30 years apart. The last influenza pandemic in the United States was in June, 2009, as declared by the World Health Organization (WHO), for the H1N1 virus. Historically pandemics occur approximately every 30 years. Even though the last pandemic occurred less than 10 years ago, the CDC is expressing some concern over the potential for an avian Influenza A H7N9 pandemic among humans. People at high risk for developing flu-related complications are children younger than 5, adults 65 years of age and older, pregnant women, and persons with underlying chronic health conditions. Approximately 20% of Delaware’s population is considered high risk. If a disease is highly contagious, by the time it is discovered, it will likely have already spread across the state or nation. This will put us at a significant disadvantage during the response and recovery.

The CDC developed an evaluation tool to determine the pandemic risk posed by Influenza A viruses that are currently circulating in animal (i.e. swine, birds) and human populations. The assessment is based on characteristics of the virus such as genomic variations, antiviral resistance, transmissibility, disease severity, population immunity, potential spillover to human populations, among others. These determine whether the virus is considered, low, moderate, or high risk to either emerge as a novel human pathogen or impact public health. Based on data available of recent outbreaks, two lineages of the Avian Influenza A H7N9 virus are considered to have moderate to high pandemic risk.

The most recent epidemic among humans associated to H7N9 virus occurred in China between 2016 and 2017. The number of cases in this epidemic exceeded previous years, and the case-fatality rate was 40%. Even though the main mode of transmission is close contact with infected poultry or poultry products, there have been few cases of limited, non-sustained, human-to-human transmission. In general, Influenza A viruses constantly change, which could increase their potential for sustained human-to-human transmission among a susceptible population, and thus create the next pandemic.

Mass Casualties Incident

Mass casualty/fatality incidents are not considered a specific hazard; however, the result of an incident that causes mass casualties /fatalities could become a hazard to the general public and/or emergency responders. The pre-planning for response type activities included in the Delaware Emergency Operations Plan (DEOP) is actually the best mitigation for this type of hazard.

Terrorism

The Federal Emergency Management Agency, in its guidance on integrating human-caused hazards into state and local hazard mitigation plans (FEMA Publication 386-7), has established a set of categories that can be applied to the profiling of intentional acts of terrorism. These categories are: contamination; energy release (i.e., explosives, arson, etc.); and disruption of a service.

Contamination

Contamination, as it relates to terrorist activity, refers to the intentional release of **chemical**, **biological** or **radiological** agents, as well as **nuclear** hazards. Contamination can apply to human and animal life, a geographic area, agriculture/food supplies (as in "**agriterrorism**"), and even the electronic world of computers and information via the Internet and e-mail (as in "**cyberterrorism**.")

According to Jane's Chem-Bio Handbook, **chemical** agents are liquid or aerosol contaminants that can be dispersed using sprayers or other aerosol generators, by liquids vaporizing from puddles or containers, or munitions. Chemical agents may pose viable threats for hours to weeks depending on the agent used and the conditions which exist at the exposed area. This type of hazard is especially volatile as contamination can be carried beyond the initial target zone by persons, vehicles, water and even the wind. Chemicals may also be corrosive or otherwise damaging *over time*, if not dealt with appropriately. **Biological** agents are liquid or solid contaminants that can be dispersed using sprayers or aerosol generators, or by point or line sources such as munitions, covert deposits or moving sprayers. Biological hazards may pose a danger for a period of hours to years, depending on the type of agent used and the conditions in which it exists. Contamination can be spread via water and/or wind, and infection can be spread via humans and/or animals.

Cleanup of hazardous materials and contaminated debris following a terrorist attack can be an arduous 24-hour-a-day operation, as captured in this photo of debris removal from Ground Zero of the 9/11 attack to the Staten Island landfill. (Photo by Andrea Booher/FEMA News Photo)

FEMA's Radiological Emergency Management Course states that **radiological** agents can also be dispersed using sprayers or aerosol generators, or by point or line sources such as munitions, covert deposits and moving sprayers. Radiological contaminants may remain hazardous for seconds to years depending on the material used. The initial effects of a radiological attack are likely to be localized to the site of the attack; however, depending on meteorological conditions, the subsequent behavior of contaminants may become more dynamic. **Nuclear** hazards include the detonation of a nuclear device underground, on the Earth's surface, in the air, or at a high altitude. Heat flashes and blast waves resulting from a detonation would last for seconds, however nuclear radiation and fallout hazards can continue on for years. In addition, an electromagnetic pulse, resulting from a high-altitude detonation and lasting for a few seconds, can affect unprotected electronic systems. The initial light, heat and blast effects of a subsurface, ground or air burst are static and are determined by the device's characteristics. The fallout of radioactive contaminants may be dynamic depending on meteorological conditions.

Energy Release

Energy release refers primarily to the use of explosive devices, such as conventional bombs, and incendiary operations such as arson attacks. The detonation of an explosive device whether on or near a target has an instantaneous effect, which can be compounded and/or prolonged by the use of multiple devices. The extent of damage caused by an explosion is, of course, determined by the type and quantity of explosive used. It should be noted that explosive incidents can result in cascading effects, such as the incremental failure of a structure or system.

Arson and other incendiary attacks refer to the initiation of fire (which can be of an explosive nature) on or near a target. This type of event can last for minutes or hours, and possibly longer depending on the type and quantity of device or accelerant used and the materials (fuels) present at the location of the attack. This type of attack can also result in cascading failures of structures or systems.

National Terrorism Advisory System

The Department of Homeland Security created the National Terrorism Advisory System, or NTAS, to replace the color-coded Homeland Security Advisory System (HSAS). This new system will more effectively communicate information about terrorist threats by providing timely, detailed information to the public, government agencies, first responders, airports and other transportation hubs, and the private sector.

It recognizes that Americans all share responsibility for the nation's security, and should always be aware of the heightened risk of terrorist attack in the United States and what they should do. The new system includes two types of alerts:

- Imminent Threat Alert*:* Warns of a credible, specific, and impending terrorist threat against the United States.
- Elevated Threat Alert*:* Warns of a credible terrorist threat against the United States.

Radiological Terrorism

The malicious use of a radiological device; and attacks on nuclear facilities, such as nuclear power plants are the two types of radiological terrorism. Both types have certain features in common, such as attempting to cause radioactive contamination and playing off public fear of radiation. The consequences of both types of attack could also have similarities, such as slightly elevated health risks or massive economic costs.

Both active and passive terrorist options can be employed in the use of radiological materials to cause fear among the public. The passive option would involve the use of radioactive materials or objects in the form of a radiation-emitting device (RED). A strong RED could be placed in high-profile areas, such as highly trafficked urban sites and government facilities, which could expose a large number of people to the intense radioactive source over a short period of time. An alternative passive option would be the use of an RED to harm a limited number of people over a long period of time. The active option would involve the scattering of radioactive material over a large or confined area using a Radiological Dispersal Device (RDD) and an Improvised Nuclear Device (IND), as described below.

A RDD is not a nuclear bomb and does not result in a nuclear explosion. Rather, an RDD is a device that contains radioactive materials and some method by which those materials can be spread over a wide area. The device can be built in a variety of sizes, and the radiation can cause physical and environmental contamination, economic damage, and some physical harm. An explosive device that is used to scatter radioactive material (dirty bomb) is a good example.

An Improvised Nuclear Device (IND) is a type of nuclear weapon. When an IND explodes, it gives off four types of energy: a blast wave, intense light, heat, and radiation. When an IND explodes, a large fireball is created. Everything inside of this fireball vaporizes and is carried upward. This creates a mushroom-shaped cloud. The material in the cloud cools into dust-like particles and drops back to the earth as fallout. Fallout can be carried by the wind and can end up miles from the site of the explosion. Fallout is radioactive and can contaminate anything it lands on.

An IND would cause great destruction, death, and injury and have a wide area of impact. People close to the blast site could experience:

- Injury or death (from the blast wave)
- Moderate to severe burns (from heat and fires)
- Blindness (from the intense light)
- Radiation sickness, also known as acute radiation syndrome or ARS (caused by the radiation released)

People farther away from the blast, but in the path of fallout, could experience health effects from:

- Fallout on the outside of the body or clothes (external contamination) or on the inside of the body (internal contamination)
- Radiation sickness
- Contaminated food and water sources

Terrorists may also opt to attack a nuclear facility. Nuclear facilities include nuclear power plants, cooling ponds for spent nuclear fuel rods, nuclear reactors used for research or other non-electricity purposes, nuclear reprocessing facilities, and nuclear waste sites. Another potential scenario for attack is during the transport of spent nuclear fuel. Among these options, this document will focus on threats to operational nuclear power plants.

Electromagnetic Pulse (EMP)

An electromagnetic pulse is a short burst of electromagnetic energy that may be the result of lighting, switching, solar magnetic disturbance, non-nuclear electromagnetic weapons or nuclear weapons. The effects may cause the failure of electricity and communications and require recovery prolonged efforts. Preparations are similar to other losses of power and communication and may include training, research and trial and error to implement proper measures to manage emergencies and protect equipment. Recovery may take months or more if a large area of the country is affected.

Utilities and the Electric Power Research Institute may consult and participate in drills to train state, local government and private organizations to minimize the effects to Delaware. A high altitude detonation of a large nuclear weapon can generate a large electromagnetic pulse that can affect a more than half the country. Damage can result to power distribution and electronic infrastructure.[1]

Conventional Terrorism

Use of conventional weapons and explosives against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom is conventional terrorism. Hazard effects are instantaneous; additional secondary devices may be used, lengthening the time duration of the hazard until the attack site is determined to be clear. The extent of damage is determined by the type and quantity of explosive. Effects are generally static other than cascading consequences, incremental structural failures, etc. Conventional terrorism can also include tactical assault or sniping from remote locations.

Delaware has not been immune to acts of terrorism or sabotage. For example, the state has experienced many bomb threats, in the distant and recent past, especially in schools and abortion clinics. Unfortunately, there will never be a way to totally eliminate all types of these clandestine activities. If person or persons are inclined to cause death and destruction, they are usually capable of finding a way to carry out their plans. As perpetrators of terrorism improve their ability to collect information, raise money, and issue rhetoric, implementation of effective counter measures becomes even more important.

Biological Terrorism

Use of biological agents against persons or property for purposes of intimidation, coercion or ransom can be described as biological terrorism. Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point of line sources such as munitions, covert deposits and moving sprayers. Biological agents may pose viable threats from hours to years depending upon the agent and the conditions in which it exists. Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. Infections can be spread via human or animal vectors.

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[1] Electric Power Research Institute, Electromagnetic Pulse (EMP) and the Power Grid (August 2013), retrieved on January 2, 2018 from https://www.epri.com/#/pages/product/3002001936/

Delaware has not been immune to acts of terrorism or sabotage. The state has experienced many threats in the past. Most incidents have been limited to reported "suspect" powders, actual threats, and hoaxes. Beginning in October 2001, following the original "Anthrax" scares, Delaware experienced a large number of responses for suspicious powders. Following the development of a threat assessment / response protocol the number of responses was reduced; and now averages a few responses each month.

Agricultural Terrorism

Causing intentional harm to an agricultural product or vandalism of an agricultural/animal related facility is **agroterrorism**. Activities could include the following examples: animal rights activists who release mink or lab animals; disgruntled employees who intentionally contaminate bulk milk tanks or poison animals; ecoterrorists who destroy crops/facilities; theft of agricultural products, machinery, or chemicals; or criminals who vandalize agricultural facilities. Delaware is home to several research laboratories that use animals in the course of their product development.

This category covers a large variety of incidents from potential to intentional introduction of disease; vandalism of facilities; theft of agricultural products, machinery, or chemicals; release of animals; and contamination of agricultural products. Depending upon the type of action taken, the implications will vary greatly.

Over the past 10 years Delaware has experienced a small number of incidents in which animal rights activists have vandalized or released animals in our agricultural facilities. Additionally, there has been or vandalism to agricultural facilities incidents of disgruntled employees causing damage to animals and animal products. There are frequent cases of theft of agricultural machinery, products, and chemicals.

Chemical Terrorism

Chemical terrorism involves the use or threat of chemical agents against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion or ransom. Liquid/aerosol or dry contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/containers; or munitions. Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists. Contamination can be carried out of the initial target area by persons, vehicles, water and wind. Chemicals may be corrosive or otherwise damaging over time if not mitigated.

Cyber Terrorism

Electronic attack using one computer system against another in order to intimidate people or disrupt other systems is a cyber attack. Cyber terrorism may last from minutes to days depending upon the type of intrusion, disruption, or infection. Generally, there are no direct effects on the built environment, but secondary effects may be felt depending upon the system being terrorized. Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks.

Cyber-security and critical infrastructure protection are among the most important national security issues facing our country today, and they will only become more challenging in the years to come. Recent attacks on our infrastructure components have taught us that security has been a relatively low priority in the development of computer software and internet systems. These attacks have not only disrupted electronic commerce, but have also had a debilitating effect on public confidence in the internet. Security experts describe the threat as "eminent." Intrusion detection systems log thousands of attempts in a single month; there are constant probes by individuals and groups with intent to cause anything from total system shutdown to simply "seeing if they can do it".

According to the National Strategy for Homeland Security, terrorists may seek to cause widespread disruption and damage, including casualties, by attacking electronic and computer networks which are linked to critical

infrastructures such as energy, financial and securities networks. In addition, terrorist groups are known to exploit information technology and the Internet to plan attacks, raise funds, circulate propaganda, gather information and communicate. In terms of hazard mitigation, cyberterrorism is often explored as a component in business continuity planning.

Disruption of Service

Disruption of service refers to the interruption, failure or denial of a service due to terrorist attack, such as the sabotage or designed breakdown of infrastructure as with an attack on transportation facilities, utilities and other public services. While the Federal Bureau of Investigation found no evidence of terrorism or criminal activity in its investigation of the August 2003 blackout in the Northeast United States, and the paralyzing blackout in London, England the same month has been labeled a "freak event," it is clear to see the potential damage and disruption that could be caused by an intentional terrorist attack on a nation's power grids.

Weapons of Mass Destruction

The term "Weapons of Mass Destruction" (WMD) has various definitions, however common to all is the assumption that WMDs may consist of any of the agents discussed above: chemical, biological, radiological, nuclear, explosive or incendiary. The purpose of a WMD is to cause death or serious injury to persons or significant damage to property, typically assumed to be of a scale which has the potential to overwhelm the capabilities of many local and state governments.

Terrorism in Delaware

Because of the relevantly recent, or heightened, focus being placed on managing terrorism and consequences of terrorism in the United States, no historical database is currently available for cataloging acts of terrorism involving chemical, radiological or biological agents. However, at the time of this plan's development, no significant historical occurrences of terrorism were known to have taken place within the State of Delaware planning area.

The **Delaware Information and Analysis Center** (DIAC) is Delaware's fusion center. Formed in 2005, the DIAC's all hazards approach is committed to the detection, prevention, investigation and response to criminal and terrorist activity through a variety of resources including: **Analytical Section** - The DIAC Analysts are available to provide support to all law enforcement agencies throughout the country. Analysts are highly trained in criminal and terrorism-related analysis, as well as other hazards. **Critical Infrastructure Unit** - The unit functions as a liaison between the DIAC, the Department of Homeland Security, and critical infrastructure owners/operators throughout the state. The unit is responsible for identifying, cataloging, and performing vulnerability assessments, for critical infrastructure sites throughout Delaware. **Delaware State Police Maritime Unit** - The unit's mission is dedicated to homeland security, focusing on critical infrastructure located along Delaware's waterways and the investigation of suspicious activity, while ensuring the safety and protection of the maritime industry and the citizens of Delaware. DIAC Website (www.dediac.org) - The DIAC is able to achieve its core mission of combating terrorism and major crime through the cooperative efforts of law enforcement agencies and private sector partners through its website. The DIAC website is a secure communication tool allowing members from law enforcement, public safety, government, and the private sector to receive and exchange information.

In order to give some perspective to these findings, the final scores for each element in **Table G-2** were compared to the maximum score defined in FEMA Publication 426. This comparison shows hospitals, military facilities and day care centers to have the three highest rankings compared to all other elements. These three elements are the focal point of the chemical and radiological agents sections.

Chemical Agents

In planning for the possible release of a chemical agent as an act of terrorism, the three counties within the state of Delaware together identified 12 hospitals and 286 day care facilities throughout their counties as potential targets. **Figures G-1** illustrates the location of hospitals in the state and **Figures G-2** through **G-4** illustrate the locations of the day care facilities in each of the counties. In order to create a more complete assessment of the damage that would be inflicted should such an attack occur, each county also determined the surrounding population and building stock within both an 8-mile radius of the target (the "Immediate

Response Zone") and a 20-mile radius (the "Protective Action Zone"). This approach is believed to more accurately represent the overall exposure of the county and its communities to the threat of a chemical agent. **Tables G-3** and **G-4** offer the results of this analysis. In order to keep this planning document brief, only the highest ranking day care facilities in terms of affected population are included in **Table G-4**. Complete information for all 286 facilities is stored in a Microsoft® Excel® file separate from this Plan and is available upon request through the Delaware Emergency Management Agency (DEMA). It is worth noting that the top 186 of these day care facilities are all in New Castle County and all have a potential affected population of greater than 100,000 people within the Immediate Response Zone (8-mile radius from the target).

Radiological Agents

In planning for the possible release of a radiological agent as an act of terrorism, the three counties within the state of Delaware previously identified 16 military facilities throughout their counties as potential targets. **Figures G-5** through **G-7** graphically illustrate the locations of military facilities. In order to create a more complete assessment of the damage that would be inflicted should such an attack occur, each county also determined the surrounding population and building stock within both an 8-mile radius of the target (the "Immediate Response Zone") and a 20-mile radius (the "Protective Action Zone"). This approach is believed to more accurately represent the overall exposure of the county and its communities to the threat of a radiological agent. **Tables G-5** and **G-6** offer the results of this analysis.

Biological Agents

Within the state, the relative risk of each county in terms of the release of a biological agent aids in demonstrating the vulnerability of the State on a statewide basis. The relative risk of New Castle County to Delaware is 90.31 percent; for Kent County 3.41 percent; and for Sussex County 6.28 percent. This is based on a risk formula of "VULNERABILITY x HAZARD x EXPOSURE." Vulnerability in this case is a measure of the speed at which infection will spread among the population. Population was studied based on general occupancy class: residential, commercial, industrial, education, government, agricultural and religious. The hazard component was considered to be a measure of the introduction of the disease among the population. This also was broken down by occupancy class, in this case residential, commercial, industrial, education, government and religious. The exposure was determined using HAZUS-MH data.

Hazardous Materials (HazMat)

Hazardous materials (***HazMat***) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the Nation's highways and on the water. According to the United States Department of Transportation ***HazMat*** Incident Portal, there were 13,168 highway ***HazMat*** incidents in 2012, resulting in 11 fatalities and over $57 million in property damage. In essence, ***HazMat*** incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A ***HazMat*** incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and possibly wildlife as well.

Propane tanks, gasoline, oil and other hazardous materials and debris in Princeville, North Carolina were cleaned up by Environmental Protection Agency crews following Hurricane Floyd in September 1999. The town remained off limits to residents for some time due to health-related concerns. (Photo by Dave Saville/FEMA News Photo)

HazMat incidents can also occur as a result of or in tandem with natural hazard events, such as floods, hurricanes, tornadoes and earthquakes, which in addition to causing incidents can also hinder response efforts.

In the case of Hurricane Floyd in September 1999, communities along the Eastern United States were faced with flooded junkyards, disturbed cemeteries, deceased livestock, floating propane tanks, uncontrolled fertilizer spills and a variety of other environmental pollutants that caused widespread toxicological concern.

Fixed Hazardous Materials Incident

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures, which presents a danger to the public health or safety, during production or handling at a fixed facility. A hazardous substance is one that may cause damage to persons, property, or the environment when released to soil, water, or air. Chemicals are manufactured and used in ever-increasing types and quantities. Each year, over 1,000 new synthetic chemicals are introduced, as many as 500,000 products pose physical or health hazards and can be defined as “hazardous chemicals.”

Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. Hazardous material incidents generally affect a localized area and the proper use of planning and zoning can minimize the area of impact. During 2006 alone, fixed facilities experienced more than 800 incidents according to the Delaware Department of Natural Resources and Environmental Control (DNREC) and the State Fire School (via DFIRS). As of November 2017, there are over 2,200 in Delaware that, because of the volume or toxicity of the materials on site, are designated as Tier II facilities under the Superfund Amendments and Reauthorization Act (SARA).

Despite increasing safeguards, more and more potentially hazardous materials are being used in commercial, agricultural, and domestic activities. This situation is made worse by the density of people and hazardous materials in some parts of the state.

Fixed Radiological Incident

An incident resulting in a release of radiological material at a fixed facility to include power plants, hospitals, laboratories and the like is a fixed radiological incident. Although the term "nuclear accident" has no strict technical definition, it generally refers to events involving the release of significant levels of radiation. Most commercial nuclear facilities in the United States were developed in the mid-1960s and are designed to withstand aircraft attack. Therefore, they should withstand most natural hazards even though they may not have been specifically designed for those forces. Emergency classifications are divided into four (4) categories. Each calls for a certain level of response from plant and government personnel. From least to most severe, the classifications are:

- Unusual Event
- Alert
- Site Area Emergency
- General Emergency

Delaware has no nuclear power plants located within its borders, but the Salem-Hope’s Creek Nuclear Plant, operated by PSEG, is across the Delaware River in New Jersey, and many areas of the state are well within the 10-mile Emergency Planning Zone. Since 1990, the Salem-Hope’s Creek Nuclear Power Plant has had a small number of Unusual Events, two Alerts, and no Site Area Emergencies or General Emergencies.

Transportation Hazardous Materials Incident

Accidental release of a chemical substance or mixture that presents a danger to public health or safety during transportation is a transportation hazardous materials incident. A hazardous substance is one that may cause damage to person(s), property, or the environment when released to soil, water, or air. Chemicals are manufactured and used in ever increasing types and quantities, as many as 500,000 products pose physical or health hazards and can be defined as “hazardous chemicals.” Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive and each year over 1,000 new synthetic chemicals are introduced and transported across the county via semi-truck and train. Hazardous materials incidents generally affect a localized area and the use of planning and zoning can minimize the area of impact.

In 2006, forty-eight significant incidents involving the transportation of hazardous materials occurred in Delaware. Large quantities of hazardous materials are transported daily on Delaware streets, highways, interstates, and railways. Roadways are a common site for the release of hazardous materials, as are railways. The Delaware Department of Transportation (DelDOT) regulates the routes and speed limits used by carriers, and monitors the types of hazardous materials crossing state lines. Despite increasing safeguards, more and more potentially hazardous materials are being used in commercial, agricultural, and domestic uses and are being transported on Delaware roads and railways.

Radiological incidents related to transportation are described as an incident resulting in a release of radioactive material during transportation. Transportation of radioactive materials through Delaware over the interstate highway system is considered a radiological hazard. The transportation of radioactive material by any means of transport is licensed and regulated by the federal government. When these materials are moved across Delaware highways, state officials are notified and appropriate escorts are provided.

As a rule there are two (2) categories of radioactive materials that are shipped over the interstate highways. Low level waste consists primarily of materials that have been contaminated by low level radioactive substances, but pose no serious threat except through long term exposure. These materials are shipped in sealed drums within placarded trailers. The danger to the public is no more than a wide array of other hazardous materials. High-level waste, usually in the form of spent fuel from nuclear plants, is transported in specially constructed casks that are built to withstand a direct hit from a locomotive. Since 1990, hundreds of shipments have been made through Delaware. There have been no significant occurrences of a radiological incident within the state.

Transportation accidents are the most common type of incident involving radioactive materials because of the sheer number of radioactive shipments. Rail and highway routes for the shipment of radioactive waste have been identified and mapped (I-95 is the only approved route for radiological waste in the state). Operators of facilities that use radioactive materials and transporters of radioactive waste are circumspect in the packaging, handling, and shipment of the radioactive waste and, since they are closely regulated by a variety of federal, state, and local organizations, the likelihood of an incident is remote.

Hazardous Materials in Delaware

Most hazardous materials incidents in Delaware are reported through the local 911 centers. When it is apparent hazardous materials are involved, both the local fire department and DNREC respond to the situation. DNREC responders, through coordination with the fire chief, work to remediate the situation. DNREC tracks these responses; the analysis of those responses is shown later in this section. Based on the size, scope and complexity of the response, the State Emergency Response Team (SERT), which can assist in coordinating information and material, may also be activated to deal with the situation.

Assessing Hazardous Material Incident threats

Assessing vulnerability to a hazardous material (HazMat) release on a statewide scale can consist of a number of factors, such as the type(s) of hazardous material(s) present, the potential for mass casualties, potential consequences for the surrounding area, accessibility, public awareness, and the likelihood of being a terrorist target. There are over 800 fixed HazMat sites in the state of Delaware.

The Accidental Release Prevention (ARP) facilities are a subset of the EPCRA Tier II extremely hazardous facilities. These ARP facilities have the highest potential to affect the people living around them. The facilities on this list (**Table G7**) represent a qualitative assessment of risk from fixed facilities in Delaware based on the chemicals they have and use, which if released would become airborne and pose an inhalation risk.

Hazardous Chemical Inventory (Tier II) Data

Background: Federal and State Emergency Planning and Community Right-to-know Act (EPCRA) laws established a series of reporting requirements for businesses in Delaware. One of the most extensive of these requirements, Annual Hazardous Chemical Inventory reporting, requires businesses with hazardous chemicals on-site above specific quantities to submit reports by March 1 annually. Referred to as “Tier II”

forms, these reports provide the specific identity, general properties and hazards for each chemical substance, as well as detailed information on the amount, container type(s) , storage conditions, and specific location(s) for each at the facility. The reports also provide a series of emergency contacts for the site along with 24-hour phone numbers, pager numbers, etc. Information collected from facilities under these reporting obligations is managed through an on-line web-based system, known as Tier II Manager. Facilities can enter and update their reports on-line. Emergency planning and response organizations access the data on-line as well. Approximately 2,200 businesses report annually on used/stored at their sites in Delaware.

Covered Facilities and Chemicals: Any facility required to maintain a Safety Data Sheet (SDS) for a hazardous chemical present at the facility may be subject to reporting. The substance must be present above threshold levels, and not subject to an exemption. For hazardous chemicals, defined by OSHA as essentially any substance that may present a physical or health hazard (there is no list), the threshold is 55 gallons or 500 pounds on-site at any one time during the year. Based on their properties and hazards, certain specific chemicals have been identified as Extremely Hazardous Substances (EHSs). These substances are identified to receive increased attention from Local Emergency Planning Committees (LEPCs). Some EHSs have thresholds lower than 55 gallons or 500 pounds. While many situations of chemical use and storage are reportable, there are notable exemptions. For example, substances in transportation are not subject to the reporting requirements. Substances used in research labs, hospitals or other medical facilities under the supervision of technical staff are exempt, as well as substances used in routine agricultural operations. One of the more significant exemptions includes substances present in the same form and concentration as a product packaged for use by the general public. If a substance at a facility is packaged in small containers and is essentially the same product a consumer could buy at a retail store, the substance is exempt from reporting regardless of the total amount being used/stored at the facility.

Data Restrictions: The State Emergency Response Commission (SERC) oversees implementation of EPCRA in Delaware. The SERC has established procedures for public access to EPCRA data. While all the data elements reported by facilities (except specific info covered by confidentiality claims) are available for public review on site to comply with the "Community Right-to-know" aspects of EPCRA, certain info, including storage amounts, is not distributed off site or provided in response to FOIAs. The attached data files contain information on storage amounts. **Please avoid listing the chemical storage amounts within the report if it is going to be distributed publicly.**

In summary, the HazMat data clearly establishes a high probability of a HazMat incident in Delaware. However, a thorough review of the data suggests the probability of a significant HazMat incident resulting in severe injuries or fatalities is moderate at best.

Transportation/Infrastructure Incidents

Air Transportation Incident

An air transportation incident may involve a military, commercial, or private aircraft. Air transportation is playing a more prominent role in transportation as a whole; airplanes, helicopters, and other modes of air transportation are used to transport passengers for business and recreation as well as thousands of tons of cargo. A variety of circumstances can result in an air transportation incident; mechanical failure, pilot error, enemy attack, terrorism, weather conditions, and on-board fire can all lead to an incident at or near the airport. Air transportation incidents can occur in remote unpopulated areas, residential areas, or downtown business districts. Incidents involving military, commercial, or private aircraft can also occur while the aircraft is on the ground. Delaware has one commercial airport, one large military airport, 30 privately-owned/public use airports, and 15 heliports. Additionally, northern Delaware is in the approach and departure paths for Philadelphia International Airport.

Any location in Delaware could experience a significant air transportation incident; the most likely scenarios exist near airports. In 2006, a C-5 military transport plane crashed on approach to Dover Air Force Base, injuring 17 people. Numerous smaller planes and helicopters have crashed in every corner of the state, resulting in a handful of fatalities and injuries.

The greater the number of landings and takeoffs, the greater the probability of a crash or an accident. More and more people are utilizing air travel now than in the past; the trend of increasing numbers of people flying is likely to continue as will the crowdedness of airports and the skies above Delaware. The Delaware Air National Guard operates several C-130 cargo aircraft from the New Castle-Wilmington airport as well. The approach and departure paths around the airport take aircraft over densely populated neighborhoods.
The U. S. Air Force flies C-5 and C-17 cargo aircraft out of Dover Air Force Base on a daily basis over neighborhoods in the Dover area.

Despite the increase in the number of people using air travel, incidents that require response personnel and involve casualties are likely to continue to decrease in number due to increases in the quality of training, equipment, and safety. Proper land-use near airports will also decrease the chance that people and property on the ground will suffer significant impacts in the event of an air transportation accident.

Highway Transportation Incident

A highway transportation incident can be single or multi-vehicle requiring responses exceeding normal day-to-day capabilities. An extensive surface transportation network exists in Delaware; local residents, travelers, business, and industry rely on this network on a daily basis. Thousands of trips a day are made on the streets, roads, highways, and interstates in the state; if the designed capacity of the roadway is exceeded, the potential for a major highway incident increases. Weather conditions play a major factor in the ability of traffic to flow safely in and through the state as does the time of day (rush hour) and day of week.

Incidents involving buses and other high-occupancy vehicles could trigger a response that exceeds the normal day-to-day capabilities of response agencies. Interstate 95, which traverses the northern portion of the state, is the primary route between New York City and many points along the east coast of the country, with an average daily traffic volume of 74,000 vehicles. (Source: DelDOT)

Numerous major and minor traffic accidents occur daily in Delaware and result in property damage and injury/death. Major accidents involving multiple vehicles and serious injury are not uncommon. In 2011 alone, there were 20,872 traffic accidents in Delaware, resulting in 7,694 injuries and 103 deaths, according to the Delaware State Police.

Although traffic engineering, inspection of traffic facilities, land use management of adjacent areas to roads and highways, and the readiness of local response agencies has increased, highway incidents continue to occur. As the volume of traffic on Delaware streets, highways, and interstates increase, the number of traffic accidents will increase. The combination of large numbers of people on the road, unpredictable weather conditions, potential mechanical problems, and human error create the potential for a transportation accident.

Railway Transportation Incident

A railway transportation incident is a train accident that directly threatens life and/or property, or adversely impacts a community's capability to provide emergency services. Railway incidents may include derailments, collisions, and highway/rail crossing accidents. Train incidents can result from a variety of causes, including human error, mechanical failure, faulty signals, and/or problems with the track. Results of an incident can range from minor "track hops" to catastrophic hazardous material incidents and even human/animal casualties. With the many miles of track in Delaware, vehicles must cross the railroad tracks at numerous at-grade crossings.

There have been a handful of documented rail incidents in Delaware. These incidents range from minor "rail jumps" to passenger train derailments. According to the Federal Railroad Administration, there were 10,927 railroad accidents/incidents that resulted in 805 fatalities in the U.S. in 2016. There are 629 railroad crossings in Delaware, and along with the hundreds of railroad track miles, the probability of a rail incident is relatively high. Derailments are also possible, while a major derailment would occur less frequently. Amtrak and SEPTA operate passenger and commuter rail services in the state.

Water Transportation Incident

A water transportation incident is an accident involving any water vessel that threatens life and/or adversely affects a community's capability to provide emergency services. Waterway incidents will primarily involve pleasure craft on rivers and lakes. In the event of an incident involving a water vessel, the greatest threat would be drowning, fuel spillage, and/or property damage.

Water rescue events would largely be handled by first responding agencies. Waterway incidents may also include events in which a person, persons, or object falls through the ice on partially frozen bodies of water. There have been no disasters causing waterway incidents in Delaware. There have been numerous search and rescue events involving a single person or small boats with only a few people on board. Small-scale incidents on the state's lakes and rivers have resulted in the loss of life from pleasure craft collisions and/or falls from vessels. The only waterways navigable for commercial purposes in Delaware are the Delaware River and the Chesapeake & Delaware Canal, which links the Delaware River with the Chesapeake Bay. Each summer thousands of Delawareans and visitors take to pleasure crafts across the state. The Delaware River and Bay Authority operates a passenger/vehicle ferry between Lewes, Delaware and Cape May, New Jersey. This service transports hundreds of passengers and vehicles several times each day.

Pipeline Transportation Incident

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near to the pipelines.

Across the nation, hundreds of deaths and many more injuries have been caused by underground pipeline incidents. The vast majority of pipeline incidents that occur are caused by third party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations. With development occurring at an unprecedented rate and the ground becoming more and more congested with utilities, the probability of an underground pipeline incident is significant. Petroleum and natural gas pipeline accidents occur with some regularity, but they usually have a limited impact and are quickly and adequately handled by pipeline company emergency crews and local and state responders. Pipeline operators are required to coordinate all safety preparedness and response activities with the communities. Continuing to plan, train, and exercise emergency procedures helps to limit the occurrence and severity of incidents.

Energy Pipeline Failures

The energy infrastructure of the United States is comprised of many components, including the physical network of pipes for oil and natural gas, electricity transmission lines, and other means for transporting energy to the Nation's consumers. This infrastructure also includes facilities that convert raw natural resources into energy products, as well as the rail network, trucking lines and marine transportation. (U.S. Department of Energy, 2003) Much of this infrastructure is aging, and in addition to the challenges of keeping the infrastructure up-to-date with the latest technological advances and consumer needs, the potential for an energy pipeline failure to become a hazard in-and-of-itself must be considered.

The two million miles of oil pipelines in the United States are the principal mode for transporting oil and petroleum products such as gasoline, and virtually all natural gas in the United States is moved via pipeline as well. (DOE, 2003) Much of this oil pipeline infrastructure is old, requiring regular safety and environmental reviews to ensure its safety and reliability. The potential risk of pipeline accidents is a significant national concern.

Virtually all natural gas in the US is moved via pipeline. (Photo courtesy of the DOE)

The energy infrastructure is vulnerable to physical and cyber disruption, either of which could threaten its integrity and safety. (DOE, 2003) Disruptions could originate with natural events such as geomagnetic storms and earthquakes, or could result from accidents, equipment failures or deliberate interference. In addition, the Nation's transportation and power infrastructures have grown increasingly complex and interdependent — consequently, any disruption could have far-reaching consequences.

Energy Pipeline Failures in Delaware

The State of Delaware Energy Emergency Response Plan (DEERP) was published in December 2003. This plan is being revised and when completed will be included in the Delaware Emergency Operation Plan, Hazard Specific Annex HS-32. The DEERP presents information and regulations that may be enacted by the State if an energy emergency occurs. Succinctly put, the overall purpose of the plan is to provide for timely and coordinated notification to state government, private sector entities, institutions, the media and residents within the state of the occurrence of an energy emergency, and define appropriate actions to be taken— including enactment of regulations, rules, laws and other actions by the state. Aside from this action plan, a detailed history of hazards is not currently available for energy pipeline failures in of Delaware.

Energy pipelines cross most of the State of Delaware. If any of these energy pipelines, oil or gas, were to rupture, such an event could endanger property and lives in the immediate area (within less than half a mile radius). **Figures G-9** through **G-11** show the location of energy pipelines within the state's boundaries in relation to population density and municipalities.

Communication Failures

Communication failure is the widespread breakdown or disruption of normal communication capabilities. This could include major telephone outages, loss of local government radio facilities, long-term interruption of electronic broadcast services, emergency 911, law enforcement, fire, emergency medical services, public works, and emergency warning systems are just a few of the vital services which rely on communication systems to effectively protect citizens. Business and industry rely heavily on various communication media as well. Mechanical failure, traffic accidents, power failure, line severance, and weather can affect communication systems and disrupt service. Disruptions and failures can range from localized and temporary to widespread and long-term. If switching stations are affected, the outage could be more widespread.

No widespread communication failures have occurred in Delaware. Local incidents, resulting from weather conditions, equipment failure, excavation incidents, or traffic accidents have been reported, but the outages were usually resolved in a timely manner. Widespread communication losses are unlikely due to backup systems and redundant system designs. Local communication failures are likely to affect small areas of a county.

Structural Failure

The collapse of part or all of any public or private structure including roads, bridges, towers, and buildings is considered a structural failure. A road, bridge, or building may collapse due to the failure of the structural components or because the structure was overloaded. Natural events such as heavy snow may cause the

roof of a building to collapse. Heavy rains and flooding can undercut and washout a road or bridge. The age of the structure is sometimes independent of the cause of the failure.

Enforcement of building codes can better guarantee that structures are designed to hold-up under normal conditions. Routine inspection of older structures may alert inspectors to "weak" points. The level of damage and severity of the failure is dependent on factors such as the size of the building or bridge, the number of occupants of the building, the time of day, day of week, amount of traffic on the road or bridge, and the type, and amount of products stored in the structure.

There have been several sporadic structural failures across the state. They have included homes, commercial structures, and communications towers. There is no central collection point for this information. Local records will have to support this area. Structures may fail for a variety of reasons. The unprecedented growth in technology has resulted in a host of problems related to complex structures, special materials, and severe operational and environmental loads, such as fire, excessive vibrations, explosion, high-energy piping failures, missiles, and high winds. With the possible exception of misuse, accidental or environmental loads, the causes of failure may be found in deficiencies of design, detailing, material, workmanship, or inspection. With the aging structures in the country along with problems with new materials discussed above, structural failures will continue to occur. Efforts to inspect and maintain these structures will lessen the probability of a failure, but not guarantee that it will not happen in the future. Internal weaknesses can be hidden from inspectors and not be realized until it is too late.

Structural Fire

A structural fire is an uncontrolled fire in populated areas that threatens life and property and is beyond normal day-to-day response capability. Structural fires present a far greater threat to life and property and the potential for much larger economic losses. Modern fire codes and fire suppression requirements in new construction and building renovations, coupled with improved firefighting equipment, training, and techniques lessen the chance and impact of a major urban fire. Most structural fires occur in residential structures, but the occurrence of a fire in a commercial or industrial facility could affect more people and pose a greater threat to those near the fire or fighting the fire because of the volume or type of the material involved.

Structural fires are almost a daily occurrence in some communities. Nearly all are quickly extinguished by on-site personnel or local fire departments. According to the State Fire Marshal's office, there have been 135 deaths and 463 injuries in Delaware from fires between January 1, 2000, and August 23, 2010. In 2011, there were an additional 4 deaths and 46 injuries. Much of the fire prevention efforts have gone into non-residential fires and the results have been highly effective. Even with an increase in the prevention efforts in residential fires, both residential and non-residential fires will continue to occur. During colder months, clogged chimneys and faulty furnaces and fireplaces can increase the probability of structural fires.

Other Incidents

Enemy Attack

Enemy attack is an incident that would cause massive destruction and extensive casualties. An all-out war would affect the entire population. Some areas would experience direct weapons effects: blast, heat, and nuclear radiation; others would experience indirect weapons effects, primarily radioactive fallout.

The federal government monitors the international political and military activities of other nations and would notify the State of Delaware of escalating military threats. There are several small military installations in Delaware; most are National Guard assets spread throughout the state comprised of various military units and functions. Additionally, Delaware is home to one of the largest military installations on the east coast – Dover Air Force Base.

There have been no enemy attacks on or in Delaware in modern times. The only history of enemy attack dates back to the days of settlement and the Civil War in the 1800s. Wilmington, as a large center for business and commerce, and home to many corporate headquarters, and Dover, as the state's capital city and home to Dover AFB, are potential targets in an all-out attack on the United States. It is unlikely that Delaware would be a primary target during an enemy attack. While the breakup of the Soviet Union and other Soviet-Bloc nations has ended the Cold War, an enemy attack is still a possibility due to international conflicts and the large number of weapons still in existence throughout the world.

Mass Migration/Repatriation

Repatriation is the procedure whereby U.S. citizens are officially processed back into the United States after evacuation from overseas. World events (war, government instability, disease, etc.) could be the catalyst for large scale repatriation.

Mass migration is the influx of a large number people into the state via any means, as the result of any precipitating action. During the aftermath of Hurricane Katrina, for example, FEMA arranged for plane loads of evacuees to go to a variety of unaffected states. Some examples of mass migration are listed in HS-71 of the DEOP, Volume II..

Public Disorder

Mass demonstrations, or direct conflict by large groups of citizens, as in marches, protest rallies, riots, and non-peaceful strikes are examples of public disorder. These involve the assembling of people together in a manner to substantially interfere with public peace and to constitute a threat. They may use unlawful force or violence against another person, cause property damage or attempt to interfere with, disrupt, or destroy the government, political subdivision, or group of people. Labor strikes and work stoppages are not considered in this hazard unless they escalate into a threat to the community. Vandalism is usually initiated by a small number of individuals and limited to a small target group or institution. Most events are within the capacity of local law enforcement.

Large-scale civil disturbances rarely occur, but when they do they are usually an offshoot or result of one or more of the following events: 1) labor disputes where there is a high degree of animosity between the participating parties; 2) high profile/controversial laws or other governmental actions; 3) resource shortages caused by a catastrophic event; 4) disagreements between special interest groups over a particular issue or cause; or 5) a perceived unjust death or injury to a person held in high esteem or regard by a particular segment of society. There have been a handful of labor disputes and protests in Delaware, but these have remained fairly non-violent. Other non-peaceful incidents have occurred in the state, but within the response capabilities of local law enforcement.

Although large-scale destructive civil disturbances are rare, the potential is always there for an incident to occur. This is even more true today, where television, radio, and the internet provide the ability to instantly broadcast information (factual or not), in real time, to the entire community. Often times that coverage helps to spread the incident to other, uninvolved or unaffected areas, exacerbating an already difficult situation. This also allows insightful people, previously not involved, to participate in the disturbance for no other reason than to riot, loot, burn, and destroy. Alcohol is often involved in public disorder, especially related to college campuses, sporting events, and concerts.

School Emergencies

Public and private schools can present a special hazard when emergency situations arise. Schools are a gathering place for a large number of people, mostly children and/or young adults. Hostage situations, incidents involving mass casualties, or incidents involving significant damage or destruction of campus facilities while school is in session are magnified significantly due to the youth of the persons involved. Incidents such as Columbine High School (1999), West Nickle Mines Amish School (2006), and Virginia Tech (2007) have demonstrated that schools are among the most vulnerable institutions when it comes to someone seeking to do harm to a large group of people. More recently, in December 2012, 26 people, including 20 elementary school children, were killed at Sandy Hook Elementary School in Newtown, Connecticut.

Plan Updates

Note Regarding 2007 Plan Update
Information in this section was included in both sections 4-1 and 4-2 of the basic plan.

Note Regarding 2010 Plan Update
Information in this section was included in both sections 4-1 and 4-2 of the basic plan.

Note Regarding 2013 Plan Update
Created a separate annex for the Public Health and Human-Caused/Technological hazards. Updated the section with significant updates to the hazardous materials section. .

Note Regarding 2018 Plan Update
Hazards in this section were updated by the Natural Hazards and Public Safety Sub-Teams consisting of functional experts and stakeholders with subject knowledge. The natural hazards section was rewritten to more accurately describe the hazards, impact, terminology and were also updated to include future conditions. The human-caused disasters were relocated from Annex G to this section and some of the "For Official Use Only" information was removed,

Data Sources

Department of Homeland Security
Web site: http://www.dhs.gov

National Railroad Administration (NRA), U.S, Department of Transportation
Web site: http://www.fra.dot.gov

Various State of Delaware Agencies

1-https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf
2-https://www.dgs.udel.edu/projects/determination-future-sea-level-rise-planning-scenarios-delaware
3-https://www.weather.gov/phi/tides
4- Runkle, J., K. Kunkel, D. Easterling, R. Frankson, S. Champion, B. Stewart, W. Sweet, D. Leathers, and A.T. DeGaetano, 2017: Delaware State Summary. NOAA Technical Report NESDIS 149-DE, 4 pp.
5- Runkle, J., K. Kunkel, D. Easterling, R. Frankson, S. Champion, B. Stewart, W. Sweet, D. Leathers, and A.T. DeGaetano, 2017: Delaware State Summary. NOAA Technical Report NESDIS 149-DE, 4 pp.

S5. Does the risk assessment address the vulnerability of state assets located in hazard areas and estimate the potential dollar losses to these assets? [44 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)]

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? [44 CFR §§201.4(c)(2)(ii) and 201.4(c)(2)(iii)]

S7. Was the risk assessment revised to reflect changes in development? [44 CFR §201.4(d)]

The *Vulnerability Assessment* section provides an overview and analysis of vulnerability in the state of Delaware for the natural hazards. This listing differs slightly in terminology, order and grouping from the *Hazard Identification* section, as those hazards affecting the state of Delaware are more fully categorized and explored. Greater detail on those hazards addressed here may be found in the corresponding sections of the Kent, New Castle and Sussex County all hazard mitigation plans.

Traditionally, state-level hazard mitigation plans have largely served an umbrella function, representing the broader-based needs of the State as a whole on a statewide basis, while establishing higher-level support for local mitigation planning efforts. Still, many feel that truly effective hazard mitigation policies and practices actually begin at the local level—in communities, cities and towns where the impacts of damaging natural hazard events are initially felt and responded to. This presents a challenge for state-level planning, in that decisions must be made as to how to appropriately incorporate the ongoing planning activities of local jurisdictions into a statewide plan, while keeping the statewide plan manageable in size, scope and authority. Much of this challenge lies in the much richer level of detail that smaller local areas are able to explore versus the much higher level of magnification that State plans typically adhere to.

The state of Delaware has reached an effective, and arguably unique, solution to this dilemma. In order to capture, present and act upon the findings of local risk assessments conducted simultaneously within the State as part of a comprehensive planning effort, the State of Delaware Standard Mitigation Plan will:

- Establish a statewide framework for analyzing overall vulnerability;
- Incorporate the findings of local risk assessments directly into the state plan;
- Analyze and summarize the local findings; and
- Draw state-level conclusions.

This approach will equip the state plan with a truer reflection of the hazards threatening its communities, the vulnerability to those threats, and the role that the state must play in an all-inclusive, multi-level-of-government effort.

The state level plan also includes a Level 2 HAZUS analysis and data set consistent for the entire state in an attempt to reconcile some differences in approaches in the three existing county plans. In 2016, the Center for Applied Demography & Survey Research at the University of Delaware provided updates for physical locations of critical facilities, including a custom update of the road layer. In 2017, an update of hospital details including current staffed bed counts was completed.

Creating the Local Risk Assessments

High-level, detailed vulnerability assessments were completed in Kent, New Castle and Sussex Counties for flood (riverine and coastal), severe winds (hurricanes and coastal storms), thunderstorms, tornadoes, drought, hail, winter storms, dam/levee failure, earthquakes, terrorism, hazardous materials and energy pipeline failures due to the higher level of risk for these hazards compared to others. The loss estimates provided in this section from these three plans were developed using available data, and the methodologies applied have resulted in an *approximation* of risk. These estimates should be used to understand relative risk from hazards and potential losses; however, it is important to understand that uncertainties are inherent in any loss estimation

methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (such as abbreviated inventories, demographics or economic parameters).

To conduct the statewide risk assessment effort, two distinct hazard risk assessment methodologies were applied; utilizing both HAZUS-MH® - version 4.0, (FEMA's loss estimation software) and a statistical risk assessment methodology. Both approaches provide estimates for the potential impact by using a common, systematic framework for evaluation.

The HAZUS-MH risk assessment methodology is parametric, in that distinct hazard and inventory *parameters* (for example, wind speed and building types) were modeled using the HAZUS-MH software to determine the impact (damages and losses) on the built environment. The HAZUS-MH software was used to estimate losses from flood, hurricane wind and earthquake hazards.

The second methodology, a statistical risk assessment methodology, was applied to analyze hazards of concern that are outside the scope of the HAZUS-MH software. The HAZUS-driven methodology uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information.

Explanation of HAZUS-MH Risk Assessment Methodology

HAZUS-MH, version 4.0, is FEMA's standardized loss estimation software program, built upon an integrated geographic information system (GIS) platform as shown in **Figure 4.2-1**. This risk assessment applied HAZUS-MH to produce regional profiles and estimate losses for three of the seven hazards addressed in this section: flood, hurricane winds and earthquake.

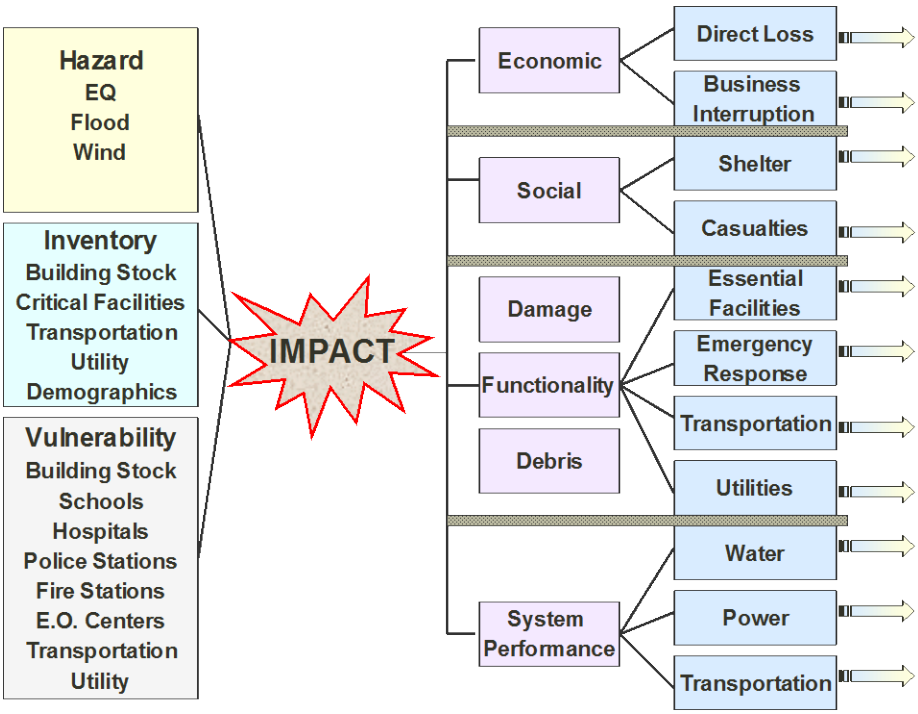


Figure 4.2-1
Conceptual Model of HAZUS-MH Methodology

Explanation of Statistical Risk Assessment Methodology

Risks associated with other hazards were analyzed using a statistical assessment methodology developed and used specifically for this effort. This approach is based on the same principals as HAZUS-MH, but does not rely on readily-available automated software. Historical data for each hazard is used and statistical evaluations are performed using manual calculations. The general steps used in the statistical risk assessment methodology are summarized below and shown in **Figure 4.2-2**:

- Compile data from national and local sources;
- Conduct statistical analysis of data to relate historical patterns within data to existing hazard models;
- Categorize hazard parameters for each hazard to be modeled (e.g., tornado);
- Develop model parameters based on analysis of data, existing hazard models, and risk engineering judgment;
- Apply hazard model including:
  - o Analysis of frequency of hazard occurrence
  - o Analysis of intensity and damage parameters of hazard occurrence
  - o Development of intensity and frequency tables and curves based on observed data
  - o Development of simple damage function to relate hazard intensity to a level of damage *(for example, one flood = $ in estimated damages)*
  - o Development of exceedance and frequency curves relating a level of damage for each hazard to an annual probability of occurrence
  - o Development of loss estimate.

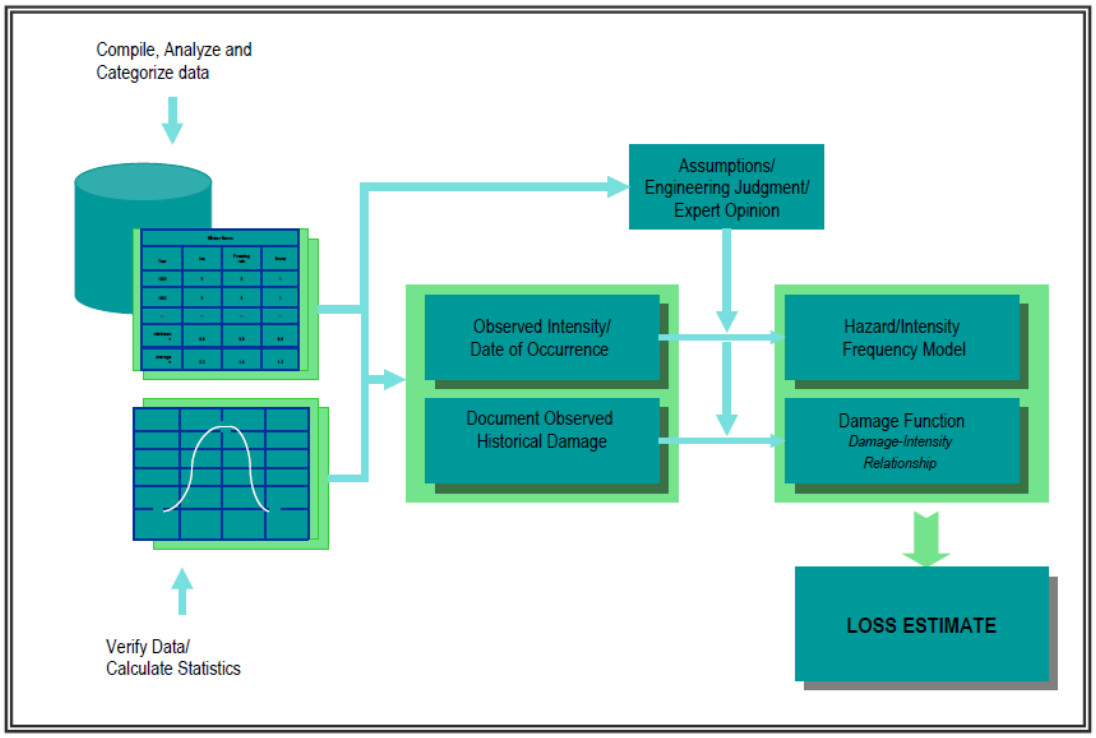


Figure 4.2-2
Conceptual Model of the Statistical Risk Assessment Methodology

Census County Divisions (CCDs)/Minor Civil Divisions (MCDs)

Many of the tables presented in the *Vulnerability Assessment* use Census County Divisions (CCDs) or Minor Civil Divisions (MCDs), which are a traditional way to divide counties into subdivisions. CCDs are recognized by the U.S. Census Bureau as the county subdivision system for Delaware. Sussex County reports MCDs in their plan although these are equivalent to the CCD boundaries. When discussing each county's plan Sussex MCDs will considered the equivalent of CCDs. A map of each county's division system is provided below in **Figures 4.2-3 to 4.2-5**. An Example of the parcel level detail available for the entire state (which can be summed to CCDs) on is shown in **Figure 4.2-6**.

