Multi-Jurisdictional
Natural Hazard Mitigation Plan
Monmouth County, New Jersey

Prepared for

Monmouth County Office of Emergency Management
300 Halls Mill Road
Freehold, New Jersey 07728

Prepared by

1255 Broad Street, Suite 201
Clifton, New Jersey 07013-3398

REVISED DRAFT
2014 PLAN UPDATE

PLAN ADOPTION RESOLUTIONS

In accordance with Part 201.6 of the Disaster Mitigation Act of 2000 (DMA 2000), as amended, Monmouth County, New Jersey, has developed this Update of its Multi-Jurisdictional Natural Hazard Mitigation Plan to identify hazards that threaten the County and ways to reduce future damages associated with these hazards.

Following this page are the signed adoption resolutions of the County and all participating jurisdictions that have adopted this 2014 Plan Update, authorizing municipal government staff to carry out the actions detailed herein.

Signed resolutions of adoption by all participating jurisdictions shall be inserted following this page after FEMA has reviewed and determined that the plan update is Approvable Pending Adoption.

EXECUTIVE SUMMARY

Across the United States and around the world, natural disasters occur each day, as they have for thousands of years. As the world's population and development have increased, so have the effects of these natural disasters. The time and money required to recover from these events often strain or exhaust local resources. The purpose of hazard mitigation planning is to identify policies, actions, and tools for implementation that will, over time, work to reduce risk and the potential for future losses. Hazard mitigation is best realized when community leaders, businesses, citizens, and other stakeholders join together an in effort to undertake a process of learning about hazards that can affect their area and use this knowledge to prioritize needs and develop a strategy for reducing damages.

Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act ("the Stafford Act"), enacted by Section 104 of the Disaster Mitigation Act of 2000 ("DMA 2000"), provides new and revitalized approaches to mitigation planning. Section 322 continues the requirement for a State mitigation plan as a condition of disaster assistance, and established a new requirement for local mitigation plans. In order to apply for Federal aid for technical assistance and post-disaster funding, local jurisdictions must comply with DMA 2000 and its implementing regulations (44 CFR Part 201.6).

While Monmouth County has always sought ways to reduce their vulnerability to hazards, the passage of DMA 2000 helped County officials to recognize the benefits of pursuing a long-term, coordinated approach to hazard mitigation through hazard mitigation planning. The County has received grant funds from the Federal Emergency Management Agency (FEMA) for both developing this very hazard mitigation plan, and its first required update. This **Monmouth County Multi-Jurisdictional Natural Hazard Mitigation Plan** represents the collective efforts of Monmouth County and each of its 53 participating jurisdictions, the general public, and other stakeholders. Natural disasters cannot be prevented from occurring. However, over the long-term, the continued implementations of this Plan will gradually, but steadily, lessen the impacts associated with hazard events.

The Monmouth County Multi-Jurisdictional Hazard Mitigation Plan has been developed by the Monmouth County Hazard Mitigation Planning Committee (the "Planning Committee"), with support from outside consultants. The efforts of the Planning Committee were headed by the Monmouth County Office of Emergency Management's Hazard Mitigation Coordinator. The overall Planning Committee was divided into a Core Planning Group (CPG) and Jurisdictional Assessment Teams (JATs), with one JAT for each of the County's participating jurisdictions. The JATs consisted of a wide range of position titles for each community, from key individuals involved in emergency management, planning, engineering, floodplain management, and local administrators. In addition there was a County Steering Committee which oversaw the process, headed by the Monmouth County Office of Emergency Management (MCOEM).

Monmouth County's first hazard mitigation plan was approved by FEMA in February 2009; it was subsequently adopted by each participating municipality later in 2009 (with only one adopting later in 2012). FEMA requires that the plan be monitored and evaluated regularly, and updated at least once every five years. This document represents the 2014 Plan Update. The plan update process was initiated in earnest in the Summer of 2012 with a Project Initiation Meeting between the County and its consultant held on June 8, 2012. A Kickoff Meeting of the full Core Planning Group was conducted on July 31, 2012. A Core Planning Group progress meeting was held on September 28, 2012. With the severe impact of Hurricane Sandy on our communities, plan update meetings of the CPG were placed on hold for a six month window to allow the team members to focus their limited resources on response and recovery efforts. Thereafter, Core Planning Group members met on April 15, 2013; June 6, 2013;

November 14, 2013; February 18, 2014; and February 27, 2014. Jurisdictional Assessment Teams in each municipality met individually throughout the plan development process as they deemed necessary.

Community support is vital to the success of any hazard mitigation plan. **The County and each participating community were responsible for conducting outreach within their respective jurisdictions. Since the plan update process began in the summer of 2012, hundreds of outreach activities have been undertaken by the planning team members, including more than 35 opportunities for public and stakeholder involvement from the County alone.** These efforts provided the general public and other stakeholders with opportunities to take part in the decisions that will affect their future.

County-Led Outreach Activities. The County-led outreach actions during the plan update were similar to those undertaken during the development of the initial plan. The County performed ongoing maintenance of its online hazard mitigation planning web presence at www.co.monmouth.nj.us/page.aspx?ID=1944 and www.monmouthsheriff.org/Sections-read-144.html with information on the planning process and where to go for additional information or comments. Press releases were issued on June 29, 2012; October 16, 2012; May 22, 2013; June 20, 2013; March 4, 2014; and Oct 20, 2014. Press releases were posted on the County web site, Facebook, and Twitter. Project fact sheets were widely distributed by MCOEM at various meetings throughout the process. They were also made available at the Monmouth County Fair in 2012, 2013, and 2014. The plan update was discussed at open public meetings of the County Planning Board on November 18, 2013; February 18, 2014; March 17, 2014; April 21, 2014; May 19, 2014; July 21, 2014; August 18, 2014; and October 20, 2014. It was also discussed at a regular meeting of the County Board of Chosen Freeholders on August 28, 2014. A public meeting on the plan update was held on May 22, 2013 in Hazlet; and subsequently reported in an article in NJ.com on May 23, 2013. Furthermore, the public and other stakeholders were invited to respond to a survey that was posted on the MCOEM mitigation planning web site; and the plan update was discussed at joint meetings of Local Emergency Planning Coordinators and CPG members on February 18, 2014 and July 10, 2014. MCOEM also contributed to public information videos on mitigation (with Sea Bright in April 2013; and with Manasquan and FEMA in June 2013). The Hazard Mitigation Plan was also discussed at the October 20, 2014 meeting of the Monmouth County Planning Board.

The County's Mitigation Planning Steering Committee met throughout the plan update process to discuss progress and work on development of the County's mitigation strategy. Meetings were held on January 7, 2013; May 2, 2013; August 15, 2013; December 16, 2013; March 11, 2014; April 3, 2014; and December 5, 2014. The Steering Committee included direct membership and participation from the following groups or individuals who attended various meetings throughout the process and provided input on action items being considered for the County's mitigation strategy:

Sherriff's Office of Emergency Management
Division of Planning
Planning Board
Administrator
Economic Development
Park System
Department of Public Works and Engineering
Health Department
Department of Buildings and Grounds
First Energy Corp., Jersey Central Power and Light (JCP&L)
Jacques Cousteau National Estuarine Research Reserve **Also representing NJNY Coastal Outreach Advisory Team*
Leckner Consulting **Also representing NJNY Coastal Outreach Advisory Team*

Manasquan River Regional Sewerage Authority
Monmouth County Mosquito Extermination Commission
Monmouth University-Urban Coast Institute
Municipal Representative-Middletown[+]
Municipal Representative-Neptune[+]
Municipal Representative-Oceanport[+]
New Jersey American Water Company
New Jersey Natural Gas

[+]*These three municipal representatives with wide local knowledge and experience were invited to participate in the steering committee in addition to their own municipalities' JATs to serve as representatives of all the communities in the County when driving the plan update's overall progress and direction.*

<u>Municipal JAT Outreach Activities</u>. Each of the 53 participating communities supplemented the above range of County-led efforts with outreach targeted toward members of the general public and other stakeholders within their respective municipalities to get the word out even further and to supplement the County's larger outreach activities. JATs employed a wide range of techniques for providing opportunities for feedback and participation from the public and other stakeholders. Many distributed copies of the project fact sheet, posted information on their web sites, discussed the plan update at open public meetings in their communities, reached out to key stakeholder groups, and collectively undertook hundreds of activities throughout the plan update process to ensure that the public and other stakeholders were made aware of the process and their opportunity to participate and provide feedback and input.

The initial hazard mitigation planning process consisted of the following key steps:

- Researching a full range of natural hazards to identify which hazards could affect the County;
- Identifying the location and extent of hazard areas;
- Identifying assets located within these hazard areas;
- Characterizing existing and potential future assets at risk;
- Assessing vulnerabilities to the most prevalent hazards; and
- Formulation and prioritization of goals, objectives, and mitigation actions to reduce or avoid long-term vulnerabilities to the identified hazards.

For the 2014 Plan update, the CPG:

- Assessed current development patterns and development pressures
- Evaluated new hazard or risk information
- Described progress in local plan maintenance and plan integration efforts
- Assessed previous goals and actions
- Summarized progress in implementing actions
- Adjusted actions to address current realities
- Explained changes in priorities
- Addressed changes in Federal/State requirements

Natural hazards that can affect Monmouth County that are included in the Plan are as follows:

- ***Atmospheric hazards***, including: extreme temperatures, extreme wind, hurricanes and tropical storms, lightning, nor'easters, tornadoes, and winter storms;
- ***Hydrologic hazards***, including: coastal erosion, dam failure, drought, flooding, storm surge, and wave action;
- ***Geologic hazards***, including: earthquakes and landslides; and
- ***Other hazards***, including: wildfires.

After evaluating these hazards and assets within the County to which they are vulnerable, each participating jurisdiction developed an updated hazard mitigation strategy to increase the disaster resistance of the County, along with procedures for monitoring, evaluating and updating the Plan to ensure that it remains a "living document." More than three hundred mitigation actions are included in this plan update to reduce the impacts of natural hazards throughout the County, including 20 projects totaling upwards of $10 million submitted by the County alone. Most jurisdictions intend to apply for various types of grant funding for at least some portion of their activities to offset the local cost burden. The robust mitigation strategies developed by each participating jurisdiction as part of this plan update are a significant expansion of many of the strategies that were proposed in the 2009 plan, and represent a substantial improvement in addressing each jurisdiction's highest hazards and key risks.

This 2014 Draft Plan Update is currently under review by the Planning Committee, NJOEM, FEMA, and the public and other stakeholders. If you have any questions or comments on the Multi-Jurisdictional Natural Hazard Mitigation Plan for Monmouth County, New Jersey, please contact:

Michael Oppegaard, Coordinator
Monmouth County Office of Emergency Management
300 Halls Mills Road
Freehold, New Jersey 07728
Phone: 732-431-7400
Fax: 732-409-7532
E-Mail: moppegaard@mcsonj.org

Margaret Murnane-Brooks, Deputy Coordinator
Monmouth County Office of Emergency Management
300 Halls Mills Road
Freehold, New Jersey 07728
Phone: 732-431-7400
Fax: 732-409-7532
E-Mail: mmurnane@mcsonj.org

For jurisdiction specific information, individuals identified as representatives of the jurisdictions should be contacted (see **Appendix 1.2** for membership lists and contact information).

After the review cycle is complete, comments will be evaluated and incorporated as needed, and the County and all participating jurisdictions will each formally adopt the Final 2014 Plan Update. The Final 2014 Plan Update will include copies of each jurisdiction's adoption resolution following Page i.

ACKNOWLEDGEMENTS

The following jurisdictions (Monmouth County and each of its 53 municipalities) participated in the development of this plan:

County of Monmouth

Aberdeen, Township of
Allenhurst, Borough of
Allentown, Borough of
Asbury Park, City of
Atlantic Highlands, Borough of
Avon-by-the-Sea, Borough of
Belmar, Borough of
Bradley Beach, Borough of
Brielle, Borough of
Colts Neck, Township of
Deal, Borough of
Eatontown, Borough of
Englishtown, Borough of
Fair Haven, Borough of
Farmingdale, Borough of
Freehold, Borough of
Freehold, Township of
Hazlet, Township of
Highlands, Borough of
Holmdel, Township of
Howell, Township of
Interlaken, Borough of
Keansburg, Borough of
Keyport, Borough of
Lake Como, Borough of
Little Silver, Borough of
Loch Arbour, Village of
Long Branch, City of
Manalapan, Township of
Manasquan, Borough of
Marlboro, Township of
Matawan, Borough of
Middletown, Township of
Millstone, Township of
Monmouth Beach, Borough of
Neptune, Township of
Neptune City, Borough of
Ocean, Township of
Oceanport, Borough of
Red Bank, Borough of
Roosevelt, Borough of
Rumson, Borough of
Sea Bright, Borough of
Sea Girt, Borough of
Shrewsbury, Borough of
Shrewsbury, Township of
Spring Lake, Borough of
Spring Lake Heights, Borough of
Tinton Falls, Borough of
Union Beach, Borough of
Upper Freehold, Township of
Wall, Township of
West Long Branch, Borough of

The records show that the following eleven stakeholder entities participated through representation on the County Steering Committee:

Municipal Representatives – Middletown, Neptune (T), and Oceanport
New Jersey Natural Gas
New Jersey American Water Company
Jersey Central Power and Light
Monmouth County Mosquito Extermination Commission
*Jacques Cousteau Natural Estuarine Research Reserve *Also representing NJNY COAT*
*Leckner Consulting *Also representing NJNY COAT*
Manasquan River Regional Sewerage Authority
Monmouth University - Urban Coast Institute

In addition to the above stakeholders who participated directly as members of the County Steering Committee, the following additional stakeholders also participated by attending one or more multi-jurisdictional planning team meetings:

New Jersey Office of Emergency Management
New Jersey Department of State
New Jersey Department of Environmental Protection
Federal Emergency Management Agency
United Way
Deal Lake Commission
Stockton College
New Jersey Sea Grant
Naval Weapons Station – Earle
Verizon Wireless

URS Corporation (Clifton, NJ) acted as the plan development consultant providing hazard mitigation plan update services.

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SECTION 1 - INTRODUCTION

Purpose

Monmouth County is susceptible to a number of different natural hazards. Each hazard event has the potential to cause property loss, loss of life, economic hardship, and threats to public health and safety. The time and money required to recover from these events often strain or exhaust local resources. 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 disaster), an equally important aspect of emergency management involves **hazard mitigation** - sustained actions taken to reduce long-term risk to life and property. They are things you do today to be more protected in the future. Hazard mitigation actions are essential to breaking the typical disaster cycle of damage, reconstruction, and repeated damage. With careful selection, they can be long-term, cost-effective means of reducing risk and helping to create a more sustainable and disaster-resilient community. Hazard mitigation actions are most effective when they are based on a comprehensive, long-term plan that is developed before a disaster occurs. When community leaders, businesses, citizens, and other stakeholders undertake a joint process of evaluating the hazards that can affect their area, and use this knowledge to develop a strategy for reducing risk and the potential for future losses, this process is known as hazard mitigation planning. A **hazard mitigation plan**[1] describes an area's vulnerability to the various natural hazards that are typically present, along with an array of actions and projects for reducing key risks. This list of actions and projects is known as a **mitigation strategy**. While natural disasters cannot be prevented from occurring, the continued implementation of mitigation strategies identified in the plan will gradually, but steadily, increase community sustainability and disaster-resilience.

The **Multi-Jurisdictional Natural Hazard Mitigation Plan for Monmouth County** was initially prepared between 2007 and 2009 to meet the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), which requires all states and local governments to have a hazard mitigation plan in order to be eligible to apply for certain types of federal hazard mitigation project grants. FEMA grant monies were received to cover the costs of the plan's development. Monmouth County used a 'multi-jurisdictional' approach, inviting all of the municipalities within the County to participate in the plan. At that time, 52 of the County's jurisdictions participated (the 2009 Plan is maintained on the County web site at: www.monmouthsheriff.org/files/oem-mitigation/MitigationMultijurPlan.pdf) and became eligible to apply to FEMA for hazard mitigation project funding, including monies that became available under the recent Federal disaster declarations for Hurricane Irene and Superstorm Sandy. Participating jurisdictions have been working to implement their mitigation actions since the plan was initially approved by FEMA in 2009.

Hazard mitigation plans must be: (a) implemented on an ongoing basis, and (b) updated every five years to ensure that they remain applicable representations of local risk and locally-preferred risk reduction strategies. Monmouth County and its jurisdictions initiated the first required plan update in 2012. This **2014 Plan Update** is expected to be reapproved by FEMA and adopted by all communities. The County has, once again, obtained FEMA grant funding to cover costs associated with the update, and has opted to continue its multi-jurisdictional approach. This time, all 53 municipalities in the County opted to participate. Each jurisdiction attended meetings, provided feedback in a wide range of topic areas, reached out to the public and other key stakeholders in their community, and developed an updated mitigation strategy. To maintain eligibility to apply for mitigation project grants, each jurisdiction must participate in the plan's ongoing maintenance and implementation. The initial plan of 2009, and the 2014

[1]Hazard mitigation plans are not intended to serve as a reference for immediate disaster response. They focus on actions that can be implemented prior to disaster events in order to reduce potential loss of life and property damage; however, they are referred to in the recovery process.

Plan Update, are maintained on the County web site at: http://www.monmouthsheriff.org/Sections-read-144.html.

For questions or other feedback, or to find out how you can become involved, contact your community's local elected officials or Emergency Management Coordinator. At the County level, please feel free to reach out to Michael E. Oppegaard, Coordinator, Monmouth County Office of Emergency Management (MCOEM) at 732-431-7400 or via email to moppegaard@mcsonj.org; or Deputy Coordinator, Margaret Murnane-Brooks at 732-431-7400 or via email to murnane@mcsonj.org. More information about the plan is maintained on the County Sheriff's Office web site at: www.mcsonj.org/Sections-read-144.html

Document Organization

This Multi-Jurisdictional Hazard Mitigation Plan for Monmouth County is organized into the following major sections.

- **Section 1 - Introduction**. Plan purpose, overview of the planning area, summary of plan development process, document organization, and key terms.

- **Section 2 - Identification of Potential Hazards.** Documentation of the Planning Committee's evaluation of a full range of natural hazards, and indication of which hazards were identified for inclusion in this plan (and why) versus those that were not identified (and why not).

- **Section 3 - Risk Assessment.** Hazard profiles, identification and characterization of assets in hazard areas, damage estimates, summary of land uses and development trends in hazard areas, and key risk findings.

- **Section 4 - Capabilities and Resources.** Overview of local, state, and federal resources for hazard mitigation.

- **Section 5 -Mitigation Goals.** Summary of hazard mitigation goals for the State Hazard Mitigation Plan and also for this county-wide multi-jurisdictional hazard mitigation plan.

- **Section 6 – Mitigation Strategies.** Information about the hazard mitigation actions identified by each jurisdiction to address their key risk findings.

- **Section 7 – Plan Maintenance and Integration.** Procedures selected for monitoring, evaluating, and updating this mitigation plan; including participation of the public and other stakeholders in plan maintenance, and plan integration.

- **Section 8 – For More Information.** Contact information for questions, comments, or how to become involved in the plan's ongoing maintenance and implementation, and future updates.

Key Terms

For the purpose of clarity throughout this document, the following definitions are briefly outlined:

- A **natural hazard** is any hazard that occurs or results from acts of nature such as floods, earthquakes, hurricanes, tornadoes and coastal storms, to name a few. *This plan addresses natural hazards only. It does not assess man-made / technological hazards or terrorism.*
- A **disaster** is any catastrophic event that causes loss of life, injuries and widespread destruction to property. For the purpose of this document, a disaster is the result of a natural hazard, whether anticipated (such as flash floods with warnings) or fortuitous (such as earthquakes).

- **Hazard mitigation** is the method by which measures are taken to reduce, eliminate, avoid or redirect natural hazards in order to diminish or eradicate the long-term risks to human life and property.
- A **hazard mitigation plan** is a well-organized and well-documented evaluation of the natural hazards and the extent that the events will occur. In addition, the plan identifies the 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 natural hazards.
- **Hazard mitigation planning** is the process of managing actions taken by individual citizens and professional organizations involved in mitigation activities. The process involves carrying out plans to reduce loss of life, injuries and damage to property, as well as reducing the costs associated with losses from natural hazards. It is a long-term process with benefits best realized over time.

About the Planning Area

The planning area for this plan encompasses the whole of Monmouth County. Monmouth County is located in eastern-central New Jersey. It is the northernmost of New Jersey's shore counties and is bounded by Middlesex, Mercer, Burlington, and Ocean Counties (from Middlesex County in the north and moving in a counter-clockwise direction to Ocean County in the south). Eastern sections of the county's northern limits are bounded by Raritan Bay and Sandy Hook Bay, while the east coast of the County lies on the Atlantic Ocean. Monmouth County is home to 53 municipalities, each with its own distinct character (two cities, 35 boroughs, 15 townships and one village). They are the Cities of Asbury Park and Long Branch; Boroughs of Allenhurst, Allentown, Atlantic Highlands, Avon-by-the-Sea, Belmar, Bradley Beach, Brielle, Deal, Eatontown, Englishtown, Fair Haven, Farmingdale, Freehold, Highlands, Interlaken, Keansburg, Keyport, Lake Como, Little Silver, Manasquan, Matawan, Monmouth Beach, Neptune City, Oceanport, Red Bank, Roosevelt, Rumson, Sea Bright, Sea Girt, Shrewsbury, Spring Lake, Spring Lake Heights, Tinton Falls, Union Beach, and West Long Branch; Townships of Aberdeen, Colts Neck, Freehold, Hazlet, Holmdel, Howell, Manalapan, Marlboro, Middletown, Millstone, Neptune, Ocean, Shrewsbury, Upper Freehold, and Wall; and Village of Loch Arbour (**Figure 1.1**). All 53 municipalities participated in the 2014 Plan Update.

Monmouth County has a total area of 665 square miles, of which 472 square miles is land and 193 square miles is water. It is New Jersey's sixth largest county in terms of land area. Monmouth County has a wide variety of natural resources and landscapes including slopes, bay front and oceanfront beaches, rivers, lakes, streams, forests, and farmlands. Much of the county is flat and low-lying; however high lands and cliffs dominate the Bayshore areas, while shorelines and rivers characterize eastern portions of the County and rolling hills and farmland characterizes the western portions of the County. Crawford Hill, in Holmdel Township, is the tallest point in the County at approximately 380 feet above sea level.

Although the land use patterns are diverse, residential development is the predominant use. County residents have access to major employment, entertainment, and transportation centers by public transportation and a superior highway network. In addition, the county features an abundance of top-rate parks, golf courses, open space, educational facilities as well as low crime rates. Over the past four decades, Monmouth County has become increasingly more suburbanized as growth increased dramatically, making this county one of the fastest growing regions in the State. Much of this growth is attributable to net in-migration. People are drawn to the exceptional quality of life in Monmouth County. As noted in the County's Open Space Plan, pressure to develop and redevelop land in Monmouth County remains strong thus presenting challenges to maintaining quality of life for present and future generations. A growing population, competition for diminishing land resources, escalating property values, and increasing public demand for control of growth and provision of recreation services point toward the importance of preserving open space. Monmouth County has preserved 44,604 acres as protected public open space and an additional 13,300 acres of farmland for a combined total of 19.2 percent of the

County's total land area (Monmouth County Profile, 2011). Vacant land is predominantly in the western portions of the County where agriculture is still the primary land use.

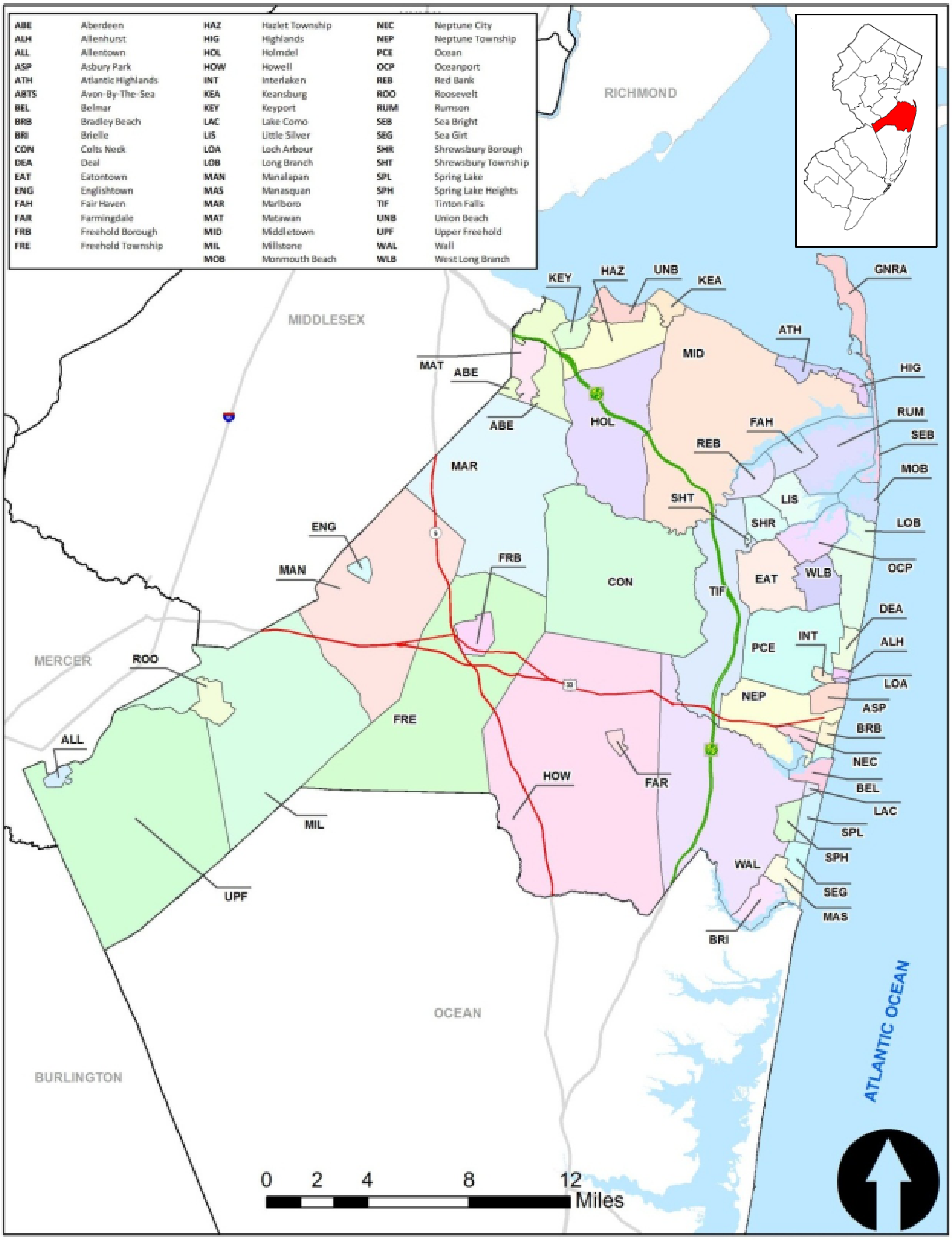

Figure 1.1 - Monmouth County Base Map

Population. The County's environmental and cultural diversity continues to attract new residents and visitors alike. A general trend of increasing population is expected to continue between now and the year 2040. According to the US Census, the population of Monmouth County in 1990 was 553,124. By 2000 it had increased by approximately 11.2 percent to 615,301. While the pace of population growth increased at a slower rate in the next ten year period from 2000 to 2010 (2.5 percent), its 2010 population of 630,380 ranked Monmouth County fifth in the state in terms of population. **Table 1.1** shows population changes and projections (1980-2040), as estimated by the North Jersey Transportation Planning Authority (NJTPA) in November 2012 in consultation with the Monmouth County Department of Planning.

Table 1.1
County Population Changes and Projections

Municipality	Population 1980 Census	Population 1990 Census	Population 2000 Census	Population 2010 Census	Population 2040 Estimate	Absolute Change 2010-2040	Percent Change 2010-2040
Monmouth County	**503,173**	**553,124**	**615,301**	**630,380**	**696,920**	**66,540**	**10.6%**
Aberdeen, Township of	17,235	17,038	17,454	18,210	20,182	1,972	10.8%
Allenhurst, Borough of	912	759	718	496	504	8	1.5%
Allentown, Borough of	1,962	1,828	1,882	1,828	1,840	12	0.7%
Asbury Park, City of	17,015	16,799	16,930	16,116	20,784	4,668	29.0%
Atlantic Highlands, Borough of	4,950	4,629	4,705	4,385	4,540	155	3.5%
Avon-by-the-Sea, Borough of	2,337	2,165	2,244	1,901	1,907	6	0.3%
Belmar, Borough of	6,771	5,877	6,045	5,794	5,857	71	1.2%
Bradley Beach, Borough of	4,772	4,475	4,793	4,298	4,367	69	1.6%
Brielle, Borough of	4,068	4,406	4,893	4,774	4,931	157	3.3%
Colts Neck, Township of	7,888	8,559	11,179	10,142	12,291	2,149	21.2%
Deal, Borough of	1,952	1,179	1,070	750	757	7	0.9%
Eatontown, Borough of	12,703	13,800	14,008	12,709	15,345	2,662	21.0%
Englishtown, Borough of	976	1,268	1,764	1,847	1,998	151	8.2%
Fair Haven, Borough of	5,679	5,270	5,937	6,121	6,274	153	2.5%
Farmingdale, Borough of	1,348	1,462	1,587	1,329	1,413	84	6.3%
Freehold, Borough of	10,020	10,742	10,976	12,052	12,606	554	4.6%
Freehold, Township of	19,202	24,710	31,537	36,184	42,100	5,916	16.3%
Hazlet, Township of	23,013	21,976	21,378	20,334	21,404	1,070	5.3%
Highlands, Borough of	5,187	4,849	5,097	5,005	5,115	110	2.2%
Holmdel, Township of	8,447	11,532	15,781	16,773	20,210	3,437	20.5%
Howell, Township of	25,065	38,987	48,903	51,075	57,249	6,174	12.1%
Interlaken, Borough of	1,037	910	900	820	830	10	1.2%
Keansburg, Borough of	10,613	11,069	10,732	10,105	10,388	269	2.7%
Keyport, Borough of	7,413	7,586	7,568	7,240	7,470	230	3.2%
Lake Como, Borough of	1,566	1,482	1,806	1,759	1,777	10	0.6%
Little Silver, Borough of	5,548	5,721	6,170	5,950	6,223	273	4.6%
Loch Arbour, Village of	369	380	280	194	203	9	4.5%
Long Branch, City of	29,819	28,658	31,340	30,719	31,884	1,165	3.8%
Manalapan, Township of	18,914	26,716	33,423	38,872	42,754	3,882	10.0%
Manasquan, Borough of	5,354	5,369	6,310	5,897	6,087	190	3.2%
Marlboro, Township of	17,560	27,974	36,398	40,191	44,532	4,341	10.8%
Matawan, Borough of	8,837	9,270	8,910	8,810	9,271	461	5.2%
Middletown, Township of	62,574	68,183	67,479	66,522	70,649	4,141	6.2%
Millstone, Township of	3,926	5,069	8,970	10,566	11,191	637	6.0%
Monmouth Beach, Borough of	3,318	3,303	3,595	3,279	3,313	34	1.0%
Neptune City, Borough of	5,276	4,997	5,218	4,869	5,051	182	3.7%
Neptune, Township of	28,366	28,148	27,690	27,935	31,184	3,249	11.6%
Ocean, Township of	23,570	25,058	26,959	27,291	28,653	1,362	5.0%
Oceanport, Borough of	5,888	6,146	5,807	5,832	7,957	2,102	35.9%
Red Bank, Borough of	12,031	10,636	11,844	12,206	13,434	1,228	10.1%
Roosevelt, Borough of	835	884	933	882	902	8	0.9%
Rumson, Borough of	7,623	6,701	7,137	7,122	7,615	493	6.9%
Sea Bright, Borough of	1,812	1,693	1,818	1,412	1,516	104	7.4%
Sea Girt, Borough of	2,650	2,099	2,148	1,828	1,835	7	0.4%
Shrewsbury, Borough of	2,962	3,096	3,590	3,809	4,259	450	11.8%
Shrewsbury, Township of	995	1,098	1,098	1,141	1,192	51	4.5%
Spring Lake, Borough of	4,215	3,499	3,567	2,993	3,002	9	0.3%
Spring Lake Heights, Borough of	5,424	5,341	5,227	4,713	4,793	80	1.7%
Tinton Falls, Borough of	7,740	12,361	15,053	17,892	24,235	6,340	35.4%
Union Beach, Borough of	6,354	6,156	6,649	6,245	6,405	160	2.6%
Upper Freehold, Township of	2,750	3,277	4,282	6,902	7,286	384	5.6%
Wall, Township of	18,952	20,244	25,261	26,164	30,741	4,577	17.5%
West Long Branch, Borough of	7,380	7,690	8,258	8,097	8,615	518	6.4%

All of Monmouth County's municipalities are likely to have some increase in their population between 2010 and 2040, with a projected 10.6 percent increase for the county as a whole. The three highest increases are expected in Oceanport (35.9 percent), Tinton Falls (35.4 percent), and Asbury Park (29.0

percent); while the three lowest increases expected are in Sea Girt (0.4 percent), Avon-By-The-Sea (0.3 percent), and Spring Lake (also 0.3 percent). Monmouth County's growing population is also aging. The overall median age has been rising over the past decades, from 35 in 1990 and 37.7 in 2000 to 41.3 in 2010. The percentage of the population over 65 years of age, however, has remained relatively constant (12.7 percent in 1990; 12.5 percent in 2000; and 13.8 percent in 2010).

Census data for the year 2010 shows that 37.6 percent of the population lives in Coastal communities (those fronting the Atlantic Ocean in the east of the County). Another 28.8 percent lives in Western areas, and 23.3 percent lives in Bayshore areas (those adjacent to Sandy Hook Bay/Raritan Bay in the north of the County). The remaining 10.3 percent resides in Central and Panhandle communities (at 7.1 and 3.2 percent, respectively). The County Cross Acceptance Report estimates that between the year 2000 and 2025, percent increases in population are likely to be the greatest in the Panhandle areas at 46.6 percent, followed by Western areas at 24.5 percent and Central regions at 13.0 percent. Coastal and Bayshore regions are projected to realize only 8.3 and 6.6 percent increases, respectively.

The 2010 U.S. Census population density per square mile of land in Monmouth County was 1,336 persons per square mile - a marginal increase from the year 2000 (1,304 persons per square mile). By 2040, however, the County's population density is projected to be 10.6 percent higher over year 2010 values (at 1,477 persons per square mile).

Roads and Bridges. Monmouth County has excellent access to all major modes of transportation. A 27 mile segment of the Garden State Parkway runs through eastern Monmouth County. There are seven Parkway interchanges in the County along with Exit 116 for the PNC Arts Center, making Monmouth County a convenient destination for tourists and visitors from northern New Jersey and New York. Interstate 195, with 17 miles in southern Monmouth County, connects the New Jersey Turnpike, Mercer County and Eastern Pennsylvania with the coast, making the county convenient for tourists from the Philadelphia area. In addition, there are 233 miles of state roads, and 381 miles of county roads. Major state and county capital improvements are keeping pace with the increased traffic.

Rail. The NJ TRANSIT North Jersey Coast Line provides easy rail access to Newark and New York City. There are 13 year-round rail stations located in Monmouth County and one seasonal station located at Monmouth Park Racetrack, operational during the racing season. Parts of the county have easy access to Amtrak stations at Metro Park, New Brunswick and Princeton Junction. NJ TRANSIT provides AirTrain service from a station near Pennsylvania Station, Newark to Newark Airport. This five minute ride allows North Jersey Coast Line passengers to use rail service to and from Newark Airport.

Bus. Virtually the entire county is served by a network of local and regional bus services. The County is expanding and enhancing these services to better accommodate growing commercial and industrial areas.

Ferry. Ferry service to New York City is available from Atlantic Highlands, Highlands and the Belford section of Middletown. In 2010, ridership from Atlantic Highlands averaged about 972 persons per day to New York City and 1,718 per day from Highlands. NY Waterway's ferries docking at the Belford terminal in Middletown served approximately 1,716 persons per day. Increases in ridership have been observed in recent years, partly attributable to recent increases in commuter rail and bus fares.

Airports. On a more regional scale, Newark International Airport is easy to access by car from all of Monmouth County. For most residents, the drive is between 45 minutes to an hour. Direct bus service to the airport is also available from central areas of the county and a new passenger rail transfer (AirTrain) provides direct access to trains originating in coastal communities of the county. Many county residents are less than an hour to the Philadelphia International Airport. Monmouth County residents can also take advantage of the Monmouth Executive Airport (formerly known as Allaire Airport) in Wall Township for charter flights all over the country. There are also numerous unpaved landing strips and heliports that service the County for both business and pleasure, albeit on a much smaller scale.

Public Water and Sewer. According to the *New Jersey Statewide Water Supply Plan*, prepared by the NJDEP in 1996, the County's water supplies are plentiful. In fact, during the 2002 water shortage, Monmouth County had ample supplies. The Monmouth County Planning Board's county-wide *Wastewater Management Plan* (2012) concluded that the County's water supply will accommodate projected future growth, and that there is sufficient wastewater capacity through 2022 and beyond.

Income. Since the 1990s, income in Monmouth County has been above both state and national averages. In 2011, it ranked 38th among the highest-income counties in the country, placing it among the top 1.2 percent of counties by wealth. Monmouth County ranks fifth in terms of highest income counties in the State, with only 6.6 percent of the population living below the poverty level and 8.3 percent of children under 18 years of age living below the poverty level. Median household income rose 40 percent between 1989 and 1999 (from $48,050 to $64,271). By 2010, median household income had increased another 28 percent over 1999 values, up to $82,265 (22 percent higher than $67,681 for New Jersey and 64 percent higher than $50,046 for the United States). Per capita income is 23 percent above the state average and 59 percent above the national average. Twenty two percent of Monmouth County households have incomes above $150,000 per year versus 16 percent for New Jersey and 7 percent for the United States.

Employment. The *Monmouth County Profile 2013* reports that 61 percent of Monmouth County's working residents are employed within the County. Another 21 percent work in Manhattan, Middlesex County, or Ocean County. Transportation infrastructure improvements have allowed for more efficient access to other regions, and have eased commutes for residents employed outside of the County. While bus, ferry, and rail services have been expanded, about 75 percent of workers still drive to work.

Tourism. The *Monmouth County Profile 2013* highlights the importance of tourism to the County's overall economy. Tourism spending in Monmouth County was $2.1 billion in 2012, up 5.4 percent from 2011; and $2.2 billion in 2013 – sixth highest in the state. While Hurricane Sandy deterred many vacation plans in Monmouth County, Richard Stockton College reported that demand for lodging was 50 percent higher in the fourth quarter of 2012 than the fourth quarter of 2011 due to housing needs for displaced residents as well as for individuals staffing the recovery effort. A report entitled "The Economic Impact of Tourism in New Jersey" for calendar year 2013 (by Tourism Economics) noted that tourism is a substantial and growing driver of both the state and county economy. Monmouth County ranks eighth in the state in terms of tourism employment. It also has some of the highest number of seasonal homes in the state. In addition to its beaches, Monmouth County offers tourists several public golf courses including two that are ranked within the top 50 public courses in the country. Monmouth County also offer tourists two major horse racing tracks at Monmouth Park and Freehold Raceway.

Military Installations. Fort Monmouth is a former installation of the Department of the Army. In its final years as an Army Post, the Fort was the County's second largest employer with about 500 military personnel and 4,800 private contractors. Final closing ceremonies were held on September 15, 2011. On April 28, Governor Jon Corzine signed into law the Fort Monmouth Economic Revitalization Act, which established the Fort Monmouth Revitalization Planning Authority (FMERPA), to plan the redevelopment of Fort Monmouth. FMERPA is no longer active following the creation of the Fort Monmouth Economic Revitalization Authority (FMERA) in 2010, to provide investment, continuity and economic growth to the communities impacted by the closure of Fort Monmouth. FMERA advances FMERPA's Reuse and Redevelopment Plan for economic development, growth and planning, with a focus on technology-based industries, for the 1,126 acres of real estate at Fort Monmouth.

Located in several Monmouth County communities, Naval Weapons Station Earle (NWS Earle) is a United States Navy base. The facility was constructed in 1943, and remains in active use. NWS Earle serves as an arsenal for weaponry and explosives, and has a rail/port cargo loading system with a 2.9 mile pier in Sandy Hook Bay where ammunition can be loaded and unloaded away from populated areas. The largest portion of the facility is Colts Neck and occupies approximately 10,000 acres.

FEMA Declarations. When a major disaster event occurs, if it is of such severity and magnitude that effective response is beyond the capabilities of the state and the local governments, supplemental Federal assistance can be requested by the state's governor. The President - under the authority of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the "Stafford Act") – has the authority to issue disaster declarations for the county or counties affected. FEMA then manages the entire process, including making federally-funded assistance available in declared areas; coordinating emergency rescue and response efforts; providing emergency resources; and providing other related activities/funding to aid citizens and local governments in the declared areas. Between 1954 and 2014, New Jersey as a whole has been included in 35 major disaster declarations (DR), 11 emergency declarations (EM), and 2 fire management assistance declarations (FMA). **Table 1.2, 1.3 and 1.4** provide a summary of disaster and emergency declarations for the State of New Jersey (based on review of the FEMA web site and the New Jersey State Hazard Mitigation Plan), with an indication as to whether Monmouth County was part of the declared area. More detailed information on historic hazard occurrences is included in Section 3a. Similar to the rest of the state, Monmouth County's major hazard is flooding.

Table 1.2
New Jersey State Major Disaster Declarations: 1955 – 2014

Year	Incident Period	Disaster Type	Disaster Number	Was Monmouth County Declared?
2012	10/26-11/8	**Hurricane Sandy**	**4086**	**Yes**
2012	6/30	Severe Storms and Straight Line Winds	4070	No
2011	10/29	Severe Storms	4048	No
2011	9/28-10/6	Remnants of Tropical Storm Lee	4039	No
2011	8/27-9/5	**Hurricane Irene**	**4021**	**Yes**
2011	8/13-8/15	Severe Storms and Flooding	4033	No
2010	**12/26-12/27**	**Severe Winter Storm and Snowstorm**	**1954**	**Yes**
2010	**3/12-4/15**	**Severe Storms and Flooding**	**1897**	**Yes**
2010	2/5-2/6	Severe Winter Storm and Snowstorm	1889	No
2009	12/19-12/20	Snowstorm	1873	No
2009	11/11-11/15	Severe Storms and Flooding - Ida and a Nor'easter	1867	No
2007	4/14-4/20	Severe Storms and Inland and Coastal Flooding	1694	No
2006	6/23-7/10	Severe Storms and Flooding	1653	No
2005	4/1-4/3	Severe Storms and Flooding	1588	No
2004	9/18-10/1	Tropical Depression Ivan	1563	No
2004	7/12-23/2004	Severe Storms and Flooding	1530	No
2000	8/12-8/21	Severe Storms, Flooding And Mudslides	1337	No
1999	9/16-9/18	Hurricane Floyd	1295	No
1998	2/4-2/8	Coastal Storm	1206	No
1997	8/20-8/21	Flooding	1189	No
1996	10/18-10/23	Severe Storms/Flooding	1145	No
1996	**1/7-1/12**	**Blizzard**	**1088**	**Yes**
1992	**12/10-12/17**	**Coastal Storm, High Tides, Heavy Rain, Flooding**	**973**	**Yes**
1992	**1/4**	**Severe Coastal Storm**	**936**	**Yes**
1985	**9/27**	**Hurricane Gloria**	**749**	**Yes**
1984	**3/28-4/8**	**Coastal Storms, Flooding**	**701**	**Yes**
1977	2/8	Ice Conditions	528	Unknown
1976	**8/21**	**Severe Storms, High Winds, Flooding**	**519**	**Yes**
1975	7/23	Heavy Rains, High Winds, Hail, Tornadoes	477	No
1973	8/7	Severe Storms, Flooding	402	No
1971	**9/4**	**Heavy Rains, Flooding**	**310**	**Yes**
1968	6/18	Heavy Rains, Flooding	245	No
1965	**8/18**	**Water Shortage**	**205**	**Yes**
1962	**3/9**	**Severe Storm, High Tides, Flooding**	**124**	**Yes**
1955	8/20	Hurricane Diane, Floods	41	Unknown

Table 1.3
New Jersey State Emergency Declarations

Year	Incident Period	Emergency Type	Declaration Number	Was Monmouth County Declared?
2012	**10/26-11/8**	**Hurricane Sandy**	**3354**	**Yes**
2011	**8/26-9/5**	**Hurricane Irene**	**3332**	**Yes**
2005	**8/29-10/1**	**Hurricane Katrina Evacuation**	**3257**	**Yes**
2003	8/14-8/16	Power Outage	3188	No
2003	**2/16-2/17**	**Snowstorm**	**3181**	**Yes**

Table 1.3 New Jersey State Emergency Declarations				
Year	**Incident Period**	**Emergency Type**	**Declaration Number**	**Was Monmouth County Declared?**
2001	**9/11**	**Terrorist Attack Emergency Declaration**	**3169**	**Yes**
2000	**5/30-11/1**	**Virus Threat**	**3156**	**Yes**
1999	**9/13-9/26**	**Hurricane Floyd**	**3147**	**Yes**
1993	3/13-3/17	Severe Blizzard	3106	Unknown
1980	10/19	Water Shortage	3083	Unknown
1974	12/21	Severe Storms, High Winds & High Tides	3005	Unknown

Table 1.4 New Jersey State Fire Management Assistance Declarations				
Year	**Incident Period**	**Emergency Type**	**Declaration Number**	**Was Monmouth County Declared?**
2007	5/16	Warren Grove Fire	2695	No
2002	6/2	Double Trouble Fire	2411	No

Participating Jurisdictions

Monmouth County took a multi-jurisdictional approach to preparing its initial hazard mitigation plan and this 2014 Plan Update, inviting all 53 of its municipalities to participate. County and local levels of government bring unique resources to the table. The County has personnel, funding, data, and capabilities that many local jurisdictions lack, while municipalities have the legal authority to enforce compliance with land use planning and development issues. For the initial 2009 Plan, 52 of the County's municipalities opted to participate in, and were covered by, the Plan (with the exception of the Borough of Roosevelt). For the 2014 Plan Update, the County and all 53 of its constituent municipalities participated. Jurisdictions covered by this plan are:

County of Monmouth

Aberdeen, Township of
Allenhurst, Borough of
Allentown, Borough of
Asbury Park, City of
Atlantic Highlands, Borough of
Avon-by-the-Sea, Borough of
Belmar, Borough of
Bradley Beach, Borough of
Brielle, Borough of
Colts Neck, Township of
Deal, Borough of
Eatontown, Borough of
Englishtown, Borough of
Fair Haven, Borough of
Farmingdale, Borough of
Freehold, Borough of
Freehold, Township of
Hazlet, Township of
Highlands, Borough of
Holmdel, Township of
Howell, Township of
Interlaken, Borough of
Keansburg, Borough of
Keyport, Borough of
Lake Como, Borough of
Little Silver, Borough of
Loch Arbour, Village of
Long Branch, City of
Manalapan, Township of
Manasquan, Borough of
Marlboro, Township of
Matawan, Borough of
Middletown, Township of
Millstone, Township of
Monmouth Beach, Borough of
Neptune, Township of
Neptune City, Borough of
Ocean, Township of
Oceanport, Borough of
Red Bank, Borough of
Roosevelt, Borough of
Rumson, Borough of
Sea Bright, Borough of
Sea Girt, Borough of
Shrewsbury, Borough of
Shrewsbury, Township of
Spring Lake, Borough of
Spring Lake Heights, Borough of
Tinton Falls, Borough of
Union Beach, Borough of
Upper Freehold, Township of
Wall, Township of
West Long Branch, Borough of

At the outset of the plan update process in 2012, participation commitments were demonstrated through each jurisdiction submitting a fully executed **Statement of Authority to Participate** to MCOEM. **Figure 1.2** shows a blank version of this letter of commitment. Completed statements are included in **Appendix 1.1 – Statements of Authority to Participate.**

Statement of Authority - Participating

Monmouth County Multi-Jurisdictional
Hazard Mitigation Plan Update - 2012
Lead Agency: Monmouth County Sheriff's Office
Emergency Management Division
300 Halls Mill Road
Freehold, New Jersey 07728
Contact: Michael E. Oppegaard, Coordinator
Margaret Murnane, Deputy Coordinator

This document is prepared as a statement of the authority advising Monmouth County Sheriff's Office, Emergency Management Division that the ____________________ of ____________________ **has opted to participate** in the first update of the Monmouth County Multi-Jurisdictional Hazard Mitigation Plan. Our municipality has committed to participating in the development of an updated county-wide, multi-jurisdictional hazard mitigation plan. We have authorized the following two individuals: ____________________ and ____________________ ("Representative" and "Alternate", respectively) as local members serving on the Multi-Jurisdictional Core Planning Group and to actively participate as requested throughout the planning process.

