



Burlington County Multi-Jurisdictional All Hazards Mitigation Plan Update



Volume I

March 2014



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SECTION 1: INTRODUCTION

BACKGROUND

In response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), Burlington County and its municipalities have developed this Multi-Jurisdictional All-Hazard Mitigation Plan (HMP) which is an update of the 2008 Burlington County Hazard Mitigation Plan. DMA 2000 amends the Stafford Act and is designed to improve planning for, response to, and recovery from, disasters by requiring State and local entities to implement pre-disaster mitigation planning and develop HMPs. The Federal Emergency Management Agency (FEMA) has issued guidelines for HMPs. The New Jersey Office of Emergency Management (NJOEM) also supports plan development for jurisdictions in New Jersey.

Specifically, DMA 2000 requires that States with support from local governmental agencies update HMPs on a five year basis to prepare for and reduce the potential impacts of natural hazards. DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to collaborate. This enhanced planning will better enable local and State governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

Hazard Mitigation is any sustained action taken to reduce or eliminate the long term risk and effects that can result from specific hazards.

FEMA defines a **Hazard Mitigation Plan** as the documentation of a state or local government evaluation of natural hazards and the strategies to mitigate such hazards.

DMA 2000 ORIGINS -THE ROBERT T. STAFFORD DISASTER RELIEF AND EMERGENCY ASSISTANCE ACT

In the early 1990s a new federal policy regarding disasters began to evolve. Rather than simply reacting whenever disasters strike communities, the federal government would encourage communities to first assess their vulnerability to various disasters and then take actions to reduce or eliminate potential risks. The logic is simply that a disaster-resistant community can rebound from a natural disaster with less loss of property or human injury, at much lower cost, and, consequently, more quickly. Moreover, other costs associated with disasters, such as the time lost from productive activity by business and industries, are minimized.

The **Federal Emergency Management Agency** (FEMA) estimates that for every dollar spent on damage prevention (mitigation), twice that amount is saved through avoided post-disaster damage repair.

DMA 2000 provides an opportunity for States, counties, tribes and local governments to take a new and revitalized approach to mitigation planning. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions (Section 409) and replacing them with a new set of requirements (Section 322). This section sets forth the requirements that communities evaluate natural hazards within their respective jurisdictions and develop an appropriate plan of action to mitigate those hazards, while emphasizing the need for State, county, tribal and local governments to closely coordinate mitigation planning and implementation efforts.

The amended Stafford Act requires that each local jurisdiction identify potential natural hazards to the health, safety and well being of its residents and identify and prioritize actions that can be taken by the community to mitigate those hazards—before disaster strikes. For communities to remain eligible for hazard mitigation assistance from the federal government, they must first prepare a HMP and maintain (this plan).

Responsibility for fulfilling the requirements of Section 322 of the Stafford Act and administering the FEMA Hazard Mitigation Program has been delegated to the State of New Jersey, specifically to NJOEM. FEMA also provides support through guidance, resources, and plan reviews. Copies of the applicable federal and state regulations are found in Appendix A.

ORGANIZATIONS INVOLVED IN THE MITIGATION PLANNING EFFORT

Burlington County and the participating jurisdictions intend to implement this HMP with full coordination and participation of County and local departments, organizations and groups, as well as by coordinating with relevant State and Federal entities. Coordination helps to ensure that stakeholders have established communication channels and relationships necessary to support mitigation planning and mitigation actions included in Section 6 and in the Jurisdictional Annexes in Volume II, Section 9.

In addition to Burlington County, all jurisdictions within the County as well as one special purpose district (Burlington County College) have participated in the planning process (Table 1-1 and Figure 1-1.)

Table 1-1. Participating Jurisdictions in Burlington County

Municipalities	
*Bass River, Township of	Medford, Township of
Beverly, City of	Moorestown, Township of
Bordentown, City of	Mount Laurel, Township of
Bordentown, Township of	Mt. Holly, Township of
Burlington, City of	New Hanover, Township of
Burlington, Township of	North Hanover, Township of
*Chesterfield, Township of	Palmyra, Borough of
Cinnaminson, Township of	Pemberton, Borough of
Delanco, Township of	Pemberton, Township of
Delran, Township of	Riverside, Township of
Eastampton, Township of	*Riverton, Borough of
Edgewater Park, Township of	Shamong, Township of
Evesham, Township of	Southampton, Township of
*Fieldsboro, Borough of	Springfield, Township of
Florence, Township of	Tabernacle, Township of
Hainesport, Township of	Washington, Township of
Lumberton, Township of	Westampton, Township of
Mansfield, Township of	Willingboro, Township of
Maple Shade, Township of	Woodland, Township of
Medford Lakes, Borough of	Wrightstown Borough
Special Purpose District	
Burlington County College	

* This municipality did not participate in the 2008 planning process.

Multiple Agency Support for Hazard Mitigation

Primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments. However, local governments are not alone; various partners and resources at the regional, state and federal levels are available to assist communities in the development and implementation of mitigation strategies. Within the State of New Jersey, NJOEM is the lead agency providing hazard mitigation planning assistance to local jurisdictions. NJOEM provides guidance to support mitigation planning. In addition, FEMA provides grants, tools, and training to support mitigation planning.

Burlington County formally created the hazard mitigation planning process by resolution on April 10, 2013 by action of the County Freeholders.

Additional input and support for this planning effort was obtained from a range of agencies and through public involvement (as discussed in Section 3).

County Emergency Management staff, planning, public safety and other county departments participated as members of the Steering Committee. Oversight for the preparation of this plan was provided by the Burlington County Hazard Mitigation Planning Committee (Planning Committee), which included representatives from:

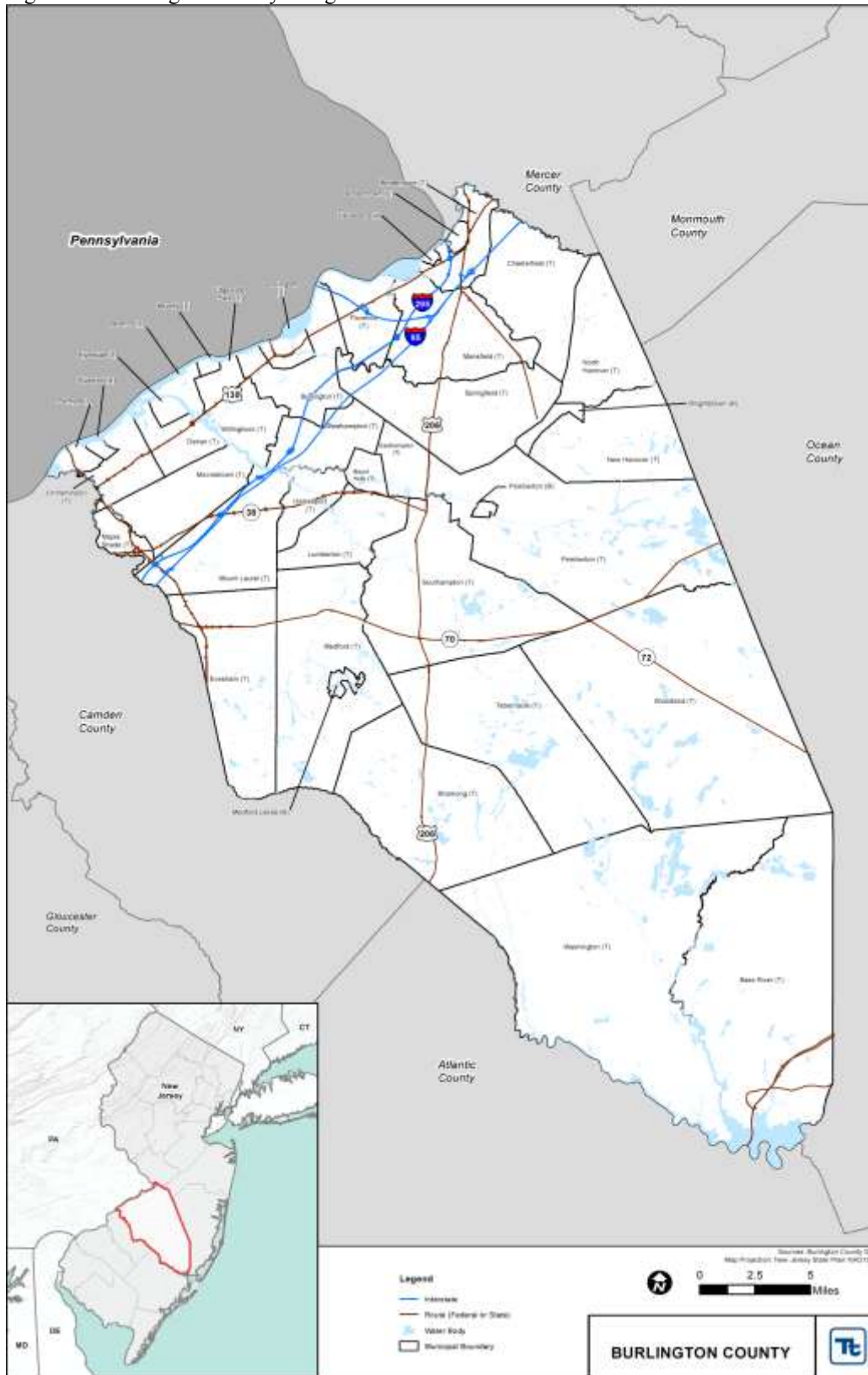
- County Geographical Information Systems (GIS) Department
- County Office of Emergency Management
- County Engineering Department
- County Public Information Department
- County Economic Development
- County Freeholders
- County Health Department
- County Director of Resource Conservation
- County Bridge Commission
- County Public Safety Director
- County and Local Public Works Departments
- Local Engineering Departments
- City Planning, Housing and Community Development
- Participating Jurisdictions
- Agencies and Non-Profit (incorporated by stakeholder surveys and satellite meetings)

The Steering Committee is a subset of the Planning Committee and was formed as a leadership group to plan, guide, expedite, and implement the planning process. The Steering Committee met throughout the planning process and provided guidance and leadership, oversaw the planning process, and has acted as the point of contact for all partners and the various interest groups in the planning area.

The Planning Committee was comprised of the Steering Committee as well as additional County representatives and the remaining participating jurisdictional representatives. A list of Steering Committee and Planning Committee members is provided in Section 3 – Planning Process.

This plan was developed under the direction of the Burlington County Office of Emergency Management staff and Coordinator, Kevin Tuno as well as Tetra Tech hazard mitigation planners Paul Miller, Cynthia Bianco and Jonathan Raser.

Figure 1-1. Burlington County Mitigation Plan Area



Source: Burlington County GIS

This HMP was prepared in accordance with the following regulations and guidance:

- Residential Flood and Wind Mitigation Publications, FEMA, February 2012
- Risk Management Series Publications, FEMA April 2011
- Local Mitigation Plan Review Guide, October 1, 2011
- DMA 2000 (Public Law 106-390, October 30, 2000).
- 44 Code of Federal Regulations (CFR) Parts 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004 Interim Final Rules).
- FEMA. 2004. “How-To Guide for Using HAZUS-MH for Risk Assessment.” FEMA Document No. 433. February.
- FEMA Local Mitigation Planning Handbook, March 2013, available at: http://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf.

Table 1-2 summarizes the requirements outlined in the DMA 2000 Interim Final Rule and where each of these requirements is addressed in this HMP.

Table 1-2. FEMA Local Mitigation Plan Review Crosswalk

FEMA Local Mitigation Plan Review Crosswalk	
Plan Criteria	Primary Location in Plan
Prerequisites	
Adoption by the Local Governing Body: §201.6(c)(5)	Volume I, Section 2.0; Appendix B
Planning Process	
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)	Volume I, Section 3.0
Risk Assessment	
Identifying Hazards: §201.6(c)(2)(i)	Volume I, Sections 5.2
Profiling Hazards: §201.6(c)(2)(i)	Volume I, Section 5.4
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)	Volume I, Section 5.4
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)	Volume I, Section 4.0 Volume I Section 5.4
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)	Volume I, Section 5.4
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)	Volume I, Section 4.0; Volume II, Section 9 Annexes
Mitigation Strategy	
Local Hazard Mitigation Goals: §201.6(c)(3)(i)	Volume I, Section 6.0; Volume II, Section 9 Annexes
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)	Volume I, Section 6.0; Volume II, Section 9 Annexes
Implementation of Mitigation Actions: §201.6(c)(3)(iii)	Volume I, Section 6.0; Volume II, Section 9 Annexes
Multi-Jurisdictional Mitigation Actions: : §201.6(c)(3)(iv)	Volume I, Section 6.0; Volume II, Section 9 Annexes
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)	Volume I, Section 7.0
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)	Volume I, Section 7.0
Continued Public Involvement: §201.6(c)(4)(iii)	Volume I, Section 7.0

Organization

The Burlington County Hazard Mitigation Plan Update has been reorganized into a two volume plan. Whereas the original plan was presented in one volume with all County and municipal mitigation strategies provided in a single section, the updated plan has been reorganized into two volumes to facilitate use of this plan as a resource for each participant.

Volume I intended to be used as a source for on-going mitigation analysis. Volume II consists of a chapter or annex dedicated to each participating jurisdiction. Each annex summarizes the jurisdiction's legal, regulatory and fiscal capabilities; vulnerabilities to natural hazards; status of past mitigation actions; and provides an individualized, updated mitigation strategy. The annexes are intended to provide a concise reference for each jurisdiction for implementation of mitigation projects and future grant opportunities.

Goals and Objectives

The plan update has incorporated five overall goals and supporting objectives as a basis for the planning process and to address all hazards of concern rather than providing ten separate goals specific to hazards as in the original plan. A matrix indicating the relationship of the new goals and objectives is provided in Section 6 of the plan.

Hazards of Concern

The County and participating jurisdictions reviewed natural hazards that caused measurable impacts in the planning area and evaluated the risk and vulnerability due to each of the hazards of concern on the assets of each participating jurisdiction. A summary of the County and jurisdictional hazard rankings are provided in Section 5.3 of the plan. The hazard risk ranks were used to focus and prioritize the individual jurisdictional mitigation strategies.

Plan Integration into Other Planning Mechanisms

It is the intention of this planning process that municipalities shall incorporate findings and recommendations of this plan into future local planning efforts and into overall execution of their land-use planning process (e.g. site plan review, permitting, and code enforcement). In cases where the jurisdiction has not been able to identify past integration, a table indicating intended areas of integrating mitigation strategies into their daily municipal operations has been provided to support improved hazard mitigation policies.

Implementation of the 2008 Plan

The status of the mitigation projects from the 2008 plan are provided in Sections 6 and 9 of the plan. Numerous projects and programs have been implemented that have reduced hazard vulnerability to assets in the planning area. The 2008 plan had not been widely integrated with local planning processes in many jurisdictions, however, during the five year period of the 2008 Hazard Mitigation Plan, the County and municipalities have collaborated on numerous projects. Namely the following initiatives have been jointly addressed:

- Improved communication before, during, and after flood events.
- Participation in CRS.
- Countywide Community Emergency Response Team

- Focus on acquiring property in hazard (flood) prone areas to reduce vulnerability to natural hazards.
- Providing back-up power for critical facilities.
- Improving emergency response and using new technology as it becomes available.
- Developing post disaster action plans.

The integration of the 2013 plan is a high priority for the next five year cycle as noted in the plan maintenance procedure. The municipal annexes and plan maintenance procedure have been developed to encourage specific activities such as review of the HMP during update of codes, ordinances, zoning, and development to ensure that a more thorough integration, with its related benefits, will be completed within the upcoming 5-year planning period.

The County Office of Emergency Management will encourage all jurisdictions to incorporate hazard mitigation plan aspects into their comprehensive and master plan updates.

The following table provides an indication of changes and additions to the 2008 plan.

Table 1-3. Mitigation Plan Update Summary

Topic	2008 Hazard Mitigation Plan Section	2013 Hazard Mitigation Plan Section	Comments
Introduction	Section 1 Introduction	Section 1	
	Section 3 Risk Assessment	Section 5	
ID of Hazards	Section 2 ID of Hazards	Section 5.3	
Profiles of Hazards	Section 3.a Profiles of Hazards	Section 5.4	
Earthquake	Section 3.a Profiles of Hazards: Earthquake	Earthquake Profile	
Flood	Section 3.a Profiles of Hazards: Flood	Flood Hazard Profile (Flash / Riverine)	
Ice Jam	Section 3.a Profiles of Hazards: Flood	Flood Hazard Profile (Flash / Riverine)	
Landslide	Section 3.a Profiles of Hazards: Landslide	Landslide Hazard Profile	
Drought	Section 3.a Profiles of Hazards: Drought	Drought Hazard Profile	
Wildfire	Section 3.a Profiles of Hazards: Wildfire	Wildfire Hazard Profile	
Extreme Wind	Section 3.a Profiles of Hazards: Extreme Wind	Severe Storm Hazard Profile (incl. hurricane and tornado)	
Hurricanes	Section 3.a Profiles of Hazards: Severe Weather Events - Hurricanes	Severe Storm Hazard Profile (incl. hurricane and tornado)	
Tornadoes	Section 3.a Profiles of Hazards: Severe Weather Events - Tornadoes	Severe Storm Hazard Profile (incl. hurricane and tornado)	
Winter Storms / Ice Storms	Section 3.a Profiles of Hazards: Severe Weather Events - Winter Storms/ Ice Storms	Severe Winter Storm Hazard Profile	
Coastal Erosion	Not Included	Coastal Erosion Hazard Profile	
Assess Vulnerability	Section 3.b - Identification And Characterization of Assets		
Assess Vulnerability	Section 3.c - Estimated Damages in Hazard Areas	Section 4 and Section 5.4	Structural inventory is provided in Section 4 and Vulnerability assessments are provided in each hazard profile in Section 5.4
Assess Vulnerability	Section 3.d - Summary of Land Uses and Development Trends in Hazard Areas	Section 4	
Mitigation Strategies	Section 5 - Mitigation Goals Section 6 - Range of Alternative Mitigation Actions Considered	Section 6	Overview of mitigation strategy update process
Mitigation Actions	Section 7 - Action Item Evaluation and Prioritization Section 8 - Implementing Mitigation Strategies	Within each jurisdictional annex in Section 9	
Plan Maintenance Procedures	Section 9 - Plan Maintenance Procedures	Section 7	
Planning Partnership	Section 4 - Capabilities and Resources	Section 8	

IMPLEMENTATION OF THE PLANNING PROCESS

The planning process and findings are to be documented in local HMPs. To support the planning process to develop this HMP, Burlington County and the participating jurisdictions have accomplished the following:

- Developed a Planning Committee
- Reviewed the 2008 Burlington County Hazard Mitigation Plan
- Identified/reviewed hazards of concern to be included in the update
- Profiled these hazards
- Estimated the inventory at risk and potential losses associated with these hazards
- Developed mitigation goals and actions that address the various hazards that impact the area
- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from NJOEM and FEMA

Based on a hazards identification worksheet and ranking process, subsequent input from the Planning Committee, and review of other available data, the planning process then proceeded to identify, rank and profile those hazards that are of greatest concern to the community (hazards of concern). The hazard profiles include location, extent, previous occurrences and losses, and the probability of future events. The process also included a vulnerability assessment to evaluate what county and municipal assets are exposed or vulnerable to the hazards.

To address the requirements of DMA 2000 and better understand their potential vulnerability to and losses associated with hazards of concern, Hazards U.S. – Multi-Hazard (HAZUS-MH or HAZUS) software package (discussed in greater detail later in this Plan) supplemented by local data, as feasible, was used to support the risk assessment and vulnerability evaluation. HAZUS-MH assesses risk and estimates potential losses for natural hazards. It produces outputs that will assist state and local governments, communities, and the private sector in implementing emergency response, recovery, and mitigation programs, including the development of HMPs.

As required by DMA 2000, Burlington County and participating jurisdictions have informed the public and provided opportunities for public comment and input. The response to the public questionnaire was tremendous with a return of over 900 responses. These comments were reviewed and incorporated as applicable in the plan. A summary can be found in Appendix H. In addition, numerous agencies and stakeholders have participated as core or support members, providing input and expertise throughout the planning process.

This Multi-Jurisdictional All-Hazard Mitigation Plan documents the process and outcomes of the County and jurisdictions' efforts. Additional information on the planning process is included in Section 3, Planning Process. Documentation that the prerequisites for plan approval have been met is included in Section 2, Plan Adoption.

BENEFITS OF MITIGATION PLANNING

The planning process will help prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows Burlington County and its municipalities to remain eligible for mitigation grant funding for mitigation projects that will reduce the impact of future disaster events. The long-term benefits of mitigation planning include:

- An increased understanding of hazards faced by communities
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts and damages to human health and structures and reduced repair costs

ORGANIZATION OF THIS MITIGATION PLAN

This Plan was organized in accordance with FEMA and NJOEM guidance. The structure of this Plan follows the four-phase planning process recommended by FEMA and summarized in Figure 1-2. The Plan is organized into two volumes: Volume I includes all information that applies to the entire planning area (Burlington County); and Volume II includes participating jurisdiction-specific information.

Volume I of this Plan includes the following sections:

Section 1: Introduction: Overview of participants and planning process

Section 2: Plan Adoption: Information regarding the adoption of the Plan by Burlington County and each participating jurisdiction.

Section 3: Planning Process: A description of the Plan methodology and development process, Planning Committee and stakeholder involvement efforts, and a description of how this Plan will be incorporated into existing programs.

Section 4: County Profile: An overview of Burlington County, including: (1) general information, (2) economy, (3) land use trends, (4) population and demographics, (5) general building stock inventory and (6) critical facilities.

Section 5: Risk Assessment: Documentation of the hazard identification and hazard risk ranking process, hazard profiles, and findings of the vulnerability assessment (estimates of the impact of hazard events on life, safety and health; general building stock; critical facilities and the economy). Description of the status of local data and planned steps to improve local data to support mitigation planning.

Section 6: Mitigation Strategies: Information regarding the mitigation goals and objectives identified by Burlington County in response to priority hazards of concern.

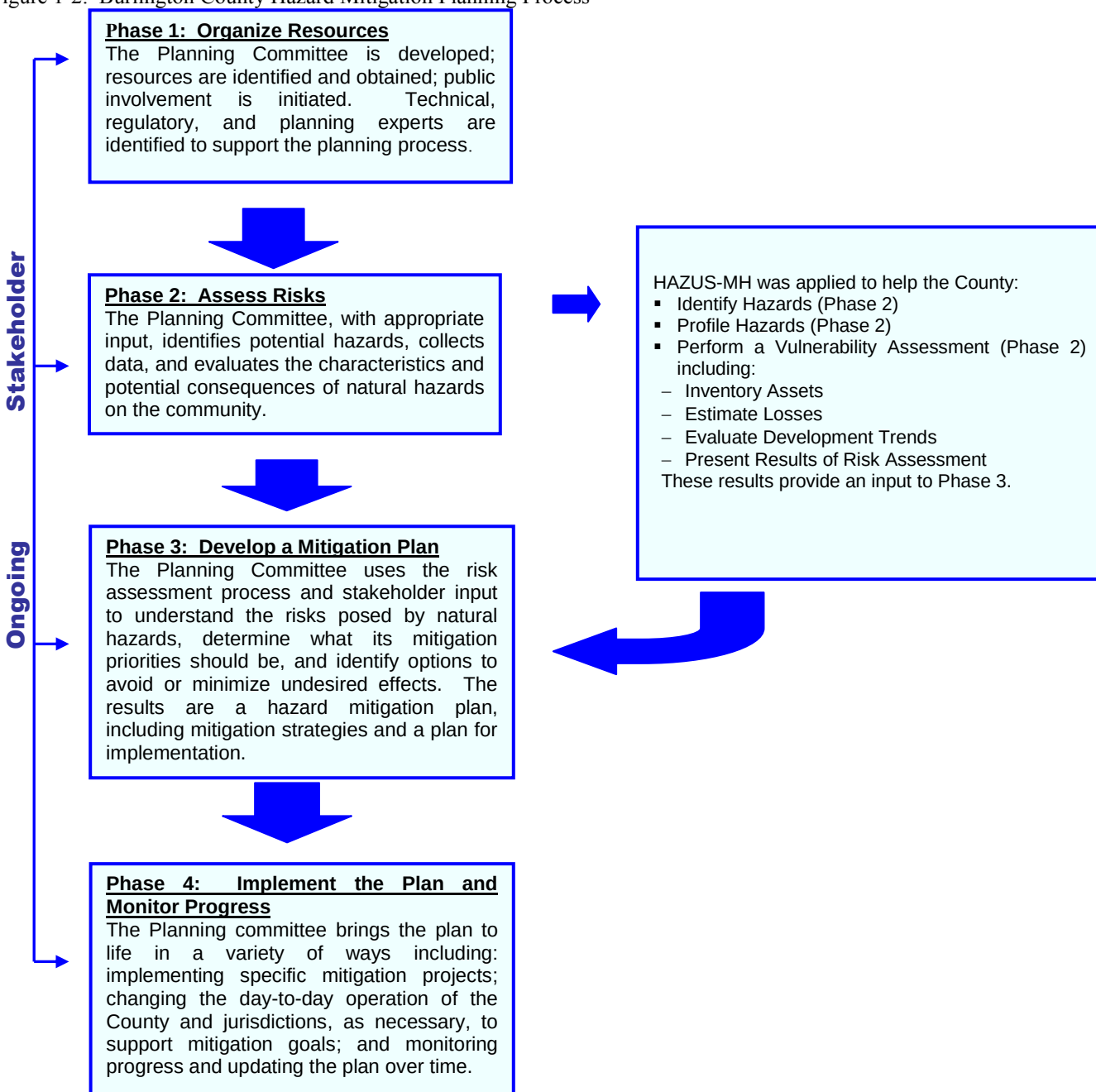
Section 7: Plan Maintenance Procedures: The system established by Burlington County to continue to monitor, evaluate, maintain and update the Plan.

Volume II of this Plan includes the following sections:

Section 8: Planning Partnership: Description of the planning partnership, and jurisdictional annexes.

Section 9: Jurisdictional Annexes: A jurisdiction-specific annex for each participating jurisdiction and the County containing their hazards of concern, hazard risk ranking, capability assessments, mitigation actions and action prioritization specific only to the County or that jurisdiction.

Figure 1-2. Burlington County Hazard Mitigation Planning Process



Appendices –

Appendix A: Applicable Federal and State Regulations: Copies of federal and state acts and regulations that apply to hazard mitigation planning within this jurisdiction.

Appendix B: Resolution of Plan Adoption: Documentation that supports the Plan approval signatures included in Section 2 of this Plan.

Appendix C: Public and Stakeholder Outreach and Comments: Results of Public Survey Public Notices, Public Service Announcements, various newspaper articles to inform the public of the hazard mitigation planning effort in Burlington County and specific public and stakeholder comments received throughout the planning process.

Appendix D: Mitigation Catalog: Comprehensive list of mitigation actions considered by Burlington County and the participating jurisdictions.

Appendix E: Federal Mitigation Programs, Activities, and Initiatives: Summary of federal funding options that could be used to fund mitigation activities.

Appendix F: Jurisdictional Annex Template and Instructions: Template and instructions used by Burlington County and each participating jurisdiction.

Appendix G: FEMA 386-4 Guidance Worksheets

Appendix H: Public Survey Results

Appendix I: Minutes of Meetings: Agendas, minutes, and sign-in sheets of major meetings convened during the planning process.

Appendix J: Sample Letter of Intent provided to participants summarizing minimum requirements of participation in the planning process.

SECTION 2: PLAN ADOPTION

OVERVIEW

This section contains information regarding adoption of the Plan by Burlington County and each participating jurisdiction.

PLAN ADOPTION BY LOCAL GOVERNING BODIES

Adoption by the local governing bodies demonstrates the commitment of Burlington County and each participating jurisdiction to fulfill the mitigation goals and objectives outlined in the Plan. Adoption legitimizes the Plan and authorizes responsible agencies to execute their responsibilities.

Each participating jurisdiction will proceed with formal adoption proceedings when FEMA provides conditional approval of this Plan, known as Approval Pending Adoption (APA) and each participating jurisdiction understands that a conditional approval of the Plan will be provided for those municipalities that meet the planning requirements with the exception of the adoption requirement as stated above. The resolution to support adoption of the plan by each jurisdiction is included as Appendix B, Sample Resolution of Plan Adoption.

Following adoption or formal action on the Plan, each participating jurisdiction must submit a copy of the resolution or other legal instrument showing formal adoption (acceptance) of the Plan as directed by the Committee to the Burlington County Office of Emergency Management. Burlington County will forward the executed resolutions to the NJOEM – Mitigation Unit, and they will be subsequently forwarded to FEMA. Each participating jurisdiction understands that FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the mitigation plan coordinator.

The resolutions issued to support adoption of the plan by each jurisdiction will be included as Appendix B, to be entitled Resolutions of Plan Adoption.

In addition to being required by DMA 2000, adoption of the plan is necessary because:

- It lends authority to the plan to serve as a guiding document for all local and state government officials;
- It gives legal status to the plan in the event it is challenged in court;
- It certifies the program and grant administrators that the plan's recommendations have been properly considered and approved by the governing authority and jurisdictions' citizens; and
- It helps to ensure the continuity of mitigation programs and policies over time because elected officials, staff, and other community decision-makers can refer to the official document when making decisions about the community's future.

Source: FEMA. 2003. "How to Series"-*Bringing the Plan to Life* (FEMA 386-4). August.

SECTION 3: PLANNING PROCESS

INTRODUCTION

This section includes a description of the planning process used to develop and update the 2008 Burlington County Multi-Jurisdictional Natural Hazard Mitigation Plan (HMP), including how it was prepared, who was involved in the process, and how the public was involved.

To ensure that the Plan met the requirements of the DMA 2000, an approach to the planning process and plan documentation was developed to achieve the following two goals:

1. The Plan is multi-jurisdictional and considers natural hazards facing Burlington County, thereby satisfying the natural hazards mitigation planning requirements specified in DMA 2000. Burlington County invited all municipalities in the county to join with them in the preparation of the Burlington County HMP Update. Burlington County, 40 of its municipalities and Burlington County College are participating in the Plan, as indicated in Table 3-1 below.

Table 3-1. Participating Burlington County Jurisdictions

City/Towns	
Bass River, Township of	Medford, Township of
Beverly, City of	Moorestown, Township of
Bordentown, City of	Mount Laurel, Township of
Bordentown, Township of	Mt. Holly, Township of
Burlington, City of	New Hanover, Township of
Burlington, Township of	North Hanover, Township of
Chesterfield, Township of	Palmyra, Borough of
Cinnaminson, Township of	Pemberton, Borough of
Delanco, Township of	Pemberton, Township of
Delran, Township of	Riverside, Township of
Eastampton, Township of	Riverton, Borough of
Edgewater Park, Township of	Shamong, Township of
Evesham, Township of	Southampton, Township of
Fieldsboro, Borough of	Springfield, Township of
Florence, Township of	Tabernacle, Township of
Hainesport, Township of	Washington, Township of
Lumberton, Township of	Westampton, Township of
Mansfield, Township of	Willingboro, Township of
Maple Shade, Township of	Woodland, Township of
Medford Lakes, Borough of	Wrightstown, Borough of
Special Purpose District	
Burlington County College	

The Burlington County HMP update was written using the best available information obtained from a wide variety of sources. Throughout Plan development, a concerted effort was made to gather information from municipal and regional agencies and staff as well as stakeholders, federal and state agencies, and the residents of the County. The HMP Committee solicited information from local agencies and individuals with specific knowledge of certain natural hazards and past historical events, as well as considering planning and zoning codes, ordinances, and other recent planning decisions. The natural hazard mitigation strategies identified in this Plan have been developed through an extensive planning process involving local, county, regional and state agencies, as well as county residents and stakeholders.

2. The Plan was developed following the process outlined by DMA 2000, FEMA regulations and guidance as well as NJOEM guidance. Following this process will ensure all the requirements are met and support Plan review.

This section of the Plan describes the mitigation planning process, including (1) Preparing to Plan; (2) Planning Partnership – Organization and Activity; (3) Stakeholder and Public Outreach and Involvement; (4) Coordination with Existing Mitigation Efforts and Programs; (5) Integration of Existing Data, Plans, and Information; and (6) Continued Public and Stakeholder Involvement.

HAZARD MITIGATION IN BURLINGTON COUNTY – PREPARING TO PLAN

Many parties supported preparation of this plan; the Steering Committee, Planning Committee and other stakeholders. This planning process does not represent the start of hazard risk management in the County; rather it is part of an ongoing process that various State, County and local agencies and individuals have continued to embrace. A summary of the past and ongoing mitigation efforts is provided below to give an historical perspective of the county and local activities implemented to reduce vulnerability to natural hazards in the planning area.

- The County and all municipalities have engaged in an update of their 2008 Mitigation Plan.
- Various regional, county and local agencies and governments have been involved in natural hazard risk assessment, mitigation planning and project activities, prior to and/or unrelated to the current planning effort. Such activities provide a strong foundation for subsequent efforts, and an awareness and understanding of the need for and benefits of mitigation planning across a broad range of regional, county and local governments and stakeholders. Several examples of such activities are presented here.
- Thirty-nine jurisdictions in the County participate in the National Flood Insurance Program, and manage their floodplains according to the requirements of participation in that program.
- Since 2008, 20 flood prone homes in Eastampton, Mt. Holly, Pemberton Twp. and Southampton have been acquired with assistance from the County Office of Engineering, Open Space Program.
- County OEM continues to support municipal and county Community Emergency Response Teams with training and equipment.
- County OEM continues to support disaster preparedness and mitigation through its public website.
- Detailed lists of actions addressed by each participating municipality are provided in the municipal annexes in Section 9 of this plan.

PLANNING PARTNERSHIP - ORGANIZATION AND ACTIVITY

This section of the Plan identifies how the planning process was organized with the many planning partners involved, and outlines the major activities that were conducted in the development of this Plan.

Organization of Planning Partnership

Recognizing the need to manage natural risk within the County, and to meet the requirements of the DMA 2000, the Burlington County Freeholders assigned the Burlington County Office of Emergency Management with the responsibility of managing the natural hazard mitigation plan update project.

On October 2, 2012, Burlington County was notified by NJOEM that their application for a planning grant to update the 2008 Multi-Jurisdictional Hazard Mitigation Plan under FEMA's Pre Disaster Mitigation Grant Program (PDM-2012) was approved. Burlington County and its municipalities experienced severe setbacks in the contractor procurement and planning process as a result of Hurricane Sandy. Through an open bid process, the County selected a contract Planning consultant (Tetra Tech Inc. –Morris Plains, NJ). A contract between Tetra Tech Inc. (Tetra Tech) and the County was executed on April 10, 2013. Specifically Tetra Tech, the contract consultant, was tasked with:

- Working with the County's Hazard Mitigation Committee and their partners to identify mitigation actions (Projects) for which the County and partners may seek grant funding.
- Recommending actions to ensure County and participating partners are in good standing and demonstrate continued compliance with National Flood Insurance Program (NFIP) regulations, including local floodplain ordinances and permitting requirements
- Preparation of an updated, FEMA approved All Hazards Mitigation Plan for the County

In support of these tasks, the consultant scope included:

- Assisting with the development and implementation of a public and stakeholder outreach program
- Data collection
- Facilitation and attendance at meetings (Planning committee, stakeholder, public and other)
- Outreach to other various outside groups, facilities, and agencies as outlined in the County's original Request for Proposals for information vital to risk identification and mitigation strategies
- Review of hazards of concern, and update of hazard profiling and risk assessment
- Assistance with the development of updated mitigation planning goals and objectives
- Assistance with the screening of new mitigation actions, identification of appropriate actions, and status updates of actions in the original 2008 plan.
- Assistance with the prioritization of mitigation actions
- Authoring of the Draft and Final Plan documents

Burlington County first met with Tetra Tech on April 18, 2013 to discuss a strategy to develop the plan and include all municipalities. A Steering Committee was developed to provide guidance and direction to the planning effort, and to ensure the resulting document will be embraced both politically and by the constituency within the planning area.

The Steering Committee was charged with:

- Providing guidance and overseeing the planning process on behalf of the general planning partnership.
- Attending and participating in Steering Committee meetings.

- Assisting with the development and completion of certain planning elements, including:
- Identification of “Hazards of Concern”
- Public and Stakeholder Outreach
- Mitigation Planning Goals and Objectives
- Identification and screening of appropriate mitigation strategies and activities.
- Reviewing and commenting on plan documents prior to submission to NJOEM and FEMA.

On April 29, 2013, the Steering Committee met for the first time and continued to meet throughout the planning process. Table 3-1 shows the current members of the Steering Committee, at the time of this draft Plan’s publication.

Members of the Steering Committee (individually and as a whole), as well as key stakeholders, convened and/or communicated on an as-needed basis to share information and participate in workshops to identify hazards; assess risks; identify critical facilities; assist in developing mitigation goals, objectives and actions; and provide continuity through the Plan development process to ensure that natural hazards vulnerability information and appropriate mitigation strategies were incorporated into the Plan. Each member of the Steering Committee reviewed the Plan, supported interaction with other stakeholders and assisted with public involvement efforts.

Table 3-2. Steering Committee Members

Organization	Name	Title
Burlington County Office of Emergency Management	Kevin Tuno *	Coordinator
County Freeholders Administration	Todd Wirth	Freeholder’s Office
County Public Information	Charlene Webster	Public Information Officer
County Parks	John Smith	Parks Director
County Resource Conservation	Mary Pat Robbie	Director
County GIS	David Rickert	GIS Specialist
County Roads and Bridges	Jeff Kerchner	Supervisor
County Office of Emergency Management	Steve King **	Deputy Coordinator
County Office of Emergency Management	Wayne Comegno	Deputy Coordinator
County Office of Emergency Management	Susan Piersanti	Administration
County Public Safety	Rich Dreby	Director
County Open Space	Matt Johnson	Manager
County Health	Eve Cullinan	Director
County Health	Holly Cucuzzella	Health Officer
County Engineer	Joe Brickley	County Public Works Director
County Economic Development	Mark Remsa	Director
County Resource Conservation	Gina Berg	Water Resource Coordinator

*Chair

**Alternate Chair

On April 19, 2013, Burlington County notified all 40 municipalities within the County of the pending planning process and invited them to formally participate. Municipalities were provided with a copy of the Planning Partner Expectations and asked to formally notify the County of their intent to participate (via a Letter of Intent to Participate) and to identify a planning point of contact to serve on a Planning Committee and represent the interests of their respective community.

A Planning Committee was then assembled to represent each of the municipalities participating in the Plan, consisting of all members of the Steering Committee, and at least one representative from each of the 40 participating municipalities.

Each municipality received a copy of the “Planning Partner Expectations” which outlined the responsibilities of the participants and the agreement of the partners to authorize a Steering Committee to represent the jurisdictions in the completion of certain planning elements as noted above.

The Planning Committee was charged with the following:

- Represent their jurisdiction throughout the planning process;
- Establish Plan development goals;
- Establish a timeline for completion of the Plan;
- Ensure that the Plan meets the requirements of DMA 2000 and FEMA and NJOEM guidance;
- Solicit and encourage the participation of regional agencies, a range of stakeholders, and citizens in the Plan development process;
- Assist in gathering information for inclusion in the Plan, including the use of previously developed reports and data;
- Organize and oversee the public involvement process;
- Identify, develop and prioritize appropriate mitigation initiatives.
- Review, amend and approve all sections of the Plan;
- Develop and author the jurisdictional annex for their jurisdiction;
- Develop, revise, adopt, and maintain the Plan.

It is noted that the Letter of Intent to Participate identifies the above “Planning Partner Expectations” as serving to identify those activities comprising overall participation by jurisdictions throughout the planning process. It is recognized that the jurisdictions in Burlington County have differing levels of capabilities and resources available to apply to the planning process, and further have differing exposure and vulnerability to the natural hazard risks being considered in this Plan. It was Burlington County’s intent to encourage participation by all inclusive jurisdictions, and to accommodate their specific needs and limitations while still meeting the intents and purpose of Plan participation. Such accommodations have included the establishment of a Steering Committee and engaging a contract consultant to assume certain elements of the Planning process on behalf of the jurisdictions, and to provide additional and alternative mechanisms to meet the purposes and intent of mitigation planning.

Ultimately, jurisdictional participation is evidenced by a completed annex (chapter) of the Plan wherein the jurisdiction has identified their planning points of contact, evaluated their risk to the hazards of concern, identified their capabilities to effect mitigation in their community, and identified and prioritized an appropriate suite of mitigation initiatives, actions, and projects to mitigate their natural hazard risk; and eventually by the adoption of the Plan via resolution.

The HMP Planning Committee was comprised of appropriate municipal personnel, local emergency first responders, and other stakeholders to effectively guide the overall process, provide significant input, and partner with Tetra Tech to develop a FEMA-approved Plan. Thus, the County formed the HMP Planning Committee as noted in Table 3-3. Broad participation of all stakeholders was encouraged throughout all phases of the planning process. A complete listing of municipal participants is identified in each of the jurisdiction annexes in Section 9.

Table 3-3 shows the current municipal members of the Planning Committee at the time of this Plan's publication. Included in the list are Steering Committee members who are also part of the overall project Planning Committee.

Table 3-3. Planning Committee Members (Municipal Representatives and Special Purpose District Members Only)

Municipality	Name	Title
Burlington County	Kevin Tuno	OEM Coordinator
Burlington County	T. Steve King	Deputy OEM
Bass River Township	David Cope	Emergency Management Coordinator
Bass River Township	Amanda Somes	Municipal Clerk
City of Beverly	Rich Wolbert	Administrator, Public Safety
City of Beverly	Donna Snyder	Municipal Clerk
City of Bordentown	James E. Lynch, Jr.	Mayor, Emergency Management Coordinator
City of Bordentown	Brian A. Maugeri, Sr.	Deputy OEM Coordinator
Bordentown Township	Andrew Law	Office of Emergency Management
Bordentown Township	Dean Burhrer	Director - DPW
City of Burlington	Frank Caruso	Emergency Management Coordinator
City of Burlington	Hugh Dougherty	Sewer and Drainage Engineer
Township of Burlington	Kevin A. Shoppas	Emergency Management Coordinator
Township of Burlington	Scott Hatfield	Township Engineer
Township of Chesterfield	Kyle Wilson	Chief of Police/OEM
Township of Chesterfield	Greg Lebak	DPW Director
Township of Cinnaminson	Danny Norman	Director of Emergency Management
Township of Cinnaminson	Frederick Turek	Twp. Engineer/ Superintendent of PW
Delanco Township	Christopher Noll	Township Engineer/NFIP Administrator
Delanco Township	Janice Lohr	Assistant Administrator/Municipal Clerk
Delran Township	Walter Bauer	Emergency Manager
Delran Township	Jeff Hatcher	Township Administrator
Eastampton Township	Thomas Czerniecki	Township Manager
Eastampton Township	Kim-Marie White	Township Clerk
Edgewater Park Township	Linda M. Dougherty	RMC/Administrator
Edgewater Park Township	John McElwee	Emergency Management Coordinator
Evesham Township	Bryan Ward	Asst. Fire Chief/Deputy OEM Coordinator
Evesham Township	Lou Cavaliere	Firefighter/Inspector, Fire Department
Borough of Fieldsboro	Joseph Conlin	Public Safety Director
Borough of Fieldsboro	David Hansell	Mayor
Florence Township	Philip Drangula	Emergency Management Coordinator
Florence Township	James Karwacki	Deputy Emergency Management Coordinator
Hainesport Township	William Boettcher	OEM Coordinator
Hainesport Township	Edward Ruggiano	Deputy OEM Coordinator

Table 3-3. Planning Committee Members (Municipal Representatives and Special Purpose District Members Only)

Municipality	Name	Title
Lumberton Township	Lt. Edward Begolly	Emergency Management Coordinator
Lumberton Township	Nicholas Peditto	Deputy Emergency Management Coordinator
Mansfield Township	Douglas J. Borgstrom	Emergency Management Coordinator
Mansfield Township	Sean Gable	Fire Inspector
Maple Shade Township	Gary La Venia	Township Manager
Maple Shade Township	Rosemary Flaherty	Community Development Director/ Planning & Zoning Officer
Medford Township	Jeffrey Wagner	Emergency Management Coordinator
Medford Township	Robert Dovi	Deputy OEM Coordinator
Borough of Medford Lakes	Julie Horner Keizer	Borough Manager
Borough of Medford Lakes	Mark J. McIntosh	Borough Clerk
Moorestown Township	Lee R. Lieber	Lieutenant/Police Department
Moorestown Township	Thomas Ford	Director of Community Development
Mount Holly Township	Ed Spooner	Emergency Management Coordinator
Mount Holly Township	Steve Martin	Chief of Police, MHPD
Mount Laurel Township	Francis W. Pagurek	Emergency Management Coordinator
Mount Laurel Township	Maureen Mitchell	Township Manager
New Hanover Township	Gary Timmons	Chief/Deputy OEM Coordinator
New Hanover Township	Patrick Murphy	Committeeman/OEM Coordinator
North Hanover Township	Mark Keubler	Chief of Police
North Hanover Township	Budd Wells	Police Detective
Borough of Palmyra	Tracy Kilmer	Palmyra Office of Emergency Management
Borough of Palmyra	Richard Derby	Palmyra Office of Emergency Management
Borough of Pemberton	Chad Bozoski	Emergency Management Coordinator / Fire Chief
Borough of Pemberton	Donna Mull	Municipal Administrator
Pemberton Township	Chief Craig L. Augustoni	Emergency Management Coordinator/Fire Chief
Pemberton Township	Chief David Jantas	Deputy EMC/COP
Riverside Township	Meghan Jack	Administrator
Riverside Township	Steve Barone	OEM Coordinator
Borough of Riverton	Scott Reed	Department of Emergency Management
Borough of Riverton	Betty Boyle	Department of Emergency Management
Shamong Township	Stanley A. Rowe	OEM Coordinator
Shamong Township	Wallace Pickard, Jr.	Deputy OEM Coordinator
Southampton Township	Kathy Agolio	OEM Coordinator
Southampton Township	Joe Boyle	Deputy OEM Coordinator
Springfield Township	Eric Trout	Police Chief/Emergency Management Coordinator
Springfield Township	J. Paul Keller	Township Manager

Table 3-3. Planning Committee Members (Municipal Representatives and Special Purpose District Members Only)

Municipality	Name	Title
Tabernacle Township	William C. Lowe	Emergency Management Coordinator
Tabernacle Township	Douglas Cramer	Township Administrator
Washington Township	Barbara L. Somes	Emergency Management Coordinator
Washington Township	Horace A. Somes, Jr.	Deputy Emergency Management Coordinator
Westampton Township	Daryl Caulfield	Emergency Management Coordinator
Westampton Township	Gene Blair	Construction Official
Willingboro Township	Richard Brevogel	Director of Public Works
Willingboro Township	John Carroll, Jr.	Emergency Management Coordinator
Woodland Township	Edward Vincent	OEM Coordinator
Woodland Township	Thomas Lisse	Township Engineer – Pennoni Associates
Borough of Wrightstown	C. Mike Borsavage	Emergency Management Coordinator
Borough of Wrightstown	James Ingling	Deputy Emergency Management Coordinator
Burlington County College	Linda Schmidt	Public Safety Director
Burlington County College	Mark Meara	Chief Information Officer

Planning Partnership Activities

A summary of Planning and Steering Committee meetings held during the development of this Plan is included in Table 3-4. It must be recognized that this summary table identifies only the formal meetings held during plan development, and does not reflect all of the activities conducted by individuals and groups throughout the planning process. In addition to these meetings there was a great deal of communication between Planning Committee members through electronic mail (email), and by phone. Significant support and communication was provided by the consultant during this process to engage the Planning Partners and to provide information and guidance in preparing the plan. Many participating municipalities required individual assistance with regard to completing their individual annexes.

All participating jurisdictions had access to the contractor and could schedule meetings or calls at any mutual agreeable time. The contractor and the County Office of Emergency Management initiated contact with those municipalities having the most difficulty in preparing the annex. These municipalities lacked personnel and were still recovering from the effects of Hurricane Sandy.

Additional guidance was provided to these municipalities to ensure they remained compliant with all plan update guidelines and recommendations. Guidance was provided through conference and individual phone calls and meetings as well as email exchanges.

After completion of the Plan, implementation and ongoing maintenance will become a function of the Steering Committee. The Steering Committee will review the Plan and accept public comment as part of an annual review and as part of the five year mitigation plan update.

Table 3-4 presents a summary of the planning partnership efforts implemented during the development process for this Plan, as well as key milestones in the Plan's development. It also identifies which DMA 2000 requirements the activities satisfy.

Table 3-4. Summary of Planning Activities

Date	Activity/DMA 2000 Requirement	Key Outcomes/Purpose	Attendees
02-13-2013	Public Meeting 1a	Legislative Committee Meeting to authorize and issue a RFP to update the Multi-Jurisdictional Hazard Mitigation Plan	Board of Chosen Freeholders
04-10-13	Public Meeting 1a, 1b, 2	Legislative Committee Meeting to discuss resolution and to accept consultant	Board of Chosen Freeholders
04-18-13	Pre-project Meeting 2	Pre-Kick-Off Meeting	Burlington County Office of Emergency Management Burlington County GIS Tetra Tech
04-29-13	Steering Committee Meeting 1b, 2	Steering Committee Meeting	Burlington County Office of Emergency Management, GIS Department, Health Department, Freeholder Representative, Public Safety Director, Resource Conservation Office, Department of Public Works, County Park Supervisor Tetra Tech
05-02-13 2:00 PM	Planning Committee Meeting 1b, 2	Municipal Kick-Off Meeting	Participating Municipalities Steering Committee members
05-02-13 7:00 PM	Planning Committee Meeting 1b, 2	Municipal Kick-Off Meeting	Participating Municipalities Steering Committee members
05-21-13	Steering Committee Meeting 1b, 2	Second Steering Committee Meeting	Steering Committee members
06-27-13	SWOO 2, 4a, 4b	Strengths, Weaknesses, Obstacles and Opportunities Meeting	Planning Committee Steering Committee Stakeholders
07-25-13	JAW 2, 3e, 4a, 4b	Jurisdictional Annex Workshop	Planning Committee Steering Committee Members
08-20-13	Mitigation Strategy 2, 3e, 4a, 4b	FEMA Workshop Mitigation Initiatives	FEMA cadre Planning Committee Steering Committee Members
09-05-13	Working Group Meeting 2, 4c, 5a, 5b, 5c	Working Group Meeting to provide assistance with Jurisdictional Annexes	Participating Municipalities County Office of Emergency Management
10-01-13	Working Group Meeting 2, 4c, 5a, 5b, 5c	Second Working Group Meeting to provide assistance with Jurisdictional Annexes	Participating Municipalities County Office of Emergency Management
11-21-13	Working Group Meeting 2, 4c, 5a, 5b, 5c	Provide final information on Annex review and sign off of municipal officials	Participating Municipalities Planning Committee Steering Committee Members
12-12-13	Public Outreach Meeting	Public Information Meeting on Plan and comment opportunity and procedures	Steering Committee Members
12-12-13	Draft Plan Posted for Public Review 1b	Public Review	General Public access to Hazard Mitigation Plan Website*

Note: *Due to the compressed project schedule and the availability of the Burlington County Hazard Mitigation website, the committee implemented an on-line public review process to capture public comments of the draft plan. Comments were collected using a feedback link on the website. Feedback was gathered by the contractor and Burlington County OEM and integrated in the plan risk assessment and mitigation strategies.

TBD = to be determined. Each number in column 2 identifies specific DMA 2000 requirements, as follows:

1a – Prerequisite – Adoption by the Local Governing Body

1b – Public Participation

2 – Planning Process – Documentation of the Planning Process

3a – Risk Assessment – Identifying Hazards

3b – Risk Assessment – Profiling Hazard Events

3c – Risk Assessment – Assessing Vulnerability: Identifying Assets

3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses

3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends

4a – Mitigation Strategy – Local Hazard Mitigation Goals

4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures

4c – Mitigation Strategy – Implementation of Mitigation Measures

5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan

5b – Plan Maintenance Procedures – Implementation through Existing Programs

5c – Plan Maintenance Procedures – Continued Public Involvement

STAKEHOLDERS INVOLVED IN MITIGATION PLANNING

This section presents (1) municipal involvement, (2) state and regional agency involvement, (3) public participation – citizen involvement, and outreach to business, utility, educational, non-profits, and other stakeholders.

Diligent efforts were made to assure broad regional, County and local representation in this planning process. To that end, a comprehensive list of stakeholders was developed with the support of the Steering and Planning Committee. Stakeholder outreach was performed early on, and continually throughout, the planning process. In addition to “mass media” notification efforts, phone calls and emails, identified stakeholders were invited to attend planning meetings and the Strengths, Weaknesses, Obstacles and Opportunities Meeting. Key stakeholders were also requested to participate on the Planning Committee.

The following is list of the various stakeholders that were invited to participate in the development of this Plan, along with a summary of how these stakeholders participated and contributed to the Plan. It should be noted that this summary listing does not represent the sum total of stakeholders that were aware of and/or contributed to this Plan, as outreach efforts were being made, both formally and informally, throughout the process by the many planning partners involved in the effort, and documentation of all such efforts is impossible. Rather, this summary is intended to demonstrate the scope and breadth of the stakeholder outreach efforts made during the development of this Plan.

Information and input provided by these stakeholders has been included throughout this Plan where appropriate, as identified in the references.

On June 6, 2013 an email was sent by Burlington County Office of Emergency Management Coordinator to the stakeholders indicated in the following table inviting them to review the draft plan documents and to participate in the development of the Plan. The email also provided links to the HMP website for further information about the Plan. Neighboring Counties were invited to participate in the planning process. Comments were directed to the Burlington County Office of Emergency Management, the point of contact tasked with collecting any information from the stakeholder outreach.

Table 3-5. Burlington County Stakeholders

Company/Organization Name	Contact Name	Contact Position/Title
Monmouth County OEM Coordinator	Mike Oppegard	Coordinator
Ocean County OEM Coordinator	William Polhemus	Coordinator
Camden County OEM Coordinator	Sam Spino	Coordinator
Atlantic County OEM Coordinator	Vincent Jones	Coordinator
Mercer County OEM Coordinator	Dean Raymond	Coordinator
Bucks County PA OEM Coordinator	Scott Forester	Director
NJ Office of Emergency Management	Lt. James Haidacher	NJOEM Mitigation Unit Head
NJ Department of Health	Gary Ludwig	Director
Joint Base McGuire Dix Lakehurst	Steve Robertson	Coordinator
NJ Conservation Foundation	Michele Beyers	Director
NJ Forest Fire Service	Michael Achey	Fire Warden
National Weather Service, Mt. Holly	Joe Miketta, Gary Szatkowski	Specialist
American Red Cross	Paul Rick	Coordinator
Burlington County Bridge Commission	Phil Adams	Manager
Lockheed Martin	David Sutton	Manager
USDA Natural Resources Conservation Service	Greg Westfall	Planner
Rancocas Creek Association	John McNamara	President
PSE&G	M. Benentt, E. Forte	Supervisor
South Jersey Gas Company	Customer Care	Customer Care
NJ American Water	Kevin Watsey	Manager

Table 3-5. Burlington County Stakeholders

Company/Organization Name	Contact Name	Contact Position/Title
Comcast Cable	Kathy Farinaccio	Manager
Salvation Army	Virginia Evans	Specialist
County Agriculture Agent	Raymond Samulis	Department Head

Note: See Table 3-3 for a list of the participating jurisdictions and their identified representatives.

The New Jersey Forest Fire Service commented on the plan and provided updated fire hazard mapping information. The public was also invited to review the draft plan via the County website on December 12, 2013. Comments were collected by the contractor via a link on the County Hazard Mitigation Plan website. A summary of the comments is included in Appendix C of this plan. All comments have been reviewed and incorporated in the plan as appropriate.

Municipal and Local Involvement

The HMP Committee and/or its members and contract consultant met and communicated with relevant representatives of the municipalities within the County to obtain data and information, review existing plans and capabilities, and facilitate the identification of appropriate mitigation initiatives. Further, these departments have reviewed the Draft Plan and provided direct input during its development.

Throughout the course of updating the Hazard Mitigation Plan, the Committee Chair though the contractor sent correspondence to participating municipalities to update them on the process, make them aware of important meeting dates and other plan review activities. This correspondence included emails, letter and phone conversations with many of the municipal stakeholders. For each of the stakeholders the distribution list included as appropriate:

- Municipal Officials (Mayor, Administrator)
- Municipal Clerk
- Highway Superintendent
- Code Enforcement
- Floodplain Administrator
- Primary Point of Contact determined by stakeholder
- Secondary Point of Contact determined by stakeholder

In addition, before finalization of the plan, all jurisdictional annexes were forwarded to each municipality for review with a directive to provide at least that portion of the plan to the above personnel and other municipal officials. Each municipal annex was reviewed and approved by municipal officials as noted by the municipal official “sign off” sheet included at the end of each municipal annex in Section 9. The Committee and its members met and communicated regularly to obtain mitigation planning information for HMP preparation. Meeting sign-in sheets which indicate the municipal and stakeholder participants are provided in Appendix I.

Federal, State, County, and Regional Agency Involvement

Throughout this Planning process, the County actively sought the involvement of a wide range of county, state and regional stakeholders. At a minimum, these stakeholders were advised of the planning process and provided an opportunity to review and provide direct input to the Plan during its development. Further, the HMP Committee and/or its members and contract consultant, met and/or directly communicated with many of these stakeholders to obtain data and information, review existing plans, and facilitate the identification of appropriate mitigation initiatives.

- New Jersey Office of Emergency Management
- New Jersey Department of Environmental Protection
- New Jersey Forest Fire Service
- New Jersey Department of Health
- Federal Emergency Management Agency (FEMA) - Region II
- USDA National Resources Conservation Service (NRCS)
- National Oceanic and Atmospheric Administration (NOAA) – Mt. Holly Office

Burlington County Government Departments

Burlington County Department of Public Works – Steering Committee member, attended Steering and Planning Committee meetings, provided input to inventory and risk assessment, reviewed plan sections, identified potential county and regional mitigation initiatives.

Burlington County GIS Department – Provided county wide structural and geographic information for the vulnerability analysis and planning effort.

Burlington County Emergency Management – Provided administrative support; provided direct representation on the Steering Committee; provided data and information on assets and vulnerabilities throughout the County; supported public and stakeholder outreach, identified completed and ongoing mitigation activities and updates to the county and local mitigation strategies; reviewed and provided comment on draft plan sections; facilitated regional mitigation planning coordination

Burlington County Health Department (BCHD) - Supported public and stakeholder outreach efforts; identified completed and ongoing mitigation activities; provided updates to the county mitigation strategy.

Burlington County Public Information Office of the Board of Chosen Freeholders (Public Information Officer) - Supported public and stakeholder outreach efforts.

Burlington County Board of Chosen Freeholders - Provided authorization for grant, contracting, and the planning organizational structure; promoted and facilitated municipal participation, up to and including adoption of the Plan update and supported public outreach.

Surrounding County Agencies

- Mercer
- Monmouth
- Ocedan
- Atlantic
- Camden

Academia

- Burlington County College
- Virtua Hospital

Government Agencies

Information regarding hazard identification, risk assessment, and mitigation actions for this plan was also requested and received from the following agencies and organizations:

- Midwest Regional Climate Center (MRCC)
- National Climatic Data Center (NCDC)
- National Hurricane Center (NHC)
- National Oceanic and Atmospheric Administration (NOAA)
- National Resources Conservation Service (NRCS)
- National Weather Service (NWS)
- New Jersey Department of Environmental Protection (NJDEP)
- New Jersey Department of Health (NJDOH)
- New Jersey Department of Transportation (NJDOT)
- New Jersey Office of Emergency Management
- New Jersey Forest Fire Service
- Storm Prediction Center (SPC)
- U.S. Army Corps of Engineers (USACE)
- U.S. Census Bureau
- U.S. Department of Agriculture (USDA)
- U.S. Department of Health and Human Services
- U.S. Environmental Protection Agency (USEPA)
- U.S. Geological Survey (USGS)
- U.S. Fish and Wildlife Service

Information received from these agencies has been incorporated into this plan update as appropriate, and as documented within the individual plan sections and associated References.

Public Participation - Citizen Involvement

In order to facilitate better coordination and communication between the Planning Committee and citizens and to involve the public in the planning process, it was determined that draft documents will be made available to the public through the County HMP website. The participating partners also feel that community input on the HMP will increase the likelihood of hazard mitigation becoming one of the standard considerations in the evolution and growth of the County.

The Planning Committee has made the following efforts toward public participation in the development and review of the Plan:

- The public was informed of the hazard mitigation planning effort commencement through press releases, new articles, and public service announcements on the county website. To inform the public of the ongoing Plan effort, updates regarding the mitigation planning process have been made on the county website.
- A public website is being maintained as a way to facilitate communication between the Planning Committee and County residents (<http://www.co.burlington.nj.us/ahmp>). The public website contains a project overview, contact information, and sections of the HMP for public review and comment. See Figures 3-1 and 3-2 for screenshots of this public website. The website also has a link for the public to submit comments on the draft plan.

- Links to the public website and questionnaire have been established by the Towns of Cinnaminson and Delanco, and are posted on the websites of those towns. All municipalities have been requested to post a link to the HMP website and Citizen Questionnaire to provide ongoing public outreach.
- Several municipalities have conducted public outreach utilizing “Nixle” to include Mount Laurel. “Nixle Connect” connects public safety agencies to their residents via text, web, and email so residents can be informed of important notifications.
- A hazard mitigation planning tri-fold brochure (see Appendix C) was developed to inform the public of the planning process, provide local contact information, and encourage the public to review the plan and provide input. This brochure was available at the County Freeholders Office, County Office of Emergency Management as well as The Freedom Run 5K and Fall Fling Festival on October 19, 2013 and the Fall Foliage Family Float Festival on October 20, 2013.
- In order to facilitate coordination and communication between the Planning Committee and citizens and involve the public in the planning process, the Plan will be available to the public through a variety of venues. A printed version of the Plan will be maintained at Burlington County Office of Emergency Management and the digital version will be maintained on the County HMP website.
- An on-line natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact the County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards (<http://www.surveymonkey.com/s/burlington-mitigation-survey>). The questionnaire asked quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The questionnaire also asked several demographic questions to help analyze trends. Responses were collected and incorporated into Strengths, Weaknesses, Obstacles, and Opportunities (SWOO) discussions and the catalog of mitigation actions.

Survey results, which included more than 900 responses, showed that 44% of respondents felt moderately prepared for natural disaster events. A question about what types of mitigation preparation residents have undertaken showed that 72% of respondents have at least two methods for receiving emergency notifications and for information during severe weather or potential emergency situations, and 77% look to local news or other media to obtain information. Only 20% have taken precautionary measures to protect his or her property, and roughly the same percent have identified the location of the nearest severe weather shelter. The majority of respondents (70.6%) believe that local, county, state or federal government agencies could be improving the damage resistance of utilities (electricity, communications, water/wastewater facilities etc.) in order to reduce the damage and disruption of natural disasters in Burlington County. The second and third highest choices for types of local, county, state, or federal intervention were retrofitting infrastructure, such as elevating roadways and improving drainage systems (62.5%), and informing property owners of ways they can mitigate damage to their properties (42.4%), respectively.

When asked about past exposure to natural disasters and hazard events in Burlington County over the past decade, 60% or more of the respondents reported experiencing Hurricane/Tropical Storm, Nor’Easter, and Severe Winter Weather events, though the same respondents noted only moderate concern about these types of events occurring in the future. Only 29% of survey respondents considered the impact that a natural disaster could have on his/her home before he/she purchased or moved in.

Almost 30% of respondents have experienced basement flooding, though only 10% have flood insurance. (It should be noted that few respondents, or 16.2%, reported that their property is located within a designated floodplain. Another 16% were unsure.) 61% of respondents indicated that he/she would consider a “buyout,” “elevation,” or “relocation” if his/her property were

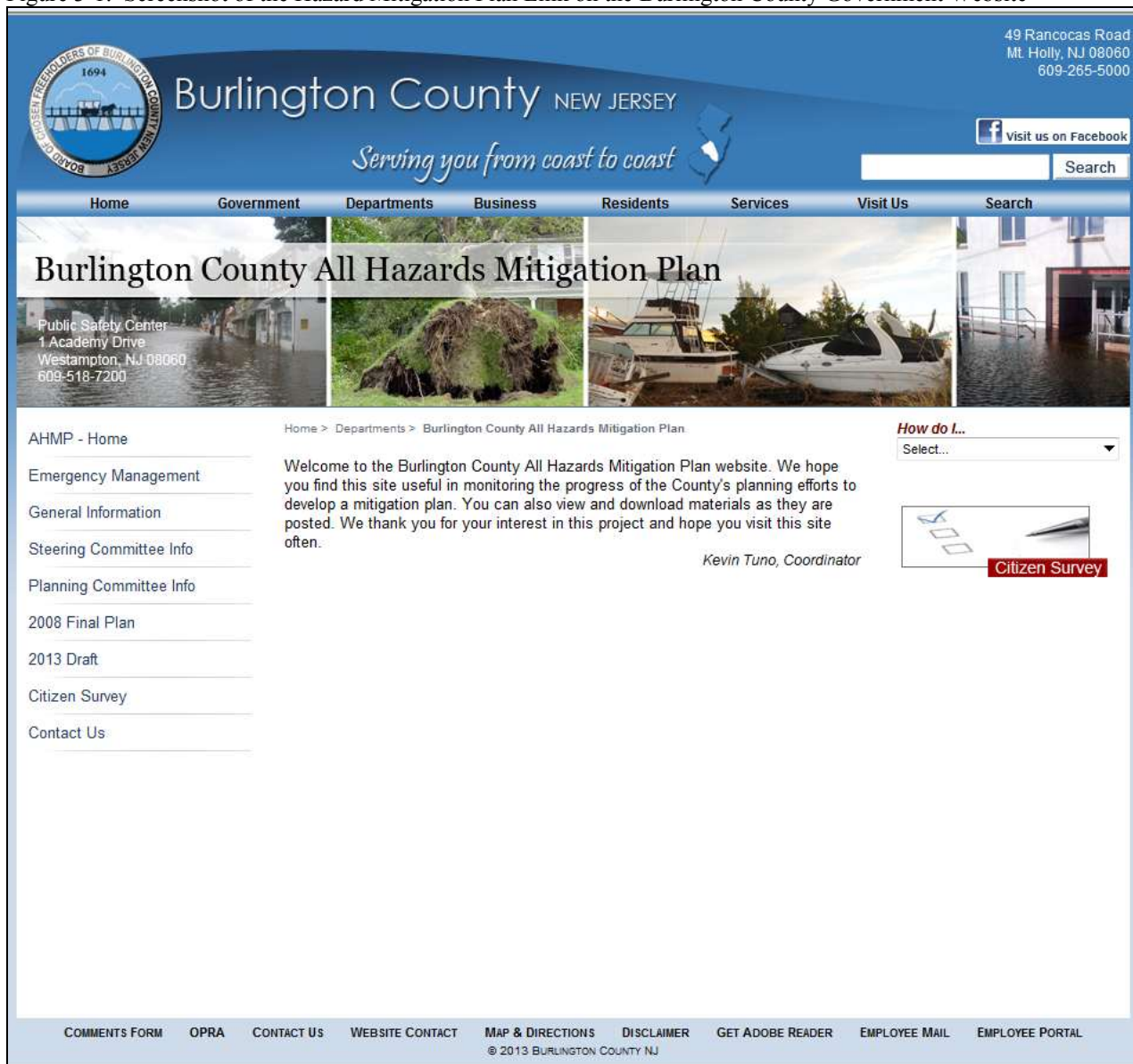
located in a designated “high hazard” area, or had received repeated damages from a natural event.

The questionnaire has been available on the public website since July 15, 2013. Response rates are considered excellent, however 403 responses represented either Moorestown or Mount Laurel Townships. The next best represented municipality was Delanco Township, with 83 or 9.5% of responses. Appendix H summarizes public input received through the website, the online survey, and other sources.

- On December 20, 2013, the Draft Plan was posted to the public website (<http://www.co.burlington.nj.us/ahmp>). This is an opportunity for the public to comment on the Draft Plan. All public comments were directed to the Burlington County Office of Emergency Management for collection and review by the Steering Committee. Any public comments received before submittal to FEMA have be incorporated into the plan.

These and other examples of public outreach efforts are are presented in Appendix C. Public comments that have been received to date are also documented in Appendix C.

Figure 3-1. Screenshot of the Hazard Mitigation Plan Link on the Burlington County Government Website



Source: <http://www.co.burlington.nj.us/ahmp>

Figure 3-2. Screenshot of the Burlington County Hazard Mitigation Plan Public Website, General Information Page

Burlington County NEW JERSEY
Serving you from coast to coast

49 Rancocas Road
Mt. Holly, NJ 08060
609-265-5000

Visit us on Facebook

Home Government Departments Business Residents Services Visit Us Search

Home > Departments > Public Safety > Burlington County All Hazards Mitigation Plan > General Information

General Information

WHAT IS HAZARD MITIGATION?

Natural hazards have the potential to cause property loss, loss of life, economic hardship, and threats to public health and safety. While an important aspect of emergency management deals with disaster recovery – those actions that a community must take to repair damages and make itself whole in the wake of a natural disaster – an equally important aspect of emergency management involves hazard mitigation. Hazard mitigation measures are efforts taken before a disaster happens to lessen the impact that future disasters of that type will have on people and property in the community. They are things you do today to be more protected in the future. Hazard mitigation actions taken in advance of a hazard event are essential to breaking the typical disaster cycle of damage, reconstruction, and repeated damage. With careful selection, hazard mitigation actions can be long-term, cost-effective means of reducing the risk of loss and help create a more disaster-resistant and sustainable community.

WHAT IS A HAZARD MITIGATION PLAN?

A Hazard Mitigation Plan is a well-organized and well-documented evaluation of the hazards that a jurisdiction is susceptible to, and the extent to which these events will occur. Hazard Mitigation Plans identify an area's vulnerability to the effects of the natural hazards typically present in a certain area, as well as the goals, objectives, and actions required for minimizing future loss of life and property damage as a result of hazard events. The primary purpose of mitigation planning is to systematically identify policies, actions, and tools that can be used to implement those actions.

PURPOSE AND NEED FOR THE PLAN

Hazard mitigation plans are developed BEFORE a disaster strikes. The plans identify community policies, actions, and tools for long-term implementation to reduce risk and potential for future losses. Adopted, implemented and maintained on an ongoing basis, these plans will gradually, but steadily, lessen the impacts associated with hazard events in Burlington County.

As of November 1, 2004 communities that do not have a FEMA-approved hazard mitigation plan in place are no longer eligible for FEMA project grant monies under programs such as the Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation Grant Program (PDM).

PARTICIPATION

Jurisdictions located within Burlington County who wish to be recognized by FEMA as being compliant with DMA 2000 must either: (a) participate with the County in the multi-jurisdictional plan development process and formally adopt the final plan, or (b) prepare their own hazard mitigation plan.

Elected and appointed government officials, business leaders, volunteers of non-profit organizations, citizens, and other stakeholders are being invited to participate in our multi-jurisdictional plan development process as part of our Burlington County Natural Hazard Mitigation Planning Committee (the "Planning Committee"). Click [here](#) for a PDF of more information on our organizational structure.

AHMP - Home
Emergency Management
General Information
Steering Committee Info
Planning Committee Info
2008 Final Plan
2013 Draft
Citizen Survey
Contact Us

Source: <http://www.co.burlington.nj.us/Pages/pages.aspx?cid=996>

COORDINATION WITH EXISTING PLANNING EFFORTS AND PROGRAMS

Local municipalities are charged with the development of local HMPs required under Section 322 of the Stafford Act by New Jersey. Therefore, the Planning Committee coordinated the development of this HMP. In New Jersey, local municipalities are authorized to prepare local disaster plans based on the contention that they are best equipped to assess their strengths and weaknesses, opportunities, and constraints. Local governments have intimate knowledge of the local geography, and in a disaster, local government personnel are on the front lines providing personnel and equipment to support the community. Burlington County and the participating jurisdictions are involved in this above program, hence the development of this Plan.

Examples of other hazard mitigation programs in which County is involved with are the National Flood Insurance Program (NFIP), the Community Rating System (CRS), and the Hazard Mitigation Grant Program (HMGP). These programs assist the County in receiving funding for flood mitigation projects and flood insurance (the HMGP also can provide funds to mitigate other natural hazards). Data from the County, based on participation in these programs, was incorporated in the risk assessment in Section 5 and used to identify mitigation options in Section 9. Continued involvement in these flood-related programs will help to administer funds and resources to support this HMP.

Federal Hazard Mitigation Funding Opportunities

FEMA's Hazard Mitigation Assistance (HMA) grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. Currently, FEMA administers the following HMA grant programs: 1) Flood Mitigation Assistance (FMA); 2) Hazard Mitigation Grant Program; and 3) Pre-Disaster Mitigation (PDM).

As of July 2013, the Repetitive Loss Grant Program (RFC) and Severe Repetitive Loss Grant Program (SRL) are no longer funded separately and are now addressed under the unified FMA program. The Biggert Waters Flood Insurance Reform Act of 2012 eliminated the SRL program. For more information Biggert Waters Flood Insurance Reform Act visit: <http://www.fema.gov/flood-insurance-reform-act-2012>. For previous year information regarding the SRL Program visit: <http://www.fema.gov/severe-repetitive-loss-program>. For previous year information on the RFC Program visit: <http://www.fema.gov/repetitive-flood-claims-program>

Federal mitigation grant funding (Stafford Act 404 and 406) is available to all communities with a current hazard mitigation plan (this plan); however most of these grants require a “local share” in the range of 10-25% of the total grant amount. Participation in FEMA 404 HMGP may cover mitigation activities including raising, removing, relocating or replacing structures within flood hazard areas. The FEMA mitigation grant programs are described below.

Hazard Mitigation Grant Program (HMGP)

The HMGP is a post-disaster mitigation program. It is made available to states by FEMA after each Federal disaster declaration. The HMGP can provide up to 75% funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved Hazard Mitigation Plan (this plan).

Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to NJOEM and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.

Flood Mitigation Assistance (FMA) Program

FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is 75%. At least 25% of the total eligible costs must be provided by a non-federal source. Of this 25%, no more than half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. FMA funds are distributed from FEMA to the state. NJOEM serves as the grantee and program administrator for FMA.

Pre-Disaster Mitigation (PDM) Program

The PDM program is an annually funded, nationwide, competitive grant program. No disaster declaration is required. Federal funds will cover 75% of a project's cost up to \$3 million. As with the HMGP and FMA, a FEMA-approved local Hazard Mitigation Plan is required to be approved for funding under the PDM program.

Federal Disaster and Recovery Assistance Programs

Following a disaster, various types of assistance may be made available by local, state and federal governments. The types and levels of disaster assistance depend on the severity of the damage and the declarations that result from the disaster event. Among the general types of assistance that may be provided should the President of the United States declare the event a major disaster are the following:

Individual Assistance (IA)

IA provides help for homeowners, renters, businesses and some non-profit entities after disasters occur. This program is largely funded by the U.S. Small Business Administration. For homeowners and renters, those who suffered uninsured or underinsured losses may be eligible for a Home Disaster Loan to repair or replace damaged real estate or personal property. Renters are eligible for loans to cover personal property losses. Individuals may borrow up to \$200,000 to repair or replace real estate, \$40,000 to cover losses to personal property and an additional 20% for mitigation. For businesses, loans may be made to repair or replace disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible. Non-profit organizations such as charities, churches, private universities, etc. are also eligible. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster. These loans are restricted, by law, to small businesses only.

Public Assistance (PA)

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

Community Development Block Grants (CDBG)

CDBG are federal funds intended to provide low and moderate-income households with viable communities, including decent housing, as suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, planning, and administration. Public improvements may include flood and drainage improvements. In limited instances, and during the times of “urgent need” (e.g. post disaster) as defined by the CDBG National Objectives, CDBG funding may be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event.

National Flood Insurance Program

Established in 1968, the NFIP provides federally-backed flood insurance to residents of communities that enact and enforce regulations that more carefully regulate development within floodplain areas. For individual property owners to be eligible to buy the federally-backed flood insurance, their property must be located within a community that participates in NFIP.

For a community to be eligible in NFIP, it must adopt and enforce a floodplain management ordinance to regulate proposed development in floodplains and officially designate a local floodplain coordinator/administrator. The intent of the program is to ensure that new construction does not exacerbate existing flood hazards and is designed to better withstand flooding. Thirty-nine municipalities in Burlington County participate in the NFIP. The communities also have Flood Insurance Rate Maps (FIRM) that at a minimum show floodways, 100-year flood zones, and 500-year flood zones. Mitigation activities related to this program are included in Section 9 and data from FEMA Region II regarding NFIP Insurance Reports was used in the risk assessment for the flood hazard included in Section 5.

Each municipality in the county has a local floodplain manager with the exception of Fieldsboro. All floodplain managers have been informed of and participated in the planning process, reviewed the plan documents, and provided direct input to the Plan. Table 3-6 summarizes the designated Floodplain Administrators for each jurisdiction.

Table 3-6. Burlington County Floodplain Administrators

Municipality	Name	Title
Bass River Township	Kris Kluk, Ph.D., P.E.	Township Engineer
Beverly City	William H.	City Engineer's Office
Bordentown City	James E. Lynch, Jr.	Mayor, Director of Public Safety & Affairs
Bordentown Township	Brian Johnson	Community Development
Burlington City	Howard Wilkins	Construction Official/Fire Sub-Code Official & Fire Official
Burlington Township	Michael Wright	Construction Official
Chesterfield Township	Kyle Wilson	OEM/Chief of Police

Table 3-6. Burlington County Floodplain Administrators

Municipality	Name	Title
Cinnaminson Township	Danny Norman	Director of OEM
Delanco Township	Christopher Noll	Township Engineer
Delran Township	Walter Bauer	Emergency Management
Eastampton Township	Gene Blair	Construction Official
Edgewater Park Township	James Scott	Building/Construction Code Official
Evesham Township	Thomas Czerniecki	Township Manager
Fieldsboro Borough	None	N/A
Florence Township	Thomas Layou	Construction Code Office
Hainesport Township	Martin Miller	Township Engineer
Lumberton Township	Brad Regn	Construction
Mansfield Township	Jeffrey K. Jones	Construction Official
Maple Shade Township	Roger Fort	Construction Code Official
Medford Lakes Borough	Robert Tassone	Construction Code Enforcement
Medford Township	Christopher Schultz	Township Manager
Moorestown Township	Steven M. Holmes	Construction Official
Mt. Holly Township	Thomas P. Casey	Construction Code Official
Mt. Laurel Township	William Long	Township Engineer
New Hanover Township	Joe Hirsh	Township Engineer
North Hanover Township	Justin Gibson, P.E.	Township Engineer
Palmyra Borough	Tracy Kilmer, CFM	Construction Official
Pemberton Borough	Chad Bozoski	OEM Coordinator
Pemberton Township	David Benedetti	Community Development Director
Riverside Township	Meghan Jack	Administrator
Riverton Borough	Scott Reed	Public Works
Shamong Township	Dante Guzzi	Township Engineer
Southampton Township	Jody Mazeall	Construction/Zoning
Springfield Township	J. Paul Keller	Township Manager
Tabernacle Township	William C. Lowe	Emergency Management Coordinator
Washington Township	Kris Kluk, P.E.	Kluk Consultants/Township Engineer
Westampton Township	M. Gene Blair Jr.	Construction Official
Willingboro Township	Duane Wallace	Inspections Construction Official
Woodland Township	Robert Perri	Construction Official
Wrightstown Borough	Harry W. Case	Construction Official

Source: updated by local contacts.

Community Rating System (CRS)

The NFIP has been successful in protecting property owners who acquire flood insurance through the program from catastrophic financial losses due to flooding, and in requiring that new buildings constructed within 100-year flood plains are better protected from flood damage.

In the 1990s, the Flood Insurance Administration (FIA) established the CRS to encourage local governments to increase their standards for floodplain development. The goal of this program is to

encourage communities, through flood insurance rate adjustments, to implement standards above and beyond the minimum required in order to:

- Reduce losses from floods
- Facilitate accurate insurance ratings
- Promote public awareness of the availability of flood insurance

CRS is a voluntary program designed to reward participating jurisdictions for their efforts to create more disaster-resistant communities using the principles of sustainable development and management. 2 communities in Burlington County are currently participating in the program. By enrolling in CRS, municipalities can leverage greater flood protection while receiving flood insurance discounts. Active involvement in this program is included as a mitigation activity for many municipalities in Section 9.

Table 3-7. CRS Municipalities in Burlington County

Municipality	CRS Rating
Burlington, City of	8
Palmyra, Borough of	8

INTEGRATION OF EXISTING DATA AND PLANS INTO MITIGATION PLAN

The mitigation plan integrates local and federal data as discussed below.

Local Data

The Planning Committee reviewed and incorporated existing data and plans to support the mitigation plan including

- Burlington County Geographic Information System (GIS) data
- Documentation of past mitigation actions and grant applications
- Historic maps and local inventory data

A number of electronic and hard copy documents were made available to support the planning process. A complete listing is included in Table 3-8.

Cross-referencing this Plan with existing planning documents has been included in Section 9 as mitigation activities.

The following local regulations, codes, ordinances and plans were reviewed during this planning process in an effort to develop mitigation planning goals, objectives and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms; and thus develop complementary and mutually supportive plans.

- Building Codes
- Zoning Ordinances
- Subdivision Ordinances
- NFIP Flood Damage Prevention Ordinances
- Site Plan Requirements
- Stormwater Management
- Emergency Response Plans

- Capital Improvement Plans
- State of New Jersey 2012 State Hazard Mitigation Plan

The “Legal and Regulatory” capability assessment of each participating jurisdiction is included in Section 9, Jurisdictional Annexes and provides a listing of the local codes, ordinances, regulations and planning mechanisms available in the jurisdictions and reviewed during this planning process.

Federal and State Data

Federal and State data was collected and used throughout the mitigation process including:

- US Census data
- HAZUS-MH provided data
- FEMA Local Mitigation Planning Handbook (March 2013)
- Public laws and other programs such as the NFIP were examined to complete this Plan.

A complete list of the existing data and plans used to support this HMP is included in the references section of this document. By incorporating data from existing programs into this mitigation plan, the County also was able to identify the relevance of mitigation planning to these existing programs. Implementation of this Plan through these existing plans is identified as a specific mitigation action in several areas in Section 9 of this Plan.

REVIEW OF EXISTING REPORTS AND PLANS

A summary of the reports and plans provided by Burlington County and reviewed in the preparation of this plan is included in the following Record of Review Matrix.

Table 3-8. Record Review (Municipalities) - Record of the review of existing programs, policies, and technical documents for participating jurisdictions (all)

Existing plan, program or technical documents	Jurisdictional Applicability
2010-2014 5-Year Consolidated Plan	Countywide
Bass River Twp. Stormwater Management Plan, 2010	Bass River Township
Burlington County College Campus Emergencies and Safety Procedures Guide	Countywide
Burlington County Community Health Improvement Plan, 2007	Countywide
Burlington County Comprehensive Farmland Preservation Plan, 2009-2018	Countywide
Burlington County Cross Acceptance Report, 2005	Countywide
Burlington County Department of Resource Conservation Parks and Open Space Master Plan, 2002	Countywide
Burlington County Flood Insurance Study, 2010	Countywide
Burlington County OEM Flood Emergency Operations Plan Rancocas Creek WMA #19, 2013	Countywide
Clean and Plentiful Water: A Management Plan for the Rancocas Creek Watershed Plan, 2003	Countywide
Community Forestry Management Plan 2011-2016, Florence Twp.	Florence Township
Community Transportation Plan, Burlington County, 2007	Countywide
Comprehensive Management Plan for the Pinelands National Reserve, 2012	Countywide
Delaware River Basin Commission, Recent Flooding Events in the Delaware River Basin, 2011	Countywide
Economic Resource Guide to Burlington County	Countywide

Table 3-8. Record Review (Municipalities) - Record of the review of existing programs, policies, and technical documents for participating jurisdictions (all)

Existing plan, program or technical documents	Jurisdictional Applicability
Evesham Township DRAFT Open Space and Recreation Plan, 2012	Evesham Township
Evesham Township Environmental Resource Inventory, 2009	Evesham Township
Evesham 2020 Vision Plan for Marlton Circle, 2010	Evesham Township
FEMA data for NFIP RL Properties and CRS Communities	Countywide
Floodplain Management Recommendations, NJ Flood Mitigation Task Force, 2009	Countywide
Joint Base Regional Wastewater & Growth Management Plan, 2013	Countywide
Joint Base Regional Transportation Mobility Study, 2011	Countywide
Moorestown Master Plan, 2002	Moorestown Township
Moorestown Stormwater Management Plan, 2005	Moorestown Township
New Jersey FIT: Route 38 Smart Growth Planning Initiative, Burlington County, 2009	Countywide
New Jersey Geological Survey Landslide Database, 2012	Countywide
New Jersey HMP, 2012	Countywide
Northern Burlington County Growth and Preservation Plan, 2008-2010, 2010	Countywide
Pompeston Creek Regional Stormwater Management Plan, 2007	Countywide
Medford Twp. Ordinance 2010-32: Drainage, Floodwater Protection and Stormwater Management	Medford Township
Route 130/Delaware River Corridor Strategic Plan, 1997	Countywide
USACE CRELL Ice Jam Database, 2012	Countywide
USDA National Agricultural Statistics Service, 2007	Countywide

* This document may or may not include all jurisdictions

The plan update has incorporated a goals and objectives hierarchy as a basis for the planning process and to address all hazards of concern rather than providing separate goals and objectives for each hazard as in the original plan. A cross-walk indicating the relationship of the original goals and objectives with the new goals and objectives is provided in Section 6 of the plan. Goals and objectives relevant to hazard mitigation of plans (noted above) reviewed in the update process have been incorporated into the updated plan goals and objectives.

CONTINUED PUBLIC INVOLVEMENT

Burlington County is committed to the continued involvement of the public. Therefore, copies of the Plan will be made available for review during normal business hours at the Burlington County Office of Emergency Management.

A notice regarding annual updates of the Plan and the location of Plan copies will be publicized annually after the Planning Committee's annual evaluation and posted on the County HMP website (<http://www.co.burlington.nj.us/ahmp>).

Each jurisdiction's Supervisor/Mayor or Clerk shall be responsible for receiving, tracking, and filing public comments regarding this Plan.

The public will have an opportunity to comment on the Plan as a part of the annual mitigation planning evaluation process and the 5-year mitigation plan update. Mr. T. Steve King, Deputy Coordinator of Burlington County Office of Emergency Management has been identified as the HMP Coordinator and is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting and

reviewing the comments, and ensuring their incorporation in the 5-year plan update as appropriate; however, members of the Planning Committee will assist the HMP Coordinator. Additional meetings may also be held as deemed necessary by the Planning Committee. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the Plan.

After completion of the Plan, implementation and ongoing maintenance will become a function of the HMP Committee. The HMP Committee will review the Plan and accept public comment as part of an annual review and as part of five-year mitigation Plan updates. A notice regarding annual updates of the Plan and the location of Plan copies will be publicized annually after the HMP Committee's annual evaluation and posted on the public web site (<http://www.co.burlington.nj.us/ahmp>).

SECTION 4: COUNTY PROFILE

This profile describes the general information of the County (physical setting, population and demographics, general building stock, and land use and population trends) and critical facilities located within Burlington County. In Section 5, specific profile information is presented and analyzed to develop an understanding of the study area, including the economic, structural, and population assets at risk and the particular concerns that may be present related to hazards analyzed (for example, a high percentage of vulnerable persons in an area).

GENERAL INFORMATION

The Lenni-Lenape Indians were the original aboriginal owners of Burlington County. In October 1677, a group of English debarked from the ship Kent and founded the Town of Burlington. Burlington County was later incorporated on May 17, 1694. The American Indians sold more and more of their lands to the new settlers until finally, in 1801, there remained less than 100 adult American Indians on the Indian Mills reservation, which was the first American Indian reservation in the U.S. and the American Indian's last dwelling place in Burlington County (Burlington County HMP, 2008).

The County's waterways were a principal factor in the early and successful seating of Burlington County. These transportation systems were vital at the time to trade, travel and provincial existence. Consequently the earliest homes and the earliest settlements were on the waterways. Burlington, thriving at its river location, was the port of entry. Several of its early inhabitants moved on to establish farms in the fertile valleys, being generally careful to choose creek-valleys where a landing and a waterway insured easy transport to Burlington or Philadelphia (Burlington County HMP, 2008).

According to the 2010 U.S. Census data, the County's population was 448,734. Burlington County is the 11th most populated county in New Jersey (U.S. Census Bureau, 2010).

Physical Setting

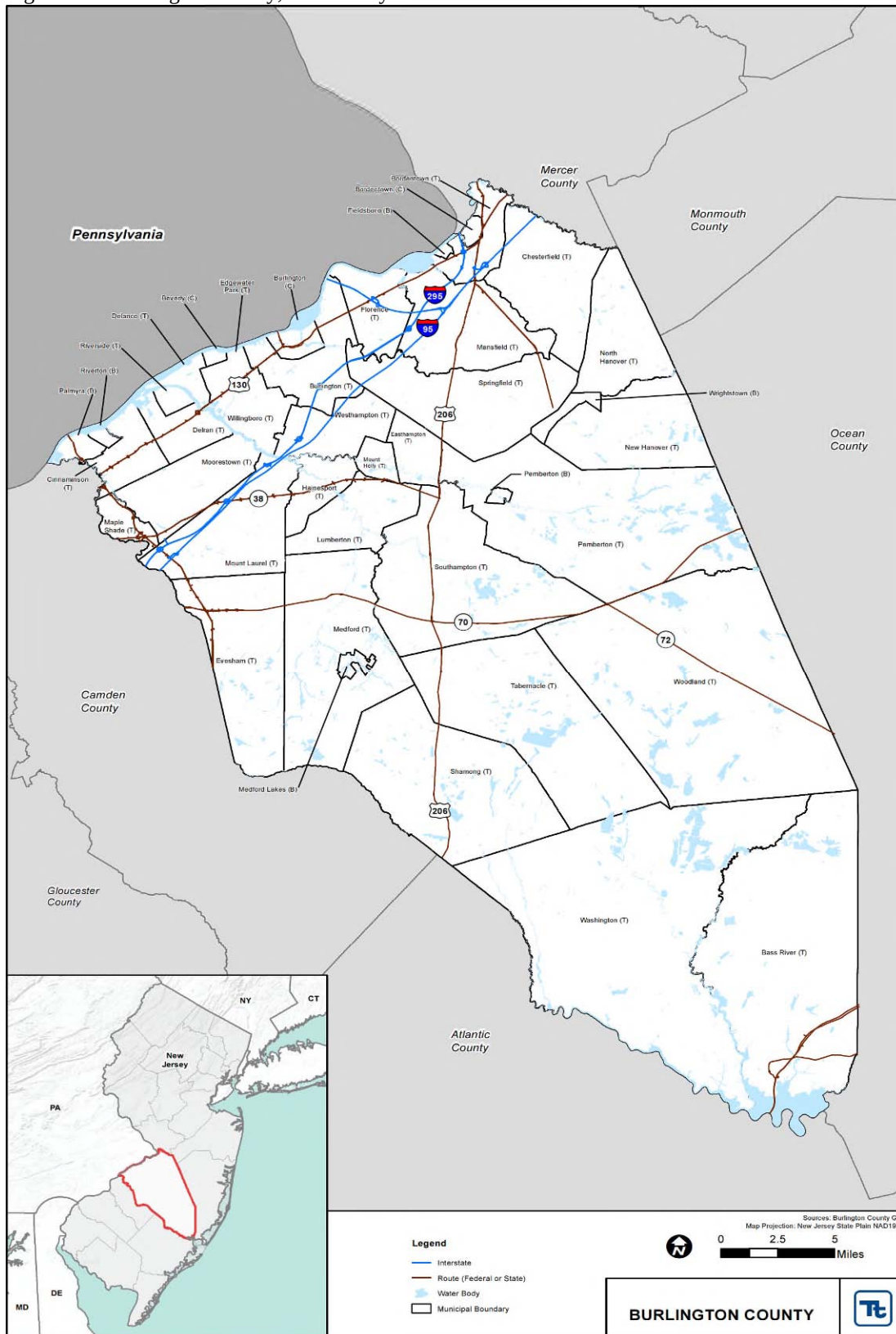
This section presents the physical setting of the County, including: location, hydrography and hydrology, topography and geology, climate, and land use/land cover.

Location

Burlington County is the largest county in New Jersey, covering 827 square miles, and extends from the Delaware River to the Great Bay. Burlington County is bordered to the north by Mercer County, to the northeast by Monmouth County, to the east by Ocean County, to the southwest by Atlantic County and to the west by Camden County. The Delaware River separates Burlington County from Pennsylvania to the west. The County has a total area of 529,351 acres including 5,191 acres of water (Burlington County, 2013). Figure 4-1 illustrates Burlington County and its surrounding area.

Forty municipalities exist within the County, consisting of three cities, six borough and 31 townships. The county seat is located in Mount Holly (Burlington County, 2013). Burlington County is located within the Philadelphia-Camden-Wilmington Metropolitan Statistical Area (MSA). Burlington County features a variety of land uses including densely populated urban development to preserved open space and military use.

Figure 4-1. Burlington County, New Jersey



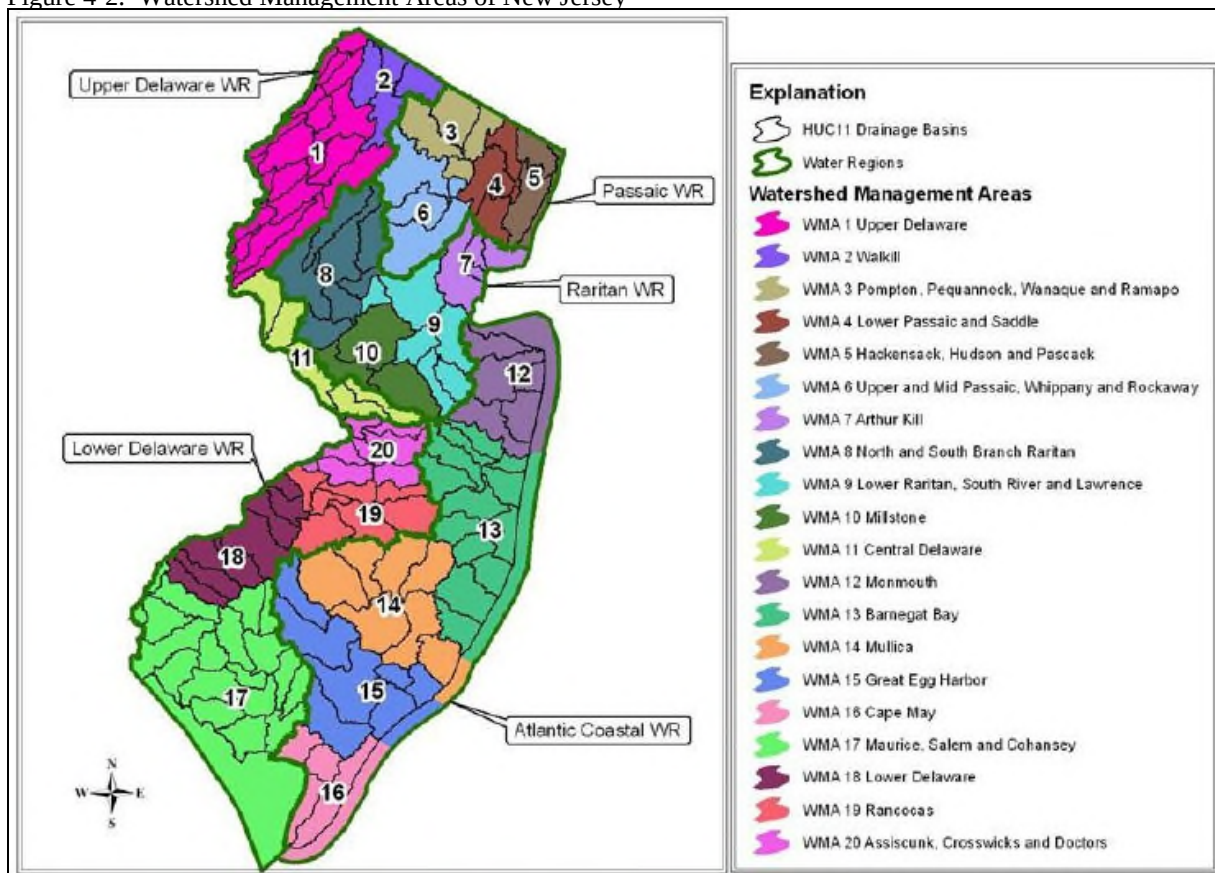
Source: Burlington County Department of Information Technology, 2013

Hydrography and Hydrology

Numerous ponds, lakes, creeks, and rivers make up the waterscape of Burlington County, which lie within two drainage basins (Lower Delaware Basin and New Jersey Coastal Basin) and three sub-basins (Crosswicks-Neshaminy, Lower Delaware, and Mullica-Toms) (NJDEP, 2012; USEPA, 2013). The major bodies of water and waterways within the County include: Delaware River, Oswego River, Bass River, Batsto River, Mullica River, Wading River, West Branch Wading River, Rancocas Creek, North Branch Rancocas Creek, South Branch Rancocas Creek, Southwest Branch Rancocas Creek, Crosswicks Creek, Big Timber Creek, South Branch Mount Misery Brook, Shoal Branch, Greenwood Branch, and Great Bay (National Atlas, 2013).

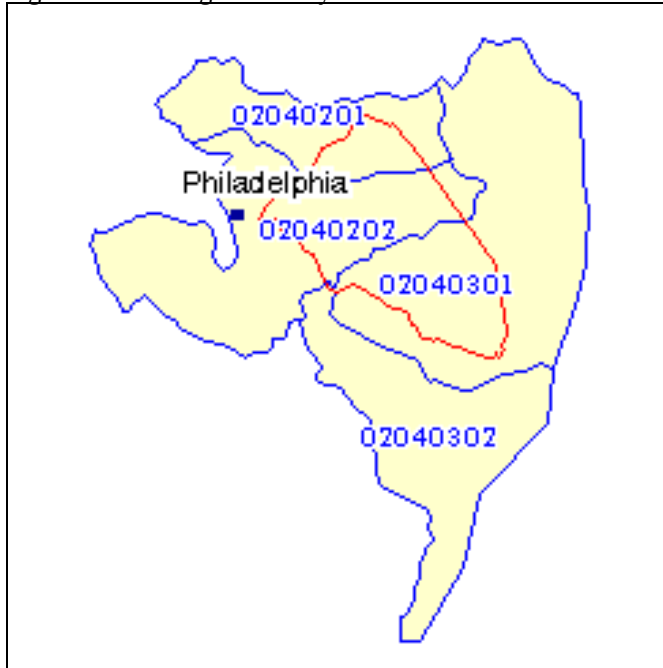
Figure 4-2 depicts the 20 Watershed Management Areas (WMAs) and drainage basins found in New Jersey and Figure 4-3 depicts the watersheds of Burlington County.

Figure 4-2. Watershed Management Areas of New Jersey



Source: New Jersey Geological and Water Survey, Date Unknown

Figure 4-3. Burlington County Watersheds



Source: USEPA, 2013

Note: 02040201 Crosswicks-Neshaminy; state(s): NJ, PA

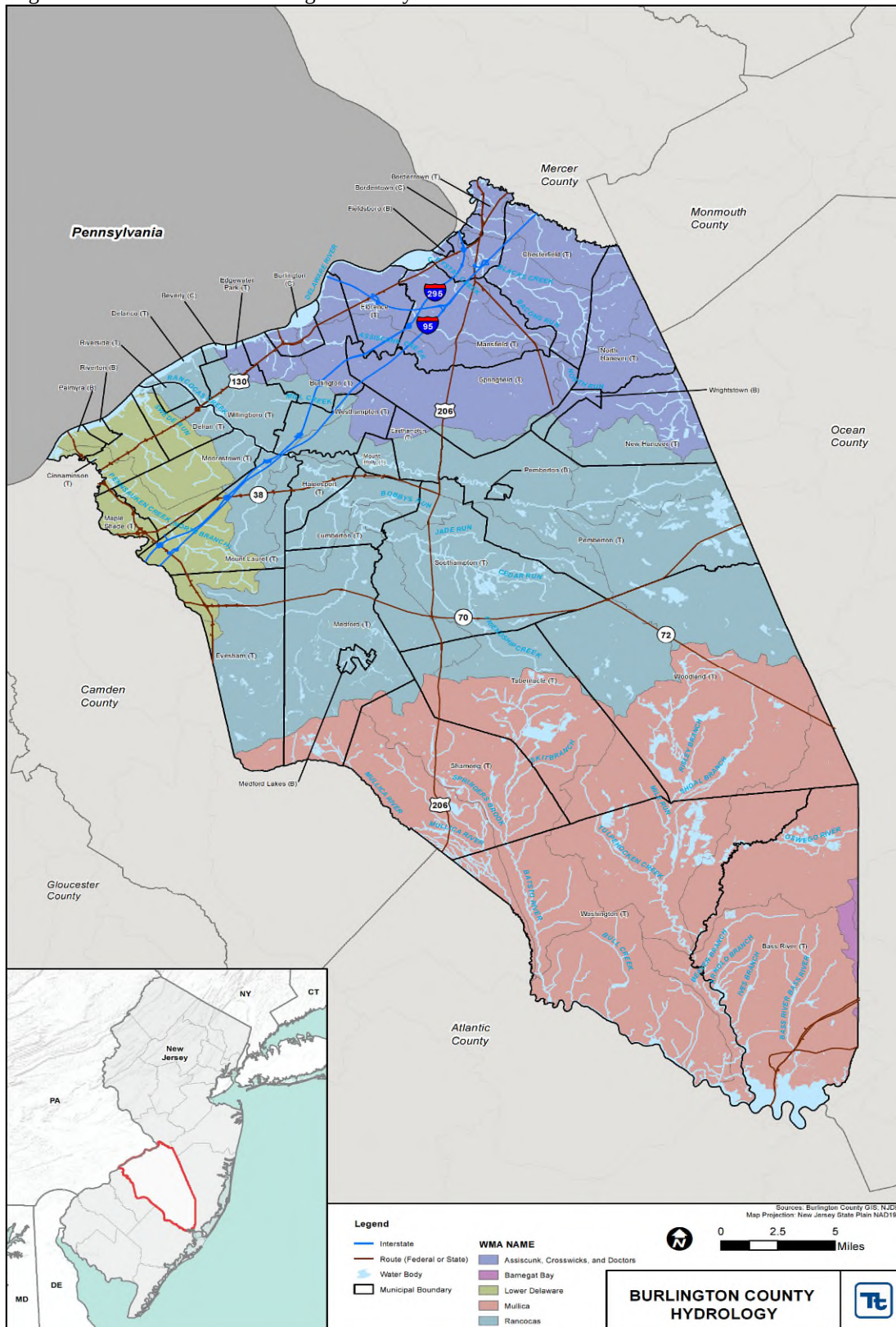
02040202 Lower Delaware; state(s): NJ, PA

02040301 Mullica-Toms; state(s): NJ

Figure 4-4 indicates that Burlington County is located in two Watershed Management Areas in New Jersey, Rancocas (19) and Mullica (14). Watershed Management Area 14, Mullica, includes watersheds draining portions of the Pinelands of New Jersey. It is approximately 561 square miles in size and approximately 80% of this watershed consists of state parks and forests. Major rivers include the Mullica, Wading River, Nochescatauxin Brook, Atsion Creek, Bass River, Batsto River, Nescochaque Creek, Landing Creek, Hammonton Creek and the Oswego River. This Management Area lies in Burlington, Atlantic and Ocean Counties and includes the watersheds of Mullica River, Mechescatauxin Creek, Wading River, Atsion Creek, Batsto River, and Doughty Creek. The Mullica River and its tributaries are considered the primary drainage system for the Pinelands (NJDEP, 2012).

Watershed Management Area 19, Rancocas, is the largest watershed in south-central New Jersey and is made up of the North and South Branch and the Main stem of the Rancocas Creek, including Mill Creek. Portions of Burlington, Camden and Ocean Counties and approximately 33 municipalities make up this management area and cover an area of 360 square miles. Of its total area, the North Branch drains 167 square miles and the South Branch drains 144 square miles. The North Branch is 31 miles long and is fed by the Greenwood Branch, McDonalads Branch and Mount Misery Brook. The major tributaries to the South Branch include the Southwest Branch Rancocas Creek; Stop the Jade Run, Haynes Creek and Friendship Creek (NJDEP, 2012).

Figure 4-4. Watersheds of Burlington County

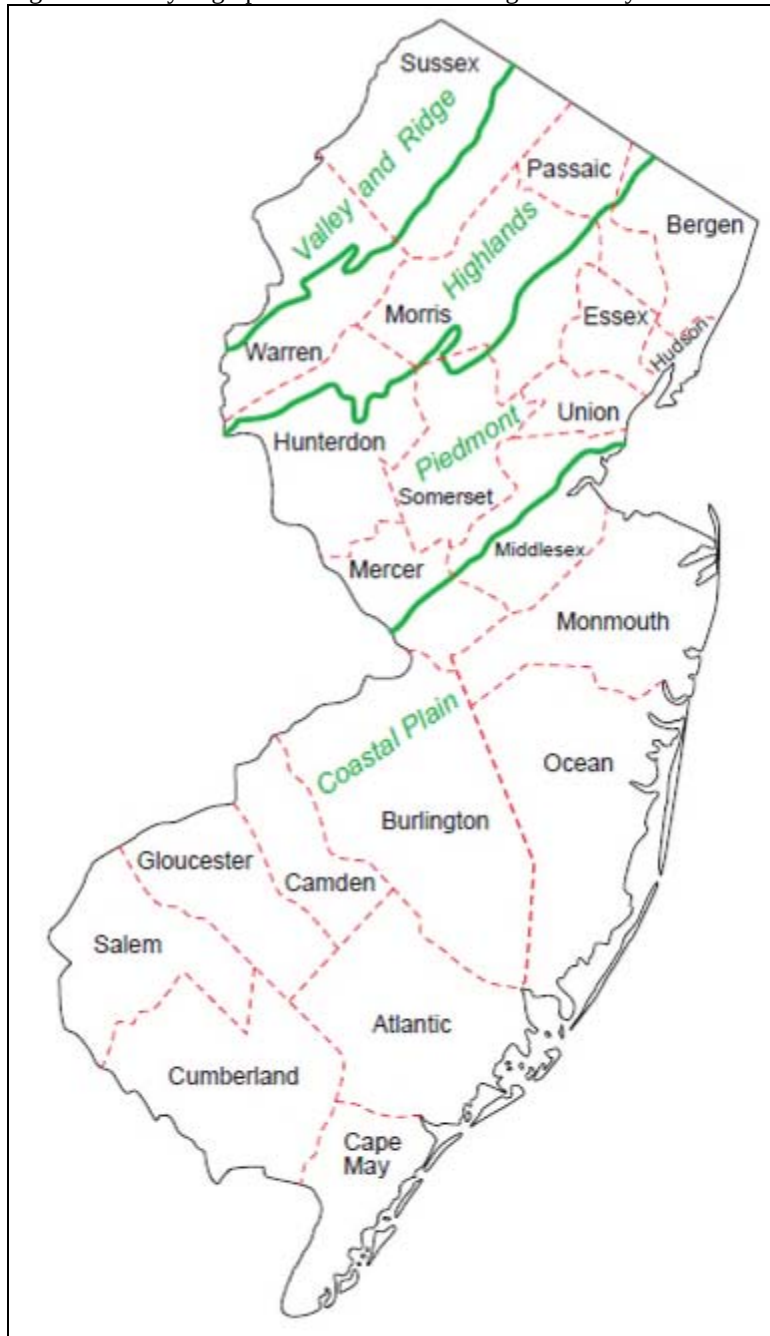


Source: NJDEP

Topography and Geology

Burlington County lies within the Atlantic Coastal Plain. The lowest part of the County is sea level at the Delaware River and the highest point is Arneys Mount, located in the Township of Springfield, at an elevation of approximately 260 feet above sea level (FEMA FIS, 2010). The Atlantic Coastal Plain is one of the four major physiographic regions of New Jersey (Figure 4-5). The unconsolidated deposits of the Coastal Plain dip gently to the southeast and range in age from the upper Cretaceous to Miocene (90 to 10 million years old) (Dalton, 2003).

Figure 4-5. Physiographic Provinces in Burlington County



Source: Dalton, 2003

According to the New Jersey Geological Survey (NJGS), the Coastal Plain begins with a broad trough that extends along the southern border of the Piedmont Province from the Raritan Bay to Trenton. Near Monmouth Junction the trough floor forms a saddle and it reaches an elevation of about 80 feet. East of that depression is a drainage divide between the Delaware River and Atlantic Ocean. The maximum elevation of the Coastal Plain, located at Crawford Hill, is 391 feet. The streams that flow northwest to the Delaware have narrow valleys, are shorter and have steeper gradients than streams that flow northwest to the Delaware which are shorter and have steeper gradients than the streams that flow southeast. The Highlands of Navesink at 266 feet above sea level is the highest point directly on the coast (Dalton, 2003).

Like New Jersey, Burlington County has distinct geological regions within the County. The Coastal Plain is divided into three subdivisions including the inner lowland, the inner upland, and the outer lowland. In Burlington County the inner lowland is the area bordering the Delaware River, where elevations rarely exceed 100 feet above sea level. Streams in this inner lowland area drain to the Delaware River (Lucey, 1977).

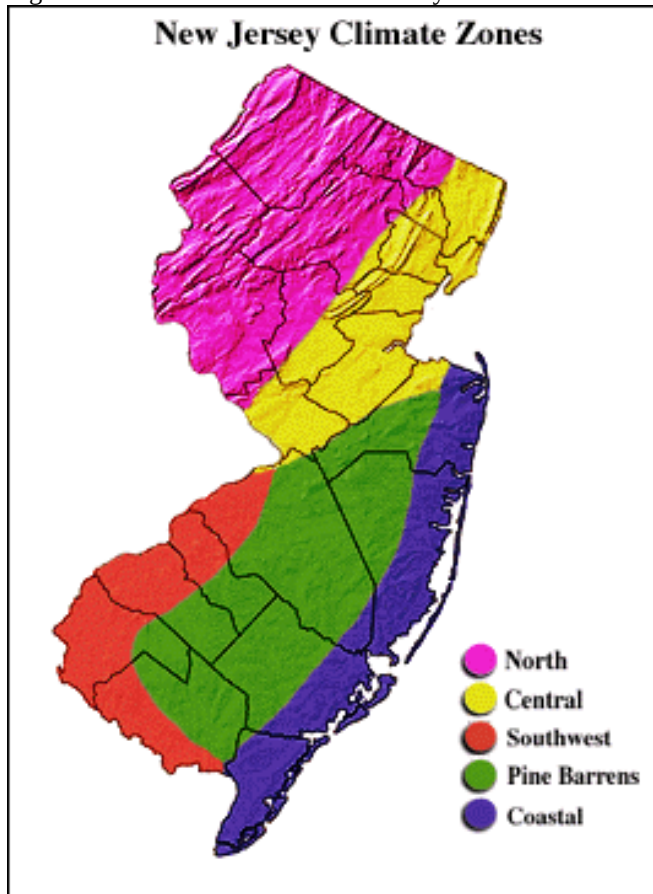
The inner upland forms the drainage divide in the county and is a narrow, slightly dissected cuesta with some elevations up to 200 feet. Erosional remnants for the prominent hills of Mount Holly, Juliustown, and Arney's Mount. The sands and gravel in these hills, in addition to having been protected by capping gravels, have frequently been partially cemented by iron-oxide precipitated by water percolating down through the ground (Lucey, 1977).

Southern Burlington County lies within the outer lowland where elevations rarely exceed 50 feet. Streams within this subprovince empty into the Atlantic Ocean. Sloping gently towards the sea, the flat terrain of this area has been slightly modified by the Mullica, Wading, and Bass Rivers (Lucey, 1977).

Climate

New Jersey is located about halfway between the equator and the North Pole, on the eastern coast of the U.S. Due to its geographic location, New Jersey is influenced by wet, dry, hot, and cold airstreams, creating a highly variable climate (ONJSC, Date Unknown). Five climate zones make up New Jersey – North, Central, Southwest, Pine Barrens, and Coastal. Figure 4-6 illustrates the climate zones of New Jersey.

Figure 4-6. Climate Zones in New Jersey



Source, ONJSC, 2013

As shown of Figure 4-6, Burlington County primarily located within the Pine Barrens zone, with the southeastern tip of the County located in the Coastal zone and the north and northwest portions in the central and southwest climate regions. Details regarding these climate zones are described below.

- Pine Barrens Climate Zone - Scrub pine and oak forests dominate the interior southern portion of New Jersey, hence the name, Pine Barrens. Sandy soils, which are porous and not very fertile, have a major effect on the climate of this region. On clear nights, solar radiation absorbed during the day is quickly radiated back into space, resulting in surprisingly low minimum temperatures. Atlantic City Airport, which is surrounded by sandy soil, can be 15-20 degrees cooler than the Atlantic City Marina on the bay, which is only about thirteen miles away.

The porous soil permits any precipitation to rapidly infiltrate and leave surfaces quite dry. Drier conditions allow for a wider range between the daily maximum and minimum temperatures, and make the area vulnerable to forest fires.

- Southwest Climate Zone - lies between sea level and approximately 100 feet above sea level. The close proximity to Delaware Bay adds a maritime influence to the climate of this region. The Southwest has the highest average daily temperatures in the state and without sandy soils, tends to have higher nighttime minimum temperatures than in the neighboring Pine Barrens (ONJSC, 2013).

This region receives less precipitation than the Northern and Central regions of the state as there are no orographic features and, it is farther away from the Great Lakes-St. Lawrence storm track. It is also far enough inland to be away from the heavier rains from some coastal storms, thus it receives less precipitation than the Coastal Zone (ONJSC, 2013).

Prevailing winds are from the southwest, except in winter when west to northwest winds dominate. High humidity and moderate temperatures prevail when winds flow from the south or east. The moderating effect of the water also allows for a longer growing season. Autumn frosts usually occur about four weeks later here than in the North and the last spring frosts are about four weeks earlier, giving this region the longest growing season in New Jersey (ONJSC, 2013).

- Coastal Climate Zone - In autumn and early winter, when the ocean is warmer than the land surface, the Coastal Zone will experience warmer temperatures than interior regions of the state. In the spring months, ocean breezes keep temperatures along the coast cooler. Being adjacent to the Atlantic Ocean, with its high heat capacity (compared to land), seasonal temperature fluctuations tend to be more gradual and less prone to extremes.

Sea breezes play a major role in the coastal climate. When the land is warmed by the sun, heated air rises, allowing cooler air at the ocean surface to spread inland. Sea breezes often penetrate 5-10 miles inland, but under more favorable conditions, can affect locations 25-40 miles inland. They are most common in spring and summer.

Burlington County has a temperate climate with warm summers and moderate winters. The annual precipitation averages approximately 43 inches, which is generally distributed evenly throughout the year (FEMA FIS, 2010).

Land Use and Land Cover

Burlington County's land area is occupied and utilized in several different ways. This includes agricultural land, barren land, forested land, urban land, and wetlands. In 2002, 19.2 percent of the land in Burlington County was used for residential, industrial, transportation, and recreational purposes. Compared to the 2007 figures which indicate that 20.9 percent of the County was developed for these purposes, it is clear that there has been an increase in urban land use. Also in 2002 38.1 percent was forested land; 11.2 percent was agricultural land; 31.1 percent was wetlands; and 0.9 percent was barren land. When compared with the land use land cover data set from 2007, there has been a decrease in agricultural land to 10.7 percent, barren land to 0.7 percent, forest to 37.2 percent and wetlands to 30.8 percent with an increase in urban land use to 20.8 percent. Refer to Table 4-1 and Figure 4-7 below.

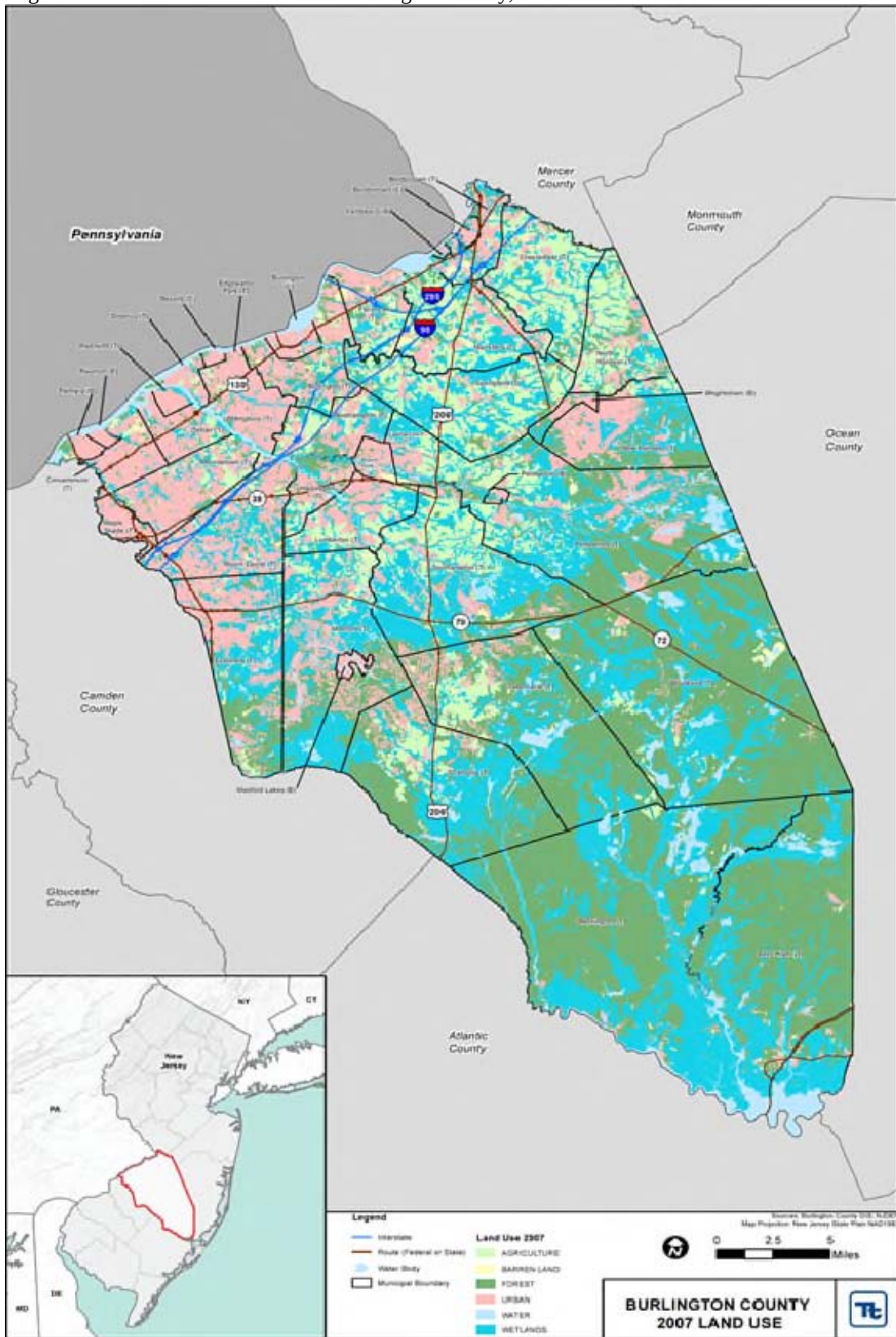
Table 4-1. Land Use Summary for Burlington County, 2002 – 2007

Land Use Category	2002 Data		2007 Data	
	Acreage	Percent of Burlington County	Acreage	Percent of Burlington County
Agriculture	58,752.14	11.2%	55,913.59	10.7%
Barren	4,774.41	0.9%	3,844.03	0.7%
Forest	199,395.22	38.1%	194,865.09	37.2%
Wetlands	163,077.85	31.1%	161,619.96	30.8%
Urban	100,758.59	19.2%	109,688.86	20.9%

Source:

Note: Urban land includes residential, industrial, transportation, and recreational land. Water is excluded from the table above.

Figure 4-7. Land Use Land Cover for Burlington County, 2007 Data



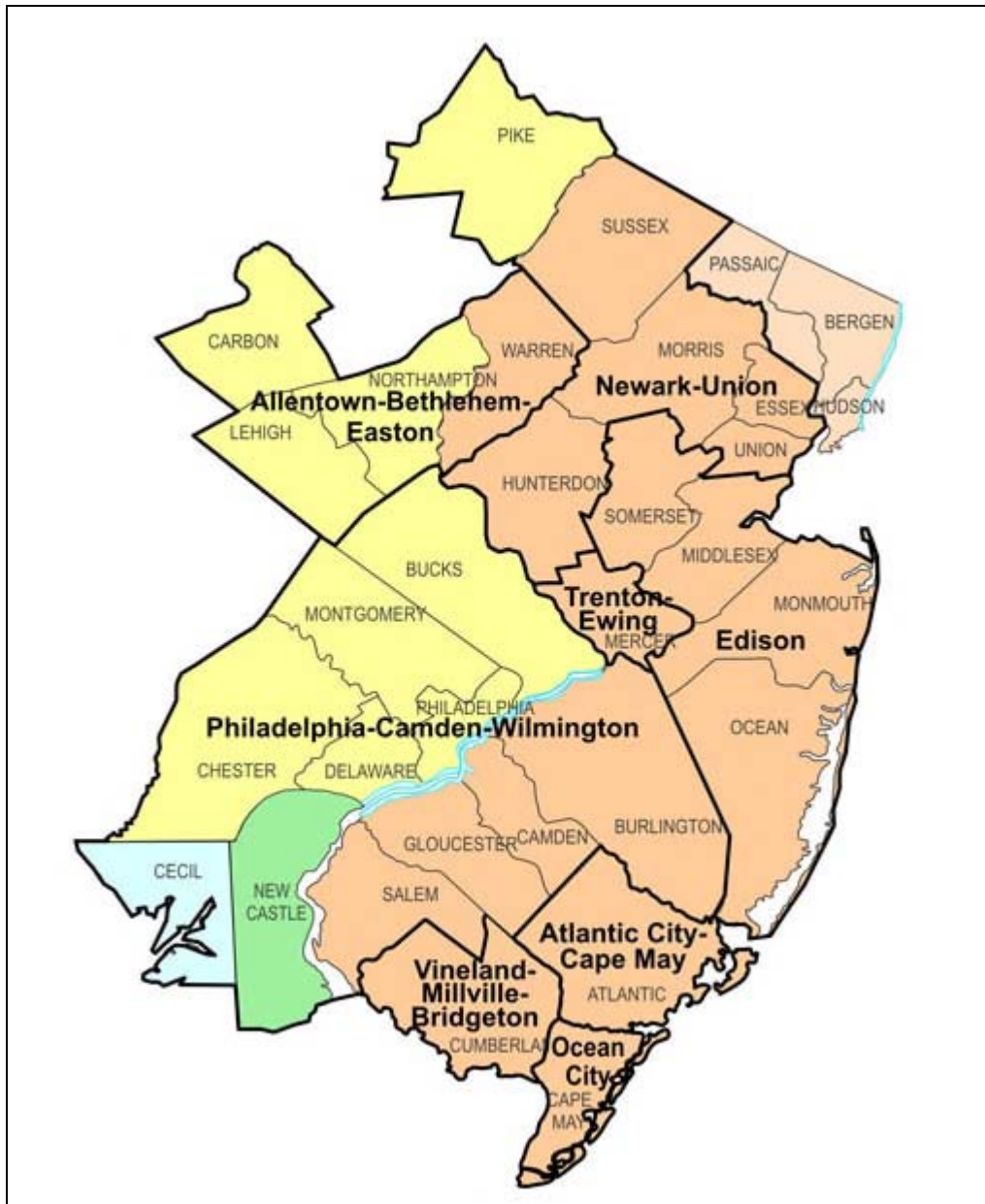
Source: NJDEP

Metropolitan/Urban Area

The Census Bureau classifies ‘urban’ as all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC). It delineates UA and UC boundaries to encompass densely settled territory, which consist of core census block groups or blocks that have a population density of at least 1,000 people per square mile; and surrounding census blocks that over an overall density of at least 500 people per square mile. An urbanized area is a densely populated area with a population density of more than 1,000 people per square mile and a population of more than 50,000 (Demographia, 2001). Urban clusters are defined in the same manner as urbanized areas; however, an urban cluster has a population density of 2,500 people per square mile and a population of more than 50,000 (Center for Information Development and Service, Date Unknown). With a population of over 448,000 and a population density of approximately 500 people per square mile, Burlington County is not considered an urban area.

Burlington County is one of the 12 counties within the Philadelphia-Camden-Wilmington Metropolitan Statistical Area, which is the sixth most populous metropolitan area in the United States. The MSA has a 2010 population of 5,965,343, which includes Burlington County. The MSA also has approximately 4,377 square miles of land. (U.S. Census Bureau). This metropolitan area is made up of 5 divisions as indicated in Figure 4-8.

Figure 4-8. Philadelphia-Camden-Wilmington Metropolitan Statistical Area, PA-NJ-DE-MD Metropolitan Statistical Area



Source: Federal Reserve Bank of Philadelphia, Date Unknown

POPULATION AND DEMOGRAPHICS

According to the 2010 U.S. Census, Burlington County had a population of 448,734 people. This is in agreement with the data included in HAZUS-MH which is based on the 2000 U.S. Census data. Table 4-2 presents the population statistics for Burlington County based on the 2000 U.S. Census data. Figure 4-9 shows the distribution of the general population density (persons per square mile) by Census block. For the purposes of this plan, data available in HAZUS-MH are used (representing 2000 data). This data is considered appropriate given the relatively small population increase between 2000 and 2008.

DMA 2000 requires that HMPs consider socially vulnerable populations. These populations can be more susceptible to hazard events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For the purposes of this study, vulnerable populations shall include (1) the elderly (persons aged 65 and over) and (2) those living in low-income households.

Table 4-2. Burlington County Population Statistics (2010 U.S. Census)

Municipality	Census 2000 Total Pop.	Census 2010 Total Pop.	Pop. 65+ Census 2010		Pop. 65+ HAZUS-MH		Low-Income Pop. ** HAZUS-MH	
			Total	% of Total	Total	% of Total	Total	% of Total
Bass River, Township of	1,510	1,443	187	13	178	11.8	129	8.5
Beverly, City of	2,661	2,577	292	11.3	312	11.7	271	10.2
Bordentown, City of	3,969	3,924	528	13.5	547	13.8	520	13.1
Bordentown, Township of	8,380	11,367	1,207	10.6	986	11.8	564	6.7
Burlington, City of	9,736	9,920	1,556	15.7	1,678	17.2	1,269	13.0
Burlington, Township of	20,294	22,594	2,719	12.0	2,603	12.8	1,537	7.6
Chesterfield, Township of	5,955	7,699	415	5.4	283	4.8	72	1.2
Cinnaminson, Township of	14,595	15,569	2,839	18.2	2,787	19.1	726	5.0
Delanco, Township of	3,237	4,283	689	16.1	421	13.0	332	10.3
Delran, Township of	15,536	16,896	2,009	11.9	1,678	10.8	1,185	7.6
Eastampton, Township of	6,202	6,069	283	4.7	452	7.3	423	6.8
Edgewater Park, Township of	7,864	8,881	1,403	15.8	1,014	12.9	876	11.1
Evesham, Township of	42,275	45,538	5,961	13.1	3,795	9.0	2,134	5.0
Fieldsboro, Borough of	522	540	57	10.6	39	7.5	18	3.4
Florence, Township of	10,746	12,109	1,534	12.7	1,277	11.9	956	8.9
Hainesport, Township of	4,126	6,110	874	14.3	499	12.1	233	5.6
Lumberton, Township of	10,461	12,559	1,312	10.4	1,106	10.6	952	9.1
Mansfield, Township of	5,090	8,544	2,382	27.9	1,566	30.8	501	9.8
Maple Shade, Township of	19,079	19,131	2,530	13.2	2,894	15.2	2,321	12.2
Medford Lakes, Borough of	4,173	4,146	611	14.7	513	12.3	122	2.9
Medford, Township of	22,253	23,033	3,212	13.9	2,295	10.3	835	3.8
Moorestown, Township of	19,017	20,726	3,360	16.2	3,123	16.4	1,126	5.9
Mount Laurel, Township of	40,221	41,864	6,723	16.1	1,312	12.2	1,204	11.2
Mt. Holly, Township of	10,728	9,536	1,054	11.1	6,001	14.9	2,873	7.1
New Hanover, Township of	9,744	7,385	276	3.7	91	0.9	258	2.6
North Hanover, Township of	7,347	7,678	648	8.4	443	6.0	834	11.4
Palmyra, Borough of	7,091	7,398	973	13.2	937	13.2	677	9.5

Table 4-2. Burlington County Population Statistics (2010 U.S. Census)

Municipality	Census 2000 Total Pop.	Census 2010 Total Pop.	Pop. 65+ Census 2010		Pop. 65+ HAZUS-MH		Low-Income Pop. ** HAZUS-MH	
			Total	% of Total	Total	% of Total	Total	% of Total
Pemberton, Borough of	1,210	1,409	187	13.3	104	8.6	142	11.7
Pemberton, Township of	28,691	27,912	3,257	11.7	2,736	9.5	2,535	8.8
Riverside, Township of	7,911	8,097	850	10.5	1,082	13.7	881	11.1
Riverton, Borough of	2,759	2,779	498	17.9	537	19.5	214	7.8
Shamong, Township of	6,462	6,409	636	9.8	376	5.8	301	4.7
Southampton, Township of	10,388	10,464	3,347	32.0	3,498	33.7	1,509	14.5
Springfield, Township of	3,227	3,414	453	13.3	346	10.7	116	3.6
Tabernacle, Township of	7,170	6,949	777	11.2	489	6.8	319	4.4
Washington, Township of	621	1,781***	N/A	N/A	133	21.4	53	8.5
Westampton, Township of	7,217	8,813	914	10.4	656	9.1	331	4.6
Willingboro, Township of	33,008	31,629	5,037	15.9	4,210	12.8	1,657	5.0
Woodland, Township of	1,170	1,788	187	10.5	94	8.0	50	4.3
Wrightstown, Borough of	746	802	63	0.07	66	8.8	164	21.9
Burlington County	423,394	448,734	26,231	5.8	53,157	12.6	31,220	7.4

Source: Census 2010 (U.S. Census Bureau); HAZUS-MH

Note: Pop. = population

* Individuals below poverty level (2012 Census poverty threshold for a 3-person family unit is \$17,959)

** Households with an income of less than \$20,000

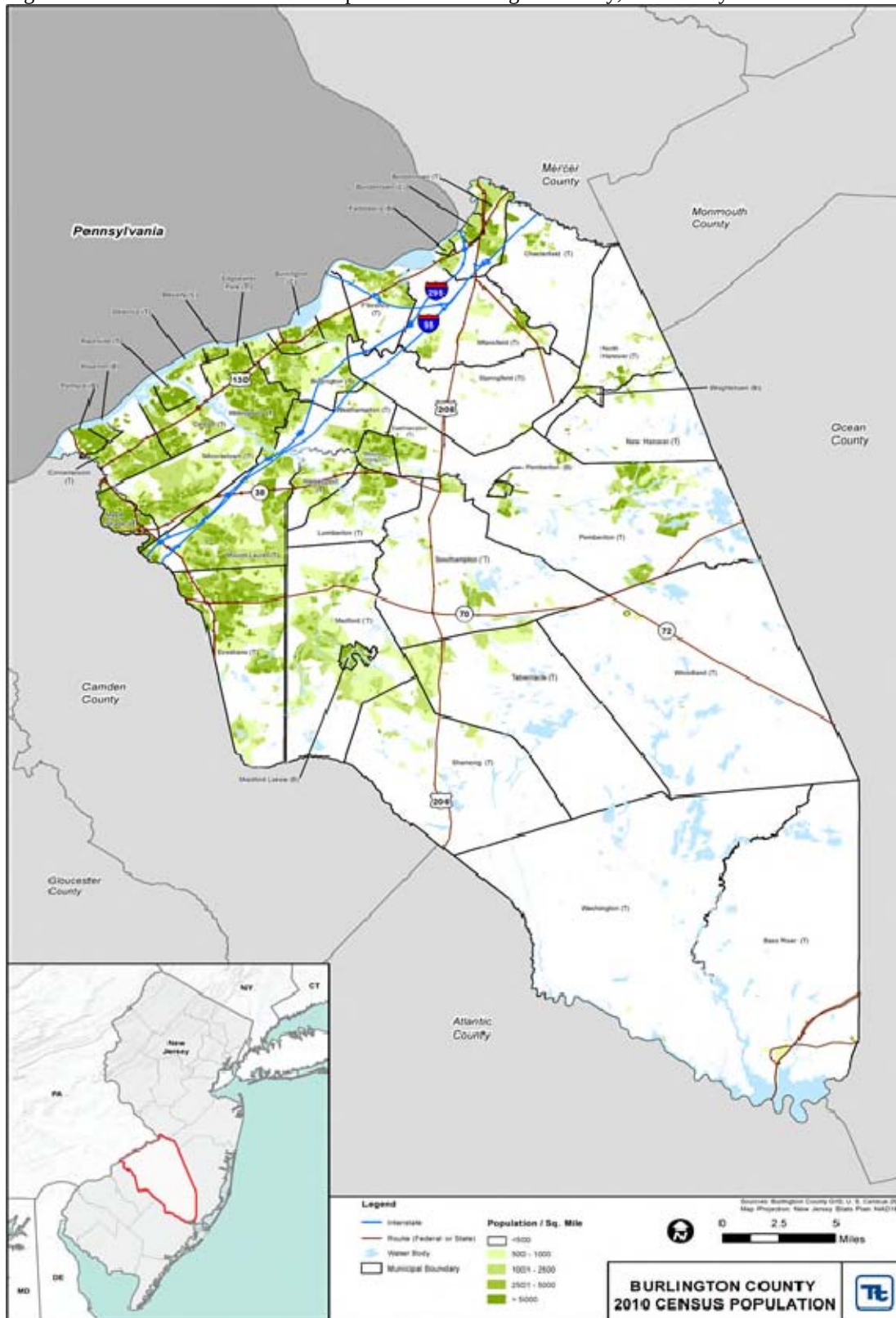
*** 2010 Census Data not available

It is noted that the census data for household income provided in HAZUS-MH includes two ranges (\$0-10,000 and \$10,000-\$20,000/year) that were totaled to provide the “low-income” data used in this study. This does not correspond exactly with the “poverty” thresholds established by the U.S. Census Bureau, which identifies households with an annual household income below \$17,959 per year as “low income”. This difference is not believed to be significant for the purposes of this planning effort.