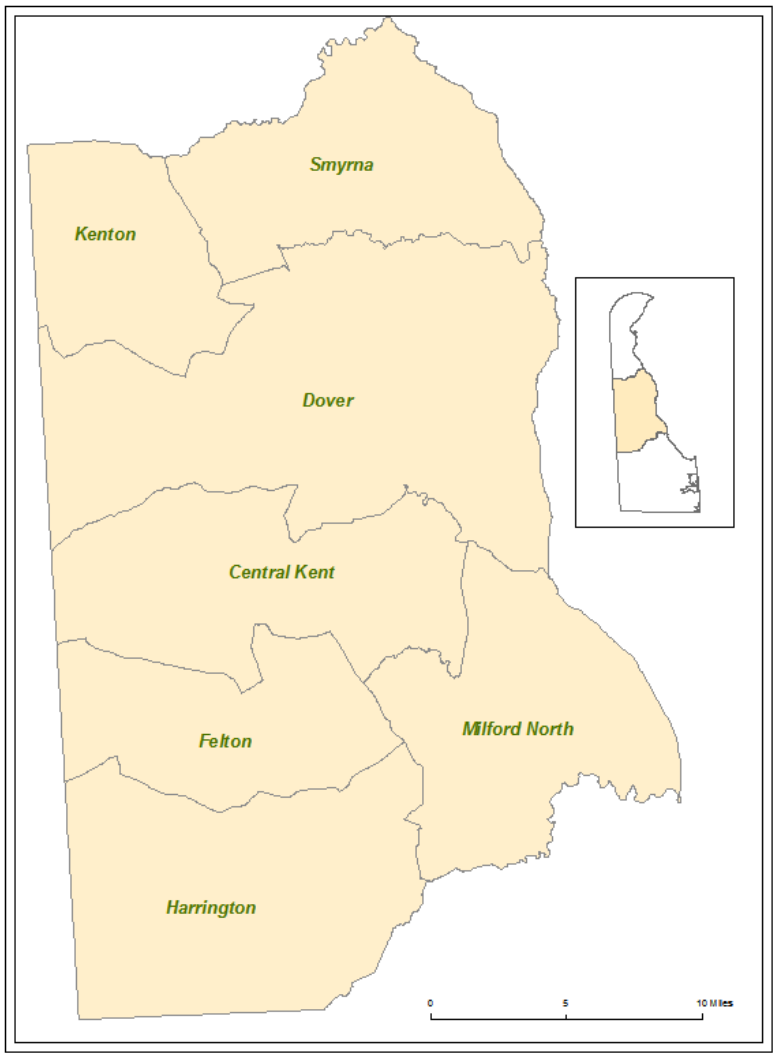


Figure 4.2-3
Kent County Plan CCD Identification

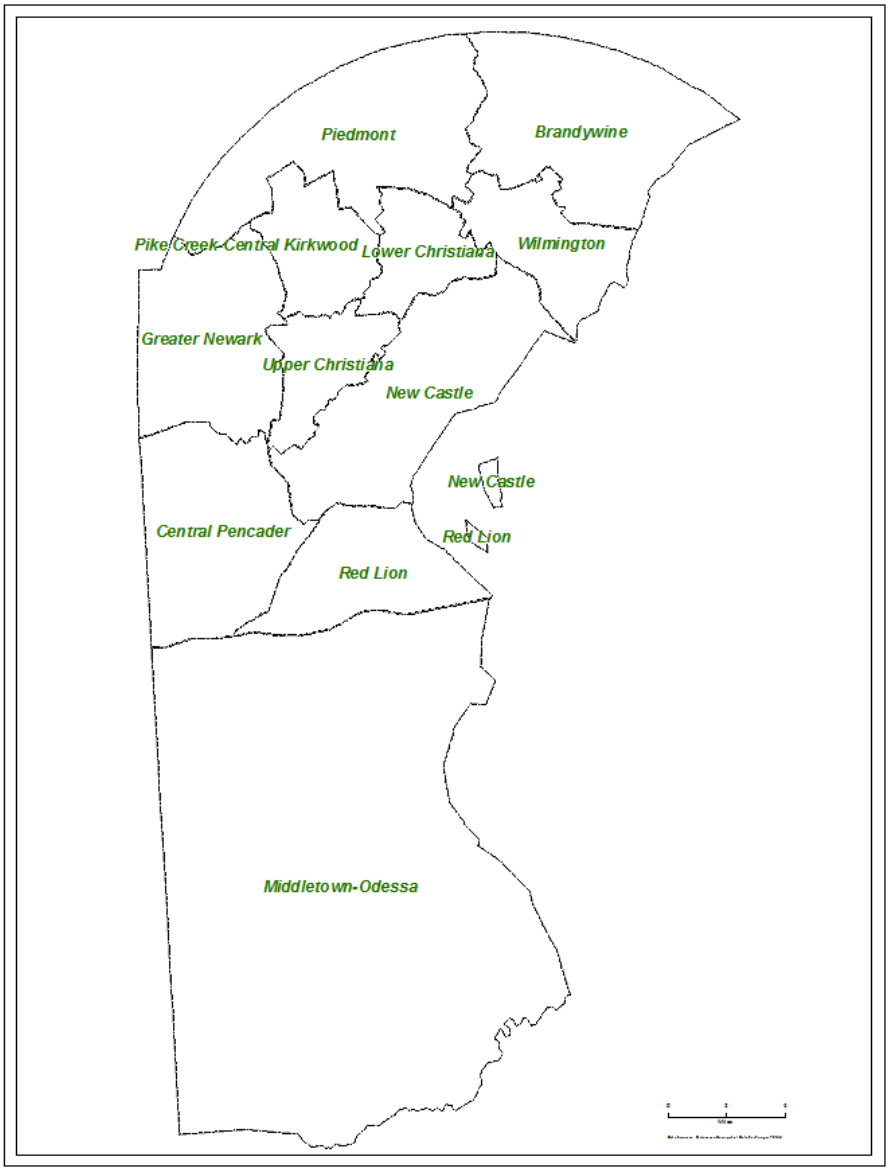


Figure 4.2-4
New Castle County Plan CCD Identification

Figure 4.2-5
Sussex County MCD Identification

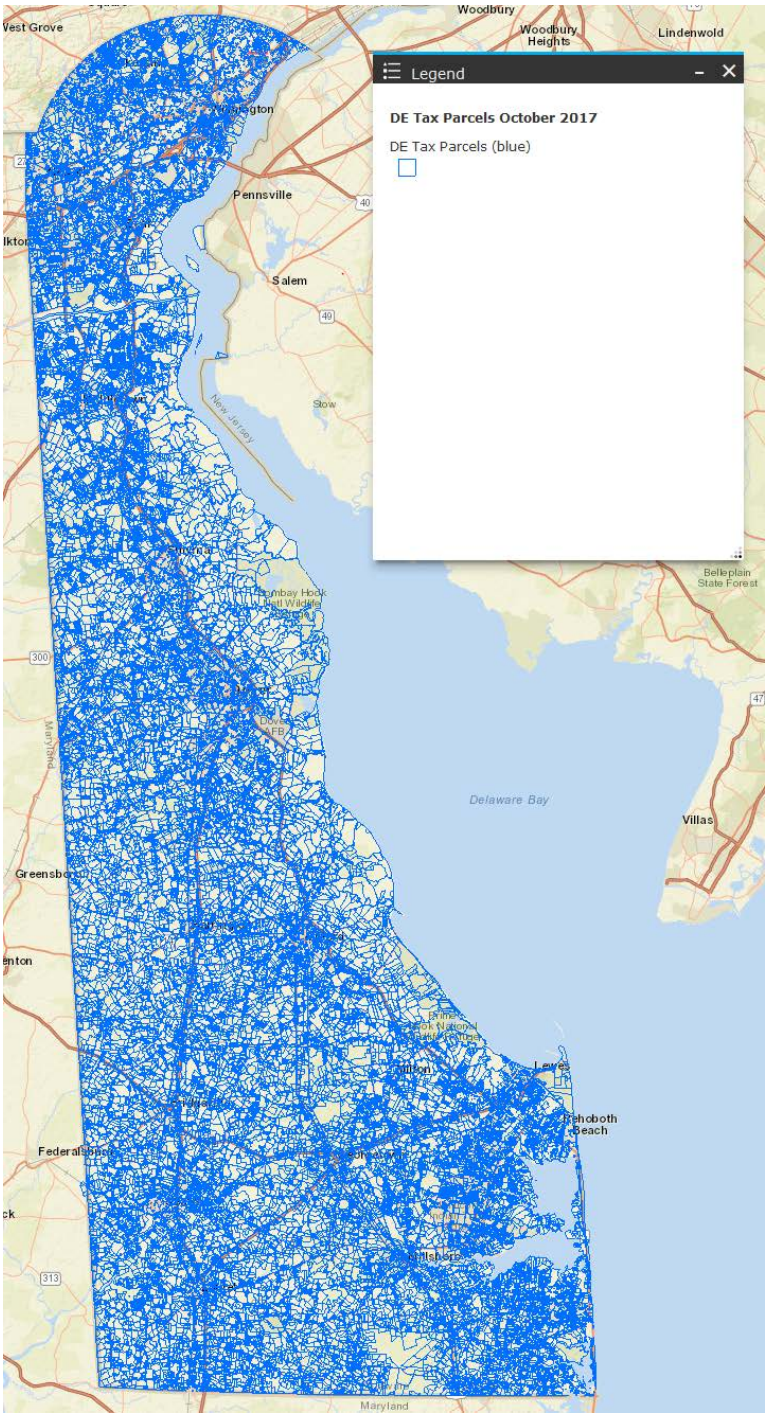


Figure 4.2-6
Statewide Tax Parcel Resolution

Population and Building Exposure

The first step in determining hazard vulnerability in the State of Delaware is an analysis of population demographics and distribution throughout the State and an assessment of total building exposure by jurisdiction (county). **Figure 4.2-7** shows the population density of the entire state based on the 2010 Census. **Figures 4.2-8 and 4.2-9** show distributions of poverty and population over 65. It is identified that pockets of elderly populations and poverty exist in areas that are prone to both flooding and coastal erosion. Other hazards would affect these populations equally. Population demographics allow planners to estimate density, evacuation, response, and recovery needs.

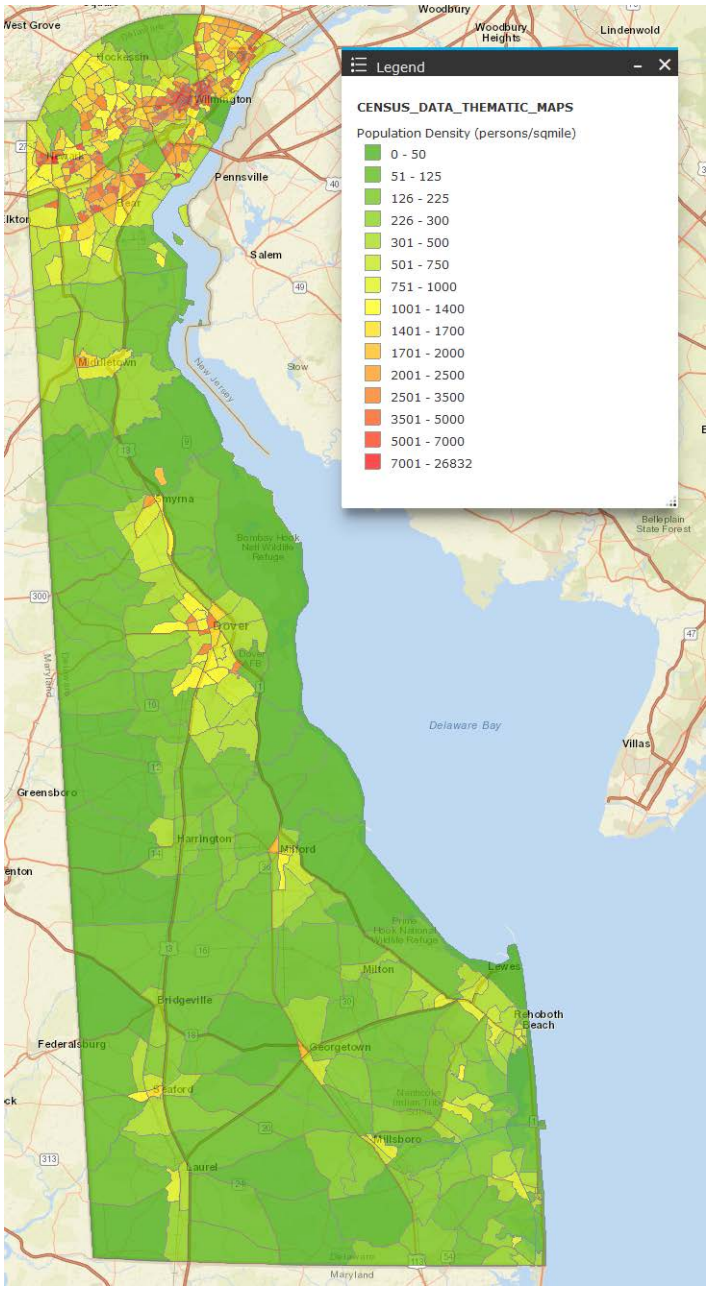


Figure 4.2-7
US Census Population Density

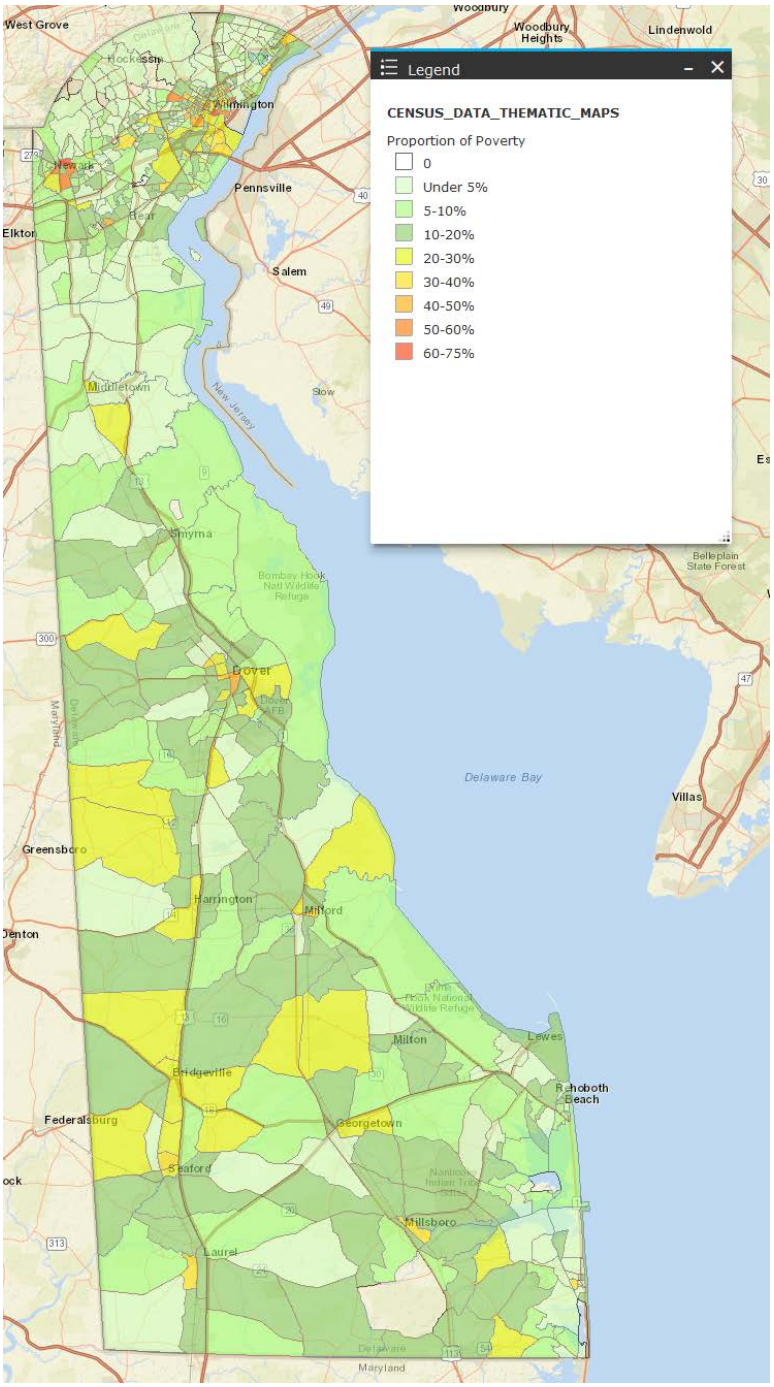


Figure 4.2-8
Population Proportion of Poverty

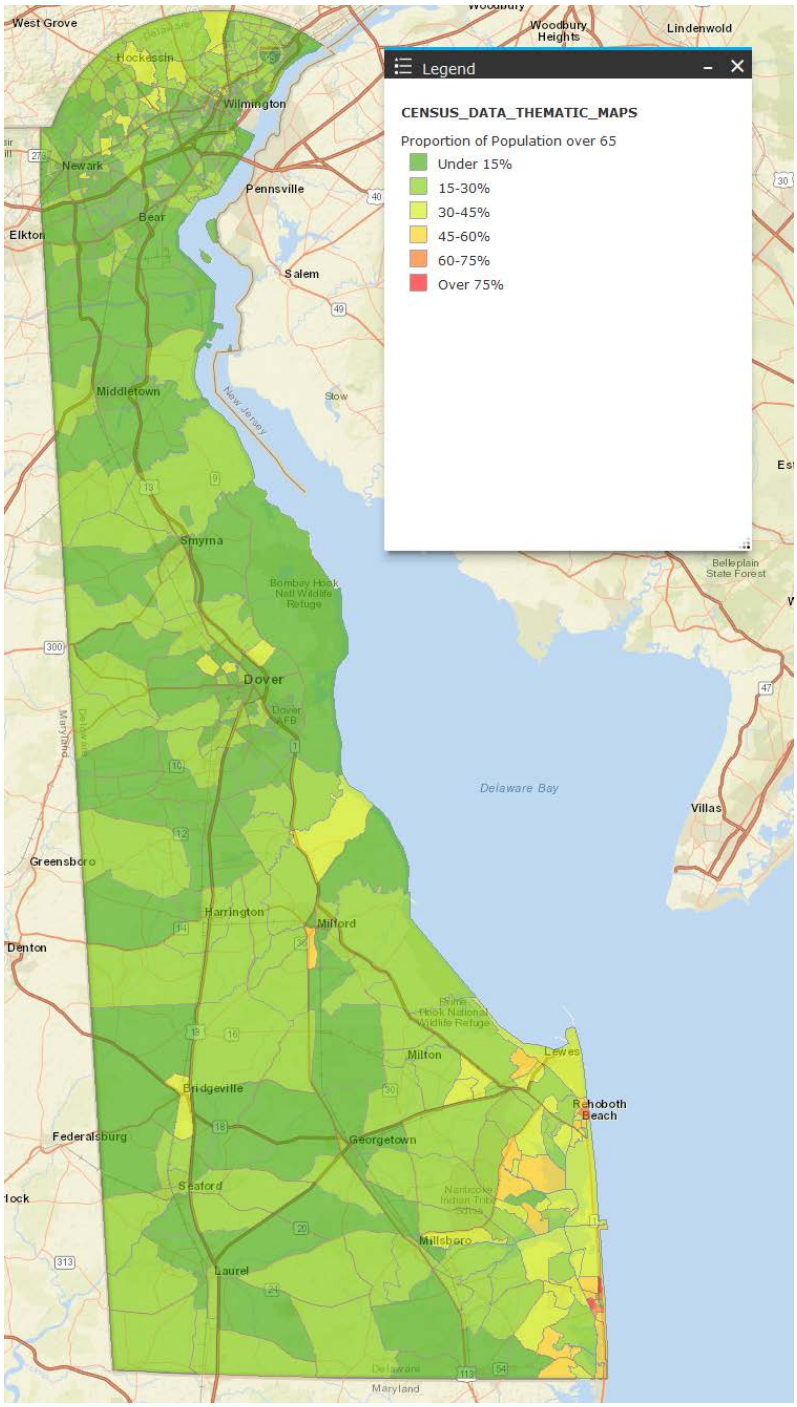


Figure 4.2-9
Proportion of Population Over 65 Years of Age

New Castle County Overview

According to the 2010 Census, the total population of New Castle County in 2010 was 546,076. **Figure 4.2-10** shows the population density of New Castle County.

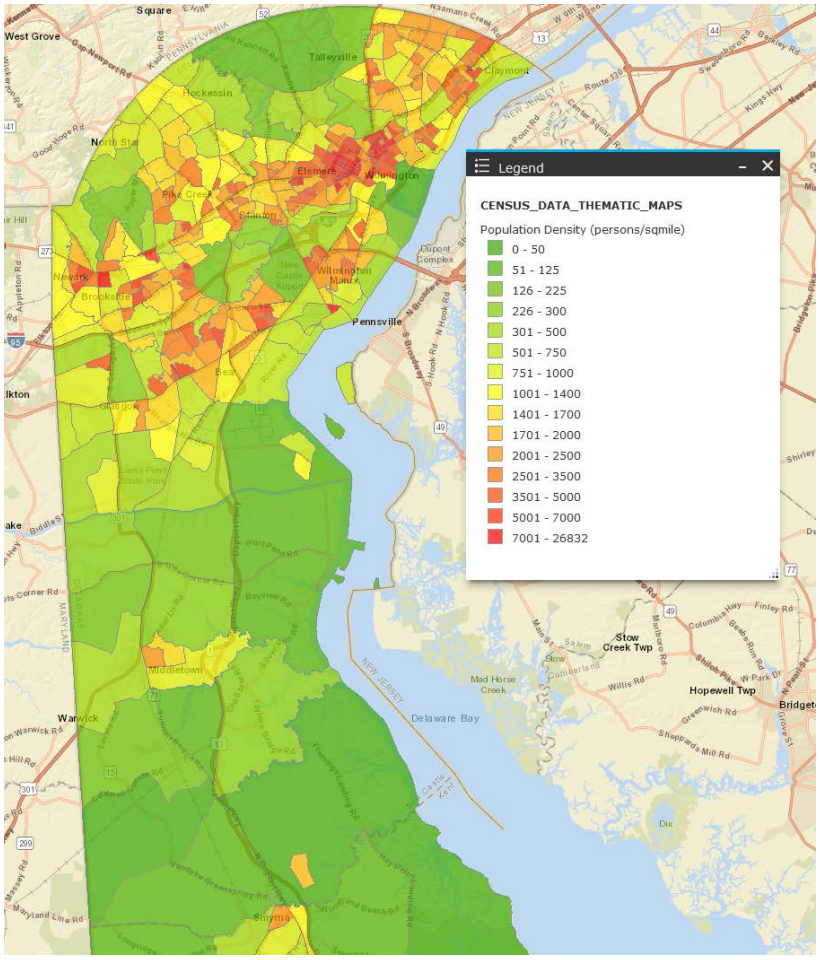


Figure 4.2-10
Population Density of New Castle County

Kent County Overview

According to the 2010 Census, the total population of Kent County in 2010 was 162,310. **Figure 4.2-11** shows the distribution of this population across the county's geographic area.

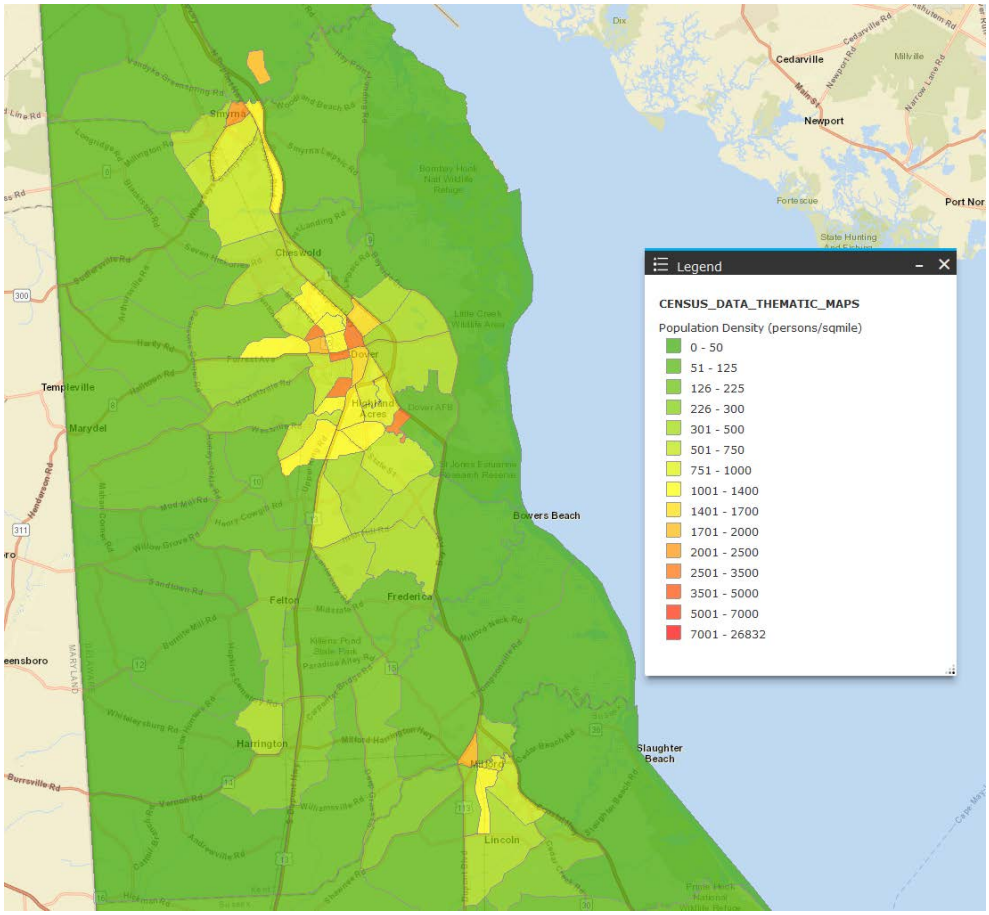


Figure 4.2-11
Kent County Population Density

Sussex County Overview

According to the 2010 Census, the total population of Sussex County in 2010 was 197,145. **Figure 4.2-12** shows the distribution of this population across the county's geographic area. It is worth noting that Sussex County has a sizable seasonal population not counted in the baseline census numbers. As of 2015, there are 46,497 vacation homes in Sussex County and seasonal population of 99,003 people. The seasonal population of Sussex county is an important modification to baseline hazard planning and evacuation tools.

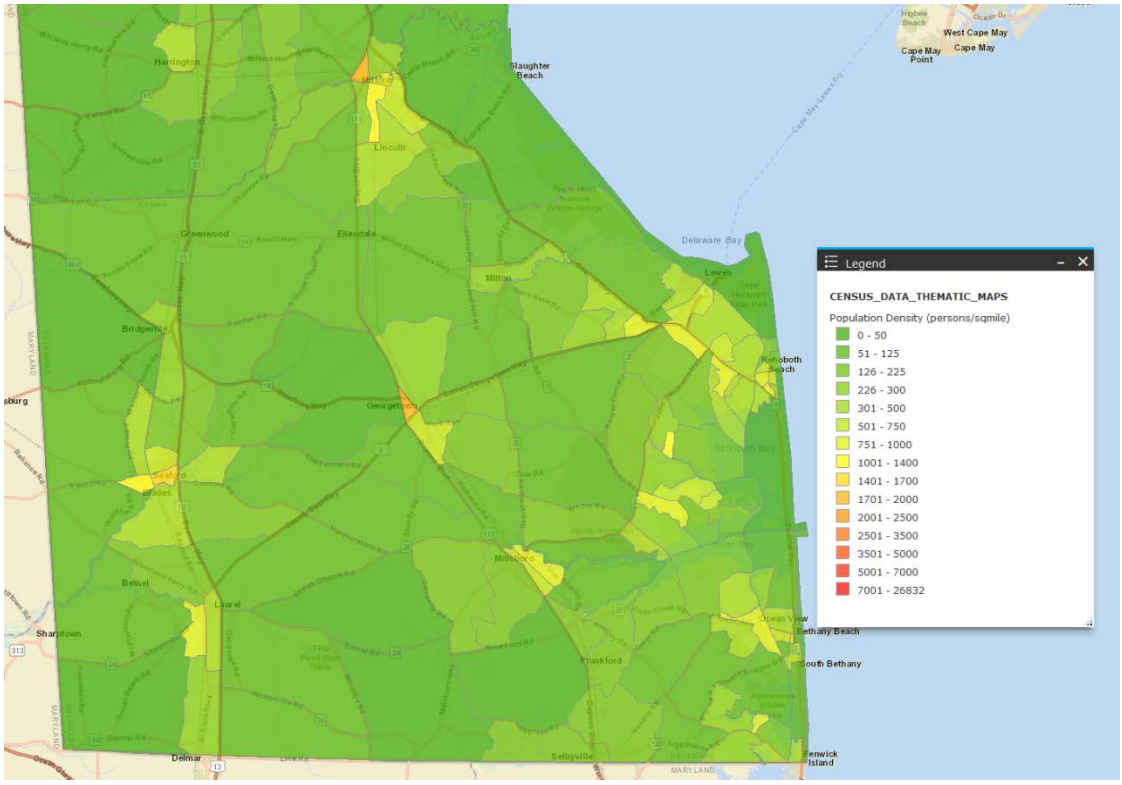


Figure 4.2-12
Sussex County Population Density

The total overall replacement value for the state of Delaware is $121,466,844,000, with the greatest portion of that exposure being in New Castle County. This information was derived from HAZUS-MH, version 4.0. **Table 4.2-1** Lists building exposure by county as calculated by HAZUS-MH.

Table 4.2-1
Population and Total Building Exposure Calculated by HAZUS-MH 4.0

County	Population	Residential Value	Non-Residential Value	Total Value
Kent	162,310	$13,664,726,000	$4,110,400,000	$17,775,126,000
New Castle	538,479	$57,077,809,000	$17,524,974,000	$74,602,783,000
Sussex	197,145	$24,583,638,000	$4,505,297,000	$29,088,935,000
Total	897,934	$95,326,173,000	$26,140,671,000	$121,466,844,000

Development Trends

According to the 2010 Census, the resident population of the state of Delaware was 897,934 with an expected growth rate of 2.1 percent, corresponding to a projected population of 1,019,558 in 2025 (DPC 2017). That projection suggests Delaware's current rate of population change at 2.1 percent annually, ranked as the 16th highest in the nation. The percent change in housing units in the state was 37 percent from 2000 to 2010, which ranks Delaware as among the top 20 fastest growing states in the nation. These trends demonstrate that Delaware's population is increasing, and consequently the number of residential structures and the associated exposure of residential buildings will increase as well. These estimates do not, of course, take into account many other development factors, such as available land for new residential construction.

Sussex County has long been the leader in population growth rates as documented by the US Census Bureau's FSCE program and the Delaware Population Consortium. Sussex grows almost completely by net in-migration driven by retirees. While this slowed somewhat filing the 2008 recession, it has recovered and returned to its 2+% annual growth rates. In addition, the County continues to grow its seasonal population in summer homes (45,000) and later retirement homes which adds over 100,000 to the population from June-August and significantly during the off-season as well. Research is currently underway to measure the day-trip population and those in hotels, motels, and campgrounds.

Critical Facilities and State Facilities

The Delaware Emergency Management Agency has compiled a statewide listing of critical facilities in coordination with other state agencies, the three county emergency managers and the City of Wilmington Emergency Manager. Critical facilities are defined as facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to: shelters, police and fire stations, and hospitals. **Figure 4.2-13** shows an example of some types of critical facilities. Similarly, **Figure 4.2-14** shows examples of vulnerable facilities that would likely require special assistance in the event of a disaster or evacuation. **Table 4.2-2** details the categories of State critical facilities, **Table 4.2-3** details vulnerable facilities, and **Table 4.2-4** details the categories of State facilities.

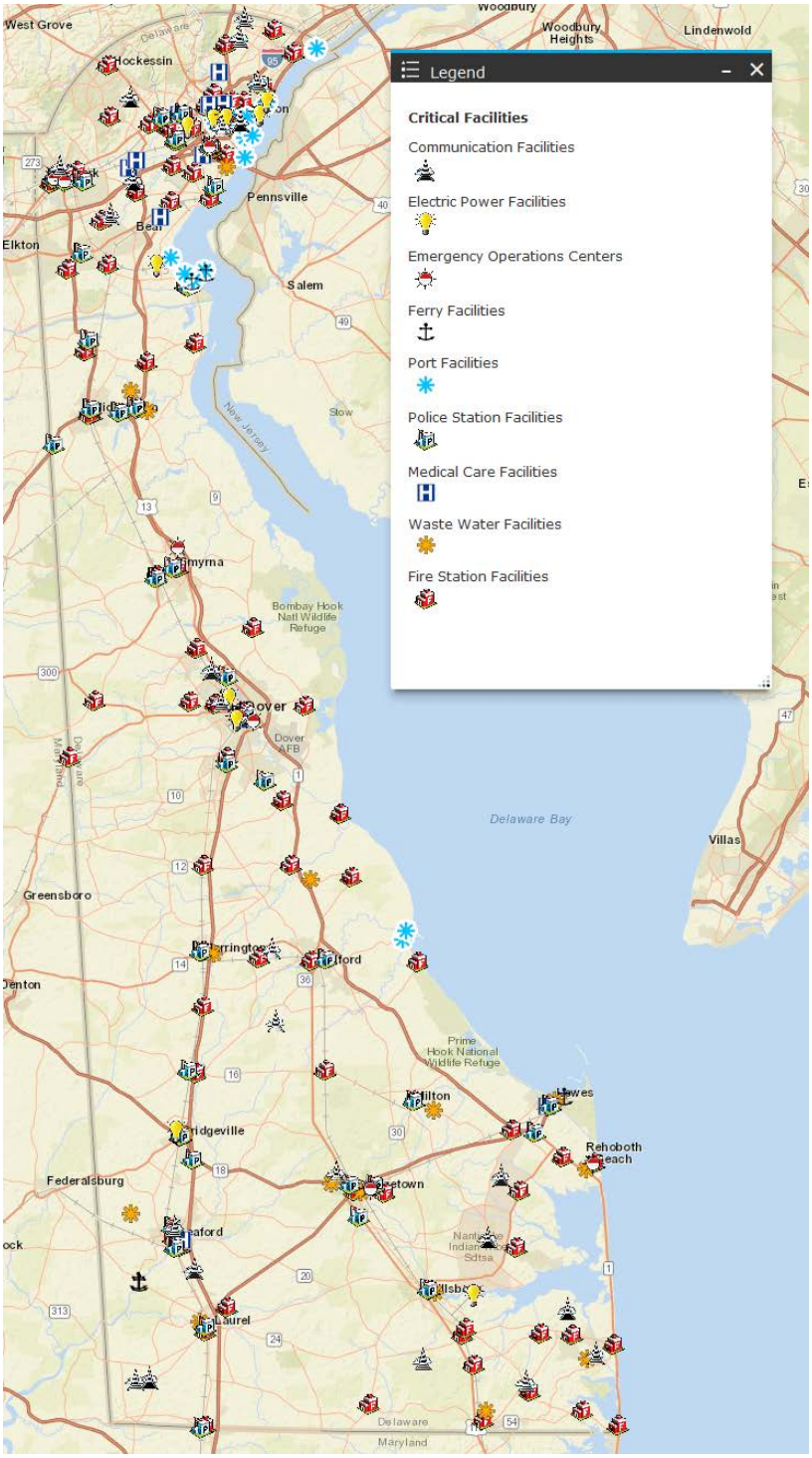


Figure 4.2-13
Example Critical Facilities

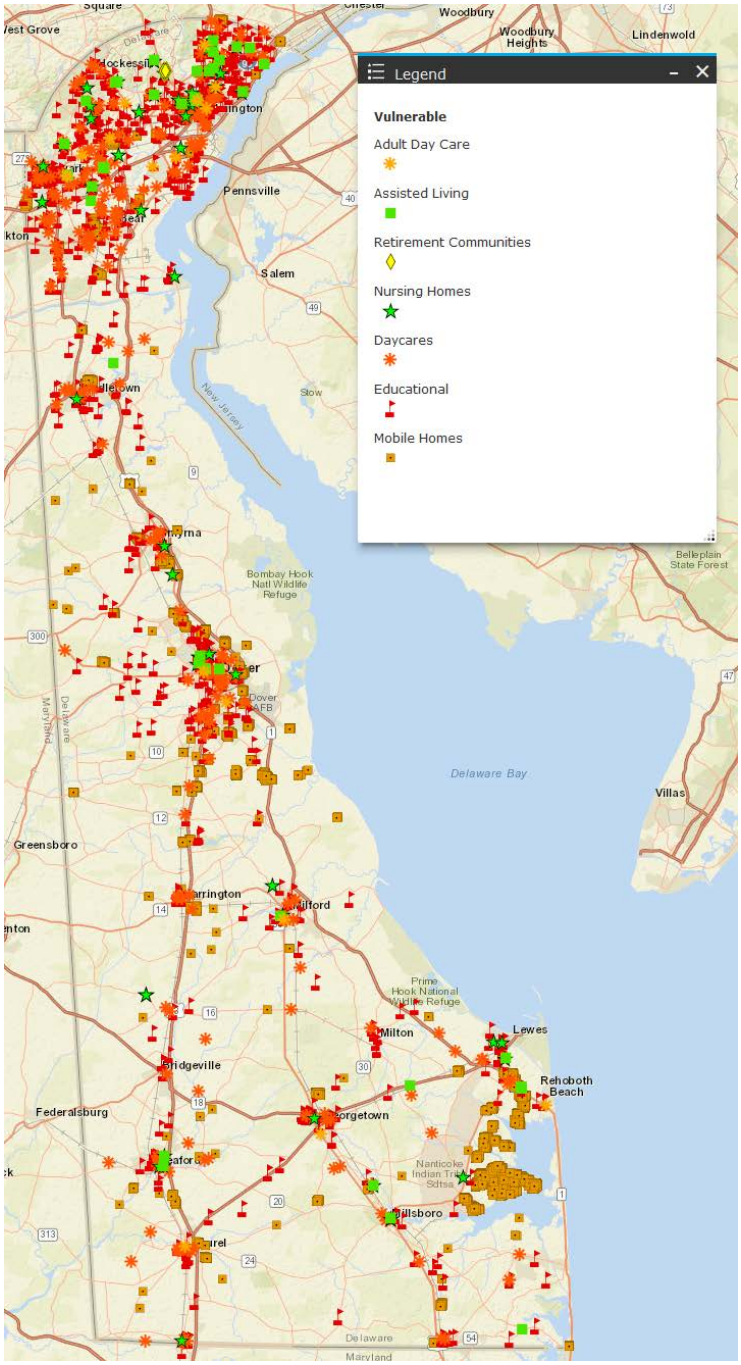


Figure 4.2-14
Example Vulnerable Facilities

Table 4.2-2
Categorized Critical Facilities in Delaware

Category	Total Number of Critical Facilities
Communication Facilities	20
Electric Power Facilities	8
Emergency Operations Centers	13
Ferry Facilities	2
Port Facilities	21
Police Station Facilities	26
Medical Care Facilities	9
Waste Water Facilities	8
Fire Station Facilities	66
Total	173

Table 4.2-3
Categorized Vulnerable Facilities in Delaware

Category	Total Number of Vulnerable Facilities
Adult Day Care	13
Assisted Living	38
Retirement Communities	167
Nursing Homes	42
Daycares	211
Education Centers	671
Mobile Homes	9,543
Prisons	15

In addition to the critical facilities identified by the state, a survey of property tax assessments identified 2,217 total state buildings, 668 in Kent County, 972 in New Castle County, and 577 in Sussex County. Due to Delaware's relatively homogeneous geography, elevation, and proximity to oceans and bays, critical facilities and state owned facilities are generally similarly exposed to hazards other than floods. Categorization of state buildings with an identified use is outlined in Table 4.2-4.

Table 4.2-4
Categorized State Facilities in Delaware

Category	Total Number of State Facilities
Agriculture	50
Corrections	142
Education	494
Historic	93
Medical Facility	92
Military	99
Natural Resources	695
Office	105
Public Safety	27
Transportation	240
Youth Services	16
Total Categorized	2,053

Repetitive Loss Properties

A repetitive loss property is an NFIP-insured property that has had at least two paid flood losses of more than $1,000. A severe repetitive loss property is an NFIP-insured property that has had at least four paid flood losses of more than $5,000, or has had two paid flood losses within 10 years that, in aggregate, equal or exceed the value of the property, or has had three or more paid losses that, in aggregate, equal or exceed the value of the property. As of January 1, 2017, there are 512 repetitive loss properties (370 repetitive loss properties and 142 severe repetitive loss properties) on record in Delaware. Addressing repetitive loss properties through the implementation of specific mitigation projects represent one of the most effective ways to reduce future flood losses. As a result, the mitigation strategies listed in this plan were specifically designed to address identified repetitive loss properties, as listed in Annex D of this plan. **Tables 4.2-5 through 4.2-7** contain a tally of the number of repetitive loss properties and severe repetitive loss properties contained in each county Figures show the identified locations and these locations by county are mapped in **Figures 4.2-15 through 4.2-17**.

Table 4.2-5
Repetitive Loss Properties Identified in Kent County

Jurisdiction	Repetitive Loss	Severe Repetitive Loss	Total
Bowers	6	2	8
Dover	2		2
Little Creek	1		1
Milford	4	3	7
Smyrna		1	1
Other	20	6	26
Kent County Total	33	12	45

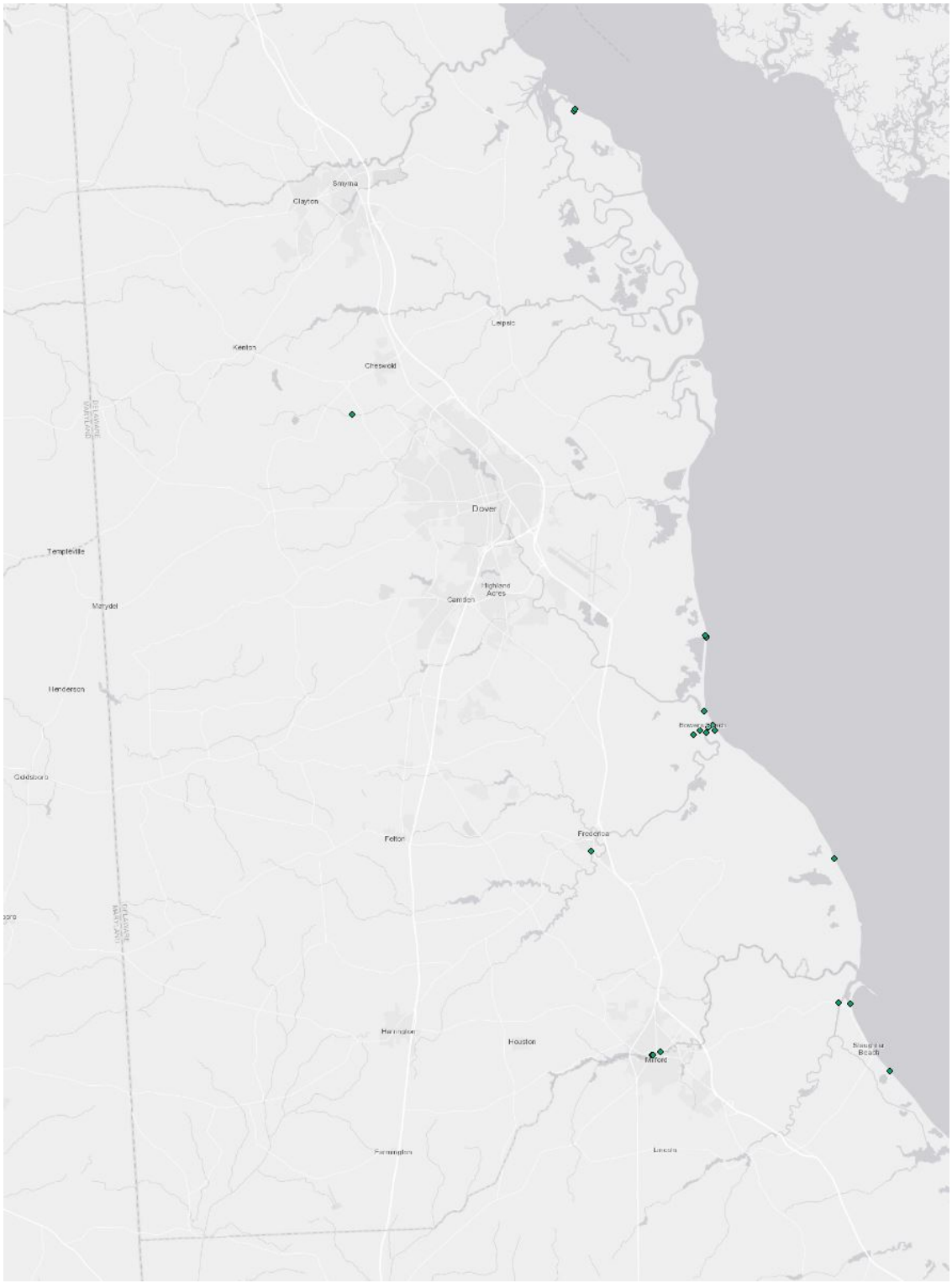


Figure 4.2-15
Repetitive Loss Properties Identified by Kent County

Table 4.2-6
Repetitive Loss Properties Identified by New Castle County

Jurisdiction	Repetitive Loss	Severe Repetitive Loss	Total
Delaware City	2		2
Elsmere	1	2	3
New Castle (City)	2		2
Newark	3	2	5
Wilmington	11	4	15
Other	96	44	140
New Castle County Total	115	52	167

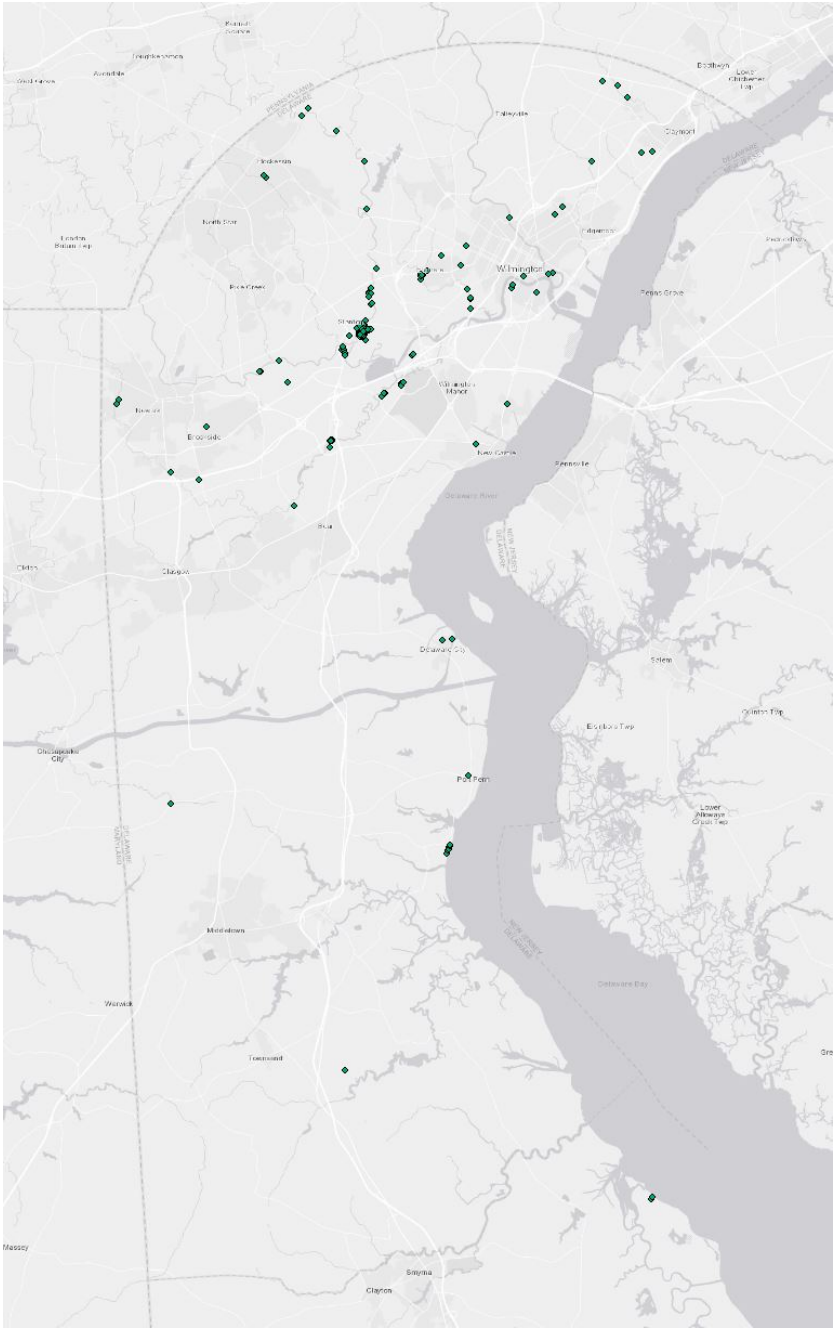


Figure 4.2-16
Repetitive Loss Properties Identified by New Castle County

Table 4.2-7
Repetitive Loss Properties Identified by Sussex County

Jurisdiction	Repetitive Loss	Severe Repetitive Loss	Total
Bethany Beach	40	9	49
Dewey Beach	14	12	26
Fenwick Island	14	1	15
Lewes	15		15
Millsboro	1		1
Milton		1	1
Ocean View	1		1
Rehoboth Beach	2	3	5
Slaughter Beach	1		1
South Bethany	29	12	41
Other	105	40	145
Sussex County Total	222	78	300

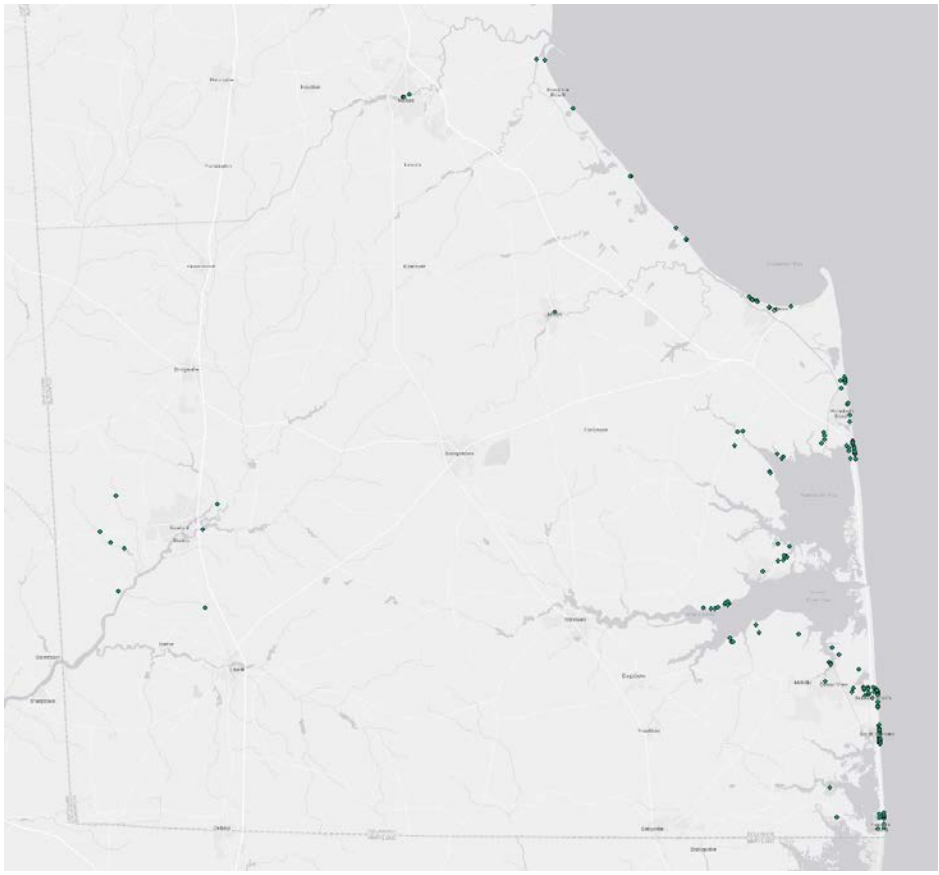


Figure 4.2-17
Repetitive Loss Properties Identified by Sussex County

Hazard Vulnerability Assessment

Significant Natural Hazards Identified in Section 4.1 Include:

- Flooding
- Storms
- Hurricanes
- Winter Precipitation
- Coastal Erosion
- Inland Flooding
- Severe Thunderstorms
- Extreme Heat
- Extreme Cold
- Tornadoes
- Dam/Levee Failure
- Drought
- Wildfire
- Earthquakes

These hazards fall into different categories for hazard modeling. Flooding and wind hazards often result in significant damage to state and private assets resulting in longer term recovery efforts with financial and logistical challenges and these can be modeled using FEMA's existing risk assessment tools. Additionally, these threats are generally not evenly distributed across the state, and it is possible to predict specific properties and municipalities at risk and predict specific financial losses, allowing for more effective hazard mitigation. These are ideal hazards to attempt to model and mitigate using the high resolution data available at the state level for Delaware. Winter storms and temperature extremes generally require response and sheltering efforts without a corresponding sustained recovery effort. Other hazards, such as Tornadoes, Earthquakes, Thunderstorms, and similar hazards generally do not have different risk profiles for different micro areas, and the entire built environment and population should be examined to calculate vulnerability. The following plan sections detail vulnerable populations, facilities, and risk valuations of the significant natural hazards identified by Delaware.

Coastal Flooding

Using Digital Flood Insurance Rate Maps (DFIRMs), along with the modeling approach as described earlier, losses were estimated using return period events ranging from 10-year to 500-year events. HAZUS-MH was used to estimate annualized losses, and similar methodology was used for the statewide models to examine differences between the counties. In general, presenting results in the annualized form serves on three fronts:
(1) In essence, contribution of potential losses from all future disasters are accounted for with this approach
(2) Results in this form from different hazards are readily comparable and hence easier to rank
(3) With respect to evaluating mitigation alternatives, utilization of annualized losses is the most objective approach to server for this purpose.

The following maps show combined inland and coastal flooding scenarios for the three counties, including FEMA DFIRM maps, 100-year and 500-year floods combined with Category 1 and 3 Hurricanes, and coastal inundation depth maps. These scenarios approximate the type of damage done for a storm such as Hurricane Harvey if a similar storm were to hit Delaware.

With higher sea levels and more intense storms, the probability will increase for major coastal and inland flooding to occur. Coastal flooding will most directly increase due to sea-level rise and higher storm surge impacts. A rise in sea level will increase the extent of flood damage over time, with areas of lower elevation more susceptible to flooding. Inland flooding will increase due to the changing precipitation patterns (i.e., increased intensity of rainfall events) that are expected for the region. This type of flooding could also be directly affected by land-use decisions, as the amount of permeable surfaces affects rainfall's infiltration

potential. During heavy rain events, not only will some roads be impassable due to flooding, but after waters recede, more roads and culverts may need repair. Additionally, the increase in precipitation levels will change streamflow and sediment delivery, with the potential for scouring of bridge foundations.

Figures 4.2-18 through 4.2-29 detail these scenarios available to Delaware for consistent statewide flood loss modeling.