We understand that our municipality will be required to name its own local hazard mitigation planning committee ("Jurisdictional Assessment Team") if it has not already done so. The Local Emergency Planning Committee may be able to serve in this capacity.

At the end of the project, when FEMA deems the plan approvable, it is understood that our municipality will need to pass a resolution formally adopting the final plan if we are in agreement with said plan and wish to apply for future funding for mitigation projects. This resolution will be provided immediately to the Monmouth County Sheriff's Office, Emergency Management Division for submittal to FEMA, who requires the resolution on file.

*Name of Municipality*____________________

*Name & Title of Authorizing Individual*____________________

*Authorizing Signature and Date*____________________

*Representative's Name & Title*____________________

*Representative's Address*____________________

*Representative's Phone, Fax and Email*____________________

*Alternate's Name & Title*____________________

*Alternate's Address*____________________

*Alternate's Phone, Fax and Email*____________________

Figure 1.2 – Statement of Authority

Hazard Mitigation Planning Team Organizational Structure

The Monmouth County Multi-Jurisdictional Hazard Mitigation Plan has been developed by the Monmouth County Hazard Mitigation Planning Committee (the "**Planning Committee**"), with support from outside consultants (URS Corporation – Clifton, NJ, "URS") who guided all jurisdictions through the planning process and ultimately authored both the initial plan in 2009, and this 2014 Plan Update.

As was the case with the initial plan's development, the overall Planning Committee for this plan update consisted of members of Monmouth County, each participating jurisdiction, and the public and other stakeholders. The Planning Committee did not meet together in one place during the planning process; instead, a team concept was used to more evenly distribute responsibilities and to make best of use of every participant's unique capabilities. The overall Planning Committee was divided into a Core Planning Group (CPG) and a series of Jurisdictional Assessment Teams (JATs), with one JAT for each participating jurisdiction (see **Figure 1.3**). The Core Planning Group includes representation of the participating jurisdictions.

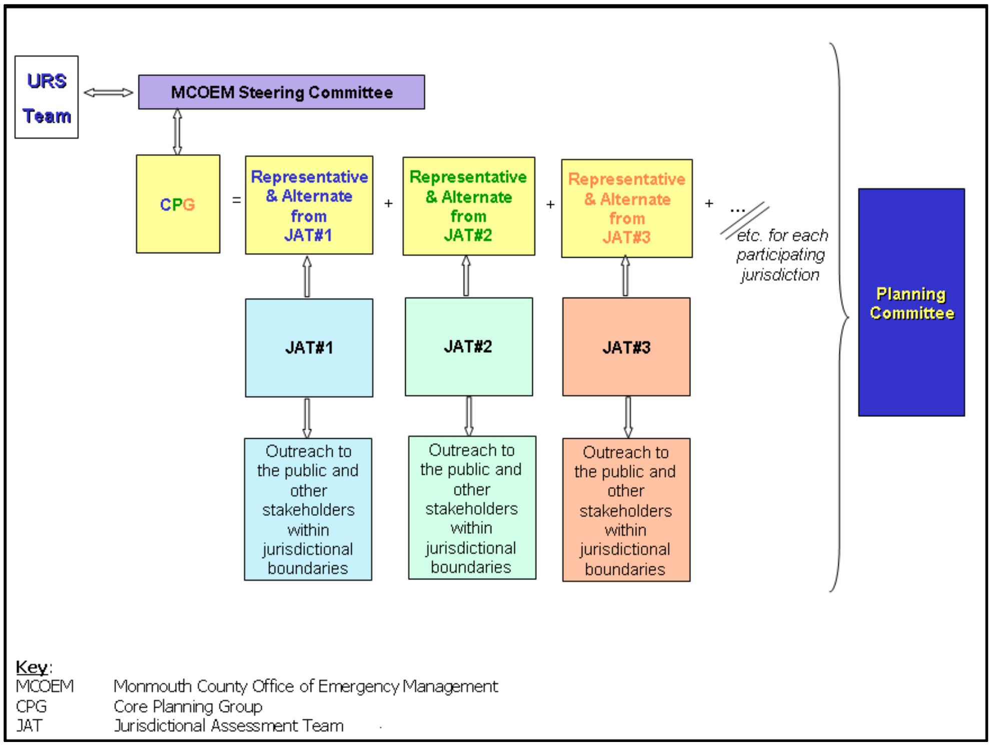

Figure 1.3 – Planning Committee Organizational Structure

The **County JAT** is the Hazard Mitigation Plan Steering Committee, who is responsible for managing overall plan formulation activities under the direction of MCOEM's Hazard Mitigation Coordinator, Michael Oppegaard and Deputy Coordinator, Margaret Murnane-Brooks. **MCOEM** was responsible for setting meeting dates and times, securing a meeting facility, and notifying all team members of upcoming meetings. They also played a very large role in reminding CPG members of certain project deadlines. The Consultant prepared meeting agendas, handouts, and PowerPoint presentations. MCOEM ensured that all meeting materials and report deliverables were posted on the County web site.

Local JATs were identified for each participating jurisdiction, and included a range of expertise - from elected officials and administrators to staff in planning, public works, and engineering, for example. Each JAT was responsible for coordinating and facilitating local planning efforts; providing information and feedback to the contractor regarding a wide range of topic areas from land uses and development trends, to local capabilities and floodplain management initiatives through completing various worksheets; involving the public and local community stakeholders in the planning process; assessing mitigation alternatives; selecting a course of action to be followed for their community; adopting the plan; reviewing draft documents; and participating in plan monitoring and implementation. JATs fulfilled these responsibilities under the leadership of their CPG members (the "representative" and "alternate" designated on the Statement of Authority to Participate).

The **CPG** as a whole - made up of head members of each JAT – was the day-to-day planning team for the overall multi-jurisdictional planning process. CPG members were the primary local points of contact for both the County Steering Committee and the consultant and were the go-betweens between the local JATs and the larger CPG. CPG members were responsible for fulfilling their jurisdiction's plan update process obligations, with assistance and direct support from the members of their JAT. CPG members attended planning meetings; conveyed meeting information back to their JAT members; solicited information and feedback needed from JAT members for incorporation into the plan (typically, on an as-needed basis depending upon the nature of the information request as compared to JAT member areas of specialty), and had primary responsibility for providing opportunities for the public and other stakeholders within their jurisdiction to be involved in the planning process. Readers are invited to review the contents of

Appendix 1.2 – Planning Committee Membership Information for a list of JAT members for each jurisdiction. CPG Representatives and Alternates are also noted therein.

At the end of the plan update process, each jurisdiction will formally adopt the Final Plan, documenting their commitment to strive to implement the actions and projects identified in the mitigation strategy to reduce or eliminate long-term risk from natural hazards and disasters in their community.

Planning Team Meetings

The initial version of this plan was prepared between 2007 and 2008. It was approved by FEMA and adopted by local communities in 2009. Participating jurisdictions have been working since that time to implement the actions that were listed in their respective mitigation strategies. FEMA requires ongoing plan implementation, regular monitoring of progress, and formal updates every five years thereafter. The 2009 Plan provided the details of the initial plan development process, which will not be reiterated here. Instead, this subsection will focus strictly on the process undertaken during the first plan update[2].

Monmouth County and its jurisdictions initiated the process for this first required plan update by submitting a planning grant application to FEMA in 2010 under the Pre-Disaster Mitigation (PDM) program. The County received notification that the grant was approved in December 2011 and advertised a Request for Proposals from qualified bidders for the hazard mitigation plan update on February 7, 2012. Bids were received on February 22, 2012. Evaluations were completed on March 7, 2012. A resolution was passed by the County Freeholders on March 22, 2012, and a contract was executed with the successful bidder (URS) on May 31, 2012. Key planning team meetings held during the plan update process are summarized in **Table 1.5.**[3] Meetings were put on hold for a period of six months following Hurricane Sandy in October 2012, in order to allow all team members to focus their time on efforts strictly related to disaster response and recovery. Meeting materials such as agendas, sign in sheets, and presentations are provided in **Appendix 1.3**.

Table 1.5
Key Planning Team Meetings [4]

Date	Title	Details
June 8, 2012	Project Initiation Meeting (MCOEM, URS)	Project Initiation Meeting – MCOEM met with URS to refine the scope of work and project schedule. They discussed the overall readiness of the CPG to begin the update process; CPG activities/progress since 2009 in plan maintenance and integration; project schedule; scope of work; approach for future meetings (particularly the Kickoff Meeting); exchanged GIS staff points of contact, and outreach to the public and other stakeholders.
July 31, 2012	CPG Kickoff Meeting	Topics discussed included: the importance of the plan update, overview of the 2009 plan, benefits of continued participation in the plan update, key steps of the plan update process, participation requirements for the update, project timeline, near term actions items for participating jurisdictions, outreach to the public and other stakeholders, long term action items for participating jurisdictions, expanded mitigation strategies; and FEMA's perspectives and expectations regarding participation, outreach, and municipal mitigation strategies. The importance of their ongoing and future activities to reach out to the public and key stakeholders in their communities was stressed (using Guidance Memo 1 as a guide, and documenting their activities in the provided Outreach Log).

[2] Parties interested in the 2009 plan development process can access that version of the plan on the County web site at: http://www.monmouthsheriff.org/files/oem-mitigation/MitigationMultijurPlan.pdf

[3] Local JAT meetings are not presented in this table. Individual JATs met on a fairly ad-hoc basis throughout the plan update process as they deemed necessary.

[4] For each CPG meeting, additional information such as meeting agendas, presentations, and handouts were posted on the Monmouth County mitigation planning web site at: http://sheriffgolden.com/Sections-read-144.html

Table 1.5 Key Planning Team Meetings [4]		
Date	**Title**	**Details**
September 28, 2012	CPG Progress Meeting	CPG members considered URS' assessment of hazards identified as significant for the plan update and indicated their concurrence with findings by a show of hands. URS highlighted some key issues including the NFIP and repetitive / severe repetitive loss properties, sea level rise, coastal erosion, hurricane risks, etc. CPG members participated in a group discussion of their experiences with natural hazards events since the last plan was prepared. URS reminded CPG members of the benefits of participating; highlighted programs that are accessed by having an approved plan; provided an overview of typically eligible project types under these programs; and introduced some key information from the State Plan, including goals and the project ranking system for the HMGP. URS facilitated a group discussion of experiences during Hurricane Irene, and other recent events; CPG members participated in the group discussion by speaking to issues such as: What happened? Were these things expected? In expected locations? Were any impacts unanticipated, or with unanticipated consequences? Was the problem simply repaired to pre-disaster conditions, or was it mitigated? And did Irene highlight any areas in need of immediate attention (mitigation)? URS then facilitated a group discussion of potential solutions to mitigate problems highlighted in past disasters. CPG members brainstormed about types of projects to provide solutions to the above discussed problems (keeping in mind project types that are potentially fundable, 'shovel-ready' actions that may also align well with State goals and rank competitively. The meeting wrapped up with URS presenting some examples of community mitigation activities. The CPG participated in a group discussion of how these things may apply to Monmouth County communities. URS reminded the group about the importance of their ongoing and future activities to reach out to the public and key stakeholders in their communities (using Guidance Memo 1 as a guide, and documenting their activities in the provided Outreach Log).
Plan Update Meetings were put on hold for a six month period following Hurricane Sandy in October 2012, in order to allow all team members to focus their time on efforts strictly related to disaster response and recovery. During this time a six month extension was granted by FEMA to the submission deadline for the plan update.		
January 7, 2013	Steering Committee Meeting	Regular meeting of the County Steering Committee to discuss plan update progress, information to be submitted to URS for incorporation into the document, and the County's mitigation strategy. This was a hybrid meeting to also discuss HMGP LOIs related to Hurricane Sandy.
April 2-5, 2013	FEMA Mitigation Strategy Workshops	FEMA hosted a series of one-day Mitigation Strategy Workshops for the CPG. These workshops provided CPG members with a chance to begin to: develop actions to reduce risk and make their community more disaster-resilient; develop cost-effective actions that save money in the long run; build a strategy for the successful implementation of their mitigation action plan; coordinate with other local officials, planners and stakeholders on potential hazard mitigation ideas and projects; use worksheets, examples and other tools to build a mitigation strategy that makes a connection between natural hazard risk, action and implementation; and communicate directly with FEMA planners to understand how to develop an effective and worthwhile Hazard Mitigation Plan.
April 15, 2013 *Postponed from initially scheduled date of 11/15/12 due to Hurricane Sandy	CPG Progress Meeting	Given the occurrence of Hurricane Sandy in October 2012 - one month after the previous CPG Progress Meeting of September 2012 - this CPG Progress Meeting began by reflecting on how perspectives and perceptions had changed in the past six months, in a post-Sandy environment. URS shared some key slides from the September 2012 meeting that best illustrated perceptions at that time as a way of highlighting how Sandy has provided a new frame of reference. CPG members listened and asked questions. The next part of the meeting was geared toward how Sandy lessons learned are shaping local mitigation strategies. CPG members discussed perspectives of how the disaster has changed the municipal perception of the severity of the problem, the need for mitigation, and what mitigation strategies to pursue. URS presented a brief overview of the FEMA April 2-5 workshops on the importance of developing a robust mitigation strategy, for those who had been unable to attend one of the three sessions. The group discussed that knowing your community's vulnerabilities and implementing hazard mitigation measures can reduce your risk and increase your community's resiliency. CPG members were reminded to: inform the public about the natural hazards in their locality; provide information that can be used to mitigate the impacts; and motivate individuals and communities to take actions that will prepare them for the next disaster and share their mitigation steps with others. URS reminded the group that outreach to the public and other stakeholders during the plan update process is required for FEMA to approve the plan for your jurisdiction; that they could refer to Guidance Memo 1 for more information and tips; and Use the Outreach Log to document your activities. CPG members participated in a group discussion and shared some of their outreach activities to date with the other communities. Next, URS discussed the link between the risk assessment and mitigation strategies, and presented examples from the last version of the plan of good approaches to emulate, as well as examples of poor approaches to try to avoid. URS navigated live to the project SharePoint site and provided an overview of structure and content; CPG members were asked to discuss whether they have been on the site yet, and any feedback they would like to share. URS navigated to the Monmouth County Sheriff's Office Facebook Page; CPG members were asked to indicate whether they have been on the site yet, and any feedback they would like to share. The meeting concluded with discussions of the Plan Update Worksheets that are used to capture the ebb and flow of information between communities and plan authors. URS began by recapping what was done for the 2009 Plan as a frame of reference, and compared this with what needs to be done for this Plan Update. URS discussed: who should complete the worksheets, what will they encompass, when they will be distributed, when they will be due back, where to get copies, how to submit responses, and why this is a necessary step of the process. The group was also reminded about the importance of their ongoing and future activities to reach out to the public and key stakeholders in their communities (using Guidance Memo 1 as a guide, and documenting their activities in the provided Outreach Log).

Table 1.5 Key Planning Team Meetings [4]		
Date	**Title**	**Details**
May 2, 2013	Steering Committee Meeting	Regular meeting of the County Steering Committee to discuss plan update progress, information to be submitted to URS for incorporation into the document, and the County's mitigation strategy.
June 6, 2013	CPG Progress Meeting	URS presented an overview of the concept of Plan Integration, and how Worksheet 6 was being used to document each community's progress in plan integration activities over the first plan maintenance cycle, as well as their desired approaches to plan integration for the next plan maintenance cycle. URS also discussed how Worksheet 5 would be used to document each community's progress in implementing the actions of their mitigation strategies over the first plan maintenance cycle. URS also spoke about common issues with other worksheets being submitted to date (Worksheet 1 – JAT members; Worksheet 2 – NFIP; Worksheet 3 – Land Uses and Development Trends; Worksheet 4 –Capability Assessment) and reminded the group about the importance of their ongoing and future activities to reach out to the public and key stakeholders in their communities (using Guidance Memo 1 as a guide, and documenting their activities in the provided Outreach Log).
August 15, 2013	Steering Committee Meeting	Regular meeting of the County Steering Committee to discuss plan update progress, information to be submitted to URS for incorporation into the document, and the County's mitigation strategy.
November 14, 2013	CPG Working Session	This working session allowed a subset of interested CPG members to receive one-on-one assistance from URS in providing the information and feedback for the six plan update worksheets that had been distributed to-date regarding: JAT membership, Land Uses and Development Trends Updates, Capabilities Updates, Continued Compliance with the NFIP, Status of Past Projects, and Plan Integration Activities.
December 16, 2013	Hybrid Steering Committee Meeting	Hybrid meeting of the County Steering Committee. The plan update was discussed briefly, but the primary purpose of the meeting was to prioritize Sandy HMGP LOIs. Stakeholders did not attend.
February 18, 2014	Joint Meeting: CPG and Municipal Coordinators	A Core Planning Group Members Session on the plan update was held during the Municipal Coordinators Meeting. URS presented an overview of the CPG one-on-one working sessions in November; reminded the group about the importance of their ongoing and future activities to reach out to the public and key stakeholders in their communities (using Guidance Memo 1 as a guide, and documenting their activities in the provided Outreach Log); reminded the communities that they and their JATs should be using this time to brainstorm about the mitigation actions that will comprise their mitigation strategy for the plan update. URS discussed activities as plan authors in streamlining the document to address municipal feedback regarding the 2009 version's overall printed length; the recent release of FEMA's preliminary flood hazard area maps which are being incorporated into the plan in lieu of the previous 2009 DFIRMs, ABFEs, and Preliminaries. Discussions were focused on Priority Risk Indices and Hazard Rankings from the 2009 Plan, and how these are being revised for the current plan update, as well as Key Risk Findings being summarized in a concise location for the updated document, and the use of both to inform mitigation strategy development. URS stressed that the mitigation strategies developed by municipalities for the last version of the plan had a substantial disconnect between the problems that were discussed throughout the plan text and the actions that were ultimately proposed in the mitigation strategies; as well the importance of bridging this gap for the plan update over the coming months. URS stressed that the plan update must include robust mitigation strategies developed by each community to address their highest hazards and key risks. And that updated mitigation strategies will consist of: (a) projects carried forward from the last version of the plan; plus (b) new projects identified as part of the update. URS also presented how to document mitigation strategy actions using the FEMA Risk Action Implementation (RAI) Worksheet (Worksheet 7). The discussion closed with a reminder for CPG members to be working with all of the members of their JAT, and the importance of soliciting input from the public and other stakeholders at this most important juncture.
February 27, 2014	CPG Mitigation Strategy Working Session	At this Mitigation Strategy Working Session, discussions were focused on Priority Risk Indices and Hazard Rankings from the 2009 Plan, and how these are being revised for the current plan update, as well as Key Risk Findings being summarized in a concise location for the updated document, and the use of both to inform mitigation strategy development. URS stressed that the mitigation strategies developed by municipalities for the last version of the plan had a substantial disconnect between the problems that were discussed throughout the plan text and the actions that were ultimately proposed in the mitigation strategies; as well the importance of bridging this gap for the plan update over the coming months. URS stressed that the plan update must include robust mitigation strategies developed by each community to address their highest hazards and key risks. And that updated mitigation strategies will consist of: (a) projects carried forward from the last version of the plan; plus (b) new projects identified as part of the update. URS also presented how to document mitigation strategy actions using the FEMA Risk Action Implementation (RAI) Worksheet (Worksheet 7). The discussion closed with a reminder for CPG members to be working with all of the members of their JAT, and the importance of soliciting input from the public and other stakeholders at this most critical juncture.
March 11, 2014	Steering Committee Meeting	Regular meeting of the County Steering Committee to discuss plan update progress, information to be submitted to URS for incorporation into the document, and the County's mitigation strategy.

Table 1.5 Key Planning Team Meetings [4]		
Date	**Title**	**Details**
March 13, 2014	FEMA Coastal Hazard Analysis Resilience Meeting	FEMA Region II, NJDEP, and Monmouth County held a Resilience meeting with local officials. The purpose of the meeting was to continue to build local capacity for implementing priority mitigation activities within the county by 1) reviewing the non-regulatory flood risk tools and how these have been useful in identifying and taking action to reduce risk, 2) sharing successful strategies to reduce flood risk, and 3) further identifying mitigation actions using the non-regulatory flood risk tools. The meeting provided an opportunity for community officials to learn about available tools and resources for taking action to address coastal flood risk, and more fully develop their mitigation strategies and action plans.
April 3, 2014	Hybrid Steering Committee Meeting	Hybrid meeting of the County Steering Committee. The plan update was discussed briefly, but the primary purpose of this working meeting for County officials only to prepare hazard mitigation action worksheets.
July 10, 2014	Joint Meeting: CPG and Municipal Coordinators	A Core Planning Group Members Session on the plan update was held during the Municipal Coordinators Meeting. MCOEM discussed the plan update, mitigation strategy, outreach logs, and draft plan update release.
December 5, 2014	Steering Committee Meeting	Regular meeting of the County Steering Committee to discuss the plan, as submitted for agency review on October 22, 2014.

Roles and Responsibilities – County, Municipalities, and Contractor

County. In addition to acting as a participating jurisdiction in its own right, Monmouth County took on the role of lead agency and facilitator in the plan development and update processes. MCOEM secured the grant funding for the 2009 Plan and its 2014 Plan Update, and solicited the participation of all 53 jurisdictions. They selected the consultant and administered the contract; managed communications between the consultant and the CPG (principally through email); distributed deliverables and outreach materials to jurisdictions, the public, other stakeholders, and reviewing agencies; facilitated meetings; procured meeting venues and presentation equipment; distributed meeting invitations; and conducted an extensive outreach strategy for the public and other stakeholders. They continue to maintain a central hazard mitigation planning website and use social media (Facebook, Twitter) to solicit feedback.

Municipalities. Each participating jurisdiction contributed throughout the overall plan development and update processes under the support and guidance of MCOEM and URS. Municipal JATs conducted outreach to the public and other stakeholders within their respective jurisdictions, assessed risk and hazard mitigation alternatives, and ultimately developed a mitigation action plan for their community. Each JAT was responsible for providing staff to participate in the CPG, attending CPG meetings, and holding their own JAT meetings as they deemed necessary. JATs were responsible for reviewing information, data and documents; submitting feedback to the Consultant; completing questionnaires/forms; reaching out to the public and other stakeholders in their respective jurisdictions; developing a unique updated mitigation strategy for their jurisdiction; and reviewing and commenting on draft documents. CPG members documented activities undertaken by their municipal JAT for URS incorporation into the document, and prepared the following written documentation at key junctures in the plan update process: As discussed previously in this section, each municipality formally advised MCOEM of their desire to participate in the multi-jurisdictional hazard mitigation plan update process. Statements of Authority to Participate from all 53 jurisdictions are included in **Appendix 1.1**.

- As discussed previously in this section, each CPG member was responsible for developing a local JAT for their community. "Worksheet 1 – JAT Membership" documents, for a range of position titles, who was approached by the CPG member and when, and whether or not that person agreed to participate in the plan update (along with their contact information). Copies of Worksheet 1 submittals are included in **Appendix 1.2.**

- At the project kickoff meeting on July 31, 2012, CPG members were responsible for providing feedback on the list of hazards to be included in the plan update, and whether they felt any hazards should be added to – or omitted from – the list. A show of hands concurred that the 2009 identified hazards would be the focus of the 2014 plan update, with no hazards omitted from or added to the list of those identified as significant. Meeting materials from this kickoff meeting and others throughout the plan update process are provided in **Appendix 1.3**.

- All of Monmouth County's municipalities participate in FEMA's NFIP. Each CPG member coordinated with their local floodplain manager to describe their community's participation in the NFIP and describe their floodplain management program for continued compliance with NFIP requirements. "Worksheet 2 – NFIP Participation" documents this information, and copies of each response are included in **Appendix 1.4.**

- Each CPG member coordinated with their JAT to document changes in land uses and development trends since the last plan was prepared. "Worksheet 3 - Land Uses and Development Trends Worksheet" documents this step. Copies of each JAT's response are included in **Appendix 1.5.**

- Each CPG member coordinated with their JAT to document changes in local capabilities since the last plan was prepared. "Worksheet 4 – Capability Assessment" documents this step, elaborating on each jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs. Copies of each JAT's response are included in **Appendix 1.6**.

- Each CPG member coordinated with their JAT to evaluate and demonstrate progress made in the past five years in achieving goals and implementing actions outlined in their 2009 mitigation strategy, including an explanation of if and how any priorities may have changed since the plan was previously approved. "Worksheet 5 – Status of Past Projects" documents this step, and copies of each JAT's response are included in **Appendix 1.7**.

- Each CPG member coordinated with their JAT to document the status of plan integration[5] activities over the first plan maintenance cycle, and jurisdiction-specific activities projected for the next plan maintenance cycle. "Worksheet 6 – Plan Integration" documents this step, and copies of each JAT's response are included in **Appendix 1.8**.

- Each CPG member coordinated with their JAT to develop an updated mitigation strategy. "Worksheet 7 – Action Worksheets" document this step (with one worksheet for each action). Each JAT's action plan describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction. Copies of each JAT's responses are included in **Appendix 1.9.**

- Each JAT provided opportunities for the general public and other stakeholders to be made aware of the plan update process, and the opportunity for them to participate and provide feedback. Outreach Logs were completed by each JAT as activities were undertaken. Copies of each JAT's Outreach Logs are included in **Appendix 1.10**.

A detailed summary of the participation demonstrated by each jurisdiction, including attendance at meetings and submission of requested deliverables, is presented in **Table 1.6** on the next page.

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[5] Plan integration is the process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.

Contractor. URS was contracted by the County to guide participating jurisdictions through the process and author the plan in a manner consistent with applicable regulations, criteria, and guidance. URS was the lead firm for this assignment for both the 2009 Plan and the 2014 Plan Update. URS was the direct County point of contact, and assisted in all aspects of the plan update, guided local municipalities through their participation in key aspects of the update in a manner that would meet current requirements, led the hazard mitigation planning efforts, was the primary presenter at CPG meetings, authored the plan document, and provided overall contract administration. URS conducted the analyses necessary to provide team members with the information they needed to make sound decisions, and helped guide them through the necessary steps of the plan development and update processes. URS also prepared a project fact sheet; sample generic press release about the plan update for use by municipalities, at their option (in full or in part); and a sample generic PowerPoint presentation about the plan update process, also for use by municipalities, at their option (in full or in part) - both to facilitate consistent messaging across participating municipalities and for the sake of efficiency by ensuring that 53 different municipalities didn’t have to each spend time generating separate presentation materials. These were all posted to an internal planning team member SharePoint site, hosted by URS, for information exchange throughout the first plan update.

Table 1.6
Monmouth County Jurisdictions Plan Participation

Entity[6]	Returned Statement of Authority to Participate	Planning Team Meetings Attended (listed in chronological order from left to right): Initiation Meeting 06/08/12[8]	CPG Kickoff Meeting[9] 07/31/12	CPG Progress Meeting[9] 09/28/12	FEMA Mitigation Strategy Workshops[10] 4/(2-5)/13	CPG Progress Meeting[9] 04/15/13	Steering Committee Meeting[11] 01/07/13	Steering Committee Meeting[11] 05/02/13	CPG Progress Meeting[9] 06/06/13	Steering Committee Meeting[11] 08/15/13	CPG Optional Working Session[12] 11/14/13	Hybrid Steering Committee Meeting[13] 12/16/13	Joint Meeting CPG and Municipal Coordinators[14] 02/18/14	CPG Mitigation Strategy Working Session[9] 02/27/14	Steering Committee Meeting[11] 03/11/14	FEMA Coastal Hazard Analysis Resilience Meeting 03/13/14	Hybrid Steering Committee Meeting[15] 04/03/14	Joint Meeting CPG and Municipal Coordinators 07/10/14	County Steering Committee Meeting[11] 12/05/14	Worksheets Submitted[7]: 1	2	3	4	5	6	7	Outreach to the Public and Other Stake-holders	Returned Declaration of Participation
Monmouth, County of		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	Forthcoming
MCOEM*		■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■									
Administrator*												■																
Economic Development*			■				■			■		■																
Public Works and Engineering Department*			■	■			■	■		■				■	■	■	■	■	■									
Parks System*							■										■											
Health Department*			■				■					■			■			■										
Planning Board*							■	■																				
Division of Planning*			■		■		■	■		■		■		■	■	■	■											
Reclamation																		■										
Communities																												
Aberdeen, Township of	■		■	■	■	■			■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Allenhurst, Borough of	■		■			■			■											■	■	■	■	■	■	■	■	Forthcoming
Allentown, Borough of	■													■						■	■	■	■	■	■	■	■	Forthcoming
Asbury Park, City of	■			■	■								■					■		■	■	■	■	■	■	■	■	Forthcoming
Atlantic Highlands, Borough of	■		■	■	■				■					■		■				■	■	■	■	■	■	■	■	Forthcoming
Avon-by-the-Sea, Borough of	■		■	■	■				■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Belmar, Borough of	■			■	■	■								■						■	■	■	■	■	■	■	■	Forthcoming
Bradley Beach, Borough of	■		■	■	■	■			■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Brielle, Borough of	■				■	■			■					■				■		■	■	■	■	■	■	■	■	Forthcoming
Colts Neck, Township of	■		■								■		■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Deal, Borough of	■		■			■			■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Eatontown, Borough of	■												■							■	■	■	■	■	■	■	■	Forthcoming
Englishtown, Borough of	■		■	■	■				■				■	■						■	■	■	■	■	■	■	■	Forthcoming

6 "*" denotes Steering Committee member entity

7 Worksheet 1 = JAT Membership; Worksheet 2 = NFIP; Worksheet 3 = Land Uses and Development Trends Update; Worksheet 4 = Capability Assessment Update; worksheet 5 = Status of Past Projects; Worksheet 6 = Plan Integration; Worksheet 7 = Action Worksheets. Worksheet 2 is not applicable for the County because the county level of government is not eligible to participate in the NFIP.

8 The project Initiation Meeting for the update process was a working coordination and planning meeting between MCOEM and URS, conducted at the outset of the plan update, while CPG membership was under development.

9 Steering Committee members were informed and kept apprised of CPG meetings, but attendance was not required.

10 FEMA's mitigation strategy workshops were geared toward local municipal officials from participating jurisdictions.

11 Only Steering Committee members were invited, except on occasion where State or Federal OEM representatives attended due to Hurricane Sandy agenda items

12 All CPG members were invited to attend the CPG Optional Working Session on 11/14/13; attendance was only expected for those communities who had requested one-on-one assistance with the consultant in completing their worksheets.

13 This 12/16/13 hybrid meeting of the Steering Committee was limited to County officials only, as Sandy HMGP LOI prioritization was the primary agenda item.

14 Joint meetings of the CPG and Municipal Coordinators included only County and municipal attendees, except on the occasion where a stakeholder entity was speaking on an agenda topic.

15 This 4/3/14 hybrid meeting of the Steering Committee was intended as a working meeting for County officials only to prepare hazard mitigation action worksheets; a targeted group of stakeholders was invited to provide expertise in various areas.

Table 1.6
Monmouth County Jurisdictions Plan Participation

Entity[6]	Returned Statement of Authority to Participate	Planning Team Meetings Attended (listed in chronological order from left to right): Initiation Meeting 06/08/12[8]	CPG Kickoff Meeting[9] 07/31/12	CPG Progress Meeting[9] 09/28/12	FEMA Mitigation Strategy Workshops[10] 4/(2-5)/13	CPG Progress Meeting[9] 04/15/13	Steering Committee Meeting[11] 01/07/13	Steering Committee Meeting[11] 05/02/13	CPG Progress Meeting[9] 06/06/13	Steering Committee Meeting[11] 08/15/13	CPG Optional Working Session[12] 11/14/13	Hybrid Steering Committee Meeting[13] 12/16/13	Joint Meeting CPG and Municipal Coordinators[14] 02/18/14	CPG Mitigation Strategy Working Session[9] 02/27/14	Steering Committee Meeting[11] 03/11/14	FEMA Coastal Hazard Analysis Resilience Meeting 03/13/14	Hybrid Steering Committee Meeting[15] 04/03/14	Joint Meeting CPG and Municipal Coordinators 07/10/14	County Steering Committee Meeting[11] 12/05/14	Worksheets Submitted[7]: 1	2	3	4	5	6	7	Outreach to the Public and Other Stake-holders	Returned Declaration of Participation
Fair Haven, Borough of	■		■	■	■				■							■		■		■	■	■	■	■	■	■	■	Forthcoming
Farmingdale, Borough of	■		■			■												■		■	■	■	■	■	■	■	■	Forthcoming
Freehold, Borough of	■		■	■					■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Freehold, Township of	■		■			■			■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Hazlet, Township of	■		■			■							■							■	■	■	■	■	■	■	■	Forthcoming
Highlands, Borough of	■			■	■													■		■	■	■	■	■	■	■	■	Forthcoming
Holmdel, Township of	■															■				■	■	■	■	■	■	■	■	Forthcoming
Howell, Township of	■		■	■	■	■			■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Interlaken, Borough of	■		■			■					■		■					■		■	■	■	■	■	■	■	■	Forthcoming
Keansburg, Borough of	■		■						■							■				■	■	■	■	■	■	■	■	Forthcoming
Keyport, Borough of	■		■	■					■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Lake Como, Borough of	■		■	■	■	■			■				■	■		■				■	■	■	■	■	■	■	■	Forthcoming
Little Silver, Borough of	■					■								■		■				■	■	■	■	■	■	■	■	Forthcoming
Loch Arbour, Village of	■		■	■		■								■						■	■	■	■	■	■	■	■	Forthcoming
Long Branch, City of	■		■	■	■	■			■				■							■	■	■	■	■	■	■	■	Forthcoming
Manalapan, Township of	■		■	■	■				■					■				■		■	■	■	■	■	■	■	■	Forthcoming
Manasquan, Borough of	■					■								■				■		■	■	■	■	■	■	■	■	Forthcoming
Marlboro, Township of	■		■	■	■	■			■					■				■		■	■	■	■	■	■	■	■	Forthcoming
Matawan, Borough of	■		■	■	■	■			■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Middletown, Township of*	■		■	■	■	■			■	■			■	■		■		■		■	■	■	■	■	■	■	■	Forthcoming
Millstone, Township of	■					■								■						■	■	■	■	■	■	■	■	Forthcoming
Monmouth Beach, Borough of	■		■	■							■					■				■	■	■	■	■	■	■	■	Forthcoming
Neptune City, Borough of	■		■	■		■							■					■		■	■	■	■	■	■	■	■	Forthcoming
Neptune, Township of*	■		■	■	■	■							■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Ocean, Township of	■		■			■			■					■				■		■	■	■	■	■	■	■	■	Forthcoming
Oceanport, Borough of*	■		■	■	■	■		■	■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Red Bank, Borough of	■			■	■	■			■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Roosevelt, Borough of	■					■			■											■	■	■	■	■	■	■	■	Forthcoming
Rumson, Borough of	■			■	■	■			■				■			■				■	■	■	■	■	■	■	■	Forthcoming
Sea Bright, Borough of	■				■				■		■			■		■		■		■	■	■	■	■	■	■	■	Forthcoming

Table 1.6
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Sea Girt, Borough of	■			■		■			■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Shrewsbury, Borough of	■		■			■			■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Shrewsbury, Township of	■		■	■					■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Spring Lake, Borough of	■		■	■		■							■	■				■		■	■	■	■	■	■	■	■	Forthcoming
Spring Lake Hts., Borough of	■		■											■				■		■	■	■	■	■	■	■	■	Forthcoming
Tinton Falls, Borough of	■		■	■					■				■					■		■	■	■	■	■	■	■	■	Forthcoming
Union Beach, Borough of	■				■				■				■			■		■		■	■	■	■	■	■	■	■	Forthcoming
Upper Freehold, Township of	■			■					■					■						■	■	■	■	■	■	■	■	Forthcoming
Wall, Township of	■		■	■		■			■				■	■				■		■	■	■	■	■	■	■	■	Forthcoming
West Long Branch, Borough of	■		■						■				■	■						■	■	■	■	■	■	■	■	Forthcoming
Stakeholders																												
NJOEM			■		■	■				■			■			■		■										
NJDOS																■												
NJDEP																		■										
NJ Natural Gas*			■											■														
FEMA			■		■	■	■									■												
NJ American Water Company*			■																									
Jersey Central Power and Light*			■					■										■										
United Way			■																									
Deal Lake Commission			■	■																								
Mosquito Extermination Commission*										■																		
Jacques Cousteau Natural Estuarine Research Reserve*								■						■	■	■	■											
Leckner Consulting*							■			■						■												
Manasquan River Regional Sewerage Authority*							■	■		■																		
Stockton College																■												
Monmouth University – Urban Coast Institute*								■							■	■												
NJ Sea Grant																■												
Naval Weapons Station - Earle																■												
Verizon Wireless													■															
Consultant:																												
URS		■	■	■	■	■			■		■		■	■		■												

KEY: [shaded cell] = Not invited; ■ = Invited and attended; [blank cell] = Invited but did not attend

Outreach to the Public and Other Stakeholders

A key element in the mitigation planning process is the discussion it promotes among community members about creating safer, more disaster-resilient communities. To meet Federal requirements, opportunities must be provided for the general public and other stakeholders[16] to be involved throughout hazard mitigation planning and plan update processes.

Outreach to the public and other stakeholders was undertaken concurrently by both the County and each participating jurisdiction. County outreach activities were broader efforts aimed at a larger, county-wide scale; while each participating jurisdiction's JAT was responsible for providing outreach opportunities for the general public and other stakeholders within their municipal borders. County activities alone totaled more than three dozen opportunities for the public and other stakeholders to participate in the plan update – not including stakeholder attendance at Steering Committee, CPG, or other planning team meetings. Additionally, JATs provided hundreds of additional opportunities at a more local level. **While this subsection of the plan presents a general overview of County-led activities for outreach to the public and other stakeholders, details of the specific activities undertaken by the County and each participating jurisdiction are provided in Appendix 1.10.**

- Stakeholders on the County Steering Committee. The County developed a Steering Committee of County Officials and Key stakeholder groups in the County to provide feedback on the plan and on mitigation actions. As shown in Table 1.6, the Steering Committee met on the following dates during the plan update process: January 7, 2013; May 2, 2013; August 15, 2013; December 16, 2013; March 11, 2014; April 3, 2014; and December 5, 2014. A list of specific member names and position titles is included in **Appendix 1.2.** The County Steering Committee consisted of the following entities:

  Monmouth County Office of Emergency Management
  Monmouth County Business Administrator
  Monmouth County Economic Development
  Monmouth County Department of Public Works and Engineering
  Monmouth County Parks System
  Monmouth County Health Department
  Monmouth County Planning Board
  Monmouth County Division of Planning
  Monmouth County Sheriff's Office
  Monmouth County Department of Buildings and Grounds
  Municipal Representative – Middletown, Township of
  Municipal Representative – Neptune, Township of
  Municipal Representative – Oceanport, Borough of
  New Jersey Natural Gas
  New Jersey American Water Company
  Jersey Central Power and Light
  Monmouth County Mosquito Extermination Commission
  *Jacques Cousteau Natural Estuarine Research Reserve (JCNERR) *Also representing NJNY COAT*
  *Leckner Consulting *Also representing NJNY COAT*
  Manasquan River Regional Sewerage Authority
  Monmouth University - Urban Coast Institute

- Other Stakeholders Attending Key Planning Team Meetings. In addition to the stakeholders who participated directly as members of the County Steering Committee, the following additional

[16] A stakeholder is any person, group, or institution that can affect or be affected by a course of action, such as neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, businesses, academia, and other private and nonprofit interests.

stakeholders also participated by attending one or more multi-jurisdictional planning team meetings (see **Table 1.6**):

New Jersey Office of Emergency Management
New Jersey Department of State
New Jersey Department of Environmental Protection
Federal Emergency Management Agency
United Way
Deal Lake Commission
Stockton College
New Jersey Sea Grant
Naval Weapons Station – Earle
Verizon Wireless

- Press. Information regarding the plan update appeared in various news outlets over the course of the project to provide opportunities for the public and other stakeholders to be informed and to participate in the process. Press releases were issued by the County on: June 29, 2012 discussing the plan update process; October 16, 2012 advertising the release of the natural hazards survey; May 22, 2013 providing notice of a public meeting on the plan update to be held in Hazlet; June 20, 2013 describing the plan update process; March 4, 2014 regarding the plan update process and soliciting feedback on areas in need of mitigation; and on October 20, 2014. All were submitted to local media outlets; many were also posted on County Facebook and Twitter pages and the mitigation plan web site. Copies of County Press Releases and a sampling of local media[17] articles are in **Appendix 1.11**.

- Public Meetings. A public meeting specifically regarding the plan update was hosted by MCOEM in Hazlet on May 22, 2013. An article about the meeting appeared on NJ.com the following day. The plan update was also discussed at Planning Board and Freeholder meetings. The plan update was included as an agenda item at the following Planning Board meetings, which are open to the public and other stakeholders: November 1, 2013; February 18, 2014; March 17, 2014; April 21, 2014; May 19, 2014; July 21, 2014; August 18, 2014; and October 20, 2014. Notification of the updated plan's status, and its ultimate release for review and comment, was discussed at a regular public meeting of the Board of Chosen Freeholders on August 28, 2014.

- Website. A hazard mitigation planning page was initiated by MCOEM in July 2007 at the onset of development of the initial plan. The County has maintained this web presence, updating its content on a regular basis. The purpose of the web content is to inform the public and other stakeholders about the purpose and need for the plan and the update and solicit their feedback and participation. Content includes general information about the process, meeting information (agendas, presentations, handouts, and minutes), other reference materials, a link for the plan, and more. In 2007, the site was located at www.co.monmouth.nj.us/page.aspx?ID=1944. In 2012, all OEM content was relocated to the Sheriff's Office site at www.monmouthsheriff.org/Sections-read-144.html (live since June 29, 2012); however, the predecessor page remains with limited content and provides a link to the Sheriff's office new page for the plan update. **Figure 1.4** shows a screen capture of the relic page on the County site, while **Figure 1.5** shows a screen capture of a portion of the current page for the plan update as maintained on the new Sheriff's Office site. All participating jurisdictions have supplemented this by posting links on their jurisdiction web sites to the overall county mitigation planning pages. Screen captures for each jurisdiction are included in **Appendix 1.12**.

[17] News articles in **Appendix 1.11** do not represent comprehensive coverage of the plan update by local news media. Other articles may have been published that do not appear in the appendix. The appendix is intended to give a flavor for the type of articles that appeared throughout the update.

Figure 1.4 – Plan Update Web Content on www.co.monmouth.nj.us

Figure 1.5 – Plan Update Web Content on www.monmouthsheriff.org

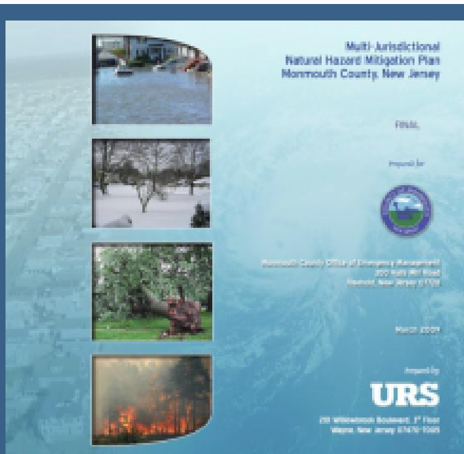
- Fact Sheet. Participating jurisdictions found the use of the plan development fact sheet to be of great use for getting the word out regarding the initial plan, and the CPG opted to use this as one component of its outreach strategy for the plan update as well. **Figure 1.6** on the next page shows the fact sheet used for the plan update. In addition to describing the purpose and need for the plan, and information about the plan update, the fact sheet also gave MCOEM contact information for interested parties to reach out to for questions or other feedback, or to learn more about how they could become involved in the plan update process. CPG members distributed this fact sheet on notice boards and at various meetings with the public and other stakeholders. Some examples of ways the County, in particular, used the fact sheet for its outreach strategy include but are not limited to: OEM distributed the fact sheet to municipal officials and stakeholders on June 29, 2012; OEM distributed the fact sheet at the Monmouth County Fair in July 2012, July 2013, and July 2014; OEM distributed the fact sheet at the Union Beach National Night Out on August 7, 2012; OEM had the fact sheet posted in the Manasquan Borough municipal building and library on August 20, 2012; OEM distributed the fact sheet at its public meeting on the plan update in Hazlet on May 23, 2013. The fact sheet was also distributed on a more ad-hoc basis throughout the process, and was posted on the web site.