The 2010 U.S. Census data also identified 9,337 of the 165,727 households as having an annual income of less than \$15,000. The 2010 U.S. Census data indicates a total of 3.7 percent persons living in households below the poverty level. Figure 4-10 shows the distribution of persons over age 65 in Burlington County, while Figure 4-11 shows the distribution of low income persons.

The following maps indicate distribution based on Census Block designations.

Figure 4-9. Distribution of General Population for Burlington County, New Jersey



Source: U.S. Census, 2010; Burlington County Department of Information Technology, 2013

Figure 4-10. Distribution of Persons over the Age of 65 in Burlington County, New Jersey

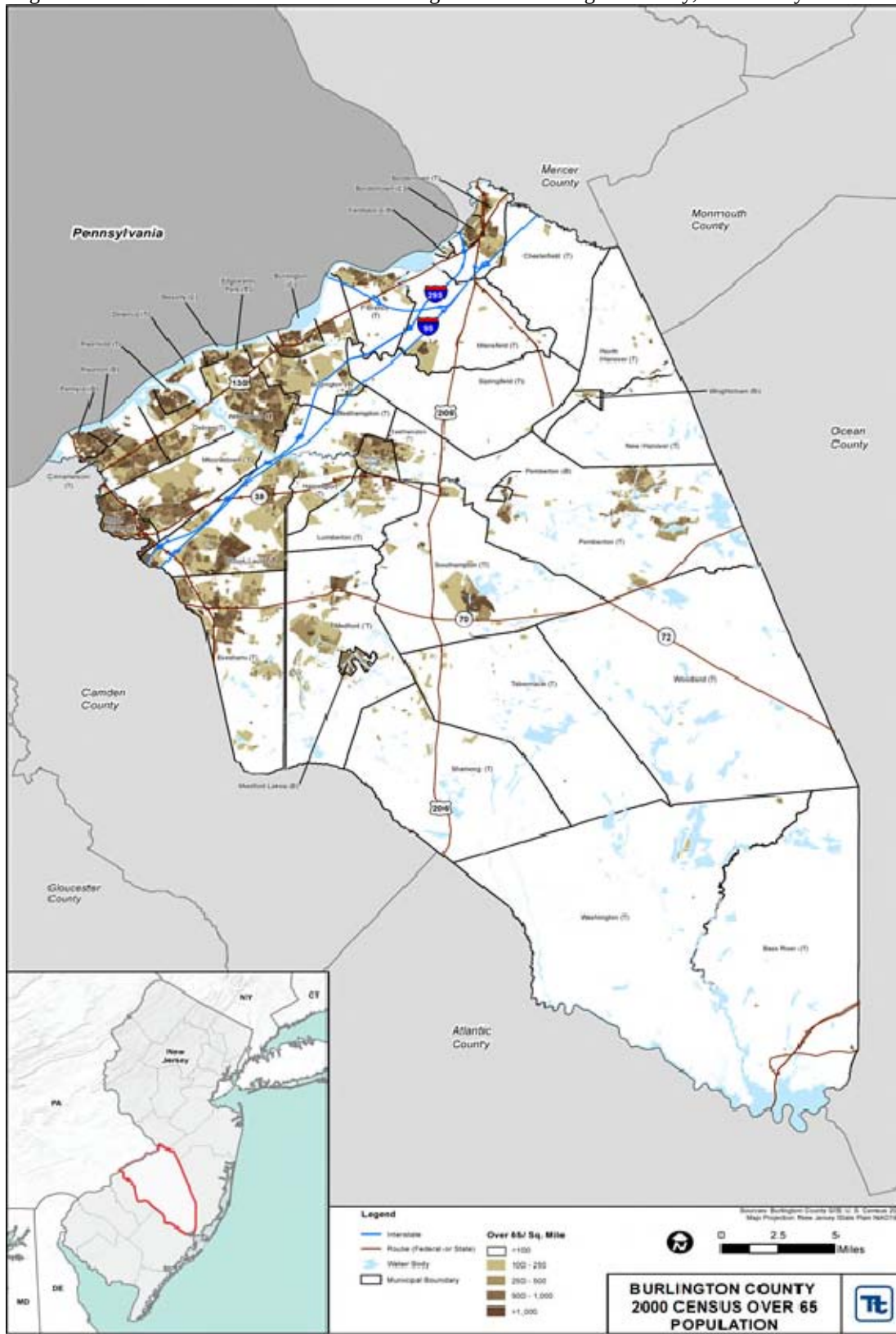
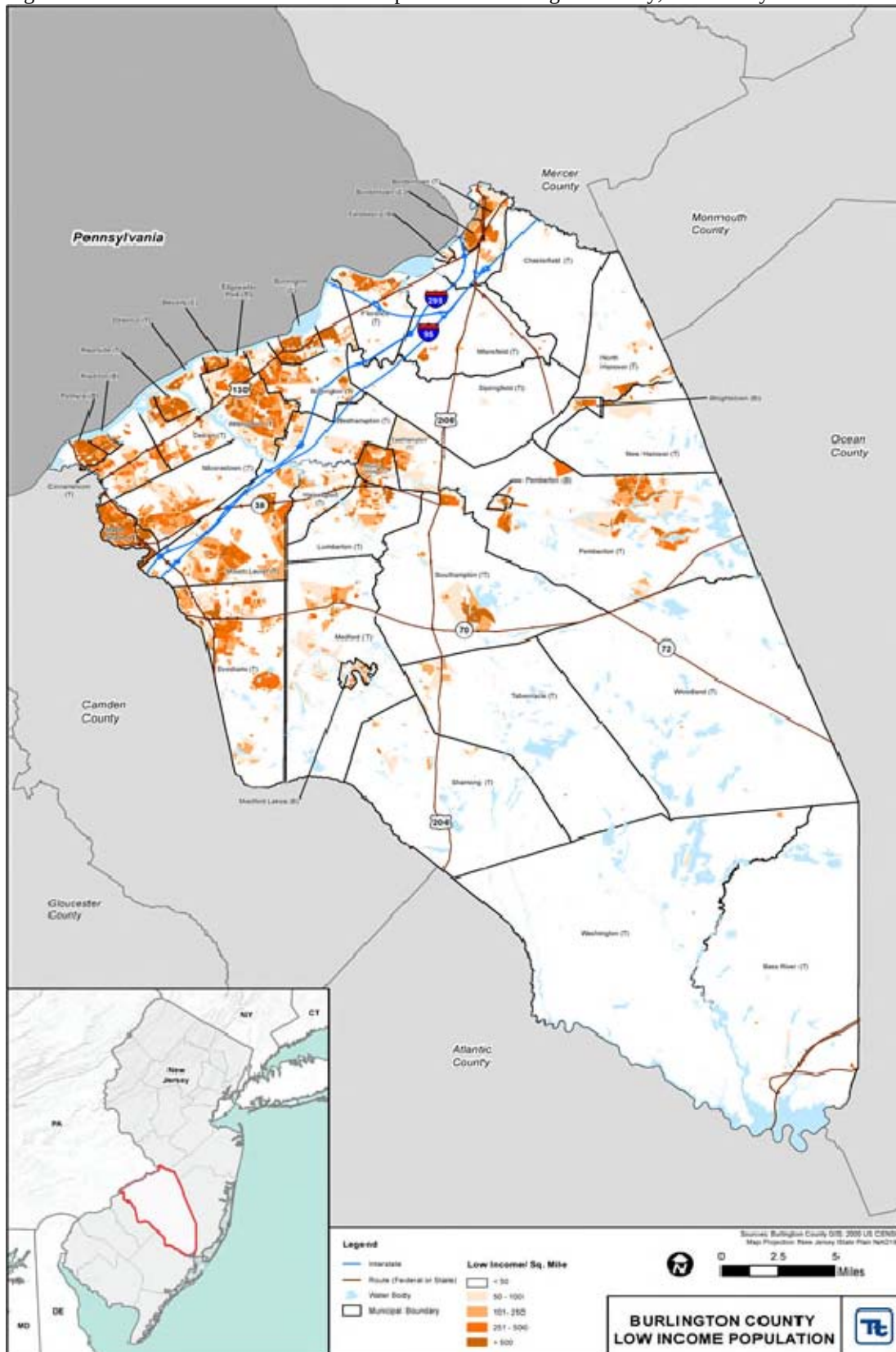


Figure 4-11. Distribution of Low-Income Population in Burlington County, New Jersey



Source: HAZUS-MH v2.1 (U.S. Census 2000); Burlington County Department of Information Technology, 2013

GENERAL BUILDING STOCK

The 2010 U.S. Census data identifies 165,727 households in Burlington County. The U.S. Census data identified 175,615 housing units in Burlington County in 2010. U.S. Census defines household as all the persons who occupy a housing unit, and a housing unit as a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. Therefore, you may have more than one household per housing unit. The median price of a single family home in Burlington County was estimated at \$266,200 in 2010 (U.S. Census, 2010).

For this update, the default general building stock in HAZUS-MH was updated and replaced with a custom building inventory for Burlington County both at the aggregate and structure level. The updated building inventory was built using detailed the building footprints, parcels and structure-specific building attributes. Burlington County has a total building replacement value (structure and content) of greater than \$62 billion. The Residential value makes up approximately 66 percent of the total replacement value. Table 4-3 presents replacement value statistics by occupancy class for Burlington County.

Table 4-3. Replacement Value by Occupancy Class

Municipality	Total Value (\$)	Residential Value (\$)	Commercial Value (\$)	Industrial Value (\$)
Bass River, Township of	158,762,000	134,280,000	8,960,000	8,881,000
Beverly, City of	351,041,000	211,485,000	42,402,000	12,110,000
Bordentown, City of	611,161,000	393,737,000	117,107,000	50,766,000
Bordentown, Township of	1,225,803,000	903,108,000	220,201,000	68,495,000
Burlington, City of	1,419,313,000	895,758,000	290,972,000	102,300,000
Burlington, Township of	3,257,758,000	2,149,795,000	679,704,000	337,950,000
Chesterfield, Township of	482,451,000	371,435,000	44,405,000	38,364,000
Cinnaminson, Township of	2,375,176,000	1,558,313,000	442,538,000	288,978,000
Delanco, Township of	484,972,000	280,667,000	103,359,000	70,705,000
Delran, Township of	2,136,079,000	1,472,600,000	468,253,000	146,919,000
Eastampton, Township of	712,944,000	574,509,000	111,502,000	10,723,000
Edgewater Park, Township of	959,473,000	676,157,000	226,250,000	24,854,000
Evesham, Township of	6,451,252,000	4,329,209,000	1,717,652,000	196,098,000
Fieldsboro, Borough of	72,125,000	47,990,000	10,076,000	13,385,000
Florence, Township of	1,509,320,000	1,067,122,000	284,106,000	83,176,000
Hainesport, Township of	839,062,000	456,922,000	252,662,000	91,662,000
Lumberton, Township of	1,504,149,000	1,103,604,000	287,992,000	71,839,000
Mansfield, Township of	1,954,839,000	496,770,000	108,397,000	57,324,000
Maple Shade, Township of	2,346,098,000	1,768,629,000	398,767,000	109,931,000
Medford Lakes, Borough of	560,603,000	490,414,000	47,793,000	11,651,000
Medford, Township of	3,746,510,000	2,588,143,000	810,838,000	203,659,000
Moorestown, Township of	4,209,509,000	2,287,551,000	1,321,969,000	480,134,000
Mount Laurel, Township of	1,650,406,000	889,208,000	519,325,000	57,566,000
Mt. Holly, Township of	6,985,988,000	4,557,995,000	1,858,942,000	380,655,000
New Hanover, Township of	1,604,641,000	654,346,000	889,210,000	14,088,000
North Hanover, Township of	685,211,000	494,808,000	123,203,000	18,499,000
Palmyra, Borough of	942,785,000	698,649,000	146,581,000	54,794,000
Pemberton, Borough of	187,379,000	111,910,000	21,094,000	17,622,000
Pemberton, Township of	3,248,981,000	2,362,804,000	522,834,000	117,508,000
Riverside, Township of	885,809,000	616,519,000	116,517,000	115,110,000
Riverton, Borough of	352,198,000	278,143,000	44,932,000	9,481,000

Table 4-3. Replacement Value by Occupancy Class

Municipality	Total Value (\$)	Residential Value (\$)	Commercial Value (\$)	Industrial Value (\$)
Shamong, Township of	797,191,000	633,573,000	100,152,000	36,582,000
Southampton, Township of	1,305,540,000	1,046,641,000	167,145,000	52,202,000
Springfield, Township of	461,104,000	327,153,000	74,986,000	25,802,000
Tabernacle, Township of	931,897,000	690,371,000	108,842,000	54,611,000
Washington, Township of	108,601,000	59,581,000	21,488,000	8,039,000
Westampton, Township of	1,326,163,000	731,320,000	360,816,000	129,563,000
Willingboro, Township of	3,602,996,000	2,989,638,000	394,480,000	55,946,000
Woodland, Township of	115,483,000	104,125,000	5,206,000	918,000
Wrightstown, Borough of	140,021,000	65,089,000	50,254,000	496,000
Burlington County	62,700,794,000	41,570,071,000	13,521,912,000	3,629,386,000

Source: HAZUS-MH v2.1 (U.S. Census 2000)

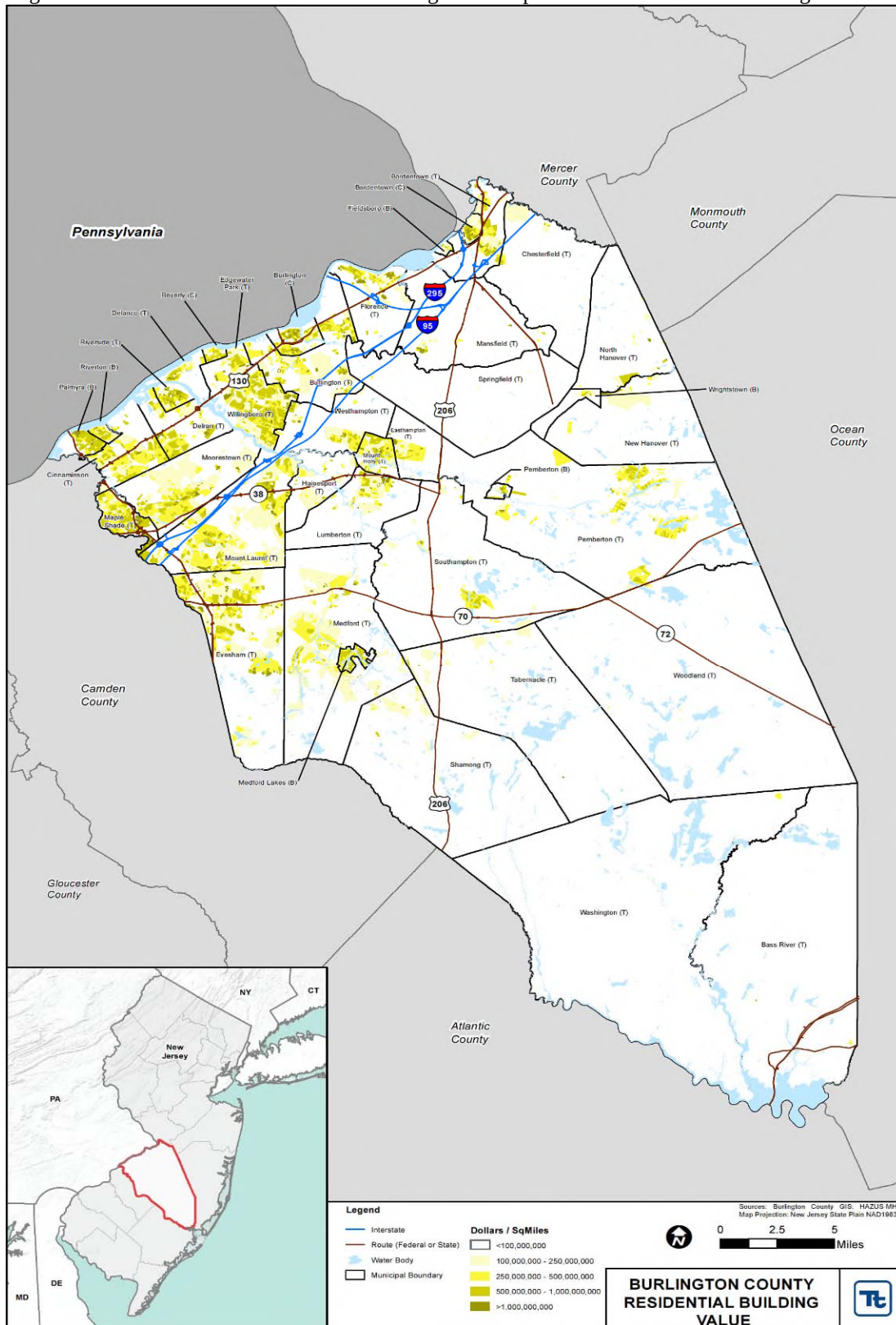
Note: Value reflects the replacement cost for building structure and contents. Generally, contents for residential structures are valued at about 50 percent of the building's value. For non-residential facilities, the value of the content is generally about equal to the building's structural value.

The 2010 Census data identify that the majority of housing units (61.7 percent) in Burlington County are single-family detached units. The 2011 U.S. Census Bureau's County Business Patterns data identified 10,330 business establishments employing 173,807 people in Burlington County. The majority (5,494) of these establishments employed between one and four employees.

Figure 4-12 through Figure 4-14 show the distribution and exposure density of residential, commercial and industrial buildings in Burlington County. Exposure density is the dollar value of structures per unit area, including building content value. Generally, contents for residential structures are valued at about 50 percent of the building's value. For commercial facilities, the value of the content is generally about equal to the building's structural value. Actual content value varies widely depending on the usage of the structure. The densities are shown in units of \$1,000,000 (\$M) per square mile.

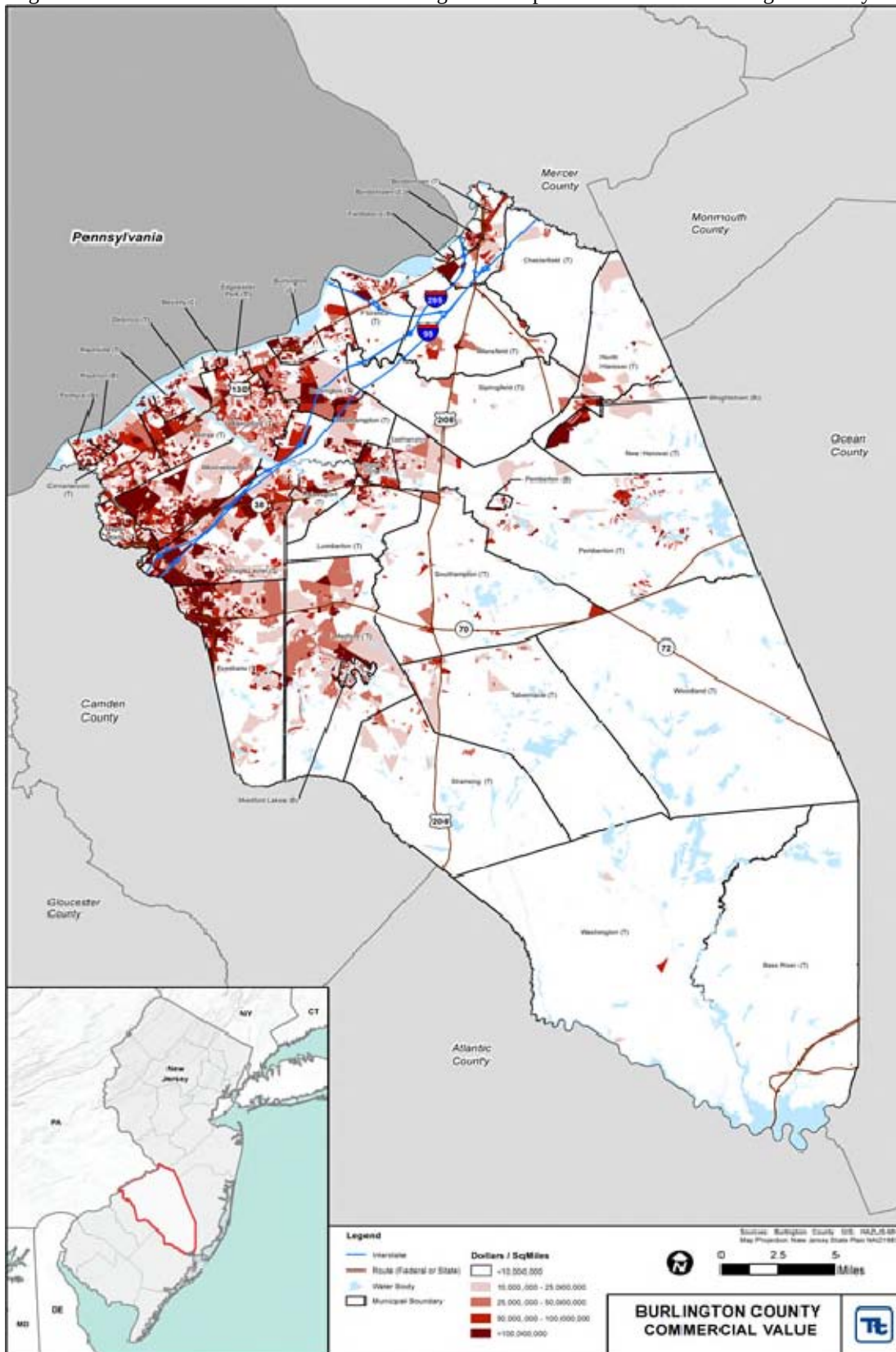
Viewing exposure distribution maps, such as Figures 4-12 through 4-14, can assist communities in visualizing areas of high exposure and in evaluating aspects of the study area in relation to the specific hazard risks.

Figure 4-12. Distribution of Residential Building Stock Replacement Cost Value in Burlington County



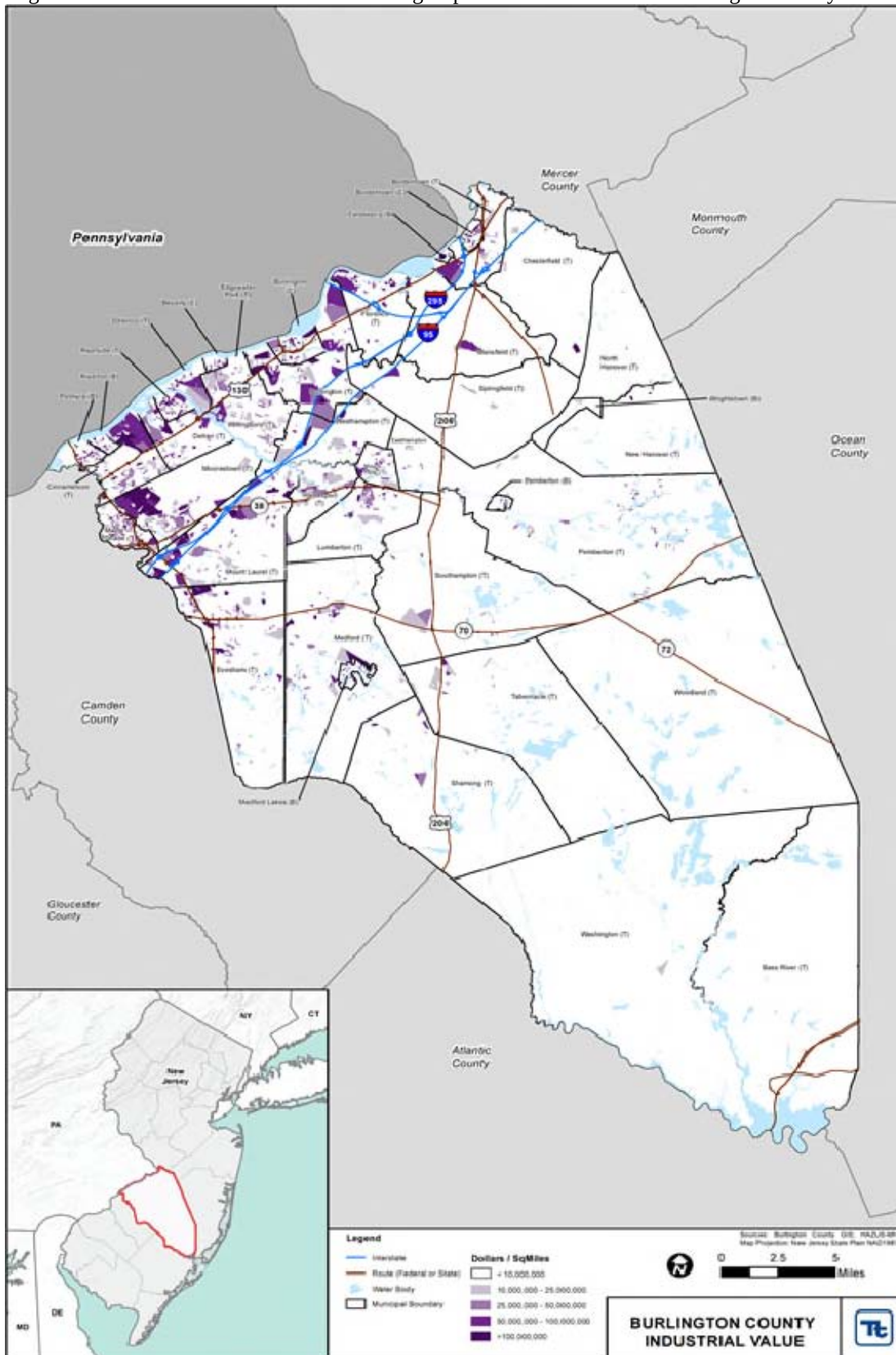
Source: HAZUS-MH v2.1

Figure 4-13. Distribution of Commercial Building Stock Replacement Value in Burlington County



Source: HAZUS-MH v2.1

Figure 4-14. Distribution of Industrial Building Replacement Cost Value in Burlington County



Source: HAZUS-MH v2.1

LAND USE AND POPULATION TRENDS

Local zoning and planning authority is provided for under the New Jersey Municipal Land Use Law, which gives municipalities zoning and planning authority. DMA 2000 requires that communities consider land use trends, which can impact the need for, and priority of, mitigation options over time. Land use trends significantly impact exposure and vulnerability to various hazards. For example, significant development in a hazard area increases the building stock and population exposed to that hazard.

This plan provides a general overview of population and land use and types of development occurring within the study area. An understanding of these development trends can assist in planning for further development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community infrastructure.

Land Use Trends

Since large portions of Burlington County are rural, there is an emphasis of preserving many of the natural resources in the County. Future development must balance the need for preserved lands as well as the demands of a growing county. This requires cooperation amongst the County Board of Chosen Freeholders, the community, and key development stakeholders in the County.

According to the Northern Burlington County Growth and Preservation Plan (2008), a balanced approach to growth is needed. Specific elements of this plan call for the preservation of farmland and open space, new development that occurs in the form of livable, lively hamlets, villages and towns which avoid low-density development. Additionally, public utilities must be provided in a manner in which it is cost effective and predictable. Another element of the vision is a community designed to accommodate a diverse set of economic and social backgrounds. According to the plan, development should also be clustered around transportation modes, and it should encourage agricultural preservation.

Agricultural Land

New Jersey is the most densely populated state in the nation. Farmland is disappearing at an average rate of 10,000 acres a year. Fields where dairy cows once grazed and peach trees once blossomed are now home to shopping malls, houses and highways (New Jersey Agricultural Preservation, Date Unknown).

Agriculture in Burlington County predates the arrival of European settlers. Native Americans farmed in the region, originally named Matinicum, at the time British Quakers arrived in the New World in the early 1600s. Native Americans cultivated a number of crops and, understanding the limitations of soils, rotated fields in order to prevent the depletion of soils. As early European settlers arrived, they were able to begin cultivation on small fields utilized by Native Americans immediately rather than having to clear forested lands. An abundance of good agricultural soils and proximity to major urban centers contributed significantly to the development of the county's early agricultural industry (Burlington County Agricultural Development Board, 2008).

Agricultural land is used primarily for the production of food and fiber. This includes cropland, pastureland, and orchards. According to the NJDEP, agricultural land includes pasturelands and grazing lands associated with horse or cattle raising operations, orchards, vineyards, nurseries and other horticultural areas. Other lands used in support of agricultural activities, such as farmsteads, associated barns, stables, and corrals, are also included (NJDEP, 2007).

Agriculture is an integral part of the natural landscapes that comprise the County. Burlington County's natural and agricultural landscapes are attractive to many farmers. According to the 2007 Census of Agriculture, there were 85,790 acres of farmland in the County, or approximately 16 % of the total lands in the County. This is significantly less than the 2002 survey which indicated that there were 111,237 acres of farmland or 21% of the total lands in the County. In 2007, there were 922 active farms in the County. The number of farms is up from 2002 when there were 906 (1.8% increase). Table 4-4 outlines the number of farms, average farm size and total acreage of farms in Burlington County from 1900 to 2007.

Table 4-4. Farms in Burlington County, 1900 to 2007

Year	Number of Farms	Change in Number of Farms	% Difference	Average Farm Size (acre)	Change in Average Farm Size	% Difference	Total Acreage	Change in Total Acreage	% Difference
1900	2,549	-	-	135	-	-	343,096	-	-
1910	2,389	-160	-6.3%	121	-14	-10.4%	287,816	-55,280	-16.1%
1920	2,172	-217	-9.1%	125	4	3.3%	271,235	-16,581	-5.8%
1925	2,132	-40	-1.8%	86	-39	-31.2%	183,940	-87,295	-32.2%
1930	1,948	-184	-8.6%	94	8	9.3%	182,740	-1,200	-0.7%
1935	2,122	174	8.9%	103	9	9.6%	219,273	36,533	20.0%
1940	1,847	-275	-13.0%	171	68	66.0%	314,825	95,552	43.6%
1945	1,629	-218	-11.8%	108	-63	-36.8%	176,242	-138,583	-44.0%
1950	1,905	276	16.9%	111	3	2.8%	211,588	35,346	20.1%
1954	1,835	-70	-3.7%	113	2	1.8%	207,618	-3,970	-1.9%
1959	1,351	-484	-26.4%	137	24	21.2%	184,727	-22,891	-11.0%
1964	1,070	-281	-20.8%	154	17	12.4%	164,835	-19,892	-10.8%
1969	857	-213	-19.9%	166	12	7.8%	142,132	-22,703	-13.8%
1974	708	-149	-17.4%	202	36	21.7%	142,751	619	0.4%
1978	717	9	1.3%	181	-21	-10.4%	129,747	-13,004	-9.1%
1982	743	26	3.6%	152	-29	-16.0%	112,689	-17,058	-13.1%
1987	834	91	12.2%	124	-28	-18.4%	103,224	-9,465	-8.4%
1992	816	-18	-2.2%	119	-5	-4.0%	97,186	-6,038	-5.8%
1997	857	41	5.0%	121	2	1.7%	103,667	6,481	6.7%
2002	906	49	5.7%	123	2	1.7%	111,237	7,570	7.3%
2007	922	16	1.8%	93	-30	-24.4%	85,790	-25,447	-22.9%

Source(s): U.S. Department of Agriculture National Agricultural Statistics Service, 2007; Burlington County Comprehensive Farmland Preservation Plan, 2008

Table 4-5 outlines the top crop items grown in Burlington County, along with the number of acres devoted to these crops. The table indicates that soybeans for beans are the predominant crop in the County and ranks second in the State for total acres of soybeans.

Table 4-5. Burlington County Farmland by Crop (Acres): 2002 and 2007

Crop Type	2002	2007
Soybeans for beans	22,022	18,589
Corn for grain	7,226	8,342
Forage - land used for all hay and haylage, grass silage, and greenchop	7,011	6,035
Land in berries	5,774	4,912
Vegetables harvested for sale	4,548	4,309

Source: USDA, 2002; USDA 2007

With active agriculture extending from the Pinelands throughout northern Burlington County, the County has always been one of the leading agricultural counties in the nation. The largest blueberries in the world were developed and raised in Burlington County and the County is ranked as the second largest blueberry-producing and third largest cranberry-producing county in the U.S. There are more acres devoted to farming than any county in the state, primarily in vegetable, fruit and timber production (Burlington County HMP, 2008).

Burlington County has adopted a Comprehensive Farmland Preservation Plan which lays out a strategy for preservation of this vital resource. Over 26,500 acres have been permanently protected from conversion to nonagricultural uses through permanent deed-restrictions. In addition, roughly 23,000 acres of land in agricultural planning areas of the state-regulated New Jersey Pinelands have been deed-restricted through the Pinelands Development Credit Program. In total, nearly 50,000 acres (roughly 45 percent of the existing agricultural land base) have been protected from conversion to non-agricultural uses (Burlington County Agricultural Development Board, 2008) .

Pineland National Reserve

The Pinelands National Reserve (PNR) was created by Congress under the National Parks and Recreation Act of 1978. The PNR is the first National Reserve in the nation. The PNR encompasses approximately 1.1 million acres covering portions of seven counties and all or parts of 56 municipalities (NJ Pinelands Commission, 2013).

This internationally important ecological region is 1.1 million acres in size and occupies 22% of New Jersey's land area. It is the largest body of open space on the Mid-Atlantic seaboard between Richmond and Boston and is underlain by aquifers containing 17 trillion gallons of some of the purest water in the land (NJ Pinelands Commission, 2013).

Approximately 64 percent of Burlington County's land area is under the jurisdiction of the New Jersey Pinelands Commission. Fourteen of Burlington County's 40 municipalities have area within the Pinelands. In its 2004 long-term monitoring report, the Pinelands Commission estimated that, as of 2002, 23 percent of the county's population and 21 percent of the county's housing units were located within the Pinelands (Burlington County HMP, 2008). Figure 4-15 illustrates the location of and municipalities within the Pinelands.

Open Space

Open space is defined as a portion of a site which is permanently set aside for public or private use and will not be developed. The space may be used for passive or active recreation, or may be reserved to protect or buffer natural areas (Kwon et al., 2007). As of 2002, Burlington County had 1,500 preserved acres of land designated for open space. The Burlington County Freeholders have focused on expanding the parks system to include:

- Regional Parks
- Recreation Areas
- Natural Resource Areas
- Special Use Areas

Connectivity will be a high priority in park planning and design. Pathway facilities and linkages in the Burlington County Parks System will include:

- park trails
- connector trails
- bikeways
- water or canoe trails
- all terrain bike trails
- cross-country ski trails
- equestrian trails

The Burlington County Park System consists of 12 county parks and historic sites. Table 4-6 outlines locations included in the County park system, as well as State parks in the County. These parks range from small to large and feature aquatic features and hiking trails.

Table 4-6. County and State Parks in Burlington County

Park	Total Acreage
Amico Island Park**	55
Amphitheater**	Unknown
Anderson Farm**	125
Bass River State Forest *	29,147
Batsto Natural Area*	9,449
Boundary Creek Natural Resource Area**	35
Brendan T. Byrne State Forest*	37,242
Burlington County Community Agricultural Center**	Unknown
Cedar Swamp Natural Area	Unknown
County Fairgrounds**	61
Crystal Lake Park**	Unknown
Long Bridge Park**	115
Oswego River Natural Area	1,927
Penn State Forest *	3,366
Pennington Park**	140
Smithville Park**	280
Rancocas Nature Center **	210
Rancocas State Park (Hainesport)*	1,252

Table 4-6. County and State Parks in Burlington County

Park	Total Acreage
Willingboro Lakes Park**	105
Wharton State Forest*	115,111

Source: Burlington County, 2013

* New Jersey State Park

** Burlington County Park

Population Trends

This section discusses population trends to use as a basis for estimating future changes of the population and significantly change the character of the area. Population trends can provide a basis for making decisions on the type of mitigation approaches to consider and the locations in which these approaches should be applied. This information can also be used to support planning decisions regarding future development in vulnerable areas.

According to the U.S. Census Bureau Burlington County's 2010 population was 448,734 persons, which is a six-percent increase from the 2000 Census population of 423,394. From 1900 to 2010, the County has experienced a constant growth in population. The largest increase was seen between the years 1950 to 1960, when the County experienced a 65.2 percent (88,589 persons) population increase. From 1890 – 1900 the population decreased 0.5 percent (-287). Table 4-7 displays the population and population differences from 1900 to 2010 in Burlington County. Table 4-8 displays the population of the County's municipalities from 1940 to 2010. Figure 4-16 depicts the past, current, and projected population statistics/trends for the County.

Table 4-7. Burlington County Population Trends, 1900 to 2010

Year	Population	Change in Population	Percent (%) Population Change
1900	58,241	-	-
1910	66,565	8,324	14.3
1920	81,770	15,205	22.8
1930	93,541	11,771	14.4
1940	97,013	3,472	3.7
1950	135,910	38,897	40.1
1960	224,499	88,589	65.2
1970	323,132	98,633	43.9
1980	362,542	39,410	12.2
1990	395,066	32,524	9.0
2000	423,394	28,328	7.2
2010	448,734	25,340	6.0

Source: U.S. Census Bureau, 2010

Note: Change in population and percent in population change was calculated from available data

Table 4-8. Burlington County Resident Population by Municipality: 1940-2000

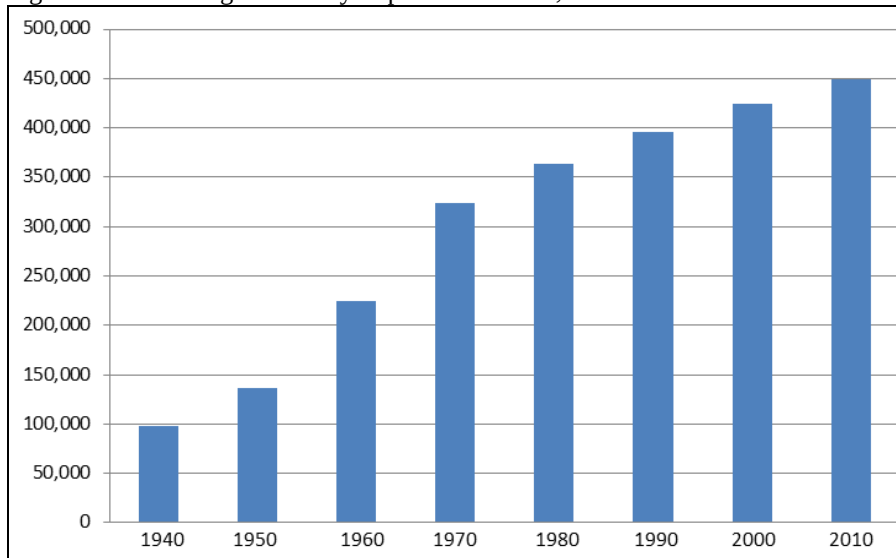
Municipality	1940	1950	1960	1970	1980	1990	2000	2010	Percent Change 2000 - 2010
Bass River, Township of	599	688	737	815	1,344	1,580	1,510	1,443	-4%
Beverly, City of	2,691	3,084	3,400	3,105	2,919	2,973	2,661	2,577	-3%

Table 4-8. Burlington County Resident Population by Municipality: 1940-2000

Municipality	1940	1950	1960	1970	1980	1990	2000	2010	Percent Change 2000 - 2010
Bordentown, City of	4,223	5,497	4,974	4,490	4,441	4,341	3,969	3,924	-1%
Bordentown, Township of	1,095	2,033	5,936	7,303	7,170	7,683	8,380	11,367	36%
Burlington, City of	10,905	12,051	12,687	12,010	10,246	9,835	9,736	9,920	2%
Burlington, Township of	2,520	3,441	6,291	10,621	11,527	12,454	20,294	22,594	11%
Chesterfield, Township of	1,766	2,020	2,519	3,190	3,867	5,152	5,955	7,699	29%
Cinnaminson, Township of	2,504	3,144	8,302	16,962	16,072	14,583	14,595	15,569	7%
Delanco, Township of	2,383	2,805	4,011	4,157	3,730	3,316	3,237	4,283	32%
Delran, Township of	5,327	10,065	14,811	13,178	15,536	13,178	15,536	16,896	9%
Eastampton, Township of	498	692	1,402	2,284	3,814	4,962	6,202	6,069	-2%
Edgewater Park, Township of	1,171	1,279	2,866	7,412	9,273	8,388	7,864	8,881	13%
Evesham, Township of	1,655	2,121	4,548	13,477	21,508	35,309	42,275	45,538	8%
Fieldsboro, Borough of	537	589	583	615	597	579	522	540	3%
Florence, Township of	7,229	7,455	8,127	8,560	9,084	10,266	10,746	12,109	13%
Hainesport, Township of	858	1,793	3,271	2,990	3,236	3,249	4,126	6,110	48%
Lumberton, Township of	1,007	1,325	2,833	3,945	5,236	6,705	10,461	12,559	20%
Mansfield, Township of	1,907	1,907	2,084	2,597	2,523	3,874	5,090	8,544	68%
Maple Shade, Township of	5,535	6,560	12,947	16,464	20,525	19,211	19,079	19,131	0%
Medford Lakes, Borough of	137	461	2,876	4,792	4,958	4,462	4,173	4,146	-1%
Medford, Township of	2,237	2,836	4,844	8,292	17,622	20,526	22,253	23,033	4%
Moorestown, Township of	7,749	9,123	12,497	15,577	15,596	16,116	19,017	20,726	9%
Mount Laurel, Township of	2,189	2,817	5,249	11,221	17,614	30,270	40,221	41,864	4%
Mt. Holly, Township of	6,892	8,206	13,271	12,713	10,818	10,639	10,728	9,536	-11%
New Hanover, Township of	983	18,168	28,528	27,410	14,258	9,546	9,744	7,385	-24%
North Hanover, Township of	731	1,155	2,796	9,858	9,050	9,994	7,347	7,678	5%
Palmyra, Borough of	5,178	5,802	7,036	6,969	7,085	7,056	7,091	7,398	4%
Pemberton, Borough of	906	1,194	1,250	1,344	1,198	1,367	1,210	1,409	16%
Pemberton, Township of	2,386	4,751	13,726	19,754	29,720	31,342	28,691	27,912	-3%
Riverside, Township of	7,072	7,199	8,474	8,591	7,941	7,974	7,911	8,079	2%
Riverton, Borough of	2,354	2,761	3,324	3,412	3,068	2,775	2,759	2,779	1%
Shamong, Township of	505	712	774	1,318	4,537	5,765	6,462	6,490	0%
Southampton, Township of	1,813	2,341	3,166	4,982	8,808	10,202	10,388	10,464	1%
Springfield, Township of	1,299	1,562	1,956	2,244	2,691	3,028	3,227	3,414	6%
Tabernacle, Township of	490	1,034	1,621	2,103	6,236	7,360	7,170	6,949	-3%
Washington, Township of	518	566	541	673	808	805	621	687	11%
Westampton, Township of	573	716	1,114	2,680	3,383	6,004	7,217	8,813	22%
Willingboro, Township of	642	852	11,861	43,386	39,912	36,291	33,008	31,629	-4%
Woodland, Township of	1,374	1,524	1,904	2,032	2,285	2,063	1,170	1,788	53%
Wrightstown, Borough of	241	1,199	4,846	2,719	3,031	3,843	746	802	8%

Source: U.S. Census of Population and Housing, Date Unknown.

Figure 4-16. Burlington County Population Trends, 1940 – 2010



Source: U.S. Census Bureau, 2010

Between 1990 and 2010, nine of the 40 municipalities experienced an overall decrease in their population all other of the municipalities saw an increase in their populations from 2000 to 2010. The municipalities which experienced population decreases were the Townships of Bass River, Easthampton, Mount Holly, New Hanover, Pemberton, and Willingboro, the Cities of Beverly and Bordentown, and the Borough of Medford Lakes. The Township of New Hanover experienced the greatest loss of population, losing 24% of its population from 2000. The Township of Woodland Township experienced a population increase of 53%.

Table 4-9 displays the 2010 Census population for the ten largest municipalities by population in Burlington County. According to the Delaware Valley Regional Planning Commission's 2040 population estimates, the County population is expected to reach 457,126 by 2020, and 494,732 by 2040. This is an increase of 45,998 persons by 2040 (DVRPC 2040 Population Estimates). With the predicted population increase, urban (residential) land use will increase, while other land uses, such as agriculture and forested land, may decrease over time.

Table 4-9. Ten Largest Municipalities in Burlington County

Rank	Municipality	Population
1	Evesham, Township of	45,538
2	Mount Laurel, Township of	41,864
3	Willingboro, Township of	31,629
4	Pemberton, Township of	27,912
5	Medford, Township of	23,033
6	Burlington, Township of	22,594
7	Maple Shade, Township of	19,131
8	Moorestown, Township of	20,726
9	Delran, Township of	16,896
10	Cinnaminson, Township of	15,569

Source: 2010 U.S. Census

FUTURE GROWTH AND DEVELOPMENT

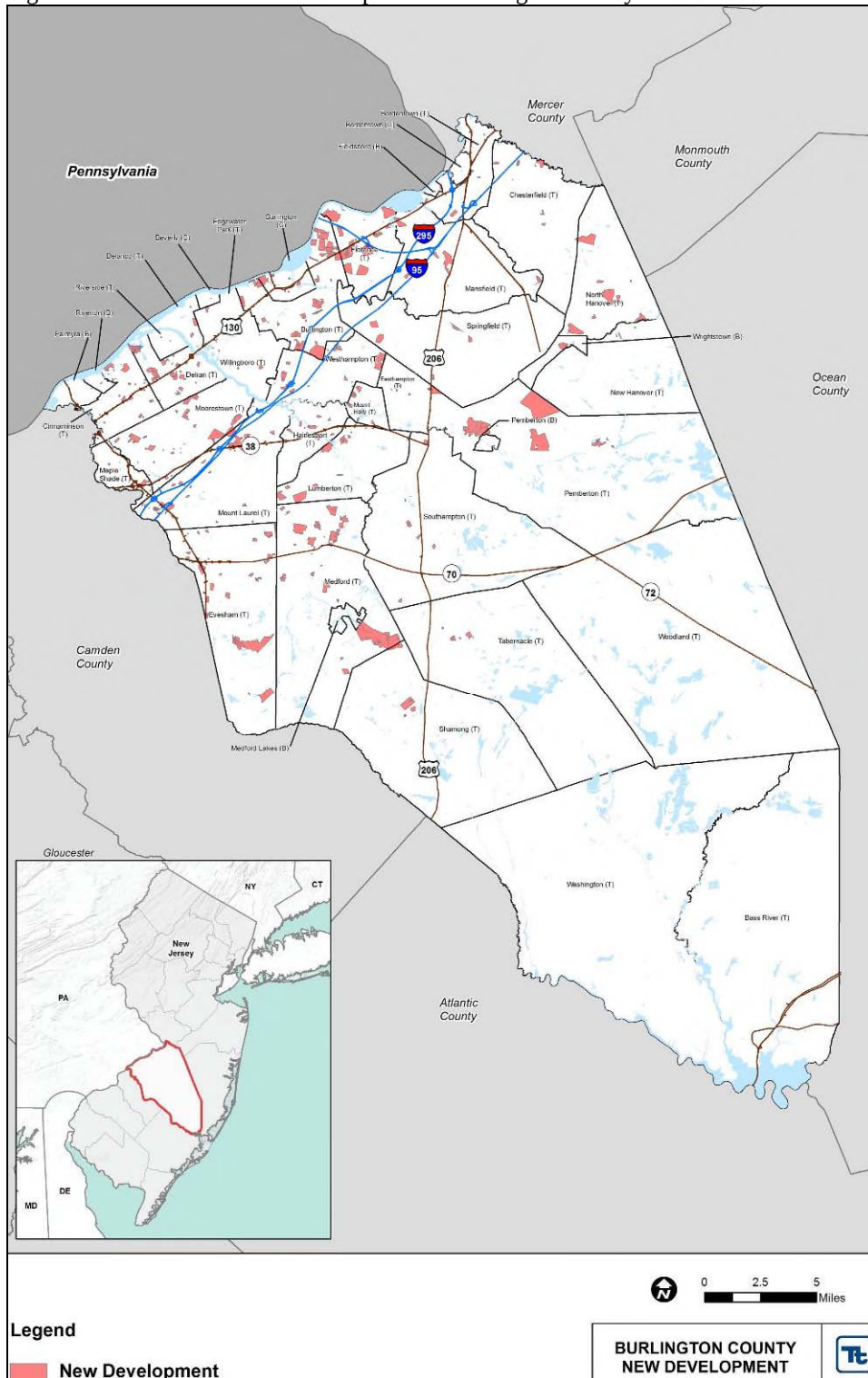
The vulnerability assessment for this Plan update used the best available defined hazard areas, population, buildings, and facilities data. Each hazard section includes tables, maps, and narrative that illustrate and describe the most vulnerable areas. The use of these updated data sets and hazard areas (e.g., preliminary working flood maps and DFIRMs) provide an update in changes in vulnerability to population and development since the 2008 Plan.

As shown in Table 4-8, the County's overall population has increased by six-percent from 2000 to 2010. The Townships of Hainesport (48%), Mansfield (68%), and Woodland (53%) have experienced the greatest increase in population. Increased development often occurs with population growth. Potential new development has been identified across the County as illustrated in Figure 4-17, in each municipal annex in Section 9 and in Appendix K.

A spatial analysis was conducted and the following municipalities have identified potential development in the floodplains: Bordentown Township, Burlington City, Burlington Township, Cinnaminson Township, Delran Township, Evesham Township, Florence Township, Hainesport Township, Mansfield Township, Medford Township, Mount Holly Township, Pemberton Township, Southampton Township and Willingboro Township. There is a potential increase in risk to life and property for new development in the floodplains. However, new construction will be required to meet current standards which may provide increased protection compared to existing development in the area. Further, the stricter construction codes are required for new and re-development in the V-zone. Changes to New Jersey's Flood Hazard Area Control Act rules, adopted March 25, 2013, set minimum elevation standards for the reconstruction of houses and buildings in areas that are in danger of flooding. These standards will help mitigate the impacts of these events.

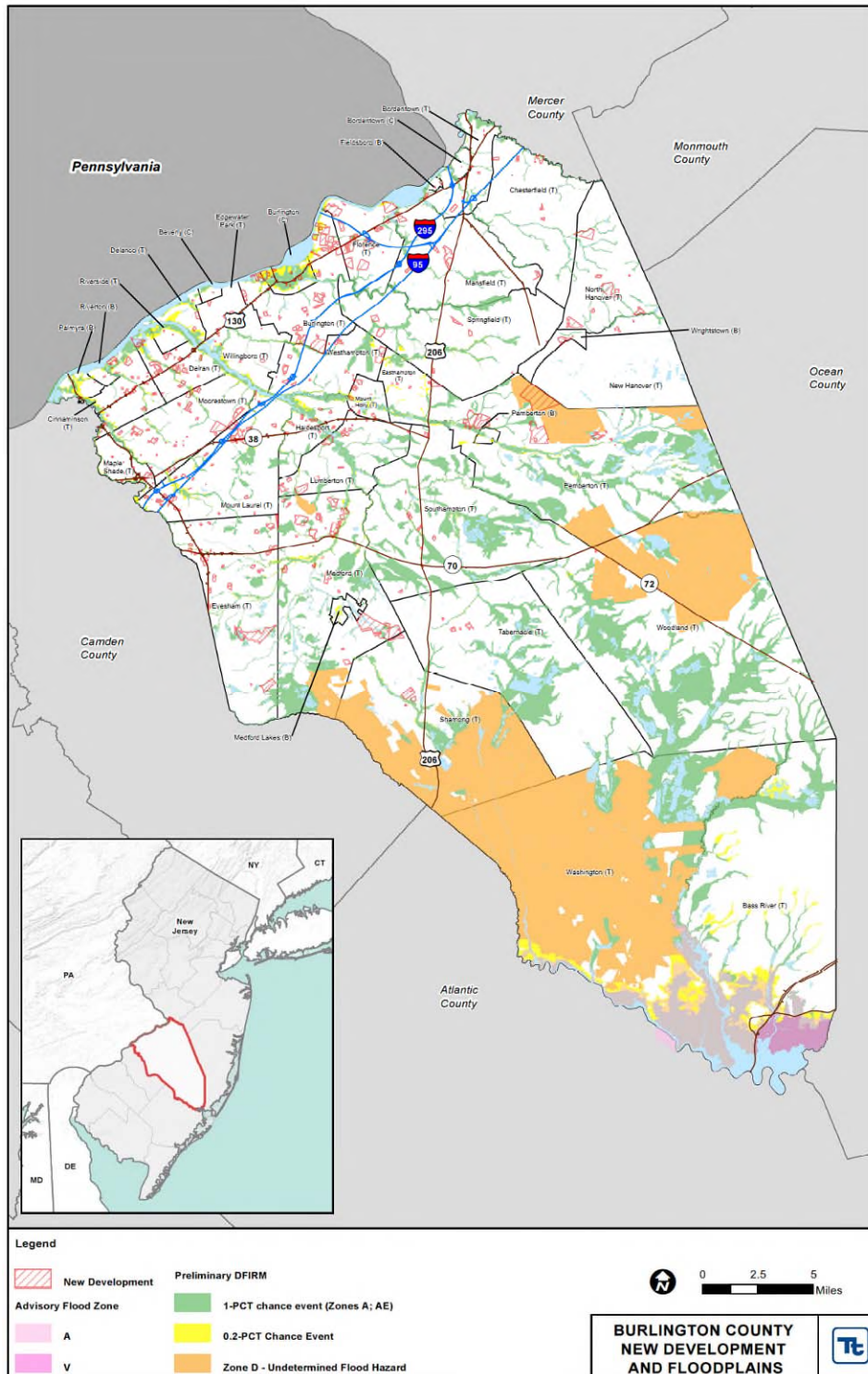
Damages and losses as a result of hazard events are generally associated with older existing infrastructure and buildings rather than new development. This is because building codes and land use limit development in hazard areas or require construction to meet higher standards within hazard areas. This provides a reduction of risk in areas where new development or redevelopment is occurring.

Figure 4-17a. Potential New Development in Burlington County



Source: 2013 Burlington County GIS

Figure 4-18b. Potential New Development and Floodplains in Burlington County



Source: 2013 Burlington County GIS; FEMA preliminary DFIRM and Advisory boundaries provided by Burlington County GIS

CRITICAL FACILITIES

A comprehensive inventory of critical facilities in Burlington County was developed from the Burlington County Department of Information Technology, GIS Division. The inventory of critical facilities presented in this section represents the current state of this effort at the time of publication of the HMP and was used for the risk assessment in Section 5.

Essential Facilities

This section provides information on emergency facilities, hospital and medical facilities, schools, shelters and senior care and living facilities.

Emergency Facilities

For the purposes of this Plan, emergency facilities include police, fire, emergency medical services (EMS) and emergency operations centers (EOC). Tables 4-10 through 4-13 provide an inventory of these emergency facilities in Burlington County.

Critical facilities are those facilities considered critical to the health and welfare of the population and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities and hazardous material facilities.

Essential facilities are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. For the County risk assessment, this category was defined to include police, fire, EMS, EOCs, schools, shelters, senior facilities and medical facilities. **Emergency Facilities** are for the purposes of this Plan, emergency facilities include police, fire, emergency medical services (EMS) and emergency operations centers (EOC).

Table 4-10. Police Stations in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Beverly City PD	446 Broad St	Beverly (City)	Municipal
Bordentown City PD	324 Farnsworth Av	Bordentown (City)	Municipal
NJ State Police - Bordentown	301 US 130	Bordentown (Twp)	State
Bordentown Twp PD	1 Municipal Dr	Bordentown (Twp)	Municipal
Burlington City Police	525 High Street	Burlington (City)	Municipal
Burlington Bristol Bridge PD	348 Conover St	Burlington (City)	County
NJSP Marine Police	601 New Pearl St	Burlington (City)	State
Burlington Twp PD	851 Old York Rd	Burlington (Twp)	Municipal
Chesterfield Twp PD	300 Bordentown Chesterfield Rd	Chesterfield (Twp)	Municipal
Cinnaminson Twp PD	900 Manor Rd	Cinnaminson (Twp)	Municipal
Delanco Police	770 Cooper St	Delanco (Twp)	Municipal
Delran PD	900 Chester Ave	Delran (Twp)	Municipal
Eastampton (wp PD	725 Smithville Rd	Eastampton (Twp)	Municipal
Edgewater Park Twp Police	400 Delanco Rd	Edgewater Park (Twp)	Municipal
Evesham Twp PD	984 Tuckerton Rd	Evesham (Twp)	Municipal
FieldsBorough PD	204 Washington St	Fields (B)	Borough
Florence Twp PD	711 Broad St	Florence (Twp)	Municipal
State Police Sub Station	100 Broad St. Po Box 477	Hainesport (Twp)	State
Lumberton Twp PD	35 Municipal Drive	Lumberton (Twp)	Municipal
Mansfield Twp PD	190A Atlantic Av	Mansfield (Twp)	Municipal
Maple Shade Twp Police	200 Stiles Av	Maple Shade (Twp)	Municipal
Medford Lakes Police Department	1 Cabin Circle	Medford Lakes (B)	Municipal
Medford Twp PD	91 Union St	Medford (Twp)	Municipal
Moorestown Twp PD	1245 N Church Street Suit 2	Moorestown (Twp)	Municipal
Burlington County Sheriffs Dept	49 Rancocas Rd	Mount Holly (Twp)	County
Mount Holly Twp PD	23 Washington St	Mount Holly (Twp)	Municipal
Mount Laurel Twp PD	100 Mt Laurel Rd	Mount Laurel (Twp)	Municipal

Table 4-10. Police Stations in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
NJ State Police - Moorestown	200 Mount Laurel Rd	Mount Laurel (Twp)	State
New Hanover Twp PD	2 Hockamick Rd	New Hanover (Twp)	Municipal
Department Of Defense Police - Fort Dix	8Th & New Jersey Ave	New Hanover (Twp)	Joint Base DOD
North Hanover Twp PD	41 Schoolhouse Rd	North Hanover (Twp)	Municipal
NJ State Police - Fort Dix	10 Wrightstown Georgetown Rd	North Hanover (Twp)	State
Palmyra PD	20 W Broad St	Palmyra (B)	Municipal
Tacony Palmyra Bridge PD	1300 Hyw 73	Palmyra (B)	County
Pemberton Borough PD	50 Egbert St	Pemberton (B)	Borough
Pemberton Twp PD	500 Hwy 530	Pemberton (Twp)	Municipal
Riverside Twp PD	1 W Scott St	Riverside (Twp)	Municipal
Riverton Borough PD	501 5Th St	Riverton (B)	Borough
NJ State Police - Red Lion	1722 Us 206	Southampton (Twp)	State
Springfield Twp PD	2159 Jacksonville Jobstown Rd	Springfield (Twp)	Municipal
NJ State Park Service - Southern Region	1168 Route 542	Washington (Twp)	State
Westampton Twp PD	710 Rancocas Rd	Westampton (Twp)	Municipal
Willingboro PD	1 Salem Rd	Willingboro (Twp)	Municipal

Source: Burlington County Department of Information Technology, 2013

B = Borough PD = Police Department TBD = To be determined (Twp) = Township

Table 4-11. Fire Stations in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
New Gretna Volunteer Fire Co #1	5 N Maple Av Po Box 32	Bass River (Twp)	Municipal
Hope Hose Fire Co #2	400 Broad St	Beverly City	Municipal
Beverly Fire Co #1	440 Laurel St	Beverly City	Municipal
Beverly City Fire Department	446 Broad St	Beverly City	Municipal
Consolidated Fire Association	20 Crosswicks St Po Box 47	Bordentown City	Municipal
Hope Hose Humane Fire Co #1	150 W Burlington St Po Box 666	Bordentown City	Municipal
Mission Fire Co #1	51 Groveville Rd	Bordentown (Twp)	Municipal
Bordentown (Twp) Volunteer Fire Co #2	262 Crosswicks Rd	Bordentown (Twp)	Municipal
Burlington City Fire Department	525 High Street	Burlington City	Municipal
Mitchell Fire Co #3	300 Federal St Pob 668	Burlington City	Municipal
Neptune Hose Co #5	721 Bordentown Rd Po Box 283	Burlington City	Municipal
Niagara Hose Co 6	656 Hwy 541	Burlington City	Municipal
Beverly Road Fire Co #2	1001 Beverly Rd	Burlington (Twp)	Municipal
Relief Fire Co #3	1020 Neck Rd	Burlington (Twp)	Municipal
Independent Fire Co#1	1601 Burlington Bypass	Burlington (Twp)	Municipal
Union Fire Co #1	18 New St Po Box 261	Chesterfield (Twp)	Municipal
Chesterfield Hose Co	300 Bordentown - Chesterfield Rd	Chesterfield (Twp)	Municipal
Cinnaminson Fire Station 202	1900 Taylors Ln	Cinnaminson (Twp)	Municipal
Cinnaminson Fire Station 201	1725 Cinnaminson Av	Cinnaminson (Twp)	Municipal
Washington Fire Co #1	1800 Burlington Av Pob 5021	Delanco (Twp)	Municipal
Delran Fire Co #1	9 S BridgeBorough St	Delran (Twp)	Municipal

Table 4-11. Fire Stations in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Delran Fire Co#2	1020 Chester Av	Delran (Twp)	Municipal
Eastampton Fire Co #1	788 Smithville Jacksonvi Rd	Eastampton (Twp)	Municipal
Marlton Fire Co #1	26 E Main St	Evesham (Twp)	Municipal
Evesham Fire Company	150 Merchants Way	Evesham (Twp)	Municipal
Kettle Run Volunteer Fire Company	498 Hopewell Road	Evesham (Twp)	Municipal
Evesham Fire-Rescue	984 Tuckerton Rd	Evesham (Twp)	Municipal
Florence Fire Volunteer Fire Company	401 Firehouse La	Florence (Twp)	Municipal
Hainesport Volunteer Fire Co #1	106 Broad St Po Box 245	Hainesport (Twp)	Municipal
Lumberton Fire Co #1	561 Main St	Lumberton (Twp)	Municipal
Franklin Fire Company #1	3135 Route 206	Mansfield (Twp)	Municipal
Independent Fire Co No 1	53 S Maple Av	Maple Shade (Twp)	Municipal
Medford Lakes Fire Department	10 Stokes Rd	Medford Lakes Borough	Municipal
Union Fire Co #1	1 Firehouse Ln	Medford (Twp)	Municipal
Taunton Fire Co Of Medford	631B Gravelly Hollow Rd	Medford (Twp)	Municipal
Lenola Fire Co	229 N Lenola Rd	Moorestown (Twp)	Municipal
Moorestown Relief Engine Co	222 Chester Av Po Box 215	Moorestown (Twp)	Municipal
Moorestown Fire Department	261 W Main St	Moorestown (Twp)	Municipal
Relief Fire Engine Co #1	17 Pine St	Mount Holly (Twp)	Municipal
Fellowship Fire Company	3824 Church Rd	Mount Laurel (Twp)	Municipal
Birchfield Fire Company	69 Elbo Ln	Mount Laurel (Twp)	Municipal
Masonville Fire Company	105 Masonville-Centeron Rd	Mount Laurel (Twp)	Municipal
Cookstown Volunteer Fire Co No 1	2 Hockamick Rd	New Hanover (Twp)	Municipal
Joint Base McGuire-Dix-Lakehurst Station 4	Bldg 5226,Eigth St.	New Hanover (Twp)	Joint Base DOD
Joint Base McGuire-Dix-Lakehurst Station 2	1712 Fire Lane	New Hanover (Twp)	Joint Base DOD
Joint Base McGuire-Dix-Lakehurst Station 1	1712 Fire Lane	New Hanover (Twp)	Joint Base DOD
Jacobstown Volunteer Fire Co	86 Chesterfield-Jacobstown Rd	North Hanover (Twp)	Municipal
Palmyra Fire Dept	115 W Broad St	Palmyra Borough	Municipal
Tri-Boroughugh Officers' Association	115 W Broad St	Palmyra Borough	Municipal
Goodwill Fire Co #1	200 Hanover St	Pemberton Borough	Municipal
Browns Mills Volunteer Fire Co	15 Trenton Rd Po Box 46	Pemberton (Twp)	Municipal
Country Lakes Volunteer Fire Co #1	103 Firehouse Rd Po Box 518	Pemberton (Twp)	Municipal
Presidential Lakes Fire & Rescue Squad	703 New York Rd Po Box 248	Pemberton (Twp)	Municipal
Riverside Fire Co #1	4 W Scott St	Riverside (Twp)	Municipal
Riverton Fire Co	505 Howard St	Riverton Borough	Municipal
Indian Mills Volunteer Fire Co #1	48 Willow Grove Rd	Shamong (Twp)	Municipal
Vincentown Fire Co #1	16 Race St Po Box 2389	Southampton (Twp)	Municipal
Hampton Lakes Volunteer Fire Co #1	74 Holly Blvd Po Box 2057	Southampton (Twp)	Municipal
Juliustown Volunteer Fire Co	420 Lewistown Rd; P.O. Box 156	Springfield (Twp)	Municipal

Table 4-11. Fire Stations in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Jacksonville Fire Co	1793 Jacksonville-Jobstown Rd	Springfield (Twp)	Municipal
Springfield Township Fire Co	2193 Jacksonville-Jobstown Rd Po Box 43	Springfield (Twp)	Municipal
Medford Farms Volunteer Fire Co	76 Hawkins Rd	Tabernacle (Twp)	Municipal
Green Bank Volunteer Fire Co	2426 Route 563	Washington (Twp)	Municipal
Lower Bank Volunteer Fire Co	5 Firehose Ln	Washington (Twp)	Municipal
Burlington County Fire Training Grounds	53 Academy Dr	Westampton (Twp)	County
Westampton Township Emergency Unit	780 Woodland Rd	Westampton (Twp)	Municipal
Headquarters Station 161	398 Charleston Rd	Willingboro (Twp)	Municipal
Willingborough Fire Station 163	603 Beverly Rancocas Rd	Willingboro (Twp)	Municipal
Woodland Volunteer Fire & EMS Station #2	13 Locust Tr Po Box 419	Woodland (Twp)	Municipal
Woodland Volunteer Fire & EMS Station #1	3991 Rt 563 Po Box 419	Woodland (Twp)	Municipal
Woodland Volunteer Fire & EMS	3991 Rt 563 Po Box 419	Woodland (Twp)	Municipal
Wrightstown Vol Fire Co#1	21 Saylor's Pond Rd	Wrightstown Borough	Municipal

Source: Burlington County Department of Information Technology

TBD = To be determined (Twp) = Township

Table 4-12. EMS Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Beverly - Edgewater Park Emergency Squad	703 Melbourne Av	Beverly City	Municipal
Hope Hose Humane Co #1	150 W Burlington St	Bordentown City	Municipal
Bordentown (Twp) Ems	262 Crosswicks Rd	Bordentown (Twp)	Municipal
Endeavor Emergency Squad	19 E Union St	Burlington City	Municipal
Chesterfield Emergency Squad	302 Bordentown Chesterfield Rd	Chesterfield (Twp)	Municipal
Delanco Emergency Squad	1800 Burlington Av	Delanco (Twp)	Municipal
Delran Emergency Squad	900 Chester Ave	Delran (Twp)	Municipal
Eastampton Emergency Squad	1380 Woodlane Rd	Eastampton (Twp)	Municipal
Evesham Fire Dept Ems	150 Merchant Way	Evesham (Twp)	Municipal
Evesham Fire Dept Ems	498 Hopewell Road	Evesham (Twp)	Municipal
Evesham Fire Dept Ems	26 E Main St	Evesham (Twp)	Municipal
Hainesport Emergency Squad	106 N Broad St	Hainesport (Twp)	Municipal
Lumberton Emergency Squad	32 Municipal Dr	Lumberton (Twp)	Municipal
Mansfield (Twp) Ambulance Corps	41 Fieldcrest Dr	Mansfield (Twp)	Municipal
Maple Shade First Aid Squad	44 S Maple Av	Maple Shade (Twp)	Municipal
Maple Shade Rescue Service	277 W Linwood Ave	Maple Shade (Twp)	Municipal
Medford Lakes Emergency Squad	200 Hwy 70	Medford (Twp)	Municipal
Medford Emergency Medical Services	20 Jackson Rd	Medford (Twp)	Municipal
Lockheed Martin Ems	119 Borton Landing Rd	Moorestown (Twp)	Municipal
Lenola Fire Company Emergency Unit	229 N Lenola Rd	Moorestown (Twp)	Municipal
Moorestown First Aid & Emergency Squad	261 W Main St	Moorestown (Twp)	Municipal
Burlington County Emergency Response	49 Rancocas Rd	Mount Holly (Twp)	County

Table 4-12. EMS Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Team			
America Emergency Squad	219 Mill St	Mount Holly (Twp)	Municipal
Jacobstown Fire House	1051 Church St	Mount Laurel (Twp)	Municipal
Mount Laurel Ems - Masonville	107 Masonville Rd	Mount Laurel (Twp)	Municipal
Wrightstown First Aid Squad	467 Sykesville Rd	North Hanover (Twp)	Municipal
Jacobstown Fire Company Ems	86 Chesterfield Jacobstown Rd	North Hanover (Twp)	Municipal
Palmyra Ambulance Association	125 W Broad St	Palmyra Borough	Municipal
Country Lakes First Aid Squad	104 Firehouse Rd	Pemberton (Twp)	Municipal
Presidential Lakes Rescue Squad	703 New York Rd	Pemberton (Twp)	Municipal
Pemberton First Aid And Rescue Squad	135 Arneys Mount Rd	Pemberton (Twp)	Municipal
Browns Mills Emergency Squad	30 Juliustown Rd	Pemberton (Twp)	Municipal
Shamong Ems	48 Willow Grove Rd	Shamong (Twp)	Municipal
Vincentown Emergency Squad	15 Race St	Southampton (Twp)	Municipal
Hampton Lakes Emergency Squad	4 Holly Blvd	Southampton (Twp)	Municipal
Springfield Ems	7 Jobstown Juliustown Rd	Springfield (Twp)	Municipal
Tabernacle Rescue Squad	81 Hawkin Rd	Tabernacle (Twp)	Municipal
Green Bank Vol Ambulance Co	2424 Rte 563	Washington (Twp)	Municipal
Westampton Emergency Services	780 Woodlane Rd	Westampton (Twp)	Municipal
Burlington County Ems	53 Academy Dr	Westampton (Twp)	County
WillingBorough Emergency Squad	396 Charleston Rd	Willingboro (Twp)	Municipal
Mercy First Aid Squad	200 Parkway Dr	Woodland (Twp)	Municipal
Wrightstown Vol Fire Co#1	21 Saylor's Pond Rd	Wrightstown Borough	Municipal

Source: Burlington County Department of Information Technology

TBD = To be determined (Twp) = Township

Table 4-13. Emergency Operation Centers in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Station 421	5 N Maple Av Po Box 32	Bass River (Twp)	Municipal
Municipal (Edgewater)	400 Delanco Rd	Beverly (Twp)	Municipal
Station 321	51 Groveville Rd	Bordentown (Twp)	Municipal
Station 609	150 W Burlington St	Bordentown City	Municipal
Police HQ	851 Old York Rd	Burlington (Twp)	Municipal
Municipal	525 High St	Burlington City	Municipal
Station 269	300 Bordentown Chesterfield Rd	Chesterfield (Twp)	Municipal
Police HQ	900 Manor Rd	Cinnaminson (Twp)	Municipal
Municipal	515 Burlington Ave	Delanco (Twp)	Municipal
Municipal	900 Chester Ave	Delran (Twp)	Municipal
Municipal	12 Manor House Ct	Eastampton (Twp)	Municipal
Municipal	400 Delanco Rd	Edgewater Park (Twp)	Municipal
Station 220	984 Tuckerton Rd	Evesham (Twp)	Municipal
Municipal	18 Washington St	FieldsBorough Borough	Municipal
Station 402 / Municipal	711 Broad St	Florence (Twp)	Municipal
Municipal	100 Broad St Po Box 477	Hainesport (Twp)	Municipal
Station 139	32 Municipal Dr	Lumberton (Twp)	Municipal
Station 330	190A Atlantic Av	Mansfield (Twp)	Municipal
Municipal	200 Stiles Ave	Maple Shade (Twp)	Municipal

Table 4-13. Emergency Operation Centers in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Municipal	17 N Main St	Medford (Twp)	Municipal
Station 371	10 Stokes Rd	Medford Lakes Borough	Municipal
Municipal	111 W Second St	Moorestown (Twp)	Municipal
Station 501	17 Pine St	Mount Holly (Twp)	Municipal
Station 369	105 Masonville-Centerton Rd	Mount Laurel (Twp)	Municipal
Municipal	41 Schoolhouse Rd	North Hanover (Twp)	Municipal
Station 801	115 W Broad St	Palmyra Borough	Municipal
Station 191	200 Hanover St	Pemberton Borough	Municipal
Municipal	500 Pemberton-Browns Mills Rd	Pemberton (Twp)	Municipal
Station 701	4 W Scott St	Riverside (Twp)	Municipal
Municipal	505A Howard St	Riverton (Twp)	Municipal
Station 289	48 Willow Grove Rd	Shamong (Twp)	Municipal
Municipal	5 Retreat Rd	Southampton (Twp)	Municipal
Municipal	2159 Jacksonville-Jobstown Rd	Springfield (Twp)	Municipal
Municipal	163 Carranza Rd	Tabernacle (Twp)	Municipal
Municipal	710 Rancocas Rd	Westampton (Twp)	Municipal
Kennedy Center	429 Kennedy Parkway	Willingboro (Twp)	Municipal
Municipal	3943 New Gretna-Chatsworth Rd Po Box 388	Woodland (Twp)	Municipal
Municipal	21 Saylor's Pond Rd	Wrightstown Borough	Municipal

Source: Burlington County Department of Information Technology

TBD To be determined

(Twp) Township

Hospitals and Medical Centers

Table 4-14 provides an inventory of hospitals and major medical facilities in Burlington County.

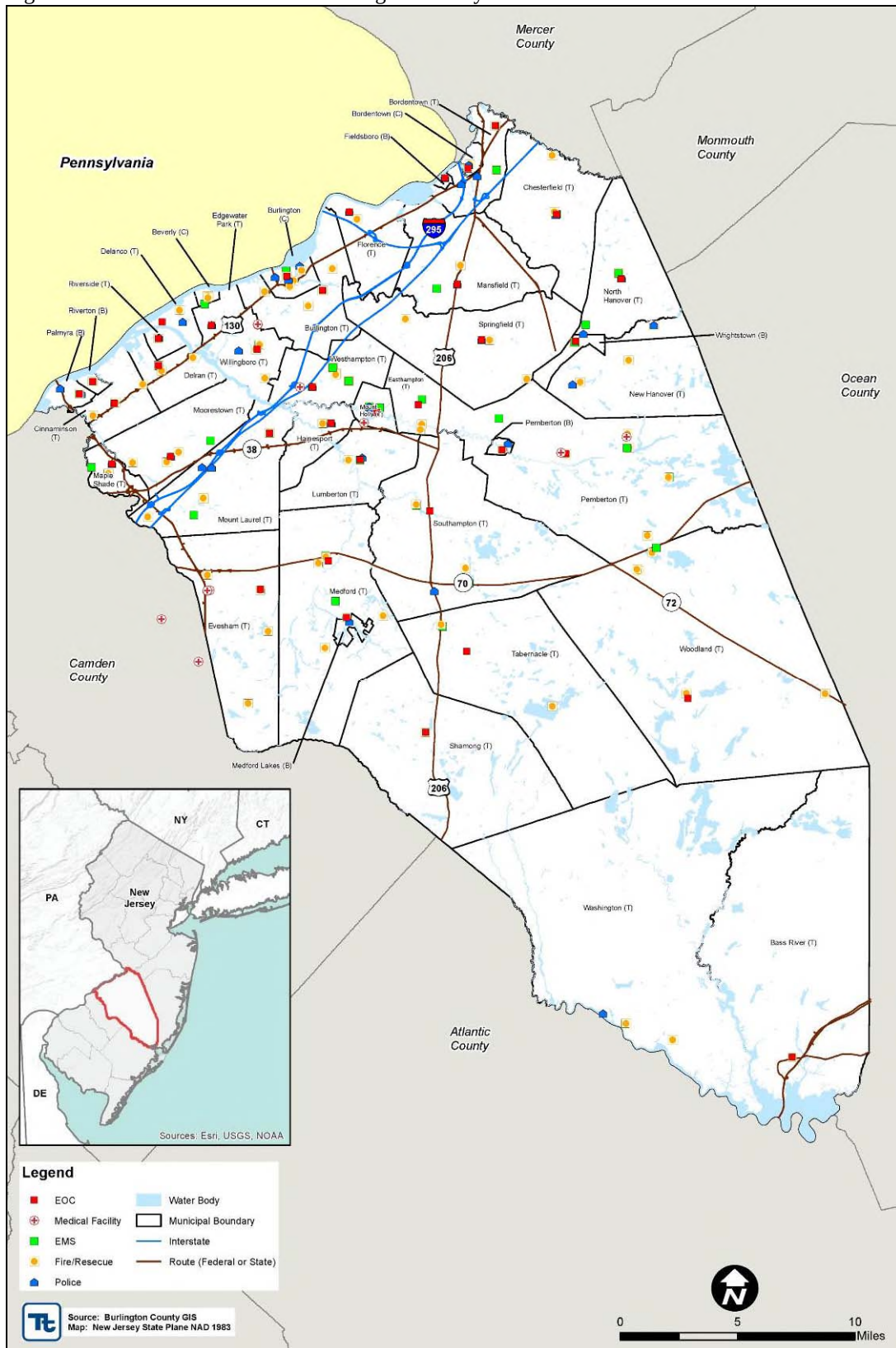
Table 4-14. Medical Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Virtua-West Jersey Hospital	90 Brick Road	Evesham (Twp)	NGO
Childrens Rehabilitation	92 Brick Road	Evesham (Twp)	NGO
Marlton Rehabilitation	92 Brick Road	Evesham (Twp)	NGO
Memorial Hospital-Burlington	175 Madison Ave	Mount Holly (Twp)	NGO
Buttonwood Hospital	600 Pemberton Browns Mills Rd	Pemberton (Twp)	NGO
Deborah Hospital Foundation	220 Trenton Rd	Pemberton (Twp)	NGO
Hampton Behavioral Health	650 Rancocas Rd	Westampton (Twp)	NGO
Lourdes Medical Center	218A Sunset Rd	Willingboro (Twp)	NGO
Lourdes Specialty Hospital	218 Sunset Rd	Willingboro (Twp)	NGO
Virtua Old Hospital	175 Madison Ave	Mount Holly (Twp)	NGO

Source: Burlington County Department of Information Technology

TBD = To be determined (Twp) = Township

Figure 4-19. Essential Facilities in Burlington County



Source: Burlington County Department of Information Technology

Shelters

Table 4-15 provides an inventory of the shelters in Burlington County.

Table 4-15. Shelter Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Backup Power
Pinelands Regional High School	565 Nugentown Road	Bass River (Little Egg)	Municipal	N
Pinelands Regional Middle School	565 Nugentown Road	Bass River (Little Egg)	Municipal	N
Bass River Elementary School	50 Crown Royal Pkwy	Bass River (Twp)	Municipal	N
Beverly Elementary School	601 Bentley Ave	Beverly City	Municipal	N
Macfarland Junior School	87 Crosswicks St	Bordentown City	Municipal	N
Clara Barton Elementary School	100 Crosswicks St	Bordentown City	Municipal	N
Hope Hose Humane Fire Co #1	150 W Burlington St	Bordentown City	Municipal	N
Cars Lake Community Center	209 Crosswicks Street	Bordentown City	Municipal	N
Bordentown Middle School	50 Dunns Mill Rd	Bordentown (Twp)	Municipal	N
Peter Muschal School	343 Ward Ave	Bordentown (Twp)	Municipal	N
Senior Community Center	3 Municipal Drive	Bordentown (Twp)	Municipal	N
Bordentown Regional High School	318 Ward Av	Bordentown (Twp)	Municipal	N
Wilbur Watts Middle School	550 High St	Burlington City	Municipal	Y
Burlington City High School	100 Blue Devil Way	Burlington City	Municipal	Y
Burlington (Twp) Highschool Annex	702 Jacksonville Rd	Burlington (Twp)	Municipal	Y
Burlington Township High Schl	610 Fountain Ave	Burlington (Twp)	Municipal	Y
Fountain Woods Elementary School	603 Fountain Ave	Burlington (Twp)	Municipal	Y
B Bernice Young Elem School	1203 Neck Rd	Burlington (Twp)	Municipal	Y
Independent Fire Co#1	1601 Burlington Bypass	Burlington (Twp)	Municipal	N
Beverly Road Fire Co #2	1001 Beverly Rd	Burlington (Twp)	Municipal	Y
Relief Fire Co #3	3 Neck Road	Burlington (Twp)	Municipal	Y
Burlington Middle School At Springside	1600 Burlington Bypass	Burlington (Twp)	Municipal	Y
Chesterfield Baptist Church	209 Crosswicks-Chesterfield Rd	Chesterfield (Twp)	NGO	N
Crosswicks Community House	480 Main St	Chesterfield (Twp)	Municipal	N
Crosswicks Methodist Church	Ward Street	Chesterfield (Twp)	NGO	N
Cinnaminson High School	1197 Riverton Rd	Cinnaminson (Twp)	Municipal	N
Cinnaminson Middle School	312 North Forklanding Rd	Cinnaminson (Twp)	Municipal	N
New Albany Elementary School	2701 New Albany Rd	Cinnaminson (Twp)	Municipal	N
Eleamor Rush Middle School	1200 Wynwood Dr	Cinnaminson (Twp)	Municipal	N
Memorial School	2195 Riverton Rd	Cinnaminson (Twp)	Municipal	N
M Joan Pearson School	Burlington Ave & Lilac La	Delanco (Twp)	Municipal	Y
Delran Township High School	50 Hartford Rd	Delran (Twp)	Municipal	N
Eastampton Community Middle School	1 Student Dr	Eastampton (Twp)	Municipal	N
Mildred Magowan Elementary School	405 Cherrix Ave	Edgewater Park (Twp)	Municipal	N
Samuel M Ridgeway School	300 Delanco Rd	Edgewater Park (Twp)	Municipal	N
Marlton Middle School	150 Tomlinson Mill Rd	Evesham (Twp)	Municipal	Y
Marlton Elementary School	190 Tomlinson Mill Rd	Evesham (Twp)	Municipal	Y
Robert B Jaggard Elem School	2 Wescott Rd	Evesham (Twp)	Municipal	Y
Richard L Rice School	50 Crown Royal Pkwy	Evesham (Twp)	Municipal	Y

Table 4-15. Shelter Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Backup Power
Florence V Evans Elem School	400 South Route 73	Evesham (Twp)	Municipal	Y
Helen L Beeler Elementary School	60 Caldwell Av	Evesham (Twp)	Municipal	N
Leroy Meland Admin Bldg Evesham	25 South Maple Av	Evesham (Twp)	Municipal	N
Frances S Demassi Elementary School	199 EvesBorough Medford Rd	Evesham (Twp)	Municipal	Y
District Operations Center	129 East Main Street	Evesham (Twp)	Municipal	N
Roebbing Elementary School 5	1300 Hornberger Av	Florence (Twp)	Municipal	N
Florence Memorial Middle School	500 East Front St	Florence (Twp)	Municipal	N
Fountain Of Life	2035 Columbus Rd	Florence (Twp)	NGO	N
Florence Memorial High School	Cedar Lane	Florence (Twp)	Municipal	N
Hainesport Township School	211 Broad St	Hainesport (Twp)	Municipal	N
Saint Pauls Lutheran Church	910 Marne Highway	Hainesport (Twp)	NGO	N
Easton Bible Church	2407 Fosterton Rd	Hainesport (Twp)	NGO	N
Lumberton Middle School	30 Dimsdale Drive	Lumberton (Twp)	Municipal	N
Florence L Walther Elementary	56 Chestnut St	Lumberton (Twp)	Municipal	N
Bobbys Run School	32 Dimsdale Drive	Lumberton (Twp)	Municipal	N
Ashbrook	33 Municipal Drive	Lumberton (Twp)	Municipal	N
Mansfield Township Elementary School	200 Mansfield Rd, E.	Mansfield	Municipal	N
Northern Burlington Regional H S	160 Mansfield Rd	Mansfield (Twp)	Municipal	N
Homestead	Homestead Drive	Mansfield (Twp)	Municipal	N
Grange Hall	88 Atlantic Av	Mansfield (Twp)	Municipal	N
Ralph J Steinhauer Elem School	North Fellowship Rd	Maple Shade (Twp)	Municipal	N
Maude M Wilkins Elem School	34-6 West Mill Rd	Maple Shade (Twp)	Municipal	N
Maple Shade High School	Frederick Ave & Clinton Av	Maple Shade (Twp)	Municipal	N
Our Lady Of Perpetual Help School	S Fellowship Rd & E Main St	Maple Shade (Twp)	NGO	N
Holy Trinity Lutheran Church	26 South Forklanding Rd	Maple Shade (Twp)	NGO	N
St John'S Episcopal Church	41 East Linwood Av	Maple Shade (Twp)	NGO	N
Immanuel Baptist Church	6 South Poplar St	Maple Shade (Twp)	NGO	N
Knights Of Columbus Hall	636 North Forklanding Rd	Maple Shade (Twp)	NGO	N
Independent Fire Co No 1	53 S Maple Av	Maple Shade (Twp)		N
Vfw Post 2445	914 East Main St	Maple Shape (Twp)	NGO	N
Nokomis Elementary School	135 Mudjekeewis Trl	Medford Lakes Borough	Municipal	N
Neeta School	44 Neeta Trail	Medford Lakes Borough	Municipal	N
Cranberry Pines Elementary School	400 Fairview Rd	Medford (Twp)	Municipal	N
Maurice & Everett Haines School	162 Stokes Rd	Medford (Twp)	Municipal	N
Taunton Forge Elementary School	32 Evergreen Trail	Medford (Twp)	Municipal	N
Medford Middle School	55 Mill Street	Medford (Twp)	Municipal	N
Milton H Allen Elementary School	24 Allen Ave	Medford (Twp)	Municipal	N
Chairville Elementary School	36 Chairville Rd	Medford (Twp)	Municipal	Y
Care One At Moorestown (Alr)	895 Westfield Rd	Moorestown (Twp)	Municipal	Y
Church St. Recreation Center	111 West Second St	Moorestown (Twp)	NGO	N
George C Baker School	139 W Maple Av	Moorestown (Twp)	Municipal	Y
Lenola Fire Company Emergency Unit	229 N Lenola Rd	Moorestown (Twp)	Municipal	Y

Table 4-15. Shelter Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Backup Power
Lutheran Home At Moorestown	225 East Main Street	Moorestown (Twp)	NGO	Y
Mary E Roberts Elementary Schl	290 Crescent Ave	Moorestown (Twp)	Municipal	Y
Moorestown Community House	16 East Main Street	Moorestown (Twp)	Municipal	N
Moorestown High School	350 BridgeBorough Rd	Moorestown (Twp)	Municipal	Y
Moorestown Mall	400 West Route 38	Moorestown (Twp)	Municipal	Y
Moorestown Middle School	801 N Stanwick Rd	Moorestown (Twp)	Municipal	Y
Moorestown Upper Elementary School	325 Borton Landing Rd	Moorestown (Twp)	Municipal	Y
New Albany Road Recreation Center	New Albany Road	Moorestown (Twp)	Municipal	N
Saint Matthews Lutheran Church	318 Chester Ave	Moorestown (Twp)	NGO	N
South Valley Elementary School	210 S Stanwick Rd	Moorestown (Twp)	Municipal	Y
The Evergreens	301 BridgeBorough	Moorestown (Twp)	NGO	Y
John Brainerd Elementary Schl	100 Wollner Dr	Mount Holly (Twp)	Municipal	N
F W Holbein Middle School	333 Levis Dr	Mount Holly (Twp)	Municipal	N
Gertrude C Folwell Elem School	455 Jacksonville Rd	Mount Holly (Twp)	Municipal	N
Sacred Heart School	250 High St	Mount Holly (Twp)	Municipal	N
Rancocas Valley Regional High Gym	520 Jacksonville Rd	Mount Holly (Twp)	Municipal	Y
America Emergency Squad	219 Mill St Po Box 567	Mount Holly (Twp)	Municipal	N
The Children'S Home Of Burlington Coun	243 Pine Street	Mount Holly (Twp)	Municipal	Y
Christian Community Chapel	275 Holeman St	Mount Holly (Twp)	NGO	N
Senior And Community Center	100 Mount Laurel Road	Mount Laurel	Municipal	Y
Parkway Elementary School	142 Ramblewood Parkway	Mount Laurel (Twp)	Municipal	Y
Larchmont School	301 Larchmont Blvd (& Unionmill)	Mount Laurel (Twp)	Municipal	Y
Countryside Elementary School	115 Schoolhouse Ln	Mount Laurel (Twp)	Municipal	Y
Fleetwood Elementary School	231 Fleetwood Ave	Mount Laurel (Twp)	Municipal	Y
Hartford School	397 Hartford Rd	Mount Laurel (Twp)	Municipal	Y
Hillside Elementary School	1370 Hainesport-Mount Laurel Rd	Mount Laurel (Twp)	Municipal	Y
Thomas H Harrington Middle School	514 Mount Laurel Rd	Mount Laurel (Twp)	Municipal	Y
Springville Elementary School	520 Hartford Road	Mount Laurel (Twp)	Municipal	Y
New Hanover Township Elementary School	122 Fort Dix St (Wrightstown)	New Hanover (Twp)	Municipal	N
New Hanover (Twp) Senior Citizen Comp	9 Browns Mills Road	New Hanover (Twp)	Municipal	N
Palmyra High School	4Th & Weart Blvd	Palmyra Borough	Municipal	N
Charles Street Elementary School	100 West Charles St	Palmyra Borough	Municipal	N
Palmyra Community Center	30 W Broad Street	Palmyra (Twp)	Municipal	N
Alexander Denbo School	1412 Junction Rd	Pemberton (Twp)	Municipal	N
Howard L Emmons School	14 Scrapetown Rd	Pemberton (Twp)	Municipal	N
Samuel T Busansky School	16 Scrapetown Rd	Pemberton (Twp)	Municipal	N
Harker-Wylie Elementary School	125C Trenton Rd	Pemberton (Twp)	Municipal	N
Aletta Crichton Elemtary School	1414 Junction Rd	Pemberton (Twp)	Municipal	N
Joseph S Stackhouse Elem School	125A Trenton Rd	Pemberton (Twp)	Municipal	N
Pemberton Township High School	148 Arney'S Mount Rd	Pemberton (Twp)	Municipal	N

Table 4-15. Shelter Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Backup Power
Helen A Fort Middle School	301 Fort Dix Road, Pemberton	Pemberton (Twp)	Municipal	N
Marcus W Newcomb School	300 Fort Dix Road, Pemberton	Pemberton (Twp)	Municipal	N
Burlington County College	601 Pemberton-Browns Mill (Rt 530)	Pemberton (Twp)	Municipal	N
Isaiah Haines School	125B Trenton Rd	Pemberton (Twp)	Municipal	N
Riverside High School	112 Washington St	Riverside (Twp)	Municipal	N
Riverton School	502 5Th St	Riverton Borough	Municipal	N
Indian Mills Public School	112 Medford Indian Mills Rd	Shamong (Twp)	Municipal	Y
Indian Mills Memorial School	295 Medford Indian Mills Rd	Shamong (Twp)	Municipal	Y
Hampton Lakes Volunteer Fire Co #1	72 Holly Blvd	Southampton (Twp)	Municipal	N
Laurel Hill	Huntington Dr & Warwick Way	Southampton (Twp)	Municipal	N
Southampton Township Bldg	5 Retreat Rd	Southampton (Twp)	Municipal	N
Southampton Township School No. 3	100 Warrior Way	Southampton (Twp)	Municipal	N
Southampton Township School No. 1	26 Pleasant St	Southampton (Twp)	Municipal	N
Southampton Township School No. 2	100 Miss Mable Dr	Southampton (Twp)	Municipal	N
Springfield Township School	2146 Jacksonville Rd	Springfield (Twp)	Municipal	N
Jacksonville Community Center	1791 Jacksonville-Jabstown Rd	Springfield (Twp)	Municipal	N
Jacksonville Fire Co	1793 Jacksonville-Jobstown Rd	Springfield (Twp)	Municipal	N
Juliustown Volunteer Fire Co	420 Lewistown Rd Po Box 156	Springfield (Twp)	Municipal	N
Old Station 439 \ Community Center	76 Hawkins Road	Tabernacle	Municipal	N
Tabernacle Elementary School	141 New Rd	Tabernacle (Twp)	Municipal	N
Kenneth R Olson Middle School	132 New Rd	Tabernacle (Twp)	Municipal	N
Green Bank Elementary School	2436 Hwy 563	Washington (Twp)	Municipal	N
Green Bank Vol Ambulance Co 459	2424 Rte 563	Washington (Twp)	Municipal	N
Green Bank Vol Ambulance Co 451	2426 Hwy 563	Washington (Twp)	Municipal	N
Green Bank Vol Ambulance Co 452	5 Firehose Ln	Washington (Twp)	Municipal	N
Senior Citizens' Center	1061 River Rd	Washington (Twp)	Municipal	N
Westampton Middle School	700 Rancocas Rd	Westampton (Twp)	Municipal	N
Holly Hills Elementary School	500 Ogden Dr	Westampton (Twp)	Municipal	N
Westampton Municipal Bldg	710 Rancocas Rd	Westampton (Twp)	Municipal	N
Kennedy Center	429 Jfk Way	Willingboro (Twp)	Municipal	N
Chatsworth School	Second St & Giles Av	Woodland (Twp)	Municipal	N
New Lisbon Developmental Center	Route 72	Woodland (Twp)	State	N

Source: Burlington County Department of Information Technology

N = No; Twp = Township; Y = Yes

Table 4-16 lists public and private schools in Burlington County.

Table 4-16. Schools in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Type of Facility
Bass River Elementary School	11 North Maple Ave Box 304	Bass River (Twp)	Municipal	Elementary
Beverly School	601 Bentley Ave	Beverly City	Municipal	Elementary
St Joseph'S School	524 Warren St	Beverly City	Municipal	Elementary
St Joseph'S School	524 Warren St	Beverly City	Municipal	Elementary
Macfarland Junior School	87 Crosswicks St	Bordentown City	Municipal	Elementary
Clara Barton Elementary School	100 Crosswicks St	Bordentown City	Municipal	Elementary
St. Mary School	30 Elizabeth St.	Bordentown City	Municipal	High School
Bordentown Region Middle School	50 Dunns Mill Rd	Bordentown (Twp)	Municipal	Middle School
Holy Cross Lutheran School	280 Crosswicks Rd	Bordentown (Twp)	Municipal	Elementary
Peter Muschal School	323 Ward Ave	Bordentown (Twp)	Municipal	Elementary
Bordentown Regional High School	318 Ward Av	Bordentown (Twp)	Municipal	High School
All Saints School	510 High St	Burlington City	Municipal	Elementary
Wilbur Watts Intermediate Schl	High St & Wood St	Burlington City	Municipal	Elementary
St Mary's Hall -Doane Academy	350 Riverbank	Burlington City	Municipal	Elementary
Holy Light Christian Academy	133 E Union St	Burlington City	Municipal	Elementary
Captain James Lawrence School	316 Barclay St	Burlington City	Municipal	Elementary
Elias Boudinot Elementary Schl	W Pearl & Ellis Sts	Burlington City	Municipal	Elementary
St Paul's Parochial School	250 James St	Burlington City	Municipal	Elementary
Samuel Smith Elementary School	250 Farner Ave	Burlington City	Municipal	Elementary
Burlington City High School	100 Dewey St	Burlington City	Municipal	High School
Springside Elementary School	1508 Mount Holly Rd	Burlington (Twp)	Municipal	Elementary
Burlington Township Middle School	700 Jacksonville Rd # 1	Burlington (Twp)	Municipal	Middle School
Burlington Township High Schl	610 Fountain Ave	Burlington (Twp)	Municipal	High School
B Bernice Young Elem School	1203 Neck Rd	Burlington (Twp)	Municipal	Elementary
Fountain Woods Elementary School	601 Fountain Ave	Burlington (Twp)	Municipal	Elementary
Burlington (Twp) Mid Schl At Springside	1600 Burlington Bypass	Burlington (Twp)	Municipal	Middle School
Chesterfield (Twp) School	295 Bordentown Chesterfld Rd	Chesterfield (Twp)	Municipal	Elementary
Meadow View Jr. Academy	241 Bordentown Chesterfield Rd	Chesterfield (Twp)	Municipal	Elementary
Cinnaminson High School	1197 Riverton Rd	Cinnaminson (Twp)	Municipal	High School
Cinnaminson Middle School	312 Forklanding Rd	Cinnaminson (Twp)	Municipal	Middle School
New Albany Elementary School	2701 New Albany Rd	Cinnaminson (Twp)	Municipal	Elementary
Elanor Rush School	1200 Wynwood Dr	Cinnaminson (Twp)	Municipal	Elementary
St Charles Borromeo Roman Schl	2500 Branch Pike	Cinnaminson (Twp)	Municipal	Elementary
Westfield Friends School	2201 Riverton Rd	Cinnaminson (Twp)	Municipal	Elementary
Student Activity Center	2195 Riverton Rd	Cinnaminson (Twp)	Municipal	Elementary
Project Challenge	2195 Riverton Rd	Cinnaminson (Twp)	Municipal	Elementary
Walnut Street Elementary Schl	411 Walnut St	Delanco (Twp)	Municipal	Elementary
M Joan Pearson School	Burlington Ave & Lilac La	Delanco (Twp)	Municipal	Elementary
Delran Township High School	50 Hartford Rd	Delran (Twp)	Municipal	High School
Holy Cross High School	5035 Hwy 130	Delran (Twp)	Municipal	High School
Delran Middle School	905 Chester Ave	Delran (Twp)	Municipal	Middle School
Millbridge Elementary School	282 Conrow Rd	Delran (Twp)	Municipal	Elementary
Delran Intermediate School	20 Creek Road	Delran (Twp)	Municipal	Elementary

Table 4-16. Schools in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Type of Facility
Montessori Academy Of NJ	28 Conrow Road	Delran (Twp)	Municipal	Elementary
Eastampton Township Middle Schl	1 Student Dr	Eastampton (Twp)	Municipal	Middle School
Eastampton Township Elem Schl	1048 Smithville Jacksonville Rd	Eastampton (Twp)	Municipal	Elementary
Timothy Christian Academy	1341 Woodlane Rd	Eastampton (Twp)	Municipal	Elementary
Magowan Elementary School	405 Cherry Ave	Edgewater Park (Twp)	Municipal	Elementary
Samuel M Ridgeway School	300 Delanco Rd	Edgewater Park (Twp)	Municipal	Elementary
Marlton Middle School	150 Tomlinson Mill Rd	Evesham (Twp)	Municipal	Middle School
Marlton Elementary School	190 Tomlinson Mill Rd	Evesham (Twp)	Municipal	Elementary
Robert B Jaggard Elem School	2 Wescott Rd	Evesham (Twp)	Municipal	Elementary
Frances S Demasi Middle School	199 EvesBorough Medford Rd	Evesham (Twp)	Municipal	Middle School
Greenberg Educational Ctr	55 E Hwy 70	Evesham (Twp)	Municipal	Elementary
Richard L Rice School	50 Crown Royal Pkwy	Evesham (Twp)	Municipal	Elementary
Florence V Evans Elem School	400 S Hwy 73	Evesham (Twp)	Municipal	Elementary
H L Beeler Elementary School	60 Caldwell Ave	Evesham (Twp)	Municipal	Elementary
J Harold Vanzant Elem School	Conestoga Dr & Bartram Rd	Evesham (Twp)	Municipal	Elementary
Frances S Demasi Elementary School	199 EvesBorough Medford Rd	Evesham (Twp)	Municipal	Elementary
St. Joan Of Arc School	101 Evans Road	Evesham (Twp)	Municipal	Elementary
Cherokee High School North	120 Tomlinson Mill Rd	Evesham (Twp)	Municipal	High School
Cherokee High School South	130 Tomlinson Mill Rd	Evesham (Twp)	Municipal	High School
Marlton Christian Academy	625 E Main St	Evesham (Twp)	Municipal	Elementary
Cherokee High School Evening North	120 Tomlinson Mill Rd	Evesham (Twp)	Municipal	High School
Little Angel Preschool	2045 Burlington Columbus Rd	Florence (Twp)	Municipal	Elementary
Riverbank Charter Schl Of Excellence	1300 Hornberger Ave & Parish Ln	Florence (Twp)	Municipal	Elementary
Roebbling Elementary School 5	1330 Hornberger Av	Florence (Twp)	Municipal	Elementary
Florence Township Mmrl Hs	500 E Front St	Florence (Twp)	Municipal	Elementary
Florence Township Middle School	500 E Front St	Florence (Twp)	Municipal	Middle School
Macella I Duffy School	208 W 2Nd St	Florence (Twp)	Municipal	Elementary
Life Center Academy	2045 Burl Columbus Rd	Florence (Twp)	Municipal	Elementary
Riverfront School	500 E Front St	Florence (Twp)	Municipal	Elementary
Fort Dix Elementary School	1199 Juliustown Rd	Fort Dix (Pemberton Twp)	Municipal	Elementary
New Hanover Township School	122 Fort Dix St	Fort Dix (Wrightstown)	Municipal	Elementary
Hainesport Township Schl	211 Broad St	Hainesport (Twp)	Municipal	Elementary
Ashbrook	33 Municipal Drive	Lumberton	Municipal	Elementary
Lumberton Middle School	30 Dimsdale Drive	Lumberton (Twp)	Municipal	Middle School
Bc Special Services School - Lumberton	71 Ark Rd	Lumberton (Twp)	Municipal	Elementary
Florence L Walther Elementary	56 Chestnut St	Lumberton (Twp)	Municipal	Elementary
Midway School	111 Municipal Drive	Lumberton (Twp)	Municipal	Elementary
Bobbys Run School	32 Dimsdale Drive	Lumberton (Twp)	Municipal	Elementary
Mansfield Township Elementary School	200 Mansfield Rd, E.	Mansfield	Municipal	Elementary
Northern Burlington Regional H S	160 Mansfield Rd	Mansfield (Twp)	Municipal	High School
Northern Burlington Junior H S	160 Mansfield Rd	Mansfield (Twp)	Municipal	High School

Table 4-16. Schools in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Type of Facility
John Hydock Elementary School	19 Locust Ave	Mansfield (Twp)	Municipal	Elementary
Yale School Central	200 Mansfield Rd E	Mansfield (Twp)	Municipal	Elementary
Ralph J Steinhauer Elem School	N Fellowship Rd	Maple Shade (Twp)	Municipal	Elementary
Howard R Yocum Elementary Schl	748 N Forklanding Rd	Maple Shade (Twp)	Municipal	Elementary
Maude M Wilkins Elem School	34-6 W Mill Rd	Maple Shade (Twp)	Municipal	Elementary
Maple Shade High School	180 Frederick Ave	Maple Shade (Twp)	Municipal	High School
Our Lady Of Perpetual Help School	Main St & Fellowship Rd	Maple Shade (Twp)	Municipal	Elementary
Columbia Elementary School	1 School Rd	Mcguire Afb(No Hanover)	Municipal	Elementary
Challenger Elementary School	4 School Rd	Mcguire Afb(No Hanover)	Municipal	Elementary
Atlantis School	3 School Rd	Mcguire Afb(No Hanover)	Municipal	Elementary
Discovery School	2 School Rd	Mcguire Afb(No Hanover)	Municipal	Elementary
Nokomis Elementary School	135 Mudjekeewis Trl	Medford Lakes Borough	Municipal	Elementary
Neeta School	44 Neeta Trl	Medford Lakes Borough	Municipal	Elementary
Yale School North	135 Mukekeewis Trl	Medford Lakes Borough	Municipal	Elementary
St Mary Of The Lakes School	196 Hwy 70	Medford (Twp)	Municipal	Elementary
Burlington County Institute Of Tech- W	10 Hawkin Rd	Medford (Twp)	County	High School
Cranberry Pine Elementary Schl	400 Fairview Rd	Medford (Twp)	Municipal	Elementary
Haines Sixth Grade Center	162 Stokes Rd	Medford (Twp)	Municipal	Elementary
Taunton Forge Elementary Schl	32 Evergreen Trl	Medford (Twp)	Municipal	Elementary
Medford Memorial School	55 Mill St	Medford (Twp)	Municipal	Elementary
Milton H Allen Elementary Schl	24 Allen Ave	Medford (Twp)	Municipal	Elementary
Lenape High School	235 Hartford Rd	Medford (Twp)	Municipal	High School
Shawnee High School	600 Tabernacle Rd	Medford (Twp)	Municipal	High School
Chairville Elementary School	36 Chairville Rd	Medford (Twp)	Municipal	Elementary
Kirbys Mill School	151 Hartford Rd	Medford (Twp)	Municipal	Elementary
Our Lady Of Good Counsel Schl	23 W Prospect Av	Moorestown (Twp)	Municipal	Elementary
Mary E Roberts Elementary Schl	290 Crescent Ave	Moorestown (Twp)	Municipal	Elementary
George C Baker School	139 W Maple Ave	Moorestown (Twp)	Municipal	Elementary
South Valley Elementary School	210 S Stanwick Rd	Moorestown (Twp)	Municipal	Elementary
Moorestown Township Adult Schl	803 N Stanwick Rd	Moorestown (Twp)	Municipal	Elementary
Moorestown Township High Schl	350 BridgeBorough Rd	Moorestown (Twp)	Municipal	High School
William W Allen Middle School	801 N Stanwick Rd	Moorestown (Twp)	Municipal	Middle School
Moorestown Friends School	110 E Ast Main St	Moorestown (Twp)	Municipal	Elementary
Orchard Friends School	16 East Main St	Moorestown (Twp)	Municipal	Elementary
Moorestown Upper Elem School	325 Borton Landing Rd	Moorestown (Twp)	Municipal	Elementary
Kingsway Learning Center	244 West Route 38	Moorestown (Twp)	Municipal	Elementary
John Brainerd Elementary Schl	100 Wollner Dr	Mount Holly (Twp)	Municipal	Elementary
F W Holbein Middle School	333 Levis Dr	Mount Holly (Twp)	Municipal	Middle School
Gertrude Folwell Elem School	455 Jacksonville Rd	Mount Holly (Twp)	Municipal	Elementary
Sacred Heart Church School	250 High St	Mount Holly (Twp)	Municipal	Elementary
Rancocas Valley Regional H S	520 Jacksonville Rd	Mount Holly (Twp)	Municipal	High School

Table 4-16. Schools in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Type of Facility
Mary Dobbins School	243 Pine St.	Mount Holly (Twp)	Municipal	Elementary
Burlco Cerebral Palsy Ghs Ctr	Cedar St	Mount Holly (Twp)	Municipal	Elementary
Burlington County College	1 High St	Mount Holly (Twp)	County	College
Heritage Christian Academy	530 Union Mill Rd	Mount Laurel (Twp)	Municipal	Elementary
Parkway Elementary School	142 Ramblewood Pky	Mount Laurel (Twp)	Municipal	Elementary
Larchmont School	301 Larchmont Blvd & Unionmill Rd	Mount Laurel (Twp)	Municipal	Elementary
Countryside Elementary School	115 Schoolhouse Ln	Mount Laurel (Twp)	Municipal	Elementary
Bancroft Adult Program	1000 Birchfield Dr	Mount Laurel (Twp)	Municipal	Elementary
Fleetwood Elementary School	231 Fleetwood Ave	Mount Laurel (Twp)	Municipal	Elementary
Mount Laurel Hartford School	397 Hartford Rd	Mount Laurel (Twp)	Municipal	Elementary
Hillside Elementary School	1370 Hainesport Mount Laurel Rd	Mount Laurel (Twp)	Municipal	Elementary
Thomas E Harrington Middle	514 Mount Laurel Rd	Mount Laurel (Twp)	Municipal	Middle School
Burlington County College And Njit	3331 Hwy 38	Mount Laurel (Twp)	County	College
Springville Elem School	520 Hartford Rd	Mount Laurel (Twp)	Municipal	Elementary
Bc Special Services High School	20 Pioneer Boulevard	Mt. Holly (Twp)	Municipal	High School
Lighthouse Christian School	716 Main St	Mt. Holly (Twp)	Municipal	Elementary
Bc Special Services Elementary School	20 Pioneer Boulevard	Mt. Holly (Twp)	Municipal	Elementary
Bc Special Services Jr/Sr High School	20 Pioneer Boulevard	Mt. Holly (Twp)	Municipal	High School
Pleasant Valley Nursery School	314 Union Mill Rd	Mt. Laurel (Twp)	Municipal	Elementary
Rancocas Valley Regional Adult School	520 Jacksonville Rd	Mt. Holly (Twp)	Municipal	Elementary
Clarence B Lamb Elem School	46 Schoolhouse Rd	North Hanover (Twp)	Municipal	Elementary
North Hanover Upper Elementary School	331 Monmouth Rd	North Hanover (Twp)	Municipal	Elementary
Palmyra Adult High School	Delaware Ave & 4Th St W	Palmyra Borough	Municipal	High School
Palmyra Community Education	4Th & Delaware Ave	Palmyra Borough	Municipal	Elementary
Palmyra High School	5Th & Weart Blvd	Palmyra Borough	Municipal	High School
Charles Street Elementary Schl	100 W Charles St	Palmyra Borough	Municipal	Elementary
Delaware Avenue School	301 Delaware Ave	Palmyra Borough	Municipal	Elementary
Pemberton Boroughugh Elementary Schl	50 Early St	Pemberton Borough	Municipal	Elementary
Alexander Denbo Elem School	1412A Junction Rd	Pemberton (Twp)	Municipal	Elementary
Howard L Emmons Elementary	14 Scrapetown Rd	Pemberton (Twp)	Municipal	Elementary
Samuel T Busansky Elementary	16 Scrapetown Rd	Pemberton (Twp)	Municipal	Elementary
Harker-Wylie Elementary School	125C Trenton Rd	Pemberton (Twp)	Municipal	Elementary
Aletta Crichton Elem School	1412B Junction Rd	Pemberton (Twp)	Municipal	Elementary
Joseph S Stackhouse Elem Schl	125A Trenton Rd	Pemberton (Twp)	Municipal	Elementary
Pemberton Township High School	148 Arney'S Mount Rd	Pemberton (Twp)	Municipal	High School
Helen A Fort Middle School	301 Fort Dix Rd	Pemberton (Twp)	Municipal	Middle School
Marcus W Newcomb Elementary	300 Fort Dix Rd	Pemberton (Twp)	Municipal	Elementary
Burlington County College	601 Pemberton Browns Mills Rd	Pemberton (Twp)	County	College
Isaiah Haines School	125B Trenton Rd	Pemberton (Twp)	Municipal	Elementary
Pemberton Evening High School	Arney'S Mount Rd	Pemberton (Twp)	Municipal	High School
Bcc Alternative High School	County Road 530	Pemberton (Twp)	Municipal	High School
St Pewter's School	101 Middleton St	Riverside (Twp)	Municipal	Elementary

Table 4-16. Schools in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Type of Facility
St Pewter's Religious Education	101 Middleton St	Riverside (Twp)	Municipal	Elementary
Riverside Township High School	112 E. Washington St	Riverside (Twp)	Municipal	High School
Riverside Middle School	112 E. Washington St	Riverside (Twp)	Municipal	Middle School
Riverside (Twp) Elementary Schl	112 E. Washington St	Riverside (Twp)	Municipal	Elementary
Riverton Borough Public School	600 5Th St	Riverton Borough	Municipal	Elementary
Indian Mills Public School	112 Medford Indian Mills Rd	Shamong (Twp)	Municipal	Elementary
Indian Mills Memorial School	295 Medford Indian Mills Rd	Shamong (Twp)	Municipal	Elementary
Southampton Township School No. 3	100 Warrior Way	Southampton (Twp)	Municipal	Elementary
Southampton Township School No. 1	26 Pleasant St	Southampton (Twp)	Municipal	Elementary
Southampton Township School No. 2	100 Miss Mabel Dr	Southampton (Twp)	Municipal	Elementary
Springfield Township School	2146 Jacksonville Rd	Springfield (Twp)	Municipal	Elementary
Tabernacle Primary School	141 New Rd	Tabernacle (Twp)	Municipal	Elementary
Kenneth R Olson Middle School	132 New Rd	Tabernacle (Twp)	Municipal	Middle School
Seneca High School	110 Carranza Rd	Tabernacle (Twp)	Municipal	High School
Sequoia Alternative Program	180 Carranza Rd	Tabernacle (Twp)	Municipal	Elementary
Green Bank School	2436 Hwy 563	Washington (Twp)	Municipal	Elementary
Rancocas Friends School	123 Second St	Westampton (Twp)	Municipal	Elementary
Westampton Middle School	700 Rancocas Rd	Westampton (Twp)	Municipal	Middle School
Burlington County Institute Of Tech- M	695 Woodlane Rd	Westampton (Twp)	Municipal	High School
Holly Hills Elementary School	500 Ogden Dr	Westampton (Twp)	Municipal	Elementary
Hampton Academy	108 Burrs Rd	Westampton (Twp)	Municipal	Elementary
Dept Human Services Regional School	704 Woodlane Rd	Westampton (Twp)	County	Elementary
Bc Special Services School - Mt Holly	20 Pioneer Boulevard	Westampton (Twp)	County	Elementary
Calvary Christian School	594 Beverly Rancocas Rd	Willingboro (Twp)	Municipal	Elementary
W.R James Sr. Elementary School	41 Pinetree Ln	Willingboro (Twp)	Municipal	Elementary
Memorial Junior High School	451 Van Sciver Pky	Willingboro (Twp)	Municipal	High School
WillingBorough High School	20 John F Kennedy Way	Willingboro (Twp)	Municipal	High School
Hawthorne Park Elementary Schl	84 Hampshire Ln	Willingboro (Twp)	Municipal	Elementary
Martin Luther King Elem School	157 Northampton Dr	Willingboro (Twp)	Municipal	Elementary
Bookbinder School	56 Brooklawn Dr	Willingboro (Twp)	Municipal	Elementary
Twin Hills Elementary School	110 Twin Hill Dr	Willingboro (Twp)	Municipal	Elementary
Garfield Park East Elem School	150 Evergreen Dr	Willingboro (Twp)	Municipal	Elementary
Joseph A Mc Ginley School	40 Middlebury Ln	Willingboro (Twp)	Municipal	Elementary
Corpus Christi School	11 Sunset Rd	Willingboro (Twp)	Municipal	Elementary
J.C. Stuart Elementary School	70 Sunset Rd	Willingboro (Twp)	Municipal	Elementary
Christ Temple Academy	299 John F. Kennedy Way	Willingboro (Twp)	Municipal	Elementary
Cathedral Of Love School	139 Beverly Rancocas Rd	Willingboro (Twp)	Municipal	Elementary
Alpha Baptist Church	15 Rose Street	Willingboro (Twp)	Municipal	Elementary
WillingBorough High School Evening	50 Rev Dr Martin Luther King Jr Dr	Willingboro (Twp)	Municipal	High School
Levitt Middle School	50 Rev Dr Martin Luther King Jr Dr	Willingboro (Twp)	Municipal	Middle School
WillingBorough High Evening Foreign	50 Rev Dr Martin Luther King Jr Dr	Willingboro (Twp)	Municipal	High School

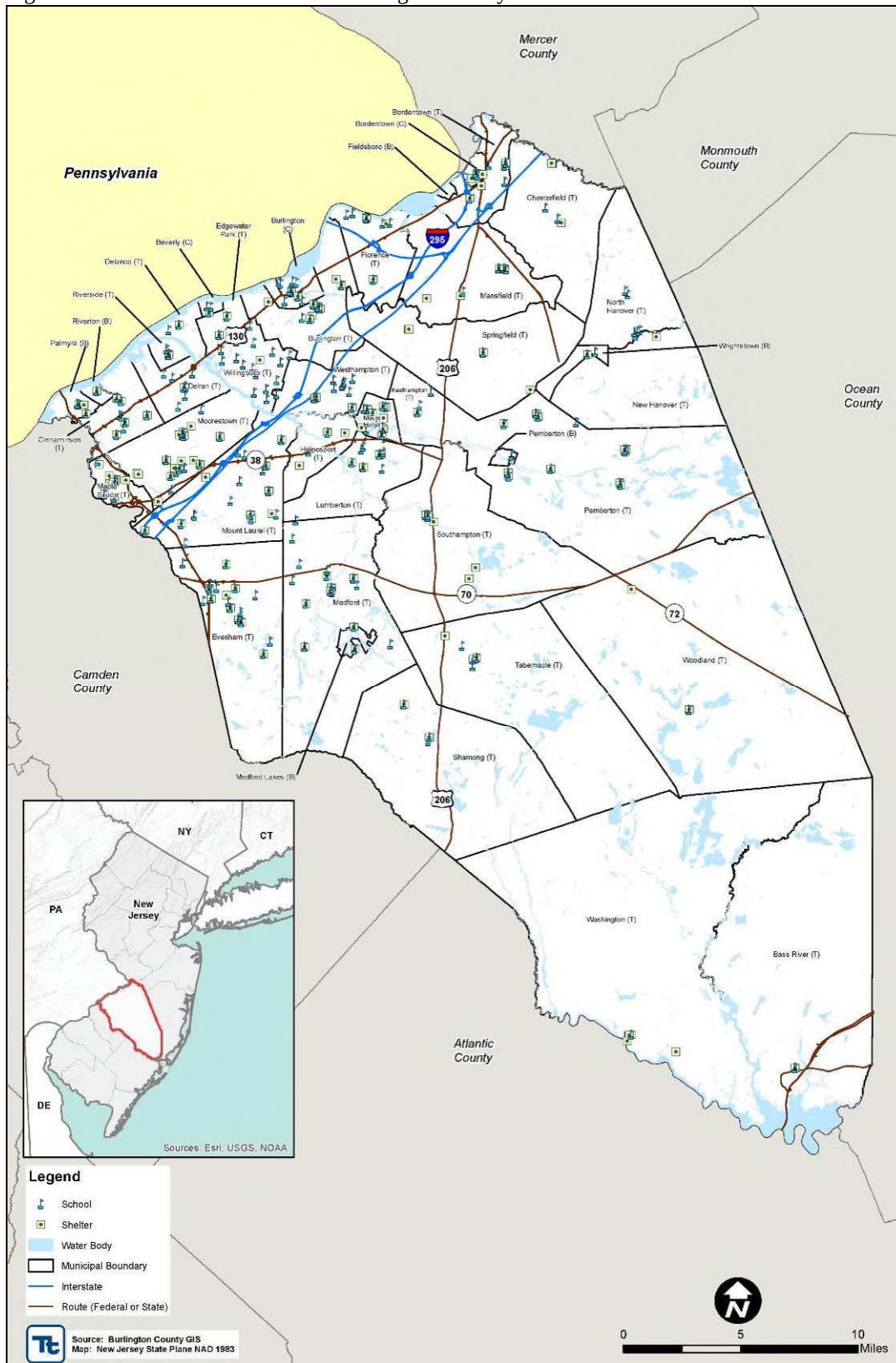
Table 4-16. Schools in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)	Type of Facility
Burlington County College	300 WillingBorough Parkway	Willingboro (Twp)	County	College
Chatsworth School	2 Giles Ave	Woodland (Twp)	Municipal	Elementary
King's Academy	131 E Main St	Wrightstown Borough	Municipal	Elementary

Source: Burlington County Department of Information Technology

Twp = Township TBD = To be determined

Figure 4-20. Schools and Shelters in Burlington County



Source: Burlington County Department of Information Technology

Senior Care and Senior Living Facilities

Table 4-17 provides an inventory of senior facilities in Burlington County.

Table 4-17. Senior Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
The Clare Estates	201 Crosswicks St	Bordentown	NGO
Marcella Center - Genesia Eldercare	2305 Rancocas Rd	Burlington	NGO
Masonic Home Of New Jersey	902 Jacksonville Rd	Burlington	NGO
Burlington Woods - Genesis Elder Care	115 Sunset Rd	Burlington	NGO
Granville House (Assisted Living Concepts Inc.)	111 Sunset Rd	Burlington	NGO
Home For Aged Women	241 York St	Burlington City	NGO
Cinnaminson Center -Gensis Elder Care	1700 Wynwood Drive	Cinnaminson	NGO
Senior Care of Delran	8008 Route 130 North Suite 300 Building B	Delran	NGO
Planned Parenthood of Southern New Jersey	4313 Route 130 S(Park Plaza Mall)	Edgewater Park	NGO
Virtua-West Jersey Hospital Marlton	90 Brick Road	Evesham	NGO
Alterra Sterling House of Florence	901 Broad Street	Florence	NGO
Fort Dix Outpatient Clinic-Community Based (VA)	Building 5437 8 th St	Fort Dix	Joint Base DOD
Burlington Association for Retared Citizens	1011 Deacon Rd	Hainesport	NGO
KNM Home Health Care, LLC	PO BOX 484 (14 Cottonwood DR)	Lumberton	NGO
Sterling Manor Nursing Center	794 N. Forklaanding Rd	Maple Shade	NGO
Americana Nursing & Rehabilitation (Rosewood)	317 Mill Road	Maple Shade	NGO
Care One AT Evesham LLC	870 East Route 70	Marlton	NGO
Wiley Mission Home for the Aged	99 East Main St	Marlton	NGO
Golden Age Excell, LLC	1400 Sagemore Drive	Marlton	NGO
Senior Care of Marlton	556A Lippincott Drive Building B	Marlton	NGO
B'nai B'rith Elmwood House	444 N. Elmwood Rd	Marlton	NGO
Medford Convalescent & Nursing Center	185 Tuckerton Rd	Medford	NGO
Medford Leas Continuing Care Retirement Community	1 Medford Leas Way	Medford	NGO
Archway Medford Group Home	106 E. Lake Blvd	Medford	NGO
Brandywine Senior (Living at Moorestown Estates)	1205 North Church St	Moorestown	NGO
The Evergreens	309 BridgeBorough Rd	Moorestown	NGO
Lutheran Home At Moorestown	255 East Main St	Moorestown	NGO
Tender Care Day Center	16 East Main Str	Moorestown	NGO
Care One at Moorestown (ALR)	895 Westfield Rd	Moorestown	NGO
The Greenleaf	28 Main Street East	Moorestown	NGO
Moorestown VNA	300 Harper Dr.	Moorestown	NGO
Virtua Health & Rehabilitation Center at Mt Holly	62 Richmond Ave	Mount Holly	NGO
Samuel Miller (Christian Retirement Center)	256 Clifton Ave	Mount Holly	NGO
Innova Health & Rehab Center	3718 Church Road	Mount Laurel	NGO
Sunrise Assisted Living of Mount Laurel (ALR)	400 Fernbrooke Lane	Mount Laurel	NGO
Preferred Health Mate LLC	1300 Route 73	Mount Laurel	NGO

Table 4-17. Senior Facilities in Burlington County

Name	Address	Municipality	Ownership (municipal, county or state)
Senior Care Of Mount Laurel	200 Birchfield Dr	Mount Laurel	NGO
Florence Klemmer House	820 Union Mill Rd	Mount Laurel Tep	NGO
Buttonwood Hospital	600 Pemberton Browns Mill Rd	Pemberton	NGO
Riverview Estates (Baptist Home of South Jersey)	303 Bank Ave	Riverton	NGO
Roebing Arms\Independent Living\Mobility Impaired	1340 Hornberger Ave	Roebing	NGO
Willow Brook Rest Home	40 Petticaot Bridge Rd	Springfield	NGO
Masonic Home Of New Jersey	902 Jacksonville Rd	Springfield (Twp)	NGO
Alterra Clare Bridge of Westampton	480 Woodlane Rd	Westampton	NGO
Virtua Community Nursing Service (BC Health Dept)	15 Pioneer Boulevard	Westampton	NGO
Bridges Adult Medical Day Care	352 Beverly Rancocas Rd	Willingboro	NGO
Riverview Estates (Baptist Home of South Jersey)	303 Bank Ave	Riverton	NGO
Roebing Arms\Independent Living\Mobility Impaired	1340 Hornberger Ave	Roebing	NGO
Willow Brook Rest Home	40 Petticaot Bridge Rd	Springfield	NGO
Masonic Home Of New Jersey	902 Jacksonville Rd	Springfield (Twp)	NGO
Alterra Clare Bridge of Westampton	480 Woodlane Rd	Westampton	NGO
Virtua Community Nursing Service (BC Health Dept)	15 Pioneer Boulevard	Westampton	NGO
Bridges Adult Medical Day Care	352 Beverly Rancocas Rd	Willingboro	NGO

Source: Burlington County Department of Information Technology

Twp = Township

TBD

=

To be determined

Transportation Systems

This section presents available inventory data for roadways, airports, railways and other transportation systems in Burlington County. Figure 4-20 shows regional transportation lifelines serving the County.

Highway, Roadways and Associated Systems

Interstates 295 and 95 are the major north-south routes that pass through the County. These routes are vital northeast corridors which connect major cities of the east coast. Additionally, a small portion of Interstate 276 connects Interstates 95 and 295 to northern Philadelphia and the Pennsylvania Turnpike's Northeast Extension. Along the eastern edge of the County the Garden State Parkway (US Route 9), another north-south route passes through the County. The Garden State Parkway extends from New York to the tip of Cape May County. This route is one of only two routes in the US with a ferry, as the Cape May-Lewes Ferry connects Cape May to Lewes, Delaware. Other important routes in Burlington County are U.S. Route 206 (north-south), U.S. Route 130 (north-south), NJ Route 70 (east-west), and NJ Route 72 (east-west).

Airports and Heliports

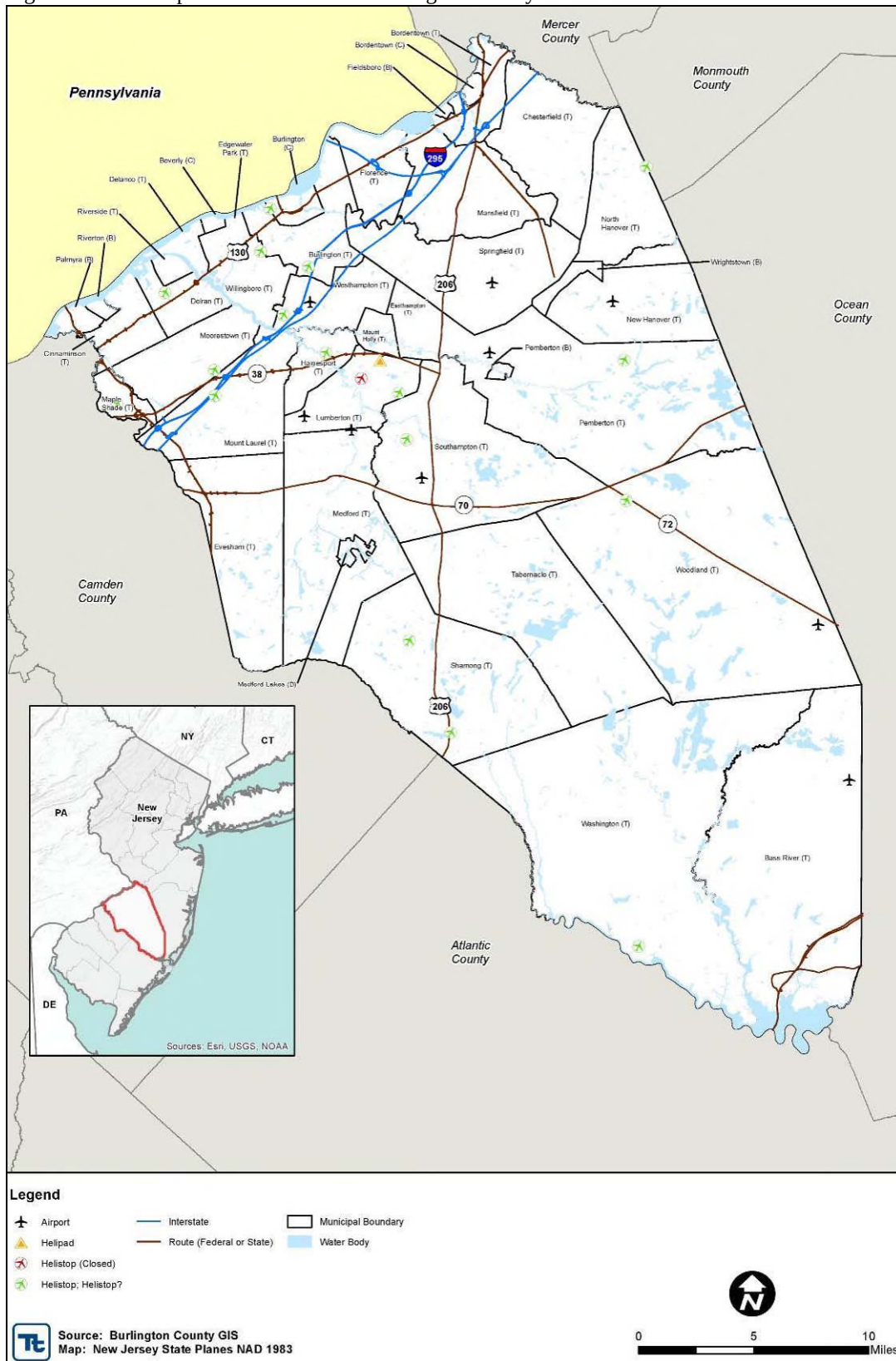
Table 4-18 summarizes the airports and heliports in Burlington County.