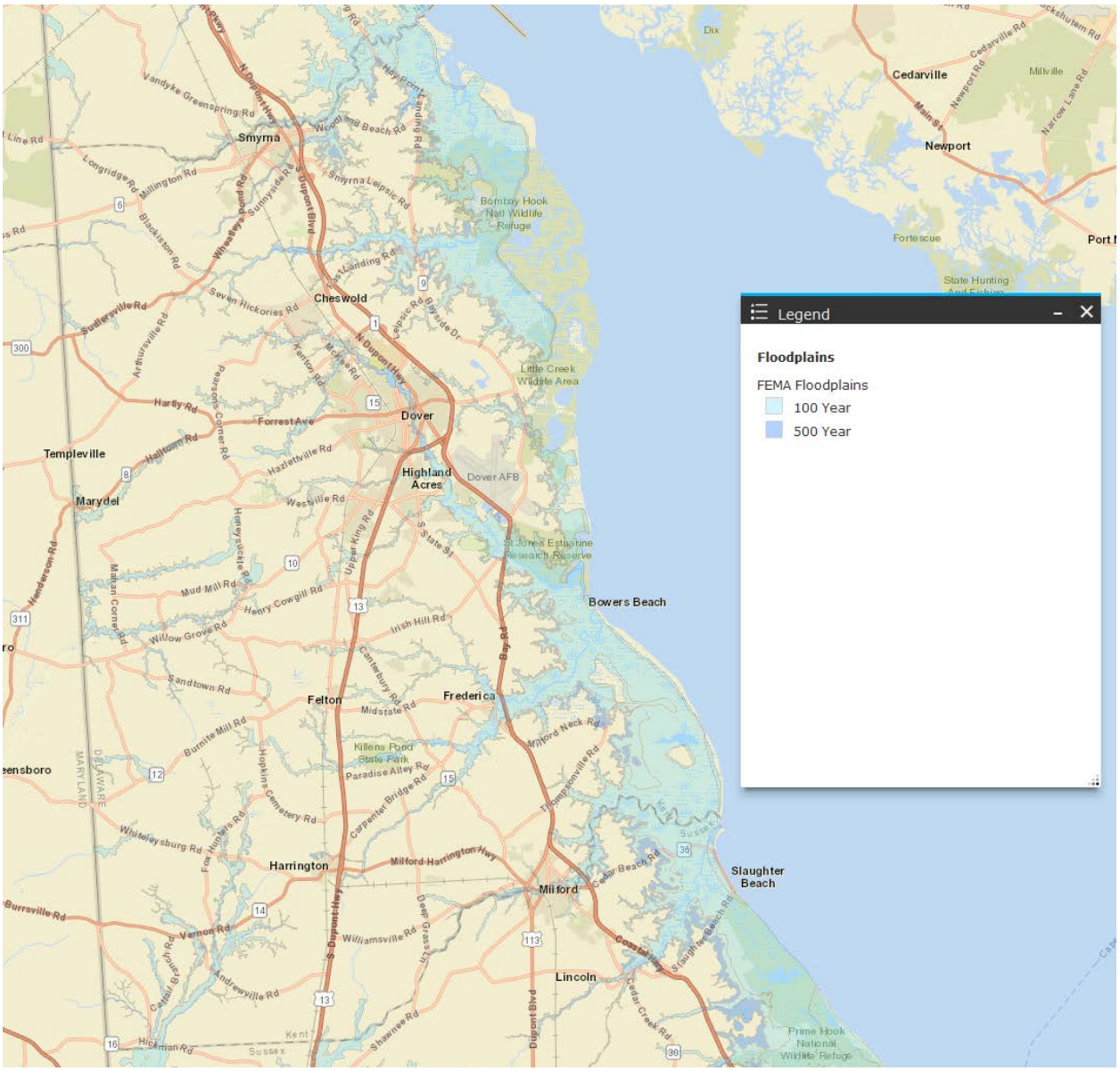


Figure 4.2-18
FEMA 100-Year and 500-Year Floodplains, Kent County

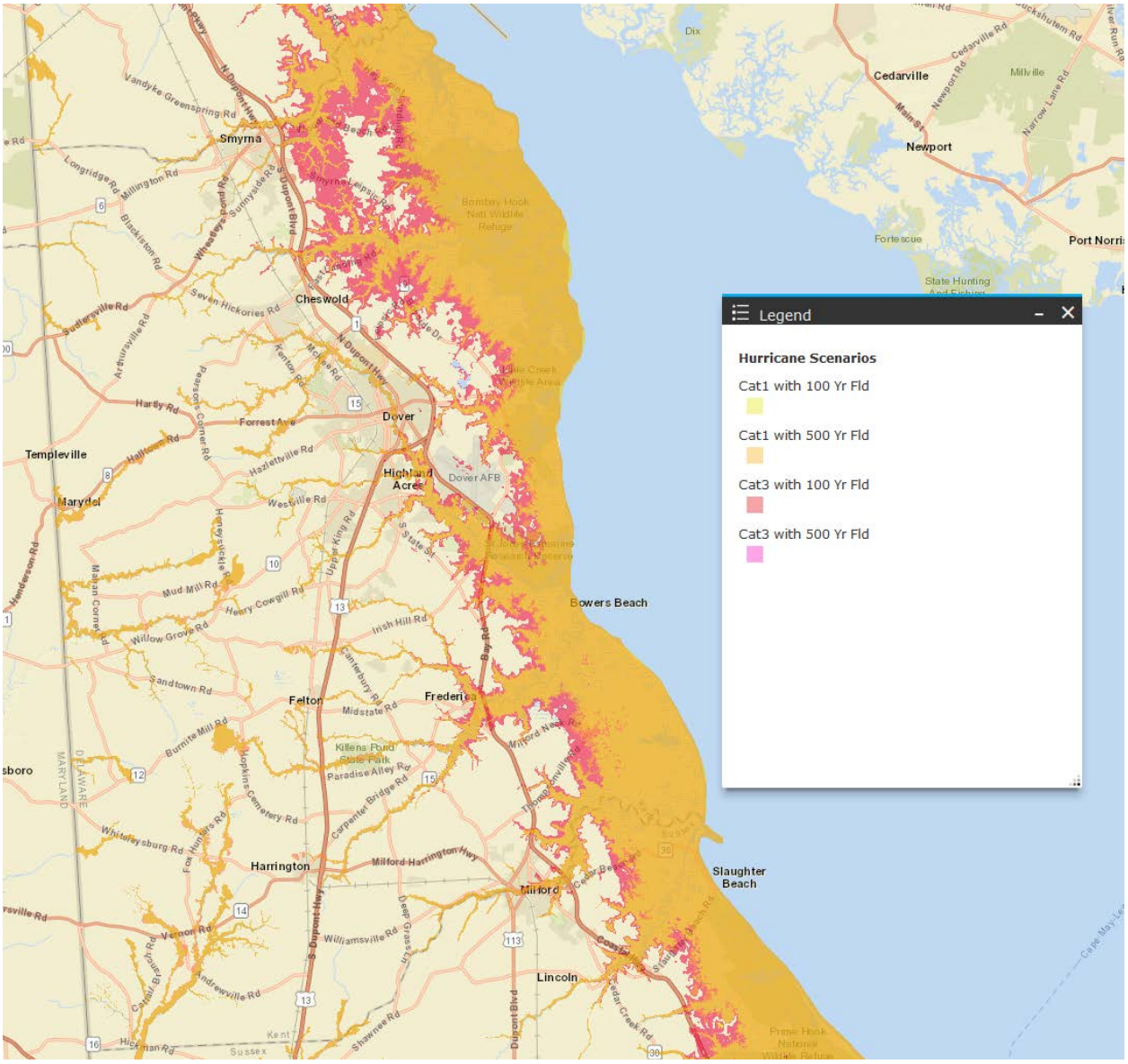


Figure 4.2-19
Category 1 Hurricane and 100-year Flood, Kent County

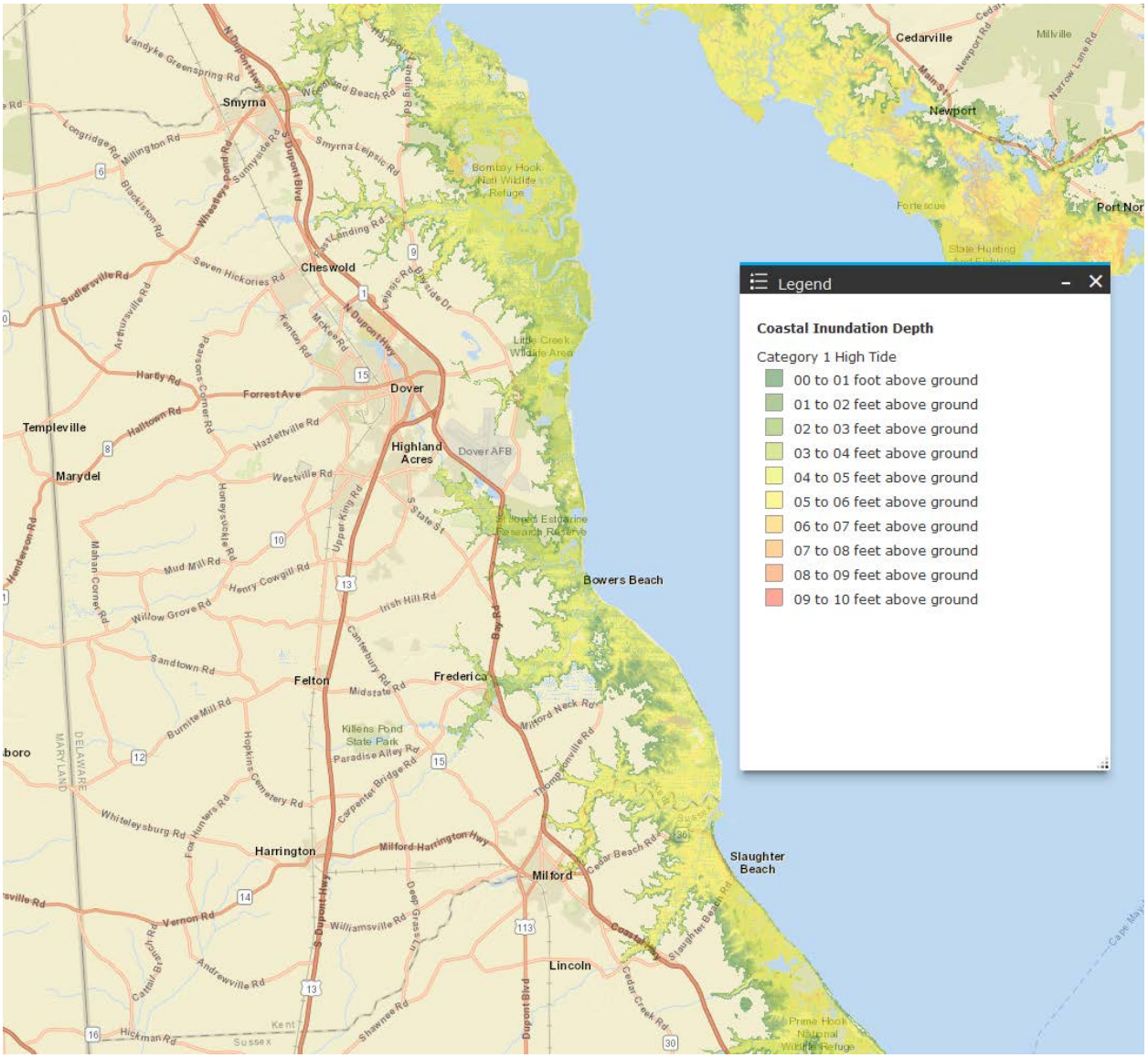


Figure 4.2-20
Coastal Inundation Depth, Category 1, Kent County

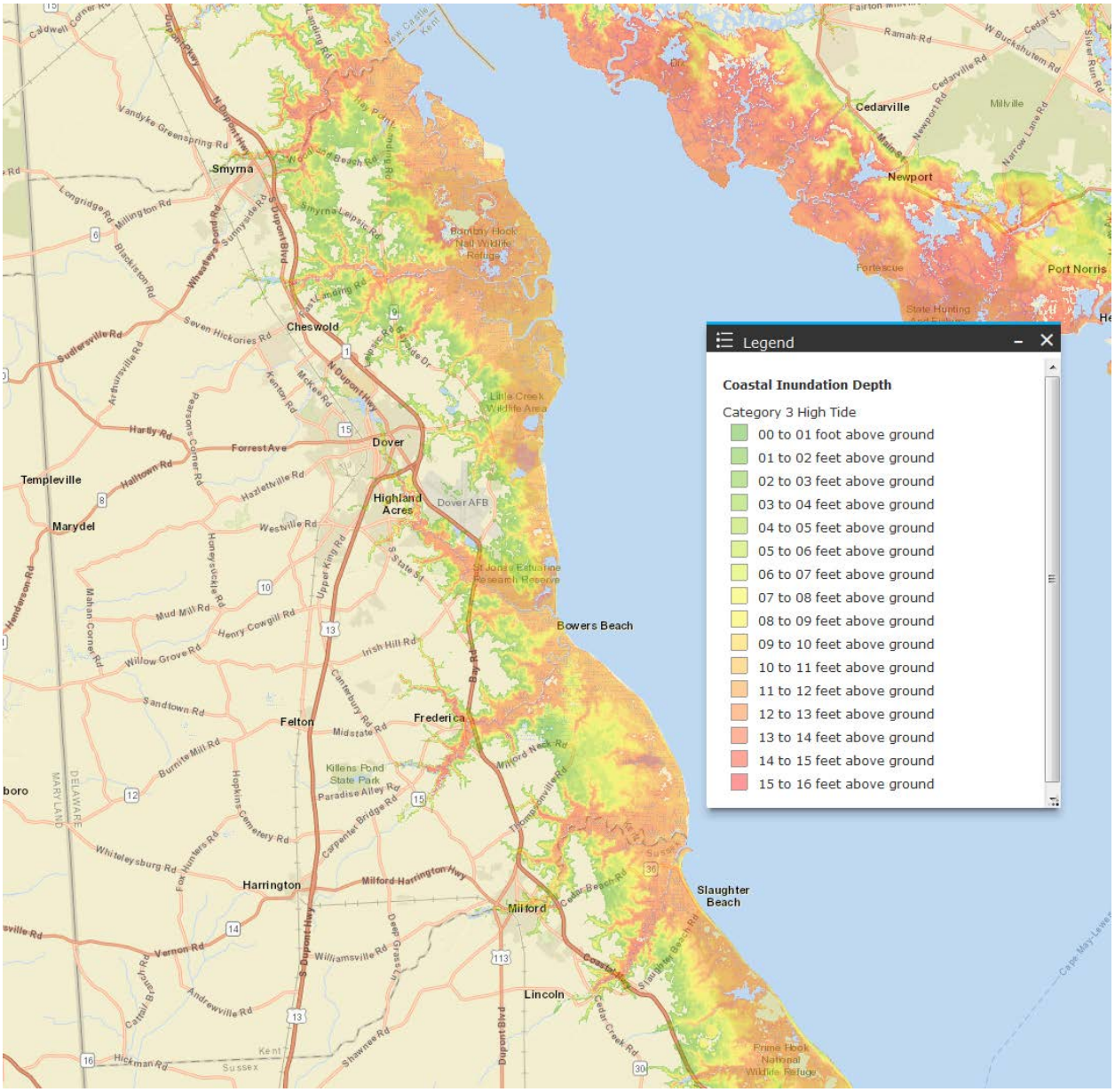


Figure 4.2-21
Coastal Inundation Depth, Category 3, Kent County

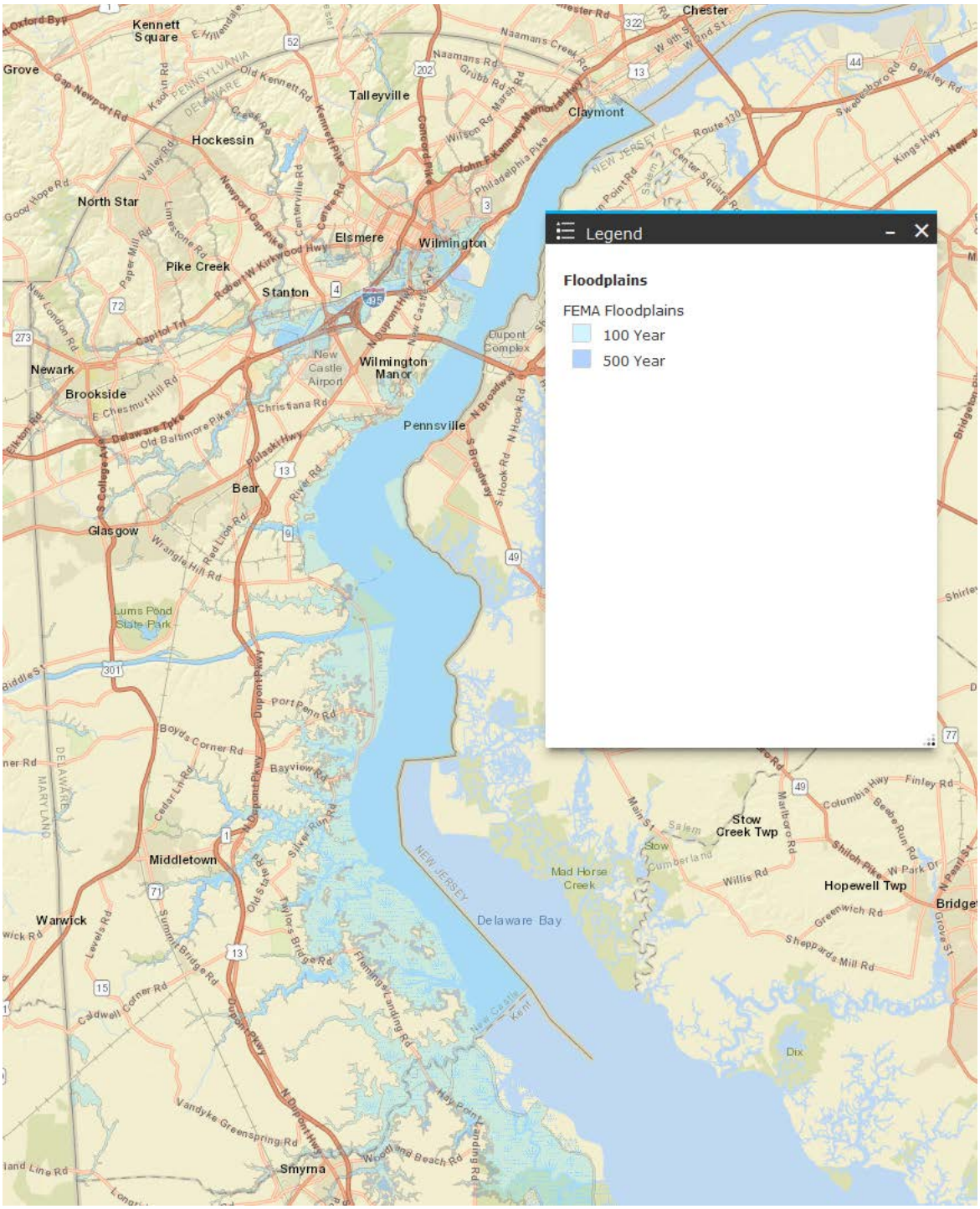


Figure 4.2-22
FEMA 100-Year and 500-Year Floodplains, New Castle County

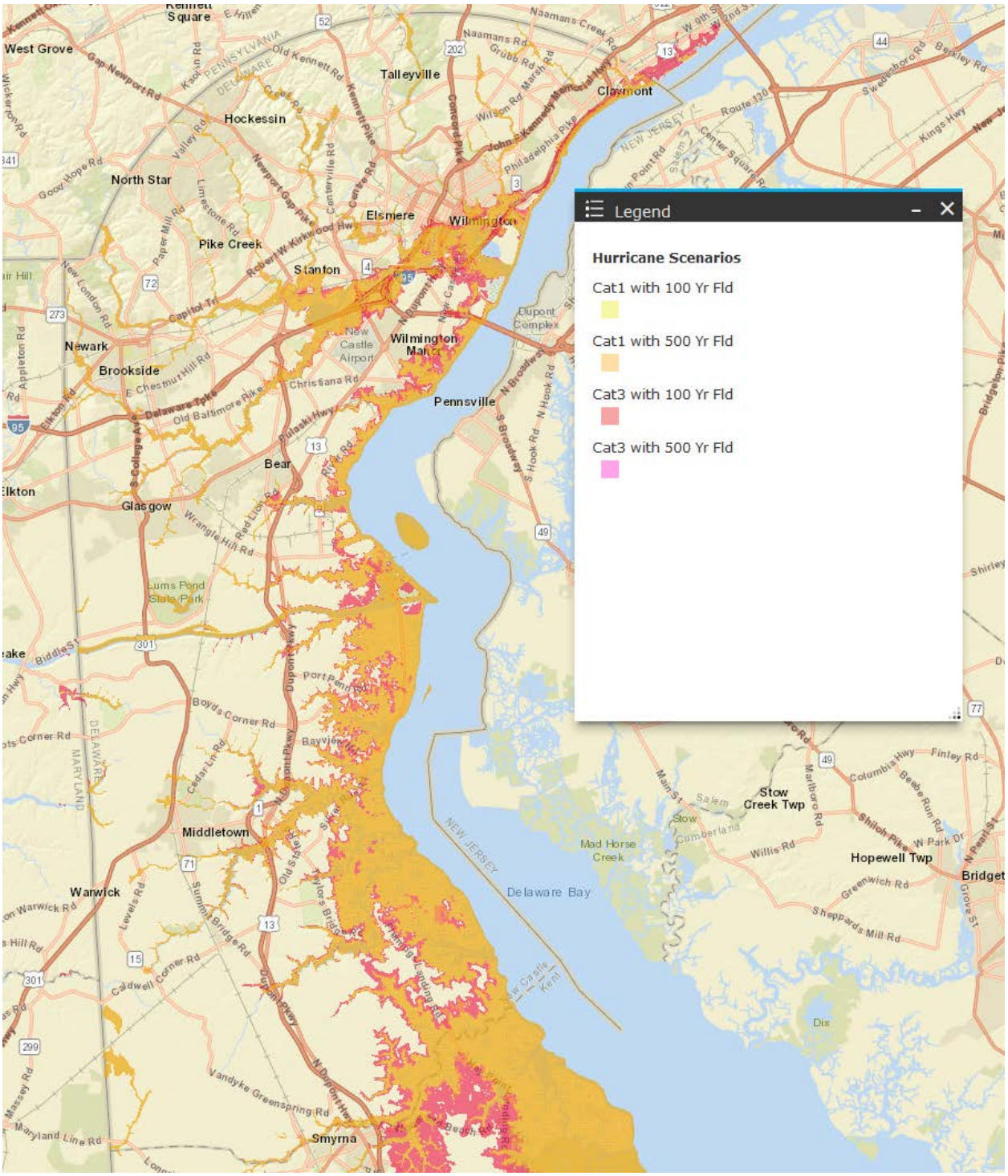


Figure 4.2-23
Combined Hurricane Inundation and Flood Scenarios, New Castle County

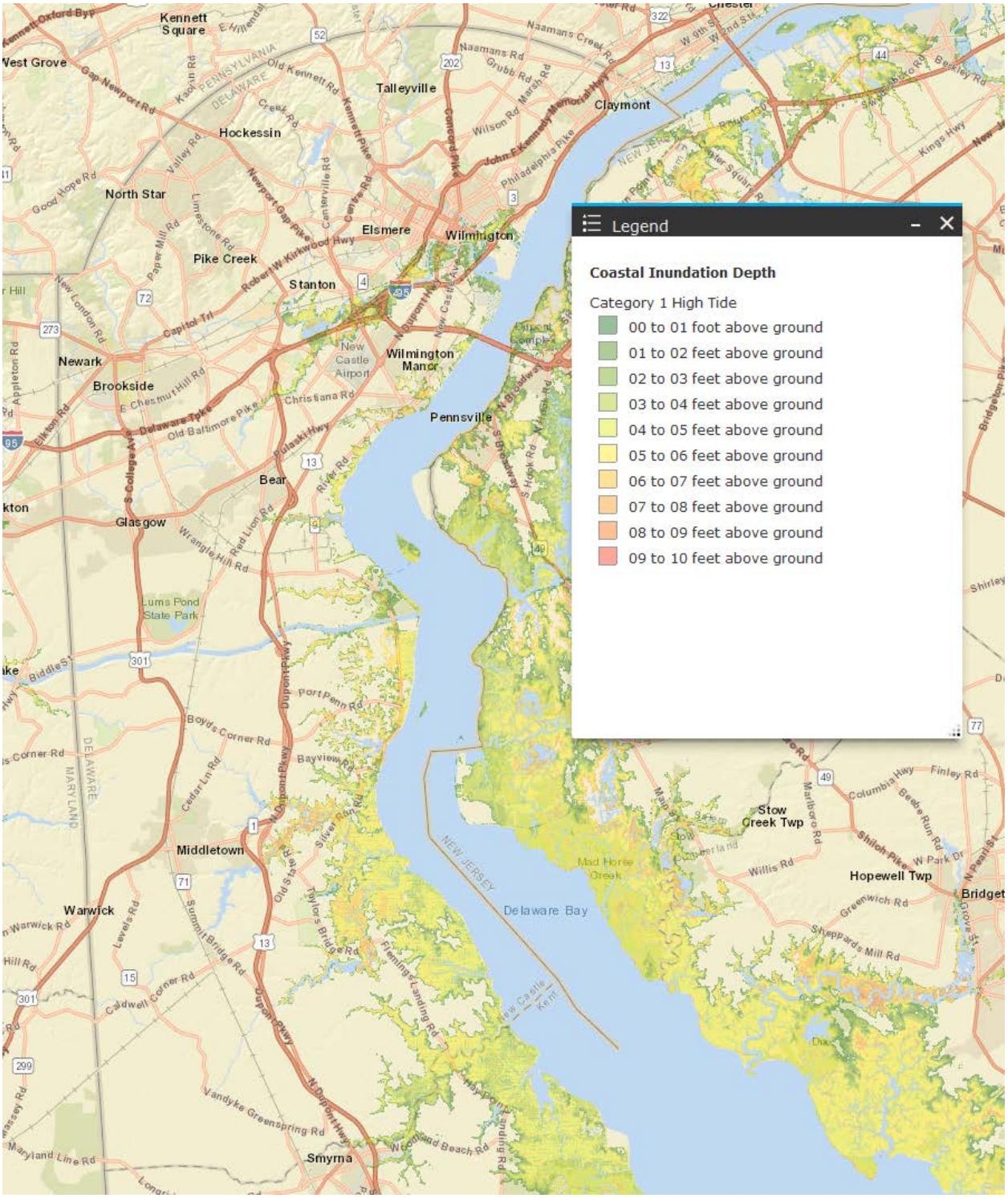


Figure 4.2-24
Coastal Inundation Depth, Category 1, New Castle County

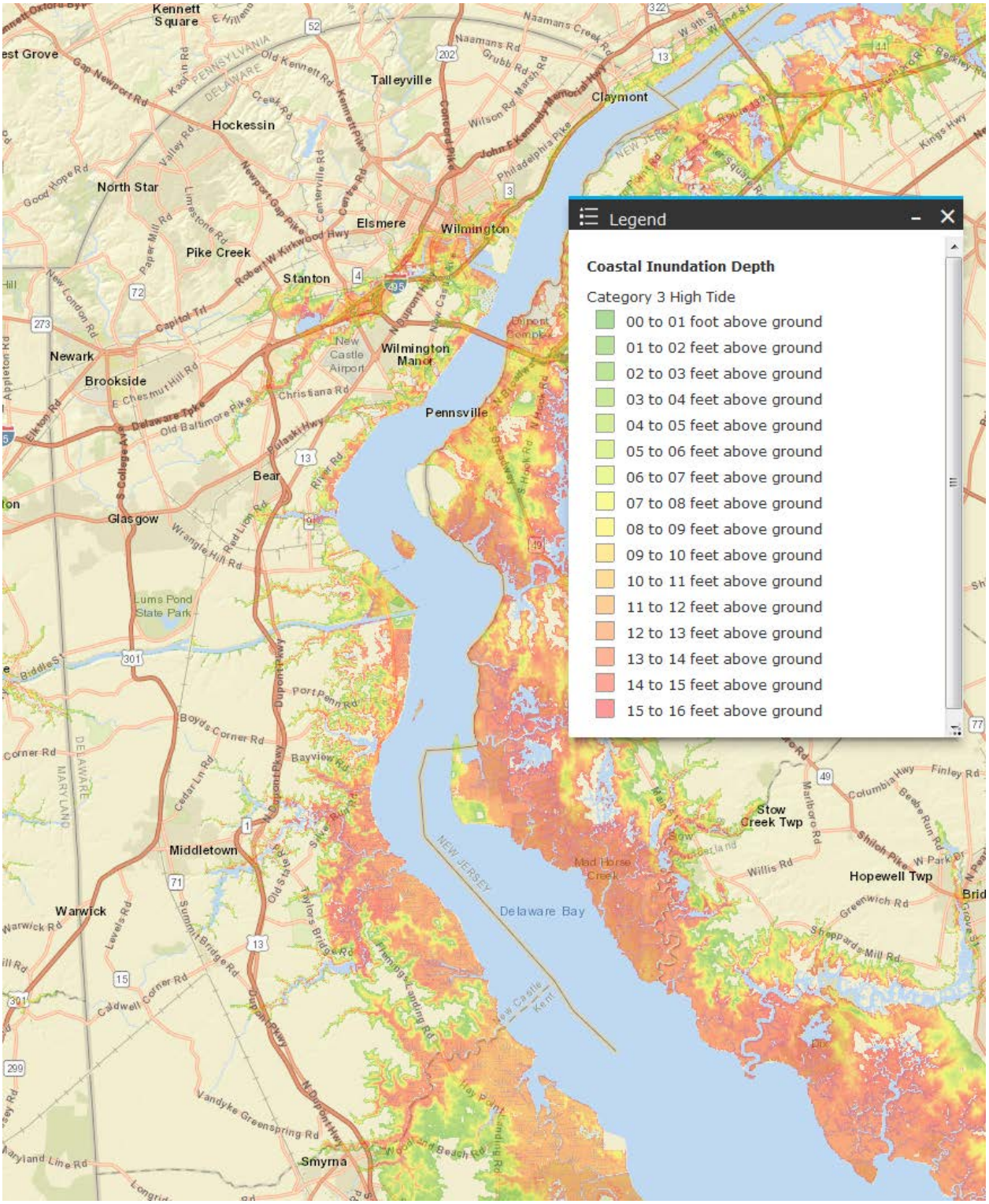


Figure 4.2-25
Coastal Inundation Depth, Category 3, New Castle County

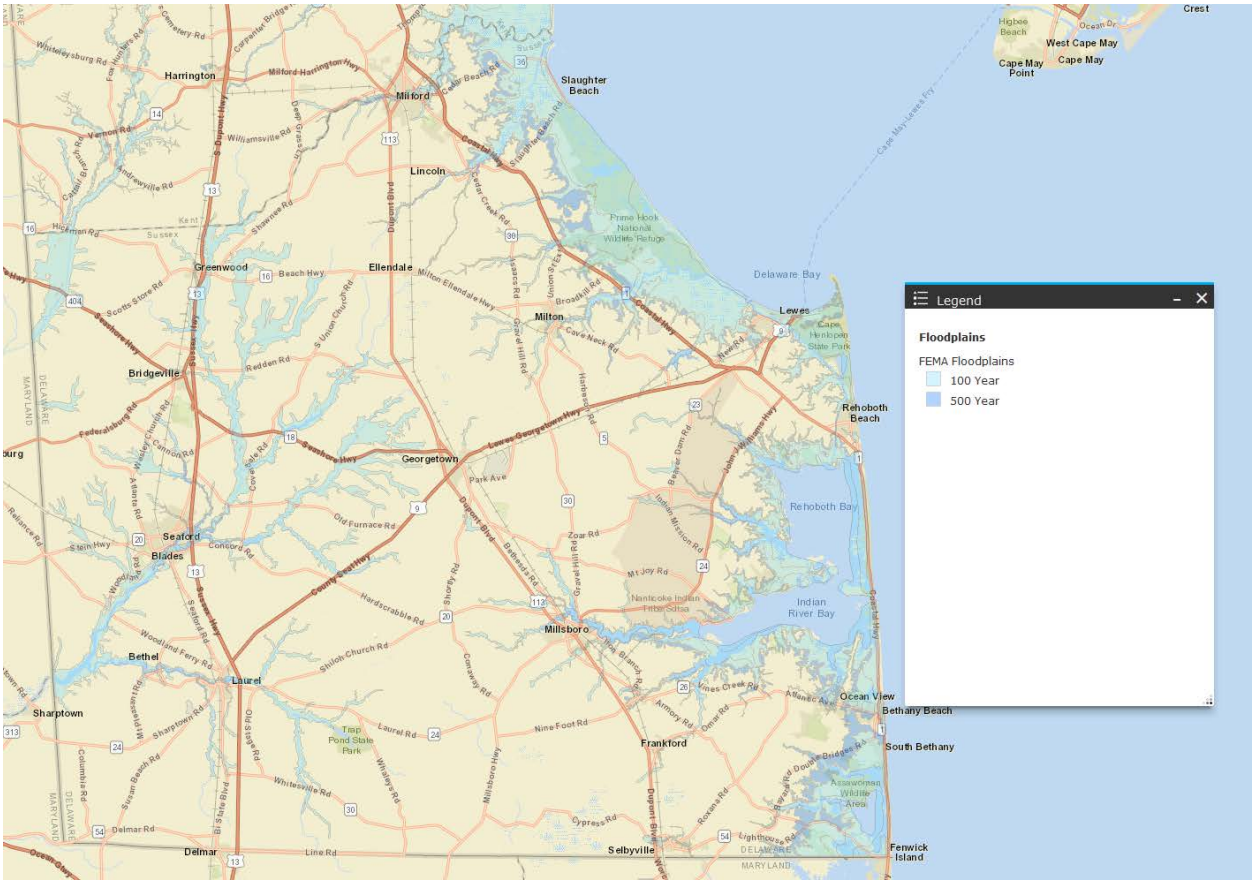


Figure 4.2-26
FEMA 100-Year and 500-Year Floodplains, Sussex County

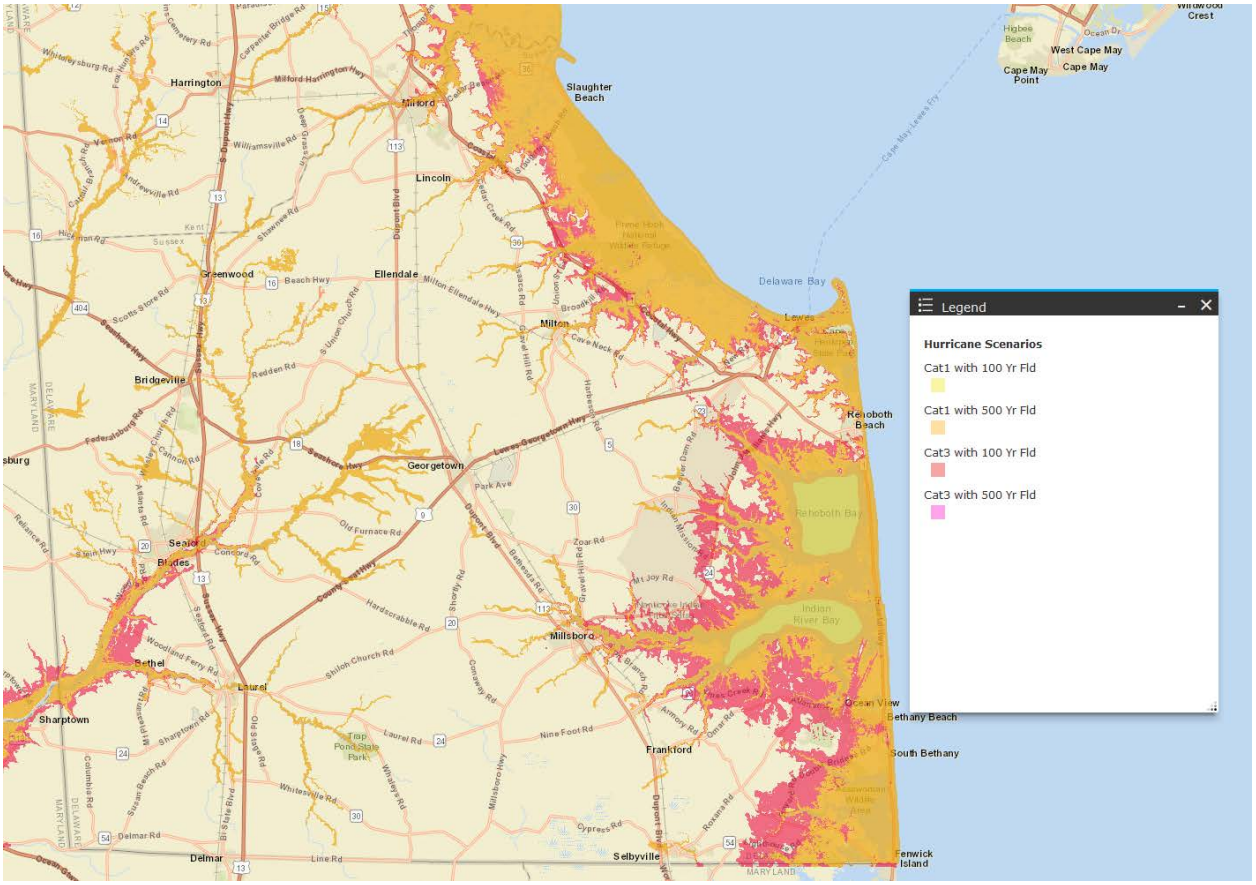


Figure 4.2-27
Category 1 Hurricane and 100-year Flood, Sussex County

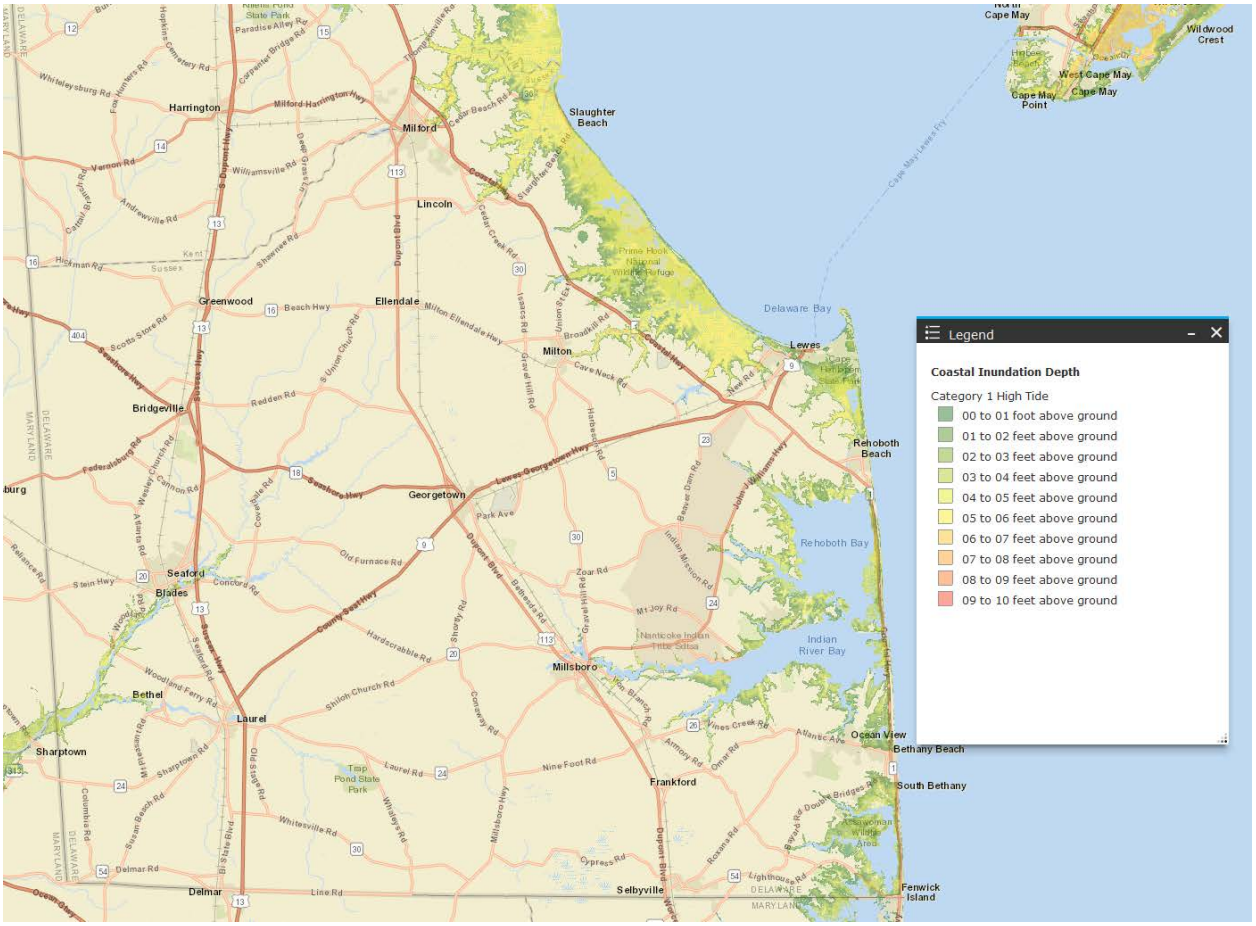


Figure 4.2-28
Coastal Inundation Depth, Category 1, Sussex County

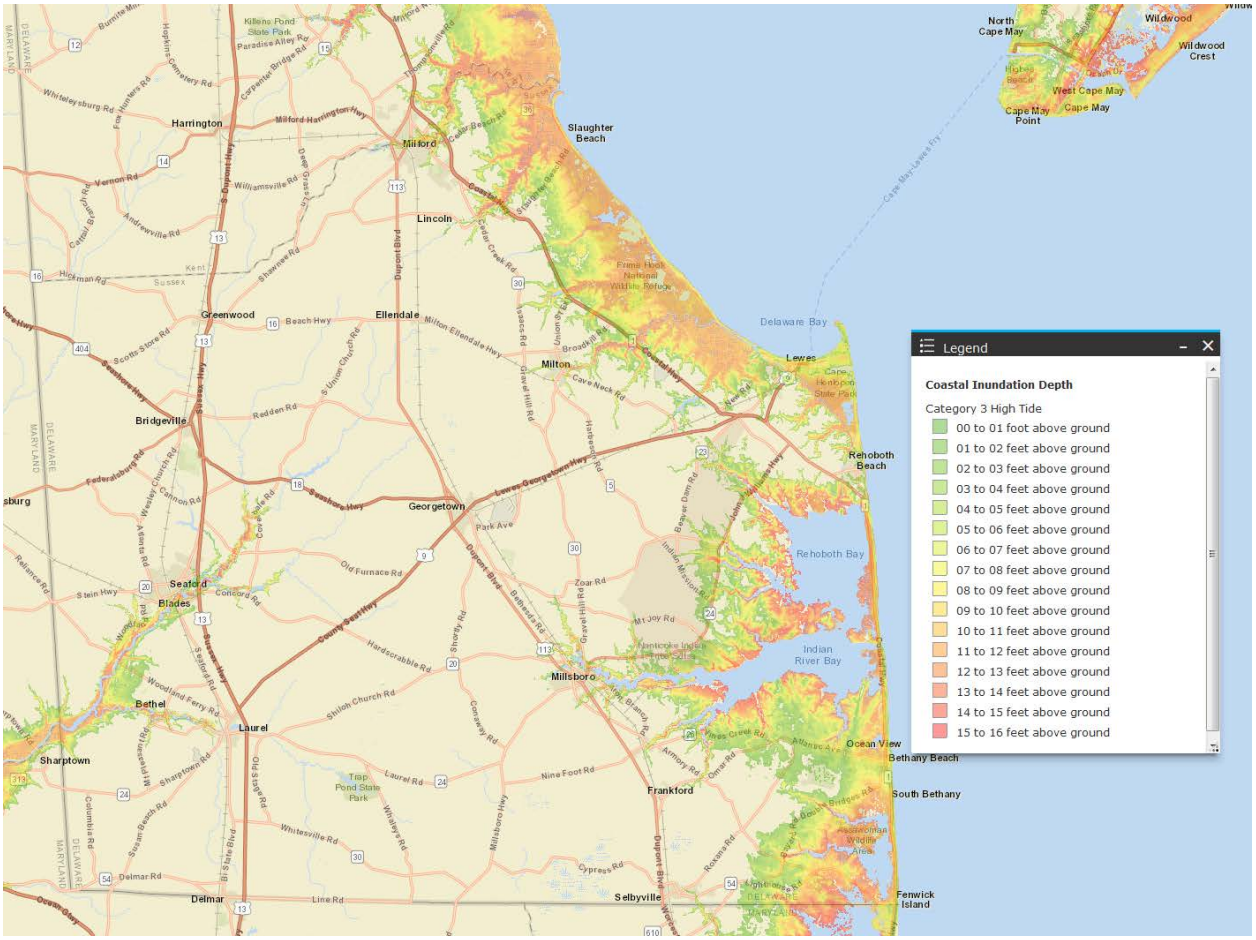


Figure 4.2-29
Coastal Inundation Depth, Category 3, Sussex County

Estimating Flood Losses

Table 4.2-8 to 4.2-10 shows the potential annualized losses to residential and commercial buildings from both coastal and riverine flooding reported from each county. Estimated losses for CCDs that do not touch the coast are based on riverine flooding only. There are significant variations in county output indicating different methodologies in use, an opportunity to increase consistency. **Table 4.2-11** details total statewide flood losses using HAZUS-MH methodology and a building footprint analysis for riverine and coastal flooding. A Statewide analysis predicts larger annualized losses for Kent and New Castle counties and smaller annualized losses for Sussex County (although Sussex still has the largest predicted flood loss).

Table 4.2-8
Potential Annualized Losses Reported by Kent County

Jurisdiction	Losses
CCD Central Kent	$51,842
CCD Dover	$125,421
CCD Felton	$2,173
CCD Harrington	$9,456
CCD Kenton	$4,055
CCD Milford North	$48,347
CCD Smyrna	$27,206
Kent CCD Total	$268,500

Table 4.2-9
Potential Annualized Losses Reported by New Castle County

Jurisdiction	Losses
CCD Brandywine	$79,340
CCD Central Pencader	$54,530
CCD Greater Newark	$115,606
CCD Lower Christiana	$25,744
CCD Middletown-Odessa	$107,342
CCD New Castle	$185,869
CCD Piedmont	$98,068
CCD Pike Creek-Central Kirkwood	$112,527
CCD Red Lion	$74,101
CCD Upper Christiana	$63,162
CCD Wilmington	$999
New Castle CCD Total	$917,288

Table 4.2-10
Potential Annualized Losses Reported by Sussex County

Jurisdiction	Losses
MCD Bridgeville-Greenwood	$1,091,200
MCD Georgetown	$255,801
MCD Laurel-Delmar	$991,374
MCD Lewes	$19,357,870
MCD Milford South	$1,912,048
MCD Millsboro	$36,640,370
MCD Milton	$445,316
MCD Seaford	$1,403,417
MCD Selbyville-Frankford	$43,167,201
Sussex MCD Total	$105,264,597

Table 4.2-11
Estimated Total Losses, State of Delaware

County	Annualized Losses	100-Year Losses	500-Year Losses
Kent	$840,784	$28,144,743	$67,496,762
New Castle	$2,687,921	$87,741,312	$221,550,301
Sussex	$6,462,703	$226,906,773	$491,532,248
Statewide Total	$9,991,409	$342,792,828	$780,579,311

Another means of gauging the vulnerability within the state of Delaware to flooding was determined to be the vulnerability of state-owned critical facilities to the 100- and 500-year flood return periods. Within the state, critical facilities were assessed with regard to flood risk by each county and for the entire state (see **Tables 4.2-12** through **4.2-15)**. **Table 4.2-16** inventories state properties at risk to floods.

Table 4.2-12
Critical Facility Damage Reported by Kent County

Jurisdiction	Critical Facilities	100-year flood		
		Moderate Damage	Slight Damage	Negligable Damage
CCD Central Kent	5	0	0	5
CCD Dover	17	0	0	17
CCD Felton	2	0	0	2
CCD Harrington	1	0	0	1
CCD Kenton	2	0	0	2
CCD Milford North	1	0	1	0
CCD Smyrna	1	0	0	1

Table 4.2-13
Critical Facility Damage Reported by New Castle County

Jurisdiction	Critical Facilities	100-year flood		
		Moderate Damage	Slight Damage	Negligable Damage
CCD Brandywine	41	0	0	0
CCD Central Pencader	10	0	0	0
CCD Greater Newark	16	0	0	0
CCD Lower Christiana	14	0	0	0
CCD Middletown-Odessa	5	0	0	0
CCD New Castle	28	0	0	0
CCD Piedmont	17	0	0	0
CCD Pike Creek-Central Kirkwood	20	0	0	0
CCD Red Lion	5	0	0	0
CCD Upper Christiana	12	0	0	0
CCD Wilmington	2	0	0	0

Table 4.2-14
Critical Facility Damage Reported by Sussex County

Jurisdiction	Critical Facilities	100-year flood		
		Moderate Damage	Slight Damage	Negligable Damage
MCD Bridgeville-Greenwood	76	12	64	0
MCD Georgetown	83	0	83	0
MCD Harrington	1	0	1	0
MCD Laurel-Delmar	172	17	155	0
MCD Lewes	175	8	166	1
MCD Milford North	1	0	1	0
MCD Milford South	121	0	121	0
MCD Millsboro	137	2	135	0
MCD Milton	62	0	62	0
MCD Seaford	163	19	144	0
MCD Selbyville-Frankford	258	4	254	0

Table 4.2-15
Critical Facility Damage, State of Delaware

County	Critical Facilities	Estimated Building Value	100-Year		500-Year	
			Damage %	Estimated Damages	Damage %	Estimated Damages
Kent	338	$169,500,000	0.16%	$268,383	0.38%	$643,635
New Castle	592	$295,500,000	0.12%	$347,541	0.30%	$877,556
Sussex	623	$311,500,000	0.78%	$2,429,840	1.69%	$5,263,592

Table 4.2-16
State Facility Potential Flood Exposure, State of Delaware

County	Med-High Risk	Low Risk	Total
Kent	322	346	668
New Castle	186	786	972
Sussex	309	268	577
Total	817	1,400	2,217

Storms and Hurricanes

Nor'Easters, Extra-Tropical Storms, Hurricanes, and Tropical Storms

Historical evidence shows that the state of Delaware is vulnerable to severe, hurricane and tropical storm-force winds. The approach for determining vulnerability to severe winds included a number of factors. HAZUS-MH was used for wind speed data as well as an inventory and in-house damage functions, which were used in estimating losses. For the worst-case scenario, the assumption used was that of a typical single event impact area with a Category 3 Hurricane and losses were then scaled accordingly. Finally, Exceeding Probability (EP) curves were developed for the planning area.

Figures 4.2-30 through **4.2-35** show the potential hurricane winds that could affect the area for 100- and 500-year wind events.

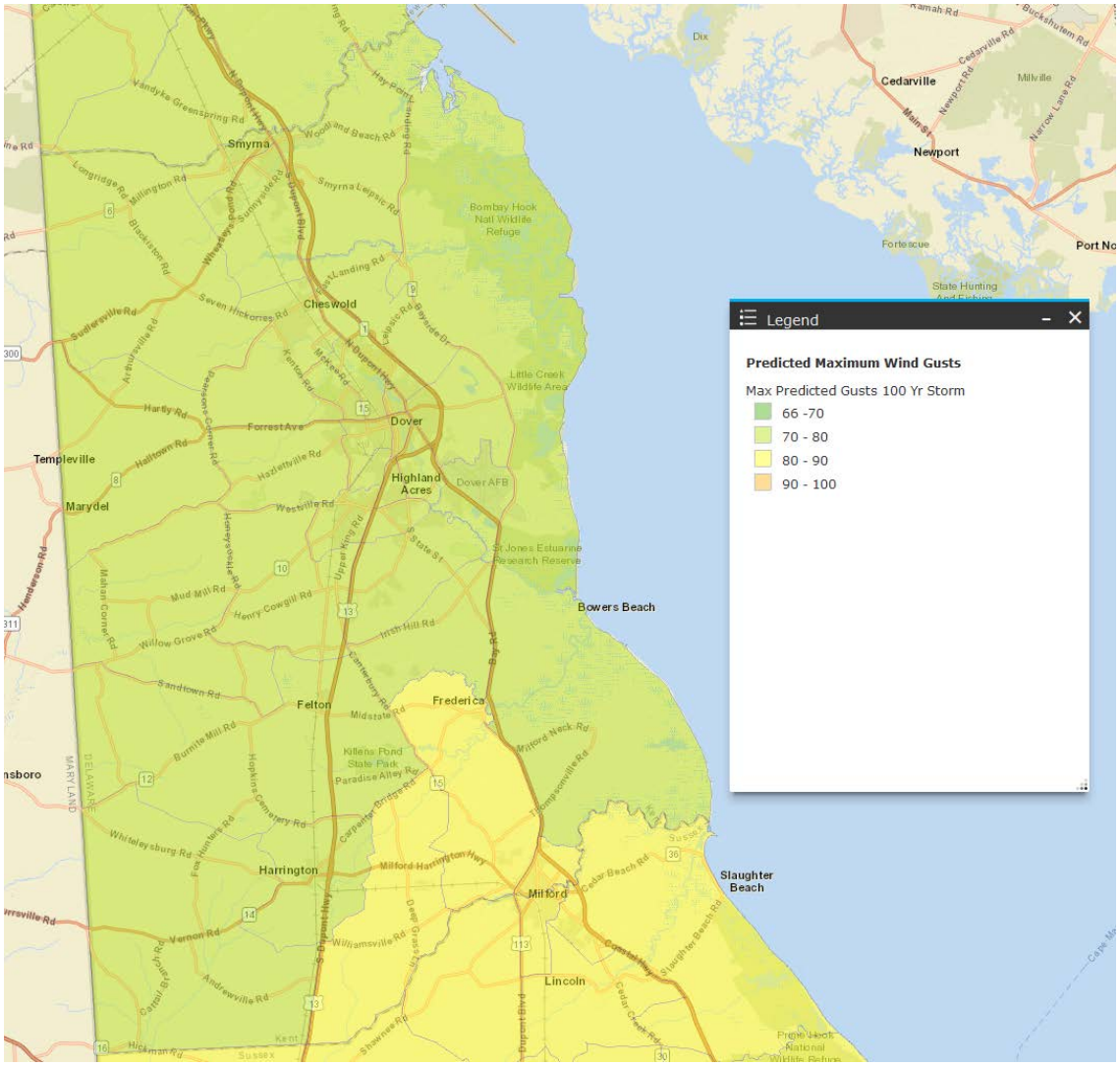


Figure 4.2-30
Maximum Wind Gusts, 100-year Storm, Kent County

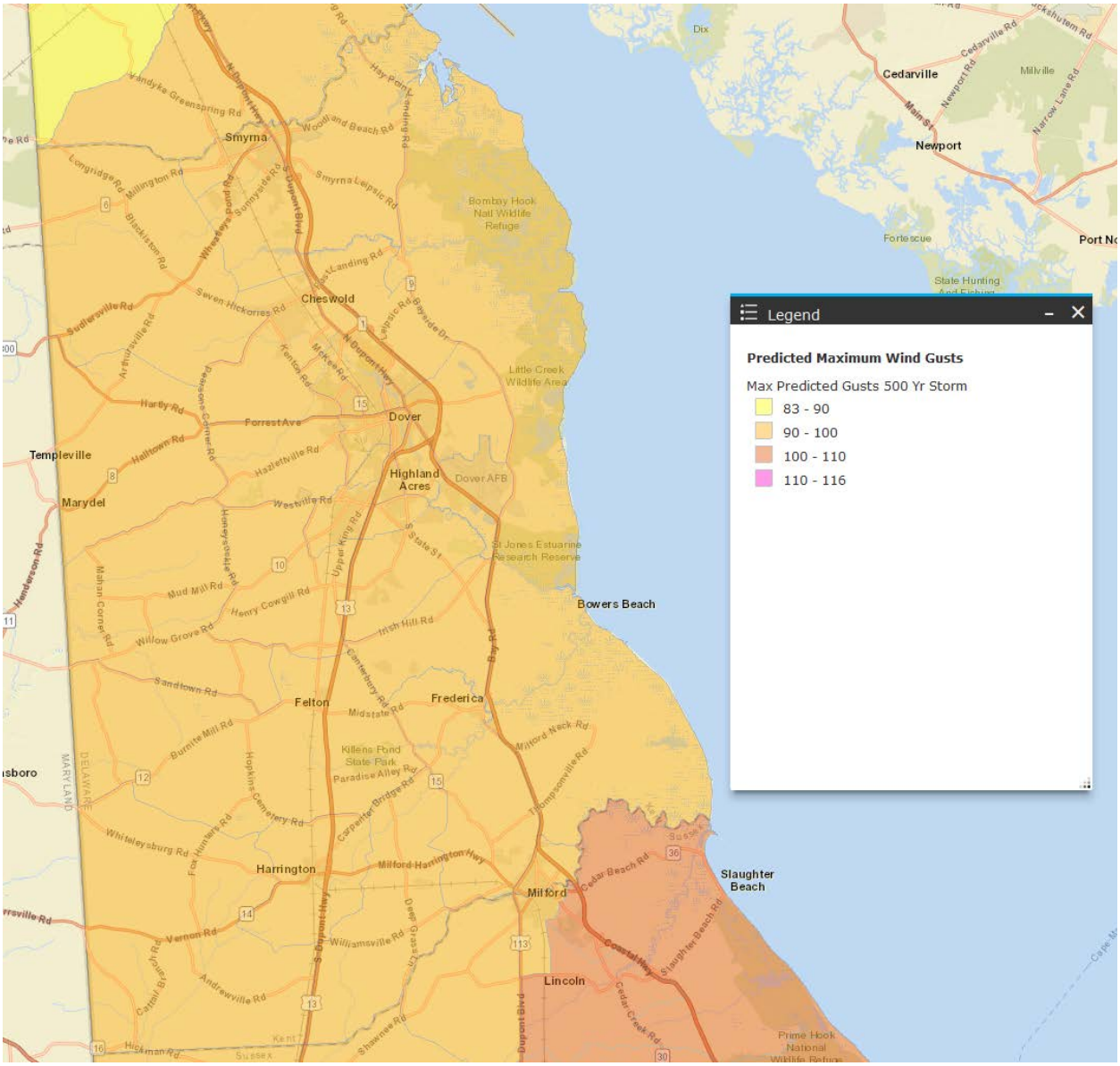


Figure 4.2-31
Maximum Wind Gusts, 500-year Storm, Kent County

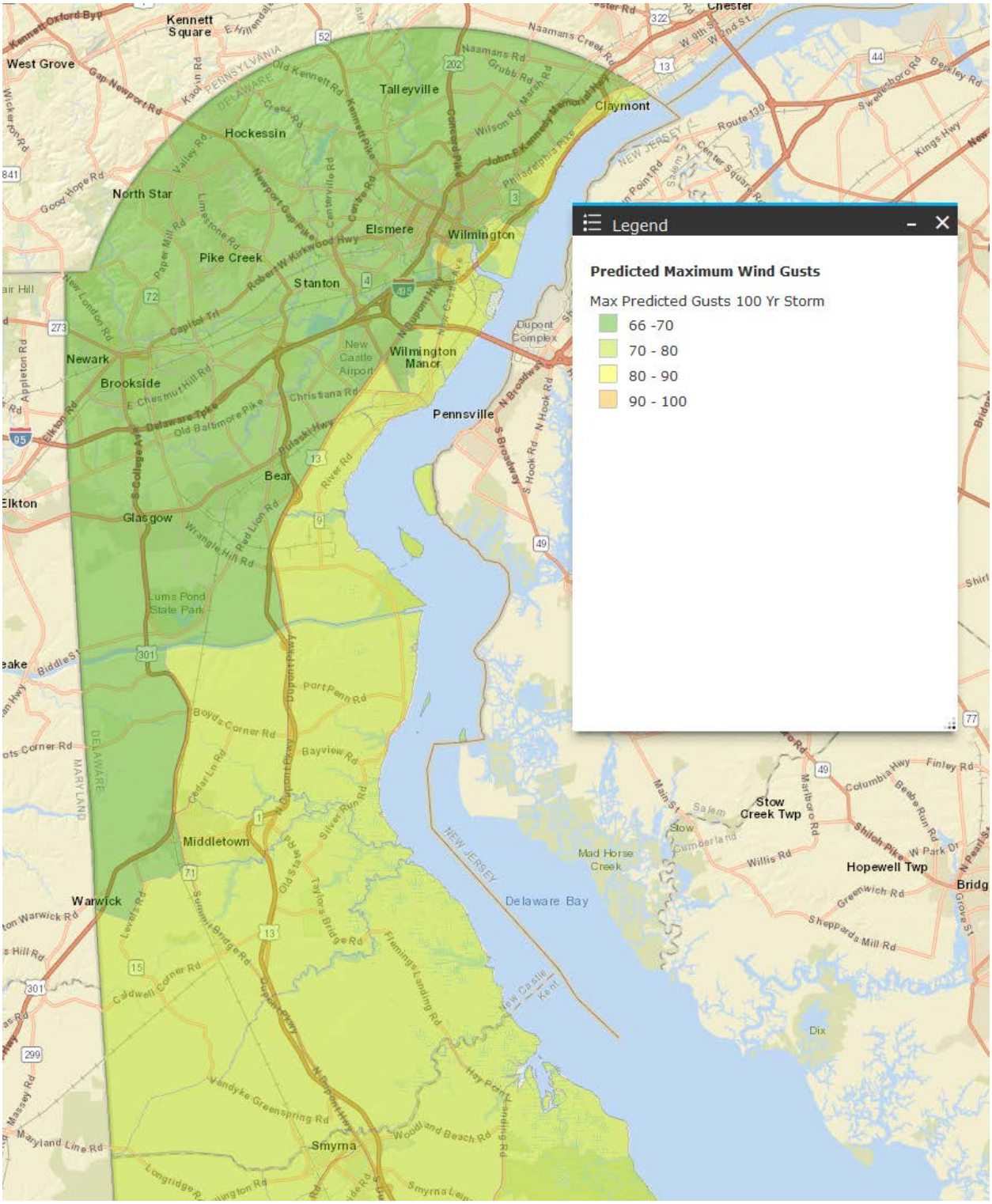


Figure 4.2-32
Maximum Wind Gusts, 100-year Storm, New Castle County

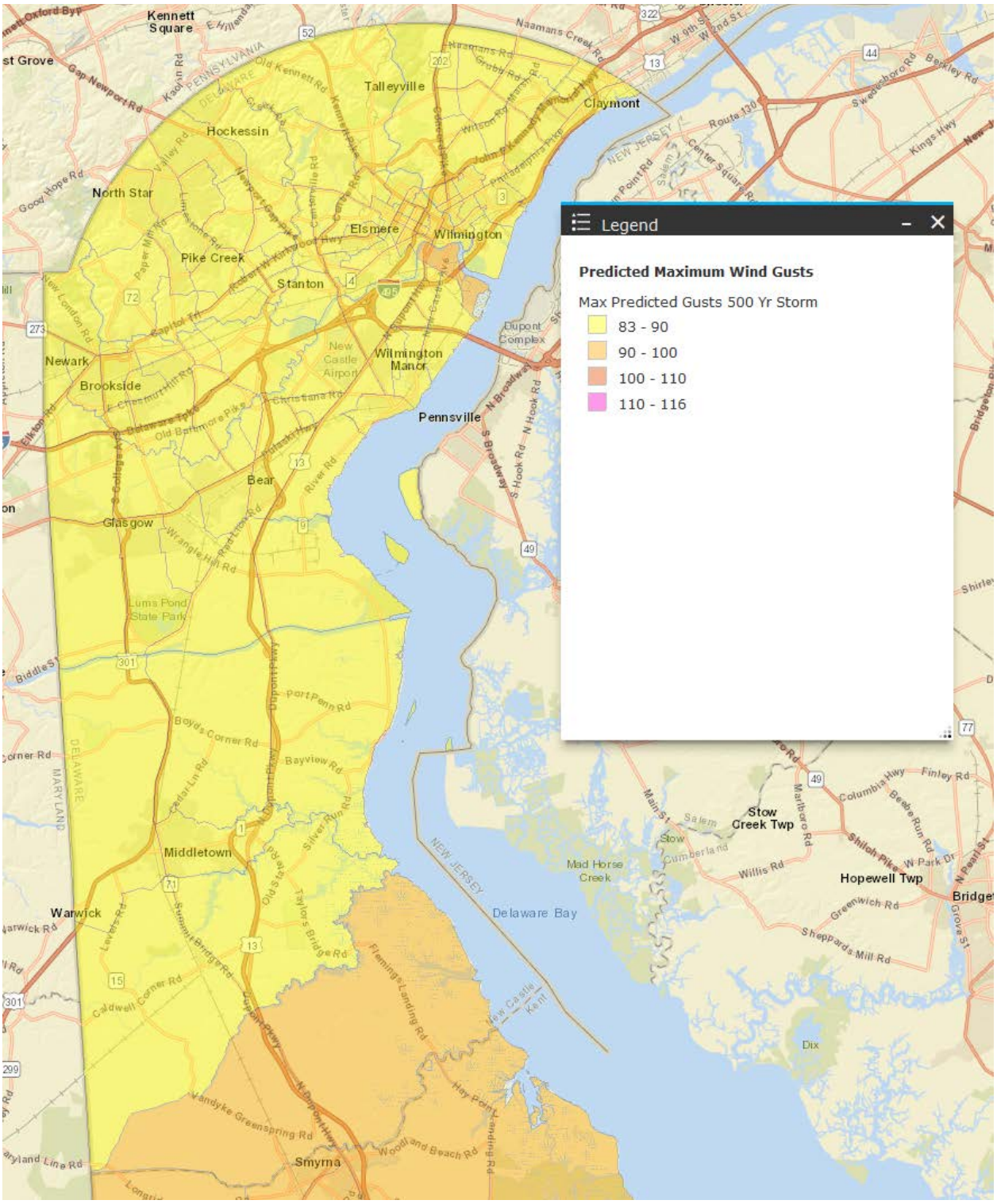


Figure 4.2-33
Maximum Wind Gusts, 500-year Storm, New Castle County

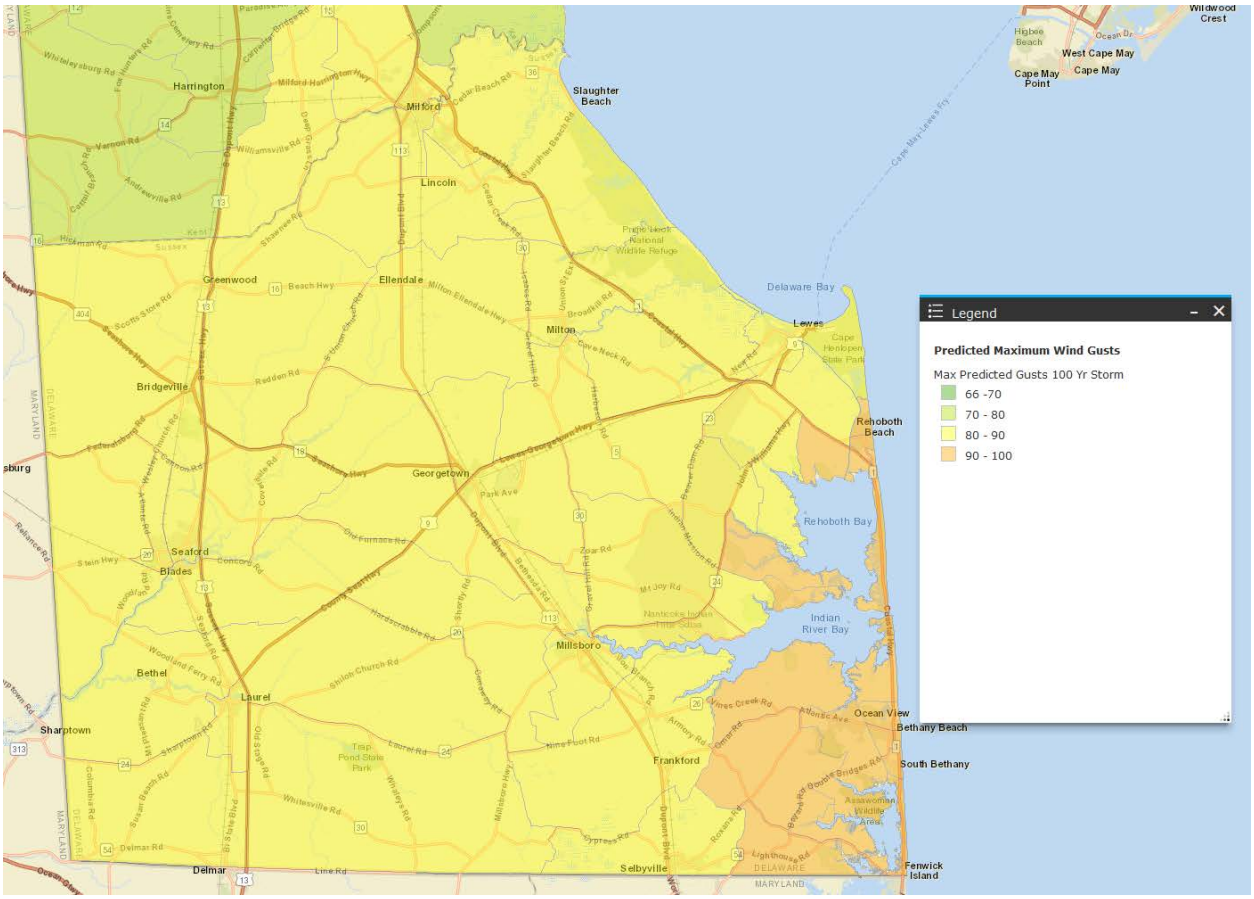


Figure 4.2-34
Maximum Wind Gusts, 100-year Storm, Sussex County

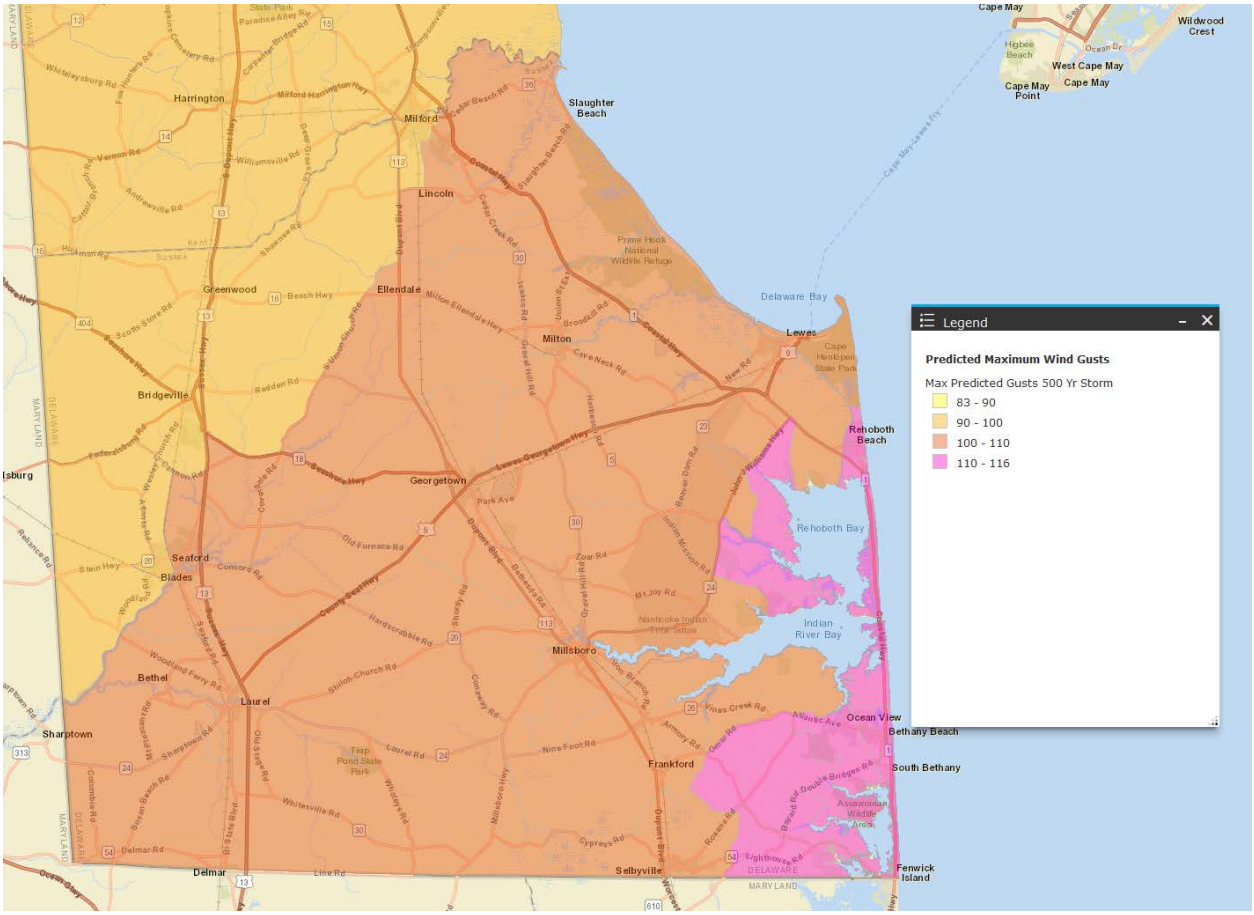


Figure 4.2-35
Maximum Wind Gusts, 500-year Storm, Sussex County

Tables 4.2-17 through **4.2-19** show the estimated annualized losses by county due to hurricane wind and **Table 4.2-20** summarizes the statewide estimated total losses using a statewide analysis and HAZUS-MH 4.0. The statewide analysis predicts significantly more wind damage for Sussex County.