- LEPC/CPG Joint Meetings. On two occasions (February 18, 2014 and July 10, 2014), MCOEM hosted joint meetings of the Local Emergency Planning Committee with the mitigation plan's Core Planning Group. This ensured that municipal coordinators were made aware of the plan update and invited to participate in the process.

- Public Information Videos on Hazard Mitigation. A FEMA video highlighting hazard mitigation in the Borough of Sea Bright was posted by MCOEM on Facebook on April 1, 2013. On June 3, 2013 MCOEM appeared in a FEMA video about Manasquan's hazard mitigation efforts; this video was later posted online.

- Social Media: Facebook and Twitter. Facebook and Twitter accounts in participating jurisdictions were used periodically throughout the plan update process to inform the public and other stakeholders about the plan update and solicit their feedback and participation. MCOEM and the Sheriff's office, for example, undertook the following activities on social media: March 1, 2013 MCOEM posted information about the plan update on Facebook; March 8, 2013 MCOEM promoted the NCNERR-Rutgers University www.njfloodmapper.org web site on its Facebook page to raise awareness of sea level rise, FEMA/NJDEP flood maps, and Hurricane Sandy inundation areas; MCOEM posted a link to FEMA's Sea Bright hazard mitigation video on its Facebook page; MCOEM posted its June 20, 2013 press release about the plan update on Facebook; March 4, 2014 MCOEM posted information about the plan update process and the mitigation strategy on its Facebook page; June 6, 2014 MCOEM posted a FEMA tweet "*Ahead of the Game: NJ's Hazard Mitigation Initiative Will Pay Off in Future Storms*"; June 10, 2013 MCOEM re-tweeted the FEMA tweet "*Mitigation Worked for NJ Couple*" on Twitter; August 8, 2013 MCOEM re-tweeted FEMA tweet "*Mitigation is Important*" on County Sheriff's Twitter site; and press releases issued in September/October 2014 regarding the release of the Draft Plan Update for review and comment were also posted on Facebook and Twitter.

Monmouth County
Multi-Jurisdictional Hazard Mitigation Plan Update



Adopted Plan Cover, 2009

Planning Timeline

- *First plan adopted in 2009; updates are required every five years*
- *Update process began in June 2012 and is ongoing*
- *FEMA approval and jurisdictional adoptions of the updated plan are anticipated in 2014*

Background

Natural hazards are a part of life throughout Monmouth County. All of our hazards have the potential to cause property loss, loss of life, economic hardship, and threats to public health and safety. An important part of emergency management involves **hazard mitigation** – which is, essentially, actions and projects undertaken to *protect* things *before* they get damaged. A **hazard mitigation plan** describes the hazards that can occur in a community, and then presents actions and projects that will be done to reduce key risks.

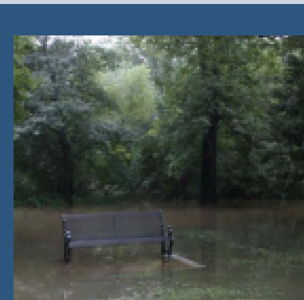
Purpose and Need

The **Multi-Jurisdictional Natural Hazard Mitigation Plan for Monmouth County** was adopted in 2009 to meet the requirements of the Disaster Mitigation Act of 2000 (or "DMA 2000"). Its development was led by the County under a FEMA planning grant that covered the costs of its preparation. Though it wasn't required, Monmouth County opted to use what FEMA calls a 'multi-jurisdictional' approach – meaning that instead of it just being a plan for the County government, every municipality was invited to participate as an equal partner with the County. Adopting a FEMA approved hazard mitigation plan opened the door for all participating municipalities to be in compliance with DMA 2000, and eligible to apply for hazard mitigation project grants. To stay in compliance with DMA 2000, the plan must be updated every five years. The update ensures that the plan remains current in its discussion of local risks and risk reduction strategies. The County has once again obtained FEMA grant funding to cover the cost of this first plan update, and has opted to continue its 'multi-jurisdictional' approach. Each jurisdiction in the County is attending meetings, providing feedback in a series of topic areas, reaching out to the public and other key stakeholders, and updating their local mitigation strategy.

For More Information

For questions or other feedback, or to find out how you can become involved, please contact your local elected official or Emergency Management Coordinator; the Monmouth County Office of Emergency Management at 732-431-7400; or visit our web site at www.mcsonj.org. Periodic updates are also posted on the Monmouth County Sheriff's Office Facebook page.

Natural disasters cannot be prevented from occurring but, if we tackle some of the biggest risks with hazard mitigation projects, eventually, our hazards won't become disasters.



Here, a flood prone home was acquired and the property was converted to parkland. During the next storm, the residents were safe in their new home on higher ground, and no damages were incurred on this parcel.

Monmouth County Multi-Jurisdictional Hazard Mitigation Plan Update • "PlanFacts" • June 2013 •

Figure 1.6 – Fact Sheet for the 2014 Plan Update

- Natural Hazards Survey. Similar to when the initial plan was prepared, the CPG used another online public survey as one component of its larger outreach strategy. The Monmouth County Steering Committee was interested in learning more about the level of knowledge local citizens have about natural disasters and vulnerable areas in their communities. They posted a short, 15 question survey on the county web site for interested parties to complete. A press release was issued on October 15, 2012, to notify interested parties that the survey was available. The survey was estimated to take approximately 5 minutes to complete. It was made to be interactive and responses were tallied automatically. The information provided was used by the County in their identification and prioritization of mitigation actions to reduce the risk of injury or property damage in the future. More than 560 people chose to submit responses to the survey. A summary of these responses is presented in **Appendix 1.13.** Some significant observations are as follows:
    - Two-thirds of all respondents have lived in Monmouth County for 20 or more years.
    - The results suggest that the hazard events of most concern to respondents were hurricanes, severe storms, and winter storms. For these events the majority of respondents were either "very concerned" or "extremely concerned", while for all other listed hazards the majority of respondents were "somewhat concerned" or "not concerned".
    - Hurricanes drew the largest number of "extremely concerned" respondents for any single hazard event (prior to Hurricane Sandy, flooding of private property had drawn the largest number of "extremely concerned" respondents).
    - Drought appears to be the hazard event of least concern to respondents, followed by landslides and excessive temperatures.
    - About 45% of respondents rated their hazard preparedness exactly in the middle of the ranking scale, while almost three times as many respondents considered themselves to be well-prepared as opposed to ill-prepared.
    - About 65% of all respondents attributed their level of preparedness wholly or partially to information from government sources and locally provided news or other media information. In contrast, only about 15% felt prepared due to knowledge obtained at schools and other academic institutions, and/or having attended meetings that have dealt with disaster preparedness.
    - In descending order of importance, responders ranked the internet, TV news, and radio news as the three most effective sources of information for protection against natural hazards (when the initial plan was prepared, TV news had been ranked highest, followed by the internet, and then radio news).
    - Almost three quarters of respondents would consider a buyout, relocation, or elevation of their property if it were repetitively damaged or located in a designated high hazard area, and if such measures were offered by a public agency (this proportion is unchanged since the initial plan was prepared).
    - About 21% of respondents knew for sure that they live in a designated flood plain, while 60% were sure they did not live in a floodplain. The remaining 19% were unsure. For comparison, when the last plan was prepared, 17% of respondents lived in a floodplain, 73% lived outside of a floodplain, and 10% were unsure.
    - About 33% of respondents reported that they have flood insurance.
    - When asked about what types of mitigation projects respondents would like to see implemented in their communities, more than 100 responses were received and ten broad categories of project types were mentioned again and again: stormwater drainage system improvements (14%); acquisition/elevation of floodprone homes (12%); utility system upgrades / underground utilities (11%); development restrictions in high risk areas / open space preservation (10%); dune and beach restoration (10%); management of lakes and streams (9%); tree trimming and removal of dead/hazardous trees near power lines (7%); and bulkheads/floodwalls/seawalls (6%). The information provided was taken into consideration by the County in their identification and prioritization of mitigation actions to reduce the risk of injury or property damage in the future.

Feedback from the Public and Other Stakeholders

As discussed in the preceding subsection and detailed in **Appendix 1.10**, the County and each participating jurisdiction collectively undertook hundreds of actions to raise awareness of the plan update process and provide the public and other stakeholders with a forum for participating in - and providing feedback throughout - the plan update. These activities ranged from web site and social media postings to use of print media, public meetings, and targeted outreach to key stakeholder groups.

Overview of Stakeholder Feedback

Stakeholders provided valuable feedback and input throughout the plan update process during fairly informal discussions at County Steering Committee meetings. For example, the utilities (NJ Natural Gas, NJ American Water Company, Jersey Central Power and Light; and the Manasquan River Regional Sewerage Authority) provided feedback about Sandy impacts to their respective systems. JCNERR and Leckner Consulting, each with representatives on the New Jersey and New York Coastal Outreach Advisory Team[18] (COAT), were able to provide valuable information about flood risk and FEMA mapping products. JCNERR also provided valuable feedback to the County in the development of actions for their mitigation strategy, projects that were in the nearby Ocean County plan that could also benefit Monmouth County if included in their mitigation strategy, and ways to integrate the Monmouth County mitigation strategy with the updated New Jersey State Hazard Mitigation Plan. JCNERR also provided valuable one-on-one assistance to local communities as they developed their own mitigation strategies. Monmouth University's Urban Coast Institute offered their expertise in urban coastal problems and potential solutions and will be reviewing and providing comments on the draft.

Stakeholders on the Steering Committee also provided data to the consultant for incorporation into the updated plan. For example, JCNERR provided the 100 year floodplain with sea level rise GIS boundary files that were used for mapping flood inundation areas potentially at risk in the future.

The County considered feedback from all stakeholders as it was updating its mitigation strategy.

Overview of Feedback Provided by the General Public

Throughout the plan update process, the County was occasionally contacted by members of the general public. In most cases, individuals called or emailed to inquire about the status of the plan and the projects that would be included in it. Some had general questions about the purpose and need for the plan, and how it benefits communities who participate in the process. One business owner from Asbury Park contacted MCOEM regarding a local flooding problem and project idea they had for possible inclusion in the plan. At a meeting of concerned citizens living near Wreck Pond, the public had questions about projects that were included in the plan to mitigate flooding in areas surrounding the pond.

The County's Planning Board Meetings are not typically well attended by the general public. Discussions about the plan update have generally included questions from meeting attendees about what the plan is, and how it can be used to benefit the County. The County's CRS User Group is also discussed at Planning Board Meetings and this generally fostered discussions and questions about links between the mitigation plan and local municipal participation in FEMA's CRS program and how the two programs are mutually beneficial.

At a Freeholders Meeting in August 2014, the public identified the Glimmerglass Bridge as a site in need

[18] Coastal Outreach Advisory Teams (COATs) are intended to increase local awareness and understanding of, and engagement in the flood study process, as well as awareness and understanding of the risk from flooding and other natural hazards. COAT members actively participate in periodic meetings to discuss outreach and communication opportunities, identifying potential issues, and providing input on strategies and tactics for communicating about flood risk and other natural hazards. COAT members include local partners, community officials, federal agency partners, representatives from non-profit organizations, academic institutions, and the private sector.

of mitigation. The bridge has been closed due to damage it sustained after being crossed by a vehicle carrying an unusually heavy load. The bridge is on an evacuation route. It also serves as a means of egress for residents on Brielle Road. When the bridge is repaired, residents would like to see the road leading to it raised as well, because it currently is flooded during periods of high tide and heavy rain and Brielle Road residents have no means of egress.

The information provided by respondents for the online natural hazards survey were taken into consideration by the County in their identification and prioritization of mitigation actions to reduce the risk of injury or property damage in the future. Feedback was provided by the more than 560 survey respondents, giving the planning team valuable information as far as perception of risk, preparation for risk, and preferences for risk reduction projects. The planning team considered the survey responses as they were developing mitigation strategies. Survey responses were considered by the County in their identification and prioritization of mitigation actions. Respondents were most concerned about hurricanes, severe storms, and winter storms; with hurricanes drawing the largest number of “extremely concerned” respondents for any single hazard event. Almost three quarters of respondents would consider a buyout, relocation, or elevation of their property if it were repetitively damaged or located in a designated high hazard area, and if such measures were offered by a public agency. And, when asked about what types of mitigation projects respondents would like to see implemented in their communities, more than 100 responses were received and ten broad categories of project types were mentioned again and again: stormwater drainage system improvements (14%); acquisition/elevation of floodprone homes (12%); utility system upgrades / underground utilities (11%); development restrictions in high risk areas / open space preservation (10%); dune and beach restoration (10%); management of lakes and streams (9%); tree trimming and removal of dead/hazardous trees near power lines (7%); and bulkheads/floodwalls/seawalls (6%). The information provided was taken into consideration by the County in their identification and prioritization of mitigation actions to reduce the risk of injury or property damage in the future.

The survey respondents ranked the internet, TV news, and radio news as the three most effective sources of information for protection against natural hazards. This feedback helped to inform the County’s outreach strategy for the plan update and maintenance phases.

The public meeting held by MCOEM in Hazlet on May 22, 2013 had the primary intent of providing information about the plan update and soliciting feedback from the public on projects they would like to see implemented in their communities. Given this meeting’s proximity to Hurricane Sandy (only seven months later), the general public was still quite overwhelmed by the magnitude of the event and its impacts in their communities and the feedback that meeting attendees provided was regarding the Hurricane Sandy response and recovery. Many residents at the meeting, most of whom represented Raritan Bayshore communities, commented that too much focus was on the County’s tourist areas, boardwalks, and beaches along the Atlantic Ocean coastline. Many meeting attendees were still homeless and awaiting funding to rebuild, as well as guidance regarding unique requirements for rebuilding (i.e., first floor elevations). Still others were overwhelmed at the prospect of increasing federal flood insurance rates on the horizon. Emergency management officials in attendance were unable to steer the focus back to the mitigation plan update; however, the feedback provided by residents who attended the meeting was valuable as the County was developing its updated mitigation strategy.

Working sections of the plan were posted on the project SharePoint site, which was accessible to CPG members as well as members of the County Steering Committee (which included several stakeholder entities); no comments were received via this forum.

Comments on the Draft 2014 Plan Update are included in **Appendix 1.14**.

Considering the wide range of opportunities that were provided to the general public and other stakeholders, the feedback received is somewhat disproportionate to the volume of opportunities that were provided. CPG members will consider more targeted outreach to the public and other stakeholders during the plan maintenance phase to elicit feedback. The purpose of these events would be to distribute literature and educate the public and other stakeholders on natural hazards and hazard mitigation, and to obtain comments and feedback regarding the mitigation action items that can be pursued. Types of activities could include: (1) increased use of social media, which is becoming more widely-used with each passing year; (2) more frequent outreach to local media outlets (television, radio, and print media partners) to prepare stories to help promote widespread public involvement and awareness, and to elicit feedback and comments; (3) more formal presentations to governing bodies regarding the hazard mitigation plan (in an open public forum setting); (4) targeted public/stakeholder events such as roundtables and public forums specifically regarding the plan, and natural hazard mitigation; and (5) small, area-specific meetings on a semi-annual basis at public libraries or other public venues.

Review and Incorporation of Existing Plans, Studies, Reports, and Technical Information

In the process of preparing this hazard mitigation plan, many other existing plans, studies, reports, and technical information were evaluated. These sources are noted throughout this report as various topics are discussed. As shown in **Table 1.7**, the development of this hazard mitigation plan included the review and incorporation of data from existing plans, studies, reports, and technical information. Relevant information was referenced or included, as applicable, to form the content of this mitigation plan.

Table 1.7
Review and Incorporation of Data from Outside Sources

Data Source	How Incorporated
Readily available on-line information from federal and state agency web sites such as: FEMA, NJOEM, NJ Department of Environmental Protection, US Forest Service National Avalanche Center, US Geological Survey, National Oceanic and Atmospheric Administration (including National Weather Service, National Climatic Data Center, and the National Severe Storms Laboratory), University of Buffalo Multidisciplinary Center for Earthquake Engineering Research (MCEER), USGS National Earthquake Information Center, NASA Space Environment Center, and the US Department of Transportation Federal Highway Authority.	Referenced throughout this report as various topics are discussed. Primarily, these sources were consulted to develop lists of historic occurrences of various hazards as well as areas at risk, probability of future occurrences, and impact information.
New Jersey State Hazard Mitigation Plan (2014)	Hazard information including historic occurrences, areas at risk, probability of future occurrences, and impact information. Also: State capabilities that can support local hazard mitigation efforts, State goals and actions (to compare against local goals and actions to ensure that the two go hand-in-hand), etc.
FEMA Flood Map Data and Municipal Flood Insurance Studies	Areas susceptible to flooding. Also, FISs included information about local flood protection features. DFIRMs were combined with parcel data in GIS to evaluate the area of the floodplain in each municipality, the value of improvements in each area.
Year 2050 Projected Special Flood Hazard Area from JCNERR	Used to show additional areas in coastal communities that could be inundated during a 100-year even by year 2050, incorporating sea level rise.
Monmouth County GIS data	Quantification of assets at risk from various hazards. County GIS data included: improved property parcel data, fire stations, police stations, hospitals, ferry ports, airports, municipal public works buildings, schools, child care facilities, and senior care facilities. Land Use data was also provided to create a land use map and to quantify percent of land of each type across jurisdictions.
Monmouth County Profile	Used to describe historic land uses and development trends, as well as current and expected future trends.

Table 1.7
Review and Incorporation of Data from Outside Sources

Data Source	How Incorporated
Monmouth County Flood Insurance Study (Preliminary – January 31, 2014)	Areas susceptible to flooding. Also, FISs included information about local flood protection features. DFIRM data was combined with parcel data in GIS to evaluate the area of the floodplain in each municipality, the value of improvements in each area.
USGS Earthquake History of New Jersey	Historic earthquake event occurrences
NJGS Earthquakes Epicentered in New Jersey	Historic earthquake event occurrences
NEHRP Soil Class Mapping	The severity of impact of an earthquake can be exacerbated by certain soil types, and soils mapping was used in the earthquake hazard profile to inform the degree to which soil type might exacerbate earthquake impacts in Monmouth County.
New Jersey Geological Survey Landslide Event Database	Historic landslide event occurrences. Landslides are more likely to occur in areas where they have happened in the past.
USGS National Landslides Program Landslide Mapping	Historic landslide event occurrences. Landslides are more likely in areas where they have happened in the past.
USGS Fact Sheet 165-00, Land Subsidence in the United States	Land subsidence hazard maps were evaluated to determine whether land subsidence is a significant hazard
USDA National Agricultural Statistics Service, Census of Agriculture, Monmouth County	Information regarding agricultural uses in the County to characterize how widespread the potential impacts of some hazards might be (drought and hail, for example).
Monmouth County Census of Agriculture	Information regarding agricultural uses in Monmouth County to characterize how widespread the potential impacts of some hazards might be (drought and hail, for example).
HAZUS-MH databases for emergency operations centers, potable water treatment facilities, and wastewater treatment facilities	The database of assets from HAZUS was imported on a GIS platform to determine assets at risk from delineable hazards
Stanford University National Performance of Dams Program web site	Dam inventory data was used to quantify the number, type, and hazard ranking of dams in Monmouth County. (as applicable for the flood hazard)
U.S. Army Corps of Engineers National Inventory of Dams	Dam inventory data was used to quantify the number, type, and hazard ranking of dams in Monmouth County. (as applicable for the flood hazard)
The American Society of Civil Engineers Standard 7-02, Minimum Design Loads for Buildings and Other Structures; and "Wind Zones in the United States" map	Map used to determine which wind region the County is in; this informed the wind hazard profile.
FEMA Publication 320 - Taking Shelter from the Storm: Building a Safe Room for your Home or Small Business	Typical damage for each Enhanced Fujita scale tornado and hurricane category, as well as wind zones and tornado activity maps
FEMA NFIP Community Status Book	NFIP participating communities, numbers of policies, historic numbers and values of paid claims, etc.
FEMA data for NFIP Repetitive Loss Properties and Community Rating System communities	Numbers of losses, value of paid claims, communities with repetitive loss properties, communities participating in the CRS (and their class), etc.
FEMA's "NFIP Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials (FEMA-480)"	Types of mitigation measures, definitions of the different categories of flooding for the hazard profile, and a table showing the odds of being flooded (for various time periods and flood events)
USGS Landslide Overview Map of the Conterminous United States, prepared in hard copy format in 1982 by Dorothy H. Radbruch-Hall, Roger B. Colton, William E. Davies, Ivo Lucchitta, Betty A. Skipp, and David J. Varnes (Geologic Survey Professional Paper 1183), compiled digitally by Jonathan W. Godt (USGS Open File Report 97-289), as viewed on NationalAtlas.gov	Landslide incidence and susceptibility
American Society of Civil Engineers (ASCE) Standard 7-98: Minimum Design Loads for Buildings and Other Structures	Minimum design loads for wind
FEMA's "Multi-Hazard Identification and Risk Assessment" (1997)	Several hazard definitions and information to support the hazard profile, as well as ideas for types of mitigation approaches

Table 1.7 Review and Incorporation of Data from Outside Sources	
Data Source	**How Incorporated**
American Meteorological Society "Glossary of Meteorology"	Definitions of meteorological hazards
FEMA's "Mitigation Ideas"	Provided information to the CPG about a range of mitigation measures for various types of hazards.
Local jurisdictions considered relevant plans, codes, and ordinances currently in place such as building codes, zoning ordinances, subdivision ordinances, special purpose ordinances, site plan review requirements, growth management ordinances, comprehensive plans, capital improvements plans, economic development plans, emergency response plans, post-disaster recovery plans, post-disaster recovery ordinances, local waterfront revitalization plans, and real estate disclosure ordinances.	Responses were recorded in the Capability Assessment of Section 4. Jurisdictions were asked to review local plans and ordinances and consider all local capabilities when developing their mitigation strategies as the enhancement of existing capabilities, or bridging identified gaps in capabilities, can further mitigation goals and objectives.
US Census 2010	Population, people per household, income, age, etc.
New Jersey State Development and Redevelopment Plan (State Plan) and Monmouth County's Cross Acceptance Report	Areas envisioned for growth, limited growth, and conservation; development trends.
Monmouth County Growth Management Guide, Monmouth County Planning Board, 1995.	This document serves as the County's official Master Plan. It was used to help assess future development trends in Monmouth County.
2004 *Western Monmouth Development Plan*	Development trends in western Monmouth County.
2011 *Panhandle Region Plan*	Development trends in Monmouth County's Panhandle Region.
2006 *Bayshore Region Strategic Plan*	Development trends in municipalities in the Raritan Bay and Atlantic Highlands region.
2010 *Coastal Monmouth Plan*	Development trends for the County's coastal region
2006 *Monmouth County Open Space Plan*	Development trends; the Monmouth County Park System's strategic plan for land acquisition and preservation.
Monmouth County Quality of Life Survey (1999)	Information about open space and future development preferences, and general information about the county
Monmouth County Open Space Plan (2006)	Municipal land reserved for open space, existing and target
USDA Understanding Soil Risks and Hazards (2004)	Reviewed for information regarding expansive soils
USGS Hydrologic Atlas 730-L (1997)	Reviewed to evaluate groundwater resources
New Jersey Drought Emergency Plan (1991)	Reviewed to determine how actions during a drought emergency mitigate impacts
USDA Monmouth County Soil Survey (1989)	Reviewed for local potential for expansive soils
Tropical Storm Floyd Post Flood Report (July 2000)	Effects of Floyd in Monmouth County
In the Wake of Doria (1971)	Reviewed for local event impacts
NJDEP Floods of August and September 1971 in New Jersey, Special Report 37 (1972)	Reviewed for local event impacts
USGS Open File Report 79-559, Flood of November 8-10, 1977 in Northeastern and Central New Jersey (April 1979)	Reviewed for local event impacts
National Weather Service, Eastern Region, Disaster Survey Report, The Great Nor'easter of December 1992 (June 1994)	Reviewed for local event impacts
New Jersey Historic Preservation Office GIS shape files for state and federally listed historic and cultural resources	Used to identify historic and culturally significant assets in hazard areas
New Jersey Administrative Code 7:7E; Coastal Zone Management Rules	Reviewed for information about management of the county's coastal zones
FEMA's "NFIP Floodplain Management Requirements: a Study Guide and Desk Reference for Local Officials (FEMA-480)"	Used to evaluate the impact of future development in flood hazard areas on overall risk (i.e., how well do existing regulations provide protection for new development where new development is in compliance with current codes and standards
NOAA's Atlantic Oceanographic and Meteorological Laboratory's mapping – "Empirical Probability of a Named Storm"	Reviewed to report on annual probability of a named storm for the hurricane and tropical storm risk assessment
Natural and Cultural Features of Monmouth County, Monmouth County Health Department, April 13, 2010.	Proportion of Monmouth County's population living within a five mile corridor along the Bayshore and Atlantic Ocean coastlines. Change in County's population from 1950 to 1970.

Table 1.7 Review and Incorporation of Data from Outside Sources	
Data Source	**How Incorporated**
County Planning Department's projected 2040 population counts for each municipality (2012)	Used to show change in exposure and potential vulnerability of people to natural hazards
Monmouth County Summer Coastal Population Study, Monmouth County Planning Board, 2008.	Average summer populations in the shore region
Residential construction permits that were approved from the years 2009 to 2012, prepared by the Monmouth County Planning Board	Development in hazard areas as an indicator of increased exposure
2012 Monmouth County Profile	Land uses and development trends, protected open space, preserved farmland
Earthquake Risk in New Jersey, NJOEM	Used in the earthquake risk assessment

Regulatory Compliance

This Hazard Mitigation Plan was prepared in a manner consistent with applicable regulations, criteria, and guidance. The Plan's components address the local hazard mitigation planning requirements of the DMA 2000. The planning team used FEMA's Local Mitigation Planning Handbook (March 2013) and its "Regulation Checklist" as a guide. Each element of the Regulation Checklist must be addressed satisfactorily for a plan to be approved by FEMA. **Table 1.8** summarizes the FEMA regulations, and where the regulation is addressed in this plan.

Table 1.8 FEMA Plan Review Criteria	
Regulation	**Location in the Plan[19]**
Element A - Planning Process	
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction (Requirement 201.6(c)(1))	Section 1
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interest to be involved in the planning process? (Requirement 201.6(b)(2))	Section 1
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement 201.6(b)(1))	Section 1
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 201.6(b)(3)	Section 1
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (requirement 2016(c)(4)(iii))	Section 7
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement 201.6(c)(4)(i))	Section 7
Element B – Hazard Identification and Risk Assessment	
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? (Requirement 201.6 (c)(2)(i))	Sections 2 and 3a
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement 201.6(c)(2)(i))	Section 3a
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement 2016(c)(2)(ii))	Sections 3b,3c, 3d, and 3e
B4. Does the Plan address NFIP insured structure within the jurisdiction that have been repetitively damaged by floods? (Requirement 201.6(c)(2)(ii)	Section 3a
Element C – Mitigation Strategy	
C1. Does the plan document each jurisdiction's existing authorities, policies, programs, and resources and its ability to expand on and improve these existing policies and programs? (Requirement 201.6(c)(3))	Section 4
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with	Section 3a

[19] "Location in the Plan" is referring to the primary plan Section where the requirement is met, and any appendices referenced in that section.

NFIP requirements, as appropriate? (Requirement 201.6(c)(3)(ii))	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 201.6(c)(3)(i))	Section 5
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 201.6(c)(3)(ii))	Section 6
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement 201.6(c)(3)(iii))	Section 6
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 201.6(c)(4)(ii))	Section 7
Element D – Plan Review, Evaluation, and Implementation (applicable to plan updates only)	
D1. Was the plan revised to reflect changes in development? (Requirement 201.6(d)(3))	Section 3d
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement 201.6(d)(3))	Section 6
D3. Was the plan revised to reflect changes in priorities? (Requirement 201.6(d)(3))	Section 6
Element E – Plan Adoption	
E1. Does the Plan include documentation that the Plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement 201.6(c)(5))	Page i[20]
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement 201.6(c)(5))	Page i[20]
Element F – Additional State Requirements	
Add here	

General Overview of Modifications to the 2009 Plan as part of the 2014 Plan Update

This section documents how the planning team reviewed and analyzed each section of the prior version of the plan (2009) and whether each section was revised as part of the 2014 Plan Update.

Consultants have reviewed the 2009 Plan, as well as FEMA's recommended revisions from their 2009 review of the document. Meetings were held between the consultant, MCOEM, and FEMA to quantify FEMA's expectations for the most critical improvements to be addressed during the plan update process. It was the consultant's opinion that the 2009 Plan would not be deemed to meet FEMA's requirements, given the changes to the FEMA guidance as released in the Local Mitigation Plan Review Guide in October 2011 and the Local Mitigation Planning Handbook in March 2013.

The document has been streamlined, at the request of participating jurisdictions, and a good deal of supporting documentation has been moved into Appendices reproduced only on CD but not in hard copy in order to make the hard copy version of the plan more portable and user-friendly for those benefiting from its contents. Printed hard copies of all data and appendices reproduced on CD will be kept on file by MCOEM for inspection upon request. Applicable and relevant information from the last version of the plan has been carried through to the updated text on a case by case basis. Many of FEMA's recommended revisions from their review of the 2009 Plan have also been addressed in this update.

As part of this update, every section of the earlier plan has been reviewed and comprehensively updated as needed to achieve compliance with FEMA mitigation planning requirements outlined in the Local Mitigation Plan Review Guide in October 2011 and the Local Mitigation Planning Handbook in March 2013 released several years after the initial plan was approved in February 2009.

Highlights of some key additional information appearing in this updated document include:

[20] Participating jurisdictions will each be responsible for passing their resolutions after agency reviews are completed and FEMA indicates that the plan is "Approvable Pending Adoption". Each jurisdiction is responsible for providing a copy of their adoption resolution to MCOEM. MCOEM is responsible for providing a copy of all resolutions to FEMA, and inserting hard copies into the bound document following Page i.

- A description of the planning process and associated outreach activities (to the public and other stakeholders) that was undertaken as part of this update.
- A listing of historical occurrences of the identified hazards since the last version of the plan was prepared in 2009 (including but not limited to major disaster and emergency declarations).
- Current information regarding changes in development, progress on local mitigation efforts, and any changes in priorities.
- The status of past projects and plan maintenance activities, as well as identification of new mitigation strategies, for the County and each of the 53 municipalities who participated in the plan update.
- A full summary of local capabilities with local assessments of how their capabilities could be improved to foster mitigation goals.
- Incorporation of recently published information not available at the time of the 2009 Plan (such as the New Jersey State Hazard Mitigation Plan of 2014).

Table 1.10 documents how each section of the plan was reviewed and analyzed, and whether each section was revised as part of the update process.

Table 1.10
Overall Summary of Plan Transition – 2009 to 2014

2009 Plan Section (s)	2014 Plan Update Section(s)	Comments
Plan Adoption Resolutions Placeholder	Plan Adoption Resolutions Placeholder	Reviewed and updated to refer to the 2014 Plan Update, but presentation remains largely unchanged.
Acknowledgements	Acknowledgements	Reviewed and updated to present details for the 2014 Plan Update, but presentation remains largely unchanged.
Executive Summary	Executive Summary	Reviewed and updated to reflect current conditions. More specific discussions of outreach activities have been added. County agencies and stakeholder entities who participated on the Steering Committee are now highlighted specifically. A paragraph has been added regarding the improvements each JAT has made to its mitigation strategy, and some broad brush descriptions of types of projects in the mitigation strategies.
Section 1 – Introduction	Section 1 – Introduction	Reviewed and updated to present details of the 2014 Plan Update process. General information about the County has been updated to current conditions. Subsections regarding the planning process and planning team organizational structure have been reorganized and updated to streamline discussions and improve readability. Discussions of outreach have also been reorganized and streamlined to improve readability, and updated to present the **substantially more comprehensive and robust outreach activities undertaken during the first update**. Text has been added to more explicitly define the incorporation of existing plans, studies, reports, and technical information. The regulatory compliance section was revised from the old Crosswalk references to the new Regulation Checklist. And a section was added to provide an overview of modifications to the previous version of the document.
Section 2 – Identification of Potential Hazards	Section 2 – Identification of Potential Hazards	Reviewed and updated to present details for the 2014 Plan Update, but data presentation remains largely unchanged. Hazard descriptions have been moved to an appendix.
Section 3a – Hazard Profiles	Section 3a - Hazard Profiles	Updated to reflect new data (such as newer flood maps) and recent hazard event occurrences. Some restructuring of data presentation to streamline content. Priority Risk Indices moved to new Section 3e. **Updated information has been incorporated such as new flood maps, current repetitive flood loss property data, local assessments of NFIP administration in each jurisdiction, newer coastal surge mapping, new information on climate change and sea level rise, etc.**
Section 3b – Identification and Characterization of Assets in Hazard Areas	Section 3b – Identification and Characterization of Assets in Hazard Areas	Reviewed and updated to reflect current conditions, but presentation remains largely unchanged. **Updated to include more recent County parcel data and critical facilities layers; more recent HAZUS stock data, and updated lists of historic and cultural resources.**

Table 1.10
Overall Summary of Plan Transition – 2009 to 2014

2009 Plan Section (s)	2014 Plan Update Section(s)	Comments
Section 3c – Damage Estimates	Section 3c – Damage Estimates	**Damage estimates updated. HAZUS runs are now Level 2. Incorporated more recent GIS data, latest hazard area maps, latest critical facilities data, County parcel data, etc. as well as new information on sea level rise.** Restructuring to eliminate some information, and move others to appendices.
Section 3d – Land Uses and Development Trends in Hazard Areas	Section 3d – Land Uses and Development Trends in Hazard Areas	Reviewed and **updated to reflect jurisdictional reassessments of current conditions, and revised to reflect changes in development since the last plan was prepared**. New subsections added regarding development trends in hazard areas, and policies being implemented in the next plan maintenance cycle that can provide some level of risk reduction.
Not in the earlier draft	**New** Section 3e – Conclusions on Hazard Risk	**New section added to present overall conclusions on hazard risk, including Priority Risk Indices and Key Risk Findings.**
Section 4 – Capabilities and Resources	Section 4 – Capabilities and Resources	This section was updated to reflect **jurisdictional reassessment of capabilities**. Restructuring of the section moved some information into appendices to streamline presentation.
Section 5 – Mitigation Goals	Section 5 – Mitigation Goals	Updated to reflect current state plan goals; presentation remains largely unchanged.
Section 6 – Range of Possible Mitigation Actions Considered Section 7 – Action Item Evaluation and prioritization Section 8 – Implementation Strategies	Combined into a new Section 6 – Mitigation Actions	Sections were combined to streamline presentation of content and ease readability. Some restructuring of information presentation. **Update provides status of projects in jurisdictional action plans in 2009, along with information on relevance and whether the action would be carried forward to the 2014 action plans. Updated strategies include upwards of 300 actions and are robust approaches to mitigation**. The most notable difference in this plan section will be observed with regard to mitigation strategies for each jurisdiction. The entire planning team spent a great deal of effort reconsidering risks and developing substantially more robust mitigation strategies that address highest hazards and key risk findings. Many more projects are included in jurisdictional action plans. Actions are documented much more thoroughly, and they now represent jurisdictional mitigation visions with a significantly more focused aim at disaster resilience and risk reduction.
Section 9 – Plan Maintenance and Integration	Section 7 – Plan Maintenance and Integration	Reviewed and updated to reflect current conditions and jurisdictional preferences. **Substantial expansion in the level of detail of plan integration activities for the next plan maintenance cycle identified by each JAT, along with a detailed jurisdictional assessment of integration activities that were undertaken during the first 5-year cycle.**
Section 10 – For More Information	Section 8 – For More Information	Presentation remains unchanged

SECTION 2 – HAZARD IDENTIFICATION

Monmouth County, New Jersey is vulnerable to a wide range of natural and human-caused hazards that threaten life and property. FEMA's current regulations and interim guidance under the Disaster Mitigation Act of 2000 (DMA 2000) require, at a minimum, an evaluation of a full range of natural hazards. An evaluation of human-caused hazards (i.e., technological hazards, terrorism, etc.) is encouraged, though not required, for plan approval. Monmouth County has focused solely on natural hazards at this time. Incorporation of human-caused hazards may be evaluated in future versions of the plan, as it is a "living document" which will be monitored, evaluated and updated regularly.

Upon a review of the full range of natural hazards suggested under FEMA planning guidance, Monmouth County has identified a number of hazards that are to be addressed in its Multi-Jurisdictional Hazard Mitigation Plan. These hazards were identified through an extensive process that utilized input from three key sources: Planning Committee members, research of past disaster declarations in the County, and the New Jersey State Hazard Mitigation Plan. Readily available online information from reputable sources (such as federal and state agencies) was also evaluated to supplement information from these key sources. The most prominent online sources of data used in this assessment to identify the occurrence of various hazards were records of declared disasters and emergencies maintained by FEMA and NJOEM, the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) Storm Event Database, and the Spatial Hazard Events and Losses Database for the United States (SHELDUS) maintained by the Hazards and Vulnerability Research Institute (HVRI) at the University of South Carolina.

At a meeting of the CPG on September 28, 2012, CPG members considered the need for adding or omitting any hazards covered in the 2009 Plan. All earlier assessments were determined to still be applicable for the plan update. CPG members in attendance indicated their concurrence with these findings by a show of hands; all who were present at the meeting were in support of the updated assessment. **Table 2.1** provides a summary of the hazard identification and evaluation process noting which of the 22 evaluated hazards were identified as significant enough for further evaluation through Monmouth County's multi-jurisdictional hazard risk assessment (marked with a "☑").

Table 2. 1
Summary Results of the Hazard Identification and Evaluation Process

ATMOSPHERIC	**GEOLOGIC**
☐ Avalanche	☑ Earthquake
☑ Extreme Temperatures	☐ Expansive Soils
☑ Extreme Wind	☑ Landslide
☐ Hailstorm	☐ Land Subsidence
☑ Hurricane and Tropical Storm	☐ Tsunami
☑ Lightning	☐ Volcano
☑ Nor'easter	**OTHER**
☑ Tornado	☑ Wildfire
☑ Winter Storm	
HYDROLOGIC	
☑ Coastal Erosion	
☑ Dam Failure	
☑ Drought	
☑ Flood	
☑ Storm Surge	
☑ Wave Action	

☑ = Hazard considered significant enough for further evaluation through Monmouth County's multi-jurisdictional hazard risk assessment.

Table 2.2[1] documents the evaluation process used for determining which of the initially identified hazards are considered significant enough for further evaluation through Monmouth County's multi-jurisdictional hazard risk assessment. For each hazard considered, the table indicates whether or not the hazard was identified as a significant hazard to be further assessed, how this determination was made, and why this determination was made. The table works to summarize not only those hazards that *were* identified (and why) but also those that *were not* identified (and why not). Hazard events not identified for inclusion at this time may be addressed during future evaluations and updates of the risk assessment if deemed necessary by the Planning Committee during the plan update process. Table 2.2 also documents the planning team's reassessment of hazard significance during the first plan update as part of its ongoing maintenance of the plan to ensure that it reflects current conditions.

Appendix 2.1 lists the full range of 22 natural hazards initially considered for inclusion in the plan and provides a brief description for each. Some of these hazards are considered to be interrelated or cascading (i.e., hurricanes can cause flooding, storm surge and tornadoes), but for preliminary hazard identification purposes these individual hazards are broken out separately. It should also be noted that some hazards, such as earthquakes or winter storms may impact a large area yet cause little damage, while other hazards, such as a tornado, may impact a small area yet cause extensive damage.

[1] Table 2.2 was updated to include events captured by readily-available data sources (particularly NCDC and SHELDUS records) as of the summer of 2012. The sources themselves are not updated to the same end date across all hazards; hence, Table 2.2 will show event records through different end dates. In the Summer of 2012, most sources had been updated through 2011, though some extended to 2012 and this variability is reflected in the table. Superstorm Sandy, however, was added for applicable hazards (flood, wind, erosion, wave action) in early 2013 due to this particular event's significance in Monmouth County. As of January 9, 2013 NOAA NCDC and SHELDUS event records were only current through September 2012 and December 2011, respectively, and therefore did not contain information on Sandy.

Table 2. 2
Documentation of the Hazard Evaluation Process

Natural Hazards Considered	2009 Plan's Assessment	First Update Assessment	How was this determination made?	Why was this determination made?
ATMOSPHERIC HAZARDS				
Avalanche	Not identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of US Forest Service National Avalanche Center web site • Review of FEMA's Multi-Hazard Identification and Risk Assessment	• There is no risk of avalanche events in New Jersey. The United States avalanche hazard is limited to mountainous western states including Alaska, as well as some areas of low risk in New England. • The topography and climate in Monmouth County would not support conditions needed for an avalanche to occur.
Extreme Temperatures	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA National Climatic Data Center (NCDC) Storm Events Database • Review of HVRI SHELDUS database	• Extreme temperature events are discussed in the state plan (in the context of the drought hazard for extreme heat, and in the context of winter storms for extreme cold). • NCDC and SHELDUS report 88 extreme temperature events for Monmouth County between November 1994 and December 2011 (including 73 extreme heat events and 15 extreme cold events. For these events there are no recorded property damages but there are a number of attributed fatalities and injuries. • Primary impacts of concern for extreme temperatures include the life-threatening effects of heat stress or hypothermia on people, particularly the elderly or people in poor physical health. Other significant impacts include strains on livestock and agriculture and excessive demands for electricity during extended heat waves that can lead to power outages and intentional rolling blackouts. • Local emergency managers noted significant concerns regarding extreme temperatures including life/safety threats and infrastructure-related losses, damages and expenses.
Extreme Wind	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database • Review of HVRI SHELDUS database • Review of maximum 3 second wind gust per the American Society of Civil Engineers (ASCE) Standard 7-98.	• Extreme wind events are discussed in the state plan. • NCDC and SHELDUS report 267 significant wind events for Monmouth County between October 1968 and December 2011. These events have resulted in recorded estimates of 7 deaths, 98 injuries and more than $34 million in property damage. • Monmouth County is located in a climate region that is highly susceptible to numerous types of extreme wind events including severe thunderstorms, hurricanes, tropical storms, nor'easters and severe winter storms. • The maximum 3 second wind gust for Monmouth County per ASCE 7-98 is 120 mph. • The remnants of Hurricane Sandy in October 2012 caused extreme wind damage throughout Monmouth County.

Hailstorm	Not identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database and National Severe Storms Laboratory (NSSL) web site • Review of HVRI SHELDUS database	• Hailstorms are discussed briefly in the state plan under the section on thunderstorms and tornadoes. • NCDC and SHELDUS report 31 severe hailstorm events (3/4 inch size hail or greater) for Monmouth County between October 1955 and December 2011. For these events there are no recorded property damages, no deaths and no injuries. • Hail probability data available on the NSSL web site indicates that Monmouth County is at minimal risk to severe weather threats from damaging hail (at least 2 inches in diameter). NCDC reports only one event in which hail of this magnitude fell in Monmouth County (Neptune Township – July 23, 2003). • Monmouth County is located in a part of the country with the lowest annual number of days with hailstorms (less than 2). Damaging hailstorm events in Monmouth County aren't very likely, nor are they likely to be very intense. • There are minimal hazard mitigation techniques available to reduce hailstorm impacts outside of the emergency preparedness procedures and severe weather warning systems already in place (i.e., mass public notifications that recommend immediate protective actions).
Hurricane and Tropical Storm	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Analysis of NOAA historical tropical cyclone tracks • FEMA HAZUS-MH storm return periods • Review of NOAA NCDC Storm Events Database and National Hurricane Center web site	• Hurricane and tropical storm events are discussed in the state plan. • NOAA historical records indicate 36 storm tracks (11 hurricanes, 25 tropical storms) have come within 75 miles of Monmouth County between 1851 and 2012 (22 percent annual probability). • The 50-year return period peak gust for hurricane and tropical storm events in Monmouth County is between 80 and 92 mph. • Recent tropical storm events including Bertha (1996), Floyd (1999), Isabel (2003), Hanna (2008) and Irene (2011) have caused significant wind, flood and coastal erosion related damages in Monmouth County. • The remnants of Hurricane Sandy in October 2012 caused catastrophic damage in Monmouth County.
Lightning	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database, NOAA lightning statistics, and National Severe Storms Laboratory (NSSL) web site • Review of HVRI SHELDUS database	• Lightning events are discussed briefly in the state plan as part of the thunderstorm hazard, and the installation of lightning rods is mentioned as a helpful mitigation action. • According to NOAA data, Monmouth County is located in an area of the country that experiences an average of 10-30 thunderstorm events and three lightning flashes per square kilometer per year. • NCDC and SHELDUS report 51 lightning events for Monmouth County between July 1994 and December 2011. These events have resulted in a recorded 4 deaths, 11 injuries and more than $1.5 million in property damage. • Local emergency managers noted significant concerns regarding lightning including historical casualties, property damages and disruption to electrical power and emergency communications.