Table 4-18. Airports/Heliports in Burlington County

Name	Municipality	Type	Owner	Use
Warren Grove Range Airport	Bass River (Twp)	Airport	U.S. Army	Private use. Permission required prior to landing
Deborah Heart & Lung Center Heliport	Browns Mills	Helistop	Private	Private use, Medical Only
Burlington Generating Station Heliport (Pseg)	Burlington City	Helistop	Private	Private use. Permission required prior to landing
Colgate Palmolive Heliport	Burlington (Twp)	Helistop	Private	Private use. Permission required prior to landing
Mac Millan Restricted Helistop	Delran (Twp)	Helistop	Private	Private use. Permission required prior to landing
Our Ladys Of Lourdes Heliport	Hainesport (Twp)	Helistop	Public	Private use. Permission required prior to landing
South Jersey Regional Airport	Lumberton (Twp)	Airport	Public	Open to the public
MOSQUITO HELIPAD	Lumberton (Twp)	Helipad		
Flying W Airport	Medford (Twp)	Airport	Public	Open to the public
Griffin Associates Heliport	Moorestown (Twp)	Helistop	Private	Private use. Permission required prior to landing
Chemical Bank - New Jersey Na Heliport	Moorestown (Twp)	Helistop	Private	Private use. Permission required prior to landing
Blue Jay Heliport	Mount Holly (Twp)	Helistop	Private	Private use. Permission required prior to landing
Mount Holly Heliport	Mount Holly (Twp)	Helistop (Closed)	Private	Private use. Permission required prior to landing
Eayrestown Helistop	Mount Holly (Twp)	Helistop ?	Private	Private use. Permission required prior to landing
NJ Turnpike Authority Heliport	Mount Laurel (Twp)	Helistop	Private	Private use. Permission required prior to landing
Mc Guire Air Force Base	New Hanover (Twp)	Airport	U.S. Air Force	Private use. Permission required prior to landing
Lz 1 Nldc Heliport	New Lisbon	Helistop	Private	Private use. Permission required prior to landing
Arneytown Veterans Cemetery Heliport	North Hanover (Twp)	Helistop	Private	Private use. Permission required prior to landing
Pemberton Airport	Pemberton (Twp)	Airport	Public	Open to the public
Indian Mills Heliport	Shamong (Twp)	Helistop	Private	Private use. Permission required prior to landing
Atsion Helistop	Shamong (Twp)	Helistop	Public	Private use. Permission required prior to landing
Red Lion Airport	Southampton (Twp)	Airport	Public	Open to the public
Redwing Airport	Springfield (Twp)	Airport	Public	Open to the public
Warren Hopely Heliport	Vincentown	Helistop	Private	Private use. Permission required prior to landing
Pacemaker Heliport	Washington (Twp)	Helistop	Private	Private use. Permission required prior to landing
Inductotherm Airport	Westampton (Twp)	Airport	Private	Private use. Permission required prior to landing
Rancocas Hospital Heliport	WillingBorough (Twp)	Helistop	Private	Private use, Medical Only
Coyle Field Airport	Woodland (Twp)	Airport	Public	Private use. Permission required prior to landing

Source: Burlington County Department of Information Technology

Figure 4-21. Transportation Lifelines in Burlington County



Source: Burlington County Department of Information Technology

Public Transportation

Burlington County is served primarily by New Jersey Transit bus and rail lines. The NJ Transit River Line connects to Amtrak's Northeast Corridor at Trenton and to PATCO which connects Philadelphia to Camden. These lines provide the connection between Burlington County and other major cities such as Washington D.C., Baltimore, MD, Wilmington, DE, Philadelphia, PA, and New York, NY. Rail service extends to points north and south. Table 4-19 lists the river line stations located in the County.

Table 4-19. Railroad Facilities in Burlington County

Name	Municipality
BEVERLY/EDGEWATER PARK	Beverly/Edgewater Park
BORDENTOWN	Bordentown
BURLINGTON SOUTH PARK & RIDE	Burlington South Park & Ride
BURLINGTON TOWN CENTER STATION	Burlington Town Center Station
CINNAMINSON	Cinnaminson
DELANCO	Delanco
FLORENCE PARK & RIDE	Florence Park & Ride
PALMYRA	Palmyra
RIVERSIDE	Riverside
RIVERTON	Riverton
ROEBLING	Roebbling

Source: Burlington County Department of Information Technology

Lifeline Utility Systems

This section presents potable water, wastewater, and energy resource utility system data. Due to heightened security concerns, local utility lifeline data sufficient to complete the analysis have only partially been obtained.

Potable Water Supply

New Jersey American Water (NJAW), serves more than 80,000 people in 20 communities in Burlington County and more than two million people in the Garden State. NJAW's main production facility in the region is the Delaware River Water Treatment Plant (DRWTP), located in Delran. The DRWTP produces an average of 22 million gallons of water per day and serves customers in Burlington, Camden and Gloucester counties. The largest water purveyor in the state, NJAW is a wholly owned subsidiary of American Water, the largest private water services provider in North America. Headquartered in Voorhees, American Water employs approximately 6,900 professionals who provide high quality water, wastewater and other related services to more than 16.2 million people in 32 states and Ontario, Canada (Burlington County Economic Resource Guide, 2008).

Aqua America New Jersey provides drinking water and wastewater services to 150,000 residents in 18 municipalities in nine New Jersey counties (Burlington County Economic Resource Guide, 2008).

Burlington County's water is predominately from surface water sources. Additionally, a small portion of the water supply is well water from well fields distributed throughout the system (Sleeper, 2008).

Table 4-20 lists the potable water facilities, tanks and wells located in Burlington County.

Table 4-20. Burlington County Potable Water Facilities

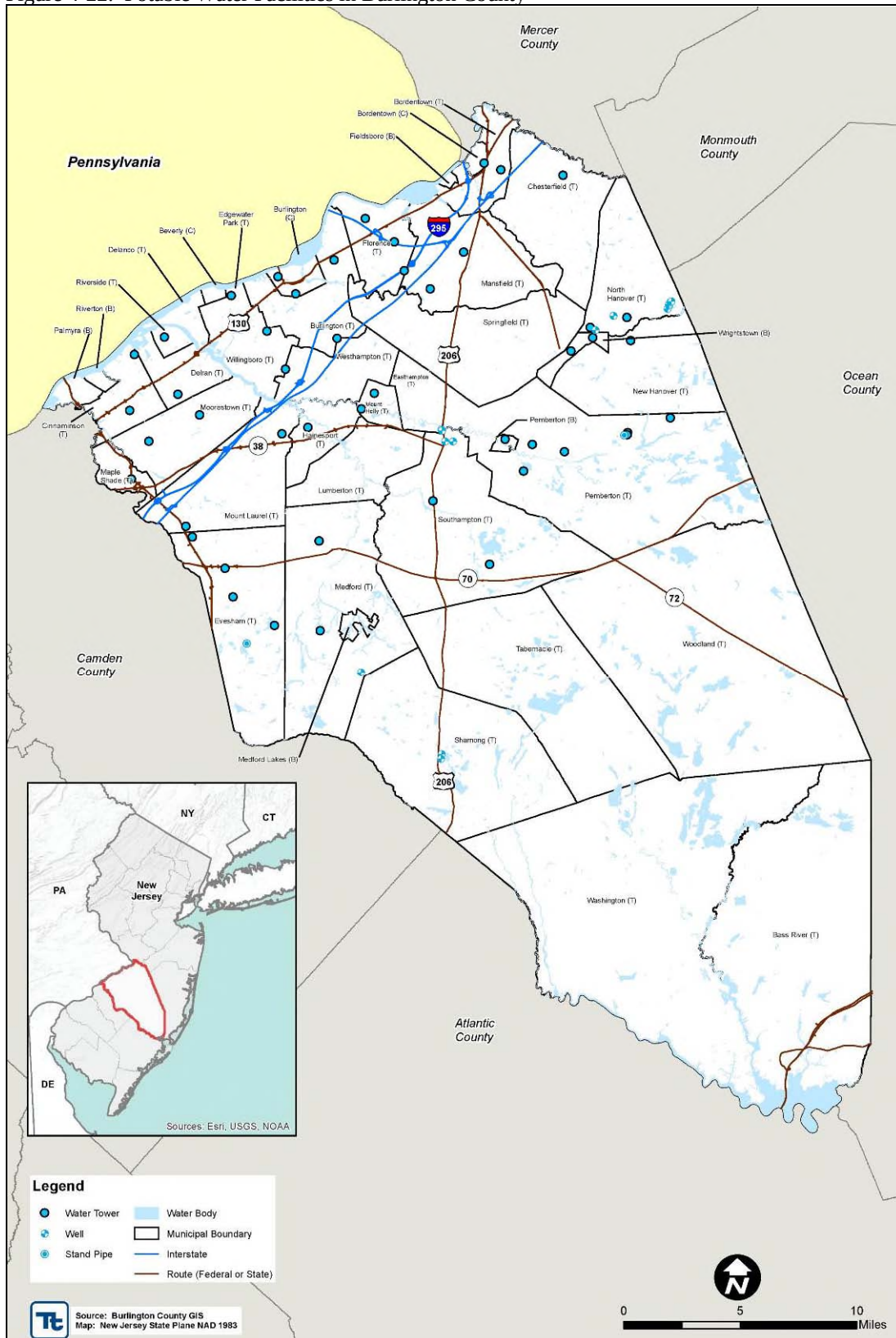
Name	Municipality	Municipal, County or Private Ownership	Type
City Of Bordentown	Bordentown City	Municipal	Water Tower
Bordentown	Bordentown Twp	Municipal	Water Tower
Comerce Square	Burlington City	Municipal	Water Tower
Burlington	Burlington City	Municipal	Water Tower
Burlington	Burlington Twp	Municipal	Water Tower
Burlington	Burlington Twp	Municipal	Water Tower
Chesterfield	Chesterfield Twp	Private	Water Tower
Cinnaminson	Cinnaminson Twp	Private	Water Tower
Cinnaminson	Cinnaminson Twp	Private	Water Tower
Delran	Delran Twp	Private	Water Tower
Fenimore Trail Park	Eastampton Twp	Private	Well
Fenimor 1	Eastampton Twp	Private	Well
Fenimor 2	Eastampton Twp	Private	Well
Edegewater Park	Edgewater Park	Private	Water Tower
Kings Grant 1	Evesham Twp	Municipal	Stand Pipe
Evesham	Evesham Twp	Municipal	Water Tower
Mua Well #8	Evesham Twp	Municipal	Water Tower
Mua Well 4	Evesham Twp	Municipal	Water Tower
Kings Grant 2	Evesham Twp	Municipal	Water Tower
Florence	Florence Twp	Municipal	Water Tower
Florence	Florence Twp	Municipal	Water Tower
Landfill	Florence Twp	County	Water Tower
Hainesport	Hainesport Twp	Private	Water Tower
Mansfield	Mansfield Twp	Private	Water Tower
Homestead	Mansfield Twp	Private	Water Tower
Maple Shade	Maple Shade Twp	Municipal	Water Tower
Medford	Medford Twp	Municipal	Water Tower
Medford	Medford Twp	Municipal	Water Tower
Moorestown	Moorestown Twp	Municipal	Water Tower
Moorestown	Moorestown Twp	Municipal	Water Tower
Mount Holly	Mount Holly Twp	Private	Water Tower
Elec Tech	Mount Holly Twp	Private	Water Tower
Mount Laurel	Mount Laurel Twp	Municipal	Water Tower
Mount Laurel Mua	Mount Laurel Twp	Municipal	Water Tower
Mcguire Afb	New Hanover Twp	Joint Base	Water Tower
Mcguire Afb	North Hanover Twp	Joint Base	Water Tower
Oconner	North Hanover Twp	Private	Water Tower
Millstream North	North Hanover Twp	Private	Well
Spartan Villages	North Hanover Twp	Private	Well
South Mobile Homes	North Hanover Twp	Private	Well
Ceder Grove Apartments	North Hanover Twp	Private	Well
California Mobile 1	North Hanover Twp	Private	Well
California Mobile 3	North Hanover Twp	Private	Well
California Mobile 2	North Hanover Twp	Private	Well
Pemberton	Pemberton Boro	Municipal	Water Tower
Village	Pemberton Boro	Private	Water Tower

Table 4-20. Burlington County Potable Water Facilities

Name	Municipality	Municipal, County or Private Ownership	Type
Stackhouse School	Pemberton Twp	Municipal	Stand Pipe
Pemberton	Pemberton Twp	Municipal	Water Tower
Deborah	Pemberton Twp	Private	Water Tower
Pemberton	Pemberton Twp	Municipal	Water Tower
Pemberton	Pemberton Twp	Municipal	Water Tower
Oak Pines	Pemberton Twp	Municipal	Water Tower
Riverside	Riverside Twp	Private	Water Tower
Medford	Shamong Twp	Municipal	Well
Fawn Lakes 1	Shamong Twp	Private	Well
Fawn Lakes 2	Shamong Twp	Private	Well
Leisuretowne	Southampton Twp	Private	Water Tower
Southampton	Southampton Twp	Private	Water Tower
Mobile Estates 1	Southampton Twp	Private	Well
Mobile Estates 2	Southampton Twp	Private	Well
Willingboro	Willingboro Twp	Municipal	Water Tower
Willingboro	Willingboro Twp	Municipal	Water Tower
Wrightstown Mua	Wrightstown Boro	Municipal	Water Tower
Fort Dix Military	Wrightstown Boro	Joint Base	Water Tower

Source: Burlington County Department of Information Technology

Figure 4-22. Potable Water Facilities in Burlington County



Source: Burlington County Department of Information Technology

Energy Resources

JCP&L and PSE&G are the primary electric and gas utility companies in Burlington County. In addition, South Jersey Gas provides natural gas service to Burlington County. Verizon is the primary provider of landline service in Burlington County.

Table 4-21 lists the electric substations and transfer stations located in Burlington County.

Table 4-21. Electric Substations and Transfer Stations in Burlington County

Name	Municipality
PSE&G	Bordentown City
PSE&G	Burlington City
PSE&G	Chesterfield Twp
PSE&G	Cinnaminson Twp
PSE&G	Cinnaminson Twp
PSE&G	Evesham Twp
PSE&G	Florence Twp
PSE&G	Lumberton Twp
PSE&G	Medford Twp
PSE&G	Moorestown Twp
PSE&G	Mount Holly Twp
PSE&G	Mount Luarel Twp
JCP&L	North Hanover Twp
JCP&L	Pemberton Twp
JCP&L	Pemberton Twp
PSE&G	Riverside Twp
PSE&G	Southampton Twp
Atlantic City Electric	Tabernacle Twp
PSE&G	Willingboro Twp

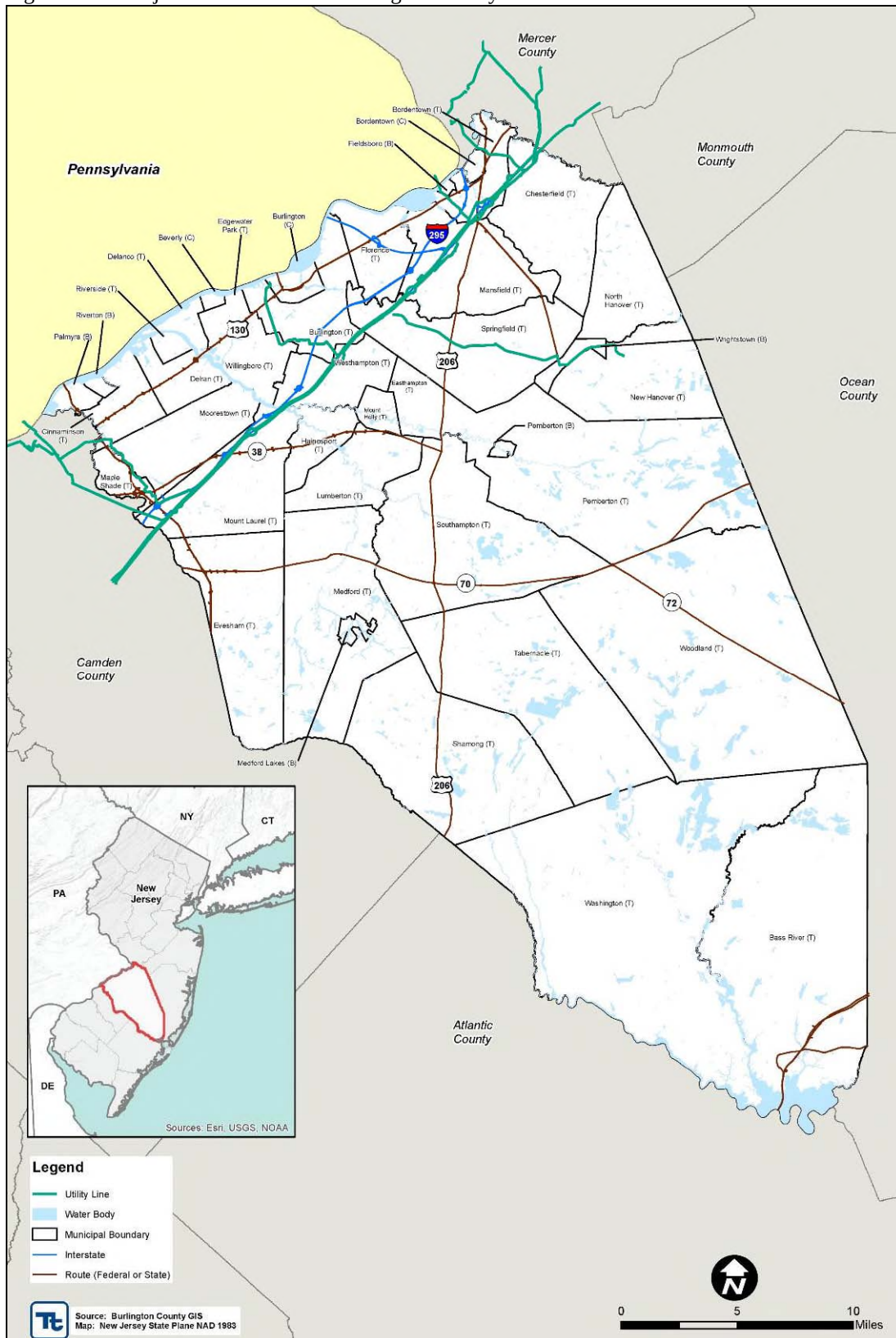
Source: Burlington County Department of Information Technology

Table 4-22. Electric Facilities in Burlington County

Name	Municipality
PSEG Burlington Generation Station	Bordentown City

Source: Burlington County Department of Information Technology

Figure 4-23. Major Utilities Lines in Burlington County



Source: Burlington County Department of Information Technology

Communication Resources

Table 4-23 lists the communication facilities located in Burlington County.

Table 4-23. Communication Facilities in Burlington County

Name	Municipality
Bordentown Twp Police	Bordentown
Burlington Twp Police	Burlington
Cinnaminson Twp Police	Cinnaminson
Delran Twp Police	Delran
Evesham Twp Police	Evesham
Lumberton Twp Police	Lumberton
Medford Twp Police	Medford
Mount Laurel Campus	Mount Laurel
Mount Laurel Twp Police	Mount Laurel
Pemberton Highway	Pemberton
Pemberton Twp Police	Pemberton
Willingboro Twp Police	Willingboro

Source: Burlington County Department of Information Technology

Wastewater Facilities

Table 4-24 lists the wastewater treatment facilities and wastewater pump stations in the County.

Table 4-24. Burlington County Wastewater Treatment Facilities and Pump Stations

Name	Municipality
Beverly Sewerage Authority	Beverly City
Bordentown Sewerage Authority	Bordentown City
A.C. Wagner Youth Correctional Institution	Bordentown Twp
Bordentown Sewerage Authority	Bordentown Twp
Bordentown Township Sewage Authority	Bordentown Twp
Common Council Burlington City	Burlington City
Central Avenue Sewerage Treatment Plant	Burlington Twp
Olde York Country Club	Chesterfield Twp
Cinnaminson Sewerage Authority	Cinnaminson Twp
Delran Sewerage Authority	Delran Twp
Elmwood Sewerage Treatment Plant	Evesham Twp
Kings Grant Sewerage Treatment Plant	Evesham Twp
Woodstream Sewerage Treatment Plant	Evesham Twp
Fieldsboro Sewerage Treatment Plant	Fieldsboro Borough
Florence Sewerage Treatment Plant	Florence Twp
National Auto Dealers Exchange	Mansfield Twp
Homestead Utility Company	Mansfield Twp
Maple Shade Sewerage Treatment Plant	Maple Shade Twp
Medford Lakes Sewerage Treatment Plant	Medford Lakes Borough
Medford Water Pollution Control	Medford Twp
Moorestown Township Sewerage Treatment Plant	Moorestown Twp
Mount Holly Municipal Utility Authority	Mount Holly Twp

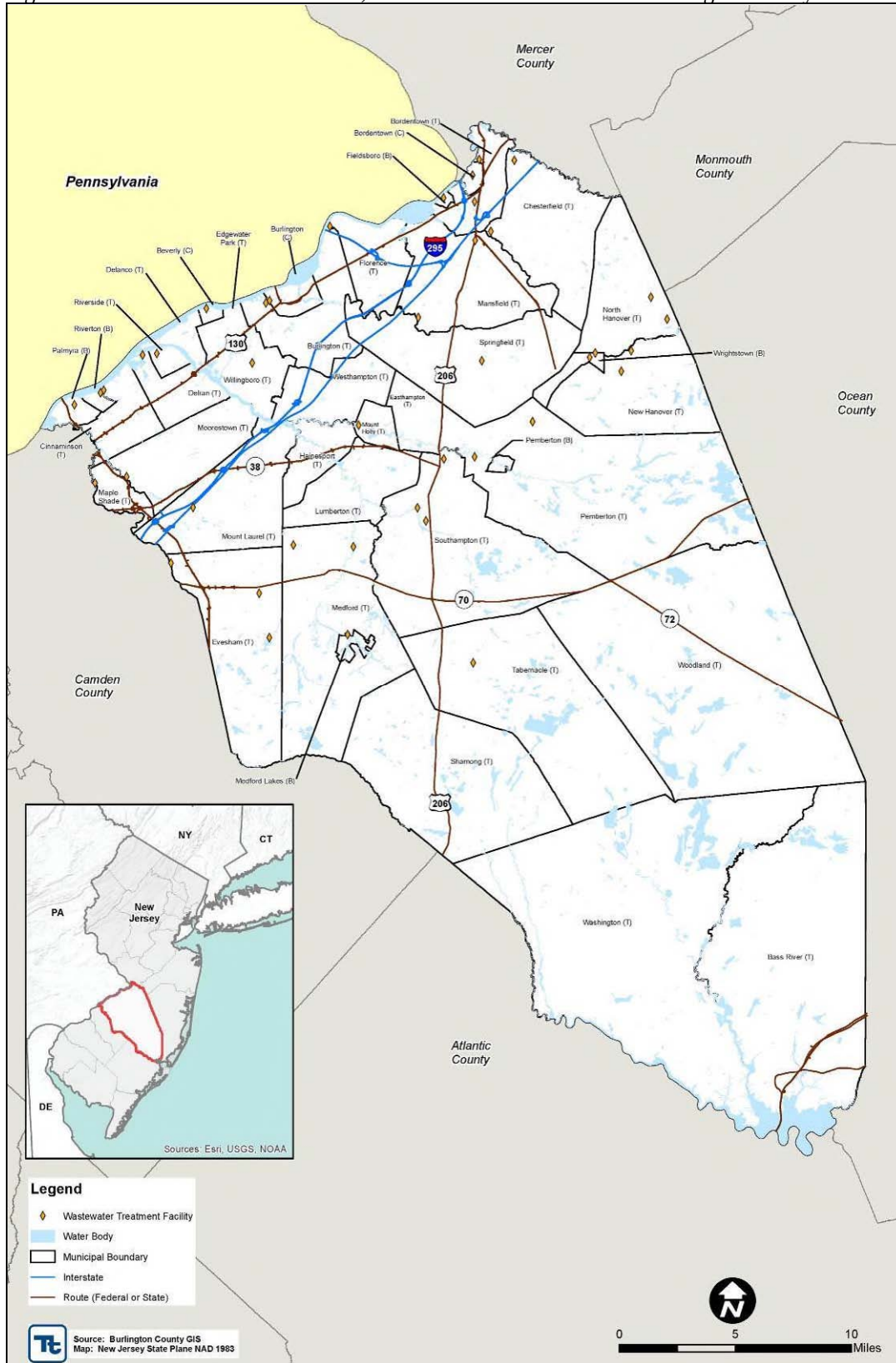
Table 4-24. Burlington County Wastewater Treatment Facilities and Pump Stations

Name	Municipality
Mount Laurel Municipal Utilities Authority	Mount Laurel Twp
Executive Days Inn	New Hanover Twp
California Village Mobile Home Park	North Hanover Twp
Hanover Mobile Home Park	North Hanover Twp
Spartan Village Mobile Home Park	North Hanover Twp
Palmyra Sewerage Treatment Plant	Palmyra Borough
Pemberton Township Municipal Utilities Authority	Pemberton Twp
US Army Fort Dix/McGuire Air Force Base	Pemberton Twp
Helen Fort Middle School	Pemberton Twp
Riverside Sewerage Treatment Plant	Riverside Twp
Riverton Sewerage Treatment Plant	Riverton Borough
Mobile Estates of Southampton	Southampton Twp
Pinelands Sewer Company	Southampton Twp
Upper Elementary	Southampton Twp
Springfield School Sewerage Treatment Plant	Springfield Twp
Tbernacle Middle School	Tabernacle Twp
Lenape High School	Tabernacle Twp
Willingboro Municipal Sewerage Treatment Plant	Willingboro Twp
Wrightstown Municipal Utilities Authority	Wrightstown Borough

Source: Burlington County Department of Information Technology

TBD = To be determined

Figure 4-24. Wastewater Service Areas, Infrastructure and Facilities in Burlington County



Source: Burlington County Department of Information Technology

High-Potential Loss Facilities

High-potential loss facilities include dams, levees, hazardous materials facilities (HAZMAT), nuclear power plants and military installations. No nuclear power plants or military installations were identified in the County. Dams, levees and HAZMAT facilities are discussed below.

Dams and Levees

According to the New Jersey Department of Environmental Protection (NJDEP), there are four hazard classifications of dams in New Jersey. The classifications relate to the potential for property damage and/or loss of life should the dam fail:

- Class I (High-Hazard Potential) - Failure of the dam may result in probable loss of life and/or extensive property damage
- Class II (Significant-Hazard Potential) - Failure of the dam may result in significant property damage; however loss of life is not envisioned.
- Class III (Low-Hazard Potential) - Failure of the dam is not expected to result in loss of life and/or significant property damage.
- Class IV (Small-Dam Low-Hazard Potential) - Failure of the dam is not expected to result in loss of life or significant property damage. Dam must also meet the requirements of a Class IV dam above.

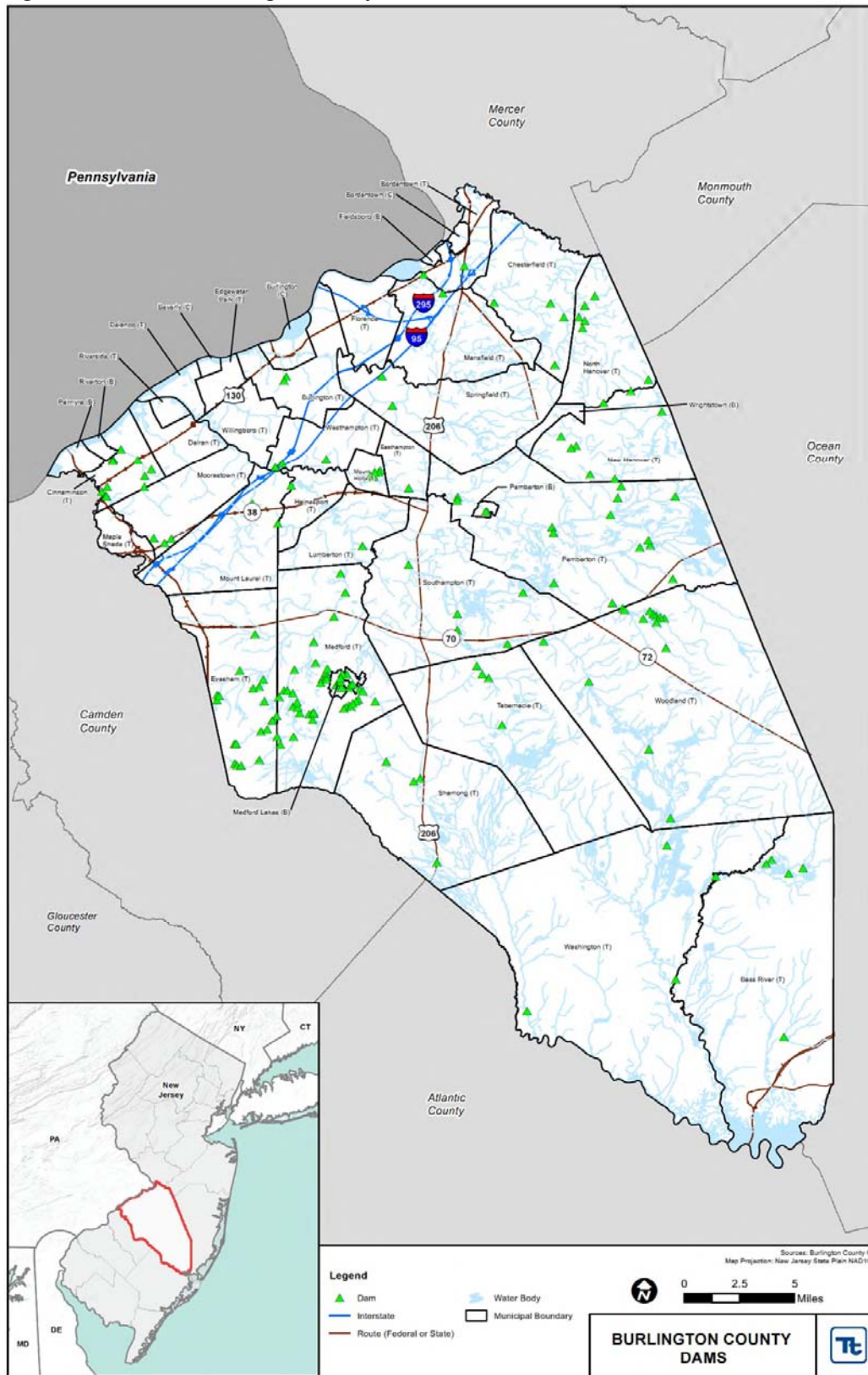
According to the NJDEP Bureau of Dam Safety, the following dams and their classifications are located in Burlington County (Table 4-25). Figure 4-24 illustrates the locations of these dams.

Table 4-25. Dams in Burlington County

County	Total Count	High	Significant	Low
Burlington	166	10	37	95

Source: NJDEP Bureau of Dam Safety, 2013

Figure 4-25. Dams in Burlington County



Source: Burlington County Department of Information Technology

HAZMAT Facilities

The U.S. Environmental Protection Agency's (EPA) 2013 Toxics Release Inventory (TRI) database indicates there are 74 TRI facilities in Burlington County. TRI facilities are those required to report on chemical storage and use based on particular volumes of specified chemicals stored and used (USEPA, 2013). NJDEP Bureau of Release Prevention identifies facilities in the County where an extraordinarily hazardous substance may be present or generated above regulatory levels that are subject to the Toxic Catastrophe Prevention Act, (N.J.S.A. 13:1K-19 et seq.) and the regulations arising from the Act as codified in N.J.A.C. 7:31 (NJDEP, 2007; NJDEP, 2008).

Other Facilities

The Planning Committee identified additional facilities (user-defined facilities) as critical including municipal buildings and dialysis centers. These facilities were included in the risk assessment conducted for the County. Table 4-26 lists the other facilities identified by Burlington County. Figure 4-25 illustrates the locations of these facilities.

Table 4-26. Other Facilities in Burlington County

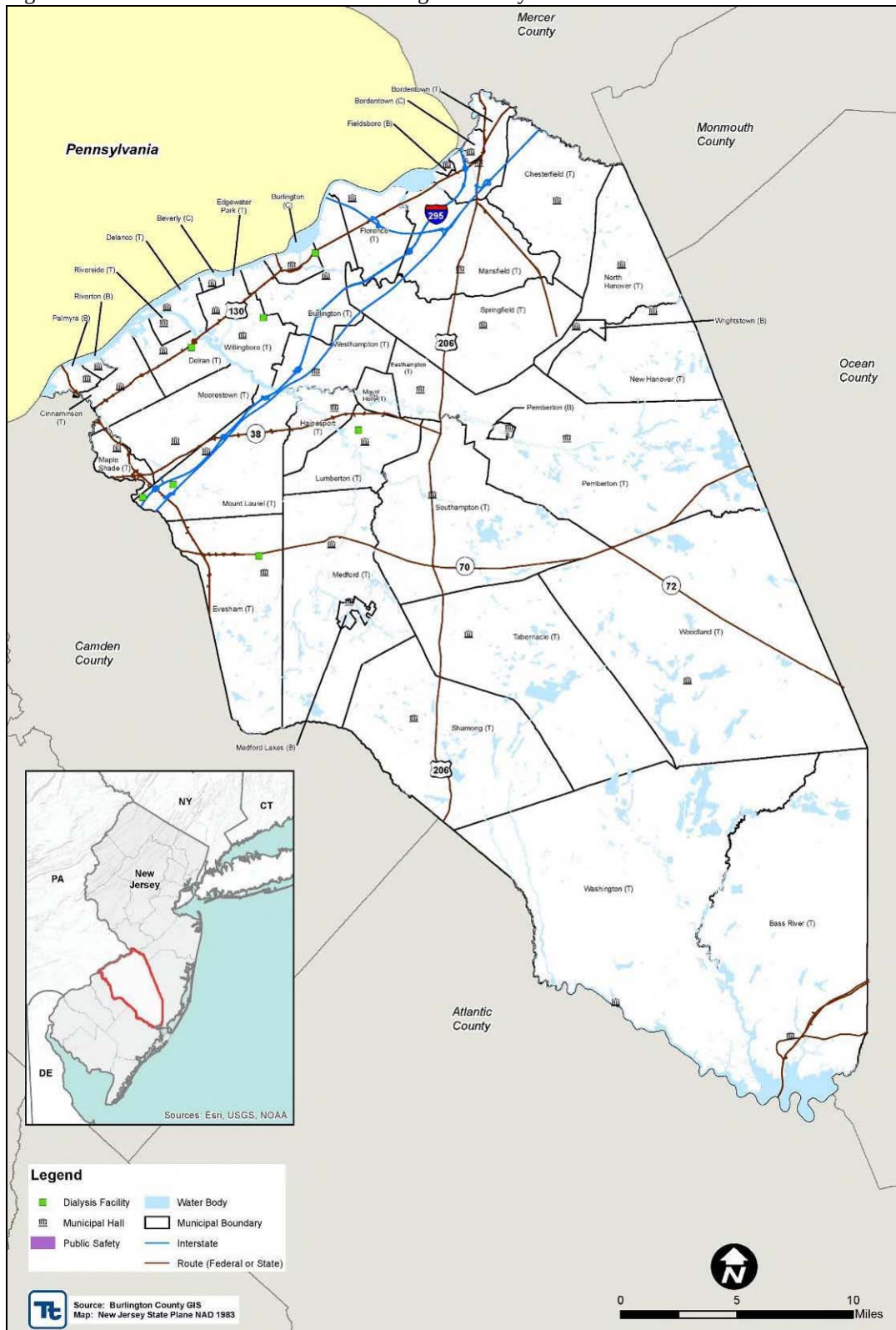
Name	Municipality	Type
BORDENTOWN CITY MUNICIPAL BUILDING	BORDENTOWN CITY	Municipal Building
BORDENTOWN TOWNSHIP MUNICIPAL BUILDING	BORDENTOWN (TWP)	Municipal Building
BURLINGTON CITY MUNICIPAL BUILDING	BURLINGTON CITY	Municipal Building
BURLINGTON TOWNSHIP MUNICIPAL BUILDING	BURLINGTON (TWP)	Municipal Building
CHESTERFIELD TOWNSHIP MUNICIPAL BUILDING	CHESTERFIELD (TWP)	Municipal Building
CINNAMINSON TOWNSHIP MUNICIPAL BUILDING	CINNAMINSON (TWP)	Municipal Building
DELANCO TOWNSHIP MUNICIPAL BUILDING	DELANCO (TWP)	Municipal Building
DELRAN TOWNSHIP MUNICIPAL BUILDING	DELRAN (TWP)	Municipal Building
EASTAMPTON TOWNSHIP MUNICIPAL BUILDING	EASTAMPTON (TWP)	Municipal Building
EDGEWATER PARK TOWNSHIP MUNICIPAL BUILDING	EDGEWATER PARK	Municipal Building
EVESHAM TOWNSHIP MUNICIPAL BUILDING	EVESHAM (TWP)	Municipal Building
FIELDSBOROUGH MUNICIPAL BUILDING	FIELDSBOROUGH	Municipal Building
BASS RIVER TOWNSHIP MUNICIPAL BUILDING	BASS RIVER (TWP)	Municipal Building
BEVERLY CITY MUNICIPAL BUILDING	BEVERLY CITY	Municipal Building
FLORENCE TOWNSHIP MUNICIPAL BUILDING	FLORENCE (TWP)	Municipal Building
HAINESPORT TOWNSHIP MUNICIPAL BUILDING	HAINESPORT (TWP)	Municipal Building
LUMBERTON TOWNSHIP MUNICIPAL BUILDING	LUMBERTON (TWP)	Municipal Building
MANSFIELD TOWNSHIP MUNICIPAL BUILDING	MANSFIELD (TWP)	Municipal Building
MAPLE SHADE TOWNSHIP MUNICIPAL BUILDING	MAPLE SHADE (TWP)	Municipal Building
MEDFORD TOWNSHIP MUNICIPAL BUILDING	MEDFORD (TWP)	Municipal Building
MEDFORD LAKES BOROUGHUGH MUNICIPAL BUILDING	MEDFORD LAKES BOROUGH	Municipal Building
MOORESTOWN TOWNSHIP MUNICIPAL BUILDING	MOORESTOWN (TWP)	Municipal Building
MOUNT HOLLY TOWNSHIP MUNICIPAL BUILDING	MOUNT HOLLY (TWP)	Municipal Building
MOUNT LAUREL TOWNSHIP MUNICIPAL BUILDING	MOUNT LAUREL (TWP)	Municipal Building
NEW HANOVER TOWNSHIP MUNICIPAL BUILDING	NEW HANOVER (TWP)	Municipal Building
NORTH HANOVER TOWNSHIP MUNICIPAL BUILDING	NORTH HANOVER (TWP)	Municipal Building
PALMYRA BOROUGHUGH MUNICIPAL BUILDING	PALMYRA BOROUGH	Municipal Building
PEMBERTON BOROUGHUGH MUNICIPAL BUILDING	PEMBERTON BOROUGH	Municipal Building
PEMBERTON TOWNSHIP MUNICIPAL BUILDING	PEMBERTON (TWP)	Municipal Building
RIVERSIDE TOWNSHIP MUNICIPAL BUILDING	RIVERSIDE (TWP)	Municipal Building
RIVERTON BOROUGHUGH MUNICIPAL BUILDING	RIVERTON BOROUGH	Municipal Building

Table 4-26. Other Facilities in Burlington County

Name	Municipality	Type
SHAMONG TOWNSHIP MUNICIPAL BUILDING	SHAMONG (TWP)	Municipal Building
SOUTHAMPTON TOWNSHIP MUNICIPAL BUILDING	SOUTHAMPTON (TWP)	Municipal Building
SPRINGFIELD TOWNSHIP MUNICIPAL BUILDING	SPRINGFIELD (TWP)	Municipal Building
TABERNACLE TOWNSHIP MUNICIPAL BUILDING	TABERNACLE (TWP)	Municipal Building
WASHINGTON TOWNSHIP MUNICIPAL BUILDING	WASHINGTON (TWP)	Municipal Building
WESTAMPTON TOWNSHIP MUNICIPAL BUILDING	WESTAMPTON (TWP)	Municipal Building
WILLINGBOROUGH TOWNSHIP MUNICIPAL BUILDING	WILLINGBOROUGH (TWP)	Municipal Building
WOODLAND TOWNSHIP MUNICIPAL BUILDING	WOODLAND (TWP)	Municipal Building
WRIGHTSTOWN BOROUGHUGH MUNICIPAL BUILDING	WRIGHTSTOWN BOROUGH	Municipal Building
DAVITA BURLINGTON NORTH	BURLINGTON	Dialysis Center
DAVITA DELRAN	DELRAN	Dialysis Center
MOUNT LAUREL DIALYSIS CENTER	MOUNT LAUREL	Dialysis Center
DAVITA LUMBERTON	LUMBERTON	Dialysis Center
LOURDES DIALYSIS AT INNOVA	MOUNT LAUREL	Dialysis Center
DAVITA WILLINGBOROUGH	WILLINGBOROUGH	Dialysis Center
DSI	EVESHAM	Dialysis Center

Source: Burlington County Department of Information Technology

Figure 4-26. User Defined Facilities in Burlington County



Source: Burlington County GIS

SECTION 5: RISK ASSESSMENT

According to the Federal Emergency Management Agency, “risk assessment” is the process of measuring the potential loss of life, personal injury, economic injury and property damage resulting from natural hazards by assessing the vulnerability of people, buildings and infrastructure to natural hazards.” Burlington County’s risk assessment is organized into four sections. Section 5.1 describes the methodology and tools used to support the risk assessment process. Section 5.2 identifies the natural hazards of concern for further profiling and evaluation. In Section 5.3, the identified hazards of concern are ranked for Burlington County as a whole to describe their probability of occurrence and their impact on population, property (general building stock including critical facilities) and the economy. Lastly, Section 5.4 profiles and assesses vulnerability for each hazard of concern.

Table 5-1 provides a summary of assets exposed to the identified hazards in Burlington County. Table 5-2 provides a summary of the assessed value of property and the percent of those properties in hazard areas

Table 5-1. Summary of Assets Exposed to the Identified Hazards in Burlington County

Hazard	Percent of Improved Property Exposed	Number of Emergency Facilities Exposed	Number of Utilities Exposed	Percent Population Exposed	Percent Area Exposed
Coastal Erosion	<1%	4	0	<1%	<1%
Drought	100%	All	All	100%	100%
Earthquake (500-year event)	100%	All	All	100%	100%
Earthquake (2,500-year event)	100%	All	All	100%	100%
Flood (100-year event)	5.1%	6	15	4.8%	20%
Surge, Cat1	0.12%	1	0	0.1%	2.4%
Surge, Cat2	0.27%	10	0	0.4%	4.3%
Surge, Cat3	0.31%	15	1	0.6%	5.1%
Surge, Cat4	1.77%	38	6	2.2%	7.4%
Landslide (moderate susceptibility/low occurrence)	20.6%	186	29	24.32%	6%
Severe Storm (wind only)	100%	All	All	100%	100%
Wildfire (Low to Moderate Risk Areas)	13.4%	45	74	20.6%	32.1%
Wildfire (High to Extreme Risk Areas)	5.1%	6	2	5.2%	39.2%

Note:

Please note ‘emergency facilities’ include the following: police, fire, EMS, EOCs, hospitals, schools, dialysis centers, senior centers, shelters, airports, riverline stations, and municipal halls.

The utilities provided by the County only included facilities in the northern portion of the County.

Table 5-2. Assessed Value of Improved Property and Percent in Hazard Areas

Municipality	Total Assessed Value of Improvements	Wildfire Low to Moderate	Wildfire High to Extreme	Flood 100 Yr	Cat1 Surge	Cat2 Surge	Cat3 Surge	Cat4 Surge	Coastal Erosion*	Landslides **
Bass River, Township of	\$112,293,600	40.5%	15.3%	55.5%	30.8%	74.1%	80.1%	93.9%	30.0%	0.0%
Beverly, City of	\$72,091,800	0.0%	0.0%	5.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Bordentown, City of	\$298,534,950	4.0%	0.2%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	96.5%
Bordentown, Township of	\$997,461,800	24.8%	2.6%	6.4%	0.0%	0.0%	0.0%	0.0%	0.0%	28.3%
Burlington , City of	\$571,882,875	4.8%	0.0%	80.4%	0.0%	0.1%	0.1%	3.6%	0.0%	96.9%
Burlington , Township of	\$2,097,110,708	6.1%	0.4%	2.2%	0.0%	0.0%	0.0%	2.4%	0.0%	35.7%
Chesterfield, Township of	\$666,455,492	22.5%	3.8%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cinnaminson, Township of	\$1,304,483,700	7.2%	0.4%	6.9%	0.0%	0.0%	0.0%	5.0%	0.0%	0.0%
Delanco, Township of	\$290,621,560	7.9%	0.1%	22.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Delran, Township of	\$1,474,866,100	12.0%	2.5%	5.0%	0.2%	0.1%	0.1%	0.1%	0.0%	84.1%
Eastampton, Township of	\$421,225,400	7.5%	1.1%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Edgewater Park, Township of	\$528,294,400	5.7%	0.3%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Evesham, Township of	\$4,389,240,875	15.8%	4.2%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fieldsboro, Borough of	\$48,903,400	15.2%	0.0%	21.9%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Florence, Township of	\$1,040,584,300	12.1%	0.8%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	68.4%
Hainesport, Township of	\$367,702,666	8.8%	1.6%	2.4%	0.0%	0.5%	0.5%	2.1%	0.0%	0.0%
Lumberton, Township of	\$1,164,991,807	12.9%	2.7%	3.1%	0.0%	0.3%	0.3%	2.2%	0.0%	0.0%
Mansfield, Township of	\$899,612,400	19.6%	3.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%
Maple Shade, Township of	\$1,405,067,900	6.2%	5.5%	11.5%	0.0%	0.0%	0.0%	5.8%	0.0%	5.0%
Medford, Township of	\$1,297,069,100	20.9%	6.6%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Medford Lakes, Borough of	\$980,612,600	0.4%	0.4%	9.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Moorestown, Township of	\$3,410,132,200	16.3%	0.8%	2.0%	0.0%	0.0%	0.0%	0.4%	0.0%	1.1%
Mt. Holly, Township of	\$1,079,081,000	8.2%	0.6%	8.3%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%
Mt. Laurel, Township of	\$2,396,695,600	9.5%	1.5%	1.8%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%
New Hanover, Township of	\$852,205,300	0.8%	94.4%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North Hanover , Township of	\$498,418,446	30.8%	10.5%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Palmyra, Borough of	\$254,304,240	2.3%	0.0%	29.7%	0.3%	1.8%	2.7%	48.9%	0.0%	100.0%
Pemberton, Borough of	\$63,520,200	7.4%	27.3%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pemberton , Township of	\$2,014,515,095	12.8%	5.5%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Riverside , Township of	\$349,218,580	0.2%	0.1%	13.5%	0.2%	0.0%	0.0%	0.0%	0.0%	100.0%

Table 5-2. Assessed Value of Improved Property and Percent in Hazard Areas

Municipality	Total Assessed Value of Improvements	Wildfire Low to Moderate	Wildfire High to Extreme	Flood 100 Yr	Cat1 Surge	Cat2 Surge	Cat3 Surge	Cat4 Surge	Coastal Erosion*	Landslides **
Riverton, Borough of	\$207,879,600	2.2%	0.7%	10.5%	0.0%	0.2%	0.2%	57.3%	0.0%	100.0%
Shamong, Township of	\$294,159,200	36.6%	7.3%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Southampton, Township of	\$549,437,950	32.8%	5.8%	6.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Springfield, Township of	\$282,324,750	60.6%	2.1%	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tabernacle, Township of	\$580,603,200	35.2%	7.8%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Washington, Township of	\$13,020,400	45.7%	40.0%	48.2%	25.4%	17.3%	17.3%	39.6%	0.0%	0.0%
Westampton, Township of	\$919,859,000	17.2%	3.9%	1.2%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Willingboro, Township of	\$1,705,779,550	3.6%	0.0%	1.3%	0.0%	0.0%	0.0%	0.1%	0.0%	29.9%
Woodland, Township of	\$305,887,600	46.2%	32.8%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wrightstown, Borough of	\$47,025,100	19.3%	5.1%	8.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Burlington County	\$36,253,174,444	13.4%	5.1%	5.1%	0.1%	0.3%	0.3%	1.8%	<1%	20.6%

Notes:

* For Coastal Erosion only area with-in CAFRA were analyzed.

** Landslide Hazard Area represents moderate susceptibility but low incidence.

5.1 METHODOLOGY AND TOOLS

This section describes the methodology and tools used to support the risk assessment process.

Methodology

The risk assessment process used for this Plan is consistent with the process and steps presented in FEMA 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA, 2001). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in the community. A risk assessment provides a foundation for the community's decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs (Section 9 of this plan).

Step 1: The first step of the risk assessment process is to identify the hazards of concern. FEMA's current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and many other assets. Often, natural hazards can be predicted, where they tend to occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Step 2: The next step of the risk assessment is to prepare a profile for each hazard of concern. These profiles assist communities in evaluating and comparing the hazards that can impact their area. Each type of hazard has unique characteristics that vary from event to event. That is, the impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, the probability of occurrence of a hazard in a given location impacts the priority assigned to that hazard. Finally, each hazard will impact different communities in different ways, based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: To understand risk, a community must evaluate what assets it possesses and which assets are exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical facilities at risk, located in Section 4, prepares the community to develop risk scenarios and estimate potential damages and losses for each hazard.

Tools

To address the requirements of DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Burlington County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Our standardized tools used to support the risk assessment are described below.

Hazards U.S. – Multi-Hazard (HAZUS-MH)

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. or HAZUS. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard methodology, HAZUS-MH with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk

calculations, which have been developed by hazard and information technology experts, to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, HAZUS-MH uses default HAZUS-MH provided data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. HAZUS-MH's open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage. The guidance *Using HAZUS-MH for Risk Assessment: How-to Guide* (FEMA 433) was used to support the application of HAZUS-MH for this risk assessment and plan. More information on HAZUS-MH is available at <http://www.fema.gov/plan/prevent/hazus/index.shtm>.

In general, probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for the earthquake, flood and wind hazards. The probabilistic hazard generates estimates of damage and loss for specified return periods (e.g., 100- and 500-year). For annualized losses, HAZUS-MH version 2.1 calculates the maximum potential annual dollar loss resulting from various return periods averaged on a "per year" basis. It is the summation of all HAZUS-supplied return periods (e.g., 10, 50, 100, 200, 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard each year is calculated.

HAZUS-MH version 2.1 (HAZUS-MH) was used to estimate losses associated with the hazards of concern for Burlington County. The following describes the methodology used to estimate exposure and potential losses to Burlington County at the municipal level.

- **Inventory:** The 2010 U.S. Census data at the Census-block level was used to estimate hazard exposure at the municipal level. In terms of building data, the total improved values from the parcel dataset provided by Burlington County Department of Information Technology, the parcel data from New Jersey's Geographic Information Network (for the City of Beverly only), and the HAZUS-MH default general building stock replacement cost values were used to evaluate exposure. The default demographic and building stock data in HAZUS-MH was used to estimate potential losses.

The critical facility inventory (essential facilities, utilities, transportation features and user-defined facilities) was updated beginning with all GIS data provided by Burlington County Geographic Information Systems. The critical facility inventory was formatted to be compatible with HAZUS-MH and its Comprehensive Data Management System (CDMS).

- **Flood:** For this plan update, a sub-meter accuracy Digital Elevation Model (DEM) was used. The 1-percent annual chance flood event was examined to evaluate Burlington County's risk and vulnerability to the flood hazard. The Preliminary Digital Flood Insurance Rate Map (DFIRM) with the addition of the Advisory Base Flood Elevation V-zone were used to estimate exposure and estimate potential losses using HAZUS-MH. HAZUS-MH flood modeling was used to generate approximate 1-percent annual chance flood boundaries within the areas covered by the two military installations where data is not available in the preliminary DFIRM. The HAZUS-MH flood model was used to estimate Burlington County's estimated potential losses at the Census-block level using the default building inventory.

- **Severe Storm (Wind and Storm Surge):** A HAZUS-MH probabilistic analysis was performed to analyze the wind hazard losses for Burlington County. The probabilistic hurricane hazard activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identify those with tracks associated with the County. Annualized losses and the 100- and 500-year MRPs were examined for the wind hazard. Default demographic and building data in HAZUS-MH and updated critical facility data were used for the analysis.

The Sea – Lake Overland Surge from Hurricanes (SLOSH) model, which represents potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide was used to estimate exposure. Please note these inundation zones do not include riverine flooding caused by hurricane surge or inland freshwater flooding. The model, developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes, considers only storm surge height and does not consider the effects of waves.

- **Earthquake:** A probabilistic assessment was conducted for Burlington County for the 100-, 500- and 2,500-year MRPs using HAZUS-MH to analyze the earthquake hazard and provide a range of loss estimates for Burlington County. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract. According to the New York City Area Consortium for Earthquake Loss Mitigation (NYCEM), probabilistic estimates are best for urban planning, land use, zoning and seismic building code regulations (NYCEM, 2003). The default assumption is a magnitude 7 earthquake for all return periods.

In addition to the probabilistic scenarios mentioned, an annualized loss run was conducted in HAZUS 2.1 to estimate the annualized general building stock dollar losses for the County. The annualized loss methodology combines the estimated losses associated with ground shaking for eight return periods: 100, 250, 500, 750, 1000, 1500, 2000, 2500-year, which are based on values from the USGS seismic probabilistic curves. Annualized losses are useful for mitigation planning because they provide a baseline upon which to 1) compare the risk of one hazard across multiple jurisdictions and 2) compare the degree of risk of all hazards for each participating jurisdiction.

- **Landslide:** To estimate Burlington County's vulnerability to ground failure due to landslides, the Geology - Landslide Incidence and Susceptibility GIS layer from National Atlas was used to coarsely define the general landslide susceptible area. The Geology - Landslide Incidence and Susceptibility GIS layer was overlaid upon the Burlington County municipalities, 2010 Census population data, custom building inventory and Burlington County's critical facility inventory to estimate exposure. The limitations of this analysis are recognized and are only used to provide a general estimate.
- **Wildfire:** The NJ Forest Fire Service Wildfire Fuel Hazard data assigns wildfire fuel hazard rankings across Burlington County. This data, developed in 2009, is based upon NJDEP's 2002 Land Use/Land Cover datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. The asset data (population, building stock and critical facilities) presented in the County Profile was used to support an evaluation of assets exposed and the potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data was overlaid upon the NJ Forest Fire Service Fuel hazard area. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

- Coastal Erosion and Sea Level Rise: The CAFRA boundary, which legislates land use within the coastal area, was used to determine exposure to the coastal erosion hazard. Land within this boundary is under the jurisdiction of the Coastal Area Facilities Review Act (CAFRA), N.J.S.A. 13:19-1 et seq (as amended to July 19, 1993). This area includes the Advisory V-zone and any area indicated by the Advisory data with wave action.

Projected sea-level rise data (in one-foot increments) available from Jacques Cousteau National Estuarine Research Reserve (<http://slrviewer.rutgers.edu/about.html>) was considered and used for this analysis. Please note these levels do not include additional storm surge due to a hurricane or Nor'easter. The current Advisory maps and preliminary DFIRMs also do not include the effects of sea-level rise. Miller et al. projects an approximate 2-foot in sea-level rise by 2050 for the State of New Jersey in *A geological perspective on sea-level rise and impacts along the U.S. mid-Atlantic coast* (July 2013, Submitted to Earth's Future). For the purposes of this planning effort, the year 2050 and associated projected 2-foot rise was used as a reasonable and responsible planning horizon.

- Other Hazards (Drought and Severe Winter Storm): HAZUS does not estimate potential losses from the drought or severe winter storm hazards. Where appropriate, an exposure analysis using HAZUS-MH default building inventory or a qualitative analysis was conducted using the best available data and professional judgment.

For this risk assessment, the loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- 1) Approximations and simplifications necessary to conduct such a study
- 2) Incomplete or dated inventory, demographic, or economic parameter data
- 3) The unique nature, geographic extent, and severity of each hazard
- 4) Mitigation measures already employed by Burlington County and the amount of advance notice residents have to prepare for a specific hazard event

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Burlington County will collect additional data to assist in developing refined estimates of vulnerabilities to natural hazards.

5.2 IDENTIFICATION OF NATURAL HAZARDS OF CONCERN

To provide a strong foundation for mitigation strategies considered in Section 6.0, Burlington County considered a full range of natural hazards that could impact the area, and then identified and ranked those hazards that presented the greatest concern. The natural hazard of concern identification process incorporated input from the County and participating jurisdictions; review of the State of New Jersey Hazard Mitigation Plan (NJ HMP) and previous hazard identification efforts; research and local, state, and federal information on the frequency, magnitude, and costs associated with the various hazards that have previously, or could feasibly, impact the region; and qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the study area's assets to them. Table 5.2-1 documents the process of identifying the natural hazards of concern for further profiling and evaluation.

Hazards of Concern are defined as those hazards that are considered most likely to impact a community. These are identified using available data and local knowledge.

For the purposes of this planning effort, the Planning Committee chose to group some natural hazards together, based on the similarity of hazard events, their typical concurrence or their impacts, consideration of how hazards have been grouped in Federal Emergency Management Agency (FEMA) guidance documents (FEMA 386-1, "Understanding Your Risks, Identifying Hazards and Estimating Losses; FEMA's "Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy"), and consideration of hazard grouping in the NJ HMP.

The "Flood" hazard includes riverine flooding, flash flooding, coastal flooding, and flooding due to dam failures. Other types of flooding such as ice jam do not typically occur within the County; therefore, it will not be further considered for inclusion within this HMP. Inclusion of the various forms of flooding under a general "Flood" hazard is consistent with that used in FEMA's "Multi-Hazard Identification and Risk Assessment" guidance.

The "Severe Storm" hazard includes windstorms that often entail a variety of other influencing weather conditions including thunderstorms, hail, lightning and tornados. Since tropical disturbances are identified as a type of severe storm event, this hazard also includes tropical cyclone events (hurricanes, tropical storms and tropical depressions). Tropical cyclones were not grouped as a separate hazard, because the County felt that these types of events do not directly impact the area on a frequent basis and that exposure and risk of such events are minimal in comparison to communities along the New Jersey coastline. However, this was found to be an exception for certain tropical events that created a regional impact upon the State, such as Hurricane Irene (2011), Tropical Storm Lee (2011) and Hurricane Sandy (2012), as further discussed in Section 5.4.1 Severe Storm of this HMP.

The "Severe Winter Storm" hazard includes heavy snowfall, blizzards, freezing rain/sleet, ice storms, and extra-tropical cyclones (nor'easters and severe winter low-pressure systems). Extra-tropical events generally occur during winter weather months; therefore, for the purpose of this HMP, all such events are to be grouped within this hazard. Although not all extra-tropical events, such as Nor'Easters, occur during the winter, they will remain grouped within this hazard category to avoid duplication of events in hazard profiles.

Please note that technological [e.g. hazardous material incidents] and man-made hazards (e.g. terrorism) are not being addressed in this planning process. The DMA 2000 regulations do not require consideration of such hazards and due to a limited schedule and funding, these were not chosen for inclusion in this plan by the County and planning participants.

SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

Table 5.2-1. Identification of Natural Hazards of Concern for Burlington County

Hazard	Is this a hazard that may occur in the County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
Avalanche	No	No	- The NJ HMP does not identify avalanche as a hazard of concern for New Jersey. - The topography and climate of Burlington County does not support the occurrence of an avalanche event. - New Jersey in general has a very low occurrence of avalanche events based on statistics provided by National Avalanche Center – American Avalanche Association (NAC-AAA) between 1950 and 2006.	- NJ HMP - Review of NAC-AAA database between 1998 and 2012.
Coastal Erosion	Yes	Yes	- The NJ HMP identifies coastal erosion as a hazard of concern for NJ. Counties bounded by coastal waters are most affected by coastal erosion. - A portion of Burlington County is located within the CAFRA area (Township of Bass River). Coastal erosion may occur because it is tidally influenced. A majority of the County is located along the Delaware River where it is densely populated and in some areas, heavily industrialized. - The Planning Committee identified coastal erosion as a significant concern affecting several municipalities within the County	- NJ HMP - Planning Committee Input
Drought	Yes	Yes	- The NJ HMP identifies drought as a hazard of concern for New Jersey. The NJHMP indicated that Burlington County experienced drought events during the following time periods: - March 1995 - December 1998 - January 1999 - July-September 1999 - November-December 2001 - January-July 2002 - September - October 2002 - September 2005 - May-July 2006 - Burlington County is located in the Southern Climate Divisions. Periods of severe and/or extreme drought in this division includes: - January-February 1931 - May 1965-August 1966 - March-June 1985 - November-December 1998	- NJ HMP - FEMA - NRCC - Planning Committee Input

SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

Table 5.2-1. Identification of Natural Hazards of Concern for Burlington County

Hazard	Is this a hazard that may occur in the County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			- o July-September 2002 - o August-September 2010 • Burlington County has been included in one FEMA Disaster Declaration for a drought event: - o FEMA-EM-3083 – Water Shortage – October 1980	
Earthquake	Yes	Yes	• The NJ HMP identifies earthquake as a hazard of concern for NJ. Although they are known to occur on a regular basis, records indicate that no major earthquakes have struck the state since the establishment of historical record-keeping (1500's). Between 1783 and 2012, there have been 179 earthquakes with epicenters in New Jersey. Of those 179 earthquakes, eight had epicenters in Burlington County. • According to the USGS seismic hazard maps, the PGA with a 10% probability of exceedance over 50 years for Burlington County is between 2%g and 4%g. FEMA's How-To Guide recommends that earthquakes be considered for further evaluation in the planning process in areas where the PGA is over 2%g.	• NJ HMP • FEMA • NJGWS • USGS • NJDEP • Planning Committee Input
Expansive Soils	No	No	• The NJ HMP does not identify expansive soils as a hazard of concern for NJ. • USGS indicated that in Burlington County, 50% or less of the soils consist of clay that has slight to moderate potential of swelling, with some areas underlain by soils with little to no clays with swelling potential.	• NJ HMP • Review of USGS 1989 Swelling Clays Map of the Conterminous United States. • Planning Committee Input
Extreme Temperature	No	No	• The NJ HMP identifies extreme heat as a hazard of concern for NJ citing 61 extreme heat events between 1950 and 2009. The NJ HMP also identifies extreme cold as a hazard of concern for NJ. • NOAA-NCDC indicated that between 2008 and 2013, Burlington County did not experience any excessive heat or extreme cold events. According to SHELDUS, there were four heat events that occurred between 2008 and 2012 that resulted in one fatality and 13 injuries. • Extreme temperature events have occurred in Burlington County and will continue to occur. However, damages associated with extreme temperature events are primarily health impacts, an	• NJ HMP • SHELDUS • NOAA – NCDC • Planning Committee Input

SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

Table 5.2-1. Identification of Natural Hazards of Concern for Burlington County

Hazard	Is this a hazard that may occur in the County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			increased need for heating and cooling centers, impacts on livestock and agriculture, and increased demand for electricity.	
Flood (Riverine, Flash, Coastal and Dam Flooding)	Yes	Yes	- NJ HMP stated that flooding is NJ's most common major natural hazard. The NJ HMP cited that between 1996 and 2010, 1,169 flood events were reported in New Jersey, with over \$1.82 billion in damages. - Burlington County has been issued five FEMA Disaster Declarations for flooding associated with various storm events (severe storms, snowstorm, severe winter storm). These events include the following: - FEMA-DR-1530 – Severe Storms and Flooding – July 2004 - FEMA-DR-1694 – Severe Storms and Flooding – April 2007 - FEMA-DR-1873 – Snowstorm – February 2010 - FEMA-DR-1889 - Severe Winter Storm and Snowstorm – March 2010 - FEMA-DR-1897 – Severe Storms and Flooding – April 2010 - Approximately 19% of Burlington County's total area is located in an A-Zone (97,640 acres); 1.4% in a V-Zone (7,356 acres); 21% in a 500-year flood area (108,514 acres); and 16% in a D-Zone (84,091 acres). - According to NOAA NCDC storm database, between 1996 and 2013, Burlington County experienced 54 flood events.	- NJ HMP - FEMA - NOAA – NCDC - Burlington County GIS - Planning Committee Input
Hailstorm	Yes	Yes	Please see Severe Storm	
Hurricane (and other Tropical Cyclones)	Yes	Yes	Please see Severe Storm and Flood	
Ice Jams	Yes	No	Please see Flood	
Ice Storm	Yes	Yes	Please see Severe Winter Storm	
Infestation	Yes	No	- The NJ HMP does not identify infestation as a hazard of concern for the State of New Jersey. - Some infestations of ticks, mosquitoes, gypsy moth and/or other types of pest may be present in the County and with the right combination of gypsy moth infestation and forest fire conditions, a potential risk may exist for residential areas. However, no sources indicate that this is a major hazard of concern across the County.	- NJ HMP - Planning Committee Input

SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

Table 5.2-1. Identification of Natural Hazards of Concern for Burlington County

Hazard	Is this a hazard that may occur in the County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
Land Subsidence	Yes	No	- NJ HMP indicates NJ is vulnerable to land subsidence; the soil collapse sinkhole is the most concerned type of sinkhole for NJ. - NJ HMP does not identify Burlington County as an area that has experienced significant land subsidence in the past. In general, areas with narrow bands of carbonate rock are prone to sinkholes and subsidence.	- NJ HMP - Planning Committee Input
Landslide	Yes	Yes	- The NJ HMP identifies landslide as a hazard of concern for NJ. - USGS indicates within the National Atlas Map Maker program that the County has a moderate susceptibility/low incidence to landslides along the northwestern most edge, and low incidence (or less than 1.5% of the area is susceptible) throughout the remainder of the County. - NJGWS provides four recorded landslides within Burlington County: - May 4, 1893 – Debris flow due to heavy rain in Bordentown Township - Unknown Date – Debris flow due to heavy rain in Bordentown Township - Unknown Date – Debris flow due to quarrying in Burlington Township - Unknown Date – Debris flow due to heavy rain in Southampton Township	- NJ HMP - NJGWS - NationalAtlas.gov (USGS) - Planning Committee Input
Nor'Easters	Yes	Yes	Please see Severe Winter Storm and Flood	
Severe Storm (Windstorms, Thunderstorms, Hail, Lightning, Tornadoes and Hurricanes)	Yes	Yes	- NJ HMP identifies thunderstorms, lightning, tornadoes, hurricanes and extreme winds as hazards of concern for NJ. - Burlington County has been issued eight FEMA Disaster Declarations for severe storm-related events (flooding and hurricane). These events include the following: - FEMA-EM-3148 – Hurricane Floyd – September 1999 - FEMA-DR-1530 – Severe Storms and Flooding – July 2004 - FEMA-DR-1694 – Severe Storms and Inland/Coastal Flooding – April 2007 - FEMA-DR-1897 – Severe Storms and Flooding – March-April 2010 - FEMA-DR-4021 – Hurricane Irene – August-September 2011 - FEMA-DR-4086 – Hurricane Sandy – October 2012	- NJ HMP - FEMA - SPC - ONJSC - Planning Committee Input

SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

Table 5.2-1. Identification of Natural Hazards of Concern for Burlington County

Hazard	Is this a hazard that may occur in the County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			Between 1950 and 2012, Burlington County experienced 18 tornadoes.	
Severe Winter Storm (Heavy Snow, Blizzards, Freezing Rain/Sleet, Nor'Easters, Ice Storms)	Yes	Yes	- NJ HMP indicates winter storms are significant hazards that impact NJ. - ONJSC indicated that normal seasonal snowfall for Burlington County ranges from 14.4 inches to 21.8 inches. - Burlington County has been issued five FEMA Disaster Declarations for winter storm-related events (severe blizzard, snow, snowstorm, and severe winter storm). These events include the following: - FEMA-EM-3106 – Severe Blizzard – March 1993 - FEMA-EM-3181 – Snow – February 2003 - FEMA-DR-1873 – Snowstorm – December 2009 - FEMA-DR-1889 – Severe Winter Storm and Snowstorm – February 2010 - FEMA-DR-1954 – Severe Winter Storm and Snowstorm – December 2010 - The NOAA-NCDC Storm Events Database indicated that between 1996 and 2013, Burlington County experienced 27 winter storm events (heavy snow, winter weather, and winter storm).	- NJ HMP - ONJSC - NWS - FEMA - NOAA – NCDC - Planning Committee Input
Tornado	Yes	Yes	Please see Severe Storm	
Tsunami	Yes	No	- The NJ HMP does not identify tsunami as a hazard of concern for NJ; however, tsunamis are discussed and it is indicated that there is no record of the generation of a catastrophic Atlantic Basin tsunami that has impacted the mid-Atlantic coastline. - Over the past 200 years, the Atlantic and Gulf Coasts have experienced very few tsunamis. The probability of a large tsunami impacting the coastal areas of New Jersey is believed to be small; however earthquake activity along the Mid-Atlantic Ridge is recognized as having the potential to pose some level of tsunami risk to the Atlantic seaboard. - NOAA/WDS Tsunami Event Database did not indicate any tsunami or tsunami-like events that impacted Burlington County. - Burlington County is bounded by coastal waters in the southeastern portion of the County. Although the County is mostly shielded by barrier islands, the impacts from a tsunami	- NJ HMP - NOAA / WDS - Planning Committee Input

SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

Table 5.2-1. Identification of Natural Hazards of Concern for Burlington County

Hazard	Is this a hazard that may occur in the County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			could flow in through one of the inlets and up the Mullica River. However, the probability of a large tsunami impacting the coast of New Jersey and Burlington County is very small.	
Volcano	No	No	The NJ HMP does not identify volcano as a hazard of concern for the State of New Jersey or its counties and jurisdictions.	- NJ HMP - Planning Committee Input
Wildfire	Yes	Yes	- Wildfires are not an uncommon occurrence in NJ, especially in the Pine Barrens. Fires which burn more than 1,000 acres occur, on average, once every 10 years in the Pine Barrens. In May 2007, a wildfire along the border of Ocean and Burlington Counties burned more than 12,000 acres (~19 square miles). - Between 1929 and 2006, there were 2,233 wildfire incidents in Burlington County. They burned over 42,000 acres and destroyed 831 acres. - In Burlington County, over 195 square miles are located within the extreme wildfire fuel hazard area; over 11 square miles in the very high area; over 106 square miles in the high area; over 86 square miles in the moderate area; and over 165 square miles in the low. - According to the NOAA-NCDC, a total of eight wildfires have occurred in Burlington County between 1996 and 2013.	- NJ HMP - NJFFS - NOAA – NCDC
Windstorm	Yes	Yes	Please see Severe Storm	

CAFRA Coastal Area Facility Review Act
 DR Presidential Disaster Declaration Number
 EM Presidential Disaster Emergency Number
 FEMA Federal Emergency Management Agency
 HMP Hazard Mitigation Plan
 NCDC National Oceanic and Atmospheric Administration National Climatic Data Center
 NJ New Jersey
 NJDEP New Jersey Department of Environmental Protection
 NJFFS New Jersey Forest Fire Service
 NJGWS New Jersey Geological and Water Survey
 NOAA National Oceanic and Atmospheric Administration
 NRCC Northeast Regional Climate Center

ONJSC Office of New Jersey State Climatologist
 SHELATUS Spatial Hazard Events and Losses Database for the U.S.
 SPC Storm Prediction Center
 TSTM Thunderstorm
 USGS U.S. Geologic Survey



SECTION 5.2: RISK ASSESSMENT – IDENTIFICATION OF HAZARDS OF CONCERN

According to input from the Planning Committee, and review of all available resources, a total of eight natural hazards of concern were identified as significant hazards affecting the entire county, to be addressed at the regional level in this Plan:

- Coastal Erosion
- Drought
- Earthquake
- Flooding (Riverine, Flash, Coastal, Dam)
- Landslides
- Severe Storm (Hail, Wind, Lightning, Thunderstorm, Tornado, and Hurricane)
- Severe Winter Storm (Heavy Snow, Blizzard, Freezing Rain/Sleet, Nor'Easters, and Ice Storms)
- Wildfire

Other natural hazards of concern have occurred within Burlington County, but have a low potential to occur and/or result in significant impacts within the County. Therefore, these hazards will not be further addressed within this version of the Plan. However, if deemed necessary by the Planning Committee, these hazards may be considered in future versions of the Plan.

5.3 HAZARD RANKING

After the hazards of concern were identified for Burlington County, the hazards were ranked to describe their probability of occurrence and their impact on population, property (general building stock including critical facilities) and the economy. Each participating borough, township, or special district may have differing degrees of risk exposure and vulnerability compared to the County as a whole; therefore each jurisdiction ranked the degree of risk to each hazard as it pertains to their community using the same methodology as applied to the County-wide ranking. This assured consistency in the overall ranking of risk process. The hazard ranking for the County and each participating district can be found in their jurisdictional annex in Volume II of this plan.

HAZARD RANKING METHODOLOGY

The methodology used to rank the hazards of concern for Burlington County is described below. Estimates of risk for the County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance and generated by FEMA's HAZUS-MH risk assessment tool.

Probability of Occurrence

The probability of occurrence is an estimate of how often a hazard event occurs. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions in Table 5.3-1.

Table 5.3-1. Probability of Occurrence Ranking Factors

Rating	Probability Category	Definition
1	Rare	Hazard event is not likely to occur within 100 years (>1% chance of occurrence in any given year)
2	Occasional	Hazard event is likely to occur within 100 years (1% chance of occurrence in any given year)
3	Frequent	Hazard event is likely to occur within 25 years (4% chance of occurrence in any given year)

Impact

The impact of each hazard is considered in three categories: impact on population, impact on property (general building stock including critical facilities), and impact on the economy. Based on documented historic losses and a subjective assessment by the Planning Committee, an impact rating of high, medium, or low is assigned with a corresponding numeric value for each hazard of concern. In addition, a weighting factor is assigned to each impact category: three (3) for population, two (2) for property, and one (1) for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard.

Table 5.3-2 presents the numerical rating, weighted factor and description for each impact category

Table 5.3-2. Numerical Values and Definitions for Impacts on Population, Property and Economy

Category	Weighting Factor	Low Impact (1)	Medium Impact (2)	High Impact (3)
Population*	3	14% or less of your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location	15% to 29% of your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location	30% or more of your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location
Property*	2	Property exposure is 14% or less of the total replacement cost for your community	Property exposure is 15% to 29% of the total replacement cost for your community	Property exposure is 30% or more of the total replacement cost for your community
Economy	1	Loss estimate is 9% or less of the total replacement cost for your community	Loss estimate is 10% to 19% of the total replacement cost for your community	Loss estimate is 20% or more of the total replacement cost for your community

Note: A numerical value of zero is assigned if there is no impact.

*For the purposes of this exercise, “impacted” means exposed for population and property and loss for economy.

Risk Ranking Value

The risk ranking for each hazard is then calculated by multiplying the numerical value for probability of occurrence by the sum of the numerical values for impact. The equation is as follows: Weighting Factor (1, 2, or 3) X Impact Value (6 to 18) = Hazard Ranking Value. Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low).

HAZARD RANKING RESULTS

Using the process described above, the risk ranking for the identified hazards of concern was determined for Burlington County. Based on the combined risk values for probability of occurrence and impact to Burlington County, a priority ranking of “high”, “medium” or “low” risk was assigned. The hazard ranking for the Burlington County planning area is detailed in the subsequent tables that present the step-wise process for the ranking. The county-wide risk ranking includes the entire planning area and may not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure, and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the County and the participating jurisdictions have applied the same methodology to develop the county-wide risk and local rankings to ensure consistency in the overall ranking of risk.

This risk ranking exercise serves two purposes: 1) to describe the probability of occurrence for each hazard and, 2) to describe the impact each would have on the people, property and economy of Burlington County. Estimates of risk for Burlington County were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance and generated by FEMA’s HAZUS-MH risk assessment tool.

Table 5.3-3 shows the probability ranking assigned for likelihood of occurrence for each hazard.

Table 5.3-3. Probability of Occurrence Ranking for Hazards of Concern for Burlington County

Hazard of Concern	Probability	Numeric Value
Severe Storms	Frequent	3
Severe Winter Storms	Frequent	3
Flooding (riverine, flash, dam overtopping, coastal)	Frequent	3
Wildfire	Frequent	3
Drought	Occasional	2
Earthquake	Occasional	2
Coastal Erosion	Rare	1
Landslides	Rare	1

Table 5.3-4 shows the impact evaluation results for each hazard of concern, including impact on property, structures, and the economy on the County level. It is noted that several hazards that have a high impact on the local jurisdictional level, may have a lower impact when analyzed county-wide. Jurisdictional ranking results are presented in each local annex in Section 9 of this plan. The weighting factor results and a total impact for each hazard also are summarized.

SECTION 5.3: RISK ASSESSMENT - HAZARD RANKING

Table 5.3-4. Impact Ranking for Hazards of Concern for Burlington County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighing Factor (3)	Impact	Numeric Value	Multiplied by Weighing Factor (2)	Impact	Numeric Value	Multiplied by Weighing Factor (1)	
Landslide	Medium	2	$2 \times 3 = 6$	Medium	2	$2 \times 2 = 4$	Medium	2	$2 \times 1 = 2$	12
Severe Winter Storms	Medium	2	$2 \times 3 = 6$	Medium	2	$2 \times 2 = 4$	Low	1	$1 \times 1 = 1$	11
Severe Storms	Low	1	$1 \times 3 = 3$	High	3	$3 \times 2 = 6$	Low	1	$1 \times 1 = 1$	10
Wildfire	Low	1	$1 \times 3 = 3$	Low	1	$1 \times 2 = 2$	High	3	$3 \times 1 = 3$	8
Coastal Erosion	Low	1	$1 \times 3 = 3$	Low	1	$1 \times 2 = 2$	Low	1	$1 \times 1 = 1$	8
Drought	Low	1	$1 \times 3 = 3$	Low	1	$1 \times 2 = 2$	Low	1	$1 \times 1 = 1$	6
Earthquake	Low	1	$1 \times 3 = 3$	Low	1	$1 \times 2 = 2$	Low	1	$1 \times 1 = 1$	6
Flooding (riverine, flash, dam-break, coastal)	Low	1	$1 \times 3 = 3$	Low	1	$1 \times 2 = 2$	Low	1	$1 \times 1 = 1$	6

SECTION 5.3: RISK ASSESSMENT - HAZARD RANKING

Table 5.3-5 presents the total ranking value for each hazard.

Table 5.3-5. Total Risk Ranking Value for Hazards of Concern for Burlington County

Hazard of Concern	Probability	Impact	Total = (Probability x Impact)
Severe Winter Storms	3	11	33
Severe Storms	3	10	30
Wildfire	3	8	24
Flooding (riverine, flash, dam-break, coastal)	3	6	18
Drought	2	6	12
Earthquake	2	6	12
Landslide	1	12	12
Coastal Erosion	1	8	6

Table 5.3-6 presents the hazard ranking category by jurisdiction assigned for each hazard of concern. The ranking categories are determined by an evaluation of the total risk ranking score into three categories, low, medium, and high whereby a total score of 14 and below is categorized as low, 15 to 30 is medium, and 31 and over is considered a high risk category.

These rankings have been used as one of the bases for identifying the jurisdictional hazard mitigation strategies included in Section 9 of this plan. The summary rankings for the County reflect the results of the vulnerability analysis for each hazard of concern and vary from the specific results of each jurisdiction. For example the severe storm hazard may be ranked high in one jurisdiction, but due to the exposure and impact county-wide, it is ranked as a medium hazard and is addressed in the county mitigation strategy accordingly.

SECTION 5.3: RISK ASSESSMENT - HAZARD RANKING

Table 5.3-6. Summary of Overall Ranking of Natural Hazards by Jurisdiction

Municipality	Hazard Ranking							
	Flood	Severe Storm	Severe Winter Storm	Coastal Erosion	Wildfire	Earthquake	Drought	Landslide
Bass River, Township of	High	High	High	Medium	High	Low	Low	Low
Beverly , City of	Medium	Medium	High	Low	Medium	Medium	Low	High
Bordentown, City of	Medium	Medium	High	Low	Medium	Low	Low	Medium
Bordentown, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Medium
Burlington , City of	High	Medium	High	Low	Medium	Low	Low	High
Burlington , Township of	Medium	Medium	High	Low	Medium	Medium	Low	High
Chesterfield, Township of	Medium	Medium	High	Low	Medium	Low	Low	Low
Cinnaminson, Township of	Medium	Medium	High	Low	Medium	Low	Medium	Medium
Delanco, Township of	Medium	Medium	High	Low	Medium	Medium	Low	High
Delran, Township of	Medium	Medium	High	Low	Medium	Low	Medium	High
Easthampton, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Edgewater Park, Township of	Medium	Medium	High	Low	Medium	Low	Low	High
Evesham, Township of	Medium	Medium	High	Low	Medium	Low	Low	Low
Fieldsboro, Borough of	Medium	Medium	High	Low	Medium	Low	Low	Medium
Florence, Township of	Medium	Medium	High	Low	Medium	Low	Medium	High
Hainesport, Township of	Medium	Medium	High	Low	Medium	Low	Low	Low
Lumberton, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Mansfield, Township of	Medium	Medium	High	Low	Medium	Low	Low	Low

SECTION 5.3: RISK ASSESSMENT - HAZARD RANKING

Table 5.3-6. Summary of Overall Ranking of Natural Hazards by Jurisdiction

Municipality	Hazard Ranking							
	Flood	Severe Storm	Severe Winter Storm	Coastal Erosion	Wildfire	Earthquake	Drought	Landslide
Maple Shade, Township of	Medium	Medium	High	Low	Medium	Low	Low	Low
Medford, Township of	Low	Medium	High	Low	Medium	Medium	Low	Low
Medford Lakes, Borough of	Medium	Medium	High	Low	High	Medium	Low	Low
Moorestown, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Mt. Holly, Township of	Medium	Medium	High	Low	Medium	Low	Low	Low
Mt. Laurel, Township of	Medium	Medium	High	Low	Medium	Medium	Medium	Low
New Hanover, Township of	Medium	Medium	High	Low	High	Medium	Low	Low
North Hanover , Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Palmyra, Borough of	Medium	High	High	Low	Medium	Medium	Low	High
Pemberton, Borough of	Medium	Medium	High	Low	High	Medium	Low	Low
Pemberton , Township of	Medium	Medium	High	Low	High	Medium	Low	Low
Riverside , Township of	Medium	Medium	High	Low	Medium	Medium	Low	High
Riverton, Borough of	Medium	High	High	Low	Medium	Medium	Low	High
Shamong, Township of	Medium	Medium	High	Low	High	Medium	Low	Low
Southampton, Township of	High	Medium	High	Low	High	Medium	Low	Low
Springfield, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Tabernacle, Township of	Medium	Medium	High	Low	High	Medium	Medium	Low

SECTION 5.3: RISK ASSESSMENT - HAZARD RANKING

Table 5.3-6. Summary of Overall Ranking of Natural Hazards by Jurisdiction

Municipality	Hazard Ranking							
	Flood	Severe Storm	Severe Winter Storm	Coastal Erosion	Wildfire	Earthquake	Drought	Landslide
Washington, Township of	High	High	High	Low	High	Medium	Low	Low
Westampton, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Willingboro, Township of	Medium	Medium	High	Low	Medium	Medium	Low	Low
Woodland, Township of	Medium	Medium	High	Low	High	Medium	Low	Low
Wrightstown, Borough of	Medium	Medium	High	Low	Medium	Medium	Low	Low
TOTAL, BURLINGTON COUNTY	Medium	Medium	High	Low	Medium	Medium	Low	Low

The hazard rankings indicated in this plan update have been adjusted from the 2008 plan due to the improved vulnerability assessment based on structure-specific data available from the County rather than HAZUS default aggregate data as discussed in Section 5.1, Methodology. Any changes to the ranking results therefore do not necessarily reflect significant changes in exposure, but a more refined vulnerability analysis methodology. The summary County level values reflect the vulnerability data on the county level and do not represent an average of jurisdiction ranks or the highest rank indicated in Burlington County. These designations are an element of the prioritization criteria as detailed in Section 6 of this plan.

HAZARDS PROFILES AND VULNERABILITY ASSESSMENT

The following sections profile and assess vulnerability for each hazard of concern. For each hazard, the profile includes: the hazard description; its location and extent; previous occurrences and losses; and the probability of future events. The vulnerability assessment for each hazard includes: an overview of vulnerability; the data and methodology used; the impact on life, health and safety; impact on general building stock; impact on critical facilities; impact on the economy; additional data needs and next steps; and the overall vulnerability assessment finding.

5.4.1 COASTAL EROSION

This section provides a profile and vulnerability assessment for the coastal erosion hazard.

HAZARD PROFILE

Hazard Profile information is provided in this section, including information on description, extent, location, previous occurrences and losses and the probability of future occurrences within Burlington County.

Description

Erosion and flooding are the primary coastal hazards that lead to the loss of lives or damage to property and infrastructure in developed coastal areas. Coastal storms are an intricate combination of events that impact a coastal area. A coastal storm can occur any time of the year and at varying levels of severity. One of the greatest threats from a coastal storm is coastal flooding caused by storm surge. Coastal flooding is the inundation of land areas along the oceanic coast and estuarine shoreline by seawaters over and above normal tidal action.

Tidal action undercuts the land along the shore, and gravity causes the land to slip into the water. As materials from banks slide into the waves, erosion continues. As this process continues, the shore recedes and the coastline moves farther inward.

Many natural factors affect erosion of the shoreline, including shore and nearshore geology, nearshore bathymetry, shoreline orientation, and climate change through increased storm frequency, temperature, and precipitation. Coastal shorelines change constantly in response to wind, waves, tides, sea-level fluctuation, seasonal and climatic variations, human alteration, and other factors that influence the movement of sand and material within a shoreline system.

High winds, erosion, heavy surf, unsafe tidal conditions, and fog are ordinary coastal hazard phenomena. Some or all of these processes can occur during a coastal storm, resulting in an often detrimental impact on the surrounding coastline. Factors including (1) storms such as Nor'Easters and hurricanes, (2) decreased sediment supplies, and (3) sea-level rise contribute to these coastal hazards.

The visible loss (erosion) and gain (accretion) of coastal land is evidence of the way shorelines are reshaped in the face of dynamic weather conditions. Shorelines tend to change seasonally, accreting slowly during the summer months when sediments are deposited by relatively low-energy waves and eroding dramatically during the winter when sediments are moved offshore by high-energy storm waves, such as those generated by Nor'Easters. Regardless of the season, coastal storms typically cause erosion. With the anticipated change in climate, an increase in intensity and frequency of storms is expected. This will, in turn, increase the likelihood of severe erosion episodes along the coast of New Jersey.

Coastal erosion can result in significant economic loss through the destruction of buildings, roads, infrastructure, natural resources, and wildlife habitats. Damage often results from the combination of an episodic event with severe storm waves and dune or bluff erosion.

Some of the methods used by property owners to stop or slow down coastal erosion or shoreline change can actually exacerbate the problem. Attempting to halt the natural process of erosion with seawalls and other hard structures typically worsens the erosion in front of the structure, prevents any sediment behind the structure from supplying down-drift properties with sediment, and subjects down-drift beaches to

increased erosion. Without the sediment transport associated with erosion, some of the State's greatest assets and attractions – beaches, dunes, barrier beaches, salt marshes, and estuaries – are threatened and will slowly disappear as the sediment sources that feed and sustain them are eliminated.

The New Jersey coastline is constantly changing as the result of wind, currents, storms, and sea-level rise. Because of this, developed shorelines are often stabilized with hardened structures (seawalls, bulkheads, revetments, rip-rap, gabions, and groins) to protect coastal properties from erosion. While hardened structures typically prove to be beneficial in reducing property damage, the rate of coastal erosion typically increases near stabilization structures, which impact natural habitats, spawning grounds, recreational activity areas, and public access (Frizzera, 2011).

The State of New Jersey has over 130 miles of coastline, most of which is within close proximity to major metropolitan centers of the mid-Atlantic as can be seen in Figure 5.4.1-8. Beach restoration and maintenance is an ongoing process for New Jersey. The State legislature provides \$25 million annually for beach restoration and every beach on the Atlantic is currently under either a design, engineering or construction phase. According to the New Jersey Department of Environmental Protection (NJDEP) website there are 41 Federal and/or State coastal engineering projects either under construction or recently completed (NJDEP, 2013).

Extent

As described in the NJDEP Coastal Management Program website, manifestations of these hazards occur at broadly different rates. Their expression ranges from the gradual, such as sea level rise and chronic erosion that can be measured on a decadal time-scale, to catastrophic events like hurricanes, extra-tropical storms, and storm surges that can be measured in terms of days or even hours. Just as their rates of occurrence differ, so are their effects expressed in profoundly different ways.

- **Catastrophic** events alter the natural features of the shoreline, such as beaches, dunes, and wetlands, and threaten people and property. In New Jersey, construction of new residential development, reconstruction of existing residential development, and the conversion of single family dwellings into multi-unit dwellings continue in hazardous areas. Although application of more stringent construction standards and techniques results in more storm-resistant structures, the value of property at risk has appreciably increased. With anticipated accelerating sea level rise and increasing storm frequency and intensity, vulnerability to the risks of coastal hazards will be exacerbated and the costs of damages and losses resulting from the events will increase. Catastrophic events require anticipatory preparations for the inevitability of an event, the capacity for rapid response to an imminent threat of an event, and preparation for addressing the aftermath of an event (NJDEP, 2013).
- **Gradually occurring** phenomena are more predictable and allow for long-range planning and measured preparation. On-going data collection, research, and modeling continue to refine our knowledge concerning the effects of climate change on the expression of phenomena that are regarded as coastal hazards. The U.S. Geological Survey evaluated the vulnerability of the mid-Atlantic region to the effects of sea level rise. The results of the study are presented in the report, Potential for Shoreline Changes Due to Sea-Level Rise along the U.S. Mid-Atlantic Region. The USGS study indicates that most of New Jersey's coast is highly susceptible to the effects of sea level rise (NJDEP, 2013).
- **Sea Level Change** - While the precise rate of sea level rise is uncertain, current models indicate that climate change will cause the rate to increase. Based on the trend of sea level rise from 1961 through 2003, sea level would rise by almost 6-inches by the end of this century in the absence of any effects of climate change. Taking climate change into account, sea level is projected to rise between 7 and 21 inches by 2100. This increase would result in the threat of more sustained

extreme storm surges, increased coastal erosion, escalating inundation of coastal wetlands and saline intrusion (NJDEP, 2013).

- **Coastal Wetlands** buffer uplands from chronic and episodic erosion caused by wave action. Conserving areas that allow for the landward migration of coastal wetlands in response to sea level rise is an example of a step that can be taken to enable the persistence of this valuable and productive feature of our coast. New Jersey's Coastal Management Program in concert with other State programs, as well as federal and local agencies, and non-profit organizations is proceeding on many fronts to reduce the societal, economic, and environmental risks associated with coastal hazards. The Coastal Management Program is collecting information that will be used to determine the relative vulnerability of coastal areas to natural hazards. Part of this effort involves examining the factors that are conducive to the landward migration of coastal wetlands, the development of pioneering coastal wetlands along open water areas and the transformation of freshwater wetlands to tidal wetlands (NJDEP, 2013).
- **Climate Change** - Several agencies, organizations, and academic institutions have addressed the potential effects of climate change on New Jersey and its coast. The New Jersey Global Warming Web site provides information regarding the State's initiatives regarding climate change. The Union of Concerned Scientists prepared an overview of how climate change may affect New Jersey including the state's coastal area. The Woodrow Wilson School of Public and International Affairs at Princeton University examined the potential effects of climate induced accelerated sea level rise on the New Jersey coast (NJDEP, 2013).

Location

Coastal erosion hazards and the vulnerability of development and infrastructure vary significantly by geographic region. By virtue of their location at the interface between oceans and land, coastal areas are among the most dynamic environments on earth susceptible to a broad range of natural hazards. Many parts of New Jersey's densely populated coast are highly vulnerable to the effects of flooding, storm surge, episodic erosion, chronic erosion, sea level rise, and extra-tropical storms. Much of the developed shoreline of New Jersey has been stabilized with seawalls and other armaments, which in some areas have caused extensive beach loss (NJOEM, 2012).

The State of New Jersey suffers significant erosion. While Burlington County has no open water on the Atlantic Ocean or Delaware Bay, it has two distinct areas that are at risk of shoreline erosion: the western border along the Delaware River and the southeastern portion along Mullica River Great Bay and its tributaries. The coastal boundary of the State of New Jersey encompasses the latter area (Craghan et al., 2010).

As defined through the New Jersey Coastal Management Program (NJCMP), the coastal zones of New Jersey includes all areas where the State has authority, through the NJDEP and the Meadowlands Commission, to regulate land and water uses that may have significant impact on coastal resources. The primary implementing authorities for NJCMP are the Coastal Area Facility Review Act (CAFRA), the Waterfront Development Law, the Wetlands Act of 1970, Tidelands Statutes and the Hackensack Meadowlands Reclamation Development Act (NJDEP, 2002).

Figure 5.4.1-1 illustrates the coastal boundary of the State of New Jersey. The figure indicates that Burlington County is in the CAFRA area. The portion of the County in the CAFRA area is a small, 19 acre, center in the Township of Bass River, where U.S. Route 9, a county road and the Garden State Parkway intersect. The rest of the southeast portion of the County is in Pinelands protected area zoning (Craghan et al., 2010).

Figure 5.4.1-1. New Jersey Coastal Boundary Map



Source: NJOEM, 2012

Note: The red line indicates the location of the CAFRA area.

A majority of the County is located along the Delaware River, where it is densely populated and, in some areas, heavily industrialized. Burlington County has four islands along the Delaware River: Newbold, Burlington, Hawk and Amico Islands (Craghan et al, 2010).

Previous Occurrences and Losses

Coastal erosion can occur gradually as a result of natural processes or from catastrophic events such as hurricanes, Nor'Easters and tropical storms. Coastal erosion also results from sea-level change, which occurs for a variety of reasons. Based on all sources researched, known events that have caused coastal erosion in Burlington County are identified in Table 5.4.1-1. The events listed in the table include those discussed previously in the 2008 county plan, in addition to events researched for this 2013 update. This table does not necessarily include all weather events that have occurred throughout the County.

SECTION 5.4.1: RISK ASSESSMENT – COASTAL EROSION

Table 5.4.1-1. Coastal Erosion Events between 1936 and 2012

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
September 19, 1936	Hurricane	N/A	N/A	This storm was a Category 2 hurricane when it passed by Burlington County, roughly paralleling the New Jersey shoreline. Coastal areas incurred flooding and beach erosion.	2008 Burlington County HMP
August 1, 1944	Tropical Storm	N/A	N/A	This tropical storm passed through the Delmarva Peninsula and subsequently made landfall in New Jersey at Cape May. Severe beach erosion and high tides were noted in coastal areas.	2008 Burlington County HMP
January 7-8, 1996	Blizzard	N/A	N/A	A record-breaking snowfall hit most of New Jersey, causing municipalities to exceed their annual snow budget, several buildings to collapse, and over 57,000 homes to lose power. The storm produced moderate flooding with moderate-to-severe beach erosion from Manasquan south along the Jersey Shore. A total of 28 deaths and numerous injuries were reported, as well as over \$50 million in damages.	NOAA-NCDC
February 16, 2003	Snow	N/A	N/A	The most powerful storm to affect New Jersey since the Blizzard of 1996 struck during the President's Day Weekend. Governor James McGreevey declared a state of emergency on the 16th. It cost state and local officials 14 million dollars to clear roadways statewide. Most businesses reopened on the 18th, but schools and state courthouses remained closed. The worst damage from the storm inland was caused by the weight of the snow and sleet which caused numerous roof collapses and collapses of "Florida rooms". Moderate tidal flooding and moderate to locally severe beach erosion affected coastal communities. In Burlington County, hundreds of residents were forced to leave their Tricia Meadows homes in Mount Laurel on the 17th after drifting snow blocked the roof top furnace flue and vent pipes. Carbon monoxide was building within their homes. A shelter was opened at a nearby school. Volunteers helped clear the roofs and residents returned that evening. The roof of an apparel printing business in Lumberton collapsed. Planes were grounded at McGuire Air Force Base through the 18th. Specific snow accumulations in Burlington County included 21.0 inches in Mount Laurel, 20.0 inches in Bordentown, and 19.0 inches in Tabernacle. Statewide, this event caused nearly \$20 million in damages.	2008 Burlington County HMP

Note (1): This table does not represent all events that may have occurred throughout the County.

Note (2): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

FEMA Federal Emergency Management Agency
HMP Hazard Mitigation Plan

NOAA National Oceanic and Atmospheric Administration
NCDC National Climatic Data Center



Impacts of Climate Change, Sea Level Rise and Coastal Erosion

Over the past several decades, the northeast U.S. has experienced noticeable changes in its climate. Since 1970, the average annual temperature rose by 2°F and the average winter temperature increased by 4°F. Heavy precipitation events increased in magnitude and frequency during this time as well (U.S. Environmental Protection Agency [USEPA], 2013).

Along with an increase in temperature, it is expected the amount of precipitation received in the northeast U.S. will increase as well. During winter months, more rain will fall rather than snow, which would likely increase the number and impact of flooding events. The intensity and duration of rain-producing events may increase as well. Sea level rise, storm surges, erosion and the destruction of coastal ecosystems will likely contribute to an increase in coastal flooding events (USEPA, 2013b).

Severe storms can cause erosion along the shorelines and are the largest cause of shoreline change. With a changing climate, coastal areas may experience an increase in the number, intensity and duration of storms, which could cause areas to experience more coastal erosion. Beaches are the first form of protection against waves and create a buffer between waves and coastal properties. When beaches are cut back during storms, they lose this buffering ability, which makes further coastal erosion more likely to occur. As beaches erode, vulnerable properties are at a greater risk (Sea Grant, Date Unknown).

As the rate of sea level rise increases, coastal erosion may increase as well. Higher sea levels could affect the coastal zone by causing a greater shoreline retreat, increasing coastal erosion, destroying properties, and cause saltwater intrusion into bays, rivers and underground water resources (Sea Grant, Date Unknown).

In New Jersey, there is more than 400 miles of shoreline that include the New York Harbor, Raritan Bay, the Atlantic Ocean and the Delaware River and Bay; with an additional 2,500 miles along back barriers and tributaries to these waterbodies, and rising sea levels threaten these coastal areas. If sea level were to rise two feet, approximately 61 square miles of dry land would be inundated. As sea level rises, the lowest lands will be eroded or inundated by the tides (Craghan et al., 2010).

Sea level is rising between three and four millimeters each year (or 12 to 16 inches per century) along New Jersey's coastline and is a major concern in the State. It is projected to rise more than the global average in the northeast portion of the State. Ocean beaches are eroding, prompting beach nourishment projects along most of the developed shoreline. Along the shores of the Delaware Bay, beaches and marshes are eroding and aging dikes are increasingly vulnerable. These effects could be more widespread if rising global temperatures cause the rate of sea level rise to accelerate. The Intergovernmental Panel on Climate Change (IPCC) estimates that by the end of the next century, sea level is likely to increase zero to three inches per decade (Craghan et al., 2010; NJDEP, 2013).

In Burlington County, along the Delaware River coast, wetlands will most likely migrate inland as sea level rises in the eastern portion of the County along the Mullica River. However, the vast majority of the County's shorelines along the Delaware River and its tributaries will be protected. In the Great Bay area, the unincorporated area of New Gretna (Bass River Township) is the primary area prone to sea level rise and needs to be protected. The remainder of the eastern part of the County will most likely be protected (Craghan et al., 2010).

Probability of Future Events

As indicated in the FEMA Multi-Hazard Identification and Risk Assessment Report, coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a specific

period of record, measured in units of feet or meters per year. Erosion rates vary as a function of shoreline type and are influenced primarily by episodic events. Monitoring of shoreline change based on a relatively short period of record does not always reflect actual conditions and can misrepresent long term erosion rates. Shorelines that are accreting, stable or experiencing mild rates of erosion over a long-term period are generally considered as not subject to erosion hazard. However, short-term and daily erosion can expose a segment of coast to an episodic storm event and associated erosion damages at any given time. Detailed methods of determining return periods and frequencies of occurrence of coastal erosion are very difficult to determine due to limited information and the relatively short period of recorded data in most areas. The long-term patterns of coastal erosion are also difficult to detect because of substantial and rapid changes in coastlines in the short-term (that is, over days or weeks from storms and natural tidal processes). It is usually severe short-term erosion events, occurring either singly or cumulatively over a few years, that cause concern and lead to attempts to influence the natural processes. Analysis of both long- and short-term shoreline changes are required to determine which is more reflective of the potential future shoreline configuration (FEMA, 1997).

As mentioned above, coastal erosion problem is an ongoing problem along many areas of the New Jersey coastline. It is difficult, if not impossible, to assign a probability to the near constant small ongoing erosion that may occur over a continuous period of time. However, a probability can be assigned to larger storm events such as Nor'Easters and hurricanes which can result in significant storm induced coastal erosion. As described in the sections below related to Nor'Easters and Hurricanes, the probabilities of these events range from a few a year (Nor'Easters) to less than one significant event per decade on average (hurricanes). The period of time over which this data is provided suggests the probability of coastal erosion will be about the same in the future, with year-to-year variation (NJ HMP, 2012).

In Section 5.3, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the County Planning Committee, the probability of occurrence for coastal erosion in Burlington County is considered 'rare' (hazard event is not likely to occur within 100 years), as presented in Table 5.3-3).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. While coastal erosion is not generally considered an imminent threat to public safety, its impact to property, infrastructure, environmental resources and local economies is clear. The following text evaluates and estimates the potential impact of coastal erosion on Burlington County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health of residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

While Burlington County has no open water on the Atlantic Ocean or Delaware Bay, it has two distinct areas that are at risk of shoreline erosion: the western border along the Delaware River and the southeastern portion along Mullica River Great Bay and its tributaries. The coastal boundary of the State of New Jersey encompasses the latter area (NJDEP, 2007; NJDEP, 2002).

As described in detail earlier in this profile, principal natural causes of erosion are wave action, wind action, and overland runoff through intense precipitation. Other contributing factors that can significantly increase erosion of a natural protective feature include length of fetch, wind direction and speed, wave length, height and period, near-shore water depth, tidal influence, increased lake levels, and overall strength and duration of storm events. Additionally, sea-level rise will exacerbate coastal erosion.

Data and Methodology

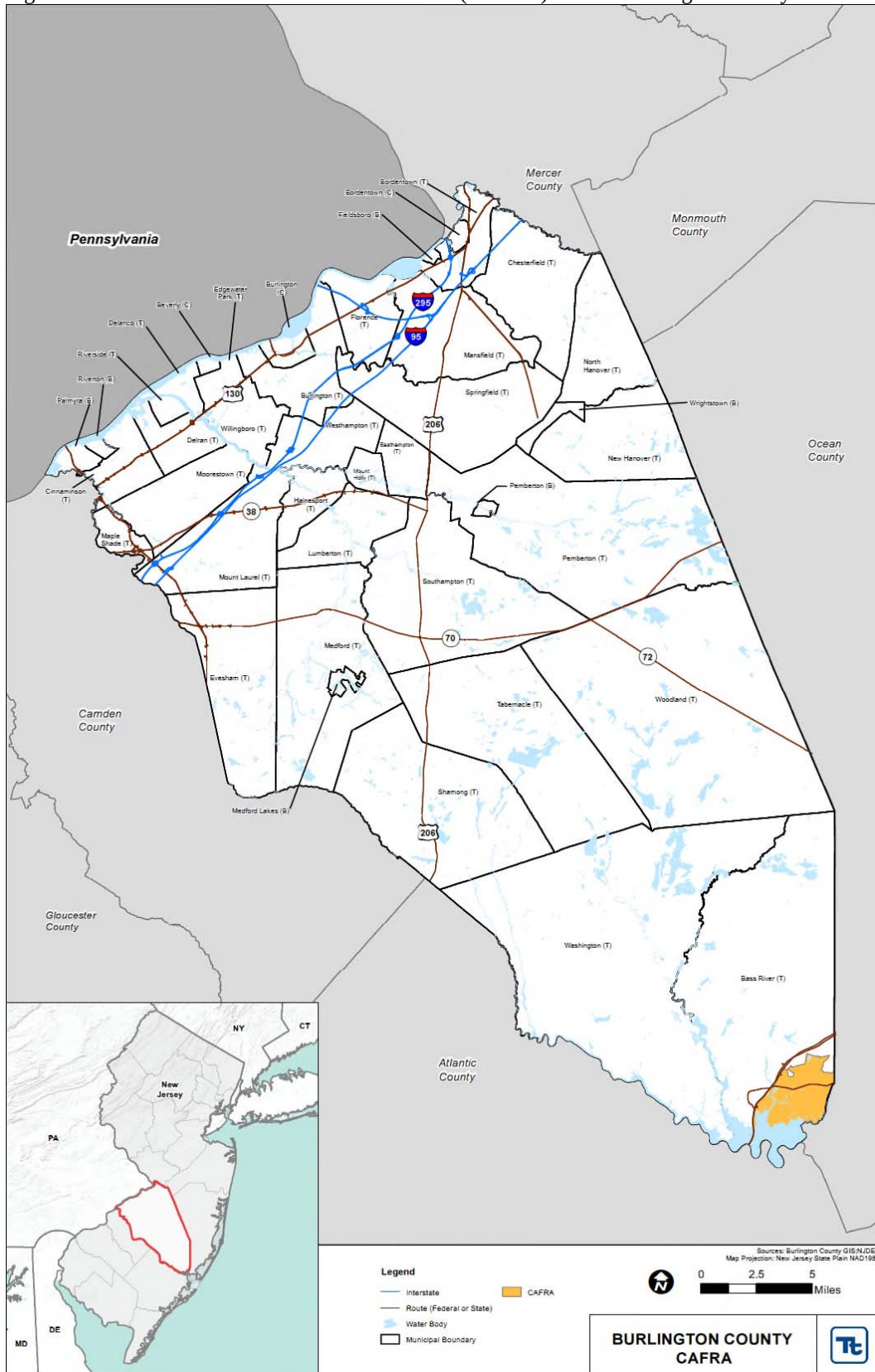
The CAFRA boundary, which legislates land use within the coastal area, was used to determine exposure to the coastal erosion hazard. As noted above, land within this boundary is under the jurisdiction of the Coastal Area Facilities Review Act (CAFRA), N.J.S.A. 13:19-1 et seq (as amended to July 19, 1993). This area includes the Advisory V-zone and any area indicated by the Advisory data with wave action.

The asset data (population, building stock and critical facilities) presented in the County Profile section (Section 4) were used to support an evaluation of assets exposed to this hazard. To determine what assets are exposed to coastal erosion, available and appropriate GIS data was overlaid upon the CAFRA polygon. Bass River Township is the only municipality in Burlington County located within the CAFRA zone. The asset data exposed is presented in Figure 5.4.1-2.

In addition, projected sea-level rise data (in one-foot increments) available from Jacques Cousteau National Estuarine Research Reserve (<http://slrviewer.rutgers.edu/about.html>) was considered and used for this analysis. Please note these levels do not include additional storm surge due to a hurricane or Nor'easter. The current Advisory maps and preliminary DFIRMs also do not include the effects of sea-level rise. Miller et al. projects an approximate 2-foot in sea-level rise by 2050 for the State of New Jersey in *A geological perspective on sea-level rise and impacts along the U.S. mid-Atlantic coast* (July 2013, Submitted to Earth's Future). For the purposes of this planning effort, the year 2050 and associated projected 2-foot rise was used as a reasonable and responsible planning horizon.

SECTION 5.4.1: RISK ASSESSMENT – COASTAL EROSION

Figure 5.4.1-2. Coastal Area Facilities Review Act (CAFRA) Area in Burlington County



Source: NJDEP

Impact on Life, Health and Safety

Coastal erosion is not generally considered an imminent threat to public safety when the changes are gradual over many years. However, drastic changes to the shoreline may occur as a result of a single storm event which can threaten homes and public safety. The population exposed is also considered vulnerable to this hazard. Only a small area in southeastern corner of Burlington County is located within the jurisdiction of CAFRA. Coastal erosion is a possibility in this area of the county, as it is tidally influenced.

Census blocks do not follow the boundaries of the CAFRA boundary and can grossly over or under estimate the population exposed when using the centroid or intersect of the Census block with these areas. Table 5.4.1-2 summarizes the approximate population located within Bass River Township.

Table 5.4.1-2. Approximate Population in the CAFRA Boundary

Municipality	Total Population (2010 U.S. Census)	Population In CAFRA Boundary	% of Total Population
Bass River Township	1,443	271	18.8%
Burlington County	448,734	271	<1%

Source: NJDEP; U.S. Census, 2010

Note: % = Percent; CAFRA = Coastal Area Facilities Review Act

To estimate the approximate population exposed to two-feet of sea level rise, the Jacques Cousteau National Estuarine Research Reserve 2-foot sea level rise boundary was used. Table 5.4.1-3 summarizes the approximate population in the area mapped with 2-feet of sea level rise by municipality.

Table 5.4.1-3. Total Improved Value Exposure to 2-Feet of Sea Level Rise

Municipality	Total Population (2010 U.S. Census)	Population In Area Mapped with 2-feet of Sea Level Rise	% of Total Population
Bass River Township	1,443	24	1.6%
Burlington County	448,734	24	.005%

Source: Burlington County GIS; Rutgers, 2013

Note: % = Percent

Impact on General Building Stock

To estimate the potential losses to the general building stock, the exposure analysis methodology was used. Table 5.4.1-4 and Table 5.4.1-5 summarize the total improved value and replacement cost value of buildings in the CAFRA boundary by municipality. This exposure estimate is considered high if used to estimate potential losses because coastal erosion generally occurs in increments of inches to feet per year along the coastline and may not necessarily occur across the entire coastal resource area at the same time from one event. Nonetheless, the total improved value and replacement cost value of state facilities within this area represents an estimated total loss value for buildings.

Table 5.4.1-4. Total Improved Value Exposure in the CAFRA Boundary

Municipality	Total Improved Value	Improved Value in CAFRA Boundary	% of Total RCV
Bass River Township	\$112,293,600	\$33,710,800	30%
Burlington County	\$36,253,174,444	\$33,710,800	<1%

Source: NJDEP; Burlington County GIS

Note: % = Percent; CAFRA = Coastal Area Facilities Review Act

Table 5.4.1-5. Building Replacement Cost Value Exposure in the CAFRA Boundary

Municipality	Total RCV	RCV in CAFRA Boundary	% of Total RCV
Bass River Township	\$158,762,000	\$35,027,000	22%
Burlington County	\$36,253,174,444	\$35,027,000	<1%

Source: HAZUS-MH; Burlington County GIS

Note: % = Percent; CAFRA = Coastal Area Facilities Review Act; RCV = Replacement Cost Value

To estimate the potential losses to the general building stock from two-feet of sea level rise, the exposure analysis methodology was used. Table 5.4.1-6 and Table 5.4.1-7 summarize the total improved value and replacement cost value of buildings in the area mapped with 2-feet of sea level rise.

Table 5.4.1-6. Total Improved Value Exposure to 2-Feet of Sea Level Rise

Municipality	Total Improved Value	Improved Value in Area Mapped with 2-feet of Sea Level Rise	% of Total RCV
Bass River Township	\$112,293,600	\$5,031,200	4.5%
Burlington County	\$36,253,174,444	\$5,031,200	.01%

Source: Burlington County GIS; Rutgers, 2013

Note: % = Percent

Table 5.4.1-7. Building Replacement Cost Value Exposure to 2-Feet of Sea Level Rise

Municipality	Total RCV	RCV in Area Mapped with 2-feet of Sea Level Rise	% of Total RCV
Bass River Township	\$158,762,000	\$2,523,000	1.6%
Burlington County	\$36,253,174,444	\$2,523,000	.005%

Source: HAZUS-MH; Rutgers, 2013

Note: % = Percent; RCV = Replacement Cost Value

Impact on Critical Facilities

There are no identified critical facilities within the CAFRA boundary. There are no identified critical facilities within the 2-foot of sea-level rise boundary.

Impact on Economy

Coastal erosion can also severely impact roads and infrastructure. There are 19.07 miles of roadway (freeway, major arterial and collector, and minor arterial) that lie within the CAFRA boundary, 4.93 miles of which are along an evacuation route.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the defined coastal risk areas could be potentially impacted by coastal erosion similar to those that currently exist within the County.

Additional Data and Next Steps

When the New Jersey Coastal Management Program maps and the New Jersey Office of Coastal Management coastal risk assessment areas are updated, this section of the plan will be updated to reflect new areas and/or assets located in the coastal erosion hazard area. Additional data on historic costs incurred to reconstruct buildings and/or infrastructure due to coastal erosion impacts would assist in estimating future losses.

5.4.2 DROUGHT

This section provides a profile and vulnerability assessment for the drought hazard.

HAZARD PROFILE

This section provides profile information including: description, location and extent, previous occurrences and losses, and the probability of future occurrences.

Description

The Climate Prediction Center (CPC) of the National Weather Service (NWS) defines drought as a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area (CPC, 2004). According to the New Jersey State Hazard Mitigation Plan (NJ HMP), drought is a period of drier-than-normal conditions that results in community water issues (NJ HMP, 2012). Other climatic factors, such as high temperatures, prolonged high winds and low relative humidity, can aggravate the severity of a drought. These conditions are caused by anomalous weather patterns when shifts in the jet stream block storm systems from reaching an area. As a result, large high-pressure cells may dominate a region for a prolonged period, thus reducing precipitation.

There are four different ways that drought can be defined or grouped:

- Meteorological drought is a measure of departure of precipitation from normal. It is defined solely on the degree of dryness. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, etc. It occurs when there is not enough water available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply and occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake and groundwater levels.
- Socioeconomic drought is associated with the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods depends on weather (e.g., water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply (National Drought Mitigation Center, 2012).

Extent

The extent (e.g., magnitude or severity) of drought can depend on the duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. The intensity of the impact from drought could be minor to total damage in a localized area or regional damage affecting human health and the economy. Generally, impacts of drought evolve gradually and regions of maximum intensity change with time. The severity of a drought is determined by areal extent as well as intensity

and duration. The frequency of a drought is determined by analyzing the intensity for a given duration, which allows determination of the probability or percent chance of a more severe event occurring in a given mean return period.

Several indices developed by Wayne Palmer (Palmer Drought Severity Index [PDSI] and Crop Moisture Index [CMI]), as well as the Standardized Precipitation Index (SPI), are the most useful for describing the many scales of drought. Other indices include accumulated departure from normal stream flows, low-flow frequency estimates and changes in water storage, groundwater levels and rates of decline, and lake levels. Most commonly used indices that are used to measure or identify the severity and classification of past and present droughts primarily include, but not limited to, the following:

Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) was developed in 1965, and indicates the prolonged and abnormal moisture deficiency or excess. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather. It can be used to help delineate disaster areas and indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and potential intensity of forest fires (NWS CPC, 2005).

The PDSI has become the semi-official drought index. It is the most effective in determining long-term droughts; however, it is not good with short-term forecasts. Table 5.4.2-1 lists the Palmer Classifications. Zero is used as normal and drought is shown in terms of negative numbers. For example, -2 is moderate drought, -3 is severe drought and -4 is extreme drought. The PDSI also reflects excess precipitation using positive numbers (NOAA, Date Unknown).

Table 5.4.2-1. PDSI Classifications

Palmer Classifications	
4.0 or more	extremely wet
3.0 to 3.99	very wet
2.0 to 2.99	moderately wet
1.0 to 1.99	slightly wet
0.5 to 0.99	incipient wet spell
0.49 to -0.49	near normal
-0.5 to -0.99	incipient dry spell
-1.0 to -1.99	mild drought
-2.0 to -2.99	moderate drought
-3.0 to -3.99	severe drought
-4.0 or less	extreme drought

Source: NDMC, Date Unknown

Crop Moisture Index

The CMI, developed by Wayne Palmer in 1968, can be used to measure the status of dryness or wetness affecting warm season crops and field activities. It gives the short-term or current status of purely agricultural drought or moisture surplus and can change rapidly from week to week (NWS CPC, 2005). The CMI responds more rapidly than the PDSI so it is more effective in calculating short-term abnormal dryness or wetness affecting agriculture. CMI is designed to indicate normal conditions at the beginning and end of the growing season; it uses the same levels as the Palmer Drought (NOAA, Date Unknown).

The Standardized Precipitation Index (SPI) is a probability index that considers only precipitation. It is based on the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive for wet conditions. The SPI is computed by NCDC for several time scales, ranging from one month to 24 months, to capture the various scales of both short-term and long-term drought (Heim, 2008).

National Drought Mitigation Center

The National Drought Mitigation Center (NDMC) helps develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning. The NDMC produces a daily drought monitor map that identifies drought areas and ranks droughts by intensity. U.S. Drought Monitor summary maps are available from May 1999 through the present and identify general drought areas and classification droughts by intensity ranging from D1 (moderate drought) to D4 (exceptional drought). Category D0, drought watch areas, are drying out and possibly heading for drought, or are recovering from drought but not yet back to normal, suffering long-term impacts such as low reservoir levels (Table 5.4.2-2).

Table 5.4.2-2. NDMC Drought Severity Classification Table

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (%)	USGS Weekly Streamflow (%)	Standardized Precipitation Index (SPI)	Satellite Vegetation Health Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	36-45
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	26-35
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	16-25
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	6-15

Table 5.4.2-2. NDMC Drought Severity Classification Table

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (%)	USGS Weekly Streamflow (%)	Standardized Precipitation Index (SPI)	Satellite Vegetation Health Index
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	1-5

Source: NDMC, 2002

Note: Additional indices used, mainly during the growing season, include the USDA/NASS Topsoil Moisture, Crop Moisture Index (CMI), and Keetch Byram Drought Index (KBDI). Indices used primarily during the snow season and in the West include the River Basin Snow Water Content, River Basin Average Precipitation, and the Surface Water Supply Index (SWSI).

Drought Impact Reporter

The Drought Impact Reporter (DIR) is an interactive tool developed by the NDMC to collect, quantify, and map reported drought impacts for the U.S., which is one of the resources used to identify known drought events throughout Burlington County for this Plan (NDMC, 2012).

North American Drought Monitor

The North America Drought Monitor is a cooperative effort between drought experts in Canada, Mexico and the U.S. to monitor drought across the continent on an ongoing basis. The Drought Monitor concept was developed as a process that synthesizes multiple indices, outlooks and local impacts, into an assessment that best represents current drought conditions. The final outcome of each Drought Monitor is a consensus of federal, state and academic scientists. Maps of U.S. droughts are available from this source from 2003 to the present (NCDC, 2012).

Drought Indicators of New Jersey

After a severe drought event in New Jersey occurred during 1998 and 1999, the NJDEP analyzed factors affecting the State's water resources and its response to the situation. During this drought event, the State's ability to manage the situation was made difficult because they did not have a way to compare the severity of drought in different portions of the State and then communicate the information to the public.

In response to these difficulties, the NJDEP developed a unique set of indicators specifically designed to monitor regional water supply sources in the State. The indicators were designed to do the following:

- Integrate large amounts of data about water supply sources
- Communicate to the public and decision makers and provide accurate information
- Be reasonable
- Be based on real-time data
- Be distributed quickly over the internet

There are drought indicators for precipitation, streamflow, reservoir levels, and groundwater levels. Each is assigned to one of four conditions: near or above normal; moderately dry; severely dry; or extremely

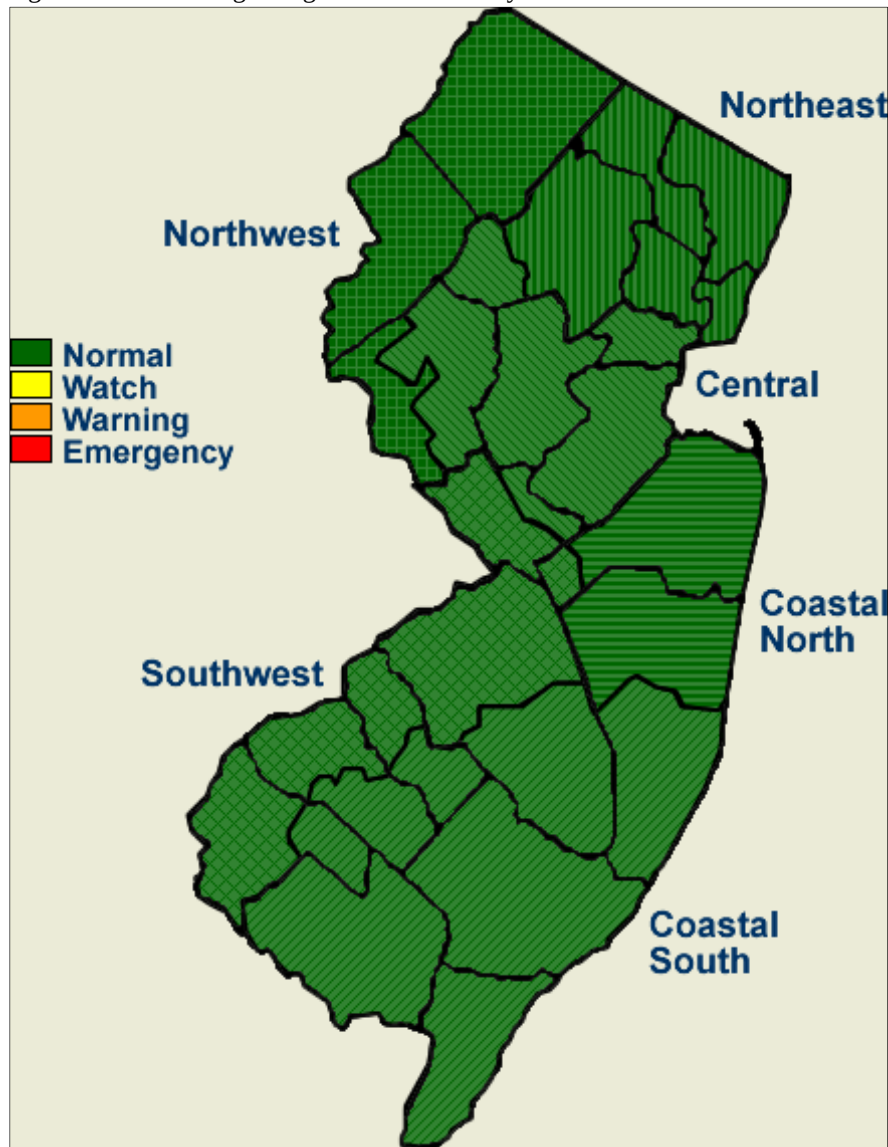
dry; a color is associated with each condition (Table 5.4.2-3). The State is divided into six drought regions (Figure 5.4.2-1) and indicators are evaluated for the water supply sources important to each region. The indicators are updated weekly during dry periods and bi-weekly in normal and wet periods. These indicators are intended to be used to evaluate water supply droughts, not other types of drought (Hoffman and Domber, 2003; Hoffman, 2010). Burlington County is located within the southwest and coastal south drought regions.

Table 5.4.2-3. Drought Indicators for New Jersey

Color	Drought Status Indicator
Green	Near or above normal
Light Yellow	Moderately dry
Dark Yellow	Severely dry
Red	Extremely dry

Source: NJDEP, 2013

Figure 5.4.2-1. Drought Regions of New Jersey



Source: NJDEP, 2006

Extent in Burlington County

In summary, the magnitude and severity of drought in Burlington County can be extensive, for the following reasons:

- Crop failure* is one common effect of drought. With active agriculture extending from the Pinelands throughout northern Burlington County, the County has always been one of the leading agricultural counties in the nation. According to the Burlington County Cross-Acceptance Report, nearly 17 percent of the County's acreage is devoted to agricultural purposes. Burlington County is ranked the second largest blueberry-producing and the third largest cranberry-producing county in the U.S. There are more acres devoted to farming in Burlington County than any county in the State, primarily in vegetable, fruit and timber production. Water for irrigation is sourced 97 percent from surface water sources and

accounts for 61 percent of all water withdrawn in the county per year. Surface water is particularly susceptible to periods of drought (Burlington County HMP, 2008).

- *Water supply shortages* are a second effect of drought. Burlington County public supply and domestic self-supply are sourced primarily from groundwater (65 percent). Groundwater is fairly resistant to drought conditions; however, the remaining 35 percent is sourced from surface water, which is more susceptible to the effects of drought. The expected likelihood of future losses associated with reductions in water supply from underground aquifers would be low. The expected likelihood of future losses associated with reductions in water supply from surface water sources would be higher because surface water sources (such as reservoirs and rivers) are much less resistant to periods of drought and are more susceptible to being impacted (Burlington County HMP, 2008).
- A third common effect of drought is *fish and wildlife mortality*. Burlington County is largely rural and has diverse populations of fish and wildlife. Its wetlands, scrub pine and oak woodlands, and Atlantic white cedar forests shelter a wide variety of wildlife, while abundant creeks, estuaries and aquifers provide essential water resources. Nine different threatened and endangered species reside in Burlington County. The New Jersey Pinelands, which cover approximately 64 percent of the County's land area, is the largest Pine Barrens complex in the world. It supports globally rare communities and species and is an area of national significance, supporting: five federally listed threatened and endangered species, 17 federal candidate species and species of concern, and 54 state listed threatened and endangered species. Because so much of the land area in Burlington County is undeveloped, fish and wildlife habitat is fairly high and therefore losses to fish and wildlife could likely be high (Burlington County HMP, 2008).
- A fourth common effect of drought is *wildfires*. Due to Burlington County's largely undeveloped nature, fuel is plentiful for wildfires, particularly in the Pine Barrens. In Burlington County, fuel tends to be most plentiful in areas where development densities are lowest; this works to reduce possible property damages and loss of life; however, the wildland-urban interface would be particularly vulnerable as well as transportation routes such as the Garden State Parkway which traverse the Pine Barrens. Wildfires are a unique hazard addressed separately in this plan (Burlington County HMP, 2008).

Feedback provided by local jurisdictions on the extent of the drought hazard in their communities includes:

- *Township of Tabernacle* OEM notes that the bulk of the economy of the Township rests in farms, while the remainder is mainly residential. The magnitude or severity of a drought event would be high due to the farmlands. There is no public water supply in the Township (residents and farms rely on private wells) (Burlington County HMP, 2008).
- *Township of Florence* noted that through years past they have had to put in place a strict water conservation program and monitoring of water storage levels (Burlington County HMP, 2008).
- *Township of Mount Laurel* has reported that drought conditions have occurred in their jurisdiction in the past, and some of their major concerns include: Township water supply, tree damage, parks and recreation facilities, and wildfires (Burlington County HMP, 2008).
- *Township of Cinnaminson* has reported putting in place strict water conservation programs and water storage level monitoring during past drought events (Burlington County HMP, 2008).
- *Mansfield Township* reports that past drought conditions have not been severe enough to pose a hazard to their community (Burlington County HMP, 2008).
- Extent of the hazard in Evesham is limited because lands are mostly forested (though there is some farmland) (Burlington County HMP, 2008).

- *Township of Delran* notes that the extent of their wildfire hazard is not limited to just the Pine Barrens. They indicate that open space preservation land is often allowed to grow wild, and a drought could produce wildfires that could pose a danger to its visitors and adjacent properties (i.e., the Town notes that this could be the case with the Anderson Peach Farm) (Burlington County HMP, 2008).
- *Burlington City* estimates that the extent of the hazard in their municipality could be increased if the water intake on the Delaware River at the water treatment plant were to be impacted (Burlington County HMP, 2008).

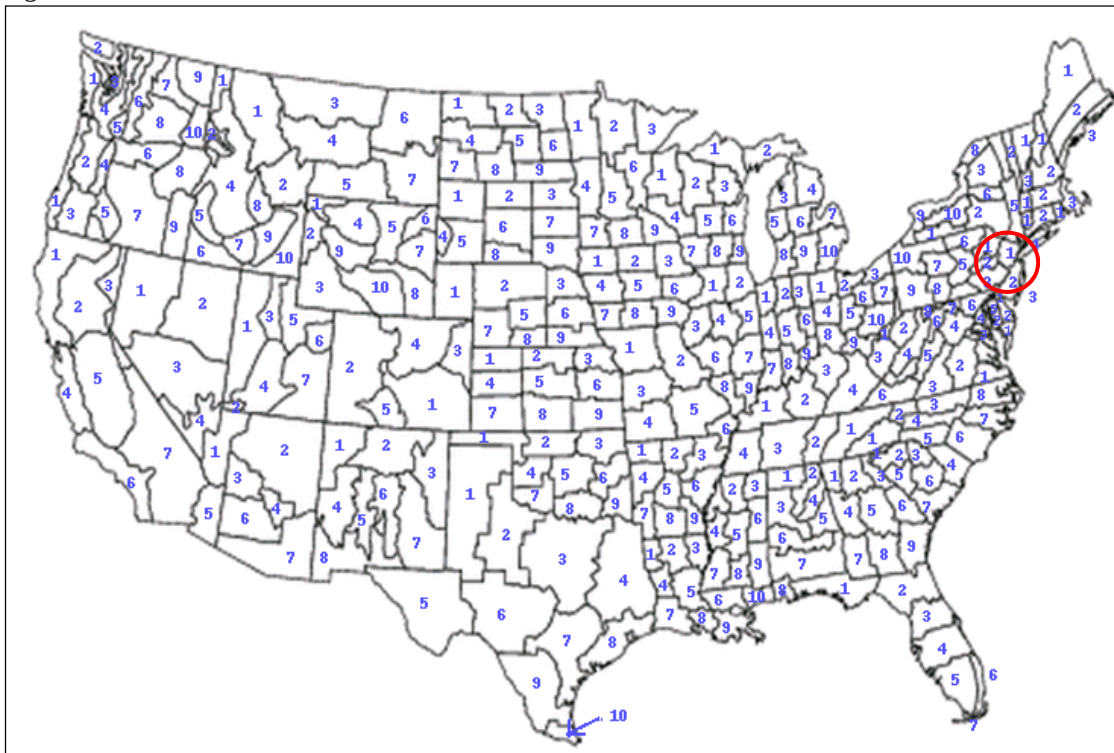
Location

The location of drought events throughout the State of New Jersey and Burlington County are further identified below.

Climate divisions are regions within a state that are climatically homogenous. The National Oceanic and Atmospheric Administration (NOAA) has divided the U.S. into 359 climate divisions. The boundaries of these divisions typically coincide with the county boundaries, except in the western U.S., where they are based largely on drainage basins (Energy Information Administration, 2005).

According to NOAA, the State of New Jersey is made up of three climate divisions: Northern Climate Division, the Southern Climate Division and the Coastal Climate Division. Burlington County is located within the Southern Climate Division (NOAA, Date Unknown). Figure 5.4.2-2 shows the climate divisions throughout the U.S. and Figure 5.4.2-3 shows the climate divisions of the State of New Jersey.

Figure 5.4.2-2. Climate Divisions of the U.S.

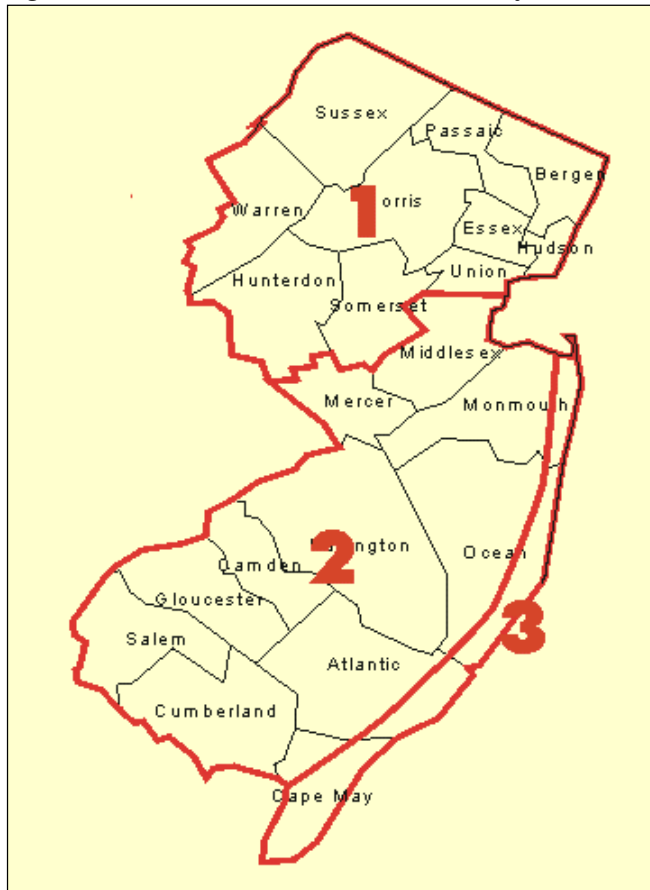


Source: NOAA, Date Unknown

Note (1): The red circle indicates the approximate location of Burlington County, Climate Division 1.