Table 4.2-17
Tropical Storm Annualized Wind Losses, Kent County

Jurisdiction	Estimated Losses
CCD Central Kent	$501,094
CCD Dover	$625,933
CCD Felton	$115,294
CCD Harrington	$270,947
CCD Kenton	$79,347
CCD Milford North	$186,014
CCD Smyrna	$242,770
Total	$2,021,399

Table 4.2-18
Tropical Storm Annualized Wind Losses, New Castle County

Jurisdiction	Estimated Losses
CCD Brandywine	$528,892
CCD Central Pencader	$369,098
CCD Greater Newark	$224,189
CCD Lower Christiana	$184,112
CCD Middletown-Odessa	$571,877
CCD New Castle	$519,608
CCD Piedmont	$271,588
CCD Pike Creek-Central Kirkwood	$258,582
CCD Red Lion	$89,372
CCD Upper Christiana	$209,675
CCD Wilmington	$3,233
Total	$3,230,226

Table 4.2-19
Tropical Storm Annualized Wind Losses, Sussex County

Jurisdiction	Estimated Losses
MCD Bridgeville-Greenwood	$25,390
MCD Georgetown	$48,865
MCD Laurel-Delmar	$95,369
MCD Lewes	$367,759
MCD Milford	$48,034
MCD Millsboro	$616,112
MCD Milton	$111,662
MCD Seaford	$61,270
MCD Selbyville-Frankford	$451,242
Total	$1,825,703

Table 4.2-20
Tropical Storm Wind Losses 100 year and 500 year events, Statewide Analysis

County	Annualized Losses	100-Year Losses	500-Year Losses
Kent	$2,730,000	$51,299,880	$240,564,340
New Castle	$4,025,000	$68,478,300	$386,661,620
Sussex	$15,646,000	$265,653,710	$1,706,989,170
Statewide Total	$22,401,000	$385,431,890	$2,334,215,130

Tables 4.2- 21 through **4.2-23** show the potential damage to critical facilities by county and **Table 4.2-24** summarizes the statewide potential damage. Sussex County uses a different method of calculating critical facilities, this is an opportunity to improve future plan continuity.

Table 4.2-21
Critical Facilities Damaged Kent County

Jurisdiction	Total Number of Critical Facilities	100-year			500-year			
		Moderate Damage	Slight Damage	Negligable Damage	Extensive Damage	Moderate Damage	Slight Damage	Negligable Damage
CCD Central Kent	5	0	0	0	0	0	0	0
CCD Dover	17	0	0	0	0	0	0	0
CCD Felton	2	0	0	0	0	0	0	0
CCD Harrington	1	0	0	0	0	0	0	0
CCD Kenton	2	0	0	0	0	0	0	0
CCD Milford North	1	0	0	0	0	0	0	0
CCD Smyrna	1	0	0	0	0	0	0	0

Table 4.2-22
Critical Facilities Damaged New Castle County

Jurisdiction	Total Number of Critical Facilities	100-year				500-year		
		Moderate Damage	Slight Damage	Negligable Damage	Extensive Damage	Moderate Damage	Slight Damage	Negligable Damage
CCD Brandywine	41	0	0	0	1	0	0	0
CCD Central Pencader	10	0	0	0	0	0	0	0
CCD Greater Newark	16	0	0	0	0	0	0	0
CCD Lower Christiana	14	0	0	0	0	0	0	0
CCD Middletown-Odessa	5	0	0	0	0	0	0	0
CCD New Castle	28	0	0	0	1	0	0	0
CCD Piedmont	17	0	0	0	0	0	0	0
CCD Pike Creek-Central Kirkwood	20	0	0	0	0	0	0	0
CCD Red Lion	5	0	0	0	0	0	0	0
CCD Upper Christiana	12	0	0	0	1	0	0	0
CCD Wilmington	2	0	0	0	0	0	0	0

Table 4.2-23
Critical Facilities Damaged Sussex County

Jurisdiction	Total Number of Critical Facilities	100-year				500-year		
		Moderate Damage	Slight Damage	Negligable Damage	Extensive Damage	Moderate Damage	Slight Damage	Negligable Damage
MCD Bridgeville-Greenwood	76	30	19	27	0	40	36	0
MCD Georgetown	83	50	11	22	15	28	39	1
MCD Harrington	1	1	0	0	0	0	1	0
MCD Laurel-Delmar	172	67	46	59	2	97	70	3
MCD Lewes	175	136	36	3	127	31	14	3
MCD Milford North	1	0	0	1	0	1	0	0
MCD Milford South	121	50	24	47	11	63	41	6
MCD Millsboro	137	91	43	3	81	40	14	2
MCD Milton	62	44	14	4	43	15	3	1
MCD Seaford	163	85	36	42	0	63	96	4
MCD Selbyville-Frankford	258	180	78	0	156	70	32	0

Table 4.2-24
Statewide Critical Facility Analysis Calculation

County	Critical Facilities	Estimated Building Value	100-Year		500-Year	
			Damage %	Estimated Damages	Damage %	Estimated Damages
Kent	338	$169,500,000	0.22%	$372,900	0.98%	$1,661,100
New Castle	592	$295,500,000	0.18%	$531,900	0.41%	$1,211,550
Sussex	623	$311,500,000	0.69%	$2,149,350	3.82%	$11,899,300

Winter Storms

Historical evidence shows that the entire State of Delaware is quite vulnerable to winter storms, with several occurring each year. Because winter storms generally impact large areas, all buildings and facilities are considered to be exposed to this hazard and could potentially be impacted. It is also difficult to estimate the number of residential, commercial, and other buildings or facilities that may experience losses. The approach for determining vulnerability to winter storms consisted of a number of factors. National Oceanic and Atmospheric Administration (NOAA) historical winter storm loss data and the Winter Storm Stochastic Model were used. **Table 4.2-25** calculates the statewide annual winter storm events probability.

Tables 4.2-26 through 4.2-28 show annualized expected losses from winter storm events by jurisdiction within the state.

Table 4.2-25
Annual Winter Storm Events (NOAA)

County	Total Events	Years	Annual Events
Kent	94	17	5.53
New Castle	119	17	7.00
Sussex	93	17	5.47
Total	155	17	9.12

Table 4.2-26
Potential Annualized Losses from Winter Storms, Kent County

Jurisdiction	Estimated Loss
CCD Central Kent	$12,294
CCD Dover	$17,400
CCD Felton	$3,034
CCD Harrington	$4,710
CCD Kenton	$3,184
CCD Milford North	$3,435
CCD Smyrna	$6,401
Kent Total	$50,458

Table 4.2-27
Potential Annualized Losses from Winter Storms, New Castle County

Jurisdiction	Estimated Loss
CCD Brandywine	$77,867
CCD Central Pencader	$31,157
CCD Greater Newark	$29,190
CCD Lower Christiana	$22,514
CCD Middletown-Odessa	$25,810
CCD New Castle	$50,394
CCD Piedmont	$45,754
CCD Pike Creek-Central Kirkwood	$31,990
CCD Red Lion	$8,309
CCD Upper Christiana	$30,813
CCD Wilmington	$191
New Castle Total	$353,989

Table 4.2-28
Potential Annualized Losses from Winter Storms, Sussex County

Jurisdiction	Estimated Loss
MCD Bridgeville-Greenwood	$35,556
MCD Georgetown	$23,189
MCD Laurel-Delmar	$62,510
MCD Lewes	$29,303
MCD Milford South	$42,395
MCD Millsboro	$33,146
MCD Milton	$21,565
MCD Seaford	$31,011
MCD Selbyville-Frankford	$44,148
Sussex Total	$322,823

The vast majority of cost associated with winter storms come from snow removal. For a FEMA emergency or disaster declaration, there must be record or near record snowfall (which would be approximately 2.5-3 feet for Delaware). Anything less than a record or near record snow, the state and its residents absorb all the costs. All critical and state-owned facilities are considered equally exposed to this hazard.

Coastal Erosion

Delaware experiences coastal erosion which was identified by stakeholders as a natural hazard. DNREC and USACE estimate annualized storm damage reductions of shoreline stabilization projects to total $16,822,000. Therefore, the annualized potential losses from discontinuing coastal erosion programs are $16,822,000, however, these losses are offset by the fact that shoreline stabilization projects are currently active, mitigating current risk to state and critical facilities. These losses are concentrated in low-lying coastal communities. All critical and state-owned facilities are considered equally exposed to this mitigated hazard including 2,053 identified state facilities. **Table 4.2-29** identifies coastal erosion risk if mitigation efforts cease, concentrated in Sussex County.

Table 4.2-29
Estimated Coastal Erosion Loss without Mitigation

State	Estimated Loss
Delaware	$16,822,000

Severe Thunderstorms

Because it cannot be predicted where a thunderstorm might cause damage, all buildings and facilities are considered to be exposed to this hazard and could potentially be impacted. In addition, it is not possible to estimate the number of residential, commercial, and other buildings or facilities that may experience losses. There are no direct critical facility losses modeled from thunderstorms, however, NOAA warns that thunderstorm conditions can often lead to tornado and wind damage, modeled in the tornado and hurricane sections respectively. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities.

Tables 4.2-30 through **4.2-32** show annualized expected losses from thunderstorm events by jurisdiction within the State. **Table 4.2-33** calculates the statewide annual severe thunderstorm wind events probability.

Table 4.2-30
Potential Annualized Losses from Thunderstorms, Kent County

Jurisdiction	Estimated Loss
CCD Central Kent	$11,981
CCD Dover	$16,956
CCD Felton	$2,957
CCD Harrington	$4,589
CCD Kenton	$3,103
CCD Milford North	$3,347
CCD Smyrna	$6,237
Kent Total	$49,170

Table 4.2-31
Potential Annualized Losses from Thunderstorms, New Castle County

Jurisdiction	Estimated Loss
CCD Brandywine	$20,815
CCD Central Pencader	$8,329
CCD Greater Newark	$7,803
CCD Lower Christiana	$6,019
CCD Middletown-Odessa	$6,900
CCD New Castle	$13,472
CCD Piedmont	$12,231
CCD Pike Creek-Central Kirkwood	$8,552
CCD Red Lion	$2,221
CCD Upper Christiana	$8,237
CCD Wilmington	$51
New Castle Total	$94,630

Table 4.2-32
Potential Annualized Losses from Thunderstorms, Sussex County

Jurisdiction	Estimated Loss
MCD Bridgeville-Greenwood	$17,559
MCD Georgetown	$11,452
MCD Laurel-Delmar	$30,869
MCD Lewes	$14,471
MCD Milford South	$20,936
MCD Millsboro	$16,369
MCD Milton	$10,649
MCD Seaford	$15,314
MCD Selbyville-Frankford	$21,801
Sussex Total	$159,420

Table 4.2-33
Annual Severe Thunderstorm Wind Events (NOAA)

County	Total Events	Years	Annual Events
Kent County, DE	318	56	5.68
New Castle County, DE	304	54	5.63
Sussex County, DE	286	52	5.50
Statewide	908	56	16.81

Extreme Heat and Cold

Extreme heat and cold tend not to generate direct economic losses to infrastructure, but these events are damaging to human population. The combination of heat and humidity in Delaware create conditions in the summer that exceed the minimums of NOAA's "Extreme Danger" heat category, and Delaware winters are cold enough to frequently create hazardous low temperature conditions.

Figure 4.2-36 shows an example set of shelters, publicly accessible buildings, and community groups that traditionally offer to assist those in need. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities. **Table 4.2-34** details shelter location counts. Examining vulnerable populations in extreme heat and cold weather events, the entire state has access to a building that can reasonably be used as a public shelter within a ten-mile radius. Models of record heat and cold events in Delaware predict no direct losses to state structures.

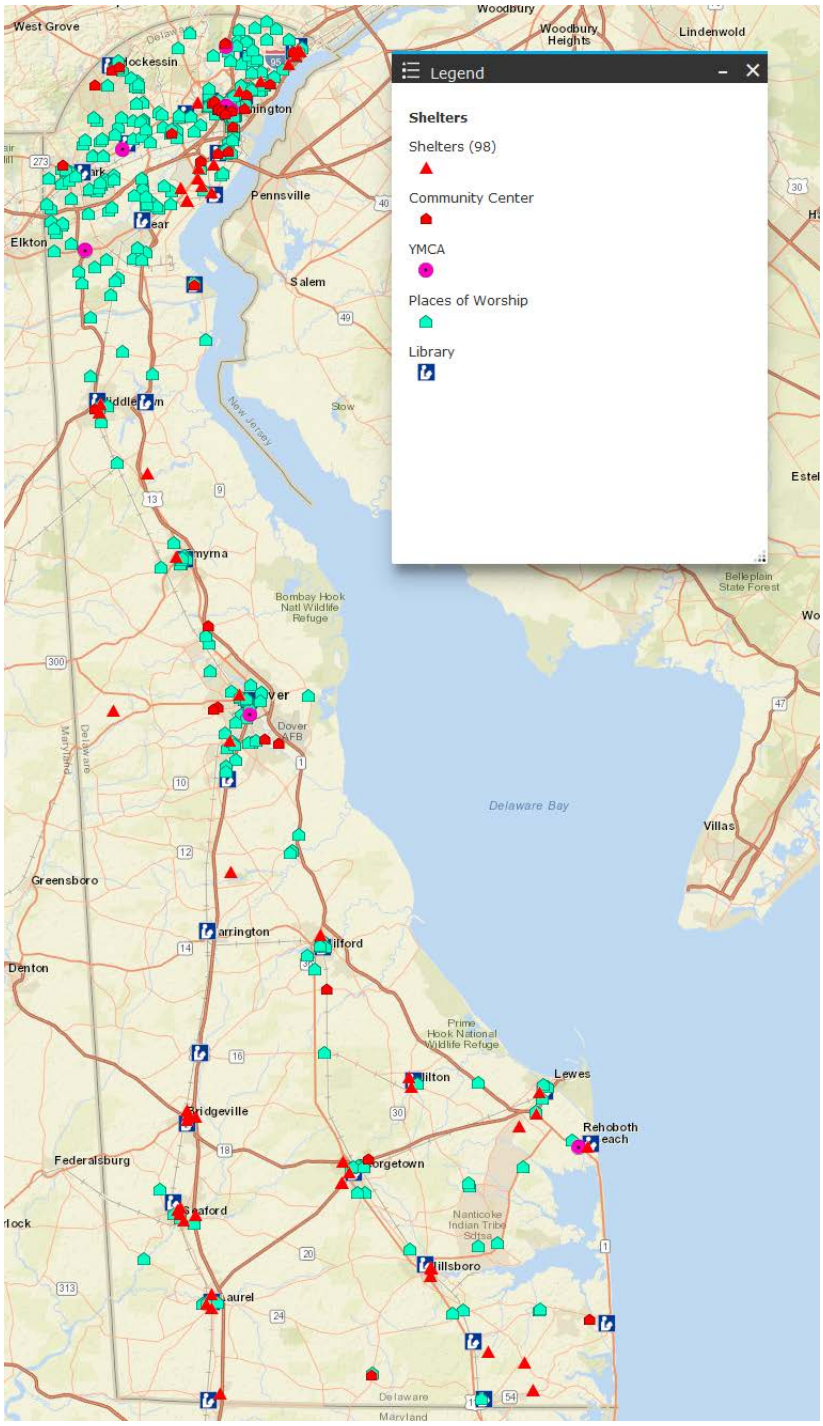


Figure 4.2-36
Potential Sheltering Options in Extreme Heat and Cold

Table 4.2-34
Potential Shelter Locations

Category	Shelter Buildings
Designated Schools	27
National Guard Facilities	35
Designated Hotels	140
Community Centers	30
YMCAs	7
Places of Worship	283
Libraries	21
Public Schools	172

Tornadoes

Historical evidence shows that most of the state is vulnerable to tornadic activity. This particular hazard may result from severe thunderstorm activity or may occur during a tropical storm or hurricane. Because it cannot be predicted where a tornado may strike, all buildings and facilities are considered to be exposed to this hazard and could potentially be impacted. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities. It is also not possible to estimate the number of residential, commercial, and other buildings or facilities that may experience losses. The worst tornado recorded in Delaware was a F-3 tornado in 1961 at the New Castle Airport. Using the current measurement system, the worst-case tornado estimated for Delaware is EF-3. All critical and state-owned facilities are considered equally exposed to this hazard.

The approach to determining vulnerability to tornadoes included a number of factors. Historical tornado loss data from the National Oceanic and Atmospheric Administration (NOAA) was used. All historical losses were scaled to account for inflation, and average historic tornado damageability was used to generate losses for historical tornado events where losses were not reported. Expected annualized losses were extrapolated through non-linear regression of historical data. Probabilistic losses were scaled to account for would-be losses where no exposure/instrument was present at the time of the event. **Table 4.2-35** computes the statewide annual tornado event probability and annualized expected losses from tornado events. The location and path of past severe tornado events within the state is presented in **Figure 4.2-37**. Assuming equal proportional risk of state critical facilities, estimated annual losses dues to tornadoes are $984 for Kent County, $489 for New Castle County, and $118 for Sussex County.

Table 4.2-35
Tornado Annual Events and Loss Information

County	Total Events	Total Loss	Years	Annual Events	Annual Loss	Deaths	Injuries
Kent County, DE	20	$5,158,000	50	0.40	$103,160	2	56
New Castle County, DE	23	$7,413,000	60	0.38	$123,550	0	8
Sussex County, DE	18	$594,000	54	0.33	$11,000	0	11

Figure 4.2-37
NOAA Severe Tornado Paths, 1950-2016

Dam/Levee Failure

From 2009-2013 the DNREC Dam Safety Program completed sunny-day dam break inundation mapping for 38 state-owned dams and the estimated population at risk for each of these dams was computed by counting the number of structures within the inundation area and using a population value of 3 people for each residential structure and 10 people for each commercial or institutional structure.

For dams without inundation mapping, estimated population at risk values were used from the 2008 DNREC Dam Safety Program inventory of dams in the State. Dam-failure inundation areas downstream of each dam were estimated using approximate methods, as explained in this excerpt from the "Final Report, Delaware Dam Inventory, October 09, 2009," prepared by URS Corporation: "The sunny-day, brim-full dam failure inundation area was estimated in accordance with the *Guidelines on Risk Assessment*, published in 2003 by the Australian National Committee on Large Dams Incorporated. These guidelines state that a basic downstream inundation area can be calculated by determining the flood peak height and then routing it downstream. For this study, it was assumed that the flood peak height could be approximated by multiplying the total dam height by a factor of 75 percent. This dam height factor was based on numerical modeling of two dams and a review of several previous inundation studies for dams with similar landscape conditions. This level of analysis is a conservative estimate, as flow dispersion and attenuation is not taken into account as the flood wave moves downstream. The flood wave was routed for 1 to 3 miles downstream, or until the channel opened up significantly, or intersected a larger channel with a larger, well-established floodplain…" For each dam, structures within the estimated inundation area were counted, and population-at-risk was estimated by assuming that each residential structure would be occupied by three people. **Table 4.2-36** through **4.2-38** show estimated exposure of people and structures to dam failure within each county. Current housing valuation is used to estimate value of structures. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities.

Table 4.2-36
Estimated Exposure of People and Structures to Dam Failure, Kent County

Dam Name	Nearest Downstream City/Town	Estimated Population at Risk	Estimated Sructures at Risk	Structure Estimated Value
Silver Lake Dam - Dover	Dover	735	245	$54,806,500
Haven Lake Dam	Milford	545	90	$20,133,000
Silver Lake Dam - Milford	Milford	477	61	$13,645,700
Wyoming Lake Dam	Dover	432	144	$32,212,800
Blairs Pond Dam	Milford	414	78	$17,448,600
Cartanza/EZ Farms Dam	Little Creek	276	92	$20,580,400
Garrisons Lake Dam	Leipsic	146	30	$6,711,000
Derby Pond Dam	Voshell Mill	114	34	$7,605,800
City of Harrington Sewage Lagoon	Harrington	105	35	$7,829,500
Voshell Pond Dam	Camden	78	26	$5,816,200
Wheatley Pond Dam	Smyrna	48	16	$3,579,200
Duck Creek Pond Dam	Smyrna	36	12	$2,684,400
Lake Como Dam	Smyrna	19	4	$894,800
Coursey Pond Dam	Frederica	12	4	$894,800
Mccauley Pond Dam	Frederica	9	3	$671,100
Moores Lake Dam	Dover	9	3	$671,100
Mudmill Pond Dam	Greensboro, MD	6	2	$447,400
Mcginnis Pond Dam	Frederica	3	1	$223,700
Andrews Lake Dam	Frederica	3	1	$223,700
	Totals:	**3,467**	**881**	**$197,079,700**

Table 4.2-37
Estimated Exposure of People and Structures to Dam Failure, New Castle County

Dam Name	Nearest Downstream City/Town	Estimated Population at Risk	Estimated Sructures at Risk	Structure Estimated Value
Edgar M. Hoopes Dam	Wooddale	3000	1000	$223,700,000
Christiana Lake Dam	Christiana	1964	Not Available	Not Available
Carousel Pond Dam	Heritage Park	1590	530	$118,561,000
Edgemoor Reservoir Dam	Edgemoor	771	257	$57,490,900
Newark Reservoir Dam	Newark	588	196	$43,845,200
Rock Manor Golf Course Dam	Wilmington	318	106	$23,712,200
Sunset Lake Dam	Cedar Farms	141	47	$10,513,900
City of Wilmington Sewage Lagoon	None	51	17	$3,802,900
City of Wilmington Sludge Disposal Area	None	51	17	$3,802,900
Bellewue Lake Dam	Holly Oak	39	13	$2,908,100
Silver Lake Dam - Middletown	Odessa	29	8	$1,789,600
New Castle County Water Farm Wastewater Lagoon	Mathews Corner	27	9	$2,013,300
Porter Reservoir Dam	Wilmington	24	8	$1,789,600
Wiggins Mill Pond Dam	St Andrews School	12	4	$894,800
Town of Middletown Wastewater Lagoon	Middletown	9	3	$671,100
	Totals:	**8,614**	**2215**	**$495,495,500**

Table 4.2-38
Estimated Exposure of People and Structures to Dam Failure, Sussex County

Dam Name	Nearest Downstream City/Town	Estimated Population at Risk	Estimated Sructures at Risk	Structure Estimated Value
Williams Pond Dam	Seaford	555	185	$41,384,500
Wagamons Pond Dam	Milton	246	39	$8,724,300
Griffith Lake Dam	Milford	200	34	$7,605,800
Shoals Branch Dam	Millsboro	126	42	$9,395,400
Trap Pond Dam	Lake Pines	125	39	$8,724,300
Betts Pond Route 113 Dam	Millsboro	123	41	$9,171,700
Ingram Pond Dam	Millsboro	123	41	$9,171,700
Betts Pond Main Dam	Millsboro	120	40	$8,948,000
Millsboro Pond Dam	Millsboro	120	40	$8,948,000
Concord Pond Dam	Cherry Tree Landing	103	25	$5,592,500
Records Pond Dam	Laurel	93	18	$4,026,600
Clendaniel Pond Dam	South Shores	63	21	$4,697,700
Town of Selbyville Wastewater Lagoon	Selbyville	63	21	$4,697,700
City of Laurel Sewage Lagoon	Laurel	45	15	$3,355,500
City of Laurel Sewage Lagoon	Laurel	45	15	$3,355,500
City of Laurel Sewage Lagoon	Laurel	45	15	$3,355,500
Cubbage Pond Dam	South Shores	40	11	$2,460,700
Horseys Pond Dam	Laurel	37	10	$2,237,000
Reynolds Pond	None	33	2	$447,400
Chipman Pond Dam	Lake Pines	30	14	$3,131,800
Portsville Mill Pond Dam	River View Acres	30	9	$2,013,300
Swiggetts Pond Dam	Argo's Corner	16	3	$671,100
Marshall Millpond Dam	None	15	5	$1,118,500
Abbotts Pond Dam	Milford	13	3	$671,100
Hearns Pond Dam	Seaford	12	4	$894,800
Collins Pond Dam	Meadow Acres	9	3	$671,100
Fleetwood Pond Dam	Cherry Tree Landing	6	2	$447,400
Red Mill Pond Dam	None	3	1	$223,700
Craigs Pond	Woodland	3	1	$223,700
Davis Pond Dam	Trap Pond State Park Campground	3	1	$223,700
Burton Pond Dam	Angola by the Bay	3	1	$223,700
	Totals :	**2,448**	**701**	**$156,813,700**

Drought

Although the state of Delaware as a whole is vulnerable to drought, estimated potential losses are somewhat difficult to calculate because drought causes little damage to the built environment, mostly affecting crops and farmland. Therefore, it is assumed that all buildings and facilities are exposed to drought but would experience negligible damage in the occurrence of a drought event. The approach used to determine vulnerability within the state of Delaware consisted of a number of factors: statistical data for the past 100 years from the University of Nebraska, developed based on Palmer Drought and Crop Severity Indices; and the data from the National Climatic Data Center. Drought event frequency/impact was then determined for New Castle County. Drought impact on the non-irrigated agriculture products profile was then determined.

According to NOAA, droughts occur quite frequently in Delaware averaging 3 per year. However, all the droughts listed were short term and did little to no damage. Extended droughts in Delaware are rare, but can result in some significant agricultural losses. **Tables 4.2-39** through **4.2-41** show annualized expected losses from drought events by jurisdiction within the state. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities.

Table 4.2-39
Estimated Drought Damage, Kent County

Jurisdiction	Estimated Losses
CCD Central Kent	$37,900
CCD Dover	$57,585
CCD Felton	$61,410
CCD Harrington	$80,453
CCD Kenton	$45,098
CCD Milford North	$123,098
CCD Smyrna	$65,044
Kent Total	$470,588

Table 4.2-40
Estimated Drought Damage, New Castle County

Jurisdiction	Estimated Losses
CCD Brandywine	$4,099
CCD Central Pencader	$2,243
CCD Greater Newark	$1,388
CCD Lower Christiana	
CCD Middletown-Odessa	$27,811
CCD New Castle	$1,089
CCD Piedmont	$17,624
CCD Pike Creek-Central Kirkwood	$139
CCD Red Lion	$3,614
CCD Upper Christiana	$240
CCD Wilmington	
New Castle Total	$58,247

Table 4.2-41
Estimated Drought Damage, Sussex County

Jurisdiction	Estimated Losses
MCD Bridgeville-Greenwood	$12,301
MCD Georgetown	$3,195
MCD Laurel-Delmar	$11,848
MCD Lewes	$74
MCD Milford	$1,824,606
MCD Millsboro	$1,426,546
MCD Milton	$928,101
MCD Seaford	$1,334,655
MCD Selbyville-Frankford	$1,900,032
Sussex Total	$7,441,358

Wildfire

Wildfire was identified by state stakeholders as a hazard. Delaware does not have a uniquely high risk of wildfire. According to the Insurance Information Institute, 2016, the most recent year tracked, Delaware was the only state with no recorded wildfire losses. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities based on seasonally-specific wildfire modeling. The US Forest Service provides a national wildfire risk map that shows some moderate and high-risk areas for Delaware, but these areas are virtually unpopulated, including Augustine Wildlife Area, Cedar Swamp Wildlife Area, Bombay Hook National Wildlife Refuge, Prime Hook National Wildlife Refuge, and Gordon Pond Wildlife Area.

Earthquakes

Delaware has exposure to earthquakes, although they frequently do not do damage to buildings in the state when they occur. The strongest earthquake recorded in Delaware (4.1 Richter) happened in 2017 during the development of this plan and no building damage was reported to DEMA. Delaware's building stock in HAZUS-MH should be changed significantly to more accurately model earthquake risk. **Table 4.2-42** through **4.2-44** shows the total annualized expected losses from earthquake events by CCD within the State.

Table 4.2-42
Estimated Earthquake Loss, Kent County

Jurisdiction	Estimated Loss
CCD Central Kent	$10,133
CCD Dover	$21,737
CCD Felton	$2,340
CCD Harrington	$4,885
CCD Kenton	$3,430
CCD Milford North	$3,878
CCD Smyrna	$11,560
Kent Total	$57,963

Table 4.2-43
Estimated Earthquake Loss, New Castle County

Jurisdiction	Estimated Loss
CCD Brandywine	$118,462
CCD Central Pencader	$42,499
CCD Greater Newark	$50,330
CCD Lower Christiana	$39,039
CCD Middletown-Odessa	$36,094
CCD New Castle	$83,481
CCD Piedmont	$51,238
CCD Pike Creek-Central Kirkwood	$54,976
CCD Red Lion	$8,774
CCD Upper Christiana	$40,456
CCD Wilmington	$715
New Castle Total	$526,064

Table 4.2-44
Estimated Earthquake Loss, Sussex County

Jurisdiction	Estimated Loss
MCD Bridgeville-Greenwood	$11,232
MCD Georgetown	$12,767
MCD Laurel-Delmar	$14,884
MCD Lewes	$40,144
MCD Milford South	$16,310
MCD Millsboro	$16,409
MCD Milton	$9,429
MCD Seaford	$21,886
MCD Selbyville-Frankford	$24,987
Sussex Total	$168,048

Tables 4.2-45 through **4.2-47** show potential damage to critical state-owned facilities from earthquake events by county and **Table 4.2-48** summarizes the statewide total using HAZUS-MH and a 5.0 earthquake. All critical and state-owned facilities are considered equally exposed to this hazard including 2,053 identified state facilities.

Table 4.2-45
Damage to Critical Facilities, Kent County

Jurisdiction	Total Number of Critical Facilities	100-year			500-year		
		Moderate Damage	Slight Damage	Negligable Damage	Moderate Damage	Slight Damage	Negligable Damage
CCD Central Kent	5	0	0	5	0	0	5
CCD Dover	17	0	0	17	0	0	17
CCD Felton	2	0	0	2	0	0	2
CCD Harrington	1	0	0	1	0	0	1
CCD Kenton	2	0	0	2	0	0	2
CCD Milford North	1	0	0	1	0	0	1
CCD Smyrna	1	0	0	1	0	0	1

Table 4.2-46
Damage to Critical Facilities, New Castle County

Jurisdiction	Total Number of Critical Facilities	100-year			500-year		
		Moderate Damage	Slight Damage	Negligable Damage	Moderate Damage	Slight Damage	Negligable Damage
CCD Brandywine	41	0	0	41	0	0	41
CCD Central Pencader	10	0	0	10	0	0	10
CCD Greater Newark	16	0	0	16	0	0	16
CCD Lower Christiana	14	0	0	14	0	0	14
CCD Middletown-Odessa	5	0	0	5	0	0	5
CCD New Castle	28	0	0	28	0	0	28
CCD Piedmont	17	0	0	17	0	0	17
CCD Pike Creek-Central Kirkwood	20	0	0	20	0	0	20
CCD Red Lion	5	0	0	5	0	0	5
CCD Upper Christiana	12	0	0	12	0	0	12
CCD Wilmington	2	0	0	2	0	0	2

Table 4.2-47
Damage to Critical Facilities, Sussex County

Jurisdiction	Total Number of Critical Facilities	100-year			500-year		
		Moderate Damage	Slight Damage	Negligable Damage	Moderate Damage	Slight Damage	Negligable Damage
MCD Bridgeville-Greenwood	76	0	0	76	0	0	76
MCD Georgetown	83	0	0	83	0	0	83
MCD Harrington	1	0	0	1	0	0	1
MCD Laurel-Delmar	172	0	0	172	0	0	172
MCD Lewes	175	0	0	175	0	0	175
MCD Milford North	1	0	0	1	0	0	1
MCD Milford South	121	0	0	121	0	0	121
MCD Millsboro	137	0	0	137	0	0	137
MCD Milton	62	0	0	62	0	0	62
MCD Seaford	163	0	0	163	0	0	163
MCD Selbyville-Frankford	258	0	0	258	0	0	258

Table 4.2-48
Statewide Critical Facility Losses

County	Critical Facilities	Estimated Building Value	100-Year		500-Year	
			Damage %	Estimated Damages	Damage %	Estimated Damages
Kent	338	$169,500,000	0.00%	$0	0.00%	$0
New Castle	592	$295,500,000	0.00%	$0	0.00%	$0
Sussex	623	$311,500,000	0.00%	$0	0.00%	$0

Conclusion on Hazard Risk

Table 4.2-49 summarizes the annualized expected losses presented for each natural hazard in this section per county jurisdiction. **Table 4.2-50** provides corresponding numbers from statewide analysis of improved HAZUS-MH simulations. Based upon the methodologies described in the beginning of this section, the risk from natural hazards in the state can be rated on a scale of Low, Moderate or High for each identified natural hazard based upon these annualized losses, detailed in **Table 4.2-51**.

Table 4.2-49
Potential Annualized Losses provided by Counties

County	Flooding	Hurricane Wind	Tornado	Hail	Thunderstorm	Winter Storm	Drought	Earthquake
Kent	$268,500	$2,021,399	$103,160	$105,000	$49,170	$50,458	$470,588	$57,963
New Castle	$917,288	$3,230,226	$123,550	$5,000	$94,630	$353,989	$58,247	$526,064
Sussex	$105,264,597	$2,035,378	$11,000	$310,000	$159,420	$322,823	$7,441,358	$168,048
Total	$106,450,385	$7,287,003	$237,710	$420,000	$303,220	$727,270	$7,970,193	$752,075

Table 4.2-50
Potential Annualized Losses provided by State-Level Analysis

County	Flooding	Hurricane Wind	Earthquake	Coastal Erosion
Kent	$841,000	$2,730,000	$0	$0
New Castle	$2,688,000	$4,025,000	$0	$0
Sussex	$6,463,000	$15,646,000	$0	$16,822,000
Total	$9,992,000	$22,401,000	$0	$16,822,000

Table 4.2-51
Estimated Level of Risk by Hazard by County (High, Moderate, Low)

County	Flood	Hurricane Wind	Thunderstorm	Tornado	Drought	Hail	Winter Storm	Earthquake
Kent	High	Moderate	Moderate	Low	High	Low	Moderate	Moderate
New Castle	High	High	Moderate	Moderate	Moderate	Low	Moderate	Moderate
Sussex	High	Low	Moderate	Low	Moderate	Low	Moderate	Low

It should be noted that although some hazards may show Medium or Low risk, hazard occurrence is still possible. Also, any hazard occurrence could potentially cause a great impact and losses could be extremely high (i.e., an F5 tornado or a Category 5 hurricane).

Table 4.2-52 offers an overall ranking of risk by hazard for each county within the state. Each county provided a list of top hazards detailed in respective columns, and DEMA led a stakeholder meeting that identified the top state level hazards in terms of displacement, property damage, and business disruption. In the 2018 update, the planning team did a ranking assessment based on the latest changes to the HIRA. The statewide priorities are shown in the last column.

Table 4.2-52
Overall Risk Ranking for the State of Delaware by County and Statewide

Hazard Ranking	Kent County	New Castle County	Sussex County	Statewide
1	Flood	Flood	Flood	Coastal Flooding
2	Drought	Coastal Wind	Thunderstorm	Nor'easters & ET Storms
3	Coastal Wind	Winter Storm	Hurricane Wind	Hurricanes & Tropical Storms
4	Earthquake	Thunderstorm	Extreme Heat/Cold	Winter Precipitation
5	Winter Storm	Tornado	Drought	Coastal Erosion
6	Thunderstorm	Earthquake	Winter Storms	Inland Flooding
7	Tornado	Drought	HazMat Incident	Severe Thunderstorms
8	Hail	Hail	Tornado	Extreme Heat
9	Extreme Heat/Cold		Hail	Extreme Cold
10	Wildfire		Tsunami	Tornadoes
Unranked	Coastal Erosion		Earthquake	Dam/Levee Failure
Unranked	Dam/Levee Failure		Wildfire	Drought
Unranked	Tsunami		Erosion	Wildfire
Unranked	Volcano		Dam/Levee Failure	Earthquakes
Unranked	Terrorism		Terrorism	Tsunami
Unranked	HazMat Incident		Pipeline Failure	Sinkholes
Unranked	Pipeline Failure			Landslides

It appears evident in all three approaches and the statewide assessment, that the top two hazards in the state are flood and storms. It is important to note that the Delaware Emergency Management Agency strives to mitigate any hazard that can impact the State. The Delaware Emergency Management analyzed the data, from a statewide perspective, for thunderstorm wind events, tornado events, hail events winter storm events.

Plan Updates

Note Regarding 2007Plan Update
For the 2007 update, the vulnerability assessments were revisited to verify their validity. The figures supplied were adjusted for inflation (11.45% higher over the four-year period). Information from the State Planning Office indicates that development in the state was not of sufficient quantity over the past three years to justify additional modifications to the data supplied. Additional hazards were considered (see Section 4.1), but there is no way to quantify the vulnerability to these new hazards outside that which was provided in the Hazard Analysis tables in the earlier section.
Note Regarding 2010 Plan Update

Note Regarding 2010 Plan Update
For the 2010 update, over 40 pages of new data was added to this section. The most significant updates included Hazardous Materials and the Dam/Levee failure areas. All sections were reviewed, almost all table data was updated and with the latest information available. The ultimate rankings of hazards also changed fairly significantly from the 2007 update.

Note Regarding 2013 Plan Update
For the 2013 update, all sections were reviewed and extensive changes were made throughout this section. New HAZUS-MH, version 2.1, was used to update the flood, hurricane wind and earthquake data. Critical facilities numbers were based on the latest critical facility listing maintained at DEMA. HAZUS analysis data was based on 2006 dollars, so all dollar loss estimates shown are in 2006 adjusted values. DFIRM data was used for the first time to update hazard maps. All technical/man-caused hazards were removed from this section and placed in Annex G.

Note Regarding 2018 Plan Update
For the 2018 update, all sections were reviewed and extensive changes were made throughout this section. New HAZUS-MH, version 4.0, was used to update the flood, wind, and earthquake data. State level analyses were completed to confirm or complement county level analyses. Critical facilities numbers were based on the latest critical facility listing maintained at DEMA. HAZUS analysis data was based on 2010 dollars, so dollar loss estimates shown are in 2010 adjusted values. Multiple flood projections were analyzed to update hazard maps.

What is a Capability Assessment?

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? ***[44 CFR §201.4(c)(3)(ii)]***

As required in 201.4(c)(3)(ii) of the Disaster Mitigation Act of 2000, each State must conduct a *Capability Assessment* that discusses and evaluates the State's laws, regulations, policies, programs and other capabilities to reduce the impacts associated with all hazards.

The data used to perform the capability assessment was obtained through the use of a survey instrument, content analysis of relevant documents, and interviews with State officials. The survey findings and content analysis are summarized in **Table 5-1**. The assessment includes a description of existing programs and how they are used to reduce future hazards losses and, where appropriate, an evaluation of where and how these capabilities should be strengthened.

In those cases where State policies and programs increased hazard vulnerability, recommendations were made to modify or eliminate those activities, whenever possible. In addition, the State *Capability Assessment* addressed local mitigation-related policies, programs and capabilities. This required that local governments provide clear documentation of capabilities requested in the *Local Capability Assessment Survey*. This information is summarized in **Tables 5-3** through **5-6**.

Conducting the Capability Assessment

The development of this standard and a future enhanced mitigation plan requires that the State effectively demonstrate the existence of a comprehensive hazard mitigation planning program. In order to meet this higher standard, six key elements must be documented. They include:

1) Project implementation capability;
2) Assessment of mitigation actions;
3) Program management capability;
4) Commitment to a comprehensive mitigation program;
5) Integration with other planning initiatives; and
6) Effective use of available mitigation funding

The information discussed throughout this section was gathered from an analysis of the former State Hazard Mitigation Plan (409 Plan) and the Hazard Mitigation Programs Administrative Plan (404 Plan).[1] This approach allowed the Delaware Emergency Management Agency and the State Hazard Mitigation Council (SHMC) to document existing capabilities and incorporate the findings into this Plan.

[1]The Mitigation Program Administrative Plan is located in Annex D

State Capability Assessment

State Capability Assessment Findings

Plans, Programs, Policies and Funding

The results of the *Capability Assessment* provide part of the foundation for determining the type of mitigation strategy developed. The assessment process also helped to identify existing gaps or weaknesses that may need to be addressed through future mitigation planning goals and actions that are deemed practical considering the State's capabilities to implement them. Finally, the *Capability Assessment* highlights the positive measures already in place or being performed that should continue to be supported through future State mitigation efforts. In addition to specific programs, plans and policies, the *Capability Assessment* will document specific hazard mitigation projects that have been completed.

State and Federal Agency Programs

The State of Delaware maintains an array of departments, agencies, offices and programs that can directly or indirectly affect the State's ability to reduce the impacts of future hazard events. The following descriptive tables consist of State and federal agencies and their programs, including their effect on hazard loss reduction (**Table 5-1**). Federal agencies are described in the context of how programs may support State mitigation planning efforts (**Table 5-2**). This information was updated and verified for the 2018 iteration of this All-Hazard Mitigation Plan.

Table 5-1
State Plans, Policies, Programs and Grants Impacting Hazard Mitigation in Delaware

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Delaware Geographic Data Committee (DGDC)	The Delaware Geographic Data Committee is a cooperative effort among government, the academic sector, and the private sector to build a Delaware GIS Community and improve the coordination of the use of GIS tools and spatial data in Delaware.	Geographic data sharing.	All hazards (natural and human- caused)	The sharing of GIS and other spatial data strongly support the practice of hazard mitigation by providing best available data and the tools necessary to determine hazard risk and vulnerability.
Delaware Geological Survey	The Delaware Geological Survey (DGS) is a science-based, public-service-driven Delaware state agency at the University of Delaware (UD) that conducts geologic and hydrologic research, service, and exploration for the benefit of the citizens of the First State. The mission of the DGS is to provide objective earth science information, advice, and service to its stakeholders–the citizens, policy makers, industries, and educational institutions of Delaware.	DGS conducts geologic, hydrologic, and geologic hazard investigations and services and by continuing development of our infrastructure through reports and publications as well as data collection, management, and dissemination programs.	Coastal Flooding, Severe Storms, Earthquakes, Stream Flooding, Coastal Erosion, Drought, Tsunamis, Sinkholes, Landslides	DGS advises, informs, and educates stakeholders about the important roles that the earth sciences play in issues regarding water resources, public health, agriculture, economic development, land-use planning, environmental protection, geologic hazards, energy and mineral resources, and recreation.
Comments on Delaware Geological Survey:				

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Delaware State Housing Authority	The Delaware State Housing Authority helps low and moderate-income Delawareans find homes and affordable rental apartments, as well as low-interest loans to purchase a home. The Authority also offers assistance in repairing homes and working with developers to build affordable housing.	Community Development Block Grant (CDBG) Program.	All hazards (natural and human-caused)	Housing programs administered by DSHA may used in conjunction with other funds to rebuild communities after a disaster. DSHA administers the Community Development Block Grants (CDBG), federally funded through the Department of Housing and Urban Development (HUD), and can be used to retrofit and repair affordable housing and infrastructure to better withstand the impacts of multiple natural hazards.
		www.DelawareHousingSearch.org		DHS is an online housing locator service supported by a partnership of nonprofit and government organizations. DHS maintains over a quarter of Delaware's entire rental housing stock and is accessible online and via a toll-free **bi-lingual** call-center. During a disaster, DHS builds on this inventory to create a comprehensive list of available **long term and short term** housing options. During an emergency, this list is updated daily and is exported to FEMA's NEMIS service. DHS also, via the Joint Information Center, posts messages, shelter lists and other salient alerts on the homepage as needed and prepare media releases and PSAs to alert residents to this centralized housing resource. Pre-disaster, DHS features Disaster Recovery prominently on the front page. From there, users can access an expanded page with key links and resources important to disaster recovery.

Comments on Delaware Housing Authority:

The Delaware Housing Authority uses CDBG funds to retrofit affordable housing to better withstand the impacts of multiple natural hazards, including flood, high winds and earthquakes.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Delaware River & Bay Authority (DRBA)	The DRBA, a bi-state agency, operates the Delaware Memorial Twin Bridges—the world's longest twin span suspension bridge; the Cape May-Lewes Ferry system; the Three Forts Ferry Crossing; and the New Castle, Cape May, Millville, Delaware Airpark, and Dover Civil Air Terminal Airports. The Authority also uses its resources to participate in economic development ventures throughout Delaware and in the four southernmost counties of New Jersey.	DRBA schedules full scale, "table-top," and drill-based emergency plan exercises. Numerous table-tops have been conducted to include each of our faculties i.e. Delaware Memorial Bridge, Cape May Lewis Ferry, and our Airports. These exercises test our all hazard response plans, which include our internal and external partners.	All hazards (natural and human-caused)	Decisions made by the DRBA can significantly affect regional vulnerability. Regional planning efforts, including the design and citing of regional infrastructure should incorporate hazards vulnerability into the pre-construction decision making process. The DRBA must continue to improve their communication capabilities in order to properly communicate with all partners, both internal and external.
Office of Management and Budget	**Facilities Management** The mission of Facilities Management is to support the activities of State government by accommodating State agencies' space needs, maintaining State facilities, and implementing programs and initiatives to ensure that each facility is energy efficient, architecturally accessible and environmentally safe. The division's mission is to also ensure that the demolition, renovation, and new construction of State buildings is completed in a timely fashion and meets the latest standards of construction technology, building and life safety codes and space standards through plan review, and technical oversight and assistance.	Working cooperatively with the State office of Policy and Planning, a more accurate inventory of state-owned facilities is being geo-coded.	All hazards (natural and human-caused)	The spatial assessment of state-owned facilities allows for the more accurate determination of exposure to hazards, particularly those that are geographically defined. The eventual capturing of additional data, including the date of construction, square footage, first finished flood elevation and structural type, will enable a much more accurate analysis of expected losses given varied hazard scenarios.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Agriculture	**Delaware Forest Service** The mission of the Forest Service is to conserve, protect, and enhance the forest and its resources for the public through education, management, demonstration, promotion, and providing technical services. The Service provides a wide range of services to help Delawareans manage and improve their forest resources, emphasizing three categories: conservation, protection, and education.	Fire Prevention and Protection Program Tree removal program on publicly owned property is offered annually and DFS works closely with local utility companies and DelDOT to identify and remove hazards along the ROWS. This program operates directly through the DFS Urban and Community Forestry Program and provides technical and financial assistance to homeowners associations, municipalities, counties, and state government agencies on tree care and hazard mitigation. DFS also provides a 50/50 cost share program to volunteer fire companies for wildland firefighting equipment annually. DFS also provides funding for the mitigation of phragmites. This program is offered annually and is to be used near structures to reduce the nature fuels and wildfire threat. Accomplished by chemically or mechanically removing them. For 2017, over $22,000 was provided to communities for this work. By partnering with DNREC Fish and Wildlife, over 6700 acres were treated in the first state.	Wildfire	The appropriate use of fire resistant construction materials, various construction techniques and land management principles, serve as important tools to reduce the impacts of wildfire. These techniques aid in the suppression of fire risk that may be triggered by other hazards such as earthquakes and thunderstorms.
Department of Agriculture	**Delaware Land Use Planning & Preservation** The Planning Section is a technical and professional enterprise that includes land use planning, agricultural lands preservation, and computer operations. The Planning Section is closely linked with the Delaware Livability Initiative	Land use planning, encouragement of land preservation.	All hazards (natural and human-caused)	Land use planning is one of the most effective long-term approaches to reduce hazards vulnerability. The Delaware Livability Initiative provides a sound venue to link land use and hazard mitigation planning.