Nor'easter	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database	• Nor'easters are discussed in the state plan as a significant hazard of concern for New Jersey communities, particularly located along the shore. • Monmouth County has a lengthy history of devastating impacts wrought by nor'easters. This includes major damages caused by the effects of high wind, rain, snow, heavy surf, coastal flooding and severe beach erosion. • Monmouth County's shore is vital to the local economy but remains highly susceptible to the effects of major coastal storms, including nor'easters.
Tornado	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database and National Severe Storms Laboratory (NSSL) web site • Review of HVRI SHELDUS database	• Tornado events are discussed in the state plan, including historic events in Monmouth County. • NCDC and SHELDUS report 9 tornado events in Monmouth County between August 1952 and December 2011. These events have resulted in no recorded deaths or injuries but have caused $1.5 million in property damage with the most severe being an F2 that struck northern Manalapan and extreme southwest Marlboro Townships in May 2001. • NSSL tornado probability data indicate that Monmouth County is in an area that experiences less than 1 tornado event per year, but life-threatening and damaging events do remain very possible.
Winter Storm	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database • Review of HVRI SHELDUS database • Office of New Jersey State Climatologist web site	• Winter storms including snow storms and ice storms are discussed in the state plan. The state plan notes that Monmouth County averages between 20 and 25 inches of snowfall per year. • NCDC and SHELDUS report that Monmouth County has been affected by 120 snow and ice events between February 1994 and December 2011. These events resulted in no reported deaths or injuries in Monmouth County, but are associated with and more than $2.8 million in property damages. • According to the Office of New Jersey State Climatologist, parts of Monmouth County experience an average of 2 days per year with daily snowfall of up to four inches (large snowstorms will bring much higher short-term accumulations). • During the winter of 1995-1996, a recorded 61-80 inches of snowfall fell across Monmouth County (highlighted by the Blizzard of 1996). • The 2003 President's Day Storm resulted in more than 20 inches of snow in Monmouth County and caused a high school roof to collapse in Wall Township among other damages.

HYDROLOGIC HAZARDS				
Coastal Erosion	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of New Jersey Department of Environmental Protection (NJDEP) Coastal Management Program web site	• Coastal erosion is discussed in the state plan as a hazard of concern for Monmouth County. • Historic shoreline data for Monmouth County indicate erratic long-term shifts between coastal erosion and accretion resulting in dynamic shoreline change. This change is linked to a variety of natural factors as well as human activity. • The most severe coastal erosion hazards for Monmouth County are related to rapid, episodic coastal storm events including hurricanes, tropical storms, and nor'easters. Following such an event, areas of Monmouth County will be even more vulnerable to the destructive effects of coastal erosion, wave action and coastal flooding. • Shore protection projects are routinely initiated and funded in Monmouth County through NJDEP and the U.S. Army Corps of Engineers. These projects in addition to many other elements of NJDEP's Coastal Management Program serve to reduce damages to public and private property caused by coastal erosion. • The remnants of Hurricane Sandy in October 2012 caused catastrophic damage in Monmouth County.
Dam Failure	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of NJDEP Bureau of Dam Safety and Flood Control web site • Review of U.S. Army Corps of Engineers National Inventory of Dams database • Review of Stanford University's National Performance of Dams Program web site	• Dam Failure is discussed in the state plan as a hazard of concern for Monmouth County (classified under "man-made disasters"). • New Jersey has seen property damages as a result of small dam failures (including damage or loss of bridges, roads and buildings), but has not experienced a catastrophic dam failure to date. • According to the National Inventory of Dams, three major dams classified as high hazard (defined as "where failure or misoperation will probably cause loss of human life") are located in Monmouth County but are not associated with any recorded dam failure events. • Some local emergency managers noted concerns regarding the potential failure of earthen dams and other dam structures that are in need of repair or replacement.
Drought	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of NJDEP Drought Information web site • Review of National Drought Mitigation Center web site and Palmer Drought Severity Index	• Drought is discussed in the state plan, but indicates that Monmouth County is among the least affected areas by drought because of massive groundwater supplies, and low development densities. • According to the Palmer Drought Severity Index, New Jersey was experienced severe or extreme drought conditions less than five percent of the time between 1895 and 1995. However less severe, short-term droughts are a more frequent occurrence and can have serious implications for local water supply and the agricultural sector of some areas. • Some local emergency managers noted concerns over recent drought conditions that resulted in local water restrictions and drought emergency declarations.

Flood	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database • Review of HVRI SHELDUS database • Review of FEMA's NFIP Community Status Book and Community Rating System (CRS) • Review of FEMA Preliminary 2013 flood maps for Monmouth County	• The flood hazard is thoroughly discussed in the state plan and indicates that it is the most common natural hazard in New Jersey. • More than half of all federal disaster declarations for Monmouth County have involved flooding. • NCDC and SHELDUS report that Monmouth County has been affected by 96 flood events between April 1993 and December 2011. These events in total caused no reported deaths or injuries but an estimated $79.8 million in property damages. • The remnants of Hurricane Sandy in October 2012 caused catastrophic damage in Monmouth County. Nearly 10% of Monmouth County is located in the identified 100-year floodplain including riverine and coastal flood hazard areas. Nearly all municipalities participate in the NFIP and six participate in CRS.
Storm Surge	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of U.S. Army Corps of Engineers SLOSH model data	• Storm surge is discussed in the state plan under the flood hazard and tropical storm and hurricane (and nor'easter) hazard, and highlights Monmouth County as being at risk to the forces of storm surge. • According to SLOSH model data the majority of Monmouth County's municipalities are at risk to storm surge, and particularly those areas located within three to five miles of the shore. • The remnants of Hurricane Sandy in October 2012 caused catastrophic damage in Monmouth County.
Wave Action	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database • Review of HVRI SHELDUS database • Review of FEMA Q3 flood data for Monmouth County	• Wave action is identified as a hazard of concern for Monmouth County in the state plan. • NCDC and SHELDUS report that Monmouth County has been affected by 93 coastal flooding and heavy surf events (including rip currents) between December 1993 and December 2011. These incidents resulted in a reported total of 19 deaths and 22 injuries in Monmouth County and caused an estimated $1 million in property damages. • The remnants of Hurricane Sandy in October 2012 caused catastrophic damage in Monmouth County. According to Q3 flood data, 26 municipalities in Monmouth County include coastal flood hazard areas with storm-induced velocity wave action.

GEOLOGIC HAZARDS				
Earthquake	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • USGS Earthquake Hazards Program web site • Review of New Jersey Geological Survey web site	• Earthquake events are discussed in the state plan. • Earthquakes have occurred in and around the State of New Jersey in the past; according to the NJGS seven have been epicentered in Monmouth County. • According to USGS seismic hazard maps, the peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years for Monmouth County is between 4%g and 5%g. FEMA recommends that earthquakes be further evaluated for mitigation purposes in areas with a PGA of 3%g or more. • Historical earthquake events have caused documented damages in Monmouth County (though all reported damages to date have been minor). • Data provided by NJGS suggest that New Jersey is overdue for a moderate, damaging earthquake.
Expansive Soils	Not identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of USDA Soil Conservation Service's Soil Survey for Monmouth County (1989) • Review of USDA Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database	• Expansive soils are not identified in the state plan. • According to FEMA and USDA sources, Monmouth County is located in an area that has a "slight to moderate" clay swelling potential. • According to USDOT FHA Report No. FHWA-RD-76-82, Monmouth County lies in an area mapped as generally of low expansive character and/or low frequency of occurrence. • The NRCS Freehold Service Center confirms that the potential for expansive soils in Monmouth County is slight to moderate, with more moderate potential in the western, less developed portions of the County where more clay soils exist. New Jersey has adopted the International Building Code of 2000, in which Chapter 18 includes provisions for building on expansive soils (through either design, removal or stabilization) so that new construction will be protected.
Landslide	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of USGS Landslide Incidence and Susceptibility Hazard Map • Review of New Jersey Geological Survey GIS database of historic landslides in New Jersey	• Landslide events are discussed in the state plan, with particular attention focused on the coastal area landsliding (or slumping) in natural bluff areas of Monmouth County. • USGS landslide hazard maps indicate "high landslide incidence" (more than 15% of the area is involved in landsliding) for areas located in nine municipalities in northeast Monmouth County. • Data provided by NJGS indicate nine recorded landslide events in Monmouth County, including five that resulted in documented property damage.

Land Subsidence	Not identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of New Jersey Geological Survey digital GIS layers of Bedrock Geology and Abandoned Mines of New Jersey	• The state plan delineates certain areas that are susceptible to land subsidence hazards in New Jersey; however none of these areas are located in Monmouth County. The plan identifies no areas of mapped known sinkholes in the County. • Monmouth County's lack of carbonate rock terrain does not favor naturally occurring land subsidence or sinkholes. Further, there are no abandoned mines located in the County that could be prone to collapse.
Tsunami	Not identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of FEMA "How-to" mitigation planning guidance (Publication 386-2, "Understanding Your Risks – Identifying Hazards and Estimating Losses).	• Tsunamis are discussed in the state plan. The plan states that the return period for a mid-Atlantic tsunami is 1 in every 36 years; however this includes small scale events with waves of less than 0.5 meters. No record exists of a catastrophic Atlantic basin tsunami impacting the mid-Atlantic coast of the United States. The plan estimates that there is a probability of 0.3% in any given year for a tsunami of great than one meter to occur. • Tsunami inundation zone maps are not available for communities located along the U.S. East Coast. • FEMA mitigation planning guidance suggests that locations along the U.S. East Coast have a relatively low tsunami risk and need not conduct a tsunami risk assessment at this time.
Volcano	Not identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of USGS Volcano Hazards Program web site	• Volcanoes are not located anywhere remotely near Monmouth County.
OTHER HAZARDS				
Wildfire	Identified as a significant hazard to be addressed in the plan at that time.	Considered again and the earlier assessment was determined to still be applicable for the plan update.	• Review of NJ State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database • Review of New Jersey Forest Fire Service web site	• Wildfires are discussed in the state plan as a significant hazard of concern, particularly with regard to the Pine Barrens in south and central portions of the state. • According to New Jersey Forest Fire Service records, Monmouth County experienced 512 wildfire incidents that burned 353 acres between 1993 and 2003. The statistics indicate an average of 51 wildfire events per year, but also that most are quickly suppressed. • NCDC historical records indicate some minor property damage associated with wildfire has occurred within Monmouth County. • According to the New Jersey Forest Fire Service Wildfire Hazard Assessment (Draft 2004), portions of Monmouth County have been mapped as high hazard and extreme hazard. • There is a high probability of future wildfire occurrences in Monmouth County. • Wildfire hazard risks will increase as low-density development along the urban/wildland interface increases.

SECTION 3A - HAZARD PROFILES

Overview

This section includes detailed profiles for each of the hazards identified in the previous section and described in **Appendix 2.1**. Each hazard profile includes a general description of the location of each hazard, its extent (magnitude or severity), notable historical occurrences and the probability of future occurrences. Profiles also include specific items noted by members of the Planning Committee as it relates to unique historical or anecdotal hazard information for Monmouth County or a particular municipal jurisdiction.

Table 3a.1 lists each significant hazard for Monmouth County and identifies whether or not it has been determined to be a specific hazard of concern for each of the 54 jurisdictions (the County and each of its 53 municipalities) based on best available data and local information provided by the Planning Committee (● = hazard of concern).

The remainder of this section will discuss, for each identified hazard, its:

- location (the geographic areas in the planning region that are affected by the hazard);
- extent (the strength or magnitude of the hazard);
- history of previous occurrences; and
- probability of future occurrences (the likelihood of the hazard occurring, in terms of general descriptors, historical frequencies, or statistical probabilities).

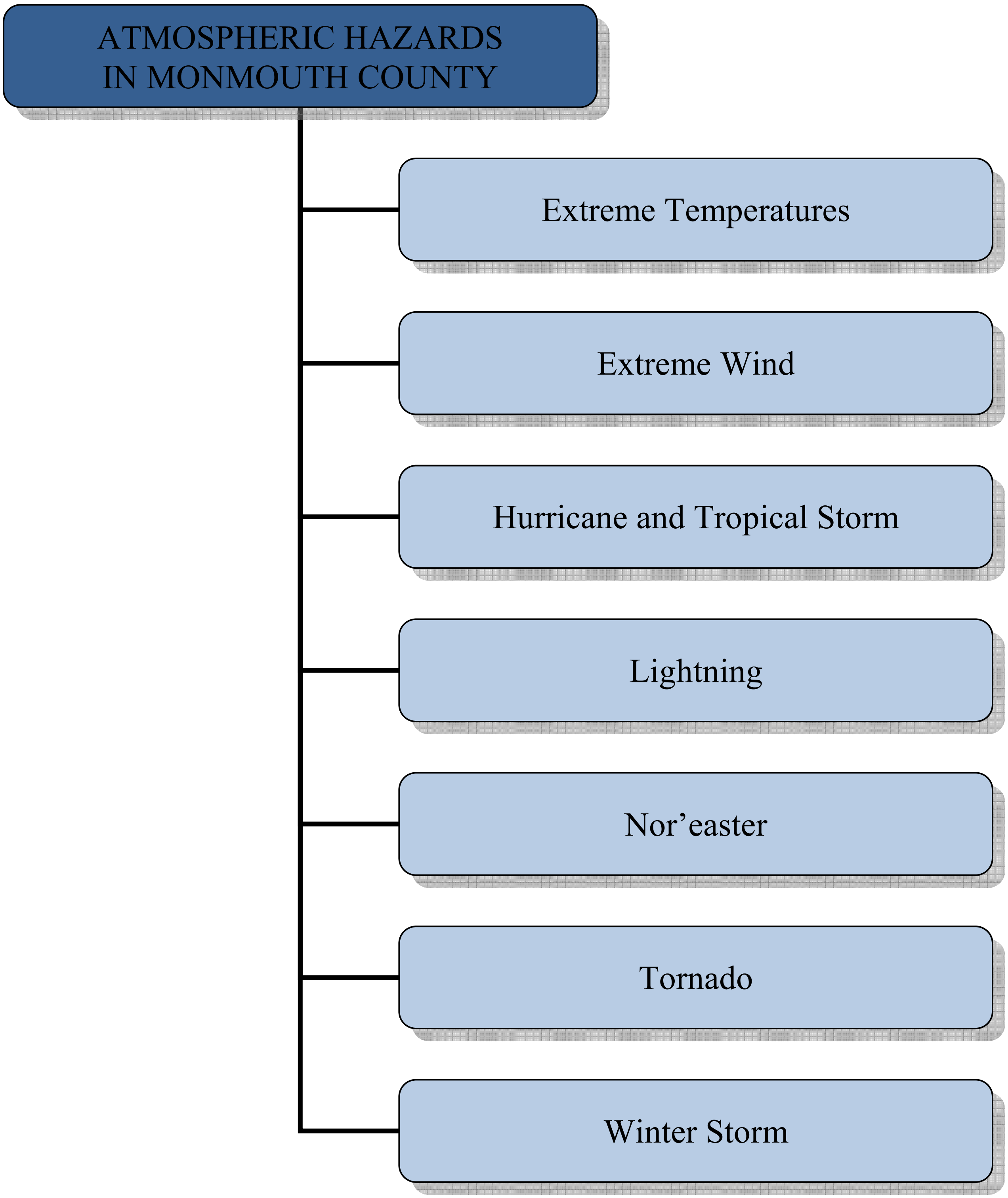
Table 3a.1
Summary of Identified Hazard Events in Monmouth County

Jurisdiction	Atmospheric							Hydrologic						Geologic		Wildfire
	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	
Aberdeen, Township of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Allenhurst, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Allentown, Borough of	●	●	●	●	●	●	●		●	●	●			●		●
Asbury Park, City of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Atlantic Highlands, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Avon-By-The-Sea, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Belmar, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Bradley Beach, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Brielle, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Colts Neck, Township of	●	●	●	●	●	●	●		●	●	●			●		●
Deal, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Eatontown, Borough of	●	●	●	●	●	●	●			●	●	●		●		●
Englishtown, Borough of	●	●	●	●	●	●	●		●	●	●			●		●
Fair Haven, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Farmingdale, Borough of	●	●	●	●	●	●	●			●	●			●		●
Freehold, Borough of	●	●	●	●	●	●	●			●				●		●
Freehold, Township of	●	●	●	●	●	●	●		●	●	●			●	●	●
Hazlet, Township of	●	●	●	●	●	●	●			●	●	●		●		●
Highlands, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Holmdel, Township of	●	●	●	●	●	●	●			●	●	●		●		●

Table 3a.1
Summary of Identified Hazard Events in Monmouth County

Jurisdiction	Atmospheric							Hydrologic						Geologic		Wildfire
	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	
Howell, Township of	●	●	●	●	●	●	●		●	●	●	●		●	●	●
Interlaken, Borough of	●	●	●	●	●	●	●			●	●	●		●		●
Keansburg, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Keyport, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Lake Como, Borough of	●	●	●	●	●	●	●			●	●	●		●		●
Little Silver, Borough of	●	●	●	●	●	●	●	●		●	●	●		●	●	●
Loch Arbour, Village of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Long Branch, City of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Manalapan, Township of	●	●	●	●	●	●	●		●	●	●			●		●
Manasquan, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Marlboro, Township of	●	●	●	●	●	●	●			●	●			●		●
Matawan, Borough of	●	●	●	●	●	●	●		●	●	●	●		●		●
Middletown, Township of	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Millstone, Township of	●	●	●	●	●	●	●		●	●	●			●		●
Monmouth Beach, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Neptune City, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Neptune, Township of	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
Ocean, Township of	●	●	●	●	●	●	●			●	●	●		●		●
Oceanport, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Red Bank, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Roosevelt, Borough of	●	●	●	●	●	●	●			●	●			●		●
Rumson, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Sea Bright, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Sea Girt, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Shrewsbury, Borough of	●	●	●	●	●	●	●			●	●	●		●		●
Shrewsbury, Township of	●	●	●	●	●	●	●			●	●			●		●
Spring Lake, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Spring Lake Heights, Borough of	●	●	●	●	●	●	●			●	●	●		●		●
Tinton Falls, Borough of	●	●	●	●	●	●	●		●	●	●	●		●	●	●
Union Beach, Borough of	●	●	●	●	●	●	●	●		●	●	●	●	●		●
Upper Freehold, Township of	●	●	●	●	●	●	●		●	●	●			●		●
Wall, Township of	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
West Long Branch, Borough of	●	●	●	●	●	●	●			●	●	●		●		●

ATMOSPHERIC HAZARDS



Extreme Temperatures

Location – Extreme Temperatures

Monmouth County is located in a region of the country that is susceptible to both extreme heat and extreme cold. During periods of extreme temperature conditions, the effects are felt over a widespread geographic area and it is generally assumed that the entire planning area is uniformly exposed to extreme heat and extreme cold. Areas along the immediate coast might experience minor differences in apparent temperatures due to the combined effects of air temperature, relative humidity, and wind speed.

Extent – Extreme Temperatures

The speed of onset of extreme temperature events typically offers 24 hours of warning time. The duration of historic events in Monmouth County is typically less than one week. The extent of extremely cold temperatures is typically measured through the Wind Chill Temperature (WCT) Index. The WCT Index provides a formula for calculating the dangers from winter winds and freezing temperatures. It is, essentially, a calculation of the temperature that is felt when the effects of wind speed are added to the base air temperature. **Figure 3a.1** shows the NOAA NWS Wind Chill Chart.

Figure 3a.1
NWS Wind Chill Index

Wind Chill Chart

Temperature (°F)

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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

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

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

Effective 11/01/01

The extent of the extremely hot temperatures is typically measured through the Heat Index, which calculates the dangers from high relative humidity and extremely hot temperatures. It is, essentially, a calculation of the temperature that is felt when the effects of relative humidity are added to the base air temperature. **Figure 3a.2** shows the NOAA NWS Heat Index.

Figure 3a.2
NWS Heat Index

NOAA national weather service: heat index

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

Caution
Extreme Caution
Danger
Extreme Danger

Historical Occurrences – Extreme Temperatures

According to the National Climatic Data Center (NCDC), 85 days of recorded **extreme heat** events have affected Monmouth County between May 1996 and June 2014. These incidents resulted in four deaths and 438 injuries in Monmouth County. Twenty-two of these events have occurred since the last version of the plan was prepared. Some notable events include the following:

June 25, 1998. A two day hot spell brought some of the highest temperatures of the summer to New Jersey. Injuries occurred when 15 people fainted at an outdoor ceremony in Fort Monmouth.

July 4-11, 1999. A brutal heat wave spanned the entire Independence Day weekend and ran through the 11th. The combination of the temperature and humidity produced heat indices of around 110 degrees during the afternoon of each day. Four heat-related deaths occurred in Monmouth County, mostly impacting elderly persons in poor health with no air-conditioning and inadequate ventilation. Utility companies issued power alerts and requested that customers reduce consumption, and some implemented rolling blackouts. High temperatures were recorded at 100 degrees in Freehold and 99 degrees in Belmar.

August 1-3, 2006. A strong area of high pressure anchored over the East Coast pushed heat indices into the 105 to 110 degree range across the state. Local utility companies broke records for demand. Sporadic blackouts occurred throughout the county. Several people were treated on the boardwalk for heat exhaustion. A total of 35 people suffered from minor heat-related injuries in Belmar on August 2nd.

June 7-10, 2008. Heat indices as high as around 100 were observed in northern New Jersey. The NCDC reported heat related injuries across Monmouth County. Many cooling centers were opened to assist senior citizens. In Monmouth and Ocean Counties about 10,000 homes and businesses lost power.

July 5-7, 2010. The hottest weather of the summer season occurred on July 5th through the 7th throughout the state of New Jersey. Many high temperatures exceeded 100 degrees for 2 to 3 consecutive days – with even higher heat index values. There were cases of heat exhaustion along Monmouth County boardwalks. A notable temperature of 104 degrees was recorded in Marlboro. Six people in Monmouth County suffered heat related injuries during this event.

July 21-24, 2011. High temperatures during this heat wave reached into the 100's. Afternoon heat indices were in the range of 110 to 120 degrees in some locations. The largest concentration of heat related injuries occurred at the Vans Warped Tour stop at Monmouth Park in Oceanport on the 24th. Three hundred and one people were treated for heat exhaustion, twenty-seven were taken to hospitals, three were admitted.

July 17-18, 2012. An unseasonably hot and humid air mass affected New Jersey on the 17th and 18th. High temperatures on the 17th reached into the mid to upper 90s in most places with afternoon heat indices near 100F. On July 18th, the combination of scorching high temperatures (around 100 degrees) and higher dew points produced hourly afternoon heat indices that reached between 105F and 110F.

July 18-19, 2013. Widespread high temperatures reached into the mid to upper 90s and the most oppressive days (combination of heat and humidity) occurred on the 18th and 19th. Morning lows those days were near 80 degrees in highly urbanized areas and afternoon heat indices reached 105 to 110 degrees. To combat the heat, many cooling centers were opened.

According to the NCDC, 22 recorded **extreme cold** events have affected Monmouth County between November 1994 and June 2014. Seven events have occurred since the last version of the plan was prepared. No deaths or property damage was reported but 7 people did suffer injuries. Notable events include the following:

January 13-28, 2003. A cold frontal passage initiated two weeks of unseasonably cold weather.The coldest mornings were on the 18th and 28th as low temperatures dipped into the single digits or below zero. The extreme cold caused homeless shelters to fill to capacity. Several water mains broke because of the extreme cold. In Monmouth County, ferry service between the county and New York City was suspended from January 23rd through the 26th because of ice in Raritan Bay and around the piers in New York City. About 70 percent of Raritan Bay was frozen. About 4,000 commuters who took the ferries in Highlands, Atlantic Highlands and the Belford section of Middletown Township had to scramble to find alternate ways to get to and from Manhattan. In Freehold, a 12-inch water main burst on U.S. Route 9 on the 30th that flooded and closed the southbound lanes of the roadway. A low temperature of 4 degrees was recorded in Freehold.

January 2004. An arctic air mass brought some of the coldest weather in years to New Jersey from the evening of the 9th through the morning of the 11th, posing a dangerous situation for the homeless and the elderly who could not afford to heat their homes. Many pipes froze and burst both inside and outside of structures. Firefighters had difficulty battling blazes as the water quickly turned to ice. There was a higher incidence of chimney fires and a general shortage of firewood. Another arctic air mass on the 15th brought similar impacts. While temperatures were slightly higher than the previous outbreak, winds were stronger and wind chill factors were lower as well. Ferry service between Monmouth County and New York City was cancelled because of excessive ice in Raritan Bay and the Hudson River. The low temperature at Freehold was recorded at 1 degree, and the lowest hourly wind chill factor in Belmar was 23 degrees below zero.

January 16-18, 2009. A large arctic high pressure system moved toward the area during the 16th and 17th. Maximum temperatures were only in the teens and minimums dropped into the single digits. Gusty winds produced wind chill values to zero and below zero, especially during the nighttime hours.

January 23, 2013. In Monmouth County, a 53-year-old man was in critical condition after he was found outdoors near the intersection of Willow and Locust Streets in Highlands Borough without a coat and in bare feet. Low temperatures on the morning of the 23rd included 5 degrees in Howell, and 8 degrees in both Wall and Holmdel.

January 2014. A series of three arctic blasts occurred on January 4th, 7th, and 22nd. Temperatures were recorded at 1 degree below zero in Howell on the 4th. On the 7th, strong northwest winds produced wind chill factors as low as 15 to 25 degrees below zero in most areas that morning. Low temperatures were near zero. High temperatures struggled to reach double digits. The excessive cold caused some schools to either cancel classes or have delayed openings. AAA Mid-Atlantic reported an 81 percent increase in service calls, mainly for dead batteries. Amtrak reported extensive delays in its rail service. The cold weather also affected power supplies. Electricity suppliers struggled to keep up with surging demand as the cold forced some power plants to shut Utilities asked their customers where possible to switch to diesel or fuel oil. While some low temperatures were higher than what occurred on January 4th, the wind made it feel much colder than the air temperatures. Lowest hourly wind chill factors during the morning of the 7th included 19 degrees below zero in Belmar. Lowest temperatures on the morning of the 22nd included 7 degrees in Belmar - or 13 degrees below zero with the wind chill.

Other notable reports of historical extreme temperature events include the following, as identified by the Planning Committee:

- The Borough of Farmingdale and the Township of Howell have experienced several heat emergencies coupled with power outages that have required evacuation and shelter of senior facilities.
- The Township of Holmdel indicated that many of the power distribution transformers are located “in ground” and on days when temperatures reach or exceed 100 degrees it is not uncommon to have two or three concurrent power outages in developments. Coupled with the potential for a wind event at the same time, power outages could cause many heavily treed areas/developments to be without power for extended periods. More and more “age restricted” developments also mean the potential for high impact on the area’s growing senior population.
- The Borough of Matawan has experienced rolling blackouts that have caused brief power outages during the extreme heat, specifically causing an issue with signalized traffic control at main intersections throughout the Borough.
- The Township of Ocean has a history of dealing with extreme temperatures. Within the town, there are multiple senior housing and low income housing units where local emergency management officials have to perform welfare (courtesy) checks to assure they are prepared to overcome extreme heat or freezing temperatures.
- The Borough of Oceanport has experienced recent power loss situations coupled with extreme heat events. Although no major damage or financial loss has occurred, power loss has impacted the local population, and particularly seniors.
- The Borough of Sea Girt indicated minor damages (pipe bursts) associated with past extreme cold events.
- The Borough of Shrewsbury indicated that extreme temperature related events have recently been on the rise. The Borough experiences power outages during extreme heat and drought conditions forcing water usage restrictions. Cold temperatures create similar power outages and property damage due to freezing water pipes in private homes and businesses alike.
- The Borough of Tinton Falls noted that a historical extreme cold and ice storm event occurred February 14, 2007, which resulted in an emergency declaration.
- The Township of Wall experienced extreme temperature conditions in the late 1990s and early 2000s including a couple of extreme heat and extreme cold events that caused damages. The extreme heat significantly strained the power infrastructure resulting in many outages. During extreme cold, water main breaks have often occurred.
- Past extreme heat events in the Borough of West Long Branch have led to various power outages.

Probability of Occurrence – Extreme Temperatures

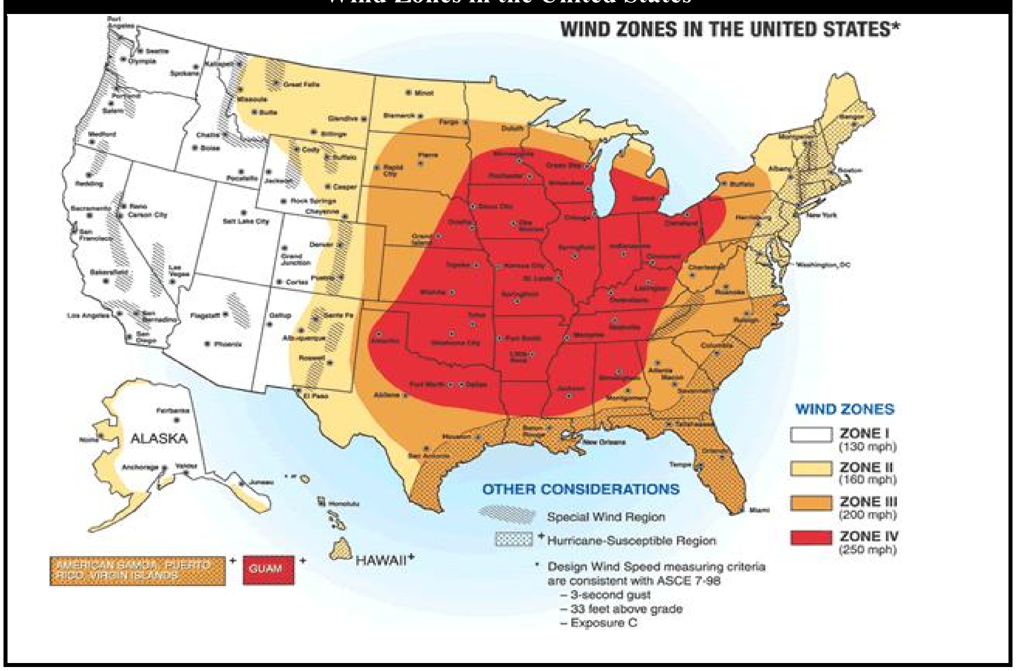
Extreme temperature events will continue to have a high probability of occurrence in Monmouth County, and the probability of future occurrences in Monmouth County is certain (higher for extreme heat than extreme cold). While the impact of such occurrences on people and property is typically minimal, it is anticipated that the threat to human lives and safety is increasing due to growing elderly populations in many of Monmouth County's municipal jurisdictions. According to the New Jersey State Hazard Mitigation Plan, "Temperatures in the Northeast United States have increased 1.5 degrees Fahrenheit (°F) on average since 1900. Most of this warming has occurred since 1970. The State of New Jersey, for example, has observed an increase in average annual temperatures of 1.2°F between the period of 1971-2000 and the most recent decade of 2001-2010 (ONJSC, 2011). Winter temperatures across the Northeast have seen an increase in average temperature of 4°F since 1970 (Northeast Climate Impacts Assessment [NECIA] 2007). By the 2020s, the average annual temperature in New Jersey is projected to increase by 1.5°F to 3°F above the statewide baseline (1971 to 2000), which was 52.7°F. By 2050, the temperature is projected to increase 3°F to 5°F (Sustainable Jersey Climate Change Adaptation Task Force 2013)."

Extreme Wind

Location – Extreme Wind

Extreme wind events are experienced in every region of the United States. The extreme wind hazard area covers the whole of Monmouth County and the entire planning area is uniformly susceptible to the extreme wind hazard. **Figure 3a.3** illustrates various wind zones throughout the country based on design wind speeds established by the American Society of Civil Engineers. It divides the country into four wind zones, geographically representing the frequency and magnitude of potential extreme wind events including severe thunderstorms, tornadoes and hurricanes. The figure shows that all areas of Monmouth County are located within Zone II and are susceptible to hurricanes, with a design wind speed for shelters of 160 mph (3-second gust).

Figure 3a.3
Wind Zones in the United States



Source: Federal Emergency Management Agency

Extent – Extreme Wind

Extreme winds can occur alone, such as during straight-line wind events and derechos, or it can accompany other natural hazards, including hurricanes and severe thunderstorms. Severe wind poses a threat to lives, property, and vital utilities primarily due to the effects of flying debris or downed trees and power lines. Severe wind will typically cause the greatest damage to structures of light construction, particularly manufactured homes. **Table 3a.2** illustrates the severity and typical effects of various sustained wind speeds. These would be reflective of high winds associated with thunderstorms, hurricanes, tropical storms and nor'easters. Typical effects of wind are very different for tornados; **Table 3a.3** illustrates the severity and typical effects of wind during tornados, as measured by various 3 second gusts. Note that tornados are addressed separately later in this plan section.

Table 3a.2
Severity and Typical Effects of Various Sustained Wind Speeds

Sustained Wind Speed* (mph)	Equivalent Saffir-Simpson Scale** (Hurricanes)	Severity of Damage	Typical Effects
0-73 *(V3S=0 to 88)*	N/A	ISOLATED	Isolated damage for winds below 50 mph. Above 50 mph, expect some minor damage to buildings of light material. Small branches blown from trees.
74-95 *(V_{3S} =89 to 115)*	1	MINOR	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.
96-110 *(V_{3S}=116 to 130)*	2	EXTENSIVE	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.
111-129 *(V_{3S}=131 to 149)*	3	DEVASTATING	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.
130-156 *(V_{3S}=150 to 176*	4	CATASTROPHIC	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.
157 or higher *(V_{3S}>177)*	5	CATASTROPHIC	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: National Oceanic and Atmospheric Administration

* *The 2003 International Building Code Table 1609.3.1 was used to convert Saffir-Simpson sustained wind speeds to 3- second gusts (V_{3S}) for the purposes of comparison between hurricane and tornado winds.*

TABLE 1609.3.1
EQUIVALENT BASIC WIND SPEEDS[a,b,c]

V_{3S}	85	90	100	105	110	120	125	130	140	145	150	160	170
V_{fm}	70	75	80	85	90	100	105	110	120	125	130	140	150

For SI: 1 mile per hour = 0.44 m/s.
a. Linear interpolation is permitted.
b. V_{3S} is the 3-second gust wind speed (mph).
c. V_{fm} is the fastest mile wind speed (mph).

** *The Saffir-Simpson Scale is described further in this section under Hurricanes.*

Table 3a.3
Severity and Typical Effects of Various Tornado Wind Speeds
3-Second Gust

Maximum Wind Speeds 3 Second Gust (mph)	Equivalent Enhanced Fujita Scale* (Tornadoes)	Severity	Typical Effects
65-85	EF0	LIGHT	Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
86-110	EF1	MODERATE	Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
111-135	EF2	SIGNIFICANT	Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; highrise windows broken and blown in; light-object missiles generated.
136-165	EF3	SEVERE	Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
166-200	EF4	DEVASTATING	Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
Over 200	EF5	INCREDIBLE	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 m (109 yd); trees debarked; steel reinforced concrete structures badly damaged.

Source: National Oceanic and Atmospheric Administration
** The Enhanced Fujita Scale is described further in this section under Tornados.*

Historical Occurrences – Extreme Wind

Monmouth County has experienced numerous types of damaging extreme wind events in the past including severe thunderstorms, tornadoes, hurricanes, tropical storms and nor'easters. According to NCDC, 240 recorded high wind events have affected Monmouth County since 1968 (data excludes tornado events which are addressed separately within this section). Forty-seven of these have occurred since the last plan was prepared. These incidents resulted in a reported total of one death, 78 injuries, and roughly $1.769 billion in property damages ($1.750 billion of which are related to Hurricane Sandy wind damages alone). Some notable events include the following:

September 9, 1998. A squall line of severe thunderstorms capsized boats and downed trees and power lines throughout Monmouth County. The USCG rescued about 60 people from overturned boats – mostly in Sandy Hook Bay. About 30 people were injured and one man drowned. In Sea Bright, lifeguards rescued people from a capsized catamaran. A wind gust to 75 mph was reported in Freehold.

August 7, 2000. A strong downburst produced by a severe thunderstorm produced wind gusts between 75 and 90 mph which caused significant tree damage in Marlboro and Colts Neck. Property damages were estimated at $1 million. The most significant damage occurred in an area bounded by State Route 18 to the west, County Route 537 to the south, Dutch Land Road to the north and Montrose Road to the east.

August 2, 2002. A line of severe thunderstorms brought hurricane-force wind gusts and downed thousands of trees and power lines, damaging homes, vehicles and hundreds of poles. Most municipalities county reported damage and a state of emergency was declared in the county. Damages were estimated at $10.2 million. A wind gust of 83 mph was measured at the North Shrewsbury Ice Boat Clubhouse before the instrument broke. In West Long Branch Borough, Monmouth University suffered extensive damage.

July 22, 2003. A severe thunderstorm caused about $500,000 in property damage. About 4,000 homes and businesses lost power. Numerous tree limbs and one large tree were downed in Wall. In Belmar, about 25 homes and six cars were damaged, one home was shifted off its foundation, and another home's roof was ripped off.

January 18, 2006. Peak wind gusts nearly reached between 45 and 70 mph. In Middletown, a school bus struck a downed tree, but no injuries occurred. Vehicles were damaged by downed trees in Colts Neck and Englishtown.

August 17, 2007. High winds from strong to severe thunderstorms during the afternoon and evening of August 17th caused damages in several areas of the county. Trees and wires were downed in Monmouth Beach, Keansburg, from Holmdel through Deal, and from Freehold southeast to Manasquan. In Keansburg, a downed limb and wires resulted in a fire which spread along electrical lines into a house.

February 13, 2008. Strong winds collapsed two large window walls at the Ocean Township Elementary School gymnasium, which caused about $5,000 in damage. About 30 to 40 students from two gym classes were in the room at the time; however, none were injured.

March 5, 2008. A line of severe thunderstorms produced nearly $100,000 in wind related damage in Monmouth County. In Eatontown, a large uprooted tree crushed one trailer and ripped a hole in the roof of the trailer next door. The same storm ripped siding from some other homes in the area. Downed trees and closed roadways were reported in Farmingdale, Wall and Neptune. Power outages because of downed wires occurred in Bradley Beach, Eatontown, Farmingdale, Howell and Neptune. Wind gusts of 61 mph and 60 mph were measured in Sandy Hook and Tinton Falls respectively. Two women were injured when a tree fell on their vehicle in Manalapan. In Middletown, the Navesink section was hit the hardest. Outages because of downed trees and limbs occurred in Colts Neck, Englishtown, Freehold, Hazlet, Middletown, Neptune, Oceanport and Union Beach. A wind gust to 68 mph was measured at Sandy Hook.

March 13, 2010. Strong to high winds downed thousands of trees and tree limbs, damaged telephone poles and caused record breaking utility outages. Damages of $500,000 were reported by the NCDC for Monmouth County, though damages were incurred across the state. Fallen trees damaged homes. Numerous roadways were closed because of downed trees and debris. Rail services were also suspended because of downed wires and poles. A state of emergency was declared state-wide on the 14th.

August 27-28, 2011. Hurricane Irene made landfall as tropical storm at Brigantine (Atlantic County). Monmouth County was impacted by tropical storm force sustained winds, with higher gusts including 63 mph recorded at Sandy Hook and 52 mph in Belmar. High winds downed trees and power lines across the county, with power outages reported for 121,000 homes.

October 29, 2012. Hurricane Sandy made landfall in Atlantic County as a post tropical storm in Brigantine. Monmouth and Ocean Counties were the two hardest-hit counties in the state. Wind damage was estimated at $1.5 billion in eastern Monmouth County, and at $250 million in western Monmouth County. Monmouth County had the greatest number of sustained outages of any county in the state. Upwards of 45,000 fallen trees had to be cut through to restore power, and power was unable to be restored to thousands of shore and barrier island customers because of massive structure and infrastructure damages. Peak wind gusts ranged from 61 mph in Wall to 87 mph at Sandy Hook. Maximum sustained winds included 68 mph at Sandy Hook and 61 mph in Long Branch.

As mentioned earlier, extreme wind events are often associated with other notable events such as hurricanes and tropical storms, nor'easters and winter storms – each of which are addressed separately within this section. According to NCDC, several notable extreme wind events in Monmouth County were directly associated with these event types, a sample of which are shown in **Table 3a.4**.

Table 3a.4
Other Notable Extreme Wind Events

Date	Associated Event Type
11/14/1995	Nor'easter
10/08/1996	Tropical Storm Josephine
03/31/1997	Winter Storm
11/07/1997	Nor'easter
02/04/1998	Nor'easter
02/(23-25)/1998	Nor'easter
09/16/1999	Hurricane Floyd
01/25/2000	Winter Storm
04/09/2000	Winter Storm
09/11/2002	Tropical Storm Gustav
10/16/2002	Nor'easter
11/16/2002	Nor'easter
02/17/2003	Winter Storm
09/18/2003	Tropical Storm Isabel
03/08/2005	Winter Storm
02/11/2006	Winter Storm
09/01/2006	Remnants of Tropical Storm Ernesto
11/03/2007	Remnants of Hurricane Noel
09/07/08	Tropical Storm Hannah
12/(21-22)2008	Winter Storm
03/(01-01)2009	Nor'easter
10/05/09	Nor'easter
11/13/09	Nor'easter
12/26/10	Blizzard
08/(27-28)/2011	Hurricane Irene
10/29/12	Hurricane Sandy

Other notable reports of historical extreme wind events include the following, as identified by the Planning Committee:

- The Borough of Atlantic Highlands is located on Raritan and Sandy Hook Bays, and high winds routinely cause large problems with boats, docks and buildings.
- The Borough of Deal experienced extreme winds including microbursts during the reported August 2002 event that resulted in approximately $250,000 in damages to Borough facilities.

- The Borough of Fair Haven reports that wind damage has caused many problems to older large trees in town over the last few years.
- The Borough of Freehold reported that many wind events have caused damages to street trees.
- The Township of Marlboro had a straight line wind occurrence in the early 1990s that caused moderate damage to a wooded area on School Road East.
- The Borough of Matawan recently experienced an extreme wind event for one portion of town resulting in the loss of power for the Freneau section and the closing of State Highway 79 for several hours due to downed trees and power lines.
- The Borough of Neptune City had numerous trees blown down with power lines taken down during a storm event in 1993, causing many outages.
- The Township of Neptune had several instances of wind damage due to Sandy: the top sections of two radio towers were sheared off; the Ocean Grove auditorium lost a portion of its roof; and the Unexcelled Fire Company on Highway 33 suffered roof damage and partial structural collapse.
- The Township of Ocean has experienced several severe windstorms between 2002 and 2007 which caused damage to both residential and commercial structures.
- The Borough of Oceanport was devastated by the August 2002 storm event. For three days they had no power, and the cleanup was extensive and costly.
- The Borough of Rumson has seen damage in recent years due to wind, mainly on trees, telephone poles and power lines.
- The Borough of Shrewsbury has sustained heavy tree damage during periods of heavy winds. Damage to private property such as homes and automobiles have been documented on numerous occasions.
- The Township of Upper Freehold experienced damaging wind events in August 2002 and August 2003, which resulted in downed trees and utilities, and impassable roads.

Probability of Occurrence – Extreme Wind

Extreme wind events will continue to have a high probability of occurrence in Monmouth County, and the probability of future occurrences in Monmouth County is certain. The entire planning area is susceptible to a wide variety of recurring events that cause extreme wind conditions including severe thunderstorms (most frequent), tornadoes, hurricanes, tropical storms and nor'easters. Based on historic occurrence data, Monmouth County can expect approximately 5 to 10 extreme wind events per year.

Hurricane and Tropical Storm

Location– Hurricane and Tropical Storm

Hurricanes and tropical storms threaten the entire Atlantic and Gulf seaboard of the United States, and while coastal areas are most directly exposed to the brunt of landfalling storms their impact is often felt hundreds of miles inland. Monmouth County is located in a region of the country that is susceptible to all of the hazards wrought by hurricanes and tropical storms. In the strictest sense, hurricanes and tropical storms are not hazards in their own right but, rather, events where the primary damaging hazards are high-level sustained winds, heavy precipitation that causes inland flooding and tornadoes (coastal areas are also susceptible to the additional forces of storm surge, wind-driven waves and tidal flooding, which can be more destructive than cyclone wind). The entire planning area is located within a geographic area that is affected by hurricanes and tropical storms. The hazard areas for the accompanying extreme wind, storm surge, coastal erosion, riverine flooding, tornadoes, and wave action hazards do, however, vary across the county. While mentioned here, each of these individual forces are more thoroughly addressed as separate hazards within this section (i.e., extreme wind, coastal erosion, flood, tornado, storm surge and wave Action).

Extent – Hurricane and Tropical Storm

As a hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression.

When maximum sustained winds reach or exceed 39 mph, the system is designated a tropical storm, given a name and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach 74 mph the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Scale (**Table 3a.5**), which rates hurricane intensity in categories on a scale of 1 to 5, with Category 5 being the most intense. The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure and storm surge potential, which are combined to estimate potential damage. Categories 3, 4 and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States.

Table 3a.5
Saffir-Simpson Scale for Hurricanes

Category	Maximum Sustained Wind Speed (mph)	Minimum Surface Pressure (Millibars)	Storm Surge (Feet)
1	74–95	Greater than 980	3–5
2	96–110	979–965	6–8
3	111–129	964–945	9–12
4	130–156	944–920	13–18
5	157 +	Less than 920	19+

Source: National Oceanic and Atmospheric Administration

Historical Occurrences – Hurricane and Tropical Storm

Monmouth County has an active history of hurricanes and tropical storms. According to NOAA historical records, 36 hurricane or tropical storm tracks have passed within 75 miles of Monmouth County since 1850. This includes six Category 2 hurricanes; five Category 1 hurricanes; and 25 tropical storms. Of the 36 recorded storm events, 11 tropical storm tracks traversed directly through Monmouth County. **Figure 3a.3** shows the track of each recorded historical storm track in relation to Monmouth County. As can be seen in the figure, almost all hurricane and tropical storm tracks traverse northward through the area. For each event, **Table 3a.6** provides the date of occurrence, storm name (if applicable), maximum wind speed (as recorded within 75 miles of Monmouth County) and category of the storm based on the Saffir-Simpson Scale.