Note (2): 1 = Northern Climate Division; 2 = Southern Climate Division; 3 = Coastal Climate Division

Figure 5.4.2-3. Climate Divisions of New Jersey

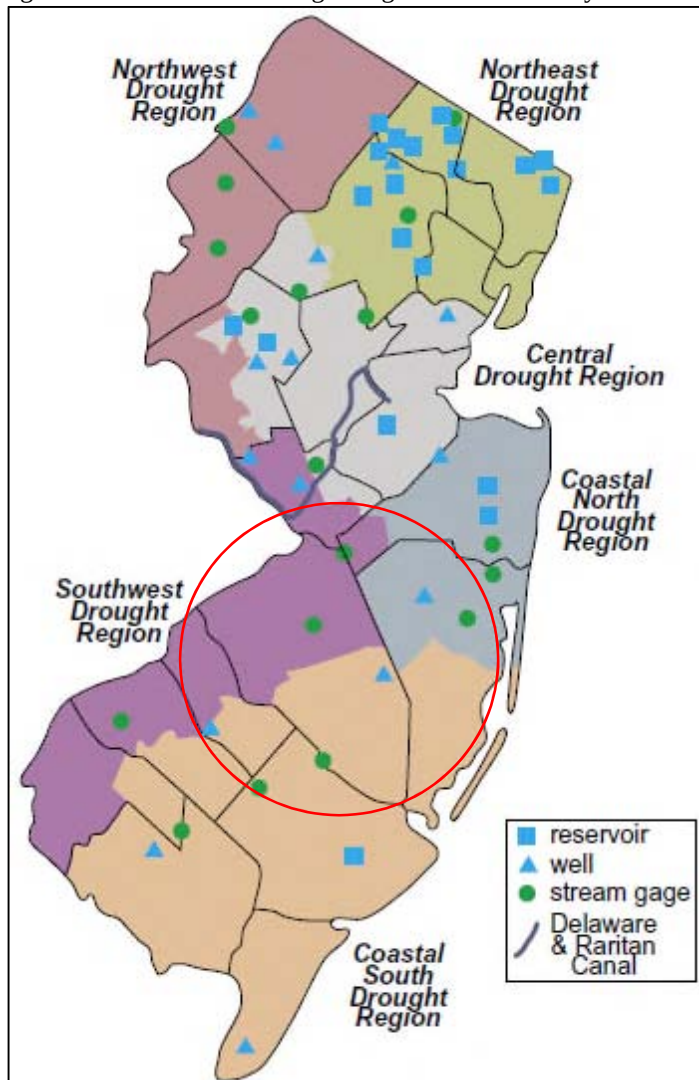


Source: Climate Prediction Center (CPC), 2005

Note: 1 = Northern Climate Division; 2 = Southern Climate Division; 3 = Coastal Climate Division

According to the New Jersey Geological Survey (NJGS), the New Jersey Department of Environmental Protection (NJDEP) divides New Jersey into six drought regions that are based on regional similarities in water-supply sources and rainfall patterns. These boundaries usually correspond to natural watershed boundaries. Regional boundaries match municipal boundaries in order to facilitate enforcement of potential water-use restrictions. The drought regions allow New Jersey to respond to changing conditions without imposing restrictions on areas that are not experiencing water shortages (Hoffman and Domber, 2003). The NJDEP indicates that Burlington County is within the Southwest and Coastal South Drought Regions (Figure 5.4.2-4).

Figure 5.4.2-4. NJDEP Drought Regions in New Jersey



Source: Hoffman and Domber, 2003

Note: The red circle indicates the approximate location of Burlington County. The County is located within the Southwest and Coastal South Drought Regions.

Groundwater is the primary source of water supply in Burlington County. According to the USGS Hydrologic Atlas 730-L for Segment 11 (which includes New Jersey, in addition to the states of Delaware, Maryland, North Carolina, West Virginia, Pennsylvania, and Virginia), published by Henry Trapp, Jr. and Marilee A. Horn in 1997, precipitation is the source of all freshwater in New Jersey. Most of the precipitation that is not evapotranspired runs directly off the land surface to streams or reaches streams after temporary storage in lakes, reservoirs, wetlands, and soils. A small part of precipitation infiltrates the land surface and percolates downward to recharge aquifers. In Burlington County, the aquifer is known as the Northern Atlantic Coastal Plain Aquifer System. Burlington County obtains its water supply from this aquifer system, which consists of several aquifers that are vertically stacked (Burlington County HMP, 2008).

NJDEP Source Water Assessment Reports show that Burlington County is supplied by 74 different Community Water Supply Systems, which together collect water through a network of 240 wells and three surface water intakes. Sixty-five percent of the wells pump from the Potomac-Raritan-Magothy

aquifer; twenty-seven percent pump from the Mount Laurel-Wenonah aquifer; and the remaining eight percent pump from the Englishtown, Piney Point, Kirkwood-Cohansey, and Vincentown aquifers. Of the three surface water intakes, two are located on the Delaware River and one is located on the Rancocas Creek. While no reservoirs are a direct water supply source, many reservoirs function to maintain water levels in rivers which have surface water intakes.

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with drought events throughout the State of New Jersey and Burlington County. With numerous sources reviewed for the purpose of this HMP, loss and impact information for events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during the HMP research.

According to NOAA's NCDC storm events database, Burlington County experienced 49 drought events between 1950 and April 30, 2013. No other drought event indicated monetary damages according to NCDC. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2013, two drought events occurred within the County. The database indicated that drought events and losses specifically associated with Burlington County and its municipalities totaled over \$5 million in crop damages. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2013, FEMA declared that the State of New Jersey experienced two drought-related disaster declarations: one major disaster (DR) and one emergency (EM); both were classified as water shortages. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, the New Jersey HMP, FEMA, and other sources indicate that Burlington County has been declared as a disaster area as a result of two drought-related events (FEMA, 2013).

Based on all sources researched, known drought events between 1950 and 2013 that have affected Burlington County and its municipalities are identified in Table 5.4.2-4. Not all sources have been identified or researched; therefore, Table 5.4.2-4 may not include all events that have occurred throughout the County and region. Events previously reported in the 2008 County HMP are sourced as "Burlington County HMP".

Table 5.4.2-4. Drought Events Affecting Burlington County Between 1950 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
1965	Drought / Water Shortage	DR-205	Yes	No reference and/or no damage reported.	FEMA
1980	Drought / Water Shortage	EM-3083	Yes	No reference and/or no damage reported.	FEMA
March 1995 – August 1995	Drought	N/A	N/A	March thru May 1995, three consecutive months of below normal precipitation. One of the driest springs on record for most of inland New Jersey. June 1995 brought statewide precipitation of 30 to 50 percent of normal, with Burlington and Ocean counties being the driest. August 1995 was one of the 10 warmest August's on record, and also one of the driest.	Burlington County HMP
June 1997 - October 1997	Drought	N/A	N/A	Unseasonably dry weather with below normal rainfall, which became worse during the summer months, forced the Delaware River Basin Commission to declare a drought warning on October 27th.	Burlington County HMP
July 1998 – September 1999	Drought	N/A	N/A	One of the driest periods on record. Estimated statewide agricultural losses of \$80 million. Stream flows some of the lowest recorded. Average precipitation was about 50 percent of normal, state wide. NJDEP declared extreme drought. DRBC declared drought warning stage 2.	Burlington County HMP
October 2000	Drought	N/A	N/A	One of driest Octobers on record for 16 of New Jersey's 21 Counties, including Burlington. Dry weather did not cause appreciable agricultural damage, but falling leaves left the affected areas susceptible to forest and brush fires.	Burlington County HMP
April 2001 – May 2001	Drought	N/A	N/A	Unseasonably dry, particularly in the second half of April and the first half of May when many areas received very little precipitation. The NJ State Forest Fire Service imposed a statewide ban on open, controlled fires. Lack of precipitation forced many farmers to delay planting soybeans and initiate irrigation for peaches and corn. Grains and grasses were either stunted or grew at a slow pace. On May 1 st , in Bordentown Township, sparks from a passing train ignited a dozen brush fires, damaging one barn. On May 15 th , in Florence, 100 acres burned.	Burlington County HMP
October 2001 – November 2002	Drought	N/A	N/A	On November 21, 2001, flow along the Mullica River at Batsto in Burlington County was at a new record low and only 14 percent of normal. In December 2001, the Delaware River Basin Commission was forced to reduce the amount of water released from its reservoirs in to the Delaware River. In January 2002, the North Branch of the Rancocas Creek at Pemberton was flowing at only	Burlington County HMP

Table 5.4.2-4. Drought Events Affecting Burlington County Between 1950 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				29 percent of its normal rate. In February 2002 record low stream flows for calendar days were set for the Rancocas Creek, Crosswicks Creek, Oswego Creek, and Mullica River. Winter wheat crop struggled, as did evergreen farms. Irrigation ponds well below normal. In March 2002 Burlington County had a seven week backlog for deepening wells. Winter 2001-2002 half of the ponds in the Mullica River Basin went dry with associated negative impacts to fish and wildlife. In August 2002, on the Fort Dix military reservation, the sun's heat ignited ammunition and sparked a wildfire which consumed about 3,000 acres. In September 2002 Federal Farm Disaster Declaration. Many New Jersey farmers suffered losses of 50 percent or more for 2002.	
September 2005	Drought	N/A	N/A	Unseasonably warm and dry month across the state of New Jersey. Lack of rain affected both the agriculture and water supplies. The governor declared a drought watch on September 13 th . Because of the higher cost for fuel, irrigation costs increased. The heat damaged the leaves of temperature sensitive plants such as lettuce, parsley and cilantro. The lack of rain reduced the size of lettuce, cabbage, leeks and arugula. The sun helped cause blistering of tomatoes, peppers, squash and beans. Some tree leaves were showing signs of scorching, especially along their edges. Dogwoods and maples showed signs of water stress. Milk production was down because of the affect the heat had on the cows. As one farmer was quoted, operational costs were up about 20 percent and yields were down 25 percent.	Burlington County HMP
May to July 2006	Drought	N/A	N/A	Burlington County entered a drought was noted as abnormally dry by the Drought Monitor on March 21, and the southern part of the county was lifted to Moderate Drought status on April 18. The drought watch on the northern half of the county was lifted on June 6 th , and on the southern portion on June 27 th . Resumption of significant precipitation in June led to lifting of watch on July 3, 2006.	NOAA-NCDC, NDMC
August to December 2008	Drought	N/A	N/A	An unseasonably dry August occurred across the state of New Jersey with the greatest departures from normal in the central part of the state. This exacerbated crop damage that was already inflicted by the heat and the large hail storm in the southern part of the state on August 10th. The combination of the June heat and the August hail storm and drought led the United States Secretary of Agriculture Edward Schafer to declare ten central and southern New Jersey Counties a natural disaster on September 22nd.	NOAA-NCDC, NDMC

Table 5.4.2-4. Drought Events Affecting Burlington County Between 1950 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				Burlington County entered a drought watch under abnormally dry conditions on July 22, 2008. The southern portion of the county was taken off watch on August 12 th , but went back on watch status on September 2 nd . The majority of the county was taken of watch status on November 18 th , and the remaining areas by December 2 nd .	
June to October 2010	Drought	N/A	N/A	The state of New jersey was placed on drought watch on June 29th. On July 13th, Burlington and other counties were lifted to Moderate Drought status. All areas of the county except for a small portion in the northwest corner remained at least on drought watch through August, with the southern portion of the county remaining in a moderate drought. NJDEP asked all state residents to voluntarily conserve water. The hot and dry summer taxed reservoir stream and groundwater levels. Shallow groundwater (private) wells were also starting to show stress. Statewide it was the 4th warmest September on record since 1895 with an average temperature of 69.2 degrees. On September 7, more than half of the county including the northern, eastern, and southern areas, was declared in a severe drought. This was lowered to moderate drought on October 5th. The drought watch was lifted from the western part of the county on October 26th, and on the rest of the county by December 14h.	NOAA-NCDC, NDMC

Source(s): NOAA-NCDC, FEMA, Burlington County HMP
 FEMA Federal Emergency Management Agency
 HMP Hazard Mitigation Plan
 K Thousand (\$)
 M Million (\$)
 N/A Not Applicable
 NCDC National Climatic Data Center
 NDMC National Drought Mitigation Center
 NOAA National Oceanic and Atmospheric Administration
 NJ New Jersey
 NJDEP New Jersey Department of Environmental Protection

Probability of Future Events

Past drought occurrences are expected to be a sound indicator of the probability of future drought occurrences for Burlington County. Certain parts of the country are more susceptible to being impacted by a drought than others are. Arid parts of the country tend to be at greater risk of experiencing long-term droughts, while more humid parts of the country tend to be more susceptible to short-term droughts. According to the USGS Division of Water Resources, Burlington County and its jurisdictions fall within what is described as a “humid region” and is more likely to experience a short-term drought (Burlington County HMP, 2008).

It is estimated that Burlington County will continue to experience direct and indirect impacts of drought and its impacts on occasion, with the secondary effects causing potential disruption or damage to agricultural activities and creating shortages in water supply within communities.

In Section 5.3, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for drought in the County is considered ‘occasional’ (likely to occur within 100 years, as presented in Table 5.3-3).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. For the drought hazard, all of Burlington County has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable to a drought. The following text evaluates and estimates the potential impact of the drought hazard on Burlington County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

Essentially, all of Burlington County is vulnerable to drought. However, areas at particular risk are areas used for agricultural purposes (farms and cropland), open/forested land vulnerable to the wildfire hazard, densely-populated areas where communities rely on surface water supplies (above ground reservoirs) for industrial, commercial, and domestic purposes, and certain areas where elderly, impoverished or otherwise vulnerable populations are located.

Data and Methodology

Sufficient data was not available at the time of the study to estimate damages due to drought. According to FEMA's How-To #2, current loss estimation methodologies are not available for estimating drought damages. If this information should become available in the future, it could be incorporated into future updates of the plan. While one could make some blanket assumptions at this time to use various tools for loss estimation, this would likely yield erroneous data given the high degree of variation in type and density of development. Acting upon such rough estimates could result in an unwise use of limited resources. At this time, vulnerability is being expressed in qualitative terms in terms of types of damages.

In general, estimated damages due to future droughts in Burlington County could be high. Types of damages are discussed qualitatively below.

Impact on Life, Health and Safety

Droughts conditions can cause a shortage of water for human consumption and reduce local fire-fighting capabilities. According to the New Jersey HMP, counties most often affected by a drought are densely populated areas that rely on above-ground reservoirs for their water supply. Areas more resistant to drought conditions are less densely populated and rely on groundwater or surface water sources (NJ HMP, 2011).

Water supply shortages are an effect of drought. Burlington County public supply and domestic self-supply are sourced primarily from groundwater (65 percent). Groundwater is fairly resistant to drought conditions. However, the remaining 35 percent is sourced from surface water, which is more susceptible to the effects of drought. The expected likelihood of future losses associated with reductions in water supply from underground aquifers would be low. However, the expected likelihood of future losses associated with reductions in water supply from surface water sources would be higher because surface

water sources (such as reservoirs and rivers) are much less resistant to periods of drought and are more susceptible to being impacted.

A second common effect of drought is fish and wildlife mortality. Burlington County is largely rural has diverse populations of fish and wildlife. Its wetlands, scrub pine and oak woodlands, and Atlantic white cedar forests shelter a wide variety of wildlife, while abundant creeks, estuaries and aquifers provide essential water resources. Nine different threatened and endangered species reside in Burlington County. The New Jersey Pinelands, which cover approximately 64 percent of the county's land area, is the largest pine barrens complex in the world. It supports globally rare communities and species and is an area of national significance, supporting: five federally listed threatened and endangered species, 17 federal candidate species and species of concern, and 54 state listed threatened and endangered species. Because so much of the land area in Burlington County is undeveloped, fish and wildlife habitat is fairly high and therefore losses to fish and wildlife could likely be high.

A third common effect of drought is wildfires. Due to Burlington County's largely undeveloped nature, fuel is plentiful for wildfires, particularly in the Pine Barrens. In Burlington County, fuel tends to be most plentiful in areas where development densities are lowest; this works to reduce possible property damages and loss of life; however, the wildland-urban interface would be particularly vulnerable as well as transportation routes such as the Garden State Parkway which traverse the Pine Barrens. Wildfires are a unique hazard addressed separately in this plan.

Impact on General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Approximately 37.2% of the land in Burlington County is forested (Burlington County GIS Land Use Land Cover 2007 data). Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high density residential, commercial and industrial) or wildland/urban interface (WUI). Refer to the Wildfire Risk Assessment for more detailed information on the vulnerability of the built environment to the wildfire hazard.

Impact on Critical Facilities

It is expected that critical facilities will continue to be operational during a drought event.

Impact on the Economy

New Jersey agriculture ranks third in economic importance to the State. According to the NJ State HMP, the market value of agricultural products sold in the State in 2008 was \$1.1Billion. As noted, agricultural resources need ample water supplies for successful production, relying on natural precipitation and the supply and demand of surface and groundwater resources, both of which become limited or compromised during times of drought. A prolonged drought can have a serious economic impact on a community (i.e., a lessened crop yield, financial loss to the farmer). The entire agricultural industry in Burlington County is vulnerable to the drought hazard.

Crop failure is one common result of drought. With active agriculture extending from the Pinelands throughout northern Burlington County, Burlington has always been one of the leading agricultural counties in the nation. Burlington County is ranked the second largest blueberry-producing and the third largest cranberry-producing county in the United States. There are more acres devoted to farming than any county in the state, primarily in vegetable, fruit and timber production. Water for irrigation is sourced

97% from surface water sources and accounts for 61% of all water withdrawn in the county per year. Surface water is particularly susceptible to periods of drought.

According to the 2007 Agriculture Census, Burlington County has 906 farms totaling 85,790 acres. Of these, 715 farms and 53,650 acres are used for cropland with 624 farms and 48,823 acres used for harvesting crops. The number of farms that irrigate land is equal to 203, and they irrigate a total of 12,620 acres. The market value of all agricultural products sold in Burlington County is \$86,302,000, with \$80,533,000 generated from crops and \$5,769,000 generated from livestock, poultry and other products. Agricultural losses, specifically losses to crops, in Burlington County could be significant during a drought.

Increased demand for water and electricity during drought conditions may result in shortages and a higher cost for these resources (FEMA, 1997). Industries that rely on water for business may be impacted the hardest (e.g., nurseries, golf courses, places of recreation). Even though most businesses will still be operational, they may be impacted aesthetically. In addition, because droughts vary in geographic extent and severity, Burlington County may also be impacted by supply/price of food for crops grown outside of the immediate area.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Future growth could impact the amount of potable water available due to a drain on the available water resources. Other areas that could be impacted include agriculture and recreational facilities such as golf courses, farms, and nurseries.

Effect of Climate Change on Vulnerability

The changes in global climate that are projected to occur in the coming decades will have significant impacts on New Jersey. Impacts related to increasing temperatures are already being felt throughout the State.

Several agencies, organizations, and academic institutions have addressed the potential effects of climate change on New Jersey. The New Jersey Climate Adaption Alliance facilitated by Rutgers University provided a description of climate change in New Jersey, the report included past changes that have been documented from historical observations as well as expected changes based on projections of temperature, precipitation and sea level through the end of the century. Among other findings the report states that projections are that short-duration warm season droughts are likely to become more common [Horton et al 2011]. However, the increase in frequency of droughts ranges from only slightly more likely under the low emissions scenario [IPCC 2000] to as frequent as once per year under the high (A1F1) emissions scenario [Frumhoff et al 2007] (New Jersey Climate Adaption Alliance, 2012).

The Union of Concerned Scientists also prepared an overview of how climate change may affect New Jersey. According to the Union rising summer temperatures coupled with little change in summer rainfall are projected to increase the frequency of short-term (one- to three month) droughts (The Union of Concerned Scientists, Date Unknown).

Both projections would increase stress on both natural and managed ecosystems across New Jersey.

Additional Data and Next Steps

Historic data available indicate that droughts can impact Burlington County and impact the local economy. For future plan updates, localized concerns and impacts will be collected and analyzed. Mitigation efforts could include development of a drought contingency plan, development of “triggers” for drought related actions, or provision of incentives to influence active water conservation techniques.

5.4.3 EARTHQUAKE

This section provides a profile and vulnerability assessment for the earthquake hazard.

HAZARD PROFILE

This section provides profile information including description, extent, location, previous occurrences and losses and the probability of future occurrences.

Description

An earthquake is the sudden movement of the Earth's surface caused by the release of stress accumulated within or along the edge of the Earth's tectonic plates, a volcanic eruption or by a manmade explosion (FEMA, 2001; Shedlock and Pakiser, 1997). Most earthquakes occur at the boundaries where the Earth's tectonic plates meet (faults); however, less than 10 percent of earthquakes occur within plate interiors. New Jersey is in an area where plate interior-related earthquakes occur. As plates continue to move and plate boundaries change over geologic time, weakened boundary regions become part of the interiors of the plates. These zones of weakness within the continents can cause earthquakes in response to stresses that originate at the edges of the plate or in the deeper crust (Shedlock and Pakiser, 1997).

According to the USGS Earthquake Hazards Program, most earthquakes occur at the boundaries where the plates meet (roughly 90%), although it is possible for earthquakes to occur entirely within plates. The State of New Jersey and Burlington County are both far from any plate boundaries. Regardless of where they are centered, earthquakes can impact locations at – and well beyond – their point of origin. They are often accompanied by “aftershocks” – secondary quakes in the earthquake sequence. Aftershocks are typically smaller than the main shock, and can continue over a period of weeks, months, or years from the main shock (Burlington County HMP, 2008).

In addition to the effects of ground shaking, earthquakes can also cause landslides and liquefaction under certain conditions. Liquefaction occurs when unconsolidated, saturated soils exhibit fluid-like properties due to intense shaking and vibrations experienced during an earthquake. Together, ground shaking, landslides, and liquefaction can damage or destroy buildings, disrupt utilities (i.e., gas, electric, phone, water), and sometimes trigger fires (Burlington County HMP, 2008).

Extent

The severity of an earthquake at a given location depends on the amount of energy released at the epicenter, and the location's distance from the epicenter. The terms “magnitude” and “intensity” are two terms used to describe the severity of an earthquake. An earthquake's “magnitude” is a measurement of the total amount of energy released while its “intensity” is a measure of the effects of an earthquake at a particular place (Burlington County HMP, 2008).

Seismic waves are the vibrations from earthquakes that travel through the Earth and are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a measured value of the earthquake size, or amplitude of the seismic waves, using a seismograph. The Richter magnitude scale (Richter Scale) was developed in 1932 as a mathematical device to compare the sizes of earthquakes (USGS, 1989). The Richter Scale is the most widely-known scale that measures the magnitude of earthquakes (Shedlock and Pakiser, 1997; USGS, 2004). It has no upper limit and is not used to express damage. An earthquake in a densely populated area, which results in many deaths and considerable

damage, may have the same magnitude and shock in a remote area that did not cause any damage (USGS, 1989). Table 5.4.3-1 presents the Richter Scale magnitudes and corresponding earthquake effects.

Table 5.4.3-1. Richter Scale

Richter Magnitude	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded by seismograph
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

Source: USGS, 2006

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. Intensity is expressed by the Modified Mercalli Scale; a subjective measure that describes how strong a shock was felt at a particular location (Shedlock and Pakiser, 1997; USGS, 2004). The Modified Mercalli Scale expresses the intensity of an earthquake's effects in a given locality in values ranging from I to XII. Table 5.4.3-2 summarizes earthquake intensity as expressed by the Modified Mercalli Scale.

Table 5.4.3-2. Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, some people awakened. Small objects moves, trees and poles may shake.
VI	Felt by everyone; people have trouble standing. Heavy furniture can move, plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel their cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Some walls collapse.
IX	Considerable damage to specially built structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Source(s): Michigan Tech University, 2007; Nevada Seismological Laboratory, 1996

Another way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak Ground Acceleration (PGA) measures the rate of change in motion of the earth's surface and expresses it as a percent of the established rate of acceleration due to gravity (9.8 m/sec²) (Burlington County HMP, 2008). PGA is expressed as a percent acceleration force of gravity (%g). For

example, 1.0 g PGA in an earthquake (an extremely strong ground motion) means that objects accelerate sideways at the same rate as if they had been dropped from the ceiling. 10% g PGA means that the ground acceleration is 10% that of gravity (NJOEM, 2011). Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures as noted in Table 5.4.3-3.

Table 5.4.3-3. Damage Levels Experienced in Earthquakes

Ground Motion Percentage	Explanation of Damages
1-2% g	Motions are widely felt by people; hanging plants and lamps swing strongly, but damage levels, if any, are usually very low.
Below 10% g	Usually cause only slight damage, except in unusually vulnerable facilities.
10-20% g	May cause minor to moderate damage in well-designed buildings, with higher levels of damage in poorly designed buildings. At this level of ground shaking, only unusually poor buildings would be subject to potential collapse.
20-50% g	May cause significant damage in some modern buildings and very high levels of damage (including collapse) in poorly designed buildings.
50% + g	May causes higher levels of damage in many buildings, even those designed to resist seismic forces.

Source: NJOEM, 2011

Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures as noted in Table 5.4.3-4, which shows an approximated relationship between PGA, magnitude, and intensity of an earthquake. Using this table, one can approximate that, for an earthquake of expected severity for Burlington County and its participating municipalities (PGA values of 2 to 4%g), perceived shaking would be light to moderate (depending upon the distance from the epicenter) and potential damage could range from none to very light (also depending upon the distance from the epicenter).

Table 5.4.3-4. Earthquake Magnitude/Intensity Comparison

PGA	Magnitude	Intensity	Perceived Shaking	Potential Damage
< 0.17	1.0 - 3.0	I	Not Felt	None
0.17 – 1.4	3.0 – 3.9	II - III	Weak	None
1.4 – 9.2	4.0 – 4.9	IV – V	IV. Light V. Moderate	IV. None V. Very Light
9.2 - 34	5.0 – 5.9	VI – VII	VI. Strong VII. Very Strong	VI. Light VII. Moderate
34 - 124	6.0 – 6.9	VIII - IX	VIII. Severe IX. Violent	VIII. Moderate/Heavy IX. Heavy
> 124	7.0 and higher	X and higher	Extreme	Very Heavy

Sources: (1) FEMA Mitigation Planning “How-To” Guide 386-2, 2001; (2) Wald, D., et al., 1999, Relationship between Peak Ground Acceleration, Peak Ground Motion, and Modified Mercalli Intensity in California”, Earthquake Spectra, V. 15, p. 557-564

An earthquake with a 10 percent chance of exceedance over 50 years in Burlington County would have a PGA of 2 to 4%g and an intensity ranging from only IV to V, which would result in light to moderate perceived shaking, and damages ranging from none to very light. For comparison purposes, an earthquake of intensity IV on the Modified Mercalli Scale would most likely cause vibrations similar to heavy trucks driving over roads, or the sensation of a jolt. Hanging objects would swing; standing cars would rock; windows, dishes and doors would rattle; and, in the upper ranges of intensity IV, wooden walls and frames would creak. An earthquake of intensity V on the Modified Mercalli Scale would be felt outdoors, awaken sleepers, disturb or spill liquids, displace small unstable objects, swing doors, and cause shutters and pictures to move.

As noted in the New Jersey State Hazard Mitigation Plan, soil type can have an impact on the severity of an earthquake at a given location. For example, soft soils (i.e., fill, sand) are more likely to amplify ground motion during an earthquake. Liquefaction is also more likely to occur in areas of soft soils. In contrast, harder soils (i.e., granite) tend to reduce ground motion during an earthquake. The National Earthquake Hazard Reduction Program (NEHRP) developed five soil classifications that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses [Tantala et al. (NYCEM), 2003].

Computer software (HAZUS, for Hazards U.S.) developed under the direction of the Federal Emergency Management Agency (FEMA) was developed to simulate ground-shaking, building damage, and estimate economic loss, for potential earthquakes (<http://www.fema.gov/hazus>). The simulations take into account the magnitude and location of the earthquake, the physical properties of the soil and bedrock, and the type of building construction in the study area. Results of these simulations are used to guide the strengthening of structures built on vulnerable soils and to plan emergency response.

The New Jersey Department of Environmental Protection (NJDEP), Geological and Water Survey Division is currently undertaking a study titled *Earthquake Loss Estimation Study For New Jersey: Geologic Component*. The Survey, with partial funding from the New Jersey State Police Office of Emergency Management (NJOEM), maps seismic soil properties by county, including shaking behavior, liquefaction susceptibility, and tendency to landslide. The mapping shows soil types in five basic categories with varying degrees in likelihood of amplifying the effects of an earthquake. At this time, the Survey is progressing at a rate of one county per year – mapping is currently not available for Burlington County but if it should become available in the future, the data can be incorporated into this section of the plan.

At the time of publication of the 2008 Burlington County HMP, the following jurisdictions expressed specific concerns about the seismic risk in their communities:

- Moorestown Township expressed a particular concern with the vulnerability of public buildings, especially schools that are not earthquake resistant.
- Florence Township indicated a concern that earthquakes could cause significant damage, even though their team was not aware of historic events in their area.
- Cinnaminson Township notes that, while a damaging earthquake has not occurred in their area, a slight tremor was noted in the late 1960s.
- Mansfield Township reported that the 1999 earthquake was felt in their municipality, but no damages were incurred.

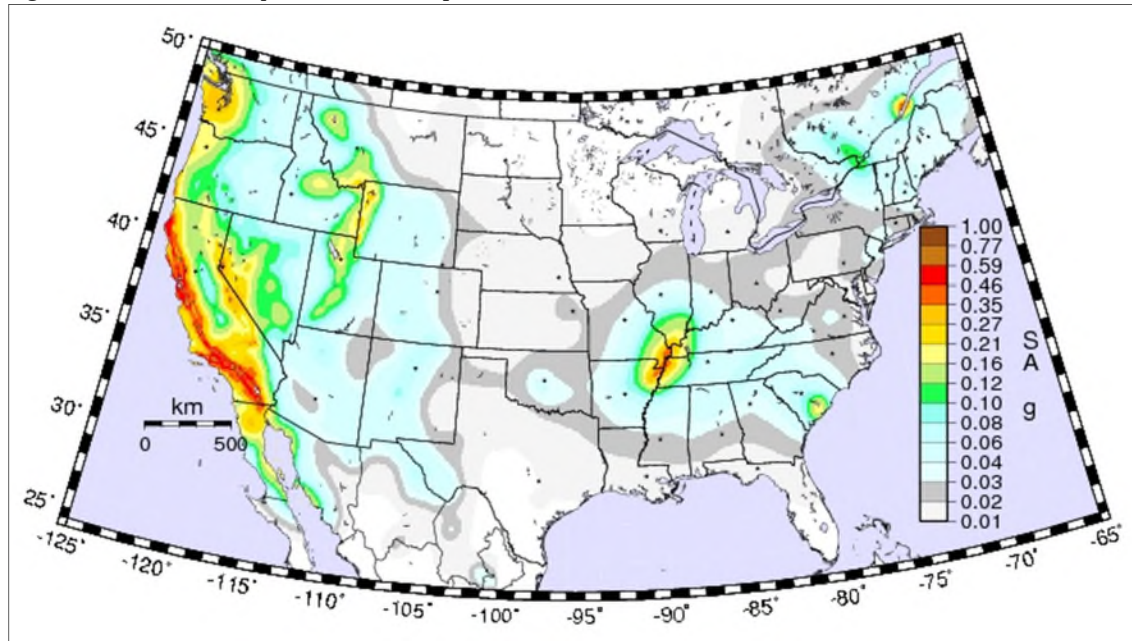
Location

Earthquakes are possible within any of Burlington County's communities. Figure 5.4.3-1 is an earthquake hazard map for the conterminous U.S. prepared by the USGS Earthquake Hazards Program. It shows that the earthquake hazard is low in Burlington County relative to other parts of the country (the west coast of the U.S.) but the possibility does exist in the State of New Jersey. Figure 5.4.3-2 shows the same hazard map in more detail, focused on the State of New Jersey, with Burlington County circled.

SECTION 5.4.3: RISK ASSESSMENT - EARTHQUAKE

As Figure 5.4.3-1 shows, the earthquake hazard is relatively uniform but shows some degree of variation across the county, with higher hazard areas being in the northern portion of the county and lower hazard areas being toward the southeastern portion of the county.

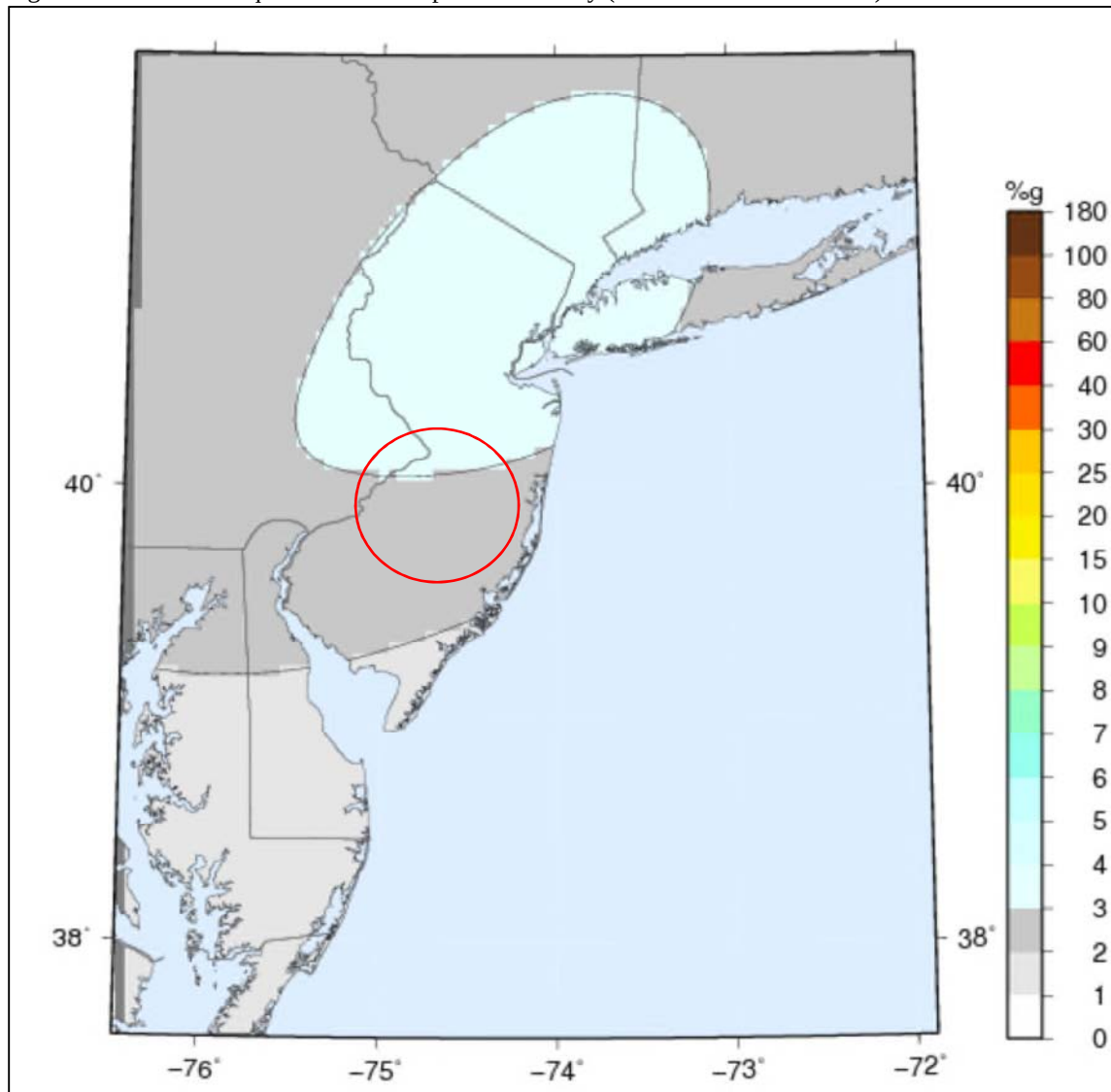
Figure 5.4.3-1. Earthquake Hazard Map of the Conterminous United States



Source: USGS, 2008

Note: This map shows a PGA of 10% in 50 years.

Figure 5.4.3-2. Earthquake Hazard Map of New Jersey (PGA of 10% in 50 Years)



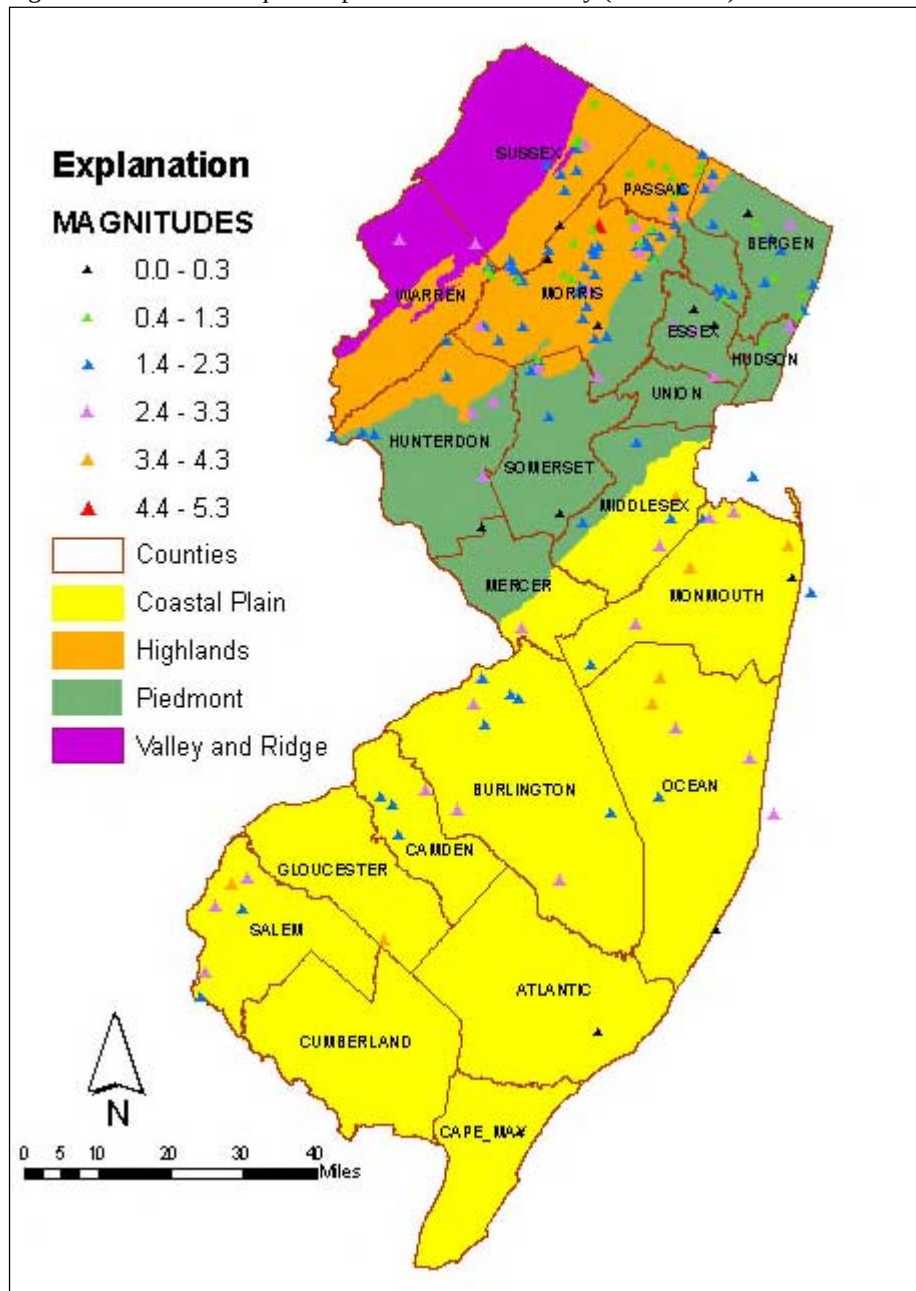
Source: USGS, 2010

Note: The red circle indicates the approximate location of Burlington County. The figure indicates that the County has a PGA of 2-4%g

Previous Occurrences and Losses

As noted in the New Jersey State Hazard Mitigation Plan, although the probability of damaging earthquakes in New Jersey is low, earthquakes do occur on a regular basis in the State. Figure 5.4.3-3 illustrates earthquake epicenters in New Jersey, as obtained from the New Jersey Geological Survey web site, for earthquakes that occurred between 1783 and June 2013. The figure depicts a total of 179 earthquakes with magnitudes ranging from a minimum of 0.4 (Jefferson Township [Morris County] on June 7, 1992) to a maximum of 5.3 (west of New York City on November 30, 1783); most magnitudes were between 1.4 and 2.9.

Figure 5.4.3-3. Earthquake Epicenters in New Jersey (1783-2013)



Source: NJDEP, 2013

Note: The figure indicates Burlington County has been the epicenter to eight earthquake events.

Since the publication of this map (November 26, 2012) one New Jersey earthquake was added:

- 1 km E of Rockaway, NJ (Morris County) on June 23, 2013, 11:54am, magnitude 2.1, depth 2.0 km.

Table 5.4.3-5 depicts these earthquakes events. Several of these events were located within the vicinity of Burlington County.

SECTION 5.4.3: RISK ASSESSMENT - EARTHQUAKE

Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
12/19/1737	5.2	Greater NYC Area*	N/A	N/A	Threw down chimneys	Lamont-Doherty
11/30/1783	5.3	North-Central New Jersey*	N/A	N/A	2 Foreshocks (11/24 and 11/30) and 1 aftershock (11/30); threw down chimneys	NJGS, Lamont-Doherty
1/25/1841	0.0	West Orange, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/26/1845	3.8	Greater NYC Area*	N/A	N/A	No reference and/or no damage reported.	Lamont-Doherty
9/9/1848	4.4	Greater NYC area*	N/A	N/A	No reference and/or no damage reported.	Lamont-Doherty
3/5/1861	0.0	Newark, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/11/1874	3.4	Near Nyack and Tarrytown, NY	N/A	N/A	No reference and/or no damage reported.	Lamont-Doherty
9/10/1877	0.0	Burlington, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/10/1880	0.0	Near Morristown, NJ	N/A	N/A	1 aftershock 9/1/1880.	NJGS
8/10/1884	5.2	Greater NYC Area	N/A	N/A	Threw down chimneys; felt from Virginia to Maine	Lamont-Doherty
1/4/1885	3.4	Hudson Valley	N/A	N/A	No reference and/or no damage reported.	Lamont-Doherty
9/1/1895	4.1	Near High Bridge, NJ	N/A	N/A	A moderately strong earthquake, centered near High Bridge, was felt over a considerable area to the northeast and southwest. The total felt area covered points from Maine to Virginia in a long, narrow elliptical zone of about 92,000 square kilometers. Articles fell from shelves and buildings rocked (intensity VI) in several Hunterdon County towns. The shock was fairly sharp at Camden and Burlington. At Philadelphia, Pennsylvania, broken windows and overturned crockery were reported.	NJGS, Lamont-Doherty, Burlington County HMP
5/27/1902	0.0	Bayonne-Wayne, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/11/1902	0.0	Bayonne-Wayne, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/20/1905	4.5	Greater NYC Area*	N/A	N/A	Probably located offshore	Lamont-Doherty
4/23/1910	0.0	Near Atlantic City, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/6/1912	0.0	Near Long Beach, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/5/1919	0.0	Cinnaminson, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/26/1921	N/A	N/A	N/A	N/A	Moorestown and Riverton were shaken moderately (intensity V). A rumbling noise was reported to be heard.	NJGS, Burlington County HMP
6/1/1927	3.9	Near Asbury Park, NJ	N/A	N/A	The highest intensity earthquake ever observed in New Jersey occurred in the Asbury Park area. Three shocks were felt along the coast from Sandy Hook to Toms River. Maximum intensities of VII were observed at Asbury Park and Long Branch. Several chimneys fell, plaster cracked, and articles were thrown from shelves. The felt area extended over approximately 7,800 square kilometers.	NJGS, Lamont-Doherty, Burlington County HMP
1/25/1933	0.0	Near Trenton, NJ	N/A	N/A	A sharp jolt was felt over central New Jersey from	NJGS, Burlington

SECTION 5.4.3: RISK ASSESSMENT - EARTHQUAKE

Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
					Lakehurst to Trenton. Although there is some doubt whether the shock was of seismic origin, the event was felt most strongly at Lakehurst, where people reported they were rolled out of bed (intensity V). Other people reported pictures shaken from walls. The shock was also felt at Bordentown, Burlington, Columbus, Englishtown, Freehold, Hightstown, New Egypt, Robbinsville, and White Horse.	County HMP
7/19/1937	3.5	Western Long Island, NY	N/A	N/A	One or few earthquakes beneath Long Island	Lamont-Doherty
9/30/1937	0.0	Verona, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/16/1938	0.0	Verona, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/23/1938	3.8	NE of New Egypt, NJ	N/A	N/A	Central New Jersey was disturbed by a shock somewhat stronger than the 1933 event. The earthquake caused minor damage at Gloucester City and Hightstown (intensity V). The total felt area was about 13,000 square kilometers, including bordering portions of Delaware and Pennsylvania. Glassware was broken at Gloucester City and Hightstown and some furniture was displaced at Pitman. A few windows and some glassware were reported broken at Ardmore, Pennsylvania. Four smaller shocks occurred on August 23rd and one on August 27th.	NJGS, Lamont-Doherty, Burlington County HMP
8/23/1938	4.0	Freehold, NJ	N/A	N/A	4 aftershocks felt.	NJGS
12/6/1938	0.0	Verona, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/13/1939	0.0	Union City, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/15/1939	3.4	Salem County, NJ	N/A	N/A	Residents of Salem County were startled by earthquake tremors which caused more excitement than damage. The disturbance was reported felt from Trenton to Baltimore, Maryland, and from Cape May to Philadelphia and its adjoining counties. About 16,000 square kilometers were affected. Small objects were reported to have overturned at Deepwater, but little or no damage was noted.	NJGS, Burlington County HMP
4/1/1947	2.7	Pompton Lakes NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/16/1949	0.0	Hopewell, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/3/1951	3.6	Rockland County, NY	N/A	N/A	Northeastern New Jersey experienced minor effects from an earthquake on September 3, 1951 that was apparently centered in Rockland County, New York. On March 23, 1957, a shock affected west-central New Jersey, near the site of the 1895 earthquake. Chimneys cracked (intensity VI), windows and dishes broke, and pictures fell at Lebanon. A cracked chimney was also reported from Hamden. At Long Valley some	Lamont-Doherty, NJGS, Burlington County HMP

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Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
					walls were cracked and plaster fell. The felt area was small in comparison with the other shocks previously described.	
8/17/1953	3.2	Bergen County, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/31/1954	0.0	Long Branch, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/23/1957	2.9	Schooley's Mountain, NJ	N/A	N/A	Walls cracked, dishes broke.	NJGS, Lamont-Doherty
12/27/1961	2.7	5 km W of Flemington, NJ	N/A	N/A	In northeastern Philadelphia and adjoining portions of New Jersey and Pennsylvania residents were alarmed by loud rumbling sounds. In New Jersey, the tremor was felt by many at Bordentown and Trenton, where houses shook (intensity V) and windows and dishes rattled.	NJGS, Burlington County HMP
10/13/1962	0.0	Pompton Lakes, NJ	N/A	N/A	1 aftershock 12/20/1962.	NJGS
12/10/1968	2.7	SE of Camden, NJ	N/A	N/A	A similar disturbance affected much of the same area as the 12/27/1961. An earthquake measured at magnitude 2.5 occurred in Burlington County. The press reported some broken windows. Intensity V effects were noted at Camden, Morrestown and at Darby and Philadelphia, Pennsylvania. It was reported that toll booths on the Benjamin Franklin and Walt Whitman Bridges in Philadelphia trembled during the shock.	NJGS, Burlington County HMP
4/25/1969	0.0	Near Sussex, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/6/1969	0.0	Ogdensburg, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/28/1973	3.5	E.OF Wilmington, DE	N/A	N/A	Most of New Jersey and adjoining portions of Delaware, Maryland, and Pennsylvania experienced a moderately strong earthquake. One town in southern Connecticut and one in eastern Virginia also reported the shock. The magnitude 3.8 tremor was centered in northwestern Salem County, near the Delaware River border with the State of Delaware. Observers reported cracked plaster (intensity V) at Laurel Springs and Penns Grove and cracked cinder blocks at Harrisonville. Also, small objects shifted and fell in several towns. Similar types of minor damage occurred in nearby areas of Delaware, Maryland, and Pennsylvania.	NJGS, Burlington County HMP
7/10/1973	2.6	E.OF Wilmington, DE	N/A	N/A	No reference and/or no damage reported.	NJGS
3/11/1976	2.8	Pompton Lakes, NJ	N/A	N/A	1 aftershock, some damage.	NJGS
4/13/1976	3.1	Near Ridgefield, NJ	N/A	N/A	The shock felt widely.	NJGS
12/5/1976	0.0		N/A	N/A	No reference and/or no damage reported.	NJGS
12/5/1976	1.8	Schooley's Mountain, NJ	N/A	N/A	1 aftershock 12/07/1976.	NJGS

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Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
1/21/1977	2.7	Lakehurst, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/10/1977	1.1	High Bridge, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
7/2/1977	2.3	Hampton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/27/1977	1.5	Sparta, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/27/1977	1.8	Oakland, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/23/1977	2.3	Schooley's Mountain, NJ	N/A	N/A	5 foreshocks 12/4 to 12/8 and 5 aftershocks 12/23	NJGS
2/15/1978	1.6	Boonton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
4/3/1978	2.0	Off Sandy Hook	N/A	N/A	No reference and/or no damage reported.	NJGS
5/18/1978	1.5	Bloomington, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/16/1978	0.0	Sparta, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/30/1978	2.9	Mahwah-Oakland, NJ	N/A	N/A	1 aftershock on same day.	NJGS
1/30/1979	3.5	Cheesequake, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/2/1979	1.9	Chester, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/23/1979	2.9	Chester, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/10/1979	3.1 "Cheesequake Earthquake"	Bernardsville, NJ (epicenter in Morris County)	N/A	N/A	Felt by some people in Manhattan	NJGS, Lamont-Doherty
3/25/1980	2.8	Hainesburg, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
4/5/1980	2.9	S. of Seaside, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/2/1980	2.8	Keyport, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/30/1980	3.0	Medford Lakes, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/19/1981	2.0	Boonton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/18/1981	2.1	Ramsey, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/21/1981	1.8	Denville, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
4/12/1982	2.4	Mt Holly, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
7/29/1982	2.4	Seaside Heights, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/16/1982	1.6	Franklin, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/19/1983	2.7	Oldwick, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/1/1983	1.5	Dover, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/6/1983	1.5	Fort Lee, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/15/1983	1.5	Ringwood, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/12/1984	2.0	Asbury Park, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/13/1984	2.1	Mount Hope, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/3/1984	1.3	Kinnelon, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/6/1984	1.7	Near Morristown, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/2/1984	1.7	Mount Olive, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/12/1984	2.4	Byram, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/12/1984	2.1	Byram, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS

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Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
10/25/1984	2.0	Near Mt. Olive, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/3/1984	1.5	Byram, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/13/1984	1.7	Byram, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/14/1984	1.7	N of Milford, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/15/1984	1.8	Byram, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/17/1984	1.6	Byram, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/19/1985	4	Ardsley, NY	N/A	N/A	Many people in the NYC area felt this earthquake	Lamont-Doherty
2/8/1986	1.7	Flanders, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/23/1986	1.8	Port Murray, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/29/1986	1.5	Kinnelon, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
7/15/1986	1.5	Franklin, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/15/1986	2.3	Near New Egypt, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/15/1986	1.9	Near Roebling, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/23/1986	2.8	Tranquility, NJ	N/A	N/A	Felt in Sussex and Warren.	NJGS
4/24/1987	1.9	South of Lake Mohawk, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/16/1987	1.4	Near Paterson, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/5/1987	1.7	SW of Newton	N/A	N/A	No reference and/or no damage reported.	NJGS
8/6/1987	1.1	SW of Newton	N/A	N/A	No reference and/or no damage reported.	NJGS
8/6/1987	1.1	SW of Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/6/1987	2.1	Burlington, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
4/13/1988	1.4	Dover, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/20/1988	1.0	10 KM NW of Morristown, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/22/1988	1.0	Wanaque, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/23/1988	1.1	Wanaque, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/22/1989	2.0	Englewood, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/27/1989	1.1	NY-NJ Border	N/A	N/A	No reference and/or no damage reported.	NJGS
9/3/1989	2.0	S of Staten Island	N/A	N/A	No reference and/or no damage reported.	NJGS
9/3/1989	2.5	S of Staten Island	N/A	N/A	No reference and/or no damage reported.	NJGS
1/26/1990	1.0	Franklin, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/10/1990	1.8	Mt. Freedom, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/21/1990	0.7	Wanaque, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/23/1990	2.9	Hancock's Bridge, NJ	N/A	N/A	Felt in NJ, DE and PA.	NJGS
5/12/1991	1.3	Wanaque, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
7/5/1991	1.3	Pompton Plains, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
9/29/1991	2.2	Somerdale Boro, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/9/1992	3.1	New Brunswick, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/4/1992	1.4	Kinnelon, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS

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Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
6/7/1992	0.4	Jefferson Township, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/13/1992	1.0	West Milford, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/26/1993	2.5	Cherry Hill, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/15/1993	2.6	Perrineville, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/23/1994	1.6	Butler, N.J.	N/A	N/A	No reference and/or no damage reported.	NJGS
1/27/1995	2.3	Rockaway, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
4/1/1995	1.5	Rockaway, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/26/1995	1.5	Kinnelon, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/27/1995	1.3	NE of Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/27/1995	1.4	NE of Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/18/1996	1.5	Ringwood	N/A	N/A	No reference and/or no damage reported.	NJGS
2/19/1996	1.7	Ringwood, NJ	N/A	N/A	1 aftershock 22 minutes later.	NJGS
2/19/1996	0.8	5 km W Ringwood, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/23/1996	0.8	6.4 km W of Ringwood, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/26/1996	0.0	Near Mt. Arlington, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/24/1996	2.0	9 km S Crestwood Village, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/12/1996	1.3	21 km NE Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/12/1996	0.8	21 km NE Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/11/1997	0.0	3 km W of Rendall Park, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/25/1997	0.5	1 km NE Fort Lee, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/27/1997	1.6	4.6 km N of Rockaway, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
7/15/1997	2.3	12 km NE of Princeton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/21/1997	0.5	3 km SW Woodcliff Lake, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/24/1997	0.5	3 km SW Secaucus, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
3/25/1998	1.9	13 km S Salem, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/20/1998	1.2	2 km SE Kinnelon, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
6/30/1998	1.9	3 km S Butler, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/12/1999	1.4	1 km NW of Clifton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/31/1999	1.5	2 km W of Emerson, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
5/31/1999	2.3	8 km W of Fort Dix, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
1/17/2001	2.4	Manhattan	N/A	N/A	Felt in the Upper East Side of Manhattan, Long Island City, and Queens	Lamont-Doherty
7/14/2001	1.9	7.1 km NE of Boonton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
10/17/2001	2.6	Manhattan	N/A	N/A	Felt in the Upper East Side of Manhattan, Long Island City, Astoria, and Queens	Lamont-Doherty
8/9/2002	1.5	5.4 km N of Somerville, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS

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Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
		(epicenter in Bridgewater)				
8/24/2003	1.5	6 km SW of Morris Plains, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
8/26/2003	3.5	3 km North of Milford, NJ	N/A	N/A	A magnitude 3.5 earthquake occurred 3 km North of Milford, NJ. No reference and/or no damage reported.	NJGS
3/22/2004	2.1	2km NE from Runnemede, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/17/2004	2.0	6km ESE from Pennsville, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
04/23/2005	1.9	1.3 Km East of Lodi, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/09/2005	2.1	16 km W of Franklin Lakes, NJ	N/A	N/A	Aftershock 55 min later, 1.3 M	NJGS
02/16/2006	2.6	22km NE of Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
02/17/2006	0.9	20km NE of Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
02/21/2006	1.3	20.4km NE of Newton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
05/15/2006	2.0	9 km S of Fair Lawn, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
06/28/2007	2.1	7 km E of Fairfield, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
02/03/2009	3.0	3.5km SSW of Rockaway, NJ	N/A	N/A	A magnitude 3.0 earthquake occurred 3.5km SSW of Rockaway, NJ. There were reports of people having felt this earthquake throughout New Jersey.	NJGS, USGS
02/14/2009	2.4	5 km NNE of Boonton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS, USGS
2/18/2009	1.1	3 km SSW of Kinnelon, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/16/2009	1.4	1 km ESE of Oradell, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
2/16/2009	2.3	2 km SSE of Dover, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
07/01/2009	2.8	2.25km ESE of Pennsville, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS, USGS
12/21/2009	2.3	13 km S of Phillipsburg, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
12/26/2009	2.0	8 km NW of Morris Plains, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
02/05/2010	1.5	3 km NW of Far Hills, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
02/07/2010	1.2	3 km NW of far Hills, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
02/10/2010	2.2	1 km W of Wanaque	N/A	N/A	No reference and/or no damage reported.	NJGS
02/21/2010	2.6	Gladstone, NJ	N/A	N/A	This earthquake hit just before 9am and prompted numerous phone calls to police. No damages were reported. Many people in New Jersey reported having felt this earthquake.	NJGS, USGS, NJ.com
02/21/2010	2.3	Gladstone, NJ	N/A	N/A	This event was most likely an aftershock from the morning's earthquake. Numerous people in New Jersey reported having felt this earthquake.	NJGS, USGS, NJ.com
06/06/2010	2.3	6 km SE of Sayreville, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS, USGS

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Table 5.4.3-5. Earthquake Occurrences in the New York/New Jersey Area, 1737-2013.

Date(s) of Event	Magnitude	Location	FEMA Declaration Number	County Designated?	Losses/Impacts	Source(s)
12/25/2010	2.1	1 km W of Clifton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
05/08/2011	1.2	1 km SW of Clifton, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
05/10/2011	1.9	2 km N of Mt. Holly, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
05/29/2011	1.3	3 km S of Fort Lee, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
05/29/2011	1.9	24 km SSW of Lakehurst, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
06/09/2011	1.6	2 km SE of S. Plainfield, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
08/23/2011	4.2	Virginia	N/A	N/A	In Burlington City, Burlington County, Temple B'nai Israel's synagogue building, built during 1801, sustained some water damage when tremor-caused openings in the roof allowed standing water to leak in, and about 20 bricks fell, damaging a congregant's car. Non-essential county employees were allowed to leave work early as precautionary measures.	Planning Committee, USGS
07/17/2012	1.1	16 km NW of Morristown, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
07/18/2012	1.1	18 km NW of Morristown, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
08/23/2012	1.2	1.4 km E of Ringwood, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS
11/05/2012	2.0	3 km SW of Mahwah, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS, USGS
11/23/2012	2.2	Greater Philadelphia Area/New Jersey	N/A	N/A	Numerous reports of people having felt the earthquake in southwestern New Jersey.	NJGS, USGS
6/23/2013	2.1	1 km E of Rockaway, NJ	N/A	N/A	No reference and/or no damage reported.	NJGS

Source: NJGS, 2013; USGS, 2013; Won-Young Kim, Lamont-Doherty Earth Observatory of Columbia University, 1999; Burlington County HMP, 2008

Note: Yellow shading indicates an event that was epicentered in Burlington County.

* Location very poorly determined; may be uncertain by 50 miles.

E East
FEMA Federal Emergency Management Agency
Km Kilometers
N North
N/A Not Applicable
NJ New Jersey
NJGS New Jersey Geologic Survey
NYC New York City
NYSDPC New York State Disaster Preparedness Commission
S South
USGS U.S. Geological Survey
W West

Earthquakes in Burlington County are not common, with documented information on earthquake events and their location is being relatively scarce. According to Planning Area officials, there is no record of earthquake occurrences within the Planning Area. However, depending on the magnitude, the impacts of earthquake events can be far-reaching; therefore, reported incidences within the surrounding counties or states could have created indirect impacts upon Burlington County.

Probability of Future Events

Earthquakes cannot be predicted. They strike without warning, at any time of the year, and at any time of the day or night. Earthquake hazard maps – sometimes referred to as “PGA maps” – are used as a tool to project the likelihood of a various intensity quake being exceed at a certain location over a given period of time. They depict the PGA, expressed as a percentage of the force of gravity that can be expected to be exceeded at a given location for a particular probability of exceedance over a specific time frame. Figure 5.4.3- is an example of an earthquake hazard map for New Jersey as prepared by the USGS Earthquake Hazards Program. It shows PGA values for New Jersey that have a 10 percent chance of being exceeded over 50 years.

Earthquake hazard maps illustrate the distribution of earthquake shaking levels that have a certain probability of occurring over a given time period. As stated previously, according to the Earthquake Hazard Map of New Jersey, there is a 10 percent chance over 50 years that an earthquake with a PGA of greater than 2%g to 4%g (Figure 5.4.3-) will be centered within Burlington County and/or its participating jurisdictions. This earthquake, if it did occur, would likely have associated with it light to moderate perceived shaking and little to no damage.

Earlier in this section, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for earthquakes in the County is considered “occasional” (is likely to occur within 100 years as presented in Table 5.3-3). Although no reported incidences have occurred within Burlington County, it is anticipated that the County will experience indirect impacts from earthquakes that may affect the general building stock, local economy and may induce secondary hazards such as sporadic ignition of fires and utility failure.

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the earthquake hazard, the entire County has been identified as the exposed hazard area. Therefore, all assets in Burlington County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable. The following section includes an evaluation and estimation of the potential impact of the earthquake hazard on Burlington County including the following:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health of residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2008 Burlington County Hazard Mitigation Plan
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

Earthquakes usually occur without warning and can impact areas a great distance from their point of origin. The extent of damage depends on the density of population and building and infrastructure construction in the area shaken by the quake. Some areas may be more vulnerable than others based on soil type, the age of the buildings and building codes in place. Compounding the potential for damage – historically, Building Officials Code Administration (BOCA) used in the Northeast were developed to address local concerns including heavy snow loads and wind; seismic requirements for design criteria are not as stringent compared to the west coast’s reliance on the more seismically-focused Uniform Building Code). As such, a smaller earthquake in the Northeast can cause more structural damage than if it occurred out west.

The level of seismic hazard, the frequency and severity of earthquakes, is substantially lower in New Jersey than in more seismically active states such as California or Alaska. The level of seismic risk, the threat to buildings, infrastructure, and people, is significant in the State, especially in northern New Jersey. The level of seismic risk (potential damages) in the State is higher than might be expected because the vast majority of the buildings and infrastructure in New Jersey have been built with minimal or no consideration of earthquakes; therefore, the majority of buildings and infrastructure in the State is more vulnerable to earthquake damage than the buildings and infrastructure in more seismically active states where inventory has been built with consideration of earthquakes (NJOEM, 2011).

The entire population and general building stock inventory of the County is at risk of being damaged or experiencing losses due to impacts of an earthquake. Potential losses associated with the earth shaking were calculated for Burlington County for three probabilistic earthquake events, the 100-year, 500- and 2,500-year mean return periods (MRP). The impacts on population, existing structures, critical facilities and the economy within Burlington County are presented below, following a summary of the data and methodology used.

Data and Methodology

A probabilistic assessment was conducted for Burlington County for the 100-, 500- and 2,500-year MRPs using HAZUS-MH 2.1 to analyze the earthquake hazard and provide a range of loss estimates for Burlington County. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract. According to the New York City Area Consortium for Earthquake Loss Mitigation (NYCEM), probabilistic estimates are best for urban planning, land use, zoning and seismic building code regulations (NYCEM, 2003). The default assumption is a magnitude 7 earthquake for all return periods. In addition, an annualized loss run was also conducted in HAZUS-MH 2.1 to estimate the annualized general building stock dollar losses for Burlington County.

In addition to the probabilistic scenarios mentioned, an annualized loss run was conducted in HAZUS 2.1 to estimate the annualized general building stock dollar losses for the County. The annualized loss methodology combines the estimated losses associated with ground shaking for eight return periods: 100, 250, 500, 750, 1000, 1500, 2000, 2500-year, which are based on values from the USGS seismic probabilistic curves. Annualized losses are useful for mitigation planning because they provide a baseline upon which to 1) compare the risk of one hazard across multiple jurisdictions and 2) compare the degree of risk of all hazards for each participating jurisdiction.

As noted in the HAZUS-MH Earthquake User Manual ‘*Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS Earthquake Model, possibly at best a factor of two or more.*’ However, HAZUS’ potential loss estimates are acceptable for the purposes of this HMP.

The occupancy classes available in HAZUS-MH 2.1 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single family dwellings. Impacts to critical facilities and utilities were also evaluated.

Data used to assess this hazard include data available in the HAZUS-MH 2.1 earthquake model, USGS data, data provided by NJ Geological and Water Survey, professional knowledge, and information provided by the County’s Planning Committee. All exposure and loss estimates discussed in the assessment below are for Burlington County.

Impact on Life, Health and Safety

Overall, the entire population of Burlington County is exposed to the earthquake hazard event. According to the 2010 U.S. Census, Burlington County had a population of 448,734 people. The impact of earthquakes on life, health and safety is dependent upon the severity of the event. Risk to public safety and loss of life from an earthquake in Burlington County is minimal with higher risk occurring in buildings as a result of damage to the structure, or people walking below building ornamentation and chimneys that may be shaken loose and fall as a result of the quake.

Populations considered most vulnerable are located in the built environment, particularly near unreinforced masonry construction. In addition, the vulnerable population includes the elderly (persons over the age of 65) and individuals living below the Census poverty threshold. These socially vulnerable

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populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing.

Residents may be displaced or require temporary to long-term sheltering due to the event. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event. Table 5.4.3-6 summarizes the households HAZUS-MH 2.1 estimates will be displaced and population that may require short-term sheltering as a result of the 100-, 500- and 2,500-year MRP earthquake events.

Table 5.4.3-6. Summary of Estimated Sheltering Needs for Burlington County

Scenario	Displaced Households	Persons Seeking Short-Term Shelter
100-Year Earthquake	0	0
500-Year Earthquake	9	5
2,500-Year Earthquake	206	121

Source: HAZUS-MH 2.1

Table 5.4.3-7. Estimated Displaced Households and Population Seeking Short-Term Shelter from the 500- and 2,500-year MRP Events per Municipality

Municipality	500-Year MRP Event		2,500-Year MRP Event	
	Displaced Households	Persons Seeking Short-Term Sheltering	Displaced Households	Persons Seeking Short-Term Sheltering
Bass River Township	0	0	0	0
Beverly City	0	0	2	1
Bordentown City	0	0	5	3
Bordentown Township	0	0	5	3
Burlington City	0	0	6	4
Burlington Township	1	0	12	8
Chesterfield Township	0	0	0	0
Cinnaminson Township	0	0	3	2
Delanco Township	0	0	1	1
Delran Township	1	1	10	6
Eastampton Township	0	0	4	2
Edgewater Park Township	1	0	9	5
Evesham Township	1	1	22	11
Fieldsboro Borough	0	0	0	0
Florence Township	0	0	7	4
Hainesport Township	0	0	1	0
Lumberton Township	0	0	7	4
Mansfield Township	0	0	1	0
Maple Shade Township	1	1	25	12
Medford Lakes Borough	0	0	0	0
Medford Township	0	0	7	4
Moorestown Township	1	0	8	4
Mount Holly Township	0	0	7	5
Mount Laurel Township	1	1	27	13

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Table 5.4.3-7. Estimated Displaced Households and Population Seeking Short-Term Shelter from the 500- and 2,500-year MRP Events per Municipality

Municipality	500-Year MRP Event		2,500-Year MRP Event	
	Displaced Households	Persons Seeking Short-Term Sheltering	Displaced Households	Persons Seeking Short-Term Sheltering
New Hanover Township	1	1	3	6
North Hanover Township	0	0	5	4
Palmyra Borough	0	0	6	3
Pemberton Borough	1	0	1	1
Pemberton Township	0	0	9	6
Riverside Township	0	0	6	4
Riverton Borough	0	0	2	1
Shamong Township	0	0	0	5
Southampton Township	0	0	1	1
Springfield Township	0	0	0	0
Tabernacle Township	0	0	1	0
Washington Township	0	0	0	0
Westampton Township	0	0	1	1
Willingboro Township	0	0	3	2
Woodland Township	0	0	0	0
Wrightstown Borough	0	0	1	1
Burlington County (Total)	9	5	208	127

Source: HAZUS-MH 2.1

Note: The population displaced and seeking shelter was calculated using the 2000 U.S. Census data (HAZUS-MH 2.1 default demographic data).

According to the 1999-2003 NYCEM Summary Report (*Earthquake Risks and Mitigation in the New York / New Jersey / Connecticut Region*), there is a strong correlation between structural building damage and the number of injuries and casualties from an earthquake event. Further, the time of day also exposes different sectors of the community to the hazard. For example, HAZUS considers the residential occupancy at its maximum at 2:00 a.m., where the educational, commercial and industrial sectors are at their maximum at 2:00 p.m., and peak commute time is at 5:00 p.m. Whether directly impacted or indirectly impact, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

There are 0 injuries or casualties estimated for the 100-year event. An estimated 6 injuries that require medical attention (no hospitalization), and one injury which requires hospitalization are estimated for the 500-year event. There are no casualties estimated for the 500-year event.

Table 5.4.3-8 summarizes the injuries and casualties estimated for the 2,500-year MRP earthquake event.

Table 5.4.3-8. Estimated Number of Injuries and Casualties from the 2,500-Year MRP Earthquake Event

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	90	91	83
Hospitalization	12	14	15
Casualties	2	2	2

Source: HAZUS-MH 2.1

Impact on General Building Stock

After considering the population exposed to the earthquake hazard, the value of general building stock exposed to and damaged by 100-, 500- and 2,500-year MRP earthquake events was evaluated. In addition, annualized losses were calculated using HAZUS-MH 2.1. The entire study area's general building stock is considered at risk and exposed to this hazard.

The HAZUS-MH 2.1 model estimates the value of the exposed building stock and the loss (in terms of damage to the exposed stock). Refer to Table 4-3 in the County Profile (Section 4) for general building stock data replacement value statistics (structure and contents).

For this plan update and using HAZUS-MH 2.1, a probabilistic model was run for the purposes of this Plan to estimate annualized dollar losses for Burlington County. Annualized losses are useful for mitigation planning because they provide a baseline upon which to 1) compare the risk of one hazard across multiple jurisdictions and 2) compare the degree of risk of all hazards for each participating jurisdiction. Please note that annualized loss does not predict what losses will occur in any particular year. The estimated annualized losses are approximately \$490,000 per year (building and contents) for the County.

According to NYCEM, where earthquake risks and mitigation were evaluated in the New York, New Jersey and Connecticut region, most damage and loss caused by an earthquake is directly or indirectly the result of ground shaking (NYCEM, 2003). NYCEM indicates there is a strong correlation between PGA and the damage a building might experience. The HAZUS-MH model is based on the best available earthquake science and aligns with these statements. HAZUS-MH 2.1 methodology and model were used to analyze the earthquake hazard for the general building stock for Burlington County. See Figure 5.4.3-earlier in this profile that illustrates the geographic distribution of PGA (g) across the County for 100-, 500- and 2,500-year MRP events at the Census-Tract level.

In addition, according to NYCEM, a building's construction determines how well it can withstand the force of an earthquake. The NYCEM report indicates that un-reinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward, whereas steel and wood buildings absorb more of the earthquake's energy. Additional attributes that contribute to a building's capability to withstand an earthquake's force include its age, number of stories and quality of construction. HAZUS-MH considers building construction and the age of buildings as part of the analysis. Because the default general building stock was used for this HAZUS-MH analysis, the default building ages and building types already incorporated into the inventory were used.

Potential building damage was evaluated by HAZUS-MH 2.1 across the following damage categories (none, slight, moderate, extensive and complete). Table 5.4.3-9 provides definitions of these five categories of damage for a light wood-framed building; definitions for other building types are included in HAZUS-MH technical manual documentation. General building stock damage for these damage categories by occupancy class and building type on a County-wide basis is summarized for the 100-, 500-

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and 2,500-year events in Table 5.4.3-10, Table 5.4.3-11, and Table 5.4.3-12. Damage loss estimates include structural and non-structural damage to the building and loss of contents.

Table 5.4.3-9. Example of Structural Damage State Definitions for a Light Wood-Framed Building

Damage Category	Description
Slight	Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.
Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations; partial collapse of room-over-garage or other soft-story configurations.
Complete	Structure may have large permanent lateral displacement, may collapse, or be in imminent danger of collapse due to cripple wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks.

Source: HAZUS-MH Technical Manual

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Table 5.4.3-10. Estimated Buildings Damaged by General Occupancy for 100-year, 500-year and 2,500-year MRP Earthquake Events

Category	Average Damage State														
	100-Year MRP					500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Residential	146,091	0	0	0	0	144,448	1,389	235	18	1	126,934	14,829	3,844	444	39
Commercial	8,373	0	0	0	0	8,223	115	31	3	0	6,907	937	448	75	6
Industrial	2,526	0	0	0	0	2,484	32	9	1	0	2,091	271	140	21	2
Education, Government, Religious and Agricultural	2,031	0	0	0	0	1,996	28	7	0	0	1,689	226	98	16	1

Source: HAZUS-MH 2.1

Table 5.4.3-11. Estimated Number of Buildings Damaged by Building Type for 100-year, 500-year and 2,500-year MRP Earthquake Events

Category	Average Damage State														
	100-Year MRP					500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Wood	128,278	0	0	0	0	127,236	951	88	3	0	113,403	12,364	2,354	153	4
Steel	6,261	0	0	0	0	6,171	71	17	1	0	5,214	642	352	50	3
Concrete	1,494	0	0	0	0	1,477	14	3	0	0	1,230	165	91	7	1
Reinforced Masonry	2,549	0	0	0	0	2,510	27	11	1	0	2,197	187	139	26	0
Un-reinforced Masonry	17,664	0	0	0	0	17,066	438	142	17	1	13,493	2,507	1,335	289	39
Manufactured housing	2,367	0	0	0	0	2,294	55	18	1	0	1,758	360	225	22	1

Source: HAZUS-MH 2.1

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Table 5.4.3-12. Estimated Building Value (Building and Contents) Damaged by the 500- and 2,500-Year MRP Earthquake Events

Municipality	Estimated Total Damages*			Percent of Total Building and Contents RV**		Estimated Residential Damage		Estimated Commercial Damage	
	Annualized Loss	500-Year	2,500-Year	500-Year	2,500-Year	500-Year	2,500-Year	500-Year	2,500-Year
Bass River Township	582	34,400	681,313	0.02%	0.43%	27,181	534,986	3,627	66,097
Beverly City	2,869	133,458	3,132,532	0.04%	0.89%	68,545	1,666,177	24,679	532,178
Bordentown City	5,670	257,933	6,168,477	0.04%	1.01%	143,997	3,526,892	74,110	1,620,981
Bordentown Township	10,342	470,498	11,448,498	0.04%	0.93%	306,706	7,602,349	123,438	2,777,673
Burlington City	12,302	581,386	13,393,965	0.04%	0.94%	314,813	7,413,190	172,572	3,706,425
Burlington Township	28,952	1,339,142	31,217,900	0.04%	0.96%	800,025	18,706,440	383,233	8,371,362
Chesterfield Township	4,065	183,065	4,465,191	0.04%	0.93%	132,588	3,224,733	25,688	576,067
Cinnaminson Township	18,882	855,855	20,698,192	0.04%	0.87%	478,128	11,734,933	249,115	5,461,562
Delanco Township	3,937	177,698	4,299,559	0.04%	0.89%	87,487	2,141,195	53,632	1,193,620
Delran Township	16,915	776,712	18,627,724	0.04%	0.87%	457,923	11,237,491	251,705	5,575,281
Eastampton Township	5,303	252,644	5,909,106	0.04%	0.83%	181,216	4,320,869	61,047	1,332,471
Edgewater Park Township	8,041	376,182	8,810,212	0.04%	0.92%	228,739	5,490,641	124,961	2,763,757
Evesham Township	45,897	2,249,290	52,194,101	0.03%	0.81%	1,223,532	29,407,873	886,896	19,272,126
Fieldsboro Borough	587	26,364	658,027	0.04%	0.91%	15,589	387,305	6,268	139,832
Florence Township	12,762	582,037	14,067,701	0.04%	0.93%	359,527	8,885,742	158,270	3,553,509
Hainesport Township	7,235	332,379	7,746,155	0.04%	0.92%	148,569	3,546,063	138,277	2,992,198
Lumberton Township	11,165	541,886	12,322,765	0.04%	0.82%	342,259	8,001,139	160,332	3,330,757
Mansfield Township	17,213	692,031	18,467,937	0.04%	0.94%	159,090	3,929,099	66,032	1,450,783
Maple Shade Township	18,835	891,009	20,823,776	0.04%	0.89%	610,247	14,457,396	218,378	4,744,609
Medford Lakes Borough	3,035	155,390	3,614,863	0.03%	0.64%	126,373	2,970,890	21,883	466,196
Medford Township	25,726	1,281,078	29,320,553	0.03%	0.78%	730,833	17,263,269	436,580	9,150,550
Moorestown Township	34,859	1,620,231	37,652,784	0.04%	0.89%	700,587	16,875,372	719,683	15,415,779
Mount Holly Township	14,388	662,828	15,420,860	0.04%	0.93%	290,701	6,945,682	270,402	6,072,289
Mount Laurel Township	55,593	2,647,509	60,735,547	0.04%	0.87%	1,444,764	34,250,301	997,422	21,265,557
New Hanover Township	15,641	695,886	16,078,842	0.04%	1.00%	266,492	6,005,592	404,214	9,474,401
North Hanover Township	6,011	291,341	6,481,531	0.04%	0.95%	182,064	4,139,009	80,081	1,665,033
Palmyra Borough	7,390	342,248	8,222,910	0.04%	0.87%	224,506	5,489,349	81,226	1,791,600
Pemberton Borough	1,338	66,456	1,551,519	0.04%	0.83%	34,815	826,066	11,762	250,874
Pemberton Township	23,092	1,123,478	26,014,189	0.03%	0.80%	726,192	16,988,323	264,983	5,880,430
Riverside Township	7,038	324,073	7,818,567	0.04%	0.88%	203,326	4,924,482	66,479	1,451,016
Riverton Borough	2,842	133,131	3,138,205	0.04%	0.89%	94,897	2,279,157	26,520	573,231

Table 5.4.3-12. Estimated Building Value (Building and Contents) Damaged by the 500- and 2,500-Year MRP Earthquake Events

Municipality	Estimated Total Damages*			Percent of Total Building and Contents RV**		Estimated Residential Damage		Estimated Commercial Damage	
	Annualized Loss	500-Year	2,500-Year	500-Year	2,500-Year	500-Year	2,500-Year	500-Year	2,500-Year
Shamong Township	4,406	224,969	5,159,622	0.03%	0.65%	159,390	3,689,784	47,757	1,004,719
Southampton Township	8,119	420,416	9,429,203	0.03%	0.72%	305,694	6,919,006	84,669	1,754,397
Springfield Township	3,624	170,342	4,007,620	0.04%	0.87%	102,955	2,479,707	44,288	948,654
Tabernacle Township	5,000	257,830	5,802,928	0.03%	0.62%	171,109	3,861,449	50,318	1,023,896
Washington Township	592	31,192	665,716	0.03%	0.61%	16,177	341,838	7,516	154,836
Westampton Township	11,500	530,753	12,342,800	0.04%	0.93%	223,821	5,417,968	221,997	4,753,228
Willingboro Township	26,015	1,236,441	29,418,463	0.03%	0.82%	912,641	22,223,133	234,479	5,060,908
Woodland Township	572	30,345	691,827	0.03%	0.60%	26,029	596,921	2,190	46,023
Wrightstown Borough	1,458	68,939	1,524,577	0.05%	1.09%	24,552	574,024	32,736	694,972
Burlington County (Total)	489,790	23,068,842	540,226,257	0.04%	0.86%	13,054,080	311,275,831	7,289,445	158,359,875

Source: HAZUS-MH 2.1

RV: Replacement Value

*Total is sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious and government).

**Total replacement value (building and contents) for the County is greater than \$62 billion.

It is estimated that there would be more than \$23 million in damages to buildings in the County during a 500-year earthquake event. This includes structural damage, non-structural damage and loss of contents, representing less than one-percent of the total replacement value for general building stock in Burlington County. For a 2,500-year MRP earthquake event, HAZUS-MH estimates 4,530 buildings will be at least moderately damaged. The estimated total building damage is greater than \$540 million, less than one-percent of the total general building stock replacement value (total replacement value is greater than \$62.7 billion for the County). Residential and commercial buildings account for most of the damage for earthquake events.

Earthquakes can cause secondary hazard events such as fires. No fires are anticipated as a result of the 100-, 500- or 2,500-year MRP events.

Impact on Critical Facilities

After considering the general building stock exposed to, and damaged by, 100-, 500- and 2,500-year MRP earthquake events, critical facilities were evaluated. All critical facilities (essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities and user-defined facilities) in Burlington County are considered exposed and vulnerable to the earthquake hazard. Refer to subsection “Critical Facilities” in Section 4 (County Profile) of this Plan for a complete inventory of critical facilities in the County.

HAZUS-MH 2.1 estimates the probability that critical facilities may sustain damage as a result of 100-, 500- and 2,500-year MRP earthquake events. Additionally, HAZUS-MH estimates percent functionality for each facility days after the event. For the 100-Year MRP event, HAZUS-MH 2.1 estimates it is 99% probable that emergency facilities (police, fire, EMS and medical facilities), schools and specific facilities identified by Burlington County as critical (i.e., user-defined facilities such shelters, municipal buildings and Departments of Public Works) will not experience any structural damage. These facilities are estimated to be nearly 100% functional on day one of the 100-year MRP earthquake event. Therefore, the impact to critical facilities is not significant for the 100-year event.

Table 5.4.3-13 and Table 5.4.3-14 list the percent probability of critical facilities sustaining the damage category as defined by the column heading and percent functionality after the event for the 500-year and 2,500-year MRP earthquake events.

Table 5.4.3-13. Estimated Damage and Loss of Functionality for Critical Facilities in Burlington County for the 500-Year MRP Earthquake Event

Type	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Fire	89 - 91	3 - 7	2- 3	0 - 1	0	88 - 91	96 - 97	99	99
Police	89 - 91	3 - 7	2- 3	0 - 1	0	88 - 91	96 - 97	99	99
EOC	89 - 91	3 - 7	2- 3	0 - 1	0	88 - 91	96 - 97	99	99
Hospital	99	1 – 3	0 – 1	0	0	98 - 99	99	99	99
School	89 - 90	6 - 7	2 - 3	0 - 1	0	88 - 90	96 - 97	99	99
Shelter	94 - 95	3 - 4	1	0	0	95 - 96	98 - 99	99	99
Senior	95	3 - 4	1	0	0	95	97 - 98	99	99
Municipal	95 - 97	3 – 7	0 - 1	0	0	95	98 - 99	99	99

Source: HAZUS-MH 2.1

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Table 5.4.3-14. Estimated Damage and Loss of Functionality for Critical Facilities in Burlington County for the 2,500-Year MRP Earthquake Event

Type	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Fire	57 - 68	17 - 21	14 - 16	4 - 5	0 - 1	58 - 68	77 - 80	94 - 96	96 - 97
Police	57 - 62	18 - 21	15 - 16	4 - 5	1	58 - 68	77 - 80	94 - 96	96 - 97
EOC	57 - 68	17 - 21	14 - 16	4 - 5	0 - 1	58 - 68	77 - 80	94 - 96	96 - 97
Hospital	78 - 79	13 - 17	0 - 10	2 - 8	0 - 1	78 - 79	87 - 92	97 - 99	99 - 100
School	57 - 61	20 - 21	15 - 16	5	1	57 - 60	78 - 79	94 - 95	96 - 97
Shelter	67 - 70	17 - 19	10 - 11	2 - 3	0	68 - 73	87 - 91	97 - 98	100
Senior	69 - 70	17 - 19	10 - 11	2 - 3	0	67 - 70	86 - 87	97	100
Municipal	67 - 74	16 - 19	9 - 11	2 - 3	0	68 - 71	87 - 91	97 - 98	100

Source: HAZUS-MH 2.1

Impact on Economy

Earthquakes also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. A Level 2 HAZUS-MH analysis estimates the total economic loss associated with each earthquake scenario, which includes building- and lifeline-related losses (transportation and utility losses) based on the available inventory (facility [or GIS point] data only). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the “Impact on General Building Stock” section discussed earlier. Lifeline-related losses include the direct repair cost to transportation and utility systems and are reported in terms of the probability of reaching or exceeding a specified level of damage when subjected to a given level of ground motion. Additionally, economic loss includes business interruption losses associated with the inability to operate a business due to the damage sustained during the earthquake as well as temporary living expenses for those displaced. These losses are discussed below.

It is significant to note that for the 500-year event, HAZUS-MH 2.1 estimates the County will incur approximately \$5.2 million in income losses (wage, rental, relocation and capital-related losses) in addition to the 500 -year event structural, non-structural and content building stock losses (\$17.9 million). For the 2,500-year event, HAZUS-MH 2.1 estimates the County will incur nearly \$86.7 million in income losses, mainly to the residential and commercial occupancy classes associated with wage, rental, relocation and capital-related losses.

Utility damage results are not considered to be significant as a result of the 100-year and 500-year events. For the 500-year event, there is a 96-percent or greater probability that utilities will not experience any damage; and up to a four-percent probability ‘slight’ damage could be experienced. Therefore, utility loss estimates as a result of the 100- and 500-year events are not discussed further in this assessment for this HMP.

Table 5.4.3-15 summarizes the estimated losses to utilities as a result of the 2,500-year event.

Earthquake events can significantly impact road bridges. These are important because they often provide the only access to certain neighborhoods. Since softer soils can generally follow floodplain boundaries, bridges that cross watercourses should be considered vulnerable. A key factor in the degree of vulnerability will be the age of the facility, which will help indicate to which standards the facility was built.

HAZUS-MH estimates the long-term economic impacts to the County for 15-years after the earthquake event. In terms of the highway transportation infrastructure, HAZUS-MH estimates \$35 Million in direct

SECTION 5.4.3: RISK ASSESSMENT - EARTHQUAKE

repair costs to bridges in the County as a result of a 2,500-year event. No loss is estimated for highway segments.

It is estimated that the airports in Burlington County will be 91% functional on day one of the 2,500-year event and an estimated 68-percent probability they will experience slight damage.

Table 5.4.3-15. Estimated Utility Impacts in Burlington County from the 2,500-year MRP Earthquake Event

Type	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Communication	36 - 41	41 - 43	17 - 19	2 - 3	0	88 - 90	99	100	100
Electric	76 - 77	13 - 14	9 - 10	1	0	83 - 85	99	100	100
Water	34 - 40	40 - 43	15 - 18	1 - 2	0	69 - 71	98 - 99	99	100
Wastewater	36 - 45	40 - 43	15 - 20	1 - 2	0	87 - 91	98 - 99	100	100

Source: HAZUS-MH 2.1

HAZUS-MH 2.1 also estimates the volume of debris that may be generated as a result of an earthquake event to enable the study region to prepare and rapidly and efficiently manage debris removal and disposal. Debris estimates are divided into two categories: (1) reinforced concrete and steel that require special equipment to break it up before it can be transported, and (2) brick, wood and other debris that can be loaded directly onto trucks with bulldozers (HAZUS-MH Earthquake User's Manual).

For the 100-year MRP event, HAZUS-MH 2.1 estimates 0 tons of debris will be generated. For the 500-year MRP event, HAZUS-MH 2.1 estimates more than 9,314 tons of debris will be generated. For the 2,500-year MRP event, HAZUS-MH 2.1 estimates greater than 125,565 tons of debris will be generated (Table 5.4.3-16).

Table 5.4.3-16. Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake Events

Municipality	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Bass River Township	12.7	2.6	132.8	43.3
Beverly City	45.9	11.7	519.8	255.4
Bordentown City	86.9	23.5	983.6	513.1
Bordentown Township	150.9	40.1	1735.8	880.6
Burlington City	194.3	51.3	2155.0	1090.1
Burlington Township	422.3	132.1	4682.0	2856.9
Chesterfield Township	56.6	17.9	648.6	394.3
Cinnaminson Township	254.9	73.6	2931.5	1643.4
Delanco Township	65.8	20.1	749.1	450.0
Delran Township	249.3	65.2	2845.0	1438.4
Eastampton Township	81.6	18.7	934.2	402.4
Edgewater Park Township	132.6	34.1	1487.7	747.2
Evesham Township	666.7	172.1	7510.7	3671.3
Fieldsboro Borough	7.9	1.9	91.9	42.8
Florence Township	187.9	48.3	2163.0	1068.7
Hainesport Township	102.4	32.2	1155.2	718.2
Lumberton Township	173.5	45.9	1898.2	945.9
Mansfield Township	258.5	119.7	2982.6	2770.1

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Table 5.4.3-16. Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake Events

Municipality	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Maple Shade Township	332.2	84.6	3663.8	1805.1
Medford Lakes Borough	46.7	8.7	534.1	177.0
Medford Township	378.3	100.5	4234.8	2128.4
Moorestown Township	500.8	161.0	5541.4	3478.1
Mount Holly Township	204.7	59.1	2300.4	1301.8
Mount Laurel Township	822.6	227.6	9103.7	4776.2
New Hanover Township	156.7	67.0	1709.9	1452.4
North Hanover Township	100.2	25.3	1126.0	523.9
Palmyra Borough	124.8	30.6	1419.0	665.6
Pemberton Borough	24.8	6.1	276.2	130.1
Pemberton Township	357.9	83.0	4077.6	1741.4
Riverside Township	126.4	33.7	1431.7	734.0
Riverton Borough	46.1	11.6	522.5	250.1
Shamong Township	70.8	16.0	811.5	324.7
Southampton Township	147.3	33.0	1663.1	670.4
Springfield Township	52.3	13.4	589.3	284.0
Tabernacle Township	86.6	21.5	949.6	421.3
Washington Township	12.7	4.5	133.3	85.7
Westampton Township	151.1	45.2	1706.5	1002.3
Willingboro Township	363.4	74.0	4210.5	1552.3
Woodland Township	10.8	1.9	122.2	37.3
Wrightstown Borough	21.1	6.2	226.9	131.0
Burlington County (Total)	7,288.8	2,025.5	81960.6	43605.3

Source: HAZUS-MH 2.1

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. It is anticipated that the human exposure and vulnerability to earthquake impacts in newly developed areas will be similar to those that currently exist within the County. Current building codes require seismic provisions that should render new construction less vulnerable to seismic impacts than older, existing construction that may have been built to lower construction standards.

Effect of Climate Change on Vulnerability

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Increased saturation of soils by more frequent and/or intense storms could increase the risk for liquefaction. Dams storing increased

volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

Additional Data and Next Steps

Additional data needed to further refine the County's vulnerability assessment include: (1) updated demographic data to update the default data in HAZUS-MH; and (2) updated building data to update the default data in HAZUS-MH. Additionally, the County can identify un-reinforced masonry critical facilities and privately-owned buildings (i.e., residences) using local knowledge and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes and plans to provide emergency response/recovery efforts for these properties can be set in place. Further mitigation actions include training of County and municipal personnel to provide post-hazard event rapid visual damage assessments, increase of County and local debris management and logistic capabilities, and revised regulations to prevent additional construction of non-reinforced masonry buildings.

5.4.4 FLOOD

This section provides a profile and vulnerability assessment for the flood hazard.

HAZARD PROFILE

This section provides profile information including description, location, extent, previous occurrences and losses and the probability of future occurrences.

Description

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (Federal Emergency Management Agency [FEMA], 2010). Most communities in the U.S. have experienced some kind of flooding, after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws (George Washington University, 2001). Floods have been and continue to be the most frequent, destructive, and costly natural hazard in the State of New Jersey. The large majority of the State's damage reported for major disasters is associated with flooding (NJOEM, 2011). There are a number of flood categories in the U.S., which include:

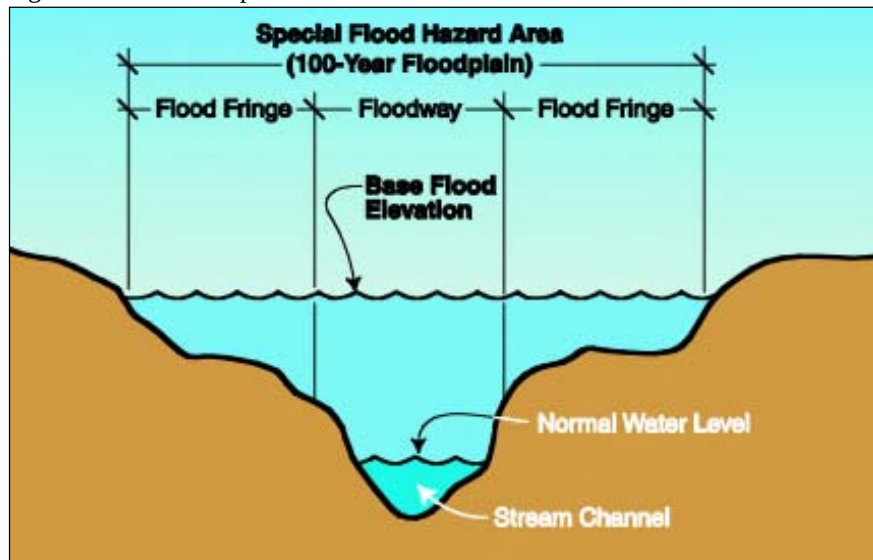
- Riverine flooding, including overflow from a river channel, flash, alluvial fan, ice-jam, and dam breaks
- Local drainage or high groundwater levels
- Fluctuating lake levels
- Coastal flooding, including storm surges
- Debris flow (NJOEM, 2011)

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not the flood that will occur once every 100 years, rather it is the flood that has a one-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. With this term being misleading, FEMA has properly defined it as the one-percent annual chance flood. This one percent annual chance flood is now the standard used by most Federal and State agencies and by the National Flood Insurance Program (NFIP) (FEMA, 2003).

One hundred-year floodplains (or 1% annual chance floodplain) can be described as a bag of 100 marbles, with 99 clear marbles and one black marble. Every time a marble is pulled out from the bag, and it is the black marble, it represents a 100-year flood event. The marble is then placed back into the bag and shaken up again before another marble is drawn. It is possible that the black marble can be picked one out of two or three times in a row, demonstrating that a 100-year flood event could occur several times in a row (Interagency Floodplain Management Review Committee, 1994).

Table 5.4.4-1 depicts the special flood hazard area, the flood fringe, base flood elevation, and the floodway areas of a floodplain.

Figure 5.4.4-1. Floodplain



Source: NJOEM, 2011

Many floods fall into three categories: riverine, coastal and shallow (FEMA, 2005). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this HMP and as deemed appropriate by the County, riverine/flash, dam failure, and coastal flooding are the main flood types of concern for the County. These types of flood are further discussed below.

Riverine/Flash Floods – Riverine floods are the most common flood type and occur along a channel, and include overbank and flash flooding. Channels are defined, ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (FEMA, 2005; FEMA, 2008).

Flash floods are “a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters” (NWS, 2009).

Dam Failure Floods – A dam is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA, 2010). Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream (FEMA, 2003). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affect a dam’s primary function of impounding water (FEMA, 2011). Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity);
- Prolonged periods of rainfall and flooding;
- Deliberate acts of sabotage (terrorism);

- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA, 2010).

Coastal Flooding - Coastal flooding generally occurs along the coasts of oceans, bays, estuaries, coastal rivers and large lakes. Coastal floods are the submersion of land areas along the ocean coast and other inland waters caused by seawater over and above normal tide action. Coastal flooding is a result of the storm surge where local sea levels rise often resulting in weakening or destruction of coastal structures. Hurricanes and tropical storms, severe storms, and Nor'easters cause most of the coastal flooding, including flooding in New Jersey. Coastal flooding not only results in the many problems identified for riverine flooding but could also include additional problems such as beach erosion, loss or submergence of wetlands and other coastal ecosystems, saltwater intrusion, high water tables, loss of coastal recreation areas, beaches, protective sand dunes, parks and open space, and loss of coastal structures (sea walls, piers, bulkheads, bridges, or buildings) (FEMA, 2011).

There are several forces that occur with coastal flooding:

- *Hydrostatic forces* against a structure are created by standing water or slowly moving water. Flooding can cause vertical hydrostatic forces or flotation.
- *Hydrodynamic forces* on buildings are created when coastal floodwaters move at high velocities. These high-velocity flows are capable of destroying solid walls and dislodging buildings with inadequate foundations. High-velocity flows can also move large quantities of sediment and debris that can cause additional damage. In coastal areas, high-velocity flows are typically associated with one or more of the following:
 - Storm surge and wave run-up flowing landward through breaks in sand dunes or across low-lying areas
 - Tsunamis
 - Outflow of floodwaters driven into bay or upland areas
 - Strong currents parallel to the shoreline, driven by waves produced from the storm
 - High-velocity flows

High-velocity flows can be created or exacerbated by the presence of manmade or natural obstructions along the shoreline and by weak points formed by roads and access paths that cross the dunes, bridges or canals, channels, or drainage features.

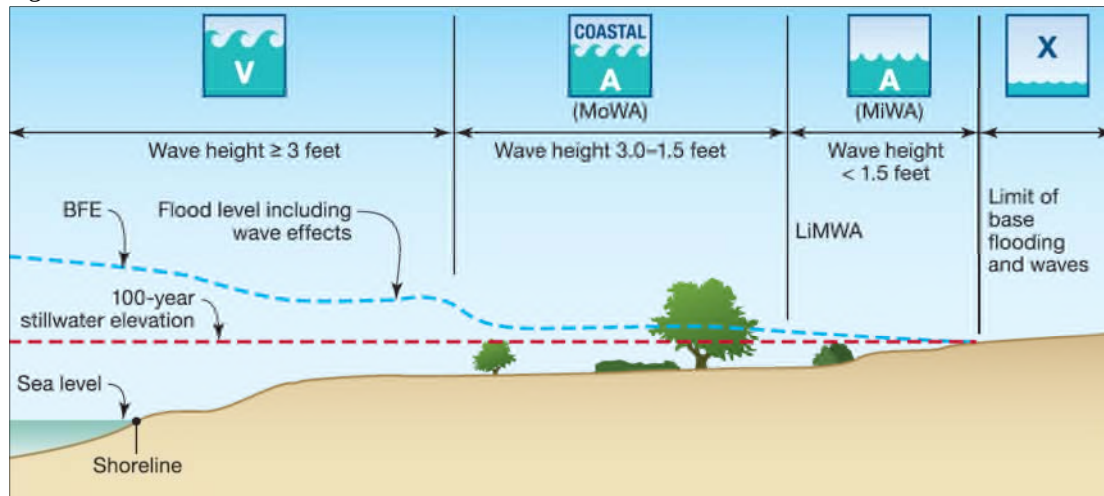
- *Waves* can affect coastal buildings by breaking waves, wave run-up, wave reflection and deflection, and wave uplift. The most severe damage is caused by breaking waves. The force created by these types of waves breaking against a vertical surface is often at least 10 more times higher than the force created by high winds during a coastal storm.
- *Flood-borne debris* produced by coastal flooding events and storms typically includes decks, steps, ramps, breakaway wall panels, portions of or entire houses, heating oil and propane tanks, cars, boats, decks and pilings from piers, fences, erosion control structures, and many other types of smaller objects. Debris from floods is capable of destroying unreinforced

masonry walls, light wood-frame construction, and small-diameter posts and piles (FEMA, 2011).

According to the 2011 Coastal Construction Manual, FEMA P-55, Zone V (including Zones VE, V1-30, and V) identifies the Coastal High Hazard Area, which is the portion of the special flood hazard area (SFHA) that extends from offshore to the inland limit of a primary frontal dune along an open coast and any other portion of the SFHA that is subject to high-velocity wave action from storms or seismic sources. The boundary of Zone V is generally based on wave heights (3 feet or greater) or wave run-up depths (3 feet or greater). Zone V can also be mapped based on the wave overtopping rate (when waves run up and over a dune or barrier). Zone A or AE, identify portions of the SFHA that are not within the Coastal High Hazard Area. These zones are used to designate both coastal and non-coastal SFHAs. Regulatory requirements of the National Flood Insurance Program (NFIP) for buildings located in Zone A are the same for both coastal and riverine flooding hazards. Zone AE in coastal areas is divided by the limit of moderate wave action (LiMWA). The LiMWA represents the landward limit of the 1.5-foot wave (FEMA, 2011).

The area between the LiMWA and the Zone V limit is known as the Coastal A Zone for building codes and standard purposes and as the Moderate Wave Action area by FEMA flood mappers. This area is subject to wave heights between 1.5 and 3 feet during the base flood. The area between the LiMWA and the landward limit of Zone A due to coastal flooding is known as the Minimal Wave Action area, and is subject to wave heights less than 1.5 feet during the base flood (FEMA P-55, 2011). Figure 10 1 is a typical transect illustrating Zone V, the Coastal A Zone and Zone A, and the effects of energy dissipation and regeneration of a wave as it moves inland. Wave elevations are decreased by obstructions such as vegetation and rising ground elevation (FEMA, 2011).

Figure 5.4.4-2. Transect Schematic



Source: FEMA, 2011

Extent

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.

- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS, 2011).

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2001).

Flood severity from a dam failure can be measured with a low, medium or high severity, which are further defined as follows:

- Low severity - No buildings are washed off their foundations; structures are exposed to depths of less than 10 feet.
- Medium severity - Homes are destroyed but trees or mangled homes remain for people to seek refuge in or on; structures are exposed to depths of more than 10 feet.
- High severity - Floodwaters sweep the area clean and nothing remains. Locations are flooded by the near instantaneous failure of a concrete dam, or an earthfill dam that turns into "jello" and washes out in seconds rather than minutes or hours. In addition, the flooding caused by the dam failure sweeps the area clean and little or no evidence of the prior human habitation remains after the floodwater recedes (Graham, 1999).

Two factors which influence the potential severity of a full or partial dam failure include (1) The amount of water impounded; and (2) The density, type, and value of development and infrastructure located downstream (City of Sacramento Development Service Department, 2005).

Several factors determine the extent of floods and are further discussed below.

- *Velocity of Water and Terrain:* High velocity floodwaters are more damaging than lower velocity floodwaters. Floodwaters flow more quickly in areas of steep topography (Burlington County HMP, 2008).
- *Size of a Watershed:* In large watersheds, it is often possible to predict flooding hours or even days in advance as conditions are observed building over time. In small watersheds in areas of steep terrain, flooding may come with little or no advance warning because of the speed of the water (Burlington County HMP, 2008).
- *Volume of Water:* As rainfall volume and intensity increase, so does the likelihood for flooding as the capacity of natural and man-made conveyances is exceeded. This is also true for higher volumes and rates of snowmelt (Burlington County HMP, 2008).

According to the National Weather Service Eastern Region Headquarters, 24-hour precipitation frequency estimates at observation stations in Burlington County are presented in Table 5.4.4-1.

Table 5.4.4-1. 24-Hour Precipitation Frequency Estimates Burlington County

Station	Inches Rain for Approximate Recurrence Interval									
	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	1000-yr
Burlington	2.75	3.33	4.25	5.03	6.21	7.22	8.34	9.58	11.4	13.1

Table 5.4.4-1. 24-Hour Precipitation Frequency Estimates Burlington County

Station	Inches Rain for Approximate Recurrence Interval									
	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	1000-yr
Indian Mills	2.74	3.33	4.31	5.15	6.43	7.54	8.79	10.2	12.3	14.2
Moorestown	2.76	3.33	4.24	5.00	6.14	7.12	8.19	9.37	11.1	12.6
Mount Holly	2.74	3.32	4.26	5.06	6.27	7.33	8.49	9.80	11.8	13.5
Pemberton	2.77	3.35	4.32	5.14	6.39	7.48	8.70	10.1	12.1	13.9
Springfield	2.83	3.42	4.39	5.22	6.47	7.55	8.75	10.1	12.1	13.9

Source: Hydrometeorological Design Studies Center, 2013

- Ground Cover:** Impervious surfaces can lead to increased runoff and higher flood levels. According to the Burlington County Soils Survey, most of the soils in Burlington County are permeable, which means more rainwater and/or snowmelt is likely to infiltrate the soils (67% permeable, 22% rapidly permeable and 11% slowly permeable). However, urban areas with higher proportions of impervious surfaces (paved areas, buildings, etc.) as opposed to natural ground cover would exhibit a much higher runoff potential because they are in essence covering up the permeable soils. Urban ground cover is lowest in the southeastern portion of the county, and increases markedly in a northwestern direction approaching the County's population centers along the Delaware River. Thus, negative impacts of impervious surfaces would affect flooding more in northwestern communities than in southeastern communities (Burlington County HMP, 2008)
- Topography:** Runoff will reach natural and man-made conveyance channels more rapidly in areas of steeper terrain. In general terms, southeastern areas of the County are generally flat, with increasing relief observed toward the northwestern areas (Burlington County HMP, 2008).
- Tides:** The timing of storms as they relate to the tidal cycle often has a drastic effect on the severity of flooding in coastal areas. The level of coastal waters and tidally affected water courses increases at the time of high tide. The coincidence of a severe storm at the time of a high tide can exacerbate the effects of flooding. These effects can be combined with high intensity rainfall and urban runoff as storm sewer outlets become blocked by high tidal waters and runoff backs up through the system onto roadways. Tidal water bodies in Burlington County are identified in the County Profile section of this Plan (Burlington County HMP, 2008).

Location

Floods can occur almost anywhere in the State of New Jersey, although they tend to occur in and around areas near existing bodies of water, such as rivers, streams, and the Atlantic Ocean. According to FEMA Flood Insurance Studies (FISs) and Flood Insurance Rate Maps (FIRMs), the most damaging floods affecting developed areas occur in the northern half of the State. This is due to the number of physiographic and physical features of the landscape. Greater geographic relief in this part of the State results in flowing water moving down steeper gradients, naturally or artificially channelized through valleys and gullies. Development patterns have resulted in denser development in North Jersey, and proximity to New York City boosts property values and thus damage dollar totals. Extensive development also leaves less natural surface available to absorb rainwater, forcing water directly into streams and rivers, swelling them more than when more natural surface existed. Since the Delaware, Raritan and Passaic Rivers drain more than 90% of the northern counties in the State, these rivers and their tributaries are common locations for flooding (NJOEM, 2011).

Burlington County and its jurisdictions experience many types of flooding. While none of the County's municipalities directly border the Atlantic Ocean or Great Bay, many waterways are influenced by the tides for at least some of their reaches. Flooding in Burlington County ranges from tidal and riverine flooding to shallow flooding which result from urban drainage issues.

Please refer to Section 4 (County Profile) for detailed information regarding the river basins and the hydrography/hydrology of Burlington County.

Advisory Base Flood Elevation (ABFE) Maps

Prior to Hurricane Sandy, FEMA had begun a coastal flood study to update FIRMs for portions of New York and New Jersey using improved methods and data to better reflect coastal flood risk. The studies included data that was collected and analyzed over a number of years. After Hurricane Sandy, FEMA released Advisory Base Flood Elevation (ABFE) maps which are based on the partially completed flood study for certain communities which were designed to help in rebuilding and recovery efforts. FEMA is currently in the process of releasing preliminary work maps that include full results of the coastal flood study (FEMA Region II, Date Unknown).

ABFEs provide a better picture of current flood risk than the existing FIRMs. The new ABFEs are the recommended elevation of the lowest floor of a building. Some communities may require that the lowest floor be built above the ABFE. ABFEs more accurately reflect the true one-percent annual chance flood hazard elevations in a given area. Following large storms, FEMA performs an assessment to determine whether the one-percent annual chance flood event, shown on the effective FIRMs, adequately reflects the current flood hazard. In some cases, FEMA determines that ABFEs need to be produced, based on the age of the analysis and the science used to develop the effective FIRMs. ABFEs are provided to communities as a tool to support in the recovery process that will aide in making those communities more resilient to future events (FEMA Region II, Date Unknown).

The ABFE maps include delineated advisory flood hazard zones (Advisory Zone V, Advisory Zone A, and Advisory Zone X). The maps also include ABFE elevations for 1% and 0.2% annual chance flood elevations. Area and limit of structurally damaging wave action and preliminary Hurricane Sandy high water marks are also be listed on the ABFE maps, along with coastal barrier resource areas (RiskMAP, Date Unknown).

The State of New Jersey has adopted emergency amendments to the Flood Hazard Area Control Act Rules (N.J.A.C. 7:13) which incorporate the use of ABFEs to determine flood elevations. Under these amendments, flood elevations are now determined either using the higher of the ABFE, the effective BFE or the design flood elevation shown on NJDEP flood maps; or site-specific calculations that demonstrate a different flood elevation (NJDEP, 2013a). ABFEs and Advisory Flood Hazard Maps shall take precedence over previous panels and FIS in only construction and development regulations. Where the SFHA and Advisory Flood Hazard Area maps conflict or overlap, whichever imposes the more stringent requirement will prevail (NJDEP, 2013b).

ABFEs are available in 10 New Jersey counties: Atlantic, Bergen, Burlington, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, and Union (RiskMAP, Date Unknown).

Flood Hazard Areas

Base flood elevations and the boundaries of the 1-percent annual chance, or 100-year floodplains and the 0.2-percent annual chance, or the 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard. The

FIRMs depict Special Flood Hazard Areas - those areas subject to inundation from the 1% annual chance flood (also known as the Base Flood or the 100-Year Flood). Those areas are defined as follows:

- Zones A1-30 and AE: Special Flood Hazard Areas that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base Flood Elevations are shown within these zones.
- Zone A (Also known as Unnumbered A Zones): Special Flood Hazard Areas where, because detailed hydraulic analyses have not been performed, no Base Flood Elevations or depths are shown.
- Coastal A Zone. A subset of Zone A. Specifically, that portion of the SFHA landward of Zone V (or landward of a coastline without a mapped Zone V) in which the principal source of flooding is coastal storms, and where the potential base flood wave height is between 1.5 and 3.0 feet.
- Zone AO: Special Flood Hazard Areas that are subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
- Zone VE, V1-30: Special Flood Hazard Areas along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base Flood Elevations derived from detailed hydraulic analysis are shown within these zones.
- Limit of Moderate Wave Action (LiMWA): Zone AE in coastal areas is divided by the LiMWA. The LiMWA represents the landward limit of the 1.5-foot wave. The area between the LiMWA and the Zone V limit is known as the Coastal A Zone for building code and standard purposes and as the Moderate Wave Action (MoWA) area by FEMA flood mappers. This area is subject to wave heights between 1.5 and 3 feet during the base flood. The area between the LiMWA and the landward limit of Zone A due to coastal flooding is known as the Minimal Wave Action (MiWA) area, and is subject to wave heights less than 1.5 feet during the base flood.
- Zone B and X (shaded): Zones where the land elevation has been determined to be above the Base Flood Elevation, but below the 500 year flood elevation. These zones are not Special Flood Hazard Areas.
- Zones C and X (unshaded): Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500 year flood elevation. These zones are not Special Flood Hazard Areas.

Flood Insurance Study (FIS)

In addition to FIRM and DFIRMs, FEMA also provides FISs for entire counties and individual jurisdictions. These studies aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. They are narrative reports of countywide flood hazards, including descriptions of the flood areas studied and the engineered methods used, principal flood problems, flood protection measures and graphic profiles of the flood sources (FEMA, Date Unknown).

A preliminary countywide FIS for Burlington County has been completed and is dated November 30, 2010. According to the FIS, the history of flooding within the County indicates that flooding may occur during any season of the year. The majority of floods have occurred during the summer and early fall months; however, floods have occurred at different times throughout the year. Portions of Burlington County experience tidal flooding from the Delaware River caused by extremely high tides, hurricane activity and tropical storms (FEMA, 2010).

The following discussion presents flood information as directly provided in the FEMA FIS document(s). The 2010 FIS discussed the principal flood problems throughout the County.

- *Township of Bass River* – flooding occurs at Bass River near Allens Dock at U.S. Route 9; at East Branch Bass River near Stage Road; and the Merrygold Branch of Wading River at Hammonton Road. All these flooding problems are affected by tidal flooding from the Great Bay.
- *City of Bordentown* – flooding is caused by runoff from intense rainfall and tidal flooding along the Delaware River.
- *Township of Bordentown* – the primary source of flooding in the Township is the Delaware River. The Township is also subject to tidal flooding.
- *City of Burlington* – tidal and riverine flooding from the Delaware River and Assicunk Creek. Heavy flooding damage has occurred in the area of U.S. Route 130.
- *Township of Burlington* – the primary source of flooding in the Township is the Delaware River. The Township is also subject to tidal flooding.
- *Township of Cinnaminson* – the Township experiences tidal, fluvial and poor drainage flooding. High tides on the Delaware River produce major flooding in Pompeston Creek’s lower reaches. The upper reaches and tributaries, particularly the East Branch and Jacks Run, are subject to fluvial flooding and easily overflow during high intensity and short duration storm events.
- *Township of Delanco* – the Delaware River and Rancocas Creek are the primary sources of flooding when high tides occur due to hurricanes and large storms that pass along the Atlantic coast. In tidal areas, flooding may be intensified or produced from tidal swells created as a result of these storms. Flooding from runoff also affects the Township.
- *Township of Delran* – primary sources of flooding are the Delaware River, Rancocas Creek, Swede Run and Laurel Run.
- *Township of Eastampton* – flooding occurs in the low-lying areas adjacent to the North Branch of Rancocas Creek during hurricanes and large storms.
- *Township of Evesham* – flooding occurs in areas where culvert openings are inadequate to handle discharge and where debris at structures restricts the flow. Increasing development within the Township has aggravated flooding along Barton Run near Kenilworth Lake, the upstream reach of Rancocas Creek South Branch and the downstream reach of Pennsauken Creek South Branch.
- *Township of Florence* – the Delaware River is the primary source of flooding and the Township is subject to tidal flooding.
- *Township of Hainesport* – flooding is primarily due to hurricanes and large storms that pass along the Atlantic coast and cause high tides on the Delaware River, Rancocas Creek North and South Branches and Masons Creek.
- *Township of Lumberton* – torrential rainstorms are the primary cause of flooding. A flood occurred in September 1940 that caused dam failures at Taunton and Medford Lakes.
- *Township of Mansfield* – the Delaware River is the primary source of flooding. The Township is also subject to tidal flooding.
- *Township of Maple Shade* - Pennsauken Creek North and South Branches are the primary sources of flooding due to heavy rainfalls and thunderstorms.
- *Borough of Medford Lakes* – lakes are the primary source of flooding in the Borough. Flooding occurs when lakes levels are at their highest, typically during the summer months, and the lakes overtop their banks.
- *Township of Medford* – torrential rainstorms during summer and autumn months are the primary source of flooding in the Township. Record flood heights were reached on the Rancocas Creek North, South and Southwest Branches in September 1940. This even caused dam failures at Taunton and Medford Lakes.
- *Township of Moorestown* – residential, commercial and industrial structures located in the floodplains are subject to inundation from riverine and tidal flooding.
- *Township of Mount Holly* – flooding in the Township is mainly due from storms that produced riverine and tidal flooding. In tidal areas, flooding may be magnified or produced from tidal swells created as a result of the storm path over the ocean. Flooding along the Rancocas Creek

North Branch is made more severe due to undersized culverts connecting the dredged stream to the former stream under the Conrail embankment and from Buttonwood Run due to an increase in development upstream in the Township of Eastampton.

- *Township of Mount Laurel* – flooding is generated from the streams located within the Township which were studied by detailed methods.
- *Borough of Palmyra* – the Delaware River and the Pennsauken Creek are the primary sources of flooding. The Delaware River flows through tidal flatlands within the Borough and the Pennsauken Creek flows through the Borough to its confluence with the Delaware River. Both of the water bodies are affected by tidal flooding.
- *Borough of Pemberton* – the Rancocas Creek North Branch is the primary source of flooding in the Borough. A gauge is located on the downstream side of the Hanover Street Bridge.
- *Township of Pemberton* – flooding is primarily due to heavy rainstorms in the summer and autumn months. These events cause the Rancocas Creek North Branch to flood.
- *Township of Riverside* – the Rancocas Creek is the primary source of flooding in the Township. The Creek floods during hurricanes and other large storms that pass along the Atlantic coast and cause high tides on the Delaware River and subsequently, the Rancocas Creek.
- *Borough of Riverton* – flooding within the Pompeston Creek watershed occurs throughout the year. Both tidal and riverine flooding occurs within the Borough and inadequate drainage causes flooding as well. High tides on the Delaware River produce major flooding in Pompeston Creek's lower reaches. Jacks Run is frequently dry and can overflow easily during a high intensity rain storm. Urbanization within the Jacks Run area has decreased the ability of the watershed to absorb water which creates more surface water for a given frequency rainfall.
- *Township of Southampton* – the primary sources of flooding are the Rancocas Creek North Branch and the Beaverdam Creek. Floods occur during torrential rain storms in the summer and autumn months.
- *Township of Tabernacle* – flooding may occur from various sources during any time of the year; however, flooding in winter is infrequent. Springtime flooding, combined with ice and snowmelt, has occurred. The most extensive flooding has occurred during late summer and early fall and usually associated with hurricanes and/or tropical storms.
- *Township of Washington* – the Mullica River is the primary cause of flooding in the Township, typically associated with hurricanes and tropical storms. Downstream of the Pleasant Mills Bridge, flooding on the River is tidally influenced. Tributaries to the River have also experienced flooding, like the Batsto River.
- *Township of Westhampton* – the Rancocas Creek is the primary source of flooding due to large storms that pass along the Atlantic Coast and bring high tides on the Delaware River and subsequently the Rancocas Creek.
- *Township of Willingboro* – the primary source of flooding is the Rancocas Creek due to large storms that pass along the Atlantic Coast and bring high tides on the Delaware River and subsequently the Rancocas Creek.
- *Township of Woodland* – flooding may occur on Bisphams Mill Creek and Wading River West Branch due to severe weather conditions during the summer and autumn months; however, flooding could occur any time of the year.

NJDEP Bureau of Dam Safety and Flood Control

A list of State Flood Hazard Area delineations were prepared by the NJDEP on May 15, 2002 for every county and municipality in the State. Flood Hazard Areas from this source within Burlington County are listed in Table 5.4.4-2. This was the most current list made available by the Bureau, dated January 2007.

Table 5.4.4-2. New Jersey State-Studied Streams in Burlington County

Municipality	River/Stream	Reach Studied
Bass River Township	None	N/A
Beverly City	None	N/A
Bordentown City	Blacks Creek	Entire Reach
	Crosswicks Creek	Entire Reach
Bordentown Township	Blacks Creek	Downstream Of U.S. Highway 206
	Crosswicks Creek	Entire Reach
	Delaware River	Entire Reach
	Delaware River Back Channel	Entire Reach
Burlington City	None	N/A
Burlington Township	Crosswicks Creek	Entire Reach
	Delaware River	Entire Reach
	Mill Creek	Downstream Of Interstate Highway 295
Chesterfield Township	None	N/A
Cinnaminson Township	None	N/A
Delanco Township	Delaware River	Entire Reach
	Rancocas Creek	Entire Reach
Delran Township	Rancocas Creek	Entire Reach
Eastampton Township	North Branch Rancocas Creek	Entire Reach
Edgewater Park Township	None	N/A
Evesham Township	Barton Run	Entire Reach
	Barton Run Tributary 1	Downstream Of New Road
	Barton Run Tributary 2	Downstream Of Taunton Lake Road
	Black Run	Downstream Of A Private Driveway Located Near Braddock Mill Road
	Black Run Tributary	Downstream Of Braddock Mill Road
	Cropwell Brook	Downstream Of North Cropwell Road
	Kettle Creek	Downstream Of A Point Located 1600 Feet Upstream Of Hopewell Road
	South Branch Pennsauken Creek	Downstream Of A Point Located 1500 Feet Upstream Of Old Marlton Pike
	Southwest Branch Rancocas Creek	Downstream Of A Point Located 1200 Feet Upstream Of Bon Air Drive
Fieldsboro Borough	Delaware River	Entire Reach
Florence Township	Bustleton Creek	Downstream Of U.S. Highway 130
	Crafts Creek	Downstream Of U.S. Highway 130
	Delaware River	Entire Reach
	Delaware River Back Channel	Entire Reach
Hainesport Township	Masons Creek	Entire Reach
	North Branch Rancocas Creek	Entire Reach
	South Branch Rancocas Creek	Entire Reach
Lumberton Township	Bobbys Run	Downstream Of Newbolds Corner-Mount Holly Road
	Little Creek	Entire Reach
	Masons Creek	Downstream Of Stacy Haines Road
	South Branch Rancocas Creek	Entire Reach
	South Branch Rancocas Creek Tributary	Downstream Of Stacy Haines Road
	Southwest Branch Rancocas Creek	Entire Reach
Mansfield	Crafts Creek	Downstream Of U.S. Highway 130

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-2. New Jersey State-Studied Streams in Burlington County

Municipality	River/Stream	Reach Studied
Township	Delaware River Back Channel	Entire Reach
Maple Shade Township	None	N/A
Medford Township	Ballinger Run	Downstream Of The Head Of Lake Stockwell
	Ballinger Run Tributary	Downstream Of A Point Located 90 Feet Upstream Of Birchwood Drive
	Barton Run	Entire Reach
	Barton Run Tributary 1	Entire Reach
	Blue Lake Run	Entire Reach
	Haynes Creek	Entire Reach
	Little Creek	Downstream Of State Highway 70
	Mimosa Lake Run	Downstream Of Scout Drive
	Sharps Run	Downstream Of Oliphants Mill-Hartford Road
	Skeet Run	Downstream Of Hawkin Road
	Southwest Branch Rancocas Creek	Entire Reach
	Taunton Lake Tributary	Downstream Of Centennial Avenue
Medford Lakes Borough	Ballinger Run	Entire Reach
	Lake Mishe-Mokwa Run	Downstream Of Hiawatha Trail
Moorestown Township	Rancocas Creek	Entire Reach
Mount Holly Township	Buttonwood Run	Downstream Of Branch Street
	Mill Race	Entire Reach
	Mount Holly By-Pass	Entire Reach
	North Branch Rancocas Creek	Entire Reach
Mount Laurel Township	Masons Creek	Entire Reach
	Rancocas Creek	Downstream Of The Confluence Of The North And South Branches
	South Branch Rancocas Creek	Entire Reach
New Hanover Township	None	N/A
North Hanover Township	None	N/A
Palmyra Borough	None	N/A
Pemberton Borough	Budds Run	Downstream Of A Point Located 850 Upstream Of Hanover Street
	North Branch Rancocas Creek	Entire Reach
Pemberton Township	Baffin Brook	Downstream Of Upton Station-Whitesbogs Road
	Budds Run	Downstream Of A Point Located 850 Feet Upstream Of Hanover Street
	County Lake Tributary	Downstream Of Upton Station-Whitesbogs Road
	Cranberry Branch	Downstream Of Lakehurst Road
	Jefferson Lake	Upstream Of Oregon Trail
	Little Pine Lake	Entire Reach
	Mirror Lake	Upstream 11600 Feet From Lakehurst Road
	Mount Misery Creek	Downstream Of A Point Located 1300 Feet Upstream Of Greenwood Bridge Road
	North Branch Rancocas Creek	Downstream Of Mirror Lake
	Ong Run	Upstream 4230 Feet From Little Pine Lake
	Pole Bridge Branch	Between County Lakes Spillway And Whitesbogs Road
	Pole Bridge Branch Tributary	Downstream Of Lakehurst Road
Riverside Township	Rancocas Creek	Entire Reach
Riverton Borough	None	N/A
Shamong	None	N/A

Table 5.4.4-2. New Jersey State-Studied Streams in Burlington County

Municipality	River/Stream	Reach Studied
Township		
Southampton Township	Beaverdam Creek	Downstream Of U.S. Highway 206
	Friendship Creek	Downstream Of State Highway 70
	Jade Run	Entire Reach
	Little Creek	Downstream Of A Point Located 2000 Feet Upstream Of Ridge Road
	North Branch Rancocas Creek	Entire Reach
	South Branch Rancocas Creek	Downstream Of Bed Beg Hill Road
Springfield Township	None	N/A
Tabernacle Township	None	N/A
Washington Township	Mullica River	Downstream Of County Route 542
Westampton Township	Assiskunk Creek Tributary	Downstream Of A Point Located 1280 Feet Upstream Of Oxmead Road
	Mill Creek	Downstream Of Interstate Highway 295
	Mill Creek Tributary	Downstream Of Woodlane Road
	Rancocas Creek	Downstream Of The Confluence Of The North And South Branches
	North Branch Rancocas Creek	Entire Reach
Willingboro Township	Mill Creek	Entire Reach
	Rancocas Creek	Entire Reach
	South Branch Mill Creek	Downstream Of Kennedy Parkway
Woodland Township	Bisphams Mill Creek	Between State Highway 70 And Cooper Road
	Burrs Mill Brook	Between A Point Located 9350 Feet Upstream Of Burrs Mill Road And A Point Located 17150 Feet Upstream Of Burrs Mill Road
	Shinns Branch	Downstream Of Lebanon State Forest
	West Branch Wading River	Between County Route 532 And Lebanon State Forest
Wrightstown Borough	None	N/A

Source: NJDEP, 2007

Note: NJDEP indicated that these sources are for informational purposes only and do not necessarily list all New Jersey State Studied Streams. Not all portions of a stream reach listed in the municipality are studied and not all municipalities are necessarily mentioned for each county.

Additional Flood-Prone Areas in Burlington County

Additional flood-prone areas in Burlington County include the following:

- *Burlington County OEM (BCOEM)* notes that, in addition to mapped flood hazard areas, there are many small flooding areas that occur during heavy rain storms that may not cause major damage but do present problems to the community. The BCOEM noted that this was particularly true for communities bordering the Delaware River and Rancocas Creek (Lumberton, Southampton, Pemberton, Eastampton, Delanco, Riverside, Mount Holly, and Washington) (Burlington County HMP, 2008).
- *Township of Bass River* – all of the Township except for Route 679/Leektown Road extending north/northwest sustained damages from Superstorm Sandy; damages to structures and property and some infrastructure (Township of Bass River, 2013).
- *Township of Bordentown* – areas prone to flooding along Jumble Gut Run and South Amboy Road (Township of Bordentown, 2013).

- *City of Burlington* – most of the City lies within the one-percent annual chance flood area. Potential for flooding includes the Delaware River, Assicunk Creek, JFK Lake, and Pope’s Run. These areas flood often during hurricanes and other severe storms when combined with high tide (City of Burlington, 2013).
- *Township of Burlington* – the Township indicated that flooding occurs along the Assicunk Creek and the Delaware River along Linden Road. In addition, flooding along Route 130 and Beverly Road occurs with heavy rain and an overflow or breach of the lower and upper Sylvan Lakes Dams threaten the Township (Township of Burlington, 2013).
- *Township of Cinnaminson* – the Township indicated areas prone to flooding include Riverside Drive, Canal Street, areas around Steels Pond and Calhoun and Adams Streets (Township of Cinnaminson, 2013).
- *Township of Delran* – the Township has identified Riverside Park as an area of concern for flooding, particularly during Nor’easters and severe storms (Township of Delran, 2013).
- *Township of Eastampton* – the Township noted that the extent of the flood hazard in their community has prompted two evacuations along the North Branch of the Rancocas Creek in the 18 month period preceding April 2007 (Burlington County HMP, 2008).
- *Township of Edgewater Park* – the Township indicated that sediment within Bogg’s Ditch contributes to flooding of several Township properties. In addition, the Township stated there are issues with flooding around Adams Avenue due to the failure of pump stations and overtopping at the Adams Avenue Basins (Township of Edgewater Park, 2013).
- *Township of Evesham* – the Township reported that roadways commonly impacted by flooding include the Old Marlton Pike, Route 73 at Baker, Route 70 at Conestoga, Tauton Lake Road, and Barton Run Boulevard.
- *Township of Florence* – the Township identified flood problem areas related to high tide for the Delaware River, coupled with heavy rain events. In addition, the Township identified two private residences along Hornberger Avenue that are prone to flooding and two pump stations prone to flooding (Township of Evesham, 2013).
- *Township of Lumberton* - the South Branch of the Rancocas Creek flows through the Township. The Township noted their experience of several floods of the downtown area in the last seventy years. The most severe flooding events occurred in 1939 and 1940 and more recently July 12-13, 2004. These floods were all the result of record-setting rainfall and the subsequent collapse of upstream dams. The major area of flooding is the village or historical center of the town. This area once contained small businesses and factories but is now all residential. Little or no development along the creek floodplain is expected to occur (Burlington County HMP, 2008).
- *Township of Mansfield* – the Township reported that flood events in 2006 and 2007 caused primarily basement flooding in their community (Burlington County HMP, 2008).
- *Township of Maple Shade* – the Township identified areas along the Pennsauken Creek that is particularly vulnerable to flooding (Township of Maple Shade, 2013).
- *Township of Medford* – the Township indicated that severe flooding occurs at the southwest branch of the Rancocas Creek. In 2004 and 2007, significant flooding caused damage to homes and public infrastructure along the area of the Creek. The Township continually monitors local dams in effort to mitigate failure and associated flooding issues (Township of Medford, 2013).
- *Borough of Medford Lakes* – severe flooding occurs along the Upper and Lower Aetna Lakes as well as Ballinger Lake. The Borough monitors the local dams in effort to mitigate dam failure and associated flooding issues. Part of this monitoring includes working with Colony Club (private entity that owns several dams in the Borough) (Borough of Medford Lakes, 2013).
- *Township of Moorestown* – the Township identified flooding issues associated with New Albany Road at Glen Avenue, Albany Road at Pomperton Creek, and North Statewide Road at Pond View (Township of Moorestown, 2013).
- *Township of Mount Laurel* – the Township identified the following areas prone to flooding:

- Flooding of the North Branch of Pennsauken Creek in the Ramblewood and Countryside sections of the Township
- Flooding of the Rancocas Creek along Union Mill Road between Hartford and Briggs Roads; Hartford Road between State Highway 38 and Union Mill Road
- New residential development of Rancocas Point, off of Creek and Centerton, lie in a potential flood zone by the Rancocas Creek
- Centerton Bridge between Mount Laurel and Westampton Townships is susceptible to flooding of the Rancocas Creek
- Township has 144 storm water management retention basins that overflow as a result of heavy rains resulting in flooded local roadways
- Flooding of Masons and Parker Creeks cause closing and impassibility of local roads (Township of Mount Laurel, 2013)
- *Borough of Palmyra* – the Borough noted issues with the Borough’s waste water treatment plant storm drain outfall (Borough of Palmyra, 2013)
- *Township of Pemberton* – the Township identified issues with the Bayberry and Hanover Dams (Township of Pemberton, 2013)
- *Borough of Pemberton* – the Borough noted that their fire station is located on the banks of the Rancocas Creek, which could be affected by floods (Burlington County HMP, 2008).
- *Township of Riverside* – the Township reported that flooding occurs with heavy rain and high tide on the Rancocas Creek, on Polk Street and Pavilion Avenue at the Delanco-Riverside Bridge. This causes the bridge to be closed until water recedes, and occurs about two to three times per year (Burlington County HMP, 2008).
- *Township of Shamong* – the Township noted that the July 2004 flood event, which had a severe impact on many of Burlington County’s jurisdictions, had a limited impact upon their municipality (Burlington County HMP, 2008).
- *Township of Southampton* – the Township indicated flooding in various areas, including Floyd Avenue, Meadowyck, Retreat/Big Hill, and Bridle Path (Township of Southampton, 2013).
- *Township of Tabernacle* – the Township noted hazard areas along the stream crossing at Bread and Cheese Run and the steam crossing at McKendum Creek (Township of Tabernacle, 2013).
- *Township of Washington* – the Township noted the following problem areas: Route 542 west of Green Bank, near Crowley Landing mile markers 10 to 11, tidal flooding; Route 542 between Lower Bank and Wading River near mile marker 16, non-tidal; Route 652/River Road in Lower Bank between Charles Avenue and the Mullica River, tidal. Washington Township also identified areas of tidal flooding of highways in adjacent jurisdictions that have direct effects upon local highways, streets and emergency services. They are: Atlantic County Rte 563 approaching Green Bank Bridge from Weekstown (fire and emergency medical mutual aid from Weekstown and Mullica Township); Atlantic County Lower Bank Road (“2 Mile Stretch”) approaching Lower Bank Bridge/Route 652 from Egg Harbor City/Atlantic County Route 563 (fire and emergency medical mutual aid from Egg Harbor City); and Burlington County Route 542 in Bass River Township at Merrygold Creek (emergency medical response from Washington Township via State Route 9/Garden State Parkway to Atlantic City Medical Center, mutual aid via Route 9 from New Gretna and Ocean County Fire and EM, and law enforcement response via Route 9 from NJSP – Tuckerton Station (Burlington County HMP, 2008).
- *Township of Westampton* – the Township noted minor flooding occurs along the Rancocas Creek that affects six homes (Township of Westampton, 2013).
- *Township of Willingboro* – the Township noted only isolated incidents of flooding in the past. The Township reported that several locations throughout the area have experienced damage mainly in terms of stream scouring behind residential properties, and that these areas are in need of stream bank restoration and repair to prevent stream blockages from downed trees which lead to flooding in the rear areas of residential properties. In addition, they noted the following

locations which have experienced flooding in the past: Northampton Drive, Pennypacker Drive (Bridge Area floods), Mainbridge Outfall Extension, Fleetwood Place Outfall repair (leads to flooding on Fleetwood Court) (Burlington County HMP, 2008).