Comments on Department of Agriculture:

The Delaware Forest Service maps wildfire data by using a GPS coordinates and also monitors acreage with handheld gps, they only map those they directly respond to and control. While the DFS does not possess a statewide forest fire management plan, one is developed based on factors at the scene. A fire plan is an outdated idea due to the fact that you have to size up the fire based on staffing, fuels, weather and topography.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Education	The mission of the Delaware Department of Education is to promote the highest quality education for every Delaware student by providing visionary leadership and superior service.	No specific plans, policies, programs or grant mechanisms have been identified as relating directly to or indirectly supporting the principles of hazard mitigation.	All hazards	The Department of Education can serve as an important vehicle to educate students and parents about natural hazards, their effects, and specific things that can be done to reduce their impact. A number of educational videos and course materials are available through the Red Cross and FEMA. The study of hazards may be incorporated into classes such as earth science, environmental studies, and geography.
Comments on Department of Education: *The Department of Education does not currently employ a statewide curriculum on hazards and disasters. The Department may consider the American Red Cross Masters of Disaster interactive disaster safety curriculum for children grades K through 8.*				
Department of Insurance	**Delaware Insurance Commissioner**	Maintains consumer services Web site that discusses flood insurance, including why it should be purchased, what to do if you experience weather-related damages, and how it can be purchased.	Relevant to all hazards, with emphasis on flood-related events.	The Delaware Department of Insurance may assist DNREC with an outreach effort to encourage greater flood insurance participation among homeowners.
Comments on Department of Insurance: *The Delaware Insurance Commissioner may consider linking the main page of their consumer services web site to the FEMA National Flood Insurance Program web site and other hazard-related insurance materials.*				

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Natural Resources and Environmental Control (DNREC)	The goal of DNREC is to protect Delaware's environment for future generations.	**Delaware Accidental Release Prevention Program**: The program led to the creation of a system that allows citizens to promptly learn of releases or discharges of contaminants or pollutants that meet or exceed certain thresholds. Following the receipt of a discharge or release report, DNREC notifies the public within 12 hours. The program was developed in response to Senate Bill 33 that was passed in July 2001. The program's mission is "protecting the lives and health of persons living and working in the vicinity of facilities handling extremely hazardous substances." The program, based on the Clean Air Act, Section 112r, requires that owners and operators of stationary sources that maintain regulated substances on site must develop and implement a risk management program that anticipates and minimizes the chances of catastrophic events. Delaware was the third State in the country to develop a chemical accident prevention regulation (Regulation for the Management of Extremely Hazardous Substances, September 1990). Delaware was the first State to regulate flammables and explosives.	Human caused hazards, including, technological accidents and acts of terrorism	Members of the Accidental Release Program participate in pre and post-disaster interagency hazard mitigation meetings as required.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
DNREC	**Delaware Coastal Programs**	Delaware Coastal Programs provide technical support to local jurisdictions through its Resilient Community Partnerships program. The Coastal Training Program offers technical assistance, seminars, hands-on skill training, and participatory workshops to lectures and technology demonstrations for local governments and planners.	Coastal storms Flooding Coastal Erosion	The Partnership helps communities work through the stages of assessing their vulnerabilities to coastal hazards, prioritizing potential adaptation and planning options, and implementing their plans.
DNREC	**Division of Energy and Climate**	The Strategic Opportunity Fund for Adaptation is a competitive grant program to support State agencies' progress toward implementing actions that will strengthen the State's preparedness and ability to adapt to current and future effects of climate change. The Division supports Sustainable Planning for local jurisdictions through technical assistance and planning grants. The Division also supports DNREC's participation in the Preliminary Land Use Service (PLUS) in coordination with the Office of State Planning Coordination	All climate-related hazards, including: Coastal Storms Inland flooding and heavy precipitatio n events Coastal erosion Drought and extreme heat	Current projects supported by Strategic Opportunity Fund for Adaptation grants are described in the Climate Action in Delaware: 2016 Progress Report.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
DNREC	Multiple agencies Technical assistance - DNREC	Guidance for State agencies includes: • "Avoiding and Minimizing Flood Damage to State Assets" is a guide for State agencies with step-by-step instruction to evaluate and avoid both existing flood risk and future risks posed by climate change during the planning and design of public building and infrastructure projects. • The Flood Planning Tool is an interactive web map that gives State agencies, floodplain managers, engineers, planners and citizens a tool to make informed decision about flood risks for properties and projects. • The Flood Risk Adaptation Map is a tool for State flood risk planning that combines current flood modeling with sea level rise projections.	Flooding	State agencies are required to prioritize resiliency and flood risk when building new infrastructure and retrofitting or updating existing structures. An executive order signed by former Governor Jack Markell requires State agencies to avoid building within areas that are currently or will be at high risk of flooding, especially given the higher risks posed by sea level rise and climate change. New and existing structures must be constructed with future conditions in mind, with measures to reduce their vulnerability to flood hazards.
DNREC	Office of the Governor Cabinet Committee on Climate and Resiliency	"Executive Order 41: Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities from Reducing Emissions" directed Delaware State agencies to address the causes and consequences of climate change. Results of the planning process facilitated by the Cabinet Committee on Climate and Resiliency include: "Climate Framework for Delaware", a summary of climate adaptation recommendations for 11 State agencies "Climate Action in Delaware: 2016 Progress Report" describes accomplishments of EO 41 activities	All climate-related hazards, including: Coastal Storms Inland flooding and heavy precip events Coastal erosion Drought and extreme heat	The executive order provides a road map for State agencies to prepare for the impacts of climate change and to reduce the greenhouse gas emissions that cause climate change. It is the backbone behind many State agency activities that will help reduce the impact of climate change to the State.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
DNREC	**Division of Air Quality** Regulates air quality standards. **Division of Waste and Hazardous Substance** Regulates hazardous waste management, including the systematic collection, storage, transportation, treatment, and disposal of hazardous waste.	Requires and reviews contingency plans from all large-quantity generators of hazardous waste, including facilities that store, treat, and/or dispose of hazardous waste, and from contractors involved in removal or remediation measures at Superfund sites. Copies of plans are provided to all State and local emergency response teams that may be called upon to provide emergency services to the facility/site.	Human-caused hazards, including technological accidents and acts of terrorism	Reviews all federally funded projects to ensure that air quality is not compromised.
DNREC	**Division of Fish & Wildlife** Responsible for fisheries management controls over commercial and certain recreational fishing and seeks to protect all critical wildlife areas and endangered species.	Delaware Open Space Program	Flood Coastal Erosion Wildfire	Receives State funding to purchase wetlands. Eligible to obtain State funding for the fee simple acquisition of land or establishment of conservation easements on eligible property as part of the Delaware Open Space Program. Lands targeted under the Open Space Program include forestland, open land, farmland, wetlands, riparian corridors, steep slopes, and beach areas. Participates in interagency hazard mitigation meetings in a post-disaster environment as required.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
DNREC	**Division of Parks & Recreation** Responsible for planning and managing the outdoor recreation opportunities of the State of Delaware, including access to and use of all Delaware coastal lands and water.	Maintains conservation easement program.	Flood Coastal Erosion Wildfire Winter Storm	Receives State funding to purchase wetlands. Eligible to obtain State funding for the fee simple acquisition of land or establishment of conservation easements on eligible property as part of the Delaware Open Space Program. Lands targeted under the Open Space Program include forestland, open land, farmland, wetlands, riparian corridors, steep slopes, and beach areas. Participates in interagency hazard mitigation meetings in a post-disaster environment as required. Staff is available to assist DEMA and local governments with recommended open space options following a multi-parcel acquisition project.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
DNREC	**Division Watershed Stewardship** Responsible for monitoring and controlling beach preservation and advising local governments on the provisions of relevant DNREC laws, rules and regulations.	**Flood Mitigation Assistance Program:** Provides project planning and technical assistance funding for flood mitigation projects to include acquisition, elevation and flood proofing of repetitive flood-prone properties. **Delaware Coastal Zone Management Program:** a network of projects and programs designed to help manage coastal resources. Advises and assists local governments to develop programs and procedures for controlling erosion and sedimentation. Tasks include eliminating sediment that may limit stream flow. Administers the Beach Preservation Act and the Sediment and Erosion Control Act. The Shoreline and Waterway Management Section is tasked with regulating coastal construction, depositing sand on beaches, planting beach grasses and installing sand fencing to promote the establishment of dunes. Drainage Section is responsible for maintaining the State's 2,000 miles of ditches that provide flood control in agricultural and urban areas. District Operations support the State's three conservation districts in implementing agricultural and urban- suburban conservation plans and best management practices addressing soil erosion, water conservation and waste management. **Dam Safety Program:** provides the framework for proper design, construction, operation, maintenance, and inspection of dams in the interest of public health, safety, and welfare.	Flood Coastal Erosion Hurricanes	Encourages governing bodies of coastal zone jurisdictions to establish a local Erosion Advisory Commission in order to be eligible for State funds to assist in erosion control of public beaches on tidal shorelines. Shoreline Management Section monitors coastal areas during storms to assess beach erosion, dune damage, and flood threats. The Section coordinates with Delaware DOT and DEMA to evaluate threats to determine areas of probable road flooding and the site of dune breakthrough before they occur. The Section conducts post-storm assessments to determine sand loss and provide technical assistance to local governments and property owners. Development along the Atlantic and Delaware Bay shoreline is regulated to reduce storm damage and limit beach impacts. Advises and assists local governments on the availability of flood insurance and the adoption, enforcement, and regulation of sound floodplain management regulations in order to participate in the National Flood Insurance Program (NFIP). Advises and assists local governments and private property owners on the design and installation of shoreline erosion control measures. Provides information to local governments on the location and characteristics of critical soils. Coordinates with federal agencies involved with stream channelization, stream, river, and coastline dredging, and other engineering projects. Participates in interagency hazard mitigation meetings in a post-disaster environment as required.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
DNREC	**Division Watershed Stewardship**	Production of Flood Risk Avoidance Maps	Maps which depict the extent of the combined effects of flooding and sea level rise. The flood event is the 1% coastal storm, the sea level rise assumed rise is 3 feet.	The Flood Risk Avoidance Maps are used both for general planning purposes for those wishing to use a future flood risk approach to project design, and more specifically for State agencies to use when following the requirements of Delaware Executive Order 41 which requires that State project be avoid areas which will experience these future impacts from flooding and sea level rise and design for future flood risk + sea level rise + freeboard when relocation is not practical.
		Cooperating Technical Partnership with FEMA, Risk Map, Floodplain Mapping	Flooding	Updated watershed modelling, HAZUS damage estimates, LiDAR topography, 1% annual chance floodplain mapping for all three counties.
DNREC	**Division of Water** Responsible for sub-aqueous land management and control over all encroachments onto state-owned sub-aqueous lands.	The Wetlands and Sub-aqueous Lands Section and the Watershed Assessment Section work to prevent development in flood hazard areas and monitor the wetlands. The Wetlands and Sub-aqueous Lands Section and the Watershed Assessment Section, along with the Delaware Department of Transportation, are considering the creation of a wetlands banking program.	Flood Hurricane	The management of sub-aqueous lands can dramatically reduce potential flood and hurricane-related damages.
Comments on DNREC:				

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Health & Social Services	**The Division of Public Health's (DPH)** mission is to protect and enhance the health of the people of Delaware by: • Working together with others • Addressing issues that affect the health of Delawareans • Keeping track of the State's health • Promoting positive lifestyles • Responding to critical health issues and disasters; • Promoting the availability of health services	The Emergency Medical Services and Preparedness Section within the Division of Public Health is responsible for providing command and control through our State Health Operations Center for all health and medical activities in a public health emergency or disaster for the State. Through the Emergency Services Branch, DPH can activate the Modular Medical Expansion System to expand the health care capacity and capability. Relevant grants include: the Center's for Disease Control and Prevention's (CDC) Cooperative Agreement; the Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response (ASPR), Hospital Preparedness Program; and the Department of Homeland Security, Homeland Security Grant.	All hazards (natural and human-caused)	Develop awareness of the events that will most likely have an impact on the public's health and healthcare systems through education, exercises, planning, workshops, conferences, and participation in public outreach with state-wide agencies and the general population. Encourage cooperative coordination of Public Health and medical emergencies based on a common understanding of hazards and their impact. Modification and promotion of plans, programs and actions for preventative measures, and for an effective healthcare response to preserve life in affected populations vulnerable to the effects of natural, human-caused and technological hazards.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Safety and Homeland Security	**Delaware Emergency Management Agency (DEMA)** DEMA is the lead State agency for coordination of comprehensive emergency preparedness, training, response, recovery and mitigation services in order to save lives, protect Delaware's economic base and reduce the impact of emergencies. DEMA is a division within the Department of Safety and Homeland Security and is authorized by Delaware Code, Title 20, Chapter 31§3101-3130.	**State Hazard Mitigation Program** The State Hazard Mitigation Officer (SHMO) coordinates and administers the State's hazard mitigation program. In so doing, the SHMO coordinates with technical support agencies through the State Hazard Mitigation Council to ensure that the goals of the State Mitigation Plan are achieved. DEMA serves as the grantee for the Hazard Mitigation Grant Program, the Pre-Disaster Mitigation Program, Emergency Management Performance Grant, and several terrorism- related grant programs. This includes all fiscal administration and file management. DEMA advises and assists local governments in the procurement and maintenance of adequate communications systems to improve warning, direction, and control of response to all natural disasters. Provides technical assistance to local governments regarding the development of hazard mitigation plans. **Citizen Corps** The mission of Citizen Corps is to harness the power of every individual through education, training, and volunteer service to make communities safer, stronger, and better prepared to respond to the threats of terrorism, crime, public health issues, and disasters of all kinds. **Shelter Strategy Work Group** Delaware's Shelter Working Group meets quarterly to evaluate shelter requirements, catalogue available resources, anticipate shortcoming, and make decisions to effect shelter program improvements. The Group consist of key State and local agencies, and non-profits (see composition in Annex E).	All hazards	The Delaware Emergency Management Agency is the key State agency driving the mitigation strategy adopted in the State Hazard Mitigation Plan. Specific loss reduction measures include the management of hazard mitigation grant programs, the provision of local hazard mitigation planning assistance and guiding State agency efforts to reduce the impacts of natural hazards through the identification or modification of existing policies and programs. A primary goal of the Delaware Emergency Management Agency is to reduce the impact of natural and human caused hazards. Specific measures include the acquisition or elevation of flood-prone structures and assisting local governments developing hazard mitigation plans that establish systematic mitigation strategies to reduce future losses. Citizen Corps has trained approximately 3000 citizens with our Community Emergency Response Team (CERT) Training which is an All Hazards, all citizens method. The trained citizens are in all three counties and the City of Wilmington, with the majority in NCC and our more vulnerable areas along the Delaware Coastlines. Additionally, citizens in Sussex and NCC have been trained as Storm Spotters for Emergency Management and the Weather Bureau at Mt Holly.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Safety and Homeland Security	**Delaware Emergency Management Agency (DEMA)**	**State Preparedness Report (SPR) and Threat and Hazard Identification and Risk Assessment (THIRA)** The SPR provides a self-assessment of Delaware's preparedness capabilities by examining the 32 Core Capabilities that address the greatest risk. The SPR is derived from the THIRA and by subject matter experts. The THIRA and SPR were conducted through workshop style discussions that included scenarios involving a Complex Coordinated Terrorist Attack (CCTA), a Radiological Dispersal Device (RDD), and a Hurricane. The Terrorism Planner worked closely with the SHMO and Mitigation planner	All hazards	Through the development of the SPR and THIRA threats, hazards, and gaps are identified; scenarios are created and evaluated based on capability targets and ratings on planning organization, equipment, training and exercise.
Department of Safety and Homeland Security	**Delaware State Police** The mission of the Delaware State Police is to enhance the quality of life for all Delaware citizens and visitors by providing professional, competent, and compassionate law enforcement services.	Assists the State during planned evacuations. Monitors the transportation of hazardous radioactive materials in Delaware. Conducts surveillance and enforces hazardous materials transportation regulations and investigates possible criminal violations of regulations.	All hazards	The Delaware State Police maintain a primary response role as it relates to hazards. Their primary rolls as it would impact loss reduction would be in the area of evacuation, life safety, and area security.
Department of State	**Division of Historical and Cultural Affairs** Pursues broad cultural and government service missions. The Division is composed of two major public service units—the State Historic Preservation Office (SHPO) and State Museums.	The SHPO operates programs to identify, evaluate, and protect the State's archaeo-logical sites, historic buildings, structures, and districts. In this capacity, the office is responsible for administering the federally mandated programs authorized under the National Historic Preservation Act of 1966. Maintains the State Historic Preservation Plan. Delaware State Museum operates a system of eight public museums statewide and manages two State conference centers and seventeen leased or vacant historic properties.	All hazards	Trained architectural historians: Historians and archaeologists are available to assist DEMA in identifying significant historic properties and provide advice on appropriate historic presser-vation treatments. This may include conducting structural and site analyses following disasters to determine the impacts to historic and other structures. Prior to the acquisition or elevation of homes, staff are available to assess historic structures and offer advice on appropriate treatments.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Transportation (DelDOT)	The mission of the Department of Transportation is to provide a safe, efficient, and environmentally sensitive transportation network that offers a variety of convenient and cost-effective choices for the movement of people and goods.	The DelDOT has primarily worked on the operations perspective of the ESF's described in Federal Policy and environmental issues that could impact critical natural resources at risk. Since September 2014 DelDOT defined an approach enhancements to include resilience and sustainability strategies starting the Division of Planning. The strategy included establishing a collaborative team representing the major Divisions of Planning, Construction and Maintenance and Operations, beyond the Transportation Management Center. A wetlands banking program has been considered in partnership with the Wetlands and Sub-aqueous Lands Section and the Watershed Assessment Section of the DNREC	All Hazards	Advises and assists local governments in flood-prone areas in the design and construction of bridges, slopes, and roads so that they will be less susceptible to water damage. Support and collaborate cross-agency Participates in damage assessments and interagency hazard mitigation meetings in a post-disaster environment as required. Advances work and participates in the development and funding of risk assessment and the development and implementation of resilience and sustainability strategies complying with policy.
Department of Transportation (DelDOT)	Division of Traffic Solution, Session: TMC – Transportation Management Center is responsible for real-time traffic management and coordination of activities to mitigate developing operational transportation issues on an ongoing basis developing and using many resources, including communications and input into construction plans to build the necessary features to enhance the transportation system.	Maintains a Transportation Incident Event Management Plan that is used to manage State transportation systems during planned (e.g. civic events, beach traffic) and unplanned events (e.g. snow storms, hurricanes.) Regional Transportation Management Teams coordinate emergency and evacuation planning across the State. Real-time traffic management and communications for coordination of activities. Funds transportation system improvements to mitigate potential effects of disasters.	All Hazards	Participate in cross-agency plans and coordinates activities and training focused on transportation infrastructure. Develops, trains and implements its own plans for emergency management, special events and traffic operations. Receives and share information through many means, including DelDOT Interactive Map, DelDOT APP to cellphones, portable radio, other wired and wireless telecommunication. Evolves in monitoring systems for environmental hazards and other complementary activities such as COOP and COG

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Department of Transportation (DelDOT)	Division of Planning - The mission of the Planning Division is to provide excellence in transportation through an inclusive and comprehensive transportation planning and permitting process that seeks solutions to the state's transportation needs by balancing safety, choice, environmental stewardship, economic development, financial accountability, and quality of life.	a) Development of user friendly data management and interface to work with FEMA Hazus-MH, the standardized risk assessment and loss estimation methodology to address transportation issues and collaborate/support other agencies and other levels of government and the community of Delaware. b) Development of an strategic study for statewide weather and flooding monitoring c) Development of worst case hurricane and storm surge scenario impact on transportation. d) Development of HAZMAT, transportation of illicit materials and human trafficking study, as it fits under new policy for commercial vehicles e) Development of a conceptual/artistic diagram of what consists a comprehensive approach to resilience, sustainability and security f) Start of the organization of a Transportation Risk Map similar to what FEMA has, just focused on transportation g) Inclusion of flooding sensor to traffic impact study through the use of anticipated flooding of roadway solutions part of last State Mitigation Plan h) Development of a proof of concept flooding sensing technology to enable deployment at Statewide scale	All Hazards	a) In collaboration to DEMA, DNREC and the University of Delaware, HAZUs became a consistent and available risk assessment tool statewide. b) Study counted with support from DEOS and DGS with many stakeholder inputs. It revealed that Delaware has weather statewide coverage for 5 and 10 miles radius as per NOAA's recommendation. The state does not have statewide coverage for flooding monitoring. c) DNREC's previous assessment suggested 1/3 of land could be impacted, including sea-level-rise. DelDOT's assessment required more detailed data and also confirmed probability for about the same proportion. d) Identification of key agencies and stakeholders improved knowledge and understanding of available resources for different issues. e) Helps provide visualization and inclusiveness to the work of implementing resilience and sustainability solutions. f) A resource that can help find the different types of maps, studies, tools. g) The use of technology to aid studies helps confirm probabilistic analysis for proactive policy and investment. h) A traditional Road Weather Information System (RWIS) to provide for statewide coverage of water related hazards.

Comments on DelDOT:
Note that DelDOT within the Division of Traffic Solutions has updated manuals for construction observing the 3 feet free board and that the Division of Operations and Maintenance has also participated in work force studies to be able to manage extreme events on staff. Many projects are in development and some have been completed.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Fire Prevention Commission (FPC)	**State Fire School** Serves as a training facility for emergency services and the public.	Offers wildfire and HazMat courses, as well as ice, water, and other natural hazard rescue classes.	Wildfire HazMat Winter Storm Flood	The ability to effectively respond to fire and other technological accidents and acts of terrorism can significantly reduce loss of life and destruction of property.
Fire Prevention Commission (FPC)	**Office of the State Fire Marshal** The mission of the State Fire Marshal is to provide a fire safe environment in the home, workplace, or wherever varied lifestyles or interests are pursued. The Commission promulgates Fire & Life Safety regulations to address Fire and Life Safety prevention activities which includes but is not limited to access, egress, detection, suppression, and National Electric Code Requirements. The Fire Marshal's office is delegated the responsibility of reviewing, inspecting, and enforcing the regulations.	No specific plans, policies, programs or grant mechanisms have been identified as relating directly to the principles of traditional pre-disaster hazard mitigation beyond the activities inherent in the fire service with regard to fire prevention.	Wildfire Human-caused Thunderstorm	A secondary effect of many natural and human-caused hazards is fire. The effective reduction of fire risk is an important part of a comprehensive mitigation program. Also, the Office of the State Fire Marshall maintains a Major Incident Response Team program as a special program within the division.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Office of State Planning Coordination	The mission of the Office of State Planning Coordination is the continuous improvement of the coordination and effectiveness of land use decisions made by State, county, and municipal governments while building and maintaining a high quality of life in Delaware.	Requires that all local governments within Delaware adopt comprehensive land use plans. The Preliminary Land Use Service (PLUS) provides for State agency review of major land use change proposals at the start of the land use development process.	All hazards	The incorporation of a hazards element into local land use planning requirements links desired objectives to an institutionalized vehicle with State regulatory standing. The continuing purpose of the Strategies for State Policies and Spending is to coordinate land-use decision-making with the provision of infrastructure and services in a manner that makes the best use of our natural and fiscal resources. The importance of such coordination lies in the fact that land-use decisions are made at the local level, while the bulk of infrastructure (e.g., roads and schools) and services (e.g., emergency services and social services) that support land-use decisions are funded by the State. Thus the development of this document with local governments and citizens helps to create a unified view toward growth and preservation priorities that all governments can use to allocate resources.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
University of Delaware System	**Disaster Research Center (DRC)** The DRC, which represents the first social science research center in the world devoted to the study of disasters, was established at The Ohio State University in 1963 and moved to the University of Delaware in 1985. The Center conducts field and survey research on group, organizational, and community preparation for, response to, and recovery from natural and technological disasters and other community-wide crises.	DRC researchers have carried out systematic studies on a broad range of disaster types, including hurricanes, floods, earthquakes, tornados, hazardous chemical incidents, and plane crashes. DRC has also done research on civil disturbances and riots, including the 1992 Los Angeles unrest. Staff has conducted nearly 600 field studies since the Center's inception, traveling to communities throughout the United States and a number of foreign countries, including Mexico, Canada, Japan, Italy, and Turkey.	All hazards	DRC staff and students may be tasked with conducting targeted research addressing needs identified by the Delaware Emergency Management Agency.
University of Delaware System	**Office of the State Climatologist/ Center for Environmental Monitoring and Analysis (CEMA)** The State Climatologist and CEMA resides in the Department of Geography at the University of Delaware, Newark. The Climatologist's mission is to provide climatological support to the government and residents of the State of Delaware. CEMA provides real-time and value added information for a various agencies of state government and sectors of Delaware's economy, including emergency management.	The State climatologist serves as the primary source of historical information and guidance on the effects of weather-related phenomena on the State of Delaware. This includes guidance on appropriate mitigation factors with respect to the hazards that face the State.	Thunder sto rms Tornado es Hurrican es and other Tropical Storms Drought Floods	The climatologist's office provides background, historical information and context and guidance with respect to the climatology of Delaware, and its effects on the developed environment. Maintains real-time environmental monitoring system for use during weather emergencies.

Table 5.2
Federal Agencies Impacting or Supporting Hazard Mitigation in Delaware

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Federal Emergency Management Agency (FEMA)	FEMA provides pre- and post-disaster technical and financial assistance to States and local governments in order to facilitate the development of hazard mitigation plans and the implementation of mitigation projects.	State and Local Mitigation Planning "How-To Guides", including: Getting Started, Understanding Your Risks, Developing the Mitigation Plan, and Integrating Human-Caused Hazards Into Mitigation Planning. FEMA administers two key mitigation programs including the National Flood Insurance Program and the National Earthquake Program. Relevant grants include the Hazard Mitigation Grant Program, the Pre-Disaster Mitigation Grant Program PDM) the Flood Mitigation Assistance Program, the Severe Repetitive Loss Program, the Repetitive Flood Claims Program, and the Public Assistance, 406 Program. The PDM, HMGP, and PA programs are administered through the Delaware Emergency Management Agency (DEMA). The National Flood Insurance Program (NFIP) and Flood Mitigation Programs (FMA) are coordinated through the Delaware Department of Natural Resources and Environmental Control (DNREC). These programs are used to implement the integrated planning process and implement mitigation measures through funding sources and policy. The HMGP, FMA, and PDM are currently used to fund State and local planning efforts and the implementation of the mitigation strategies identified in this plan.	All hazards	The how-to series provides general guidance on methods that can be used to develop, implement and update State and local hazard mitigation plans. The National Flood Insurance Program is one of the most effective regulatory tools States and local governments possess to reduce the impacts of flooding. In addition to the development of a Local Flood Damage Prevention Ordinance, communities can join the Community Rating System, which provides a direct financial incentive to flood policyholders if a municipality or county implements CRS-approved techniques. The National Earthquake Program provides technical assistance and grants to States and local governments to implement risk reduction measures. FEMA grant programs provide the financial means to implement identified hazard mitigation projects. Following federally-declared disasters, the HMGP provides funding up to 15% of total disaster costs. The Pre-Disaster Mitigation Grant Program is available to implement cost-effective mitigation measures prior to a disaster. The Flood Mitigation Assistance Program provides planning, project and technical assistance funds to states and local governments that can be used to address repetitively flooded insured properties.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
Federal Highway Administration (FHA)	The FHA stated mission is to "continually improve the quality of our Nation's highway system and its intermodal connections"	The Federal-Aid Highway Program provides highway construction grants to States and directs federal highway construction appropriations. It ensures that the construction and maintenance of highways built with federal aid comply with existing regulations and directives. These regulations provide for the protection of roadway embankments and bridge structures located in floodplains. The Federal Lands Highway Program provides access to and within National Forests, National Parks, Indian Lands and other public lands by administering the Federal Lands Highway, Emergency Relief and Defense Access Roads Program, performing transportation planning and conducting engineering studies. The FHA is concerned with stream channel changes (rural areas) and detention facilities (urban areas) affecting highway routes. The design of bridge projects may involve reshaping channels for short distances upstream and downstream. The agency is involved with debris erosion control during the construction stage as well as channel cleaning as part of project maintenance schedules. FHA provides funds to aid in the cost of maintaining traffic and rebuilding flood-damaged highway facilities on the federal aid system when such work is beyond the financial capability of the owner of the highway. FHA assists in the surveying of roadway damage in flood-stricken areas.	Flood	The FHA Emergency Relief programs focus on minimizing the time needed to return highways to full service following disasters. Balancing this approach with the incorporation of mitigation measures during reconstruction can reduce the likelihood that future events will damage at-risk infrastructure.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
National Weather Service (NWS)	Part of NOAA, the NWS is responsible for providing weather forecasts, issuing severe weather warnings and watches, flash flood warnings and watches, hurricane warnings and watches, and flood warnings. The NWS oversees the IFLOWS program, which consists of an array of automated sensors sited to provide flood warning.	IFLOWS, US Hazards Assessment, NOAA Weather Radios, Forecast Modeling. StormReady Program.	Flood Hurricanes Winter Storm Tornado	The data compiled by the NWS is a valuable source of information that can be used during the formulation and update of State and local hazard mitigation plans. Weather forecasts and warnings can significantly reduce the loss of life due to severe meteorological events.
U. S. Army Corps of Engineers (USACE)	USACE programs in Delaware include reconnaissance and feasibility studies, continuing authority projects, emergency operations, floodplain management services, and permit issuance.	**Civil Works Program** This program encompasses a broad range of resource development activities for navigation, flood reduction, major drainage, shore and beach restoration and protection, flood protection, related hydroelectric power development, water supply, water quality control, fish and wildlife conservation and enhancement, outdoor recreation, and environmental quality. Silver Jackets - Silver Jackets teams are collaborative state-led interagency teams, continuously working together to reduce flood risk at the State level. Various members of the State Planning Team participate in this program. Beach Restoration and Shoreline Protection Program - This program authorizes USACE under Section 103 of the 1962 River and Harbor Act, as amended, to develop and construct small projects for the purpose of shore protection and beach restoration on Great Lakes and coastal areas.	Flood Hurricane Coastal Erosion	USACE programs can significantly reduce the impacts of flooding, hurricanes and coastal erosion. In addition to property protection measures, the Corps of Engineers has begun to consider other alternatives, including floodplain management planning. Relevant programs include: Aquatic Ecosystem Restoration, Aquatic Habitats and Wetlands, Beach Erosion Control Projects, Clearing and Snagging Projects, Emergency Advance Measures for Flood Prevention, Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works, Emergency Streambank and Shoreline Protection, Floodplain Management Services, Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works, Planning Assistance to States, Small Ecosystem Restoration, Small Flood Projects, and Small Navigation Projects.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
National Oceanic and Atmospheric Administration (NOAA)	NOAA programs include assisting States administer coastal management programs. Specific assistance includes annual funding, technical guidance and training.	Coastal Zone Management Program	Flood Hurricane Nor'easter Coastal Erosion	The effective management of coastal resources includes protecting natural systems and property from the damaging impacts of natural hazards, including hurricanes and coastal erosion. Following coastal disasters, including hurricanes, tropical storms and nor'easters, NOAA may provide technical assistance, including the implementation of post disaster recovery studies as tasked by FEMA under disaster recovery mission assignments or administration directives.
U.S. Fish and Wildlife Service	"The U.S. Fish and Wildlife Service's mission is, working with others, to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."	The U.S. Fish & Wildlife Service is responsible for flood hazard mitigation in the Bombay Hook National Wildlife Center and Refuge and the Prime Hook National Wildlife Refuge. Relevant grants include the National Coastal Wetlands Conservation Grant Program; Habitat Conservation Planning Assistance; Habitat Conservation Planning Land Acquisition; Recovery Land Acquisition; and the Landowner Incentive Program.	Flood Coastal Erosion Hurricane	The maintenance of federal lands, including refuges, particularly those located in areas subject to natural hazards, serve to limit development. In the case of the Bombay Hook National Wildlife Center and Refuge, and the Prime Hook National Wildlife Refuge, maintaining land in its natural state also absorbs the impacts of flooding and coastal storm surge. The U.S. Fish and Wildlife Service administer the Coastal Barrier Resources Act.

Agency	Division (Mission/Function)	Relevant Plans, Policies, Programs and/or Grants	Hazard(s) Addressed	Effect(s) On or Significance To Hazard Loss Reduction
U.S. Geological Survey (USGS)	The USGS assists communities and State agencies collect, develop, and compute basic data and information for floodplain engineering studies and investigations. Information available from the USGS records includes water gauge heights, discharge, historic flood peaks, and inundated areas. Reports of magnitude, frequency, and duration of flood flows are also kept.	Flood-prone areas subject to inundation by floods of approximately the 100-year frequency have been delineated on topographic maps for selected areas within Delaware and can be obtained through the Delaware Geological Survey. USGS conducts studies of earthquake vulnerability and provides the findings to the State.	Flood Earthquake	The flood and earthquake data collected by the USGS can be incorporated into State and local level risk assessments. Flood data may be used to assist in the identification of cost-effective HMGP, PDM and FMA projects.
U.S. Natural Resources Conservation Service (NRCS)	The U. S. Natural Resources Conservation Service offers technical assistance in the conservation, development, and productive use of soil and water resources.	Relevant programs include Emergency Watershed Protection, Watershed Protection and Flood Prevention Program, Watershed Rehabilitation Information, and the Wetlands Reserve Program.	Flood	NRCS activities in Delaware include watershed protection, flood protection, conservation technical assistance, and soil surveys. The Emergency Watershed Protection program can be used to fund the purchase of floodplain easements. Watershed Protection and Flood Prevention Program can fund flood hazard analyses, watershed planning, and other forms of floodplain management assistance.

Local Capability Assessment

S13 - Does the plan generally describe and analyze the effectiveness of local and tribal, as applicable, mitigation policies, programs, and capabilities? **[44 CFR §201.4(c)(3)(ii)]**

S14 - Does the plan describe the process to support the development of approvable local and tribal, as applicable, mitigation plans? **[44 CFR §§201.3(c)(5) and 201.4(c)(4)(i)]**

S15 - Does the plan describe the criteria for prioritizing funding? **[44 CFR §201.4(c)(4)(iii)]**

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? **[44 CFR §§201.3(c)(6)/ 201.4(c)(2)(ii), 201.4(c)(3)(iii), and 201.4(c)(4)(ii)]**

The findings of the statewide local capability assessment are summarized in this Plan to provide insight into relevant capacity of Delaware's local jurisdictions to implement hazard mitigation activities. This information may be used to assist decision makers at the State level determine how to best allocate or distribute their technical or fiscal resources for enhancing local capabilities in implanting hazard mitigation practices. Assessment information is based upon the responses provided by local government officials to a *Capability Assessment Survey*[5] and during meetings of the local mitigation advisory committees.

The survey instrument asked specific questions about existing local plans, policies, programs or ordinances that contribute to and/or hinder the community's ability to implement hazard mitigation actions. In addition, a series of questions were asked concerning each jurisdiction's technical, fiscal, administrative and political capabilities to implement hazard mitigation actions. The survey results provided an extensive inventory of existing local plans, policies, programs and ordinances and required local officials to conduct a self-assessment of their jurisdiction's specific capabilities.

The information provided by the participating jurisdictions in response to the survey questionnaire was incorporated into a database for further analysis. A general scoring methodology was then applied to quantify and rank each jurisdiction's overall capability relative to one another. According to the scoring system, each plan, policy, ordinance or program was assigned a point value based on its relevance to hazard mitigation. Additional points were added based on each jurisdiction's self-assessment of their fiscal, technical, administrative and political capabilities. A total score and general capability rating (High, Moderate or Limited) was then determined according to the total number of points received, according to the following points scale:

0-12 points = Limited overall capability
13-25 points = Moderate overall capability
26-38 points = High overall capability

According to the assessment, the average local capability score for all local governments in Delaware is 14.76, just shy of a moderate capability. The highest countywide average score was 26.21 in New Castle County, followed by 23.32 in Sussex County and 14.33 in Kent County. The scoring results of the local capability assessment are summarized in Table 5-3 and reflect the results of the local capability assessment conducted as part as the local plan updates in 2015 and 2016.

[5] A copy of the local Capability Assessment Survey and the scoring methodology used to assess county and municipal capabilities is available at DEMA.

Table 5-3
Local Capability Assessment Survey Results

Kent County	Capability Score
Bowers Beach	15
Camden	26
Cheswold	25
Clayton	17
Dover	29
Farmington	5
Felton	18
Frederica	11
Harrington	15
Hartly	5
Houston	6
Kent County	29
Kenton	6
Leipsic	10
Little Creek	19
Magnolia	6
Milford	14
Smyrna	23
Viola	6
Woodside	5
Wyoming	11
County Average	**14.33**

New Castle County	Capability Score
Arden	17
Ardencroft	17
Ardentown	21
Bellefonte	18
Delaware City	28
Elsmere	28
Middletown	20
New Castle	38
New Castle County	37
Newark	34
Newport	27
Odessa	21
Townsend	26
Wilmington	35
County Average	**26.21**

Sussex County	Capability Score
Bethany Beach	37
Bethel	15
Bridgeville	31
Dagsboro	18
Delmar	17
Dewey Beach	21
Ellendale	9
Fenwick Island	31
Frankford	18
Georgetown	21
Greenwood	21
Henlopen Acres	23
Laurel	23
Lewes	15
Millsboro	38
Millville	17
Milton	15
Ocean View	14
Rehoboth Beach	27
Seaford	32
Selbyville	30
Slaughter Beach	29
South Bethany	31
Sussex County	33
Blades	17
County Average	**23.32**

Tables 5-4 through **5-6** provide a summary of the local plans and programs in place for Delaware's local governments, by county. An "X" indicates that the given plan or program is currently in place and being implemented by the local jurisdiction (or in some cases by the County on behalf of the local jurisdiction).

Key to Tables 5-4 though 5-6:

HMP – Hazard Mitigation Plan
DRP – Disaster Recovery Plan
CLUP – Comprehensive Land Use Plan
FMP – Floodplain Management Plan / Flood Mitigation Plan
SMP – Stormwater Management Plan
EOP – Emergency Operations Plan
COOP – Continuity of Operations Plan
REP – Radiological Emergency Plan
SARA – SARA Title III Emergency Response Plan
TRANS – Transportation Plan
CIP – Capital Improvements Plan (that regulates infrastructure in hazard areas)
REG-PL – Regional Planning
HPP – Historic Preservation Plan
ZO – Zoning Ordinance
SO – Subdivision Ordinance
FDPO – Flood Damage Prevention Ordinance
NFIP – National Flood Insurance Program
CRS – Community Rating System
BC – Building Codes

Table 5-4
Kent County Local Capability Assessment Survey Results (2015)

Jurisdiction	HMP	DRP	CLUP	FMP	SMP	EOP	COOP	REP	SARA	TRANS	CIP	REG-PL	HPP	ZO	SO	FDPO	NFIP	CRS	BC
Kent County	X	X	X	X		X	X	X	X			X		X	X	X	X		X
Bowers Beach						X	X		X					X		X	X		X
Camden	X		X	X	X	X			X	X			X	X	X	X	X		X
Cheswold	X		X	X		X			X		X			X		X	X		X
Clayton			X	X					X					X	X	X	X		X
Dover	X		X	X		X			X	X	X	X	X	X	X	X	X		X
Farmington									X					X					X
Felton	X		X	X		X			X					X	X				X
Frederica			X						X							X	X		X
Harrington			X						X			X		X	X	X	X		X
Hartly									X					X					X
Houston									X					X	X				X
Kenton			X						X										X
Leipsic									X					X		X	X		X
Little Creek	X		X	X					X					X		X	X		X
Magnolia									X					X	X				X
Milford	X		X						X							X	X		X
Smyrna			X			X			X	X	X	X	X	X	X	X	X		X
Viola			X						X										X
Woodside									X					X					X
Wyoming									X					X	X	X	X		X

Table 5-5 (2015)
New Castle County Local Capability Assessment Survey Results (2015)

Jurisdiction	HMP	DRP	CLUP	FMP	SMP	EOP	COOP	REP	SARA	TRANS	CIP	REG-PL	HPP	ZO	SO	FDPO	NFIP	CRS	BC
New Castle County	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Arden, Village of	X		X	X				X	X			X	X	X					X
Ardencroft, Village of	X		X	X				X	X			X	X	X					X
Ardentown, Village of	X		X	X	X			X	X			X	X			X	X		X
Bellefonte, Town of	X		X		X			X	X				X	X	X		X		X
Delaware City, City of	X		X	X	X			X	X	X		X	X	X	X	X	X	X	X
Elsmere, Town of	X		X	X	X	X		X	X					X	X	X	X	X	X
Middletown, Town of	X		X		X			X	X				X	X	X	X	X		X
New Castle, City of	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Newark, City of	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X
Newport, City of	X		X	X	X			X	X	X	X	X		X	X	X	X		X
Odessa, Town of	X		X	X	X			X	X	X			X	X	X	X			X
Townsend, Town of	X		X	X	X	X		X	X		X	X		X	X	X			X
University of Delaware	X							X											
Wilmington, City of	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X

Table 5-6
Sussex County Local Capability Assessment Survey Results (2016)

Jurisdiction	HMP	DRP	CLUP	FMP	SMP	EOP	COOP	REP	SARA	TRANS	CIP	REG-PL	HPP	ZO	SO	FDPO	NFIP	CRS	BC
Sussex County	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X		X
Bethany Beach	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Bethel	X								X			X	X	X		X	X		X
Blades	X		X						X					X	X	X	X		X
Bridgeville	X		X	X		X	X	X	X	X	X	X	X	X		X	X		X
Dagsboro			X						X		X	X		X	X	X	X		X
Delmar			X			X	X		X	X	X			X	X	X	X		X
Dewey Beach			X	X					X			X		X	X	X	X	X	X
Ellendale			X						X					X	X				X
Fenwick Island	X		X	X	X	X			X		X	X		X	X	X	X	X	X
Frankford				X	X				X		X			X	X	X	X		X
Georgetown			X	X					X		X	X		X	X	X	X		X
Greenwood	X		X	X					X			X		X	X	X	X		X
Henlopen Acres				X		X	X		X		X	X		X	X	X	X		X
Laurel				X		X	X		X		X	X		X	X	X	X		X
Lewes			X		X				X					X	X	X	X		X
Millsboro	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Millville			X	X					X					X	X	X	X		X
Milton			X	X					X			X	X	X	X	X	X		X
Ocean View			X	X								X	X	X	X	X	X		X
Rehoboth Beach	X		X	X		X			X		X	X		X	X	X	X		X
Seaford		X	X	X	X	X	X		X		X		X	X	X	X	X	X	X
Selbyville		X	X	X		X	X		X	X		X	X	X	X	X	X	X	X
Slaughter Beach	X		X	X	X	X			X		X	X	X	X	X	X	X		X
South Bethany		X	X	X		X	X		X		X	X		X	X	X	X	X	X

Assessment Analysis

Based on the assessment of existing State policies, programs, plans and projects, a basic analysis of the findings are summarized across the following capabilities:

1. Administrative Capability
2. Technical Capability
3. Fiscal Capability
4. Legal Capability
5. Political Willpower

Administrative Capability

The State of Delaware has a moderate level of administrative capability to implement hazard mitigation policies and projects given existing natural hazard vulnerabilities. The State is taking a series of steps to enhance their capability over time as evidenced by this plan (see Sections 6.1 and 6.2). Examples include the goals developed addressing enhanced legislation and codes, improved interagency coordination, the identification and implementation of specific mitigation projects, the improved use of existing resources and data and enhancing outreach and training efforts. Capability was evaluated by reviewing State staffing and the existing organizational structure found across State government generally and at the Delaware Emergency Management Agency (DEMA) more specifically. Since it is the responsibility of DEMA to coordinate statewide mitigation efforts, an emphasis was placed on the review of DEMA capabilities, including internal staffing patterns and their ability to coordinate State agencies' participation in hazard mitigation-related activities. Specific examples include a review of the 409 Plan and the existing State Hazard Mitigation Council (SHMC). An explicit goal of the State of Delaware Hazard Mitigation Plan is to more effectively build on existing programs and improve the level of coordination across agencies (see Section 6.1, *Mitigation Strategy*).

Recent Hazard Mitigation Studies

Several natural hazards mitigation studies have been conducted across the state of Delaware. The plans are listed below:

DNREC - Delaware Climate Change Impact Assessment.

DNREC - Preparing for Tomorrow's High Tide 2014

DNREC - Climate Framework for Delaware

DEMA has two staff members devoted to undertaking mitigation- related duties, including the State Hazard Mitigation Officer (SHMO) and a Planner IV. The SHMO coordinates statewide hazard mitigation activities with technical support from State agencies through the State Hazard Mitigation Council (SHMC). The SHMO oversees the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation (PDM) Grant Program, the update and revision of the State Hazard Mitigation Plan, and is the principle liaison in updating all the local mitigation plans. The Planner IV has been tasked with the coordination, development, and project management of mitigation projects for the SHMO. In addition, the State Floodplain Administrator, who is located in the Delaware Department of Natural Resources and Environmental Control (DNREC), is responsible for the oversight of statewide floodplain management duties, including the administration of the National Flood Insurance Program in the State of Delaware. The State Floodplain Administrator also manages the Flood Mitigation Assistance (FMA) Program. A concerted effort has been made to continue the close working relationship between DEMA and DNREC via the State and local hazard mitigation planning process.

In addition to technical experts, DEMA has the support of the SHMC to develop and implement the goals and mitigation actions found in this Plan. Furthermore, DEMA has in place an organizational structure that served as the foundation for the oversight of the planning process. The SHMC, comprised of State, federal and public sector agency officials, will continue to work closely with DEMA and FEMA to ensure the plan's maintenance, track progress, and update the plan as needed.

The State of Delaware Hazard Mitigation Plan (409 Plan), last updated in 2013, established the approach taken by the State to address natural hazards. As part of a policy recommendation in this plan, the SHMC was expanded to include an all-hazards focus. This allowed for a more comprehensive assessment of natural and human-caused hazards, including technological accidents and acts of terrorism. Within the SHMC, a number of State agencies have been assigned specific responsibilities to carry out mitigation activities or hazard specific tasks (see Table 5.1 and Section 6.1).

While it was determined that each of these agencies are adequately staffed, trained and funded to accomplish their primary missions, improvements can be made in the degree to which State agencies coordinate complimentary objectives that address hazard mitigation activities. Improved coordination will build on established relationships, existing hazard studies conducted across the State, the role of the University of Delaware, the use of existing State planning data, and the positive working relationship between DEMA and the State of Delaware's Floodplain Management Program.[6]

The Mitigation Action Plan, which can be found in Section 6.1 - Mitigation Strategy and Section 6.2 – Mitigation Actions, is designed to serve as a primary means to achieve an improved level of inter-agency coordination. By establishing clear actions that are linked to specific agencies, accountability is increased. Actions are assigned timelines approved by the SHMC, further linking policy and project completion with accountability. Therefore actions can be tracked over time to assess the degree to which the plan is achieving desired goals. Finally, the Mitigation Action Plan is easily updated as needed, following a disaster or as required by the Disaster Mitigation Act, thereby increasing the likelihood that State agencies will remain involved over time.

In addition to internal capacity and coordination with other statewide partners, DEMA supports the development of local mitigation plans by acting as a centralized training center for the state. All HMGP related trainings brought into the state at no cost and promoted to local and county partners. In addition to training support, DEMA offers technical assistance to local planning partners by actively participating in local plan review processes, and by acting as a liaison between local and federal planning partners to ensure efficient review and approval of local mitigation plans. Additionally, DEMA supports the counties in their planning process to identify, evaluate, and prioritize local projects that are cost-effective, environmentally sound, and technically feasible, that also contribute to and are aligned with mitigation actions identified by the state. Technical planning assistance is also provided for local planning efforts through input from state partners at the Delaware Department of Transportation, the Delaware Geological Survey, the Delaware Department of Natural Resources and Environmental Control, and more in areas of engineering, infrastructure capability, vulnerability analysis, and other relevant fields. Additionally, DEMA offers funding opportunities to help support local planning efforts and revisions through various grant programs, for which DEMA acts as the applicant (See Section 2). Outreach to the counties is done annually to ensure they have sufficient notice of available funding opportunities. Finally, all local planning partners are included on the State Mitigation Council to ensure that state and local hazard mitigation planning objectives and priorities align and are consistent throughout Delaware (See section 2). Both local and state mitigation planning cycles are defined in five year increments to ensure consistency in planning review and update processes.

Floodplain Management

Sound floodplain management involves a series of programs designed to reduce flood-related damages. Programs such as the National Flood Insurance Program (NFIP), the Community Rating System (CRS) and the Flood Mitigation Assistance (FMA) program provide the framework needed to implement a successful floodplain management program. The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. In order for a county or municipality to join the NFIP, they must adopt a *Local Flood Damage Prevention Ordinance.* This document provides local governments with a powerful regulatory tool to reduce future flood-related losses.

Another key service provided by the NFIP includes the mapping of identified flood hazard areas. Flood Insurance Rate Maps are used to assess flood hazard risk and set flood insurance rates. The maps also provide an important means to educate residents, government officials and the business community about the likelihood of flooding in their community.[7]

Community Rating System Participation

An indicator of statewide floodplain management capability, undertaken at the local level, is the degree of community participation in the CRS. The primary goals of the CRS are to reduce flood losses, facilitate accurate insurance ratings, and to promote the awareness of flood insurance. These goals are achieved through the administration of a program that goes beyond the requirements of NFIP participation. The CRS is an incentive-based program that encourages counties and municipalities to undertake defined actions designed to reduce the impacts of future flooding.

[6] Specific goals and mitigation actions designed to address these issues are found in Section 6, Mitigation Strategy.
[7] For additional information on the Delaware Floodplain Management program, see Plans, Programs, Policies and Funding, Table 5.1.

Each of the 18 activities, or measures, is assigned points. As points are accumulated and reach identified thresholds, communities can apply for a reduced CRS class. Class ratings, which run from 1 to 10, are tied to flood insurance premium reductions. Therefore, as class ratings decrease, the percent reduction of flood insurance for policies held in that community increases (see **Table 5-7**).

Table 5-7
CRS Premium Discounts

1. 45%
2. 40%
3. 35%
4. 30%
5. 25%
6. 20%
7. 15%
8. 10%
9. 5%
10. ---

All counties and 73 percent of municipalities in Delaware participate in the National Flood Insurance Program.[8] In the State of Delaware, the following communities listed in **Table 5-8** participate in the Community Rating System.

Table 5-8
Community Rating System Participation in the State of Delaware
(2018)

Community	Date of Entry	CRS Classification	CRS Premium Discount
Town of Bethany	05/01/2009	8	10%
Town of Dewey Beach	10/01/1994	8	10%
Town of Fenwick Island	10/01/1994	8	5%
City of Lewes	10/01/1992	9	5%
City of New Castle	10/01/1994	8	10%
City of Newark	10/01/1992	7	15%
City of Rehoboth Beach	10/01/1994	8	10%
City of Seaford	10/01/1996	9	5%
Town of South Bethany	10/01/2007	8	10%
*Delaware City	10/01/2012	8	10%
*New Castle County	05/01/2013	8	10%

*** Denotes a new community added in 2013 update**

Flood Insurance

An essential element of this State's capability to recover from a disaster is the amount of flood insurance coverage, especially in the special flood hazard areas. **Table 5-9** shows the number of policies in our high risk zones, total policies, and the total flood insurance coverage by county.

[8] Some jurisdictions surveyed do not participate in the NFIP due to the lack of mapped Special Flood Hazard Areas or the belief that they do not face a significant flood risk. However, localized flooding may occur regardless of existing streams, rivers or low lying areas. Furthermore, homeowners are not eligible to maintain flood insurance unless the jurisdiction in which they own property participates in the NFIP.

Table 5-9
Flood Insurance Coverage (2018)

County	V-Zone	A-Zone	Policies	Total Coverage
New Castle	0	1,981	3,213	$832 Million
Kent	23	485	1,089	$289 Million
Sussex	720	15,295	22,461	$5.9 Billion
Total	**743**	**17,761**	**26,763**	**$7.02 Billion**

Planning

Local governments are required to adopt and update Comprehensive Land Use Plans according to State law. Local plans must contain a series of planning elements. Counties are required to adopt comprehensive plans that contain open space and conservation elements. Thus, local and county plans provide an important institutionalized vehicle to address hazards. However, neither local nor county-level plans contain a land use or hazard mitigation element (see Institute for Business and Home Safety website: www.ibhs.org/land_use_planning/). An important addition to the State of Delaware All Hazard Mitigation Plan includes the proposed incorporation of mitigation-related activities into local and county- level plans. In addition, the Plan states that counties and municipalities should attempt to identify innovative ways to use existing planning requirements to reduce future disaster losses.

Technical Capability

The State of Delaware has a moderate level of technical capability to implement the State hazard mitigation strategy given existing capabilities. While there currently exists a wide range of technical resources across State agencies, the development of a systematic protocol for sharing resources to analyze natural hazards and develop meaningful actions to reduce their impact could be improved. This will be accomplished through periodic meetings of the State Hazard Mitigation Council, benefit-cost analysis training, and mitigation workshops. Additional factors affecting technical capability include:

- Information on past disasters and mitigation projects;
- Experience in disaster management and mitigation planning;
- The application of technology to address hazards. Examples include the use of GIS-driven risk assessments and information technologies to facilitate the formulation, development, implementation and monitoring of mitigation actions.

Technical capability can be defined as possessing the skills and tools needed to accomplish specific tasks and disseminate the results to those associated with the State of Delaware Hazard Mitigation Program. Technical capability can be measured across three primary elements: 1) geographic information systems (GIS) and database management; 2) grants management; and 3) hazard mitigation planning. Measuring the degree to which each element is found in the State of Delaware was conducted using the *State Capability Assessment Survey* and through interviews with State staff.

Geographic information systems (GIS) and database management capabilities can be measured by reviewing existing tools (hardware and software) and the access to individual experts who can effectively gather, analyze and display relevant information. In the case of Delaware, the Delaware Emergency Management Agency has access to information developed in-house as well as that data housed at the Office of State Planning,[9] The University of Delaware, the Department of Natural Resources and Environmental Control (Flood Mitigation Program), and the State of Delaware Geological Survey (earthquake data). For example, the Delaware Geospatial Data Exchange houses an array of local and state-level data that can be used to assess both natural systems and the built environment.

[9] State and local spatial data, which includes some natural hazards information, is available through the Delaware Geospatial Data Exchange (https:// dataexchange.gis.delaware.gov/

The Delaware Geospatial Data Exchange represents a cooperative effort among State agencies, the University of Delaware, county and municipal governments, and others. The goal of this group is to build a "Delaware GIS Community" and in so doing improve the use of GIS and spatial data in Delaware.

The University of Delaware maintains a nationally-recognized Disaster Research Center that conducts hazards-related research and analysis. The Center conducts field and survey research on group, organizational, and community preparation for, response to, and recovery from natural and technological disasters and other community-wide crises. The State Geological Survey has conducted numerous earthquake-related studies in Delaware, including a historical review of past events and an on-going analysis of earthquake vulnerability in the Wilmington area. As this analysis is refined over time, it will be incorporated into the City of Wilmington Hazard Mitigation Plan and the State of Delaware Hazard Mitigation Plan.

The information generated and analyzed has proven valuable to assist in the identification of hazard vulnerability, assess past events and document specific mitigation measures that have been adopted across the State. However, the dissemination of research findings and relevant data to State and local emergency management practitioners and could be improved. In particular, the use of such data could be used to more effectively shape sound hazard mitigation policies and practices. Finally, State and local emergency management agency's now have at least part time GIS experts to effectively analyze hazard data.[10]

Hazard mitigation-related grants management capabilities were measured by assessing the State HMGP Administrative Plan, the number of staff assigned to conduct identified duties, and the degree to which State and FEMA mitigation staff have adequately trained local governments to implement mitigation grant programs. Adequate staff support and training were reviewed in the context of the overall vulnerability of the State to hazards, which took into account the size of the State and the number and magnitude of past events. In the State of Delaware, hazard mitigation grants management duties are the responsibility of the State Hazard Mitigation Officer (SHMO) who administers the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) Program, and the State Floodplain Administrator who manages the Flood Mitigation Assistance (FMA) program. FEMA Region III provides technical support as needed. One factor impacting the statewide mitigation strategy involves the reluctance of some local governments to administer mitigation grant programs. Two primary factors contribute to this problem: 1) financial difficulties assuming the non-federal match[11], and 2) available staffing and expertise to administer mitigation grant programs at the municipal level.

Hazard mitigation planning capabilities are the responsibility of the Natural Hazards Planner in DEMA. The Natural Hazards Planner also relies on the State Hazard Mitigation Council to assist in the multi-agency implementation of this plan. The three county plans, New Castle, Kent and Sussex, were approved by FEMA prior to the initiation of the State All Hazards Mitigation planning process started. This timing allowed the State to provide technical assistance to the counties on the drafting, review and approval of their mitigation plans.

All three county plans used Federal funding under two subsequent disasters to assist with the funding of their mitigation plan updates, Disaster 4037 Hurricane Irene and Disaster 4090 Hurricane Sandy. Mitigation planning staff from DEMA attended local planning meetings on the plan update and provided technical assistance where necessary to assist the counties. Due to limited planning staff at the county level each county decided to contract out their plan update.

[10] The State maintains a cadre of GIS specialists who can assist State agencies as needed. The Delaware Emergency Management Agency does have one staff member assigned GIS-related duties.
[11] The State of Delaware requires local governments to provide the non-federal match for the various mitigation assistance programs.

Fiscal Capability

The ability to take action in a State is often closely associated with the amount of money available to implement policies and projects.[12] Funding may be obtained from grants or State and locally-based revenue. The costs associated with policy and project implementation vary widely. In some cases, policies are tied to staff costs associated with the creation and monitoring of a given program. In other cases, money is linked to a project, like the acquisition of flood-prone homes, which can require a substantial commitment from local, State and federal funding sources. In either case, decisions must be made concerning how the State can reduce vulnerability to an acceptable level considering the availability of existing and future finances.

Taking into account both State agency operating budgets tied to mitigation-related activities and external funding sources obtained in recent years, the Delaware Emergency Management Agency has a limited to moderate fiscal capability for a State of Delaware's size and hazard vulnerability. Fiscal capability can be increased over time as a more direct link is made between existing state-level environmental and economic development programs and hazard mitigation objectives identified in this Plan. Specific examples include the use of existing State and non-profit environmental land acquisition programs and the Community Development Block Grant Program to address mitigation-related projects.[13] The identification of eligible Pre-Disaster Mitigation projects, as well as other federal funding sources identified in this Plan, should allow communities in the State of Delaware to compete nationally for available funding and serve to highlight opportunities for State agencies to coordinate funding resources.[14]

Legal Capability

In general, the legal authority of State government is granted to them by their constitution and federal law. In the case of local governments, their authority to act is granted to them by their home state. This principle is referred to as "Dillon's Rule." It is important to note that while the State may provide the authority of a local government to act, much of the specific mitigation projects implemented in any given State are often done at the municipal level. Yet broader policy objectives and programs often exist at the State and federal levels of government. Furthermore, federal and State funding often drive local project initiatives. Therefore, in order to be effective, this Plan should recognize the local, State and federal legal framework surrounding hazard mitigation planning.

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

[13] The implementation of hazard mitigation projects often has positive environmental and economic impacts. It is the responsibility of DEMA and the Hazard Mitigation Council to educate State agency officials about these positive
impacts in order to better coordinate complimentary actions.

[14] A specific challenge facing the State of Delaware is the ability to identify willing participants for mitigation program funding. Part of the problem stems from the fact that these funds require a local match that is assumed by the homeowner. In order to address this issue, DNREC is developing an implementation and outreach strategy that will describe the technical aspects of the grant development and implementation process, while educating homeowners and local government officials about the merits of the programs.

In general, local governments have the authority to enact the following categorical actions: regulation (including general police power, building codes and building inspections, land use), acquisition of property for public use, taxation and spending. Each of these categories can provide tools that can be used by local governments to implement hazard mitigation measures.

Police Power. Local governments have the authority to enact hazard mitigation measures, based on their authority to protect public health, safety and welfare. One means to do this is through the use of local ordinances. In addition, local governments can cite their authority to address "nuisances," which may include, under certain circumstances, those actions that make people or property more vulnerable to hazards.

Building Codes. Building codes represent a well established regulatory tool that can be used to reduce the impacts of hazards. Local governments in the State of Delaware are granted the authority to adopt and enforce local building codes, including those specified in their Local Flood Damage Prevention Ordinance. The State of Delaware has a standard minimum building code that local governments in Delaware are empowered to enforce.

Land Acquisition. Land acquisition can be a useful tool for pursuing mitigation goals. The acquisition of land in identified hazard areas represents a permanent means to reduce the impacts of geographically defined hazards. Governments may find the most effective method for completely "hazard-proofing" a particular piece of property or area is to acquire the property (either in fee or a lesser interest, such as an easement), thus removing the property from the private market. As part of House Bill 235, the Realty Transfer Tax for Conservation Fund established a nine million dollar budget to fund the acquisition and management of undeveloped land.[15] In many cases, environmentally sensitive land is also subject to significant hazard risk. Examples include coastal property and wetlands. A potential modification to the existing House Bill may include the consideration of undeveloped land that is located in identified high hazard areas, thereby reducing sprawl and hazard vulnerability simultaneously.

Taxation. The power to levy taxes and special assessments can be used by states to achieve desired aims. The power of taxation extends beyond merely the collection of revenue and can have a profound impact on the pattern of development. In the case of Delaware, the Governor signed legislation designed to reduce sprawl by imposing higher impact fees on development in areas where development was not planned. Two additional methods that could be used to reduce hazard risk include the assessment of impact fees associated with development in identified high hazard areas, and the development of a State fee that could be used to fund the implementation of identified hazard mitigation projects. The establishment of a local impact fee would require the State of Delaware Legislature to grant municipalities this authority. In the case of a State Hazard Mitigation Fee, the State may choose from a variety of revenue streams including, but not limited to: 1) fees levied on selected goods or services sold; 2) increased property taxes; or 3) a flat fee. State officials would also have to decide if those who own property located in identified hazard areas would be assessed at a higher rate.

Spending. The *Strategies for State Policies and Spending* coordinates land-use decision-making with the provision of infrastructure and services in a manner that makes the best use of our natural and fiscal resources. The Cabinet Committee on State Planning Issues, through the Office of State Planning Coordination, originally developed the first Delaware *Strategies for State Policies and Spending* document published in 1999 to provide policy guidance for state activities and serve as a framework for coordinating the plans and actions of local governments. The importance of such coordination lies in the fact that land-use decisions are made at the local level, while the bulk of infrastructure (e.g., roads and schools) and services (e.g., emergency services and social services) that support land-use decisions are funded by the state. Thus the development of this document with local governments and citizens helps to create a unified view toward growth and preservation priorities that all governments can use to allocate resources. The *Strategies* have been regularly updated every five years with the most recent version adopted in 2015. The *State Strategies* is a result of extensive coordination with local governments, citizens, and state agencies to determine what areas are most prepared for growth and where the state can make the most cost-effective investments in roads, schools, and other public facilities and services.

[15] The Realty Transfer Tax for Conservation Fund was budgeted for eighteen years.

Enabling Legislation, Rules and Executive Orders

The state of Delaware and the Federal government maintain several relevant forms of enabling legislation, rules and executive orders that are directly relevant to hazard mitigation planning:

- Federal-state Agreement (The agreement is executed between the Governor and FEMA Regional Director following a disaster in order to receive federal assistance);
- The Robert T. Stafford Act of 1988 in accordance with 44 CFR 206.44;
- Section 409 of Public Law 93-288, as amended by Public Law 100-707 (requirement to perform a state hazard mitigation plan following a presidential disaster declaration);
- President's Executive Order 11988, Floodplain Management;
- President's Executive Order 11990, Protection of Wetlands;
- Flood Control Act of 1950, Section 215, PL 81-516 (33 USC 4001, et. seq.);
- National Flood Insurance Act of 1968, as amended (42 USC 4001, et. seq.);
- National Flood Insurance Program Implementing Regulations (24 CFR 46962), promulgated October 26, 1976;
- Delaware state agency's Rules and Regulations; and
- State Code 7-702; Quality of Life Act, Chapter 26 of State Code.

Political Willpower

One of the most difficult and sensitive capabilities to evaluate involves the political will of a State to enact meaningful policies and projects designed to reduce the impact of hazards. A variety of qualitative information was gathered to assist in this evaluation, including a review of current practices, programs and policies, the use of survey results, and conversations with State staff. Following an analysis of this information it was determined that the State of Delaware has a moderate to high level of political will to enact meaningful and proactive mitigation policies. The Delaware Emergency Management Agency and members of the State Hazard Mitigation Council are knowledgeable about the potential hazards that their State faces, and have become more familiar with the practices and principles of mitigation, particularly in light of recent disasters. The signing of an executive order by the Governor establishing the State of Delaware as a Disaster Resilient State is demonstrative of a commitment to hazard mitigation at the highest levels of State government. The current political climate at the state-level is favorable for supporting and advancing both existing and future hazard mitigation measures. Disasters, including Tropical Storm Henri, Hurricane Isabel, the 2010 double snow storms, Hurricane Irene in 2011, and Hurricane Sandy in 2012, and the January 22-23 winter storms have resulted in a greater awareness of hazards and caused government officials to seek ways to reduce the impact of future events. Additionally, major national disasters (i.e., Hurricane Katrina, Hurricane Harvey, Hurricane Irma, and Hurricane Maria)) generate interest in addressing catastrophic disasters in a more comprehensive manner. Political will could be further increased by building a supportive coalition of State agencies advocating the connection between hazard mitigation and complimentary agency objectives such as those found in the Delaware Livability Initiative.

Completed hazard mitigation projects indicate an understanding of hazard mitigation, including the political will necessary to implement them. When possible, local governments should attempt to assess their effectiveness following future events. The results should be presented to elected officials in order to provide examples of how mitigation can protect the lives and property of the citizens they represent. This, in turn, can provide the political support necessary to develop a more comprehensive mitigation program.