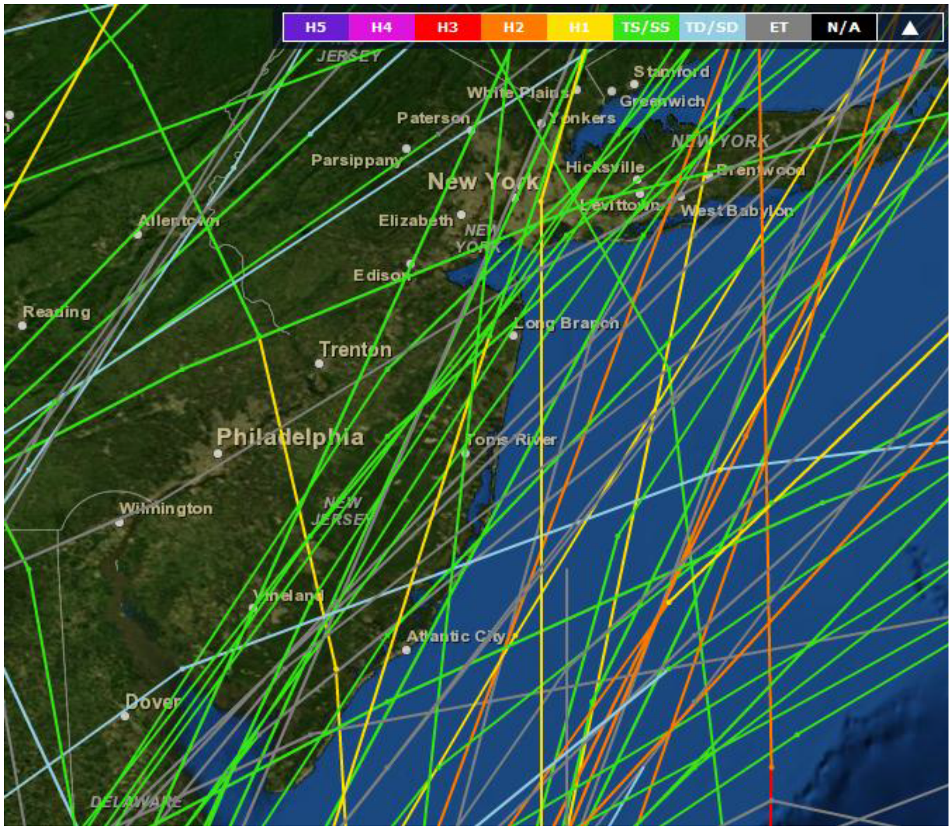
Table 3a.6
Historical Storm Tracks within 75 Miles of Monmouth County (Since 1850)

Date of Occurrence	Storm Name	Maximum Wind Speed* (mph)	Storm Category
8/20/1856	Unnamed	60	Tropical Storm
9/16/1858	Unnamed	90	Category 1 Hurricane
9/28/1861	Unnamed	70	Tropical Storm
11/3/1861	Unnamed	70	Tropical Storm
9/19/1863	Unnamed	60	Tropical Storm
10/30/1866	Unnamed	70	Tropical Storm
10/26/1872	Unnamed	45	Tropical Storm
09/30/1874	Unnamed	70	Tropical Storm
8/18/1879	Unnamed	105	Category 2 Hurricane
9/24/1882	Unnamed	45	Tropical Storm
8/22/1888	Unnamed	45	Tropical Storm
8/24/1893	Unnamed	85	Category 1 Hurricane
8/29/1893	Unnamed	65	Tropical Storm
10/10/1894	Unnamed	85	Category 1 Hurricane
9/24/1897	Unnamed	70	Tropical Storm

Table 3a.6 Historical Storm Tracks within 75 Miles of Monmouth County (Since 1850)			
Date of Occurrence	**Storm Name**	**Maximum Wind Speed* (mph)**	**Storm Category**
9/16/1903	Unnamed	80	Category 1 Hurricane
9/15/1904	Unnamed	65	Tropical Storm
5/30/1908	Unnamed	60	Tropical Storm
9/19/1936	Unnamed	100	Category 2 Hurricane
8/3/1944	Unnamed	40	Tropical Storm
9/14/1944	Unnamed	100	Category 2 Hurricane
9/1/1952	Able	40	Tropical Storm
8/31/1954	Carol	100	Category 2 Hurricane
8/19/1955	Diane	45	Tropical Storm
7/30/1960	Brenda	50	Tropical Storm
9/12/1960	Donna	110	Category 2 Hurricane
9/15/1961	Unnamed	40	Tropical Storm
8/28/1971	Doria	60	Tropical Storm
6/22/1972	Agnes	70	Tropical Storm
8/10/1976	Belle	90	Category 1 Hurricane
9/27/1985	Gloria	100	Category 2 Hurricane
9/24/1985	Henri	40	Tropical Storm
7/13/1996	Bertha	70	Tropical Storm
9/16/1999	Floyd	70	Tropical Storm
9/6/2008	Hanna	45	Tropical Storm
8/28/2011	Irene	65	Tropical Storm
10/29/12	Sandy		Post-Tropical Storm

Source: National Oceanic and Atmospheric Administration
** As recorded within 75 miles of Monmouth County*

Figure 3a.3
Historical Hurricane and Tropical Storm Tracks, 1856-2011*



* *Source: NOAA 2013d; (latest date available from data source).*

Some notable events include the following:

September 14-15, 1944
The entire coast of New Jersey was struck by hurricane force winds associated with the Category 2 Hurricane. Wind velocities ranged from 90 miles per hour at Atlantic City to over 100 miles per hour at New York City. The storm produced a maximum tidal elevation of 7.4 feet at a gage in Sandy Hook, located in the Township of Middletown.

September 12, 1960 (Hurricane Donna)
Hurricane Donna was a Category 2 storm when it reached Monmouth County with wind speeds up to 110 miles per hour. The concurrence of the hurricane tidal surge and mean high tide resulted in a maximum tidal elevation of 8.6 feet at the gage at Sandy Hook.

August 9, 1976 (Hurricane Belle)
Hurricane Belle, a Category 1 storm with wind speeds up to 90 miles per hour. In Asbury Park, 2.56 inches of rain fell in a 24-hour period. At Beach Haven, a tidal surge combined with high tide levels produced a tidal height six feet above normal stage.

September 27, 1985 (Hurricane Gloria)
Hurricane Gloria came ashore in Long Island, New York as a Category 2 storm. The storm knocked out power and forced people to be evacuated from homes along the Jersey Shore, including Monmouth County. Floodwaters on Long Beach Island split the island in half for a period of time. Gloria downed thousands of trees and caused extensive power outages across the state. Storm surge tides averaged two meters above predicted tide levels; however, coastal flooding was minimized as the peak surge arrived during low tide.

July 13, 1996 (Tropical Storm Bertha)
A weakening Tropical Storm Bertha passed across eastern parts of the state on July 13th. One storm-related death occurred on the 12th. A 41-year-old man from New Egypt drowned while surfing at Ocean Beach in the Borough of Belmar. Most beaches were already closed due to the rough surf and the potential for rip tides. Otherwise, tidal departures were about two feet or less from normal. Only Monmouth Beach suffered severe beach erosion. Sixty feet of the 120-foot wide beach at the south of the borough was gone. This beach is one of dozens in New Jersey that was being replenished under a U.S. Army Corps of Engineers project. There was little beach erosion elsewhere. While there was urban and poor drainage flooding, no serious property or vehicular damage was reported and there were only a few water rescues of trapped motorists.

July 16, 1999 (Tropical Storm Floyd)
Tropical Storm Floyd will go down in history as one of the greatest natural disasters to impact New Jersey before Superstorm Sandy in 2012. Wind gusts rarely exceeded 50 mph, but all the flooding rains made it easier for trees to be knocked over. In Monmouth County, the worst flood-related problems occurred as the torrential rain coincided with the high tide. The worst flooding was reported in Union Beach and bay areas of Middletown, requiring some evacuation. State Routes 35 and 36 were closed due to flooding. Farther inland, Manalapan was hardest hit with overflowing brooks that forced the closure of six roads and sandbagging of homes on Birmingham Road. The strongest winds occurred during the evening and blew down transformers, wires, tree limbs and several trees throughout the county. Coastal areas escaped with minimal damage: just some minor beach erosion and minor backbay flooding at times of high tide. Precipitation storm totals in Monmouth County include 6.4 inches in Hazlet, 5.82 inches in Marlboro, 5.2 inches in Sandy Hook, and 4.57 inches in Keansburg.

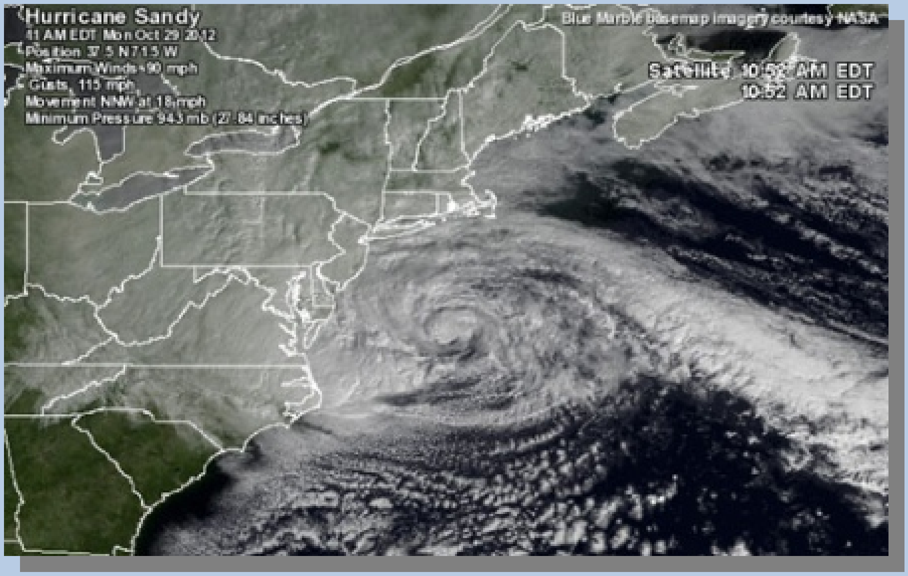
September 18-19, 2003 (Tropical Storm Isabel). Isabel produced strong winds and rough surf. In Monmouth County, $100,000 in property damage was recorded by NCDC. Peak wind gusts included 52 mph in Keansburg, and downed trees, tree limbs and power lines. While tide heights along the oceanside only reached minor, wave action caused beach erosion. The heaviest rain with tropical systems often falls west of its storm track, thus the region was spared from the heavier rain with most locations reporting less than 1.5 inches.

September 6, 2008 (Tropical Storm Hanna)
Tropical Storm Hanna made landfall on September 6th near the border of North and South Carolina before making a second landfall in New Jersey in eastern Cumberland County. Hanna brought heavy rain and strong winds with storm totals ranging from around 2 to 5 inches and peak wind gusts in Monmouth County of 45 mph in Keansburg and Ocean Grove. The combination of the winds and heavy rain caused some weak trees and tree limbs to be knocked down. About 2,600 homes and businesses lost power in Monmouth and Ocean Counties. All power was restored by the 7th. Minor tidal flooding occurred as the surge averaged around two feet. Many scheduled events were either cancelled or postponed. Strong rip currents on the 7th claimed the life of a 38-year-old man in Spring Lake, and led to multiple rescues along Monmouth County beaches including Long Branch, Sea Bright, and Bradley Beach.

August 27-28, 2011 (Tropical Storm Irene)

Irene produced torrential downpours that resulted in major flooding and a number of record breaking crests on area rivers, tropical storm force wind gusts with record breaking outages for New Jersey utilities, and a three to five foot storm surge that caused moderate to severe tidal flooding with extensive beach erosion over the weekend of August 27-28, 2011. Irene was the costliest natural disaster in the history of New Jersey after Tropical Storm Floyd (before Sandy later struck in 2012). In Keansburg, Monmouth Beach and Sea Bright it was mandatory for all residents to evacuate. Evacuations in Asbury Park, Belmar, Bradley Beach, Highlands, Middletown, Manasquan, Spring Lake, Union Beach and Wall Township were limited to flood prone areas. Power outages were widespread. Moderate to severe tidal flooding occurred along the Atlantic Coast and Raritan Bay. Coastal erosion was a major impact. Preliminary damage estimates statewide were near one billion dollars to approximately 200,000 homes and businesses. The combination of wind and flooding forced the closure of about 350 main roadways in the state. Among the major roadways that were closed included U.S. Route 9 and State Routes 33, 35, 36 and 79. In Middletown, a dam broke at the Swimming River Reservoir and flooded the southern part of the township around County Route 50. Elsewhere in the township, a bridge washed out at Hubbard Avenue over the Navesink River. In Allentown, businesses located near Doctors Creek and Conines Millpond were damaged. In Matawan, a thirty-five foot sinkhole forced the suspension of service along the New Jersey Transit North Jersey Coast Line. The Manasquan River at Squankum had major and record breaking flooding, cresting at 13.06 feet on the 28th. Event rainfall totals included 8.75 inches in Freewood Acres, 8.57 inches in Howell, 8.07 inches in Red Bank, 6.72 inches in Eatontown and 6.13 inches in Lake Como. FEMA reported that federal disaster assistance statewide topped \$275 million through December 12th. As of December 12th:

- 48,904 registrations were approved for assistance
- Nearly \$152 million was approved under the Housing Assistance program for housing repairs
- Nearly \$100 million was approved in U.S. Small Business Administration low-interest loans to 2,585 households and businesses
- More than \$13 million was approved for Other Needs Assistance (i.e., personal property, transportation, medical/dental expenses, etc.)
- More than \$10 million in Public Assistance funds for rebuilding public infrastructure
- Nearly \$100,000 Disaster Unemployment Assistance for those who lost jobs because of the disaster



October 29, 2012 (Post Tropical Storm Sandy). Prior to Sandy′s arrival, Governor Christie called for voluntary evacuations of barrier communities on the 26th. A State of Emergency was declared on the 27th a mandatory evacuation of all barrier island communities was ordered. More than 2,000 National Guard troops were deployed. Tolls along sections of the Garden State Parkway and all of the Westbound Atlantic City Expressway were suspended. On October 28th, President Barack Obama signed a federal emergency declaration for New Jersey. All State Parks and Historic Sites were closed. Late that afternoon, New Jersey transit began a gradual system-wide shutdown.

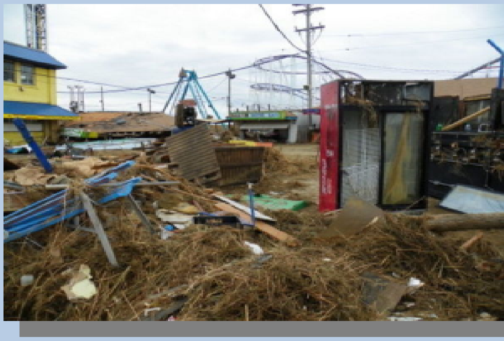
Sandy made landfall in Atlantic County as a post tropical storm in Brigantine City on the 29th. Approximately 130 miles of the Garden State Parkway was closed from Woodbridge in Middlesex County to its terminus in Cape May County. The New Jersey Turnpike was closed in central New Jersey. Most schools were closed. The nuclear power plants at Oyster Creek (Ocean County) and Salem (Salem County) suspended operations because of tidal flooding. On the 30th, the day after Sandy′s landfall, all 580 school districts in the state were closed. All courts and state offices were closed. Over 200 roadways were closed. Numerous boil water advisories were issued for the northern and coastal parts of the state, some that lasted into November. Governor Christie postponed Halloween in the state until November 5th. On October 31st, Amtrak started limited rail service. State offices were still closed, but some schools reopened. Most major roadways away from the immediate coast including the New Jersey Turnpike were reopened. On November 1st, Governor Christie rescinded evacuation orders for some of the Atlantic County barrier islands. The River Line Transit service between Camden and Trenton resumed. New Jersey Transit bus service resumed as did the Cape May-Lewes Ferry. On November 2nd, the governor lifted the evacuation order for Atlantic City and the casinos opened the next day. Evacuation orders were also lifted for Cape May County. Limited New Jersey Rail Service resumed. Because of power outages, lines for gas reached 100 cars long in the northern part of the state. The governor declared a limited state of emergency and imposed odd-even rationing for gasoline purchases in twelve northern New Jersey counties because of the shortages. They remained in effect through November 12th. The EPA temporarily suspended some Clean Air Act restrictions. The entire state was also under odd-even water restrictions. On November 3rd about 75 major roadways were still closed. On November 4th, rail service between Philadelphia and Atlantic City resumed. It was estimated that the average New Jersey beach became 30 to 40 feet narrower. It was difficult for people whose homes were uninhabitable to find rental properties.

Sandy was the costliest natural disaster by far in the state of New Jersey. Record breaking high tides and wave action combined with sustained winds as high as 60 to 70 mph with gusts as high as 80 to 90 mph battered the state. Statewide, Sandy caused an estimated $29.4 billion in damage; destroyed or significantly damaged 30,000 homes and businesses; affected 42,000 additional structures; and was responsible directly or indirectly for 38 deaths. A new temporary inlet formed in Mantaloking (Ocean County) where some homes were swept away. About 2.4 million households in the state lost power. It would take weeks for power to be fully restored.

Hardest hit were the coastal areas of Ocean and Monmouth Counties. Every municipality that bordered Raritan Bay and the Atlantic Ocean suffered widespread damage in Monmouth County and every inland municipality had at least some sporadic damage. Union Beach and Sea Bright were among the most hardest hit locations. In Sea Bright, many businesses were totally destroyed and the fishing pier collapsed. Both Spring Lake and Belmar had miles of their boardwalks destroyed. Some schools were damaged beyond use. Monmouth University was used as an evacuation center. The New Jersey Transit line had to be rebuilt because it was severely damaged. Ferry service between Manhattan and Atlantic Highlands was suspended indefinitely. One death was reported, a 61-year-old male who died of hypothermia after failing to evacuate in Long Branch.

Sandy produced record breaking power outages. Statewide, 2.7 million utility customers lost power, by far surpassing the record from Tropical Storm Irene in 2011. Public Service Electric and Gas alone had power lost to 1.4 million of its customers and reported about 48,000 trees had to be removed or trimmed to restore power and over 2,400 poles had to be replaced. Jersey Central Power and Light estimated that nearly 1.0 million of its customers lost power, about ninety percent of its customer base. This included hardest hit areas of Ocean and Monmouth Counties. Monmouth County had the greatest number of sustained outages of any county in the state. The utility had to cut through approximately 45,000 fallen trees. It was unable to restore power to about 30,000 of its shore and barrier island customers because of massive infrastructure damage to those homes and businesses. Elsewhere in the state, power restoration was hampered by a nor'easter that occurred on November 7th. Public Service Electric and Gas restored all power on November 12th and Jersey Central Power and Light by November 14th.

The unique aspect of Sandy and unlike most tropical systems was the multi-tide cycle increase of onshore winds prior to landfall. This caused multiple high tide cycles with tidal flooding and also helped produce catastrophic wave action. Record breaking or near record breaking high tides were exacerbated by the high astronomical spring tides associated with the full moon. Sandy's landfall coincided closely with the high tide cycle on the evening of the 29th. On the oceanside, Raritan Bay and the lower Delaware Bay, minor tidal flooding started during the high tide cycle on the morning of the 28th with some moderate tidal flooding during the high tide cycle on the evening of the 28th. Widespread major tidal flooding occurred during the morning and evening high tide cycles on the 29th. The highest tide (and surge) along the ocean front and Raritan Bay was with the landfalling high tide cycle on the evening of the 29th. The ocean front and Raritan Bay surge was 5 to 9 feet. A new all-time record tide was set in Sandy Hook. The tide reached 13.31 feet above mean lower low water before the pier collapsed about 45 minutes before high tide. An after the event survey performed by the USGS and Rutgers University determined that an estimated crest of 14.40 feet above mean lower low water will be used as the new record for Sandy Hook. The entrance to New York Harbor Buoy (a relatively new buoy)



had record breaking seas of 32.5 feet. The Delaware Bay Buoy (about 19 miles east of Fenwick Island, Delaware) had seas that reached 24.5 feet. It was estimated that waves likely reached 12 to 24 feet along the ocean front with the largest waves along Monmouth County. Most of the surveyed damage to barrier island homes that were either destroyed or moved indicated that it was the storm surge and wave action that caused most of the damage. Either minor or no tidal flooding occurred with the subsequent high tide cycles the rest of the month. The highest tide reached a record breaking 13.31 feet above mean lower low water in Sandy Hook before the pier collapsed approximately 45 minutes before the evening high tide on the 29th. The previous record was 10.1 feet above mean lower low water during Hurricane Donna on September 12, 1960 and the December 11, 1992 nor'easter. While there are no established benchmarks for tidal flooding levels at these other stations, the following is a list of the highest tides during Sandy. These may not represent the highest actual tide as there were power outages and some of the graphs plateaued at high crest. The tide gages whose peak crest looks suspect (and may be higher) are marked with an asterisk. At Keansburg* the highest crest was 8.96 feet above mean lower low water, at Sea Bright, the highest crest was 13.79 feet above mean lower low water, at Belmar* the highest crest was 8.70 feet above mean lower low water.

Strong winds associated with Sandy started to spread across the state during the morning of the 29th; most of the peak wind gusts (between 70 mph and 90 mph) occurred during the late afternoon and evening hours as Sandy was making landfall. Most of the strong wind gusts were over by the following morning. The most widespread measured hurricane force wind gusts occurred in northern Ocean County and in Monmouth County. Peak wind gusts included 87 mph at Sandy Hook, 79 mph in Sea Girt, Barnegat Light (Ocean County) and High Point (Sussex County), 78 mph in Brick Township (Ocean County), 75 mph in Long Branch, 73 mph in Monmouth Beach, and 61 mph in Wall Township. Maximum sustained winds included 68 mph at Sandy Hook and 61 in Long Branch. Sandy was estimated to have caused $1.75billion in wind-related property damages alone in Monmouth County.

Heavy rain also occurred with Sandy. This made it easier for shallow rooted and leafed trees to be uprooted, it also complicated the tidal flooding. Event rainfall totals averaged 1 to 3 inches in the northern half of the state and 3 to 7 inches in the southern half of the state, except 6 to 12 inches along the southern tier counties of Salem, Cumberland, Cape May County as well as coastal Atlantic County. The steady rains associated with Sandy were from the 28th to the 30th throughout most of the state.

Probability of Occurrence – Hurricane and Tropical Storm

The probability of future hurricane and tropical storm events for Monmouth County is high. According to NOAA statistical data, Monmouth County is located in an area with an annual probability of a named storm between 18 and 24 percent (**Figure 3a.4**). This empirical probability is fairly consistent with other scientific studies and observed historical data made available through a variety of federal, state and local sources. According to the NOAA data on historical storm tracks, the annual probability of a hurricane or tropical storm coming within 75 miles of Monmouth County is 22 percent. Also, a recent study headed by Colorado State University's Dr. William Gray concluded that the probability of a named storm *making landfall* in the vicinity of Monmouth County is 13.2 percent. Occurrences are most likely during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in this basin is six. The probability of storm occurrences will vary significantly based on the return interval for different categories of magnitude. The probability of less intense storms (lower return periods) is higher than more intense storms (higher return periods). **Table 3a.7** profiles the potential peak gust wind speeds that can be expected in Monmouth County during a hurricane event for various return periods according to FEMA's HAZUS-MH® loss estimation methodology.

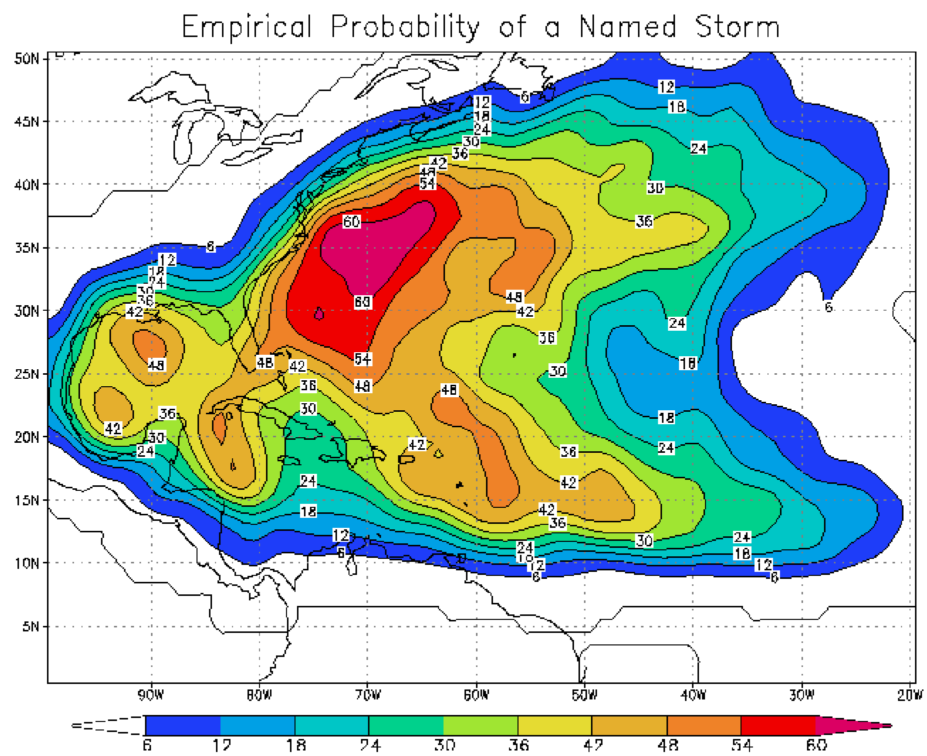
The frequency and intensity of coastal storms and severe weather events is expected to increase in the future due to climate change. In the years to come, it is anticipated that Monmouth County will observe drastic changes in storm character, intensity, frequency, and storm tracking. Hurricanes are likely to become more intense with rising sea water temperatures. Coastal erosion rates are likely to increase with rising sea-level, to levels higher than those rates that have been observed over the last century. Storm effects will be more extensive in the future. The following types of impacts can be anticipated in Monmouth County's future as a result of climate change and sea level rise: inundation of low-lying areas; increased frequency and extent of storm-related flooding; wetland loss; saltwater intrusion into estuaries and freshwater aquifers; land loss through submergence and erosion of lands in coastal areas; migration of coastal landforms and habitats; increased salinity in estuaries and coastal fresh; impacts to human populations (property losses, more frequent flood damage, more frequent flooding of roadways and urban centers, risks to people as the population of coastal areas increases); more buildings and infrastructure exposed; currently exposed buildings and infrastructure could be subject to potentially greater losses as water levels increase, and continued rapid coastal development exacerbates the impacts of sea level rise; impacts on gravity flow stormwater systems; impacts on non-coastal areas. Impacts of climate change and sea level rise can affect all parts of a community, including: transportation infrastructure (ports, marinas, airports, roads, bridges, railways); public infrastructure (stormwater and wastewater management systems, drinking water supply and distribution systems, power utility systems, communications systems); public facilities (i.e., police, fire, ambulance, hospitals, schools, daycare centers, adult living facilities, historic landmarks, government buildings, libraries, parks, etc.); economic viability of a community – particularly for communities where tourism tends to drive local economies, as is the case in many of Monmouth County's coastal communities. Climate change and sea level rise could lead to a potential loss of assets that support tourism (i.e., beaches themselves as well beach access points, lodging, restaurants, marinas, fishing habitats, ecotourism, etc.).

Table 3a.7
Peak Gust Wind Speeds versus Return Period for Monmouth County, NJ

10-Year	20-Year	50-Year	100-Year	200-Year	500-Year	1,000-Year
44 mph	63 mph	86 mph	102 mph	115 mph	132 mph	143 mph

Source: HAZUS-MH, MR2

Figure 3a.4
Empirical Probability of a Named Storm*



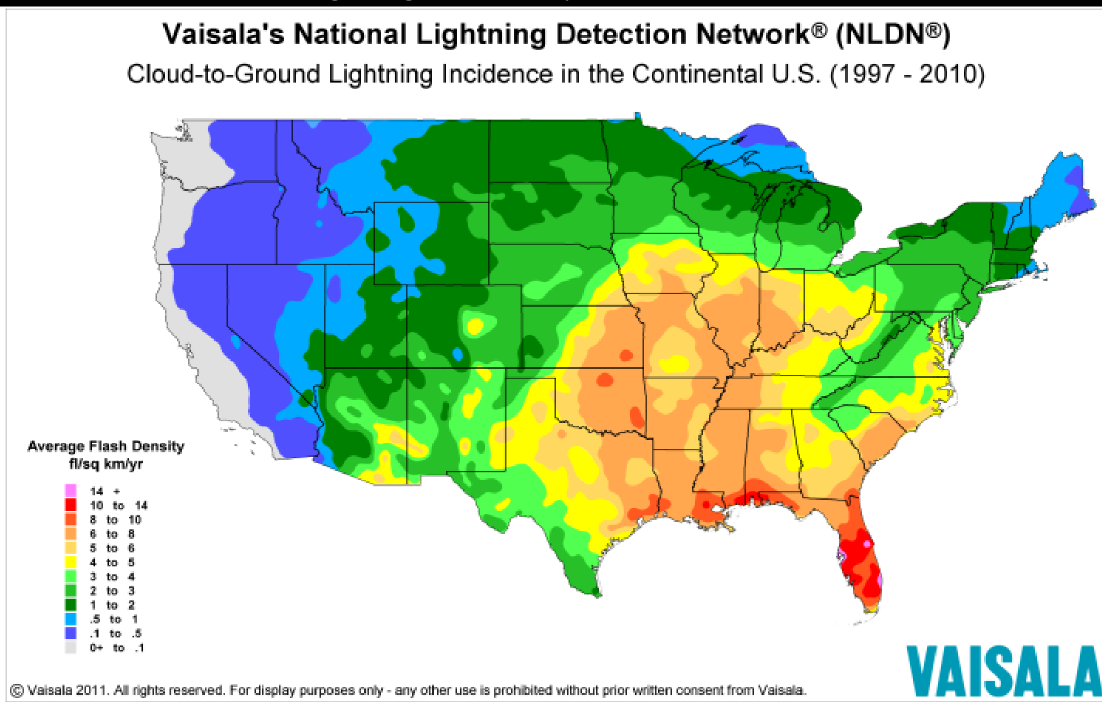
Source: NOAA

Lightning

Location and Extent – Lightning

Monmouth County is located in a region of the country that is susceptible to lightning strikes, though not as susceptible as southeastern states. **Figure 3a.4** shows a lightning flash density map for the years 1996-2000 based upon data provided by Vaisala's U.S. National Lightning Detection Network (NLDN®).

Figure 3a.4
Lightning Flash Density in the United States



Source: http://www.vaisala.com/Vaisala%20Documents/Scientific%20papers/2014%20ILDC%20ILMC/ILMC-Thursday/Roeder%20et%20al-Mapping%20Lightning%20Fatality%20Risk-2014-ILDC-ILMC.pdf

All areas of Monmouth County are equally susceptible to lightning strike. While lightning occurs randomly anywhere and anytime, the most common location for lightning fatalities and injuries to people is in open areas such as parks, beaches, golf courses and other recreational areas. Monmouth County remains susceptible to lightning deaths and injuries due to the large number of people who engage in outdoor activities, particularly more so along the shoreline of its coastal jurisdictions.

Historical Occurrences – Lightning

According to NCDC, 50 recorded lightning strike incidents have affected Monmouth County from May 1997 to September 2014. A total of 18 events have occurred since the last version of this plan was prepared. These incidents resulted in a reported total of seven deaths and 13 injuries, and caused an estimated $2.424 million in property damages. Some more notable events include the following:

> **September 15, 2000.** Lightning struck the communications tower of the Neptune Township Police Department, damaging the police radios, repeaters and dispatch consoles. All 911 calls were forwarded to the county center. The police operated from a backup communications center until normal operations resumed later in the evening. Damages were estimated at $40,000.

August 27, 2001. Lightning struck a three-story home in Upper Freehold Township. The four alarm fire totally destroyed the home and damages were estimated at $500,000.

July 11, 2002. A woman was fatally struck by lightning in Bradley Beach. She was found in distress on the beach with burn marks on the mid-section of her body before she died.

August 17, 2007. A severe thunderstorm caused two fatalities and an estimated $200,000 in damages across Monmouth County. A woman was struck by lightning as she was about to enter a restaurant on U.S. Route 9 North in Howell. She was pronounced dead about one hour later. A two-story home's roof was struck by a bolt of lightning in Middletown Township. A fire in the attic area caused moderate damage.

June 1, 2010. A 12-story condominium was evacuated for three days after a lightning strike struck one of the towers and knocked out the sprinkler system pump, which is needed to get water up to the twelfth floor in the event of a fire. Estimated damages were $10,000.

July 13, 2010. Two lightning strikes caused about 8,200 homes and businesses to lose power in Ocean Township. The lightning struck a power substation and a transformer around East Mall Drive and State Route 35. Damages were estimated at $5,000.

July 19, 2010. A line of strong to locally severe thunderstorms occurred. A man was struck and killed by lightning in Middletown while in contact with a tree and observing a house fire that was started by a previous lightning strike. Another man and a police officer were also injured by the same lightning strike. A lightning strike set the attic of a house on fire in Middletown Township. One firefighter was injured. Damages were estimated at $25,000.

September 16, 2010. Lightning struck the roof of an apartment building in Eatontown. About three apartments sustained fire damage and all units below them suffered water and smoke damage. Tenants from all twenty-four units were evacuated for at least one night. No injuries were reported. Damages were estimated at $100,000.

July 7, 2011. For the third time in 2011, the water treatment plant in Allentown Borough was struck by lightning. This lightning strike fried computerized controls and caused about an estimated $40,000 in damages.

August 14, 2011. A lightning strike and ensuing fire badly damaged a Maxim Road home in Howell. The fire started toward the rear of the home's attic and third floor and spread to the second floor before it was declared under control at 9 a.m. EDT. No serious injuries were reported but the fire was estimated to have caused $225,000 in damages.

August 21, 2011. An estimated $22,000 in damages was reported due to lightning strikes during this event. A lightning strike started an insulation fire at a home in Atlantic Highlands. Lightning struck a cable wire and traveled along it and ignited the home's insulation. No injuries were reported. Lightning struck the Monmouth County 911 radio tower in Freehold. A lightning strike to one of its water towers on Union Lane caused Brielle to declare an emergency on the 21st The lightning strike damaged electrical panels and also short circuited the entrance gate and a computer on the premises.

August 13, 2013. A complex of showers and thunderstorms produced wind damage and flash flooding. Cloud-to-ground lightning strikes peaked at 6,000 per hour as this complex moved through New Jersey. The thunderstorms caused about 14,500 homes and businesses to lose power on the 13th. A lightning strike at the Borough Hall in Manasquan caused damage and disrupted the communication systems in the borough. They were transferred to other facilities.

Other notable reports of historical lightning events include the following, as identified by the Planning Committee:

- The Borough of Bradley Beach has dealt with at least two significant lightning situations in recent years, one in which lightning struck the ocean in the vicinity of a swimmer who was killed, and the other was a lightning storm in which two houses were struck causing extensive damage.
- The Borough of Farmingdale’s Police Department radio tower was struck once and lost power (a portable field communications unit was mobilized to handle dispatch duties).
- The Borough of Highlands has experienced lighting storms, which have resulted in buildings being struck and damaged, trees being struck and knocked down thus blocking roadways and critical facilities (Borough Hall and Police Department) being struck and having computer and electrical equipment damaged/destroyed.
- The Borough of Keansburg’s Police Department radio tower has been struck by lightning twice.
- The Borough of Matawan Police Department Headquarters suffered a direct lightning strike in 2005 which resulted in the loss of power and all communication, including radio, telephone and computer equipment.
- The Township of Ocean has experienced numerous lightning events which caused several large trees to come down onto private property and cause extensive damage.
- The Borough of Oceanport had a police officer on traffic post during the summer struck during a lightning event. The lightning knocked him to the ground, but he suffered no serious injury.
- The Borough of Sea Bright has experienced lightning strikes in the past knocking out power stations and pumping (sewer) stations.
- The Township of Upper Freehold reports that from February 2000 to August 2007 records from the fire company show that lightning struck 15 houses (one of which burnt to the ground), plus numerous power poles and transformers and trees that endangered structures.

Probability of Occurrence – Lightning

The probability of occurrence for future lightning events in Monmouth County is certain. According to NOAA, Monmouth County is located in an area of the country that experiences three lightning flashes per square kilometer per year (approximately 2,300 flashes countywide per year). Given this regular frequency of occurrence, it can be expected that future lightning events will continue to threaten life and cause minor property damages throughout Monmouth County.

Nor’easter

Location – Nor’easter

Nor’easters threaten the entire Atlantic Coast of the United States, and while coastal areas are most directly exposed to the damaging forces of such storm systems their impact is often felt far inland. Monmouth County is located in an area that is extremely susceptible to nor’easters. All areas throughout the County are susceptible to the hazard effects of extreme wind, flooding and heavy snowfall. Monmouth County’s coastal jurisdictions are also extremely susceptible to the added effects of storm surge, wave action, coastal erosion and tidal flooding.[1]

Extent – Nor’easter

While there are a variety of indicators for nor’easter intensity, **Table 3a.8** describes the Dolan-Davis Nor’easter Intensity Scale which is based on coastal storm erosion, degradation and property damage.

[1] Distinct hazard area locations for coastal flooding, wave action and coastal erosion are discussed elsewhere in this section.

Table 3a.8
Dolan-Davis Nor'easter Intensity Scale

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 WEAK	Minor changes	None	No	No
2 MODERATE	Modest; mostly to lower beach	Minor	No	Modest
3 SIGNIFICANT	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 SEVERE	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community-scale
5 EXTREME	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: Federal Emergency Management Agency

Historical Occurrences – Nor'easters

Monmouth County has a lengthy history of devastating impacts wrought by nor'easters. This includes damages caused by the effects of extreme wind, heavy rain, snow, wave action, storm surge, coastal flooding and beach erosion (also addressed separately within this section).

One of the state's worst nor'easters occurred on March 6-8, 1962 when gale force winds (sustained of 45 miles per hour and gusts to 70 miles per hour) kept storm surges on shore for five successive high tides during a three-day period with a maximum tidal elevation of 7.8 feet at the Sandy Hook gage. During these tides, waves reached heights of 20 to 30 feet doing tremendous damage to dunes and coastal properties. The erosive effect of the storm reportedly changed the face of the shoreline, eroding some beaches entirely away, while also carving new channels and inlets in Monmouth County. Many inland areas were inundated as well, with hundreds of homes damaged or destroyed.

Other notable nor'easter events include the following:

> **November 25, 1950.** This nor'easter brought gale force winds and more than three inches of rainfall to the entire coastline of Monmouth County. A wind velocity of 70 miles per hour was recorded in the City of Long Branch. The gage at Sandy Hook recorded a maximum tidal elevation of 7.2 feet.
>
> **March 1984, October 1991 and January 1992.** Nor'easters in March 1984, October 1991, and January 1992 all caused severe beach and dune erosion, widespread damage to oceanfront roads, promenades and boardwalks, as well as extensive flooding to coastal and riverine areas. These storm events coincided with astronomically high tides, which worsened the flooding, erosion and associated damages.
>
> **December 1992.** The nor'easter of **December 1992** was the harshest New Jersey storm since 1962, in terms of both damage and weather conditions. The storm caused extreme coastal flooding and extensive beach erosion. Tide heights ranged from a little over 9 feet above mean low water along the ocean front, to an estimated 10 feet above mean low water on some back bays, which is four to five feet above normal. The storm resulted in destruction of public property including debris-ridden roadways, beach erosion, collapsed public facilities, boardwalks and damage to storm drainage facilities. Private properties were also pummeled by the storm; some of these properties were rendered uninhabitable.

According to NCDC, 18 nor'easters have affected Monmouth County since 1993. Some notable events include the following:

> **March 12-13, 1993.** According to the National Weather Service, this "Storm of the Century" was an extremely intense nor'easter which impacted New Jersey with a wide variety of hazardous weather. It was one of the most powerful storms (tropical or extratropical) on record to hit New Jersey, having a record low

minimum central pressure of 961 millibars at almost the same time as it passed over New Jersey. Accumulations ranged from three to six inches on the southeastern sections, six to 14 inches in east central and southwestern sections, 10 to 18 inches in west central and northeastern sections, and 15 to 26 inches in northwestern sections. Winds were sustained at 30 to 45 mph, with gusts to 75 mph (hurricane force) measured in Cape May. Moderate coastal flooding occurred the morning of the 13th as a result of the high winds, tides and pounding surf, with waves of six to eight feet above high tide levels. Tide levels reached seven to 7.5 feet above mean low water in the back bays.

February 4, 1998. The strongest nor'easter of the winter season battered coastal New Jersey. Monmouth County was spared by the eastward movement of the nor'easter off of Cape Hatteras, experiencing moderate to severe beach erosion due to the continuous onshore flow. Two to four feet of beach were lost in most areas. At Sandy Hook, tides measured 3.2 feet above normal and about 80 percent of the new sand placed in a replenishment project was lost as several hundred feet of beach disappeared. Both Bradley Beach and Ocean Grove were hard hit by erosion. The waves washed sand onto Ocean Avenue in Bradley Beach. State Route 36 was flooded in Sea Bright. In Middletown, Raritan Bay tidal flooding closed roads.

February 24, 1998. Another strong nor'easter brought very strong winds and coastal flooding to the New Jersey Shore. But, unlike the previous nor'easter, the worst conditions affected Monmouth County. Tidal departures averaged around three feet above normal. A breach in the sea wall occurred in Allenhurst. Flooding forced the closure of New Jersey State Routes 35 and 36 in Keyport, Ocean Avenue in Sea Bright and the entrance road to Sandy Hook, as well as several roads along the bay side of Sea Bright. Wind gusts reached as strong as 61 mph in Ocean Grove.

October 16, 2002. A strong nor'easter caused tidal flooding along the New Jersey coast and in the back bays, gusty winds and beach erosion. Tides, winds and erosion were worse in Ocean and Monmouth counties than farther south. Two downed trees damaged a home in Wall Township. Peak wind gusts included 49 mph winds in Keansburg and 47 mph winds at Sandy Hook. Streets were knee deep in water in Sea Bright. Water spilled over the docks along the Shark River and also in Manasquan. Several roads were flooded in Manasquan, and the Glimmer Glass Bridge was left in the open position. Tides reached seven feet above mean low water at Sandy Hook and six feet above average tide levels in Sea Bright.

December 5-6, 2003. A nor'easter dropped heavy snow across much of New Jersey. Many municipalities declared snow emergencies to help clear the roads for plowing. A man died in Millstone Township after his vehicle left the westbound lanes of Interstate 195 and struck a tree. Specific snow accumulations included 15 inches in Clarksburg, 12.8 inches in Cream Ridge, and 11.5 inches in Oakhurst.

March 15-17, 2007. Strong to high winds along coastal areas with heavy rain and snowfall and minor tidal flooding occurred as a result of the nor'easter. Precipitation started as rain on the evening of the 15th, and changed over quickly to snow. Storm totals averaged 1.5 to 3.0 inches across southeast New Jersey, 2 to 6 inches across much of central New Jersey (including Monmouth County) and 6 to 12 inches across northwestern New Jersey. High winds caused a few scattered power outages. Heavy rains that preceded the snow resulted in minor flooding. Minor tidal flooding occurred with the evening high tide on the 16th including 6.89 feet above mean lower low water at Sandy Hook. Motor vehicle accidents were widespread. Two people were injured after their vehicle struck a pole on State Route 36 in Middletown. In Highlands, on the same route, five people were injured in a three vehicle accident.

April 15-16, 2007. Statewide damage was estimated at $180 million dollars. NOAA NCDC damage records indicate $1 million dollars of damages in Monmouth County associated with this system. At the time, it was the second worst rain storm (not related to a hurricane) in the state's history. Widespread minor tidal flooding with pockets of moderate tidal flooding occurred along Delaware Bay, Raritan Bay and the Atlantic Ocean. It also caused beach erosion. The worst reported tidal flooding occurred in Monmouth County where tidal flooding occurred for up to three high tide cycles. The combination of the run-off from the heavy rain and the tides caused many roads to flood including State Roads 35 and 36. Municipalities affected by tidal and roadway flooding included Aberdeen, Belford, Belmar, Hazlet, Manasquan, Middletown, Port Monmouth, Sea Bright and Union Beach. In an effort to reduce tidal flooding, water was pumped from Lake Como in Belmar. On the beaches themselves, vertical cuts to the beaches averaged 2 to 4 feet, but reached as high as 6 feet in Sea Bright, Deal and Asbury Park. Cuts to the dune systems themselves occurred in Deal, Long

Branch, Monmouth Beach and Sea Bright. The horizontal dune cut in Sea Bright reached 1500 feet. The highest tides included 8.13 feet above mean lower low water at Sandy Hook (Monmouth County) on the morning of the 16th. Minor tidal flooding starts at 6.7 feet above mean lower low water and moderate tidal flooding starts at 7.7 feet above mean lower low water. The heavy rain also closed roadways inland in Monmouth County in Brielle, Howell, Manasquan and Middletown. In Wall Township, the Allenwood-Lakewood Bridge was closed. Precipitation totals included 3.64 inches in Keansburg, 3.00 inches in Oceanport, 2.45 inches in Sea Girt, 2.38 inches in Manasquan, and 2.32 at Belmar Airport. The combination of the heavy rain, even some snow and the winds helped knock down numerous trees and power lines. Peak wind gusts averaged between 40 and 60 mph.

October 15-19, 2009. A pair of nor'easters caused minor to moderate tidal flooding along the ocean from the evening high tide of the 15th into the morning high tide of the 19th. Heavy surf contributed to and exacerbated erosion along the coast. Several major roadways were flooded and closed. In Monmouth County, roadways were closed in Monmouth Beach, Sea Bright and Manasquan. Peak wind gusts reached around 45 mph from Monmouth County southward. A few trees were knocked down in Monmouth County.

November 12-14, 2009. A powerful nor'easter produced wind gusts to nearly 60 mph, widespread moderate tidal flooding, heavy rain and severe beach erosion along the New Jersey coast. By several measures this was one of the worst nor'easters to affect New Jersey since 1990. The Dolan Davis Nor'easter power ranking for Long Island Buoy 44025 ranked it 4th strongest nor'easter to affect New Jersey since 1990, and the strongest since March of 1994. The Miller Storm Erosion Index and the Kraus and Wise Maximum Wave Run-up Index were both ranked second only to December 1992 nor'easter. The highest winds occurred from the afternoon of the 12th into the afternoon of the 13th. Several thousand people lost power. The heaviest rain fell on the 12th. The highest tides in Monmouth County occurred with the morning high tide on the 14th. Those were the highest tides in central and southern New Jersey since either 1998 or 1996. Tidal departures reached up to four feet. Governor Jon Corzine declared a state of emergency in Atlantic, Burlington, Cape May, Cumberland, Ocean and Monmouth Counties on November 15th. More than $500,000 in damages was reported by NOAA in Monmouth County.