- *Township of Woodland* - flooding occurs in remote areas only and does not impact local roadways (Burlington County HMP, 2008).

Dam Break Hazard Area

According to FEMA, three classification levels are adopted for dams: low, significant, and high. The classification levels build on each other. For example, the higher order classifications add to the list of consequences for the lower classification levels, as noted in Table 5.4.4-3. This hazard classification system categorizes dams based on the probable loss of human life and the impacts where persons are only temporarily in the potential inundation area. The classification levels are as follows:

- **Low Hazard Potential** – Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are primarily limited to the owner's property.
- **Significant Hazard Potential** – Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant potential classification dams are often located in predominately rural or agricultural areas but could also be located in areas with population and significant infrastructure.
- **High Hazard Potential** – Dams assigned the high hazard potential classification are those where failure or misoperation will most likely cause loss of human life (FEMA, 2004).

Table 5.4.4-3. Hazard Potential Classification for Dams

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable; one or more expected	Yes (but not necessary for this classification)

Source: FEMA, 2004

According to the New Jersey Department of Environmental Protection (NJDEP), there are four hazard classifications of dams in New Jersey. The classifications relate to the potential for property damage and/or loss of life should the dam fail:

- Class I (High-Hazard Potential) - Failure of the dam may result in probable loss of life and/or extensive property damage
- Class II (Significant-Hazard Potential) - Failure of the dam may result in significant property damage; however loss of life is not envisioned.
- Class III (Low-Hazard Potential) - Failure of the dam is not expected to result in loss of life and/or significant property damage.
- Class IV (Small-Dam Low-Hazard Potential) - Failure of the dam is not expected to result in loss of life or significant property damage. Dam must also meet the requirements of a Class IV dam above.

Refer to Figure 4-24 in the County Profile (Section 4) for dams located in Burlington County. Below are descriptions of high-hazard potential dams in the County that have experienced historical dam flooding.

Table 5.4.4-4. High Hazard Dams in Burlington County

NPDP ID	Dam Name	Dam Type	Location	River	Dam Height (ft)	Dam Storage (acre-feet)
NJ00041	Atsion Lake Dam	Earth Gravity	Shamong Township	Mullica River	19	250
NJ00043	Smithville Dam	Timber Crib	Eastampton Township	North Branch Rancocas Creek	10	65
NJ00151	Sylvan Lake Dam	Earth Gravity	Burlington Township	Mill Stream	18	99
NJ00396	Vincentown Mill Dam	Earth Gravity	Southampton Township	South Branch Rancocas Creek	12	107
NJ00416	Timber Lake Dam	Earth Gravity	Medford Township	Haynes Creek-Tr	19	55
NJ00419	Mishe - Mokwa Dam	Earth Gravity	Medford Lakes Borough	Haynes Creek	13	120
NJ00424	Centennial Lake Dam	Earth Gravity	Medford Township	Haynes Creek	18	344
NJ00425	Breakneck Dam	Earth Gravity	Medford Township	Haynes Creek	14	354
NJ00458	Mirror Lake Dam	Earth Gravity	Pemberton Township	Rancocas Creek	18	1900
NJ00459	Hanover Lake Dam	Earth	Fort Dix	Hartshorne Mill	8	880
NJ00583	Ballinger Lake Dam	Earth Gravity	Medford Lakes Borough	Rancocas Creek-Tr	11	21

Source: NPDP Multi-Attribute Dams Directory Query Summary, Date Unknown.

It is required by the State of New Jersey that all High Hazard and Significant Hazard dams must have NJDEP-approved Emergency Action Plans in place. It is the responsibility of the dam owner to review and update the EAP on an annual basis. New Jersey Dam Safety Standards also require that are periodically inspected to identify conditions that may adversely affect the safety and functionality a dam its appurtenant structures; to note the extent of deterioration as a basis for long term planning, periodic maintenance or immediate repair; to evaluate conformity with current design and construction practices; and to determine the appropriateness of the existing hazard classification. Inspection guidelines, as identified in the State Hazard Mitigation Plan, are reproduced in Table 5.4.4-5 in brief. Complete inspection and operating requirements for dams can be found in the New Jersey Dam Safety Standards (N.J.A.C 7:20-1.11).

Table 5.4.4-5. New Jersey Dam Inspection Requirements

Dam Size/Type	Regular Inspection	Formal Inspection
Class I (High Hazard) Large Dam	Annually	Once every 3 years
Class I (High Hazard) Dam	Once every 2 years	Once every 6 years
Class II (Significant Hazard) Dam	Once every 2 years	Once every 10 years

Table 5.4.4-5. New Jersey Dam Inspection Requirements

Dam Size/Type	Regular Inspection	Formal Inspection
Class III (Low Hazard) Dam	Once every 4 years	Only as required
Class IV (Zero Hazard) Dam	Once every 4 years	Only as required

In New Jersey, every dam in the State as defined in the Safe Dam Act, N.J.S.A. 58:4 is required to meet State dam safety standards. Dam Safety Laws provide the NJDEP with enforcement capabilities to achieve statewide compliance with dam safety standards. This includes issuing orders for compliance to dam owners, and pursuing legal action if the owner does not comply (with the goal of compliance and possible fines levied on a per-day basis for violations).

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with flooding events throughout the State of New Jersey and Burlington County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

According to NOAA's NCDC storm events database, Burlington County experienced 45 flood events between April 30, 1950 and December 31, 2012. Total property damages, as a result of these flood events, were estimated at \$165.5 million. Total crop damages, as a result of these flood events, were estimated at \$1 million. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2012, 21 flood events occurred within the County. The database indicated that severe storm events and losses specifically associated with Delaware County and its municipalities totaled over \$176.5 million in property damage and over \$10,000 in crop damage. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2012, FEMA declared that the State of New Jersey experienced 28 flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: coastal storm, high tides, heavy rain, hurricane, tropical storm, Nor'easter, mudslides, and tropical depression. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, Burlington County has been declared as a disaster area as a result of eight flood events (FEMA, 2012).

Based on all sources researched, known flooding events that have affected Burlington County and its municipalities are identified in Table 5.4.4-6. With flood documentation for the State of New Jersey being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.4-6 may not include all events that have occurred throughout the County and region. Events previously reported in the 2008 County HMP are sourced as "Burlington County HMP".

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
August 1933	Flooding	N/A	N/A	A storm that was approximately equivalent to a four-percent annual chance event struck Burlington County. Local gages recorded flood stages of 9.4 feet at the Delaware River, 8.8 feet at the mouth of Pompeston Creek, and 9 feet at the mouth of Pennsauken Creek. A high water mark was recorded in the Borough of Fieldsboro at 9.3 feet.	FEMA FIS
September 1940	Flooding	N/A	N/A	This was a record event that struck the County. In the Township of Pemberton, 6.7 inches of rain fell. Along the Rancocas Creek North Branch, a gage recorded 1,480 cfs (flood stage of 14.8 feet). A high water mark along the same stream was recorded at 25.6 feet, higher than the deck of the bridge. A gage recorded a flood stage of 12.8 feet along Rancocas Creek South Branch at the Marne Highway bridge. In the Townships of Mount Holly and Lumberton, 150 people were left homeless. The storm also resulted in the failure of the Medford and Taunton Lakes dams.	FEMA FIS
August 17, 1955	Hurricanes Connie and Diane	N/A	N/A	Hurricanes Connie and Diane struck near Burlington County in August. Precipitation from the remnants of Hurricane Diane fell upon soil saturated by rainfall from the remnants of Hurricane Connie that fell only five days earlier. This flood caused record damage in the Delaware and Passaic River Basins. Statewide, 191 deaths and over \$460 million in damages were recorded (1955 dollars). In Burlington County, the City of Burlington was particularly hard-hit, with more structures inundated than in any other community along the Delaware (956 structures damaged).	Burlington County HMP, FEMA FIS
August 26-28, 1971	Heavy Rains and Flooding (Tropical Storm Doria)	DR-310	Yes	Tropical Storm Doria struck New Jersey and resulted in peak flows greater than any recorded at 41 streams throughout the state, including Crosswicks Creek (16.24 feet recorded). Heavy precipitation fell for 32 hours. In Burlington County, northwest areas suffered the greatest in the Delaware River Basin. Burlington County received rainfall ranging from three inches in Bass River to 11 inches at McGuire Air Force Base. In the Delaware River Basin, flooding was primarily along tributaries to the Delaware.	Burlington County HMP, FEMA FIS
July 1975	Heavy Rains, High Winds, Hail and Tornadoes	DR-477	Yes	No reference and/or no damage reported.	FEMA

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
July 14, 1994	Flooding	N/A	N/A	Northwest Portion. Estimated \$500,000 property damage. No further description reported.	Burlington County HMP
January 19, 1996	Flooding	N/A	N/A	No reference and/or no damage reported.	Burlington County HMP
June 19, 1996	Flooding	N/A	N/A	Northwest Portion. Nearly stationary thunderstorms doused northwestern parts of Burlington County. In Tabernacle, 2.75 inches of rain fell within 45 minutes. Three inches of rain fell in Mount Holly, 2.8 inches in Mount Laurel, 2.45 inches in Willingboro and 2.21 inches in Westampton. This caused flash flooding on roadways and smaller creeks. The foundation of one house in Mount Holly collapsed. Up to four feet of water accumulated on several roadways including Burlington County Roads 528 and 537 in North Hanover Township.	Burlington County HMP
July 31, 1996	Flooding	N/A	N/A	Southwest and West Portion. Thunderstorms with heavy rain caused poor drainage flooding and flooding of some of the smaller streams in southwestern and extreme western Burlington County. Kings Highway (New Jersey State Route 41) had four feet of water in several places. Rainfall totals included 1.93 inches in Mount Laurel, 1.84 inches in Mount Holly, and 2.20 inches in Beverly, most of which fell within a two hour period.	Burlington County HMP
August 16, 1996	Flooding	N/A	N/A	Northwest Portion. Thunderstorms caused considerable urban and poor drainage flooding as well as flooding of the smaller streams in the area. Hardest hit was Hanover Township. Storm totals included 3.15 inches at McGuire Air Force Base and 2.49 inches in Mount Holly. Most of this fell within two hours between 6 p.m. and 8 p.m.	Burlington County HMP
October 19, 1996	Flooding	N/A	N/A	Northwest Portion. Rain, heavy at times, during the first half of the day on the 19th caused urban and poor drainage flooding and flash flooding of some of the smaller streams within Burlington County including Barker Brook and Beaverdam Creek. The heavy rain and high astronomical tides forced the closure of the Delanco-Riverside Bridge both the nights of the 19th and 20th. It was the first time in two years that the bridge was closed due to tidal flooding. Representative storm totals included 5.41 inches in Blackwell Mills, 3.8 inches in Mount Holly, 3.68 inches in New Lisbon, 3.39 inches in Willingboro, 3.3 inches in Mount Laurel and 2.44 inches in Atsion.	Burlington County HMP
August 20, 1997	Flooding	N/A	N/A	New Gretna. Torrential rain fell for several hours across the extreme southeast tip of Burlington County. Doppler Radar	Burlington County HMP

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				estimated 6 to 8 inches of rain fell across the extreme southeast tip of the county. Storm totals decreased quickly farther northwest. Only 3.48 inches of rain fell in Atsion, 3.43 inches in New Lisbon and 1.51 inches in Mount Holly. The torrential rain helped set a new record stage height for the East Branch of the Bass River at New Gretna. The river crested at 7.28 feet. The previous record was 6.36 feet on July 4, 1978. According to the United States Geological Survey, this represents a recurrence interval of greater than 100 years. No major damage or injuries were reported.	
August 14, 1999	Flooding	N/A	N/A	Northwest Portion. A series of thunderstorms with torrential downpours caused urban and poor drainage flooding as well as flash flooding of streams and creeks in Mercer County and also in adjoining sections of Northwestern Burlington County. Doppler Radar storm total estimates ranged between 2 and 5 inches across the area. Most of the rain fell within three hours. In Burlington County, storm totals included 3.91 inches at McGuire AFB. No serious injuries were reported.	Burlington County HMP
August 26, 1999	Flooding	N/A	N/A	Northeast Portion. During the late afternoon and early evening of the 26th thunderstorms with torrential downpours caused considerable poor drainage flooding as well as flooding of some of the smaller creeks and streams in northeastern Burlington County around the Lebanon State Forest and in central and northeast Ocean County. Doppler Radar storm total estimates around six inches Manchester Township in Ocean County and Pemberton and Woodland Townships in Burlington County. In Burlington County, several roads in Browns Mills were under water. Reported storm totals included 2.90 inches in New Lisbon and 2.19 inches at the McGuire AFB.	Burlington County HMP
September 16-18, 1999	Hurricane Floyd	EM-3148	Yes	Countywide. Estimate \$7 million in property damage. Hurricane Floyd battered New Jersey (especially the central and northern thirds) and brought with it torrential and in some areas, unprecedented and record breaking rains and damaging winds. The effects of Floyd's outer bands were impacting Mount Holly as early as the 15th, as Floyd was just making landfall at the Mouth of Cape Fear or Bald Head Island in North Carolina. At 5pm on the 16th, Floyd was downgraded to a tropical storm as it passed about 10 miles east of Atlantic City. This hurricane was the greatest natural disaster to ever	Burlington County HMP

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				effect the State of New Jersey. Statewide, most storm totals ranged from three to ten inches, with storm totals increasing farther west with locations along the Delaware River receiving the heaviest amounts. The highest verifiable total was 14.5 inches in Pompton Lakes (Passaic County). The combination of winds funneling into the Delaware Bay and the Delaware River and the record runoff from inland waterways produced minor to moderate tidal flooding at the times of high tide in Cumberland, Salem, Gloucester, Camden and Burlington Counties. Evacuations occurred in low-lying areas near the river. The evening high tide on the 16th also slowed the discharge of streams into the Delaware. In Burlington County, some of the worst flooding occurred along the larger waterways in the area (including the Rancocas Creek) and along tidal sections of tributaries to the Delaware River. Tidal flooding peaked during the evening high tide. In Burlington County, some evacuations occurred in Riverside around the Delanco-Riverside Bridge. The bridge was also closed. Farther upstream along the Rancocas Creek the Centerton Bridge in Willingboro was closed. Voluntary evacuations also occurred along the Delaware River in Delran and roads near the Rancocas Creek were closed. Several evacuations also occurred along the Assiscunk Creek in Burlington City. Creek flooding (mainly the Rancocas) occurred in Medford, Mount Holly and Westampton Townships. About 10 roads in the county were closed due to flooding. The North Branch of the Rancocas Creek in Pemberton crested at 3.2 feet at 9pm on the 17th; flood stage is 2.7 feet. Highest reported wind gusts were 62 mph in Browns Mills. Precipitation storm totals for the four highest report amounts in Burlington County were: 7.07 inches in Mount Laurel, 6.48 inches in New Lisbon, 6.32 inches in Willingboro, and 6.20 inches in Mount Holly. The highest wind gusts were mainly less than 60 mph. Preliminary damage estimates were, for the entire state, \$1.1 billion. Bergen and Somerset Counties were hit the hardest. A federal disaster declaration was issued, but Burlington County, though hard-hit, was not declared. Nearby Philadelphia international airport set a new daily precipitation record of 6.63 inches, and a new 24-hour record of 6.77 inches.	
August 12,	Flooding	N/A	N/A	Northwest Portion. Thunderstorms with copious amounts of	Burlington County

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
2000				rain drifted across northwestern Burlington County during the afternoon and early evening of the 12th. The heaviest rain fell in a swath from Willingboro east through Westampton and Southampton Townships. Residential and poor drainage flooding was reported in Burlington City, Edgewater Park and Willingboro. An off-duty National Weather Service Employee in Willingboro reported that 3 inches of rain fell in 45 minutes. Four major roadways were closed. Farther to the east, two roadways were closed in Westampton Township and U.S. Route 206 was closed in both Eastampton and Southampton Townships. The Rancocas Creek caused some low lying farmland flooding in Eastampton and Southampton Townships. Storm totals included 3.08 inches in Willingboro, 2.31 inches in New Lisbon, 2.14 inches in Lumberton Township and 2.12 inches in Mount Holly. Although no stream flooding was reported, heavy rain in nearby Camden and Mercer Counties produced some poor drainage flooding. In Camden County, U.S. Route 130 from Collingswood to the Airport Circle was flooded. Storm totals included 2.17 inches in Somerdale (Camden County), 1.97 inches in Trenton (Mercer County), 1.65 inches in Pennsauken (Camden County) and 1.43 inches in Hightstown (Mercer County)	HMP
December 17, 2000	Flooding	N/A	N/A	West Portion. An unseasonably warm air mass and an intense low pressure system and cold front produced heavy rain, flooding and high winds across southwest New Jersey. In Burlington County, northwest areas were affected. Doppler Radar storm total estimates were 1.5 to 3.0 inches within this band with the heaviest rain falling in Camden and Burlington Counties. In Willingboro, Beverly-Rancocas Road was closed because of a flooded creek. A flooded creek caused the closure of Rancocas Road in Westampton Township. Storm totals in Burlington County included 2.78 inches in Mount Laurel, 2.70 inches in Mount Holly, and 2.24 inches in Willingboro.	Burlington County HMP
August 4, 2001	Flooding	N/A	N/A	Beverly. Slow moving thunderstorms with torrential downpours produced urban flooding and flash flooding of smaller streams in and around Beverly. Numerous roads were flooded in Beverly. Doppler Radar one hour precipitation estimates reached between 3 and 3.5 inches.	Burlington County HMP
June 19,	Flooding	N/A	N/A	Marlton. Thunderstorms also produced very heavy rain across	Burlington County

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
2002				Evesham Township and caused poor drainage and stream flooding. Vehicles were flooded up to their chassis at the Marlton Traffic Circle (intersection of New Jersey State Routes 73 and 70). Doppler Radar storm total estimates reached between 2 and 3 inches in the township, most of which fell in about an hour.	HMP
July 19, 2002	Flooding	N/A	N/A	Palmyra. Thunderstorms with very heavy rain caused considerable urban and poor drainage flooding as well as creek flooding from Palmyra south to Evesham. Adjusted Doppler Radar storm total estimates indicated that 4 to 5 inches of rain fell within a three hour period in this area. In Mount Laurel Township, State Route 38 near Interstate 295 was flooded. South Jersey Regional Airport in Lumberton Township reported a storm total of 3.04 inches. Elsewhere in the county, the heavy rain apparently contributed to a fatal accident in which three teenage boys were killed on State Route 38 in Southampton Township. The driver was heading westbound and lost control of the vehicle and veered into the eastbound lanes where it struck another vehicle.	Burlington County HMP
July 12, 2004	Severe Storms and Flooding	DR-1530	Yes	Central Portion. Estimated \$50 million in property damage. Thunderstorms with torrential downpours kept on redeveloping along the Interstate 295 corridor in southern Burlington County and moved east, continuing for several hours and resulting in widespread storm totals exceeding 6 inches across most of the Rancocas Creek Basin. A storm total of 13.2 inches was reported in Tabernacle within a 12 hour period and represented a once in a thousand year storm. The excessive rain caused record breaking flash flooding along nearly every stream in the Rancocas Basin and led to the failure or damage of 51 dams in Burlington County. 21 dams were destroyed (eight of the dams were classified as significant hazard and 13 were classified as low hazard) and another 26 dams were damaged. Widespread poor drainage flooding also occurred. The combination of the dam failure and stream flooding led to the evacuation of 760 residents; the destruction of seven homes in Lumberton and Southampton Townships; major flood damage to around 200 homes; flood damage to about 1,000 homes;	Burlington County HMP, FEMA

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				countless water rescues from vehicles and homes; the closing of 25 major roads including the New Jersey Turnpike, New Jersey State Routes 70 and 73; the contamination of drinking water and failure of sewage systems and the serious damage or destruction of fourteen bridges. Hardest hit municipalities included Lumberton, Medford (receiving over 17 inches of rainfall that resulted in the failure of several dams in Medford and Medford Lakes, and causing severe flooding in the Birchwood Lakes, Oakwood Lakes, and Lake Cotoxen areas as well as all along the Rancocas Cree, with numerous homes damaged or destroyed and total damage to public property of an estimated \$2 million, according to Medford Township), Medford Lakes, Mount Laurel, Pemberton and Southampton all of whom declared states of emergency. Agricultural damage was estimated in the millions of dollars, especially to the cranberry bogs where many retention walls and earthen roads were damaged. Property damage was estimated at \$50 million. Rainfall totals in Burlington County included 13.2 inches in Tabernacle, 11.23 inches in New Lisbon, 7.5 inches at Mount Holly Airport, 6.27 inches in Mount Laurel, and 6.17 inches at McGuire Air Force Base. One hundred and twenty-five homes were damaged and three were destroyed. Most of the flooded homes remained flooded for several days. Although there was no warning to the residents of Lumberton in advance of the flood there were no serious injuries. Lumberton's only fire house was flooded and could not have responded to a fire emergency. A sanitary sewer pump station was inundated and had to be replaced. Route 541 was flooded and could not be used to transport victims/patients to the area hospital in Mount Holly. Property losses in Lumberton covered by FEMA amounted to \$3.4 million and additional losses were estimated at \$9.1 million.	
August 31, 2004	Flooding	N/A	N/A	Central Portion. Thunderstorms with heavy rain associated with the remnants of Tropical Storm Gaston caused poor drainage flooding and some stream flooding mainly across the central portion of Burlington County. Doppler Radar storm total estimates exceeded 1.50 inches across much of the central portion of the county. While smaller streams flooded, the crests were much lower than they were on July 12th (during	Burlington County HMP

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				the dam break event). In Pemberton Township, flooding was reported in the Lace Valley Development and flood waters reached vehicle's windows on College Avenue. Storm totals included 7.00 inches in Southampton Township, 3.74 inches in New Lisbon, 3.20 inches in Mount Holly, 2.28 inches in Mount Laurel Township and 2.09 inches in Lumberton Township.	
August 8, 2005	Flooding	N/A	N/A	Northwest Portion. Repeated thunderstorms with very heavy rain caused poor drainage flooding and flooding of some of the smaller streams in northwestern Burlington County from Mount Laurel and Burlington Townships east through Medford Lakes Borough. Saint Andrews Drive in the Ramblewood section of Mount Laurel looked like a lake. Specific storm totals included 3.00 inches in Tabernacle and 2.78 inches in Burlington Township.	Burlington County HMP
October 14, 2005	Flooding	N/A	N/A	Rancocas Basin. County-wide three-day storm totals of 3 to 6 inches. Around 20 families in Eastampton and Lumberton Townships evacuated. In Eastampton Township, flooding along Rabbit Run and the North Branch of the Rancocas Creek cause evacuations from three blocks in the Ewansville Section of the township. Several dozen homes were surrounded by flood waters. In Lumberton Township, two blocks of the downtown section were evacuated. In Southampton Township, minor flooding occurred along the South Branch of the Rancocas Creek in the Vincentown Village. The Trinity Episcopal Church barely avoided being flooded again. In Pemberton Township, two roads were closed near the North Branch of the Rancocas Creek.	Burlington County HMP
January 4, 2006	Flooding	N/A	N/A	A low pressure system that exited the Delaware coast on the 3rd and runoff from the heavy rain produced some minor tidal flooding during the daytime high tide on the 4th in Upper Delaware Bay and along the Delaware River as well as along tidal sections of its tributaries.	Burlington County HMP
December 31, 2006	Flooding	N/A	N/A	Widespread minor tidal flooding during the daytime high tide along the Delaware River and tidal sections of its tributaries during the late morning and afternoon.	Burlington County HMP
June 24, 2006	Flooding	N/A	N/A	West Central Portion. Thunderstorms with heavy rain caused flooding of roadways and small streams from central Gloucester County northeast through central portions of Burlington County. Doppler Radar storm total estimates average 2 to 4 inches in this area. Roadway closures in	Burlington County HMP

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				Burlington County occurred in Burlington, Pemberton and Southampton Townships. Measured storm totals included 2.89 inches in Medford and 2.59 inches in Wrightstown.	
June 27, 2006	Flooding	N/A	N/A	Freshwater run-off from heavy rain combined with the higher of the two astronomical high tides of the day to cause moderate tidal flooding during the early morning on the 28th and 29th and minor tidal flooding during the early morning on the 27th and 30th. To a lesser degree flooding extended inland on tidal sections of tributaries to the Delaware River. The highest tides occurred during the early morning on the 29th. In Burlington County minor flooding occurred with the early morning high tides on the 27th through the 29th in Burlington City, Delran and Bordentown. The Delanco-Riverside Bridge was closed around the early morning high tide on the 28th and 29th.	Burlington County HMP
October 6-7, 2006	Flooding	N/A	N/A	No reference and/or no damage reported.	Burlington County HMP
October 28, 2006	Flooding	N/A	N/A	No reference and/or no damage reported.	Burlington County HMP
November 8, 2006	Flooding	N/A	N/A	Heavy rain caused flooding along Parkers Creek in Mount Laurel. Union Mill Road was closed. Storm totals included 3.47 inches in Wrightstown, 2.86 inches in Willingboro, 2.54 inches in Medford, 2.51 inches in Chatsworth, 2.47 inches in Mount Laurel, 2.38 inches in Burlington Township and 1.94 inches in Southampton.	Burlington County HMP
November 16, 2006	Flooding	N/A	N/A	No reference and/or no damage reported.	Burlington County HMP
January 1, 2007	Flooding	N/A	N/A	No reference and/or no damage reported.	Burlington County HMP
January 8, 2007	Heavy Rain and Flooding	N/A	N/A	Heavy rain that fell during the evening and overnight on the 7th caused poor drainage flooding and flooding along Parkers Creek in Mount Laurel Township. Union Mill Road was closed between Briggs and Hartford Roads. Storm totals included 1.83 inches in Mount Laurel and Southampton, 1.77 inches in Lumberton, 1.75 inches in Medford, 1.71 inches in Mount Holly and 1.66 inches in Willingboro.	Burlington County HMP
March 2, 2007	Flooding	N/A	N/A	High stages along the Delaware River	Burlington County HMP
April 14-20, 2007	Severe Storms and Inland and Coastal Flooding	DR-1694	Yes	Major flooding in locations throughout the State and County. The April 15 and 16 nor'easter dumped upwards of 7 inches of rain across the state. The damage cost in Burlington County	BCOEM, NWS, local news reports, NJOEM, FEMA,

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				was estimated at \$8.3 million, with Lumberton, Medford and Southampton among the most seriously affected. The Rancocas watershed was particularly impacted, with heavy rainfall coupled with unusually high tides. Gages along the main stem of the Delaware River experienced 1.5-year to 4-year events. Tributaries to the Delaware River generally experienced 4-15 year return interval floods, except on the Southwest Branch and South Branch of the Rancocas Creek in Burlington County where peaks equaled approximately the 30 and 50-year return interval flood, respectively. In Delran Township, roads were closed in the Riverside Park neighborhood. The fire department responded to numerous calls for assistance pumping out basements. Maple Shade Township experienced power outages. EMS, police and DPW employees worked overtime. Pemberton Township had road closures, utility outages and commercial closures and had an estimated \$29 K in losses. Acting Governor Codey declared a state of emergency for New Jersey. Damages for the State were estimated at over \$180 M in property damages. FEMA issued a disaster declaration for this event, which included Burlington County. Overall, FEMA approved \$18,821,508.61 in IA and \$17,513,033.42 in PA.	NOAA-NCDC, SHELDUS, Planning Committee Input
June 6, 2008	TSTM / Flooding	N/A	N/A	Thunderstorms brought heavy rain during the late afternoon of the 6th, causing roadway flooding and flooding of smaller creeks in and around Palmyra Borough. Several roads in Palmyra were flooded and some minor flooding also occurred at the entrance of the Palmyra Tacony Bridge.	NOAA-NCDC
September 6, 2008	Remnants of Tropical Storm Hanna	H/A	N/A	Heavy rain associated with Tropical Storm Hanna caused widespread heavy rain and poor drainage flooding, especially in the northern part of New Jersey. The runoff also caused some isolated flooding along some of the smaller streams and creeks in the area. Flash flooding occurred in and around Palmyra Borough. The Tacony-Palmyra Bridge Toll Plaza was flooded and all eastbound traffic into New Jersey was halted for about 45 minutes until the water receded. Two other roadways in Palmyra were also closed. Doppler Radar adjusted storm total amounts exceeded three inches in the borough. Some roadway lane closures occurred in Pemberton Township	NOAA-NCDC

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				because of the heavy rain. Event precipitation totals included 2.25 inches in Willingboro Twp., 2.18 inches in Mount Holly Twp., 1.98 inches in Wrightstown Borough and 1.76 inches in Burlington Twp.	
June 13, 2009	Flooding	N/A	N/A	Widely scattered but slow moving thunderstorms with heavy rain affected southern New Jersey during the afternoon on the 13th and caused isolated flooding. The torrential rain caused poor drainage and stream flooding in Medford Township. Several roads were closed. Hardest hit roadways were the intersection of New Jersey State Route 70 and Hartford Road in the township. One car was stranded in the flood waters. Doppler Radar storm total estimates reached between 3 and 4 inches in parts of Medford and Southampton Townships; most fell within one hour.	NOAA-NCDC
December 26, 2009	Melting Snow / Flooding	N/A	N/A	The combination of melting snow and between 1.5 and 3.0 inches of rain led to poor drainage and widespread river flooding in New Jersey. The North Branch of the Rancocas Creek at Pemberton Twp. was above its 2.5 foot flood stage from 8:15 p.m. on the 26th through 11:00 a.m. on the 30th. It crested at 3.06 feet at 100 a.m. on the 28th. Event precipitation totals included 2.34 inches in Medford Twp., 2.1 inches in Moorestown Twp., 2.02 inches in Mount Laurel Twp., 1.92 inches in Pemberton Twp. and 1.74 inches in Mount Holly Twp.	NOAA-NCDC
February 24, 2010	Snowstorm	DR-1873	Yes	A protracted period of rain coupled with snow melt caused flooding of some of the more flood prone creeks and rivers in central and southern New Jersey from the 24th into the 27th. Ironically it was snowing when some of the waterways were above flood stage on the 25th and 26th. The North Branch of the Rancocas Creek at Pemberton was above its 2.5 foot flood stage from 11 a.m. on the 24th through 330 p.m. on the 27th. It crested at 2.66 feet at 2 a.m. on the 25th. Precipitation totals included 1.69 inches in Pemberton Twp., 1.31 inches in Medford Twp., 1.15 inches in Moorestown Twp., 1.09 inches in Mount Laurel Twp., and 0.97 inches in Burlington Twp.	NJOEM, NOAA-NCDC, FEMA
March 13, 2010	Flooding	N/A	N/A	Four days of rain, heaviest on the 13th, culminated in major flooding in the Passaic and Raritan Basins and flooding throughout New Jersey. Four day storm totals averaged	NOAA-NCDC, NJOEM

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				around 2.5 to 6 inches with the highest amounts in the Raritan and Passaic Basins. It was the worst flooding in the Raritan Basin since April of 2007 and the worst flooding in the Passaic Basin since April of 1984. Damage was estimated at 30 million dollars as thousands of homes and businesses were damaged. New Jersey Governor Chris Christie declared a state of emergency on March 14th. The North Branch of the Rancocas Creek at Pemberton Twp. was above its 2.5 foot flood stage from 545 p.m. on the 13th through 615 a.m. on the 19th. It crested at 3.68 feet at 115 p.m. on the 15th. Event precipitation totals included 4.16 inches at the McGuire Air Force Base, 3.86 inches in Medford Twp., 3.84 inches in Moorestown Twp. and 3.06 inches in Mount Holly Twp.	
March 29, 2010	Flooding	N/A	N/A	A series of low pressure systems that brought between two and five inches of rain from the evening of the 28th into the early morning of the 31st. Coupled with already wet antecedent conditions, the rain caused renewed flooding in New Jersey, especially in the Raritan and Passaic Basins. While the flooding was not as severe as it was in the middle of the month, it took until early April for all of the rivers to recede back within bankfull. The North Branch of the Rancocas Creek at Pemberton was above its 2.5 foot flood stage from 715 p.m. EDT on the 29th through 100 p.m. EDT on April 3rd. It crested at 3.51 feet at 1230 p.m. EDT on the 31st. Event precipitation totals included 3.70 inches in Pemberton Twp., 3.30 inches in Mount Holly Twp. and 3.21 inches in Mount Laurel Twp.	NOAA-NCDC
April 1, 2010	Severe Storms and Flooding	DR-1897	Yes	River and stream flooding from the heavy rain that fell on March 28th and 30th continued through April 4th in parts of Morris, Somerset, Burlington, Ocean, Salem and Cumberland Counties. A federal disaster was declared for the State of New Jersey (DR-1897) for severe storms and flooding, and Individual Assistance funding was made available. The North Branch of the Rancocas Creek at Pemberton Twp. was above its 2.5 foot flood stage from 715 p.m. on March 29th through 1:00 p.m. on April 3rd. It crested at 3.51 feet at	NOAA-NCDC, FEMA, NJOEM

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				12:30 p.m. on March 31st.	
July 14, 2010	Flooding	N/A	N/A	For the second consecutive day, thunderstorms with torrential downpours caused flash flooding of smaller creeks as well as urban and poor drainage flooding in the Philadelphia suburbs in southwestern New Jersey. Doppler Radar two day storm total estimates reached as high as 6 inches. Torrential downpours caused the closure of Northbound State Route 73 near Greentree Road in Evesham Twp. Two day Doppler Radar storm total estimates reached 5 to 6 inches in Burlington County. At South Jersey Regional Airport in Lumberton Twp., 3.72 inches of rain fell during the afternoon of the 14th.	NOAA-NCDC
April 16-17, 2011	Flooding	N/A	N/A	Heavy rain caused poor drainage and stream and river flooding, mainly in west central and northern New Jersey. Major flooding occurred again in sections of the Passaic River Basin. Flooding along Parkers Creek in Mount Laurel Township forced the closure of Union Mill Road. The heavy rain also caused basement flooding of homes on Oregon Trail in Medford Township. Event precipitation totals included 2.89 inches in Mount Laurel Twp., 2.79 inches in Lumberton Twp., 2.78 inches in Westampton Twp., 2.61 inches in Medford Twp., 2.50 inches in Wrightstown Twp., 2.46 inches in Moorestown Twp., 2.43 inches in Southampton Twp., 2.33 inches in Medford Lakes Twp. and 2.32 inches in Burlington Twp. SHELDUS reported \$250,000 in damages for Burlington County.	SHELDUS, NOAA-NCDC
July 6, 2011	Flooding	N/A	N/A	Scattered strong to severe thunderstorms affected central New Jersey during the afternoon and into the early evening of the 6th. Flash flooding occurred in northwestern Burlington County. Adjusted Doppler Radar storm total estimates were 3 to 4 inches in parts of Florence, Mansfield and Bordentown Townships. Thunderstorms with heavy rain caused flash flooding along the U.S. Route 206 corridor in Bordentown Twp. A couple of water rescues occurred and no injuries were	NOAA-NCDC

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				reported. Adjusted Doppler Radar storm total estimates were 3 to 4 inches in parts of Bordentown Twp. More small stream and roadway flash flooding occurred in Florence Township, where adjusted Doppler Radar storm total estimates were 3 to 4 inches. An observer in neighboring Chesterfield Township measured 2.49 inches of rain.	
September 4, 2012	Hurricane Irene	DR-4021 EM-3332	Yes	Successive waves of thunderstorms with very heavy rain overnight on the 3rd into the 4th produced flash flooding in southeastern Burlington County, including small stream and poor drainage flooding in sections of Bass River and Woodland Township. The runoff from the torrential rains caused flooding along the Oswego and Wading Rivers that lasted into the 6th. Additional thunderstorms during the next couple of days slowed the recession of the flooding along those rivers. Flooding affected Burlington County Routes 563 and 679. Burlington County Route 563 was closed and barricaded at the Evans Bridge in Wading River. The bridge was expected to remain closed at least into the 7th until it could be evaluated for damage. The roadway itself was closed between Greenbank-Chatsworth Road in Washington Township and Leektown Road in Bass River Township. In Delran Township, roads were closed throughout. In Evesham Township, the Township experienced power outages, road closures and damages, and flooding. Residential structures had flood damage. Doppler Radar storm total estimates reached around 10 inches in southeastern Burlington County, more than half of which fell with the first wave of torrential downpours. Event precipitation totals included 5.19 inches in Chatsworth (Woodland Township).	NOAA-NCDC, Planning Committee Input
August 28-31, 2011	Hurricane Irene	EM-3332 DR-4021	Yes Yes	Hurricane Irene hit the State of New Jersey on August 27th, resulting in a state disaster declaration August 29th and a presidential disaster declaration August 31st. Irene produced torrential downpour rains that resulted in major flooding and a number of record breaking crests on area rivers, including the Rancocas Creek in Burlington County. Flooding lasted as long as September 5th. Thousands of homes were flooded;	NOAA-NCDC, SHELDUS, Planning Committee Input

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				including approximately 300 basements in Burlington City. Record flooding along the North Branch of the Rancocas Creek affected Mount Holly Twp. About 300 families were evacuated. The township municipal building, the county courthouse, and many downtown roads were flooded. Farther upstream, many properties were flooded in the Unionville section of Eastampton Twp. and the North Pemberton Railroad Station was badly damaged. Dozens of homes were flooded in downtown Lumberton Twp. along the South Branch of the Rancocas Creek. In the southeastern part of the county, flooding occurred at both the Mullica and Batsto Rivers, and Batsto Village was damaged. In Maple Shade Township, shelters had to be open to house residents who were affected. The Township had numerous road closures and approximately \$33 K in property damages. Mansfield Township experienced numerous road closures and power outages. Westampton Township reported road closures, utility outages and commercial closures. Washington Township opened a shelter for residents; experienced flooding and power outages. Batsto and Pleasant Mills Bridges/Route 542 were damaged. Tabernacle Township reported minor power outages. Springfield Township had power outages and road closures; roads were damaged and the fire department had to pump out basements. Southampton Township had to evacuate residents; flooding caused extensive damage to portions of the Township (south branch of the Rancocas River). Roads were closed due to debris and flooding. Forty-six homes had minor damage. Pemberton Township had road closures, utility outages and commercial closures and had an estimated \$42 K in losses. Palmyra Borough experienced downed trees and utility lines. Shelters were open for residents. The North Branch of the Rancocas Creek at Pemberton had a record breaking major flooding crest of 4.91 feet at 8:15 a.m. on the 29th. The creek was above its 2.5 foot flood stage from 11:45 p.m. on the 27th through 6:45 p.m. on Sept. 1st. Event rainfall totals included 7.14 inches in Chesterfield Twp., 6.67 inches in Mount Laurel Twp., 6.66 inches in West Moorestown Twp., 6.37 inches in Hainesport Twp. and 6.28 inches in	

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				Moorestown Twp. Damage from the storm was so widespread that for the first time in state history, all 21 counties became eligible for both Individual Assistance (IA) and Public Assistance (PA). At the time of this report, a total \$176.6M in IA had been approved and \$111.9M in PA had been obligated throughout the state of New Jersey. Burlington County had approximately \$500K in damage due to the storm.	
September 1, 2011	Flooding	N/A	N/A	While all the highest crests with Irene occurred in August, river and creek flooding persisted into September in parts of Burlington County. The North Branch of the Rancocas Creek at Pemberton Twp. had a record breaking major flooding crest of 4.91 feet at 8:15 a.m. on August 29th. The creek was above its 2.5 foot flood stage from 11:45 p.m. on August 27th through 6:45 p.m. on September 1st.	NOAA-NCDC
September 29, 2011	Flooding	N/A	N/A	The combination of fresh water runoff, unusually high spring astronomical tides and a weak southeasterly flow produced moderate tidal flooding during the afternoon high tide cycle along tidal sections of the Delaware River and its tributaries. While the worst tidal flooding for this event occurred during that afternoon, minor tidal flooding also occurred during the afternoon of the 28th, early morning of the 29th, and the late afternoons of September 30th, October 1st and October 2nd. In Burlington County, tidal sections of the Rancocas Creek also flooded. Flooding along the Delaware River affected Stewart Avenue and River Drive in Delran Township. Tidal flooding also affected the East Riverton section of Cinnaminson Township as the Pompeston Creek also flooded. Dozens of homes were flooded along Zeisner Avenue and Kern Street. River Road was also flooded. In both Delran and Cinnaminson, flood waters reached into basements and made it impossible to use indoor plumbing. In Camden County, the Admiral Wilson Boulevard flooded. The afternoon high tide in Burlington City reached 10.51 feet above mean lower low water. There is no current categorical tide gage information for this site.	SHELDUS. NOAA-NCDC

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				Burlington County had approximately \$100K in damages.	
September 2012	Flooding	N/A	N/A	In Washington Township, the Evans Bridge/Route 563 sustained damage. Roads were closed due to flooding. The Pine Island Cranberry Company sustained damage to agricultural infrastructure and crops.	Planning Committee Input
October 26 – November 8, 2012	Hurricane Sandy	EM-3354 DR-4086	Yes Yes	Hurricane Sandy made landfall in New Jersey on October 28, causing widespread damage. The result of the storm was devastation to homes and infrastructure along the Delaware River and near the Atlantic coast in Burlington County, and record disruptions of transportation and communications. The heavy rain caused urban and poor drainage flooding and exacerbated the tidal flooding along the Delaware River and near the Atlantic coast in Burlington County. Along the Delaware River, tidal flooding occurred in the Columbus Park Development along the Assiscunk Creek in Burlington City. The most widespread damage (mainly tidal and flood related) was reported in Bass River Township. Westampton Township reported road closures, utility outages and commercial closures. Tabernacle Township reported minor damage with power outages. Springfield Township had power outages and road closures; many pieces of road and safety equipment were lost during the storm. Southampton Township reported utility outages in the Liesuretowne section of the Township which affected 342 homes, in addition to homes in the areas of Burrs Mills Road and Firelane for four days. Thirty homes experienced minor to major damage. Pemberton Township had road closures, utility outages and commercial closures. The Bayberry Dam had infrastructure damage. In Mount Laurel Township, Union Mill Road was closed because Parkers Creek flooded. The North Branch of the Rancocas Creek at Pemberton was above its 2.5 foot flood stage from 430 p.m. on the 30th through 6 p.m. on the 31st. It crested at 2.58 feet at 130 a.m. on the 31st. The McDonald's Branch in Woodland Township was above its 1.7 foot flood stage from 345 p.m. through 944 p.m. on the 27th, cresting at 1.71 feet at 4 p.m. In Delran Township, roads were closed throughout the	SHELDUS, NOAA-NCDC, NJOEM, FEMA, Planning Committee Input

Table 5.4.4-6. Flooding Events between 1933 and 2013.

Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
				Township. In Evesham Township, power outages, road closures and damages, and flooding were all reported. Minor damages were reported to roadways and sidewalks due to downed trees. The MUA pump station experienced minor damage. The Township reported approximately \$29K in damages. Hainesport Township had to remove debris throughout the Township as a result of hurricane-force winds. The Township DPW building sustained damage. Mansfield Township experienced numerous road closures and power outages. Event precipitation totals included 4.10 inches in Medford Township, 3.51 inches in Woodland Township at Chatsworth, 3.15 inches in Medford Lakes Borough, 2.92 inches in Mount Laurel Township, 2.82 inches in Moorestown Township, and 2.42 inches in Westampton Township. A federal emergency declaration was announced for New Jersey on October 29, and a major disaster declaration followed the next day, making IA and PA funds available to affected residents. At the time of this report, a total \$274.9M in IA had been approved and \$81M in PA had been obligated throughout the State of New Jersey.	

Note (1): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

B	Billion
DR	Federal Disaster Declaration
EM	Federal Emergency Declaration
FEMA	Federal Emergency Management Agency
IA	Individual Assistance
K	Thousand (\$)
M	Million (\$)
N/A	Not applicable
NCDC	National Climate Data Center
NOAA	National Oceanic Atmospheric Administration
NWS	National Weather Service
PA	Public Assistance
SHELDUS	Spatial Hazard Events and Losses Database for the U.S.
Twp.	Township

Federal Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study (FIS). The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard.

The FIRMs depict Special Flood Hazard Areas - those areas subject to inundation from the 1-percent annual chance flood (also known as the Base Flood or the 100-Year Flood). Those areas are defined as follows:

- Zones A1-30 and AE: Special Flood Hazard Areas that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base Flood Elevations are shown within these zones.
- Zone A (Also known as Unnumbered A Zones): Special Flood Hazard Areas where, because detailed hydraulic analyses have not been performed, no Base Flood Elevations or depths are shown.
- Zone AO: Special Flood Hazard Areas that are subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
- Zone VE, V1-30: Special Flood Hazard Areas along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base Flood Elevations derived from detailed hydraulic analysis are shown within these zones.
- Zone B and X (shaded): Zones where the land elevation has been determined to be above the Base Flood Elevation, but below the 500 year flood elevation. These zones are not Special Flood Hazard Areas.
- Zones C and X (unshaded): Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500-year flood elevation. These zones are not Special Flood Hazard Areas.

NFIP data for Burlington County is presented further in **Error! Reference source not found.** in the Vulnerability Assessment section of this profile.

Biggert-Water Flood Insurance Reform Act of 2012

In July 2012, the U.S. Congress passed the Biggert-Water Flood Insurance Reform Act of 2012 (BW-12) which calls on FEMA and other agencies to make a number of changes to the way the NFIP is run. Key provisions of the legislation will require the NFIP to raise rates to reflect true flood risk, make the program more financially stable, and change how FIRM updates impact policyholders. BW-12 also eliminated the Repetitive Flood Claims and Severe Repetitive Loss programs and made significant changes to the Flood Mitigation Assistance (FMA) program. These changes include:

- The definitions of repetitive loss and severe repetitive loss properties were modified
 - A severe repetitive loss property is a structure that is covered under a contract for flood insurance made available under the NFIP. These properties have incurred flood-related damage for which four or more separate claims payments have been made under flood

insurance coverage with the amount of each such claim exceeding \$5,000 and with the cumulative amount of such claims payments exceeding \$20,000. Or for which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding that market value of the insured structure.

- A repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that has incurred flood-related damage on two occasions, in which the cost of the repair, on average, equaled or exceeded 25% of market value of the structure at the time of each such flood event. Also, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.
- There is no longer a State cap of \$10 million or a community cap of \$3.3 million for any five-year period
- There is no longer a limit on in-kind contributions for the non-federal cost share
- Mitigation reconstruction is an eligible activity
- Cost-share requirements have changed to allow more federal funds for properties with repetitive flood claims and severe repetitive loss properties
- The development or update of mitigation plans shall not exceed \$50,000 federal share to any applicant or \$25,000 federal share to any sub applicant
- There is no longer a restriction that a planning grant can only be awarded not more than one every five years to a state or community (FEMA, 2013).

Homeowners of certain older properties in high-risk areas have been charged premiums that do not reflect the full flood risk. Only properties known as “pre-FIRM” were eligible for these subsidies. Only 20% of NFIP policies are subsidized. BW-12 requires FEMA to phase out these subsidies for certain properties and prohibits FEMA from offering subsidies for other pre-FIRM properties. Not all subsidies will be removed the same way at the same time (FEMA, 2013). Increases to pre-FIRM subsidized rates include the following:

- By January 1, 2013 – owners of non-primary residences with pre-FIRM subsidized rates will see a 25% annual increase until full-risk rates are reached
- By October 1, 2013:
 - Owners of businesses with pre-FIRM subsidized rates will see a 25% annual increase until full-risk rates are reached
 - Owners of properties of one to four residences with a pre-FIRM subsidized rate that have experienced severe or repetitive flooding will see a 25% annual increase until full-risk rates are reached
 - Pre-FIRM subsidized policies first in effect on or after July 6, 2012 will move directly to full-risk rates
 - Pre-FIRM subsidized policies on homes purchased on or after July 6, 2012 will move directly to full-risk rates
 - Lapsed pre-FIRM subsidized policies reinstated on or after October 4, 2012 will move directly to full-risk rates (FEMA, 2013)

Upon a revised or updated flood map, BW-12 requires adjustment and phase-in rates over five years to accurately reflect the current risk of flood to properties (FEMA, 2013).

In New Jersey there are a total of 2,097 SRL properties throughout the State. Burlington County has a total of nine SRL properties.

Community Rating System (CRS)

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions to meet the CRS goals of reducing flood losses, facilitating accurate insurance rating, and promoting awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5%. For example, a Class 1 community would receive a 45% premium discount, and a Class 9 community would receive a 5% discount (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities (discussed below) can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks. The CRS program is administered by the Insurance Services Office (ISO) under contract to FEMA.

As of May 2013, FEMA reports that two communities in Burlington County participate in the CRS, achieving benefits in the form of premium discounts for their policy holders, in recognition of the community's efforts to exceed the minimum requirements of the NFIP (Table 5.4.4-7).

Table 5.4.4-7. CRS Communities in Burlington County

Community Name	Community Number	CRS Entry Date	Current Effective Date	Current Class	Discount for Special Flood Hazard Areas	Discount for Non-Special Flood Hazard Areas	Status
Burlington, City of	345287	04/01/98	10/01/03	8	10%	5%	Current
Palmyra, Borough of	340110	10/01/09	10/01/09	8	10%	5%	Current

Source: FEMA, 2013

Note: Current as of May 1, 2013

Probability of Future Events

Given the history of flood events that have impacted Burlington County, it is apparent that future flooding of varying degrees will occur. The fact that the elements required for flooding exist and that major flooding has occurred throughout the county in the past suggests that many people and properties are at risk from the flood hazard in the future.

In Section 5.3, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for flood in the County is considered 'frequent' (likely to occur within 25 years, as presented in Table 5.3-3).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the flood hazard, the 1% annual chance event (100-year) is examined for exposure and estimated losses and the 0.2-percent annual chance event (500-year) for exposure. The following text evaluates and estimates the potential impact of flooding in Burlington County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health, (2) general building stock, (3) critical facilities and infrastructure, (4) economy and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

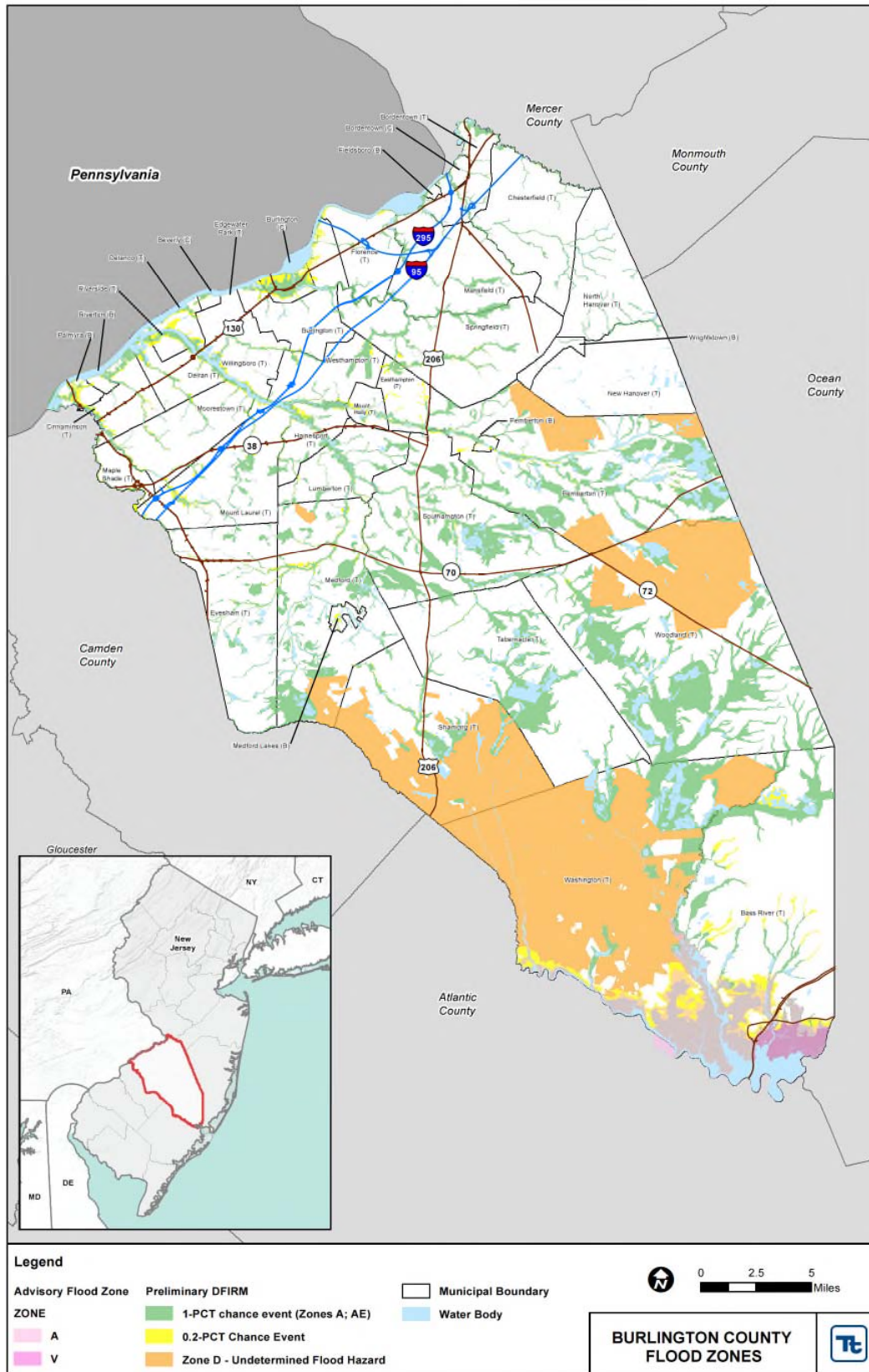
Flood is a significant concern for Burlington County. To assess vulnerability, potential losses were calculated for the County for 1-percent annual chance (100-year) Mean Return Period (MRP) flood events. The flood hazard exposure and loss estimate analysis is presented below.

Data and Methodology

The 1-percent annual chance flood event was examined to evaluate Burlington County's risk and vulnerability to the flood hazard. The Preliminary Digital Flood Insurance Rate Map (DFIRM) with the addition of the Advisory Base Flood Elevation V-zone were used to estimate exposure and estimate potential losses using HAZUS-MH. HAZUS-MH flood modeling was used to generate approximate 1-percent annual chance flood boundaries within the areas covered by the two military installations where data is not available in the preliminary DFIRM.

The HAZUS-MH model uses 2000 U.S. Census demographic data. This data was not updated for this analysis due to technical availability; however, the 2010 U.S. Census data was used to estimate population exposure to provide the best available output. In terms of building data, both the total improved values from the parcel dataset provided by Burlington County Department of Information Technology and the parcel data from New Jersey's Geographic Information Network (for the City of Beverly only), and the HAZUS-MH default general building stock replacement cost values were used for this analysis. Figure 5.4.4-2 illustrates the flood boundaries used for this vulnerability assessment.

Figure 5.4.4-3. Burlington County Flood Zones



Source: FEMA preliminary DFIRM and Advisory boundaries provided by Burlington County GIS

Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable.

To estimate the population exposed to the 1-percent flood event, the floodplain boundaries were overlaid upon the 2010 Census population data in GIS (U.S. Census 2010). Census blocks do not follow the boundaries of the floodplain. The 2010 Census blocks with their centroid the flood boundaries were used to calculate the estimated population exposed to this hazard. Using this approach, it is estimated that 21,740 people are within the 1-percent annual chance floodplain or 4.8% of the total County population. Table 5.4.4-8 lists the estimated population located within the 1-percent annual chance flood zone by municipality.

Table 5.4.4-8. Estimated Burlington County Population Exposed to the 1-Percent Flood Hazard (2010 Census)

Municipality	Total Population	1-Percent Annual Chance Event	
		Estimated Population Exposed	Percent Population in Boundary
Bass River (T)	1,143	326	28.5%
Beverly (C)	2,577	125	4.9%
Bordentown (C)	3,924	137	3.5%
Bordentown (T)	11,367	751	6.6%
Burlington (C)	9,920	5,560	56.0%
Burlington (T)	22,629	571	2.5%
Chesterfield (T)	7,689	22	0.3%
Cinnaminson (T)	15,560	539	3.5%
Delanco (T)	4,283	191	4.5%
Delran (T)	16,896	570	3.4%
Eastampton (T)	6,069	36	0.6%
Edgewater Park (T)	8,881	0	0.0%
Evesham (T)	45,538	1,450	3.2%
Fieldsboro (B)	540	0	0.0%
Florence (T)	12,109	88	0.7%
Hainesport (T)	6,051	175	2.9%
Lumberton (T)	12,559	911	7.3%
Mansfield (T)	8,546	110	1.3%
Maple Shade (T)	19,172	464	2.4%
Medford (T)	23,006	1,466	6.4%
Medford Lakes (B)	4,146	243	5.9%
Moorestown (T)	20,815	171	0.8%
Mt. Holly (T)	9,536	606	6.4%
Mt. Laurel (T)	42,102	673	1.6%

Table 5.4.4-8. Estimated Burlington County Population Exposed to the 1-Percent Flood Hazard (2010 Census)

Municipality	Total Population	1-Percent Annual Chance Event	
		Estimated Population Exposed	Percent Population in Boundary
New Hanover (T)	7,385	0	0.0%
North Hanover (T)	7,686	160	2.1%
Palmyra (B)	7,398	599	8.1%
Pemberton (B)	1,412	0	0.0%
Pemberton (T)	27,909	1,734	6.2%
Riverside (T)	8,079	271	3.4%
Riverton (B)	2,779	35	1.3%
Shamong (T)	6,493	281	4.3%
Southampton (T)	10,464	1,588	15.2%
Springfield (T)	3,374	52	1.5%
Tabernacle (T)	6,971	166	2.4%
Washington (T)	695	348	50.1%
Westampton (T)	8,816	487	5.5%
Willingboro (T)	31,629	621	2.0%
Woodland (T)	1,782	167	9.4%
Wrightstown (B)	804	46	5.7%
Burlington County (Total)	448,734	21,740	4.8%

Source: FEMA preliminary DFIRM and Advisory boundaries provided by Burlington County GIS; U.S. Census 2010

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available due to isolation during a flood event and they may have more difficulty evacuating.

Using 2000 U.S. Census data, HAZUS-MH 2.1 estimates the potential sheltering needs as a result of a 1-percent chance flood event. For the 1-percent flood event, HAZUS-MH 2.1 estimates 28,797 households will be displaced and 20,666 people will seek short-term sheltering, representing approximately 5% of the Burlington County population seeking short-term shelter. These statistics, by municipality, are presented in Table 5.4.4-9.

Table 5.4.4-9. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Flood Events

Municipality	Total Population (2010 U.S. Census)	1-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Bass River (T)	1,143	314	214
Beverly (C)	2,577	147	117
Bordentown (C)	3,924	155	104
Bordentown (T)	11,367	460	280

Table 5.4.4-9. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Flood Events

Municipality	Total Population (2010 U.S. Census)	1-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Burlington (C)	9,920	5,502	4,849
Burlington (T)	22,629	731	538
Chesterfield (T)	7,689	379	27
Cinnaminson (T)	15,560	921	618
Delanco (T)	4,283	156	98
Delran (T)	16,896	636	475
Eastampton (T)	6,069	226	143
Edgewater Park (T)	8,881	1	0
Evesham (T)	45,538	1,958	1,498
Fieldsboro (B)	540	32	4
Florence (T)	12,109	314	221
Hainesport (T)	6,051	438	322
Lumberton (T)	12,559	801	578
Mansfield (T)	8,546	230	71
Maple Shade (T)	19,172	518	468
Medford (T)	23,006	119	22
Medford Lakes (B)	4,146	2,084	1,554
Moorestown (T)	20,815	684	324
Mt. Holly (T)	9,536	566	328
Mt. Laurel (T)	42,102	1,966	1,624
New Hanover (T)	7,385	650	516
North Hanover (T)	7,686	880	754
Palmyra (B)	7,398	584	409
Pemberton (B)	1,412	47	8
Pemberton (T)	27,909	2,518	1,536
Riverside (T)	8,079	279	155
Riverton (B)	2,779	73	50
Shamong (T)	6,493	380	188
Southampton (T)	10,464	1,354	866
Springfield (T)	3,374	290	85
Tabernacle (T)	6,971	243	101
Washington (T)	695	272	195
Westampton (T)	8,816	385	192
Willingboro (T)	31,629	1,176	962
Woodland (T)	1,782	186	60
Wrightstown (B)	804	142	112
Burlington County (Total)	448,734	28,797	20,666

Source: HAZUS-MH v2.1; U.S. Census 2010

Note: The population displaced and seeking shelter was calculated using the 2000 U.S. Census data (HAZUS-MH 2.1 default demographic data).

B = Borough; C = City; T = Township

The total number of injuries and casualties resulting from typical riverine flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood. Mitigation action items addressing this issue are included in Section 9 (Mitigation Strategies) of this plan.

All population in a dam failure inundation zone is considered exposed and vulnerable. Similar to riverine flooding, of the population exposed to dam failure and flash flooding, the most vulnerable include the economically disadvantaged and the population over the age of 65.

There is often limited warning time for dam failure and flash flooding. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard. Ongoing mitigation efforts including dissemination and early warning systems are noted in Section 9 (Mitigation Strategies) of this plan should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

Impact on General Building Stock

After considering the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure in the flood zone includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

The total land area located in the 1- and 0.2-percent annual chance flood zones was calculated for each municipality, as presented in Table 5.4.4-10 below.

Table 5.4.4-10. Total land area located in the 1- and 0.2-percent annual chance flood zones (acres)

Municipality	Total Area (acres)	1% Flood Event Hazard Area				0.2% Flood Event Hazard Area		D Zone	
		A-Zone Area Exposed (acres)	% of Total	V-Zone Area Exposed (acres)	% of Total	Area Exposed (acres)	% of total	Area Exposed (acres)	% of total
Bass River (T)	50,140	6,178	12%	7,356	15%	17,063	34%	6.25	<1%
Beverly (C)	486	173	36%	0	-	185	38%	0	-
Bordentown (C)	618	104	17%	0	-	119	19%	0	-
Bordentown (T)	5,926	1,338	23%	0	-	1,338	23%	0	-
Burlington (C)	2,426	1,331	55%	0	-	1,897	78%	0	-
Burlington (T)	8,992	771	9%	0	-	1,119	12%	0	-
Chesterfield (T)	13,736	734	5%	0	-	773	6%	0	-
Cinnaminson (T)	5,099	950	19%	0	-	1,146	22%	0	-
Delanco (T)	2,190	843	38%	0	-	1,124	51%	0	-
Delran (T)	4,654	888	19%	0	-	1,046	22%	0	-
Eastampton (T)	3,723	450	12%	0	-	613	16%	0	-
Edgewater Park (T)	1,976	85	4%	0	-	106	5%	0	-
Evesham (T)	18,943	1,834	10%	0	-	1,904	10%	0	-
Fieldsboro (B)	224	18	8%	0	-	73	33%	0	-
Florence (T)	6,559	622	9%	0	-	755	12%	0	-
Hainesport (T)	4,344	977	22%	0	-	1,159	27%	0	-
Lumberton (T)	8,327	1,380	17%	0	-	1,414	17%	0.01	<1%
Mansfield (T)	14,010	1,282	9%	0	-	1,319	9%	0	-
Maple Shade (T)	2,451	154	6%	0	-	265	11%	0	-
Medford (T)	812	73	9%	0	-	173	21%	0	-
Medford Lakes (B)	25,474	5,587	22%	0	-	5,901	23%	1,821	7.2%
Moorestown (T)	9,585	712	7%	0	-	854	9%	0	-
Mt. Holly (T)	1,837	226	12%	0	-	377	21%	0	-
Mt. Laurel (T)	14,066	1,249	9%	0	-	1,524	11%	0	-
New Hanover (T)	14,483	134	1%	0	-	140	1%	7.7	<1%
North Hanover (T)	11,203	667	6%	0	-	671	6%	0	-
Palmyra (B)	1,673	591	35%	0	-	896	54%	0	-

Table 5.4.4-10. Total land area located in the 1- and 0.2-percent annual chance flood zones (acres)

Municipality	Total Area (acres)	1% Flood Event Hazard Area				0.2% Flood Event Hazard Area		D Zone	
		A-Zone Area Exposed (acres)	% of Total	V-Zone Area Exposed (acres)	% of Total	Area Exposed (acres)	% of total	Area Exposed (acres)	% of total
Pemberton (B)	403	50	12%	0	-	70	17%	0	-
Pemberton (T)	40,171	10,260	26%	0	-	10,536	26%	6,560.3	16.3%
Riverside (T)	1,048	308	29%	0	-	432	41%	0	-
Riverton (B)	614	215	35%	0	-	250	41%	0	-
Shamong (T)	28,791	2,155	7%	0	-	2,203	8%	16,638.8	57.8%
Southampton (T)	28,446	7,484	26%	0	-	7,575	27%	5.47	<1%
Springfield (T)	18,924	1,900	10%	0	-	1,863	10%	0.41	<1%
Tabernacle (T)	31,688	5,988	19%	0	-	5,975	19%	0.17	<1%
Washington (T)	66,539	14,208	21%	0	-	17,284	26%	43,524.4	65.4%
Westampton (T)	7,104	1,030	14%	0	-	1,049	15%	0	-
Willingboro (T)	5,175	672	13%	0	-	806	16%	0	-
Woodland (T)	61,001	16,635	27%	0	-	16,491	27%	15,525.4	25.5%
Wrightstown (B)	1,146	28	2%	0	-	28	2%	2.2	<1%
Burlington County (Total)	525,009	97,640	19%	7,356	1.4%	108,514	21%	84,091.97	16.0%

Source: FEMA preliminary DFIRM and Advisory boundaries provided by Burlington County GIS
The area presented includes the area of inclusive water bodies.

To provide a general estimate of number of structural/content replacement value exposure, the FEMA DFIRM flood boundaries (1-percent flood zone) was overlaid upon Burlington County’s parcel data to get an estimated total improved value exposed, and the building stock replacement cost values in HAZUS-MH at the Census-block level. Refer to Table 5.4.4-11 and Table 5.4.4-12 below.

There is approximately \$1.85 billion of total improved value exposed to the 1-percent annual chance flood in Burlington County. This represents approximately 5% of the County’s total improved value inventory (\$36 billion) available from the parcel data.

There is approximately \$3.4 billion of building/contents replacement cost value exposed to the 1-percent annual chance flood in Burlington County. This represents approximately 5.5% of the County’s total general building stock replacement value inventory (\$62.7 billion). For the 0.2-percent annual chance flood event, it is estimated there is nearly \$5.2 billion of buildings/contents exposed in Burlington County. This is approximately 8.3% of the County’s total general building stock replacement value inventory.

The potential damage estimated to the general building stock inventory associated with the 1-percent annual chance flood is greater than \$889 million.

Table 5.4.4-11. Total Improved Value Exposure to the 1-Percent Annual Chance Flood Event

Municipality	Total Improved Value	1% Annual Chance Flood Boundary	
		Estimated Improved Value Exposure	% of Total
Bass River Township	\$112,293,600	\$62,321,000	55.5%
Beverly*	\$72,091,800	\$4,096,900	5.7%
Bordentown	\$298,534,950	\$3,879,600	1.3%
Bordentown Township	\$997,461,800	\$ 64,332,000	6.4%
Burlington	\$571,882,875	\$459,532,300	80.4%
Burlington Township	\$2,097,110,708	\$46,002,100	2.2%
Chesterfield Township	\$666,455,492	\$4,704,100	0.7%
Cinnaminson Township	\$1,304,483,700	\$90,518,700	6.9%
Delanco Township	\$290,621,560	\$66,109,600	22.7%
Delran Township	\$1,474,866,100	\$73,603,600	5.0%
Eastampton Township	\$421,225,400	\$9,741,800	2.3%
Edgewater Park Township	\$528,294,400	\$7,691,400	1.5%
Evesham Township	\$4,389,240,875	\$36,230,700	0.8%
Fieldsboro Borough	\$48,903,400	\$10,699,800	21.9%
Florence Township	\$1,040,584,300	\$18,115,800	1.7%
Hainesport Township	\$367,702,666	\$8,739,700	2.4%
Lumberton Township	\$1,164,991,807	\$36,534,600	3.1%
Mansfield Township	\$899,612,400	\$3,506,500	0.4%
Maple Shade Township	\$1,405,067,900	\$162,072,900	11.5%
Medford Lakes Borough	\$1,297,069,100	\$55,366,700	4.3%
Medford Township	\$980,612,600	\$91,571,200	9.3%
Moorestown Township	\$3,410,132,200	\$67,226,100	2.0%

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-11. Total Improved Value Exposure to the 1-Percent Annual Chance Flood Event

Municipality	Total Improved Value	1% Annual Chance Flood Boundary	
		Estimated Improved Value Exposure	% of Total
Mount Holly Township	\$1,079,081,000	\$90,062,500	8.3%
Mount Laurel Township	\$2,396,695,600	\$44,262,800	1.8%
New Hanover Township	\$852,205,300	\$5,678,800	0.7%
North Hanover Township	\$498,418,446	\$3,997,800	0.8%
Palmyra Borough	\$254,304,240	\$75,508,245	29.7%
Pemberton Borough	\$63,520,200	\$312,800	0.5%
Pemberton Township	\$2,014,515,095	\$66,340,720	3.3%
Riverside Township	\$349,218,580	\$47,046,320	13.5%
Riverton Borough	\$207,879,600	\$21,903,500	10.5%
Shamong Township	\$294,159,200	\$5,621,500	1.9%
Southampton Township	\$549,437,950	\$33,725,300	6.1%
Springfield Township	\$282,324,750	\$13,142,700	4.7%
Tabernacle Township	\$580,603,200	\$9,669,500	1.7%
Washington Township	\$13,020,400	\$ 6,276,200	48.2%
Westampton Township	\$919,859,000	\$11,364,900	1.2%
Willingboro Township	\$1,705,779,550	\$21,719,900	1.3%
Woodland Township	\$305,887,600	\$6,839,700	2.2%
Wrightstown Borough	\$47,025,100	\$ 3,983,550	8.5%
Burlington County	\$36,253,174,444	\$1,850,053,835	5.1%

Source: FEMA preliminary DFIRM and Advisory boundaries provided by Burlington County GIS

Notes: * The City of Beverly improvement value data 2011 NJGIN MODIV

Table 5.4.4-12. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event

Municipality	Total RCV	1% Annual Chance Flood Boundary	
		Estimated Replacement Cost Value (RCV) Exposure	% of Total
Bass River (T)	\$158,762,000	\$25,096,000	15.8%
Beverly (C)	\$351,041,000	\$14,690,000	4.2%
Bordentown (C)	\$611,161,000	\$22,536,000	3.7%
Bordentown (T)	\$1,225,803,000	\$47,635,000	3.9%
Burlington (C)	\$1,419,313,000	\$761,446,000	53.7%
Burlington (T)	\$3,257,758,000	\$79,372,000	2.4%
Chesterfield (T)	\$482,451,000	\$2,784,000	0.6%
Cinnaminson (T)	\$2,375,176,000	\$112,410,000	4.7%
Delanco (T)	\$484,972,000	\$5,474,000	1.1%
Delran (T)	\$2,136,079,000	\$77,216,000	3.6%
Eastampton (T)	\$712,944,000	\$15,276,000	2.1%
Edgewater Park (T)	\$959,473,000	0%	0.0%
Evesham (T)	\$6,451,252,000	\$298,462,000	4.6%

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-12. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event

Municipality	Total RCV	1% Annual Chance Flood Boundary	
		Estimated Replacement Cost Value (RCV) Exposure	% of Total
Fieldsboro (B)	\$72,125,000	\$3,842,000	5.3%
Florence (T)	\$1,509,320,000	\$27,215,000	1.8%
Hainesport (T)	\$839,062,000	\$13,001,000	1.6%
Lumberton (T)	\$1,504,149,000	\$132,384,000	8.8%
Mansfield (T)	\$1,954,839,000	\$37,575,000	1.9%
Maple Shade (T)	\$2,346,098,000	\$20,928,000	0.9%
Medford (T)	\$560,603,000	\$373,385,000	66.6%
Medford Lakes (B)	\$3,746,510,000	\$21,913,000	0.6%
Moorestown (T)	\$4,209,509,000	\$195,075,000	4.6%
Mt. Holly (T)	\$1,650,406,000	\$82,109,000	5.0%
Mt. Laurel (T)	\$6,985,988,000	\$72,650,000	1.0%
New Hanover (T)	\$1,604,641,000	0%	0.0%
North Hanover (T)	\$685,211,000	\$33,483,000	4.9%
Palmyra (B)	\$942,785,000	\$88,139,000	9.4%
Pemberton (B)	\$187,379,000	0%	0.0%
Pemberton (T)	\$3,248,981,000	\$289,072,000	8.9%
Riverside (T)	\$885,809,000	\$69,606,000	7.9%
Riverton (B)	\$352,198,000	\$22,139,000	6.3%
Shamong (T)	\$797,191,000	\$32,852,000	4.1%
Southampton (T)	\$1,305,540,000	\$217,814,000	16.7%
Springfield (T)	\$461,104,000	\$20,662,000	4.5%
Tabernacle (T)	\$931,897,000	\$27,544,000	3.0%
Washington (T)	\$108,601,000	\$29,667,000	27.3%
Westampton (T)	\$1,326,163,000	\$50,733,000	3.8%
Willingboro (T)	\$3,602,996,000	\$101,801,000	2.8%
Woodland (T)	\$115,483,000	\$7,591,000	6.6%
Wrightstown (B)	\$140,021,000	\$11,856,000	8.5%
Burlington County (Total)	\$62,700,794,000	\$3,445,433,000	5.5%

Source: FEMA preliminary DFIRM and Advisory boundaries provided by Burlington County GIS; HAZUS-MH v2.1

Notes: % = Percent; RCV = Replacement cost value (structure and contents)

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-13. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event

Municipality	Total RCV	1% Annual Chance Flood Boundary	
		Estimated Replacement Cost Value (RCV) Loss	% of Total
Bass River (T)	\$158,762,000	\$1,547,000	1.0%
Beverly (C)	\$351,041,000	\$4,292,000	1.2%
Bordentown (C)	\$611,161,000	\$12,832,000	2.1%
Bordentown (T)	\$1,225,803,000	\$32,256,000	2.6%
Burlington (C)	\$1,419,313,000	\$118,605,000	8.4%
Burlington (T)	\$3,257,758,000	\$31,789,000	1.0%
Chesterfield (T)	\$482,451,000	\$8,947,000	1.9%
Cinnaminson (T)	\$2,375,176,000	\$51,788,000	2.2%
Delanco (T)	\$484,972,000	\$7,235,000	1.5%
Delran (T)	\$2,136,079,000	\$35,726,000	1.7%
Eastampton (T)	\$712,944,000	\$3,832,000	0.5%
Edgewater Park (T)	\$959,473,000	\$4,000	0.0%
Evesham (T)	\$6,451,252,000	\$26,706,000	0.4%
Fieldsboro (B)	\$72,125,000	\$2,660,000	3.7%
Florence (T)	\$1,509,320,000	\$18,457,000	1.2%
Hainesport (T)	\$839,062,000	\$23,565,000	2.8%
Lumberton (T)	\$1,504,149,000	\$30,554,000	2.0%
Mansfield (T)	\$1,954,839,000	\$47,983,000	2.5%
Maple Shade (T)	\$2,346,098,000	\$12,046,000	0.5%
Medford (T)	\$560,603,000	\$76,554,000	1.0%
Medford Lakes (B)	\$3,746,510,000	\$5,509,000	2.0%
Moorestown (T)	\$4,209,509,000	\$45,454,000	1.1%
Mt. Holly (T)	\$1,650,406,000	\$17,264,000	1.1%
Mt. Laurel (T)	\$6,985,988,000	\$57,533,000	0.8%
New Hanover (T)	\$1,604,641,000	\$9,625,000	0.6%
North Hanover (T)	\$685,211,000	\$15,522,000	2.3%
Palmyra (B)	\$942,785,000	\$19,807,000	2.1%
Pemberton (B)	\$187,379,000	\$1,090,000	0.6%
Pemberton (T)	\$3,248,981,000	\$49,124,000	1.5%
Riverside (T)	\$885,809,000	\$12,766,000	1.4%
Riverton (B)	\$352,198,000	\$3,115,000	0.9%
Shamong (T)	\$797,191,000	\$4,046,000	0.5%
Southampton (T)	\$1,305,540,000	\$27,750,000	2.1%
Springfield (T)	\$461,104,000	\$3,834,000	0.8%
Tabernacle (T)	\$931,897,000	\$8,835,000	1.0%
Washington (T)	\$108,601,000	\$3,812,000	3.5%

Table 5.4.4-13. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event

Municipality	Total RCV	1% Annual Chance Flood Boundary	
		Estimated Replacement Cost Value (RCV) Loss	% of Total
Westampton (T)	\$1,326,163,000	\$9,302,000	0.7%
Willingboro (T)	\$3,602,996,000	\$38,506,000	1.1%
Woodland (T)	\$115,483,000	\$1,172,000	1.0%
Wrightstown (B)	\$140,021,000	\$7,627,000	5.5%
Burlington County (T)	\$62,700,794,000	\$889,071,000	1.4%

Source: HAZUS- MH v2.1; 2000 CENSUS

Notes: % = Percent; RCV = Replacement cost value

In addition to total building stock modeling, individual data available on flood policies, claims, Repetitive Loss Properties (RLP) and severe RLP (SRLs) were analyzed. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims and multiple claims (RLPs). According to the metadata provided: “The (sic National Flood Insurance Program) NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than \$1,000 for each loss. The two losses must be within 10 years of each other & be as least 10 days apart. Only losses from (sic since) 1/1/1978 that are closed are considered.”

SRLs were then examined for the County. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10-year period, and must be greater than 10 days apart.

Table 5.4.4-14 **Error! Reference source not found.** summarizes the NFIP policies, claims and repetitive loss statistics for Burlington County. According to FEMA, Table 5.4.4-14 summarizes the occupancy classes of the repetitive loss and severe repetitive loss properties in Burlington County. The majority of the repetitive loss occupancy class is single family residences (85%). All severe repetitive loss properties as classified as single family residences (100%) (FEMA Region 2, 2013). This information is current as of February 28, 2013.

Table 5.4.4-14. Occupancy Class of Repetitive Loss Structures in Burlington County by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties					Total per Municipality
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	
Bordentown (C)					1						1
Burlington (C)					6						6
Cinnaminson (T)					8					1	9
Delran (T)					8						8
Eastampton (T)					3					1	4
Evesham (T)					2						2
Lumberton (T)	1		1	1	29					2	34
Maple Shade (T)				1							1
Medford Lakes (B)					1						1
Medford (T)		10	1		6					1	18
Mount Holly (T)					2						2
Mount Laurel (T)					1						1
Palmyra (B)					1					1	2
Pemberton (T)					2						2
Riverside (T)					3						3
Southampton (T)			1		13					3	17
Washington (T)					1						1
Westampton (T)					2						2
Willingboro (T)					1						1
Totals by structure	1	10	3	2	90	0	0	0	0	9	115

Note: Only municipalities with RL/SRL structures are included in this table. Unlisted municipalities do not have reported RL/SRL properties.

Source: FEMA Region 2, 2013

(1) Statistics provided by FEMA Region 2 are current as of February 28, 2013.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others.

Table 5.4.4-15 indicates the repetitive loss areas within the County. Information regarding the locations of the NFIP policies and claims is cataloged at the County.

Table 5.4.4-15. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)	# Policies in the 0.2% Flood Boundary (3)	# Policies Outside the Combined 1% and 0.2% Flood Boundaries Hazard Areas (3)
Bass River, Township Of	62	53	\$1,317,833	0	0	42	57	5
Beverly, City Of	9	1	\$3,514	0	0	0	2	7
Bordentown, City Of	11	6	\$31,802	1	0	5	6	5
Bordentown, Township Of	54	3	\$112,099	0	0	6	7	47
Burlington, City Of	1058	120	\$501,475	6	0	852	1019	39
Burlington, Township Of	107	21	\$254,229	1	0	35	45	62
Chesterfield, Township Of	10	2	\$2,128	0	0	0	0	10
Cinnaminson, Township Of	261	91	\$945,575	8	1	120	160	101
Delanco, Township Of	84	9	\$67,299	0	0	23	55	29
Delran, Township Of	137	58	\$557,562	8	0	64	92	45
Eastampton, Township Of	37	83	\$715,586	2	1	17	21	16
Edgewater Park, Township Of	14	4	\$35,201	0	0	0	0	14
Evesham, Township Of	159	23	\$250,315	2	0	10	12	147
Fieldsboro, Borough of	0	1	\$707	0	0	0	0	0
Florence, Township Of	34	2	\$16,325	0	0	9	9	25
Hainesport, Township Of	29	3	\$25,021	0	0	9	11	18
Lumberton, Township Of	94	141	\$6,227,869	32	2	68	68	26
Mansfield, Township Of	25	1	\$4,060	0	0	2	2	23
Maple Shade, Township Of	40	5	\$240,619	1	0	0	8	32
Medford Lakes, Borough Of	65	20	\$224,385	1	0	0	14	51
Medford, Township Of	298	127	\$3,197,307	17	1	90	104	194
Moorestown, Township Of	150	27	\$252,772	0	0	25	35	115
Mount Holly, Township Of	99	70	\$1,139,746	2	0	35	78	21
Mount Laurel, Township Of	326	43	\$400,697	1	0	53	93	233
New Hanover, Township Of	6	2	\$889	0	0	1	1	5
North Hanover, Township Of	3	1	\$13,060	0	0	1	1	2
Palmyra, Borough Of	188	22	\$152,868	1	1	58	144	44

Table 5.4.4-15. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)	# Policies in the 0.2% Flood Boundary (3)	# Policies Outside the Combined 1% and 0.2% Flood Boundaries Hazard Areas (3)
Pemberton, Borough Of	5	1	\$459	2	0	0	0	5
Pemberton, Township Of	237	64	\$825,155	0	0	92	96	141
Riverside, Township Of	88	31	\$124,837	3	0	36	79	9
Riverton, Borough Of	44	2	\$9,225	0	0	9	15	29
Shamong, Township Of	15	4	\$8,927	0	0	1	1	14
Southampton, Township Of	127	109	\$2,208,330	14	3	73	78	49
Springfield, Township Of	18	5	\$136,102	0	0	5	5	13
Tabernacle, Township Of	18	1	\$6,407	0	0	7	7	11
Washington, Township Of	45	22	\$697,601	1	0	23	41	4
Westampton, Township Of	29	13	\$165,778	2	0	11	13	16
Willingboro, Township Of	84	9	\$40,453	1	0	9	15	69
Woodland, Township Of	3	1	\$862	0	0	2	2	1
Wrightstown, Borough Of	7	1	\$15,632	0	0	2	2	5
Burlington County (Total)	4,080	1,202	\$20,930,712	106	9	1,795	2,398	1,682

Source: FEMA Region 2, 2013

(1) Policies, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of February 28, 2013.

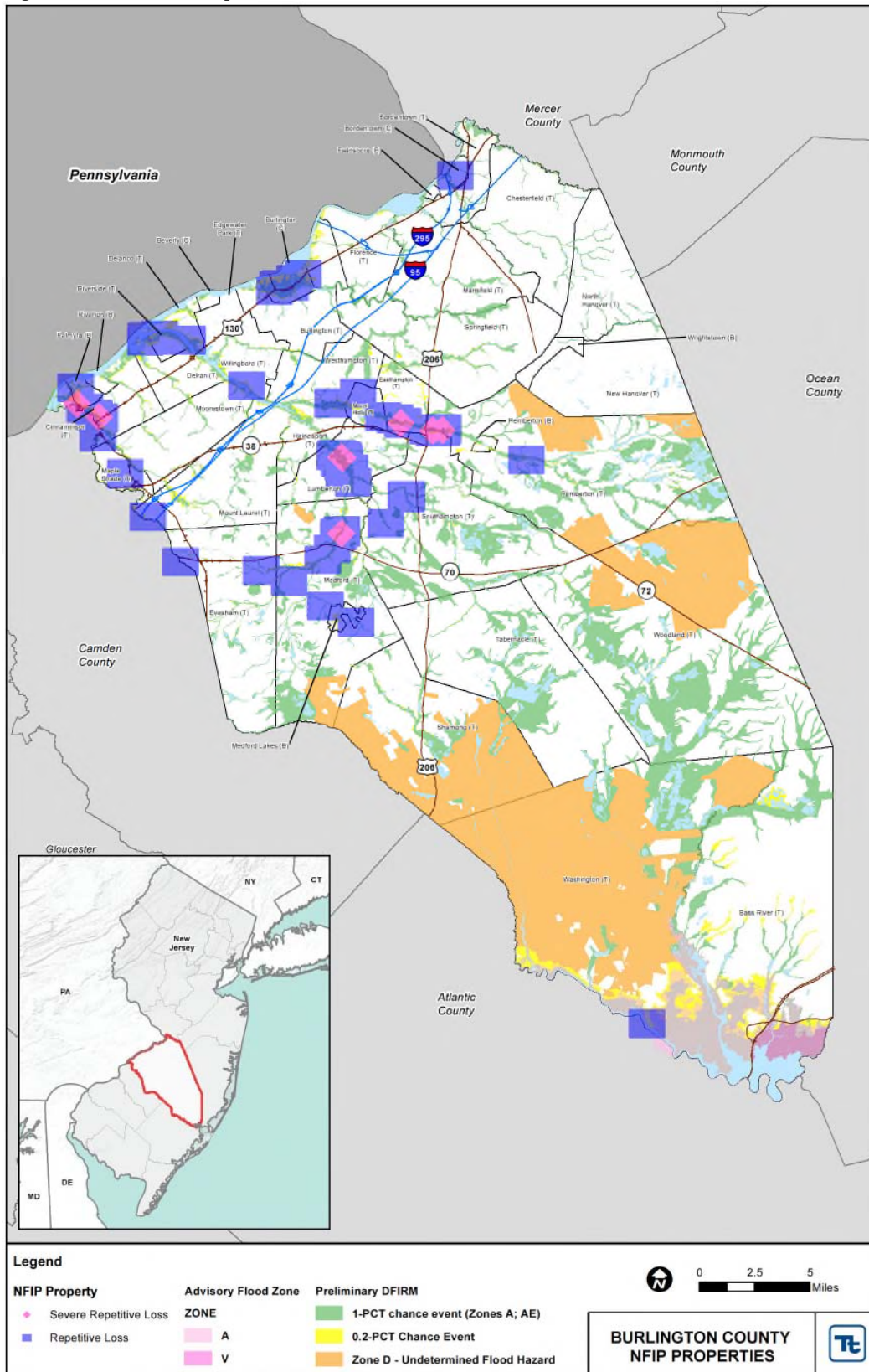
Please note the total number of repetitive loss properties excludes the severe repetitive loss properties. The number of claims represents claims closed by February 28, 2013.

(2) Total building and content losses from the claims file provided by FEMA Region 2.

(3) The policies inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file.

Notes: FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility.

Figure 5.4.4-4. NFIP Repetitive Loss Areas



Source: Burlington County GIS; FEMA Region 2, 2013

Impact on Critical Facilities

In addition to considering general building stock at risk, the risk of flood to critical facilities, utilities, transportation facilities and user-defined facilities was evaluated. HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves, HAZUS estimates the percent of damage to the building and contents of critical facilities. Table 5.4.4-16 lists the critical facilities located in the FEMA flood zones and the percent damage HAZUS-MH 2.1 estimates to the facility as a result of the 1-percent annual chance event Table 5.4.4-17 summarizes the utilities and transportation features located in the FEMA flood zones and the percent damage HAZUS-MH 2.1 estimates as a result of the 1-percent annual chance event.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impact to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs. Actions addressing shared services agreements are included in Section 9 (Mitigation Strategies) of this plan.

In summary, there are 18 bridges were exposed to the flood hazard with a modeled damage of 2% or less for the 1-percent annual chance event and 20 bridges are estimated to have less than 3% damage for the 1-percent annual chance event.

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-16. Critical Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries and Estimated Potential Damage for the 1-Percent Annual Chance Flood Event

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Percent Structure Damage	Percent Content Damage	Days to 100-Percent ⁽²⁾
Municipal	Burlington City	EOC	X	X	8.0	12.2	480
BURLINGTON BRISTOL BRIDGE POLICE DEPT	Burlington City	Police	X	X	9.3	17.3	480
BURLINGTON CITY POLICE	Burlington City	Police	X	X	7.0	8.0	480
NJSP MARINE POLICE	Burlington City	Police		X			
BURLINGTON CITY FIRE DEPARTMENT	Burlington City	Fire	X	X	8.0	12.2	480
BURLINGTON CITY FIRE DEPARTMENT	Burlington City	Fire	X	X	8.0	12.2	480
MITCHELL FIRE CO #3	Burlington City	Fire	X	X	9.4	17.5	480
NEPTUNE HOSE CO #5	Burlington City	Fire	X	X	8.8	15.1	480
NIAGARA HOSE CO 6	Burlington City	Fire	X	X	10.4	26.8	480
ENDEAVOR EMERGENCY SQUAD	Burlington City	Fire		X			
ALL SAINTS SCHOOL	Burlington City	School	X	X	7.3	39.9	480
WILBUR WATTS INTERMEDIATE SCHL	Burlington City	School	X	X	7.7	43.1	480
HOLY LIGHT CHRISTIAN ACADEMY	Burlington City	School	X	X	5.3	28.8	480
BURLINGTON BOARD OF EDUCATION	Burlington City	School	X	X	9.0	59.3	480
BURLINGTON CITY HIGH SCHOOL	Burlington City	School	X	X	6.4	34.8	480
ST MARY'S HALL-DOANE ACADEMY	Burlington City	School		X			
CAPTAIN JAMES LAWRENCE SCHOOL	Burlington City	School		X			
ELIAS BOUDINOT ELEMENTARY SCHL	Burlington City	School		X			
SAMUEL SMITH ELEMENTARY SCHOOL	Burlington City	School		X			
Home For Aged Women	Burlington City	Senior	X	X	23.8	31.1	
BURLINGTON CITY MUNICIPAL BUILDING	Burlington City	Municipal	X	X	22.7	27.5	
LUMBERTON FIRE CO #1	Lumberton Township	Fire	X	X	10.9	36.4	480
MAPLE SHADE RESCUE SERVICE	Maple Shade Township	Fire		X			
BURLINGTON COUNTY INSTITUTE OF TECH	Medford Township	School	X	X	6.1	32.9	480
CHALLENGER ELEMENTARY SCHOOL	Medford Township	School	X	X	5.6	30.2	480
CRANBERRY PINE ELEMENTARY SCHOOL	Medford Township	School	X	X	9.0	59.4	480

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-16. Critical Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries and Estimated Potential Damage for the 1-Percent Annual Chance Flood Event

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Percent Structure Damage	Percent Content Damage	Days to 100-Percent ⁽²⁾
MOUNT HOLLY TWP POLICE DEPT	Mount Holly Township	Police		X			
BURLINGTON COUNTY COLLEGE	Mount Holly Township	School		X			
MOUNT HOLLY TOWNSHIP MUNICIPAL BUILDING	Mount Holly Township	Municipal		X			
TACONY PALMYRA BRIDGE POLICE DEPT	Palmyra Borough	Police	X	X	8.1	12.3	480
SHAMONG BOARD OF EDUCATION	Shamong Township	School		X			
SHAMONG TOWNSHIP SCHOOL DIST	Shamong Township	School		X			
VINCENTOWN EMERGENCY SQUAD	Southampton Township	Fire	X	X	7.6	10.4	480
Section B3 (17, 18, 29, 43)	Tabernacle Township	Fire	X	X	4.7	5.3	480
NJ STATE PARK SERVICE - SOUTHERN REGION	Washington Township	Police		X			
WASHINGTON TOWNSHIP MUNICIPAL BUILDING	Washington Township	Municipal		X			

Source: HAZUS-MH 2.1

Notes: x = Facility located within the flood boundary.

(1) HAZUS-MH 2.1 provides a general indication of the maximum restoration time for 100% operations. Clearly, a great deal of effort is needed to quickly restore essential facilities to full functionality; therefore this will be an indication of the maximum downtime (HAZUS-MH 2.1 User Manual).

SECTION 5.4.4: RISK ASSESSMENT – FLOOD

Table 5.4.4-17. Utilities and Transportation Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Boundaries

Name	Municipality	Type	Exposure	
			1% Event	0.2% Event
Beverly Sewerage Authority	Beverly City	Sewer	X	X
Bordentown Sewerage Authority	Bordentown City	Sewer	X	X
Cinnaminson Sewerage Authority	Cinnaminson Township	Sewer	X	X
Central Avenue Sewerage Treatment Plant	Burlington Township	Sewer	X	X
Delran Sewerage Authority	Delran Township	Sewer	X	X
Florence Sewerage Treatment Plant	Florence Township	Sewer	X	X
Medford Lakes Sewerage Treatment Plant	Medford Lakes Borough	Sewer	X	X
Riverside Sewerage Treatment Plant	Riverside Township	Sewer	X	X
Riverton Sewerage Treatment Plant	Riverton Borough	Sewer	X	X
Common Council Burlington City	Burlington City	Sewer	X	X
Palmyra Sewerage Treatment Plant	Palmyra Borough	Sewer	X	X
PSE&G Substation – Fairview St.	Riverside Township	Electric	X	X
PSE&G Substation – Broad St.	Cinnaminson Township	Electric	X	X
Commerce Square	Burlington City	Water	X	X
Medford	Medford Township	Water	X	X
Burlington Heliport	Burlington City	Airport	X	X
Mount Holly Heliport	Mount Holly Township	Airport	X	X
Burlington South Park & Ride	Burlington City	Rail	X	X
Mount Holly Municipal Utility Authority	Mount Holly Township	Sewer		X
Medford Water Pollution Control	Medford Township	Sewer		X
PSE&G Substation – W. Broad St.	Burlington City	Electric		X
PSE&G Burlington Generation Station	Burlington	Electric		X
Fenimore Mobil Home Park	Eastampton Township	Water		X
Pacemaker Heliport	Washington Township	Airport		X
Burlington Town Center Station	Burlington City	Rail		X
Delanco	Delanco Township	Rail		X
Cinnaminson	Cinnaminson Township	Rail		X

Source: HAZUS-MH 2.1

Notes: x = Facility located within the flood boundary.



Impact on the Economy

For impact on economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, impacts to tourism and tax base to Burlington County. Damages to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty. For the purposes of this analysis, general building stock damages are discussed further.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster, Date Unknown).

Direct building losses are the estimated costs to repair or replace the damage caused to the building. The potential damage estimated to the general building stock inventory associated with the 1-percent flood is approximately \$889 million which represents less than one-percent of the County's overall total general building stock inventory. These dollar value losses to the County's total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact the local economy.

HAZUS-MH estimates the amount of debris generated from the flood events as a result of 1- and 0.2-percent events. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.) and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 5.4.4-18 summarizes the debris HAZUS-MH 2.1 estimates for these events.

Table 5.4.4-18. Estimated Debris Generated from the 1-Percent Flood Event

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Bass River (T)	117	90	9	18
Beverly (C)	553	296	160	97
Bordentown (C)	2,548	665	1,093	791
Bordentown (T)	3,771	1,082	1,555	1,134
Burlington (C)	4,551	4,085	283	182
Burlington (T)	1,094	570	300	224
Chesterfield (T)	1,172	393	521	258
Cinnaminson (T)	2,432	1,353	629	451
Delanco (T)	508	235	156	116
Delran (T)	1,259	588	384	287
Eastampton (T)	402	188	104	110
Edgewater Park (T)	0	0	0	0
Evesham (T)	561	442	70	49
Fieldsboro (B)	360	80	162	118
Florence (T)	2,285	545	971	769
Hainesport (T)	822	420	224	178

Table 5.4.4-18. Estimated Debris Generated from the 1-Percent Flood Event

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Lumberton (T)	1,905	620	727	559
Mansfield (T)	3,403	495	1,639	1,270
Maple Shade (T)	485	420	38	28
Medford (T)	395	2,142	1,143	43
Medford Lakes (B)	4,116	290	62	831
Moorestown (T)	661	434	131	96
Mt. Holly (T)	1,586	644	543	399
Mt. Laurel (T)	879	597	163	119
New Hanover (T)	738	633	59	45
North Hanover (T)	2,112	913	640	558
Palmyra (B)	1,050	405	379	267
Pemberton (B)	75	65	6	4
Pemberton (T)	2,630	1,734	478	419
Riverside (T)	511	224	156	130
Riverton (B)	301	165	82	53
Shamong (T)	257	134	62	61
Southampton (T)	2,299	1,292	539	468
Springfield (T)	207	125	46	35
Tabernacle (T)	534	330	125	80
Washington (T)	237	212	16	8
Westampton (T)	140	98	25	18
Willingboro (T)	7,223	1,980	3,018	2,226
Woodland (T)	65	57	3	4
Wrightstown (B)	455	312	87	56
Burlington County (Total)	54,698	25,355	16,787	12,557

Source: HAZUS-MH 2.1

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events. While predicting changes of flood events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas. Figure 5.4.4-5 illustrates the identified areas of potential new development in relation to the flood boundaries. It is the intention of the County to discourage development in vulnerable areas or to encourage higher regulatory standards on the local level.

Additional Data and Next Steps

A HAZUS-MH riverine flood analysis was conducted for Burlington County using the most current and best available data including critical facility inventories, preliminary DFIRMs, advisory zones and DEM created using 10-foot contours. For future plan updates, more accurate exposure and loss estimates can be produced by replacing the national default demographic inventory with 2010 U.S. Census data when it becomes available in the HAZUS-MH model, as well as a custom building inventory with the HAZUS analysis conducted at the structure level. In addition, the 0.2-percent annual chance flood event may be analyzed to estimate potential losses for the inventories discussed.

FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program provides the flood depth and analysis grids as part of the publicly available DFIRM deliverable. When these depth grids are available for Burlington County, they can be incorporated into HAZUS and used to recalculate the potential losses to the County's inventory for these recurrence intervals.

Specific mitigation actions addressing improved data collection and further vulnerability analysis is included in Section 9 (Mitigation Strategies) of this plan.

5.4.5 LANDSLIDE

This section provides a profile and vulnerability assessment for the landslide hazard.

HAZARD PROFILE

This section provides profile information including description, location, extent, previous occurrences and losses and the probability of future occurrences.

Description

Landslides are a major geologic hazard that occurs in all 50 states. Nationwide, landslides cause over \$3 billion in damages and account for over 25 deaths each year. In New Jersey, landslides are a hazard in areas with steep to moderate slopes and where geologic formations are prone to failure. Landslides can damage utilities, property, and transportation routes. Over time, 19 fatalities have been attributed to landslides in the State of New Jersey (Pallis, 2009).

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. Landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 33-percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Landslides are typically triggered by other natural hazards, such as earthquakes, heavy rain, floods or wildfires. Frequency of landslides is often related to the frequency of these other hazards. They can occur suddenly or slowly. Assessing the geology, vegetation, and amount of predicted precipitation for an area can assist in predicting landslides. Warning signs for landslide activity include:

- Springs, seeps or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavement or sidewalk
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity
- Sudden increase in creek water levels though rain is still falling or just recently ended
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb

- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together (USGS, 2009).

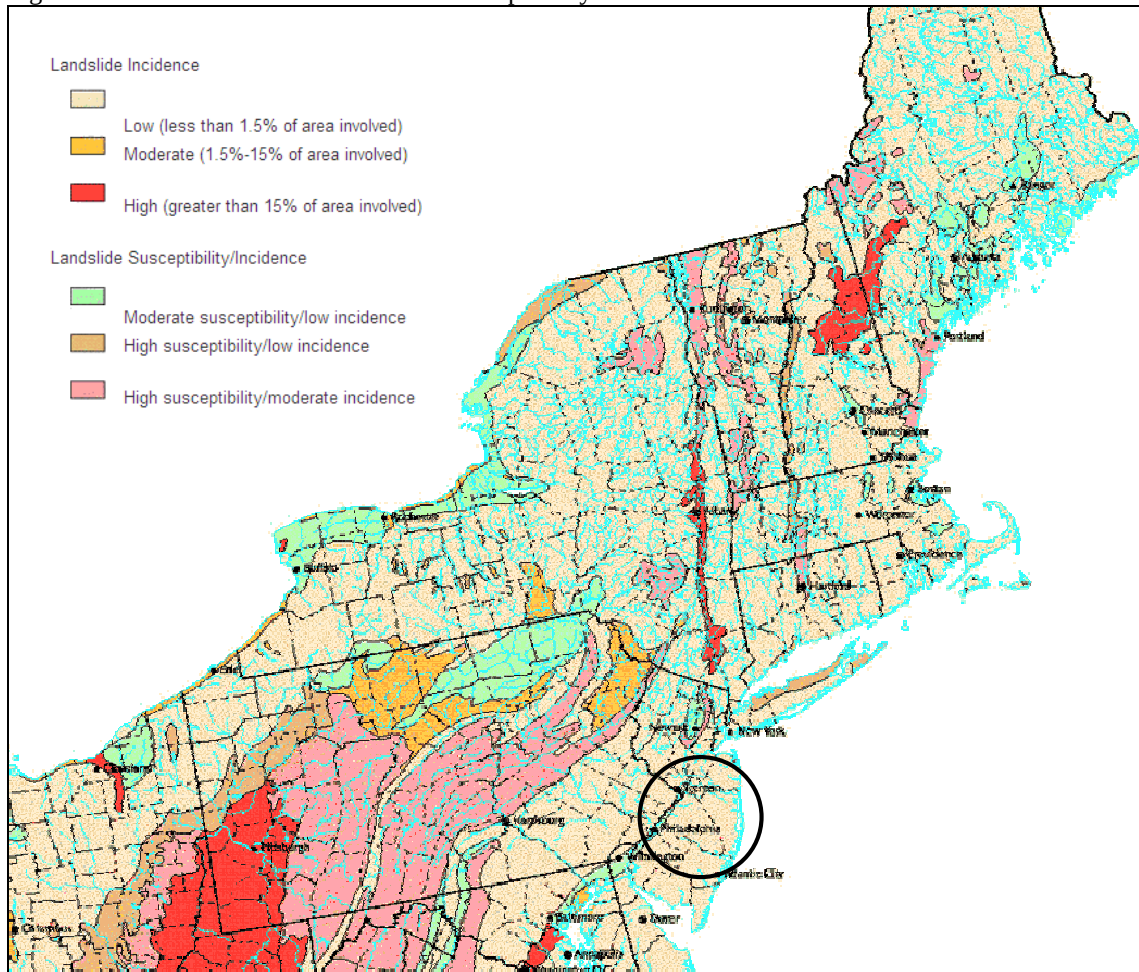
Extent

To determine the extent of a landslide hazard, the affected areas need to be identified and the probability of the landslide occurring within some time period needs to be assessed. Natural variables that contribute to the overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, the landslide hazard is often represented by landslide incidence and/or susceptibility, defined below:

- Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15-percent of a given area has been involved in landsliding; medium incidence means that 1.5 to 15-percent of an area has been involved; and low incidence means that less than 1.5-percent of an area has been involved. (Geological Hazards Program, Date Unknown).
- Landslide susceptibility is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying the incidence of landsliding (Geological Hazards Program, Date Unknown).

Figure 5.4.5-1 depicts the landslide incidence and susceptibility of the northeastern U.S., identifying areas that have the potential for landslides. These areas are determined by correlating some of the principal factors that contribute to landsliding, such as steep slopes, weak geologic units that lose strength when saturated, and poorly drained rock or soil, with the past distribution of landslides.

Figure 5.4.5-1. Landslide Incidence and Susceptibility in the Northeast U.S.



Source: USGS, 1982

Note: The circle indicates the approximate location of Burlington County. A majority of the County has a low landslide incidence (less than 1.5% of area involved); however, the northwestern/southwestern border of the County has a moderate susceptibility/low incidence.

Landslide incidence is defined as the number of landslides that have occurred in a given geographic area. Susceptibility to landsliding is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past (Geological Hazards Program, Date Unknown). Figure 5.4.5-6 depicts the landslide susceptibility in New Jersey. Figure 5.4.5-7 depicts the landslide susceptibility in Burlington County.

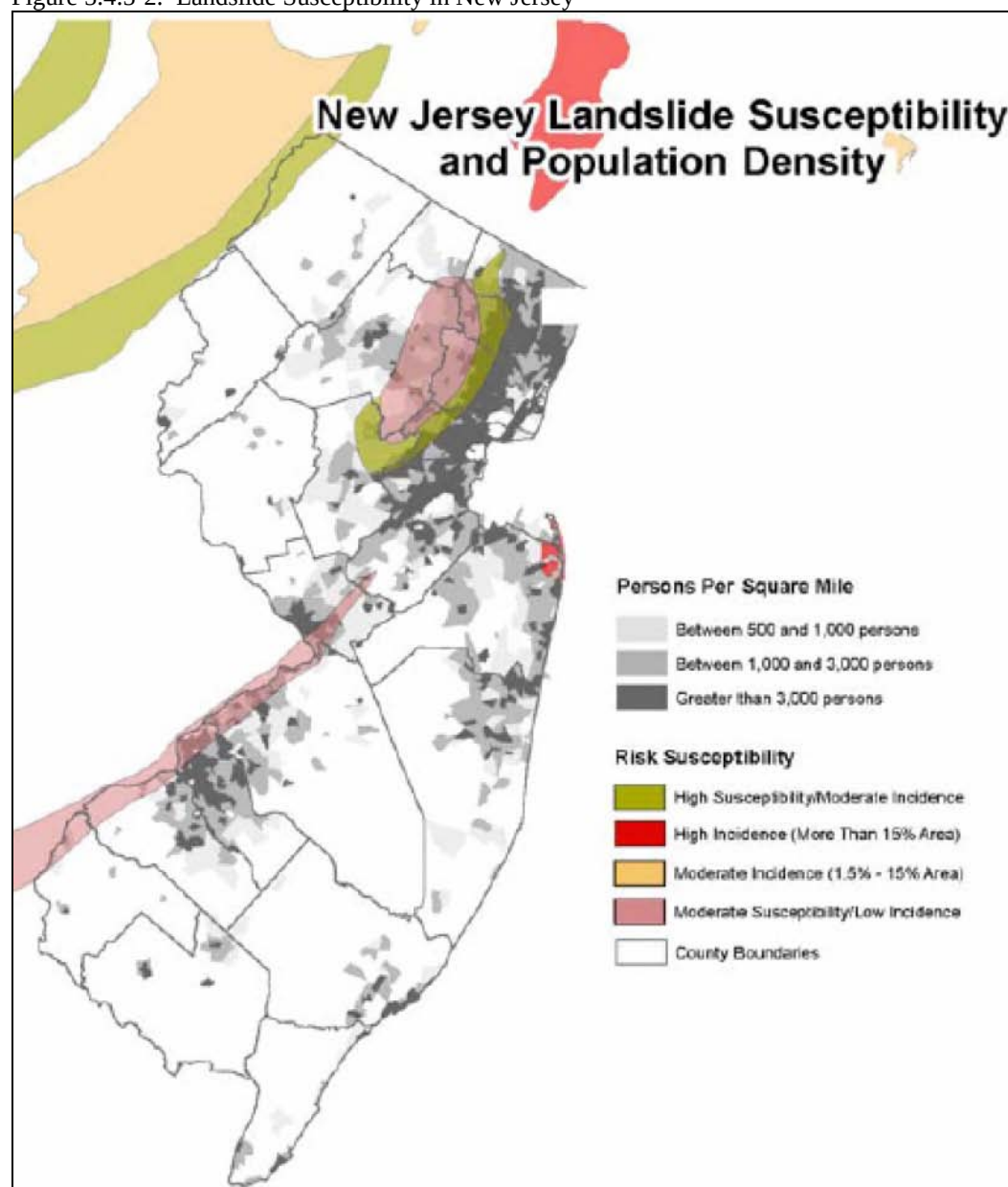
The map units are split into three incidence categories according to the percentage of the area affected by landslides. High incidence means greater than 15 percent of a given area has been involved in landsliding; medium incidence means that 1.5 to 15 percent of an area has been involved; and low incidence means that less than 1.5 percent of an area has been involved. High, medium, and low susceptibility are delimited by the same percentages used for classifying the incidence of landsliding (Geological Hazards Program, Date Unknown).

Location

The entire U.S. experiences landslides and other ground failure hazards, with 36 states having moderate to highly severe landslide hazards. Landslide losses are increasing in the U.S. and worldwide as development expands in areas previously left undeveloped because they were not as stable as other areas. The resulting encroachment of developments into hazardous areas, expansion of transportation infrastructure, deforestation of landslide-prone areas, and changing climate patterns may lead to increasing landslide losses in the future. However, the potential increase in the risk posed by the landslide hazard can be curbed through better understanding and mapping of the hazards and improved capabilities to mitigate and respond to the landslide hazard (Spiker and Gori, 2003).

Natural landslides occur throughout New Jersey where streams or wave action undermine banks, bluffs, and slopes. Rock falls occur wherever there are near-vertical cliffs. The largest geological erosional landsliding occurs in the Atlantic Highlands in portions of the Atlantic Highlands Borough, Highlands Borough, and Middletown Township (Figure 5.4.5-2). Slump blocks are present in the bluffs of the Atlantic Highlands area along the south side of Sandy Hood Bay and the north side of the Navesink River (NJ OEM, 2005).

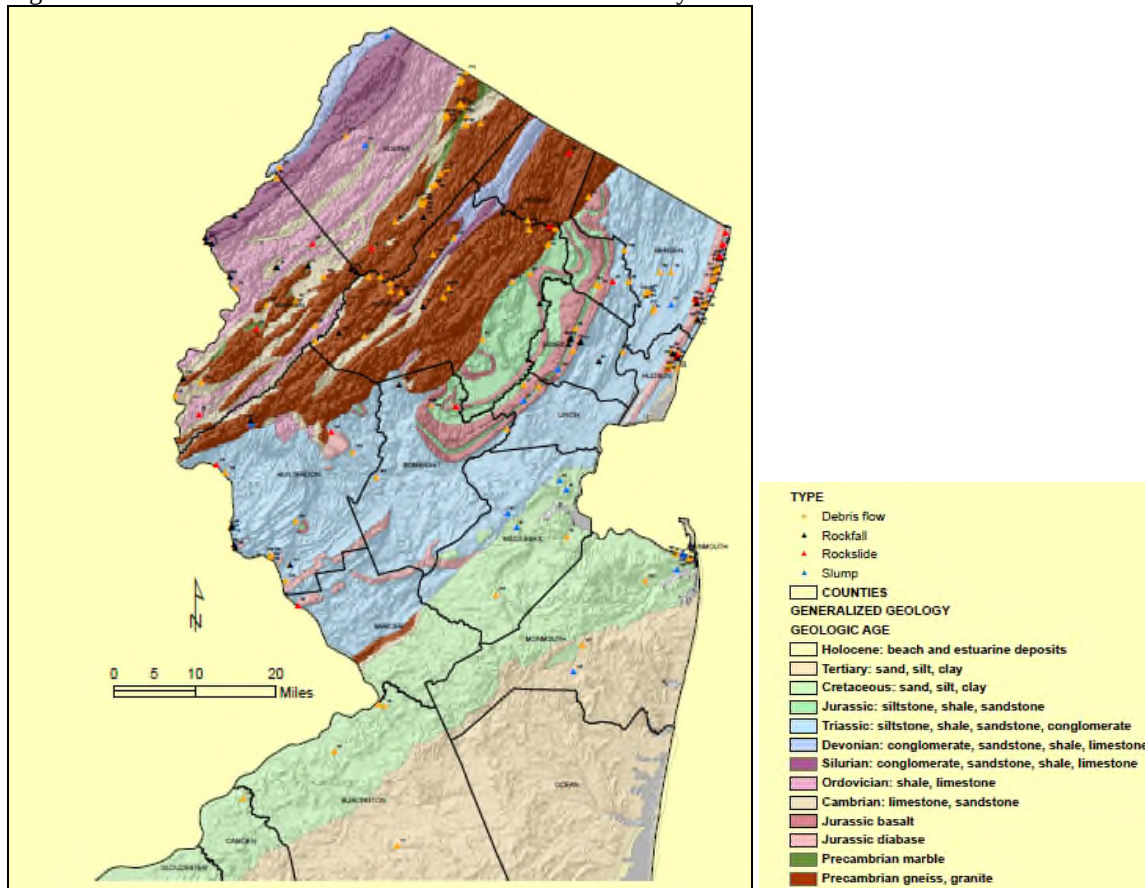
Figure 5.4.5-2. Landslide Susceptibility in New Jersey



Source: NJ HMP, 2012

The location of landslides is highly site-specific, although Figures 5.4.5-2 and Figure 5.4.5-3 show the general location of the hazard in Burlington County, based on historical events and technical analysis. Figure 5.4.5-2 shows a moderate susceptibility/low incidence to landslides along the northwestern most edge of the county, and low incidence (or less than 1.5% of the area is susceptible) throughout the remainder of the County. Figure 5.4.5-3 provides a graphic depiction of all NJDEP recorded landslides in the State of New Jersey through 2012, with a total of four landslides occurring in Burlington County. The image is clipped in the middle of Burlington County, due to a lack of recorded incidences in the southern part of the county.

Figure 5.4.5-3. Recorded Landslides in the State of New Jersey



Source: NJDEP, 2012

Previous Occurrences and Losses

As identified through the review of variety of sources, landslide events have been the most common ground failure throughout New Jersey. Information regarding land subsidence throughout the State was scarce, therefore indicating that this hazard may not be a common occurrence.

Historical records of ground failures (primarily landslide events) in New Jersey date back to the 1900s. Based on all sources researched, several notable ground failure events have directly or indirectly impacted Burlington County between the 1900s and 2013, and are identified in Table 5.4.5-1 below. Figure 5.4.5-9 displays the locations of some landslide incidences listed in Table 5.4.5-1.

As identified through the review of variety of sources, landslide events have been the most common ground failure throughout New Jersey. Information regarding land subsidence throughout the State was scarce, therefore indicating that this hazard may not be a common occurrence in the State and Burlington County.

NOAA's NCDC storm events data base did not list any landslide events for Burlington County between 1950 and April 30, 2013. The Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS) did not list any landslide events for Burlington County between 1960 and 2012.

Between 1954 and 2013, FEMA declared that the State of New Jersey experienced one landslide-related disaster (DR) classified as one or a combination of the following disaster types: severe storms, flooding and mudslides. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, Burlington County has not been declared as a disaster area in any landslide event (FEMA, 2013).

Based on all sources researched, known landslide events that have affected Burlington County and its municipalities are identified in Table 5.4.5-1. Table 5.4.5-1 may not include all events that have occurred throughout the County and region. Events previously reported in the 2008 County HMP are sourced as “Burlington County HMP”.

Table 5.4.5-1. Landslide Events between 1893 and 2007

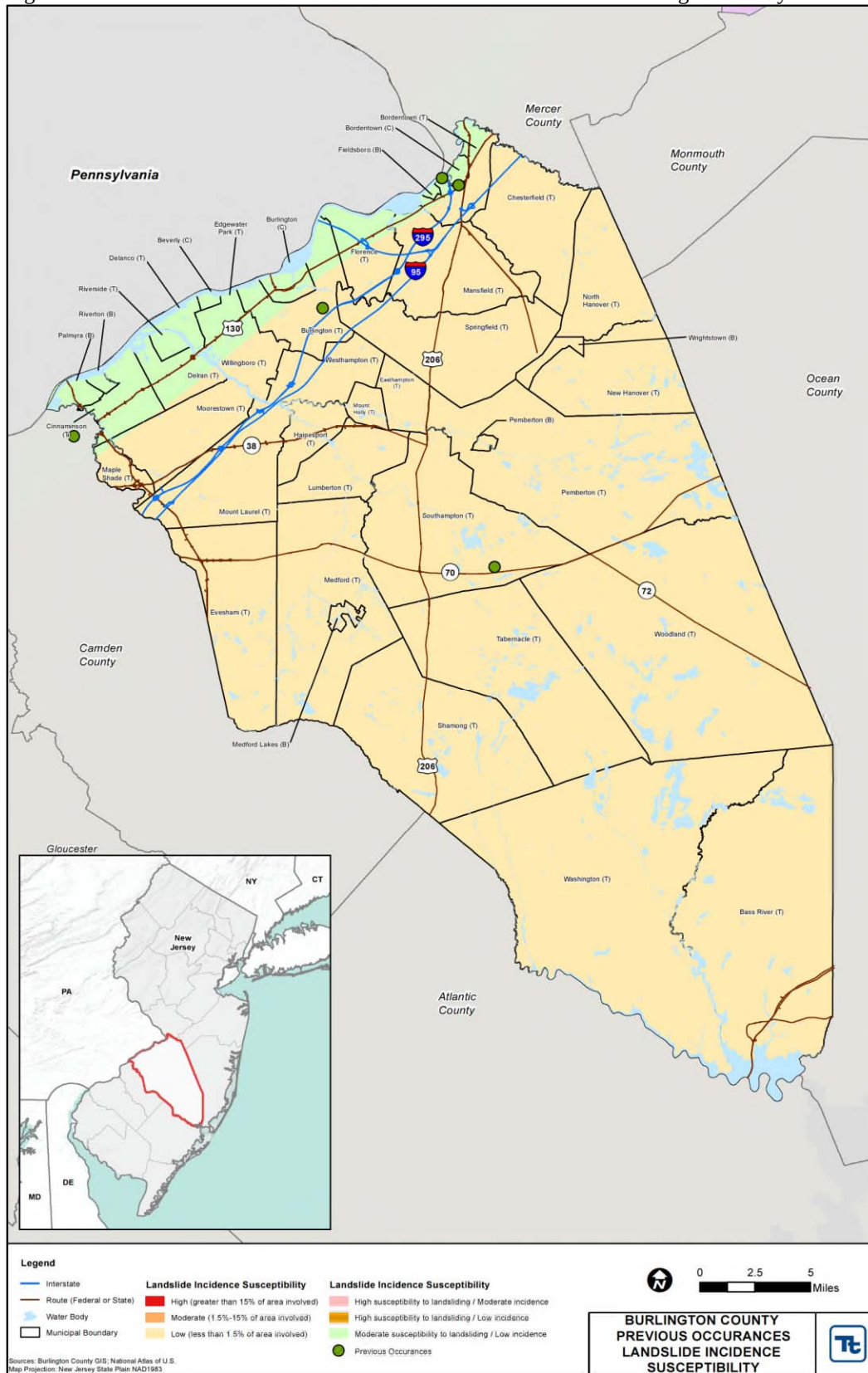
Date of Events	Event Type	FEMA Declaration Number	County Designated?	Location and Description	Source(s)
May 14, 1893	Debris Flow	N/A	N/A	Heavy rain caused a landslide of a 50-foot bank above a home in the Township of Bordentown to fall on the home and knock it off of its foundation. The two-story home was buried and destroyed.	NJGS
December 1902	Debris Flow	N/A	N/A	Heavy rain caused a landslide at the Irondale School (Township of Bordentown). Tons of earth gave way and a portion covered the last bound track of the Amboy Division Railroad.	NJGS
November 1908	Debris Flow	N/A	N/A	A quarry worker in the Township of Burlington was crushed to death under a landslide of hundreds of tons of earth in the Bowen gravel pit.	NJGS
1982	Debris Flow	N/A	N/A	Heavy rains caused a debris flow at the BEMS Big Hill Landfill in the Township of Southampton, causing damage to nearby homes.	NJGS
March 2007	N/A	N/A	N/A	A landslide occurred along the riverfront in the Township of Mansfield	NJDEP

Source: NJGS, 2013; FEMA, 2013; Burlington County HMP, 2008

FEMA Federal Emergency Management Agency

NJGS New Jersey Geological Society

Figure 5.4.5-4. Previous Occurrences and Landslide Hazard Areas in Burlington County



Source: Godt, 2011 (Geology WMS Layer from the National Atlas of the United States); NJGS, 2006

Probability of Future Events

Vulnerability to landslide hazards is a function of location, type of human activity, use, and frequency of landslide events. The effects of landslides on people and structures can be lessened by total avoidance of landslide hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity. Local governments can reduce landslide effects through land use policies and regulations. Individuals can reduce their exposure to hazards by educating themselves on past hazard history of the site and by making inquiries to planning and engineering departments of local governments (National Atlas, 2007).

The NJ HMP indicates that natural landslides occur throughout New Jersey where streams or wave action undermine banks, bluffs, and slopes. Erosion can cause instability in these areas over time, eventually allowing gravity to break portions of the slope loose, moving material downslope. Today, in some areas, building and transportation development has now become an even greater force in altering the landscape than erosion. Both of these processes cause slope failure and result in a landslide (NJ OEM, 2005). Although a majority of Burlington County has a low susceptibility to landslides, they have occurred in various locations throughout the County.

While it is possible for landslides to occur within Burlington County, the probability of future occurrence is low. The vast majority of the County (96 percent) lies outside of mapped hazard areas. Therefore, the probability would be low; however, that probability would increase slightly within the narrow band of land roughly bounding the Delaware River in the northwestern portion of Burlington County in the municipalities of: Cities of Beverly and Burlington, Townships of Burlington, Cinnaminson, Delanco, Delran, Edgewater Park, Riverside and Florence, and the Boroughs of Palmyra and Riverton, and a small portion (approximately 2 percent) of the Township of Moorestown. Areas of past landslides are also more susceptible. NJGS' Scott Stanford indicated in March 2007 that the landslide hazard in Burlington County is basically restricted to small areas of steep banks along creeks and rivers, where slumping could be caused by undercutting or gulying by streams, such as along riverbanks and tributaries to the Delaware such as the Rancocas and Crosswicks Creeks (Burlington County HMP, 2008).

In Section 5.3, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for landslides in the County is considered 'rare' (not likely to occur within 100 years, as presented in Table 5.3-3).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following section discusses the potential impact of the ground failure hazard on Burlington County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact to: (1) life, safety and health of County residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

Vulnerability to ground failure hazards is a function of location, soil type, geology, type of human activity, use, and frequency of events. The effects of ground failure on people and structures can be lessened by total avoidance of hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity. Local governments can reduce ground failure effects by educating themselves on past hazard history of the site and by making inquiries to planning and engineering departments of local governments (National Atlas, 2007).

Data and Methodology

In an attempt to estimate Burlington County's vulnerability to ground failure due to landslides, the Geology - Landslide Incidence and Susceptibility GIS layer from National Atlas was used to coarsely define the general landslide susceptible area. The Geology - Landslide Incidence and Susceptibility GIS layer was overlaid upon the Burlington County municipalities, 2010 Census population data, custom building inventory and Burlington County's critical facility inventory to estimate exposure.

According to Radbruch-Hall et.al., the Landslide Incidence and Susceptibility GIS layer from National Atlas '....was prepared by evaluating formations or groups of formations shown on the geologic map of the United States (King and Beikman, 1974) and classifying them as having high, medium, or low landslide incidence (number of landslides) and being of high, medium, or low susceptibility to landsliding. Thus, those map units or parts of units with more than 15 percent of their area involved in landsliding were classified as having high incidence; those with 1.5 to 15 percent of their area involved in landsliding, as having medium incidence; and those with less than 1.5 percent of their area involved, as having low incidence. This classification scheme was modified where particular lithofacies are known to have variable landslide incidence or susceptibility. In continental glaciated areas, additional data were used to identify surficial deposits that are susceptible to slope movement. Susceptibility to landsliding was defined as the probable degree of response of the areal rocks and soils to natural or artificial cutting or loading of slopes or to anomalously high precipitation. High, medium, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. For example, it was estimated that a rock or soil unit characterized by high landslide susceptibility would respond to widespread artificial cutting by some movement in 15 percent or more of the affected area. We did not evaluate the effect of earthquakes on slope stability, although many catastrophic landslides have been generated by ground shaking during earthquakes. Areas susceptible to ground failure under static conditions would probably also be susceptible to failure during earthquakes' (Radbruch-Hall, 1982).

The limitations of this analysis are recognized and are only used to provide a general estimate. Over time additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

Impact on Life, Health and Safety

Table 5.4.5-2 summarizes the area within each hazard ranked area, specific to Burlington County jurisdictions. To estimate the population located within the ground failure hazard areas, the approximate hazard area boundaries were overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center (centroid) within the boundary of the landslide incidence hazard areas were used to calculate the estimated population considered exposed to this hazard. Tables 5.4.5-3 and 5.4.5-4 summarize the population within each identified area by municipality (U.S. Census 2010).

Impact on General Building Stock

In general, the built environment located in the high susceptibility zones and the population, structures and infrastructure located downslope are vulnerable to this hazard. In an attempt to estimate the general building stock vulnerable to this hazard, the building replacement values (buildings and contents) were determined for the buildings with their centroids within the approximate landslide and karst hazard areas.

Table 5.4.5-2. Total Assessed Value of Improvements Exposed to Landslides in Burlington County

Municipality	Total Assessed Value of Improvements	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low	% of Total	Moderate/Low	% of Total
Bass River Township	\$112,293,600	\$112,293,600	100%		0.0%
Beverly*	\$72,091,800		0.0%	\$72,091,800	100%
Bordentown	\$298,534,950	\$10,317,000	3.5%	\$288,217,950	96.5%
Bordentown Township	\$997,461,800	\$715,065,900	71.7%	\$282,395,900	28.3%
Burlington	\$571,882,875	\$17,979,300	3.1%	\$553,903,575	96.9%
Burlington Township	\$2,097,110,708	\$1,348,003,851	64.3%	\$749,106,857	35.7%
Chesterfield Township	\$666,455,492	\$666,455,492	100%		0.0%
Cinnaminson Township	\$1,304,483,700	\$25,016,100	1.9%		0.0%
Delanco Township	\$290,621,560		0.0%	\$290,621,560	100%
Delran Township	\$1,474,866,100	\$234,433,000	15.9%	\$1,240,433,100	84.1%
Eastampton Township	\$421,225,400	\$421,225,400	100%		0.0%
Edgewater Park Township	\$528,294,400		0.0%	\$528,294,400	100%
Evesham Township	\$4,389,240,875	\$4,389,240,875	100%		0.0%
Fieldsboro Borough	\$48,903,400		0.0%	\$48,903,400	100%
Florence Township	\$1,040,584,300	\$328,463,000	31.6%	\$712,121,300	68.4%
Hainesport Township	\$367,702,666	\$367,702,666	100%		0.0%
Lumberton Township	\$1,164,991,807	\$1,164,991,807	100%		0.0%
Mansfield Township	\$899,612,400	\$889,371,100	98.9%	\$10,241,300	1.1%
Maple Shade Township	\$1,405,067,900	\$1,334,291,300	95.0%	\$70,776,600	5.0%
Medford Lakes Borough	\$1,297,069,100	\$1,297,069,100	100%		0.0%
Medford Township	\$980,612,600	\$980,612,600	100%		0.0%

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-2. Total Assessed Value of Improvements Exposed to Landslides in Burlington County

Municipality	Total Assessed Value of Improvements	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low	% of Total	Moderate/Low	% of Total
Moorestown Township	\$3,410,132,200	\$3,371,566,200	98.9%	\$38,566,000	1.1%
Mount Holly Township	\$1,079,081,000	\$1,079,081,000	100%		0.0%
Mount Laurel Township	\$2,396,695,600	\$2,396,695,600	100%		0.0%
New Hanover Township	\$852,205,300	\$852,205,300	100%		0.0%
North Hanover Township	\$498,418,446	\$498,418,446	100%		0.0%
Palmyra Borough	\$254,304,240		0.0%	\$254,304,240	100%
Pemberton Borough	\$63,520,200	\$63,520,200	100%		0.0%
Pemberton Township	\$2,014,515,095	\$2,014,515,095	100%		0.0%
Riverside Township	\$349,218,580		0.0%	\$349,218,580	100%
Riverton Borough	\$207,879,600		0.0%	\$207,879,600	100%
Shamong Township	\$294,159,200	\$294,159,200	100%		0.0%
Southampton Township	\$549,437,950	\$549,437,950	100%		0.0%
Springfield Township	\$282,324,750	\$282,324,750	100%		0.0%
Tabernacle Township	\$580,603,200	\$580,603,200	100%		0.0%
Washington Township	\$13,020,400	\$13,020,400	100%		0.0%
Westampton Township	\$919,859,000	\$919,859,000	100%		0.0%
Willingboro Township	\$1,705,779,550	\$1,196,375,150	70.1%	\$509,404,400	29.9%
Woodland Township	\$305,887,600	\$305,887,600	100%		0.0%
Wrightstown Borough	\$47,025,100	\$47,025,100	100%		0.0%
Burlington County	\$36,253,174,444	\$28,767,226,282	79.4%	\$7,486,047,162	20.6%

Source: Burlington County Department of Information Technology, 2013; Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

*Beverly data source: 2011 NJGIN MODIV

Table 5.4.5-5 list the total assessed value of improvements and replacement cost value (structure and contents) of the general building stock exposed to this hazard.