Project Implementation Capability

Documentation supporting the ability of the State of Delaware to implement hazard mitigation projects is contained in the Hazard Mitigation Administrative Plan (404 Plan)[16], the review of completed mitigation projects, and captured as part of interviews conducted with State staff and documents evaluated in the *State Capability Assessment Survey*. For the purposes of this Plan, the Delaware Emergency Management Agency assessed the following grant programs:

- Hazard Mitigation Grant Program (HMGP);
- Pre-Disaster Mitigation (PDM);
- Flood Mitigation Assistance (FMA).

The State Hazard Mitigation Administrative Plan describes eligible HMGP projects and how the State will review potential applicants. Eligibility criterion for FMA is determined directly from the guidance published annually by FEMA. The State will rely on the list of projects identified in the county-level all hazard mitigation plans as mitigation funds become available. In the case of locally proposed mitigation actions, projects are prioritized based on a variety factors: county assessment, benefits to the community, cost, cost effectiveness, ability of the sub-recipient to complete the project, and the timeline for completion.[17]

As part of this State All Hazard Mitigation Plan, the Delaware Emergency Management Agency and the Department of Natural Resources and Environmental Control take the leading role in the identification, monitoring and closeout of hazard mitigation projects. The following proposed actions are intended to improve the capacity of the State to actively manage future HMGP and FMA projects:

- Promote participation throughout the State in FEMA sponsored benefit-cost analysis training workshops conducted at the FEMA Emergency Management Institute or the Disaster Field Office following a federally-declared disaster;
- Establish a State project review team responsible for the assessment of HMGP and FMA projects. Specific tasks will include conducting benefit-cost analysis and environmental review for projects passing an initial project screening.[18]
- Develop a Memorandum of Agreement between Delaware Emergency Management Agency, Delaware Department of Natural Resources and Environmental Control, the Delaware Geological Survey, and the Delaware State Climatologist to assist staff with the environmental review of mitigation projects as needed.
- Utilize the results of the county-level risk assessments and prioritized mitigation actions when reviewing and ultimately submitting mitigation projects under any program to FEMA for approval.
- Regularly conduct outreach and educational efforts to keep county and local government officials abreast of new rules and techniques used to develop sound mitigation projects.

[16] See Annex D, Hazard Mitigation Grant Program Administrative Plan.
[17] See Section 6.2, State Hazard Mitigation Actions, which describe specific measures intended to enhance project implementation capability.
[18] Four Delaware Emergency Management Agency staff members have successfully completed the FEMA on-line environmental review course offered by the Emergency Management Institute titled "Coordinating Environmental and Historic Preservation Compliance."

Previously Implemented Mitigation Projects

Table 5-10 list the statewide Hazard Mitigation Assistance Program projects completed. **Table 5-11** through **Table 5-13** lists all Hazard Mitigation Assistance program projects and Public Assistance Mitigation projects completed by county. Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, Flood Mitigation Assistance (FMA) program, and 406 Mitigation (Public Assistance) projects funded in the State of Delaware, including the scope of work, budget and date of completion. This information will be used to assess the effectiveness of past projects in reducing future losses.

Table 5-10
Statewide Hazard Mitigation Projects

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Mitigation Plan Update	Update the City of Wilmington, New Castle County, Kent County, and Sussex County	June 2010	PDM 2007	PDM	$83,888	$111,850
All hazard Mitigation Planning	Planning grant for the University of Delaware to develop their own	September 2010	PDM 2008	PDM	$55,107	$87,301
U of D Homeowner's Handbook	Outreach brochure on hazard mitigation for homeowner's	April 2013	DR 1896	HMGP	$36,584	$48,817
Flooding Sensors 5% Initiative	To assist with understanding future potential roads and structures might be overwhelmed by flooding	On-Going	DR-4265	HMGP	$2,863.50	$8,590.50

Table 5-11
New Castle County Hazard Mitigation Projects

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
EOC Relocation	Relocate Delaware EOC from Delaware City to Penns Way.	June 1997	DR-933	HMGP	$14,509	$84, 249
			DR-976	HMGP	$4,729	
			DR-1017	HMGP	$43,949	
Flood Mitigation Planning	Developed Flood Mitigation Plans for New Castle and Sussex Counties, and Bethany Beach, Dewey Beach, Lewes, Wilmington and Delaware City.	November 1999	DR-933	HMGP	$114,986	$237183
			DR-976	HMGP	$62,901	
Fire Weather Monitoring Stations	Install fire-weather monitoring stations at Redden State Forest and Blackbird State Forest to allow Forest Service to monitor and predict forest fire potential.	December 1998	DR-1017	HMGP	$22,495	$29,993
Newark Acquisition Project	Acquisition of flood prone property located at Rahway Drive in Newark, DE.	May 2002	DR-1297	HMGP	$129,443	$172,591
Wilmington Public Sewer	Construct diesel storage tank enclosure to protect sewer pumping station during flooding events.	July 2002	DR-1297	HMGP	$30,262	$40,349
Delaware City Structural Barrier	Retrofit existing bulkhead, revetment and elements in Battery Park to the 100-year flood elevation. Install soil berm near Dragon run.	October 2004	DR-1297	HMGP	$482,648	$482,648
Bell Plumbing Supply Floodproofing	Floodproof a plumbing supply store and warehouse to the 50-year flood level.	2001	FMA 2000	FMA	$150,000	$200,000
Riverwalk Apartment Flood Levee	Build protective levee around flood-prone apartment complex.	2001	FMA 2000/2001	FMA	$175,000	$233,333
Delaware City Seawall	Extend existing seawall vertically to provide 100-year flood protection to downtown area.	October 2004	FMA 2001	FMA	$800,000	$1,066,667
Yorklyn Center for Creative Arts Floodproofing	Floodproof basement and first floor of private non-profit community art center.	December 2004	FMA 2003	FMA	$140,000	$186,667

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Standard Technologies Flood Proofing	Flood-proof Standard Technologies machine Shop.	October 2005	FMA 2004	FMA	$212,000	$282,667
Glenville Buyout	Acquire 155 repeatedly flood-damaged homes	December 2005	State/Local $32 Million	N/A	$0	$0
Glenville Buyout	Acquire 7 repeatedly flood-damaged homes.	December 2005	FMA 2003	FMA	$784,500	$1,046,000
Glenville Buyout	Acquire 17 repeatedly flood-damaged homes.	September 2007	FMA 2004	FMA	$1,806,808	$2,409,077
Glenville Buyout	Acquire 1 repeatedly flood-damaged home.	September 2007	FMA 2005	FMA	$126,953	$169,271
905 Kiamensi Road Buyout	Purchase and remove repeatedly flooded home.	October 2007	FMA 2006	FMA	$286,000	$381,333
New Castle County 123 Longview Drive Acquisition	Purchase dwelling, at 123 Longview Drive, Newkirk Estates, in Newark, Delaware, demolish the property and restore site.	May 2006	DR-1494	HMGP	$177,227	$236,302
New Castle County 132 and 134 Longview Drive Acquisition	Purchase dwellings at 132 and 134 Longview Drive, Newkirk Estates, in Newark, Delaware, demolish residents and restore site.	May 2006	DR-1495	HMGP	$435,139	$580,185
New Castle County Christiana Hospital Flood Mitigation	Dig a storm water retention pond and two floodwalls to protect Christiana Hospital's pharmacy loading dock and emergency power facilities.	May 2009	PDM 2007	PDM	$1,036,462	$1,382,160
Buttonwood Tide Gate Project	Install new tide gates in the Buttonwood area of New Castle	February 2009	DR-1654	HMGP	$31,976	$102,788
Home Elevation	Elevate the home at 202 Carlisle Drive in South Bethany	May 2009	DR-1654	HMGP	$17,146	$23,919
Metroform Medical Center Floodproofing	Floodproof the Metroform Medical Center	July 2009	FMA 2008	FMA	$195,000	$260,000
Shone Lumber Floodproofing Project	Floodproof Shone Lumber	October 2010	FMA 2009	FMA	$562,500	$750,000
Mitigation Plan Update	Update the City of Wilmington, New Castle County, Kent County, and Sussex County plans.	June 2010	PDM 2007	PDM	$83,888	$111,850

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Newark Hazard Mitigation	Relocate two sewer lines that run above the Christina river into the streambed.	September 2012	PDM 2007	PDM	$1,054,689	$1,406,252
Blades Town Hall Generator	Install a backup generator at Town Hall	November 2012	HMGP 1896	HMGP	$9,036	$12,049
Union Church Rd Acquisition	Acquire flood prone home at 515 Union Church Rd	March 2013	HMGP 1896	HMGP	$153,935	$205,247
3419 Faulkland Road Buyout	Acquire flood prone home at 3419 Faulkland Road	July 2012	FMAP 2009	FMAP	$172,500	230,000
NVF Corporate Office Buyout	Acquire flood prone business in Yorklyn area.	March 2013	FMAP 2009	FMAP	$1,640,250	$2,187,000
Barley Mill Rd Floodproofing	Flood proof a flood prone residence on Barley Mill Rd	April 2013	PDM 2011	PDM	$75,000	$124,993
Marsh Rd Acquisition	Acquire a flood prone home on Marsh Rd	On Going	HMGP 4037	HMGP	$214,959	$286,612
Wilmington EOC Floodproofing	Place a flood wall around the City of Wilmington EOC	On Going	PDM 2010	PDM	$260,730	$347,640
Newark Booster Retrofit	Retrofit potable water booster station	On Going	PDM 2010	PDM	$225,000	$325,000
Public Assistance Mitigation	Install riprap along a walkway in the City of New Castle.	On-going	PA 4090	PA	$6,179	$8,239
New Castle County Mitigation Plan	Update the New Castle County Hazard Mitigation Plan	June 2015	DR-4090	HMGP	$37,800	$50,400
Delaware City Flood Control	Improved outfall pipes, drainage systems, and pumping station installation.	On Going	PDM 2013	PDM	$690,000	$920,000
Bayview Beach Home Elevations	Elevating 9 homes in flood prone area along North & South New Rd.	On-Going	DR-4090	HMGP	$649,443	$865,922
Home Elevation	Elevate a home at 143 Fishers Wharf Rd	On-Going	PDM 2015	PDM	$85,875	$114,500
Home Acquisition	Acquire a home located at 9 Don Ave.	On-Going	PDM 2015	PDM	$160,500	$214,000
Generator	Backup generator for the City of Newark's Northwest Booster Station.	Submitted	PDM 2017	PDM	$78,126	$104,168

Source: Delaware Emergency Management Agency

Table 5-12
Kent County Hazard Mitigation Projects

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Big Stone Beach Relocation Project	Move two houses landward from an eroding shoreline and elevate on piles.	1999	FMAP 1997	FMAP	$78,000	$104,000
118 Williams Street. Buyout	Acquisition of property at 118 Williams Street in Bowers Beach.	July 2012	FMAP 2009	FMAP	$146, 250	$195,000
DNREC 5% Analysis	Analysis of Bay Beach Properties	March 2015	DR-4037	HMGP	$16,474	$65,900
Kent Mitigation Plan Update	Update the Kent County Mitigation Plan.	March 2015	DR-4037	HMGP	$23,066	$30,754

Source: Delaware Emergency Management Agency

Table 5-13
Sussex County Hazard Mitigation Projects

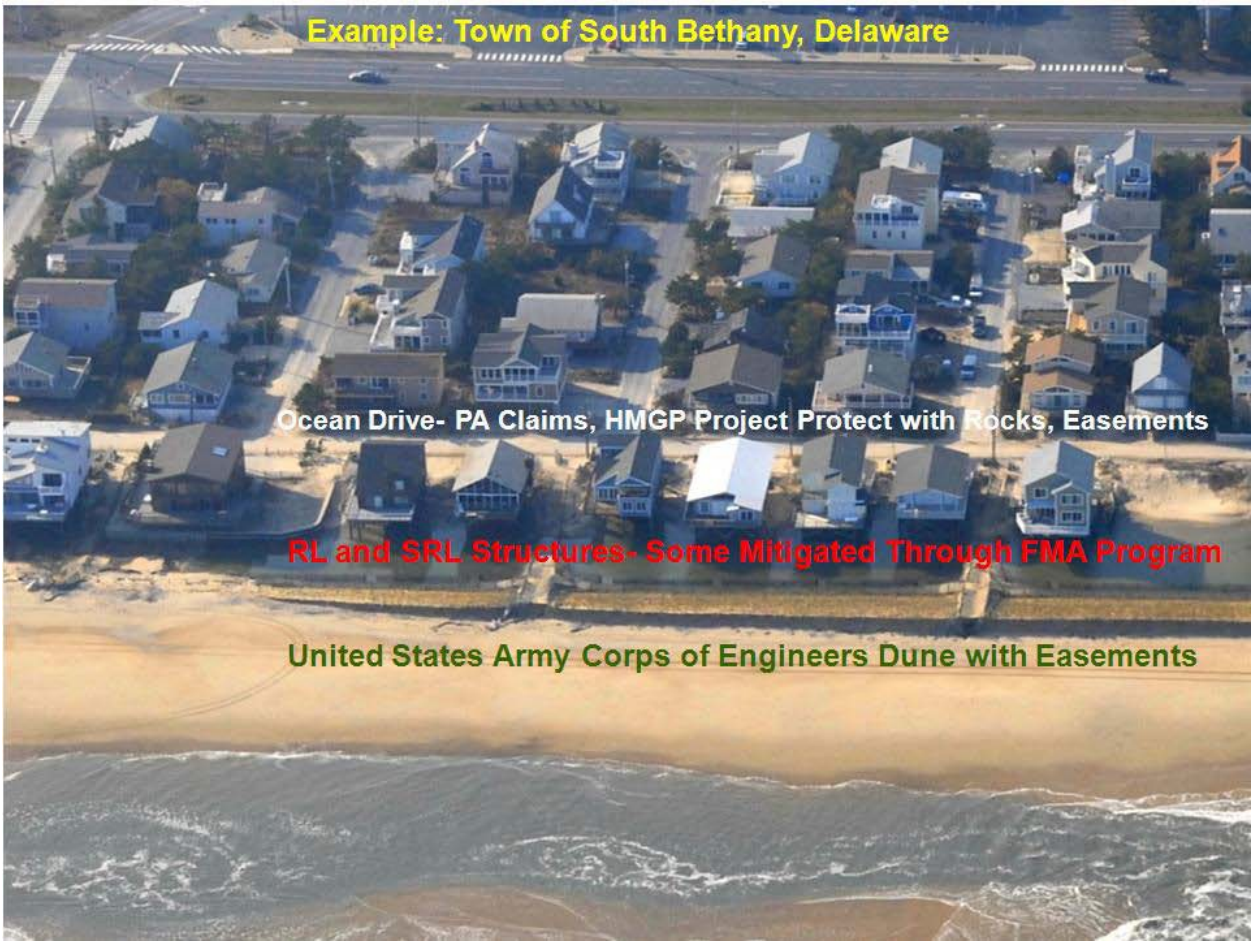
Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Flood Mitigation Planning	Developed Flood Mitigation Plans for New Castle and Sussex Counties, and Bethany Beach, Dewey Beach, Lewes, Wilmington and Delaware City.	November 1999	DR-933	HMGP	$114,986	$237,182
			DR-976	HMGP	$62,901	
Fire Weather Monitoring Stations	Install fire-weather monitoring stations at Redden State Forest and Blackbird State Forest to allow Forest Service to monitor and predict forest fire potential.	December 1998	DR-1017	HMGP	$22,495	$29,993
Coastal Sewer Floodproofing Near South Bethany	Elevate manhole openings, floodproof hatch-cover doors where opening are in roadways, elevate electrical components in water proof cabinets in sanitary sewer system.	December 1997	DR-933	HMGP	$74,548	$99,397
Dewey Beach Protective Dune	Project managed by DNREC to develop protective dune for Dewey Beach.	September 1994	DR-933	HMGP	$64,834	$86,445
South Bethany Emergency Pamphlet	Develop a renter's emergency pamphlet for South Bethany.	August 1996	DR-933	HMGP	$2,162	$2,883
Long Neck, Bethany Sewer Floodproofing	Elevate manhole openings, floodproof hatch-cover doors where opening are in roadways, elevate electrical components in water proof cabinets in sanitary sewer system.	December 1996	DR-976	HMGP	$26,997	$35,996
South Bethany Ocean Drive Flood Protection	Construct rip-rap along Ocean Drive to protect homeowner's properties, Ocean Drive roadway, and infrastructure from future coastal storms.	March 2000	DR-933	HMGP	$55,353	$80,699
			DR-976	HMGP	$5,171	
Bethany Beach Handicapped Ramp Retrofit	Retrofit Bethany Beach boardwalk for handicap access.	August 1996	DR-976	HMGP	$12,342	$16,456
Primehook Electric Utilities	Bury overhead electric power lines to Primehook, DE by Delaware Electric Cooperative to protect the line from wind and ice damage.	November 1998	DR-1017	HMGP	$71,204	$94,939
Fenwick Island Home Elevation	Elevation of two flood-prone structures onto properly elevated engineered foundations.	June 2000	DR-1017	HMGP	$41,690	$55,587

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Fenwick Island Home Elevation Phase II	Elevation of seven flood-prone structures onto properly elevated engineered foundations. Also funded under Disaster 1205.	April 2002	DR-1017	HMGP	$120,798	$161,064
City of Lewes Home Elevation	Elevation of eight flood-prone structures onto properly elevated engineered foundations.	June 2000	DR-1017	HMGP	$161,556	$215,408
Sussex County Home Elevation	Elevation of 11 flood-prone structures onto properly elevated engineered foundation.	December 2002	DR-1017	HMGP	$326,848	$509,669
			DR-1205	HMGP	$55,404	
Fenwick Island Home Elevation Rescope	Elevation of four flood-prone structures onto properly elevated engineered foundation.	June 2002	DR-1205	HMGP	$84,432	$112,576
City of Lewes Home Elevation Rescope	Elevation of five flood-prone structures onto properly elevated engineered foundations.	September 2002	DR-1205	HMGP	$138,562	$184,749
South Bethany Elevation Project	Elevate two oceanfront houses and two adjacent houses on pilings.	2000	FMAP 1997	FMA	$112,000	$149,333
Bethany Beach Tideflex Valve Project	Install backflow valves to prevent tidal flooding from backing up through storm drains and flooding streets and businesses in downtown Bethany Beach.	2002	FMA 2000	FMA	$90,000	$120,000
Fenwick Island Elevation Project	Elevate two flood-prone houses.	2003	FMA 2001/2002	FMA	$100,000	$133,333
Sussex County Home Elevation Project	Elevate three flood-prone houses to pile foundation in estuarine V Zone near Oak Orchard.	2003	FMA 1999/2000	FMA	$205,000	$273,333
City of Laurel Hignutt Acquisition	Purchase dwelling at 104 Chipman Street, in the Town of Laurel, Delaware, demolish the property, and restore site.	March 2005	DR-1494	HMGP	$82,155	$109,540
City of Laurel Sewer Pump Mitigation	Elevate manhole covers above the 100 year flood plain where practicable and where not practicable, install Inflow covers to prevent sewer pump damage.	August 2007	DR-1572	HMGP	$8,030	$11,268
Sussex County Hazard Mitigation Plan	This project was to update the Sussex County Hazard Mitigation Plan	April 2017	DR-4090	HMGP	$30,687	$42,000
South Bethany Home Elevation	Elevate a home at 204 Carlisle Dr. in the Town of South Bethany	June 2016	DR-4090	HMGP	$39,787.50	$53,050

Project	Description	Completion Date	Funding Source	Federal Grant	Federal Funds	Total Costs
Fenwick Island Home Elevation	Elevate a home at 29 W Atlantic Ave in Fenwick Island	June 2017	PDM 2014	PDM	$55,022.43	$73,363.23
University of DE Building Floodproofing	Build a floodwall around the UD Marine Operations Building	On-Going	PDM 2016	PDM	$571,657	$762.209
Public Assistance Mitigation	Foam filled Fenders placed along the piles to reduce future damages	November 2016	DR-4265	PA	$2,962.50	$3,950.00

Source: Delaware Emergency Management Agency

Figure 5-1
South Bethany Mitigation projects



Post Disaster Assessment

The Post Disaster Progress Assessment is completed by DEMA. The findings and information obtained from the assessment, information received immediately after a disaster, and the results and conclusion will be incorporated into mitigation success stories. The success stories aid in the assessment of the current and future goals, objectives, and measures of mitigation programs.

Evaluation of future disasters and their potential impact on a community is another means of evaluating the success of a mitigation project. The method is utilized to evaluate the success of acquisition projects. The structures are removed from the flood hazard area, which reduces or eliminates the potential threat for the family as well as the disaster assistance costs.

Effectiveness Assessment Strategy

The DEMA Mitigation Branch assesses the effectiveness of mitigation programs before approval. The projects must comply with the following items, at a minimum:

- Complements the overall mitigation strategy of the State and applicable local government Suitable funding, to include the local match (if needed), must be available
- The project must be cost-effective. The FEMA benefit-cost module is generally used to make this determination.
- The project must be in compliance with all other federal, State and local regulations and policies.
- The project must provide a benefit to the community at large

It is difficult to determine of the actual cost avoidance and effectiveness of many mitigation projects during the development of the projects. The potential impact of these mitigation projects and initiatives can only be estimated, but DEMA can utilize information from past experience with similar projects (as well as the experiences from other States) to make an educated determination as to the potential for success of the proposed mitigation project. The State evaluates previous project sites and conducts an assessment of the impact on the community post-disaster. Contact is made with each impacted community and requested to provide information about the effectiveness of the mitigation project. The SHMO captures this information and utilizes it in one of several ways:

- State and federal mitigation staff incorporates the information into mitigation success stories, which are used by federal and State representatives in disaster recovery to encourage communities and property owners to develop mitigation strategies and projects to improve their disaster resistance.
- Mitigation and public affairs personnel use it as an educational tool and initiatives to promote disaster resistance.
- DEMA staff use the examples to describe the effectiveness of mitigation projects to State legislators and members of Congress

DEMA plans to incorporate mitigation project information into the agency's GIS system to document buyouts, to provide post-project assessments relative to future disasters, and to further refine the monitoring process of the projects in the program and improve the accuracy of future assessments.

Program Management Capability

The documentation of sound program management capability can be found by reviewing the existing HMGP Administrative Plan. In addition, the State of Delaware has developed a series of project management indicators that will serve to monitor regular improvements over time. The indicators are listed in **Table 5-14**. The indicators are intended to provide evidence regarding the ability of the State of Delaware to submit eligible applications, effectively administer financial accounting procedures, and closeout completed projects.[19] A database containing all relevant information associated with these indicators will be maintained by Delaware Emergency Management Agency in order to provide clear evidence supporting their program management capability and how it is enhanced over time.[20]

Table 5-14
Project Management Indicators

1) Historic record of the percentage of mitigation grants submitted to FEMA by the State that are ultimately approved;
2) Historic record of the percentage of eligible applications submitted to FEMA by the State within pre-established deadlines;
3) Historic record of the percentage of applications submitted to FEMA with accurate environmental reviews;
4) Historic record of the percentage of applications submitted to FEMA with accurate benefit-cost analyses;
5) Historic record of the percentage of State quarterly progress reports submitted to FEMA within pre-established deadlines;
6) Historic record of the percentage of hazard mitigation projects completed and closed out by the State and FEMA within pre-established deadlines.

[19] DEMA has incorporated additional benefit-cost analysis training and mitigation grant development workshops into their list of mitigation actions (see Section 6.2).
[20] The development and maintenance of this database will be assigned to appropriate DEMA staff.

Available Federal Mitigation Programs

There are a variety of federal grant programs that Delaware has access to that can be used to fund mitigation programs.

Hazard Mitigation Grant Program: Authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program (HMGP) administered by the Federal Emergency Management Agency (FEMA) provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster**.** HMGP funding is only available to applicants that reside within a presidentially declared disaster area. Eligible applicants include: State and local governments; Indian tribes or other tribal organizations; certain non-profit organizations. Individual homeowners and businesses may not apply directly to the program; however a community may apply on their behalf. In Delaware, this program is managed by DEMA.

This post-disaster program is currently available to the State of Delaware at the 15% funding level. In other words, funding representative of 15% of the total cost of eligible federal and State disaster recovery programs including individual assistance, public assistance, other needs assistance and special mission assignments becomes available to the State for hazard mitigation projects that support structural mitigation and demolition/acquisition projects, limited hazard mitigation planning projects and special initiative projects. Per federal requirements outlined in CFR 44, at least 88% of the total monies available in HMGP are allotted to structural mitigation and demolition-acquisition projects that fully meet State program priorities. Further, these projects must be deemed eligible by FEMA Region III and meet all Benefit-Cost Analysis requirements, environmental and historical program regulations. In addition, all nuances and requirements of HMGP regarding property ownership and use of lands purchased by local governments must be met.

Pre-Disaster Mitigation Program: The Pre-Disaster Mitigation (PDM) program provides funds to States, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to State allocations, quotas, or other formula-based allocation of funds. In Delaware, this program is managed by DEMA.

Flood Mitigation Assistance Program: The Flood Mitigation Assistance (FMA) program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). FEMA provides FMA funds to help States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program. The FMA program emphasizes the need to address severe repetitive loss (SRL) and repetitive loss (RL) properties. Properties that meet the SRL or RL criteria are eligible for an increased Federal cost share. For mitigation activities to SRL properties, FEMA may contribute up to 100 percent of Federal funding. For RL properties, FEMA may contribute up to 90 percent of Federal funding. The FMA program is managed by the Delaware Department of Natural Resources and Environmental Control (DNREC). FMA provides for several different kinds of grants:

- **Planning Grants** to prepare Flood Mitigation Plans. Only NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project grants
- **Project Grants** to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures. States are encouraged to prioritize FMA funds for applications that include repetitive loss properties; these include structures with 2 or more losses each with a claim of at least $1,000 within any ten-year period since 1978
- **Technical Assistance Grants** for the State to help administer the FMA program and activities. Up to ten percent (10%) of Project grants may be awarded to States for Technical Assistance Grants.

Homeland Security Grants: Several Department of Homeland Security grant programs have been created during the past several years to assist State and local governments with structural "hardening" and other security projects. As hazard mitigation planning expands to include human caused hazards, these funding sources will become critical in plan implementation.

Community Development Block Grants (CDBG): Administered by the Delaware Housing Authority, this program provides housing and commercial revitalization to many local communities. CDGB has been effectively used in comprehensive recovery from major disasters such as Hurricanes Isabel and Henri, as well as severe storm and flooding events. CDBG will continue to be a critical funding source for housing mitigation programs.

Commitment to a Comprehensive Mitigation Program

The State of Delaware is committed to a comprehensive mitigation program as evidenced by the development of this Plan. Specific indicators of this effort include a commitment to local mitigation planning, the statewide promotion of mitigation, inter-departmental coordination, the initiation of training and outreach efforts, and the support of the Governor's Office. Additional evidence of a long-term, future commitment to a comprehensive mitigation program can be found in Section 6.2, State of Delaware Mitigation Actions.

Specific examples that have been discussed throughout this Plan include:

1) Conducting regular mitigation and floodplain management training programs to assist local governments with grants administration, hazard mitigation planning and floodplain management-related duties;

2) Providing Pre-Disaster Mitigation grant funds to counties and municipalities to develop Disaster Mitigation Act-compliant hazard mitigation plans;

3) Developing an Executive Order, signed by the Governor, that promotes taking action before an event to make the State of Delaware more disaster resilient;

4) The establishment of the State Hazard Mitigation Council, which is responsible for assisting DEMA in the development and updating of this plan, evaluating hazard mitigation grant proposals, and convening post-disaster to evaluate how they can assist in the recovery effort;

5) The identification of critical State facilities and their exposure to natural hazards prevalent in the State of Delaware;

6) Adopting a nationally applicable building code;

7) The State of Delaware, its three counties and the City of Wilmington are participants in the StormReady® program, and are certified by the National Weather Service as "Storm Ready."

8) The designation of four Project Impact communities, including Lewes, Bethany, Milford and Wilmington; and

9) Improving the level of coordination across State agency programs who share objectives that are complimentary to the aims of this plan.

Integration with Other Planning Initiatives (EP)

This Plan is intended to serve as a coordinating mechanism, first identifying State and regional planning processes, and where possible, integrating the objectives of complimentary initiatives. Specific examples include:

1) Delaware Strategy 2010 and Land Use Planning;
2) Floodplain Management; and
3) Coastal Zone Management.

It is important to note that over time, additional State planning programs will be identified and common goals pursued. This approach has been incorporated into this planning document and will be regularly revisited as appropriate. The State Hazard Mitigation Council will establish an interagency subcommittee responsible for the ongoing identification and incorporation of existing and new State planning initiatives into the State Hazard Mitigation Plan. In addition, the Delaware Emergency Management Agency, working with the Governor's office, has developed an executive order directing State agencies to work together in order to make the State of Delaware more disaster resistant. This directive will be used to encourage ongoing State agency participation.[21]

Delaware Strategies and Land Use Planning

The State of Delaware does not maintain a statewide land use plan. However, Delaware has developed a Delaware Strategies document that is updated on a five year basis and was last updated in 2015. The continuing purpose of the Strategies for State Policies and Spending is to coordinate land-use decision-making with the provision of infrastructure and services in a manner that makes the best use of our natural and fiscal resources. The importance of such coordination lies in the fact that land-use decisions are made at the local level, while the bulk of infrastructure (e.g., roads and schools) and services (e.g., emergency services and social services) that support land-use decisions are funded by the State. Thus the development of this document with local governments and citizens helps to create a unified view toward growth and preservation priorities that all governments can use to allocate resources.

The Strategies for State Policies and Spending builds on the groundwork laid in 1999, 2004, and 2010 by the Cabinet Committee on State Planning Issues. The document is a result of extensive coordination with local governments and State agencies to determine which areas are most prepared for growth and where the State can make the most cost-effective investments in roads, schools and other public facilities and services. Smart growth issues were addressed in a coordinated manner when the Cabinet Committee on State Planning Issues hosted the Shaping Delaware's Future conference mid 1990's. A primary outcome of the conference was the identification of specific consequences of failing to coordinate State and local planning efforts. Ten goals were ultimately created, forming the basis for the report, *Shaping Delaware's Future*, which was published in 1995.[22]

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[21] Additional examples of how planning initiatives have been integrated into the State Hazard Mitigation Plan can be found in Section 6.2: State of Delaware Mitigation Actions.

[22] The 10 goals include: 1) Directing State investment and future development to existing communities, urban concentrations, and designated growth areas; 2) protecting important farmland from ill-advised development; protecting critical natural resource areas from ill-advised development; 4) developing methods for assessing the fiscal impact and cost-benefit analysis of development for use by both State and local governments when considering land-use policies and infrastructure investment; 5) streamlining regulatory processes and providing flexible incentives and disincentives to encourage growth in desired areas; 6) encouraging redevelopment and improving livability of existing communities and urban areas, and guiding new employment into underused commercial and industrial sites; 7) providing high quality employment opportunities for citizens with various skill levels, and attracting and retaining a diverse economic base; 8) protecting the State's water supplies, open spaces, farmlands, and communities by encouraging revitalization of existing water and wastewater systems and the construction of new systems; 9) promoting mobility for people and goods through a balanced, multi-modal transportation system; and 10) providing access to educational opportunities and health care for all Delawareans. *Shaping Delaware's Future*. 1995.

Legislation has been passed and an executive order has been issued that guide state-level public expenditures. Specific measures include House Bill 255, which provides funding and technical assistance to help municipalities develop comprehensive plans, Senate Bill 105, which established a Governor's Advisory Council on Planning Coordination, an executive order requiring State agencies and departments to develop specific measures to reduce sprawl, and House Bill 192, which created the Realty Transfer Tax for Conservation Fund.

Finally, the Delaware Office of State Planning Coordination, working within the framework of the broader Livable Delaware Initiative, has refined the State Land Use Planning Act, commonly referred to as LUPA. The revisions, collectively referred to as the Preliminary Land Use Service, or PLUS, allows State agencies to provide valuable technical input into proposed land development decisions. Past processes have resulted in the lack of timely decisions, poor review consistency across State agencies and a limited number of feasible alternatives. The new process is intended to identify and reduce the negative regional impacts of development, better integrate State and local land use planning processes and link State agency staff with developers and local officials in the decision making process. The Delaware Emergency Management Agency staff is currently using this process to provide input regarding how proposed development decisions mayimpact future hazard vulnerability.

The Delaware Strategies contains several additional components addressing a range of issues. However, the elements discussed in the *Capability Assessment* are intended to represent actions that are directly relevant to reducing the impacts of natural and human-caused hazards. For example, the concept of guiding growth to more suitable locations or acquiring and maintaining open space can serve as important hazard mitigation measures. In order to take advantage of these opportunities, State officials must not only identify these linkages, but educate others about how they are interconnected. The State Hazard Mitigation Council will take an active role in making sure that these complimentary programs are effectively integrated.

Floodplain Management

The Floodplain Management program is responsible for the administrational oversight of the National Flood Insurance Program and the Flood Mitigation Assistance Program in the State of Delaware. The Programs are managed by the DNREC, Division of Watershed Stewardship, NFIP Coordinator and the Flood Mitigation Assistance Administrator. Specific tasks include: 1) Assisting local governments administer and enforce their Local Flood Damage Prevention Ordinances, 2) Conducting regular training programs in order to educate local floodplain administrators on floodplain management techniques, and 3) Providing technical and program oversight of the Flood Mitigation Assistance Program.[23]

Floodplain Management program seeks funds annually under the Flood Mitigation Assistance (FMA) Program to address flooding issues throughout Delaware. The State coordinates briefings for county and local governments upon receiving notification that the opportunity for funding under the FMA program will become available. These briefings cover topics such as the grant application process, grant management information, and FEMA's priorities when awarding funds. Any county or local governments that are interested are able to work with the Floodplain Management Program to develop pre-applications for the FMA program. When reviewing pre-applications for FMA, the Floodplain Management program prioritizes projects that will address Severe Repetitive Loss and Repetitive Loss properties.

Coastal Management

Delaware Coastal Management is a collection of programs and projects within the Delaware Department of Natural Resources and Environmental Control, designed to manage the State's shoreline, coastal zone and navigable waterways. Among the various programs that directly impact coastal issues include: the Delaware Riparian Buffer Initiative, Delaware National Estuarine Research Reserve, and the Sediment and Stormwater Program. The Delaware Coastal Management Program maintains close working relationships with a number of other DNREC Divisions, including the Division of Water Resources, Fish and Wildlife and Parks and

[23] For additional information on the Delaware Floodplain Management program, see the discussion of Plans, Policies and Funding, including Table 5.1 and the description of administrative capability.

Recreation. The Coastal Management Program received federal approval by the National Oceanic and Atmospheric Administration in 1979. For an additional discussion of coastal programs, refer to Table 5.1 State of Delaware Hazard Mitigation Capability Assessment: State Plans, Policies, Programs and Grants Impacting Hazard Mitigation in Delaware.

It is clear that the majority of coastal programs are complimentary to the objectives of this Plan. Furthermore, the concepts and practices in place have been institutionalized in State and local government given that the Coastal Management Program has been operational for almost twenty-five years. This enhanced regulatory standing provides the State, counties and municipalities with the authority to implement a series of hazard mitigation actions that can be incorporated into existing State and local coastal plans.

In order to effectively integrate program objectives, DNREC and DEMA officials should convene to identify specific projects, programs, grant streams and other administrative functions that are complimentary. Once these are identified, existing coordinating mechanisms should be used to implement and sustain the ideas generated. Specific organizational vehicles include the State Hazard Mitigation Council, Delaware Coastal Programs, and the Livable Delaware Initiative.

Natural Hazards and Climate Change in the City of Lewes

This is a project that involves multiple agencies at all levels of government. The concept began with a dialogue between the City of Lewes, Sea grant, and ICLEI (International organization that studies the effects of climate change) regarding possible assistance and guidance towards development of an updated plan for mitigating and adapting to natural hazards and climate change. The idea is to consider how changes in climate already are and will continue to affect how hazards impact the Lewes community.

The project team, consisting of Delaware Sea Grant and ICLEI will provide a foundation for the City to move forward with a public process to refine and develop an adaptation plan related to existing hazards and climate change to improve community sustainability. The ultimate objective is to enhance community resilience towards natural hazards and climate change.

Effective Use of Available Mitigation Funding

The State of Delaware has in place a method to manage mitigation programs, including both the administration of grant programs and the broader goals initially outlined in the State's former State Hazard Mitigation Plan (409 Plan). This plan is specifically designed to improve the linkage between the HMGP, FMA, and Pre-Disaster Mitigation grant programs, other existing State and federal mitigation initiatives, and the stated goals of the plan. This was achieved in four ways:

1) The integration of the Hazard Mitigation Program Administrative Plan (404+ Plan) into this plan;

2) The identification and analysis of State and federal programs, plans, policies, and grants that compliment or contradict State mitigation goals;

3) The development of State mitigation goals that account for identified areas in need of improvement that will facilitate the effective use of available mitigation funding; and

4) The development of complimentary State and county-level Mitigation Action Plans identifying proposed mitigation projects, potential funding sources and those responsible for their implementation.

Each of the items listed above are part of a strategic and comprehensive effort to link planning processes with identified funding. The integration of the Administrative Plan represents the first step in the strategic planning process. As mitigation goals and priorities change, amendments to the State plan and the Administrative Plan will follow. Similarly, significant policy changes to the Administrative Plan will occur, only if they comply with the stated objectives of this plan or the State Hazard Mitigation Council agree that such changes are warranted.

As projects that are part of the State or approved local plans are implemented and completed, Delaware Emergency Management Agency staff will assess the effectiveness of these projects using methods proposed earlier in this section. In order for this approach to function effectively, State and local staff assigned the responsibility for the implementation of specific mitigation measures must be held accountable as noted in the State and each local mitigation action plan. Regular monitoring of progress will be the responsibility of the State and local hazard mitigation planning committees. This will allow the State to document, quantitatively, the dollar losses avoided following the completion of given projects.

Currently, the State uses Flood Hazard Mitigation Assistance Program, the Hazard Mitigation Grant Program and the Pre-Disaster Mitigation Program to assist local governments develop all hazard mitigation plans and implement eligible mitigation actions identified in these plans. In addition, the State and local governments have identified a series of other funding sources in their hazard mitigation action plans. This approach increased the likelihood of identifying adequate funding to implement proposed policies and projects.
The Delaware State Legislature annually appropriates discretionary funds for State Agencies. The Strategic Opportunity Fund for Adaptation (SOFA) is intended to support state agencies' progress toward implementing actions that will strengthen the state's preparedness and ability to adapt to current and future effects of climate change. The Department of Natural Resources and Environmental Control (DNREC) have used the funds to supplement mitigation projects. Additionally, Delaware has a State Revolving Loan program that counties and municipalities can borrow funds to offset cost share requirements of federally funded mitigation projects. For a more detailed listing of identified funding sources, please refer to Section 6.1 and Section 6.2 of the State or local all hazard mitigation plans.

The most effective use of mitigation funds is the elimination of repetitive loss properties; through acquisition or elevation. Delaware's highest priority during its selection of process is RL and SRL properties. The Policy group which prioritize projects, uses a scoring sheet which includes criteria such as Repetitive Loss Property and History of flood damage.

The identification of complimentary and contradictory policies throughout State and federal government agencies enable DEMA and SHMC members to strategically target areas of collaboration or change in order to better reflect the stated goals of this plan. If necessary, DEMA staff may emphasize the stated intent of the Governor's executive order requiring State agencies to work collaboratively to reduce the vulnerability of Delaware to natural and human-caused hazards. This may require agencies to re-evaluate their current actions in the context of how they increase or decrease hazard vulnerability.

The State of Delaware hazard mitigation strategy has been designed to link identified goals, and actions to a series of specific funding streams whenever possible. This approach, which is closely aligned with identified gaps in existing policies and an analysis of State capabilities, was coupled with the identification of hazard vulnerabilities in order to increase the likelihood of identifying the appropriate funding stream given existing conditions.

The collaborative development of this plan and local all hazard mitigation plans was done in order to facilitate a clear connection between identified local needs and the development of state-level goals and actions developed to meet those needs. As local needs were identified, the State, in turn, developed their mitigation strategy, rather than adopting a top-down approach. This method will continue over time as the SHMC will include local concerns during regular plan updates.

Conclusions

The findings of the State *Capability Assessment* are intended to help the Delaware Emergency Management Agency and members of the State Hazard Mitigation Council meet the needs of county and local governments, while creating a state-level approach that is feasible given identified agency capabilities. In addition, the assessment is intended to identify potential agency partners who can assist in the development of a comprehensive mitigation strategy as well as identify areas in need of improvement. As noted in the introduction to this section, the capability assessment serves as part of the planning foundation, helping to craft a practical statewide mitigation strategy. As capabilities change over time, it will be necessary to revise the assessment to reflect these changes.

Plan Updates

Note Regarding 2007 Plan Update

There were significant changes and modifications for the 2007 update to Section 5 of the State Hazard Mitigation Plan. Updates were done to reflect:

- Changes in programs and policies within the various mitigation programs sponsored by FEMA (i.e., the addition of information about the SRL and RFC programs
- Changes to reflect DEMA's capability of performing its own BCAs and other administrative functions with respect to project management.
- Updated the list of hazard mitigation projects the State is involved in (either pending on completed).
- Updated the Local Capability Assessment tables to reflect changes in legal and administrative capabilities that impact hazard mitigation.
- Updated the State Capability Assessment tables to reflect changes in governmental structure, agency capabilities, and hazard applicability.

Note Regarding 2010 Plan Update

There were significant changes and modifications for the 2010 update to Section 5 of the State Hazard Mitigation Plan. Updates were done to reflect:

- Updated CRS listing.
- Updated the hazard mitigation projects the State is involved in, pending or completed.
- Added information on the DEMA interns used to monitor mitigation actions.
- Added a new section, "Statewide Mitigation Accomplishments", which highlights completed mitigation actions around the State and ties them to State mitigation objectives and actions.
- Edited information on the "Disaster Resilient State Initiative" section.
- Added a section on the "Natural Hazards and Climate Change and the City of Lewes" in the "Integration with Other Planning Initiatives" section.

Note Regarding 2013 Plan Update

There were significant changes and modifications for the 2013 update to Section 5 of the State Hazard Mitigation Plan. Updates were done to reflect:

- Validated and significantly updated Table 5-1, State Plans, Policies, Programs and Grants Impacting Hazard Mitigation in Delaware
- Updated NFIP and CRS listing.
- Added information on Flood insurance policies.
- Added the State Housing Authority's new search engine for rental properties.
- Added Citizen Corps to Table 5-1.
- Updated and reformatted the list of hazard mitigation projects the State is involved in (either pending or completed).
- Updated the Statewide Mitigation Accomplishments.

Note Regarding 2018 Plan Update

There were significant changes and modifications for the 2018 update to Section 5 of the State Hazard Mitigation Plan. Updates were done to reflect:

- Validated and significantly updated Table 5-1, State Plans, Policies, Programs and Grants Impacting Hazard Mitigation in Delaw~~are~~
- Updated and reformatted the list of hazard mitigation projects the State is involved in (either pending or completed).
- Added information on the Strategic Opportunity Fund for Adaptation (SOFA) to strengthen the state's preparedness and ability to adapt to current and future effects of climate change.

S8. Does the mitigation strategy include goals to reduce long-term vulnerabilities from the identified hazards? ***[44 CFR §201.4(c)(3)(i)18]***

S9. Does the plan prioritize mitigation actions to reduce vulnerabilities identified in the risk assessment? ***[44 CFR §201.4(c)(3)(iii) and (iv)]***

S10. Does the plan identify current and potential sources of funding to implement mitigation actions and activities? ***[44 CFR §201.4(c)(3)(iv)]***

S11. Was the plan updated to reflect progress in statewide mitigation efforts and changes in priorities? ***[44 CFR §201.4(d)]***

Introduction

This section provides the State of Delaware with the basis for action. Based on the findings of the Hazard Identification and Risk Assessment (HIRA) and the State Capabilities Assessment, the mission statement, goals, and actions that follow are intended to guide both the day-to-day operations and the long-term approach taken by the State of Delaware to reduce the impacts of hazards both natural and human-caused. In order to effectively implement this strategy, this section has been separated into the following components:

- Mission Statement;
- Mitigation Program Goals and Objectives;
- Identification and Analysis of Mitigation Techniques; and
- Mitigation Action Plan
- Plan Updates

The State of Delaware's All-Hazard Mitigation Plan is both comprehensive and strategic in nature. That is, the plan is designed to provide a comprehensive review of hazards and identify far-reaching policies and projects intended to not only reduce the future impacts of hazards, but also assist the state, counties and municipalities achieve compatible economic, environmental and social goals. In addition, the plan is strategic, in that all policies and projects are linked to departments or individuals responsible for their implementation. Funding sources are identified that can be used to assist in project implementation.

The crucial basis for action in the State of Delaware All-Hazard Mitigation Plan can be found in the Mitigation Action Plan (MAP), which lists specific actions, those responsible for their implementation, potential funding sources that may be used, and an estimated target date for completion. Each action will be listed with the accompanying information. This approach provides those in charge of plan implementation with an important monitoring tool. The collection of actions also serves as an easily understood menu of policies and projects for those individuals who want to quickly review the most important part of the state plan.

Planning Approach

In order to guide the actions of those charged with implementation, the plan follows a traditional planning approach, beginning with a mission statement that provides the overall guiding principle. The identification of goals and objectives is intended to meet the intent of the mission statement. Finally, mitigation actions are identified that will allow the state to meet the specified goals. Actions may include policies or projects designed to reduce the impacts of future hazard events. Each hierarchical step is intended to provide a clearly defined set of policies and projects based on a rational framework for action. The components of the planning framework are explained in greater detail below:

Mission Statement: Provides universal guiding principles of the Hazard Mitigation Plan.

Goals & Objectives:	Goals represent broad statements that are achieved through the Implementation of more specific, action-oriented objectives. Goals provide the framework for achieving the intent of the mission statement. Goals and objectives make the plan ***strategic***.
Strategies & Actions:	Strategies are tactical means of accomplishing the plan's objectives. Actions are specific activities or services that an organization performs to accomplish the objectives identified as critical to meeting the plan's goals. They are usually time-bounded and directly measurable, and typically take less than a year to accomplish. Strategies and actions make this plan ***functional***. Specific strategies and actions are provided in *Section 6.2, Mitigation Action Plan*.
Hazard Mitigation Policies:	Policies are defined as a course of action agreed to by members of the Planning Team.
Hazard Mitigation Projects:	Projects are defined as specific actions taken to address defined vulnerabilities to existing buildings or systems. Potential funding sources are listed for each project.
Mitigation Action Plan:	Prioritized listing of actions (policies and projects), including a categorization of mitigation technique, hazards addressed, individual or organization responsible for implementation, estimated timeline for completion, and potential funding source.

Mission Statement

The State of Delaware will develop and maintain a comprehensive pre- and post-disaster hazard mitigation program. This program will be guided by the adoption and implementation of state legislation and codes, an increased level of inter-agency coordination and planning, the collection and utilization of resources and data, the implementation of cost effective and technically feasible hazard mitigation projects, an enhanced public outreach and training efforts designed to reduce the vulnerability of individuals, families households, businesses, infrastructure and critical facilities to the negative effects of natural and human-caused hazards, in a manner sensitive to the inherent qualities of the historic and natural resource of the State.

Mitigation Goals & Objectives

The following goals and objectives represent a comprehensive approach taken by the State of Delaware to reduce the impacts of natural and human-caused hazards. Initial goals and actions were identified as part of a brainstorming session held 2003, and modified and expanded for the 2007 plan and 2010 plan updates.

For the 2018 update, the State Hazard Mitigation Planning Team, established a Mitigation Strategy and Actions Sub-Team made up of a cross-section of the Planning Team. The Sub-Team held a one-day workshop which focused on the State's Mitigation Strategy by identifying gaps in the States mitigation efforts. The identification of gaps followed the Sub-Teams review of the Hazard Identification Risk Assessment (HIRA), Sections 4.1 and 4.2. The workshops brainstorming of gaps and review of the highest risk hazards, resulted in the identification of five key areas of improvement or gaps. The Coordination and Review Sub-Team then reviewed the current goals, objections, and mitigation actions and vetted the identified gaps and improvement areas from the Workshop. The result was the consolidation of one of the five goals and several of the objectives. After a thorough review of the 77 mitigation actions, approximately 26 were, completed, canceled, or consolidated with like actions. The five gaps identified during the Workshop were integrated into four of the current mitigation actions and one new mitigation action was created. The outcome of the workshop discussions were clearly addressed and the new Mitigation Strategy and Actions Sub-Team will use the workshop to affect improvements in Delaware's mitigation program efforts. The following are the revised, goals, objectives, and the associated mitigation actions.

Goal 1: Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters.

Objective 1.1: Maintain a robust mitigation program that addresses ways to mitigate the loss of life from disaster events.

Mitigation Actions - Objective 1.1: 1, 2, 3, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18, 19, 21, 23, 24, 25, 26, 27, 30, 34, 35, 36, 38, 39, 40, 41, 43, 45, 46, 47, 49, 50, and 51.

Objective 1.2: Strengthen cooperation with DEMA's mitigation partners and help educate them about mitigation.

Mitigation Actions - Objective 1.2: 4, 8, 11, 12, 13, 14, 18, 22, 30, 32, 34, 35, 37, 39, 44, and 51.

Objective 1.3: Support the development of sensible enabling legislation, programs and capabilities of federal, state, and local governments and public-private partnerships engaged in mitigation activities.

Mitigation Actions - Objective 1.3: 2, 5, 7, 8, 9, 10, 17, 31, and 51.

Objective 1.4: Assist eligible communities with the development of viable proposals to implement long-term, cost-effective and environmentally sound hazard mitigation projects.

Mitigation Actions - Objective 1.4: 2, 3, 5, 13, 18, 19, 22, 23, 25, 28, 30, 38, 39, 46, 47, 50, and 51.

Objective 1.5: Maintain a high level of mitigation program proficiency within the state of Delaware.

Mitigation Actions - Objective 1.5: 11, 12, 17, 18, 23, 24, 25, 29, 35, 37, 38, 41, 42, 43, 45, 46, 47, 48, 50, and 51.

Goal 2: Implement mitigation actions that improve the protection of continuity of government and essential services safely from the adverse effects of disasters.

Objective 2.1: Promote mitigation as an effective means of reducing impact of future disasters.

Mitigation Actions - Objective 2.1: 1, 3, 5, 6, 7, 8, 9, 10, 13, 17, 19, 22, 23, 24, 25, 26, 27, 30, 34, 36, 40, 43, 46, 47, and 50.

Objective 2.2: Support the development of sensible mitigation projects to protect key and essential facilities and services.

Mitigation Actions - Objective 2.2: 1, 6, 7, 8, 9, 11, 18, 19, 20, 22, 24, 26, 27, 29, 32, 36, 38, 40, 48, and 50.

Objective 2.3: Educate state and local officials concerning the need to use sensible mitigation techniques for new facility construction.

Mitigation Actions - Objective 2.3: 1, 4, 5, 7, 9, 12, 18, 23, 40, 49, and 51.

Objective 2.4: Encourage maximum participation in maintaining effective state and local mitigation plans, disaster plans and business continuity plans.

Mitigation Actions - Objective 2.4: 11, 13, 44, and 45.

Objective 2.5: Encourage federal, state and local officials, educational institutions, private associations and private business entities that provide essential services to incorporate mitigation into other plans.

Mitigation Actions - Objective 2.5: 10, 11, 13, 44, and 45.

Goal 3: Implement mitigation actions that improve the protection of communities, public and private property, with emphasis on Severe Repetitive Loss and Repetitive Loss properties, from the adverse effects of disasters.

Objective 3.1: Encourage development outside of hazard areas and promote disaster-resistant development inside hazard areas for government, businesses, land developers, real estate professionals, etc.

Mitigation Actions - Objective 3.1: 2, 3, 5, 8, 9, 10, 22, 23, 34, 42, and 44.

Objective 3.2: Strengthen cooperation and support with DEMA's mitigation partners and help educate them and the general public about mitigating the loss of property, with emphasis on Severe Repetitive Loss and Repetitive Loss properties.

Mitigation Actions - Objective 3.2: 4, 11, 13, 17, 25, 30, 31, 35, 39, 41, 42, 44, and 49.

Objective 3.3: Support organizations that work to help mitigate the adverse effects of disasters.

Mitigation Actions - Objective 3.3: 6, 11, 12, 14, 17, 19, 20, 26, 27, 29, 30, 45, and 47.

Objective 3.4: Increase public awareness of disaster risks and effective mitigation measures that protect property.

Mitigation Actions - Objective 3.4: 2, 15, 16, 19, 34, 39, 43, and 47.

Objective 3.5: Support the NFIP, CRS, and other programs that serve to lessen the adverse impact of disaster property losses.

Mitigation Actions - Objective 3.5: 11, 15, 16, 28, 41, 45, and 49.

Goal 4: Support and enhance the emergency preparedness, response and recovery posture of the State of Delaware and its local jurisdictions.

Objective 4.1: Facilitate the enhancement of state and local emergency operations planning and preparedness and provide related training and technical assistance.

Mitigation Actions - Objective 4.1: 1, 7, 11, 17, 37, 44, 45, and 51.

Objective 4.2: Facilitate the capabilities of the state and local governments to handle the effects of disasters and to address recovery issues in the aftermath of disasters.

Mitigation Actions - Objective 4.2: 1, 8, 9, 11, 17, 20, 27, 29, 30, 32, 33, 36, 38, 40, and 48.

Objective 4.3: Encourage integration of relevant data into statewide GIS initiatives to facilitate analysis and evaluation of existing, proposed and future hazard mitigation projects.

Mitigation Actions - Objective 4.3: 3, 12, 28, 33, 34, 36, 37, 42, and 43.

These goals and objectives will be reviewed as part of the regular plan review process. They will also be reviewed in conjunction with the review/approval process of local hazard mitigation plans. This will help ensure that state and local hazard mitigation plans complement each other and that both state and local governments are working together to accomplish the mitigation goals of the State of Delaware. Additionally, proposed mitigation projects will be reviewed to determine how mitigation projects help state and local governments meet established goals and objectives.

Identification and Analysis of Mitigation Techniques

In formulating this Mitigation Strategy, a wide range of activities were considered in order to help achieve the goals of the State of Delaware All-Hazard Mitigation plan. All of the activities chosen by the Hazard Mitigation Council fall into one of the following broad categories of mitigation techniques.

Mitigation Techniques

Prevention

Preventative activities are intended to keep hazard-related problems from getting worse. They are particularly effective in reducing a community's vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Hazard mapping
- Building codes
- Studies / data collection and analysis
- Open space preservation
- Floodplain regulations
- Stormwater management
- Drainage system maintenance
- Capital improvements programming
- Riverine setbacks

Property Protection

Property protection measures enable structures to better withstand hazard events, remove structures from hazardous locations, or provide insurance to cover potential losses. Cost effective and technically feasible projects involving SRL or RL properties will be deemed a higher priority over similar projects not involving SRL or RL properties. Examples include:

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection or "hardening"
- Retrofitting (i.e., wind proofing, flood proofing, seismic design standards, etc.)
- Insurance
- Safe room construction

Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of environmental systems. Examples of natural systems that can be classified as high hazard areas include floodplains, wetlands and barrier islands. Thus, natural resource protection measures can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Parks, recreation or conservation agencies and organizations often implement natural resource protection measures. Examples include:

- Floodplain protection
- Riparian buffers
- Fire resistant landscaping
- Fuel Breaks
- Erosion and sediment control
- Wetland preservation and restoration

- Habitat preservation
- Slope stabilization

Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by physically modifying the environment. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Levees / dikes / floodwalls
- Diversions / Detention / Retention
- Beach nourishment
- Channel modification
- Storm sewer construction
- Generators

Emergency Services

Although not typically considered a "mitigation technique," emergency services minimize the impact of a hazard on people and property. These actions are typically taken immediately prior to, during, or in response to a hazard event.

Examples include:

- Warning systems
- Search and rescue
- Evacuation planning and management
- Flood "fighting" techniques

Public Information and Awareness

Public Information and awareness activities are used to advise residents, business owners, potential property buyers, visitors and government officials about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Measures used to educate and inform the public include:

- Outreach and education
- Speaker series, demonstration events
- Real estate disclosure
- Training

Mitigation Techniques in the State of Delaware

In considering the appropriate mitigation techniques for the State of Delaware All-Hazard Mitigation Plan, the State Hazard Mitigation Council reviewed the findings of the Risk Assessment and Capability Assessment.[1] The Mitigation Strategy and Actions Sub-Team reviewed the top 10 hazards and selected the applicable mitigation technique through discussion and team consensus. The State of Delaware Mitigation Matrix was completed in order to provide a baseline understanding of the techniques used by the State to address the top 10 identified and prioritized hazards.

[1] The updated Risk Assessment and Capability Assessment findings were presented to the State Hazard Mitigation Council on March 15, 2018.

State of Delaware Mitigation Matrix Table 6.1

MITIGATION TECHNIQUE	HIGH RISK HAZARDS			MODERATE RISK HAZARDS				LOW RISK HAZARDS		
	Coastal Flooding	*Nor'easters & ET Storms*	*Huricanes & Trop Storms*	*Winter Precipitation*	*Coastal Erosion*	*Inland Flooding*	*SevereThunderStorms*	*Extreme Heat*	*Extreme Cold*	*Tornadoes*
Prevention	X	X	X	X	X	X	X	X	X	X
Property Protection	X	X	X	X	X	X	X			X
Natural Resource Protection	X		X							
Structural Projects	X	X				X				
Emergency Services	X	X	X	X	X	X	X	X	X	X
Public Information & Awareness	X	X	X	X	X	X	X	X	X	X

Introduction to the Mitigation Action Plan

State of Delaware Mitigation Actions

The mitigation actions identified by the State of Delaware are listed on the pages that follow. Each has been designed to achieve the goals of the State of Delaware Hazard Mitigation Plan. The mitigation actions are short-term, specific measures to be undertaken by the members of the State Hazard Mitigation Council and will be used as the primary measure of the plan's progress over time (see **Figure 6.1**). This approach is intended to ease the implementation of the actions and facilitate the quick review and update of the plan as described in the Plan Maintenance Procedures (Section 7).

Figure 6.1
Mitigation Action Worksheet

Mitigation Action	
Action Item (describe):	
Goals/Objectives Supported:	
Category:	
Hazard(s) Addressed:	
Lead Agency/Department Responsible:	
Estimated Cost:	
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	
Implementation Schedule:	
Priority:	
2007 Status Update:	
2010 Status Update:	
2013 Status Update:	
2018 Status Update:	

a. **Action Item:** Identify specific actions that, if accomplished, will reduce hazard vulnerability. Actions should match mitigation goals and objectives.

b. **Goals/Objectives Addressed**: Identifies the specific state mitigation goals and objectives identified in the plan.

c. **Category:** Mitigation actions fall within the following categories: prevention, property protection, natural resource protection, structural projects, emergency services and public information and awareness. The classification of actions allows those responsible for the plan's development to assess whether they are pursuing a comprehensive mitigation strategy.

d. **Hazard(s) Addressed:** The hazard(s) the action is designed to mitigate.

e. **Lead Agency/ Department Responsible:** Identify the local agency, department or organization that is best suited to accomplish the mitigation action.

f. **Estimated Cost:** If applicable, indicate what the cost will be to accomplish the mitigation action. The amount should be estimated until a more accurate project cost can be determined.

g. **Funding Method:** If applicable, indicate how the action will be funded. For example, funds may be provided from existing operating budgets (General Revenue), from a previously established contingency fund (Contingency/Bonds), or a federal or state grant (External Sources).

h. **Schedule:** Indicate when the action will begin and when the action is expected to be completed. Some actions will require only a minimum amount of time, while others may require a long-term commitment.

i. **Priority:** Indicate whether the action is a 1) High priority – short-term immediate – reducing overall risk to life and property; 2) Moderate priority – an action that should be implemented in the near future due to political or community support or ease of implementation; 3) Low priority – an action that should be implemented over time, but does not have the same sense of urgency or impact on hazard vulnerability as other higher priority actions.

j. **2007 Status Update:** Provide information about actions taken to complete or implement these projects since the 2004 plan was promulgated, and any actions identified that will be taken to further the process if the project has not been completed. If the project is new to the 2007 update, it will be listed as "New."

k. **2010 Status Update:** Provide information about actions taken to complete or implement these projects since the 2007 plan was promulgated, and any actions identified that will be taken to further the process if the project has not been completed. If the project is new to the 2010 update, it will be listed as a "New Mitigation Action."

l. **2013 Status Update:** Provide information about actions taken to complete or implement these projects since the 2010 plan was promulgated, and any actions identified that will be taken to further the process if the project has not been completed. If the project is new to the 2013 update, it will be listed as a "New Mitigation Action."

m. **2018 Status Update:** Provide information about actions taken to complete or implement these projects since the 2018 plan was promulgated, and any actions identified that will be taken to further the process if the project has not been completed. If the project is new to the 2018 update, it will be listed as a "New Mitigation Action."