Other notable reports of historical nor'easter events include the following, as identified by the Planning Committee:

- The Township of Aberdeen has experienced significant beach erosion caused by past nor'easter events.
- The Borough of Atlantic Highlands suffered more than $4 million in damages from the 1992 nor'easter, not including damages to private boats. Repairs to local infrastructure took two years to complete.
- The Borough of Avon-By-The-Sea reportedly experienced the most severe damage in the past 40 years during the 1992 nor'easter event.
- The Borough of Bradley Beach has been victim to several nor'easters over the years, which have caused extensive destruction and beach erosion.
- The Borough of Deal cites that annual storm events cause flooding of Poplar Brook and beach erosion.
- The Borough of Fair Haven indicated that power outages lasted up to six days during the 1992 event.
- The Borough of Little Silver reported that the 1992 event was devastating, and resulted in an 11-foot storm surge for the area.
- The Borough of Manasquan's local records indicate that the 1992 nor'easter brought the highest tide of recent memory, with an approximate tide height of 5 feet above average.
- The Township of Marlboro has had issues with power outages, localized flooding, and significant snow storms causing lengthy disruptions of service to the community as well as limiting the public's ability to travel and commute.
- The Borough of Matawan has experienced minor flooding and other effects from nor'easters, but no major damages to date.
- The Borough of Neptune City has had numerous nor'easters affect the area, with most of the damage attributed to downed power lines and trees as well as flooding from the Shark River.
- The Township of Neptune had beach erosion during the 1992 nor'easter, and the Ocean Grove area lost portions of the boardwalk and had localized flooding. Evacuations were conducted along the North Island/South Concourse area due to flooding. In the Shark River Hills area, there was localized flooding, road closures, and property damage.

- The Township of Ocean reports that nor'easters have caused extensive damage throughout the township between the years 2000 and 2005.
- The Borough of Sea Girt has experienced flooding, beach erosion and major property damage associated with nor'easter events. The 1992 event caused major infrastructure damage along Ocean Avenue and the boardwalk.
- The Borough of Union Beach indicated that severe storm impacts were felt in the area following the 1992 nor'easter event.
- The Township of Upper Freehold reports that approximately $10,000 was spent on debris removal and emergency response associated with the 1992 event. Damages and impacts included road obstructions, flash flooding, downed utilities, and the destruction of a communications tower. Another nor'easter event in April 2007 caused flooding to roads and private property.
- The Borough of West Long Branch indicated that some minor flood damage has occurred as a result of past nor'easters.

Probability of Occurrence – Nor'easters

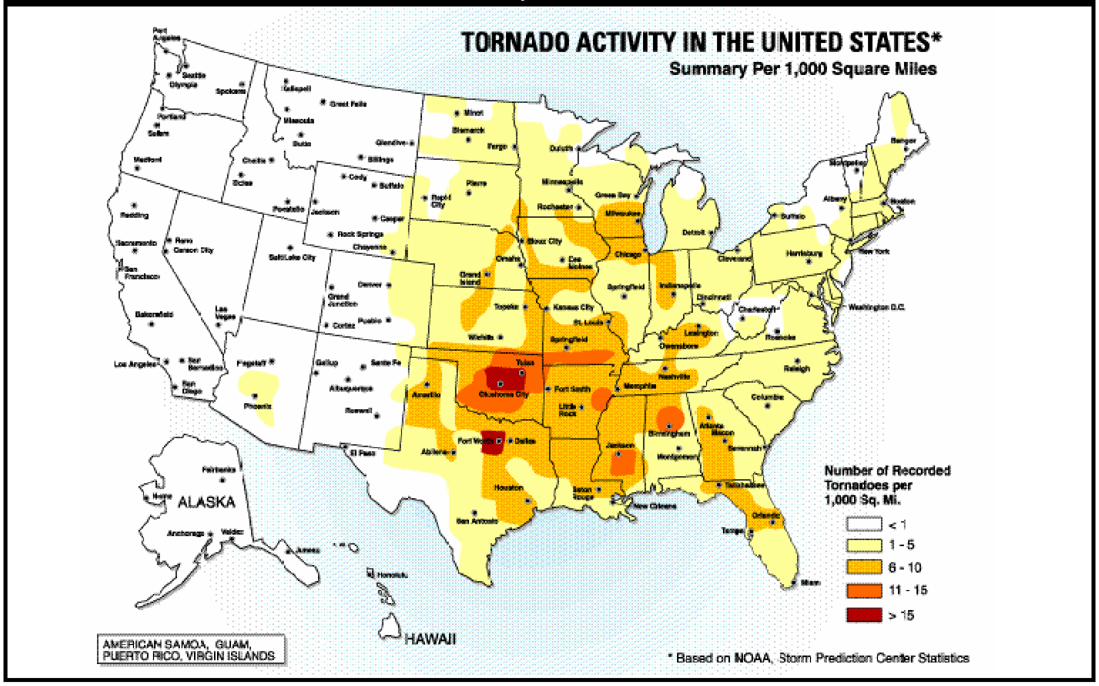
Nor'easters will continue to have a high probability of occurrence for Monmouth County, and the probability of future occurrences affecting all of Monmouth County's jurisdictions is certain. The frequency and intensity of coastal storms and severe weather events is expected to increase in the future due to climate change. In the years to come, it is anticipated that Monmouth County will observe drastic changes in storm character, intensity, frequency, and storm tracking. Hurricanes are likely to become more intense with rising sea water temperatures. Coastal erosion rates are likely to increase with rising sea-level, to levels higher than those rates that have been observed over the last century. Storm effects will be more extensive in the future. The following types of impacts can be anticipated in Monmouth County's future as a result of climate change and sea level rise: inundation of low-lying areas; increased frequency and extent of storm-related flooding; wetland loss; saltwater intrusion into estuaries and freshwater aquifers; land loss through submergence and erosion of lands in coastal areas; migration of coastal landforms and habitats; increased salinity in estuaries and coastal fresh; impacts to human populations (property losses, more frequent flood damage, more frequent flooding of roadways and urban centers, risks to people as the population of coastal areas increases); more buildings and infrastructure exposed; currently exposed buildings and infrastructure could be subject to potentially greater losses as water levels increase, and continued rapid coastal development exacerbates the impacts of sea level rise; impacts on gravity flow stormwater systems; impacts on non-coastal areas. Impacts of climate change and sea level rise can affect all parts of a community, including: transportation infrastructure (ports, marinas, airports, roads, bridges, railways); public infrastructure (stormwater and wastewater management systems, drinking water supply and distribution systems, power utility systems, communications systems); public facilities (i.e., police, fire, ambulance, hospitals, schools, daycare centers, adult living facilities, historic landmarks, government buildings, libraries, parks, etc.); economic viability of a community – particularly for communities where tourism tends to drive local economies, as is the case in many of Monmouth County's coastal communities. Climate change and sea level rise could lead to a potential loss of assets that support tourism (i.e., beaches themselves as well beach access points, lodging, restaurants, marinas, fishing habitats, ecotourism, etc.).

Tornado

Location – Tornado

Monmouth County is located in an area that is susceptible to tornados, though their occurrence is not nearly as frequent or intense as it is in other regions of the country. Of the roughly five tornadoes that touch down in New Jersey each year, most tend to be of low magnitude (from EF0 to EF2) and typically impact only relatively small areas. **Figure 3a.5** shows tornado activity in the United States based on the number of recorded tornadoes per 1,000 square miles. Tornadoes are completely random and it is not possible to predict specific tornado hazard areas. Tornadoes can occur anywhere, and no one location is more susceptible than another. All of Monmouth County is uniformly exposed.

Figure 3a.5
Tornado Activity in the United States



Source: Federal Emergency Management Agency

Extent – Tornado

Table 3a.9 shows the Enhanced Fujita Scale for Tornadoes which was developed to measure tornado strength and associated damages.

Table 3a.9
Enhanced Fujita Scale for Tornadoes

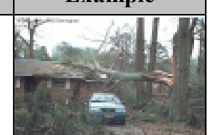
Storm Category	Damage Level	3 Second Gust (mph)	Description of Damages	Photo Example
EF0	LIGHT	65–85	Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.	
EF1	MODERATE	86–110	Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.	
EF2	SIGNIFICANT	111–135	Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; highrise windows broken and blown in; light-object missiles generated.	

Table 3a.9
Enhanced Fujita Scale for Tornadoes

Storm Category	Damage Level	3 Second Gust (mph)	Description of Damages	Photo Example
EF3	SEVERE	136–165	Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.	
EF4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.	
EF5	INCREDIBLE	200+	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 m (109 yd); trees debarked; steel reinforced concrete structures badly damaged.	

Source: National Oceanic and Atmospheric Administration; Federal Emergency Management Agency

The tornadoes associated with tropical cyclones are most frequent in September and October when the incidence of tropical storm systems is greatest. This type of tornado usually occurs around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction.

Historical Occurrences – Tornado

According to NCDC, there have been nine recorded tornado events in Monmouth County between 1950 and September 2014. One of these has occurred since the last version of the plan was prepared. Most of these events were determined to be of minimal tornado intensity, as shown in **Table 3a.10**. These events resulted in no recorded deaths or injuries, but did cause an estimated $1.525 million in property damages, with the most severe event being an F2 tornado that touched down in northern Manalapan Township and extreme southwest Marlboro Township in May 2001 that caused an estimated $1M in damages.

Table 3a.10
Historical Tornadoes in Monmouth County (Since 1950)

Location	Date	Magnitude	Deaths	Injuries	Property Damage
Millstone, Township of	08/10/1952	F1	0	0	$25,000
Tinton Falls, Borough of	10/16/1955	F2	0	0	$0
Upper Freehold, Township of	04/18/1960	F1	0	0	$0
Howell, Township of	03/10/1964	F1	0	0	$250,000
Neptune, Township of	03/26/1964	F0	0	0	$25,000
Loch Arbour, Village of	11/01/1994	F0	0	0	$75,000*
Middletown, Township of / Highlands, Borough of	08/13/1997	F0	0	0	$50,000
Gordons Corner (northern Manalapan/ southwest Marlboro)	05/27/2001	F2	0	0	$1,000,000
Millstone, Township of	08/09/2011	EF0	0	0	$100,000
		Total	**0**	**0**	**$1,525,000**

Source: National Climatic Data Center
** Note: the Village of Loch Arbour indicated that damages were closer to $200,000 for this event.*

Notable events include the following:

November 1, 1994. A tornado briefly touched down in the Village of Loch Arbour around 6 p.m. at the intersection of Euclid and Edgemont Avenues. The tornado lifted between Spier and Corlies Avenue about 100 yards from the Atlantic Ocean. About five homes on Euclid Avenue suffered substantial roof damage. Most of the eight other homes which sustained minor damage were on Buena Vista Court. About two dozen trees were uprooted. Most of them were decaying within. Tops were sheared off a number of other trees. Damage was estimated by the NCDC at $75,000; however, the Village indicated that damages were closer to $200,000 for this event.

August 13, 1997. A F0 tornado touched down briefly in Middletown Township and Highlands Borough before it went into Sandy Hook Bay and dissipated. The path length was about 1.2 miles and the path width about 75 yards. The tornado damaged several cars and homes, and uprooted and/or snapped numerous trees, but no injuries were reported. The tornado touched down in northeastern Middletown Township near Pape Drive and Navesink Avenue, moving northeast where it uprooted a tree on Williams Street that crushed three parked cars. Another car was burned when it came in contact with downed wires on Buttermilk Valley Road. A tree also crushed an awning in the Shadow Lane Mobile Home Park. In Highlands Borough, a shed was blown off its foundation and carried by the tornado between two houses. Other structural damage was mainly confined to broken windows, torn shingles and gutters. Maximum wind speeds were estimated at the high end of the F0 scale at about 70 mph.

May 27, 2001. An F2 tornado struck extreme northern Manalapan and extreme southwest Marlboro Townships. The tornado's path length was estimated at 1.5 miles and its path width was around 200 feet. It was initially a relatively weak tornado (F0), but intensified into an F1 before it reached Kentucky Court in Manalapan Township. One property on Kentucky Court lost dozens of trees. The tornado also downed trees on Ivanhoe and Rowena Roads. The tornado reached its maximum strength (F2) as it passed through Debracy Court, where the worst damage occurred. Four houses were severely damaged, and about 12 others suffered minor damage. The tornado weakened to an F1 after it left Debracy Court. As the tornado crossed into Marlboro Township, it knocked down dozens of trees in Hawkins Road Park. As the tornado exited the park, it weakened to an F0. It still knocked a tree onto a house on MacLeisch Drive and ripped shingles and gutters from homes on Guest and MacLeisch Drives. The tornado lifted as it approached Barclay Brook.

August 9, 2011. An EF0 tornado touched down in Millstone Township in Monmouth County. The tornado initially touched down north of Buono Farm and tracked northeast where it crossed New Jersey State Route 33 and damaged a flag pole and business fencing. A barn was damaged on Prodelin Way. Numerous trees and some wires were knocked down along its path, especially on Prodelin and Arrowhead Ways and Bergen Mills Road. The tornado moved along Arrowhead Way before it lifted. The tornado's approximate path length was 1.7 miles, maximum path width of 50 yards and estimated maximum wind speed of 70 mph. No deaths or injuries were reported, though property damages were estimated at $100,000.

Table 3a.11 lists the number of tornado events in Monmouth County by municipal jurisdiction and by their estimated magnitude. As tornado events might impact multiple jurisdictions, the total number of events in this table is greater than the number of records provided by NCDC based on detailed information regarding impacted areas. The specific location of reported touchdown occurrences for each of these events in Monmouth County (where known) is shown in **Figure 3a.6**.

Table 3a.11
Historical Tornadoes in Monmouth County (1950-2011), By Jurisdiction

Jurisdiction	Number of Events	Magnitude (Enhanced Fujita Scale)						Maximum F Scale
		EF0	EF1	EF2	EF3	EF4	EF5	
Aberdeen, Township of	0	0	0	0	0	0	0	*Not applicable*
Allenhurst, Borough of	0	0	0	0	0	0	0	*Not applicable*
Allentown, Borough of	0	0	0	0	0	0	0	*Not applicable*
Asbury Park, City of	0	0	0	0	0	0	0	*Not applicable*
Atlantic Highlands, Borough of	0	0	0	0	0	0	0	*Not applicable*

Table 3a.11 Historical Tornadoes in Monmouth County (1950-2011), By Jurisdiction								
Jurisdiction	**Number of Events**	**Magnitude (Enhanced Fujita Scale)**						**Maximum F Scale**
		EF0	**EF1**	**EF2**	**EF3**	**EF4**	**EF5**	
Avon-By-The-Sea, Borough of	0	0	0	0	0	0	0	*Not applicable*
Belmar, Borough of	0	0	0	0	0	0	0	*Not applicable*
Bradley Beach, Borough of	0	0	0	0	0	0	0	*Not applicable*
Brielle, Borough of	0	0	0	0	0	0	0	*Not applicable*
Colts Neck, Township of	0	0	0	0	0	0	0	*Not applicable*
Deal, Borough of	0	0	0	0	0	0	0	*Not applicable*
Eatontown, Borough of	0	0	0	0	0	0	0	*Not applicable*
Englishtown, Borough of	0	0	0	0	0	0	0	*Not applicable*
Fair Haven, Borough of	0	0	0	0	0	0	0	*Not applicable*
Farmingdale, Borough of	0	0	0	0	0	0	0	*Not applicable*
Freehold, Borough of	0	0	0	0	0	0	0	*Not applicable*
Freehold, Township of	0	0	0	0	0	0	0	*Not applicable*
Hazlet, Township of	0	0	0	0	0	0	0	*Not applicable*
Highlands, Borough of	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**EF0**
Holmdel, Township of	0	0	0	0	0	0	0	*Not applicable*
Howell, Township of	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**EF1**
Interlaken, Borough of	0	0	0	0	0	0	0	*Not applicable*
Keansburg, Borough of	0	0	0	0	0	0	0	*Not applicable*
Keyport, Borough of	0	0	0	0	0	0	0	*Not applicable*
Lake Como, Borough of	0	0	0	0	0	0	0	*Not applicable*
Little Silver, Borough of	0	0	0	0	0	0	0	*Not applicable*
Loch Arbour, Village of	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**EF0**
Long Branch, City of	0	0	0	0	0	0	0	*Not applicable*
Manalapan, Township of	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**EF2**
Manasquan, Borough of	0	0	0	0	0	0	0	*Not applicable*
Marlboro, Township of	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**EF2**
Matawan, Borough of	0	0	0	0	0	0	0	*Not applicable*
Middletown, Township of	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**EF0**
Millstone, Township of	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**EF1**
Monmouth Beach, Borough of	0	0	0	0	0	0	0	*Not applicable*
Neptune City, Borough of	0	1	0	0	0	0	0	*Not applicable*
Neptune, Township of	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**EF0**
Ocean, Township of	0	0	0	0	0	0	0	*Not applicable*
Oceanport, Borough of	0	0	0	0	0	0	0	*Not applicable*
Red Bank, Borough of	0	0	0	0	0	0	0	*Not applicable*
Roosevelt, Borough of	0	0	0	0	0	0	0	*Not applicable*
Rumson, Borough of	0	0	0	0	0	0	0	*Not applicable*
Sea Bright, Borough of	0	0	0	0	0	0	0	*Not applicable*
Sea Girt, Borough of	0	0	0	0	0	0	0	*Not applicable*
Shrewsbury, Borough of	0	0	0	0	0	0	0	*Not applicable*
Shrewsbury, Township of	0	0	0	0	0	0	0	*Not applicable*
Spring Lake, Borough of	0	0	0	0	0	0	0	*Not applicable*
Spring Lake Heights, Borough of	0	0	0	0	0	0	0	*Not applicable*
Tinton Falls, Borough of	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**EF2**
Union Beach, Borough of	0	0	0	0	0	0	0	*Not applicable*
Upper Freehold, Township of	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**EF1**
Wall, Township of	0	0	0	0	0	0	0	*Not applicable*
West Long Branch, Borough of	0	0	0	0	0	0	0	*Not applicable*
Total	**11**	**5**	**3**	**3**	**0**	**0**	**0**	**EF2**

Source: National Climatic Data Center

Other notable reports of historical tornado events include the following, as identified by the Planning Committee:

- The Village of Loch Arbour indicated that the F0 tornado reported in 1994 resulted in property damages totaling $200,000.
- The Township of Upper Freehold reported that property damages associated with its one historic event included damage to communications antennas, schools, and horse and agricultural farms.

Probability of Occurrence – Tornado

It is likely that Monmouth County will continue to experience weak to moderate tornado events, though their frequency of occurrence will be fairly low. Probability data made available through NOAA's National Severe Storms Laboratory (NSSL) indicate that Monmouth County is in an area that experiences less than one tornado event per year. Historical storm data made available through NCDC confirm this data (nine confirmed events in 59 years, resulting in an estimated annual probability of a tornado event of 15 percent). In New Jersey, tornadoes are more likely to occur during the months of March through August and tend to form in the late afternoon and early evening.

[redacted]

Winter Storm

Location – Winter Storm

Nearly the entire continental United States is susceptible to winter storms, but the degree of exposure typically depends on the normal expected severity of local winter weather. Monmouth County is accustomed to severe winter weather conditions and is prepared for the potential disruptions they might cause, though intense winter storms might still overwhelm local capabilities. While Monmouth County is located south of the typical boundary between freezing and non-freezing precipitation during wintertime, annual snowfall on a countywide basis averages 25 to 26 inches and the maximum recorded seasonal snowfall is 70 inches (1957-1958). All areas throughout the County are susceptible to the hazard effects of winter storms including snow and ice, and Monmouth County's coastal jurisdictions are also extremely susceptible to the added effects of storm surge, wave action, coastal erosion and tidal flooding that might be wrought by nor'easters.[2]

Extent – Winter Storm

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (i.e., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified by meteorological measurements and by evaluating its societal impacts. 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 United States. The RSI ranks snowstorm impacts on a scale from one to five. It is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population (based on the 2000 Census). The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA-NCDC 2011). **Table 3a.12** presents the five RSI ranking categories.

Table 3a.12
Regional Snowfall Index 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+

Historical Occurrences – Winter Storm

According to NCDC, 136 recorded winter storm events (classified as: blizzard, heavy snow, ice storm, sleet, winter storm, winter weather) have affected Monmouth County between January 1996 and September 2014. These incidents resulted in no reported deaths or injuries in Monmouth County, but are associated with approximately $5 million in property damages. Notable events include the following:

January 6-8, 1996. The Blizzard of 1996 brought record breaking snow to most of New Jersey and paralyzed the region for several days, caused most municipalities to exceed their annual snow budgets during this one storm. A state

[2] Nor'easters and their hazard effects are discussed separately within this section.

of emergency was declared by Governor Whitman, which lasted a week. The state was also declared a federal disaster area. Snowfall accumulations averaged 20 to 30 inches in Monmouth County, with 30 inches in Howell and 28 inches in Freehold. In addition to the heavy snow, wind gusts reached hurricane force along the coast. Eight housing additions in Manasquan collapsed. Navigation Tower aides at Manasquan were toppled. Many areas lost power. Evacuations of some coastal residents occurred in Belmar, Port Monmouth, Sea Bright and Manasquan. Street flooding was reported in these areas and also in Avon. In Sea Bright, flooding from the Shrewsbury River exacerbated the flooding. State Route 36 was closed from the Highlands/Sea Bright Bridge through Monmouth Beach. The worst damage along the coast was the erosion.

February 16-17, 2003 (President's Day Storm). The most powerful storm to affect New Jersey since the Blizzard of 1996 struck during the President's Day Weekend. Governor McGreevey declared a state of emergency, and many municipalities declared their own snow emergencies. In Monmouth County, drifts reached six feet. In Wall, a high school roof collapsed on the 18th because of four foot drifts at one corner of the roof. A country store was badly damaged in Freehold. The National Guard was deployed to assist with evacuations. The strong winds caused about 11,000 homes and businesses to lose power. Monmouth Beach was hit the hardest by power outages, waiting two days for power to be restored. Peak wind gusts included 49 mph in Keansburg and snow accumulations included 22.8 inches in Cream Ridge, 22 inches in Hazlet, 21 inches in Manalapan, and 20.5 inches in Wall.

January 22, 2005. A very potent Alberta low pressure system dropped heavy snow across northern and southwestern New Jersey and a wintry mix across southeastern New Jersey. Governor Codey declared a state of emergency, requiring vehicles 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. The unseasonably cold weather also rendered the salt less effective. Snow emergencies were declared by many municipalities. Specific snowfall accumulations included 17 inches in Howell and 16.5 inches in Cream Ridge.

February 14, 2007 (Valentine's Day Storm). A severe winter storm impacted the Ohio Valley before moving northeast over New England. Monmouth County experienced a severe icing, with 0.5 inches of ice accumulation reported at Tinton Falls. Peak wind speeds ranged from 36 to 48 mph. Cream Ridge recorded 3.2 inches of total precipitation, which was all sleet. Numerous trees were downed and extensive power outages plagued the area.

December 26, 2010. A major and for parts of eastern New Jersey record breaking winter storm and blizzard affected the state on Sunday the 26th and Monday the 27th. A state of emergency was declared in New Jersey. The heavy snow bands and blizzard conditions resulted in snowfall rates of two to three inches per hour at times. Strong to high winds continued to hamper snow plow operations through the 27th. Bus service was suspended throughout the state as of 830 p.m. on the 26th and did not resume until the 28th. While the overall number of accidents was low, about 2,300 motorists were stranded on average for 10 to 12 hours. The Red Cross opened shelters in the eastern part of the state. In addition, stranded motorists used town halls, rest stops and movie theaters as shelters. Blood supplies ran low. Trash schedules were delayed about a day and recycling schedules were delayed up to one week. Monmouth County was one of the counties that were most affected by the blizzard as many roadways were closed and remained closed through the 27th because of drifting. An eleven mile stretch of State Route 18 remained closed for a couple of days. The weight of the snow caused a roof collapse at the

Naval Weapons Station Earle in Colts Neck. An overturned vehicle in Tinton Falls resulted in an injury. A train struck an abandoned vehicle in Red Bank, but no injuries were caused. Closed malls in Monmouth County did not open until the 28th at the earliest. The Sea Streak Manhattan Ferry service from Monmouth County ran on a modified schedule on the 27th. Athletic competitions were either postponed or cancelled. Major roadways such as Interstate 195 (8 foot drifts) and New Jersey State Routes 18, 35, 36, 66 and 138 were closed into the 27th. Long Branch emergency personnel alone responded to about 700 calls. This was a new single snowstorm record surpassing the previous record of 20.0 inches during the President's Day snowstorm of February 2003. Representative snowfall included 25.0 inches in Colts Neck, 24.0 inches in Neptune, 22.0 inches in Red Bank and 20.0 inches in Holmdel. At Sandy Hook, the high tide reached 7.13 feet above mean lower low water. Minor tidal flooding starts at 6.7 feet above mean lower low water.

November 7-8, 2012. A strong nor'easter caused high winds, heavy snow, and damaging waves and minor tidal flooding days after Hurricane Sandy, causing setbacks in the start of many local restoration efforts and forced evacuations of some coastal areas yet again. Unfortunately the heaviest snow fell in the counties that were affected the hardest by Sandy and upwards of an additional 150,000 customers lost power. The combination of heavy snow and wind brought down additional trees, poles and wires. Representative snowfall included 13.0 inches in Freehold, 12.0 inches in Allaire, 11.0 inches in Howell, and 6.0 inches in Oakhurst.

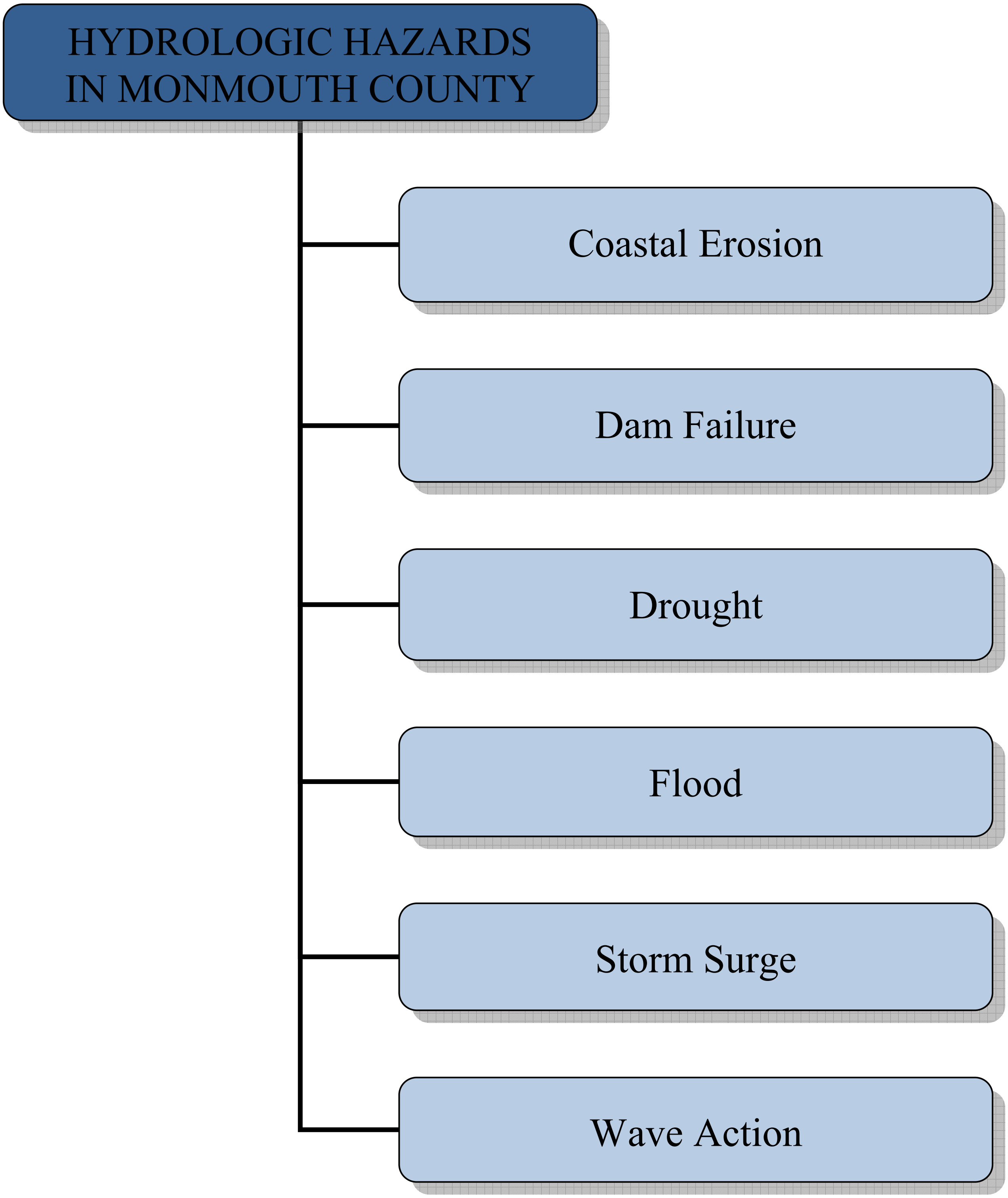
Other notable reports of historical winter storm events include the following, as identified by the Planning Committee:

- The Township of Aberdeen was affected by the Blizzard of 1996, as well as severe snowstorms in 2003, 2005 and 2006. The Township incurred substantial costs related to emergency protective measures, snow removal, etc.
- The Borough of Avon-By-The-Sea reported that winter storms have been the most common occurrence resulting in disaster declarations for their jurisdiction in the past few years.
- The Borough of Brielle indicated that the most severe winter storms affecting Brielle are usually coastal/nor'easter events, during which the Borough experiences minor to moderate coastal flooding. The other major concern is power outages due to snow laden trees/branches falling on power lines.
- The Borough of Fair Haven reported that the Valentine's Day Storm of 2007 caused power outages that lasted for several days.
- The Township of Ocean was heavily impacted by the Valentine's Day Storm of 2007 which paralyzed a section of town by fallen trees across roadways and downed power/phone lines, which caused the evacuation of several hundred residents.
- The Borough of Oceanport indicated that the Valentine's Day Storm of 2007 had a big impact on all areas. Major cleanup lasted over a month and some areas went without power for 12 to 18 hours.
- The Borough of Shrewsbury was heavily affected by the ice storm of February 2007, which caused three days of power outage for 90 percent of the area's homes and businesses, and up to seven days for several dozen homes. It also caused damage to three private homes.

Probability of Occurrence – Winter Storm

Winter storm events will continue to have a high probability of occurrence in Monmouth County, and the probability of future occurrences in Monmouth County is certain. While the impact of snow and ice storms will cause major disruptions to transportation, commerce and electrical power as well as significant overtime work for government employees, large scale property damages and/or threats to human life and safety are not expected. Nor'easters occur less frequently but represent a much greater hazard of concern as it relates to the impacts of winter storm events (addressed separately within this section). Winter storms typically occur in New Jersey from late November through mid-April, with peak months being December through March. Nor'easters are one type of severe winter storm that typically bring high winds, coastal surge and tidal flooding along with heavy precipitation, which are addressed separately within this section.

HYDROLOGIC HAZARDS



Coastal Erosion

Location – Coastal Erosion

All of Monmouth County's coastal jurisdictions are susceptible to the coastal erosion hazard. Following a review of historic shoreline data dating back to 1836 provided by the New Jersey Department of Environmental Protection (NJDEP), it is clear that Monmouth County has experienced significantly changing shorelines (moving landward and seaward) due to the effects of erosion, accretion, beach nourishment and structural shoreline protection measures.

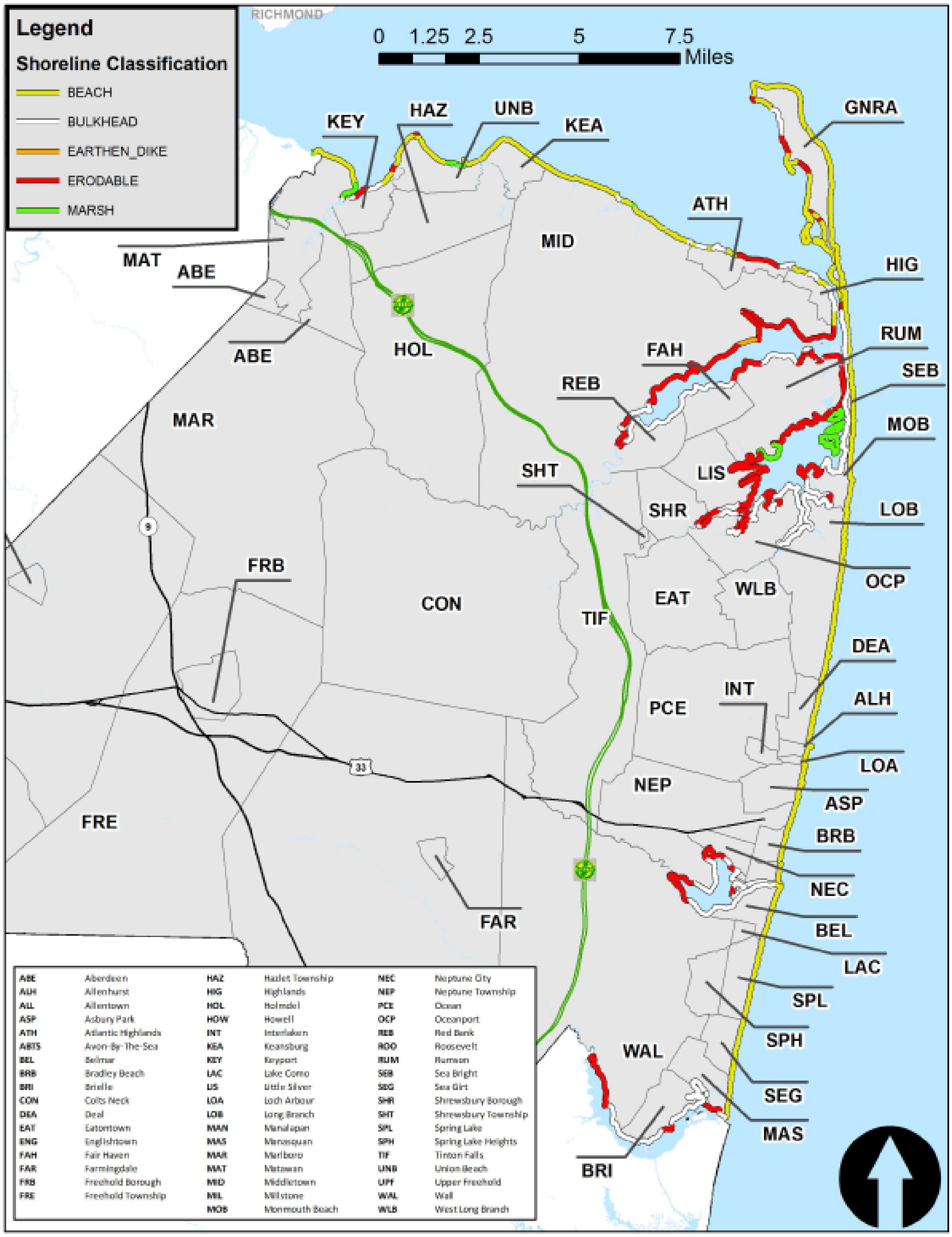
Figure 3a.7 illustrates the type of shorelines in Monmouth County as classified by NJDEP. These include the following types: (1) beach, which includes waterfront areas comprised of 100 percent sand; (2) bulkhead, which includes manmade structures at the water's edge, after the rip-rap, which were designed to hold back water and protect the adjacent areas from erosion; (3) marsh, which is classified areas of natural marsh edge; (4) earthen dike, classified as structures which serve as natural barriers between the land and the water; and (5) erodable, which includes any soft shoreline other than beach, rock, marsh or earthen dike, which are vulnerable at the water's edge. As can be seen in the figure, most of Monmouth County's shoreline is classified as susceptible to coastal erosion (including "beach" and "erodable" classifications). Coastal erosion in these areas, where coupled with densely developed or significant recreational shorelines, are routinely addressed through beach nourishment programs.

Although not shown on the countywide map figure, there are also many shoreline protection features located along the Monmouth County shore that are designed to reduce coastal storm and erosion hazards. These include hard structures such as jetties, groins, revetments, sea walls and breakwaters. Jetties and groins are protective structures (usually built from rock, wood or concrete) which extend outward from the shoreline. They look alike and provide similar function, but the difference between the two is that jetties are located at inlets, while groins are located along beaches. Sea walls are similar to bulkheads in function, but unlike bulkheads, they are located along the high beach line adjacent to the ocean, protecting property from ocean forces. Revetments are sea walls, which are surrounded on either side by rock or earth fill. A breakwater structure is a protective barrier placed in the water, out in front of a harbor.

The New Jersey State Hazard Mitigation Plan summarizes the number of type of NJDEP shoreline structures off the coastline of New Jersey along the Atlantic Ocean and Inland Bays (current as of 1993). Monmouth County is reported to have 0 breakwaters, 172 groins, 9 jetties, 1 revetment, and 11 seawalls.

In addition to hard structures, some areas also feature coastal protection systems incorporating engineered dunes and beaches, which are maintained through regular scheduled maintenance and renourishment. Failure to continue these activities would result in an increased risk of damage in many areas during coastal storm events, as the levels of protection are degraded. However, local government entities within Monmouth County and the State of New Jersey have been very active in cooperating with Federal government agencies to ensure that these activities continue to be implemented and adequately maintained. These practices are encouraged and expected to continue.

Figure 3a.7
NJDEP Shoreline Classifications for Monmouth County



Source: NJDEP

Extent – Coastal Erosion

Coastal erosion is measured as the rate of change in the position or displacement of a riverbank or shoreline over a period of time. Short-term erosion typically results from periodic natural events, such as flooding, hurricanes, storm surge, and windstorms, but may be intensified by human activities. Long-term erosion is a result of multi-year impacts such as repetitive flooding, wave action, sea level rise, sediment loss, subsidence, and climate change. The severity of coastal erosion is typically measured through a quantitative assessment of annual shoreline change for a given beach cross-section of profile (feet or meters per year) over a long period of time.[3] Erosion rates vary as a function of shoreline type and are influenced primarily by episodic events, but can be used in land use and hazard management to define areas of critical concern. Unfortunately, there is no uniform erosion rate database or GIS data layer that defines erosion rates or such areas of critical concern for Monmouth County's shoreline. However, NJOEM indicates that the New Jersey coast is characterized by episodic change resulting from severe but episodic storm events with a recurrence interval of 25 years or greater. Areas of natural erosion and accretion show erratic and almost cyclical patterns in response to storm events. The recovery process, although long, results in a stable beach with a slight recession of approximately one foot per year, half of which can be attributed to relative sea level rise. While erosion rates experienced along the New Jersey shore may vary significantly from location to location, and no global maximum rate is readily available for Monmouth County, according to a study prepared by the Heinz Center[4], much of the coastline of New Jersey, including Monmouth County, experiences an average of three feet of erosion per year.

Historical Occurrences – Coastal Erosion

The State of New Jersey has experienced eight FEMA coastal erosion related disaster declarations between 1954 and 2012. Monmouth County was declared during three of these events: the December 1992 Coastal Storm, Hurricane Irene in 2011, and Hurricane Sandy in 2012. The NJ State Plan reports 12 instances of coastal erosion affecting Monmouth County from 1936 to 2012 (see **Table 3a.13**). Three of these events have occurred since the last version of the plan was prepared.

Table 3a.13
Historical Incidents of Coastal Erosion in Monmouth County

Date	Associated Hazard Event Type
March 6-8, 1962	Nor'easter
October 28-November 4, 1991	Nor'easter
September 22-26, 1992	Tropical Storm Danielle
December 10-17, 1992	Coastal Storm
August 8-25, 1994	Hurricane Felix
December 22-26, 1994	Storm
January 7-8, 1996	Blizzard
July 13, 1996	Tropical Storm Bertha
February 4-9, 1998	Nor'easter
April 16, 2007	Nor'easter
August 27-September 5, 2011	Hurricane Irene
October 29, 2011	Nor'easter
October 29, 2012	Hurricane Sandy

[3] Seasonal fluctuations in beach width is common along the New Jersey shore, but is not considered erosion as the sand removed is typically re-deposited at other times of the year.
[4] "*Evaluation of Erosion Hazards*" prepared by The H. John Heinz III Center for Science, Economics and the Environment, April 2000

Some of the more recent notable events include:

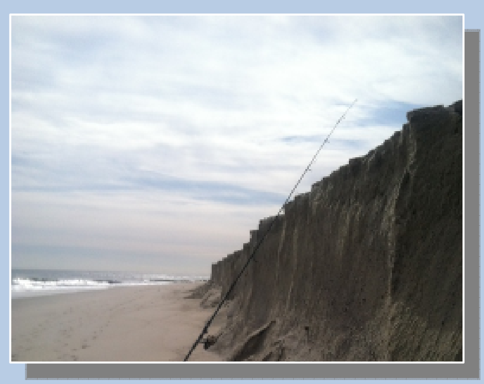
January 6-8, 1996. The Blizzard of 1996 created erosion damage as a result of high winds and waves. Sand was scoured away by the blizzard, leaving some locations vulnerable to future storms with the worst damage from Manasquan southward. In Manasquan, the storm scoured vertically about four feet of beach for a 500-foot stretch.

July 13, 1996. As a result of Tropical Storm Bertha, Monmouth Beach suffered severe beach erosion. Fifty percent of the beach at the south of the borough was gone. This beach is one of dozens in New Jersey that was being replenished under a U.S. Army Corps of Engineers project. There was little beach erosion elsewhere.

February 4, 1998. The strongest nor'easter of the winter caused continuous onshore flow resulting in moderate to severe beach erosion in Monmouth County. Two to four feet of beach were lost in most areas. At Sandy Hook, about 80 percent of the new sand placed in a replenishment project was lost as several hundred feet of beach disappeared. Both Bradley Beach and Ocean Grove were hard hit by erosion. The waves washed sand onto Ocean Avenue in Bradley Beach.

Hurricane Irene (August 27-28, 2011). Many Monmouth County communities were hard hit by this storm and suffered significant beach erosion as waves washed ashore. Sea Girt's beach was eroded and its boardwalk was severely damaged. Significant beach erosion was reported in Long Branch. Most every coastal community in Monmouth County was impacted to some degree or another by erosion – even those with USACE beach nourishment projects.

Hurricane Sandy (October 29, 2012). Many Monmouth County communities were hard hit by this storm and suffered severe beach erosion as waves washed ashore. Richard Stockton College researchers noted nearly all of their 105 monitored beach sites showed evidence of sand volume losses (Richard Stockton College 2013). NOAA's NCDC reports an estimate that the average New Jersey beach became 30 to 40 feet narrower. Despite early USACE estimates that 12 million cubic yards of sand were lost as a result of the storm, later reports indicated that only 6.2 million cubic yards were lost as a result of Sandy (Thompson 2013). Displacement was reported to have occurred primarily in Monmouth and Ocean counties.



Other notable reports of historical coastal erosion events include the following, as identified by the Planning Committee:

- The Township of Aberdeen reported that there has been significant beach erosion in the Cliffwood Beach section of town resulting from hurricanes, tropical storms and nor'easters.
- The Borough of Avon-By-The-Sea indicated that even moderate storms have eaten away at its beachfront leaving portions of the community at risk.
- The Borough of Deal cited that coastal erosion occurs annually for their jurisdiction, and particularly during winter nor'easters.
- The Borough of Keansburg indicated that it is currently experiencing severe coastal erosion.
- The Village of Loch Arbour stated that in 1994 persistent northeasterly winds through the winter to early spring resulted in severe coastal erosion and threatened beach facilities.
- The Township of Ocean has a severe coastal erosion issue along its waterways that lead to the ocean. As storm surge from the ocean pushes back up the waterways, it breaks down the embankments and causes more flooding issues for the ongoing storm and future storms.
- The Borough of Sea Bright has experienced coastal beach erosion since the turn of the 20th century and continues to do so. Also, the Shrewsbury River overtops the western bulkhead every moon tide and in most moderate storms, causing flooding in both the downtown residential and commercial areas of town. The back bay / Shrewsbury River shoreline is mostly bulkhead, but most of it is privately owned and in very poor condition. In some locations the bulkheads require fairly urgent replacement since erosion though the bulkhead line has been observed.
- The Borough of Union Beach, similar to other areas, relies on its coastline as a major line of defense against coastal flooding. Every other year the Borough participates in a sand replenishment program to maintain its line of defense but each coastal storm event increases the amount of sand required for replenishment.

Probability of Occurrence – Coastal Erosion

Coastal erosion remains a natural, dynamic and continuous process for Monmouth County's coastal jurisdictions and its probability of occurrence is certain. The damaging impacts of coastal erosion are lessened through continuous (and costly) beach nourishment and structural shoreline protection measures; however, it is likely that the impacts of coastal erosion will increase in severity due to future episodic storm events as well as the anticipated slow onset, long-term effects of climate change and sea level rise.

The frequency and intensity of coastal storms and severe weather events is expected to increase in the future due to climate change. In the years to come, it is anticipated that Monmouth County will observe drastic changes in storm character, intensity, frequency, and storm tracking. Hurricanes are likely to become more intense with rising sea water temperatures. Coastal erosion rates are likely to increase with rising sea-level, to levels higher than those rates that have been observed over the last century. Storm effects will be more extensive in the future. The following types of impacts can be anticipated in Monmouth County's future as a result of climate change and sea level rise: inundation of low-lying areas; increased frequency and extent of storm-related flooding; wetland loss; saltwater intrusion into estuaries and freshwater aquifers; land loss through submergence and erosion of lands in coastal areas; migration of coastal landforms and habitats; increased salinity in estuaries and coastal fresh; impacts to human populations (property losses, more frequent flood damage, more frequent flooding of roadways and urban centers, risks to people as the population of coastal areas increases); more buildings and infrastructure exposed; currently exposed buildings and infrastructure could be subject to potentially greater losses as water levels increase, and continued rapid coastal development exacerbates the impacts of sea level rise; impacts on gravity flow stormwater systems; impacts on non-coastal areas. Impacts of climate change and sea level rise can affect all parts of a community, including: transportation infrastructure (ports, marinas, airports, roads, bridges, railways); public infrastructure (stormwater and wastewater management systems, drinking water supply and distribution systems, power utility systems, communications systems); public facilities (i.e., police, fire, ambulance, hospitals, schools, daycare centers, adult living facilities, historic landmarks, government buildings, libraries, parks, etc.); economic viability of a community – particularly for communities where tourism tends to drive local economies, as is the case in many of Monmouth County's coastal communities. Climate change and sea level rise could lead to a potential loss of assets that support tourism (i.e., beaches themselves as well beach access points, lodging, restaurants, marinas, fishing habitats, ecotourism, etc.).