Table 5.4.5-3. Estimated Area Exposed to Landslides in Burlington County

Municipality	Total Area in Acres	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low		Moderate/Low	
		Acres	% of Total	Acres	% of Total
Bass River Township	50,140	50,140	100%	0	0%
Beverly	486	0	0%	486	100%
Bordentown	618	36	6%	581	94%
Bordentown Township	5,926	3,295	56%	2,632	44%
Burlington	2,426	147	6%	2,272	94%
Burlington Township	8,992	5,532	62%	3,477	39%
Chesterfield Township	13,736	13,736	100%	0	0%

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-3. Estimated Area Exposed to Landslides in Burlington County

Municipality	Total Area in Acres	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low		Moderate/Low	
		Acres	% of Total	Acres	% of Total
Cinnaminson Township	5,099	51	1%	5,040	99%
Delanco Township	2,190	0	0%	2,190	100%
Delran Township	4,654	872	19%	3,772	81%
Eastampton Township	3,723	3,723	100%	0	0%
Edgewater Park Township	1,976	0	0%	1,976	100%
Evesham Township	18,943	18,932	100%	0	0%
Fieldsboro Borough	224	0	0%	224	100%
Florence Township	6,559	3,411	52%	3,137	48%
Hainesport Township	4,344	4,343	100%	0	0%
Lumberton Township	8,327	8,327	100%	0	0%
Mansfield Township	14,010	13,576	97%	446	3%
Maple Shade Township	2,451	2,244	92%	207	8%
Medford Lakes Borough	812	812	100%	0	0%
Medford Township	25,474	25,475	100%	0	0%
Moorestown Township	9,585	9,415	98%	164	2%
Mount Holly Township	1,837	1,837	100%	0	0%
Mount Laurel Township	14,066	14,073	100%	0	0%
New Hanover Township	14,483	14,483	100%	0	0%
North Hanover Township	11,203	11,203	100%	0	0%
Palmyra Borough	1,673	0	0%	1,673	100%
Pemberton Borough	403	403	100%	0	0%
Pemberton Township	40,171	40,164	100%	0	0%
Riverside Township	1,048	0	0%	1,047	100%
Riverton Borough	614	0	0%	614	100%
Shamong Township	28,791	28,824	100%	0	0%
Southampton Township	28,446	28,422	100%	0	0%
Springfield Township	18,924	18,920	100%	0	0%
Tabernacle Township	31,688	31,725	100%	0	0%
Washington Township	66,539	67,067	101%	0	0%
Westampton Township	7,104	7,101	100%	0	0%
Willingboro Township	5,175	3,540	68%	1,654	32%
Woodland Township	61,001	60,439	99%	0	0%
Wrightstown Borough	1,146	1,146	100%	0	0%
Burlington County	525,009	493,412	94%	31,592	6%

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-4. Estimated Population Exposed to Landslides in Burlington County

Municipality	Total Population (U.S. Census 2010)	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low		Moderate/Low	
		Pop.	% of Total	Pop.	% of Total
Bass River Township	1,443	1,443	100%		
Beverly	2,577			2,577	100%
Bordentown	3,924	1,93	4.92%	3,731	95.08%
Bordentown Township	11,367	7,598	66.84%	3,769	33.16%
Burlington	9,920	352	3.55%	9,568	96.45%
Burlington Township	22,594	14,032	62.10%	8,562	37.90%
Chesterfield Township	7,699	7,699	100%		
Cinnaminson Township	15,569	208	1.34%	15,361	98.66%
Delanco Township	4,283			4283	100%
Delran Township	16,896	3,185	18.85%	13,711	81.15%
Eastampton Township	6,069	6,069	100%		
Edgewater Park Township	8,881			8,881	100%
Evesham Township	45,538	45,538	100%		
Fieldsboro Borough	540			540	100%
Florence Township	12,109	2,598	21.46%	9,511	78.54%
Hainesport Township	6,110	6,110	100%		
Lumberton Township	12,559	12,559	100%		
Mansfield Township	8,544	8,486	99%	58	0.68%
Maple Shade Township	19,131	17,736	92%	1,395	7.29%
Medford Lakes Borough	4,146	4,146	100%		
Medford Township	23,033	23,033	100%		
Moorestown Township	20,726	20,680	99.78%	46	0.22%
Mount Holly Township	9,536	9,536	100%		
Mount Laurel Township	41,864	41,864	100%		
New Hanover Township	7,385	7,385	100%		
North Hanover Township	7,678	7,678	100%		
Palmyra Borough	7,398			7398	100%
Pemberton Borough	1,409	1,409	100%		
Pemberton Township	27,912	27,912	100%		
Riverside Township	8,079			8,079	100%
Riverton Borough	2,779			2,779	100%
Shamong Township	6,490	6,490	100%		
Southampton Township	10,464	10,464	100 %		
Springfield Township	3,414	3,414	100%		
Tabernacle Township	6,949	6,949	100%		
Washington Township	687	687	100%		

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-4. Estimated Population Exposed to Landslides in Burlington County

Municipality	Total Population (U.S. Census 2010)	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low		Moderate/Low	
		Pop.	% of Total	Pop.	% of Total
Westampton Township	8,813	8,813	100%		
Willingboro Township	31,629	22739	71.89%	8890	28.11%
Woodland Township	1,788	1788	100%		
Wrightstown Borough	802	802	100%		
Burlington County	448,734	339,595	75.67%	109,139	24.32%

Source: U.S. Census 2010; Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

Note: Pop. = Population

Table 5.4.5-5. Total Assessed Value of Improvements Exposed to Landslides in Burlington County

Municipality	Total Assessed Value of Improvements	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low	% of Total	Moderate/Low	% of Total
Bass River Township	\$112,293,600	\$112,293,600	100%		0.0%
Beverly*	\$72,091,800		0.0%	\$72,091,800	100%
Bordentown	\$298,534,950	\$10,317,000	3.5%	\$288,217,950	96.5%
Bordentown Township	\$997,461,800	\$715,065,900	71.7%	\$282,395,900	28.3%
Burlington	\$571,882,875	\$17,979,300	3.1%	\$553,903,575	96.9%
Burlington Township	\$2,097,110,708	\$1,348,003,851	64.3%	\$749,106,857	35.7%
Chesterfield Township	\$666,455,492	\$666,455,492	100%		0.0%
Cinnaminson Township	\$1,304,483,700	\$25,016,100	1.9%		0.0%
Delanco Township	\$290,621,560		0.0%	\$290,621,560	100%
Delran Township	\$1,474,866,100	\$234,433,000	15.9%	\$1,240,433,100	84.1%
Eastampton Township	\$421,225,400	\$421,225,400	100%		0.0%
Edgewater Park Township	\$528,294,400		0.0%	\$528,294,400	100%
Evesham Township	\$4,389,240,875	\$4,389,240,875	100%		0.0%
Fieldsboro Borough	\$48,903,400		0.0%	\$48,903,400	100%
Florence Township	\$1,040,584,300	\$328,463,000	31.6%	\$712,121,300	68.4%
Hainesport Township	\$367,702,666	\$367,702,666	100%		0.0%
Lumberton Township	\$1,164,991,807	\$1,164,991,807	100%		0.0%
Mansfield Township	\$899,612,400	\$889,371,100	98.9%	\$10,241,300	1.1%
Maple Shade Township	\$1,405,067,900	\$1,334,291,300	95.0%	\$70,776,600	5.0%
Medford Lakes Borough	\$1,297,069,100	\$1,297,069,100	100%		0.0%
Medford Township	\$980,612,600	\$980,612,600	100%		0.0%
Moorestown Township	\$3,410,132,200	\$3,371,566,200	98.9%	\$38,566,000	1.1%
Mount Holly Township	\$1,079,081,000	\$1,079,081,000	100%		0.0%
Mount Laurel Township	\$2,396,695,600	\$2,396,695,600	100%		0.0%
New Hanover Township	\$852,205,300	\$852,205,300	100%		0.0%

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-5. Total Assessed Value of Improvements Exposed to Landslides in Burlington County

Municipality	Total Assessed Value of Improvements	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low	% of Total	Moderate/Low	% of Total
North Hanover Township	\$498,418,446	\$498,418,446	100%		0.0%
Palmyra Borough	\$254,304,240		0.0%	\$254,304,240	100%
Pemberton Borough	\$63,520,200	\$63,520,200	100%		0.0%
Pemberton Township	\$2,014,515,095	\$2,014,515,095	100%		0.0%
Riverside Township	\$349,218,580		0.0%	\$349,218,580	100%
Riverton Borough	\$207,879,600		0.0%	\$207,879,600	100%
Shamong Township	\$294,159,200	\$294,159,200	100%		0.0%
Southampton Township	\$549,437,950	\$549,437,950	100%		0.0%
Springfield Township	\$282,324,750	\$282,324,750	100%		0.0%
Tabernacle Township	\$580,603,200	\$580,603,200	100%		0.0%
Washington Township	\$13,020,400	\$13,020,400	100%		0.0%
Westampton Township	\$919,859,000	\$919,859,000	100%		0.0%
Willingboro Township	\$1,705,779,550	\$1,196,375,150	70.1%	\$509,404,400	29.9%
Woodland Township	\$305,887,600	\$305,887,600	100%		0.0%
Wrightstown Borough	\$47,025,100	\$47,025,100	100%		0.0%
Burlington County	\$36,253,174,444	\$28,767,226,282	79.4%	\$7,486,047,162	20.6%

Source: Burlington County Department of Information Technology, 2013; Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

*Beverly data source: 2011 NJGIN MODIV

Table 5.4.5-6. Estimated General Building Stock Replacement Cost Value Exposed to Landslides in Burlington County

Municipality	Total GBS RCV	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low	% of Total	Moderate/Low	% of Total
Bass River Township	\$158,762,000	\$158,762,000	100%		0.0%
Beverly City	\$351,041,000		0.0%	\$351,041,000	100%
Bordentown City	\$611,161,000	\$12,381,000	2.0%	\$598,780,000	98.0%
Bordentown Township	\$1,225,803,000	\$918,661,000	74.9%	\$307,142,000	25.1%
Burlington City	\$1,419,313,000	\$23,959,000	1.7%	\$1,395,354,000	98.3%
Burlington Township	\$3,257,758,000	\$2,191,018,000	67.3%	\$1,066,740,000	32.7%
Chesterfield Township	\$482,451,000	\$482,451,000	100%		0.0%
Cinnaminson Township	\$2,375,176,000	\$31,173,000	1.3%	\$2,344,003,000	98.7%
Delanco Township	\$484,972,000		0.0%	\$484,972,000	100%
Delran Township	\$2,136,079,000	\$371,415,000	17.4%	\$1,764,664,000	82.6%
Eastampton Township	\$712,944,000	\$712,944,000	100%		0.0%
Edgewater Park Township	\$959,473,000		0.0%	\$959,473,000	100%
Evesham Township	\$6,451,252,000	\$6,451,252,000	100%		0.0%
Fieldsboro Borough	\$72,125,000		0.0%	\$72,125,000	100%

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-6. Estimated General Building Stock Replacement Cost Value Exposed to Landslides in Burlington County

Municipality	Total GBS RCV	Landslide Incidence		Landslide Susceptibility/Incidence	
		Low	% of Total	Moderate/ Low	% of Total
Florence Township	\$1,509,320,000	\$215,102,000	14.3%	\$1,294,218,000	85.7%
Hainesport Township	\$839,062,000	\$839,062,000	100%		0.0%
Lumberton Township	\$1,504,149,000	\$1,504,149,000	100%		0.0%
Mansfield Township	\$1,954,839,000	\$1,926,462,000	98.5%	\$28,377,000	1.5%
Maple Shade Township	\$2,346,098,000	\$2,205,857,000	94.0%	\$140,241,000	6.0%
Medford Lakes Borough	\$560,603,000	\$560,603,000	100%		0.0%
Medford Township	\$3,746,510,000	\$3,746,510,000	100%		0.0%
Moorestown Township	\$4,209,509,000	\$4,173,379,000	99.1%	\$36,130,000	0.9%
Mount Holly Township	\$1,650,406,000	\$1,650,406,000	100%		0.0%
Mount Laurel Township	\$6,985,988,000	\$6,985,988,000	100%		0.0%
New Hanover Township	\$1,604,641,000	\$1,604,641,000	100%		0.0%
North Hanover Township	\$685,211,000	\$685,211,000	100%		0.0%
Palmyra Borough	\$942,785,000		0.0%	\$942,785,000	100%
Pemberton Borough	\$187,379,000	\$187,379,000	100%		0.0%
Pemberton Township	\$3,248,981,000	\$3,248,981,000	100%		0.0%
Riverside Township	\$885,809,000		0.0%	\$885,809,000	100%
Riverton Borough	\$352,198,000		0.0%	\$352,198,000	100%
Shamong Township	\$797,191,000	\$797,191,000	100%		0.0%
Southampton Township	\$1,305,540,000	\$1,305,540,000	100%		0.0%
Springfield Township	\$461,104,000	\$461,104,000	100%		0.0%
Tabernacle Township	\$931,897,000	\$931,897,000	100%		0.0%
Washington Township	\$108,601,000	\$108,601,000	100%		0.0%
Westampton Township	\$1,326,163,000	\$1,326,163,000	100%		0.0%
Willingboro Township	\$3,602,996,000	\$2,599,739,000	72.2%	\$1,003,257,000	27.8%
Woodland Township	\$115,483,000	\$115,483,000	100%		0.0%
Wrightstown Borough	\$140,021,000	\$140,021,000	100%		0.0%
Burlington County	\$62,700,794,000	\$48,673,485,000	77.6%	\$14,027,309,000	22.4%

Source: Burlington County Department of Information Technology, 2013; Godt, 2011 (Geology WMS Layer from the National Atlas of the United States); HAZUS-MH v2.1

Notes: GBS = General Building Stock; RCV = Replacement Cost Value.

The total building count and total replacement values are the sum of all seven general occupancy classifications (residential, commercial, industrial, agricultural, religious, government and educational) for that jurisdiction.

Impact on Critical Facilities

To estimate exposure, the approximate landslide hazard areas were overlaid upon the essential and municipal facilities. Table 5.4.5-7 lists the essential facilities (i.e., police, fire, EOCs, hospitals and schools) that are located in the low/moderate Landslide susceptibility/incidence hazard areas.

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
Municipal (Edgewater)	400 DELANCO RD	BEVERLY CITY	EOC	x
BEVERLY - EDGEWATER PARK EMERG SQUAD	703 MELBOURNE AV	BEVERLY CITY	EMS	x
BEVERLY CITY FIRE DEPARTMENT	446 BROAD ST	BEVERLY CITY	FIRE	x
BEVERLY CITY POLICE DEPT	446 BROAD ST	BEVERLY CITY	POLICE	x
BEVERLY ELEMENTARY SCHOOL	601 BENTLEY AVE	BEVERLY CITY	SCHOOL	x
BEVERLY FIRE CO #1	440 LAUREL ST	BEVERLY CITY	FIRE	x
BEVERLY SCHOOL	601 BENTLEY AVE	BEVERLY CITY	SCHOOL	x
BEVERLY SUPERINTENDENT'S OFC	601 BENTLEY AVE	BEVERLY CITY	ADMIN	x
Beverly/Edgewater Park	LEFT SIDE PLATFORM	BEVERLY CITY	CSWPR	x
BOARD OF EDUCATION	401 BROAD ST	BEVERLY CITY	BOARD OF ED	x
BOARD OF EDUCATION SECRETARY	401 BROAD ST	BEVERLY CITY	BOARD OF ED	x
CHILD STUDY TEAM	401 BROAD ST	BEVERLY CITY	CHILD STUDY TM	x
HOPE HOSE FIRE CO #2	400 BROAD ST	BEVERLY CITY	FIRE	x
ST JOSEPH'S SCHOOL	524 WARREN ST	BEVERLY CITY	SCHOOL	x
ST JOSEPH'S SCHOOL	524 WARREN ST	BEVERLY CITY	SCHOOL	x
Station 321	51 GROVEVILLE RD	BORDENTOWN CITY	EOC	x
Bordentown	RIGHT SIDE PLATFORM	BORDENTOWN CITY	CSWPR	x
BORDENTOWN CITY POLICE DEPT	324 FARNSWORTH AV	BORDENTOWN CITY	POLICE	x
BORDENTOWN REGION SCHOOL DIST	78 CROSSWICKS ST	BORDENTOWN CITY	ADMIN	x
CLARA BARTON ELEMENTARY SCHOOL	100 CROSSWICKS ST	BORDENTOWN CITY	SCHOOL	x
CONSOLIDATED FIRE ASSOCIATION	20 CROSSWICKS ST PO Box 47	BORDENTOWN CITY	FIRE	x
HOPE HOSE HUMANE CO #1	150 W BURLINGTON ST	BORDENTOWN CITY	EMS	x
HOPE HOSE HUMANE FIRE CO #1	150 W BURLINGTON ST POB 666	BORDENTOWN CITY	FIRE	x
HOPE HOSE HUMANE FIRE CO #1	150 W BURLINGTON ST	BORDENTOWN CITY	FIRE	x
MACFARLAND JUNIOR SCHOOL	87 CROSSWICKS ST	BORDENTOWN CITY	SCHOOL	x

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
MACFARLAND JUNIOR SCHOOL	87 CROSSWICKS ST	BORDENTOWN CITY	SCHOOL	x
ST. MARY SCHOOL	30 ELIZABETH ST.	BORDENTOWN CITY	SCHOOL	x
Station 609	150 W BURLINGTON ST	BORDENTOWN CITY	EOC	x
MISSION FIRE CO #1	51 GROVEVILLE RD	BORDENTOWN TWP	FIRE	x
NJ STATE POLICE - BORDENTOWN	301 US 130	BORDENTOWN TWP	POLICE	x
Burlington City Police	525 High Street	BURLINGTON CITY	POLICE	x
DAVITA BURLINGTON NORTH	1164 ROUTE 130 NORTH	BURLINGTON CITY	DIALYSIS	x
ALL SAINTS SCHOOL	510 HIGH ST	BURLINGTON CITY	SCHOOL	x
BURLINGTON CITY FIRE DEPARTMENT	525 HIGH STREET	BURLINGTON CITY	FIRE	x
BURLINGTON BOARD OF EDUCATION	518 LOCUST AVE	BURLINGTON CITY	BOARD OF ED	x
BURLINGTON BRISTOL BRIDGE POLICE DEPT	348 CONOVER ST	BURLINGTON CITY	POLICE	x
BURLINGTON CITY HIGH SCHOOL	100 DEWEY ST	BURLINGTON CITY	SCHOOL	x
BURLINGTON GENERATING STATION HELIPORT(PSEG)	901 W BROAD ST	BURLINGTON CITY	Private	x
Burlington South Park & Ride	LEFT AND RIGHT SIDE PLATFORM	BURLINGTON CITY	CSWPR	x
Burlington Town Center Station	RIGHT SIDE PLATFORM	BURLINGTON CITY	CS	x
CAPTAIN JAMES LAWRENCE SCHOOL	316 BARCLAY ST	BURLINGTON CITY	SCHOOL	x
ELIAS BOUDINOT ELEMENTARY SCHL	W PEARL & ELLIS STS	BURLINGTON CITY	SCHOOL	x
ENDEAVOR EMERGENCY SQUAD	19 E UNION ST	BURLINGTON CITY	EMS	x
HOLY LIGHT CHRISTIAN ACADEMY	133 E UNION ST	BURLINGTON CITY	SCHOOL	x
MITCHELL FIRE CO #3	300 FEDERAL ST POB 668	BURLINGTON CITY	FIRE	x
Municipal	525 HIGH ST	BURLINGTON CITY	EOC	x
NEPTUNE HOSE CO #5	721 BORDENTOWN RD POB 283	BURLINGTON CITY	FIRE	x
NIAGARA HOSE CO 6	656 HWY 541	BURLINGTON CITY	FIRE	x
NJSP MARINE POLICE	601 NEW PEARL ST	BURLINGTON CITY	POLICE	x
SAMUEL SMITH ELEMENTARY SCHOOL	250 FARNER AVE	BURLINGTON CITY	SCHOOL	x

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
ST MARY'S HALL -DOANE ACADEMY	350 RIVERBANK	BURLINGTON CITY	SCHOOL	x
ST PAUL'S PAROCHIAL SCHOOL	250 JAMES ST	BURLINGTON CITY	SCHOOL	x
WILBUR WATTS INTERMEDIATE SCHL	HIGH ST & WOOD ST	BURLINGTON CITY	SCHOOL	x
WILBUR WATTS MIDDLE SCHOOL	550 HIGH ST	BURLINGTON CITY	SCHOOL	x
BEVERLY ROAD FIRE CO #2	1001 BEVERLY RD	BURLINGTON TWP	FIRE	x
Police HQ	900 MANOR RD	CINNAMINSON TWP	EOC	x
Cinnaminson	CENTER ISLAND PLATFORM	CINNAMINSON TWP	CSWPR	x
CINNAMINSON BOARD OF EDUCATION	905 S RTE 130	CINNAMINSON TWP	BOARD OF ED	x
CINNAMINSON FIRE STATION 201	1725 CINNAMINSON AV	CINNAMINSON TWP	FIRE	x
CINNAMINSON FIRE STATION 202	1900 TAYLORS LN	CINNAMINSON TWP	FIRE	x
CINNAMINSON HIGH SCHOOL	1197 RIVERTON RD	CINNAMINSON TWP	SCHOOL	x
CINNAMINSON HIGH SCHOOL	1197 RIVERTON RD	CINNAMINSON TWP	SCHOOL	x
CINNAMINSON MIDDLE SCHOOL	312 NORTH FORKLANDING RD	CINNAMINSON TWP	SCHOOL	x
CINNAMINSON MIDDLE SCHOOL	312 FORKLANDING RD	CINNAMINSON TWP	SCHOOL	x
CINNAMINSON TWP FIRE DEPT	1621 RIVERTON ROAD	CINNAMINSON TWP	FIRE	x
CINNAMINSON TWP POLICE DEPT	900 MANOR RD	CINNAMINSON TWP	POLICE	x
ELANOR RUSH SCHOOL	1200 WYNWOOD DR	CINNAMINSON TWP	SCHOOL	x
MEMORIAL SCHOOL	2195 RIVERTON RD	CINNAMINSON TWP	SCHOOL	x
NEW ALBANY ELEMENTARY SCHOOL	2701 NEW ALBANY RD	CINNAMINSON TWP	SCHOOL	x
PROJECT CHALLENGE	2195 RIVERTON RD	CINNAMINSON TWP	SCHOOL	x
ST CHARLES BORROMEO ROMAN SCHL	2500 BRANCH PIKE	CINNAMINSON TWP	SCHOOL	x
STUDENT ACTIVITY CENTER	2195 RIVERTON RD	CINNAMINSON TWP	SCHOOL	x
WESTFIELD FRIENDS SCHOOL	2201 RIVERTON RD	CINNAMINSON TWP	SCHOOL	x
Municipal	515 BURLINGTON AVE	DELANCO TWP	EOC	x
Delanco	LEFT AND RIGHT SIDE PLATFORM	DELANCO TWP	CSWPR	x

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
DELANCO EMERGENCY SQUAD	1800 BURLINGTON AV	DELANCO TWP	EMS	x
DELANCO POLICE	770 COOPER ST	DELANCO TWP	P	x
DELANCO TOWNSHIP SCHOOL DIST	411 WALNUT ST	DELANCO TWP	ADMIN	x
M JOAN PEARSON SCHOOL	BURLINGTON AVE & LILAC LA	DELANCO TWP	SCHOOL	x
WALNUT STREET ELEMENTARY SCHL	411 WALNUT ST	DELANCO TWP	SCHOOL	x
WASHINGTON FIRE CO #1	1800 BURLINGTON AV POB 5021	DELANCO TWP	FIRE	x
DAVITA DELRAN	8008 ROUTE 130 NORTH	DELRAN TWP	DIALYSIS	x
Municipal	900 CHESTER AVE	DELRAN TWP	EOC	x
DELRAN CHILD STUDY TEAM	52 HARTFORD RD	DELRAN TWP	CHILD STUDY TM	x
DELRAN EMERGENCY SQUAD	900 CHESTER AVE	DELRAN TWP	EMS	x
DELRAN FIRE CO #1	9 S BRIDGEBORO ST	DELRAN TWP	FIRE	x
DELRAN FIRE CO#2	1020 CHESTER AV	DELRAN TWP	FIRE	x
DELRAN FIRE DEPARTMENT	900 CHESTER AVENUE	DELRAN TWP	FIRE	x
DELRAN INTERMEDIATE SCHOOL	20 CREEK ROAD	DELRAN TWP	SCHOOL	x
DELRAN MIDDLE SCHOOL	905 CHESTER AVE	DELRAN TWP	SCHOOL	x
DELRAN POLICE DEPT	900 CHESTER AVE	DELRAN TWP	POLICE	x
DELRAN TOWNSHIP BOARD OF EDCTN	52 HARTFORD RD	DELRAN TWP	BOARD OF ED	x
DELRAN TOWNSHIP HIGH SCHOOL	50 HARTFORD RD	DELRAN TWP	SCHOOL	x
DELRAN TOWNSHIP HIGH SCHOOL	50 HARTFORD RD	DELRAN TWP	SCHOOL	x
HOLY CROSS HIGH SCHOOL	5035 HWY 130	DELRAN TWP	SCHOOL	x
MAC MILLAN RESTRICTED HELISTOP	900 CHESTER AVENUE	DELRAN TWP	Private	x
MILLBRIDGE ELEMENTARY SCHOOL	282 CONROW RD	DELRAN TWP	SCHOOL	x
MONTESSORI ACADEMY OF NJ	28 CONROW ROAD	DELRAN TWP	SCHOOL	x
Municipal	400 DELANCO RD	EDGEWATER PARK TWP	EOC	x
EDGEWATER PARK TWP POLICE	400 DELANCO RD	EDGEWATER PARK TWP	POLICE	x

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
MAGOWAN ELEMENTARY SCHOOL	405 CHERRY AVE	EDGEWATER PARK TWP	SCHOOL	x
MILDRED MAGOWAN ELEMENTARY SCHOOL	405 CHERRIX AVE	EDGEWATER PARK TWP	SCHOOL	x
SAMUEL M RIDGEWAY SCHOOL	300 DELANCO RD	EDGEWATER PARK TWP	SCHOOL	x
SAMUEL M RIDGEWAY SCHOOL	300 DELANCO RD	EDGEWATER PARK TWP	SCHOOL	x
Municipal	18 WASHINGTON ST	FIELDSBORO BORO	EOC	x
FIELDSBORO POLICE DEPT	204 WASHINGTON ST	FIELDSBORO BORO	POLICE	x
Station 402 / Munici	711 BROAD ST	FLORENCE TWP	EOC	x
Florence Park & Ride	CENTER ISLAND PLATFORM	FLORENCE TWP	CSWPR	x
Roebbling	LEFT SIDE PLATFORM	FLORENCE TWP	CSWPR	x
FLORENCE CHILD STUDY CTR	440 WEST FOURTH STREET	FLORENCE TWP	CHILD STUDY TM	x
FLORENCE FIRE DEPARTMENT	401 FIREHOUSE LA	FLORENCE TWP	FIRE	x
FLORENCE FIRE VOLUNTER FIRE COMPANY	401 FIREHOUSE LA	FLORENCE TWP	FIRE	x
FLORENCE MEMORIAL HIGH SCHOOL	CEDAR LANE	FLORENCE TWP	SCHOOL	x
FLORENCE MEMORIAL MIDDLE SCHOOL	500 EAST FRONT ST	FLORENCE TWP	SCHOOL	SCHOOL
FLORENCE TOWNSHIP MIDDLE SCHOOL	500 E FRONT ST	FLORENCE TWP	SCHOOL	x
FLORENCE TOWNSHIP MMRL HS	500 E FRONT ST	FLORENCE TWP	SCHOOL	x
FLORENCE TOWNSHIP SCHOOL DIST	201 CEDAR ST	FLORENCE TWP	ADMIN	x
FLORENCE TWP POLICE DEPT	711 BROAD ST	FLORENCE TWP	POLICE	x
MACELLA I DUFFY SCHOOL	208 W 2ND ST	FLORENCE TWP	SCHOOL	x
RIVERBANK CHARTER SCHL OF EXCELLENCE	1300 HORNBERGER AVE & PARISH LN	FLORENCE TWP	SCHOOL	x
RIVERFRONT SCHOOL	500 E FRONT ST	FLORENCE TWP	SCHOOL	x
ROEBLING ELEMENTARY SCHOOL 5	1300 HORNBERGER AV	FLORENCE TWP	SCHOOL	x
HOWARD R YOCUM ELEMENTARY SCHL	748 N FORKLANDING RD	MAPLE SHADE TWP	SCHOOL	x
Station 801	115 W BROAD ST	PALMYRA BORO	EOC	x
CHARLES STREET ELEMENTARY SCHL	100 W CHARLES ST	PALMYRA BORO	SCHOOL	x

SECTION 5.4.5: RISK ASSESSMENT – LANDSLIDE

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
CHARLES STREET ELEMENTARY SCHOOL	100 WEST CHARLES ST	PALMYRA BORO	SCHOOL	x
DELAWARE AVENUE SCHOOL	301 DELAWARE AVE	PALMYRA BORO	SCHOOL	x
PALMYRA ADULT HIGH SCHOOL	DELAWARE AVE & 4TH ST W	PALMYRA BORO	SCHOOL	x
PALMYRA AMBULANCE ASSOCIATION	125 W BROAD ST	PALMYRA BORO	EMS	x
PALMYRA BOARD OF EDUCATION	301 DELAWARE AVE	PALMYRA BORO	BOARD OF ED	x
PALMYRA CHILD STUDY TEAM	301 DELAWARE AVE	PALMYRA BORO	CHILD STUDY TM	x
PALMYRA COMMUNITY EDUCATION	4TH & DELAWARE AVE	PALMYRA BORO	SCHOOL	x
PALMYRA FIRE DEPT	115 W BROAD ST	PALMYRA BORO	FIRE	x
PALMYRA HIGH SCHOOL	5TH & WEART BLVD	PALMYRA BORO	SCHOOL	x
PALMYRA POLICE DEPT	20 W BROAD ST	PALMYRA BORO	POLICE	x
TACONY PALMYRA BRIDGE POLICE DEPT	1300 HYW 73	PALMYRA BORO	POLICE	x
TRI-BOROUGH OFFICERS' ASSOCIATION	115 W BROAD ST	PALMYRA BORO	FIRE	x
Palmyra	RIGHT SIDE PLATFORM	PALMYRA BORO	CS	x
36th Street	NA	Pennsauken Township	CS	x
Pennsauken/Route 73 Park & Ride	LEFT AND RIGHT SIDE PLATFORM	Pennsauken Township	CSWPR	x
Station 701	4 W SCOTT ST	RIVERSIDE TWP	EOC	x
Riverside	LEFT AND RIGHT SIDE PLATFORM	RIVERSIDE TWP	CSWPR	x
RIVERSIDE CHILD STUDY TEAM	112 E. WASHINGTON ST	RIVERSIDE TWP	CHILD STUDY TM	x
RIVERSIDE FIRE CO #1	4 W SCOTT ST	RIVERSIDE TWP	FIRE	x
RIVERSIDE HIGH SCHOOL	112 WASHINGTON ST	RIVERSIDE TWP	SCHOOL	x
RIVERSIDE MIDDLE SCHOOL	112 E. WASHINGTON ST	RIVERSIDE TWP	SCHOOL	x
RIVERSIDE TOWNSHIP BOARD EDCTN	112 E. WASHINGTON ST	RIVERSIDE TWP	BOARD OF ED	x
RIVERSIDE TOWNSHIP HIGH SCHOOL	112 E. WASHINGTON ST	RIVERSIDE TWP	SCHOOL	x
RIVERSIDE TWP ELEMENTARY SCHL	112 E. WASHINGTON ST	RIVERSIDE TWP	SCHOOL	x
RIVERSIDE TWP POLICE DEPT	1 W SCOTT ST	RIVERSIDE TWP	POLICE	x

Table 5.4.5-7. Emergency Critical Facilities Exposed to Estimated Landslide Hazard Areas in Burlington County

Name	Address	Municipality	Type	Landslide Susceptibility/ Incidence Moderate/ Low
SCHOOL SUPERINTENDENT OFFICE	120 WASHINGTON ST	RIVERSIDE TWP	ADMIN	x
ST PETER'S RELIGIOUS EDUCATION	101 MIDDLETON ST	RIVERSIDE TWP	SCHOOL	x
ST PETER'S SCHOOL	101 MIDDLETON ST	RIVERSIDE TWP	SCHOOL	x
SUPERINTENDENT OF SCHOOLS	120 WASHINGTON ST	RIVERSIDE TWP	ADMIN	x
Municipal	505A HOWARD ST	RIVERTON BORO	EOC	x
RIVERTON BORO POLICE DEPT	501 5TH ST	RIVERTON BORO	POLICE	x
RIVERTON BOROUGH PUBLIC SCHOOL	600 5TH ST	RIVERTON BORO	SCHOOL	x
RIVERTON BOROUGH SCHOOL DIST	600 5TH ST	RIVERTON BORO	ADMIN	x
RIVERTON FIRE CO	505 HOWARD ST	RIVERTON BORO	FIRE	x
RIVERTON SCHOOL	502 5TH ST	RIVERTON BORO	SCHOOL	x
Riverton	RIGHT SIDE PLATFORM	RIVERTON BORO	CSWPR	x
ALPHA BAPTIST CHURCH	15 ROSE STREET	WILLINGBORO TWP	SCHOOL	x
BOOKBINDER SCHOOL	56 BROOKLAWN DR	WILLINGBORO TWP	SCHOOL	x
BURLINGTON COUNTY COLLEGE	300 WILLINGBORO PARKWAY	WILLINGBORO TWP	SCHOOL	x
CATHEDRAL OF LOVE SCHOOL	139 BEVERLY RANCOCAS RD	WILLINGBORO TWP	SCHOOL	x
CORPUS CHRISTI SCHOOL	11 SUNSET RD	WILLINGBORO TWP	SCHOOL	x
J.C. STUART ELEMENTARY SCHOOL	70 SUNSET RD	WILLINGBORO TWP	SCHOOL	x
LOURDES MEDICAL CENTER	218A SUNSET RD	WILLINGBORO TWP	Hospital	x
LOURDES SPECIALTY HOSPITAL	218 SUNSET RD	WILLINGBORO TWP	Hospital	x
RANCOCAS HOSPITAL HELIPORT	218A SUNSET RD	WILLINGBORO TWP	Private	x
W.R JAMES SR. ELEMENTARY SCHOOL	41 PINETREE LN	WILLINGBORO TWP	SCHOOL	x

Source: Burlington County Department of Information Technology, 2013; Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

Note: 'X' indicates the facility's presence in the identified area.

Impact on the Economy

Ground failure's impact on the economy and estimated dollar losses are difficult to measure. As stated earlier, ground failure can impose direct and indirect impacts on society. Direct costs include the actual damage sustained by buildings, property and infrastructure. Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, ground failure threatens transportation corridors, fuel and energy conduits and communication lines (USGS, 2003). Estimated potential damages to general building stock can be quantified as discussed above. For the purposes of this analysis, general building stock damages are discussed further.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. There are zero buildings located in the high incidence and high/moderate susceptibility/incidence landslide hazard areas. A total risk exposure of \$14 billion or approximately 22% of Burlington County's total inventory is estimated for the buildings located in the landslide moderate susceptibility/low incidence area. These dollar value losses to Burlington County's total building inventory replacement value would impact Burlington County's tax base and the local economy.

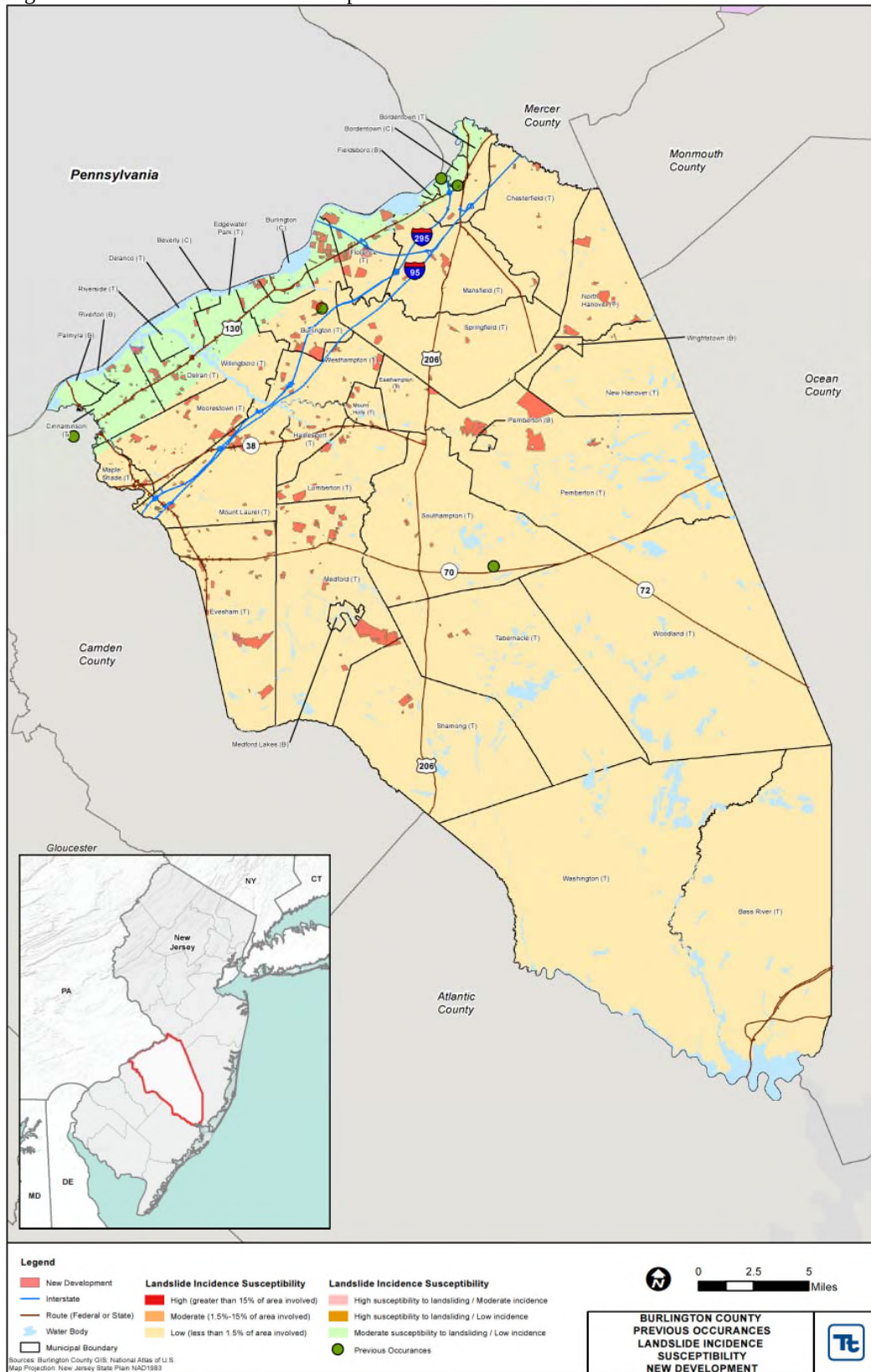
New Jersey Turnpike, Route 295, and Route 130 are the major roadways that traverse the western portion of the county from northeast to southwest. These roads serve as the major thoroughfares of the county and run through the most densely populated areas of the county. The landslide moderate susceptibility/low incidence area in Burlington County is located along the western boundary of the county adjacent to the Delaware River. Route 130 is the only major roadway that is located within this hazard area. The Garden State Parkway traverses the southeastern corner of the county, but is not located in the landslide moderate susceptibility/low incidence area.

Since the county is substantially developed in the areas adjacent to the Delaware River many of the major utilities including power generation plants and regional sewerage treatment plants are located with the landslide moderate susceptibility/low incidence area.

Future Growth and Development

As discussed in Section 4 and Volume II, Section 9, areas targeted for future growth and development have been identified across Burlington County. It is anticipated that new development within the identified hazard area will be exposed to such risks.

Figure 5.4.5-5. Potential New Development and Previous Occurrences and Landslide Hazard Areas



Source: Burlington County GIS 2013

Additional Data and Next Steps

Obtaining historic damages to buildings and infrastructure incurred due to ground failure will help with loss estimates and future modeling efforts, given a margin of uncertainty. More detailed landslide susceptibility zones can be generated so that communities can more specifically identify high hazard areas. A pilot study was conducted for Schenectady County, New York as described in the 2011 New York State Hazard Mitigation Plan to develop higher resolution landslide susceptibility zones. The methodology included using the Natural Resource Conservation Services (NRCS) Digital Soil Survey soil units and their associated properties including the American of State Highway Transportation Officials (AASHTO) rating, liquid limit, hydrologic group, percentage of silt and clay, erosion potential and slope derived from high resolution digital elevation models. Further, research on rainfall thresholds for forecasting landslide potential may also be an option for Burlington County.

5.4.6 SEVERE STORM

This section provides a profile and vulnerability assessment for the severe storm hazards.

HAZARD PROFILE

Hazard profile information is provided in this section, including information on description, extent, location, previous occurrences and losses and the probability of future occurrences within Burlington County.

Description

For the purpose of this HMP and as deemed appropriated by Burlington County, the severe storm hazard includes hailstorms, windstorms, lightning, thunderstorms, tornadoes, and tropical cyclones (e.g. hurricanes, tropical storms, and tropical depressions), which are defined below. Since most northeasters, (or Nor'Easters) a type of an extra-tropical cyclone, generally take place during the winter weather months, Nor'Easters have been grouped as a type of severe winter weather storm, further discussed in Section 5.4.6 (Severe Winter Storm).

Hailstorm: According to the National Weather Service (NWS), hail is defined as a showery precipitation in the form of irregular pellets or balls of ice more than five millimeters in diameter, falling from a cumulonimbus cloud (NWS, 2009). Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight; they fall as precipitation, in the form of balls or irregularly shaped masses of ice. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size. Hailstorms are a potential damaging outgrowth of severe thunderstorms (Northern Virginia Regional Commission [NVRC], 2006). They cause over \$1 billion in crop and property damages each year in the U.S., making hailstorms one of the most costly natural disasters (Federal Alliance for Safe Homes, Inc., 2006).

Windstorm: According to the Federal Emergency Management Agency (FEMA), wind is air moving from high to low pressure. It is rough horizontal movement of air (as opposed to an air current) caused by uneven heating of the earth's surface. It occurs at all scales, from local breezes generated by heating of land surfaces and lasting tens of minutes to global winds resulting from solar heating of the earth (FEMA, 1997). A type of windstorm that is experienced often during rapidly moving thunderstorms is a derecho. A derecho is a widespread and long-lived windstorm associated with thunderstorms that are often curved in shape (Johns et al., 2011). The two major influences on the atmospheric circulation are the differential heating between the equator and the poles, and the rotation of the planet. Windstorm events are associated with cyclonic storms (for example, hurricanes, thunderstorms and tornadoes (FEMA, 1997).

Destructive Wind: Destructive wind is a windstorm that poses a significant threat to life and property and destroying everything in its path. Destructive wind can also cause damage by flying debris, such as rocks, lumber, fuel drums, sheet metal and loose gear of any type which can be picked up by the wind and hurled with great force (Burlington County HMP, 2008).

Lightning: According to the NWS, lightning is a visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds or between a rain cloud and the ground (NWS, 2009). The discharge of electrical energy resulting from the buildup of positive and negative charges within a

thunderstorm creates a “bolt” when the buildup of charges becomes strong enough. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit (°F). Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. Annually, on average, 300 people are injured and 89 people are killed due to lightning strikes in the U.S. (NVRC, 2006).

Thunderstorm: According to the NWS, a thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NWS, 2009). A thunderstorm forms from a combination of moisture, rapidly rising warm air and a force capable of lifting air such as a warm and cold front, a sea breeze, or a mountain. Thunderstorms form from the equator to as far north as Alaska. These storms occur most commonly in the tropics. Many tropical land-based locations experience over 100 thunderstorm days each year (Pidwirny, 2007). Although thunderstorms generally affect a small area when they occur, they are very dangerous due to their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and damaging lightning. A thunderstorm produces wind gusts of less than 57 miles per hour (mph) and hail, if any, of less than 3/4-inch diameter at the surface. A severe thunderstorm has thunderstorm-related surface winds (sustained or gusts) of 57 mph or greater and/or surface hail 3/4-inch or larger (NWS, 2005). Wind or hail damage may be used to infer the occurrence/existence of a severe thunderstorm (Office of the Federal Coordinator for Meteorology, 2001).

Tornado: A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. It is spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Tornado season is generally March through August, although tornadoes can occur at any time of year. Tornadoes tend to strike in the afternoons and evening, with over 80 percent (%) of all tornadoes striking between noon and midnight (New Jersey Office of Emergency Management [NJOEM], 2011). The average forward speed of a tornado is 30 mph, but can vary from nearly stationary to 70 mph (NWS, 1995). The NOAA Storm Prediction Center (SPC) indicates that the total duration of a tornado can last between a few seconds to over one hour; however, a tornado typical lasts less than 10 minutes (Edwards, 2011). High-wind velocity and wind-blown debris, along with lightning or hail, result in the damage caused by tornadoes. Destruction caused by tornadoes depends on the size, intensity, and duration of the storm. Tornadoes cause the greatest damage to structures that are light, such as residential homes and mobile homes, and tend to remain localized during impact (NVRC, 2006).

Tropical Cyclone: Tropical cyclone is a generic term for a cyclonic, low-pressure system over tropical or sub-tropical waters (National Atlas, 2011); containing a warm core of low barometric pressure which typically produces heavy rainfall, powerful winds and storm surge (New York City Office of Emergency Management [NYCOEM], 2011). It feeds on the heat released when moist air rises and the water vapor in it condenses (Dorrego, Date Unknown). Depending on their location and strength, there are various terms by which tropical cyclones are known, such as hurricane, typhoon, tropical storm, cyclonic storm and tropical depression (Pacific Disaster Center, 2006). While tropical cyclones begin as a tropical depression, meaning the storm has sustained winds below 38 mph, it may develop into a tropical storm (with sustained winds of 39 to 73 mph) or a hurricane (with winds of 74 mph and higher).

Tropical Depression: A tropical depression is an organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of less than 38 mph. It has no “eye” (the calm area in the center of the storm) and does not typically have the organization or the spiral shape of more powerful storms (Emanuel, Date Unknown; Miami Museum of Science, 2000).

Tropical Storm: A tropical storm is an organized system of strong thunderstorms with a defined surface circulation and maximum sustained winds between 39 and 73 mph (FEMA, 2011). Once a storm has reached tropical storm status, it is assigned a name. During this time, the storm itself becomes more

organized and begins to become more circular in shape, resembling a hurricane. The rotation of a tropical storm is more recognizable than a tropical depression. Tropical storms can cause a lot of problems, even without becoming a hurricane; however, most of the problems stem from heavy rainfall (University of Illinois, Date Unknown).

Hurricane: A hurricane is an intense tropical cyclone with wind speeds reaching a constant speed of 74 mph or greater (FEMA, 2011). It is a category of a tropical cyclone characterized by thunderstorms and defined surface wind circulation. They are caused by the atmospheric instability created by the collision of warm air with cooler air. They form in the warm waters of tropical and sub-tropical oceans, seas, or Gulf of Mexico (NWS, 2011). Most hurricanes evolve from tropical disturbances. A tropical disturbance is a discrete system of organized convection (showers or thunderstorms), that originate in the tropics or subtropics, does not migrate along a frontal boundary, and maintains its identity for 24 hours or more (NWS, 2009). Hurricanes begin when areas of low atmospheric pressure move off the western coast of Africa and into the Atlantic, where they grow and intensify in the moisture-laden air above the warm tropical ocean. Air moves toward these atmospheric lows from all directions and circulates clock-wise under the influence of the Coriolis Effect, thereby initiating rotation in the converging wind fields. When these hot, moist air masses meet, they rise up into the atmosphere above the low pressure area, potentially establishing a self-reinforcing feedback system that produces weather systems known to meteorologists as tropical disturbances, tropical depressions, tropical storms, and hurricanes (Frankenberg, Date Unknown).

Almost all tropical storms and hurricanes in the Atlantic basin, which includes the Gulf of Mexico and Caribbean Sea, form between June 1st and November 30th. This time frame is known as hurricane season. August and September are peak months for hurricane development. The threats caused by an approaching hurricane can be divided into three main categories: storm surge, wind damage and rainfall/flooding:

- *Storm Surge* is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. Storm surge is responsible for nearly 90-percent of all hurricane-related deaths and injuries.
- *Wind Damage* is the force of wind that can quickly decimate the tree population, down power lines and utility poles, knock over signs, and damage/destroy homes and buildings. Flying debris can also cause damage to both structures and the general population. When hurricanes first make landfall, it is common for tornadoes to form which can cause severe localized wind damage.
- *Rainfall / Flooding* the torrential rains that normally accompany a hurricane can cause serious flooding. Whereas the storm surge and high winds are concentrated around the “eye”, the rain may extend for hundreds of miles and may last for several days, affecting areas well after the hurricane has diminished (Mandia, 2011).

Extent

The extent (that is, magnitude or severity) of a severe storm is largely dependent upon sustained wind speed. Straight-line winds, winds that come out of a thunderstorm, in extreme cases, can cause wind gusts exceeding 100 mph. These winds are most responsible for hailstorm and thunderstorm wind damage. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado (NVRC, 2006).

Hail

Hail can be produced from many different types of storms. Typically, hail occurs with thunderstorm events. The size of hail varies related to the severity and size of the thunderstorm that produced it, and is

estimated by comparing it to a known object. Most hail storms are made up of a variety of sizes, and only penny size (.75" in diameter) or larger hail is considered severe (NJ HMP, 2011; NSSL, 2003). Table 5.4.6-1 shows the different types of hail and the comparison to real-world objects.

Table 5.4.6-1. Hail Size

Description	Diameter
Pea	1/4"
Plain M&M	1/2"
Dime/Penny	3/4"
Nickel	7/8"
Quarter	1"
Half Dollar	1.25"
Walnut or Ping Pong Ball	1.50"
Golf ball	1.75"
Hen's Egg	2"
Tennis Ball	2.25
Baseball	2.75
Tea Cup	3"
Softball	4"
Grapefruit	4.5"
Computer CD/DVD	4.75 – 5"

Source: NWS, 2012

Tornado

The magnitude or severity of a tornado was originally categorized using the Fujita Scale (F-Scale) or Pearson Fujita Scale introduced in 1971, based on a relationship between the Beaufort Wind Scales (B-Scales) (measure of wind intensity) and the Mach number scale (measure of relative speed). It is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure (Tornado Project, Date Unknown). The F-Scale categorizes each tornado by intensity and area. The scale is divided into six categories, F0 (Gale) to F5 (Incredible) (Edwards, 2012). Table 5.4.6-2 explains each of the six F-Scale categories.

Table 5.4.6-2. Fujita Damage Scale

Scale	Wind Estimate (MPH)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.

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Table 5.4.6-2. Fujita Damage Scale

Scale	Wind Estimate (MPH)	Typical Damage
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: SPC, 2012

Although the F-Scale has been in use for over 30 years, there are limitations of the scale. The primary limitations are a lack of damage indicators, no account of construction quality and variability, and no definitive correlation between damage and wind speed. These limitations have led to the inconsistent rating of tornadoes and, in some cases, an overestimate of tornado wind speeds. The limitations listed above led to the development of the Enhanced Fujita Scale (EF Scale). The Texas Tech University Wind Science and Engineering (WISE) Center, along with a forum of nationally renowned meteorologists and wind engineers from across the country, developed the EF Scale (NOAA, 2008).

The EF Scale became operational on February 1, 2007. It is used to assign tornadoes a ‘rating’ based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DIs) and Degree of Damage (DOD), which help better estimate the range of wind speeds produced by the tornado. From that, a rating is assigned, similar to that of the F-Scale, with six categories from EF0 to EF5, representing increasing degrees of damage. The EF Scale was revised from the original F-Scale to reflect better examinations of tornado damage surveys. This new scale has to do with how most structures are designed (NOAA, 2008). Table 5.4.6-3 displays the EF Scale and each of its six categories.

Table 5.4.6-3. Enhanced Fujita Damage Scale

F-Scale Number	Intensity Phrase	Wind Speed (mph)	Type of Damage Done
EF0	Light tornado	65–85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	Moderate tornado	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	Significant tornado	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	Severe tornado	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	Devastating tornado	166-200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	Incredible tornado	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: SPC, Date Unknown

In the Fujita Scale, there was a lack of clearly defined and easily identifiable damage indicators. The EF Scale takes into account more variables than the original F-Scale did when assigning a wind speed rating to a tornado. The EF Scale incorporates 28 DIs, such as building type, structures, and trees. For each

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damage indicator, there are eight DODs, ranging from the beginning of visible damage to complete destruction of the damage indicator. Table 5.4.6-4 lists the 28 DIs. Each one of these indicators has a description of the typical construction for that category of indicator. Each DOD in every category is given an expected estimate of wind speed, a lower bound of wind speed, and an upper bound of wind speed.

Table 5.4.6-4. EF Scale Damage Indicators

Number	Damage Indicator	Abbreviation	Number	Damage Indicator	Abbreviation
1	Small barns, farm outbuildings	SBO	15	School - 1-story elementary (interior or exterior halls)	ES
2	One- or two-family residences	FR12	16	School - jr. or sr. high school	JHSH
3	Single-wide mobile home (MHSW)	MHSW	17	Low-rise (1-4 story) bldg.	LRB
4	Double-wide mobile home	MHDW	18	Mid-rise (5-20 story) bldg.	MRB
5	Apt, condo, townhouse (3 stories or less)	ACT	19	High-rise (over 20 stories)	HRB
6	Motel	M	20	Institutional bldg. (hospital, govt. or university)	IB
7	Masonry apt. or motel	MAM	21	Metal building system	MBS
8	Small retail bldg. (fast food)	SRB	22	Service station canopy	SSC
9	Small professional (doctor office, branch bank)	SPB	23	Warehouse (tilt-up walls or heavy timber)	WHB
10	Strip mall	SM	24	Transmission line tower	TLT
11	Large shopping mall	LSM	25	Free-standing tower	FST
12	Large, isolated ("big box") retail bldg.	LIRB	26	Free standing pole (light, flag, luminary)	FSP
13	Automobile showroom	ASR	27	Tree - hardwood	TH
14	Automotive service building	ASB	28	Tree - softwood	TS

Source: SPC, Date Unknown

Since the EF Scale recently went into effect in February 2007, previous occurrences and losses associated with historic tornado events, described in the next section (Previous Occurrences and Losses) of this hazard profile, are based on the former Fujita Scale. Events after February 2007 are based on the Enhance Fujita Scale.

Hurricanes

The extent of a hurricane is categorized by the Saffir-Simpson Hurricane Scale. The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous and require preventative measures (NOAA, National Hurricane Center 2013). Table 5.4.6-5 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes land fall.

Table 5.4.6-5. The Saffir-Simpson Scale

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

Source: NOAA, 2013

mph = Miles per hour

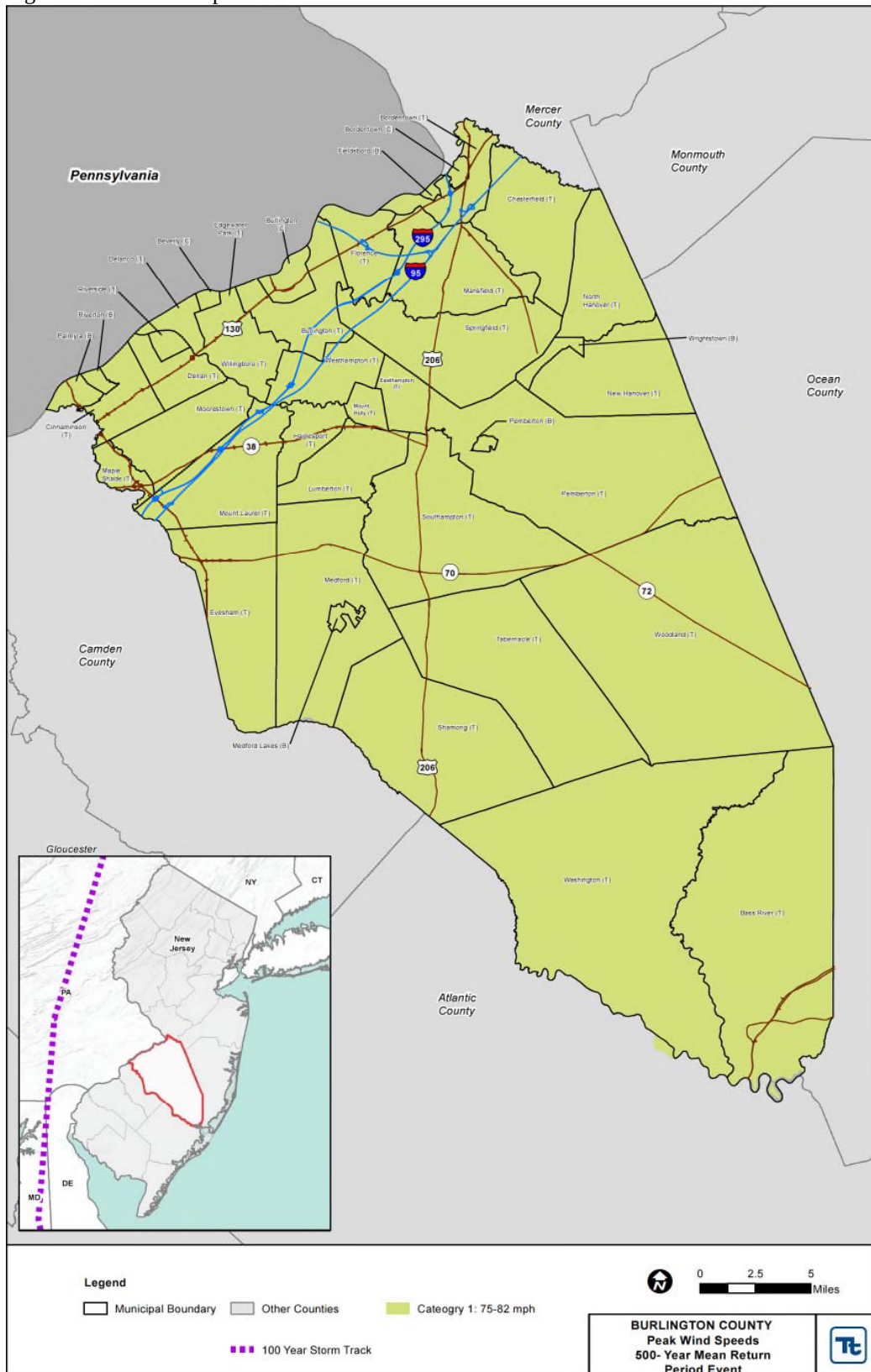
In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that may occur within any given year based on past recorded events. MRP is the average period of time, in years, between occurrences of a particular hazard event (equal to the inverse of the annual frequency of exceedance). For example, a flood that has a 1-percent chance of being equaled or exceeded in any given year is also referred to as the base flood and has a MRP of 100. This is known as a 100-year flood. The term “100-year flood” can be misleading; it is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a one-percent chance of being equaled or exceeded each year. Therefore, the 100-year flood could

occur more than once in a relatively short period of time or less than one time in 100 years (Dinicola, 2009).

Figure 5.4.6-1 and Figure 5.4.6-2 show the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP HAZUS-MH model runs. The estimated hurricane track for the 100- and 500-year event is also shown. For the 100-year MRP event, the maximum 3-second gust wind speeds for the County range from 75 to 82 mph, characteristic of a Category 1 hurricane or tropical storm. For the 500-year MRP event, the maximum 3-second gust wind speeds for the County range from 94 to 112 mph, characteristic of a Category 1, Category 2, and Category 3 hurricane. The associated impacts and losses from these 100-year and 500-year MRP hurricane event model runs are reported in the Vulnerability Assessment later in this section.

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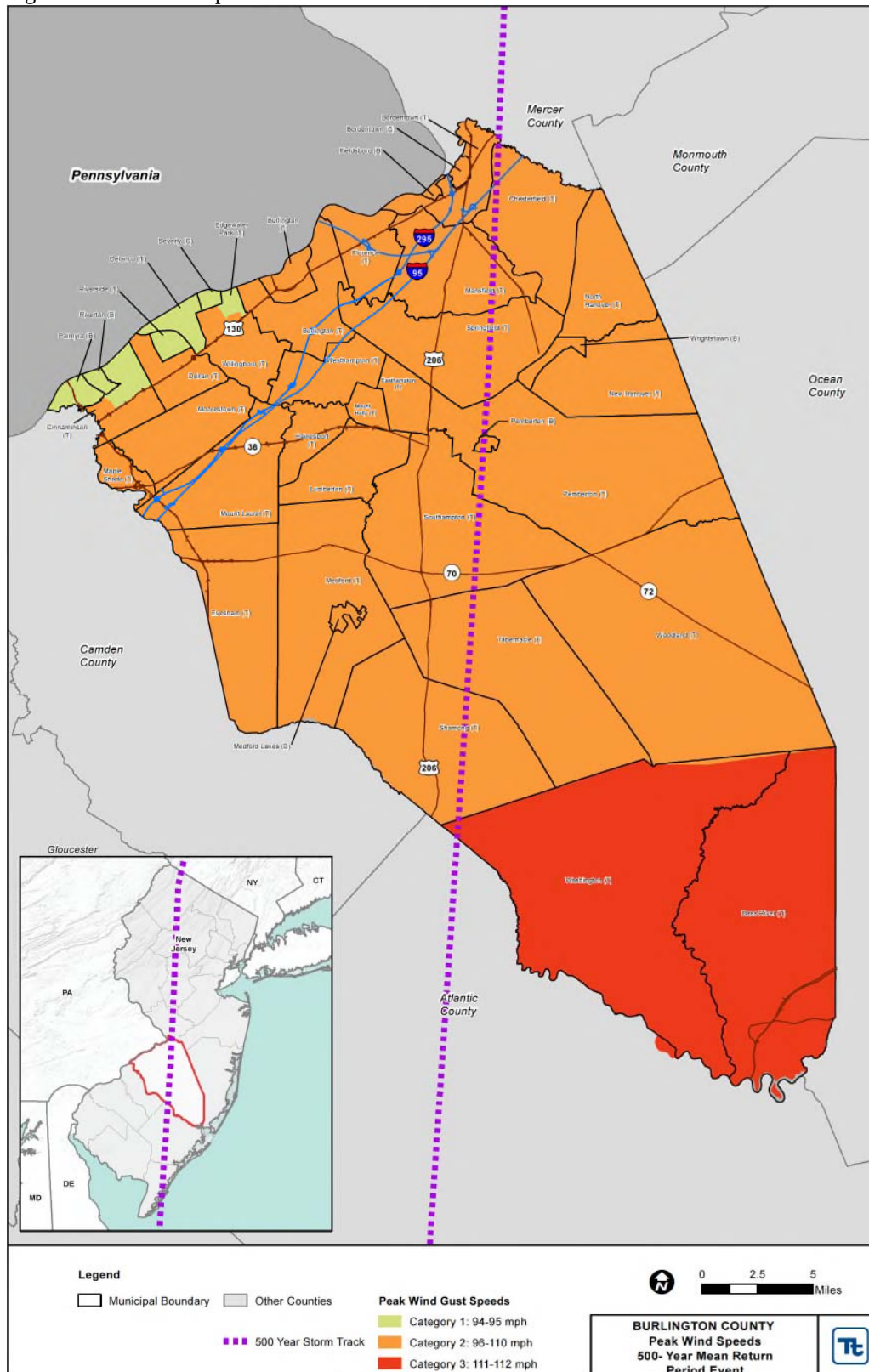
Figure 5.4.6-1. Wind Speeds and Storm Track for the 100-Year Mean Return Period Event in Burlington County.



Source: HAZUS-MH 2.1

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Figure 5.4.6-2. Wind Speeds and Storm Track for the 500-Year Mean Return Period Event in Burlington County.



Source: HAZUS-MH 2.1

Location

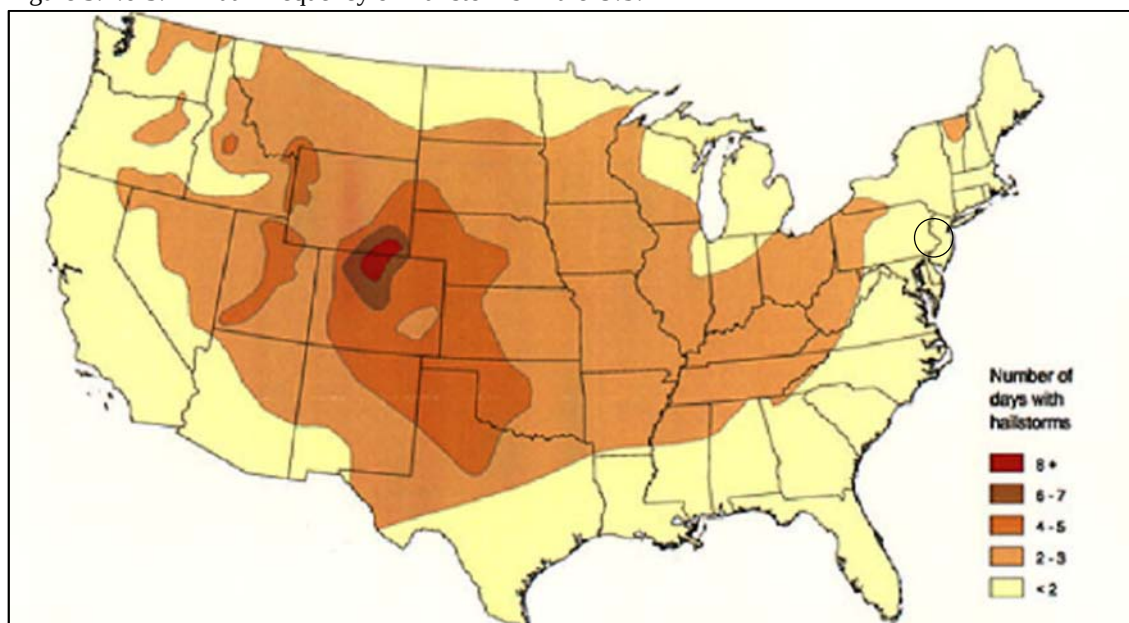
New Jersey is located in the path of precipitation-producing weather systems (“storm paths”) that move across the U.S. from all directions. These systems commonly produce thunderstorms during the warm season and snow during the cold season. Occasional hurricanes, tropical storms, and Nor’easters approach New Jersey from the southeast and northeast. Severe storms are a common occurrence throughout New Jersey and can affect the entire study area of Burlington County.

Severe storms are a common natural hazard in New Jersey because the State features a unique blend of meteorological factors that influence the potential for severe storms and associated flooding. Factors include temperature, which is affected by latitude, elevation, proximity to water bodies and source of air masses; and precipitation which includes snowfall and rainfall. Precipitation intensities and effects are influenced by temperature, proximity to water bodies, and general frequency of storm systems. The geographic position of New Jersey, along with other states in the Northeast U.S., makes it vulnerable to frequent storm and precipitation events. This is because nearly all storms and frontal systems moving eastward across the continent pass in close proximity to the state. Additionally, the potential for prolonged thunderstorms or coastal storms and periods of heavy precipitation is increased throughout the state because of the available moisture that originates from the Atlantic Ocean (Cornell University College of Agriculture and Life Sciences, 2011; NYS HMP, 2011).

Hailstorms

Hailstorms are more frequent in the southern and central plain states, where the climate produces violent thunderstorms. However, hailstorms have been observed in almost every location where thunderstorms occur (Federal Alliance for Safe Homes, Inc., 2006). Figure 5.4.6-3 illustrates that Burlington County and all other areas in New Jersey experience less than two hailstorms per year.

Figure 5.4.6-3. Annual Frequency of Hailstorms in the U.S.

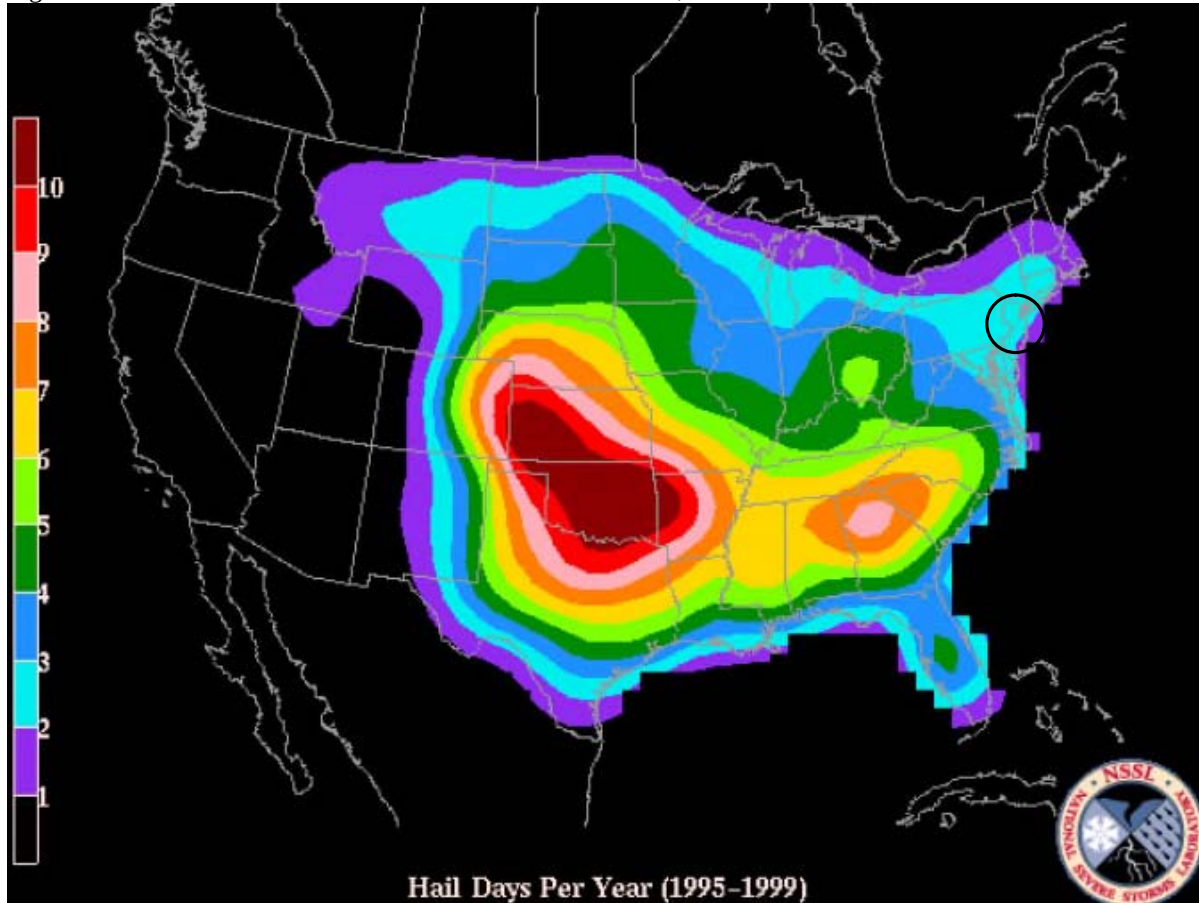


Source: FEMA, 1997

Note: The black circle indicates the approximate location of Burlington County; the County experiences less than two hailstorms annually.

Figure 5.4.6-4 illustrates the number of hail days, per year, between 1995 and 1999 in the U.S. According to this figure, New Jersey experiences between one and three days of hail each year, with Burlington County experiencing between one and three days.

Figure 5.4.6-4. Total Annual Threat of Hail Events in the U.S., 1995-1999



Source: NSSL, 2003

Note: The mean number of days per year with one or more events within 25 miles of a point is shown here. The fill interval for tornadoes is 0.2, with the purple starting at 0.2 days. For the nontornadic threats, the fill interval is 1, with the purple starting at 1. For the significant (violent), it's 5 days per century (millennium)
The black circle indicates the approximate location of Burlington County.

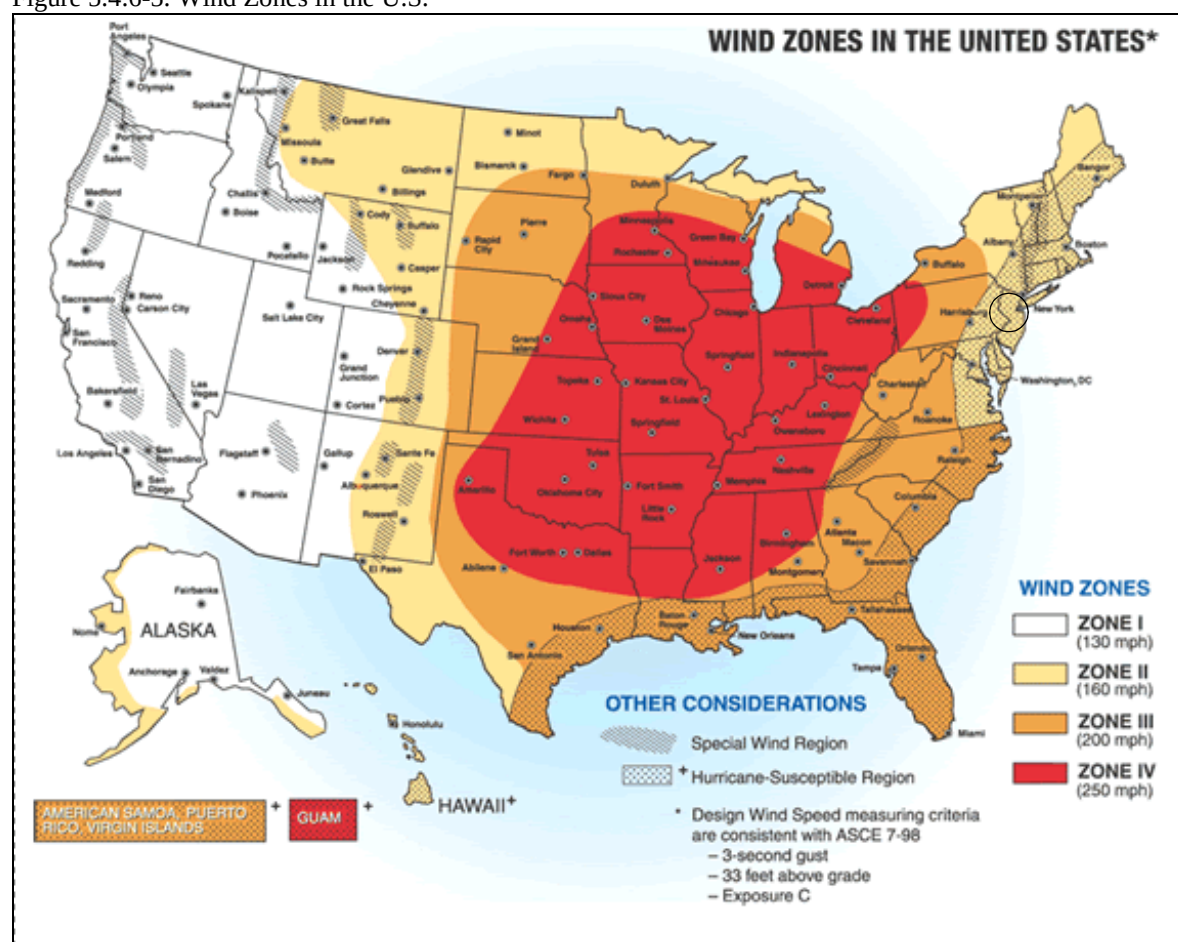
Windstorms

In New Jersey, new construction must be built in accordance with the state-adopted International Building Code (IBC). For Burlington County, the IBC's design wind speeds (according to the ASCE 7-98, 3 second gust, 33 feet above grade, Exposure Category C) range from a low of 90 miles per hour in areas nearest the Delaware River to a maximum of 120 miles per hour in areas nearest to Great Bay. While building codes require that a building withstand a "design" event, extreme wind events can cause wind speeds in excess of those on which local code requirements are based (Burlington County HMP, 2008).

Figure 5.4.6-5 indicates how the frequency and strength of windstorms impacts the U.S. and the general location of the most wind activity. This is based on 40 years of tornado history and 100 years of hurricane history, collected by FEMA. States located in Wind Zone IV have experienced the greatest number of tornadoes and the strongest tornadoes (NVRC, 2006). Burlington County is located in Wind Zone II with speeds up to 160 miles per hour (FEMA, 2012). The entire state of New Jersey is also

categorized as the Hurricane Susceptibility Region, which extends along the northeastern coastline of the U.S.

Figure 5.4.6-5. Wind Zones in the U.S.



Source: FEMA, 2012

Note: The black circle indicates the approximate location of Burlington County; the County is located within Wind Zone II and in the hurricane susceptible region.

Table 5.4.6-6. Wind Zones in the U.S.

Wind Zones	Areas Affected
Zone I (130 mph)	All of Washington, Oregon, California, Idaho, Utah, and Arizona. Western parts of Montana, Wyoming, Colorado and New Mexico. Most of Alaska, except the east and south coastlines.
Zone II (160 mph)	Eastern parts of Montana, Wyoming, Colorado, and New Mexico. Most of North Dakota. Northern parts of Minnesota, Wisconsin and Michigan. Western parts of South Dakota, Nebraska and Texas. All New England States. Eastern parts of New York, Pennsylvania, Maryland, and Virginia. Washington, DC.
Zone III (200 mph)	Areas of Minnesota, South Dakota, Nebraska, Colorado, Kansas, Oklahoma, Texas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, Kentucky, Pennsylvania, New York, Michigan, and Wisconsin. Most or all of Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia. All of American Samoa, Puerto Rico, and Virgin Islands.
Zone IV (250 mph)	Mid US including all of Iowa, Missouri, Arkansas, Illinois, Indiana, and Ohio and parts of adjoining states of Minnesota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, Kentucky, Pennsylvania, Michigan, and Wisconsin. Guam.
Special Wind Region	Isolated areas in the following states: Washington, Oregon, California, Idaho, Utah,

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-6. Wind Zones in the U.S.

Wind Zones	Areas Affected
	Arizona, Montana, Wyoming, Colorado, New Mexico. The borders between Vermont and New Hampshire; between New York, Massachusetts and Connecticut; between Tennessee and North Carolina.
Hurricane Susceptible Region	Southern US coastline from Gulf Coast of Texas eastward to include entire state of Florida. East Coastline from Maine to Florida, including all of Massachusetts, Connecticut, Rhode Island, Delaware, and Washington DC. All of Hawaii, Guam, American Samoa, Puerto Rico and Virgin Islands.

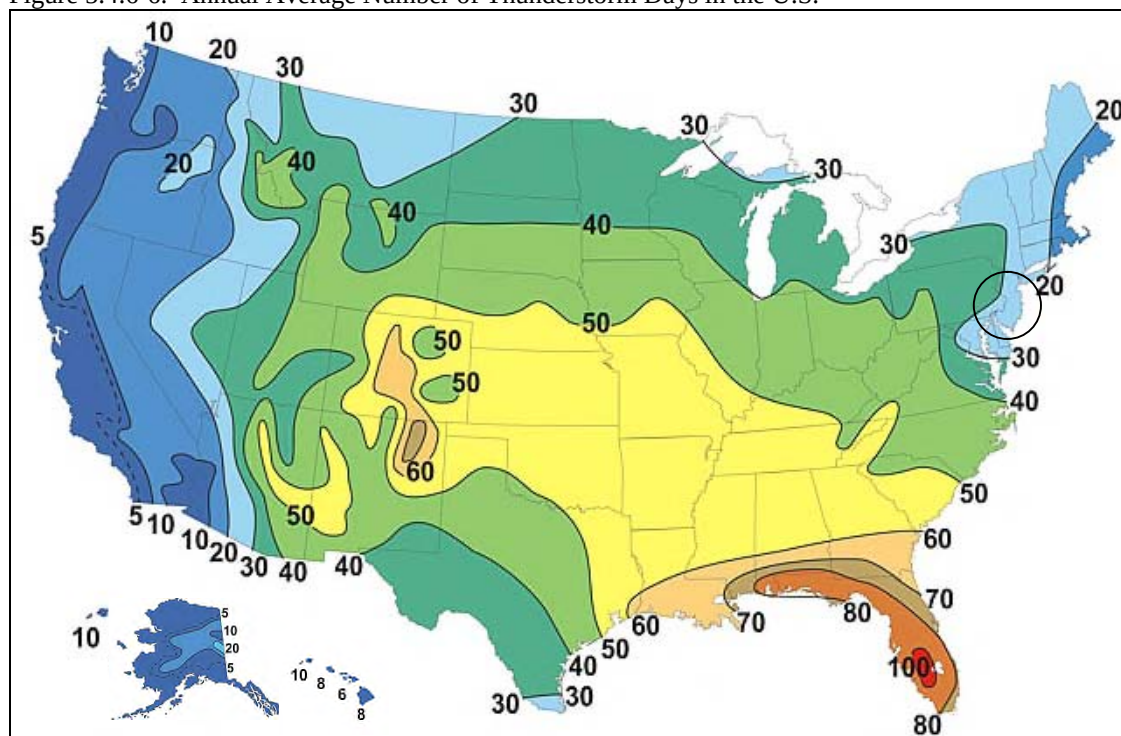
Source: FEMA, 2012

Thunderstorms

Thunderstorms affect relatively small localized areas, rather than large regions much like winter storms, and hurricane events (NWS, 2010). Thunderstorms can strike in all regions of the U.S.; however, they are most common in the central and southern states. The atmospheric conditions in these regions of the country are most ideal for generating these powerful storms (NVRC, 2006). It is estimated that there are as many as 40,000 thunderstorms each day world-wide.

Figure 5.4.6-6 shows the average number of thunderstorm days throughout the U.S. The most thunderstorms are seen in the southeast states, with Florida having the highest incidences (80 to over 100 thunderstorm days each year) (NWS, 2010). This figure indicates that most of New Jersey, including Burlington County, experiences approximately 20 thunderstorm days each year.

Figure 5.4.6-6. Annual Average Number of Thunderstorm Days in the U.S.



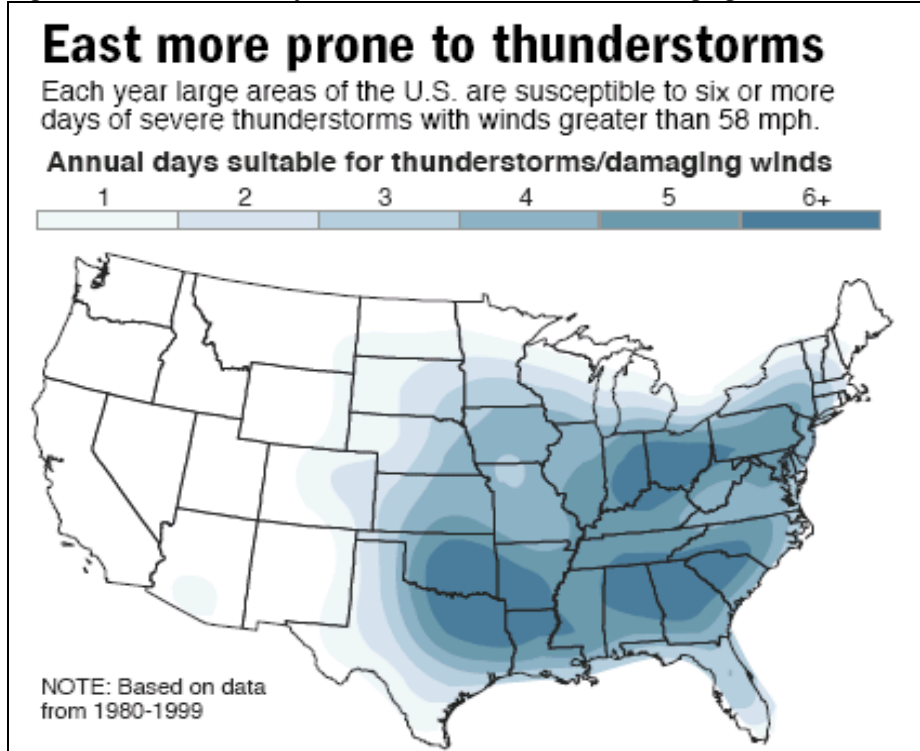
Source: NWS, 2010

Note: The black circle indicates the approximate location of New Jersey; Burlington County experiences approximately 20 thunderstorms annually, on average.

NASA scientists suggest that the U.S. will face more severe thunderstorms in the future, with deadly lightning, damaging hail and the potential for tornadoes in the event of climate change (Borenstein, 2007).

A recent study conducted by NASA predicts that smaller storm events like thunderstorms will be more dangerous due to climate change (Figure 5.4.6-8). As prepared by the NWS, Figure 5.4.6-8 identifies those areas, particularly within the eastern U.S. that are more prone to thunderstorms, which includes all of the state of New Jersey.

Figure 5.4.6-8. Annual Days Suitable for Thunderstorms/Damaging Winds



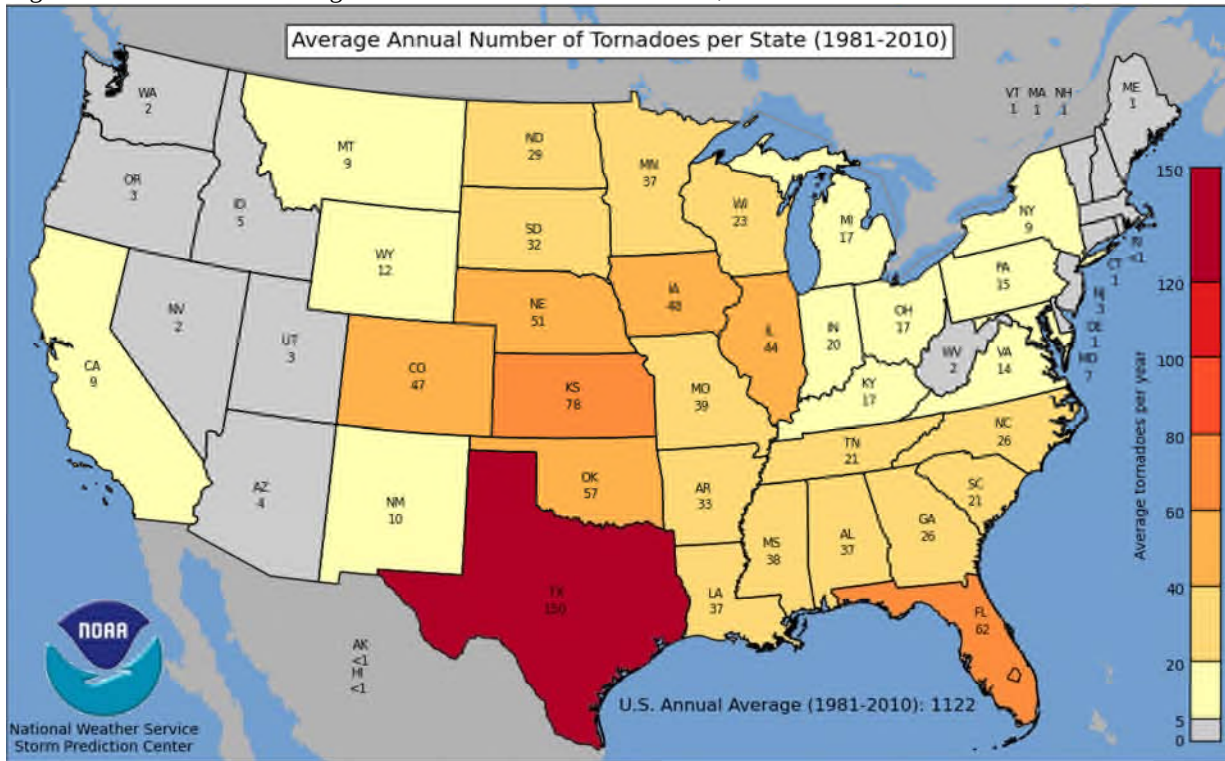
Source: MSNBC.com, 2007

Tornado

The U.S. experiences more tornadoes than any other country. In a typical year, approximately 1,000 tornadoes affect the U.S. The peak of the tornado season is April through June, with the highest concentration of tornadoes in the central U.S. Figure 5.4.6-9 shows the annual average number of tornadoes between 1981 and 2010 (NWS, 2012). New Jersey experienced an average of three tornado events annually between 1981 and 2010.

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Figure 5.4.6-9. Annual Average Number of Tornadoes in the U.S., 1981 to 2010



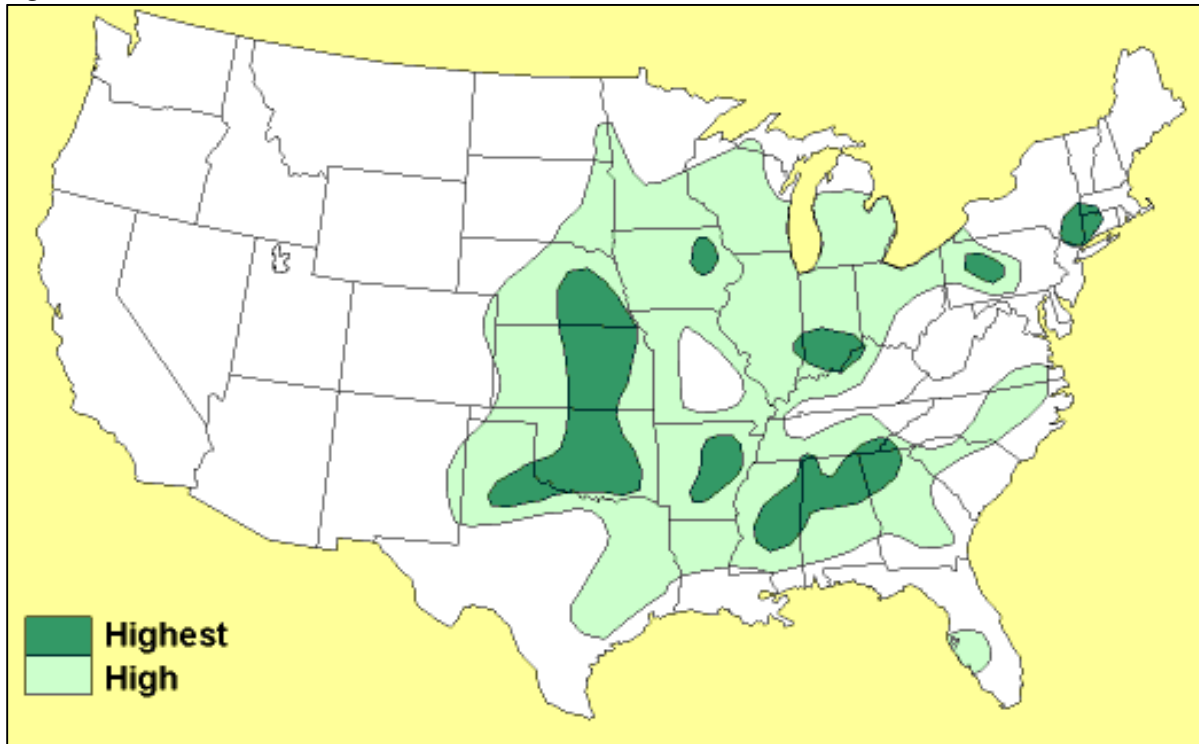
Source: NWS, 2012

Note: Between 1981 and 2010, New Jersey experienced an average of three tornadoes annually.

New Jersey ranks 37th in the U.S. for frequency of tornadoes, 30th for injuries per area and 23rd for cost per area. When compared to other states on the frequency of tornadoes per square mile, New Jersey ranks 20th (NJOEM, 2011).

Figure 5.4.6-10 indicates that a majority of the State, with the exception of the northern-most border, has an overall low risk of tornado activity. Burlington County is located in central New Jersey, which according to the figure, has a low risk of tornadoes.

Figure 5.4.6-10. Tornado Risk in the U.S.

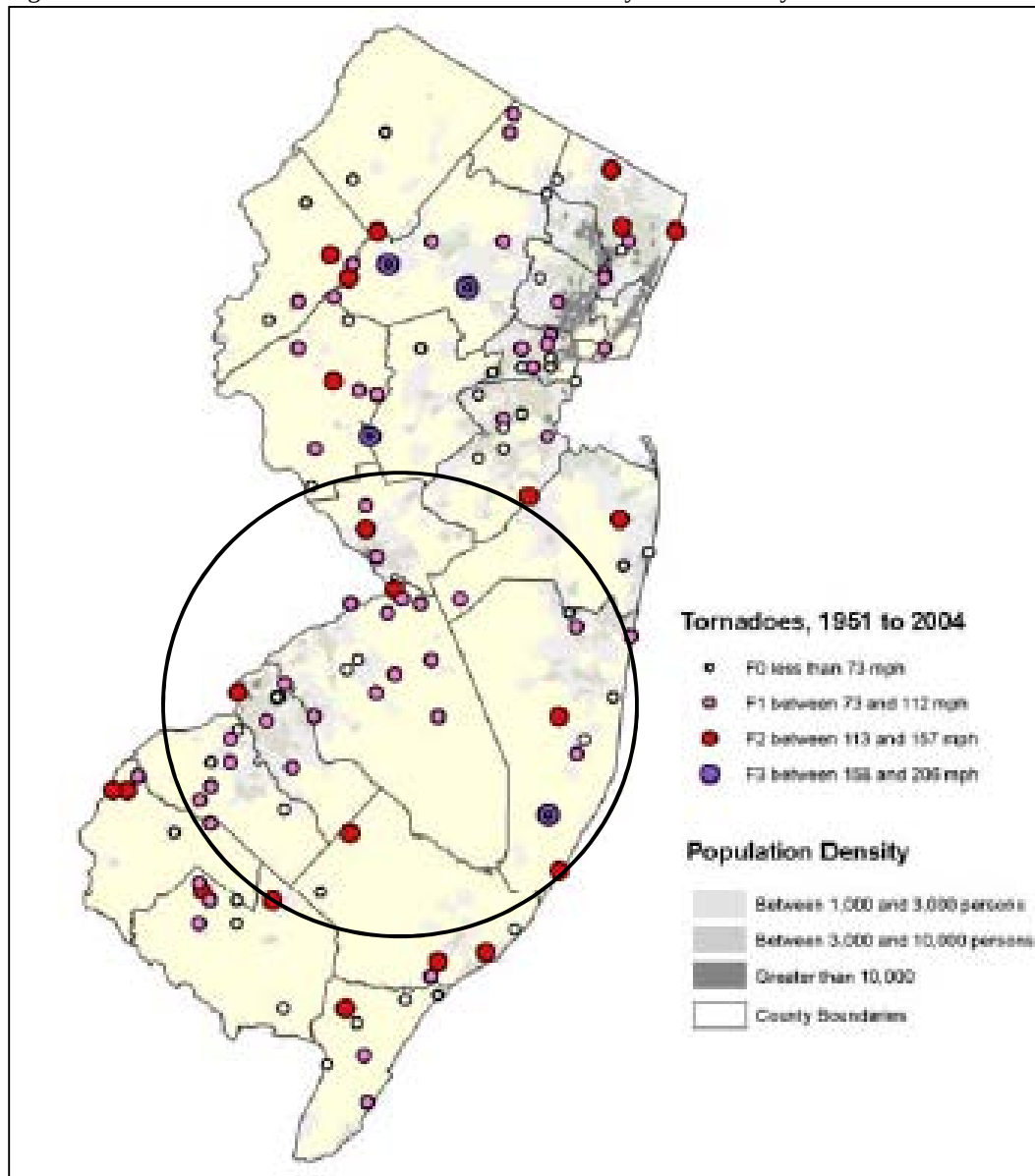


Source: The Physical Environment, 2012

Note: Burlington County is shown as having a low risk of tornado occurrences.

According to Figure 5.4.6-11, every county in New Jersey has experienced a tornado between 1951 and 2004 (NJOEM, 2011). No tornadoes have been reported in Burlington County since the publication of the initial HMP, dated 2008.

Figure 5.4.6-11. Historic Tornado distribution and Intensity in New Jersey

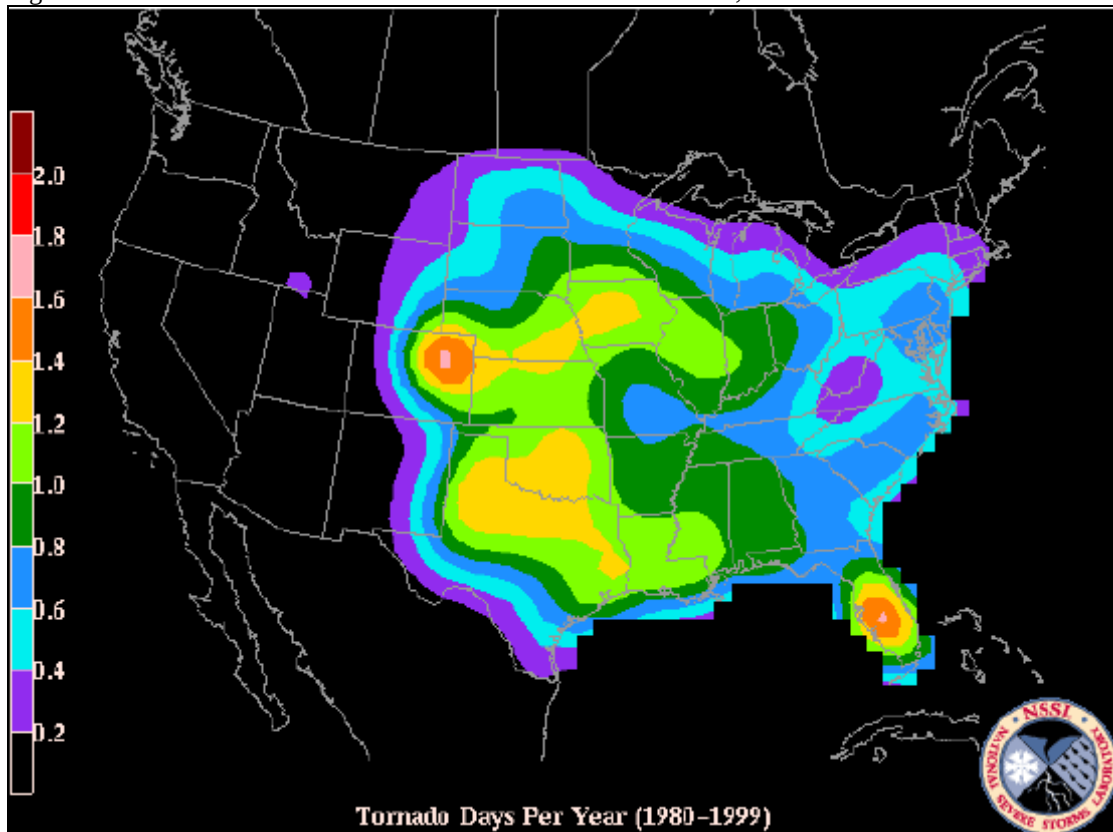


Source: NJOEM, 2011

Note: The black circle indicates the approximate location of Burlington County.

A study from NOAA's National Severe Storms Laboratory (NSSL) provided estimates of the long-term threat from tornadoes. The NSSL used historical data to estimate the daily probability of tornado occurrences across the U.S., no matter the magnitude of the tornado. Figure 5.4.6-12 shows the estimates prepared by the NSSL. In the State of New Jersey, it is estimated that the probability of a tornado occurring is 0.4 and 0.8 days per year. In Burlington County, it is estimated that the probability of tornado occurring is 0.6 to 0.8 days per year (NSSL, 2003; NJOEM, 2011).

Figure 5.4.6-12. Total Annual Threat of Tornado Events in the U.S., 1980-1999



Source: NJOEM, 2011; NSSL, 2003

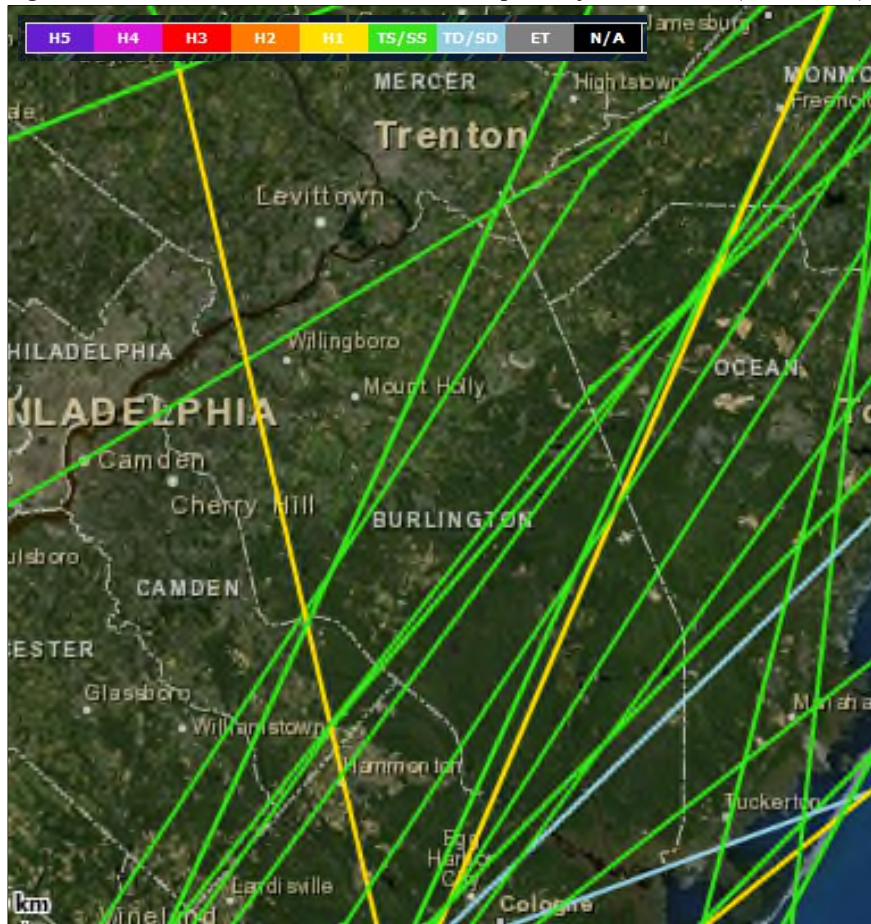
Note: The mean number of days per year with one or more events within 25 miles of a point is shown here. The fill interval for tornadoes is 0.2, with the purple starting at 0.2 days. For the nontornadic threats, the fill interval is 1, with the purple starting at 1. For the significant (violent), it's 5 days per century (millennium)

Hurricanes/Tropical Storms

Hurricanes and tropical storms can impact the state of New Jersey and Burlington County from June to November, the official eastern U.S. hurricane season. However, late July to early October is the period hurricanes and tropical storms are most likely to impact the state, due to the coolness of the North Atlantic Ocean waters (NYS HMP, 2011).

The Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool tracks tropical cyclones from 1842 to 2013. Figure 5.4.6-14 displays specific tropical cyclone tracks for Burlington County. Between 1842 and 2012, 34 tropical cyclone events have passed through Burlington County within 65 nautical miles (NOAA, 2012).

Figure 5.4.6-14. Historical North Atlantic Tropical Cyclone Tracks (1842-2013)



Source: NOAA, 2012

Input from Planning Committee

Specific items identified by Planning Committee members include:

- Moorestown Township has many large older trees that have been brought down by high winds in the past. This trend is expected in the future, causing power outages and traffic obstructions, etc. They also noted numerous nursing homes and assisted care facilities in their area that would be of concern for damage to electric power distribution systems (Burlington County HMP, 2008).
- Tabernacle noted that it is highly susceptible to extreme winds in its most flat areas made up of farm tracts and open lands (Burlington County HMP, 2008).
- Florence indicated that extreme winds have caused damage in the Township throughout the past few years, where windstorms have caused emergency situations resulting in power outages due to overgrown trees knocking down power lines and structure damage due to winds and debris (Burlington County HMP, 2008).
- Mount Laurel noted that their major concerns regarding extreme winds include tree damage, downed wires, traffic problems, power outages, and communication problems (Burlington County HMP, 2008).
- Cinnaminson has been impacted by extreme winds in the past, which have caused emergency situations, power outages, and structural damages. They note recent tornado touchdowns in

neighboring townships causing severe damage, and in their community, damages in recent years from wind downdrafts (Burlington County HMP, 2008).

- Mansfield Township recalls a past extreme wind event in the early 1990's which downed trees and damaged dwellings (Burlington County HMP, 2008).
- Wrightstown Borough reports that the extent of the extreme wind hazard in their community has been observed by a straight line wind even in 1995 which destroyed 19 mobile homes and damaged over 100 other structures (Burlington County HMP, 2008).

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with severe storm events throughout the State of New Jersey and Burlington County. With so many sources reviewed for the purpose of this HMP Update, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP update.

According to NOAA's National Climatic Data Center (NCDC), 554 severe storm events (hurricane/tropical storms, tornadoes, thunderstorm/wind, lightning, funnel clouds, hail, heavy rain, and high wind) have been reported in Burlington County between January 1, 1950 and April 30, 2013. These events resulted in six fatalities, 45 injuries, \$69.8 million in property damages and \$1 million in crop damages. For most events affecting Burlington County, downed trees and power lines were common effects of high winds, which ranged from a minimum of 58 miles per hour to a maximum of 102 miles per hour, with most events being in the range of approximately 58 to 74 miles per hour and often were the result of severe thunderstorms or strong pressure systems moving through the area between the months of May and August. The first 78 events in the database (from July 1956 through July 1992) do not include descriptions. The majority of the remaining reported wind events included downed trees and power lines, and associated power outages and road closures.

Between 1955 and 2012, FEMA declared that the state of New Jersey experienced 32 severe storm-related disasters (DR) and/or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, flooding, coastal storms, heavy rains, remnants of tropical storm, hurricane, high tides, and straight-line winds. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, sources indicate that Burlington County has been declared as a disaster area as a result of 10 of these severe storm events (FEMA, 2012).

Based on all sources researched, known severe storm events that have affected Burlington County and its municipalities since the original HMP was published are identified in Table 5.4.6-7. With severe storm documentation for New Jersey being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.6-7 may not include all events that have occurred throughout the County and region. Many severe storm events resulted in major flooding throughout the county, therefore, the flood impact of these events are further mentioned in Section 5.4.6 (Flood). According to many sources, certain severe storm events have actually been classified as Nor'Easters; therefore, further discussed in Section 5.4.6 (Severe Winter Storm) and the flooding impact of the events are further discussed in Section 5.4.6 (Flood). Events previously reported in the 2008 County HMP are sourced as "Burlington County HMP".

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
September 16, 1903	Hurricane	N/A	N/A	This storm made landfall on September 16, 1903 at Atlantic City as an 80 mph Category 1 hurricane, making it the most recent hurricane to directly strike the State of New Jersey. The storm track crossed over Burlington County in a north-northwesterly direction. The storm reportedly caused some damage to coastal areas, with most significant impacts inland particularly in the Passaic River Basin in northern New Jersey due to significant rainfall of up to 15 inches in some areas.	Burlington County HMP
August 26, 1924	Hurricane	N/A	N/A	This unnamed storm was a Category 2 storm when it passed approximately 150 nautical miles off the southeastern corner of Burlington County with winds of 100 to 105 mph.	Burlington County HMP
September 19, 1936	Hurricane	N/A	N/A	This storm was a Category 2 hurricane when it passed by Burlington County, roughly paralleling the New Jersey shoreline. Coastal areas incurred flooding and beach erosion.	Burlington County HMP
September 21, 1938	Hurricane	N/A	N/A	The New England Hurricane of 1938 passed to the east of New Jersey. Coastal areas saw heavy winds and wave action. Statewide, tomato crops and apple harvests suffered.	Burlington County HMP
August 1, 1944	Tropical Storm of August 1944	N/A	N/A	This tropical storm passed through the Delmarva Peninsula and subsequently made landfall in New Jersey at Cape May. Severe beach erosion and high tides were noted in coastal areas.	Burlington County HMP
September 14, 1944	Great Atlantic Hurricane	N/A	N/A	This storm was a Category 3 when it passed off the coast of New Jersey. It caused damages primarily in northern New Jersey, New York City, Long Island, and portions of the Mohawk and Hudson watersheds. Burlington City received 4.75 inches of rain. Severe flooding occurred statewide, particularly in coastal areas which saw storm surges of up to nearly ten feet, waves of up to 40 feet, and strong winds gusting to 125 mph.	Burlington County HMP
August 10, 1952	Tornado (F0)	N/A	N/A	2 miles in length; 100 yards in width; approximately \$25 K in damages. Location of the tornado was not reported.	Burlington County HMP
August 1955	Tropical Storms Connie and Diane	DR-41	N/A	Tropical storm Connie saturated much of New Jersey when it passed through the Delmarva Peninsula on August 13, 1955. When Tropical Storm Diane arrived on August 19, 1955, significant rain fell on already saturated ground, causing significant flooding particularly in the Delaware River Basin (including western Burlington County). In Burlington City, this event flooded more structures than any other community along the Delaware River, leaving the Township with 875 residential, 77 commercial, and 4 industrial structures damaged by the floodwaters. Within the Delaware River Basin as a whole, this event was one of the most destructive along the main stem.	Burlington County HMP

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
July 13, 1956	Tornado (F1)	N/A	N/A	1 mile in length; 150 yards in width; approximately \$25 K in damages. Location of the tornado was not reported.	Burlington County HMP
June 13, 1958	Tornado (F1)	N/A	N/A	The length, width and location of this tornado were not reported. It caused \$250 K in damages and one injury was reported.	Burlington County HMP
September 12, 1960	Hurricane Donna	N/A	N/A	Hurricane Donna passed New Jersey as a Category 3 hurricane while moving at a high forward speed. Damage was significant along the coastline, but was minimized because Donna was not a direct hit in New Jersey. The hurricane caused winds gusts of up to 109 mph, heavy rainfall, and a storm surge of 6 feet.	Burlington County HMP
March 10, 1964	Tornado (F1)	N/A	N/A	25 miles in length; 200 yards in width; approximately \$250 K in damages and five injuries. Location of the tornado was not reported.	Burlington County HMP
September 1971	Heavy Rains and Flooding	DR-310	Yes	No reference and/or no damage reported.	FEMA
July 1975	Heavy Rains, High Winds, Hail, Tornadoes	DR-477	Yes	No reference and/or no damage reported.	FEMA
June 3, 1980	Tornado (F0)	N/A	N/A	One mile in length; 30 yards in width; approximately \$25 K in damages. Location of the tornado was not reported.	Burlington County HMP
June 21, 1981	Tornado (F1)	N/A	N/A	The length, width and location of this tornado were not reported. It caused \$250 K in damages.	Burlington County HMP
September 27, 1985	Hurricane Gloria			Hurricane Gloria passed just east of Burlington County, before making landfall on Long Island.	Burlington County HMP
July 2, 1987	Tornado (F0)	N/A	N/A	One mile in length; 30 yards in width; approximately \$250 K in damages. Location of the tornado was not reported.	Burlington County HMP
July 12, 1987	Tornado (F1)	N/A	N/A	2 miles in length; 10 yards in width; approximately \$3 K in damages. Location of the tornado was not reported.	Burlington County HMP
1990	Wind Shear	N/A	N/A	City of Burlington experienced a wind shear event that downed 200 year old trees, powerlines and close off roadways in the City.	Burlington County HMP
October 18, 1990	Tornado (F1)	N/A	N/A	One mile in length; 100 yards in width; approximately \$250 K in damages. Location of the tornado was not reported.	Burlington County HMP
August 19, 1991	Tornado (F1)	N/A	N/A	Two miles in length; 70 yards in width; approximately \$3 K in damages. Location of the tornado was not reported.	Burlington County HMP
June 27, 1994	Microburst	N/A	N/A	A severe microburst (estimated wind gusts to 70 mph) affected most of the downtown and lake shore areas of Pemberton with at least a dozen large trees uprooted with numerous limbs down. The greatest damage was done on East Lake Shore Drive. Damaging wind gusts continued in McGuire Air Force Base where a roof blew off and knocked down an adjoining wall of the same building. Numerous trees were downed at the base.	Burlington County HMP

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
July 25, 1994	TSTM	N/A	N/A	In Burlington City, thunderstorm winds caused the partial collapse of an unused building at a private school on River Bank Road. Trees were uprooted in Burlington City and also in North Hanover. PSE&G reported thousands of customers were without power in Burlington County	Burlington County HMP
August 2, 1994	Tornado (F0)	N/A	N/A	A rare westward moving tornado was formed from merging thunderstorms in northern Burlington County. The tornado touched down in Chesterfield Township and destroyed a brick barn, uprooted trees, damaged the roof of a home under construction and also damaged a couple of classic autos in a garage.	Burlington County HMP
May 29, 1995	Tornado (F1)	N/A	N/A	The same thunderstorm that produced the Norristown tornado and funnel clouds over the Burlington Bristol Bridge dropped another tornado on Chesterfield Township. The tornado (F1) touched down near the intersection of Old York and Bordentown-Chesterfield Road (County Road 528). The tornado paralleled Bordentown-Chesterfield Road for most of its lifetime. Four houses suffered damage from both the tornado and the hail. The remaining damage was toppled trees, twisted limbs and downed power lines. No injuries were reported.	Burlington County HMP
June 22, 1996	TSTM	N/A	N/A	A severe TSTM occurred on June 22nd in Burlington County and uprooted trees; downed powerlines; brought golf ball sized hail and caused considerable wind damage to most of the County. In Bordentown Township, the storms uprooted trees and downed wires. Most of the damage to structures and vehicles were caused by fallen trees. Hundreds of trees were damaged and approximately 20 to 30 trees between 200 and 300 years old were destroyed on the World Missionary grounds. In Fieldsboro Borough, golf ball sized hail fell and approximately 60 reports of wind-related damage was reported in the Browns Mills and Country Lakes sections of Pemberton Township. In North Hanover Township, the storms caused wind damage to farm crops and mobile homes in Spartan Village (nine homes destroyed, 70% of mobile homes suffered some damage). There was some wind damage reported at McGuire Air Force Base as well. A 26-year-old National Guardsman died during the clean-up on the base when he tried to move a downed tree and it collapsed	Burlington County HMP

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				on him on Pennsylvania Avenue. One-third of the County's total damages occurred in North Hanover Township. Overall, in Burlington County, 10 homes were destroyed, 116 homes suffered severe damage, 374 homes had minor to moderate damage, and 22,000 homes were without power. Burlington County was declared a disaster area. Wind damages were reported throughout the County, with wind gusts reaching 84 mph in some locations. Entire fields of crops at 12 farms were destroyed from Chesterfield through North Hanover to Fort Dix. Countywide damage from the thunderstorms was estimated at \$12 million (\$11 million property damage and \$1 million crop damage).	
July 18, 1997	High Winds	N/A	N/A	A gust front of damaging winds moved through northwestern Burlington County and knocked down power lines in Burlington City and in the Townships of Cinnaminson, Delran, Mansfield, Medford, Moorestown, Mount Holly, Southampton and Westampton. In Moorestown Township, downed wires on Kings Highway (State Route 41) closed the road for one hour. PSE&G reported 18,000 customers lost power due to the downed wires from the wind gusts that occurred throughout central New Jersey.	Burlington County HMP
June 1, 1998	Severe TSTMs	N/A	N/A	A squall line of severe thunderstorms caused pockets of wind damage throughout the northwest half of Burlington County. The riverfront townships were the hardest hit in the County. There was a second burst of wind damage inland in the Townships of Evesham, Medford, Pemberton and Southampton. Pemberton Township declared a local state of emergency as 12 roads were closed and most of the Township was without power. Eight school districts cancelled classes because of power outages. Power outages also affected two of the County's hospitals and cancelled the morning court session in Mount Holly. Peak wind gusts of 74 mph were reported at McGuire Air Force Base. In Palmyra Township, numerous trees were knocked down, especially along Morgan Avenue. A porch of one home was damaged by a fallen tree. In Willingboro Township, a tree crushed a garage and many trees were knocked down, mainly in the Martin's Beach area. In Burlington Township, at least one vehicle was damaged by fallen trees. The thunderstorm tore a metal roof away and knocked down wires in twenty different	Burlington County HMP

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				locations. In Springfield Township, a barn collapsed after its roof was blown off. Debris was scattered up to 3,000 feet. In Pemberton Township, an elderly couple was trapped in their mobile home, several roofs were damaged in the Country Lakes area, the Browns Mills Fire Station was damaged and most of the downtown area was blacked out. Numerous trees were knocked down in the Hoot Owl section of Medford Township. Minor wind damage was also reported in Lumberton and Mount Laurel Townships. About 74,000 PSE&G customers lost power during the height of the storm throughout their service area. Most of the outages though were in Burlington, Camden and Gloucester Counties. There were still 32,500 customers without power the evening of the first. All power was restored the morning of the second.	
June 30, 1998	Strong Winds	N/A	N/A	A gust front the squall line moved through western Burlington County and produced scattered pockets of wind damage. In Medford Township, a 40 foot high cinderblock wall at a construction site in St. Mary of the Lakes School collapsed. The west wall of the planned gym was knocked down by the gust front. The gust front knocked over trees and power lines in Burlington, Chesterfield, Delanco, Edgewater Park, Mansfield, Medford, Mount Laurel, Springfield and Willingboro Townships. A tree crushed a vehicle in Edgewater Park.	Burlington County HMP
September 16-18, 1999	Hurricane Floyd	EM-3148	Yes	Tropical Storm Floyd passed roughly 10 miles east of Atlantic City. Bergen and Somerset Counties were the hardest hit in New Jersey. Across the southern half of New Jersey, the most widespread flooding occurred in townships along the Delaware River. In Burlington County, flooding was worst along the Rancocas Creek and along tidal sections of tributaries to the Delaware River. Some evacuations occurred in Riverside around the Delanco-Riverside Bridge. The bridge was also closed. Farther upstream along the Rancocas Creek the Centerton Bridge in Willingboro was closed. Voluntary evacuations also occurred along the Delaware River in Delran and roads near the Rancocas Creek were closed. Several evacuations also occurred along the Assicunk Creek in Burlington City. Creek flooding (mainly the Rancocas) occurred in Medford, Mount Holly, and Westampton Townships. About ten roads in the County were closed due to flooding. The North Branch of the Rancocas Creek in Pemberton	Burlington County HMP

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				crested at 3.2 feet at 9pm on the 17th; flood stage is 2.7 feet. Highest reported wind gusts were 62 mph in Browns Mills. The four highest precipitation storm totals for Burlington County were 7.07 inches in Mount Laurel, 6.48 inches in New Lisbon, 6.32 inches in Willingboro and 6.20 inches in Mount Holly.	
August 30, 2003	Severe TSTMs	N/A	N/A	A severe thunderstorm tore down trees and wires in Florence Township and large tree limbs and wires in Mansfield and North Hanover Townships. Downed trees closed the ramps at Exit 6 to the New Jersey Turnpike in Florence for a few hours. U.S. Route 130 in Florence was closed for about an hour because of downed utility poles.	Burlington County HMP
September 18-19, 2003	Tropical Storm Isabel			Hurricane Isabel made landfall on the outer banks of North Carolina on September 18, 2003. It quickly weakened over land and was a Tropical Storm by the time it passed over Pennsylvania. Tropical storm force winds were felt across much of the County, but rainfall was not terribly heavy. Moderate tidal flooding was observed; the high was 10.6 feet on the Delaware River in Burlington. Downed trees and powerlines were the most common type of damage.	Burlington County HMP
September 23, 2003	Severe TSTMs / Tornado (F0)	N/A	N/A	A powerful line of severe thunderstorms uprooted numerous trees and power lines throughout Burlington County. About 23,000 homes and business lost power in Mercer, Burlington, Camden and Gloucester Counties. All power was restored by the afternoon of the 24th. The combination of the Florence Township tornado and the line of severe storms produced an estimated property damage of \$2.1 M throughout the County. An F1 tornado touched down in Florence Township and uprooted about 100 trees along its path. Some of the trees fell on and damaged homes. The maximum wind speeds were estimated at 85 mph. The tornado remained on the ground for about 1.75 miles and lifted in the Roebling Section of the Township. A state of emergency was declared in the Township. The worst wind damage occurred along Grove Street and Third Avenue. Trees up to three feet in diameter were snapped. A two ton central air conditioning unit was tossed into a home. At the Florence High School bleachers, concession stands and fences were badly damaged. Most of the wind damage was caused by trees falling on homes	Burlington County HMP

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				and vehicles. Other hard hit areas included Beverly, Bordentown, Burlington City, Burlington Township, Cinnaminson, Delanco, Delran, Edgewater Park, Palmyra, Riverside and Willingboro Townships. States of emergency were declared in Delanco, Riverside and Edgewater Park. The County 911 center received 770 weather related calls which included 130 reports of downed lines. In Cinnaminson, at the Mar-Khem Industrial site, the winds ripped the front half of a metal roof from a warehouse and office building. Several support beams were twisted and a trailer was blown over. In Beverly, part of a roof was torn from a trucking warehouse. In Edgewater Park, Colonial and Regency Roads were hit hard. Trees were removed from bedrooms and living rooms. Schools were closed. In Delanco, the steeple on the Abundant Life Fellowship Church was toppled. In Riverside, downed wires caused a fire that damaged the annex of the First Baptist Church. In Delran, two tractor-trailer boxes overturned on U.S. Route 130 and snarled it for hours. The leg of a plastic picnic table pierced the windshield of a vehicle. Numerous trees were downed including one that landed on a car. DPW staff finished the cleanup one day after the event occurred. The Fire Department responded to over 30 calls. In Burlington City, wind damage was concentrated on Riverbank Avenue, Wood Street, West Pearl Street and West Union Street.	
October 27, 2003	Tornado (F1)	N/A	N/A	A weak tornado touched down in a wooded area between Marne Highway and the Holly Bowl bowling alley in Hainesport Township. It moved east and lifted just before crossing New Jersey State Route 38. The tornado snapped large tree limbs and tossed them. A nine inch wide limb was tossed about 100 feet and struck and killed a 77-year-old woman who was about to enter her vehicle in the Holly Bowl parking lot. She suffered massive head trauma and spinal cord injuries. The same limb damaged her and two neighboring vehicles. The tornado caused small damage to the bowling alley's roof, smashed a fence and toppled a couple of light standards. It was the first tornado related death in New Jersey since August 25, 1941 in Gloucester County. The tornado was on the ground for about a half mile and its maximum path width was 30 yards. The strongest speed of the tornado was estimated at 70 mph.	Burlington County HMP
July 12-23, 2004	Severe Storms and Flooding	DR-1530	Yes	No reference and/or no damage reported.	FEMA

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
July 27, 2004	Tornado (F1)	N/A	N/A	An F1 tornado touched down in Woodland Township, injuring two people, damaged the New Lisbon Development Center and about 350 acres of trees in the Brendan T. Byrne State Forest. The tornado touched down in a wooded area about one mile south of the intersections of State Routes 70 and 72. A second much smaller and weaker funnel also briefly touched down in that area. The tornado proceeded east through the New Lisbon Development Center where all the property damage and injuries occurred and crossed State Route 72 into the Brendan Byrne State Forest. Two staff members were injured. A thrift store on campus was destroyed and several apartments in the same attached building were also destroyed. None of the residents were injured. The roof and walls from the thrift shop were tossed more than one hundred yards. A metal bench was found in a tree. The tornado also badly damaged the administration center building. A tractor-trailer used for storage near the thrift shop was found in the woods. Several vehicles were overturned. The tornado uprooted and snapped trees, bent bird cage poles and ripped light poles from the ground. One-hundred-year-old trees were snapped. The tornado then proceeded into the Brendan Byrne State Forest where approximately 350 acres of trees were damaged or destroyed. Several hiking trails were closed through the 31st until the debris was cleared. Overall, the tornado closed down State Route 72 and 100 people were without power. Maximum wind speeds were approximately 110 mph. The tornado remained on the ground for about 2.6 miles and its path width was around 100 yards. The tornado caused approximately \$500 K in damages.	Burlington County HMP
June 6, 2005	Severe TSTM	N/A	N/A	A severe thunderstorm produced a measured wind gust of 79 mph at the McGuire Air Force Base in Burlington County. Two army vehicles were struck by a wooden storage shed that had been blown over by the high winds. The shed damaged the front end of one vehicle and dented and scratched the trunk and lid of the other vehicle.	NOAA-NCDC
July 27, 2005	Severe TSTM	N/A	N/A	The gust front from a severe thunderstorm downed trees, tree limbs and wires in northwestern Burlington County including the townships of Willingboro, Maple Shade and Mount Laurel. At the Riverton Yacht Club, the gust front capsized eleven boats and	NOAA-NCDC

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				sixteen people tumbled into the Delaware River. They were rescued without being injured. PSE&G reported about 16,000 of their customers, statewide, lost power including Burlington County. It took most of the night to restore power to all homes and businesses with homes in Willingboro the last to have their power restored.	
August 2006	Extreme Wind	N/A	N/A	No reference and/or no damage reported.	Tabernacle Township
April 14-20, 2007	Severe Storms and Inland and Coastal Flooding	DR-1897	Yes	One of the worst Nor'Easters to hit New Jersey in several decades. Governor Codey indicated that the storm caused over \$180 M in damages, making it the second worst rain storm in history.	FEMA, NJ HMP
October 28, 2008	Strong Winds	N/A	N/A	Gusty northwest winds combined with heavy wet snow and trees wet with leaves caused widespread utility outages throughout New Jersey. In central New Jersey, about 9,000 homes and businesses lost power. Peak wind gusts in Burlington County were recorded at 32mhr in Mount Holly Township. SHELDUS reported over \$207K in damages.	NOAA-NCDC, SHELDUS
February 12, 2009	High Winds	N/A	N/A	After a cold front passed through, strong to high winds affected the State of New Jersey during the day on the 12th. Peak wind gusts averaged between 50 and 60 mph, knocking down trees, tree limbs, power lines and signs. The New Jersey Turnpike Authority banned motorcycles and car-pulled trailers. About 86,000 homes and businesses lost power in the State, with the strongest winds and most damage occurring in the central and northern parts of the state. Peak wind gusts in Burlington County included 52 mph in Chatsworth (Woodland Township and Lumberton Township. SHELDUS reported over \$38K in damages.	NOAA-NCDC, SHELDUS
July 29, 2009	Severe TSTMs	N/A	N/A	A pair of severe thunderstorms moved through Burlington County in the afternoon and evening, leaving approximately 20,000 homes and businesses without power. The storms tore down scores of trees in Willingboro Township, damaging vehicles and telephone wires and displacing at least one family. Some trees and wires were also knocked down in neighboring Burlington Township and Burlington City. Gusts of up to 59 mph were recorded. The County experienced approximately \$100K in damages.	NOAA-NCDC
July 31, 2009	Severe TSTMs	N/A	N/A	Severe thunderstorms moved throughout the state in the late afternoon of the 31st. Most of the wind damage occurred as a line	NOAA-NCDC

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				of severe thunderstorms moved across the southern half of the state, leaving about 67,000 homes and businesses without power. In Burlington County, a damaging microburst knocked down hundreds of trees and damaged dozens of homes in Medford Lakes Borough and Medford Township. Both municipalities declared states of emergency as there were approximately a combined 1,200 weather related calls in both municipalities. Two men were injured: a firefighter clearing debris and another who tried to secure a carnival float as the damaging winds began. In Medford Lakes Borough, approximately 400 trees were knocked down. About 25 homes were damaged by downed trees. Downed trees blocked 22 roadways. A tree fell on a vehicle on Lenape Trail. The hardest hit areas within the borough included Tabernacle Road, Chippewa Trail and Stokes Road near Upper Aetna Lake. Half the borough lost power. In Medford Township, a downed tree created a four foot wide hole in a home on McKendimen Road, displacing the family. Another downed tree punctured a hole in a home on Sunset Trail. The Tamarac section of the township was hardest hit. Six roadways were closed by downed trees. Power was restored the night of the 1st. Gusts of up to 85 mph were recorded. The County experienced approximately \$500K in damages.	
September 10-11, 2009	Strong Winds	N/A	N/A	Peak wind gusts in Burlington County were recorded at 50 km/h in Mount Holly Township. SHELDUS reported over \$23K in damages.	NOAA-NCDC, SHELDUS
March 12 - April 15, 2010	Series of Severe Storms, Nor'Easters and High Winds	DR-1897	Yes	A Nor'Easter moved into the area on March 12. On March 13, strong to high winds downed thousands of trees and tree limbs, hundreds of telephone poles, and caused utility outages throughout the state. The strongest winds occurred during the afternoon on the 13th. Governor Chris Christie declared a state of emergency on March 14th, and on March 26 requested a major disaster declaration. A state-wide federal disaster declaration was announced on April 2, making IA and PA available for affected areas. At the time of this report, a total \$16.9M in IA had been approved and \$30.7M in PA had been obligated throughout the State of New Jersey.	NOAA-NCDC, SHELDUS, FEMA

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				Peak wind gusts included 65 mph in Woodland Township at Chatsworth, 63 mph at McGuire AFB, and 61 mph in Burlington (City). SHELDOUS reported \$100K in damages.	
June 24, 2010	Severe TSTMs	N/A	N/A	Severe thunderstorms caused considerable tree damage during the afternoon into the early evening of the 24th across the southern third of New Jersey and claimed the life of one woman and injured two other persons in Burlington County. Peak wind gusts in Burlington County included 50 knots in Shamong Township at Atsion. The storm knocked down trees and tree limbs in Shamong Township. A 47-year-old woman died while camping at the Atsion Recreation Area within the township. A tree snapped and fell on top of a tent she as well as a 51-year-old man and 31-year-old woman were taking shelter within. The latter two suffered minor injuries. Another downed tree damaged a vehicle within the town. About 130,000 Public Service Electric & Gas and 65,000 Atlantic City Electric customers lost power.	NOAA-NCDC
July 25, 2010	Severe TSTMs	N/A	N/A	A strong cold frontal passage triggered strong to severe thunderstorms across New Jersey during the second half of the afternoon on the 25th. Numerous trees and wires were knocked down and approximately 66,000 homes and businesses lost power. Power was not fully restored until after the evening of the 26th. In Burlington County, the gust front from a severe thunderstorm knocked down a couple of trees in Mount Laurel Township. Wind gusts in the Township were recorded at 57 mph, and \$1K in damage was reported.	NOAA-NCDC
September 16, 2010	Severe TSTMs	N/A	N/A	A squall line of strong to severe thunderstorms moved across most of New Jersey during the late afternoon and early evening on the 16th. At the same time, a warm front was advancing north through the state. About 50,000 homes and businesses lost power until the evening of the 17th. Many shore high school football games were postponed because of the dangerous weather. In Burlington County, a severe thunderstorm knocked down a telephone pole in Southampton Township. A Skywarn spotter's anemometer was broken by the damaging winds. At nearby South Jersey Regional Airport in Lumberton Township, a measured wind	NOAA-NCDC

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				gust of 55 mph occurred. Wind gusts were recorded at 59 mph in Southampton Township, and \$1K in damage was reported.	
February 19, 2011	Strong Winds	N/A	N/A	Strong to high west to northwest winds affected New Jersey from the evening of the 18th into the evening of the 19th. Peak wind gusts averaged around 55 mph. The winds tore down trees, tree limbs and wires and caused power outages. Most of the highest winds and damage occurred in the central and southern part of the state. About 22,000 homes and businesses lost power. While more than two-thirds of the outages were resolved by the evening of the 19th, full power restoration did not occur until the evening of the 20th. In Burlington County, a downed century old oak tree damaged the back of a home in Cinnaminson Township. In Edgewater Park, a greater than 200-year-old white pine tree was split in half. Peak wind gusts in Burlington County included 54 mph Florence Township, 51 mph at Lumberton Township, 50 mph in Chatsworth, Woodland Township. SHELDUS reported over \$75K in damages.	NOAA-NCDC, SHELDUS
February 25, 2011	TSTMs	N/A	N/A	A strong cold frontal passage during the afternoon on the 25th triggered a squall line of strong to severe thunderstorms that moved through central and southern New Jersey. A severe thunderstorm knocked down a couple of trees in Westampton Township. Peak wind gusts in Burlington County were recorded at 57 mph in Timbuctoo, Westhampton Township. SHELDUS reported over \$25K in damages.	NOAA-NCDC, SHELDUS
July 6, 2011	TSTMs	N/A	N/A	Scattered strong to severe thunderstorms affected central New Jersey during the second half of the afternoon into the early evening of the 6th. In Burlington County the storms uprooted a very large pine tree onto and damaged a fence in Wrightstown Borough. Neighboring McGuire Air Force Base recorded a wind gust of 54 mph. \$1K in damages were reported.	NOAA-NCDC
July 24, 2011	TSTMs	N/A	N/A	Strong thunderstorms occurred during the afternoon and early evening of the 24th across New Jersey, with isolated severe thunderstorms in the southern half of the state. In Burlington County, a severe thunderstorm produced a strong wet microburst and knocked down numerous trees in Jenkins, Washington Township including one that fell onto a moving vehicle. The driver was not injured. The severe thunderstorm also caused the partial collapse of a couple of buildings. In Washington Township, gusts	NOAA-NCDC

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				of up to 74 mph were reported in the Jenkins area of the Township and 59 mph in Buddtown (Southampton Township). \$100K in damages was reported.	
July 29, 2011	TSTMs	N/A	N/A	An approaching cold front helped trigger strong to severe thunderstorms across central and northern New Jersey during the early evening of the 29th. Hardest hit were Sussex, Burlington and Ocean Counties. About 37,000 Jersey Central Power and Light and PSE&G customers lost power in the state. Full power restoration did not occur until the 31st. In Willingboro Township of Burlington County, the storm knocked down numerous trees, tree limbs and wires, and westbound Garfield road was closed. One downed tree on Twig Court fell through a home and damaged a vehicle. In Mount Laurel Township, lightning strikes were reported and one downed tree on Rancocas Boulevard fell through the roof of a house. A lightning strike started an attic fire at a house on Melissa Court in Moorestown Township. The fire was contained in the attic and no injuries were reported. Recorded wind speeds in Burlington County included 59 mph in Cinniminson Township, 64 mph in Centerton, Mount Laurel Township, 59 mph in Marlton, Evesham Township, and 59 mph in Buddtown, Washington Township. In total, the County incurred \$325K in damages.	NOAA-NCDC
August 13-19, 2011	TSTMs	DR-4033	No	A series of thunderstorms preceding a cold front dropped three to seven inches of rain across a wide area of the State of New Jersey from overnight on the 13th into the day on the 14th. Another series of strong to severe thunderstorms affected the State on the 18th and 19th. In Burlington County, penny size hail fell in Mount Laurel Township on the 18th. The next day, a few trees and large limbs fell in Medford Township, causing some damage to houses. Wind speeds included 59 mph in Maple Shades Township, 59 mph in Ramblewood (Mount Laurel Township), and 59 mph in Medford Lakes Borough, causing \$10K in damages.	NOAA-NCDC, FEMA
August 27 – September 5, 2011	Hurricane Irene	DR-4021 EM-3332	Yes	Hurricane Irene hit the State of New Jersey on August 27th, resulting in a state disaster declaration August 29th and a presidential disaster declaration August 31st. Approximately 1.6	NOAA-NCDC, FEMA

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				million customers of JCP&L and PSE&G throughout the State lost power, which was not fully restored until September 5th. Widespread tree wind damage (and damage to homes and vehicles when trees fell on them) occurred in every county. The highest wind gusts recorded in Burlington County during Hurricane Irene were 51 mph at Ft Dix-Wrightstown in New Hanover Township, and 47 mph in Mount Holly Township. Thousands of homes were flooded, including about 300 reported basement floods in Burlington City. Damage from the storm was so widespread that for the first time in state history, all 21 counties became eligible for both Individual Assistance (IA) and Public Assistance (PA). At the time of this report, a total \$176.6M in IA had been approved and \$111.9M in PA had been obligated throughout the state of New Jersey. Burlington County had approximately \$500K in damage due to the storm.	
September 28 – October 6, 2011	Remnants of Tropical Storm Lee	DR-4039	No	Remnants of Tropical Storm Lee brought a series of thunderstorms with torrential downpours the State of New Jersey. The thunderstorms caused small stream and poor drainage flash flooding across northwest New Jersey. No damage was reported in Burlington County.	NOAA-NCDC, FEMA
June 1, 2012	TSTMs	N/A	N/A	Scattered strong thunderstorms moved over central parts of New Jersey during the afternoon and early evening of the 3rd. These thunderstorms dropped penny to nickel-size hail in Hunterdon County and produced minor wind damage in Burlington county. In Burlington County, storms knocked down one tree onto a house on Montrose Lane in the Millbrook Park section of Willingboro Township. Doppler Radar suggested the wind gusts were around 45 mph. No injuries and \$10K in damages were reported.	NOAA-NCDC
June 22, 2012	TSTMs	N/A	N/A	Scattered strong to severe thunderstorms produced pockets of very heavy rain and some wind damage across parts of New Jersey, eastern Pennsylvania, and Delaware during the afternoon and evening of the 22nd. Atlantic City Electric reported that roughly 16,000 of its customers lost power at the height of the storm. In Burlington County, wind gusts knocked down trees in Chesterfield Township, and trees and wires fell in Southampton	NOAA-NCDC

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				Township. In Palmyra Borough, trees fell on West Broad Street and Washington Avenue and in Moorestown Township numerous large tree limbs fell on East Main Street. Recorded wind speeds included 50knts in Chesterfield Township, Riverton Borough, Mount Laurel Township at Ramblewood, and Southampton Township at Vincentown. Hail was reported of 1 inch in Jacobstown and .75 inch in Willingboro Township. The County experienced a total of \$2K in damages.	
July 4, 2012	TSTMs	N/A	N/A	Strong to severe thunderstorms developed during the late evening and overnight across the central part of New Jersey. In Burlington County, lightning struck a transformer, downing wires and causing a brief fire near Old York Road in Burlington Township. Penny-size hail as well as a peak wind gust of 48 mph was reported in Florence Township. Another thunderstorm produced estimated wind gusts of 40 to 50 mph in Willingboro Township and knocked down a 150-year-old tree in Westhampton Township. It also caused some minor wind damage to a couple of homes. Wind speeds of 57 mph were reported in Timbuctoo (Westhampton Township). The County experienced a total of \$2K in damages.	NOAA-NCDC
October 26 – November 8, 2012	Hurricane Sandy	DR-4086 EM-3354	Yes	Hurricane Sandy made landfall in New Jersey on October 28, causing widespread damage. However, since the storm merged with a cold-air system, it was no longer considered a tropical cyclone by the time of landfall, even though it still had hurricane-force winds. Sustained winds were well over tropical storm force in northern and central New Jersey, and gusts exceeded hurricane force (74 mph) at many coastal locations and at some exposed inland sites. The result of the storm was devastation to homes and infrastructure along the Delaware River and near the Atlantic coast in Burlington County, thousands of trees falling on homes, automobiles, and power lines across the state, unprecedented damage to the power grid, the loss of power to over 75% of customers, and record disruptions of transportation and communications. In Burlington County, a 73-year-old man and his 70-year-old wife died from a generator related house fire in Willingboro Township, and a Mount Holly Township resident was trapped inside their home after a tree landed on it. Indicative of further tree damage in the county, seven roadways were closed in Medford Township. Along the Delaware River, tidal flooding occurred in the Columbus	NOAA-NCDC, FEMA

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM EVENTS

Table 5.4.6-7. Severe Storm Events between 1903 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source (s)
				Park Development along the Assiscunk Creek in Burlington City. The most widespread damage (mainly tidal and flood related) was reported in Bass River Township. Recorded wind speeds in the county include gusts of up to 70 mph in Florence Township, 66 mph at the McGuire Air Force Base in New Hanover Township, 60 mph in Lumberton Township, and 56 mph in Woodland Township (Burlington County). Event precipitation totals included 4.10 inches in Medford Township, 3.51 inches in Woodland Township at Chatsworth, 3.15 inches in Medford Lakes Borough, 2.92 inches in Mount Laurel Township, 2.82 inches in Morrestown Township, and 2.42 inches in Westampton Township. A federal emergency declaration was announced for New Jersey on October 29, and a major disaster declaration followed the next day, making IA and PA funds available to affected residents. At the time of this report, a total \$274.9M in IA had been approved and \$81M in PA had been obligated throughout the State of New Jersey.	