The Coordination and Review Sub-team validated each of the Mitigation Actions to ensure they were cost effective, environmentally sound, and technically feasible. The 2018 Status Update for each action was coordinated with the lead agency or the responsible department. Priorities were determined through Planning Team consensus with both technical input from our partners in the science community and information gathered during our State Threat and Hazard Identification and Risk Assessment (THIRA) process. The above factors were used to determine the priority of new mitigation actions and to validate the priority of on-going actions. The following are the priorities for mitigation actions:

- High priority – short-term immediate – reducing overall risk to life and property;
- Moderate priority – an action that should be implemented in the near future due to political or community support or ease of implementation;
- Low priority – an action that should be implemented over time, but does not have the same sense of urgency or impact on hazard vulnerability as other higher priority actions.

Plan Updates

Note Regarding 2007 Plan Update
The update for the 2007 version of the State Hazard Mitigation Plan includes a complete reframing of the Mitigation Goals and Objectives for the State of Delaware. This was done to allow the state to better focus its mitigation activities toward specific achievable and measureable objectives. The status of the Mitigation Action items from the 2004 SHMP has been provided, and a section was added to each item that attaches it to specific goals/objectives for the overall State Mitigation Strategy. Items that were deleted or consolidated in the Action Item list are summarized at the end of Section 6.2.

Note Regarding 2010 Plan Update
The 2010 update encompassed a complete review of all the goals and objectives listed in this section. The goals and objectives, as listed, are still valid for the State. A reference to the specific mitigation actions supporting each objective was added to this section.

Note Regarding 2013 Plan Update
The 2013 update encompassed a complete review of all the goals and objectives listed in this section. We coordinated with the sea level rise advisory committee to assess the need to update the verbiage to better address sea level rise. It was decided that the goals and objectives, as written, fully supports the sea level rise adaptation strategy being developed. Only minor changes were made to this section. .

Note Regarding 2018 Plan Update
The 2018 update encompassed a complete review of all the goals, objectives, and mitigation actions. One of five goals and several of the objectives were consolidated. After a thorough review of the 77 mitigation actions, approximately 26 were, completed, canceled, or consolidated with like actions. The five gaps identified during a Strategy and Actions Workshop were integrated into four of the current mitigation actions and three new mitigation actions was created.

MITIGATION ACTIONS

Overview

The Mitigation Actions section identifies State of Delaware active mitigation actions, identifies completed mitigation actions, and provides a status on all mitigation actions, list specific local that have been completed that support this plan. This section includes:

Overview
Active Mitigation Actions
Completed or Cancelled Mitigation Actions (2007 – 2013)
Completed or Cancelled Mitigation Actions (2018)
Plan Updates

During the 2018 update of the Planning Team established a Mitigation Strategy and Actions Sub-Team which consist of a cross-section of Council and Planning Team members. The primary purpose of the Sub-Team was to review, revise, and update the Strategy and Mitigation Actions. Following the approval of the Plan, the Mitigation Strategy and Actions Sub-Team will continue to function as a working group of the Council and will periodically meet to assess and provide directions for the approved mitigation actions.

Table 6.2-1 establishes a link between the lead agencies or departments responsible for the specific mitigation actions and the mitigation action numbers themselves. The mitigation actions follow the table**.**

Table 6.2-1

Lead Agency/Department Responsible	Mitigation Actions Identified
County Emergency Managers	8, 39, 45, 46
County Public Works	9
County Officials	4, 7
Delaware Emergency Management Agency (DEMA)	1, 8, 10, 11, 12,14, 18, 22, 23, 30, 35, 36, 39, 40, 41, 43, 44, 46, 47,48, 49, 52, 53
Department of Agriculture	26
Department of Education (DOE)	1, 8, 21
Department of Natural Resources and Environmental Control (DNREC)	3, 4, 5, 6, 7, 9, 15, 16, 19, 22, 23, 24, 25, 28, 30, 31, 34, 37, 40, 41, 42, 44, 45, 46, 47, 49
Department of State (DOS)	13, 32, 38
Delaware Department of Transportation (DelDOT)	20, 33, 51, 52
Delaware Real Estate Commission	2
Delaware State Housing Authority (DSHA)	17, 31
Delaware State Police (DSP)	21
DHSS, Division of Public Health	1, 8, 27, 29, 33
Local Government Officials	22, 23, 24, 25, 48
OMB, Facilities Management	1, 20, 32, 36, 38
OMB, Office of State Planning Coordination (OSPC)	3, 5, 10, 46
U.S. Army Corps of Engineers (USACE)	4, 19
Delaware Geological Survey (DGS)	36, 47
University of Delaware (UD)	45, 47, 49

Active Mitigation Actions

Mitigation Action 1	
Action Item (describe):	**Consider the inclusion of a generator "quick-connect" in the design of new structures, specifically critical facilities, constructed (fully or in part) with public funds.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 2.3, 4.1, 4.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards, with emphasis on Tropical Event, Nor'easter, and Winter Storm
Lead Agency/Department Responsible:	Delaware Emergency Management Agency (DEMA), Department of Education (DOE), Office of Management & Budget (OMB)-Facilities Management, and Department Health and Social Services (DHSS)
Estimated Cost:	N/A
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue. No direct cost involved to enact building code requirement
Implementation Schedule:	Ongoing
Priority:	High
2007 Status Update:	In progress
2010 Status Update:	Although this action is still an active action, the phrasing of the action was changed to the present form from, 'Require the inclusion of a generator "quick connect" in the design of new structures constructed (fully or in part) with public funds. DEMA has been working with county and local officials to clearly identify all critical facilities in Delaware (new and old). We are also coordinating with the Army Corps of Engineers on "quick connect" requirements for each facility. Once all the requirements are established, the state will work through various funding sources to get the facilities modified.
2013 Status Update:	Facilities continue to be modified. Item remains open.
2018 Status Update:	DOE and DEMA are working with the school districts on an ongoing basis to determine which schools have generators and the capacity of the generators. *DFM Facility Design Standards for critical facilities will include the requirement for an emergency generator docking station with "pigtail/post" connectors.*

Mitigation Action 2	
Action Item (describe):	**Develop stringent State flood hazard real estate disclosure requirements.**
Goals/Objectives Supported:	1.1, 1.3, 1.4, 3.1, 3.4
Category:	Public Information and Awareness
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Delaware Real Estate Commission
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	This proving difficult. Will continue to pursue.
Priority:	High
2007 Status Update:	Ongoing review of disclosure requirements
2010 Status Update:	Reviewed this action. It is still a desirable action but has not been accomplished. DEMA will monitor this action over the next few years to see if it is actually achievable.
2013 Status Update:	This is currently being accomplished and new floodplain and drainage recommendations, under Senate Bill 64 have been forward to the legislature to bolster this effort.
2018 Status Update:	This action is being re-evaluated against current policies and procedures for implementation.

Mitigation Action 3	
Action Item (describe):	**The State of Delaware will consider flood hazard vulnerability when identifying "designated growth areas" in certified comprehensive plans.**
Goals/Objectives Supported:	1.1, 1.4, 2.1,3.1, 4.3
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Office of State Planning Coordination (OSPC) and technical support provided by the DNREC Division of Watershed Stewardship.
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	Begin project Fall 2004 and continuous.
Priority:	High
2007 Status Update:	Ongoing .
2010 Status Update:	Changed the phraseology from, "The State of Delaware will consider flood hazard vulnerability when identifying "designated growth areas" (as defined in Shaping Delaware's Future)", to the present form. A lot of comprehensive planning has been accomplished in the state. These plans do consider flood hazard vulnerability. More work is needed.
2013 Status Update:	This is currently being accomplished and new floodplain and drainage recommendations, under Senate Bill 64 have been forwarded to the legislature to bolster this effort.
2018 Status Update:	Office of State Planning: will look for inclusion of flood hazard vulnerability considerations, in designated growth areas, during the review of comprehensive plans.

Mitigation Action 4	
Action Item (describe):	**Continue to promote local prohibitions on the use of fill in order to remove the property from the floodplain or to support re-mapping.**
Goals/Objectives Supported:	1.2, 2.3, 3.2,
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	County officials – prohibition of fill based on Local Flood Damage Prevention Ordinance. DNREC - Division of Watershed Stewardship and United States Army Corps of Engineers – prohibition of fill in tidal and freshwater wetlands. (County and Municipal government are lead agency)
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	Fall 2004 and continuous.
Priority:	High
2007 Status Update:	Ongoing – part of review process
2010 Status Update:	Changed the phraseology of this action from, “Prohibit the use of fill in order to remove the property from the floodplain or to support re-mapping”, to the present form. Although this is done on a regular basis for all permit requests, it is felt this action should be completed during project reviews, if feasible.
2013 Status Update:	This is currently not being accomplished uniformly and new floodplain and drainage recommendations, under Senate Bill 64 have been forwarded to the legislature to bolster this effort.
2018 Status Update:	DNREC has developed voluntary model code language to assist communities in adopting and enforcing these provisions. Some communities have adopted this higher floodplain standard, many communities have not, and DNREC continues to provide training and assistance.

Mitigation Action 5	
Action Item (describe):	**Strongly encourage riparian buffer requirements. Recommend environmentally sensitive development such as greenways and trails as opposed to commercial and residential development.** (Delaware Riparian Buffer Initiative)
Goals/Objectives Supported:	1.1, 1.3, 1.4, 2.1, 2.3, 3.1, 1.1,
Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC-Division of Watershed Stewardship, Office of State Planning
Estimated Cost:	Staff time and resources associated with development of proposed State legislation
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	On-going and continuous.
Priority:	Moderate
2007 Status Update:	Not started
2010Status Update:	Changed the phraseology to, "Establish State riparian buffer requirements. Recommend environmentally sensitive development such as greenways and trails as opposed to commercial and residential development", to the present form. New Castle County has adopted these requirements, Kent and Sussex County are considering requirements that support this.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	There has been a Delaware Chesapeake Riparian Forest Buffer Initiative-Final Report and a 6-page brochure on Delaware Riparian Buffers. As part of the State Watershed Implementation Plan (WIP), Delaware developed for the Chesapeake Bay, Delaware has set an ambitious goal of enrolling 5,571 acres of forested riparian buffers (RFBs) on private lands and restoring and protecting 1,449 acres of RFBs on public lands by 2025. Implementation Schedule changed to on-going and continuous.

Mitigation Action 6	
Action Item (describe):	**Encourage greenways "zoning" along river corridors.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 3.3
Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Parks and Recreation
Estimated Cost:	$ 50,000 Costs associated with the development of a model greenways ordinance for local governments
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Delaware Open Space Program, Environmental Protection Agency – Wetlands Grants, Environmental Protection Agency – Non-point Source Grant Program, Natural Resource Conservation Service – Watershed Protection and Flood Prevention Program, Natural Resource Conservation Service – Watershed Surveys and Planning, Natural Resource Conservation Service – Wetlands Reserve Program, Flood Mitigation Assistance Program
Implementation Schedule:	Spring 2005 and continuous
Priority:	Moderate
2007 Status Update:	Ongoing
2010 Status Update:	Changed the phraseology from, "Develop greenways "zoning" along river corridors", to the present form. There have been funding issues with the development of a model ordinance. However, this is an action that DNREC strongly encourages with all projects, so it is being done. It is also felt that this action should remain active because it is something that will always need to be done.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	This action is being coordinated and reviewed by the responsible agency and will re-evaluated against current policies.

Mitigation Action 7	
Action Item (describe):	**Strongly encourage that all new construction of wastewater treatment plants occur outside of the 100-year floodplain.**
Goals/Objectives Supported:	1.1, 1.3, 2.1, 2.2, 2.3, 4.1
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	County officials. DNREC - Division of Water Resources – Surface Water Discharge Section
Estimated Cost:	Staff time and resources associated with the development of proposed State legislation
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	Ongoing (in conjunction with Delaware River Basin Commission activities) and continuous
Priority:	Moderate
2007 Status Update:	Ongoing (in conjunction with Delaware River Basin Commission activities)
2010Status Update:	Phraseology changed from, "Require that all new construction of waste water treatment plants occur outside of the 100-year floodplain", to the present form. This is being accomplished, although there has been no ordinance established to require it. As written, this remains an active mitigation action.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	This action was reviewed by DNREC and is in-line with Department policy and regulations. When practicable the Department strongly encourages construction of wastewater infrastructure outside of the floodplain as recommended in the State's Flood Avoidance Guidance document. When construction outside of the floodplain is not practicable the Department follows the *Recommended Standards for Wastewater Facilities* which states (51.2 Flood Protection): "The treatment plant structures, electrical, and mechanical equipment shall be protected from physical damage by the one hundred (100) year flood. Treatment plants should remain fully operational and accessible during the twenty-five (25) year flood. This requirement applies to new construction and to existing facilities undergoing major modification. Flood plain regulations of state, province, and federal agencies shall be considered." This item is on-going and remains open.

Mitigation Action 8	
Action Item (describe):	**Strongly encourage the disaster resistance of shelters through the implementation of measures identified in existing and new studies.**
Goals/Objectives Supported:	1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 4.2
Category:	Property Protection
Hazard(s) Addressed:	Flood, Hurricane, Tornado, Earthquake
Lead Agency/Department Responsible:	Department of Education, DHSS, County Emergency Management (EM) Agencies, and DEMA
Estimated Cost:	Cost will depend on the results of shelter studies and the mitigation techniques chosen to be implemented.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Public Assistance (406 mitigation), Economic Development Administration – Economic Development Technical Assistance
Implementation Schedule:	Five year implementation schedule to complete project
Priority:	High
2007 Status Update:	New Action item.
2010 Status Update:	This action not only ties into the 2010 update to Mitigation Action 8, but goes much further. Shelter reviews are going on and will be implemented as funding becomes available.
2013 Status Update:	Some degree of disaster resistance was built into the design of the new Dover High School. Item remains open.
2018 Status Update:	Delaware's Shelter Working Group meets quarterly to evaluate shelter requirements, catalogue available resources, anticipate shortcoming, and make decisions to effect shelter program improvements. The Group consist of key State and local agencies, and non-profits (see group composition in Annex E). The 2009/2010 Study is outdated and requires updating.

Mitigation Action 9	
Action Item (describe):	**Strongly encourage sewer line check valves for new construction or the repair of sewer lines in the 100 and 500-year floodplain.**
Goals/Objectives Supported:	1.1, 1.3, 2.1, 2.3, 2.2, 2.3, 3.1, 4.2
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	County Public Works, support required from county and city commissions. DNREC - Surface Water Discharge Section, Groundwater Discharge Section)
Estimated Cost:	Approximately $600 per household
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Cost assumed by homeowner
Implementation Schedule:	Ongoing and continuous.
Priority:	Moderate
2007 Status Update:	Ongoing – part of the review/approval process for new facilities
2010 Status Update:	Phraseology changed from, "Establish State code requiring sewer line check valves for new construction or the repair of sewer lines in the 100 and 500-year floodplain", to present form. There is no initiative to adopt any state code requirements. However, the use of check valves is strongly encouraged at all levels of government and remains an active mitigation action.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	This action is in-line with Department policy and regulations. It is on-going and remains open.

Mitigation Action 10	
Action Item (describe):	**The State of Delaware should limit State expenditures (infrastructure investments) in identified hazard areas. Limits placed on expenditures should be incorporated into the most recent Strategies for State Policies and Spending document.**
Goals/Objectives Supported:	1.3, 2.1, 2.5, 3.1,
Category:	Prevention
Hazard(s) Addressed:	Flood, Coastal Erosion
Lead Agency/Department Responsible:	Office of State Planning. Support provided by Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources to develop investment strategy. $200,000 to assess hazard vulnerability relative to differing infrastructure scenarios
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Hazard Mitigation Grant Program, Economic Development Administration – Economic Development State and Local Economic Development Planning, Flood Mitigation Assistance Program, Pre-Disaster Mitigation, U.S. Army Corps Of Engineers – Planning Assistance to States, U.S. Army Corps of Engineers – Floodplain Management Services
Implementation Schedule:	End of 2010
Priority:	Moderate
2007 Status Update:	Ongoing
2010 Status Update:	Changed the phraseology from, "The State of Delaware should limit State expenditures (infrastructure investments) in identified hazard areas. Limits placed on expenditures should be incorporated into the document Managing Growth in 21st Century Delaware: Strategies for State Policies and Spending", to the present form. The state actively pursues this policy and will continue to pursue this policy. There are public meetings scheduled to review the most recent draft document.
2013 Status Update:	This is not currently being accomplished in any uniform manner and new floodplain and drainage recommendations, under Senate Bill 64 have been forwarded to the legislature to bolster this effort. Item remains open.
2018 Status Update:	The Strategies for State Policies and Spending was updated in 2015 to include reference to sea level rise and climate change, specifically, Executive Order directed state agencies to avoid siting structures and infrastructure in areas at risk to current and future flood events; and, if avoidance is not possible, structures should be elevated to 18" above the base flood elevation, plus additional to accommodate future sea level rise. The State Strategies report also includes maps in Appendix C: "Avoiding and Minimizing Risk of Flood Damage to State Assets" (March 2016) is a guide for state agencies to prioritize resiliency and flood risk when building new infrastructure and retrofitting or updating existing structures (Executive Order 41).

See Jenifer D comments

Mitigation Action 11	
Action Item (describe):	**Continue to host semi-annual meetings of the State Hazard Mitigation Council.- The Council may be convened following federal disaster declarations, if the situation warrants.**
Goals/Objectives Supported:	1.1, 1.2, 1.5, 2.2, 2.4, 2.5, 3.2, 3.3, 3.5, 4.1, 4.2
Category:	Public Information and Awareness
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	Ongoing and Continuous.
Priority:	High
2007 Status Update:	SHMC has been renewed. Meetings will be held semi-annually.
2010 Status Update:	Phraseology changed from, "Initiate semi-annual meetings of the State Hazard Mitigation Council' to its present form. Mitigation council meetings are being conducted on a continuous basis. The SHMO has determined that maintaining this action item as a active mitigation action is beneficial to the program.
2013 Status Update:	This continues to be a desired action. However, limited staff and involvement in additional activities outside of mitigation has made it difficult to meet with the State Hazard Mitigation council twice a year. The last two meetings were in September of 2012 and May of 2013 and the next mitigation council meeting is scheduled for the fall of 2013. Item remains open.(#12 - We have convened the State Hazard Mitigation Council following the Snow Disaster, Hurricane Irene, and Hurricane Sandy. This continues to be a desired action.)
2018 Status Update:	The SHMC will meet semi-annually with new purpose in the future.

Mitigation Action 12	
Action Item (describe):	***Maintain* inter-agency collaboration with the Office of State Planning, the University of Delaware Disaster Research Center, Delaware Geological Survey, and floodplain management to assist with hazard data collection and analysis.**
Goals/Objectives Supported:	1.2, 1.5, 2.3, 3.3, 4.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	EMPG and Mitigation funding, DEMA and DNRECA
Implementation Schedule:	Based on availability and funding of staff.
Priority:	Low.
2007 Status Update:	Not completed. Formal agreements will be pursued in the 2007-2008 time frame, concurrently with the update/rewrite of the DEOP.
2010 Status Update:	DEMA maintains a solid working relationship with all the above agencies, although no formal agreement exists. This remains an active mitigation action. However, since the normal day to day working relationship with these agencies on sharing information has been very good, the priority is changed from “High” to “Moderate”. Lack of staff is the main reason this is not accomplished to date.
2013 Status Update:	Rewrote this action to reflect current agencies involved. Working relationships between agencies remains very good and the priority for this action was changed to low. However, this remains a desired action.
2018 Status Update:	This action was revised to reflect continual partnership with agencies to evaluate hazard data. Utilize contact with UD to improve HAZUS data analysis.

Mitigation Action 13	
Action Item (describe):	**Develop property-specific mitigation plans for Delaware State museums, historic properties and all publicly-owned historic properties**.
Goals/Objectives Supported:	1.2, 1.4, 2.1, 2.4, 2.5, 3.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of State - Division of Historical and Cultural Affairs
Estimated Cost:	$100,000. Cost dependent on number of facilities assessed
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	National Park Service – Historic Preservation Fund Grants-In-Aid, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Non-profit grant funds (Delaware Preservation Revolving Fund), State Capital Appropriations Fund, FEMA – All Hazards Emergency Operational Planning, U.S. Army Corps of Engineers – Planning Assistance to States, Floodplain Management Service, Economic Development Administration – Special Economic Development and Adjustment Assistance Program Sudden and Severe Economic Dislocation and Long-Term Economic Deterioration
Implementation Schedule:	Based on availability of funding.
Priority:	High
2007 Status Update:	In discussion phase
2010 Status Update:	Not started due to lack of funding and personnel.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	Recently updated GIS mapping of cultural resource survey data into the Cultural and Historical Resources Information System (CHRIS). Participated in a pilot project that included conducting vulnerability assessments of three State-owned historic properties, produced a final report of recommendations.

Mitigation Action 14	
Action Item (describe):	**Develop Memorandum of Understanding with the University of Delaware Disaster Research Center to provide staff and graduate students to assist the Delaware Emergency Management Agency address hazard mitigation – related research questions.**
Goals/Objectives Supported:	1.1, 1.2, 3.3,
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	EMPG
Implementation Schedule:	Based on staff availability.
Priority:	Moderate
2007 Status Update:	Not accomplished. Will be reviewed and re-evaluated. DEMA currently uses interns from University of Delaware to assist local communities with review of mitigation projects, action items, etc.
2010 Status Update:	Not formally completed. DEMA currently uses interns from the University of Delaware to collect data on local mitigation actions, potential new mitigation actions and any completed mitigation actions. This program will be expanded to address state mitigation actions in the future. DEMA also has a very good working relationship with the University Research center. However, it still remains a long term goal to formalize an agreement.
2013 Status Update:	Intern program has expanded with three interns to be utilized this summer with two of the interns to work mitigation. However, we still do not have a formal agreement.
2018 Status Update:	Coordinating a formal intern process with UD for graduate and non-graduate interns to work mitigation projects.

Mitigation Action 15	
Action Item (describe):	**Increase the number of CRS communities in the State of Delaware.**
Goals/Objectives Supported:	1.1, 3.4, 3.5,
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship
Estimated Cost:	$20,000. Costs associated with staff time and the development of workshop or outreach efforts.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Army Corps of Engineers – Floodplain Management Services
Implementation Schedule:	Ongoing and continuous.
Priority:	Moderate
2007 Status Update:	One additional community has been added to the CRS. Work is in progress on adding additional communities.
2010 Status Update:	Two new members since the last update. The Town of South Bethany joined in October of 2007, and the Town of Bethany joined in May of 2009. DNREC continually encourages participation during the annual HMA workshops held in each of the counties.
2013 Status Update:	Both Delaware City and New Castle County joined CRS bringing the total number of communities participating in CRS to 9 of the 57 statewide. Item to remain open
2018 Status Update:	Delaware currently has 11 communities that participate in the Community Rating System (CRS). New Castle County was the last community to join in May 2013. Newark is the highest rated community at a Class 7, which provides a 15 % discount to policies for structures in the floodplain. The 11 communities participate in Delaware's CRS Users Group that meets on a quarterly basis.

Mitigation Action 16	
Action Item (describe):	**Improve the CRS rating among participating communities by one point per year for the next two years. After two years, a re-evaluation should occur that determines the benefit of continued class rating reductions versus the time and effort necessary to make this happen.**
Goals/Objectives Supported:	1.1, 3.4, 3.5,
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Army Corps of Engineers – Floodplain Management Services
Implementation Schedule:	Ongoing and continuous.
Priority:	Moderate
2007 Status Update:	One community's CRS rating was lowered. Work continues with other communities on reducing CRS ratings.
2010 Status Update:	No community's rating was lowered, although the Town of South Bethany joined in October, 2007, with a rating of 8 and the Town of Bethany joined in May, 2009, also with a rating of 8. Work continues with other communities on reducing CRS ratings. The program is highlighted during annual HMA workshops held in each of the counties.
2013 Status Update:	No communities were upgraded, but New Castle County and Delaware City joined with a rating of 8.
2018 Status Update:	Changed action from "Lower the CRS rating" to "Improve the CRS rating." DNREC: Delaware currently has 11 communities that participate in the Community Rating System (CRS). New Castle County was the last community to join in May 2013. Newark is the highest rated community at a Class 7, which provides a 15 % discount to policies for structures in the floodplain. The 11 communities participate in Delaware's CRS Users Group that meets on a quarterly basis.

Mitigation Action 17	
Action Item (describe):	**Use Community Development Block Grant (CDBG) funds to relocate or elevate low to moderate income households that are located in the floodplain.**
Goals/Objectives Supported:	1.1, 1.3, 1.5, 2.1, 3.2, 3.3, 4.1, 4.2
Category:	Property Protection
Hazard(s) Addressed:	Flooding, including riverine and coastal
Lead Agency/Department Responsible:	Delaware State Housing Authority
Estimated Cost:	Project cost is dependent on the number of homes relocated or elevated.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Community Development Block Grant Program. The Hazard Mitigation Grant Program, Pre-Disaster Mitigation Grant program and Housing and Urban Development Disaster Recovery Initiative funding may be considered to supplement CDBG funds. CDBG funds may lose their federal designation when combined with other federal grant programs and can therefore be used as a match.
Implementation Schedule:	Ongoing and continuous.
Priority:	High
2007 Status Update:	Ongoing
2010 Status Update:	Although this has not been done, it is something that is considered when evaluating home elevation projects. Projects completed to date have not been eligible. This remains an active mitigation action.
2013 Status Update:	No change in status. Better coordination between the Delaware State Housing Authority, DNREC, and DEMA is required. Item remains open.
2018 Status Update:	DSHA: Projects must meet the CDBG national Objective 'Urgent Needs" criteria in order to be eligible. This remains a viable action.

Mitigation Action 18	
Action Item (describe):	**Conduct periodic benefit-cost training workshops for DEMA staff, members of the State Hazard Mitigation Council and county and local government officials.**
Goals/Objectives Supported:	1.1,1.2, 1.4, 1.5, 2.2, 2.3
Category:	Public Information and Awareness
Hazard(s):	Flood, Earthquake, Hurricane, Tornado
Lead Agency/Department, or Organization Responsible for Implementation:	Delaware Emergency Management Agency
Estimated Cost:	$50,000
Funding Method:	Flood Mitigation Assistance Program (technical assistance), Hazard Mitigation Grant Program, Pre-Disaster Mitigation Grant program
Implementation Schedule:	Ongoing and continuous.
Priority:	High
2007 Status Update:	Hazard Mitigation workshops were done in counties following development of 2004 State Hazard Mitigation Plan.
2010 Status Update:	Changed Phraseology from, “Conduct 5 benefit-cost training workshops for DEMA staff, members of the State Hazard Mitigation Council and county and local government officials” to present form. DEMA has been coordinating BCA classes in the state on a bi-annual basis. If events warrant additional classes, additional classes will be scheduled. Periodic classes are essential to maintaining proficiency with the software.
2013 Status Update:	This has been done on an as needed basis. We are currently looking at hosting another BCA course here at DEMA due to the release of version 4.8 of the BCA software. Item remains open.
2018 Status Update:	Hosted BCA training course in 2016, will continue as required. We take extra effort to ensure BCA training. The next level is train-the-trainer and conduct local training classes.

Mitigation Action 19	
Action Item (describe):	**Consider the use of shoreline protection measures, including inlet stabilization, beach nourishment and dune enhancement.**
Goals/Objectives Supported:	1.1, 1.4, 2.1 2.2, 3.3, 3.4
Category:	Structural Projects, Property Protection
Hazard(s) Addressed:	Coastal Flooding (riverine and storm surge)
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship – Shoreline and Management Section, U.S. Army Corps of Engineers
Estimated Cost:	$10,000,000 to $20,000,000 annually
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	State hotel tax dedicated to beach maintenance, Corps of Engineers – Beach Erosion Control Projects, Corps of Engineers – Emergency Advance Measures for Flood Prevention, Corps of Engineers – Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works
Implementation Schedule:	Annually or appropriate maintenance cycle.
Priority:	High
2007 Status Update:	A great deal has been accomplished in this area. Beach re-nourishment projects have been completed in Rehoboth Beach, Dewey, Slaughter Beach, Broadkill Beach and Fenwick Island. Additional projects are underway in Bethany and South Bethany (est. completion in 2008), and a project is underway to protect historic structures at Cape Henlopen State Park.
2010 Status Update:	A great deal has been accomplished in this area. Beach nourishment projects are required for the long term protection of the beaches. This remains a top priority in the state. The extreme cost of this action sometimes limits the availability of swift responses to the need for beach nourishment. However, these projects do move forward. This item will remain an active mitigation action.
2013 Status Update:	With extensive damages done to the dune system from Hurricanes Irene and Sandy, this remains a high priority within the state. The U.S Army corps of Engineers is actively involved in current dune replenishment efforts. It to remain open.
2018 Status Update:	Since the last update, the USACE has performed maintenance to their Storm Damage reduction project in Rehoboth, Dewey, Lewes, and Broadkill Beach. In 2018 work is scheduled in Bethany, South Bethany, and Fenwick.

Mitigation Action 20	
Action Item (describe):	**Purchase and install emergency power sources in identified State-owned facilities.**
Goals/Objectives Supported:	2.2, 3.3, 4.2
Category:	Property Protection
Hazard(s) Addressed:	Hurricanes, Tornados, Lightning, Winter Storms
Lead Agency/Department Responsible:	Office of Management & Budget- Facilities Management, Delaware Department of Transportation
Estimated Cost:	Cost dependent on the number and type of emergency power sources desired.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Delaware Department of Transportation, Hazard Mitigation Grant Program, Pre-Disaster Mitigation, FEMA – All Hazards Emergency Operational Planning, FEMA – Emergency Management Performance Grants, FEMA – Emergency Operations Center Funding
Implementation Schedule:	As funding becomes available.
Priority:	High
2007 Status Update:	Ongoing
2010 Status Update:	Part of the critical facility analysis that will be finalized later this year. Actual implementation of the analysis will be based on availability of funding.
2013 Status Update:	Generators are being upgraded or installed through a variety of programs around the state. The Town of Blades installed a generator, funded under HMGP, in 2012. Item remains open.
2018 Status Update:	The list of identified State-owned facilities is under revision and is being coordinated with Facilities Management and DEMA. Following the revision of the list, critical facilities will be identified and potential funding for generators will be explored. Funding for the purchase of the generators is an ongoing challenge. *DFM plans to replace generators on a lifecycle maintenance basis.*

Mitigation Action 21	
Action Item (describe):	**Install video cameras in and around all school buildings.**
Goals/Objectives Supported:	1.1
Category:	Prevention
Hazard(s) Addressed:	All Hazards, including Human-Caused. Video cameras should be viewable by emergency responders. Video surveillance would improve emergency response activities in the event of an emergency or disaster.
Lead Agency/Department Responsible:	Individual School Districts and Department of Education. Supporting agencies include, State Police and local school districts.
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Various funding sources – new school construction project to include funding for security
Implementation Schedule:	Immediate and ongoing
Priority:	High
2007 Status Update:	In progress. No ETC date available (contingent upon funding)
2010 Status Update:	This is being done across the state. More is still needed. The limiting factor is predominantly funding.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	This action is being reviewed by the responsible agencies and will be tracked Quarterly as part of the Mitigation Planners responsibilities.

Mitigation Action 22	
Action Item (describe):	**Encourage local governments to continue to relocate shoreline buildings outside the Special Flood Hazard Area (SFHA), when elevation is not a cost effective alternative.**
Goals/Objectives Supported:	1.2, 1.4, 2.1,2.2, 3.1
Category:	Property Protection
Hazard(s) Addressed:	Flood, Coastal Erosion
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship, Delaware Emergency Management Agency, and Local government officials
Estimated Cost:	Costs based on the number and type of buildings
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Hazard Mitigation Assistance Program, Pre-Disaster Mitigation, Repetitive flood Claims, Severe Repetitive Loss Corps of Engineers – Emergency Advance Measures for Flood Prevention, Corps of Engineers – Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works, Community Development Block Grant Program, Public Assistance, Small Business Administration - Pre-Disaster Mitigation Loans
Implementation Schedule:	As funding becomes available
Priority:	High
2007 Status Update:	Ongoing – some projects have been completed (See tables in Capabilities Section). DNREC continues to encourage this through grant programs and construction guidelines.
2010Status Update:	Although no projects of this type have been completed in the last few years, this is still strongly encouraged. This G action to remain active.
2013 Status Update:	Three acquisition projects have been completed since the last update. This remains the top mitigation priority. Item remains open.
2018 Status Update:	Governor's Executive Order 41 specifically directs State Agencies to direct expenditures towards relocation away from floodplains along the coast which are vulnerable to sea level rise and increased flood risk.

Mitigation Action 23	
Action Item (describe):	**Encourage local governments to continue to floodproof or acquire commercial or public buildings where cost effective. (Acquisition should be the first consideration as it removes the property from the SFHA.)**
Goals/Objectives Supported:	1.1, 1.4, 1.5, 2.1, 2.3, 3.1
Category:	Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Department of Natural Resources and Environment Control , Delaware Emergency Management Agency, and Local government officials
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Repetitive Flood Claims, Severe Repetitive Loss, Corps of Engineers – Floodplain Management Services, Community Development Block Grant Program, Housing and Urban Development – Disaster Recovery Initiative, Small Business Administration - Pre-Disaster Mitigation Loans, Public Assistance (406 mitigation)
Implementation Schedule:	Dependent on funding and the identification of flood-prone facilities at the county and municipal level.
Priority:	High
2007 Status Update:	Cancelled.
2010 Status Update:	This mitigation action was reviewed, although it was cancelled in the 2007 update. In 2007, it was felt that it was actually the same mitigation action as Mitigation Action 29. This action, along with Mitigation Action 29, has been re-phrased to clarify the changes. Currently, there is a major project being pursued through FMA to Acquire the NVF facility in New Castle County. Shone Lumber also in New Castle County has been floodproofed.
2013 Status Update:	We are now completing a floodproofing project at the City of Wilmington Emergency Operations Center. This remains a high priority.
2018 Status Update:	Wilmington EOC project completed. Currently, working on PDM 2016 Flood-proofing project at the UD Marine Operations Building in Lewes. The USACE has approved and funded proposals to work with the State and local communities in Kent, New Castle, and Sussex counties to: 1) conduct workshops to educate locals on non-structural flood proofing methods and 2) assess homes and businesses for viability of non-structural flood proofing methods and put together a list of possible properties.

Mitigation Action 24	
Action Item (describe):	**Encourage local governments to continue to elevate or acquire flood-prone residential buildings where cost effective. (Acquisition should be the first consideration as it removes the property from the SFHA.)**
Goals/Objectives Supported:	1.1, 4.4, 3.3
Category:	Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship, Delaware Emergency Management Agency, and Local government officials
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Repetitive Flood Claims, Severe Repetitive Loss, Corps of Engineers – Floodplain Management Services, Community Development Block Grant Program, Housing and Urban Development – Disaster Recovery Initiative, Small Business Administration - Pre-Disaster Mitigation Loans, Public Assistance (406 mitigation)
Implementation Schedule:	Dependent on funding and the identification of flood-prone homes at the county and municipal level.
Priority:	High
2007 Status Update:	Ongoing. Several projects have been completed, including Glenville (see project tables)
2010 Status Update:	Changed the phraseology from, “Encourage local governments to elevate or acquire flood-prone buildings where cost effective”, to the present form. Completed one home elevation project in South Bethany. Currently evaluating six elevation projects in Sussex County for cost effectiveness and consideration under the Hazard Mitigation Grant program.
2013 Status Update:	Three acquisition projects have been completed since the last update. This remains the top mitigation priority. Item remains open.
2018 Status Update:	One acquisition project and two elevation projects have been completed since the last update. Acquisition and elevation projects still remain a priority for the State as we continue to accept, review, and work to complete more of these project types. The USACE has approved and funded proposals to work with the State and local communities in Kent, New Castle, and Sussex counties to: 1) conduct workshops to educate on locals non-structural flood proofing methods and 2) assess homes and businesses for viability of non-structural flood proofing methods and put together a list of possible properties.

Mitigation Action 25	
Action Item (describe):	**Require the flood-proofing of on-site residential septic systems located in the 100-year floodplain.**
Goals/Objectives Supported:	1.1, 1.5, 2.1, 2.2
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Water Resources and Local government officials
Estimated Cost:	No cost associated with the development of regulations requiring the flood-proofing of sanitary systems. The cost of implementing this proposed regulation is unknown.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Small Business Administration – Pre-Disaster Mitigation Loans
Implementation Schedule:	First, sanitary systems must be defined and those located in the 100-year floodplain identified. Next, cost estimates for each system should be estimated. Finally, a prioritization plan should be developed in order to rank potential projects.
Priority:	High
2007 Status Update:	Ongoing
2010 Status Update:	DNREC monitors this closely. Although this action is being accomplished, it was decided to maintain this item as an active mitigation action.
2013 Status Update:	This is currently being accomplished and new floodplain and drainage recommendations, under Senate Bill 64 have been forwarded to the legislature to bolster this effort.
2018 Status Update:	DNREC: limited success.

Mitigation Action 26	
Action Item (describe):	**Encourage the acquisition of land in flood-prone areas.**
Goals/Objectives Supported:	1.1, 1.4, 1.5, 2.1, 3.2,
Category:	Natural Resource Protection
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for Implementation:	DNREC (Division of Parks and Recreation, Open Space Council), Local government officials, Land trusts
Estimated Cost:	Cost based on land acquired. Land acquisition will require the General Assembly appropriating State dollars to acquire selected parcels of land.
Funding Method:	Delaware Open Space Program (Division of Fish and Wildlife, Division of Parks and Recreation), Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, Natural Resources and Conservation Service – Wetlands Reserve Program, Natural Resources and Conservation Service – Watershed Surveys and Planning, Environmental Protection Agency – Wetlands Grants
Implementation Schedule:	Ongoing as State funds are appropriated. Actions should be closely coordinated with the DNREC - Division of Watershed Stewardship, which administers the National Flood Insurance Program.
Priority:	Moderate
2007 Status Update:	Ongoing
2010 Status Update:	This is still being encouraged at all levels of government. Funding limitations are often an overriding obstacle with this action. Action to remain active.
2013 Status Update:	Three acquisition projects completed since last update.
2018 Status Update:	DNREC: open space program has received no funding last two years.

Mitigation Action 27	
Action Item (describe):	**Research the feasibility to remove dead trees that pose a threat to power lines, road right of ways and property. Trees prone to wind damage should be replaced with more appropriate species, if possible.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 3.3,
Category:	Prevention
Hazard(s) Addressed:	High Wind, Winter Storm, Hurricane, Thunderstorm, Nor'easter
Lead Agency/Department Responsible:	Department of Agriculture (Delaware Forest Service). At the local level, local government officials or municipal Parks and Recreation Departments may perform this service.
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Local funds, State Community Transportation Funds, United States Department of Agriculture
Implementation Schedule:	Program should begin Summer 2004
Priority:	Moderate
2007 Status Update:	Ongoing – part of REC mitigation processes
2010 Status Update:	A lot of dead tree removal has been accomplished, but this is a never ending proposition. Item to remain active.
2013 Status Update:	Two communities have developed tree maintenance programs since the last update. Item remains open.
2018 Status Update:	The DFS works closely with local utility companies and DelDOT to identify and remove hazards along the ROWS. This program operates directly through the DFS Urban and Community Forestry Program. The DFS continues to provide technical and financial assistance to homeowners associations, municipalities, counties, and state government agencies on tree care and hazard mitigation.

Mitigation Action 28	
Action Item (describe):	**Conduct vulnerability assessment of hospital back-up power sources.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 3.3, 4.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Health and Social Services (Division of Public Health)
Estimated Cost:	$50,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA – Emergency Management Performance Grants, Department of Justice – State and Local Domestic Preparedness Technical Assistance, FEMA – All Hazards Emergency Operational Planning, Hazard Mitigation Grant Program, PDM, HSRA and CRC grants
Implementation Schedule:	End of 2011
Priority:	High
2007 Status Update:	In progress. Project has been approved by FEMA to flood-proof power supply infrastructure (including back-up generators) at Christiana Hospital in New Castle County.
2010 Status Update:	Christiana Hospital mitigation project to floodproof the generators and pharmacy loading dock is now complete. Reassessing other facilities as to the need for some sort of protection.
2013 Status Update:	This continues to be a concern as hospitals expand and energy requirements change. Item remains open.
2018 Status Update:	This action is being coordinated and reviewed by the DHSS/DPH; they have requested updates from hospitals.

Mitigation Action 29	
Action Item (describe):	**Assess the accuracy of current digital Flood Insurance Rate Maps and aerial base maps and prioritize improvements to both based on flood hazard vulnerability and development patterns.**
Goals/Objectives Supported:	1.4, 3.5, 4.3,
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA – Map Modernization Program, FEMA – Flood Hazard Mapping Program, FEMA – Flood Recovery Mapping, Hazard Mitigation Grant Program, Pre-disaster Mitigation, Flood Mitigation Assistance Program, Corps of Engineers – Floodplain Management Services, Hurricane Sandy Relief funds.
Implementation Schedule:	As requirements are identified
Priority:	High
2007 Status Update:	Ongoing - Map improvements are underway at FEMA. Seventy five miles of stream in Sussex County is currently under study by DNREC, with an estimated delivery date to FEMA of late 2007.
2010 Status Update:	Ongoing – DNREC has coordinated the use of LIDAR in mapping for the entire state. As new potential hazard areas are identified, they are put in the queue to be better assessed. This is another item that is continuous and will remain active.
2013 Status Update:	DNREC, DGSD, and DelDOT are cooperating with the USGS on potentially flying new LIDAR to further update the Delaware Digital Elevation Model.
2018 Status Update:	DNREC – this is an ongoing activity.

Mitigation Action 30	
Action Item (describe):	**Conduct all-hazard assessment of critical healthcare system facilities and services (both public and private) to include: nursing homes and long-term facilities, hospitals, free-standing surgery and emergency centers, State public health clinics and State service centers, Federally Qualified Health Centers, EMS facilities and dialysis centers.**
Goals/Objectives Supported:	1.5, 2.2, 3.3, 4.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Health and Social Services (Division of Public Health)
Estimated Cost:	$500,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA – Emergency Management Performance Grants, Department of Justice – State and Local Domestic Preparedness Technical Assistance, Department of Justice – State and Local Domestic Preparedness Exercise Support, FEMA – All Hazards Emergency Operational Planning, Hazard Mitigation Grant Program
Implementation Schedule:	Assessment complete within eight months of signing contract.
Priority:	High
2007 Status Update:	Ongoing – part of annual licensure/certification process. DHSS conducted an evaluation of all healthcare facilities and determined that a shortfall existed in the evacuation planning and therefore, during FY2006, required all healthcare facilities to develop evacuation plans for 1) building evacuation within a campus, 2) evacuation to a new or different campus, and 3) evacuation out of state. FEMA has provided the state with inundation data for 14 hospitals, 28 assisted living facilities, 15 dialysis centers, and 116 nursing homes in DE, to be used for preparedness planning.
2010 Status Update:	This is a long term goal. Many facilities have completed their assessments to some degree and the situation has improved dramatically. All the hospitals and most of the nursing homes and assisted living facilities and dialysis centers have completed some sort of assessment. DHSS is considering adding group homes to this requirement.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	This action is being reviewed by DHSS/DPH.

Mitigation Action 31	
Action Item (describe):	**Conduct risk analysis and resiliency assessments for Delaware's affordable housing properties that will result in property-specific mitigation actions, and avoidance of flood prone areas.**
Goals/Objectives Supported:	1.1, 1.3, 1.4, 1.5, 3.2, 4.1,
Category:	Prevention, Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Delaware State Housing Authority (DSHA). Other state and local affordable housing providers.
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Strategic Opportunity Funds for Adaptation (SOFA); possibly Sustainable Energy Utility
Implementation Schedule:	Based on availability of funding.
Priority:	High
2018 Status Update:	**New mitigation action.** Pending funding availability, DSHA will analyze its affordable housing portfolio and DSHA properties and identify those that are prone to flooding based on specified risk factors. The analysis will help DSHA create a list of building resilience action items to be included in Low Income Housing Tax Credit program for preservation projects and changes in DSHA construction and design standards to mitigate future resiliency issues for affordable housing.

Mitigation Action 32	
Action Item (describe):	**Assist communities with the enforcement of state stormwater management regulations.**
Goals/Objectives Supported:	1.3, 3.2, 4.2,
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship, Drainage Section
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	General Revenue
Implementation Schedule:	Ongoing and continuous
Priority:	High
2007 Status Update:	Ongoing
2010 Status Update:	DNREC is constantly assisting communities around the state to identify and improve stormwater management. Item to remain active.
2013 Status Update:	This is currently being accomplished and new floodplain and drainage recommendations, under Senate Bill 64 have been forward to the legislature to bolster this effort.
2018 Status Update:	Ongoing. Court decision striking down regulatory changes has set this back.

Mitigation Action 33	
Action Item (describe):	**Conduct in-depth vulnerability assessment of state-owned facilities, to include the prioritization of possible retrofitting strategies.**
Goals/Objectives Supported:	1.2, 2.2, 4.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Management & Budget (Division of Facilities Management), Department of State (Historic and Cultural Affairs)
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA - All Hazards Emergency Operational Planning, FEMA – Emergency Management Performance Grants, Department of Justice – State and Local Domestic Preparedness Technical Assistance, Hazard Mitigation Grant Program, State funding
Implementation Schedule:	Ongoing, should be completed by the end of 2010.
Priority:	High
2007 Status Update:	Ongoing
2010 Status Update:	This is part of the study to identify critical facilities. The study is being finalized. Currently the ADA requirements are being reviewed.
2013 Status Update:	Currently plan to develop a User Defined Facility listing in HAZUS-MH to better analyze both state owned and all critical facilities.
2018 Status Update:	GIS mapping of Cultural resource survey data has been updated in the Cultural and Historical Resources Information System (CHRIS). A vulnerability assessment of three State-owned historic properties produced a final report of recommendations. Three (3) State facilities have been studied for their risk and vulnerability to potential future sea level rise and climate change. Additional facilities will be assessed in the future based upon risk and resources available for study.

Mitigation Action 34	
Action Item (describe):	**Assess the vulnerability of access and egress routes to hospitals within the State of Delaware.**
Goals/Objectives Supported:	4.2, 4.4
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Health and Social Services (Division of Public Health), Department of Transportation (DelDOT)
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA - All Hazards Emergency Operational Planning, FEMA – Emergency Management Performance Grants, Department of Justice – State and Local Domestic Preparedness Technical Assistance, Hazard Mitigation Grant Program, State funding
Implementation Schedule:	Spring 2005
Priority:	High
2007 Status Update:	Ongoing – part of transportation emergency planning process
2010 Status Update:	Completed, however this item will remain active due to the fact that this is always going to be reassessed.
2013 Status Update:	No change in status as this continues to be assessed and reassessed.
2018 Status Update:	This action is being reviewed by DHSS/DPH and DelDOT and will be re-evaluated against current policies and procedures.

Mitigation Action 35	
Action Item (describe):	**Develop base flood elevations in areas which are prone to flooding and a FEMA detailed flood study has not been conducted.**
Goals/Objectives Supported:	1.1, 1.2, 2.1, 3.1, 3.1, 3.4, 4.3
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA – Map Modernization Program, FEMA – Flood Hazard Mapping Program, FEMA – Flood Recovery Mapping, Hazard Mitigation Grant Program, Pre-disaster Mitigation, Flood Mitigation Assistance Program, Corps of Engineers – Floodplain Management Services
Implementation Schedule:	Initiate study Winter 2004
Priority:	High
2007 Status Update:	Ongoing. About 75 miles of streams in Sussex County are being studied as of this writing.
2010 Status Update:	This continues to be an ongoing process. Both Federal and local funding has been utilized to support this initiative. A local engineering firm completed a hydrology study along Barley Mill Road, in the Newark area that identified flood elevations in an area not identified as a SFHA. This Item remains open.
2013 Status Update:	Most of Delaware now has a detailed flood study. New preliminary flood studies for all three counties are expected to go final in 2014.
2018 Status Update:	DNREC: Currently there are preliminary maps in all three counties that primarily looked at establishing a BFE for those approximate Zone A areas that never had a BFE before.

Mitigation Action 36	
Action Item (describe):	**Develop centralized database of past disasters, including the impact of events and the amount and type of disaster assistance provided. Database should contain detailed information regarding completed hazard mitigation projects.**
Goals/Objectives Supported:	1.1, 1.2, 1.5, 3.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	$50,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Hazard Mitigation Grant Program, Pre-Disaster Mitigation, FEMA - Hazard Mitigation Technical Assistance Program, FEMA – All Hazards Emergency Operational Planning
Implementation Schedule:	Based on availability of staff and funding
Priority:	Moderate
2007 Status Update:	Not initiated due to personnel limitations. Will be undertaken as a part of the development of the Comprehensive Hazard Analysis being completed for the 2008 rewrite of the DEOP.
2010 Status Update:	DNREC has developed a shell of an application to serve as the State's mitigation Portfolio. He has identified past project locations and loaded this into a GIS file. This application easily highlights mitigation successes. Additional funding is needed to finalize this project. In addition, DEMA has created a database to track mitigation actions around the State. This database was originally developed to track local mitigation actions. It is being modified to also track state mitigation actions. In the summers of 2008 and 2009, we used interns to coordinate with locals to obtain status of the mitigation actions. The interns have served to make the local mitigation plans more of a living document. The information compiled by these interns was used in both the local and state mitigation plan updates. This item to remain active.
2013 Status Update:	Much of this data is collected and included in updates of the State Hazard Mitigation Plan. This will take coordination between DEMA, DGS, the State climatologist and DNREC to complete. Personnel resources will be required to complete this action.
2018 Status Update	This action was identified as a gap (data collection) during the Feb 2018 Mitigation Strategy and Actions Workshop; it will be a priority of the newly established Mitigation Strategy and Actions Sub-Team and the DEMA Mitigation Planner. This action encompasses action #48: which also dealt with the collection of data.

Mitigation Action 37	
Action Item (describe):	**Collect and document existing spatially-correct facilities data in order to more accurately assess hazard exposure and vulnerability to the impacts of hazards.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 4.2, 4.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Geological Survey, Office of State Planning or the Department of Technology and Information Geospatial Data Exchange and the Delaware Emergency Management Agency.
Estimated Cost:	$50,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	State funding, Hazard Mitigation Grant Program, Pre-Disaster Mitigation
Implementation Schedule:	The new facilities will be evaluated prior to the next update of the State Hazard Mitigation Plan.
Priority:	Moderate
2007 Status Update:	Phase II Risk Assessments were conducted for Newark, Dover and the city of New Castle in 2005.
2010 Status Update:	This action item was actually completed. It applies to critical facilities designated around the state. New facilities on the new critical facility list, which should be finalized the end of 2010, will have to be evaluated for their vulnerability.
2013 Status Update:	Corrected the lead agency responsible. Ongoing, DEMA to be more involved in the process.
2018 Status Update:	GIS mapping of Cultural resource survey data has been updated in the Cultural and Historical Resources Information System (CHRIS). A vulnerability assessment of three State-owned historic properties produced a final report of recommendations. Three (3) State facilities have been studied for their risk and vulnerability to potential future sea level rise and climate change. Additional facilities will be assessed in the future based upon risk and resources available for study. This action is being reviewed by the responsible agencies. Office of State Planning will work with various State agencies to get facilities data available on the GIS database. Data will be available to FirstMap users.

Mitigation Action 38	
Action Item (describe):	**Train State and local floodplain managers in the use of GIS-based digital floodplain maps.**
Goals/Objectives Supported:	1.2, 1.5, 4.1, 4.3,
Category:	Public Information and Awareness
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship
Estimated Cost:	$25,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Corps of Engineers – Floodplain Management Services, Flood Hazard Mapping Program, FEMA - Flood Recovery Mapping, Hazard Mitigation Technical Assistance Program (post-disaster)
Implementation Schedule:	Ongoing and continuous.
Priority:	Moderate
2007 Status Update:	DNREC offers classes to any state or local personnel involved in flood plain management, oversight, etc.
2010 Status Update:	DNREC continues to offer classes to any state or local personnel involved in flood plain management, oversight, etc. Item to remain active.
2013 Status Update:	DNREC continues to offer classes to any state or local personnel involved in flood plain management, oversight, etc. Item to remain active.
2018 Status Update:	DNREC continues to offer classes-on average of four per year. Item to remain active.

Mitigation Action 39	
Action Item (describe):	**Utilize existing architectural expertise and engineering services to assist in pre and post-disaster structural evaluation and stabilization.**
Goals/Objectives Supported:	1.1, 1.4, 1.5, 2.2, 4.2,
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of State (Division of Historic and Cultural Affairs), Office of Management and Budget - Facilities Management
Estimated Cost:	Staff time required to complete tasks assigned
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	National Park Service – Historic Preservation Fund Grants-In-Aid, FEMA - Public Assistance, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Delaware Preservation Revolving Fund, State Capital Appropriations Fund, FEMA – All Hazards Emergency Operational Planning, U.S. Army Corps of Engineers – Planning Assistance to States, Economic Development Administration – Special Economic Development and Adjustment Assistance Program Sudden and Severe Economic Dislocation and Long-Term Economic Deterioration
Implementation Schedule:	Staff assigned on an as needed basis.
Priority:	High
2007 Status Update:	Ongoing
2010 Status Update:	Ongoing and continuous, Item to remain active.
2013 Status Update:	Ongoing
2018 Status Update	In-house A/E services during disaster: OMB/DFM will work with DEMA to keep data of potential capabilities and services current.

Mitigation Action 40	
Action Item (describe):	**Develop coordinated community-level disaster education initiative involving State, county and non-governmental organizations.**
Goals/Objectives Supported:	1.1, 1.2, 1.4, 3.2, 3.4
Category:	Public Information and Awareness
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency, County Emergency Management Agency, Red Cross, DSHA
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Local funds, FEMA - Hurricane Local Grant Program
Implementation Schedule:	Develop and implement program within 1 year
Priority:	Moderate
2007 Status Update:	Ongoing via Citizen Corps, the Community Emergency Response Teams, the DEMA Public Information Officer and other programs
2010 Status Update:	Ongoing via Citizen Corps, the Community Emergency Response Teams, the DEMA Public Information Officer and other programs. It is actually a very good program that requires constant effort. Item to remain active.
2013 Status Update:	Citizen Corps has been extremely active in addressing this and has trained over 3,000 volunteers statewide
2018 Status Update	DHSA was added as a responsible agency. DelawareHousingSearch.org was redesigned to feature Disaster Resources. From front page, users can access an expanded page with key links and resources to help citizens prepare before a disaster.

Mitigation Action 41	
Action Item (describe):	**Enhance disaster resistance of state facilities through the implementation of measures identified in existing and new studies.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 2.3, 4.2
Category:	Property Protection
Hazard(s) Addressed:	All hazards
Lead Agency/Department Responsible:	All state agencies, with assistance from DEMA and the Department of Natural Resources and Environmental Control
Estimated Cost:	Cost will depend on the results of studies and the mitigation techniques chosen to address identified deficiencies.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Hazard Mitigation Grant Program, Pre-Disaster Mitigation, Repetitive Flood Claims, Flood Mitigation Assistance, Public Assistance (406 mitigation), Economic Development Administration – Economic Development Technical Assistance
Implementation Schedule:	Implementation schedule will vary according to specific nature of the projects
Priority:	High
2007 Status Update:	New
2010 Status Update:	This action is constant. Although this is being accomplished on a regular basis, it may be better to specifically identify implementation measures. This would allow better tracking of actual measures that are completed. This it to remain active, but will likely be modified in the next update of the state plan
2013 Status Update:	New information comes from a variety of sources. New detailed preliminary flood studies have been done in all three counties. DNREC completed a sea level rise vulnerability assessment July of 2012. Item remains open.
2018 Status Update:	A guidance document was released in 2016 with related flood risk guidance tools and information: "Avoiding and Minimizing Risk of Flood Damage to State Assets" a guide for state agencies to prioritize resiliency and flood risk when building new infrastructure and retrofitting or updating existing structures; developed by an inter-agency workgroup under Executive Order 41. "Recommendation Sea-level Rise Planning Scenarios for Delaware: Technical Report" (Nov 2017) – This report prepared by Delaware Geological Survey is the most recent update to SLR scenarios used in the state. DNREC will be updated other planning and technical guidance using these scenarios.

Mitigation Action 42	
Action Item (describe):	**Emphasize, prioritize, and Target Repetitive Loss (RL), Severe Repetitive Loss (SRL), and hazard-prone properties; in every aspect of mitigation funding, planning, and outreach.**
Goals/Objectives Supported:	1.1, 1.5, 3.2, 3.5,
Category:	Prevention and Property Protection
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for Implementation:	DNREC FMM and DEMA SHMO
Estimated Cost:	Varies depending on funding levels of the various programs.
Funding Method:	Flood Mitigation Assistance Program, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Army Corps of Engineers – Floodplain Management Services, Local funded
Implementation Schedule:	Ongoing and continuous.
Priority:	High
2010 Status Update:	New Mitigation Action. Work has already started on this. Repetitive loss properties are highlighted during annual HMA mitigation Workshops. Much need to be done to clean up the Repetitive Loss data. It is hoped to hire interns, possibly over two summers starting in 2011, to assist in fully implementing this action.
2013 Status Update:	The repetitive loss list is used to assist in prioritization of all mitigation projects. Item remains open.
2018 Status Update:	This action was re-written to consolidate four previous actions (56-59). RL properties receive the highest emphasis in DE. The USACE has approved and funded proposals to work with the State and local communities in Kent, New Castle, and Sussex counties to: 1) conduct workshops to educate locals on non-structural flood proofing methods and 2) assess homes and businesses for viability of non-structural flood proofing methods and put together a list of possible properties.

Mitigation Action 43	
Action Item (describe):	**Validate repetitive loss data to provide more accurate addressing and mapping. Work with FEMA annually and following Declared disasters to ensure all eligible RL or SRL properties are listed.**
Goals/Objectives Supported:	1.5, 3.2, 3.1, 3.2, 4.3
Category:	Prevention, Public Information and Awareness
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for Implementation:	DNREC (Flood Mitigation Manager)
Estimated Cost:	$20,000.00
Funding Method:	Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Agency funds
Implementation Schedule:	Ongoing and Continuous
Priority:	High
2010 Status Update:	New Mitigation Action. DNREC has made significant progress in incorporating repetitive loss data into a GIS portfolio. Additional work is needed. DNREC is seeking funding for a contractor to finalize the project.
2013 Status Update:	Repetitive Loss Data now managed through BureauNet, a web based application that has improved the quality of the data. Currently looking to geo-code each repetitive loss property.
2018 Status Update	Not completed, but some progress made. During the Feb 2018 Mitigation Strategy and Actions Workshop, missing eligible Delaware properties was identified as a “gap.” Therefore, this action was revised to include annually working with FEMA to ensure all eligible properties are included. Reference to the Mitigation Portfolio GIS files was deleted because it is no longer current.