Dam Failure

Location – Dam Failure

The New Jersey Department of Environmental Protection has identified and classified 106 state-regulated dams[5] located within Monmouth County. Of these, nine dams have been classified as having "high hazard potential," meaning their failure may cause the probable loss of life or extensive property damage. Another 13 dams have been classified as having "significant hazard potential," meaning their failure may cause significant damage to property and project operation, but loss of human life is not envisioned. This classification applies to predominantly rural, agricultural areas, where dam failure may damage isolated homes, major highways or railroads or cause interruption of service of relatively important public utilities. The remaining 84 dams are classified as "low hazard potential" meaning their failure would cause loss of the dam itself but little or no additional damage to other property. It is important to note that dam hazard classification is based on the consequences of dam failure—not the condition, probability or risk of failure itself. Specific locations for all state-regulated dams that have been geo-referenced for mapping purposes are illustrated in **Figure 3a.8**.

Extent – Dam Failure

The extent or magnitude of a dam failure event can be measured in terms of the classification of the dam. The NJDEP assigns one of four hazard classifications to state-regulated dams in New Jersey. The classifications relate to the potential for property damage and/or loss of life in the event of a dam failure:

- 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.

Table 3a.14 lists information for all state-regulated dams in Monmouth County reported as having high (H) hazard potential or significant (S) hazard potential (a total of 22 dams, 9 being classified as high hazard potential and 13 being classified as significant hazard potential)[6].

[5] As defined in NJAC 7:20 (Dam Safety Standards),"Dam" means any artificial dike, levee or other barrier, together with appurtenant works, which is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of dam.

[6] In addition to the dams listed in Table 3a.14, representatives of Wall Township have also expressed concern about the Brick Reservoir. While this dam is not currently considered a major dam by the Federal NID, or a high/significant hazard dam in the State's Inventory, local authorities have reported concerns regarding the impact any failure of this dam would have on the Herbertsville Road area of the Township.

[redacted]

[redacted]

[redacted]

Probability of Occurrence – Dam Failure

The probability of a dam failure occurrence in Monmouth County is relatively low due to routine inspection, repair and maintenance programs, though the possibility of a future failure event is likely increasing due to aging dam structures that may be in need of repair or reconstruction. The NJDEP's Dam Safety program serves to ensure the safety and integrity of dams in New Jersey and, thereby, protect people and property from the consequences of dam failures.

Drought

Location – Drought

Droughts occur in all parts of the country and at any time of year, depending on temperature and precipitation over time. Similarly, droughts can occur in all parts of Monmouth County at any time of year, depending on temperature and precipitation over time. While arid regions of the United States are more susceptible to long-term or extreme drought conditions, other areas such as Monmouth County tend to be more susceptible to short-term, less severe droughts. It is impossible to delineate a drought hazard area for the County, per se, but it is generally assumed that drought is a county-wide hazard, with drought conditions being possible in all geographic areas.

Extent – Drought

The extent (i.e., 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 extreme 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.

The Palmer Drought Severity Index (PDSI) in one of many available drought indices used to assess the extent of a drought event. It was developed by Wayne Palmer in 1965 and indicates prolonged and abnormal moisture deficiency or excess. The PDSI tends to be used more commonly than other available indices, and is an important tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather. PDSI drought classifications are based on observed drought conditions and will range from -0.5 (incipient dry spell) to -4.0 (extreme drought). The PDSI also reflects excess precipitation using positive numbers. The PDSI is the most effective in determining long-term droughts; but has limitations in terms of use for short-term forecasts. To improve monitoring and measurement of drought severity from region to region within the State of New Jersey, NJDEP implemented a unique set of indices in January 2001specifically designed for the particular characteristics and needs of the State. This new set of statewide indicators supplements the Palmer Drought Severity Index (PDSI) with the measurement of regional precipitation, stream-flow, reservoir levels, and groundwater levels. New Jersey currently measures the status of each indicator as near or above normal, moderately dry, severely dry, or extremely dry. The status is based on a statistical analysis of historical values with generally the driest 10% being classified as extremely dry, from 10% to 30% as severely dry, and 30% to 50% as moderately dry.

Historical Occurrences – Drought

According to NCDC, 40 recorded instances of drought conditions have affected Monmouth County between1997 and 2014, causing significant losses to agricultural crops.

October 1997. 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. The commission urged the seven million residents within the basin's 13,539 square mile area to voluntarily conserve water. Water levels in the New York City Reservoirs, which are in the headwaters of the Delaware River, fell below 40 percent of capacity in late October. Precipitation deficits through October 31st averaged around five inches.

1998-1999. What began as unseasonably dry weather became a drought, which heavily impacted agriculture and water supplies. As reservoir levels continued to fall, the Delaware River Basin Commission declared a drought warning in December 1998. Also in December, NJDEP declared a drought warning for the entire state. In late December, the Delaware River Basin Commission declared Stage Two of its drought warning. In July 1999, Governor Christie Whitman declared a water shortage alert and called for residents to voluntarily conserve water by not watering lawns or washing cars. In Monmouth County, a drought emergency was declared and odd/even non-essential watering restrictions were implemented. The drought finally ended as Tropical Storm Floyd dumped significant rainfall amounts across the state. Agricultural losses throughout the state as a result of this long drought were estimated at $80 million.

October 2001 - October 2002. Unseasonably dry weather again turned to drought as precipitation levels fell short of normal levels. Continued dry weather, the drop in stream flow and groundwater levels and the reduced levels in the New York State reservoirs prompted NJDEP to upgrade the drought watch to a drought warning for counties in the Delaware River Basin and southern New Jersey in November 2001, including Monmouth County. By October 2002, a drought disaster was declared by the U.S. Department of Agriculture for several states including New Jersey. Several rain events in October 2002 helped quench the drought and returned the area’s reservoirs to normal levels.

August to September 2008. Excessive heat in June followed by an unseasonably dry August resulted in drought conditions in August of 2008. Rainfall returned to above normal levels in September, but was too late to be helpful for farmers. Crops had already been damaged by the combination of excessive June heat and an August hail storm and drought. The United States Secretary of Agriculture issued a drought disaster declaration for ten central and southern New Jersey Counties on September 22^{nd}. Mercer, Monmouth, Burlington, Ocean, Camden, Gloucester, Atlantic, Salem, Cumberland and Cape May Counties were included in the declaration. This made farmers who suffered thirty percent or more direct losses to be eligible for low interest emergency loans from the Farm Services Agency. Loans could cover up to 100 percent of the dollar value of crop losses.

August to October 2010. On August 5, the NJDEP issued a drought watch for northeast New Jersey including Morris County. On a statewide average, August 2010 was the 15^{th} driest August on record (dating back to 1895) with 2.37 inches of rain. The meteorological summer was the 10th driest (8.65 inches) on record dating back to 1895 in New Jersey and was also the driest summer since 1966. At the Atlantic City International Airport, it was the fourth driest August (1.09 inches) and fifth driest meteorological summer (5.92 inches) on record. In Trenton, it was the third driest August (0.80 inches) and fifth driest meteorological summer (5.90 inches) on record.

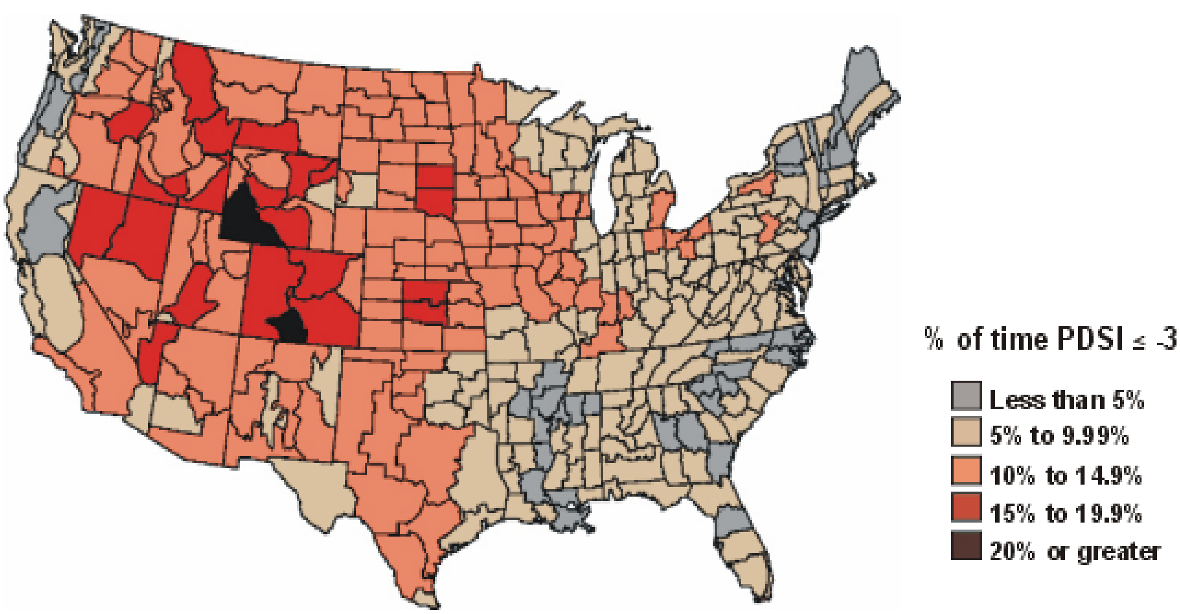
Other notable reports of historical drought events include the following, as identified by the Planning Committee:

- The Borough of Union Beach indicated that it has been put on water restrictions on many occasions due to the lack of water in the local reservoir.
- The Township of Upper Freehold has reportedly experienced severe drought conditions, which lowered the head pressure of potable water in wells and caused numerous wells to go dry. Most of the area depends on wells for potable water, so it is vitally important to maintain head pressure from the aquifers.

Probability of Occurrence – Drought

Monmouth County faces a low to moderate probability of severe drought conditions, though short-term instances of drought will be a more frequent occurrence. **Figure 3a.9** shows the PDSI Summary Map for the United States from 1895 to 1995. According to the PDSI map, Monmouth County is in a zone that experienced severe drought conditions less than 5 percent of the time between 1895 and 1995, but short-term, less severe drought conditions are more common and may occur several times in a decade.

Figure 3a.9
Palmer Drought Severity Index Summary Map for the United States



Source: National Drought Mitigation Center, 1895-1995

Flood

Location – Flood

Monmouth County is subject to both riverine and coastal flooding. **Riverine flooding** occurs along inland channels such as rivers, creeks, streams. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas. **Coastal flooding**, on the other hand, is a result of the storm surge where local sea levels rise to inundate areas along the coasts of oceans, bays, estuaries, coastal rivers, and large lakes. Hurricanes and tropical storms, severe storms, and Nor'easters cause most of the coastal flooding in New Jersey.

Many areas of Monmouth County are susceptible to riverine and urban (stormwater) flooding, and its coastal jurisdictions are also very susceptible to tidal and coastal flooding due to coastal storm events including storm surge.[7] It is estimated that nearly 10 percent of lands within Monmouth County are located in the 100-year floodplain. **Figure 3a.10** illustrates the location and extent of currently mapped special flood hazard areas for Monmouth County based on FEMA's 2014 Preliminary Digital Flood Insurance Rate Maps (DFIRMs). This includes Zones A/AE (100-year floodplain), Zone VE (100-year coastal flood zones, associated with wave action) and Zone X500 (500-year floodplain). It is important to note that while FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood-related losses often do occur outside of delineated special flood hazard areas – particularly in areas that were not included in detailed study areas.

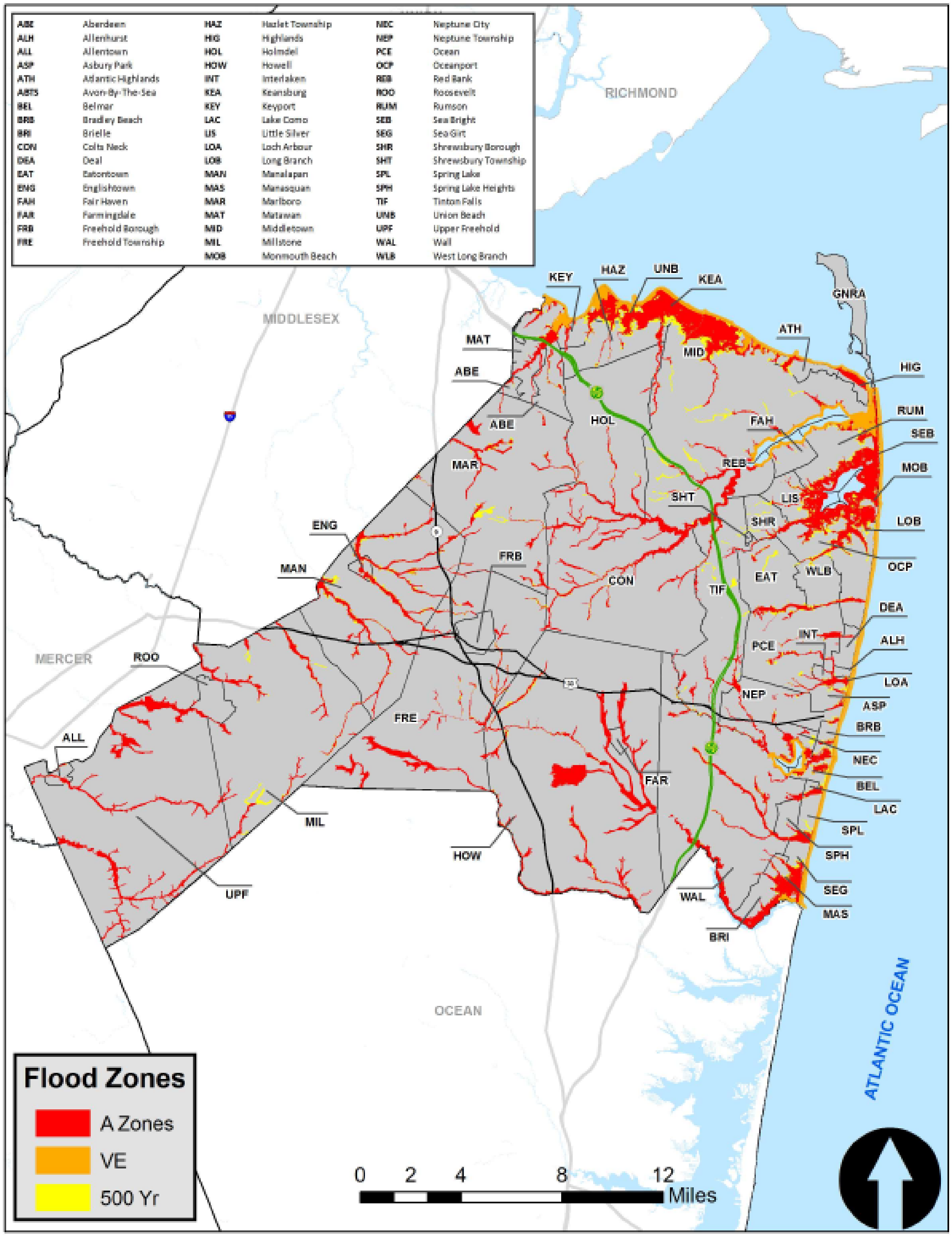
Several municipalities in the County, mostly in coastal areas, already benefit from some existing flood protection structures such as levees, floodwalls, and beach/dune systems. The FEMA FIS notes that small dams are located on Conines Mill Pond and Indian Run in the Borough of Allentown, on Swimming River in the Township of Middletown, on Pine Brook near Tinton Avenue in the Borough of Tinton Falls, and scattered elsewhere throughout the County. Small weirs restrict the passage of tidal surges into inland areas on Whale Pond Brook and Poplar Brook in the Township of Ocean, and small erosion control structures have been placed along the streams in the Township of Holmdel. The Township of Wall has also placed small stone wave protection measures near roads and other critical infrastructure. A bulkhead was constructed along Marine Park in the Borough of Red Bank.

In cases where flood protection structures have been certified by FEMA as providing protection to the "100-year" flood event, their effectiveness in reducing flood risk is implicit in the current flood mapping (**Figure 3a.10**), since the areas they protect to this level have been removed from the A/AE Zones. However, there is currently no readily available database which identifies these structures, their construction types, dimensions, level of protection, assets protected, and existing maintenance operations. For future updates of this plan, the County should consider as an action item a comprehensive effort to compile such a database, which will aid both the County and individual municipalities in future flood mitigation planning activities.

The flooding portion of this hazard mitigation plan has been revised as part of this first update to reflect changes between the Q3 mapping and new January 2014 Preliminaries.

[7] Storm surge is addressed separately within this section.

Figure 3a.10
Special Flood Hazard Areas in Monmouth County



Source: FEMA, Preliminary Flood Hazard, 2014

Extent – Flooding

In the case of riverine flood hazard, 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 extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood, **Figure 3a.10** for Monmouth County) is used as the regulatory boundary by many agencies. Also referred to as the SFHA, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage.

Historical Occurrences – Flood

Flooding is the most common major natural hazard in New Jersey. The FIS notes that flooding in Monmouth County is attributed mainly to tropical storms, extratropical cyclones (nor'easters) and, to a lesser extent, severe thunderstorms. According to NCDC, 129 recorded flood events (coastal flood, flash flood, and flood) have occurred in Monmouth County since 1996. These events have resulted in two reported injuries and an estimated $10.038 billion in property damages ($10.0 billion of this is reportedly attributable to Hurricane Sandy). Some recent notable events include the following:

February 4, 1998. In Monmouth County, damage was estimated at $500,000 as the county was spared by the eastward movement of the nor'easter off of Cape Hatteras. The continuous onshore flow caused moderate to severe beach erosion (described under coastal erosion hazard). New Jersey State Route 36 was flooded in Sea Bright. In Raritan Bay, tidal flooding caused road closures in Middletown Township.

September 16, 1999. Hurricane Floyd brought torrential rains. In Monmouth County, the worst flooding related problems occurred when the torrential rain coincided with the high tide. The worst flooding was reported in Union Beach and bay areas of Middletown Township. Mandatory evacuations occurred in Union Beach (which became an island) and voluntary evacuations occurred in Middletown Township along the bay and near Compton's and Pew Creeks. New Jersey State Routes 35 and 36 were closed due to flooding. Farther inland, Manalapan Township was hardest hit with overflowing brooks that forced the closure of six roads and sandbagging of homes on Birmingham Road. Coastal areas escaped with minimal damage: just some minor beach erosion and minor back bay flooding at times of high tide. Thousands of barrels and drums (some containing hazardous solvents and acids) were found bobbing in the waters of Raritan and Sandy Hook Bays and washed ashore on local beaches. Precipitation totals in Monmouth County included 6.4 inches in Hazlet, 5.82 inches in Marlboro, 5.2 inches in Sandy Hook and 4.57 inches in Keansburg.

October 13-14, 2005. Heavy rain associated with a low pressure system southeast of New Jersey moved into Monmouth County on the 13th. Three-day storm totals (from the 11th through the 14th) in the county averaged between four and 11 inches, with the highest amounts near the coast. In Asbury Park and Loch Arbour Village, Deal Lake overflowed and forced the evacuation of about 65 homes in Loch Arbour and 30 homes in Asbury Park. In Eatontown Borough, Eatoncrest Apartments flooded as water was three to four feet deep in areas. In Belmar Borough, flooding occurred along Lake Como and along the Shark River. In Monmouth Beach, flooding along the Shrewsbury River affected several blocks. In Ocean Township, flooding along the Poplar Brook caused the evacuation of the entire 104 unit Poplar Village Senior Citizens Center. After the brook receded, 22 units were deemed uninhabitable. In Rumson Borough, flooding along the Shrewsbury River closed roads near the Sea Bright-Rumson Bridge. In Howell Township, seven units of the Friendship Gardens (Senior Citizen) complex were evacuated. Metedeconk River flooding also affected Freehold Township, the Borough of Spring Lake and Wall Township. Dozens of homes were flooded, mainly along Ocean Road and Union Avenue. The borough sewage treatment plant flooded. Saint Catherine's Grammar School was hit hard with up to 2.5 feet of water on its first floor. In Spring Lake Heights, Borough Shore Road and Jersey Avenue flooded with cars under water. The Brighton Avenue Bridge was also damaged. About 11 homes were evacuated and three were classified as uninhabitable. Elsewhere in the township, flooding along Whalepond Brook inundated Branch Road. The Manasquan River at Squankum reached its 7.5 foot flood stage on the 13th, cresting at 9.62 feet on the 14th. Specific storm totals included 11.58 inches in Manasquan and 10.15 inches in Tinton Falls.

March 2, 2007. Flooding occurred during the morning of the 2nd along State Route 35 in Hazlet and Aberdeen. The flooding may have been enhanced due to the high tide. Flooding also occurred along State Route 33, Howell Road, Church Road and Fairfield near Freehold. Some rainfall totals include: 1.81 inches in Jackson; 1.54 inches in Marlboro; and 1.23 inches in Cream Ridge. The NCDC does not report injuries, fatalities, property damages, or crop damages for this event.

June 14, 2008. A slow moving cold front helped trigger scattered showers and thunderstorms across New Jersey during the evening of the 14th. The thunderstorms moved slowly and caused flash flooding in Monmouth County. Torrential downpours caused roadway flooding and flooding of smaller streams and creeks in the northeastern part of Monmouth County. A Skywarn spotter measured 3 inches of rain within 45 minutes in Middletown Township. Roadway flooding was reported in Middletown and Highlands.

August 21, 2011. Thunderstorms with torrential downpours caused small stream flash flooding as well as poor drainage flooding in the southern half of Monmouth County. Howell, Ocean and Wall Townships were hardest hit with around a dozen homes damaged. The runoff also caused moderate flooding along the Manasquan River that lasted into the 22nd. In Howell, the Mariner's Cove development near the Manasquan River was hard hit by flooding. Rescue boats were used to evacuate families as mud and water entered the first floor of homes. The U.S. Route 9 bridge over the Manasquan River was closed due to concern about its integrity. It was re-opened on the 22nd. Another bridge over the Manasquan River on Allentown-Lakewood Road near Robert Brice Memorial Park was also flooded and closed. In Ocean Township, flooding displaced residents of the Middlebrook at Monmouth Apartments on Deal Road. In Freehold, Post Road flooded by a creek and State Route 33 was closed in both directions at Hills Mills Road. In Long Branch, 2nd Avenue was under three feet of water, the barricades were even floating away. In Deal, State Route 71 was closed in both directions. Streams were reported out of their banks in Millstone Township. Precipitation totals included 4.61 inches in Howell Township, 3.75 inches in Ocean Township, 3.16 inches in Asbury Park and 2.96 inches in Eatontown.

Hurricane Irene 2011. Irene's torrential downpours caused major flooding and a number of record breaking crests on area rivers and a three to five foot storm surge that caused moderate to severe tidal flooding with extensive beach erosion over the weekend of August 27th and 28th. Moderate to severe tidal flooding occurred along the Atlantic Coast and Raritan Bay. Event precipitation totals averaged 5 to 10 inches and caused widespread record breaking flooding. There were numerous reports of dune fence damage and sand overwashes onto streets and boardwalks. Along the Raritan Bay side of Middlesex and Monmouth Counties, most of the vertical cuts were less than two feet and no breaches were reported. In Keansburg and Union Beach in Monmouth County low lying bayshore communities experienced tidal flooding. About 3,000 county residents were evacuated along Raritan Bay. Along the Atlantic Ocean side of Monmouth County, vertical cuts averaged 2 to 5 feet. In Spring Lake, about one and a half miles of the borough's boardwalk was damaged and closed. Peak storm tides included 9.75 feet above mean lower low water in Sandy Hook ; Severe tidal flooding starts at 8.7 feet above mean lower low water. This was the third highest tide on record and highest tide since the December 1992 nor'easter. In Monmouth County, flooding rains and winds damaged and or closed seventy-one roadways and bridges. Infrastructure damage alone was estimated near nine million dollars. Among the major roadways that were closed included U.S. Route 9 and New Jersey State Routes 33, 35, 36 and 79. In Middletown Township, a dam broke at the Swimming River Reservoir and flooded the southern part of the township around County Route 50. Elsewhere in the township, a bridge washed out at Hubbard Avenue over the Navesink River. In Allentown Borough, businesses located near Doctors Creek and Conines Millpond were damaged. In Matawan Borough, a huge thirty-five foot sinkhole forced the suspension of service along the New Jersey Transit North Jersey Coast Line. The Manasquan River at Squankum had major and record breaking flooding. It was above its 7.5 foot flood stage from 1146 p.m. EDT on the 27th through 733 a.m. EDT on the 29th. It crested at 13.06 feet at 1030 a.m. EDT on the 28th. Event rainfall totals included 8.75 inches in Freewood Acres, 8.57 inches in Howell Township, 8.07 inches in Red Bank, 6.72 inches in Eatontown and 6.13 inches in Lake Como.

Hurricane Sandy 2012. Monmouth County was one of the two hardest-hit counties in the State of New Jersey. A unique aspect of Sandy was the multi-tide cycle increase of onshore winds prior to landfall which caused multiple high tide cycles with tidal flooding and also helped produce catastrophic wave action. Record breaking or near record breaking high tides were exacerbated by the high astronomical spring tides associated with the full moon. Recording breaking high tides would have occurred regardless of the lunar tidal cycle in northern New Jersey. Sandy’s landfall coincided closely with the high tide cycle on the evening of the 29th. On the oceanside, Raritan Bay and the lower Delaware Bay, minor tidal flooding started during the high tide cycle on the morning of the 28th, with some moderate tidal flooding during the high tide cycle on the evening of the 28th. Widespread major tidal flooding occurred during the morning and evening high tide cycles on the 29th. The highest tide (and surge) along the ocean front and Raritan Bay was with the landfalling high tide cycle on the evening of the 29th. The ocean front and Raritan Bay surge was 5 to 9 feet. A new all-time record tide was set in Sandy Hook. The tide reached 13.31 feet above mean lower low water before the pier collapsed about 45 minutes before high tide. An after the event survey performed by the USGS and Rutgers University determined that an estimated crest of 14.40 feet above mean lower low water will be used as the new record for Sandy Hook. It was estimated that waves likely reached 12 to 24 feet along the ocean front with the largest waves along Monmouth County. Most of the surveyed damage to barrier island homes that were either destroyed or moved indicated that it was the storm surge and wave action that caused most of the damage. Either minor or no tidal flooding occurred with the subsequent high tide cycles the rest of the month. Heavy, steady rain also occurred with Sandy. The heaviest rain was in the southern half of the state. Event rainfall totals averaged 1 to 3 inches in the northern half of the state and 3 to 7 inches in the southern half of the state, except 6 to 12 inches along the southern tier counties of Salem, Cumberland, Cape May County as well as coastal Atlantic County. Monmouth and Ocean Counties suffered the greatest damage from Sandy. Every municipality that bordered Raritan Bay and the Atlantic Ocean suffered widespread damage in Monmouth County and every inland municipality had at least some sporadic damage. Union Beach and Sea Bright were among the most hardest hit locations. In Sea Bright, many businesses were totally destroyed and the fishing pier collapsed. Both Spring Lake and Belmar had miles of their boardwalks destroyed. Some schools were damaged beyond use. Monmouth University was used as an evacuation center. The New Jersey Transit line will have to be rebuilt because it was severely damaged. Ferry service between Manhattan and Atlantic Highlands was suspended indefinitely. Miraculously the only Sandy related injury was carbon monoxide poisoning in Middletown. While there are no established benchmarks for tidal flooding levels at these other stations, the following is a list of the highest tides during Sandy. These may not represent the highest actual tide as there were power outages and some of the graphs plateaued at high crest. The tide gages whose peak crest looks suspect (and may be higher) are marked with an asterisk. At Keansburg* the highest crest was 8.96 feet above mean lower low water, at Sea Bright, the highest crest was 13.79 feet above mean lower low water; and at Belmar* the highest crest was 8.70 feet above mean lower low water.

Other notable reports of historical flood events include the following, as identified by the Planning Committee:

- Major tidal and storm surge flooding occurred to jurisdictions located along the immediate shoreline and along the Shrewsbury River during the 1992 nor’easter, resulting in an estimated $270 million in insured damage to public and private property.
- The Township of Aberdeen indicated that the low-lying areas of Cliffwood Beach have been subject to repeated flooding during storms. They also noted that several roadways in the Township are flood prone, including but not limited NJDOT’s State Highway 35 at Long Neck Creek, Lakeshore Drive and Greenwood Avenue, and Amboy Avenue.
- The Borough of Allentown reported that during periods of heavy rainfall, Doctors Creek and Indian Creek have overflowed their banks and backed up the municipality’s drainage system, which causes flooding of streets and adjacent properties.
- The Borough of Avon-By-The-Sea reported that coastal flooding occurs even during moderate storm events.

- The Borough of Bradley Beach has had flooding situations due to storms in the past, and currently a lake frequently crests due to outfall pipes being inoperable.
- The Borough of Brielle indicated that historically the damages caused by flood events have been confined to flooded basements on private property.
- The Borough of Farmingdale stated that Mariners Cove rests in the middle of an ox-bow in the Manasquan River and has flooded five residences on at least five different occasions and has inundated the road and threatened the residences on a regular basis.
- The Township of Hazlet indicated that there are multiple roadways that flood during extreme rain events, including state highways.
- The Borough of Keansburg has certain areas that currently flood during extreme high tides and severe rain storms.
- The Village of Loch Arbour reported that the flood event of October 2005 affected 80 percent of the village.
- The Township of Marlboro explained that its flooding issues have been worsening in the past seven to 10 years. Small streams overflow their banks regularly during prolonged rain events, and severe storms cause widespread flooding in these areas.
- The Borough of Matawan reported that Aberdeen Road, Ravine Drive and occasionally Main Street (near Lake Matawan) have been subject to historical flooding.
- The Borough of Neptune City indicated that it is vulnerable to both street flooding during heavy rains as well as tidal and storm flooding from the Shark River.
- The Township of Neptune noted that the Shark River Hills and North Island section of the community frequently flood on high moon tides, heavy rains, and certain storm events. The Ocean Grove section of the Township experiences flooding during certain tidal and heavy rain events. The coastal lakes (Fletcher and Wesley Lakes) also experience flooding during high tides and heavy rains.
- The Township of Ocean experiences a severe flooding issue every time it rains hard for more than 30 minutes. During any storm, there is an 85 percent chance or better that the Township will have to evacuate residents (mostly senior citizens) from their homes. This has occurred every year since 1985.
- The Borough of Oceanport indicated that even frequent heavy rains will cause minor to moderate flooding (particularly street flooding) due to the low lying nature of the area. In addition, the storm drainage infrastructure reportedly needs improvements due to development over the years. Past flooding has caused major traffic issues with County and local roadways flooding.
- The Borough of Shrewsbury has reported that only minor localized flooding occurs in the town, mostly surrounding local streams and due to poor storm drainage along the roads.
- The Borough of Spring Lake reported significant riverine flooding occurrences in the Wreck Pond subwatershed. Damages of $9.8 million were reported in this area following the October 2005 flood event.
- The Township of Upper Freehold has indicated that all County and Township roads in its jurisdiction have no shoulders, and heavy rain from storm events erodes or washes out the roadways.

Historical Summary of Insured Flood Losses

According to FEMA flood insurance policy records, there have been 21,481 flood losses reported in Monmouth County through the National Flood Insurance Program (NFIP) since 1972, totaling almost $853 million in claims payments. Every municipal jurisdiction in Monmouth County is listed by FEMA as being an active participant in the NFIP (with Freehold Borough and Shrewsbury Township recently joining in August 2013). The name of the Floodplain Administrator (the person responsible for ensuring that development activities comply with floodplain management ordinances and NFIP regulations) for each jurisdictions included in **Appendix 1.4**.

In addition to NFIP participation, the eight communities of Aberdeen, Bradley Beach, Hazlet, Manasquan, Middletown, Oceanport, Spring Lake, and Union Beach are listed by FEMA as Community Rating System (CRS) eligible communities[8]. Under the CRS, communities which implement floodplain management actions that go beyond the minimum requirements of the NFIP are eligible for discounts on flood insurance premiums for properties within that community.

[8] As per the Community Status Book of May 2014, which was still the most recent available status book posted online by FEMA as of October 2014, Sea Bright's status is listed as "Rescinded".

Monmouth County OEM will continue to work with all jurisdictions in the County, encouraging them all to participate fully in the National Flood Insurance Program, and to take full advantage of additional FEMA programs such as the Community Rating System (CRS). Jurisdictions already eligible for the CRS will be encouraged to upgrade their CRS status, while non-eligible jurisdictions will be encouraged to work towards eligibility. The County will also support local jurisdiction participation in the Cooperating Technical Partners Program (CTP), of which the main objective is to increase local involvement in the floodplain mapping process.

Table 3a.15 lists the total number of losses and total claims payments under the NFIP, by municipal jurisdiction. It should be emphasized that this listing includes only those losses to structures that were insured through the NFIP policies. Total number of losses includes some losses in which claims were sought and not received. It is likely that many additional instances of flood losses in Monmouth County were either uninsured or not reported.

Before Hurricane Sandy had even occurred, the total value of all claims paid county-wide had increased by 42 percent between May 2008 and May 2012, ($76.8 million in May 2008 as compared to $109.5M in May 2012. At that time, many of the claims paid were due to Hurricane Irene. The impacts of Sandy are truly staggering. Between May 2008 and August 2014, the total value of all claims paid has increased from $76.8 million to $852 million. This represents about a 1009 percent increase over May 2008 values that were presented in the initial version of this hazard mitigation plan.

Table 3a.15
National Flood Insurance Program Loss Statistics (as of August 31, 2014)*
Source: FEMA / http://bsa.nfipstat.com/reports/1040.htm#34

Jurisdiction	Date Entered NFIP	Current Effective FIRM Date	CRS Class (as of May 1, 2014)	Total Number of Policies 2014	Total Num ber of Losse s 2008	Total Claims Payments 2008	Municipal Claims as % of Countywid e Total 2008	Total Number of Losses 2014	Total Claims Payments 2014	Munici pal Claims as % of County wide Total 2014
Aberdeen, Township of	3/18/1985	9/25/2009	9	154	22	$146,428	0.19%	70	$2,735,240	0.32%
Allenhurst, Borough of	3/15/1979	9/25/2009		43	15	$171,799	0.22%	21	$689,812	0.08%
Allentown, Borough of	9/16/1981	9/25/2009		15	3	$5,143	0.01%	5	$63,666	0.01%
Asbury Park, City of	2/15/1979	9/25/2009		385	28	$197,171	0.26%	70	$3,668,424	0.43%
Atlantic Highlands, Borough of	8/3/1981	9/25/2009		136	31	$210,553	0.27%	95	$4,057,703	0.48%
Avon-By-The-Sea, Borough of	3/15/1979	9/25/2009		406	99	$549,967	0.72%	294	$13,854,348	1.62%
Belmar, Borough of	5/12/1972	9/25/2009		896	133	$941,070	1.22%	471	$17,466,021	2.05%
Bradley Beach, Borough of	8/1/1979	9/25/2009	7	359	18	$44,103	0.06%	74	$2,397,715	0.28%
Brielle, Borough of	4/2/1979	9/25/2009		297	77	$491,890	0.64%	214	$9,952,944	1.17%
Colts Neck, Township of	4/15/1982	9/25/2009		58	23	$54,771	0.07%	38	$503,360	0.06%
Deal, Borough of	3/5/1976	9/25/2009		173	54	$350,314	0.46%	79	$1,502,018	0.18%
Eatontown, Borough of	9/16/1981	9/25/2009		53	11	$10,503	0.01%	21	$142,856	0.02%
Englishtown, Borough of	3/15/1981	9/25/2009		35	10	$32,719	0.04%	30	$637,023	0.07%
Fair Haven, Borough of	10/16/1979	9/25/2009		65	16	$82,518	0.11%	30	$316,390	0.04%
Farmingdale, Borough of	11/26/1982	9/25/2009		22	4	$144,860	0.19%	27	$1,016,197	0.12%
Freehold, Borough of	8/23/2013	9/25/2009		1	NP	NP	NP	0	$0	0.00%
Hazlet, Township of	12/1/1982	9/25/2009	6	510	43	$343,377	0.45%	100	$1,437,978	0.17%
Highlands, Borough of	9/3/1971	9/25/2009		1,163	654	$5,904,615	7.68%	1728	$66,379,151	7.78%
Holmdel, Township of	3/1/1982	9/25/2009		51	7	$244,282	0.32%	11	$258,169	0.03%
Howell, Township of	1/6/1983	9/25/2009		200	33	$148,975	0.19%	44	$249,257	0.03%
Interlaken, Borough of	1/2/1981	9/25/2009		30	5	$98,988	0.13%	17	$182,430	0.02%
Keansburg, Borough of	5/16/1983	9/25/2009		1,919	66	$200,032	0.26%	1305	$42,979,526	5.04%
Keyport, Borough of	7/2/1979	9/25/2009		143	75	$1,700,470	2.21%	134	$6,221,309	0.73%
Lake Como, Borough of	11/28/1980	9/25/2009		106	8	$14,263	0.02%	38	$2,100,285	0.25%
Little Silver, Borough of	2/1/1978	9/25/2009		353	158	$3,256,482	4.24%	389	$32,768,348	3.84%
Loch Arbour, Village of	3/15/1979	9/25/2009		58	37	$377,636	0.49%	87	$2,912,834	0.34%
Long Branch, City of	5/5/1976	9/25/2009		2,171	504	$4,463,572	5.81%	1,341	$49,594,207	5.81%
Manalapan, Township of	9/15/1977	9/25/2009		224	27	$120,925	0.16%	77	$1,181,539	0.14%

Table 3a.15
National Flood Insurance Program Loss Statistics (as of August 31, 2014)*
Source: FEMA / http://bsa.nfipstat.com/reports/1040.htm#34

Jurisdiction	Date Entered NFIP	Current Effective FIRM Date	CRS Class (as of May 1, 2014)	Total Number of Policies 2014	Total Num ber of Losse s 2008	Total Claims Payments 2008	Municipal Claims as % of Countywid e Total 2008	Total Number of Losses 2014	Total Claims Payments 2014	Munici pal Claims as % of County wide Total 2014
Manasquan, Borough of	5/12/1972	9/25/2009	7	1,579	774	$6,103,304	7.94%	2,202	$97,262,608	11.40%
Marlboro, Township of	6/15/1978	9/25/2009		217	36	$48,034	0.06%	84	$435,155	0.05%
Matawan, Borough of	9/30/1981	9/25/2009		25	21	$96,578	0.13%	23	$174,529	0.02%
Middletown, Township of	2/15/1984	9/25/2009	6	2,807	391	$2,842,987	3.70%	1,677	$53,585,376	6.28%
Millstone, Township of	1/20/1982	9/25/2009		24	4	$4,417	0.01%	8	$46,633	0.01%
Monmouth Beach, Borough of	5/16/1977	9/25/2009		1,835	864	$11,060,063	14.39%	1,741	$101,407,912	11.89%
Neptune City, Borough of	8/11/1978	9/25/2009		169	19	$225,891	0.29%	50	$2,681,287	0.31%
Neptune, Township of	2/16/1977	9/25/2009		792	93	$815,829	1.06%	391	$21,462,103	2.52%
Ocean, Township of	10/14/1977	9/25/2009		424	418	$4,094,476	5.33%	279	$6,518,103	0.76%
Oceanport, Borough of	2/16/1977	9/25/2009	8	718	371	$6,684,169	8.69%	952	$59,225,948	6.94%
Red Bank, Borough of	5/19/1981	9/25/2009		84	10	$368,110	0.48%	32	$4,977,759	0.58%
Roosevelt, Borough of	5/25/1978	9/25/2009		3	0	$0	0.00%	3	$94,420	0.01%
Rumson, Borough of	12/21/1973	9/25/2009		628	399	$5,012,777	6.52%	929	$59,688,550	7.00%
Sea Bright, Borough of	10/8/1971	9/25/2009	R**	1,183	1134	$11,560,466	15.04%	1,937	$80,324,453	9.42%
Sea Girt, Borough of	3/5/1976	9/25/2009		313	31	$164,371	0.21%	105	$2,048,767	0.24%
Shrewsbury, Township of	8/9/2013	9/25/2009		0	NP	NP	NP	0	$0	0.00%
Spring Lake, Borough of	2/17/1982	9/25/2009	6	733	191	$4,551,528	5.92%	500	$15,963,740	1.87%
Spring Lake Heights, Borough of	12/15/1981	9/25/2009		161	17	$191,495	0.25%	42	$723,344	0.08%
Union Beach, Borough of	5/15/1980	9/25/2009	8	1,200	340	$2,276,597	2.96%	1,543	$78,501,450	9.20%
Upper Freehold, Township of	10/2/1979	9/25/2009		27	2	$5,235	0.01%	4	$13,142	0.00%
Wall, Township of	2/16/1977	9/25/2009		234	29	$361,373	0.47%	68	$1,861,451	0.22%
West Long Branch, Borough of	1/16/1981	9/25/2009		50	10	$13,274	0.02%	15	$31,846	0.00%
			Total	**23,474**	**7,347**	**$76,881,948**	**100%**	**21,481**	$852,907,567	100%

*NP= was Not Participating in 2008
**R = CRS status reported as Rescinded.

Repetitive Loss Properties

FEMA defines a repetitive loss property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. According to FEMA repetitive loss property records there are 1,618 repetitive loss properties located in Monmouth County as of February 4, 2014 of which 1,593 are "non-mitigated". These non-mitigated properties are associated with a total of 4,596 losses and approximately $199.4 million in claims payments under the NFIP since January 1978 (the earliest recorded date of loss), as shown in **Table 3a.16**.

While forty-six (87 percent) of Monmouth County's municipal jurisdictions are identified as having one or more Repetitive Loss (RL) properties. Highlands and Sea Bright have the most RL properties (219 and 191, respectively; 66% of all the RL properties in the County). Total paid claims are the highest in three communities: Sea Bright ($32.9 million from 191 properties; as compared to $9.4 million from 140 properties in 2008); Monmouth Beach ($26.5 million from 149 properties; as compared to $8.0 million from 116 properties in 2008); Highlands ($22.6 million from 219 properties; as compared to $1.2 million from 101 properties in 2008). Paid claims per RL property are highest, on average, in the Borough of Keyport where only 10 properties have been paid $3,694,415, or $369,441per claim. Mitigating RL properties is one of the goals of the State Hazard Mitigation Plan and jurisdictions with RL properties in their communities should aim toward this same goal wherever possible.