Sources: FEMA, NOAA-NCDC, NWS, SHELDUS, ONJSC, NJWCN , Weather Underground

Note: Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

DR	Federal Disaster Declaration	Mph	Miles Per Hour
EM	Federal Emergency Declaration	NCDC	National Climate Data Center
FEMA	Federal Emergency Management Agency	NOAA	National Oceanic Atmospheric Administration
HMP	Hazard Mitigation Plan	NWS	National Weather Service
IA	Individual Assistance	PA	Public Assistance
K	Thousand (\$)	SHELDUS	Spatial Hazard Events and Losses Database for the U.S.
M	Million (\$)	TSTM	Thunderstorms

Probability of Future Events

Predicting future severe storm events in a constantly changing climate has proven to be a difficult task. Predicting extremes in New Jersey is particularly difficult because of the region's geographic location. It is positioned roughly halfway between the equator and the North Pole and is exposed to both cold and dry airstreams from the south. The interaction between these opposing air masses often leads to turbulent weather across the region (Keim, 1997).

In Section 5.2, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for severe storms in the County is considered 'frequent' (likely to occur within 25 years, as presented in Table 5.3-3); however, impacts only related to severe storms, excluding those associated with hurricanes, tropical storms, Nor'Easters and flooding, are expected to be minimal.

It is estimated that Burlington County will continue to experience direct and indirect impacts of severe storms annually that may induce secondary hazards such as flooding, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

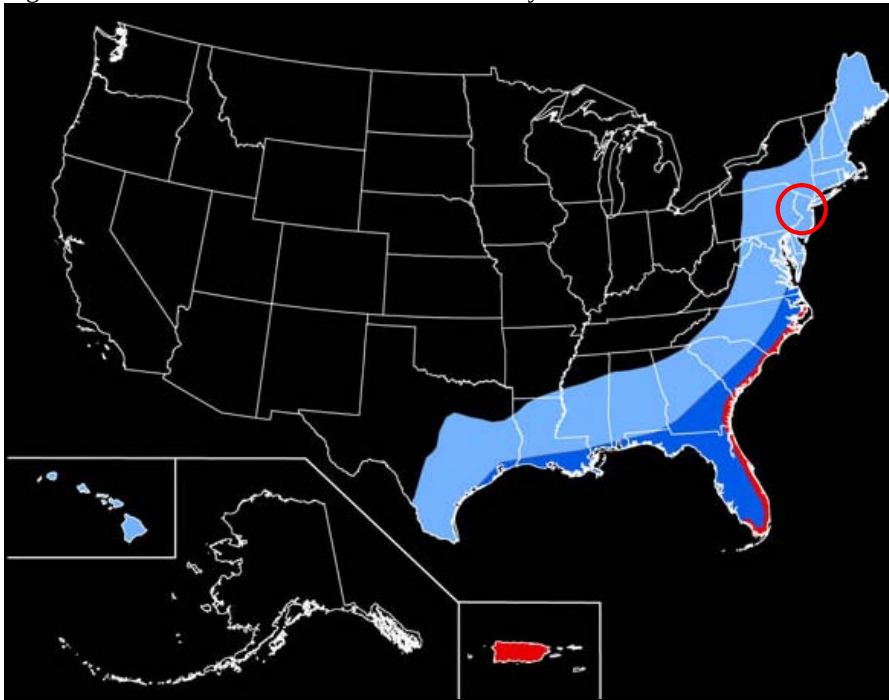
Tornadoes

For tornado events, this plan indicates the probability of future occurrences in terms of frequency based on historical events. According to the NOAA-NCDC Storm Database, Burlington County has experienced 28 tornadoes in the 63 year period between 1950 and 2013, or an average of 0.44 tornadoes per year.

Hurricanes

Figure 5.4.6-3 illustrates the number of hurricanes expected to occur during a 100-year period. According to this map, portions of New Jersey, including Burlington County, can expect between 20 and 40 hurricanes during a 100-year return period.

Figure 5.4.6-3. Number of Hurricanes for a 100-year Return Period



Source: USGS, 2005

Note: The number of hurricanes expected to occur during a 100-year MRP based on historical data—light blue area, 20 to 40; dark blue area, 40 to 60; red area, more than 60. Map not to scale.

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe storms, the entire County has been identified as the hazard area. Therefore, all County assets (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable. The following text evaluates and estimates the potential impact of severe storms on the County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health of residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

The high winds and air speeds of a hurricane or any severe storm often result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, people. The risk assessment for severe storm evaluates available data for a range of storms included in this hazard category.

Due to the large geographic area the County covers with both coastal and inland locations, the loss associated with hurricanes can vary across the County (see flooding discussion in Section 5.4.4 Flood). Secondary flooding associated with the torrential downpours during hurricanes/tropical storms is also a primary concern in the County. The County has experienced flooding in association with several hurricanes and tropical storms in the past.

The entire inventory of the County is at risk of being damaged or lost due to impacts of severe wind. Certain areas, infrastructure, and types of building are at greater risk than others due to proximity to falling hazards and/or their manner of construction. Potential losses associated with high wind events were calculated for the County for two probabilistic hurricane events, the 100-year and 500-year MRP hurricane events. The impacts on population, existing structures, critical facilities and the economy are presented below, following a summary of the data and methodology used.

Table 5.4.6-8. Summary of Potential Surge Inundation Areas by Community

Municipality	Total Acres	% in CAT1 Surge Zone	% in CAT2 Surge Zone	% in CAT3 Surge Zone	% in CAT4 Surge Zone
Bass River (T)	50,140	12.6%	22.7%	25.6%	31.6%
Beverly (C)	486	0.4%	0.5%	0.5%	0.7%
Bordentown (C)	618	5.0%	5.0%	5.0%	5.0%
Bordentown (T)	5,926	2.9%	2.9%	2.9%	2.9%
Burlington (C)	2,426	5.3%	5.4%	5.4%	7.7%
Burlington (T)	8,992	0.3%	0.4%	0.6%	3.0%
Chesterfield (T)	13,736	0.0%	0.0%	0.0%	0.0%
Cinnaminson (T)	5,099	0.6%	0.7%	0.7%	8.6%
Delanco (T)	2,190	0.8%	0.9%	0.9%	1.4%
Delran (T)	4,654	2.1%	2.2%	2.2%	3.2%

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-8. Summary of Potential Surge Inundation Areas by Community

Municipality	Total Acres	% in CAT1 Surge Zone	% in CAT2 Surge Zone	% in CAT3 Surge Zone	% in CAT4 Surge Zone
Eastampton (T)	3,723	0.0%	0.0%	0.0%	0.0%
Edgewater Park (T)	1,976	0.1%	0.1%	0.2%	0.2%
Evesham (T)	18,943	0.0%	0.0%	0.0%	0.0%
Fieldsboro (B)	224	1.0%	1.0%	1.0%	1.0%
Florence (T)	6,559	0.3%	0.4%	0.4%	0.4%
Hainesport (T)	4,344	0.1%	11.9%	13.8%	20.7%
Lumberton (T)	8,327	0.0%	3.2%	4.1%	8.1%
Mansfield (T)	14,010	0.4%	0.4%	0.4%	0.4%
Maple Shade (T)	2,451	0.0%	0.0%	0.0%	3.7%
Medford (T)	812	0.0%	3.1%	4.0%	9.4%
Medford Lakes (B)	25,474	0.0%	0.0%	0.0%	0.0%
Moorestown (T)	9,585	0.2%	0.4%	0.4%	2.4%
Mt. Holly (T)	1,837	0.0%	0.4%	0.8%	3.2%
Mt. Laurel (T)	14,066	0.1%	0.7%	0.8%	1.5%
New Hanover (T)	14,483	0.0%	0.0%	0.0%	0.0%
North Hanover (T)	11,203	0.0%	0.0%	0.0%	0.0%
Palmyra (B)	1,673	1.7%	1.8%	4.4%	39.2%
Pemberton (B)	403	0.0%	0.0%	0.0%	0.0%
Pemberton (T)	40,171	0.0%	0.0%	0.0%	0.0%
Riverside (T)	1,048	0.5%	0.5%	0.6%	0.9%
Riverton (B)	614	1.3%	0.0%	1.6%	36.1%
Shamong (T)	28,791	0.0%	0.0%	0.0%	0.0%
Southampton (T)	28,446	0.0%	0.0%	0.0%	0.1%
Springfield (T)	18,924	0.0%	0.0%	0.0%	0.0%
Tabernacle (T)	31,688	0.0%	0.0%	0.0%	0.0%
Washington (T)	66,539	8.3%	14.3%	18.2%	27.0%
Westampton (T)	7,104	0.0%	1.6%	1.9%	3.2%
Willingboro (T)	5,175	0.9%	1.0%	1.1%	1.7%
Woodland (T)	61,001	0.0%	0.0%	0.0%	0.0%
Wrightstown (B)	1,146	0.0%	0.0%	0.0%	0.0%
Burlington County (Total)	525,009	2.4%	4.3%	5.1%	7.4%

Source: Burlington County GIS

Data and Methodology

After reviewing historic data, the HAZUS-MH methodology and model were used to analyze the severe storm hazard for Burlington County. Data used to assess this hazard include data available in the HAZUS-MH 2.1 hurricane model, professional knowledge, information provided by the Steering Committee and input from the public.

A probabilistic scenario was run for Burlington County for annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. These results are shown in Figure 5.4.6-1 and

Figure 5.4.6-2, earlier in this section, which show the HAZUS-MH maximum peak gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP hurricane events. The estimated hurricane track for the 100- and 500-year events is also shown.

HAZUS-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Hurricane and inventory data available in HAZUS-MH were used to evaluate potential losses from the 100- and 500-year MRP events (severe wind impacts). Other than updated data for the general building stock and critical facility inventories, the default data in HAZUS-MH 2.1 was the best available for use in this evaluation.

The “Sea – Lake Overland Surge from Hurricanes – SLOSH Model, which represents potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide were used to estimate exposure. Please note these inundation zones do not include riverine flooding caused by hurricane surge or inland freshwater flooding. The model, developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes, considers only storm surge height and does not consider the effects of waves.

Impact on Life, Health and Safety

The impact of a severe storm on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time was provided to residents. It is assumed that the entire County’s population (U.S. Census 2010 population of 448,734 people) is exposed to this storm hazard (wind).

To estimate potential exposure to storm surge, the SLOSH inundation zones were used. The estimated population in the Category 1 through 4 inundation zones is summarized in Table 5.4.6-9 by municipality.

Table 5.4.6-9. Estimated Population Exposed to Storm Surge in Burlington County

Municipality	Total Population (U.S. Census 2010)	Percent Population in Hazard Area			
		Cat 1	Cat 2	Cat 3	Cat 4
Bass River township	1,443	3.8%	66.7%	67.7%	92.7%
Beverly city	2,577	0.0%	0.0%	0.0%	0.0%
Bordentown city	3,924	0.0%	0.0%	0.0%	0.0%
Bordentown township	11,367	0.0%	0.0%	0.0%	0.0%
Burlington city	9,920	2.7%	2.7%	2.7%	2.7%
Burlington township	22,594	0.0%	0.0%	0.0%	2.0%
Chesterfield township	7,699	0.0%	0.0%	0.0%	0.0%
Cinnaminson township	15,569	0.0%	0.0%	0.0%	5.2%
Delanco township	4,283	0.0%	0.0%	0.0%	0.0%
Delran township	16,896	0.2%	0.2%	0.2%	1.3%
Eastampton township	6,069	0.0%	0.0%	0.0%	0.0%
Edgewater Park township	8,881	0.0%	0.0%	0.0%	0.0%
Evesham township	45,538	0.0%	0.0%	0.0%	0.0%
Fieldsboro borough	540	0.0%	0.0%	0.0%	0.0%
Florence township	12,109	0.0%	0.0%	0.0%	0.0%

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-9. Estimated Population Exposed to Storm Surge in Burlington County

Municipality	Total Population (U.S. Census 2010)	Percent Population in Hazard Area			
		Cat 1	Cat 2	Cat 3	Cat 4
Hainesport township	6,110	0.0%	0.2%	1.2%	1.5%
Lumberton township	12,559	0.0%	1.3%	2.5%	3.3%
Mansfield township	8,544	0.0%	0.0%	0.0%	0.0%
Maple Shade township	19,131	0.0%	0.0%	0.0%	0.6%
Medford Lakes borough	4,146	0.0%	0.0%	0.0%	0.0%
Medford township	23,033	0.0%	0.0%	0.0%	0.0%
Moorestown township	20,726	0.0%	0.0%	0.0%	0.0%
Mount Holly township	9,536	0.0%	0.0%	0.0%	1.2%
Mount Laurel township	41,864	0.0%	0.0%	0.0%	0.6%
New Hanover township	7,385	0.0%	0.0%	0.0%	0.0%
North Hanover township	7,678	0.0%	0.0%	0.0%	0.0%
Palmyra borough	7,398	0.0%	0.0%	6.1%	55.0%
Pemberton borough	1,409	0.0%	0.0%	0.0%	0.0%
Pemberton township	27,912	0.0%	0.0%	0.0%	0.0%
Riverside township	8,079	0.0%	0.0%	0.0%	0.0%
Riverton borough	2,779	0.0%	0.0%	0.0%	45.4%
Shamong township	6,490	0.0%	0.0%	0.0%	0.0%
Southampton township	10,464	0.0%	0.0%	0.0%	0.0%
Springfield township	3,414	0.0%	0.0%	0.0%	0.0%
Tabernacle township	6,949	0.0%	0.0%	0.0%	0.0%
Washington township	687	18.5%	57.6%	69.4%	73.5%
Westampton township	8,813	0.0%	0.0%	0.0%	0.2%
Willingboro township	31,629	0.0%	0.0%	0.0%	0.0%
Woodland township	1,788	0.0%	0.0%	0.0%	0.0%
Wrightstown borough	802	0.0%	0.0%	0.0%	0.0%
Burlington County	448,734	0.1%	0.4%	0.6%	2.2%

Source: Burlington County Department of Information Technology, 2013; U.S. Census 2010

Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings and debris carried by high winds can lead to injury or loss of life. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. HAZUS-MH estimates there will be 8 households displaced and 1 person that may require temporary shelter due to a 100-year MRP event. For a 500-year MRP event, HAZUS-MH estimates 561 households will be displaced and 116 require short-term sheltering. Refer to Table 5.4.6-10 which summarizes the sheltering estimates for the 500-year MRP event by municipality.

Table 5.4.6-10. Sheltering Needs for the 500-year MRP Hurricane Events for Burlington County

Municipality	Displaced Households	Households Requiring Short-Term Shelter
Bass River Township	3	1

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-10. Sheltering Needs for the 500-year MRP Hurricane Events for Burlington County

Municipality	Displaced Households	Households Requiring Short-Term Shelter
Beverly	2	0
Bordentown	6	1
Bordentown Township	6	1
Burlington	7	1
Burlington Township	17	5
Chesterfield Township	1	0
Cinnaminson Township	3	0
Delanco Township	1	0
Delran Township	18	4
Eastampton Township	13	3
Edgewater Park Township	14	4
Evesham Township	93	19
Fieldsboro Borough	0	0
Florence Township	10	2
Hainesport Township	2	0
Lumberton Township	23	5
Mansfield Township	2	0
Maple Shade Township	60	14
Medford Lakes Borough	5	1
Medford Township	38	7
Moorestown Township	16	3
Mount Holly Township	18	4
Mount Laurel Township	74	15
New Hanover Township	11	3
North Hanover Township	10	2
Palmyra Borough	6	1
Pemberton Borough	3	1
Pemberton Township	42	10
Riverside Township	7	1
Riverton Borough	2	0
Shamong Township	12	2
Southampton Township	15	3
Springfield Township	1	0
Tabernacle Township	13	2
Washington Township	0	0
Westampton Township	4	1

Table 5.4.6-10. Sheltering Needs for the 500-year MRP Hurricane Events for Burlington County

Municipality	Displaced Households	Households Requiring Short-Term Shelter
Willingboro Township	1	0
Woodland Township	1	0
Wrightstown Borough	1	0
Burlington County (Total)	561	116

Source: HAZUS-MH v 2.1 (U.S. Census 2000)

Note: Sheltering estimates are based on the default 2000 U.S. Census data in HAZUS-MH. Therefore, these are conservative estimates given the increase in population as indicated by the 2010 U.S. Census data.

Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions based on the major economic impact to their family and may not have funds to evacuate. The population over the age of 65 is also more vulnerable and, physically, they may have more difficulty evacuating. The elderly are considered most vulnerable because they require extra time or outside assistance during evacuations and are more likely to seek or need medical attention which may not be available due to isolation during a storm event. Please refer to Section 4 for the statistics of these populations in the County.

Impact on General Building Stock

After considering the population exposed to the severe storm hazard, the general building stock replacement value exposed to and damaged by 100- and 500-year MRP events was examined. Wind-only impacts from a severe storm are reported based on the probabilistic hurricane runs in HAZUS-MH 2.1. Potential damage is the modeled loss that could occur to the exposed inventory, including damage to structural and content value based on the wind-only impacts associated with a hurricane (using the methodology described in Section 5.1).

It is assumed that the entire County's general building stock is exposed to the severe storm wind hazard (greater than \$37.7 billion structure only). Expected building damage was evaluated by HAZUS across the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. Table 5.4.6-11 summarizes the definition of the damage categories.

Table 5.4.6-11. Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
No Damage or Very Minor Damage Little to no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof over, with no or very limited water penetration.	≤ 2%	No	No	No	No	No
Minor Damage Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.	> 2% and ≤ 15%	One window, door, or garage door failure	No	< 5 Impacts	No	No

Table 5.4.6-11. Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	> 15% and ≤ 50%	> the larger of 20% & 3 and ≤ 50%	1 to 3 Panels	Typically 5 to 10 Impacts	No	No
Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	> 50%	> one and ≤ the larger of 20% & 3	> 3 and ≤ 25%	Typically 10 to 20 Impacts	No	No
Destruction Complete roof failure and/or failure of wall frame. Loss of more than 50% of roof sheathing.	Typically > 50%	> 50%	> 25%	Typically > 20 Impacts	Yes	Yes

Source: HAZUS-MH Hurricane Technical Manual

As noted earlier in the profile, HAZUS estimates the 100-year MRP peak gust wind speeds for Burlington County to be 75 to 82 miles per hour (mph). This equates to a Category 1 hurricane. For the 100-year MRP event, HAZUS-MH 2.1 estimates \$87.3 Million in structure damages across the County. Residential buildings comprise the majority of the building inventory and are estimated to experience all of the damage.

HAZUS estimates the 500-year MRP peak gust wind speeds for Burlington County to range from 94 to 112 mph. This equates to a Category 2 hurricane and \$491 Million in damages to the general building stock (structure only). This is between one- and two-percent of the County's building inventory. The residential buildings are estimated to experience the majority of the damage. **Error! Reference source not found.** summarizes the building value (structure only) damage estimated for the annualized and 100- and 500-year MRP wind-only events by occupancy class.

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-12. Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year Mean Return Period Hurricane-Related Winds for All Occupancy Classes

Municipality	Total Building Replacement Value (\$) (Structure Only)	Total Building Damage (All Occupancies)						Residential Buildings		Commercial Buildings	
		Annualized		100 Year		500 Year		100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)
		Loss (\$)	% of GBS RCV Total	Loss (\$)	% of GBS RCV Total	Loss (\$)	% of GBS RCV Total				
Bass River Township	101,257,000	37,847	0.04%	154,318	0.15%	2,962,003	2.93%	152,979	2,819,295	572	55,172
Beverly City	203,182,000	25,830	0.01%	479,929	0.24%	1,708,818	0.84%	456,408	1,543,769	10,313	65,023
Bordentown City	364,327,000	47,510	0.01%	627,501	0.17%	3,398,007	0.93%	599,189	3,130,801	17,680	154,143
Bordentown Township	756,748,000	120,728	0.02%	1,548,645	0.20%	7,654,391	1.01%	1,491,283	7,117,586	43,969	380,731
Burlington City	847,191,000	109,674	0.01%	1,807,851	0.21%	7,593,207	0.90%	1,702,752	6,754,403	67,030	507,680
Burlington Township	1,950,990,000	245,224	0.01%	3,934,147	0.20%	17,322,137	0.89%	3,725,784	15,467,146	145,944	1,175,144
Chesterfield Township	299,950,000	57,304	0.02%	549,141	0.18%	3,424,906	1.14%	533,952	3,141,644	6,902	109,021
Cinnaminson Township	1,416,712,000	179,386	0.01%	3,406,602	0.24%	12,127,904	0.86%	3,229,064	10,834,136	106,086	708,604
Delanco Township	282,362,000	37,068	0.01%	669,730	0.24%	2,346,132	0.83%	626,038	1,998,296	26,338	181,574
Delran Township	1,295,952,000	175,012	0.01%	3,304,645	0.25%	12,834,451	0.99%	3,145,164	11,673,098	122,138	812,286
Eastampton Township	451,284,000	92,452	0.02%	1,183,308	0.26%	6,878,200	1.52%	1,155,334	6,508,778	23,540	297,154
Edgewater Park Township	589,879,000	83,300	0.01%	1,587,967	0.27%	6,312,256	1.07%	1,520,976	5,822,149	55,416	389,750
Evesham Township	3,885,335,000	648,986	0.02%	10,709,394	0.28%	66,500,797	1.71%	10,180,513	59,215,598	450,422	5,884,305
Fieldsboro Borough	42,846,000	5,936	0.01%	86,223	0.20%	379,174	0.88%	82,801	351,607	1,716	14,771
Florence Township	922,519,000	135,347	0.01%	2,107,560	0.23%	9,186,065	1.00%	2,022,422	8,377,118	62,038	541,414
Hainesport Township	485,136,000	70,104	0.01%	982,703	0.20%	5,634,614	1.16%	904,096	4,480,864	55,923	713,995
Lumberton Township	926,654,000	180,814	0.02%	2,296,362	0.25%	15,479,326	1.67%	2,214,990	14,011,533	63,585	1,043,378
Mansfield Township	1,053,948,000	212,326	0.02%	1,388,861	0.13%	15,443,283	1.47%	1,026,823	5,489,978	28,053	388,078
Maple Shade Township	1,455,690,000	212,265	0.01%	4,423,676	0.30%	20,254,781	1.39%	4,284,511	19,169,724	103,257	756,506
Medford Lakes Borough	361,430,000	68,996	0.02%	1,025,309	0.28%	7,136,110	1.97%	1,012,316	6,869,915	10,069	194,203
Medford Township	2,279,232,000	380,377	0.02%	5,566,083	0.24%	38,802,642	1.70%	5,333,910	34,525,123	172,298	2,929,451
Moorestown Township	2,427,401,000	317,996	0.01%	5,625,366	0.23%	24,229,181	1.00%	5,162,163	20,363,556	349,917	2,780,730
Mount Holly Township	942,557,000	147,778	0.02%	1,876,325	0.20%	11,210,691	1.19%	1,747,323	9,588,717	97,116	1,151,357
Mount Laurel Township	4,195,041,000	615,445	0.01%	10,560,323	0.25%	52,585,049	1.25%	9,948,584	46,569,948	507,797	4,686,832
New Hanover Township	825,998,000	128,011	0.02%	670,640	0.08%	8,166,556	0.99%	556,403	6,198,060	107,910	1,816,213

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-12. Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year Mean Return Period Hurricane-Related Winds for All Occupancy Classes

Municipality	Total Building Replacement Value (\$) (Structure Only)	Total Building Damage (All Occupancies)						Residential Buildings		Commercial Buildings	
		Annualized		100 Year		500 Year		100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)
		Loss (\$)	% of GBS RCV Total	Loss (\$)	% of GBS RCV Total	Loss (\$)	% of GBS RCV Total				
North Hanover Township	419,942,000	93,182	0.02%	714,968	0.17%	5,512,851	1.31%	692,275	5,105,014	15,873	262,672
Palmyra Borough	582,624,000	78,752	0.01%	1,577,661	0.27%	5,548,368	0.95%	1,522,767	5,189,404	36,056	215,605
Pemberton Borough	110,647,000	20,583	0.02%	202,708	0.18%	1,660,510	1.50%	190,266	1,451,101	3,706	59,729
Pemberton Township	1,970,889,000	469,439	0.02%	3,503,278	0.18%	32,300,687	1.64%	3,416,502	29,903,888	56,865	1,384,464
Riverside Township	533,916,000	64,698	0.01%	1,256,716	0.24%	4,616,209	0.86%	1,202,734	4,267,098	28,109	171,187
Riverton Borough	221,269,000	29,162	0.01%	612,407	0.28%	2,094,136	0.95%	594,462	1,989,291	11,633	63,900
Shamong Township	500,704,000	123,629	0.02%	1,248,162	0.25%	12,474,610	2.49%	1,225,593	11,580,476	15,362	506,708
Southampton Township	823,737,000	184,197	0.02%	1,959,866	0.24%	15,666,963	1.90%	1,913,818	14,567,944	32,953	691,924
Springfield Township	282,453,000	56,897	0.02%	650,398	0.23%	3,548,219	1.26%	627,210	3,161,953	14,129	193,796
Tabernacle Township	576,928,000	132,231	0.02%	1,119,419	0.19%	13,217,824	2.29%	1,086,920	11,936,026	16,985	517,065
Washington Township	63,380,000	12,122	0.02%	55,433	0.09%	1,224,191	1.93%	49,762	964,411	2,760	122,264
Westampton Township	769,854,000	117,578	0.02%	1,584,986	0.21%	8,054,625	1.05%	1,473,645	6,632,248	72,507	803,589
Willingboro Township	2,284,353,000	342,492	0.01%	6,044,451	0.26%	22,896,527	1.00%	5,903,119	21,809,426	95,811	690,224
Woodland Township	75,012,000	19,936	0.03%	124,862	0.17%	1,508,673	2.01%	123,969	1,472,935	495	18,781
Wrightstown Borough	80,320,000	14,582	0.02%	101,450	0.13%	1,001,049	1.25%	90,853	827,698	6,868	114,375
Burlington County (Total)	37,659,649,000	6,095,196	0.02%	87,329,374	0.23%	490,896,123	1.30%	82,929,673	432,881,755	3,046,141	33,553,798

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-12. Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year Mean Return Period Hurricane-Related Winds for All Occupancy Classes

Municipality	Industrial Buildings		Agriculture Buildings		Religious Buildings		Government Buildings		Education Buildings	
	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)
Bass River Township	419	49,621	49	11,444	78	4,939	96	8,718	124	12,813
Beverly City	1,839	17,618	70	784	5,870	33,262	435	3,915	4,995	44,446
Bordentown City	4,471	50,729	93	2,269	4,020	41,543	978	7,824	1,070	10,698
Bordentown Township	8,052	97,347	770	16,201	3,294	29,641	880	9,192	396	3,693
Burlington City	12,862	127,290	209	3,766	16,542	124,008	1,434	15,225	7,022	60,836
Burlington Township	46,565	528,538	1,311	20,780	10,483	91,998	1,677	18,116	2,383	20,415
Chesterfield Township	3,477	83,380	1,064	36,159	3,291	45,254	55	1,010	402	8,438
Cinnaminson Township	52,108	445,345	2,308	28,868	8,056	53,389	2,074	12,798	6,905	44,764
Delanco Township	11,396	122,053	463	5,649	3,320	19,919	621	6,214	1,553	12,427
Delran Township	27,048	269,297	1,047	15,760	4,637	32,960	814	5,814	3,798	25,236
Eastampton Township	1,278	24,115	607	16,080	1,879	21,415	251	4,651	419	6,007
Edgewater Park Township	4,448	50,015	155	2,144	5,071	32,388	308	3,133	1,593	12,678
Evesham Township	34,913	684,502	4,487	135,399	19,912	248,668	10,843	201,066	8,305	131,260
Fieldsboro Borough	1,579	11,737	-	-	121	997	7	63	-	-
Florence Township	11,819	158,187	405	8,061	5,164	44,671	2,266	25,812	3,447	30,803
Hainesport Township	15,647	339,642	845	21,965	3,779	42,325	451	8,347	1,963	27,476
Lumberton Township	9,818	263,819	1,578	54,455	3,904	55,924	202	5,242	2,287	44,976
Mansfield Township	11,737	293,549	317,042	9,193,009	2,393	29,328	401	8,283	2,413	41,058
Maple Shade Township	20,200	200,882	1,111	16,849	8,216	60,813	2,037	16,944	4,344	33,062
Medford Lakes Borough	1,259	34,058	146	7,125	554	10,934	98	2,548	866	17,328
Medford Township	31,772	800,444	3,370	121,259	13,306	214,719	2,458	52,982	8,970	158,665
Moorestown Township	85,320	823,724	3,691	57,869	14,972	123,446	2,537	23,993	6,766	55,863
Mount Holly Township	6,997	117,635	312	8,825	9,437	117,023	9,748	155,968	5,393	71,167
Mount Laurel Township	64,905	894,855	3,095	65,175	20,303	193,058	8,973	108,161	6,666	67,021
New Hanover Township	1,245	48,468	146	7,900	1,306	24,382	2,862	55,051	768	16,483

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-12. Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year Mean Return Period Hurricane-Related Winds for All Occupancy Classes

Municipality	Industrial Buildings		Agriculture Buildings		Religious Buildings		Government Buildings		Education Buildings	
	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)	100 Year Loss (\$)	500 Year Loss (\$)
North Hanover Township	1,938	42,968	578	26,588	1,941	32,876	1,265	18,972	1,099	23,762
Palmyra Borough	9,063	82,329	296	3,517	7,204	42,679	751	5,422	1,524	9,411
Pemberton Borough	2,067	40,722	22	850	5,308	84,928	279	5,863	1,060	17,317
Pemberton Township	6,069	291,347	1,426	80,790	9,099	243,457	2,092	65,302	11,224	331,439
Riverside Township	17,217	126,416	148	1,858	6,042	36,257	1,061	6,010	1,406	7,384
Riverton Borough	1,253	10,740	378	4,234	3,899	21,443	465	2,790	316	1,738
Shamong Township	3,906	210,910	994	98,923	1,435	50,222	311	11,655	561	15,716
Southampton Township	6,179	203,539	2,207	103,646	3,453	67,126	563	16,383	693	16,401
Springfield Township	3,490	86,721	1,284	44,930	3,378	47,292	295	5,159	612	8,368
Tabernacle Township	6,050	244,599	3,732	350,827	2,228	74,280	611	20,767	2,893	74,259
Washington Township	687	48,972	60	6,049	982	36,014	497	18,036	685	28,444
Westampton Township	21,344	397,655	975	22,917	6,092	63,352	1,719	27,504	8,705	107,359
Willingboro Township	8,076	87,720	2,124	34,799	24,670	183,971	2,529	20,577	8,122	69,811
Woodland Township	46	1,882	8	1,120	181	6,787	163	7,168	-	-
Wrightstown Borough	50	818	-	-	2,595	35,684	782	16,296	301	6,179
Burlington County (Total)	558,609	8,414,189	358,606	10,638,843	248,415	2,723,372	65,889	1,008,974	122,049	1,675,201

Source: HAZUS-MH 2.1

Notes: B = Borough; GBS = General Building Stock; RCV = Replacement Cost Value; T = Town

Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. The damage counts include buildings damaged at all severity levels from minor damage to total destruction. Total dollar damage reflects the overall impact to buildings at an aggregate level.

Of the exceeding \$27.7 billion in total residential replacement value (structure) for the entire County, an estimated \$82.9 million in residential building damage can be anticipated for the 100-year event and \$433 million in residential building damage can be anticipated for the 500-year event. Residential building damage accounts for 95-percent and 88-percent of total damages for the 100- and 500-year wind-only events, respectively. This illustrates residential structures are the most vulnerable to the wind hazard.

Annualized losses were also examined for Burlington County. A total of \$6.1 Million is estimated as the annualized loss for the entire County; see **Error! Reference source not found.** above. Please note that annualized loss does not predict what losses will occur in any particular year.

To estimate potential building exposure to storm surge, the SLOSH inundation zones were used. The estimated total assessed improved value in the Category 1 through 4 inundation zones is summarized in Table 5.4.6-13 by municipality.

Table 5.4.6-13. Estimated Assessed Value of Improved Property in the SLOSH Inundation Zones

Municipality	Total Assessed Value of Improvements	Percent Improved Value in Hazard Area			
		Cat 1	Cat 2	Cat 3	Cat 4
Bass River Township	\$112,293,600	30.78%	74.14%	80.14%	93.93%
Beverly*	\$72,091,800	0.00%	0.00%	0.00%	0.00%
Bordentown	\$298,534,950	0.00%	0.00%	0.00%	0.00%
Bordentown Township	\$997,461,800	0.03%	0.00%	0.00%	0.00%
Burlington	\$571,882,875	0.04%	0.09%	0.09%	3.62%
Burlington Township	\$2,097,110,708	0.00%	0.00%	0.01%	2.38%
Chesterfield Township	\$666,455,492	0.00%	0.00%	0.00%	0.00%
Cinnaminson Township	\$1,304,483,700	0.03%	0.02%	0.02%	4.99%
Delanco Township	\$290,621,560	0.00%	0.00%	0.00%	0.03%
Delran Township	\$1,474,866,100	0.22%	0.06%	0.06%	0.08%
Eastampton Township	\$421,225,400	0.00%	0.00%	0.00%	0.00%
Edgewater Park Township	\$528,294,400	0.00%	0.00%	0.00%	0.00%
Evesham Township	\$4,389,240,875	0.00%	0.00%	0.00%	0.00%
Fieldsboro Borough	\$48,903,400	0.00%	0.00%	0.00%	0.00%
Florence Township	\$1,040,584,300	0.00%	0.00%	0.00%	0.00%
Hainesport Township	\$367,702,666	0.00%	0.46%	0.50%	2.07%
Lumberton Township	\$1,164,991,807	0.00%	0.27%	0.31%	2.18%
Mansfield Township	\$899,612,400	0.01%	0.00%	0.00%	0.00%
Maple Shade Township	\$1,405,067,900	0.00%	0.00%	0.00%	5.81%
Medford Lakes Borough	\$1,297,069,100	0.00%	0.00%	0.00%	0.02%
Medford Township	\$980,612,600	0.00%	0.00%	0.00%	0.00%
Moorestown Township	\$3,410,132,200	0.01%	0.01%	0.01%	0.40%

Table 5.4.6-13. Estimated Assessed Value of Improved Property in the SLOSH Inundation Zones

Municipality	Total Assessed Value of Improvements	Percent Improved Value in Hazard Area			
		Cat 1	Cat 2	Cat 3	Cat 4
Mount Holly Township	\$1,079,081,000	0.00%	0.00%	0.00%	1.15%
Mount Laurel Township	\$2,396,695,600	0.00%	0.01%	0.11%	0.18%
New Hanover Township	\$852,205,300	0.00%	0.00%	0.00%	0.00%
North Hanover Township	\$498,418,446	0.00%	0.00%	0.00%	0.00%
Palmyra Borough	\$254,304,240	0.26%	1.79%	2.73%	48.89%
Pemberton Borough	\$63,520,200	0.00%	0.00%	0.00%	0.00%
Pemberton Township	\$2,014,515,095	0.00%	0.00%	0.00%	0.00%
Riverside Township	\$349,218,580	0.16%	0.00%	0.00%	0.00%
Riverton Borough	\$207,879,600	0.02%	0.20%	0.20%	57.25%
Shamong Township	\$294,159,200	0.00%	0.00%	0.00%	0.00%
Southampton Township	\$549,437,950	0.00%	0.00%	0.00%	0.00%
Springfield Township	\$282,324,750	0.00%	0.00%	0.00%	0.00%
Tabernacle Township	\$580,603,200	0.00%	0.00%	0.00%	0.00%
Washington Township	\$13,020,400	25.42%	17.34%	17.34%	39.59%
Westampton Township	\$919,859,000	0.00%	0.02%	0.02%	0.16%
Willingboro Township	\$1,705,779,550	0.01%	0.04%	0.04%	0.13%
Woodland Township	\$305,887,600	0.00%	0.00%	0.00%	0.00%
Wrightstown Borough	\$47,025,100	0.00%	0.00%	0.00%	0.00%
Burlington County	\$36,253,174,444	0.12%	0.27%	0.31%	1.77%

Source: Burlington County Department of Information Technology, 2013

*Beverly data source: 2011 NJGIN MODIV

Impact on Critical Facilities

HAZUS-MH estimates the probability that critical facilities (i.e., medical facilities, fire/EMS, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of 100-year and 500-year MRP wind-only events. Additionally, HAZUS-MH estimates the loss of use for each facility in number of days. HAZUS-MH estimates a 1 to 3-percent chance that critical facilities in Burlington County will experience minor damage; and continuity of operations at these facilities will not be interrupted (loss of use is estimated to be zero days) as a result of a 100-year MRP event.

At this time, HAZUS-MH 2.1 does not estimate losses to transportation lifelines and utilities as part of the hurricane model. Transportation lifelines are not considered particularly vulnerable to the wind hazard; they are more vulnerable to cascading effects such as flooding, falling debris etc. Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting) transportation needs.

Utility structures could suffer damage associated with falling tree limbs or other debris. Such impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to citizens (including the young and elderly, who are particularly vulnerable to temperature-related health impacts).

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

To estimate potential building exposure to storm surge, the SLOSH inundation zones were used. The critical facilities and utilities located in the Category 1 through 4 inundation zones are summarized in Table 5.4.6-14 by municipality.

Table 5.4.6-14. Critical Facilities and Utilities Located in the SLOSH Inundation Zones

Name	Municipality	Type	Located in the SLOSH Zone			
			Cat 1	Cat 2	Cat 3	Cat 4
Station 421	Bass River	Fire		x	x	x
Bass River Elementary School	Bass River	School		x	x	x
Bass River Township Municipal Building	Bass River	Municipal Hall		x	x	x
Bass River Township Schl Dist	Bass River	Admin		x	x	x
New Gretna Volunteer Fire Co #1	Bass River	Fire		x	x	x
Cinnaminson	Cinnaminson	Riverline				x
Lumberton Fire Co #1	Lumberton Twp	Fire				x
Mount Holly Heliport	Mount Holly Twp	Airport		x	x	x
Delaware Avenue School	Palmyra Boro	School				x
Palmyra Board Of Education	Palmyra Boro	Board Of Ed				x
Palmyra Child Study Team	Palmyra Boro	Child Study Tm				x
Tacony Palmyra Bridge Police Dept	Palmyra Boro	Police				x
Municipal	Riverton	Municipal Hall				x
Riverview Estates (Baptist Home Of South Jersey)	Riverton	Long-Term Care				x
Riverton Boro Police Dept	Riverton Boro	Police				x
Riverton Borough Municipal Building	Riverton Boro	Municipal Hall				x
Riverton Borough Public School	Riverton Boro	School				x
Riverton Borough School Dist	Riverton Boro	Admin				x
Riverton Fire Co	Riverton Boro	Fire				x
Riverton School	Riverton Boro	School				x
Green Bank Elementary School	Washington Twp	School				x
Green Bank School	Washington Twp	School				x
Green Bank Vol Ambulance Co	Washington Twp	EMS			x	x
Green Bank Vol Ambulance Co 451	Washington Twp	EMS			x	x
Green Bank Vol Ambulance Co 452	Washington Twp	EMS			x	x
Green Bank Vol Ambulance Co 459	Washington Twp	EMS			x	x
Green Bank Volunteer Fire Co	Washington Twp	Fire			x	x
Lower Bank Volunteer Fire Co	Washington Twp	Fire			x	x
Nj State Park Service - Southern Region	Washington Twp	Police		x	x	x
Pacemaker Heliport	Washington Twp	Airport		x	x	x
Senior Citizens' Center	Washington Twp	Senior Center	x	x	x	x
Washington Township Municipal Building	Washington Twp	Municipal Hall	x	x	x	x

Source: Burlington County Department of Information Technology, 2013

Impact on Economy

Severe storms also impact the economy, including: loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. HAZUS-MH estimates the total economic loss associated with each storm scenario (direct building losses and business interruption losses). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the “Impact on General Building Stock” section discussed earlier. Business interruption losses are the losses associated with the inability to operate a business because of the wind damage sustained during the storm or the temporary living expenses for those displaced from their home because of the event.

For the 100-year MRP wind event, HAZUS-MH estimates \$2.9 Million in relocation costs. For the 500-year MRP wind only event, HAZUS-MH estimates \$61.7 Million in business interruption losses for Burlington County which includes loss of income, relocation costs, rental costs and lost wages. Further HAZUS-MH estimates \$1.7 Million in loss of inventory.

HAZUS-MH 2.1 also estimates the amount of debris that may be produced a result of the 100- and 500-year MRP wind events. Table 5.4.6-15 estimates the debris produced. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. According to the HAZUS-MH Hurricane User Manual: *‘The Eligible Tree Debris columns provide estimates of the weight and volume of downed trees that would likely be collected and disposed at public expense. As discussed in Chapter 12 of the HAZUS-MH Hurricane Model Technical Manual, the eligible tree debris estimates produced by the Hurricane Model tend to underestimate reported volumes of debris brought to landfills for a number of events that have occurred over the past several years. This indicates that there may be other sources of vegetative and non-vegetative debris that are not currently being modeled in HAZUS. For landfill estimation purposes, it is recommended that the HAZUS debris volume estimate be treated as an approximate lower bound. Based on actual reported debris volumes, it is recommended that the HAZUS results be multiplied by three to obtain an approximate upper bound estimate. It is also important to note that the Hurricane Model assumes a bulking factor of 10 cubic yards per ton of tree debris. If the debris is chipped prior to transport or disposal, a bulking factor of 4 is recommended. Thus, for chipped debris, the eligible tree debris volume should be multiplied by 0.4’.*

Table 5.4.6-15. Debris Production for 100- and 500-Year Mean Return Period Hurricane-Related Winds

Municipality	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Bass River Township	6	400	-	3	4,958	76,849	2,479	38,425
Beverly City	65	297	-	-	123	321	1,148	2,985
Bordentown City	86	594	-	-	124	466	994	3,727
Bordentown Township	139	1,037	-	2	1,186	4,362	3,788	13,866
Burlington City	238	1,303	-	2	493	1,482	2,897	8,373
Burlington Township	437	2,543	-	6	1,589	5,838	6,970	24,136
Chesterfield Township	36	432	-	2	2,062	11,619	1,640	9,248
Cinnaminson Township	287	1,501	-	6	1,324	3,746	7,976	22,737
Delanco Township	75	367	-	1	541	1,407	1,731	4,501
Delran Township	377	1,910	-	5	1,159	3,518	6,342	19,249
Eastampton Township	119	975	-	3	745	3,354	2,385	10,734

SECTION 5.4.6: RISK ASSESSMENT – SEVERE STORM

Table 5.4.6-15. Debris Production for 100- and 500-Year Mean Return Period Hurricane-Related Winds

Municipality	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Edgewater Park Township	232	1,085	-	2	449	1,579	2,822	10,024
Evesham Township	999	9,118	-	59	5,285	20,555	22,489	87,120
Fieldsboro Borough	7	47	-	-	26	122	190	887
Florence Township	219	1,355	-	4	1,369	5,013	4,075	13,553
Hainesport Township	84	741	-	4	859	3,864	2,748	12,364
Lumberton Township	224	2,220	-	10	2,082	8,330	4,853	19,411
Mansfield Township	250	2,434	-	56	2,858	11,178	4,221	16,356
Maple Shade Township	708	3,688	-	5	654	2,010	5,457	16,927
Medford Lakes Borough	47	770	-	4	209	1,002	1,754	8,418
Medford Township	392	4,646	-	22	6,853	29,571	17,594	75,624
Moorestown Township	527	3,179	-	9	2,385	7,631	12,341	39,490
Mount Holly Township	243	1,900	-	5	380	1,696	2,991	13,211
Mount Laurel Township	1,047	7,396	-	22	3,504	12,973	20,366	75,202
New Hanover Township	95	1,269	-	2	2,008	11,267	1,657	9,344
North Hanover Township	74	910	-	2	1,666	9,441	2,295	13,003
Palmyra Borough	201	910	-	2	343	1,048	2,121	6,000
Pemberton Borough	26	283	-	2	58	390	357	2,378
Pemberton Township	256	4,516	-	20	6,296	39,424	9,888	66,852
Riverside Township	192	878	-	-	228	616	1,654	4,401
Riverton Borough	75	324	-	-	150	391	1,399	3,637
Shamong Township	60	1,452	-	10	5,759	43,196	5,184	38,877
Southampton Township	144	2,174	-	23	4,843	30,310	5,984	36,219
Springfield Township	42	462	-	2	3,799	17,119	2,652	11,943
Tabernacle Township	62	1,607	-	11	6,329	45,886	5,696	41,298
Washington Township	7	203	-	1	13,147	111,752	5,259	44,701
Westampton Township	131	1,059	-	5	1,426	6,062	3,280	13,942
Willingboro Township	449	2,902	-	12	1,215	3,945	9,907	32,302
Woodland Township	7	191	-	1	9,240	83,156	3,696	33,263
Wrightstown Borough	18	180	-	-	162	916	341	1,969
Burlington County (Total)	8,683	69,258	-	325	97,886	623,405	201,619	906,694

Source: HAZUS-MH 2.1

Future Growth and Development

As discussed and illustrated in Section 4, areas targeted for future growth and development have been identified across Burlington County. Any areas of growth could be potentially impacted by the severe storm hazard because the entire County is exposed and vulnerable to the wind hazard associated with severe storms.

Additional Data and Next Steps

Over time, Burlington County will obtain additional data to support the analysis of this hazard. Data that will support the analysis would include additional detail on past hazard events and impacts, specific building information such as type of construction and details on protective features (for example, hurricane straps). In addition, information on particular buildings or infrastructure age or year built would be helpful in future analysis of this hazard.

5.4.7 WILDFIRE

This section provides a profile and vulnerability assessment for the wildfire hazard.

HAZARD PROFILE

This section provides profile information including description, location, extent, previous occurrences and losses and the probability of future occurrences.

Description

Wildfire is the term applied to any unwanted, unplanned, damaging fire burning in forest, shrub or grass and is one of the most powerful natural forces known to people. The Federal Emergency Management Agency's (FEMA) Fire Management Assistance Grant Program (FMAGP) indicates that a wildfire is also known as a forest fire, vegetation fire, grass fire, or brush fire, is an uncontrolled fire requiring suppression action and often occurring in wildland areas, but which can also consume houses or agricultural resources. Common causes of wildfires include lightning, negligent human behavior and arson (FMAGP, Date Unknown).

The Legislature declares it to be the policy of the State to prevent, control, and manage wildfires on or threatening the forest or wildland of New Jersey in order to preserve forests and other natural resources; to enhance the growth and maintenance of forests; to protect recreational, residential, wildlife, plant life, watershed, airshed, and other values; to promote the stability of forest using industries; and to prevent loss of life, bodily injury and damage to property from wildfire and conflagrations.

In the State of New Jersey, an average of 1,500 wildfires damage or destroy 7,000 acres of the State's forests. Wildfires not only damage woodlands, but are becoming an increasing threat to homeowners who live within or adjacent to forest environments. From January 1, 2012 to August 11, 2013, there have been 648 wildfires in New Jersey, burning approximately 852 acres (New Jersey Forest Fire Service, 2013).

There are three different classes of wildfires: surface fires, ground fires, and crown fires. Surface fires are the most common type and burns along the forest floor, moving slowly and killing or damaging trees. Ground fires are usually started by lightning and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees.

FEMA indicates that there are four categories of wildfires that are experienced throughout the U.S. These categories are defined as follows:

- Wildland fires – fueled almost exclusively by natural vegetation. They typically occur in national forests and parks, where Federal agencies are responsible for fire management and suppression.
- Interface or intermix fires – urban/wildland fires in which vegetation and the built-environment provide fuel
- Firestorms – events of such extreme intensity that effective suppression is virtually impossible. Firestorms occur during extreme weather and generally burn until conditions change or the available fuel is exhausted.
- Prescribed fires and prescribed natural burns – fires that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes (FEMA, 1997).

The potential for wildfire, and its subsequent development (growth) and severity, is determined by three principal factors including the area's topography, the presence of fuel, and weather. These factors are described below:

Topography - Topography can have a powerful influence on wildfire behavior. The movement of air over the terrain tends to direct a fire's course. Gulches and canyons can funnel air and act as a chimney, intensifying fire behavior and inducing faster spread rates. Saddles on ridgetops tend to offer lower resistance to the passage of air and will draw fires. Solar heating of drier, south-facing slopes produces upslope thermal winds that can complicate behavior.

Slope is an important factor. If the percentage of uphill slope doubles, the rate at which the wildfire spreads will most likely double. On steep slopes, fuels on the uphill side of the fire are closer physically to the source of heat. Radiation preheats and dries the fuel, thus intensifying fire behavior. Terrain can inhibit wildfires: fire travels downslope much more slowly than it does upslope, and ridgetops often mark the end of wildfire's rapid spread (FEMA, 1997).

Fuel - Fuels are classified by weight or volume (fuel loading) and by type. Fuel loading can be used to describe the amount of vegetative material available. If this doubles, the energy released can also be expected to double. Each fuel type is given a burn index, which is an estimate of the amount of potential energy that may be released, the effort required to obtain a fire in a given fuel, and the expected flame length. Different fuels have different burn qualities and some burn more easily than others. Grass releases relatively little energy but can sustain very high rates of spread (FEMA, 1997). According to the U.S. Forest Service, a forest stand may consist of several layers of live and dead vegetation in the understory (surface fuels), midstory (ladder fuels), and overstory (crown fuels). Fire behavior is strongly influenced by these fuels. Each of these layers provides a different type of fuel source for wildfires.

- Surface fuels consist of grasses, shrubs, litter, and woody material lying on the ground. Surface fires burn low vegetation, woody debris, and litter. Under the right conditions, surface fires reduce the likelihood that future wildfires will grow into crown fires.
- Ladder fuels consist of live and dead small trees and shrubs; live and dead lower branches from larger trees, needles, vines, lichens, mosses, and any other combustible biomass located between the top of the surface fuels and the bottom of the overstory tree crowns.
- Crown fuels are suspended above the ground in treetops or other vegetation and consists mostly of live and dead fine material. When historically low-density forests become overcrowded, tree crowns may merge and form a closed canopy. Tree canopies are the primary fuel layer in a forest crown fire (U.S. Forest Service, 2003).

Weather / Air Mass - Weather is the most important factor in the make-up of a fire's environment, yet it is always changing. Air mass, which is defined by the National Weather Service (NWS) as a body of air covering a relatively wide area and exhibiting horizontally uniform properties, can impact wildfire through climate, including temperature and relative humidity, local wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere at the time of the fire (NWS, 2009). Extreme weather leads to extreme events and it is often a moderation of the weather that marks the end of a wildfire's growth and the beginning of successful containment. High temperatures and low humidity can produce vigorous fire activity. Fronts and thunderstorms can produce winds that are capable of radical and sudden changes in speed and direction, causing similar changes in fire activity. The rate of spread of a fire varies directly with wind velocity. Winds may play a dominant role in directing the course of a fire. The most damaging firestorms are typically marked by high winds (FEMA, 1997).

Fire probability depends on local weather conditions, outdoor activities (e.g. camping, debris burning, and construction), and the degree of public cooperation with fire prevention measures. Dry weather, such as drought, can increase the likelihood of wildfire events. Lightning can also trigger wildfire and urban fire events. Other natural disasters can increase the probability of wildfires by producing fuel in both urban and rural areas. 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 (NVRC, 2006).

Extent

The extent (that is, magnitude or severity) of wildfires depends on weather and human activity. There are several tools available to estimate fire potential, extent, danger and growth including, but not limited to the following:

Wildland/Urban Interface (WUI) is the area where houses and wildland vegetation coincide. Interface neighborhoods are found all across the U.S., and include many of the sprawling areas that grew during the 1990s. Housing developments alter the structure and function of forests and other wildland areas. The outcomes of the fire in the WUI are negative for residents; some may only experience smoke or evacuation, while others may lose their homes to a wildfire. All states have at least a small amount of land classified as WUI. To determine the WUI, structures per acre and population per square mile are used. Across the U.S., 9.3-percent of all land is classified as WUI. The WUI in the area is divided into two categories: intermix and interface. Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface areas have more than one house per 40 acres, have less than 50-percent vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75-percent vegetated (Stewart et al., 2006).

Concentrations of WUI can be seen along the east coast of the U.S., where housing density rarely falls below the threshold of one housing unit per 40 acres and forest cover is abundant. In the mid-Atlantic and north central regions of the U.S., the areas not dominated by agriculture have interspersed WUI and low density vegetated areas. Areas where recreation and tourism dominate are also places where WUI is common, especially in the northern Great Lakes and Missouri Ozarks (Stewart et al., 2006).

Wildland Fire Assessment System (WFAS) is an internet-based information system that provides a national view of weather and fire potential, including national fires danger, weather maps and satellite-derived “greenness” maps. It was developed by the Fire Behavior unit at the Fire Sciences Laboratory in Missoula, Montana and is currently supported and maintained at the National Interagency Fire Center (NIFC) in Boise, Idaho (USFS, Date Unknown).

Each day during the fire season, national maps of selected fire weather and fire danger components of the National Fire Danger Rating System (NFDRS) are produced by the WFAS (NWS, Date Unknown). Fire Danger Rating level takes into account current and antecedent weather, fuel types, and both live and dead fuel moisture. This information is provided by local station managers (USFS, Date Unknown). Table 5.4.7-1 shows the fire danger rating and color code.

Table 5.4.7-1. Fire Danger Rating and Color Code

Fire Danger Rating and Color Code	Description
Low (L) (Dark Green)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.

Table 5.4.7-1. Fire Danger Rating and Color Code

Fire Danger Rating and Color Code	Description
Moderate (M) (Light Green or Blue)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H) (Yellow)	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH) (Orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E) (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and tree tops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

Source: USFS, Date Unknown

The **Fire Potential Index (FPI)** is derived by combining daily weather and vegetation condition information and can identify the areas most susceptible to fire ignition. The combination of relative greenness and weather information identifies the moisture condition of the live and dead vegetation. The weather information also identifies areas of low humidity, high temperature, and no precipitation to identify areas most susceptible to fire ignition. The FPI enables local and regional fire planners to quantitatively measure fire ignition risk (USGS, 2005). FPI maps are provided on a daily basis by the U.S. Forest Service. The scale ranges from 0 (low) to 100 (high). The calculations used in the NFDRS are not part of the FPI, except for a 10-hour moisture content (Burgan et al, 2000).

Fuel Moisture (FM) content is the quantity of water in a fuel particle expressed as a percent of the oven-dry weight of the fuel particle. FM content is an expression of the cumulative effects of past and present weather events and must be considered in evaluating the effects of current or future weather on fire potential. FM is computed by dividing the weight of the “water” in the fuel by the oven-dry weight of the fuel and then multiplying by 100 to get the percent of moisture in a fuel (NWS, Date Unknown).

There are two kinds of FM: live and dead. Live fuel moistures are much slower to respond to environmental changes and are most influenced by things such as a long drought period, natural disease and insect infestation, annuals curing out early in the season, timber harvesting, and changes in the fuel models due to blow down from windstorms and ice storms (NOAA, Date Unknown). Dead fuel moisture is the moisture in any cured or dead plant part, whether attached to a still-living plant or not. Dead fuels absorb moisture through physical contact with water (such as rain and dew) and absorb water vapor from the atmosphere. The drying of dead fuels is accomplished by evaporation. These drying and wetting processes of dead fuels are such that the moisture content of these fuels is strongly affected by fuel sizes, weather, topography, decay classes, fuel composition, surface coatings, fuel compactness and arrangement (Schroeder and Buck, 1970).

Fuels are classified into four categories which respond to changes in moisture. This response time is referred to as a time lag. A fuel's time lag is proportional to its diameter and is loosely defined as the time it takes a fuel particle to reach two-thirds of its way to equilibrium with its local environment. The four categories include:

- 1-hour fuels: up to ¼-inch diameter – fine, flashy fuels that respond quickly to weather changes. Computed from observation time, temperature, humidity, and cloudiness.
- 10-hour fuels: ¼-inch to one-inch in diameter - computed from observation time, temperature, humidity, and cloudiness or can be an observed value.
- 100-hour fuels: one-inch to three-inch in diameter - computed from 24-hour average boundary condition composed of day length (daylight hours), hours of rain, and daily temperature/humidity ranges.
- 1000-hour fuels: three-inch to eight-inch in diameter - computed from a seven-day average boundary condition composed of day length, hours of rain, and daily temperature/humidity ranges (National Park Service, Date Unknown).

The **Keetch-Byram Drought Index (KBDI)** is a drought index designed for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers (USFS, Date Unknown). The index increases each day without rain and decreases when it rains. The scale ranges from 0 (no moisture deficit) to 800 (maximum drought possible). The range of the index is determined by assuming that there is eight inches of moisture in a saturated soil that is readily available to the vegetation. For different soil types, the depth of soil required to hold eight inches of moisture varies. A prolonged drought influences fire intensity, largely because more fuel is available for combustion. The drying of organic material in the soil can lead to increased difficulty in fire suppression (Florida Forest Service, Date Unknown).

The **Haines Index**, also known as the Lower Atmosphere Stability Index, is a fire weather index based on stability and moisture content of the lower atmosphere that measures the potential for existing fires to become large fires. It is named after its developer, Donald Haines, a Forest Service research meteorologist, who did the initial work and published the scale in 1988 (Storm Prediction Center [SPC], Date Unknown).

The Haines Index can range between 2 and 6. The drier and more unstable the lower atmosphere is, the higher the index. It is calculated by combining the stability and moisture content to the lower atmosphere into a number that correlates well with large fire growth. The stability term is determined by the temperature difference between two atmospheric layers; the moisture term is determined by the temperature and dew point different. The index, as listed below, has shown to correlate with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior (USFS, Date Unknown).

- Very Low Potential (2) – moist, stable lower atmosphere
- Very Low Potential (3)
- Low Potential (4)
- Moderate Potential (5)
- High Potential (6) – dry, unstable lower atmosphere (USFS, Date Unknown)

The Haines Index is intended to be used all over the U.S. It is adaptable for three elevation regimes: low elevation, middle elevation, and high elevation. Low elevation is for fires at or very near sea level. Middle elevation is for fires burning in the 1,000 to 3,000 feet in elevation range. High elevation is intended for fires burning above 3,000 feet in elevation (SPC, Date Unknown).

The ***Landscape Fire and Resource Management Planning Tools Project (LANDFIRE)*** is a five-year, multi-partner project. The project is producing comprehensive and consistent maps and data describing vegetation, fire and fuel characteristics for the entire U.S. LANDFIRE is a shared project between the U.S. Department of Agriculture Forest Service and the U.S. Department of the Interior. The project has several principal partners, which include the USFS Missoula Fire Sciences Laboratory, the USGS Center for Earth Resources Observation and Science, and the Nature Conservancy (LANDFIRE, Date Unknown).

Additionally, the U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station developed a historical natural fire regimes dataset. The fire regimes are described in terms of frequency and severity and represent pre-settlement, historical fire processes. Fire regimes I and II represent frequent fire return intervals. The 0-35+ years/low severity fire regime (I) occurs mostly on forested land. The 0-35+years/stand-replacement regime (II) occurs mostly on grasslands and shrublands. Fire regimes III, IV, and V have longer fire return intervals and occur on forest lands, shrublands, and grasslands. These coarse-scale data were developed for national-level planning and were not intended to be used at finer spatial scales (Schmidt et al., 2002).

The ***Buildup Index (BUI)*** is a number that reflects the combined cumulative effects of daily drying and precipitation in fuels with a 10 day time lag constant. The BUI can represent three to four inches of compacted litter or can represent up to six inches or more of loose litter (North Carolina Forest Service, 2009).

New Jersey Wildfire Fuel Hazard

The New Jersey Forest Fire Service (NJFFS), a division of the New Jersey Departmental of Environmental Protection (NJDEP), has developed this Wildfire Fuel Hazard data based upon NJDEP's 2002 Land Use/Land Cover (LU/LC) datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. The NJFFS took the NJDEP Modified Anderson Land Use/Land Cover Classification System 2002 and assigned Wildfire Fuel Hazard Rankings to it. The NJFFS used NJDEP's 2002 10-meter Digital Elevation Grids and calculated areas of 30% or greater slope throughout New Jersey. For areas of Wildfire Fuel Hazard 1 to 4 (i.e. Low to Very High) that were coincident with areas of 30% or greater slope, the Wildfire Fuel Hazard Ranking was increased by 1 value (i.e. Low was increased to Moderate, Moderate to High, etc.). For areas of Wildfire Fuel Hazard 0, and 5-8, the Wildfire Fuel Hazard Ranking remained the same. Once the LU/LC was coded according to Wildfire Fuel Hazard, taking into account 30% or greater slopes, the data was divided up by County. The project began in March 2009 and was completed in May 2009. Table 5.4.7-2 summarizes the County-wide area within each hazard ranked area, and Figure 5.4.7-1 displays the ranking across the County. Table 5.4.7-3 summarizes the area within each hazard ranked area, specific to Burlington County jurisdictions.

Table 5.4.7-2. Area in the Wildfire Fuel Hazard Ranking Zones in Burlington County

Hazard Area	Area (Square Miles)
Extreme	195.75
Very High	11.95
High	106.32
Moderate	86.53
Low	165.69

Source: NJ Forest Fire Service

Note: The remainder of the County is classified as 'water', 'barren land', 'urban', or 'agriculture.'

SECTION 5.4.7: RISK ASSESSMENT – WILDFIRE

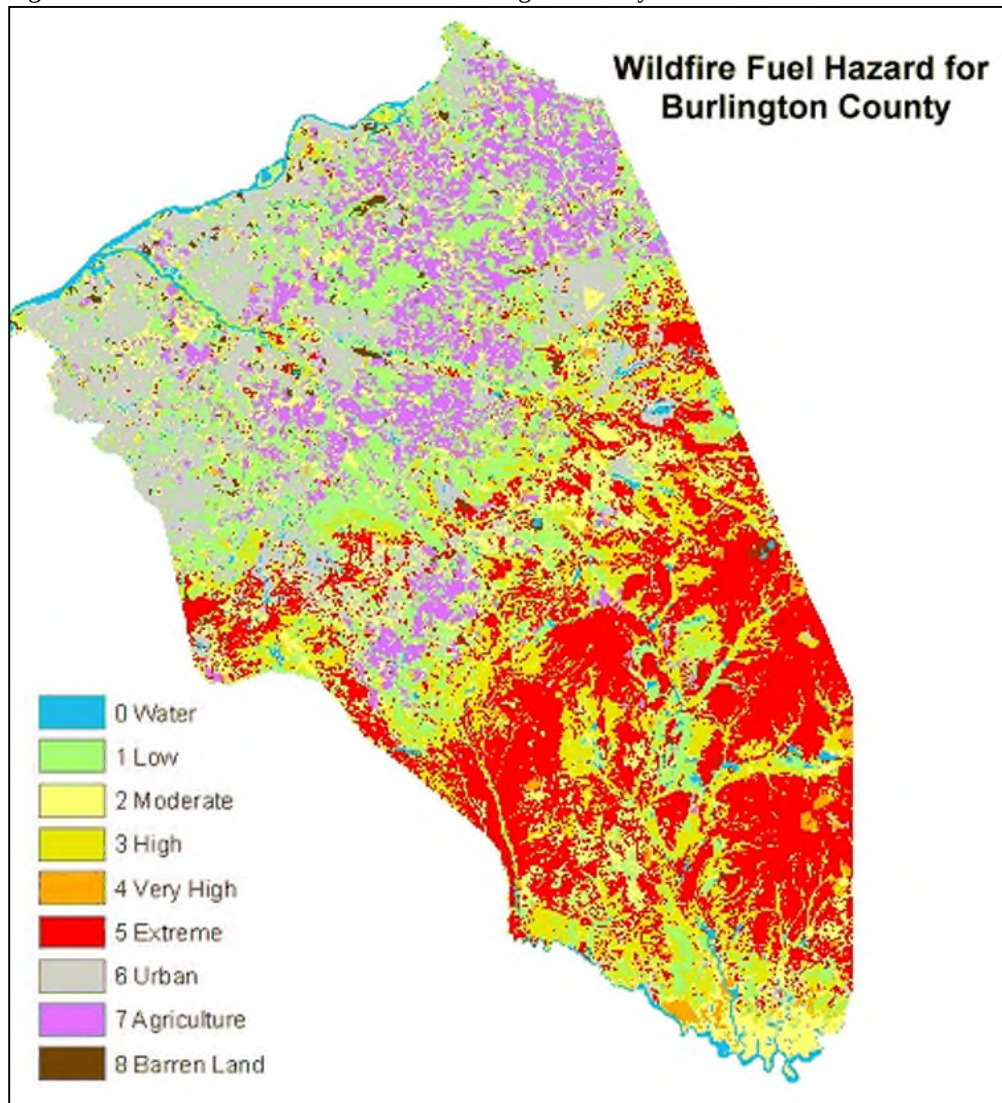
Table 5.4.7-3. Approximate Area in the New Jersey Forest Service Risk Areas in Burlington County (Acres)

Municipality	Total Area	NJ Forest Service Risk Areas			
		Low to Moderate	% in Hazard Area	High to Extreme	% in Hazard Area
Bass River (T)	50,140	11,372	22.7%	35,840	71.5%
Beverly (C)	486	48	9.9%	3	0.7%
Bordentown (C)	618	153	24.7%	31	5.1%
Bordentown (T)	5,926	2,225	37.5%	558	9.4%
Burlington (C)	2,426	605	24.9%	83	3.4%
Burlington (T)	8,992	3,142	34.9%	640	7.1%
Chesterfield (T)	13,736	5,718	41.6%	294	2.1%
Cinnaminson (T)	5,099	1,077	21.1%	240	4.7%
Delanco (T)	2,190	434	19.8%	105	4.8%
Delran (T)	4,654	1,203	25.8%	320	6.9%
Eastampton (T)	3,723	1,699	45.6%	92	2.5%
Edgewater Park (T)	1,976	515	26.1%	24	1.2%
Evesham (T)	18,943	6,846	36.1%	4,775	25.2%
Fieldsboro (B)	224	79	35.2%	0	0.1%
Florence (T)	6,559	2,223	33.9%	509	7.8%
Hainesport (T)	4,344	1,486	34.2%	768	17.7%
Lumberton (T)	8,327	3,422	41.1%	270	3.2%
Mansfield (T)	14,010	5,953	42.5%	494	3.5%
Maple Shade (T)	2,451	332	13.5%	60	2.5%
Medford (T)	812	108	13.3%	20	2.5%
Medford Lakes (B)	25,474	10,441	41.0%	7,203	28.3%
Moorestown (T)	9,585	3,393	35.4%	390	4.1%
Mt. Holly (T)	1,837	418	22.8%	40	2.2%
Mt. Laurel (T)	14,066	5,166	36.7%	808	5.7%
New Hanover (T)	14,483	4,846	33.5%	4,302	29.7%
North Hanover (T)	11,203	4,458	39.8%	482	4.3%
Palmyra (B)	1,673	314	18.8%	84	5.0%
Pemberton (B)	403	158	39.2%	53	13.1%
Pemberton (T)	40,171	15,654	39.0%	14,127	35.2%
Riverside (T)	1,048	118	11.3%	124	11.9%
Riverton (B)	614	62	10.1%	13	2.2%
Shamong (T)	28,791	9,155	31.8%	15,310	53.2%
Southampton (T)	28,446	14,630	51.4%	5,496	19.3%
Springfield (T)	18,924	9,618	50.8%	529	2.8%
Tabernacle (T)	31,688	8,249	26.0%	18,380	58.0%
Washington (T)	66,539	17,203	25.9%	46,795	70.3%
Westampton (T)	7,104	2,828	39.8%	513	7.2%
Willingboro (T)	5,175	1,062	20.5%	157	3.0%
Woodland (T)	61,001	11,603	19.0%	45,637	74.8%
Wrightstown (B)	1,146	439	38.3%	144	12.6%
Burlington County (Total)	525,009	168,455	32.1%	205,714	39.2%

Source: NJ Forest Fire Service

Note: The remainder of the County is classified as ‘water’, ‘barren land’, ‘urban’, or ‘agriculture.’

Figure 5.4.7-1. Wildfire Fuel Hazard for Burlington County



Source: NJDEP NJFFS, 2009

Location

According to the U.S. Fire Administration (USFA), the fire problem in the U.S. varies from region to region. This often is a result of climate, poverty, education, demographics, and other causal factors (USFA, 2012). Wildfires occur in virtually all of the U.S. The western portion of the U.S. is subject to more frequent wildfires, due to their more arid climate and prevalent conifer and brush fuel types. Wildfires have proven to be the most destructive in California, but have become an increasingly frequent and damaging phenomenon nationwide (FEMA, 1997). States with a large amount of wooded, brush, and grassy areas, such as California, Colorado, New Mexico, Montana, Kansas, Mississippi, Louisiana, Georgia, Florida, North and South Carolina, Tennessee, Massachusetts, and the national forests of the western U.S. are at highest risk for wildfires (University of Florida, 1998).

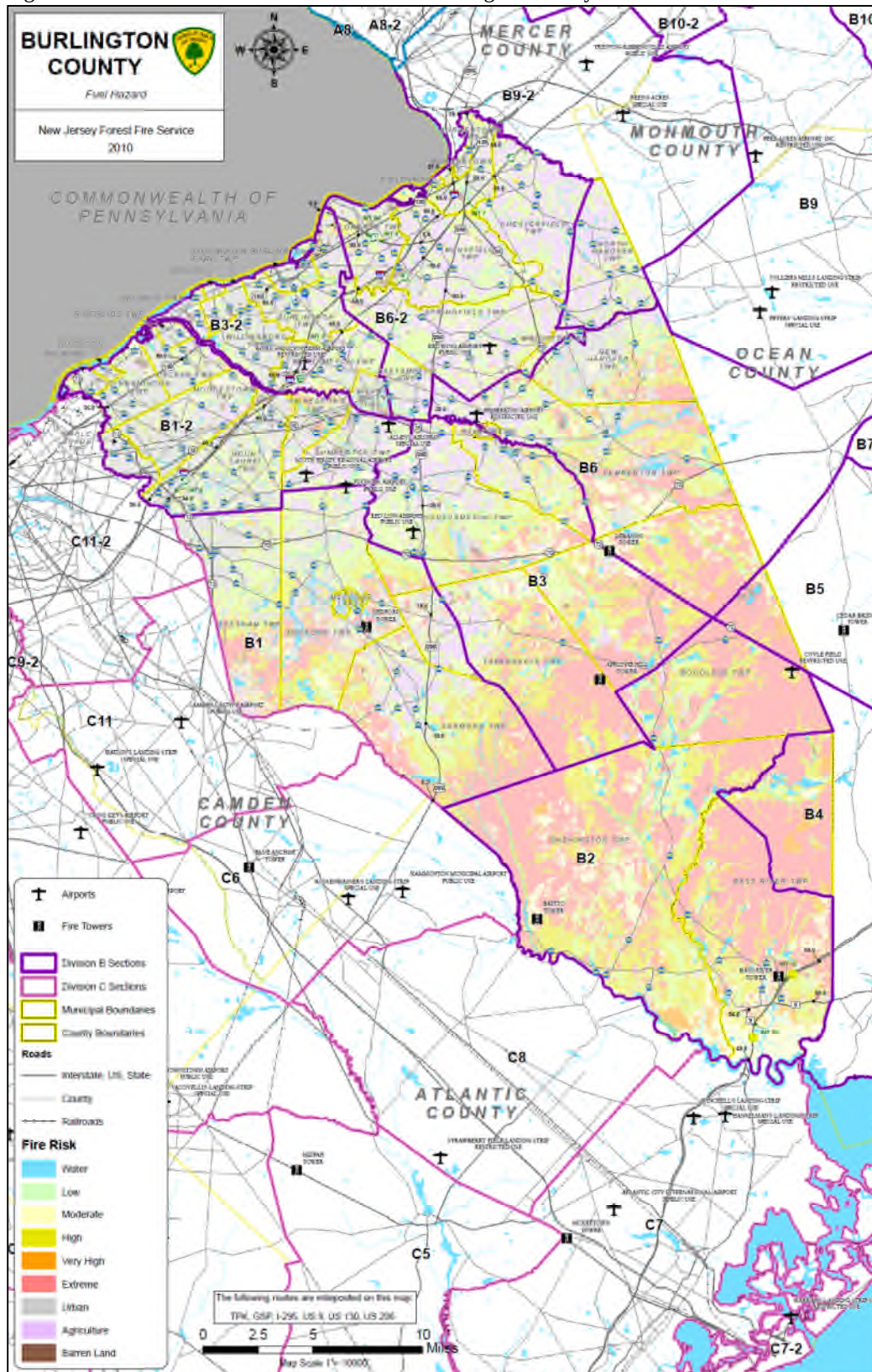
Although wildfires can occur during all months of the year, spring is the period when the most devastating incidents typically happen. With the coming of longer days, drying conditions, stronger winds, the weather provides excellent conditions for the rapid spread of fire. A second “season” develops

in the northern part of the State during the fall when the abundance of freshly fallen leaves provide a bed of fuel for wildfire to race rapidly up the slopes. Wildfire locations in the State tend to be in the less developed areas because they are more likely to have sources of fuel for fires, and because detection and suppression are somewhat less likely because there is lower population.

Areas that are typically considered to be safe from wildfires include highly urbanized, developed areas that are not contiguous with vast areas of wild lands. Areas typically considered to be prone to wildfires include large tracts of wild lands containing heavier fuels with high continuity, at steeper slopes. These less developed areas are prone to wildfire not only because they are more likely to have sources of fuel for fires, but also because detection and suppression are somewhat less likely because there is lower population. Although wildfires can occur during all months of the year, spring is the period when the most devastating incidents typically happen. With the coming of longer days, drying conditions, stronger winds, the weather provides excellent conditions for the rapid spread of fire (NJOEM, 2012).

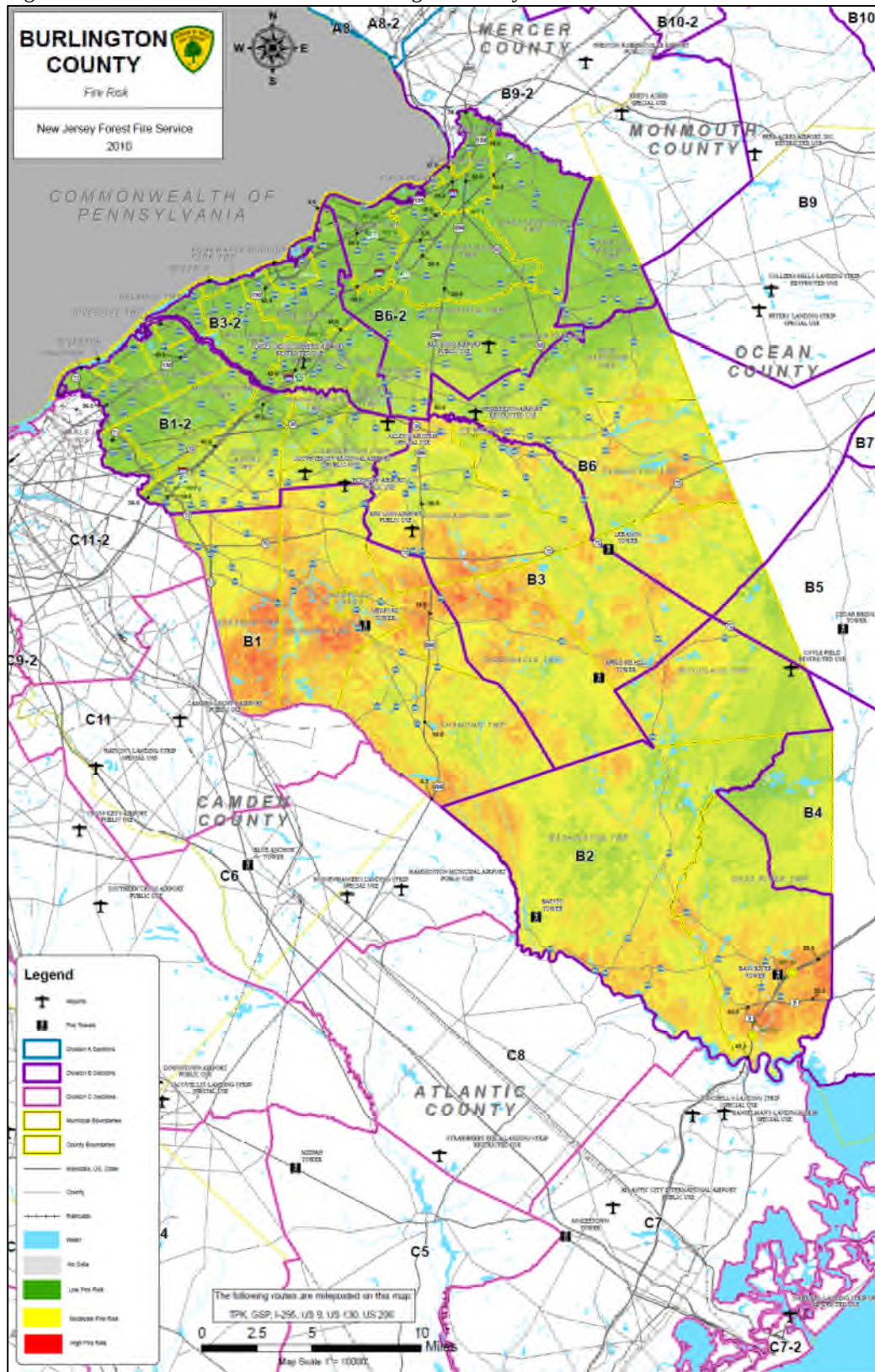
The New Jersey Forest Fire Service (NJFFS) cites the major contributing factors to the state’s continuing wildfire problems as two parts of the “Wildfire Equation,” which can be grouped into the two areas of hazard and risk. NJFFS has conducted a Wildfire Hazard Assessment for much of the State, and published maps of fuel hazard and fire risk areas, representing both parts of the “wildfire equation” for all New Jersey counties. Figures 5.4.7-2 and 5.4.7-3 illustrate this data for Burlington County. The figures show that wildfire hazard areas are located predominantly in the southeast portions of the county, coinciding with the location of the New Jersey Pine Barrens.

Figure 5.4.7-2. Fuel Hazard Risk Areas within Burlington County



Source: New Jersey Forest Fire Service, 2010.

Figure 5.4.7-3. Fire Risk Areas within Burlington County

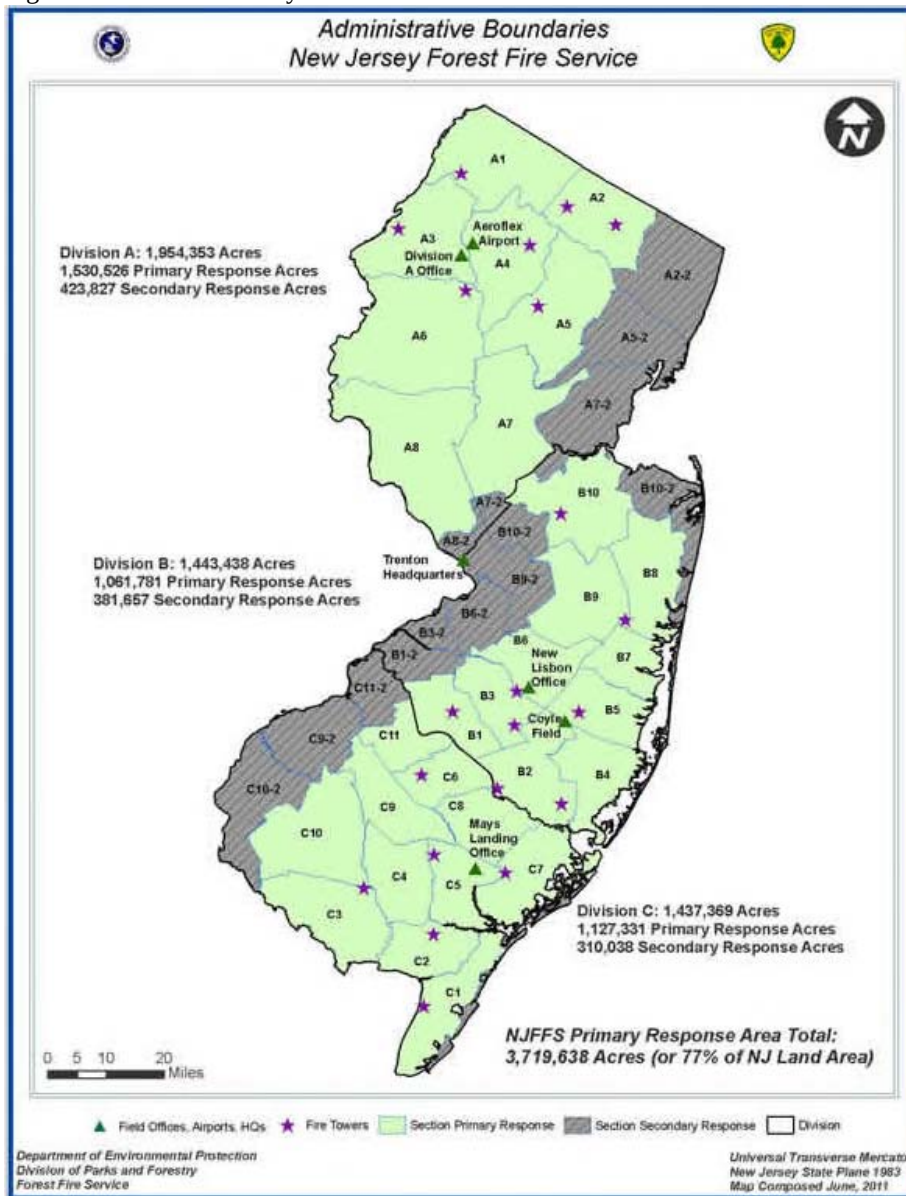


Source: New Jersey Forest Fire Service 2010

As noted in the New Jersey State HMP, New Jersey's high population density has created land use pressures in which more people are moving from urban areas to build homes in rural wildland areas. With more people living in the state's wildlands, as well as visiting them for various forms of recreation, the number of fires started and the seriousness of their consequences increases. The danger and risk are compounded when the factors of hazardous wildland fuels, interface home development, and an increased risk of human caused ignition come together under extreme fire weather conditions (NJOEM).

The New Jersey Forest Fire Service consists of three divisions: A, B, and C. Division A contains Bergen, Essex, Hudson, Morris, Passaic, Somerset, Sussex Warren, Hopewell township within Mercer, Union, Hunterdon, and northern Middlesex Counties. Division B contains Burlington, Monmouth, Ocean, southern Middlesex, and the remainder of Mercer. Division C contains Atlantic, Camden, Cape May, Cumberland, Gloucester, and Salem. Refer to Figure 5.4.7-4 below.

Figure 5.4.7-4. New Jersey Forest Fire Service Administrative Boundaries



Source: State of New Jersey Forest Fire Service, 2011

Input from Planning Committee

- *Moorestown Township* noted residential construction in heavily forested areas with limited firefighting access along the Rancocas Creek (particularly during drought conditions) (Burlington County HMP, 2008).
- *Township of Medford* – the Township indicated that wildfires occur throughout the southeastern portion of the Township. Beginning in 1933 and through the 1960s, large wildfires (>100 acres) burned frequently with at least one extremely large fire (>1,000 acres) each decade. In the 1960s, eight large wildfires burned over 11,000 acres (Township of Medford, 2013).
- *Borough of Medford Lakes* – the Township stated that beginning in 1933 through the 1960s, large wildfires (>100 acres) burned frequently in Medford Township and Medford Lakes Borough areas, with at least one extremely large fire (>1,000 acres) each decade. In the 1960s, eight large wildfires burned over 11,000 acres (Township of Medford Lakes, 2013).
- *Township of Mount Laurel* – the Rancocas Woods Development is located in the WUI and adjacent to the Rancocas State Park (Township of Mount Laurel, 2013).
- *Woodland* reported that wildfires pose a major problem for the Township (Burlington County HMP, 2008).
- *Tabernacle* reports that wildfires are a major concern for their Township, as lands are heavily forested and have extensive farmland, both of which dry out in the summer and fall months (Burlington County HMP, 2008).
- *Florence* indicated that there is a concern regarding some heavily wooded areas that have a limited water supply or a water supply that would have to be brought in by water tenders with remote fill sites (Burlington County HMP, 2008).
- *Pemberton Township* reported that they have experienced several wildfires throughout the years, since their jurisdiction is surrounded with vegetation that is prone to wildfires. They reported a total of 15 wildfires, 13 of which burned over 100 acres. One of the largest fires they reported occurred in April of 1963, when a fire started in the New Lisbon section of the Township and burned to the Barnegate Bay in Ocean County, killing and injuring several people. It also caused significant property damage. Today, they report that the same problem exists but on a much larger scale due to the human population inhabiting the area (Burlington County HMP, 2008).
- *Mount Laurel* reports that multiple parks and open space lands in the Township are located within and around developments, including the Rancocas Woods development bordering the state park. Some major concerns expressed by the Township are traffic problems and possible property losses (Burlington County HMP, 2008).
- While *Cinnaminson* is generally at a low risk from wildfires, they did express a concern for some wooded areas that may have limited nearby water supplies (Burlington County HMP, 2008).
- *Mansfield Township* reports that they have no past incidences of any significant wildfires (Burlington County HMP, 2008).
- *Evesham* notes that there are several developments in local forested areas with greater hazard extent, namely: Kings Grant and Marlton Lakes Sanctuary (Burlington County HMP, 2008).

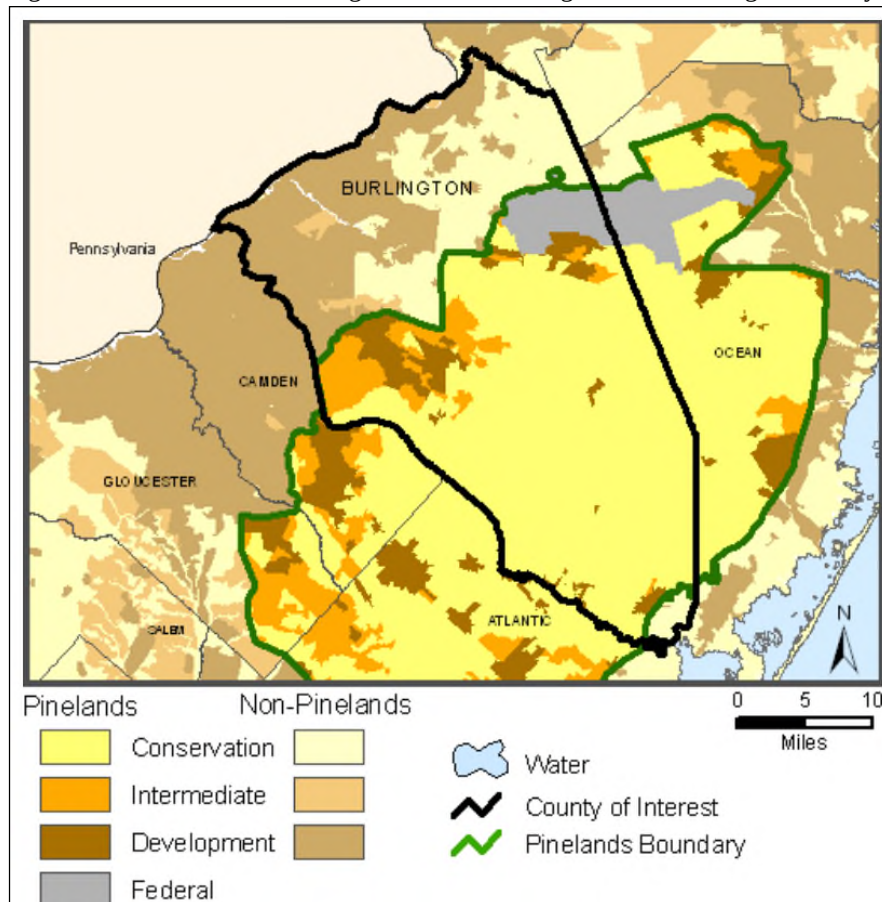
The Pinelands and Pine Barrens

The New Jersey Pine Barrens are characterized by low, dense forests of pine and oak, ribbons of cedar and hardwood swamps bordering drainage courses, pitch pine lowlands, and bogs and marshes combine to produce an expansive vegetative mosaic unsurpassed in the Northeast. The Pine Barrens was recognized as a nationally and internationally important ecological region when, in 1978, Congress created the Pinelands National Reserve, our country's first National Reserve and a U.S. Biosphere Reserve of the Man and the Biosphere Program. The Pinelands National Reserve encompasses approximately 1.1 million acres statewide, occupying 22% of New Jersey's land area and covering

portions of seven counties and all or parts of 56 municipalities. It is the largest body of open space on the Mid-Atlantic seaboard between Richmond and Boston and is underlain by aquifers containing 17 trillion gallons of some of the purest water in the land. Through the creation of the Pinelands Commission, the State of New Jersey formed the necessary partnerships to preserve, protect and enhance the natural and cultural resources of the Pinelands (Burlington County HMP, 2008).

According to the New Jersey Pinelands Commission 2011-2012 Pinelands Long-Term Economic Monitoring Program, 35 percent of Burlington County’s municipalities (or 14 of the 40 municipalities) are located within the Pinelands Area, as shown in Figure 5.4.7-5 below. 21 percent of Burlington County’s 2010 population (93,385 residents) resided in the Pinelands Area. 20 percent of the county’s housing units (35,141 housing units) and 64 percent of the county’s total land area (334,250 acres) were also reported as located within the Pinelands Area (New Jersey Pinelands Commission, 2012).

Figure 5.4.7-5. Pinelands Management and Planning Areas in Burlington County



Source: New Jersey (State of) Pinelands Commission, 2012

Naturally occurring wildfires burning several thousands of acres per year have been a common occurrence in the Pinelands for many hundreds of years. Development of the unique flora of the Pinelands is closely related to the occurrence of fire, with many plant species relying on fire for a part of their reproductive cycle (Burlington County HMP, 2008).

Pinelands fires tend to burn extremely hot and spread rapidly. Crown fires here are fairly common (spreading from treetop to treetop). While Pinelands fires generally do not cause casualties due to the low population residing within its limits, property loss can run in the thousands of dollars per event, not

including costs associated with emergency response and firefighting. Often, state roads have closed because of smoke conditions (Burlington County HMP, 2008).

Conditions conducive to forest fires are some of the most consistent and serious impacts of drought, a hazard profiled earlier in this plan. This applies particularly to the Pine Barrens, where drying conditions favor the combustion of forest fuels. Generally, a relative humidity of less than 40 percent, winds greater than 13 miles an hour, and precipitation of less than 0.01 inches during a month are ideal conditions for forest fires in the Pine Barrens. The season of greatest fire threat runs from March through May, though extensive fires have occurred in the summer and autumn months (NJOEM, 2012).

Previous Occurrences and Losses

There are a number of early accounts and newspaper stories of fires burning thousands of acres of New Jersey woodlands, causing extensive damage to improved property and untold loss of life. One such account from 1755 reports a fire 30 miles long between Barnegat and Little Egg Harbor. In 1895, John Gifford reported to the state geologist that 49 fires burned 60,000 acres in Burlington, Atlantic and Ocean counties. Other early surveys, including those of 1872 and 1885, indicate that as many as 100,000 to 130,000 acres burned annually in the Pine Barrens region alone.

Between 1929 and 2006, there were 2,233 wildfire incidents in Burlington County. These incidents burned over 42,000 acres and destroyed 831 acres. Of those incidents, 193 of them burned over 10 acres in Burlington County. The following table presents a summary of historic wildfires in Burlington County, reported by the NJFFS, the NOAA-NCDC, and the NJSHMP.

SECTION 5.4.7: RISK ASSESSMENT – WILDFIRE

Table 5.4.7-4. Wildfire Events in New Jersey and Burlington County between 1755 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
1755	Wildfire - Pine Barrens	N/A	N/A	30 mile long wildfire from Barnegat to Little Egg Harbor	NJOEM, NJDEP, FEMA
September 7-10, 1838	Wildfire - Burlington and Monmouth Counties	N/A	N/A	A 14-mile wide and 20-mile long fire reported, burned approximately 179,200 acres, property damage reported, possible fatalities	NJOEM, NJDEP, FEMA, Burlington County HMP
1871	Wildfire - Burlington County	N/A	N/A	50,000 acres burned in Bass River	NJOEM, NJDEP, FEMA, Burlington County HMP
May 20, 1872	Wildfire - Sussex and Morris Counties	N/A	N/A	Forest fire burned 25,000 acres and caused \$1 M in property damage, houses and 2 churches destroyed in Coleville and Middle Forge (Green Pond Mountains)	NJOEM, NJDEP, FEMA
July 25, 1885	Wildfire - Atco, Jackson, Atsion, and Barnegat	N/A	N/A	15,000-acre fire near Atco, 47,000-acre fire near Barnegat	NJOEM, NJDEP, FEMA, Burlington County HMP
1930	Wildfire - Multi-County	N/A	N/A	Worst year for fires, 267,547 acres burned, huge fire in May destroyed Forked River	NJOEM, NJDEP, FEMA
1936	Wildfire - Bass River	N/A	N/A	58,000-acre fire killed five Civilian Conservation Corps fire fighters	NJOEM, NJDEP, FEMA, Burlington County HMP
1941	Wildfire - Lakewood and Lakehurst	N/A	N/A	Huge fires destroyed 400 structures	NJOEM, NJDEP, FEMA
1954	Wildfire - Chatsworth and Moore's Meadows	N/A	N/A	20,000 acre wildfire threatened Chatsworth	NJOEM, NJDEP, FEMA, Burlington County HMP
1955	Wildfire - Ocean County	N/A	N/A	Easter Sunday fire killed the section firewarden	NJOEM, NJDEP, FEMA
April 20-22, 1963	Wildfire	N/A	N/A	Series of 37 wildfires burned 193,000 acres, 186 homes and 197 buildings destroyed, 7 fatalities, \$8.5 M in property damages, one fire burned 76,000 acres and traveled 21 miles from New Lisbon to the Garden State Parkway	NJOEM, NJDEP, FEMA, Burlington County HMP
1971	Wildfire - Manahawkin	N/A	N/A	Manahawkin Fire burned 21,000 acres in 7 hours and 13 minutes	NJOEM, NJDEP, FEMA
1977	Wildfire - Burlington, Ocean, and Atlantic Counties	N/A	N/A	A 15,000-acre fire on March 31 burned six homes and caused extensive damage in Burlington, Ocean and Atlantic counties. On July 22, a 2,300-acre fire in Bass River State Forest killed four volunteer firefighters from Eagleswood Volunteer Fire Department and forced the evacuation of the Bass River	NJOEM, NJDEP, FEMA, Burlington County HMP

SECTION 5.4.7: RISK ASSESSMENT – WILDFIRE

Table 5.4.7-4. Wildfire Events in New Jersey and Burlington County between 1755 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				Recreation Area.	
1992	Wildfire - Ocean and Burlington Counties	N/A	N/A	Four major fires burned 14,000 acres on May 3 rd ; a 4,800-acre fire in Lacey threatened and closed down Oyster Creek Nuclear Power Plant; 2,900-acre fire in Woodland destroyed one home and threatened 100 others; June 13 th – 5,400-acre fire burned through Lacey	NJOEM, NJDEP, FEMA, Burlington County HMP
April 4, 1995	Wildfire - Ocean County	N/A	N/A	Wind-driven 19,225-acre fire burned through Manchester, Lacey, and Ocean	NJOEM, NJDEP, FEMA
July 1997	Wildfire - Ocean and Atlantic Counties	N/A	N/A	July 19 th – Wrangle Brook wildfire - 800-acre fire damaged 52 homes and threatened over 300 homes in Ocean County July 29 th – Rockwood II wildfire - 1,900-acre fire threatened Batsto Historic Site and 80 Atlantic County homes	NJOEM, NJDEP, FEMA, Burlington County HMP
April 30, 1999	Wildfire - Burlington County	N/A	N/A	Bass River fire burned over 11,000 acres. The fire was located primarily in the Bass River State Forest. It was reportedly caused by an errant missile from the Warren Grove Bombing Range.	NJOEM, NJDEP, FEMA, Burlington County HMP
2001	Wildfire - Multi-County	N/A	N/A	Airport Fire – 765-acre fire, 60 homes evacuated Cheesequake Creek Fire – 151-acre fire, 25 homes evacuated Warren Grove Fire – 1,600 acres destroyed	NJOEM, NJDEP, FEMA
May 1, 2001	Wildfire	N/A	N/A	In Burlington County in Bordentown Township, sparks from a passing train around 120 p.m. EDT was enough to ignite a dozen brush fires along the tracks from Amboy Road north to Groveville Road. One firefighter was taken to the hospital suffering from heat exhaustion. The siding of a barn on Amboy Road sustained minor heat damage; otherwise no other damage was reported. The fire was extinguished at 630 p.m. EDT. Another smaller train related brush fire occurred the same afternoon in Mansfield Township.	Burlington County HMP
May 15, 2001	Wildfire	N/A	N/A	In Florence, approximately 100 acres burned. No other information was reported.	Burlington County HMP
June 10, 2011	Wildfire	N/A	N/A	In Wading River, about 1,600 acres were burned, mainly pygmy pine trees on state and federal land south of New Jersey State Route 72 and west of County Route 539. The fire was reportedly started by a 25 pound practice bomb.	Burlington County HMP
June 2002 "Double Trouble Fire"	Wildfire - Berkeley and Beachwood	FM-2411	No	Jake's Branch Fire – started in Berkeley and destroyed 3 homes and 15 outbuildings before it was controlled at 1,277-acres, the fire seriously damaged 18 homes and outbuildings, forced the evacuation of 500 residents in Beachwood, closed the Garden State Parkway for 2 days	NJOEM, NJDEP, FEMA
August 15, 2002	Wildfire	N/A	N/A	A wildfire on the Fort Dix Military Reservation consumed about 3,000 acres of forest, fields, old cranberry bogs and swamps.	Burlington County HMP

Table 5.4.7-4. Wildfire Events in New Jersey and Burlington County between 1755 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				The fire was reportedly caused when the Sun's heat ignited a practice round of ammunition.	
February 12, 2007	Wildfire - Somerset and Union Counties	N/A	N/A	Extremely dry weather caused brush fires in these two counties. In SC, dense brush burned near Bridgewater and headed towards the Darby Tract.	NJOEM, NJDEP, FEMA
May 2007 "Warren Grove Fire"	Wildfire	FM-2695	Yes	A wildfire likely sparked at the Warren Grove Gunnery Range in the Pine Barrens burned along the County border. The fire burned 14,000 acres, damaged or destroyed a handful of homes, and forced thousands to evacuate. The fire originated in Little Egg Harbor and traveled toward Stafford and Barnegat Townships. Numerous neighborhoods and mobile homes in Burlington and Ocean counties were evacuated.	Burlington County HMP
August 3, 2007	Wildfire	N/A	N/A	A forest fire started in Wharton State Forest in Washington Township, burning 2,443 acres in Washington and Shamong Townships before it was contained. The fire jumped the Mullica River and spread into Shamong Township quickly. U.S. Route 206 was sporadically closed in the area. As a precaution, the Atsion Lake recreational area, the Mullica and Lower Forge Camping areas and canoeing sites on the Mullica and Batsto Rivers were closed until the fire was completely contained at 8 a.m. Aug. 6th. The fire was believed to have been the work of an arsonist. No injuries or property damage was reported.	NOAA-NCDC
June 27, 2008	Wildfire	N/A	N/A	A lightning strike helped ignite a fire that burned 8 acres of woodland in Shamong Township. The lightning struck a tree and ignited dry leaves, pine needles and underbrush in Wharton State Forest surrounded by swampy ground, making firefighting difficult. The fire was five miles off of U.S. Route 206. The fire smoldered for about twenty-four hours before it was spotted. No homes or campers were threatened.	NOAA-NCDC
October 21, 2008	Wildfire	N/A	N/A	The Sauder Ditch Wildfire consumed about 1950 acres of forest before it was contained. The fire began in Camden County on the 21st, west of U.S. Route 206 and south of the Atsion Recreational Area. It spread into parts of Shamong Township (Burlington County) and Hammonton Township (Atlantic County). Gusty northwest winds along with recent dry weather helped spread the fire quickly and hampered firefighting efforts on the 21st and 22nd. The fire reached up to 100 feet in the air and was visible from Atlantic City. Smoke was smelled as far away as Ocean County. A state of emergency was declared in Shamong	NOAA-NCDC, SHELDUS

SECTION 5.4.7: RISK ASSESSMENT – WILDFIRE

Table 5.4.7-4. Wildfire Events in New Jersey and Burlington County between 1755 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				Township (Burlington County) on the 21st and lifted on the 22nd. Sections of U.S. Route 206 were closed in Shamong Township through the 25th. About 200 fire fighters battled the blaze and used brush trucks, helicopters, bull dozers and air tankers in their efforts. A firefighter suffered an irregular heartbeat from battling the blaze and one traffic cop was struck by a vehicle. Heavy rain on the 25th helped firefighting efforts. Prior to the 25th, only 0.16 of an inch of rain had fallen at Atlantic City International Airport during the month of October.	
April 7, 2010	Wildfire	N/A	N/A	Unseasonably warm and dry weather coupled with gusty southwest winds made it easy for wildfires to spread in New Jersey on the 7th. In Burlington County, a wildfire occurred at the intersection of Magnolia Road and New Jersey State Route 70 in Pemberton Township. The fire was reported at 3:35 p.m. and was contained at 7:00 p.m. No traffic disruptions or evacuations were reported. Local firefighters remained on the scene to extinguish hot spots and flare ups.	NOAA-NCDC
May 8, 2010	Wildfire	N/A	N/A	Strong gusty west winds and dry weather during the past couple of days helped spread a wildfire in Pemberton Township on the 8th. The fire burned 500 acres in the Brendan Byrne State Forest, forcing the closure of busy New Jersey State Route 70 on the 8th. No homes were damaged or injuries reported.	NOAA-NCDC
July 25, 2010	Wildfire	N/A	N/A	A lightning strike on the 25th started a wildfire within the Bass River State Forest, in a swampy area north of Dan Bridge Road in Bass River Township. The fire was first spotted on the 26th and caused the evacuation of about twenty-two families that were within the camp site and recreation area. The park was reopened on the 27th. The wildfire also forced the closures of portions of Stage Road and East Greenbush Road. The smoke was visible as far away as Atlantic County. Approximately 677 acres were consumed by the wildfire.	NOAA-NCDC
June 9, 2011	Wildfire	N/A	N/A	A lightning strike started a wildfire in Wharton State Forest off of U.S. Route 206 in Shamong Township. Approximately 152 acres were consumed before it was contained.	NOAA-NCDC
June 27, 2011	Wildfire	N/A	N/A	A lightning strike started a wildfire in Wharton State Forest off of U.S. Route 206 in Shamong Township. The swampy terrain made it cumbersome to battle the blaze. About 50 firefighters battled the blaze. No property was in danger, but a state campground about seven miles from the blaze was closed. Approximately 171 acres	NOAA-NCDC

Table 5.4.7-4. Wildfire Events in New Jersey and Burlington County between 1755 and 2013

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				were consumed before it was contained.	
April 8 – 10, 2012	Wildfire	N/A	N/A	The unseasonably dry weather coupled with strong winds helped quickly spread two wildfires on the 9th in central Burlington County. The South Park fire started just after Midnight in Woodland Township in near South Park and Sooy Roads, burning mostly on the grounds of the South Park Hunting Club. The strong winds helped spread the fire quickly. It was suspected that gypsy moth tree damage also contributed to the rapid spread of the fire. Air resources and over 250 local and state forestry fire fighters helped battle the blaze. By 8 a.m. the fire was partially contained and already burned 400 acres. Sections of Sooy Road and South Park Roads were closed in Tabernacle and Woodland Townships. On noon on the 10th, the wildfire reached 75 percent containment. It was expected to consume about 1000 acres before total containment was reached. A second wildfire occurred on the Fort Dix Military Installation, near the Burlington and Ocean County border on the 9th, and spread toward a controlled burn area. It was totally contained on the 10th. There were no reported injuries or damage. The fire consumed about 300 acres.	NOAA-NCDC
July 5, 2012	Wildfire	N/A	N/A	A wildfire began during the afternoon of the 5th and before it was contained on the evening of the 6th scorched about 300 acres along the Camden and Burlington County line in the Wharton State Forest in Waterford and Shamong Townships. The fire could be seen as far away as Atlantic City. The wildfire was believed to have started as a small brush fire in the Goshen Pond Camping Area within the state forest off of Atsion Road and the Raritan Avenue Spur. By the middle of the day on the 6th, it was ninety percent contained. About forty firefighters battled the blaze in this remote area off of U.S. Route 206. Aggressive bulldozer lines and back fires were undertaken to mitigate and bring the fire under containment. Some traffic control was required along U.S. Route 206 and Jackson Road. No property was damaged or serious injuries reported.	NOAA-NCDC

Sources: Burlington County HMP, 2008; NOAA-NCDC, 2013; FEMA, 2013

Note: Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

FEMA Federal Emergency Management Agency

K Thousand (\$)

HMP Hazard Mitigation Plan

M Million (\$)

N/A Not available/not applicable
NCDC National Climatic Data Center
NJDEP New Jersey Department of Environmental Protection

NJOEM New Jersey Office of Emergency Management
NOAA National Oceanic and Atmospheric Administration
SHELDUS Spatial Hazard Events and Losses Database for the United States

Probability of Future Events

New Jersey is unique, in that it is the most densely populated state with over 8.7 million residents, and over 50 percent of the land is used for individual residences and housing developments. The continual increase of developments expands into forested regions. This spread of development into the forested regions is known as the wildland urban interface. According to the New Jersey Hazard Mitigation Plan, the wildland urban interface is defined as the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildlands or vegetative fuel (NJOEM, 2012.) The New Jersey Forest Fire Service is faced with a significant threat with the increase of wildland urban interface. This means that many parts of the state, including Burlington County, will continue to face wildfires as a threat due to growing population, development, and increased wildland urban interface areas. At the time of completion of this plan, a comprehensive forest fire hazard analysis is being planned, documented, and published by the New Jersey Bureau of Forest Fire Management.

Although it is not necessary for a fire to be large to possess a serious threat or loss to homes and improved property, the New Jersey Forest Fire Service regards fires over 100-acres as “major”. Analysis of fire data for the last several years reveal trends that can help predict the probability of major fire events. New Jersey Office of Emergency Management expects an average of three fires greater than 100 acres each year (NJOEM 2012.)

Mr. Ronald Neilson of the U.S. Forest Service’s Pacific Northwest Research Station stated that climate change may bring a greater wildfire risk not just to the western U.S., but to the eastern and southeastern portions of the country as well. It is in the east and southeast where these climate change risks, such as dried out vegetation, heat and drought, will grow most dramatically. Currently, forests typically dry out just as the trees are going dormant for the winter. In the future, however, forests in the east may dry long before the trees have a chance to shut down. An increasing number of eastern woodlands could become prime wildfire fuel with the combination of forests drying out and infestation (Shapley, 2007). However, not enough information has been made available to support these studies or theories and too many uncertainties exist in regards to climate change and global warming to claim that wildfires will increase within the eastern U.S., without further research.

In Section 5.3, the identified hazards of concern for Burlington County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for wildfire in the County is considered ‘frequent’ (likely to occur within 25 years, as presented in Table 5.3-3).

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following text evaluates and estimates the potential impact of the wildfire hazard on Burlington County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health of residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

Wildfire hazards can impact significant areas of land, as evidenced by wildfires throughout the U.S. over the past several years. Fire in urban areas has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas. Wildfire, however can spread quickly, become a huge fire complex consisting of thousands of acres, and present greater challenges for allocating resources, defending isolated structures, and coordinating multi-jurisdictional response. If a wildfire occurs at a WUI, it can also cause an urban fire and in this case has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas.

Data and Methodology

Information regarding the wildfire hazard included input and data from NJ DEP NJ Forest Fire Service and the Steering Committee. The NJ Forest Fire Service Wildfire Fuel Hazard data assigns wildfire fuel hazard rankings across Burlington County. This data, developed in 2009, is based upon NJDEP's 2002 Land Use/Land Cover datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. Refer to Figure 1-X earlier in this section for an illustration of these defined wildfire fuel hazard rankings. The asset data (population, building stock and critical facilities) presented in the County Profile (Section 2) was used to support an evaluation of assets exposed and the potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data was overlaid upon the NJ Forest Fire Service Fuel hazard area. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

Impact on Life, Health and Safety

As demonstrated by historic wildfire events in New Jersey and other parts of the country, potential losses include human health and life of residents and responders, structures, infrastructure and natural resources. In addition, wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment.

Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

SECTION 5.4.7: RISK ASSESSMENT – WILDFIRE

As a way to estimate the County’s population vulnerable to the wildfire hazard, the population located within low to moderate and high to extreme NJ Forest Service risk areas were overlaid upon the 2010 Census population data to calculate the estimated population exposed (approximately 115,889 people in Burlington County). Table 5.4.7-5 summarizes the estimated population exposed by municipality.

Table 5.4.7-5. Estimated Population Exposed to the Wildfire Hazard in Burlington County

Municipality	U.S. Census 2010 Population	NJ Forest Service Risk Area			
		Low to Moderate	% of Total	High to Extreme	% of Total
Bass River Township	1,443	1,015	70.3%	205	14.2%
Beverly City	2,577	125	4.9%	0	0.0%
Bordentown City	3,924	603	15.4%	69	1.8%
Bordentown Township	11,367	2,856	25.1%	578	5.1%
Burlington City	9,920	1,035	10.4%	233	2.3%
Burlington Township	22,594	4,904	21.7%	130	0.6%
Chesterfield Township	7,699	4,098	53.2%	112	1.5%
Cinnaminson Township	15,569	2,684	17.2%	490	3.1%
Delanco Township	4,283	590	13.8%	82	1.9%
Delran Township	16,896	3,106	18.4%	94	0.6%
Eastampton Township	6,069	1,913	31.5%	7	0.1%
Edgewater Park Township	8,881	763	8.6%	0	0.0%
Evesham Township	45,538	10,831	23.8%	2,977	6.5%
Fieldsboro Borough	540	188	34.8%	0	0.0%
Florence Township	12,109	1,180	9.7%	208	1.7%
Hainesport Township	6,110	1,024	16.8%	558	9.1%
Lumberton Township	12,559	1,661	13.2%	467	3.7%
Mansfield Township	8,544	2,496	29.2%	227	2.7%
Maple Shade Township	19,131	1,819	9.5%	12	0.1%
Medford Lakes Borough	4,146	37	0.9%	67	1.6%
Medford Township	23,033	8,403	36.5%	3,582	15.6%
Moorestown Township	20,726	3,832	18.5%	104	0.5%
Mount Holly Township	9,536	1,701	17.8%	490	5.1%
Mount Laurel Township	41,864	10,430	24.9%	534	1.3%
New Hanover Township	7,385	371	5.0%	190	2.6%
North Hanover Township	7,678	2,069	26.9%	112	1.5%
Palmyra Borough	7,398	91	1.2%	0	0.0%
Pemberton Borough	1,409	199	14.1%	327	23.2%
Pemberton Township	27,912	4,362	15.6%	4,478	16.0%
Riverside Township	8,079	515	6.4%	95	1.2%
Riverton Borough	2,779	177	6.4%	0	0.0%
Shamong Township	6,490	3,053	47.0%	1,397	21.5%
Southampton Township	10,464	3,849	36.8%	1,626	15.5%
Springfield Township	3,414	1,838	53.8%	383	11.2%
Tabernacle Township	6,949	3,234	46.5%	1,399	20.1%
Washington Township	687	144	21.0%	501	72.9%
Westampton Township	8,813	2,650	30.1%	721	8.2%
Willingboro Township	31,629	2,291	7.2%	31	0.1%
Woodland Township	1,788	341	19.1%	815	45.6%

Table 5.4.7-5. Estimated Population Exposed to the Wildfire Hazard in Burlington County

Municipality	U.S. Census 2010 Population	NJ Forest Service Risk Area			
		Low to Moderate	% of Total	High to Extreme	% of Total
Wrightstown Borough	802	103	12.8%	17	2.1%
Burlington County	448,734	92,581	20.6%	23,318	5.2%

Source: Burlington County GIS 2013; NJ Forest Fire Service

Impact on General Building Stock

The most vulnerable structures to wildfire events are those within the high to extreme NJ Forest Service risk areas. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. To estimate the buildings exposed to the wildfire hazard, the assessed improved value in the NJ Forest Service risk areas are summarized in Table 5.4.7-6 by municipality. In addition, the default HAZUS-MH general building stock replacement cost values (Census block) located within the NJ Forest Service risk areas are summarized in Table 5.4.7-7.

Table 5.4.7-6. Estimated Assessed Value of Improvements Exposed to the Wildfire Hazard in Burlington County

Municipality	Total Assessed Value of Improvements	NJ Forest Service Risk Area			
		Low to Moderate	% Total	High to Extreme	% Total
Bass River Township	\$112,293,600	\$45,499,000	40.5%	\$17,140,100	15.3%
Beverly*	\$72,091,800	\$0	0.0%	\$0	0.0%
Bordentown	\$298,534,950	\$12,071,000	4.0%	\$455,000	0.2%
Bordentown Township	\$997,461,800	\$247,446,700	24.8%	\$26,066,100	2.6%
Burlington	\$571,882,875	\$27,559,900	4.8%	\$179,200	0.0%
Burlington Township	\$2,097,110,708	\$127,788,000	6.1%	\$8,196,200	0.4%
Chesterfield Township	\$666,455,492	\$149,925,800	22.5%	\$25,586,900	3.8%
Cinnaminson Township	\$1,304,483,700	\$94,118,400	7.2%	\$4,826,300	0.4%
Delanco Township	\$290,621,560	\$22,910,400	7.9%	\$350,000	0.1%
Delran Township	\$1,474,866,100	\$176,568,500	12.0%	\$36,520,800	2.5%
Eastampton Township	\$421,225,400	\$31,566,400	7.5%	\$4,767,700	1.1%
Edgewater Park Township	\$528,294,400	\$29,948,800	5.7%	\$1,781,000	0.3%
Evesham Township	\$4,389,240,875	\$695,492,100	15.8%	\$182,403,600	4.2%
Fieldsboro Borough	\$48,903,400	\$7,435,300	15.2%	0	0.0%
Florence Township	\$1,040,584,300	\$126,038,500	12.1%	\$8,692,600	0.8%
Hainesport Township	\$367,702,666	\$32,486,533	8.8%	\$5,731,033	1.6%
Lumberton Township	\$1,164,991,807	\$150,415,700	12.9%	\$31,198,600	2.7%
Mansfield Township	\$899,612,400	\$175,876,300	19.6%	\$28,973,900	3.2%
Maple Shade Township	\$1,405,067,900	\$86,845,200	6.2%	\$76,792,000	5.5%
Medford Lakes Borough	\$1,297,069,100	\$270,611,600	20.9%	\$84,977,800	6.6%
Medford Township	\$980,612,600	\$3,524,800	0.4%	\$3,849,400	0.4%
Moorestown Township	\$3,410,132,200	\$556,387,100	16.3%	\$27,837,100	0.8%
Mount Holly Township	\$1,079,081,000	\$88,406,800	8.2%	\$6,068,000	0.6%
Mount Laurel Township	\$2,396,695,600	\$228,148,900	9.5%	\$36,195,400	1.5%
New Hanover Township	\$852,205,300	\$6,825,700	0.8%	\$804,829,700	94.4%
North Hanover Township	\$498,418,446	\$153,362,650	30.8%	\$52,369,000	10.5%
Palmyra Borough	\$254,304,240	\$5,958,300	2.3%	\$4,900	0.0%

SECTION 5.4.7: RISK ASSESSMENT – WILDFIRE

Table 5.4.7-6. Estimated Assessed Value of Improvements Exposed to the Wildfire Hazard in Burlington County

Municipality	Total Assessed Value of Improvements	NJ Forest Service Risk Area			
		Low to Moderate	% Total	High to Extreme	% Total
Pemberton Borough	\$63,520,200	\$4,707,000	7.4%	\$17,324,200	27.3%
Pemberton Township	\$2,014,515,095	\$257,378,920	12.8%	\$110,647,170	5.5%
Riverside Township	\$349,218,580	\$804,000	0.2%	\$509,700	0.1%
Riverton Borough	\$207,879,600	\$4,662,900	2.2%	\$1,517,000	0.7%
Shamong Township	\$294,159,200	\$107,663,400	36.6%	\$21,427,200	7.3%
Southampton Township	\$549,437,950	\$180,316,800	32.8%	\$31,940,700	5.8%
Springfield Township	\$282,324,750	\$171,059,200	60.6%	\$6,017,600	2.1%
Tabernacle Township	\$580,603,200	\$204,393,100	35.2%	\$45,289,600	7.8%
Washington Township	\$13,020,400	\$5,955,300	45.7%	\$5,211,500	40.0%
Westampton Township	\$919,859,000	\$158,050,100	17.2%	\$35,676,800	3.9%
Willingboro Township	\$1,705,779,550	\$61,941,500	3.6%	\$776,000	0.0%
Woodland Township	\$305,887,600	\$141,310,500	46.2%	\$100,321,700	32.8%
Wrightstown Borough	\$47,025,100	\$9,089,050	19.3%	\$2,410,500	5.1%
Burlington County	\$36,253,174,444	\$4,860,550,153	13.4%	\$1,854,862,003	5.1%

Source: NJ Forest Service, 2013; HAZUS-MH v2.1

*Beverly data source: 2011 NJGIN MODIV

Notes: GBS = General Building Stock; RV = Replacement Value

Table 5.4.7-7. Estimated Replacement Cost Value Exposed to the Wildfire Hazard in Burlington County

Municipality	Total Replacement Cost Value (Structure and Contents)	NJ Forest Service Risk Area			
		Low to Moderate	% Total	High to Extreme	% Total
Bass River Township	\$158,762,000	\$72,483,000	45.7%	\$54,030,000	34.0
Beverly City	\$351,041,000	\$16,793,000	4.8%	\$0	0.0
Bordentown City	\$611,161,000	\$75,010,000	12.3%	\$11,329,000	1.9
Bordentown Township	\$1,225,803,000	\$201,799,000	16.5%	\$41,994,000	3.4
Burlington City	\$1,419,313,000	\$128,499,000	9.1%	\$94,196,000	6.6
Burlington Township	\$3,257,758,000	\$1,020,110,000	31.3%	\$64,987,000	2.0
Chesterfield Township	\$482,451,000	\$197,052,000	40.8%	\$14,165,000	2.9
Cinnaminson Township	\$2,375,176,000	\$323,958,000	13.6%	\$22,325,000	0.9
Delanco Township	\$484,972,000	\$81,957,000	16.9%	\$0	0.0
Delran Township	\$2,136,079,000	\$238,043,000	11.1%	\$252,654,000	11.8
Eastampton Township	\$712,944,000	\$205,895,000	28.9%	\$12,732,000	1.8
Edgewater Park Township	\$959,473,000	\$72,222,000	7.5%	\$0	0.0
Evesham Township	\$6,451,252,000	\$2,055,424,000	31.9%	\$416,656,000	6.5
Fieldsboro Borough	\$72,125,000	\$22,612,000	31.4%	\$0	0.0
Florence Township	\$1,509,320,000	\$187,295,000	12.4%	\$58,649,000	3.9
Hainesport Township	\$839,062,000	\$103,023,000	12.3%	\$33,537,000	4.0
Lumberton Township	\$1,504,149,000	\$294,473,000	19.6%	\$30,036,000	2.0
Mansfield Township	\$1,954,839,000	\$239,536,000	12.3%	\$21,300,000	1.1
Maple Shade Township	\$2,346,098,000	\$266,654,000	11.4%	\$13,391,000	0.6
Medford Lakes Borough	\$560,603,000	\$3,683,000	0.7%	\$1,897,000	0.3

Table 5.4.7-7. Estimated Replacement Cost Value Exposed to the Wildfire Hazard in Burlington County

Municipality	Total Replacement Cost Value (Structure and Contents)	NJ Forest Service Risk Area			
		Low to Moderate	% Total	High to Extreme	% Total
Medford Township	\$3,746,510,000	\$1,700,503,000	45.4%	\$509,028,000	13.6
Moorestown Township	\$4,209,509,000	\$771,267,000	18.3%	\$114,129,000	2.7
Mount Holly Township	\$1,650,406,000	\$259,958,000	15.8%	\$42,323,000	2.6
Mount Laurel Township	\$6,985,988,000	\$1,887,036,000	27.0%	\$127,914,000	1.8
New Hanover Township	\$1,604,641,000	\$986,959,000	61.5%	\$14,175,000	0.9
North Hanover Township	\$685,211,000	\$197,201,000	28.8%	\$8,301,000	1.2
Palmyra Borough	\$942,785,000	\$11,987,000	1.3%	\$172,000	0.0
Pemberton Borough	\$187,379,000	\$41,397,000	22.1%	\$9,502,000	5.1
Pemberton Township	\$3,248,981,000	\$569,149,000	17.5%	\$544,733,000	16.8
Riverside Township	\$885,809,000	\$48,205,000	5.4%	\$18,422,000	2.1
Riverton Borough	\$352,198,000	\$16,705,000	4.7%	\$11,333,000	3.2
Shamong Township	\$797,191,000	\$300,344,000	37.7%	\$168,386,000	21.1
Southampton Township	\$1,305,540,000	\$455,362,000	34.9%	\$181,483,000	13.9
Springfield Township	\$461,104,000	\$208,967,000	45.3%	\$39,104,000	8.5
Tabernacle Township	\$931,897,000	\$401,226,000	43.1%	\$139,789,000	15.0
Washington Township	\$108,601,000	\$63,223,000	58.2%	\$44,542,000	41.0
Westampton Township	\$1,326,163,000	\$292,260,000	22.0%	\$103,879,000	7.8
Willingboro Township	\$3,602,996,000	\$363,124,000	10.1%	\$39,156,000	1.1
Woodland Township	\$115,483,000	\$29,840,000	25.8%	\$64,191,000	55.6
Wrightstown Borough	\$140,021,000	\$39,295,000	28.1%	\$3,294,000	2.4
Burlington County	\$62,700,794,000	\$14,450,529,000	23.0%	\$3,327,734,000	5.3

Source: Radeloff et al, 2005; HAZUS-MH v2.1

Notes: GBS = General Building Stock; RV = Replacement Value

Impact on Critical Facilities

It is recognized that a number of critical facilities are located in the wildfire hazard area, and are also vulnerable to the threat of wildfire. Many of these facilities are the locations for vulnerable populations (i.e., schools, senior facilities) and responding agencies to wildfire events (i.e., fire, police). Table 5.4.7-8 summarizes critical facilities located within the high to extreme NJ Forest Service risk areas.

Table 5.4.7-8. Facilities in the High to Extreme NJ Forest Service Risk Areas in Burlington County

Name	Municipality	Type
Davita Delran	Delran	Dialysis
Medford Emergency Medical Services	Medford Township	EMS
Taunton Fire Co Of Medford	Medford Township	Fire
Davita Willingboro	Willingboro	Dialysis

Source: Burlington County 2013

Impact on the Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed businesses and decreases in tourism. Wildfire can also

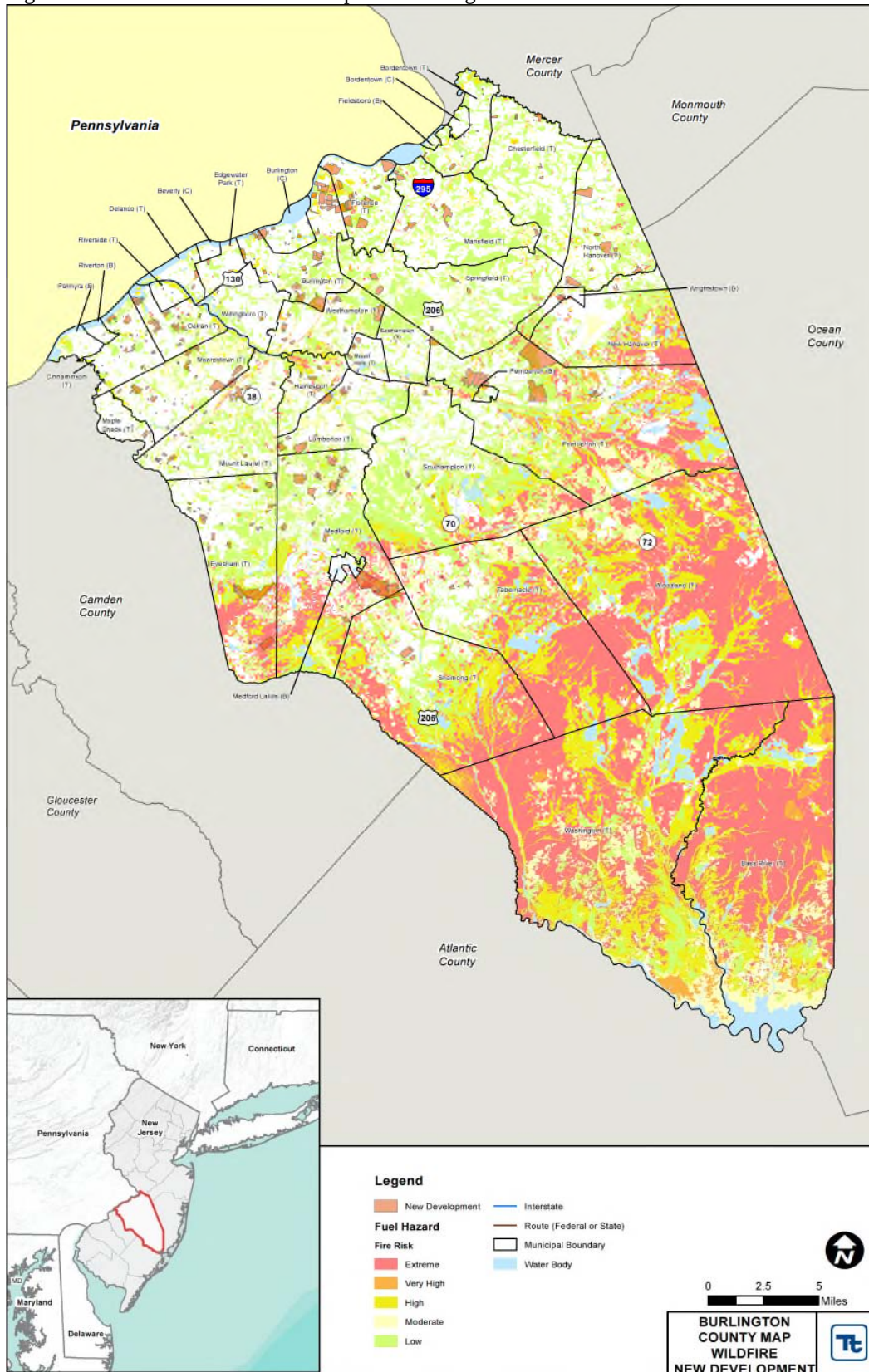
severely impact roads and infrastructure. Route 206 which runs north to south through the county is located in portions of the wildfire hazard areas that are associated with the Pineland forests. This should be considered for evacuation route purposes since it serves as the major north/south corridor in the interior of the county. No major utilities such as power generation facilities are located in fire hazard areas.

Due to a lack of data regarding past structural and economic losses specific to Burlington County or its municipalities, it is not possible to estimate future losses due to wildfire events at this time.

Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) years have been identified across Burlington County at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. It is anticipated that any new development and new residents in the high to extreme hazard areas will be exposed to the wildfire hazard. Refer to Figure 5.4.7-6 of the potential new development in the County and the high to extreme risk areas.

Figure 5.4.7-6. Potential New Development and High to Extreme Risk Areas



Source: Burlington County GIS 2013

Additional Data and Next Steps

The custom building inventory developed for this Plan should be updated as data regarding the construction of structures, such as roofing material, fire detection equipment, structure age, etc. are available. As stated earlier, buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. The proximity of these building types to the WUI and high to extreme risk areas should be identified for further evaluation. Development and availability of such data would permit a more detailed estimate of potential vulnerabilities, including loss of life and potential structural damages.

5.4.8 SEVERE WINTER STORM

This section provides a profile and vulnerability assessment for the severe winter storm hazard.

HAZARD PROFILE

This section provides profile information including description, extent, location, previous occurrences and losses and the probability of future occurrences.