Mitigation Action 44	
Action Item (describe):	**Track status of all mitigation actions around the state.**
Goals/Objectives Supported:	1.1, 1.5, 2.1, 3.4, 4.3
Category:	Prevention, Public Information and Awareness
Hazard(s):	All
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA (SHMO)
Estimated Cost:	$5,000 annually
Funding Method:	Agency Funding
Implementation Schedule:	Summer 2011 with Summer Intern(s)
Priority:	Moderate
2010 Status Update:	New Mitigation Action. However, this was done in 2008 and 2009 with great success. Summer interns were tasked to coordinate with all municipalities and obtain the status of their identified mitigation actions and to identify potential new mitigation requirements. This data was provided to the contractor that updated the local mitigation plans. The data reflecting completed mitigation actions in the Sussex County plan was actually lauded by FEMA Region III. The interns were the source of this data. We have budgeted for an intern to assist in the summer of 2011 and hope to continue this program and expand it to assess all mitigation actions, including actions identified in this plan.
2013 Status Update:	The intern program continued in 2012 and a new intern has been selected to work this issue in the summer of 2013.
2018 Status Update	Mitigation actions will be reviewed with the responsible agencies and updates tracked.

Mitigation Action 45	
Action Item (describe):	**Formalize assistance to Delaware communities in developing community resiliency plans and integrating hazard mitigation into local plans.**
Goals/Objectives Supported:	1.2, 2.4, 2.5, 3.1, 3.2, 4.1
Category:	Prevention, Public Information and Awareness
Hazard(s):	All
Lead Agency/Department, or Organization Responsible for Implementation:	DNREC, University of Delaware Sea Grant Program, DEMA
Estimated Cost:	Staff time
Funding Method:	General Revenue
Implementation Schedule:	3 years
Priority:	Moderate
2013 Status Update:	New mitigation action.
2018 Status Update	The University of Delaware's Institute for Public Administration created the "Delaware Database for Funding Resilient Communities" that provides a searchable source of financial assistance programs available to local governments. The Resilient and Sustainable Communities League (RASCL) is an affiliation of 14 agencies and organizations assisting Delaware communities to promote climate preparedness and sustainability. Delaware Coastal Programs provide technical support to local jurisdictions through its Resilient Community Partnerships program. The Coastal Training Program offers technical assistance, seminars, hands-on skill training, and participatory workshops to lectures and technology demonstrations for local governments and planners. The Division of Energy and Climate supports Sustainable Planning for local jurisdictions through technical assistance and planning grants. Ongoing and much progress made.

Mitigation Action 46	
Action Item (describe):	**Coordinate with the Counties and the University of Delaware on a potential grant for the update of their local mitigation plans.**
Goals/Objectives Supported:	1.1, 1.5, 2.4, 2.5, 3.3, 3.5, 4.1
Category:	Prevention, Public Information and Awareness
Hazard(s):	All
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA (SHMO), County EM, and the University of Delaware Emergency Manager
Estimated Cost:	Staff time, cost of update to be picked up by the owner of the plan.
Funding Method:	Pre-Disaster Mitigation
Implementation Schedule:	December, 2013
Priority:	High
2010 Status Update:	New Mitigation Action. Needed to support the next update of the local mitigation plans which expire starting in December 2014.
2013 Status Update:	Kent County has an approved HMGP grant funding their next edition to their plan. New Castle and Sussex County are submitting HMGP applications to update their plans. The City of Wilmington has decided to roll their plan into the County plan.
2018 Status Update	HMGP funds were used to update all three Delaware county plans since the last plan revision. Removed City of Wilmington from description, included in County Plan.

Mitigation Action 47	
Action Item (describe):	**Support mitigation actions eligible under the Unified Hazard Mitigation Assistance program.**
Goals/Objectives Supported:	1.1, 1.4, 1.5, 2.1
Category:	Prevention
Hazard(s):	All
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA, DNREC, and County Emergency Managers
Estimated Cost:	Staff time by implementation of projects
Funding Method:	Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance, Severe Repetitive Loss, and Repetitive Flood Claims
Implementation Schedule:	Ongoing and continuous.
Priority:	High
2010 Status Update:	New Mitigation Action. Item needed to support all eligible activities associated with HMA.
2013 Status Update:	Ongoing action and ensures all activities identified the Unified Guidance remain authorized for implementation.
2018 Status Update	This mitigation action ensures that all activities identified in the Unified Guidance are eligible for funding in Delaware. Ongoing

Mitigation Action 48	
Action Item (describe):	**Work closely with DNREC, the University of Delaware, and DGS on developing and encouraging the use of an early warning and monitoring system for coastal flooding**
Goals/Objectives Supported:	1.1, 1.4, 1.5, 2.1, 3.3, 3.4
Category:	Protection
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA, DNREC, University of Delaware, and DGS.
Estimated Cost:	$400,000
Funding Method:	Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance, Hurricane Sandy Relief Funds, Emergency Preparedness Performance Grant.
Implementation Schedule:	5 Years
Priority:	High
2013 Status Update:	New Mitigation Action.
2018 Status Update	A coastal flood monitoring and early warning system is up and operational as a joint effort between DGS and University of Delaware Center for Environmental Monitoring and Analysis (UD CEMA). This system only covers the Delaware coastline between New Castle and Lewes. Additional research and support is needed to extend the system to cover the Atlantic and Inland Bays coastal communities as well as the Delaware River north of New Castle.

Mitigation Action 49	
Action Item (describe):	**Develop stand alone generator project applications.**
Goals/Objectives Supported:	1.5, 2.2, 4.2
Category:	Prevention and Protection
Hazard(s):	All Hazards
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA, Local Communities
Estimated Cost:	$15,000 to $100,000 per generator
Funding Method:	Pre-Disaster Mitigation and Hazard Mitigation Grant Program
Implementation Schedule:	Continuous
Priority:	Moderate
2013 Status Update:	New Mitigation Action.
2018 Status Update	Submitted a generator project for the City of Newark using PDM 2017 funds. Generator projects will be considered that pass the BCA and are within Delaware's mitigation priorities.

Mitigation Action 50	
Action Item (describe):	**Support development of education and awareness programs that inform and educate citizens, elected officials, and property owners about hazards and ways to mitigate them. Emphasize advantages of Community Rating System (CRS) involvement and National Flood Insurance Program (NFIP) participation**
Goals/Objectives Supported:	1.2, 2.3, 3.2, 3.5
Category:	Public Information and Awareness
Hazard(s):	All Hazards
Lead Agency/Department, or Organization Responsible for Implementation:	University of Delaware Sea Grant Program, DEMA, and DNREC
Estimated Cost:	$100,000
Funding Method:	University of Delaware and Statewide agency staff time.
Implementation Schedule:	5 years
Priority:	Moderate
2013 Status Update:	New Mitigation Action. The Delaware specific Homeowners Manual, developed by the University of Delaware Sea Grant Program and funded through HMGP is indicative of ongoing efforts. However, more needs to be done.
2018 Status Update	The USACE has approved and funded proposals to work with the State and local communities in Kent New Castle, and Sussex counties to: 1) conduct workshops to educate locals on non-structural flood proofing methods and 2) assess homes and businesses for viability of non-structural flood proofing methods and put together a list of possible properties.

Mitigation Action 51	
Action Item (describe):	**Complete the sensors -on-roads projects that provides for real time monitoring of water levels in river and stream areas considered high risk areas.**
Goals/Objectives Supported:	1.1, 1.4, 1.5, 2.1, 2.2
Category:	Prevention
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for Implementation:	DelDOT, UD, DGS
Estimated Cost:	$300,000
Funding Method:	Transportation funds
Implementation Schedule:	5 years
Priority:	High
2013 Status Update:	New Mitigation Action. DelDOT has created a listing of locations they wish to add sensors to and has begun installing some of the sensors.
2018 Status Update	Flood sensor being purchase from Disaster 4265 funds as a 5% Initiative. On-going project. UN and DGS have provided assistance to DelDOT in identifying locations where flooding occurs frequently as well as the integration of hydrologic information into their operations for mitigating flooding of the transportation network.

Mitigation Action 52	
Action Item (describe):	**Evaluate and improve the mitigation eligibility and application process to maximize the use of available mitigation funding.**
Goals/Objectives Supported:	1.1, 1.2, 1.3, 1.4,1.5, 2.1, 2.3, 4.1
Category:	All
Hazard(s):	All hazards with emphasis on Coastal Flooding, Nor'easters, Tropical Storms and Hurricanes.
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA
Estimated Cost:	Unknown
Funding Method:	Federal, State, and local.
Implementation Schedule:	On-going
Priority:	High
2018 Status Update	New mitigation action. Resulted from gaps identified by the newly formed Mitigation Strategy and Action Sub-Team, of the State Hazard Mitigation Council Planning Team. Sub-recipients include: State agencies, county governments, local governments/communities, and private non-profits.

Mitigation Action 53	
Action Item (describe):	**Develop a Hurricane Evacuation Study.**
Goals/Objectives Supported:	1.1, 1.3, 1.5, 2.1, 4.1
Category:	Prevention
Hazard(s):	All hazards with emphasis on Coastal Flooding, Nor'easters, Tropical Storms and Hurricanes.
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA
Estimated Cost:	Unknown
Funding Method:	Federal, State, and local.
Implementation Schedule:	On-going
Priority:	High
2018 Status Update	New mitigation action.

Completed or Cancelled Mitigation Actions (2007 - 2013)

Mitigation Action A	
Action Item (describe):	**The State of Delaware should allow local governments the ability to levy impact fees associated with development in designated high hazard areas.**
Goals/Objectives Supported:	1.3
Category:	Prevention
Hazard(s) Addressed:	Flood (including riverine and coastal), Coastal Erosion
Lead Agency/Department Responsible:	Office of State Planning. Technical support provided by the DNREC Division of Watershed Stewardship.
Estimated Cost:	Staff time and resources. Development of a local "Hazards Impact Fee" template or ordinance would cost approximately $50,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Hazard Mitigation Grant Program, Flood Mitigation Assistance Program
Implementation Schedule:	Winter 2004
Priority:	Moderate
2007 Status Update:	HB 235 was passed in 2002 to provide for higher impact fees in areas that were not planned for development.
2010 Status Update:	This item cancelled. Although the state still encourages this action, there has been no action to further this item at the lower levels of government.

Mitigation Action B	
Action Item (describe):	**Integrate Livable Delaware Initiatives into the Department of Safety and Homeland Security Plan.**
Goals/Objectives Supported:	2.5, 2.6
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency, Office of State Planning
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	N/A
Implementation Schedule:	Spring 2005
Priority:	Moderate
2007 Status Update:	Will be accomplished following a revision of the State Hazard Analysis scheduled for 2007/2008.
2010 Status Update:	Cancelled. This was a program that the previous Governor was actively pushing.

Mitigation Action C	
Action Item (describe):	**Consider developing a flood reconstruction and recovery plan that serves to guide the procedures and techniques used to rebuild flood damaged communities and State infrastructure.**
Goals/Objectives Supported:	4.2, 4.6
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	County officials
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Economic Development Administration – Special Economic Development and Adjustment Assistance Program Sudden and Severe Economic Dislocation and Long-Term Economic Deterioration, Army Corps of Engineers – Floodplain Management Services Army Corps of Engineers – Planning Assistance to States, Natural Resources Conservation Service – Watershed Surveys and Planning, Environmental Protection Agency – Water Protection Coordination Grants
Implementation Schedule:	Complete plan by May 2005
Priority:	Moderate
2007 Status Update:	Not initiated - will be updated during local mitigation plan updates
2010Status Update:	This item is cancelled. The recovery plan will be developed following a disaster and be specific to the disaster.

Mitigation Action D	
Action Item (describe):	**The State of Delaware should establish a State hazard fee that could be used to fund hazard mitigation projects.**
Goals/Objectives Supported:	1.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of State Planning. Technical support provided by Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	N/A
Implementation Schedule:	Winter 2004
Priority:	Moderate
2007 Status Update:	Not started. Under review
2010 Status Update:	It has been decided as of now that no fee will be levied. Item closed.

Mitigation Action E	
Action Item (describe):	**Develop evacuation guide for elected officials to more effectively address "political issues" that hamper timely evacuations in emergency situations.**
Goals/Objectives Supported:	2.3, 2.5, 5.1
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency. Support provided by County Emergency Management Association.
Estimated Cost:	$50,000 dollars.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA - Emergency Management Planning Grant funds, FEMA – All Hazards Emergency Operational Planning, National Governor's Association
Implementation Schedule:	Develop evacuation guide prior to the 2004 hurricane season
Priority:	High
2007 Status Update:	Not initiated. Will be reviewed with the update of the DEOP and the completion of the Evacuation Annex to that document, and as a part of DelDOT's evacuation planning process.
2010 Status Update:	Item cancelled. There is no effort under way to develop the guide.

Mitigation Action F	
Action Item (describe):	**Incorporate findings of the Weapons of Mass Destruction Assessments and Catastrophic Planning Issue Identification into the State of Delaware Mitigation Plan.**
Goals/Objectives Supported:	2.1, 2.2
Category:	Prevention
Hazard(s) Addressed:	Human-caused Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	N/A
Implementation Schedule:	On-going
Priority:	High
2007 Status Update:	Accomplished
2010 Status Update:	Item review, it is complete.

Mitigation Action G	
Action Item (describe):	**Evaluate the interconnectivity of water supply systems in order to facilitate the sharing of water resources during times of drought below the C&D canal.**
Goals/Objectives Supported:	1.2, 1.3, 3.3
Category:	Prevention
Hazard(s) Addressed:	Drought
Lead Agency/Department Responsible:	University of Delaware, Institute for Public Administration, Water Resources Agency
Estimated Cost:	$100,000 to conduct study. Findings will determine the costs associated with enhancing the physical interconnectivity of water supply systems.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Environmental Protection Agency – Water Protection Coordination Grants, Natural Resources Conservation Service – Watershed Surveys and Planning, Economic Development Administration
Implementation Schedule:	Spring 2005
Priority:	Moderate
2007 Status Update:	Interconnectivity and supply capabilities were evaluated and it was determined that systems throughout New Castle County were sufficiently robust as to preclude the typical short term droughts the state of Delaware experiences from being problematic from a water supply problem. This mitigation action item is therefore closed.
2010Status Update:	This item was reviewed and is still considered closed.

Mitigation Action H	
Action Item (describe):	**Designate suitable areas for sand/debris storage immediately following an event. Note: The State owns approximately 50% of the Atlantic shoreline in Delaware. Once debris is removed, the area should be restored to its pre-disaster condition.**
Goals/Objectives Supported:	2.1, 2.2, 5.2
Category:	Emergency Services
Hazard(s) Addressed:	Flood, Hurricane, Winter Storm, Nor'easter
Lead Agency/Department Responsible:	Department of Natural Resource and Environmental Control (Division of Parks and Recreation) and Delaware Emergency Management Agency, County Emergency Management Agencies, Department of State (Historic and Cultural Affairs)
Estimated Cost:	$50,000 dollars. Costs tied to the identification of sites and the development of debris management plan.
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Corps of Engineers – Planning Assistance to States
Implementation Schedule:	Debris sites and management plan should be completed by December 2005.
Priority:	Moderate
2007 Status Update:	In progress – DEMA and other agencies have begun work on state Debris Management Plan
2010 Status Update:	Complete. The Debris Management Plan was completed in 2009.

Mitigation Action I	
Action Item (describe):	**Explore the use of geo-tubes (sand-filled tubes) in coastal areas subject to high erosion rates.**
Goals/Objectives Supported:	1.1
Category:	Property Protection
Hazard(s) Addressed:	Coastal Flooding, Coastal Erosion
Lead Agency/Department Responsible:	Department of Natural Resources and Environmental Control (DNREC Division of Watershed Stewardship)
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Corps of Engineers – Floodplain Management Services, Corps of Engineers – Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works, Corps of Engineers – Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works, Corps of Engineers – Planning Assistance to States, Corps of Engineers – Small Flood Control Projects
Implementation Schedule:	Fall 2004
Priority:	High
2007 Status Update:	No work has been completed in this area.
2010 Status Update:	Removed from the active list. State and local officials consider this as an option. To date, the geo-tubes have not been used in Delaware. They will continue to be an option, but the planning team has decided to remove this item from the active list.

Mitigation Action J	
Action Item (describe):	**Establish comprehensive stormwater management guidelines for county and local governments.**
Goals/Objectives Supported:	1.3, 1.5, 3.1
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Department of Natural Resources and Environmental Control (Division of Watershed Stewardship – Drainage Section).
Estimated Cost:	$100,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	State funding, Corps of Engineers – Floodplain Management Services, Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Natural Resources Conservation Service – Watershed Protection and Flood Prevention
Implementation Schedule:	Complete draft of stormwater management guidelines by December 2004
Priority:	High
2007 Status Update:	Completed.
2010 Status Update:	Action evaluated – no reason to change status.

Mitigation Action K	
Action Item (describe):	**Implement the recommendations of the "Coastal Vulnerability Study."**
Goals/Objectives Supported:	1.3, 3.1
Category:	Prevention
Hazard(s) Addressed:	Hurricane, Flood
Lead Agency/Department Responsible:	Department of Natural Resources and Environmental Control (DNREC Division of Watershed Stewardship)
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	Corps of Engineers – Planning Assistance to States, Corps of Engineers – Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works, Flood Mitigation Assistance Program, Corps of Engineers – Beach Erosion Control Projects, Hazard Mitigation Grant Program
Implementation Schedule:	Complete
Priority:	High
2007 Status Update:	Ongoing, although the state legislature has prevented certain portions of the study recommendations from being implemented.
2010 Status Update:	This action was reviewed. It was felt that each action identified in the study should have been listed separately. However, it was also determined any actions completed to support the study are already done. This action is now complete and closed.

Mitigation Action L	
Action Item (describe):	**Hire one Geographic Information System specialist**.
Goals/Objectives Supported:	5.2, 5.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	$40,000 annually
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	State funding
Implementation Schedule:	Hire individual Winter 2004
Priority:	Moderate
2007 Status Update:	Agency has one information systems specialist who has GIS duties assigned to him as part of his job description. Current budget realities preclude hiring someone for a full time position at this point.
2010 Status Update:	Completed. An Information Technology section employee has been assigned these duties as part of his job description.

Mitigation Action M	
Action Item (describe):	**Apply for a PDM grant in the December 2011 timeframe to update the State Hazard Mitigation Plan.**
Goals/Objectives Supported:	1.1
Category:	Prevention, Public Information and Awareness
Hazard(s):	All
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA (SHMO)
Estimated Cost:	$100,000 to $200,000
Funding Method:	Pre-Disaster Mitigation
Implementation Schedule:	December, 2011 through June 2013
Priority:	High
2010 Status Update:	New Mitigation Action. Needed to support the next update of the State Hazard Mitigation Plan.
2013 Status Update:	This option was not exercised. The State Hazard Mitigation Plan was updated 100% in-house by the SHMO

This concludes the Completed or Cancelled Mitigation Actions from 2007 – 2013.

Completed or Cancelled Mitigation Actions (2018)

The following section contains actions that were completed, cancelled, or consolidated during the 2018 revision. The mitigation action number and heading color, remains the same and a letter was added for clarity and cross-referencing. Of the previous 77 mitigation actions, approximately 27 were, completed, canceled, or consolidated with like actions.

Mitigation Action ~~8~~ – A	
Action Item (describe):	**Pursue the strategy of co-locating general population, unattended minors, medical needs and companion animals in single shelter facilities. Complete shelter facility identification, facilitate engineering structural study of identified shelters and establish memoranda of understanding with appropriate agencies, school districts and emergency management coordinators.**
Goals/Objectives Supported:	1.1, 1.4, 1.6
Category:	Prevention
Hazard(s) Addressed:	All hazards
Lead Agency/Department Responsible:	Department of Education, DEMA, Red Cross and County Emergency Management, Division of Public Health, Department for Services For Children Youth and their families, other supporting agencies and volunteer groups.
Estimated Cost:	Unknown
Potential Funding	Unknown – Agency funding
Implementation Schedule:	New requirements should be identified by the end of 2010.
Priority:	High
2007 Status Update:	New Action item.
2010 Status Update:	A lot of work has been accomplished towards meeting this goal. DEMA has been working with a variety of partners to review all shelters and to ensure they can accommodate special populations, animals, and unattended minors into shelters
2013 Status Update:	This action is technically complete. Item to remain as active action to help ensure compliance in the future.
2018 Status Update:	DOE: has granted DEMA access to the Buzzsaw software program. This program houses floor plans of all DE district schools and will assist in shelter planning /mapping of shelter occupants/populates. DHSS conducts community sheltering. **COMPLETE**

Mitigation Action ~~13~~ – B	
Action Item (describe):	**Convene the State Hazard Mitigation Council following all federal disaster declarations to discuss broad policy issues and clarify post-disaster mitigation strategy, including the review of HMGP priorities and the evaluation of applications.**
Goals/Objectives Supported:	1.1, 1.2
Category:	Public Information and Awareness
Hazard(s) Addressed:	All hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency
Estimated Cost:	Staff time and resources
Potential Funding Method(s):	N/A
Implementation Schedule:	Convene following federally declared disasters
Priority:	High
2007 Status Update:	This has been neglected. New policy requires review of SHMP through the Council following each declared disaster.
2010 Status Update:	The State Hazard Mitigation council is integral to project prioritization following a federally declared disaster. This policy remains in effect. The SHMO prefers to
2013 Status Update:	We have convened the SHMC following the Snow Disaster, Hurricane Irene, and Hurricane Sandy. This continues to be a desired action.
2018 Status Update:	The jest of this mitigation action (and the 2013 update) were combined with Mitigation Action #12. **CANCELLED**

Mitigation Action ~~14~~ – C	
Action Item (describe):	**Develop inter-agency agreements with the Delaware Homeland Security Council, State Emergency Response Commission and Catastrophic Work Group to assist with hazard data collection and analysis associated with human-caused hazards.**
Goals/Objectives Supported:	1.2, 5.3
Category:	Prevention
Hazard(s) Addressed:	Human-caused Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency and Delaware State Police
Estimated Cost:	Staff time and resources
Potential Funding Method(s):	N/A
Implementation Schedule:	Based on availability and funding of staff.
Priority:	Moderate
2007 Status Update:	Information sharing has been accomplished through informal means. Delaware Information Analysis Center (DIAC) has been stood up to support information analysis and sharing activities across agency boundaries.
2010 Status Update:	DEMA maintains a solid working relationship with all the above agencies, although no formal agreement exists. This remains an active mitigation action. However, since the normal day to day working relationship with these agencies on sharing information has been very good, the priority is changed from “High” to “Moderate”. Lack of staff is the main reason this is not accomplished to date.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	Because of the solid working relationship, good information sharing, and open avenues of support, an inter-agency agreement is not required. **CANCELLED**

Mitigation Action ~~17~~ - D	
Action Item (describe):	**Improve the level of regional mitigation planning across the DELMARVA Peninsula.**
Goals/Objectives Supported:	1.2, 1.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	DEMA. Support provided by the Delaware River and Bay Authority, Maryland Emergency Management Agency, Virginia Department of EM t
Estimated Cost:	$50,000. Staff time, travel and meeting costs associated with coordinating activities and enhancing the quality of regional mitigation planning.
Potential Funding Method(s): (General Revenue,	Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Corps of Engineers – Floodplain Management Services, Corps of Engineers – Nonstructural Alternatives
Implementation Schedule:	Based on availability of staff.
Priority:	Moderate
2007 Status Update:	Ongoing
2010 Status Update:	Not accomplished. This item remains active and very well could be pursued with additional staff resources.
2013 Status Update:	There is cooperation at the SHMO level through regional conferences, coordination on the SHMOnet (Yahoo User Group), and monthly calls. However, greater emphasis needs to be placed at all levels of government. Item remains open.
2018 Status Update:	This action is accomplished at the SHMO level through regional conferences and coordination FEMA Region III counterparts. **COMPLETED**

Mitigation Action ~~21~~ - E	
Action Item (describe):	**Develop inter-agency agreements to streamline hazard mitigation project reviews for compliance with Section 106 of the National Historic Preservation Act.**
Goals/Objectives Supported:	1.2, 1.3, 4.1, 4.2
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of State (Division of Historic and Cultural Affairs), Delaware Emergency Management Agency, FEMA
Estimated Cost:	Minimal. Costs associated with staff time and use of State resources.
Potential Funding Method(s):	N/A
Implementation Schedule:	Based on staff availability
Priority:	Moderate
2007 Status Update:	In 2007, a programmatic agreement was completed among FEMA, DEMA and the Delaware SHPO to formalize the historical review process.
2010 Status Update:	The agreement with the SHPO was held up in the legal review and never signed. This is still a desirable mitigation action that needs to be pursued Additional staffing will be required to complete.
2013 Status Update:	Current reviews are done at FEMA. However, actions done at state level during project development can speed project approvals. DEMA assigned a mitigation project officer that helped in the coordination process. Item remains open.
2018 Status Update:	Coordination continues and a formal process is in place. **COMPLETED**

Mitigation Action ~~25~~ - F	
Action Item (describe):	**Retrofit existing schools and other identified public/community buildings to address any structural and/or system deficiencies limiting the facilities use as a shelter**
Goals/Objectives Supported:	5.2, 3.1, 4.1, 1.1
Category:	Property Protection - Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency, Department of Education, Red Cross, County EMA, Division of Public Health, DSCYF, and other supporting agencies.
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	To Be Determined
Implementation Schedule:	No later than December 31, 2013.
Priority:	High priority
2007 Status Update:	Work is in progress, awaiting completion of engineering studies on identified schools
2010 Status Update:	Part of the critical facility analysis that will be finalized later this year. Actual implementation of the analysis will be based on availability of funding.
2013 Status Update:	Currently looking for funding for additional schools. Item remains open.
2018 Status Update:	The USACE study identified facility limitations; retrofitting not economically feasible. **CANCELLED**

Mitigation Action ~~31~~ - G	
Action Item (describe):	**Incorporate a "hazards reduction element" into the Community Development Block Grant Program application scoring system following a Presidential Declared Disaster.**
Goals/Objectives Supported:	1.1, 1.2, 1.4, 2.1, 3.2, 3.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware State Housing Authority (DSHA). Additional technical support provided by members of the State Hazard Mitigation Council, including DEMA and DNREC staff.
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	N/A
Implementation Schedule:	Following a Presidential Declared Disaster
Priority:	High
2007 Status Update:	Policy in place. Accomplished as warranted.
2010 Status Update:	Policy in place. Has not been utilized to date, mostly because the right opportunity to implement the policy has not been realized as of yet. Item to remain active.
2013 Status Update:	Policy in place. Has not been utilized to date, mostly because the right opportunity to implement the policy has not been realized as of yet. Item to remain active.
2018 Status Update:	This action is completed per DSHA.

Mitigation Action ~~31~~ - H	
Action Item (describe):	**Upgrade security systems in Delaware hospitals and State public health laboratory based on security assessments.**
Goals/Objectives Supported:	2.2, 2.6, 5.2
Category:	Prevention
Hazard(s) Addressed:	Terrorism, Workplace and/or domestic violence
Lead Agency/Department Responsible:	Division of Public Health
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	FEMA – All Hazards Emergency Operational Planning, FEMA – Emergency Management Performance Grants, Department of Justice – State and Local Domestic Preparedness Technical Assistance
Implementation Schedule:	Three year implementation schedule
Priority:	High
2007 Status Update:	Ongoing – part of facilities review process
2010 Status Update:	No change.
2013 Status Update:	Security improvements have been made and are still ongoing. Item remains open.
2018 Status Update:	Security improvements are ongoing and will continue. **COMPLETED**

Mitigation Action ~~39~~ - I	
Action Item (describe):	**Develop model drainage code for county and local governments.**
Goals/Objectives Supported:	1.3, 1.5, 3.1
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Div. of Watershed Stewardship – Drainage Sec./ Land Use and Zoning.
Estimated Cost:	$50,000
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External	State funding, Corps of Engineers – Floodplain Management Services, Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Environmental Protection Agency – Non-point Source Grant Program, Natural Resources
Implementation Schedule:	Based on availability of funding
Priority:	High
2007 Status Update:	No model has been developed, but DNREC does work with local communities to establish and implement drainage standards and guidelines.
2010 Status Update:	Lack of funding has precluded the completion of this action. This item to remain active.
2013 Status Update:	This is currently being accomplished and new floodplain and drainage recommendations, under Senate Bill 64 have been forwarded to the legislature to bolster this effort
2018 Status Update:	DNREC: developed a model drainage ordinance based on the recommendations of the Drainage and Flood Abatement Task for Created by Senate Bill 64. We then held workshops in all three counties with county and municipal officials. However to my knowledge no jurisdictional has chosen to adopt the model ordinance. We consider this effort complete because we have no authority to require adoption. Completed. **COMPLETED**

Mitigation Action ~~44~~ – J	
Action Item (describe):	**Support the training of local government officials on the use of electronic grantsmanship to speed the process of grant writing, review and approval of Flood Mitigation Assistance grants, Hazard**
Goals/Objectives Supported	1.5, 5.1
Category:	Prevention
Hazard(s):	All Hazards
Lead Agency/Department, or Organization Responsible for	DNREC - Division of Watershed Stewardship, DEMA, and FEMA
Funding Method:	FMA Program, PDM, HMGP, Hazard Mitigation Technical Assistance Program, Staff time and resources
Implementation Schedule:	As required.
Priority:	Moderate
2007 Status Update:	Two e-Grant training sessions were conducted for state mitigation staff during 2004 (September and October). The state's mitigation staff has provided technical assistance to local subgrantees over the past three
2010 Status Update:	The SHMO has developed an e-Grants handout that he can provide to prospective users that helps them gain access to e-grants and navigate through the application development. Item to remain active.
2013 Status Update:	Training and technical assistance is provided to local communities requiring the use of the e-grant system. Both PDM and FMA use this system to submit project applications. Item remains open
2018 Status Update:	FEMA has an Independent Study 32 Mitigation eGrants course which provides training and special assistance on the e-Grants for submitting mitigation grants. **COMPLETED**

Mitigation Action ~~47~~ – K	
Action Item (describe):	**Collect and document existing parks and recreation facilities in a spatially-correct format, to include the 450 buildings and 23,000 acres of land maintained by the Division of Parks and Recreation. AutoCAD plans, which are available, should be converted into a GIS format.**
Goals/Objectives Supported:	1.2, 5.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead gency/Department Responsible:	DNREC - Division of Parks and Recreation. Technical support should be provided by the Office of State Planning or the Department of Technology and Information Geospatial Data exchange, Department of the Interior - National Cooperative Geologic Mapping Program, USGS.
Estimated Cost:	Unknown
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External	Delaware Open Space Program, National Park Service – Urban Park and Recreation Recovery Program
Implementation Schedule:	Based on availability of staff and funding
Priority:	Moderate
2007 Status Update:	State Parks has some data, main thrust of project not initiated
2010 Status Update:	Not completed. Lack of resources to complete the project. Project to remain active, but will re-evaluate on next update of the State Mitigation Plan.
2013 Status Update:	Updated lead agency responsible. Ongoing!
2018 Status Update:	DNREC: has collected all spatial information on park boundaries, buildings, and facilities. The data is in GIS format. **COMPLETED**

Mitigation Action ~~48~~ - L	
Action Item (describe):	**The State Hazard Mitigation Council should establish a research and data dissemination subcommittee tasked with the identification, procurement, and dissemination of relevant emergency management-related research and data that can be used by the local, State and federal emergency management**
Goals/Objectives Supported:	5.1, 5.2, 5.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency. The Office of State Planning or the Department of Technology and Information Geospatial Data Exchange will provide technical assistance, and the Delaware Geological Survey.
Estimated Cost:	Staff time and resources
Potential Funding Method(s):	N/A
Implementation Schedule:	Based on availability of resources, mostly staff time
Priority:	Moderate
2007 Status Update:	Not initiated due to personnel shortages
2010 Status Update:	Still very desirable, but not initiated due to personnel shortages. This item will be seriously reassessed during the next update of the State Mitigation plan.
2013 Status Update:	The Department of Technology and Information has developed a Geospatial Data Exchange to share GIS type files. We are currently looking at the need and ability of sharing other types of files. Item remains open.
2018 Status Update:	The jest of this action was identified as a gap during the Feb 2018 Mitigation Strategy and Actions Workshop; it will be a priority of the newly established Mitigation Strategy and Actions Sub-Team and the DEMA Mitigation Planner. This mitigation action will be consolidated with #45. **CANCELLED**

Mitigation Action ~~49~~ – M	
Action Item (describe):	**The State of Delaware should consider incorporating a hazard vulnerability element into the Delaware Open Space Program selection criteria.**
Goals/Objectives Supported:	1.3, 3.5
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	DNREC - Division of Watershed Stewardship and Division of Parks and Recreation
Estimated Cost:	Staff time associated with drafting proposed change in the Open Space selection criteria
Potential Funding Method(s):	N/A
Implementation Schedule:	Based on availability of resources, mostly staff time.
Priority:	Moderate
2007 Status Update:	No progress. DEMA & DNREC will work on this within the PLUS process.
2010 Status Update:	This is being accomplished to some extent through the comprehensive planning process. Additional work is required.
2013 Status Update:	No change in status. Item remains open.
2018 Status Update:	DNREC: the Open Space Program does take into account hazard vulnerability in its scoring system. In 2011, the Open Space Program selection criteria incorporated prioritizing properties that are adjacent to lands that are predicted to be inundated by Sea Level Rise (SLR) to provide a buffer to lands which will likely to be flooded in the short term by flood events and in the long term by SLR. Additionally, wetlands and lands adjacent to streams and waterbodies are given a higher priority in the Open Space Program scoring system. **COMPLETED**

Mitigation Action ~~53~~ - N	
Action Item (describe):	**Develop coordinated statewide education initiative to publicize the Delaware Emergency Notification System (DENS).**
Goals/Objectives Supported:	1.3, 1.4, 5.2
Category:	Public Information and Awareness
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency, County Emergency Management Agencies
Estimated Cost:	Staff time and resources
Potential Funding Method(s): (General Revenue, Contingency/Bonds, External Sources)	N/A
Implementation Schedule:	Develop and implement program within 1 year
Priority:	Moderate
2007 Status Update:	Ongoing
2010 Status Update:	DENS is now a fully functional system in the state of Delaware. The system is constantly being updated and tested. The public educational aspect of the program is ongoing and continuous. Item to remain active.
2013 Status Update:	DENS outreach and education continues to be priority. Item remains open.
2018 Status Update	**COMPLETED**

Mitigation Action ~~54~~ - O	
Action Item (describe):	**Develop and update comprehensive, statewide hazard assessment to support emergency operations, mitigation and recovery functions.**
Goals/Objectives Supported:	1.1, 1.4, 1.6, 2.1, 2.2, 2.3, 2.5, 3.1, 3.4, 5.2, 5.3
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Delaware Emergency Management Agency, Other Local/State/Federal Agencies
Estimated Cost:	Staff time and resources, $100,000.00 , if contracted out.
Potential Funding Method(s): (General Revenue,	Pre-Disaster Mitigation, HGMP, State Funding/General Budget
Implementation Schedule:	Implement within one year to support update of Delaware Emergency Operations Plan
Priority:	High
2007 Status Update:	New
2010 Status Update:	The Hazard Assessment was updated as part of the State Mitigation Plan update. Originally, $100K in EMPG was allocated to this project. The funds were approved, but the funds were not released in time to support this update. Although the hazard assessment was accomplished in house and does support the Delaware Emergency
2013 Status Update:	The first comprehensive update of the Hazard Identification and Risk Assessment was conducted as part of this update. Flood depth grid maps, site specific date and user defined facilities are currently being developed which will further improve the assessment. Item remains open.
2018 Status Update	This is part of the SHMP. **COMPLETED**

Mitigation Action ~~57~~ - P	
Action Item (describe):	**Support implementation of structural mitigation of targeted hazard-prone properties, i.e., repetitive flood properties (FEMA repetitive loss and severe repetitive loss lists) through sponsorship of FEMA HMGP, FMA, and PDM grant programs.**
Goals/Objectives Supported:	4.1, 3.1, 3.2
Category:	Prevention, Property Protection
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for	DEMA -State Hazard Mitigation Officer and DNREC - Flood Mitigation Manager.
Estimated Cost:	Varies based on funding levels of the various programs.
Funding Method:	Flood Mitigation Assistance Program, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Repetitive Flood Claims, and Severe Repetitive Loss, and , Army Corps of Engineers – Floodplain Management Services
Implementation Schedule:	Immediately, with implementation of the current HMA programs
Priority:	High
2010 Status Update:	New Mitigation Action. Repetitive loss properties currently receive priority treatment over projects not involving repetitive loss. Summer interns could be used to better implement this action by helping to clarify the repetitive loss,
2013 Status Update:	Deleted reference to the Repetitive Flood Claims and Severe Repetitive Loss programs in the description. This remains a high priority within the state.
2018 Status Update:	Consolidated with Mitigation Action #42 **CANCELLED**

Mitigation Action ~~58~~ - Q	
Action Item (describe):	**Target repetitive loss property mitigation through development of mitigation strategies for repetitive loss and severe repetitive loss properties to reduce damages from flooding and maintain local government eligibility for FMA, RFC and SRL grant mitigation programs. Encourage targeting of repetitive and severe repetitive loss properties for mitigation funding through HMGP**
Goals/Objectives Supported:	5.1, 5.2, 3.1, 3.2
Category:	Prevention
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for	DEMA (State Hazard Mitigation Officer) and DNREC (Flood Mitigation Manger)
Estimated Cost:	Varies based on project types.
Funding Method:	Flood Mitigation Assistance Program, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Army Corps of Engineers – Floodplain Management Services
Implementation Schedule:	Ongoing and Continuous
Priority:	High
2010 Status Update:	New Mitigation Action. Repetitive loss properties are already being targeted at annual HMA workshops. Much is to be done!
2013 Status Update:	Changed the priority for this action to high as this remains a top priority.
2018 Status Update:	Consolidated with Mitigation Action #42 **CANCELLED**

Mitigation Action ~~59~~ - R	
Action Item (describe):	**Target repetitive loss property communities with direct mailings, workshops. Software tools, web-based guidance and project applications, and technical support to maximize use of the FEMA grant programs to mitigate targeted repetitive loss and severe repetitive loss list properties. Maximize outreach through technical workshops.**
Goals/Objectives Supported:	5.1, 5.2
Category:	Prevention
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for	DNREC - Division of Watershed Stewardship
Estimated Cost:	$10,000.00
Funding Method:	Flood Mitigation Assistance Program, Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Army Corps of Engineers – Floodplain Management Services,
Implementation Schedule:	Ongoing and Continuous
Priority:	Moderate
2010 Status Update:	New Mitigation Action. Repetitive loss properties are already being targeted at annual HMA workshops.
2013 Status Update:	Repetitive loss properties continue to be targeted at mitigation workshops. DNREC is currently developing site specific data in high risk flood areas import into HAZUS-MH. Based on the results of this analysis, the results may be used to
2018 Status Update	Consolidated with Mitigation Action #42 **CANCELLED**

Mitigation Action ~~61~~ - S	
Action Item (describe):	**Validate data shown in Annex E, which is a restricted access annex. Cross-reference and verify Increased Cost of Compliance (ICC) claims data with repetitive loss data. Identify funding sources for mitigated properties shown on the repetitive loss list.**
Goals/Objectives Supported:	1.1, 1.2, 2.1, 5.1
Category:	Prevention
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for	DEMA (SHMO)
Estimated Cost:	5,000 annually
Funding Method:	EMPG, General funds,
Implementation Schedule:	Ongoing and Continuous
Priority:	High
2010 Status Update:	New Mitigation Action. This action could be enhanced with assistance through the intern program.
2013 Status Update:	Repetitive Loss Data now managed through BureauNet, a web based application that has improved the quality of the data. Currently looking to geo-code each repetitive loss property.
2018 Status Update	Annex E will no longer include repetitive loss data. **CANCELLED**

Mitigation Action ~~62~~ - T	
Action Item (describe):	**Develop a Mitigation Actions database to track all mitigation actions from concept to completion.**
Goals/Objectives Supported:	1.1, 2.1, 3.1, 4.3, 4.4, 5.1
Category:	Prevention, Public Information and Awareness
Hazard(s):	All
Lead Agency/Department, or Organization Responsible for	DEMA (SHMO)
Estimated Cost:	None
Funding Method:	N/A
Implementation Schedule:	Based on availability of resources, mostly staff time. Ongoing (minimum of 5 years to complete)
Priority:	Low
2010 Status Update:	New Mitigation Action. The shell of a database has been developed and actually used by the summer interns to assist in updating mitigation actions. State mitigation action will have to be loaded to the database.
2013 Status Update:	This is actually being done and updated with every edition of the State Hazard Mitigation Plan. The shell database is still being used and updated by interns. Item remains open.
2018 Status Update	Mitigation Actions are listed in the SHMP. **COMPLETED**

Mitigation Action ~~69~~ - U	
Action Item (describe):	**Update the core Delaware data within HAZUS-MH.**
Goals/Objectives Supported:	1.4, 3.3,5.1
Category:	Public Information and Awareness, Property Protection
Hazard(s):	Flood, Earthquake, and Hurricane Wind
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA, DNREC, DelDOT, and DGS.
Estimated Cost:	$100,000
Funding Method:	Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance, Severe Repetitive Loss, and Repetitive Flood Claims
Implementation Schedule:	Ongoing and continuous.
Priority:	Moderate
2013 Status Update:	New Mitigation Action
2018 Status Update	The core Delaware data has been; updated in HAZUS by the UD, compliments of DelDOT. **COMPLETE**

Mitigation Action ~~71~~ - V	
Action Item (describe):	**Develop user defined facility lists to incorporate into HAZUS-MH analysis.**
Goals/Objectives Supported:	1.4, 3.3,5.1
Category:	Public Information and Awareness, Property Protection
Hazard(s):	Flood, Earthquake, and Hurricane Wind
Lead Agency/Department, or Organization Responsible for Implementation:	DEMA, DNREC, University of Delaware, and DGS.
Estimated Cost:	$50,000
Funding Method:	Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance, Hurricane Sandy Relief Funds, Emergency Preparedness Performance Grant.
Implementation Schedule:	5 Years
Priority:	Moderate
2013 Status Update:	New Mitigation Action.
2018 Status Update	User defined facility lists have been developed and incorporated into HAZUS-MH; templates and instructions are available. **COMPLETE**

Mitigation Action ~~73~~ - W	
Action Item (describe):	**Complete a sea level rise adaptation strategy.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 3.1, 4.1
Category:	Prevention and Protection
Hazard(s):	Flood
Lead Agency/Department, or Organization Responsible for Implementation:	DNREC
Estimated Cost:	$100,000
Funding Method:	Statewide agency staff time.
Implementation Schedule:	6 months
Priority:	High
2013 Status Update:	New Mitigation Action. This process is ongoing and the final strategy should be published in the fall of 2013.
2018 Status Update	This action was largely completed with the release of “Preparing for Tomorrow’s High Tide: Recommendations for Adapting to Sea Level Rise in Delaware.” **COMPLETED**

Mitigation Action ~~74~~ – X	
Action Item (describe):	**Complete a Delaware specific Climate Change Vulnerability Assessment.**
Goals/Objectives Supported:	1.1, 2.1, 2.2, 3.1, 4.1
Category:	Prevention and Protection
Hazard(s):	All Natural Hazards
Lead Agency/Department, or Organization Responsible for Implementation:	DNREC
Estimated Cost:	$100,000
Funding Method:	Statewide agency staff time.
Implementation Schedule:	6 months
Priority:	High
2013 Status Update:	New Mitigation Action. This process is ongoing and the final assessment should be finished in the fall of 2013.
2018 Status Update	**COMPLETE**

Mitigation Action ~~75~~ - Y	
Action Item (describe):	**Develop/compile/maintain a list of model hazard and adaptation policies/ordinances, best practices, and examples of suggested mitigation/adaptation/preparedness measures to be shared and considered for adoption by local governments.**
Goals/Objectives Supported:	1.1
Category:	Public Information and Awareness
Hazard(s):	All Hazards
Lead Agency/Department, or Organization Responsible for Implementation:	University of Delaware Sea Grant Program, DEMA, and DNREC
Estimated Cost:	$100,000
Funding Method:	University of Delaware and Statewide agency staff time.
Implementation Schedule:	5 years
Priority:	Moderate
2013 Status Update:	New Mitigation Action.
2018 Status Update	**COMPLETE**

Plan updates

Note Regarding 2007 Plan Update

Disposition of Items removed from 2004 Mitigation Action List

The following projects from the 2004 SHMP were deleted from the 2007 State Hazard Mitigation Plan for the indicated reasons:

- **Develop legislation providing renters insurance for those affected should an evacuation be ordered** (Section 6.2, Page 35 in the 2004 plan). In discussions among DEMA, the Department of Natural Resources and Environmental Control (DNREC), and the Department of Insurance, no one could firmly establish the original intent of this action item. It is believed to have originally been intended to provide some form of insurance for transient vacationers' property in the event an evacuation forced them to leave possessions behind, but it was decided that it was up to the individual to have insurance and the state should not provide that service.
- **Enhance the disaster resistance of shelters through the implementation of measures identified in existing and new studies** (Section 6.2, Page 16 in the 2004 Plan). This action item was subsumed into the new action item added at Section 6.2, Page 4 (bottom item).
- **Encourage local governments to continue to acquire or flood proof commercial and non- residential buildings when cost effective** (Section 6.2, Page 19 in the 2004 Plan). This specific item was deleted because it was, for all intents and purposes, identical to the Mitigation Action identified in the lower half of Page 18 (of the 2004 Plan).
- **Train school district personnel in the management and operation of emergency shelters.** (Section 6.2, Page 34 in the 2004 Plan). This was removed because it is part of the standard training provided to teachers and administrative personnel during in-service training by the Department of Education.
- **Develop outreach effort to notify school administrators and staff about the proper storage of chemicals in schools**. (Section 6.2, Page 35 in the 2004 Plan). This was deleted because it is part of the standard training and orientation given to instructors and administrative personnel in the schools as required under various OSHA and USDE regulations.

Additionally, for 2007, three new Mitigation Action items were added.

Note Regarding 2010 Plan Update

Sectionalized this section. Added an 'Overview' and a 'Completed and Cancelled Mitigation Actions' section to the plan. Numbered all active mitigation actions and assigned an alpha character to all completed or cancelled mitigation actions. Added 11 new mitigation actions, mostly to support the Repetitive Loss 90/10 split.

Note Regarding 2013 Plan Update

Reviewed and updated all mitigation actions. Moved one action to the completed/cancelled mitigation actions. Added 11 new mitigation actions.

Note Regarding 2018 Plan Update

The 2018 update encompassed a complete review of all the mitigation actions. Of the 77 mitigation actions, approximately 26 were, completed, canceled, or consolidated with like actions. Three new mitigation actions were created.

PLAN MAINTENANCE PROCEDURES

This section discusses how the mitigation strategy will be implemented by participating agencies and how the overall Plan will be evaluated and enhanced over time. This section also discusses how the public will continue to be involved in the hazard mitigation planning process. It is broken down into the following sub-sections:

- Implementation;
- Monitoring Progress of Mitigation Activities;
- Evaluation and Enhancement;
- Continued Public Involvement; and
- Plan Updates.

S17. Is there a description of the method and schedule for keeping the plan current? ***44 CFR 201.4(c)(5)(i) and 201.4(d)***

S18. Does the plan describe the systems for monitoring implementation and reviewing progress? ***44 CFR 201.4(c)(5)(ii) and (iii):***

The State Hazard Mitigation Council will monitor the efficiency and effectiveness of various mitigation strategies and will make recommendations for additional improvements. DEMA and the Council will review the year's local hazard events and impacts, community actions that may help or hinder mitigation capabilities, and the progress of mitigation activities. Any changes will be noted in the planning document accordingly, along with a summary of their findings and associated changes in a memorandum from DEMA to the Council.

An annual report will be made available to the governing body in order to report progress on the actions identified in the Plan and to provide information on the latest legislative requirements and/or changes. This report is normally a verbal report provided during the semi-annual State Hazard Mitigation Council Meeting. If the situation warrants it, a written report can be compiled. In such situations, the annual reports will be attached to future updates of the plan. The Council will be responsible for working with DEMA to determine the best schedule for these updates. A recommended timeframe for these annual updates is the middle of August; summer interns could be tasked to collect the data and prepare the reports prior to the completion of their internships. Reviewing the plan at a time when media coverage and community awareness tends to be high may help serve as a reminder to local officials that the community needs to be prepared for hurricanes and other disasters.

Implementation

Periodic monitoring and reporting of the Plan is required to ensure that the goals and objectives for the State of Delaware are kept current, that state mitigation efforts are being carried out and the plan complies with state and federal requirements, including the Disaster Mitigation Act of 2000. The plan has, therefore, been designed to be user-friendly in terms of meeting monitoring and implementation goals, preparing regular progress reports, and documenting public participation. The State Mitigation Plan Review Tool is found in Annex B.

The State of Delaware Hazard Mitigation Plan is intended to be a living document, one that can be updated over time as hazard vulnerabilities change and new policies and projects are identified, implemented and completed. As required under the Disaster Mitigation Act, update reviews will occur at least every five (5) years. In addition, DEMA and the Council will review and update the plan as necessary. If disasters should occur during the five year window, the Council will evaluate whether an update is needed. In contrast, monitoring of the plan is an on-going process, led by DEMA and the Council. Individuals and departments assigned the responsibility for monitoring specific objectives, strategies, and projects will be held accountable to the timelines found in the Mitigation Action Plan (Section 6).

Each agency/jurisdiction participating in this plan is responsible for implementing specific mitigation actions as prescribed in their locally adopted Mitigation Action Plan. In the Mitigation Action Plan, each proposed action is assigned to a specific agency or department in order to increase accountability and the likelihood of implementation. This approach enables individual agencies to update their unique mitigation strategy as needed without altering the broader focus of the statewide plan elements. The separate specific actions also ensure that each agency is not held responsible for the actions of every other agency, or department involved in the planning process.

In addition to the specific agency or department, an implementation time period or a specific implementation date has been assigned in order to assess whether actions are being implemented in a timely fashion. The State of Delaware and its agencies will seek outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. Whenever possible, a funding source has been identified for proposed actions listed in the Mitigation Action Plan.

It will be up to each participating agency to determine additional implementation procedures beyond their Mitigation Action Plan. This includes integrating the requirements of the plan into other planning documents, processes or mechanisms such as comprehensive or capital improvement plans, when appropriate.

Monitoring Progress of Mitigation Activities

Review of mitigation activities is an ongoing process. Generally, mitigation activities and projects will be monitored as outlined in the Hazard Mitigation Grants Program Administrative Plan (see Annex D). Mitigation activities related to HMGP, PDM, and related programs in Delaware have been documented and summarized herein. DEMA and the Council will work jointly to monitor and coordinate mitigation activities across the state. Each agency will monitor grant and programmatic activity through the respective authorities, rules and regulations associated with the programs for which they are responsible. The Council functions as an inter-agency coordinating group that lends advice and technical assistance to other agencies in the group (and across the state) in order to maximize the effectiveness of monitoring activities. Monitoring the progress of these and other programs and activities included in the Capability Assessment is a major function of the State Hazard Mitigation Council.

In an effort to better track the status of outstanding mitigation actions and identify new mitigation actions, DEMA initiated a program in 2008 to use interns from local Universities to coordinate the status of mitigation actions statewide. This program has continued and was funded under EMPG for 2015 and 2016. This program was and is a great success, and data gathered was used in both this update and the update of the Local Mitigation Plans. It remains a priority within DEMA to continue this program indefinitely, when resources permit.

As the recipient for the Hazard Mitigation Grant Program (HMGP) and the Pre-disaster Mitigation Program (PDM), DEMA implements a record-keeping and financial system for each grant awarded based on the approved scope of work and the project's budget. DNREC, as the recipient for the Flood Mitigation Assistance (FMA) Program operates similarly. Sub-recipients are required to maintain appropriate financial records and receipts necessary to document expenditures relative to their projects. Sub-recipients are accountable to DEMA/DNREC for the use of grant funds. State of Delaware agencies are audited by independent auditors in accordance with generally accepted government auditing standards, and are required to address any shortcomings in a timely manner.

Evaluation and Enhancement

Periodic revisions and updates of the plan are required to ensure that the goals and objectives of the Plan are kept current, taking into account potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the plan is in full compliance with applicable federal regulations or state statutes. Periodic evaluation of the plan will also ensure that specific mitigation actions are being reviewed and carried out according to each agency's or departments individual Mitigation Action Plan.

FEMA Risk Consultations

From 2015-2018 Delaware participated in four FEMA Risk Reduction Consultations. The consultations have been useful in identifying priorities and additional opportunities to reduce risk. Attendees have included numerous state agencies, county representative, responders, and mitigation partners. The consultation have focused on prioritizing highest risk communities and statewide priorities. Participants identified 46 potential strategies to reduce risk in Delaware. The objective were to validate state identified goals, highlight successes and discuss realities experienced in implementing hazard mitigation goals and identified strategies. And identify additional strategies/resources needed to implement existing strategies.

Plan Reviews

The plan will undergo a comprehensive review and evaluation process as required by FEMA, currently every five (5) years, by the Council under the authority of DMA2K to determine whether there have been any significant changes in the state necessitating changes in the types of mitigation actions proposed. New developments in identified hazard areas, an increased exposure to hazards, the increase or decrease in capability to address hazards, and changes to federal or state legislation are examples of factors that may affect the content of the Plan.

These reviews also provide agencies with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures.

In addition to the FEMA-required reviews, the Council will continue to meet bi-annually and may meet after major events occur. This will ensure that the plan is continuously updated to reflect changing conditions within the state.

Disaster Declaration

Following a disaster declaration, the Plan may need to be revised to reflect lessons learned, or to address specific circumstances arising from the event.

Reporting Procedures

The plan shall be reviewed **annually**, as agreed upon by the State Hazard Mitigation Officer (SHMO) and the Council, or as situations dictate, such as following a disaster declaration. Changes to the plan will be assigned to the appropriate agency with pre-determined timelines for completion. If changes are required of individual Mitigation Action Plans, the appropriate agency will be assigned responsibility for the completion of the task. This agency, department or individual will ensure the following:

1. The Council members will receive an implementation status report of the plan. This report will include, at a minimum, a completed, printed version of the Mitigation Action Plan. The Mitigation Action Plan is a Microsoft Excel spreadsheet maintained by the DEMA as a tool for monitoring this plan's implementation and for reporting progress to FEMA and the Council.

2. The review includes an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the plan. The means to assess effectiveness include the benefit-cost analysis, the documentation of losses avoided, and a number of qualitative assessment methods. The documentation of losses avoided is found in Section 4, Vulnerability Assessment and Risk Assessment.

3. The plan is linked to existing planning practices and day-to-day activities of state agency officials whenever possible. Specific examples of on-going hazard mitigation programs and practices are described in the Capability Assessment.

4. The report will recommend, as appropriate, any required changes or amendments to the plan.

The results of the five year review will be summarized by the Council under the direction of the Mitigation Planner in a report that will include an evaluation of the effectiveness of the plan and any required or recommended changes or amendments. The report will also include an evaluation of implementation progress for each of the proposed mitigation actions, identifying reasons for delays or obstacles to their completion, along with recommended strategies to overcome them.

Review and changes to multi-jurisdictional plan will be assigned to appropriate local officials with pre-determined timelines for completion. If changes are required of individual Mitigation Action Plans, the appropriate local designee will assign responsibility for the completion of the task.[1]

If the State Hazard Mitigation Council determines that the recommendations warrant modification to the plan, the Mitigation Planner may initiate a plan amendment as described below, or if conditions justify, may undertake a complete update of the plan.

Plan Amendment Process

An amendment to the plan should be initiated only by the Council, either at its own initiative or upon the recommendation of the Director of DEMA, the SHMO, the Federal Emergency Management Agency, or through changes in relevant legislation.

Upon initiation of the amendment process, DEMA, on behalf of the Council, will forward information on the proposed changes to all interested parties including, but not limited to, Council members, the Director of DEMA and appropriate FEMA staff. This information will be sent out in order to seek input on the proposed plan amendment for not less than a fifteen (15) day review and comment period. If no comments are received from the reviewing parties within the specified review period, such will be noted accordingly.

At the end of the 15 day review and comment period, the proposed amendment and all comments will be forwarded to the SHMO for consideration. The Mitigation Planner will review the proposed amendment, along with the comments received from other parties, and submit a recommendation to the Council within fifteen (15) days.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered:

1. Errors or omissions made in the identification of issues or needs during the preparation of the plan;
2. New issues or needs have been identified, which were not adequately addressed in the plan;
3. There has been a change in information, data, or assumptions from those on which the plan was based.

Upon receiving the recommendation of the SHMO, the Council or DEMA may hold a public hearing. The Council will review the recommendation (including the factors listed above) and any oral or written comments received from the public. Following that review, the Council will take one of the following actions:

1. Adopt the proposed amendment as presented.
2. Adopt the proposed amendment with modifications.
3. Refer the amendments request back to the SHMO for further consideration.
4. Defer the amendment request for further consideration and/or hearing.

[1] Local jurisdictions do have the authority to approve/adopt changes to their own Mitigation Action Plans without approval from the county; however, the county should be advised of all changes as a courtesy and for consideration for changes or modifications to the countywide plan. Changes to either the multi-jurisdictional plan or local Mitigation Action Plans will necessitate the adoption of these changes by the appropriate governing body. Ultimately, the updated plan or plan component(s) will be submitted to DEMA.

Continued Public Involvement

The opportunity for public input was part of the completion of this plan and will continue to be essential as it changes over time. Meetings of the State Hazard Mitigation Council are subject to the Delaware Open Meeting Law and are posted to the Delaware Public Meeting Calendar. The meetings and the agenda and minutes provide a means for the public involvement in the planning process. Draft copies of the plan were placed in public libraries statewide for reviewing and to solicit feedback. The copies provide a means for the public to comment and offer suggested additions or improvements. Comments were considered for inclusion during the update process. As is the case with any officially adopted plan or ordinance, changes to this plan may require a public hearing. The following are efforts made to involve the public in the maintenance, evaluation and revision process:

- Advertising meetings of the State Hazard Mitigation Council in the local newspaper, social media, television and public meeting calendar;
- Utilizing local media to update the public of any maintenance and/or periodic review activities taking place;
- Utilizing state web sites to advertise any maintenance and/or periodic review, activities taking place; and
- Placing draft copies of the plan in public libraries for viewing

Plan Updates

Note Regarding 2007 Plan Update
This section of the 2007 SHMP was updated to include the monitoring process that will be used by DEMA to monitor the status and efficacy of the state's mitigation program.

Note Regarding 2010 Plan Update
This section of the 2010 SHMP was updated to include the use of interns to monitor the status of mitigation actions around the State.

Note Regarding 2013 Plan Update
This section of the 2013 SHMP contains only minor updates. There were no significant additions or deletions to this section of the plan.

Note Regarding 2018 Plan Update
This section of the SHMP was thoroughly reviewed and there were minor updates. The Federal requirement for plan updates was change from three (3) to five (5) years, the term grantee was replaced with recipient, and the position of Mitigation Planner was added.