Description

For the purpose of this HMP, as deemed appropriate by Burlington County, and per the State of New Jersey Hazard Mitigation Plan (NJ HMP), winter weather events include snow storms, ice storms, cold waves and wind chill with snow storms being “the most obvious manifestation of winter weather.” Since most extra-tropical cyclones (mid-Atlantic cyclones locally known as Northeasters or Nor’Easters), generally take place during the winter weather months (with some events being an exception), these hazards have also been grouped as a type of severe winter weather storm. These types of winter events or conditions are further defined below.

Heavy Snow: According to the National Weather Service (NWS), heavy snow is generally snowfall accumulating to 4 inches or more in depth in 12 hours or less; or snowfall accumulating to six inches or more in depth in 24 hours or less. A snow squall is an intense, but limited duration, period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds and possibly lightning (generally moderate to heavy snow showers) (NWS, 2005). Snowstorms are complex phenomena involving heavy snow and winds, whose impact can be affected by a great many factors, including a region’s climatologically susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and occurrence during the course of the day, weekday versus weekend, and time of season (Kocin and Uccellini, 2011).

Blizzard: Blizzards are characterized by low temperatures, wind gusts of 35 miles per hour (mph) or more and falling and/or blowing snow that reduces visibility to ¼-mile or less for an extended period of time (three or more hours) (NWS, 2005).

Sleet or Freezing Rain Storm: Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground. Both types of precipitation, even in small accumulations, can cause significant hazards to a community (NWS, 2005).

Ice storm: An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous, and can create extreme hazards to motorists and pedestrians (NWS, 2005).

Extra-Tropical Cyclone: Extra-tropical cyclones, sometimes called mid-latitude cyclones, are a group of cyclones defined as synoptic scale, low pressure, weather systems that occur in the middle latitudes of the Earth. These storms have neither tropical nor polar characteristics and are connected with fronts and horizontal gradients in temperature and dew point otherwise known as “baroclinic zones”.

Extra-tropical cyclones are everyday weather phenomena which, along with anticyclones, drive the weather over much of the Earth. These cyclones produce impacts ranging from cloudiness and mild showers to heavy gales and thunderstorms. Tropical cyclones often transform into extra-tropical cyclones at the end of their tropical existence, usually between 30 degrees (°) and 40° latitude, where there is sufficient force from upper-level shortwave troughs riding the westerlies (weather systems moving west to east) for the process of extra-tropical transition to begin. A shortwave trough is a disturbance in the mid or upper part of the atmosphere which induces upward motion ahead of it. During an extra-tropical transition, a cyclone begins to tilt back into the colder air mass with height, and the cyclone's primary energy source converts from the release of latent heat from condensation (from thunderstorms near the center) to baroclinic processes (Canadian Hurricane Centre [CHC], 2003).

Nor'Easter (abbreviation for North Easter): Nor'Easters are named for the strong northeasterly winds that blow in from the ocean ahead of the storm and over coastal areas. They are also referred to as a type of extra-tropical cyclones (mid-latitude storms, or Great Lake storms). A Nor'Easter is a macro-scale extra-tropical storm whose winds come from the northeast, especially in the coastal areas of the northeastern U.S. and Atlantic Canada. Wind gusts associated with Nor'Easters can exceed hurricane forces in intensity. Unlike tropical cyclones that form in the tropics and have warm cores (including tropical depressions, tropical storms and hurricanes); Nor'Easters contain a cold core of low barometric pressure that forms in the mid-latitudes. Their strongest winds are close to the earth's surface and often measure several hundred miles across. Nor'Easters may occur at any time of the year but are more common during fall and winter months (September through April) (NYCOEM, 2008).

Nor'Easters can cause heavy snow, rain, gale force winds and oversized waves (storm surge) that can cause beach erosion, coastal flooding, structural damage, power outages and unsafe human conditions. If a Nor'Easter cyclone stays just offshore, the results are much more devastating than if the cyclone travels up the coast on an inland track. Nor'Easters that stay inland are generally weaker and usually cause strong winds and rain. The ones that stay offshore can bring heavy snow, blizzards, ice, strong winds, high waves, and severe beach erosion. In these storms, the warmer air is aloft. Precipitation falling from this warm air moves into the colder air at the surface, causing crippling sleet or freezing rain (McNoldy [Multi-Community Environmental Storm Observatory (MESO)], 1998-2007). While some of the most devastating effects of Nor'Easters are experienced in coastal areas (e.g. beach erosion, coastal flooding), the effects on inland areas, like Burlington County, may include heavy snow, strong winds and blizzards.

Winter storms can also generate coastal flooding, ice jams and snow melt, resulting in significant damage and loss of life. Coastal floods are caused when the winds generated from intense winter storms cause widespread tidal flooding and severe beach erosion along coastal areas. Ice jams are caused when long cold spells freeze up rivers and lakes. A rise in the water level or a thaw breaks the ice into large chunks. These chunks become jammed at man-made and natural obstructions. The ice jams act as a dam and result in flooding (NSSL, 2006).

Extent

The magnitude or severity of a severe winter storm depends on several factors including a region's climatologically susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified by meteorological measurements, such as those above, and by evaluating its societal impacts. The Northeast Snowfall Impact Scale (NESIS) categorizes snowstorms, including Nor’easter events, in this manner. Unlike the Fujita Scale (tornado) and Saffir-Simpson Scale (hurricanes), there is no widely used scale to classify snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the NWS to characterize and rank high-impact, northeast snowstorms. These storms have large areas of 10 inch snowfall accumulations and greater. NESIS has five ranking categories: Notable (1), Significant (2), Major (3), Crippling (4), and Extreme (5) (Table 5.4.8-1). The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm’s societal impacts. This scale was developed because of the impact northeast snowstorms can have on the rest of the country in terms of transportation and economic impact (Kocin and Uccellini, 2011).

Table 5.4.8-1. NESIS Ranking Categories 1 - 5

Category	Description	NESIS Range	Definition
1	Notable	1.0 – 2.49	These storms are notable for their large areas of 4-inch accumulations and small areas of 10-inch snowfall.
2	Significant	2.5 – 3.99	Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches).
3	Major	4.0 – 5.99	This category encompasses the typical major Northeast snowstorm, with large areas of 10-inch snows (generally between 50 and 150 × 103 mi ² —roughly one to three times the size of New York State with significant areas of 20-inch accumulations.
4	Crippling	6.0 – 9.99	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S, with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-inch snowfalls, and each case is marked by large areas of 20-inch and greater snowfall accumulations.
5	Extreme	10 +	The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 inches. These are the only storms in which the 10-inch accumulations exceed 200 × 103 mi ² and affect more than 60 million people.

Source: Kocin and Uccellini, 2004

NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. These numbers are calculated into a raw data number ranking from “1” for an insignificant fall to over “10” for a massive snowstorm. Based on these raw numbers, the storm is placed into its decided category. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers (Enloe, 2011).

NOAA’s National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the U.S. The RSI ranks snowstorm impacts on a scale from one to five, which is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. The RSI differs from the NESIS because it includes population. RSI is based on the spatial extent of the storm, the amount of snowfall, and the combination of the extent and snowfall totals with population (based on the 2000 Census) (NOAA-NCDC, 2011). Table 5.4.8-2 explains the five categories:

Table 5.4.8-2. RSI Ranking Categories

Category	Description	RSI Value
1	Notable	1-3
2	Significant	3-6
3	Major	6-10
4	Crippling	10-18
5	Extreme	18.0+

Source: NOAA-NCDC, 2011

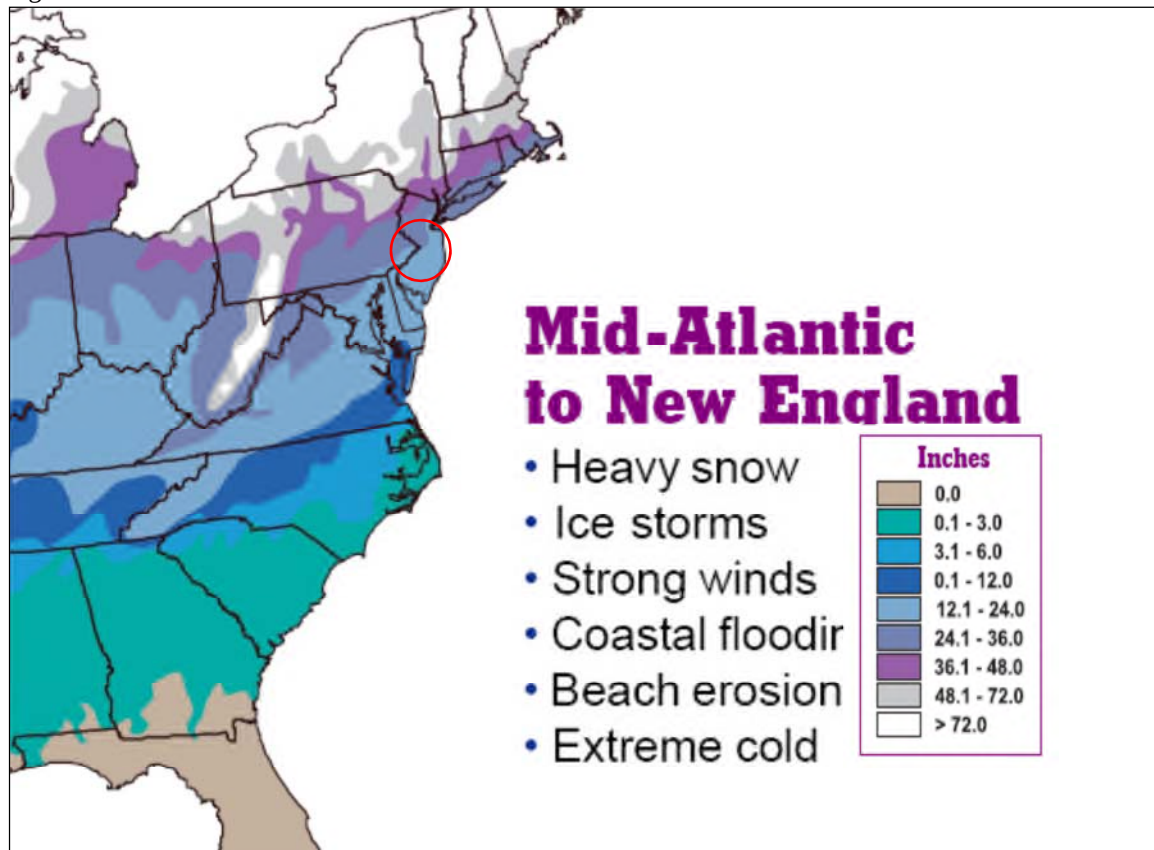
The indices for RSI are calculated similar to those for NESIS; however, the new indices require region-specific parameters and thresholds for the calculations. The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA-NCDC, 2011).

Location

Winter weather, particularly snowstorm events, has historically affected many U.S. states, mainly in the states located in the Northeast and Midwest, including all of New Jersey. Winter weather can reach the state as early as October and is usually in full force by late November with average winter temperatures average between 20 and 40° F.

As indicated in the NJ HMP, winter storm hazards in New Jersey are guaranteed annually from late November to March, including ice storms. The zone of heaviest snowfall across New Jersey usually occurs in the southwest-to-northeast strip about 150 miles wide, approximately parallel to the path of the storm center, and about 125 and 175 miles northwest of it. If the center passes well offshore, only south Jersey receives substantial snowfall. When the track passes close to shore, warm air from the ocean is drawn into the surface circulation, resulting in rain falling over south Jersey and snow over the rest of the State. Often, a passing storm center brings rain to the south, mixed precipitation to central sections and snow to the north. On average, the State receives a seasonal amount of 12.8 inches of snow or more (NWS, 2001). The average annual snowfall is greater than 24 inches over much of New Jersey's central and northern area (Figure 5.4.8-1).

Figure 5.4.8-1. Annual Mean Snowfall within the Eastern U.S.

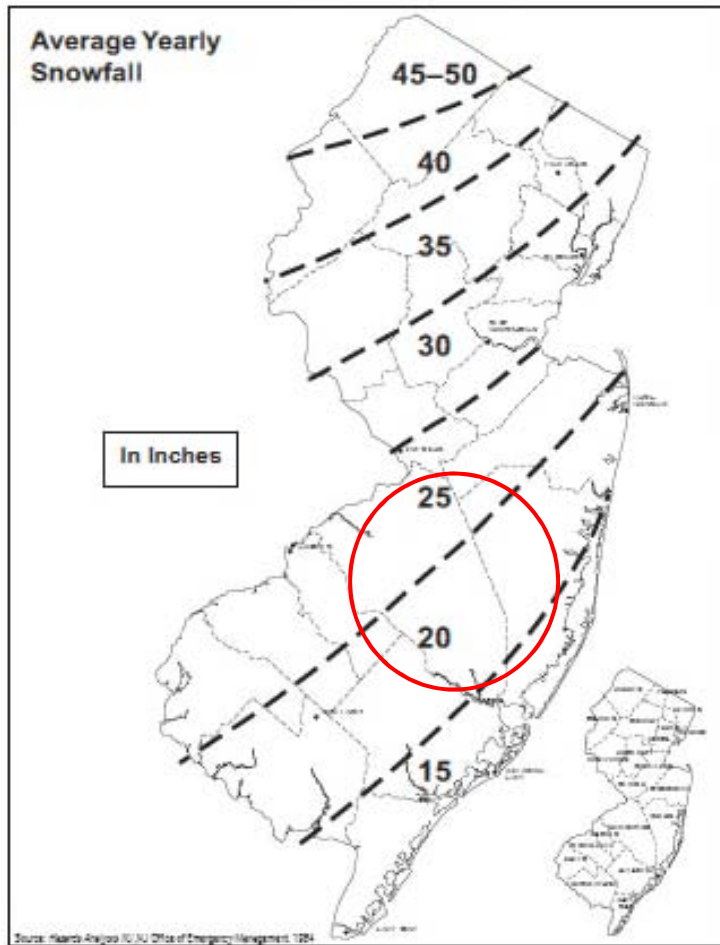


Source: NWS, 2001

Note: Burlington County is indicated by a red circle with an average annual snow accumulation of 12.1 to 24-inches.

Statewide, average annual snowfall ranges from a low of approximately 15 inches in southeastern New Jersey to a high of approximately 50 inches in northwestern New Jersey. For Burlington County, average annual snowfall ranges from a low of approximately 15 inches in the extreme southern portion of the county, to a high of roughly 25 inches in northwestern areas nearest the Delaware River (see Figure 5.4.8-2). This can vary greatly from one year to the next, particularly if several major extended-period storms impact the area (during which snowfall totals can approach or exceed annual averages) (Burlington County HMP, 2008).

Figure 5.4.8-2. Average Yearly Snowfall for New Jersey



Source: NJOEM, 2012

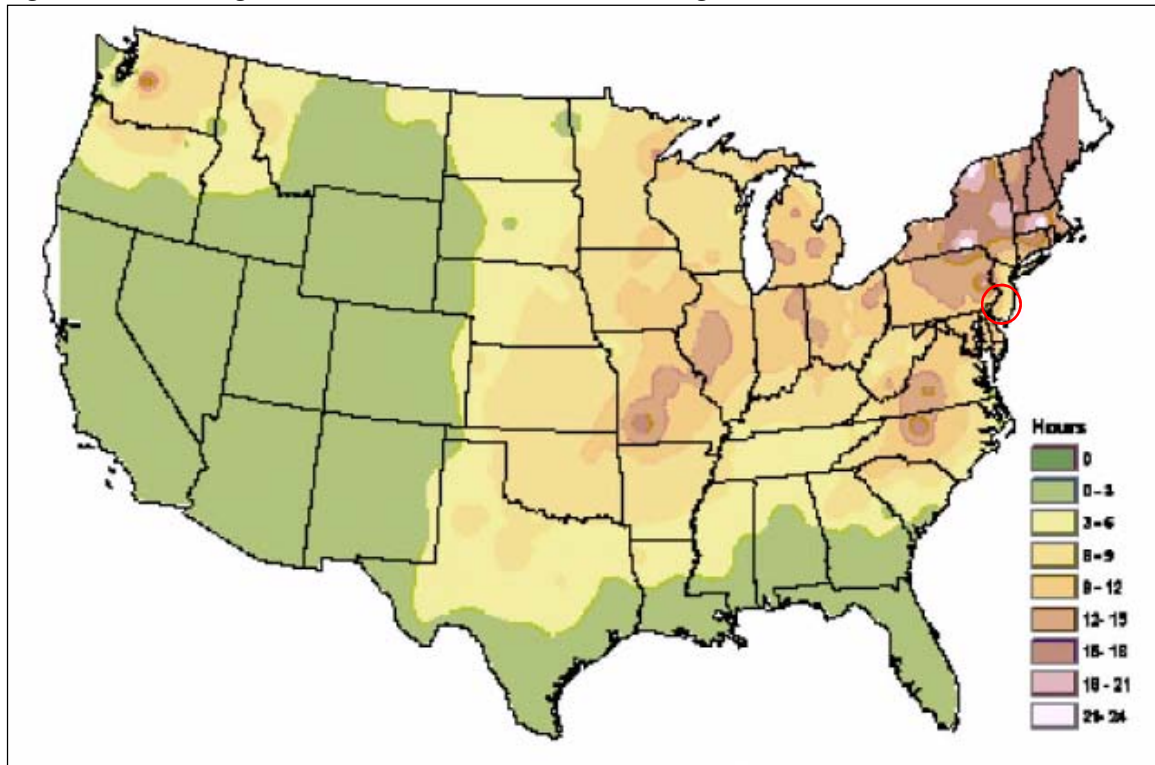
Note: Red circle indicates approximate location of Burlington County

Most extreme snowfall events occur as the result of extremely strong low pressure systems moving to the north, northeast off of the coast of New Jersey from early winter through mid-spring. If the conditions are ideal, these coastal lows transport Atlantic moisture over a cold layer of air over New Jersey resulting in extremely high snowfall rates and occasionally blizzard conditions (NJOEM, 2011).

In many parts of New Jersey, the distribution of ice storms coincides with the general distribution of snow, and their occurrence similarly depends on regional pressure distribution and local weather conditions. Therefore, the entire state of New Jersey is susceptible to ice storms (NJOEM, 2012). However, areas experiencing lower temperatures are more susceptible to all winter storms. Interestingly, this can mean that areas at higher elevations with colder air may experience more ice and freezing rain than their neighbors in a lower valley; but in other cases it is the lowlands that experience ice storms when cold air gets trapped in the valleys of regions with more significant topographical change (NJOEM, 2012).

Figure 5.4.8-3 illustrates the average number of hours per year with freezing rain in the U.S. According to the figure, Burlington County experiences between three and 12 hours per year (NYS HMP, 2011).

Figure 5.4.8-3. Average Number of Hours Per Year with Freezing Rain in the United States



Source: NYS HMP, 2011

Note: Burlington County is indicated by a red circle with an average number of 3 to 12 hours of freezing rain each year.

According to a November 14, 2005 press release from the NJOEM, Nor'Easters have the potential to cause as much damage as hurricanes and other tropical cyclone storms in New Jersey's latitudes, with powerful winds, rain or snow and large waves. They can pound and erode beaches with heavy surf, affect inland areas with flooding, or coat the land with thick layers of ice and snow. Nor'Easters result from the counterclockwise rotation of a low-pressure system and the clockwise rotation of a high-pressure system, combining to send wind and moisture to New Jersey from the Northeast. The Nor'Easters ferocity will depend on the strength of the two systems. One reason Nor'Easters are so dangerous is that they tend to move much more slowly than hurricanes at our latitudes. That slow movement allows the storm's effects to accumulate in a given area. The worst disasters in New Jersey history, in terms of cost and widespread damage, have been from Nor'Easters that moved slowly and remained for several days. Nor'Easters can occur all year long, but in New Jersey they are primarily a risk between September and April (Buccino, 2005).

Input from Planning Committee

- Medford Township noted that they regularly receive snowfall amounts in excess of four inches each winter and that generally, snowfall amounts are sufficient enough to close schools one or twice per year. They also noted that during the President's Day 2003 storm, they received approximately 17 inches of snowfall, resulting in a declared state of emergency and, in January 1987, Medford was hit by a freezing rainstorm that resulted in over a half inch of ice on streets, wires, and trees resulting in numerous motor vehicle accidents, power outages, and downed trees (Burlington County HMP, 2008).

- Florence Township reported that their most recent event was the Presidents Day snow storm in February 2003. This storm impacted Florence by stopping travel, commerce, and putting a strain on the local public works system. The public works department was overwhelmed with the amount of snow that came down compared to the available workers and plows available to clear it. Snow and ice storms are always a challenge for Florence due to parking and the lack of areas to push and store snow (Burlington County HMP, 2008).
- Pemberton Township reported the following five recent and significant events in their community over the last eleven years: 1996 Blizzard (over 3 feet of snow); 2000 major snow event (4 to 9 inches of snow); 2001 major snow event (up to 5 inches); 2002 significant snow event (amount unknown); 2003 significant snow event (amount unknown) (Burlington County HMP, 2008).
- Mount Laurel reports that winter storms and ice storms can cripple their Township. From past events, major concerns are traffic movement and clearing roadways for emergency vehicles. Other problems include power outages, downed trees, and safety of employees (Burlington County HMP, 2008).
- Cinnaminson reported that, most recently, they were affected by the Blizzard of February 2003, which impacted travel, commerce, and caused power outages. The Departments of Public Works, Police and Fire were all overwhelmed. They noted that major winter storms are always a challenge for their jurisdiction (Burlington County HMP, 2008).
- Mansfield reported that roads were closed after the 1994 and 1995 ice storms and the 1996 blizzard. They also noted an increased potential for snow drift formation in areas near large farm fields (Burlington County HMP, 2008).

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with severe winter storms and extreme cold events throughout the State of New Jersey and Burlington County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

According to NOAA's NCDC storm events database, Burlington County experienced 32 severe winter weather events between January 1, 1996 and April 30, 2013 (the database does not list any severe winter events prior to 1996). Total property damages and/or crop damages were not specified in the database. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2012, 63 winter storm events occurred within the County. The database indicated that severe winter storm events and losses specifically associated with Burlington County and its municipalities totaled over \$5.7 million in property damage, though no crop damage was reported. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2012, FEMA declared that the state of New Jersey experienced seven winter storm-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe winter storm, snowstorm, blizzard, and ice conditions. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, Burlington County has been declared as a disaster area as a result of six winter storm-related events (FEMA, 2012). In some cases, what FEMA

may classify as a severe storm or coastal storm event, various other sources including the NJ HMP and NJOEM indicate that they were identified as Nor'Easter events, which are further identified in Table 5.4.8-3.

It is possible that Burlington County was declared as a disaster area for more events; however, not enough information was found to make that determination. Also, although Burlington County may have not been listed as an official FEMA disaster area for all of the events identified in New Jersey, Burlington County may have still experienced indirect or cascading losses or impacts associated with the events. Because flooding was the primary result of some of these hazard events, the severe flooding impact of major events are also mentioned in Section 5.4.4 (Flood).

Based on all sources researched, known severe winter storm events that have affected Burlington County and its municipalities are identified in Table 5.4.8-3. With flood documentation for the State of New Jersey being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.8-3 may not include all events that have occurred throughout the County and region. Events previously reported in the 2008 County HMP are sourced as “Burlington County HMP”.

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
March 13-17, 1993	Severe Blizzard	EM-3106	Yes	No reference and/or no damage reported.	FEMA
February 3, 1995	Snow	N/A	N/A	Snowfall varied, from 8 to 12 inches in communities nearest to the Delaware River with lesser amounts in areas nearer to the coast.	Burlington County HMP
February 15, 1995	Ice	N/A	N/A	Freezing rain, particularly in northern parts of the county, in the evening hours, with black ice on the morning of 02/16/95.	Burlington County HMP
February 26, 1995	Snow/Ice	N/A	N/A	Snow followed by sleet and freezing rain. Precipitation amounts were less than one tenth of an inch, but the mixture of freezing rain and sleet made for a slippery morning commute.	Burlington County HMP
December 9, 1995	Snow	N/A	N/A	No reference and/or no damage reported.	Burlington County HMP
December 14, 1995	Snow/Ice	N/A	N/A	Snow followed by sleet and then freezing rain. Accumulations were low (averaging one to three inches across the southern half of the state) but freezing rain hampered travel.	Burlington County HMP
January 7, 1996	Blizzard	DR-1088	Yes	No reference and/or no damage reported.	Burlington County HMP
February 2, 1996	Snow	N/A	N/A	Snow accumulations averaged around six inches in Burlington County.	Burlington County HMP
February 16, 1996	Snow	N/A	N/A	Snow accumulations averaged 6 to 8 inches in most areas. Individual accumulations included 13 inches in Bordentown and Mount Laurel, and 10 inches in Mount Holly. This storms occurrence on the Friday of an upcoming three day weekend hampered travel. In the Philadelphia area travel was described as the worst of the year.	Burlington County HMP
March 2, 1996	Snow	N/A	N/A	Snow accumulations of 6 to 8 inches were fairly common throughout the southern half of the state. Some representative accumulations included 9 inches at McGuire AFB and Tabernacle, and 8 inches in Mount Holly. Because this snow fell on a Saturday morning, the number of accidents was held down.	Burlington County HMP
March 8, 1996	Snow	N/A	N/A	Snow accumulations averaged 3 to 5 inches throughout Central and Southern New Jersey, including 5 inches in Willingboro and 4 inches in Mount Holly.	Burlington County HMP
January 9, 1997	Snow/Ice	N/A	N/A	Mixture of snow, sleet and freezing rain across Central and Southern New Jersey. Accumulations were light, mainly an inch or less and Although the wintry mix of precipitation did cause slippery roads, no serious accidents or traffic tie-ups were reported.	Burlington County HMP
January 11, 1997	Snow	N/A	N/A	Light snow with accumulations averaging between 2 and 4 inches, with the highest accumulations (all near 4 inches) falling in a band across Eastern Burlington, Northwest Ocean and Southern Monmouth Counties.	Burlington County HMP
January 16, 1997	Snow/Ice	N/A	N/A	Snow followed by a prolonged period of sleet and freezing rain that lasted through the morning commute. Snow accumulations averaged an inch or less. Ice accretions averaged between one-quarter to one-half of an inch across most of the area and made traveling extremely hazardous on untreated roadways and	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				surfaces.	
January 22, 1997	Ice	N/A	N/A	Black ice formed on roadways, bridges and overpasses the morning of the 22nd. For the affected areas there were three traffic fatalities and over 100 injuries in the Greater Philadelphia Metropolitan Area (including in New Jersey Burlington, Camden, Gloucester, Ocean and Salem Counties).	Burlington County HMP
February 14, 1997	Snow/Ice	N/A	N/A	Wintry mix of snow and freezing rain across Central and Southwest New Jersey. Precipitation started as snow throughout the area the night of the 13th/morning of the 14 th , and changed the snow to freezing rain between 4 and 7 a.m., changing to just plain rain during the morning commute. Accumulations prior to the change over averaged approximately 1.0 to 1.5 inches. Driving on untreated roadways prior to the change to rain was very hazardous.	Burlington County HMP
March 31, 1997	Snow	N/A	N/A	Rain changed to heavy wet snow around midday in the Greater Philadelphia Metropolitan Area. Sussex and Warren Counties along with the northwest part of Morris County were hit the hardest but several bands of heavier snow brought season high accumulations to sections of Hunterdon, Somerset, Mercer and Burlington Counties. Coastal communities suffered high winds. Accumulations included 10 inches in Willingboro and 6 inches in Mount Holly.	Burlington County HMP
December 27, 1997	Snow	N/A	N/A	A low pressure system spread a swath of light snow across much of New Jersey. Snow began falling during the morning on the 27th and ended by midnight in all areas. The snow was mixed with rain at times across southern New Jersey, especially near Delaware Bay and the coast. Accumulations averaged 1 to 3 inches. The heaviest snow occurred in two bands: from Hunterdon to Morris Counties and from western Atlantic County through southeastern Burlington County and Southern Ocean County. Accumulations included 1.8 inches in Atsion (Burlington County).	Burlington County HMP
March 22, 1998	Snow	N/A	N/A	Narrow burst of heavier snow in a southwest to northeast corridor from Mount Laurel in Burlington County to Sandy Hook in Monmouth County. Accumulations within this band averaged 3 to 5 inches. Elsewhere across central and southern New Jersey, accumulations were lighter and generally two inches or less. Accumulations included 4.5 inches in Mount Laurel.	Burlington County HMP
December 23, 1998	Snow	N/A	N/A	Precipitation fell mainly as snow, primarily from around 6 p.m. on the 23 rd through the early morning of the 24th. Heaviest accumulations occurred just to the north of the transition zone to sleet across Salem, southern Gloucester, southern Camden, western Atlantic, southern Burlington and central Ocean Counties. Accumulations in this band averaged around 4 inches. Elsewhere accumulations were mainly 2 to 3 inches. Accumulations included 4.5 inches in Tabernacle and 2.0 inches in Mount Holly.	Burlington County HMP
January 2, 1999	Snow/Ice	N/A	N/A	Wintry precipitation affected New Jersey the late evening of the 2nd and morning of the 3rd. Precipitation started as light freezing rain and sleet in central and southern New Jersey. Precipitation intensity was light for the first several hours of this event.	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				Water equivalents of ice and sleet in central and southern New Jersey were only a few hundredths of an inch. Because this occurred late on a weekend night, the number of reported vehicular accidents was not very high.	
January 8, 1999	Snow/Ice	N/A	N/A	Snow, sleet, and freezing rain. Accumulations averaged between 2 and 5 inches. Ice accretions were generally one-tenth of an inch or less in most areas. In Burlington County, a speeding Greyhound bus slid off the New Jersey Turnpike in Springfield Township. Six persons were injured. Accumulations included 4.5 inches in Tabernacle, 4 inches in Moorestown, and 3.5 inches in Mount Laurel.	Burlington County HMP
January 13, 1999	Snow/Ice	N/A	N/A	Snow, sleet and freezing rain. Freezing rain of 1.0 to 1.5 inches in many parts of the state, particularly northern areas. Event total water equivalents included 2.09 inches in Atsion and 1.67 inches at the McGuire AFB.	Burlington County HMP
March 14, 1999	Snow	N/A	N/A	Heavy wet snow to most of New Jersey from northern Burlington and Ocean Counties northward. Accumulations in southwest New Jersey were mainly between 2 and 4 inches with higher amounts in the northern portion of the state. Heavy snow downed trees and power lines resulting in many power outages. Accumulations included 3.5 inches in Mount Holly and Moorestown.	Burlington County HMP
January 20, 2000	Snow	N/A	N/A	Accumulations were 3 to 6 inches to the southeast of the New Jersey Turnpike and generally 1 to 3 inches across the rest of the state. Accumulations included in Burlington County 5 inches in Tabernacle and the McGuire AFB, 4.7 inches in Mount Laurel and 3.6 inches in Maple Shade.	Burlington County HMP
January 25, 2000	Snow	N/A	N/A	The most intense winter storm since the Blizzard of 1996 buried New Jersey on the 25th with 6 to 15 inches of snow, sleet and freezing rain, wind gusts as strong as 60 mph along the shore, moderate coastal flooding and drifts as high as four feet. For the first time since 1996 county and government offices were closed. Many businesses and all schools were closed. Many malls never opened and all the others closed early. Dozens of public events were postponed. Many schools were also closed the next day (the 26th). Scores of vehicles slid off roadways. Downed power lines caused about 3,100 homes and businesses to lose power. Total accumulations included in Burlington County were 13 inches in Moorestown, 10 inches in Lumberton and Marlton, 9 inches in Mount Laurel and 7 inches in Bordentown.	Burlington County HMP
January 30, 2000	Snow	N/A	N/A	A mix of snow, sleet and freezing rain across New Jersey with primarily rain in the southeast part of the state and heavy snow in the northwest part of the state.	Burlington County HMP
February 3, 2000	Snow	N/A	N/A	Accumulations were quite uniform and ranged between 1 and 2 inches. While accumulations were considerably lighter than what fell during the two largest snow storms during the second half of January, this storm coincided with the evening commute home and many untreated roads were slippery. Accumulations in Burlington County included 1.7 inches in Mount Holly.	Burlington County HMP
February 18, 2000	Snow/Ice	N/A	N/A	A mix of snow, sleet and freezing rain. Snowfall accumulations prior to the changeover averaged between 4 and 6 inches in Morris, Sussex and Warren	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				Counties and 2 to 4 inches throughout the rest of the state, except along the coast. In Cape May County and along coastal areas, accumulations were around an inch. In Burlington County, there were 15 accidents in Medford Township alone. Accumulations included 3 inches in Bordentown.	
April 9, 2000	Snow	N/A	N/A	Accumulations ranged from about an inch in coastal areas of Cumberland and Atlantic Counties to 8 inches in Sussex County. The combination of the heavy wet snow and strong gusty winds downed trees, tree limbs and power lines, particularly in the northwest part of the state. Slushy roadways also led to several fender bender type accidents. Accumulations included 3.5 inches in Mount Holly and 2 inches in Wrightstown.	Burlington County HMP
December 13, 2000	Snow/Ice	N/A	N/A	Snow, sleet and freezing rain with ice accumulations particularly in northwestern portions of the state.	Burlington County HMP
December 19, 2000	Snow	N/A	N/A	This storm brought most of the state of New Jersey its first widespread snow of the winter season. Accumulations were not heavy and ranged between 1 and 3 inches. However, driving conditions on untreated roadways were reported treacherous. Accumulations included 1.5 inches in New Lisbon (Burlington County).	Burlington County HMP
December 22, 2000	Snow	N/A	N/A	The heaviest snow fell across southern parts of Salem, Gloucester, Camden, Burlington and Monmouth Counties as well as the rest of southeast New Jersey. Even within this band, there was an axis of maximum snowfall (around 4 inches) across eastern Cumberland County, Atlantic County between New Jersey State Route 50 and the Garden State Parkway and extreme southeast Burlington County. Accumulations in Burlington County included 2.8 inches in Tabernacle, 2.5 inches in Shamong, and 2 inches in New Lisbon.	Burlington County HMP
December 30, 2000	Snow	N/A	N/A	This storm impacted northern parts of the state most severely, where accumulations were mainly between 4 and 12 inches. Amtrak canceled its Metroliner Service between Washington D.C. and New York City. New Jersey Transit canceled bus service in the northern half of the state. New Jersey Transit had about 20 minute rail delays on their line. Businesses and malls either closed early, or never opened, especially in the northern half of the state. The number of accidents were relatively low given this snow occurred on a Saturday morning. The snow was powdery and nature thus few tree limbs and wires were downed. Accumulations in Burlington County included 11 inches in Bordentown, 10 inches in Browns Mills, and 9.5 inches in Tabernacle.	Burlington County HMP
January 5, 2001	Snow	N/A	N/A	Light snow, with accumulations mainly between one and three inches, causing slippery travel conditions on untreated roadways. Specific accumulations in Burlington County included 1.5 inches in Willingboro.	Burlington County HMP
January 20, 2001	Snow/Ice	N/A	N/A	Mix of sleet and snow across the state. The largest accumulation of sleet and snow occurred across the northwest half of the state. Accumulations ranged from less than one inch in Cape May County to 10 inches in Morris County. Because this event occurred on a weekend, the number of traffic accidents was relatively lower.	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				Specific accumulations in Burlington County included 4 inches in Moorestown and Tabernacle.	
February 5, 2001	Snow/Ice	N/A	N/A	Many schools and businesses across the state closed early, an early rush hour produced numerous accidents congested nearly every major roadway to the point that emergency personnel and snow plows could not get through. Specific accumulations included in Burlington County: 3.5 inches in Bordentown and 3 inches in Moorestown.	Burlington County HMP
February 22, 2001	Snow	N/A	N/A	Accumulations averaged between 4 and 8 inches with much uniformity throughout the state. Average commutes took as much as eight times longer than normal. The southern half of the state had the most serious accidents of the day. In Mount Laurel a multi-vehicle accident caused two dozen injuries (one serious) and caused two hour delays on Interstate 295. Specific accumulations in Burlington County included in Burlington County: 6.8 inches in Wrightstown, 6.7 inches in Marlton, 6 inches in Tabernacle and 5.5 inches in Maple Shade.	Burlington County HMP
March 4, 2001	Snow/Ice	N/A	N/A	Wintry mix of precipitation. Snowfall totals were highest in northern parts of the state, including 15 inches in Sussex County. Specific accumulations in Burlington County included 2.1 inches in Mount Holly.	Burlington County HMP
March 26, 2001	Snow	N/A	N/A	Snow showers across southeast New Jersey. Accumulations averaged between 1 and 2 inches. Secondary and tertiary roadways were slippery, mainly before sunrise. Specific accumulations in Burlington County included 1.6 inches in Mount Laurel, 1.5 inches in Mount Holly, and 1 inch in New Lisbon.	Burlington County HMP
January 19, 2002	Snow/Ice	N/A	N/A	Wintry mix of snow, sleet and freezing rain. Most accumulations were between 3 and 5 inches. Lighter amounts accumulated in the southeast part of the state. Bridges, overpasses and untreated roadways became very treacherous and numerous accidents were reported. Specific accumulations in Burlington County included 4.5 inches in Marlton, and 4.3 inches in Moorestown.	Burlington County HMP
March 17, 2002	Snow/Ice	N/A	N/A	Mix of snow, sleet and freezing rain. Snowfall and sleet accumulations averaged 1 to 2 inches as the heaviest precipitation remained south of the region. Ice accretions from the freezing rain were less than one-quarter of an inch. High temperatures in the 60s and 70s the previous two days helped keep road surfaces relatively warm and ice free, with most accumulations reported on grassy surfaces. Specific accumulations in Burlington County included 0.5 inches in Mount Laurel and 0.3 inches in Maple Shade.	Burlington County HMP
December 5, 2002	Snow	N/A	N/A	The first winter storm of the season dropped four to ten inches of snow across most of New Jersey with slightly lower amounts across the immediate Cape May County coast. In many places in the southern half of the state, this was more snow than fell all of last winter. Two hundred forty of the state's five hundred ninety-seven school districts never opened. The rest (mainly in the northern half of the state) dismissed their children early. There were many midday closures of courthouses, county and municipal offices and also colleges and universities. The state started dismissing	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				non-essential workers at 1 p.m. in Trenton. The New Jersey State Senate and Assembly meeting was canceled. Horse racing and simulcasting was cancelled at Freehold and Monmouth Park. The snowy conditions delayed New Jersey Transit trains 15 to 30 minutes and New Jersey Transit buses by up to one hour. Many evening Freeholder meetings, schools and social functions were cancelled. Clinic, dentist and doctor offices closed early. Specific accumulations in Burlington County included 8.5 inches in Moorestown, 8.2 inches in Mount Holly, and 6.2 inches in Tabernacle.	
January 5, 2003	Snow/Ice	N/A	N/A	Heavy snow across extreme southwestern New Jersey and an accumulating snow of two to four inches across much of the rest of the southern half of southern New Jersey. Accumulations farther north were less than two inches. The largest accumulations were in Salem and Gloucester Counties. Many roads in the southwestern part of the state became slippery and snow covered. Accumulations in Burlington County included 3.7 inches in Tabernacle, 3.1 inches in Mount Holly, 3.0 inches in Mount Laurel and 2.5 inches in Delran.	Burlington County HMP
January 29, 2003	Snow/Ice	N/A	N/A	Precipitation mixed with sleet and freezing rain at times. Accumulations averaged between one and three inches. Untreated roads were hazardous with many fender benders on major highways and side streets. In Burlington County, a 74-year-old woman passenger died in Westampton Township on the New Jersey Turnpike after her husband lost control of the car, spun off the road and struck a tree. In Edgewater Park, southbound lanes of U.S. Route 130 were closed through the evening because of a three vehicle crash. Specific accumulations in Burlington County included 2.5 inches in New Lisbon, 2.3 inches in Mount Laurel, and 2.0 inches in Maple Shade.	Burlington County HMP
February 6, 2003	Snow	N/A	N/A	This storm dropped about 5 to 8 inches of snow across most of New Jersey. Many main roads were snowpacked for the morning commute when most of these minor accidents occurred. Specific accumulations included 8.5 inches in Mount Holly, 8.0 inches in Bordentown (Burlington County), 7.8 inches in Maple Shade.	Burlington County HMP
February 10, 2003	Snow/Ice	N/A	N/A	Across New Jersey accumulations were mainly between one and two inches with the highest amounts across the eastern parts of the state. In the southern half of the state, since temperatures were either at or slightly above the freezing mark, the snow did not typically stick to most roadways.	Burlington County HMP
February 16-17, 2003	Snow	EM-3181	Yes	The most powerful storm to affect New Jersey since the Blizzard of 1996 struck during the President's Day Weekend. Governor James McGreevey declared a state of emergency on the 16th. It cost state and local officials 14 million dollars to clear roadways statewide. Most businesses reopened on the 18th, but schools and state courthouses remained closed. The worst damage from the storm inland was caused by the weight of the snow and sleet which caused numerous roof collapses and collapses of "Florida rooms". Moderate tidal flooding and moderate to locally severe beach erosion affected coastal communities. In Burlington County,	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				hundreds of residents were forced to leave their Tricia Meadows homes in Mount Laurel on the 17th after drifting snow blocked the roof top furnace flue and vent pipes. Carbon monoxide was building within their homes. A shelter was opened at a nearby school. Volunteers helped clear the roofs and residents returned that evening. The roof of an apparel printing business in Lumberton collapsed. Planes were grounded at McGuire Air Force Base through the 18th. Specific snow accumulations in Burlington County included 21.0 inches in Mount Laurel, 20.0 inches in Bordentown, and 19.0 inches in Tabernacle. Statewide, this event caused nearly \$20 million in damages.	
February 23, 2003	Snow/Ice	N/A	N/A	Runoff from the heavy rain and snow melt began to freeze over on area roadways as temperatures plunged below freezing during the evening of the 23rd. This led to the formation of black ice and caused numerous multi-vehicle accidents and road closures. The road salt that was on roadways was washed away by the heavy rain and snow melt on both the 22nd and earlier on the 23rd.	Burlington County HMP
February 26, 2003	Snow/Ice	N/A	N/A	A steady light snow from the morning of the 26th until just past midnight on the 27th. Untreated roads became slippery, especially during the evening commute on the 26th. Burlington County was not particularly impacted, except in the more southern portions of the county.	Burlington County HMP
February 27, 2003	Snow/Ice	N/A	N/A	Southern half of New Jersey was primary area affected. Accumulations ranged from 1.5 to 5.0 inches with the highest amounts in Atlantic County. Specific accumulations in Burlington County included 3.0 inches in Tabernacle, and 2.2 inches in Mount Holly. The storm track was too far southeast to bring heavy snow into most of New Jersey.	Burlington County HMP
March 6, 2003	Snow/Ice	N/A	N/A	Wintry transition from rain to sleet, freezing rain and then snow across most of the rest of northern and southwestern New Jersey. Accumulations averaged around an inch or less across central and southwest New Jersey. Warmer ground temperatures kept most road surfaces clear. Ice accretions on exposed surfaces, mainly those with northern exposures, neared one-quarter of an inch. Specific snow and sleet accumulations in Burlington County included 0.4 inches in Mount Holly. In Burlington County, primarily northwestern areas were impacted.	Burlington County HMP
April 7, 2003	Snow/Ice	N/A	N/A	In Burlington County, primarily northwestern areas were impacted. Accumulations ranged from 1 to 8 inches with the highest amounts in the Passaic and Raritan River Basins. Nearly every major thoroughfare in the state reported accidents with numerous accidents reported on the New Jersey Turnpike, Interstates 80, 78, 287 and 295. The only reported fatal accident occurred in the northbound lanes of Interstate 295 in Mount Laurel Township (Burlington County) when a 55-year-old man died while trying to pass a pickup truck and tractor trailer. The collision between the vehicles sent the driver into a median and caused the truck and trailer to jackknife across the highway. Specific accumulations in Burlington County included 2.0 inches in Willingboro.	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
December 5, 2003	Snow	N/A	N/A	Northeaster. Accumulations averaged between 7 and 14 inches, with lighter accumulations in the southeast part of the state. In Burlington County, areas affected were primarily to the northwest. Statewide, the heavy snow wreaked havoc with holiday parades, festivals and tree lighting ceremonies. Many schools dismissed early. Forty-seven accidents occurred on Interstate 295 in Mercer and Burlington County. On the 5th, bus routes ran up to 90 minutes late while rail lines reported delays of up to 30 minutes. Delays on the 6th were less. The college entrance SAT exams on the 6th were postponed. The winter storm put a big dent in the holiday shopping on Saturday the 6th. Some stores never opened. Hospitals had a difficult time getting their employees to and from work. Libraries were closed. Many municipalities declared snow emergencies to help clear the roads for plowing. The plows had a hard time keeping back roads with northwestern exposure clear on the weekend (6th and 7th) as strong winds blew the snow back on the road. In Burlington County, a tractor trailer overturned on U.S. Route 130 in Willingboro and slid into a home. Another multi-vehicle accident closed the roadway in the same township. Specific accumulations in Burlington County included 10.0 inches in Wrightstown, 8.5 inches in Mount Laurel, and 5.0 inches in Tabernacle.	Burlington County HMP
January 14, 2004	Snow/Ice	N/A	N/A	Snow across all of New Jersey with the heaviest amounts in the northern half of the state. Accumulations ranged from one to three inches across much of the southern half of the state and from three to eight inches across Ocean County and much of the northern half of the state. The snow led to hazardous traveling conditions with many fender-benders and slip-sliding accidents. Specific accumulations in Burlington County included 4.0 inches at the McGuire Air Force Base (Burlington County) and 2.0 inches in Maple Shade.	Burlington County HMP
January 17, 2004	Snow/Ice	N/A	N/A	Wintry mix of precipitation across central and southern New Jersey. Snowfall accumulations were around one inch in central New Jersey and less than one inch in southern New Jersey. Ice accretions were generally less than one-tenth of an inch. Untreated roads became very hazardous and slippery, especially since the recent weather was unseasonably cold.	Burlington County HMP
January 25, 2004	Snow	N/A	N/A	Snow fell across the southern half of New Jersey. Accumulations averaged between 2 and 6 inches with the highest accumulations in the southern tier counties. Nearly all schools in the southern half of the state either closed for the day or had delayed openings. Untreated roads were slippery. Specific accumulations in Burlington County included 4.0 inches at the McGuire Air Force Base and Willingboro. Accumulations farther north in New Jersey were generally two inches or less.	Burlington County HMP
January 27, 2004	Snow/Ice	N/A	N/A	A wintry mix of freezing rain, sleet and snow. Heavy snow fell across the northern half of New Jersey. Some spotty light freezing drizzle or freezing rain fell throughout most of the day on the 27th. Accumulations averaged between 5 and 10	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				inches in the northern half of the state and 2 to 5 inches in the southern half of the state. Untreated roads were slippery and numerous accidents occurred. During the freezing drizzle on the morning of the 27th in Burlington County, five cars skidded into each other in the southbound lanes of the New Jersey Turnpike. A couple skidded off the road and one overturned. A female passenger in the car died. The following day, a 48-year-old Mount Laurel man died of a heart attack while shoveling the snow. Many schools dismissed early on the 27th and many schools were closed in the northern half of the state on the 28th. Specific accumulations included 4.5 inches in Mount Holly.	
February 5, 2004	Snow/Ice	N/A	N/A	Winter storm of snow, sleet and freezing rain to northwest New Jersey and a lighter mix of wintry precipitation throughout most of the rest of New Jersey. With the exception of northwestern New Jersey, snowfall accumulations were generally less than one inch and ice accretions were less than one quarter of an inch. Untreated roadways and walkways were very treacherous.	Burlington County HMP
February 17, 2004	Snow	N/A	N/A	Accumulations in Cape May and Ocean Counties, the primarily affected areas, averaged 4 to 6 inches. Farther to the north or west, there was a sharp drop in snowfall intensity and accumulations were generally 2 inches or less. Because of warm ground temperatures, the first reports of accumulating snow were received several hours after the onset of the storm. Specific accumulations in Burlington County included 2.5 inches in Browns Mills. Burlington County was most affected in southeastern areas.	Burlington County HMP
March 16, 2004	Snow/Ice	N/A	N/A	One overturned on Interstate 295 in Burlington County as a result of the storm. Most of the accidents were minor and involved vehicles slipping off of roads and into signs and ditches. Snow spread from south to north during the morning of the 16th. As warmer air moved in from the Atlantic Ocean, precipitation changed to rain in the greater Philadelphia Metropolitan Area during the early afternoon of the 16th. Accumulations ranged from two to eight inches, with the highest amounts in Sussex and Morris Counties. Specific accumulations in Burlington County included 3.8 inches in Willingboro and 3.1 inches in Mount Holly. In Burlington County, primarily northwestern areas were impacted.	Burlington County HMP
March 19, 2004	Snow/Ice	N/A	N/A	For the second time in the same work week snow, some of it heavy, fell across central and northern New Jersey. Accumulations ranged between two and seven inches in most locations. The number of accidents overall were less than what occurred with the snow on the 16th as most of it fell overnight. Specific accumulations in Burlington County included 3.0 inches in Browns Mills and 2.4 inches in Mount Holly. In Burlington County, primarily northwestern areas were impacted.	Burlington County HMP
December 19, 2004	Snow/Ice	N/A	N/A	This storm was accompanied by dense fog across central and southern New Jersey after midnight on the 19th. Air temperatures were at or below freezing in the area and this permitted black ice to form on area roadways and walkways.	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				Untreated roadways and walkways were slippery. In Burlington County, a multi-vehicular pile-up on the Garden State Parkway in Bass River Township resulted in the death of a 40-year-old woman; lesser black ice and fog related accidents occurred along New Jersey State Route 38 in Mount Laurel Township. In Burlington County, primarily northwestern areas were impacted.	
December 26, 2004	Snow	N/A	N/A	Light snow fell across New Jersey from the evening of the 26th into the pre-dawn hours of the 27th. For many, this was the first accumulating snow of the season. Accumulations averaged between one to two inches across much of the area, with slightly lower accumulations far south and slightly higher accumulations in Monmouth County. The snow, even though it was light, led to many accidents. Accumulations in Burlington County included 2.1 inches in Mount Laurel. In Burlington County, primarily northwestern areas were impacted.	Burlington County HMP
January 19, 2005	Snow/Ice	N/A	N/A	Light snow fell during the afternoon and evening on the 19th. Since the recent weather was very cold, it stuck instantly to all surfaces. Traveling on untreated roadways became very slippery. Accumulations averaged only an inch or two, but many accidents occurred. Sixty accidents occurred on Interstate 295 between New Jersey State Route 73 in Burlington County and East Greenwich Township in Gloucester County. Some schools dismissed early and there were many cancellations of evening school classes and organizational events. Specific accumulations in Burlington County included 1.5 inches in Maple Shade.	Burlington County HMP
January 22, 2005	Snow	N/A	N/A	Heavy snow fell across northern and southwestern New Jersey with a wintry mix across southeastern New Jersey. Only Cape May County and coastal Atlantic County were spared heavy accumulations. In northern and southwestern New Jersey accumulations ranged from 8 to 17 inches with the highest amounts in Ocean, Burlington, Monmouth and Middlesex Counties. Across southeastern New Jersey accumulations ranged from around 10 inches in interior Atlantic and Cumberland Counties to less than an inch along coastal Cape May County. Seventeen of the twenty-one New Jersey counties reported at least one measurement of a foot or greater of snow. Governor Richard Codey declared a state of emergency from 8 p.m. EST on the 22nd through 8 a.m. EST on the 23rd. Vehicles were required to stay off of public roads and thoroughfares. Gusty northwest winds which followed in the wake of the storm caused considerable drifting snow and hampered road crews efforts as drifts continued to form on roads through the night of the 23rd. The unseasonably cold weather also rendered the salt less effective. Many of the reported accidents were minor. Some municipalities were reporting more sledding than vehicular accidents. Many sporting, community events and church services were cancelled. Museums and malls closed early on the 22nd and many opened late on the 23rd. Snow emergencies were declared by many municipalities. Regional rail lines reported delays from the 22nd through the 24th. For the first time in 9 years, nearby Philadelphia International Airport was	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				closed for about 5 hours on the 22nd. Eight hundred passengers were stranded. Only half of the normal flights left the airport on the 23rd. Specific snowfall accumulations in Burlington County included 16.5 inches in Wrightstown, 15.0 inches in Tabernacle, and 12.2 inches in Mount Holly. This storm caused approximately \$16.2 million statewide.	
February 3, 2005	Snow	N/A	N/A	Highest snow accumulations (1 to 3 inches) across east central New Jersey. Snow fell elsewhere in the state, but accumulations were generally less than one inch. Untreated roadways were slippery, especially in Monmouth County. Precipitation ended as light rain in southeastern New Jersey. Specific accumulations in Burlington County included 2.0 inches in New Lisbon and 1.1 inches in Wrightstown.	Burlington County HMP
February 20, 2005	Snow/Ice	N/A	N/A	Heavy snow fell across northwestern New Jersey and a wintry mix of snow and freezing rain affected central and southwestern New Jersey from the evening of the 20th into the morning of the 21st. Snowfall accumulations averaged 5 to 8 inches in northwestern New Jersey and 2 to 5 inches across central and southwestern New Jersey. Accumulations in southeastern New Jersey were less than 2 inches. Ice accretions in central and southwestern New Jersey averaged less than one tenth of an inch. Conditions were generally reported as quiet although many rural and northern area roads were slick and slippery in spots. Specific accumulations in Burlington County included 3.2 inches in Burlington and Edgewater Park, 3.1 inches in Maple Shade, 3.0 inches in Mount Holly, and 2.5 inches in Tabernacle.	Burlington County HMP
February 24, 2005	Snow	N/A	N/A	Heavy snow fell across most of New Jersey on the 24th into the 25th. Accumulations averaged between 3 and 7 inches in most areas. The lightest accumulations were in Warren and Sussex Counties and along the immediate southern New Jersey coast. The snow arrived too late to cancel schools and accumulated enough by the evening rush hour to cause traveling headaches. On the morning of the 25th many schools had delayed openings. There were hundreds of weather related accidents, many were minor. A multi-vehicle accident on Interstate 295 near Burlington Township blocked the southbound lanes for hours and caused a five mile traffic snarl. Specific accumulations in Burlington County included 6.0 inches in Edgewater Park, 5.8 inches in Mount Laurel and Shamong.	Burlington County HMP
February 28, 2005	Snow	N/A	N/A	This wintry weather was caused by a true northeaster. Heavy snow fell across northern and southwestern New Jersey from the morning of the 28th into the morning of March 1st. Accumulations averaged 4 to 8 inches, with some higher amounts in Sussex and Warren Counties and lower amounts in the southeastern part of the state. Many schools dismissed early on the 28th. Many after school activities and classes as well as municipal and school board meetings were cancelled. Many minor accidents occurred. In Burlington County, a 17-year-old boy, a 17-year-old girl and their 41-year-old bus driver were injured when two school buses collided in Medford Township. Specific accumulations in Burlington County	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				included 8.0 inches in Southampton and Wrightstown, and 6.8 inches in Medford.	
March 8, 2005	Snow/Ice	N/A	N/A	Accumulations averaged an inch or two in the southern part of New Jersey and 2 to 4 inches in the northern part of the state. Poor driving conditions, particularly on untreated roadways in the northern part of the state. Specific snow accumulations in Burlington County included 2.5 inches in Florence and 1.5 inches in Tabernacle.	Burlington County HMP
December 4, 2005	Snow/Ice	N/A	N/A	Mix of snow and freezing rain across most of New Jersey. Accumulations averaged 1 to 3 inches with some higher amounts in Mercer County. Except for parts of Sussex County, the snow changed to freezing rain before ending during the morning with ice accretions of one to two tenths in most areas. Numerous accidents, some with serious injuries and fatalities occurred. In Bordentown (Burlington County), a 43-year-old man was struck and killed on the New Jersey Turnpike. He lost control of his vehicle and became disabled on the left shoulder. He was killed after he vacated his vehicle and was struck by another passing vehicle. Snowfall accumulations in Burlington County included 2.0 inches in Mount Holly.	Burlington County HMP
December 6, 2005	Snow	N/A	N/A	Heavy snow across much of the southern half of New Jersey, with lighter snow across Mercer and Middlesex Counties. Little if any snow fell across the rest of the Raritan Basin and northwestern New Jersey. Accumulations averaged three to seven inches with the highest amounts in Monmouth and Ocean Counties. Many schools in the coastal counties were closed. Schools farther inland had two hour delayed openings. Mainly minor accidents (vehicles striking poles) were reported. Burlington County reported about 25 weather related accidents. Specific accumulations in Burlington County included 4.3 inches in Maple Shade, 4.0 inches in Willingboro, and 3.5 inches in Mount Holly.	Burlington County HMP
December 9, 2005	Snow/Ice	N/A	N/A	Snow, sleet, and freezing rain affected most of the state. Precipitation along the coast fell mainly as rain. Snow accumulations averaged 1 to 3 inches in the southern half of the state where there was more sleet and freezing rain and 3 to 11 inches in the northern half of the state with the highest accumulations in the extreme northern part of the state. Ice accretions in the southern part of the state averaged around one-quarter of an inch and reached nearly four-tenths of an inch in Cumberland and Burlington Counties. Many schools never opened or had delayed openings. Non-essential state workers did not have to report to work until 10 a.m. EST. New Jersey Transit delays into New York City averaged 40 minutes. For the municipalities, the heaviest snow could not have fallen at a more inopportune time just before and during the morning commute. The combination of the ice on trees and power lines and stronger winds during the day caused about 21,000 homes and businesses to lose power in southern New Jersey. Snow accumulations in Burlington County included 2.5 inches in Chesterfield and 1.7 inches in Mount Holly.	Burlington County HMP
December	Snow/Ice	N/A	N/A	Mix of snow and freezing rain. Snowfall accumulations were less than one inch.	Burlington

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
15, 2005				The shore and Delaware Bay facing counties changed over to plain rain quickly. It took a bit longer for the strong southeast flow from the still relatively warm Atlantic Ocean to change the freezing rain to rain farther inland. Before the change to plain rain occurred, around one quarter of an inch of ice accrued on exposed surfaces. Travel on untreated roadways was treacherous. In Burlington County, areas primarily in the northwest were most severely impacted.	County HMP
January 15, 2006	Snow	N/A	N/A	A very intense low pressure system produced bands of heavier snow across New Jersey and affected the northwestern and southeastern part of the state the most. Some embedded thunderstorms within the bands formed across southern New Jersey. The strong winds combined with the heavy snow to produce near blizzard conditions during the one to two hour period when the heaviest snow fell. Accumulations along the Sussex and Morris County border averaged 3 to 6 inches. Similar accumulations occurred from Burlington and Ocean Counties southeast through Cape May County. Lesser accumulations occurred elsewhere in the state. Because the heavy snow occurred late on a Saturday night and was over by Sunday morning, very few accidents were reported. Most of the reported accidents were minor: mainly spinouts and fender-benders. Specific accumulations in Burlington County included 5.7 inches in Mount Laurel and 5.5 inches in Florence.	Burlington County HMP
February 11-12, 2006	Snow	N/A	N/A	Major northeast winter storm, accompanied by thunder and lightning. Winds gusting to around 40 mph across inland areas, with higher gusts along the coast, producing near white out conditions. New Jersey Transit suspended all bus service statewide on the 12th. A school bus slid into a ditch in Southampton (Burlington County) on the 13th and turned onto its side. No injuries were reported, however three children were taken to a nearby hospital as a precaution. A Willingboro (Burlington County) police officer suffered a broken ankle and leg when his patrol vehicle slid off the road in slippery conditions during the morning of the 12th on Route 130. The officer's vehicle was totaled as a result of the accident. Sports activities were cancelled or postponed in Burlington County during the 11th and 12th, with even a code blue weather emergency was issued in Burlington County during the storm. The Burlington Center Mall in Burlington County closed on the 12th due to the winter storm. Some specific snowfall amounts in Burlington County include, 14.0 inches in Lumberton and 12.8 inches in Mount Laurel.	Burlington County HMP
March 2, 2006	Snow/Ice	N/A	N/A	Wintry mix of snow, sleet and freezing rain across New Jersey mainly to the west of the New Jersey Turnpike. Snow accumulations averaged 2 to 4 inches in northwestern New Jersey and less than one inch in Mercer County and the Raritan Basin. Ice accretions across Warren and Morris Counties averaged one quarter of an inch and around one tenth of an inch in Sussex County and Mercer Counties and the Raritan Basin. Ice accretions in the local Philadelphia suburbs were just a trace. The indirect insulation from the sun kept roadways wet and most of the ice accretions were on exposed surfaces as well as bridges and overpasses. Minimal	Burlington County HMP

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				power outages occurred. The rapid movement of this system prevented heavier precipitation from occurring. In Burlington County, primarily northwestern areas were impacted.	
April 14-20, 2007	Severe Storms and Inland/Coastal Flooding (Nor'Easter)	DR-1694	Yes		
December 24, 2008	Winter Weather	N/A	N/A	A wintry mix of sleet and freezing rain fell during the first half of the morning on the 24th across central and northern New Jersey. The resulting glaze on untreated roadways led to numerous accidents. Ice accretions in the southern part of the state were less than one-tenth of an inch while ice accretions across the northern part of the state averaged between one-tenth and two-tenths of an inch. Precipitation briefly started as sleet a little after before changing to freezing rain overnight. Temperatures continued to rise that morning and by 9 a.m. EST, the freezing rain changed to plain rain. This unseasonably cold weather made it easier for slippery conditions to develop on untreated roadways and led to a rash of accidents. No damages were reported in Burlington County.	NOAA-NCDC
January 19, 2009	Winter Weather	N/A	N/A	An upper-level disturbance from the eastern Great Lakes produced an area of moderate to locally heavy snow across mainly portions of northern New Jersey. The enhanced snowfall rates along with temperatures below freezing, produced very slippery conditions. The snow tapered off from southwest to northeast during the early evening hours of the 19th. A fatal accident occurred in Burlington County during the morning of the 19th when a combination of snow and fog produced slippery roads. The fatal crash occurred in Westampton Township when a car slid and went underneath a tractor-trailer. No other details were available. Some snowfall totals in Burlington County included 0.4 of an inch in Mount Holly township. No damages were reported.	NOAA-NCDC
December 19 - 20, 2009	Heavy Snow/ Strong Wind/ Winter Weather	DR-1873	Yes	A major winter storm dropped heavy snow across most of New Jersey. Snowfall averaged 6 to 12 inches across northwest New Jersey and the Raritan Basin and 12 to 24 inches across central and southern New Jersey. Snow began around Noon in the Raritan Basin and mixed with sleet at times during the day on the 19th. The snow fell at its heaviest between the afternoon and early evening, and lingered through 8 a.m. on the 20th. Since this storm occurred on the weekend, the number of traffic accidents was down. Nevertheless, there were 77 reported accidents in Burlington County. The winter storm came at an inopportune time for retailers as the Saturday (the 19th) before Christmas is usually one of the	NOAA-NCDC, SHELDUS, FEMA, Planning Committee Input

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				busiest shopping days of the year. The storm left motorists stranded, caused accidents, school closures, delayed public services and interrupted public transit. Representative snowfall in Burlington County included in Tabernacle Township and 19.0 inches in Moorestown Township. Delran Township experienced road closures throughout the Township. Record snowfall disrupted transportation and public safety systems in Hainesport Township. Mansfield Township experienced numerous road closures and power outages. Westampton Township experienced road closures, utility outages, and commercial closures. The Township was responsible for snow removal. Washington Township required on-call duties for employees and equipment for snow removal. Tabernacle Township had minor damage from this event, with power outages and road closures. Springfield Township had several road closures. Moorestown Township had road closures. Medford Township had road, school and commercial closure. SHELDUS reported over \$25K in damages in Burlington County.	
February 5 - 6, 2010	Severe Winter Storm and Snowstorm	DR-1889	Yes	A major winter storm dropped 10 to 20 inches across central of New Jersey from the afternoon of the 5th into the afternoon of the 6th. Many county and municipalities declared snow emergencies. On March 23, President Barack Obama declared Atlantic, Burlington, Cape May, Camden, Cumberland, Gloucester and Salem Counties a Major Disaster Area. About 100,000 homes and businesses lost power in the state. Some roads and highways were impassable, speed limits were reduced, and Amtrak canceled train service. Where the snow was relatively lighter, more accidents and fender benders were reported. Representative snowfall in Burlington County included 21.0 inches in Willingboro Township, 19.6 inches in Tabernacle Township, and 19.0 inches in Maple Shade Borough. Delran Township experienced road closures throughout the Township. Evesham Township experienced power outages and a structural collapse was documented due to heavy snow accumulation. Mansfield Township experienced numerous road closures and power outages. Westampton Township experienced road closures, utility outages, and commercial closures; Township was responsible for snow removal. Washington Township experienced power outages. Tabernacle Township had minor damage from this event, with power outages and road closures. Springfield Township had several road closures. Pemberton Township had road closures, utility outages and commercial closes; Township experienced \$53 K in losses. Palmyra Township had disruption with their transportation and public safety systems; roads were closed. Moorestown Township had road closures. Medford Township had to open a shelter for its residents; schools and roads were closed.	NOAA-NCDC, Planning Committee Input

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				As of 4/4/2013, total public assistance grants obligated to affected NJ communities topped \$13.7M.	
February 9 - 10, 2010	Winter Storm/ Winter Weather	DR-1889	Yes	For the second time within a week a major winter storm affected New Jersey. Blizzard conditions occurred at times across the extreme southern part of the state during the afternoon and early evening of the 10th. Snowfall averaged 7 to 15 inches across northwest New Jersey, 12 to 20 inches across central New Jersey and 6 to 12 inches across the southern third of New Jersey. Ice accretions were less than one tenth of an inch. Two storm related deaths occurred in Burlington and Middlesex Counties. In Burlington County, a 51-year-old man in Riverside died after a porch awning collapsed onto him. A Sunnyside Farm barn collapsed in Westampton and the roof of a Rite-Aid collapsed in Marlton. A shelter was opened in Medford as 1,900 homes within the township lost power. Record snowfall disrupted transportation and public safety systems in Hainesport Township. Representative snowfall in Burlington County included 16.0 inches in Medford Township, 15.9 inches in Mount Holly Township, 15.1 inches in Tabernacle Township, and 14.5 inches in Mount Laurel Township.	NOAA-NCDC, FEMA
March 12 - April 15, 2010	Severe Storms and Flooding/ Strong Wind	N/A	N/A	A Nor'Easter moved into the area on March 12. On March 13, strong to high winds downed thousands of trees and tree limbs, hundreds of telephone poles, and caused utility outages throughout the state. The strongest winds occurred during the afternoon on the 13th. Governor Chris Christie declared a state of emergency on March 14th, and on March 26 requested a major disaster declaration. A state-wide federal disaster declaration was announced on April 2, making IA and PA available for affected areas. At the time of this report, a total \$16.9M in IA had been approved and \$30.7M in PA had been obligated throughout the State of New Jersey. Peak wind gusts included 65 mph in Woodland Township at Chatsworth, 63 mph at McGuire AFB, and 61 mph in Burlington (City). SHELDCUS reported \$100K in damages.	NOAA-NCDC
December 26-27, 2010	Severe Winter Storm and Snowstorm	DR-1954	Yes	A severe winter storm affected 15 counties in New Jersey, including Burlington County. In Hainesport Township, roads were closed or severely compromised. Mansfield Township experienced numerous road closures and power outages. Westampton Township experienced road closures, utility outages and commercial closures; Township was responsible for snow removal. Washington Township cleared and sanded roadways throughout their Township. Tabernacle	FEMA, Planning Committee Input

SECTION 5.4.8: RISK ASSESSMENT – SEVERE WINTER STORM

Table 5.4.8-3. Winter Storm Events Between 1993 and 2012.

Date of Event	Event Type	FEMA Declaration #	County Designated?	Location and Description	Source(s)
				Township had minor damage from this event, with power outages and road closures. Springfield Township had to close roads due to snow accumulation. Pemberton Township had road closures, utility outages and commercial closures. Palmyra Township had disruption with their transportation and public safety systems; roads were closed. Moorestown Township had road closures.	
October 29, 2011	Severe Winter Storm	DR-4048	No	A winter storm dropped heavy snow across parts of central and all of northwest New Jersey. Across the Raritan Basins precipitation changed from rain to snow by 11 a.m. in most places, falling heavy at times until 5 p.m. As precipitation became lighter, it mixed with some sleet and rain, ending late that evening. In the Raritan Basin accumulations averaged 3 to 7 inches. Over 800,000 utility customers in the state lost power, not fully restored until Nov. 4th. On November 30, President Obama declared a state-wide major disaster declaration. According to FEMA's preliminary damage assessment, the storm's primary impact was costs associated with debris removal. As of 4/4/2013, total public assistance cost estimate state-wide was over \$24.7M. Representative snowfall in Burlington County included 1.2 inches in Florence and Mount Laurel Townships. No property damages were reported.	FEMA, NOAA-NCDC
April 2012	Nor'Easter	N/A	N/A	In Delran Township, roads were closed in the Riverside Park neighborhood. The fire department responded to numerous calls for assistance to pump out basements.	

Sources: NOAA-NCDC, FEMA, SHELDUS, Burlington County HMP, NJ HMP

Note: Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

DR	Disaster Declaration
EM	Emergency Declaration
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
IA	Individual Assistance
K	Thousand (\$)
M	Million (\$)
N/A	Not Applicable
NCDC	National Climatic Data Center
NJ	New Jersey
NOAA	National Oceanic and Atmospheric Administration
PA	Public Assistance
SHELDUS	Spatial Hazard Events and Losses Database for the United States



Probability of Future Events

According to the NJ HMP, winter storms are frequent events for the State and occur from late November until March. Because of New Jersey’s northern location at a climactic crossroads and its distinctive geography, it experiences the full effect of the winter season. Normally experiencing lower temperatures on most winter days, the north has a greater chance of all types of winter storms occurring (NJOEM, 2012).

This plan indicates the probability of future occurrences in terms of frequency based on historical events. Using the historical data presented in Table 5.4.8-4, Burlington County and its participating jurisdictions have experienced 131 winter weather events between February 3, 1995 and January 25, 2013 – an average of seven storms per year. Based on historic records, it is by far most likely that the storm will be one involving snow or a wintery mix as opposed to consisting of merely an ice event.

Table 5.4.8-4. Probability of Occurrence of Winter Storms/Ice Storms, Burlington County

Type	Total Number of Events	Probability of Occurrence * (%)	Average Annual Number of Events **
Snow Events	45	34%	2.5
Snow/Ice Events/Winter Weather	84	64%	4.67
Ice Events	2	2%	0.11
All Winter Storm / Ice Storm Events	131	100%	7.28

Source: NOAA’s NCDC Storm Events Database

Note: * The probability of occurrence is presented in terms of frequency based on historical events. Probability of Occurrence has been calculated by dividing the number of events of a given type by the total number of events for all categories. For example, the probability of occurrence of a snow event in Burlington County = $45/131 = 34\%$. In other words, if a winter storm/ice storm event were to occur, there is a 49% chance that it would be a snow event.
 ** Average annual number of events has been calculated by dividing the number of events of a given type by the number of years of historical record (which, in this case, is 11 years. For example, the average annual number of snow events in the County = $45/18 = 2.5$.

The identified hazards of concern for Burlington County are ranked in Section 5.3. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the County Planning Mitigation Committee, the probability of occurrence for severe winter storms in Burlington County is considered ‘frequent’ (event likely to occur within 25 years) as presented in Table 5.3-3 and impacts only related to severe winter storms, excluding those associated with hurricanes, tropical storms, and flooding, are expected to be medium.

It is estimated that Burlington County and all of its jurisdictions, will continue to experience direct and indirect impacts of severe winter storms annually that may induce secondary hazards such as flooding, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe winter storm events, the entire County has been identified as the hazard area. Therefore, all assets in Burlington County (population, structures, critical facilities and lifelines), as described in Burlington County Profile section (Section 4), are vulnerable. The following section includes an evaluation and estimation of the potential impact severe winter storm events have on Burlington County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, safety and health, (2) general building stock, (3) critical facilities (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

Severe winter storms are of significant concern to Burlington County because of their frequency and magnitude in the region. Additionally, they are of significant concern due to the direct and indirect costs associated with these events; delays caused by the storms; and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure (power outages) and traffic accidents, and stress on community resources.

Data and Methodology

National weather databases and local resources were used to collect and analyze severe winter storm impacts on Burlington County and the participating municipalities. The 2010 U.S. Census data and default HAZUS-MH 2.1 general building data was used to support an evaluation of assets exposed to this hazard and the potential impacts associated with this hazard.

Impact on Life, Health and Safety

According to the NOAA National Severe Storms Laboratory (NSSL); every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. Heavy accumulations of ice can bring down trees and power lines, disabling electric power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. Storms near the coast can cause coastal flooding and beach erosion as well as sink ships at sea. The economic impact of winter weather each year is huge, with costs for snow removal, damage and loss of business in the millions (NSSL, 2006).

Heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of

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snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns (NSSL, 2006).

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days/weeks while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL, 2006).

For the purposes of this HMP, the entire population of Burlington County (448,734 people) is exposed to severe winter storm events (U.S. Census, 2010). Snow accumulation and frozen/slippery road surfaces increase the frequency and impact of traffic accidents for the general population, resulting in personal injuries. Refer to Table 4-2 in Burlington County Profile for population statistics for each participating municipality.

The elderly are considered most susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, severe winter storm events can reduce the ability of these populations to access emergency services. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). Table 5.4.8-5 summarizes the population over the age of 65 and individuals living below the Census poverty threshold.

Table 5.4.8-5. Burlington County Population Statistics (2010 U.S. Census)

Municipality	Census 2010 Total Pop.	Pop. 65+ Census 2010		Low-Income Pop. ** HAZUS-MH	
		Total	% of Total	Total	% of Total
Bass River, Township of	1,443	187	13	129	8.5
Beverly, City of	2,577	292	11.3	271	10.2
Bordentown, City of	3,924	528	13.5	520	13.1
Bordentown, Township of	11,367	1,207	10.6	564	6.7
Burlington, City of	9,920	1,556	15.7	1,269	13.0
Burlington, Township of	22,594	2,719	12.0	1,537	7.6
Chesterfield, Township of	7,699	415	5.4	72	1.2
Cinnaminson, Township of	15,569	2,839	18.2	726	5.0
Delanco, Township of	4,283	689	16.1	332	10.3
Delran, Township of	16,896	2,009	11.9	1,185	7.6
Eastampton, Township of	6,069	283	4.7	423	6.8
Edgewater Park, Township of	8,881	1,403	15.8	876	11.1
Evesham, Township of	45,538	5,961	13.1	2,134	5.0
Fieldsboro, Borough of	540	57	10.6	18	3.4
Florence, Township of	12,109	1,534	12.7	956	8.9
Hainesport, Township of	6,110	874	14.3	233	5.6
Lumberton, Township of	12,559	1,312	10.4	952	9.1
Mansfield, Township of	8,544	2,382	27.9	501	9.8
Maple Shade, Township of	19,131	2,530	13.2	2,321	12.2
Medford Lakes, Borough of	4,146	611	14.7	122	2.9
Medford, Township of	23,033	3,212	13.9	835	3.8

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Table 5.4.8-5. Burlington County Population Statistics (2010 U.S. Census)

Municipality	Census 2010 Total Pop.	Pop. 65+ Census 2010		Low-Income Pop. ** HAZUS-MH	
		Total	% of Total	Total	% of Total
Moorestown, Township of	20,726	3,360	16.2	1,126	5.9
Mount Laurel, Township of	41,864	6,723	16.1	1,204	11.2
Mt. Holly, Township of	9,536	1,054	11.1	2,873	7.1
New Hanover, Township of	7,385	276	3.7	258	2.6
North Hanover, Township of	7,678	648	8.4	834	11.4
Palmyra, Borough of	7,398	973	13.2	677	9.5
Pemberton, Borough of	1,409	187	13.3	142	11.7
Pemberton, Township of	27,912	3,257	11.7	2,535	8.8
Riverside, Township of	8,097	850	10.5	881	11.1
Riverton, Borough of	2,779	498	17.9	214	7.8
Shamong, Township of	6,409	636	9.8	301	4.7
Southampton, Township of	10,464	3,347	32.0	1,509	14.5
Springfield, Township of	3,414	453	13.3	116	3.6
Tabernacle, Township of	6,949	777	11.2	319	4.4
Washington, Township of	1,781***	N/A	N/A	53	8.5
Westampton, Township of	8,813	914	10.4	331	4.6
Willingboro, Township of	31,629	5,037	15.9	1,657	5.0
Woodland, Township of	1,788	187	10.5	50	4.3
Wrightstown, Borough of	802	63	0.07	164	21.9
Burlington County	448,734	26,231	5.8	31,220	7.4

Source: U.S. Census 2000; HAZUS 2.1

Note: Pop. = population

* Individuals below poverty level (2012 Census poverty threshold for a 3-person family unit is \$17,959)

** Households with an income of less than \$20,000 based on 2000 U.S. Census statistics in HAZUS-MH v2.1

Impact on General Building Stock

The entire general building stock inventory in Burlington County is exposed and vulnerable to the severe winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Table 5.4.8-6 presents the total exposure value for general building stock for each participating municipality (structure only).

There was no historic information available that identified property damages within Burlington County due to a single severe winter storm event. Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers percentage damages that could result from severe winter storm conditions. Table 5.4.8-6 below summarizes percent damages that could result from severe winter storm conditions for Burlington County's total general building stock (structure only). Given professional knowledge and information available, the potential losses for this hazard are considered to be overestimated.

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Table 5.4.8-6. General Building Stock Exposure (Structure Only) and Estimated Losses from Severe Winter Storm Events in Burlington County

Municipality	Total (All Occupancies) RV	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Bass River Township	\$101,257,000	\$1,012,570	\$5,062,850	\$10,125,700
Beverly City	\$203,182,000	\$2,031,820	\$10,159,100	\$20,318,200
Bordentown City	\$364,327,000	\$3,643,270	\$18,216,350	\$36,432,700
Bordentown Township	\$756,748,000	\$7,567,480	\$37,837,400	\$75,674,800
Burlington City	\$847,191,000	\$8,471,910	\$42,359,550	\$84,719,100
Burlington Township	\$1,950,990,000	\$19,509,900	\$97,549,500	\$195,099,000
Chesterfield Township	\$299,950,000	\$2,999,500	\$14,997,500	\$29,995,000
Cinnaminson Township	\$1,416,712,000	\$14,167,120	\$70,835,600	\$141,671,200
Delanco Township	\$282,362,000	\$2,823,620	\$14,118,100	\$28,236,200
Delran Township	\$1,295,952,000	\$12,959,520	\$64,797,600	\$129,595,200
Eastampton Township	\$451,284,000	\$4,512,840	\$22,564,200	\$45,128,400
Edgewater Park Township	\$589,879,000	\$5,898,790	\$29,493,950	\$58,987,900
Evesham Township	\$3,885,335,000	\$38,853,350	\$194,266,750	\$388,533,500
Fieldsboro Borough	\$42,846,000	\$428,460	\$2,142,300	\$4,284,600
Florence Township	\$922,519,000	\$9,225,190	\$46,125,950	\$92,251,900
Hainesport Township	\$485,136,000	\$4,851,360	\$24,256,800	\$48,513,600
Lumberton Township	\$926,654,000	\$9,266,540	\$46,332,700	\$92,665,400
Mansfield Township	\$1,053,948,000	\$10,539,480	\$52,697,400	\$105,394,800
Maple Shade Township	\$1,455,690,000	\$14,556,900	\$72,784,500	\$145,569,000
Medford Lakes Borough	\$361,430,000	\$3,614,300	\$18,071,500	\$36,143,000
Medford Township	\$2,279,232,000	\$22,792,320	\$113,961,600	\$227,923,200
Moorestown Township	\$2,427,401,000	\$24,274,010	\$121,370,050	\$242,740,100
Mount Holly Township	\$942,557,000	\$9,425,570	\$47,127,850	\$94,255,700
Mount Laurel Township	\$4,195,041,000	\$41,950,410	\$209,752,050	\$419,504,100
New Hanover Township	\$825,998,000	\$8,259,980	\$41,299,900	\$82,599,800
North Hanover Township	\$419,942,000	\$4,199,420	\$20,997,100	\$41,994,200
Palmyra Borough	\$582,624,000	\$5,826,240	\$29,131,200	\$58,262,400
Pemberton Borough	\$110,647,000	\$1,106,470	\$5,532,350	\$11,064,700
Pemberton Township	\$1,970,889,000	\$19,708,890	\$98,544,450	\$197,088,900
Riverside Township	\$533,916,000	\$5,339,160	\$26,695,800	\$53,391,600
Riverton Borough	\$221,269,000	\$2,212,690	\$11,063,450	\$22,126,900
Shamong Township	\$500,704,000	\$5,007,040	\$25,035,200	\$50,070,400
Southampton Township	\$823,737,000	\$8,237,370	\$41,186,850	\$82,373,700
Springfield Township	\$282,453,000	\$2,824,530	\$14,122,650	\$28,245,300
Tabernacle Township	\$576,928,000	\$5,769,280	\$28,846,400	\$57,692,800
Washington Township	\$63,380,000	\$633,800	\$3,169,000	\$6,338,000
Westampton Township	\$769,854,000	\$7,698,540	\$38,492,700	\$76,985,400
Willingboro Township	\$2,284,353,000	\$22,843,530	\$114,217,650	\$228,435,300
Woodland Township	\$75,012,000	\$750,120	\$3,750,600	\$7,501,200
Wrightstown Borough	\$80,320,000	\$803,200	\$4,016,000	\$8,032,000
Burlington County	\$37,659,649,000	\$376,596,490	\$1,882,982,450	\$3,765,964,900

Source: HAZUS-MH 2.0

Notes: RV = Replacement Cost Value. The building values shown are building structure only because damage from the severe winter storm hazard generally impact structures such as the roof and building frame (rather than building content). The valuation of general building stock and the loss estimates determined in Burlington County were based on the default general building stock database provided in HAZUS-MH 2.1.

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood hazard profile (Section 5.4.1). Generally, losses from flooding associated with severe winter storms should be less than that associated with a 100-year or 500-year flood. In summary, snow and ice melt can cause both riverine and urban flooding. Estimated losses due to riverine flooding in Burlington County are discussed in Section 5.4.1.

Impact on Critical Facilities

Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a severe winter storm event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires infrastructure to clear roadways, alert citizens to dangerous conditions, and following the winter requires resources for road maintenance and repair. Additionally, freezing rain and ice storms impact utilities (i.e., power lines and overhead utility wires) causing power outages for hundreds to thousands of residents.

Impact on Economy

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. Another impact on the economy includes impacts on commuting into, or out of, the area for work or school. The loss of power and closure of roads prevents the commuter population traveling to work within and outside of the County.

The County of Burlington budgets annually for rock salt and liquid calcium to be used for snow & ice removal application. In addition, supplemental snow removal services are budgeted for and publicly bid on an annual basis as well. Please note that these snow removal services are used only during snow events when required.

Future Growth and Development

As discussed in Sections 4 and 9, areas targeted for future growth and development have been identified across Burlington County. Any areas of growth could be potentially impacted by the severe winter storm hazard because the entire planning area is exposed and vulnerable. Please refer to the specific areas of development indicated in tabular form (subsection B) and/or on the hazard maps (subsection I) included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Additional Data and Next Steps

The assessment above identifies vulnerable populations and economic losses associated with this hazard of concern. Historic data on structural losses to general building stock are not adequate to predict specific losses to this inventory; therefore, the percent of damage assumption methodology was applied. This methodology is based on FEMA's How to Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA, 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA, 2004). The collection of additional/actual valuation data for general building stock and critical infrastructure losses would further support future estimates of potential exposure and damage for the general building stock inventory.

SECTION 6: MITIGATION STRATEGIES

This section presents mitigation actions for Burlington County to reduce potential exposure and losses identified as concerns in the Risk Assessment portion of this plan. The Planning Committee reviewed the Risk Assessment to identify and develop these mitigation actions, which are presented herein.

This section includes:

- (1) Background and Past Accomplishments
- (2) General Mitigation Planning Approach
- (3) Guiding Principle, Mitigation Goals and Objectives
- (4) Capability Assessment

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events. Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.

Mitigation actions can include activities such as: revisions to land-use planning, training and education, and structural and nonstructural safety measures.

BACKGROUND AND PAST ACCOMPLISHMENTS

Although DMA 2000 does not require a discussion regarding past mitigation activities, an overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and activities outlined in this Plan. The County, through previous and ongoing hazard mitigation activities, has demonstrated that it is pro-active in protecting its physical assets and citizens against losses from natural hazards. Examples of previous and ongoing actions and projects include:

- All jurisdictions with the exception of Fieldsboro participate in the NFIP, which requires the adoption of FEMA floodplain mapping and certain minimum construction standards for building within the floodplain.
- The County has been actively attempting to update the All-Hazards Mitigation Plan on an annual basis. Due to limited staffing and disaster events, annual meetings were not convened. Future convening of the hazard mitigation committee and preparing annual progress reports to support CRS communities will be conducted as outlined in the Plan Maintenance section of this plan. These efforts will continue to develop the hazard mitigation plan to reduce hazard vulnerability on the county and municipal levels.
- Two jurisdictions participating in this Plan participate in the CRS, the City of Burlington (CRS Classification 8), and the Borough of Palmyra (8).
- The Pinelands National Reserve Comprehensive Management Plan was updated in 2012.
- Burlington County has a robust Public Information system to disseminate information prior, during and after hazard events.
- The County continues to encourage the use of higher regulatory standards such as local floodplain management ordinances and zoning codes.
- The Burlington County Office of Emergency Management Flood Emergency Operations Plan, Rancocas Creek Watershed Management Area #19 was updated in 2013.

These past and ongoing activities have contributed to the County's understanding of its hazard preparedness and future mitigation activity needs, costs, and benefits. These efforts provide a foundation for the Planning Committee to use in developing this HMP.

GENERAL MITIGATION PLANNING APPROACH

The general mitigation planning approach used to develop this plan is based on the FEMA publication, developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies (FEMA 386-3) and input provided by NJOEM. The FEMA document and NJOEM guidance include four steps, which were used to support mitigation planning. These steps are summarized below and presented in more detail in the following sections.

- Develop mitigation goals and objectives:** Mitigation goals were developed using the hazard characteristics, inventory, and findings of the risk assessment, and through the results of the public outreach program. By reviewing these outputs and other municipal policy documents, objectives tying to these overarching goals were identified and characterized into similar themes.
- Identify and prioritize mitigation actions:** Based on the risk assessment outputs, the mitigation goals and objectives, existing literature and resources, and input from the participating entities, alternative mitigation actions were identified. The potential mitigation actions were qualitatively evaluated against the mitigation goals and objectives and other evaluation criteria. They were then prioritized into three categories: high, medium, and low.
- Prepare an implementation strategy:** High priority mitigation actions are recommended for first consideration for implementation, as discussed under each hazard description in the following sections. However, based on community-specific needs and goals and available funding and costs, some low or medium priority mitigation actions may also be addressed or could be addressed before some of the high priority actions.
- Document the mitigation planning process:** The mitigation planning process is documented throughout this Plan.

FEMA defines **Goals** as general guidelines that explain what should be achieved. Goals are usually broad, long-term, policy statements, and represent a global vision.

FEMA defines **Objectives** as strategies or implementation steps to attain mitigation goals. Unlike goals, objectives are specific and measurable, where feasible.

FEMA defines **Mitigation Actions** as specific actions that help to achieve the mitigation goals and objectives.

Guiding Principle, Mitigation Goals and Objectives

This section presents the guiding principle for this Plan, and mitigation goals and objectives identified to reduce or avoid long-term vulnerabilities to the identified hazards.

Mission Statement

Per FEMA guidance (386-1), a mission statement or guiding principle describes the overall duty and purpose of the planning process, and serves to identify the principle message of the plan. It focuses or constrains the range of goals and objectives identified. This is not a goal because it does not describe outcomes. Burlington County's mission statement is broad in scope, and provides a direction for the Plan. The Burlington County Hazard Mitigation Steering Committee developed the mission statement for the 2013 Burlington County Hazard Mitigation Plan as follows:

Through partnerships and careful planning, identify and reduce the vulnerability to natural hazards in order to protect the health, safety, quality of life, environment, and economy of the communities within Burlington County.

Goals and Objectives

According to CFR 201.6(c)(3)(i): “The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.” The Planning Committee developed mitigation goals and objectives based on the risk assessment results, discussions, research, and input from amongst the committee, existing authorities, policies, programs, resources, stakeholders and the public.

In 2008, the Steering Committee identified ten goals. Goals were developed by taking into consideration both state and jurisdictional goals for mitigation. None of the goals or actions in the 2008 County plan contradicted with the goals of the State Hazard Mitigation Plan.

1. Promote disaster-resistant development.
2. Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.
3. Reduce the possibility of damage and losses due to drought.
4. Reduce the possibility of damage and losses due to flooding caused by floods and hurricanes.
5. Reduce the possibility of damage and losses due to earthquakes.
6. Reduce the possibility of damage and losses due to landslides.
7. Reduce the possibility of damage and losses due to wildfires.
8. Reduce the possibility of damage and losses due to winter storms.
9. Reduce the possibility of damage and losses due to tornadoes and high winds caused by windstorms and hurricane winds.
10. Reduce the possibility of damages to emergency facilities from flooding, wind damage and wildfire damage

The Steering Committee revised the goals and five new goals were established. These new goals were identified through a facilitated exercise, working from a catalog of goal statements created through review of the State Hazard Mitigation Plan, similar plans and FEMA planning guidance. Once the goals were established, objectives that meet multiple goals were selected through a similar facilitated exercise. For the purposes of this Plan, goals are defined as follows:

Goals are general guidelines that explain what is to be achieved. They are usually broad, long-term, policy-type statements and represent global visions. Goals help define the benefits that the Plan is trying to achieve. The success of the Plan, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of hazard mitigation).

The following are the mitigation plan goals for the 2013 update as established by the Steering Committee:

- Protect Life
- Protect Property
- Promote a Sustainable Economy
- Protect the Environment
- Increase Public Awareness

Burlington County goals are compatible with the needs and goals expressed in other available community planning documents as well as the NJ State Hazard Mitigation Plan. Objectives were created to further define the specific actions or implementation steps of the goals. Achievement of these goals and

objectives will define the effectiveness of a mitigation strategy. The goals also are used to help establish priorities.

The objectives were developed and/or selected by the Steering Committee through its knowledge of the local area, review of past efforts, findings of the risk assessment, qualitative evaluations, and identification of mitigation options. The objectives are used to 1) measure the success of the Plan once implemented, and 2) to help prioritize identified mitigation actions. For the purposes of this Plan, objectives are defined as follows:

Objectives are short-term aims which, when combined, form a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

The Steering Committee developed multi-goal objectives in the 2013 plan update. Therefore, the objectives stated below are long-term statements of what the participating jurisdictions hope to achieve over time through implementation of the plan. They are based on the findings of the risk assessment, and will apply to each jurisdiction adopting this plan.

SECTION 6: MITIGATION STRATEGY

Table 6-1. Burlington County Hazard Mitigation Plan Objectives

Obj. #	Objective Statement	Protect Life	Protect Property	Promote a Sustainable Economy	Protect the Environment	Increase Public Awareness
O-1	Promote disaster-resistant development.	x	x	x	x	
O-2	Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.	x	x	x		x
O-3	Reduce the possibility of damages to emergency facilities from natural hazards.	x	x	x		
O-4	Reduce the possibility of damage and losses due to natural hazards affecting the county and its municipalities.	x	x	x	x	
O-5	Educate the public on the risk from natural and man-made hazards and increase their awareness of preparation, mitigation, response, and recovery activities.	x	x			x
O-6	Ensure continuity of government operations, emergency services, and essential facilities at the local level during and immediately after hazard events.	x	x	x		
O-7	Increase communications before, during, and after natural hazard events.	x	x	x	x	x
O-8	Retrofit, acquire, or relocate vulnerable property in high hazard areas including those known to be subject to repetitive damages.	x	x	x	x	
O-9	Utilize the best available information on hazard exposure and vulnerability to support appropriate land use decisions within Burlington County.	x	x	x	x	x

Capability Assessment

According to FEMA 386-3, a capability assessment is an inventory of a community's missions, programs and policies; and an analysis of its capacity to carry them out. This assessment is an integral part of the planning process. The assessment process enables identification, review and analysis of local and state programs, policies, regulations, funding and practices currently in place that may either facilitate or hinder mitigation.

A capability assessment was prepared by Burlington County and each participating jurisdiction. The capability assessments are presented in Section 9, Volume II of this Plan. By completing this assessment, Burlington County and each jurisdiction learned how or whether they would be able to implement certain mitigation actions by determining the following:

- Types of mitigation actions that may be prohibited by law;
- Limitations that may exist on undertaking actions; and
- The range of local and/or state administrative, programmatic, regulatory, financial and technical resources available to assist in implementing their mitigation actions.
- Action is currently outside the scope of capabilities (funding)
- The jurisdiction is not vulnerable to the hazard
- Action is already being implemented

IDENTIFICATION, PRIORITIZATION, ANALYSIS, AND IMPLEMENTATION OF MITIGATION ACTIONS

This subsection discusses the identification, prioritization, analysis and implementation of mitigation actions for Burlington County.

Strengths, Weaknesses, Opportunities and Obstacles (SWOO)

On June 27, 2013, a Strengths, Weaknesses, Opportunities, and Obstacles (SWOO) session was held with the Planning Committee and the invited agencies/stakeholders identified in table 6.2 below. The purpose of this session was to review information garnered from the risk assessment and the public involvement strategy to identify strengths, weaknesses, opportunities and obstacles in hazard mitigation within Burlington County through a facilitated brainstorming session on risks, vulnerabilities, and capabilities. All information shared during this session was recorded and used to prepare catalogs of mitigation alternatives to be used by the Planning Committee in preparing their individual jurisdictional annexes. Many of the strategies (such as community outreach) identified in the catalogs could be applied to multiple hazards. This Plan identifies strategies for multiple hazards for the County and each jurisdictional annex for participating jurisdictions (Section 9).

Table 6-2. Agencies/Stakeholders

Agency/Stakeholder
Evesham
Springfield
Moorestown
Medford Lakes
Pemberton
Mt. Laurel
Bordentown City
Burlington City
Burlington County Health
Westampton
Delanco
Burlington County OEM
Tabernacle
Wrightstown
Hainesport
Southampton
Burlington County College
Palmyra
County Resource Conservation
Washington
PSE&G
Florence
Edgewater Park
Burlington Township
Environmental Resolutions
Ocean County OEM
Bordentown
VIRTUA Health
Burlington County Highway Dept.
Lumberton
Bass River
NJ American Water
NJ Forest Fire Service

The Planning Committee generated a mitigation catalog which includes a comprehensive list of mitigation actions (see Appendix D) to be considered that met the following objectives:

- Use information obtained from the public involvement strategy;
- Use information provided in the risk assessment;
- Seek mitigation actions consistent with the goals and objectives for the Burlington County Plan;
- Create catalogs of mitigation actions to be used as a tool by the Planning Committee in selection of mitigation actions.

Catalog of Mitigation Actions

Based on information gathered during the SWOO session, a catalog of mitigation actions was created listing initiatives that could manipulate the hazard, reduce exposure to the hazard, reduce vulnerability to the hazard, and to increase the ability to respond to or be prepared for a hazard (Appendix D). In addition, the catalog indicates responsibility for implementation (i.e., who would most likely implement the initiative: personal property owners, private sector business, or government). The FEMA publication, “Mitigation Ideas” dated January 2013 was also provided to each plan participant to use as a resource and to compliment the mitigation catalog. Based on the risk assessment, the hazards included in the catalog are deemed to be those to which the planning area is most vulnerable.

The catalog is not meant to be exhaustive or site-specific but rather to inspire thought and provide members of the Planning Committee a baseline of initiatives backed by a planning process, consistent with the goals and objectives of the planning area, and within the capabilities of the Participants. The Planning Committee was not bound to these actions. They had the opportunity to add further actions subsequent to the SWOO workshop. Actions in the catalog that were not selected by the Partners to include in their jurisdictional annexes were not selected based on the following:

- Action is currently outside the scope of capabilities (funding)
- The jurisdiction is not vulnerable to the hazard
- Action is already being implemented

All proposed mitigation actions were identified in relation to the goals and objectives presented above. The mitigation actions include a range of options in line with the six types of mitigation actions described in FEMA guidance (FEMA 386-3), including:

1. **Prevention:** Government, administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, floodplain local laws, capital improvement programs, open space preservation, and storm water management regulations.
2. **Property Protection:** Actions that involve (1) modification of existing buildings or structures to protect them from a hazard or (2) removal of the structures from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.
3. **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
4. **Natural Resource Protection:** Actions that minimize hazard loss and also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
5. **Emergency Services:** Actions that protect people and property, during and immediately following, a disaster or hazard event. Services include warning systems, emergency response services, and the protection of essential facilities.

Mitigation Actions

The mitigation actions are the key element of the natural hazards mitigation plan. It is through the implementation of these actions that Burlington County and the participating jurisdictions can strive to

become disaster-resistant through hazard mitigation. For the purposes of this Plan, mitigation actions are defined as follows:

Mitigation actions are activities designed to reduce or eliminate losses resulting from natural hazards.

Although one of the driving influences for preparing this Plan was grant funding eligibility, its purpose is more than just access to federal funding. It was important to the Planning Committee to look at mitigation actions that will work through all phases of emergency management. Some of the actions outlined in this Plan may not be grant eligible—grant eligibility was not the focus of the selection. Rather, the focus was the actions’ effectiveness in achieving the goals of the Plan and whether they are within the County or each jurisdiction’s capabilities.

A series of mitigation actions were identified by Burlington County and each participating jurisdiction. These actions are summarized in the County and Jurisdictional Annexes, located in Section 9, Volume II of this Plan. Along with the hazards mitigated, goals and objectives met, lead agency, estimated cost, potential funding sources and the proposed timeline are identified. The parameters for the timeline are as follows:

- Short Term = To be completed in 1 to 5 years
- Long Term = To be completed in greater than 5 years
- Ongoing = Currently being funded and implemented under existing programs.

Common Mitigation Actions are identified in the table below. All mitigation strategies for each municipality were reviewed and compiled into common mitigation types, as seen below in Table 6-3.

Those identified as “opting out” of acquisition/elevation as per Chris T. include: Burlington Twp; Cinnaminson; Eastampton; Evesham; Mount Laurel; Mt. Holly; Pemberton Borough; Washington; Westampton; Willingboro. Jon, please come up with an initiative we can send these munis and ask if it can be included in their annex.

Table 6-3. Common Mitigation Actions

Municipality	Acquisitions	Elevations	Generators	Drainage / Stormwater	Education / Public Outreach
Bass River, Township of			X	X	X
Beverly, City of			X	X	X
Bordentown, City of			X	X	X
Bordentown, Township of			X	X	X
Burlington, City of			X	X	X
Burlington, Township of	*		X	X	X
Chesterfield, Township of	X	X	X		X
Cinnaminson, Township of	*		X	X	X
Delanco, Township of			X	X	X
Delran, Township of	X	X	X	X	X
Eastampton, Township of	*		X		X
Edgewater Park, Township of			X	X	X
Evesham, Township of	*		X	X	X
Fieldsboro, Borough of	X	X	X		X
Florence, Township of	X	X	X	X	X
Hainesport, Township of			X		X
Lumberton, Township of		X	X		X

SECTION 6: MITIGATION STRATEGY

Municipality	Acquisitions	Elevations	Generators	Drainage / Stormwater	Education / Public Outreach
Mansfield, Township of			X		X
Maple Shade, Township of	X	X	X		X
Medford Lakes, Borough of	X	X	X	X	X
Medford, Township of	X	X	X	X	X
Moorestown, Township of	X		X	X	X
Mount Laurel, Township of	X	X	X	X	X
Mt. Holly, Township of	X	X	X		X
New Hanover, Township of			X		X
North Hanover, Township of			X	X	X
Palmyra, Borough of			X	X	X
Pemberton, Borough of	*		X	X	X
Pemberton, Township of			X	X	X
Riverside, Township of	X	X	X	X	X
Riverton, Borough of			X	X	X
Shamong, Township of			X	X	X
Southampton, Township of	X	X	X	X	X
Springfield, Township of			X		X
Tabernacle, Township of	X		X		X
Washington, Township of	*		X	X	X
Westampton, Township of	*		X	X	X
Willingboro, Township of	*		X		X
Woodland, Township of			X		X
Wrightstown Borough			X		X

Prioritization

Section 201.c.3.iii of 44 CFR requires an action plan describing how the actions identified will be prioritized. The Burlington County Planning Committee, along with their contract consultant, developed a prioritization methodology for the Plan that meets the needs of the County and participating jurisdictions while at the same time meeting the requirements of Section 201.6 of 44 CFR. The mitigation actions identified in Volume II of this plan were prioritized according to the criteria defined below.

- **High Priority:** A project that meets multiple plan goals and objectives, benefits exceed cost, has funding secured under existing programs or authorizations, or is grant-eligible, and can be completed in 1 to 5 years (short-term project) once project is funded.
- **Medium Priority:** A project that meets at least one plan goal and objective, benefits exceed costs, funding has not been secured and would require a special funding authorization under existing programs, grant eligibility is questionable, and can be completed in 1 to 5 years once project is funded.
- **Low Priority:** A project that will mitigate the risk of a hazard, benefits exceed costs, funding has not been secured, and project is not grant-eligible and/or timeline for completion is considered long-term (5 to 10 years).

It is noted that these priority definitions are considered to be dynamic and can change from one category to another based on changes to a parameter such as availability of funding. For example, a project might be assigned a medium priority because of the uncertainty of a funding source. This priority could be changed to high once a funding source has been identified such as a grant. The prioritization schedule for

this Plan will be reviewed and updated as needed annually through the plan maintenance strategy described in Section 7 of this Plan.

The planning committee reviewed the prioritization process and determined that this provided an acceptable method to prioritize the projects. In addition, specific guidance was provided by FEMA during the jurisdictional annex workshops to provide an understanding of how the resources, funding and costs factor into prioritizing projects. Therefore the STAPLEE method was not utilized in the update of the plan but instead the general philosophy was employed in conjunction with the review of the mitigation strategy.

Benefit/Cost Review

Section 201.6.c.3iii of 44CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. The County was asked to weigh the estimated benefits of a project versus the estimated costs to establish a parameter to be used in the prioritization of a project, utilizing the same parameters used by each of the participating jurisdictions as outlined in Volume II of this Plan.

This benefit/cost review was qualitative; that is, it did not include the level of detail required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. This qualitative approach was used because projects may not be implemented for up to 10 years, and the associated costs and benefits could change dramatically in that time. Each project was assessed by assigning subjective ratings (high, medium, and low) to its costs and benefits, described in Table 6-4.

Table 6-4. Project Assessment

Costs	
High	Existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
Benefits	
High	Project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. For some of the County initiatives identified, Burlington County may seek financial assistance under FEMA's HMGP or PDM programs. Both of these programs require detailed benefit/cost analysis as part of the application process. These analyses will be performed when funding applications are prepared, using the FEMA BCA model process. The Planning Committee is committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the Planning Committee reserves the right to define "benefits" according to parameters that meet its needs and the goals and objectives of this plan.

The annexes presented in Section 9, Volume II present the results of applying the prioritization methodology presented to the set of mitigation actions identified by Burlington County and each participating jurisdiction, and includes the following prioritization parameters:

- Number of objectives met by the initiative
- Benefits of the project (high, medium, or low)
- Cost of the project (high, medium, or low)
- Do the benefits equal or exceed the costs?
- Is the project grant-eligible?
- Can the project be funded under existing programs and budgets?
- Priority (high, medium, or low)

Jurisdictional Annexes

The annexes present the County's and each participating jurisdiction's mitigation action implementation strategy including:

- Mitigation actions for individual and multiple hazards
- Mitigation objectives supported by each action. Goals are not listed because all objectives meet multiple goals.
- Implementation priority
- Potential funding sources for the mitigation action (grant programs, current operating budgets or funding, or the agency or jurisdiction that will supply the funding; additional potential funding resources are identified)
- Estimated budget for the mitigation action (financial requirements for new funding or indication that the action is addressed under current operating budgets)
- Time estimated to implement and complete the mitigation action
- Existing policies, programs, and resources to support implementation of the mitigation action (additional policies, programs, and resources identified)

Specific mitigation actions were identified to prevent future losses; however, current funding is not identified for all of these actions at present. Burlington County has limited resources to take on new responsibilities or projects. The implementation of these mitigation actions is dependent on the approval of the local elected governing body and the ability of the community to obtain funding from local or outside sources. Where such actions are high priorities, the community will work together with NJOEM, FEMA and other Federal, State and County agencies to secure funds.

Each jurisdiction participating in this update (both the County and all municipalities) has assisted in the authoring of their own annex or chapter to this plan, included in Section 9. One of the key elements of each annex is the updated jurisdictional mitigation strategy.

As data, information and other input was compiled and received from the municipality, it was input directly into their draft annex. To help support the selection of an appropriate, risk-based mitigation strategy, each annex provided a summary of hazard vulnerabilities identified during the plan update process, either directly by municipal representatives, through review of available county and local plans and reports, and through the hazard profiling and vulnerability assessment process.

Annexes were then pre-populated with jurisdictional-specific mitigation actions identified during the course of the plan update, as well as general (“common”) initiatives developed during the planning process and included for municipal consideration.

Specific mitigation actions included in the draft municipal annexes included:

- Those being carried forward from the 2008 plan;
- Those specifically identified by the jurisdiction during the course of the planning process;
- Those identified in other relevant county and local plans and reports (e.g. Stream Corridor Management Plans, Highway Management Plans, Master Plans, local engineering studies, etc.);
- Those identified during the public and stakeholder outreach process (see Section 3); and,
- Those that became evident through the updated hazard profiling and risk/vulnerability assessment effort.

Throughout the plan update process, and in consideration of federal and state mitigation guidance, the Steering Committee recognized that all municipalities would benefit from the inclusion of certain “general” or “common” mitigation initiatives. These include initiatives to address vulnerable public and private properties, including RL and SRL properties; initiatives to support continued and enhanced participation in the NFIP; improved public education and awareness programs; initiatives to build greater local mitigation capabilities; and a commitment to implement and maintain the plan.

All municipalities were advised to thoroughly review these “general” initiatives, and include, amend or delete them as they found appropriate for their jurisdiction. Multiple municipal officials reviewed all initiatives included in their respective annex as noted on the municipal “sign-off” sheet found at the end of each annex.

In general, mitigation actions ranked as high priorities will be addressed first. However, medium or even low priority mitigation actions will be considered for concurrent implementation. Therefore, the ranking levels should be considered as a first-cut, preliminary ranking and will evolve based on input from Burlington County departments and representatives, municipal government departments and representatives, the public, municipal government departments and representatives, NJOEM, and FEMA as the Plan is implemented.

Area-Wide Collaborative Actions

During the five year period of the 2008 Hazard Mitigation Plan, the County and municipalities have collaborated on numerous projects. Namely the following initiatives have been jointly addressed:

- Improved communication before, during, and after flood events.
- Participation in CRS.
- Countywide Community Emergency Response Team
- Focus on acquiring property in hazard (flood) prone areas to reduce vulnerability to natural hazards.
- Providing back-up power for critical facilities.
- Improving emergency response and using new technology as it becomes available.
- Developing post disaster action plans.

SECTION 7: PLAN MAINTENANCE PROCEDURES

This section describes the system that Burlington County and all participating jurisdictions have established to monitor, evaluate, and update the mitigation plan; implement the mitigation plan through existing programs; and solicit continued public involvement for plan maintenance.

MONITORING, EVALUATING AND UPDATING THE PLAN

The procedures for monitoring, evaluating, and updating the plan are provided below.

It is recommended that a staff member of the Burlington County Office of Emergency Management (BCOEM) be designated as the county's Hazard Mitigation Coordinator, to provide leadership and continuity for plan maintenance to ensure over-arching, long term goals of the plan are addressed rather than focusing predominantly on one area such as emergency management or engineering.

Each participating jurisdiction is expected to maintain a representative on the Mitigation Planning Committee (MPC) who shall fulfill the monitoring, evaluation and updating responsibilities identified in this Section. Table 7-1 identifies the representation of the MPC as of the date of this Plan as indicated in each of the jurisdiction's annexes.

Table 7-1. Mitigation Planning Committee

Organization	Name	Title	POC	Alternate POC
Burlington County	Kevin Tuno	OEM Coordinator	X	
Burlington County	T. Steve King	Deputy OEM		X
Bass River Township	David Cope	Emergency Management Coordinator	X	
Bass River Township	Amanda Somes	Municipal Clerk		X
City of Beverly	Rich Wolbert	Administrator	X	
City of Beverly	Donna Snyder	Municipal Clerk		X
City of Bordentown	James E. Lynch, Jr.	Mayor, Emergency Management Coordinator	X	
City of Bordentown	Brian A. Maugeri, Sr.	Deputy OEM Coordinator		X
Bordentown Township	Andrew Law	Office of Emergency Management	X	
Bordentown Township	Dean Burhrer	Director - DPW		X
City of Burlington	Frank Caruso	Emergency Management Coordinator	X	
City of Burlington	Hugh Dougherty	Sewer and Drainage Engineer		X
Township of Burlington	Kevin A. Shoppas	Emergency Management Coordinator	X	
Township of Burlington	Scott Hatfield	Township Engineer		X
Township of Chesterfield	Kyle Wilson	Chief of Police/OEM	X	
Township of Chesterfield	Greg Lebak	DPW Director		X
Township of Cinnaminson	Danny Norman	Director of Emergency Management	X	
Township of Cinnaminson	Frederick Turek	Twp. Engineer/ Superintendent of PW		X
Delanco Township	Christopher Noll	Township Engineer/NFIP Administrator	X	
Delanco Township	Janice Lohr	Assistant Administrator/Municipal Clerk		X
Delran Township	Walter Bauer	Emergency Manager	X	
Delran Township	Jeff Hatcher	Township Administrator		X
Eastampton Township	Thomas Czerniecki	Township Manager	X	
Eastampton Township	Kim-Marie White	Township Clerk		X

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Organization	Name	Title	POC	Alternate POC
Edgewater Park Township	Linda M. Dougherty	RMC/Administrator	X	
Edgewater Park Township	John McElwee	Emergency Management Coordinator		X
Evesham Township	Bryan Ward	Asst. Fire Chief/Deputy OEM Coordinator	X	
Evesham Township	Lou Cavaliere	Firefighter/Inspector, Fire Department		X
Borough of Fieldsboro	Joseph Conlin	Public Safety Director	X	
Borough of Fieldsboro	David Hansell	Mayor		X
Florence Township	Philip Drangula	Emergency Management Coordinator	X	
Florence Township	James Karwacki	Deputy Emergency Management Coordinator		X
Hainesport Township	William Boettcher	OEM Coordinator	X	
Hainesport Township	Edward Ruggiano	Deputy OEM Coordinator		X
Lumberton Township	Lt. Edward Begolly	OEM Coordinator	X	
Lumberton Township	Nicholas Peditto	Deputy OEM Coordinator		X
Mansfield Township	Douglas J. Borgstrom	Emergency Management Coordinator	X	
Mansfield Township	Sean Gable	Deputy OEM Coordinator		X
Maple Shade Township	Gary La Venia	Township Manager	X	
Maple Shade Township	Rosemary Flaherty	Community Development Director/ Planning & Zoning Officer		X
Medford Township	Jeffrey Wagner	Emergency Management Coordinator	X	
Medford Township	Robert Dovi	Deputy OEM Coordinator		X
Borough of Medford Lakes	Julie Horner Keizer	Borough Manager	X	
Borough of Medford Lakes	Mark J. McIntosh	Borough Clerk		X
Moorestown Township	Lee R. Lieber	Lieutenant/Police Department	X	
Moorestown Township	Thomas Ford	Director of Community Development		X
Mount Holly Township	Ed Spooner	Emergency Management Coordinator	X	
Mount Holly Township	Steve Martin	Chief of Police, MHPD		X
Mount Laurel Township	Francis W. Pagurek	Emergency Management Coordinator	X	
Mount Laurel Township	Maureen Mitchell	Township Manager		X
New Hanover Township	Gary Timmons	Chief/Deputy OEM Coordinator	X	
New Hanover Township	Patrick Murphy	Committeeman/OEM Coordinator		X
North Hanover Township	Mark Keubler	Chief of Police, OEM Coordinator	X	
North Hanover Township	Budd Wells	Police Detective, Deputy OEM Coordinator		X
Borough of Palmyra	Tracy Kilmer	Palmyra Office of Emergency Management	X	
Borough of Palmyra	Richard Dreby	Palmyra Office of Emergency Management		X
Borough of Pemberton	Chad Bozoski	Emergency Management Coordinator / Fire Chief	X	
Borough of Pemberton	Donna Mull	Borough Clerk		X
Pemberton Township	Chief Craig L. Augustoni	Emergency Management Coordinator/Fire Chief	X	
Pemberton Township	Chief David Jantas	Deputy EMC/COP		X
Riverside Township	Meghan Jack	Administrtor	X	
Township	Steve Barone	OEM Coordinator		X
Borough of Riverton	Scott Reed	Department of Emergency Management	X	
Borough of Riverton	Betty Boyle	Department of Emergency Management		X
Shamong Township	Stanley A. Rowe	OEM Coordinator	X	
Shamong Township	Wallace Pickard, Jr.	Deputy OEM Coordinator		X

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Organization	Name	Title	POC	Alternate POC
Southampton Township	Kathy Agolio	OEM Coordinator	X	
Southampton Township	Joe Boyle	Deputy OEM Coordinator		X
Springfield Township	Eric Trout	Police Chief/Emergency Management Coordinator	X	
Springfield Township	J. Paul Keller	Township Manager		X
Tabernacle Township	William C. Lowe	Emergency Management Coordinator	X	
Tabernacle Township	Douglas Cramer	Township Administrator		X
Washington Township	Barbara L. Somes	Emergency Management Coordinator	X	
Washington Township	Horace A. Somes, Jr.	Deputy Emergency Management Coordinator		X
Westampton Township	Daryl Caulfield	Police Officer/OEM Coordinator	X	
Westampton Township	Donna Ryan	Municipal Clerk		X
Willingboro Township	Joanne G. Diggs	Township Manager	X	
Willingboro Township	John Carroll, Jr.	Emergency Management Coordinator		X
Woodland Township	Edward Vincent	OEM Coordinator	X	
Woodland Township	Thomas Leisse	Township Engineer – Pennoni Associates		X
Borough of Wrightstown	James Ingling	Deputy Coordinator, Emergency Management	X	
Borough of Wrightstown	Costic Borsavage	Coordinator, Emergency Management		X
Burlington County College	Linda Schmidt	Director of Public Safety	X	
Burlington County College	Mark Meara	Public Safety		X

*TBD=to be determined

It is recognized that individual commitments change over time, and it shall be the responsibility of each jurisdiction and its representatives to inform the HMP Coordinator of any changes in representation. The HMP Coordinator will strive to keep the committee makeup as a uniform representation of planning partners and stakeholders within the planning area.

Monitoring

The MPC shall be responsible for monitoring progress on, and evaluating the effectiveness of, the Plan, and documenting annual progress. Each year, beginning one year after plan development, county and local MPC representatives will collect and process information from the departments, agencies and organizations involved in implementing mitigation projects or activities identified in their jurisdictional annexes (Volume II, Section 9) of this Plan, by contacting persons responsible for initiating and/or overseeing the mitigation projects.

Local MPC representatives may use the FEMA progress reporting guidance worksheets included in Appendix G to facilitate collection of progress data and information on specific mitigation actions. This information **shall be provided to the County HMP Coordinator prior to the annual MPC meeting to be held on the last Wednesday in September.**

The information that MPC representatives shall be expected to document, as needed and appropriate include:

- Any grant applications filed on behalf of any of the participating jurisdictions
- Hazard events and losses occurring in their jurisdiction,
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding,

- Obstacles or impediments to implementation of actions,
- Additional mitigation actions believed to be appropriate and feasible,
- Public and stakeholder input .

Evaluating

The evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, if the Plan goals are being reached, and whether changes are needed. The Plan will be evaluated on an annual basis to determine the effectiveness of the programs, and to reflect changes that may affect mitigation priorities or available funding.

The status of the HMP will be discussed and documented at an annual plan review meeting of the Mitigation Planning Committee. The Burlington County HMP Coordinator will be responsible for scheduling and coordinating the meeting. MPC representatives will be responsible for assessing progress toward meeting plan goals and objectives for their respective jurisdictions. The MPC may refer to the evaluation forms (provided in Appendix G), to assist in the evaluation process. These evaluations will assess whether:

- Goals and objectives address current and expected conditions.
- The nature or magnitude of the risks has changed.
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available.
- Actions were cost effective.
- Schedules and budgets are feasible.
- Implementation problems, such as technical, political, legal or coordination issues with other agencies exist.
- Outcomes have occurred as expected.
- Changes in county or municipal resources impacted plan implementation (for example, funding, personnel, and equipment)
- New agencies/departments/staff should be included, including other local governments as defined under 44 CFR 201.6.
- Documentation for hazards that occurred during the last year

Specifically, the MPC will review the mitigation goals, objectives, and activities/projects using performance based indicators, including:

- New agencies/departments created that have authority to implement mitigation actions or are required to meet goals, objectives, and actions
- Project evaluation based on current needs of the mitigation plan
- Project completion regarding progress of proposed or ongoing actions
- Under/over spending regarding proposed mitigation action budgets
- Achievement of the goals and objectives
- Resource allocation to note if resources are required to implement mitigation activities
- Timeframes comment on whether proposed schedules are sufficient to address actions

- Budgets note if budget basis should be changed or is sufficient
- Lead/support agency commitment note if there is a lack of commitment on the part of lead or support agencies
- Resources regarding whether resources are available to implement actions
- Feasibility comment regarding whether certain goals, objectives, or actions prove to be unfeasible

Finally, the MPC will evaluate how other programs and policies have conflicted or augmented planned or implemented measures, and shall identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions (see the “Implementation of Mitigation Plan through Existing Programs” subsection later in this section). Other programs and policies can include those that address:

- Economic Development
- Environmental Preservation & Permitting
- Historic Preservation
- Redevelopment
- Health and/or safety
- Recreation
- Land use/zoning
- Public Education and Outreach
- Transportation

The MPC Coordinator shall be responsible for collecting data from each municipality, and sharing it with the MPC, as appropriate and relevant. This information will provide data for the 5-year update of this HMP and will assist in pinpointing implementation challenges.

Updates to the plan resulting from the annual evaluation shall be posted on the Burlington County website (<http://www.co.burlington.nj.us/ahmp>) to keep the public apprised of the Plan’s implementation. It will also be provided to each community participating in the CRS to meet CRS Activity 510 and annual CRS recertification requirements. To meet this recertification timeline, the MPC will complete the review process and prepare an Annual HMP Progress Report.

The Plan will also be evaluated and revised following any major disasters, to determine if the recommended actions remain relevant and appropriate. The risk assessment will also be revisited to see if any changes are necessary based on the pattern of disaster damages or if data listed in the Section 5.4 (Hazard Profiles) of this Plan has been collected to facilitate the risk assessment. This is an opportunity to increase the community’s disaster resistance and build a better and stronger community.

Updating

44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under DMA 2000. It is the intent of the Burlington County MPC to continue to update this Plan on a five year cycle from the date of initial plan adoption.

Two years from the plan update adoption, the MPC shall determine what resources will be needed to complete the update. The Burlington County HMP Coordinator shall be responsible for assuring that needed resources and funding are secured.

To facilitate the update process, the Burlington County HMP Coordinator, with support of the MPC, shall use the **third annual MPC meeting** (the last Wednesday in September, 2017, assuming this plan's adoption in 2014) to develop and commence the implementation of a detailed Plan update program which will include seeking funding opportunities. The Burlington County HMP Coordinator shall invite representatives from NJOEM to this meeting to provide guidance on plan update procedures. This program shall, at a minimum, establish who shall be responsible for managing and completing the Plan update effort, what needs to be included in the updated plan, and a detailed timeline with milestones to assure that the update is completed according to regulatory requirements.

Following each five year update of the mitigation plan, the plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and made available to all municipal planning committee members, special purpose district participants and the New Jersey Hazard Mitigation Officer.

IMPLEMENTATION OF MITIGATION PLAN THROUGH EXISTING PROGRAMS

Participating jurisdictions have provided a detailed listing of related programs, through which mitigation planning may be implemented, in the local capability assessments provided in each jurisdictional annex (Volume II, Section 9).

It is the intention of the Steering Committee, Planning Committee and participating jurisdictions to incorporate mitigation planning as an integral component of daily government operations. Steering Committee members will work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. Further, the sample adoption resolution (Appendix B) includes an item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Steering Committee anticipates that:

- 1) Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts;
- 2) The Hazard Mitigation Plan and Comprehensive and Emergency Management Plans for both Burlington County and its municipalities will become mutually supportive documents that work in concert to meet the goals and needs of County residents; and
- 3) Duplication of effort can be minimized.

The information on hazard, risk, vulnerability and mitigation contained in this Plan is based on the best science and technology available at the time of the Plan's preparation. It is recognized by all participating jurisdictions that this information can be invaluable in making decisions under other planning programs, such as comprehensive, capital improvement, and emergency management plans.

During the time period of the existing hazard mitigation plan, hazard mitigation goals were incorporated into ongoing planning, zoning, building, and engineering activities for Burlington County and two municipalities, Evesham and Bass River Townships, as noted below.

SECTION 7: MAINTENANCE PROCEDURES

Table 7-2. Incorporation into Ongoing Planning, Zoning, Building, and Engineering Activities

Municipality	Related Documents/Programs/Activities	HMP-Relevant Goals, Objectives, and Actions
Burlington County	Burlington County Comprehensive Farmland Preservation Plan (2009-2018)	Goals: 1. Preservation of an Additional 20,000 Acres 2. Stewardship of Protected Land and Natural Resources 2.2 Strategies Related to Stewardship of Natural Resources: A. Ensure that all preserved farms have farmland conservation plans approved by the NRCS. D. Promote regional solutions to drainage and other water resource issues. 4. Coordination of Land Use Planning Activities 4. A. Continue to employ carefully designed TDR plans or density transfers to increase the acres of preserved farmland (at little to no cost to the public) while managing growth.
Burlington County	Burlington County Department of Resource Conservation Parks and Open Space Master Plan (Aug. 2002) – amended 2010	Aggressively protect significant natural resources. - Acquire and develop sufficient open space and parkland to meet current and future needs. - Enhance biodiversity and identify and protect significant environmental and natural resources best conserved through land preservation. Potential funding Sources: 1992 Dam Restoration and Inland Water Projects Loan Program Incorporate the Municipal Park development Program and allow for allocation of funds from the Open Space, Recreation, Farmland and Historic Preservation Trust Fund ("Trust Fund")
Burlington County	Burlington County Community Health Improvement Plan (Aug. 2007)	Promotion of preventative healthcare practices Promotion of Environmental Health
Burlington County	2010-2014 5-Year Consolidated Plan-DRAFT	Heater Replacement Program: The County anticipates providing continued funding for its Heater Replacement Program. The Heater Replacement Program provides grant to income eligible homeowners to replace old (25 years or older) or "red-tagged" heaters with energy efficient heating systems. The replacement heater will be "Energy Star" –rated, therefore reducing the cost of operation and the amount of heating fuel used. The Heater Replacement Program will assist approximately 20 homeowners per year for a total of 100 homeowners assisted during the span of this plan.
Burlington County	Burlington County Office of Emergency Management Flood Emergency Operations Plan, Rancocas Creek Watershed Management Area #19 (updated 6/10/13)	Operational Plan: 1. Installation of gages and upgrade of telemetry at several sites in Burlington County. 2. Establish a monitoring system which can activate the Plan. Burlington County will fund annual maintenance costs. These devices are part of the County's Flood Warning System (FWS). 1. Purchase and install, stream/weather monitoring gages in Burlington County. a. Phase I (COMPLETED JUNE 2006) will include installation of a gage in Medford and upgrade of existing telemetry at Pemberton Borough, Greenwood Branch and Vincentown. b. Phase II (COMPLETED DEC 2007) will install crest-stage gages at the following Dams; Mount Holly, Kirby's Mill and Smithville. Also, install rain gages in Shamong Township. A new monitoring DIAdvisor stations will be installed in Burlington County Central Communications and Burlington County EOC.
Burlington County	Northern Burlington County Growth and Preservation plan, 2008-2010 (October, 2010)	Regional Goals: 2. Conserve No Burlington County's agricultural and natural resources and ecosystems. 4. Protect the environment, prevent and clean up pollution

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Municipality	Related Documents/Programs/Activities	HMP-Relevant Goals, Objectives, and Actions
		Protect open spaces and environmental resources through the protection of large contiguous areas of land 8. Ensure sound and integrated planning and implementation throughout the region.
Bass River Township	Bass River Township Stormwater Management Plan - Revised April, 2010	Goals: Reduce flood damage, including damage to life and property Minimize any increase in stormwater runoff from any new development Reduce soil erosion from any development or construction project Assure the adequacy of existing and proposed culverts and bridges and other in-stream structures Maintain groundwater recharge Prevent an increase in non-point pollution Minimize pollutants in stormwater runoff from new and existing development Protect public safety through the proper design and operations of stormwater basins
Evesham Township	Evesham 2020 Vision Plan for Marlton Circle (May 20, 2010)	Create the Evesham Crossroads Trail Network - link residential neighborhoods with a network of trails, sidewalks, and greenways. Goals: 2. Prepare a Form Based Code to incentivize more sensible and compact design, development, and conservation.

Comprehensive plans for the following jurisdictions were updated during the time period covered under Burlington County's previous All Hazards Mitigation Plan:

- Bordentown Twp
- Burlington City
- Chesterfield
- Delran
- Evesham
- Lumberton
- Medford
- Moorestown
- North Hanover
- Pemberton Twp
- Riverton
- Tabernacle
- Willingboro
- Woodland

The County will ensure through the Hazard Mitigation Coordinator duties that all jurisdictions are aware they need to incorporate hazard mitigation plan aspects into their comprehensive and master plan updates, as well as making specific recommendations, such as having the Floodplain Administrator review all site plan review and zoning permits within the 1 percent floodplain and including the hazards map in their plan. The Town of Beverly is now in the process of updating their comprehensive plan, so they will be the immediate focus.

Table 7-3 below includes existing processes and programs through which the mitigation plan should be implemented.

Table 7-3. Existing Processes and Programs for Mitigation Plan Implementation

Process	Planning Mechanism	Implementation of Plan
Administrative	Departmental or organizational work plans, policies, and procedural changes	• Burlington County Emergency Management Office • Burlington County Emergency Medical Services • Burlington County Department of Public Works • Burlington County Industrial Development Agency • Burlington County Geographic Information Services • Burlington County Economic Development & Planning • Burlington County Department of Public Health
Administrative	Other organizations' plans (e.g. Comprehensive Plans/Updates Long Term Community Resilience Plans (Town of Union))	• Include reference to this plan in: - o Burlington County Comprehensive Emergency Management Plan - o Jurisdiction-specific Comprehensive Plans - o Jurisdiction-specific Emergency Management Plans - o Long Term Community Resilience Plans - o Other county and local plans as appropriate
Budgetary	Capital and operational budgets	• Review of county and local budgets to include line item mitigation actions
Regulatory	Executive Orders, ordinances and other directives	• Comprehensive Planning - Institutionalize hazard mitigation for new construction and land use. • Zoning and Ordinances • Building Codes • Capital Improvements Plan - Ensure that the person responsible for projects under this plan evaluates if the new construction is in a high hazard area, floodplain, etc. so the construction is designed to mitigate the risk. Revise requirements for this plan to include hazard mitigation in the design of new construction. • National Flood Insurance Program – Continue participation in this program. • Continue to implement storm water management plans. • Prior to formal changes (amendments) to comprehensive plans, zoning, ordinances, capital improvement plans, or other mechanisms that control development must be reviewed to ensure they are consistent with the hazard mitigation plan
Funding	Secure traditional sources of financing	• Apply for grants from federal or state government, nonprofit organizations, foundations, and private sources including Pre-Disaster Mitigation Program (PDM), Flood Mitigation Assistance Program (FMA), and the Hazard Mitigation Grant Program (HMGP-Stafford Act, Section 404). • Research grant opportunities through U.S. Department of Housing and Urban Development's Community Development Block Grant (CDBG) • Other potential federal funding sources include: - o Stafford Act, Section 406 – Public Assistance Program Mitigation Grants - o Federal Highway Administration - o Catalog of Federal Domestic Assistance - o United States Fire Administration – Assistance to Firefighter Grants - o United States Small Business Administration Pre and Post Disaster Mitigation Loans - o United States Department of Economic Development Administration Grants - o United States Army Corps of Engineers - o United States Department of Interior, Bureau of Land Management - o Other sources as yet to be defined • See Appendix E for additional funding sources

Process	Planning Mechanism	Implementation of Plan
Partnerships	Develop creative partnerships, funding and incentives	• Public-Private Partnerships • State Cooperation • In-kind resources
Partnership	Existing Committees and Councils	• Property Owners Associations • Local Government Committees: - o Planning Boards - o Zoning Board of Appeals - o Chambers of Commerce
Partnership	Working with other federal, state, and local agencies	• Army Corps of Engineers (USACE) • American Red Cross of NJ • Department of Homeland Security (DHS) • Federal Emergency Management Agency (FEMA) • National Oceanic and Atmosphere Agency (NOAA) • National Weather Service (NWS) • State Department of Environmental Protection (NJDEP) • State Department of Transportation (NJDOT) • NJ Office of Emergency Management (NJOEM) • United States Department of Agriculture (USDA) • United States Department of Transportation (USDOT) • United States Geological Service (USGS) • Joint Base McGuire Dix Lakehurst

During the annual plan evaluation process, the Steering Committee will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions.

CONTINUED PUBLIC INVOLVEMENT

Burlington County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. Therefore, the plan will be posted on-line (<http://www.co.burlington.nj.us/ahmp>) and copies of the Plan will be made available for review during normal business hours at the Burlington County Public Safety Center, Office of Emergency Management.

In addition, public outreach will/may include :

- Links to the plan on municipal websites of each jurisdiction with capability.
- Provide links to informational resources on the county website
- Utilization of existing social media outlets (Facebook, Twitter) to inform the public of flood hazards and severe storm events. Educate the public via the county website on how these applications can be used in an emergency situation.
- Development of annual articles or workshops on Flood Hazards to educate the public and keep them aware of the dangers of flooding.

Municipal supervisors/mayors or clerks and the Burlington County HMP Coordinator will be responsible for receiving, tracking, and filing public comments regarding this HMP. Contact information for the County is included in the Point of Contact information in the County annex of this document.

The public will have an opportunity to comment on the Plan via the Hazard Mitigation website at any time. Burlington County will maintain this website, posting new information and maintaining an active link to collect public comments.

The Burlington County HMP Coordinator is responsible for coordinating the Plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the 5-year plan update as appropriate. Additional meetings may also be held as deemed necessary by the planning group to provide the public an opportunity to express concerns, opinions, and ideas about the mitigation plan.

The Jurisdictional MPC representatives shall be responsible to assure that:

- Public comment and input on the Plan, and hazard mitigation in general, are recorded and addressed, as appropriate. Opportunity to comment on the plan will be provided directly on the Hazard Mitigation page, part of the Burlington County Freeholders website. Provisions for public comment in writing will also be made. All public comments shall be addressed to:

Burlington County Hazard Mitigation Coordinator
1 Academy Drive
PO Box 6000
Westampton, NJ 08060-6000
Email: burlcooem@co.burlington.nj.us
Fax: 609-518-7214

- Copies of the latest approved Plan (or draft in the case that the five year update effort is underway) are available for review at the Burlington County Public Safety Complex, Office of Emergency Management along with instructions to facilitate public input and comment on the Plan.
- Appropriate links to the Burlington County website (www.co.burlington.nj.us/ahmp) are maintained
- Public notices are made as appropriate to inform the public of the availability of the Plan, particularly during Plan update cycles.

The Burlington County HMP Coordinator shall be responsible to assure that:

- Public comment and input on the Plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- The Burlington County Hazard Mitigation website is maintained and updated as appropriate.
- All public and stakeholder comments received are document and maintained.
- Copies of the latest approved Plan (or draft in the case that the five year update effort is underway) are available for review at the Burlington County Public Safety Complex, Office of Emergency Management and website www.co.burlington.nj.us/ahmp, along with instructions to facilitate public input and comment on the Plan.
- Public notices, including media releases, are made as appropriate to inform the public of the availability of the Plan, particularly during Plan update cycles.