Table 3a.16
NFIP Repetitive Loss Property Statistics (as of February 14, 2014) for Non-mitigated RL Properties
(Source: FEMA Region 2)

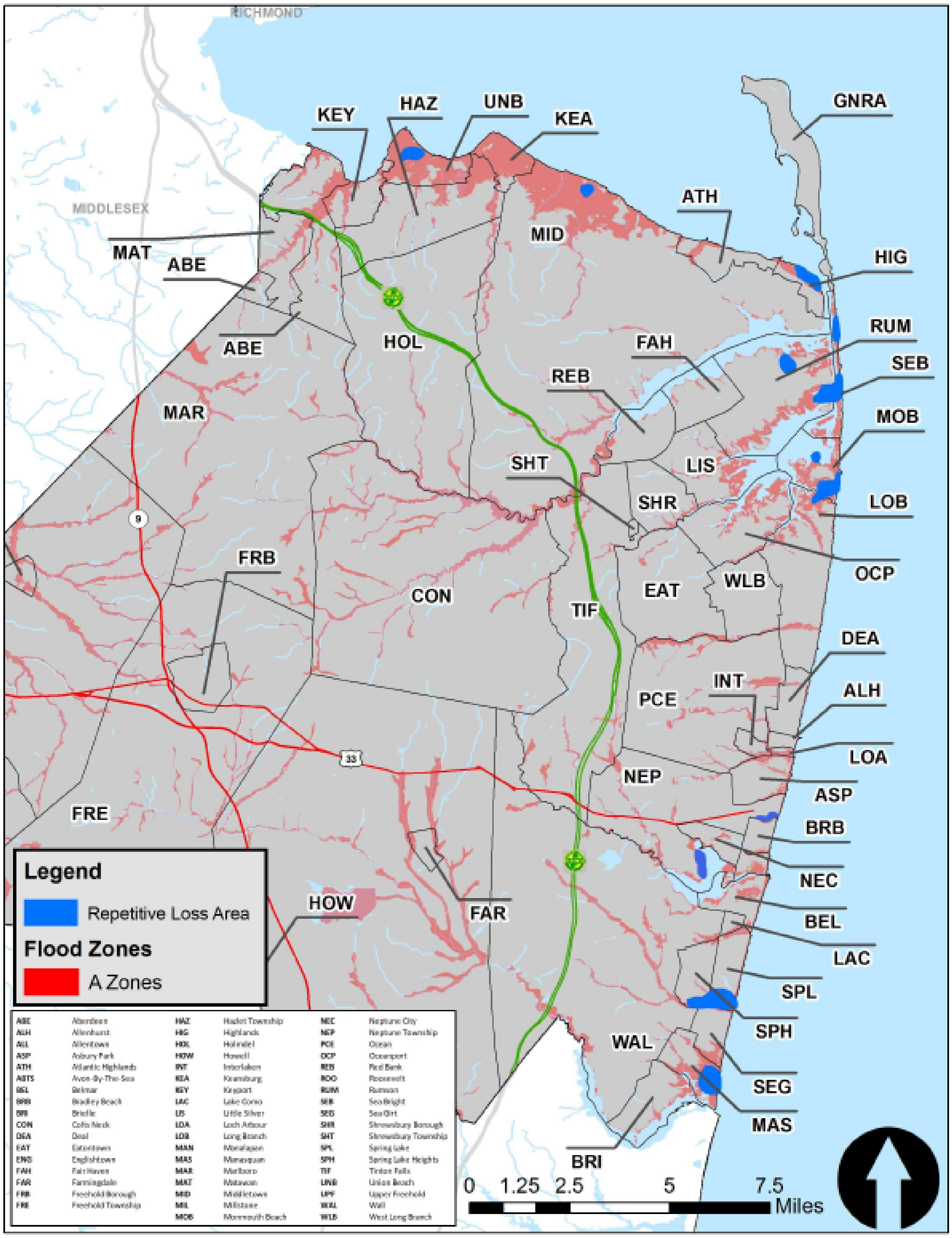
Jurisdiction	Totals for Non-mitigated RL Properties			
	Non-Mitigated RLP Properties	Total Losses	Total Payments	Average Payments per Non-mitigated RLP
Aberdeen, Township of	3	16	$973,573	$324,524
Allenhurst, Borough of	2	7	$152,088	$76,044
Allentown, Borough of	0	0	$0	--
Asbury Park, City of	6	13	$1,523,641	$253,940
Atlantic Highlands, Borough of	6	18	$1,197,579	$199,596
Avon-By-The-Sea, Borough of	19	57	$2,919,530	$153,659
Belmar, Borough of	41	106	$3,733,107	$91,051
Bradley Beach, Borough of	4	9	$124,221	$31,055
Brielle, Borough of	10	26	$741,176	$74,118
Colts Neck, Township of	3	10	$354,440	$118,147
Deal, Borough of	3	13	$429,089	$143,030
Eatontown, Borough of	1	2	$9,923	$9,923
Englishtown, Borough of	3	8	$96,698	$32,233
Fair Haven, Borough of	0	0	$0	--
Farmingdale, Borough of	7	14	$862,476	$123,211
Freehold, Borough of	0	0	$0	--
Freehold, Township of	5	11	$119,357	$23,871
Hazlet, Township of	3	16	$310,931	$103,644
Highlands, Borough of	219	583	$22,602,414	$103,207
Holmdel, Township of	1	2	$8,996	$8,996
Howell, Township of	4	9	$100,971	$25,243
Interlaken, Borough of	2	4	$74,334	$37,167

Table 3a.16
NFIP Repetitive Loss Property Statistics (as of February 14, 2014) for Non-mitigated RL Properties
(Source: FEMA Region 2)

Jurisdiction	Totals for Non-mitigated RL Properties			
	Non-Mitigated RLP Properties	Total Losses	Total Payments	Average Payments per Non-mitigated RLP
Keansburg, Borough of	63	130	$3,596,384	$57,085
Keyport, Borough of	10	58	$3,694,415	$369,441
Lake Como, Borough of	2	4	$70,255	$35,128
Little Silver, Borough of	24	64	$5,029,307	$209,554
Loch Arbour, Village of	18	42	$969,341	$53,852
Long Branch, City of	64	192	$8,050,025	$125,782
Manalapan, Township of	3	6	$51,317	$17,106
Manasquan, Borough of	160	451	$13,666,533	$85,416
Marlboro, Township of	4	9	$52,320	$13,080
Matawan, Borough of	0	0	$0	--
Middletown, Township of	156	392	$12,125,139	$77,725
Millstone, Township of	0	0	$0	--
Monmouth Beach, Borough of	149	527	$26,528,355	$178,043
Neptune City, Borough of	4	8	$808,862	$202,215
Neptune, Township of	19	47	$3,009,244	$158,381
Ocean, Township of	39	114	$4,030,351	$103,342
Oceanport, Borough of	52	162	$10,304,414	$198,162
Red Bank, Borough of	3	8	$1,317,438	$439,146
Roosevelt, Borough of	0	0	$0	--
Rumson, Borough of	41	255	$15,686,743	$182,404
Sea Bright, Borough of	191	625	$32,927,563	$172,396
Sea Girt, Borough of	2	4	$69,360	$34,680
Shrewsbury, Borough of	1	2	$5,628	$5,628
Shrewsbury, Township of	0	0	$0	--
Spring Lake, Borough of	112	312	$11,179,200	$99,814
Spring Lake Heights, Borough of	5	16	$464,680	$92,936
Tinton Falls, Borough of	1	2	$17,620	$17,620
Union Beach, Borough of	77	225	$9,072,148	$117,820
Upper Freehold, Township of	1	6	$50,532	$50,532
Wall, Township of	4	9	$303,172	$75,793
West Long Branch, Borough of	1	2	$7,773	$7,773
Total	**1,593**	**4,596**	**$199,422,664**	**$125,187**

The approximate areas where RL properties are clustered are plotted in **Figure 3a.11** in comparison with the extent of the mapped FEMA Preliminary DFIRMs (the Base/100-year floodplain). This figure does not show areas of the County where occasional isolated RL properties are located, and show only the approximate areas covering clusters of RL properties, since the component data is subject to the 1974 Privacy Act. This legislation prohibits the public release of any information regarding individual NFIP claims or information which may lead to the identification of associated individual addresses and property owners. However, while this information is not available to the general public, the County may subsequently obtain comprehensive RL property data from FEMA for the purposes of targeted mitigation of RL areas or individual RL structures.

Figure 3a.11
Repetitive Loss Property Cluster Areas



Source: Monmouth County

Since the plan was initially prepared in 2008, the number of listed repetitive loss properties has increased dramatically, with 594 non-mitigated RLPs in August 2008 as compared to 1,593 as of February 2014. FEMA has indicated that their system depends heavily on programmed address matching to identify repetitive losses and, while the software makes some allowances for misspellings and incomplete addresses, it is not perfect and sometimes legitimate address matches are missed. Sometimes repetitive loss properties go undetected for years because of address anomalies. There are FEMA contractors and FEMA regional staff who are actively working the repetitive loss system which allows them to link addresses that they have found should be linked. When they do, new repetitive loss properties can be created even though the loss dates may have been older. Sometimes repetitive loss properties can be combined as well and may create severe loss properties.

The average repetitive loss property in Monmouth County has experienced 2.9 loss events. At the extreme end, two properties in the Boroughs of Keyport and Sea Bright are recorded as having experienced 21 and 14 losses respectively, with a combined $1,278,945 in paid claims. All told, there are six properties in the county that have had 10 or more losses. They are located one in Hazlet, one in Monmouth Beach, two in Sea Bright, one in Aberdeen, and one in Keyport. These six properties have had a total of 78 losses and $3,226,178 in paid claims. The following six communities have no RL properties within their borders: Allentown, Fair Haven, Matawan, Millstone, Roosevelt, and Shrewsbury Township. The majority of all RL properties are located in the 100-year floodplain, and leaving aside scattered individual RL properties, the RL clusters are almost entirely within the 100-year floodplain.

Severe Repetitive Loss Properties

FEMA defines a severe repetitive loss property as a residential property that is covered under an NFIP flood insurance policy and: (a) that has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or (b) 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; and (c) for both (a) and (b), at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart. According to FEMA repetitive loss property records (as of February 4, 2014) there are a total of 114 severe repetitive loss properties located in 17 Monmouth County communities of which all are identified as "non-mitigated". These 114 severe repetitive loss properties are associated with a total of 591 losses and $23,727,939 in claims payments under the NFIP since January 1978 (the earliest recorded date of loss), as shown in **Table 3a.17**. There are an average of 5.18 claims per property and an average payment of $40,149 per paid claim.

Table 3a.17
NFIP Severe Repetitive Loss Property Statistics (as of February 14, 2014)
for Non-mitigated Severe RL Properties
(Source: FEMA Region 2)

Jurisdiction	Totals for Non-mitigated SRL Properties			
	Non-Mitigated SRL Properties	Total Losses	Total Payments	Average Payments per Non-mitigated SRL
Atlantic Highlands, Borough of	1	4	$84,240	$21,060
Avon-By-The-Sea, Borough of	1	4	$93,456	$23,364
Hazlet, Township of	2	14	$284,410	$20,315
Highlands, Borough of	7	32	$827,183	$25,849
Little Silver, Borough of	2	9	$196,895	$21,877

Table 3a.17
NFIP Severe Repetitive Loss Property Statistics (as of February 14, 2014)
for Non-mitigated Severe RL Properties
(Source: FEMA Region 2)

Jurisdiction	Totals for Non-mitigated SRL Properties			
	Non-Mitigated SRL Properties	Total Losses	Total Payments	Average Payments per Non-mitigated SRL
Long Branch, City of	3	21	$555,299	$26,443
Manasquan, Borough of	7	36	$664,638	$18,462
Middletown, Township of	6	29	$711,066	$24,520
Monmouth Beach, Borough of	22	122	$7,866,045	$64,476
Ocean, Township of	2	14	$328,915	$23,494
Oceanport, Borough of	2	10	$299,089	$29,909
Rumson, Borough of	12	56	$3,393,406	$60,597
Sea Bright, Borough of	19	116	$3,728,900	$32,146
Spring Lake Heights, Borough of	3	12	$389,528	$32,461
Spring Lake, Borough of	20	81	$3,672,685	$45,342
Union Beach, Borough of	4	25	$581,652	$23,266
Upper Freehold, Township of	1	6	$50,532	$8,422
Total:	**114**	**591**	**$23,727,939**	**$40,149**

Probability of Occurrence – Flood

Flooding will continue to have a high probability of occurrence in Monmouth County, and the probability of future occurrences in Monmouth County is certain. The probability of future flood events based on magnitude and according to best available data is illustrated in **Figure 3a.10**, which indicates those areas susceptible to the 1 percent annual chance flood (100-year floodplain); the 1 percent annual chance flood with wave action (100-year coastal floodplain); and the 0.2 percent annual chance flood (500-year floodplain). The frequency of intense precipitation events in Monmouth County is expected to increase in the future with climate change; this is likely to result in more riverine and flash flooding events.

Flooding in Monmouth County is attributed mainly to tropical storms, nor'easters, and - to a lesser extent - severe thunderstorms. Usually occurring during late summer and early autumn, these storms can result in severe damage to coastal areas. Although extratropical cyclones can develop at almost any time of the year, they are more likely to occur during winter and spring. Thunderstorms are a common occurrence during the warm summer months.

It should also be noted that anticipated sea level rise will increase the risk of damages/losses due to future coastal flooding events. Rising sea level over time will shorten the return period (increasing the frequency) of significant flood events. For example; sea level rise of 1 foot over a typical project analysis period (50 years) may cause a flood event currently of annual probability 2 percent (50-year flood) to become an event of 10 percent annual probability (10-year flood). This increased probability obviously has an effect on the estimation of annualized loss/damage, but one that is typically only analyzed during detailed feasibility studies for projects proposed by the US Army Corps of Engineers.

Appendix 3a.1 includes maps, for each jurisdiction, showing the SFHA under high and moderate assumptions for sea level rise in each community and highlights critical facilities that may be exposed to 100-year flooding under future conditions. See **Section 3c** for estimates of riverine flood losses in 2050 with high estimates of sea level rise (2 feet).

Storm Surge

Location – Storm Surge

There are many areas in Monmouth County subject to potential storm surge inundation as modeled and mapped by the U.S. Army Corps of Engineers (USACE). **Figure 3a.14** illustrates inundation zones storm surges associated with hurricanes of Category 1 to 4 for Monmouth County derived from georeferenced SLOSH (Sea, Lake and Overland Surge from Hurricanes) data produced by the USACE in coordination with NOAA[9]. SLOSH is a modeling tool used to estimate storm surge for coastal areas resulting from historical, hypothetical or predicted hurricanes taking into account maximum expected levels for pressure, size, forward speed, track and winds. Therefore, the SLOSH data is best used for defining the potential maximum surge associated with various storm intensities for any particular location. Storm surge arrives prior to a hurricane's landfall, and the greater the hurricane's intensity, the sooner the surge arrives. As shown in the figure, all of Monmouth County's coastal jurisdictions are at high risk to storm surge inundation. While non-coastal areas may not be directly impacted by storm surge inundation, they might experience flooding caused by storm surge and extremely high tides that can affect the drainage of areas further inland. In total, 41 (77 percent) of municipal jurisdictions have been identified as being at risk to the storm surge hazard in Monmouth County.

Extent – Storm Surge

The magnitude or severity of the storm surge hazard is generally related to the category of storm making landfall, where Category 1 potential storm surge inundation areas are smaller than Category 4 potential inundation areas. The Saffir-Simpson is one scale used to classify storms according to their magnitude or severity. **Table 3a.18 shows the relationship between storm category and surge, as well as typical types of damages.**

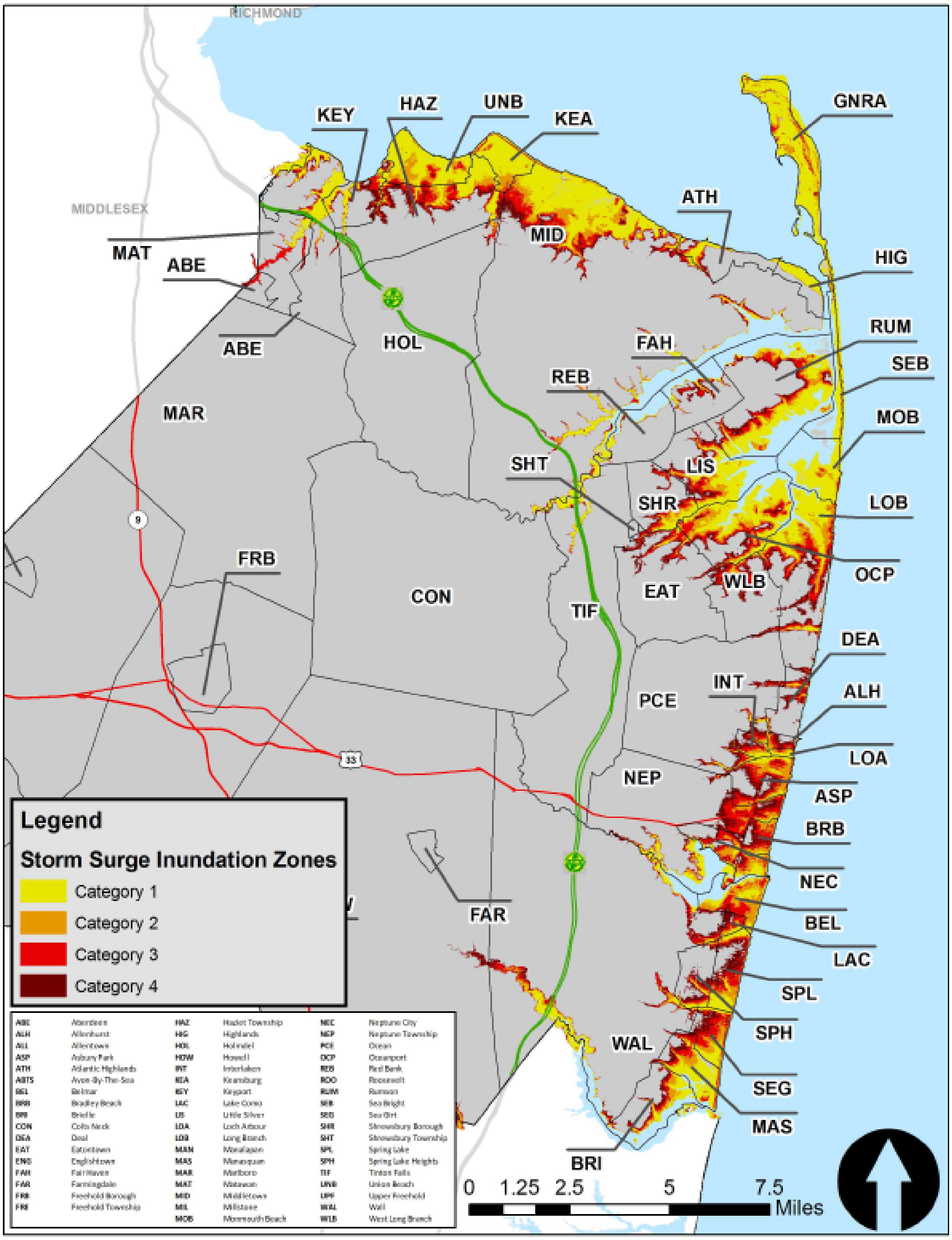
Table 3a.18
Saffir-Simpson Scale for Hurricanes

Storm Category	Maximum Sustained Wind Speed (mph)	Minimum Surface Pressure (Millibars)	Storm Surge (ft)	Damage Level	Description of Damages
1	74–95	Greater than 980	3–5	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery and trees. Also, some coastal flooding and minor pier damage.
2	96–110	979–965	6–8	MODERATE	Some roofing material, door and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings might break their moorings.
3	111–129	964–945	9–12	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain might be flooded well inland.
4	130–156	944–920	13–18	EXTREME	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain might be flooded well inland.
5	157 +	Less than 920	19+	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas might be required.

Source: National Oceanic and Atmospheric Administration

[9] This data represents a polygon feature set in Monmouth County showing the limits of potential flooding from Category 1-4 hurricanes. The data was compiled by the U.S. Army Corps of Engineers as part of a Hurricane Evacuation Study (HES) in 2005-2006 (http://www.nap.usace.army.mil/HES/nj/index.html). The USACE gathered 2003 contour lines data from Monmouth County as part of its calculations in using the National Weather Service- National Hurricane Center's SLOSH model (Sea, Lake and Overland Surges from Hurricanes).

Figure 3a.14
Hurricane Storm Surge Inundation Zones in Monmouth County



Source: Monmouth County

Historical Occurrences – Storm Surge

Before Superstorm Sandy, there is very limited data available for historical weather events that have caused storm surge inundation in Monmouth County. According to NCDC records, Monmouth County experienced a storm surge event in February 2006 that accounted for an estimated $900,000 in property damages, as described below. Storm surge has been a major factor associated with other weather events affecting Monmouth County, particularly nor'easters (as described separately within this section).

> **February 12, 2006.** The major winter storm that affected New Jersey had a major impact on the New Jersey shore. Strong onshore winds along with high tides produced coastal flooding along with beach erosion. Across coastal Monmouth County, minor to locally moderate coastal flooding was reported across many areas. In the Monmouth Beach area, a storm surge flooded the Patten Avenue Bridge along with some other streets during the early morning, where some cars were overtaken by water.
>
> **Hurricane Irene 2011. Hurricane Sandy 2012.** Storm surge associated with Hurricane's Irene and Sandy was extensive – and devastating for most coastal and bayshore communities during Sandy- and is discussed in detail in the section on Hurricanes and Tropical Storms.

Other notable reports of historical storm surge events include the following, as identified by the Planning Committee:

- The Borough of Allenhurst lost numerous beach buildings to storm surge during the 1992 nor'easter event.
- The Borough of Bradley Beach has experienced significant flooding issues due to storm surge in the past.
- Little Silver Borough indicated that the storm surge associated with the 1992 nor'easter was measured at a height of 11 feet and caused major coastal flooding along the waterfront.

Probability of Occurrence – Storm Surge

Monmouth County faces a relatively low probability of major storm surge inundation as derived from current SLOSH data for major hurricanes (Category 3-4). As described elsewhere in this section, the probability of a named storm making landfall in the vicinity of Monmouth County is 13 percent but is less for events that cause significant storm surge (dependent on storm speed, direction, tides, etc.). However, less severe to moderate storm surge events typically associated with nor'easters and less intense coastal storms are more likely to occur, and in the case of nor'easters will last longer and possibly cause more damage than fast-moving hurricanes. Additionally, the long-term rise in sea level can be expected to impact the occurrence of significant storm surges and hence future damages from coastal flooding in Monmouth County. Rising sea levels over time will shorten the return period (or exceedance interval) and hence increase the frequency of significant storm surge events. To take a hypothetical example, a one foot rise in sea level over 50 years could result in a storm surge event with a current annual occurrence probability of 2% (a "50-year" event) becoming an event of 10% annual probability (a "10-year" event).

The frequency and intensity of coastal storms and severe weather events is expected to increase in the future due to climate change. In the years to come, it is anticipated that Monmouth County will observe drastic changes in storm character, intensity, frequency, and storm tracking. Hurricanes are likely to become more intense with rising sea water temperatures. Coastal erosion rates are likely to increase with rising sea-level, to levels higher than those rates that have been observed over the last century. Storm effects will be more extensive in the future. The following types of impacts can be anticipated in Monmouth County's future as a result of climate change and sea level rise: inundation of low-lying areas; increased frequency and extent of storm-related flooding; wetland loss; saltwater intrusion into estuaries and freshwater aquifers; land loss through submergence and erosion of lands in coastal areas; migration of coastal landforms and habitats; increased salinity in estuaries and coastal fresh; impacts to human populations (property losses, more frequent flood damage, more frequent flooding of roadways and urban centers, risks to people as the population of coastal areas increases); more buildings and infrastructure exposed; currently exposed buildings and infrastructure could be subject to potentially greater losses as water levels increase, and continued rapid coastal development exacerbates the impacts of sea level rise; impacts on gravity flow stormwater systems; impacts on non-coastal areas. Impacts of climate change and sea level rise can affect all parts of a community, including: transportation infrastructure (ports, marinas, airports, roads, bridges, railways); public infrastructure (stormwater and wastewater management systems, drinking water supply and distribution systems, power utility systems, communications systems); public facilities (i.e., police, fire, ambulance, hospitals, schools, daycare centers, adult living facilities, historic landmarks, government buildings, libraries, parks, etc.); economic viability of a community – particularly for communities where tourism tends to drive local economies, as is the case in many of Monmouth County's coastal communities. Climate change and sea level rise could lead to a potential loss of assets that support tourism (i.e., beaches themselves as well beach access points, lodging, restaurants, marinas, fishing habitats, ecotourism, etc.).

Wave Action

Location – Wave Action

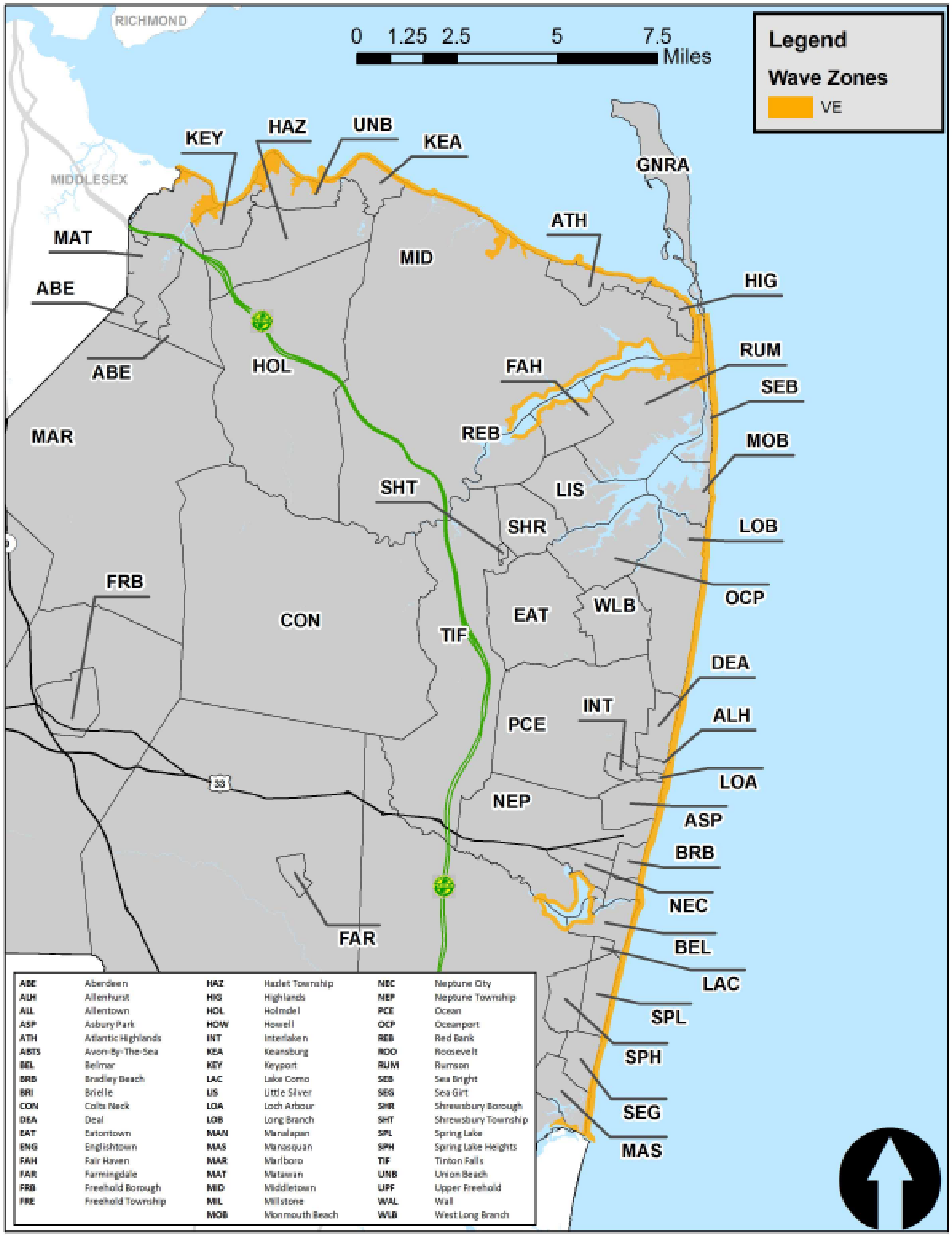
The areas most susceptible to wave action in Monmouth County are predominantly located along the immediate coastal and shoreline areas of the Atlantic Ocean and Raritan Bay. Additional areas may occasionally experience wave action during extremely large storm events that cause storm surge (addressed separately within this section). **Figure 3a.15** illustrates the wave action hazard zones for Monmouth County based on FEMA 2014 Preliminary FIRMs. This includes areas mapped as Zone VE according to the most recent Flood Insurance Study (FIS) completed by FEMA. Zone VE refers to coastal areas with a 1 percent or greater chance of flooding and an additional hazard associated with storm-driven velocity waves of three feet or more.[10]

Extent – Wave Action

There is no particular scale that classified the magnitude or severity of different wave events for different category storms. The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies and this mapping does include mapping of the V-zone, or the lands that can support breaking waves of three feet or more. This boundary is therefore a convenient tool for assessing the extent of the wave action hazard and risk in flood-prone communities. Higher Category storms on the Saffir-Simpson scale would, however, typically have more destructive waves breaking into the built environment at the coastline causing more extensive damages to those susceptible structures with increasing storm category.

[10] Figure 3a3.12 illustrates best available data based on the most recent FEMA Flood Insurance Study (FIS). It should be noted that although wave action hazard areas are not delineated along the Navesink River for the municipalities of Red Bank and Fair Haven, it has been determined that these areas in general should be considered susceptible to wave action. It is anticipated that future, more detailed flood studies for the area will delineate VE Zones that will support this determination.

Figure 3a.15
Wave Action Hazard Zones in Monmouth County



Source: FEMA, Preliminary Flood Hazard, 2014

Historical Occurrences – Wave Action

According to NCDC's latest records, 28 recorded wave action events ("high surf") have affected Monmouth County from August 1996 to September 2014 (data excludes wave action associated with other major historical events addressed separately within this section, such as hurricanes and nor'easters). These incidents resulted in a reported total of three deaths and 2 injuries in Monmouth County and caused an estimated $40,000 in property damages. Some recent notable events include the following:

August 14-20, 1995. Swells associated with Hurricane Felix generated rough surf and rip currents for about one week along the New Jersey shore. A 17-year-old surfer drowned off Deal. Two boys were swept off the beach by a large wave at Point Pleasant Beach. A 45-year-old male drowned in Avon-By-The-Sea. Numerous injuries were reported, five alone in Long Beach Township. The rough surf spread to Monmouth County and municipalities along the shore began restricting bathing. By the 16th, waves reached up to eight feet at Sandy Hook and most bathing was prohibited. As Felix weakened offshore, bathing restrictions began to be lifted on the 20th.

August 23-28, 1998. Rip currents and large waves associated with Hurricane Bonnie in the Atlantic Ocean caused hundreds of water rescues and resulted in swimming restrictions up and down the New Jersey shore. In Monmouth County, 10 swimmers were rescued at Bradley Beach and 25 were rescued at Manasquan and Spring Lake. On the 24th, swimming restrictions started as swells increased to six to eight feet. The most reported rescues on the 24th were in Monmouth County (about 25) in Manasquan and Spring Lake. One teenager in Spring Lake was injured. As Bonnie neared the North Carolina Coast on the 26th, beach restrictions became tighter. Numerous beaches were closed and surfing was banned in several communities.
August 30-31, 1999. The combination of swells from Hurricane Dennis and a stiff northeast flow caused by a strong high pressure system building over New England produced rough surf, some minor tidal flooding and beach erosion. A major contributing factor to the winds and rip currents was a very strong high pressure system that built into eastern Canada and New England. Bathing restrictions were in place. The highest recorded tide in Monmouth County was 6.7 feet above average tide heights at Sandy Hook.

August 25-26, 2001. The northeast to east flow around a high and a developing low pressure system produced rough surf and rip currents along the New Jersey shore. A person nearly drowned while fishing along the shore. A total bathing ban was in effect in Allenhurst, while yellow cautionary flags flew and partial bathing bans were in effect in other places such as Sea Girt. A 17-foot vessel capsized half a mile off of Shark River Inlet in five to six foot seas. In Belmar, a 42-foot sport fisher vessel carrying eight persons ran aground between the south jetty and a fishing pier.

March 13, 2010. The pounding surf and moderate to locally severe coastal flooding took its toll on the New Jersey coast. The tidal flooding in Monmouth County brought back memories of the December 1992 nor'easter. Wave heights reached 7 to 9 feet. On the Raritan Bay side, a 20 foot wide cut in a dune occurred at Point Comfort in Keansburg. Shore Boulevard was severely flooded. Smaller dune cuts also occurred in Bayshore, Port Monmouth and Belford. On the ocean side, 4 to 5 foot vertical cuts were common. Sea Bright lost fifty percent of its dune system. Tidal flooding along the Shrewsbury River spilled into homes and businesses in the central and southern side of the borough. In Manasquan, road damage occurred at the intersection of Third Avenue and Riverside Drive.

- *Note: See the Hurricane and Tropical Storm subsection for discussion of wave impacts during Sandy.*

Other notable reports of historical wave action events include the following, as identified by the Planning Committee:

- The Borough of Brielle has indicated that sustained wave action over the years has caused substantial deterioration to a bulkhead along the Manasquan River (at the end of Ocean Avenue). It is believed that during a future coastal storm, severe wave action could cause complete failure of the bulkhead causing great damage to not only the Borough-owned street but could also threaten a large commercial structure and a marine fuel facility located in the immediate proximity of this bulkhead. Salt water infiltration to the borough's potable water system may also occur.

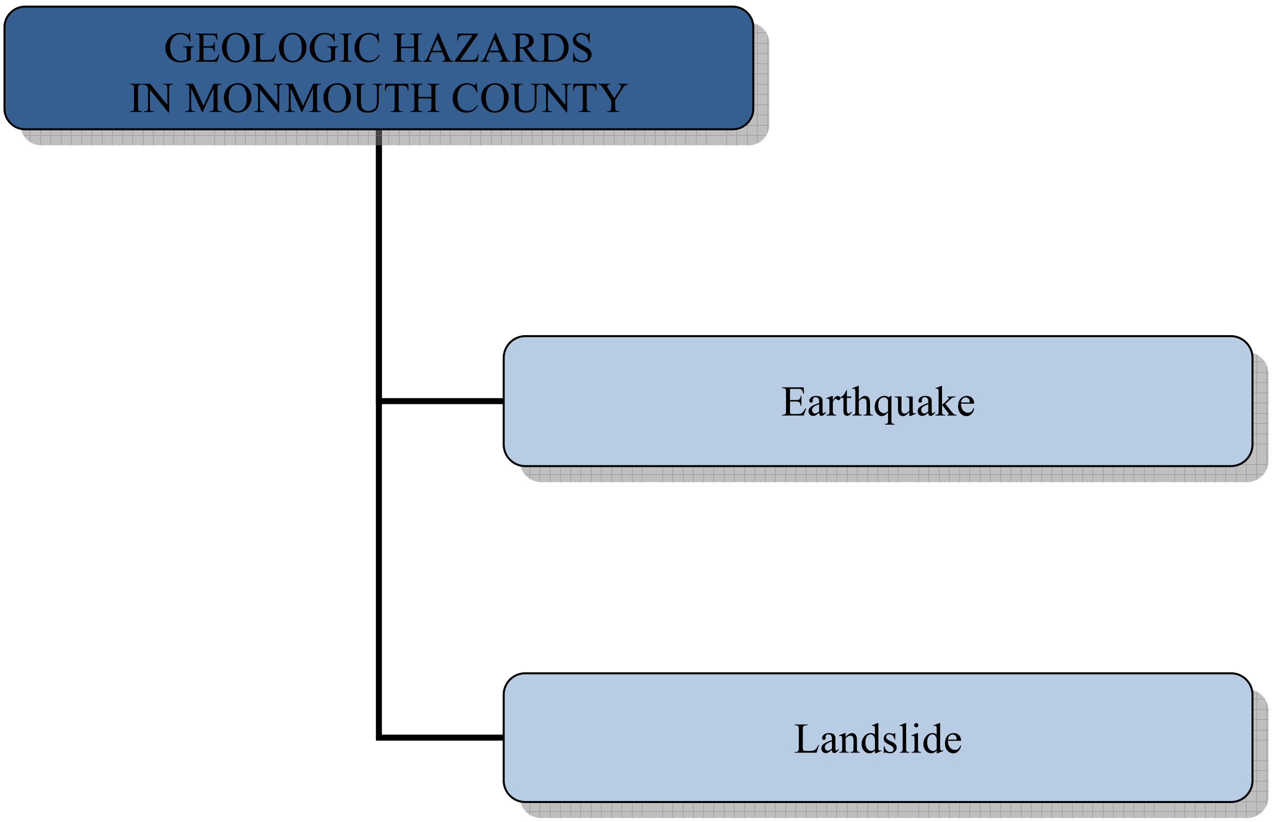
- The Township of Neptune has indicated that a one-block section of the Shark River Hills area experienced wave action during Sandy. The Ocean Grove area also experienced wave action during Sandy, which damaged the fishing pier portions of the boardwalk and dune. During the 1992 nor'easter, sections of the boardwalk were lost, along with some dune erosion.

Probability of Occurrence – Wave Action

Wave action will remain continue to have a high probability of occurrence for the coastal flood hazard zones of Monmouth County, and the probability of future occurrences is certain. Less severe wave action events will be more frequent but likely cause less impact (i.e., minor damages, coastal erosion, etc.), while more severe waves associated with less frequent coastal storm events such as hurricanes and nor'easters will cause higher impacts (including property damages) along Monmouth County's shoreline.

The frequency and intensity of coastal storms and severe weather events is expected to increase in the future due to climate change. In the years to come, it is anticipated that Monmouth County will observe drastic changes in storm character, intensity, frequency, and storm tracking. Hurricanes are likely to become more intense with rising sea water temperatures. Coastal erosion rates are likely to increase with rising sea-level, to levels higher than those rates that have been observed over the last century. Storm effects will be more extensive in the future. The following types of impacts can be anticipated in Monmouth County's future as a result of climate change and sea level rise: inundation of low-lying areas; increased frequency and extent of storm-related flooding; wetland loss; saltwater intrusion into estuaries and freshwater aquifers; land loss through submergence and erosion of lands in coastal areas; migration of coastal landforms and habitats; increased salinity in estuaries and coastal fresh; impacts to human populations (property losses, more frequent flood damage, more frequent flooding of roadways and urban centers, risks to people as the population of coastal areas increases); more buildings and infrastructure exposed; currently exposed buildings and infrastructure could be subject to potentially greater losses as water levels increase, and continued rapid coastal development exacerbates the impacts of sea level rise; impacts on gravity flow stormwater systems; impacts on non-coastal areas. Impacts of climate change and sea level rise can affect all parts of a community, including: transportation infrastructure (ports, marinas, airports, roads, bridges, railways); public infrastructure (stormwater and wastewater management systems, drinking water supply and distribution systems, power utility systems, communications systems); public facilities (i.e., police, fire, ambulance, hospitals, schools, daycare centers, adult living facilities, historic landmarks, government buildings, libraries, parks, etc.); economic viability of a community – particularly for communities where tourism tends to drive local economies, as is the case in many of Monmouth County's coastal communities. Climate change and sea level rise could lead to a potential loss of assets that support tourism (i.e., beaches themselves as well beach access points, lodging, restaurants, marinas, fishing habitats, ecotourism, etc.).

GEOLOGIC HAZARDS

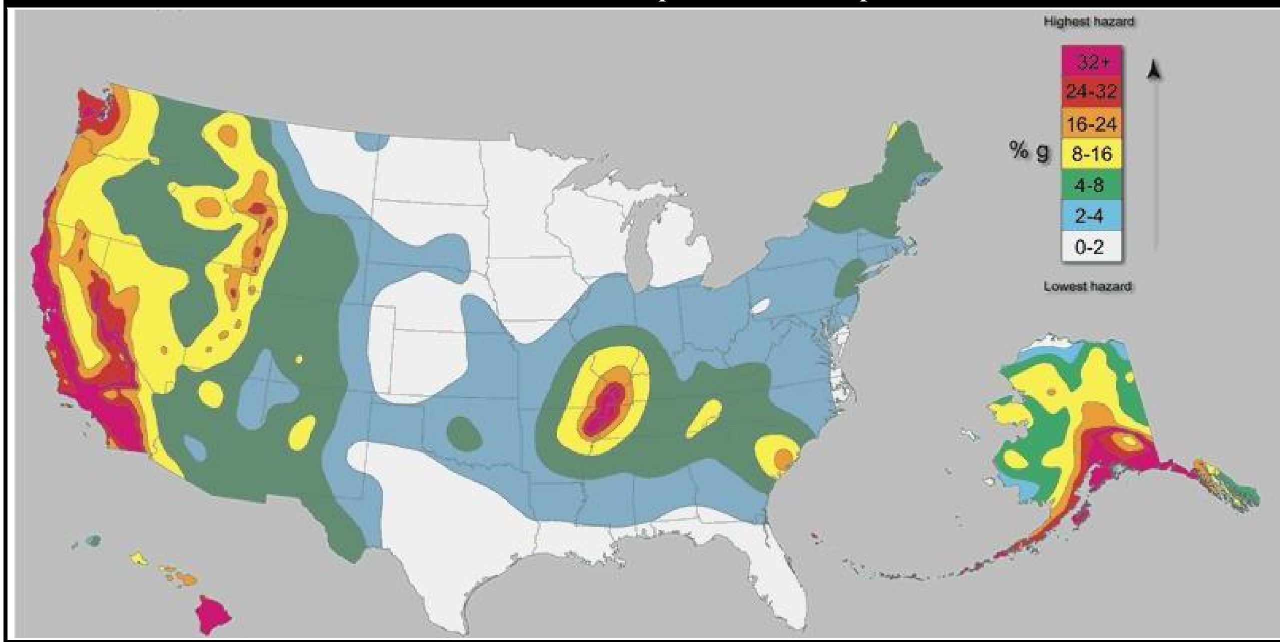


Earthquake

Location – Earthquake

The greatest earthquake threat in the United States is along tectonic plate boundaries and seismic fault lines located in the central and western states; however, the East Coast does face moderate risk to less frequent, less intense earthquake events. **Figure 3a.16** shows relative seismic risk for the United States.

Figure 3a.16
United States Earthquake Hazard Map



Source: United States Geological Survey

Figure 3a.17 shows the probability that ground motion will reach a certain level during an earthquake in Monmouth County and the surrounding region. The data shows peak horizontal ground acceleration (the fastest measured change in speed for a particle at ground level that is moving horizontally due to an earthquake) with a 10 percent probability of exceedance in 50 years. Monmouth County is located in an area with peak ground acceleration (PGA) values between 4%g and 5%g, which is a relatively low seismic risk but still enough to suggest that Monmouth County is susceptible to moderate, damaging earthquakes over time.

Extent – Earthquake

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude. Each unit increase in magnitude on the Richter Scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in **Table 3a.19**.

Table 3a.19
Magnitude/Intensity Comparison for Earthquakes

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

Source: US Geological Survey (http://earthquake.usgs.gov/learn/topics/mag_vs_int.php, page last modified September 29, 2014)

Historical Occurrences – Earthquake

Earthquakes do occur on a fairly regular basis in New Jersey, though most are of very low magnitude (MMI intensity of less than II) and often not felt by people or capable of causing property damage. According to the New Jersey Geological Survey, there have been 150 recorded earthquakes in New Jersey since 1783, including seven with epicenters located in Monmouth County (as shown in **Figure 3.17**). However, New Jersey's susceptibility to earthquakes extends to events located beyond state borders, and some of the most damaging earthquakes were associated with larger, more significant events occurring elsewhere along the East Coast (also shown in **Figure 3.17**). Most past earthquake damage in New Jersey has been to building contents and architectural damage, such as fallen chimneys, cracked plaster and masonry, and items falling off shelves. Some of the more notable earthquake events for the New Jersey region are identified in **Table 3a.20**.

Table 3a.20
Damaging Earthquakes Felt in the New Jersey Region[11]

Date	Location	Richter Magnitude	Description
12/19/1737	Greater NYC Area	5.2	Chimneys down in New York City. Felt from Boston, MA to Philadelphia, PA.
11/30/1783	North-Central New Jersey	5.3	Felt from New Hampshire to Pennsylvania. Two foreshocks (11/24 and 11/30) and one aftershock (11/30); threw down chimneys.
08/10/1884	Greater NYC Area	5.2	Threw down chimneys; felt from Virginia to Maine
09/01/1895	Near High Bridge, NJ	7.7	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.
06/01/1927	Near Asbury Park, NJ	3.9	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.
01/25/1933	Near Trenton, NJ	0.0	A sharp jolt was felt over central New Jersey from 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.
08/23/1938	Northeast of New Egypt, NJ	3.8	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 8/23 and one on 8/26.
11/15/1939	Salem County, NJ	3.4	The disturbance was reportedly 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.
3/23/1957	Schooley's Mountain, NJ	2.9	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 walls were cracked and plaster fell. The felt area was small in comparison with the other shocks previously described.
3/10/1979 "Cheesequake Earthquake"	Bernardsville, NJ (epicenter in Morris County)	3.1	Felt by some people in Manhattan
10/19/1985	Ardsley, NY	4	Many people in the NYC area felt this earthquake.

[11] *Source: NJ State Hazard Mitigation Plan ((http://www.state.nj.us/njoem/programs/pdf/mitigation2014b/mit2014_section5-5.pdf excerpts from Table 5.5-6).*

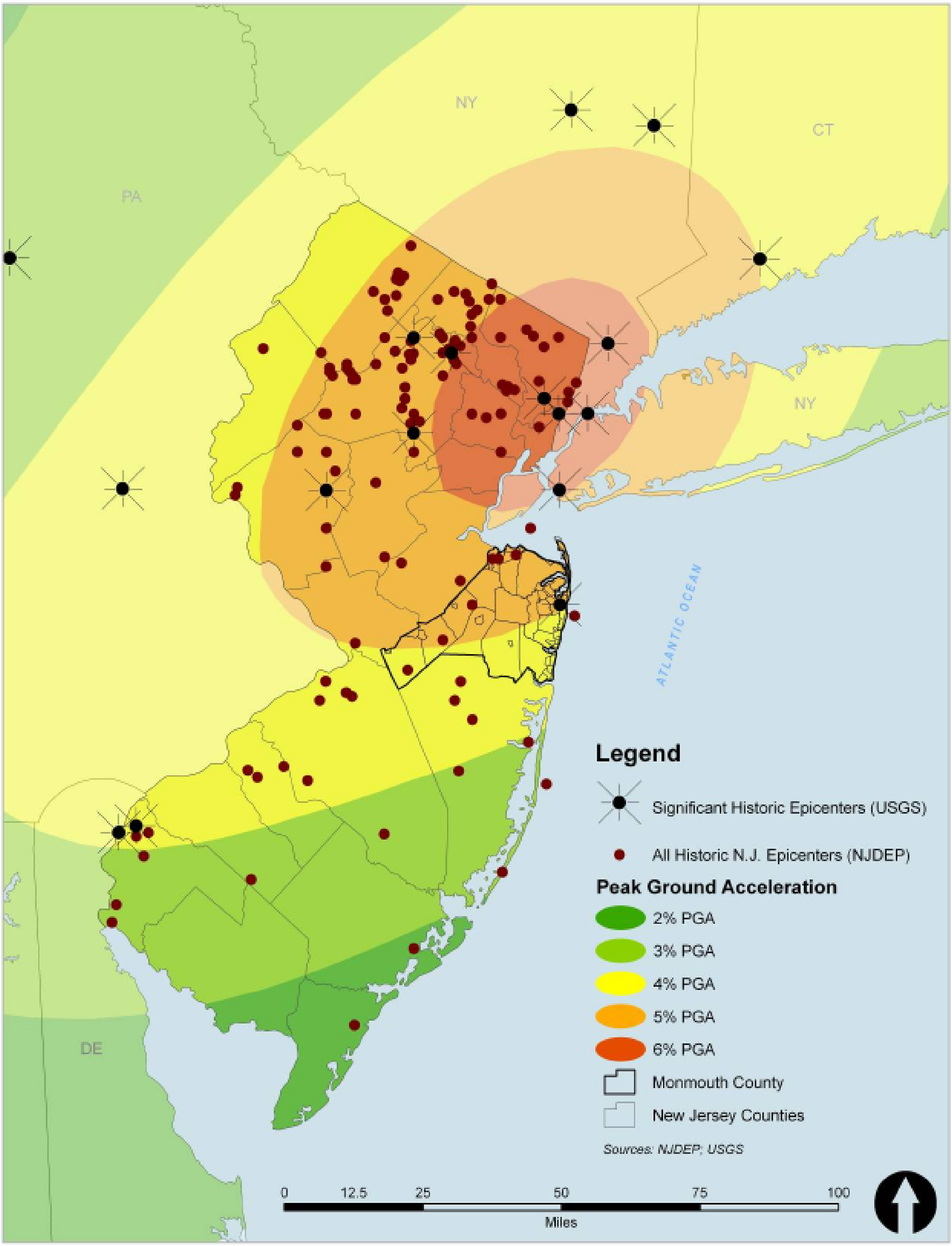
Table 3a.20
Damaging Earthquakes Felt in the New Jersey Region

Date	Location	Richter Magnitude	Description
10/23/1990	Hancock's Bridge, NJ	2.9	Felt in New Jersey, Delaware, and Pennsylvania
02/03/2009	3.5km South-Southwest of Rockaway, NJ	3.0	There were reports of people having felt this earthquake throughout New Jersey.
02/14/2009	5 km North-Northeast of Boonton, NJ	2.4	There were reports of people having felt this earthquake throughout New Jersey.
07/01/2009	2.25km East-Southeast of Pennsville, NJ	2.8	There were reports of people having felt this earthquake throughout New Jersey.
02/21/2010	Gladstone, NJ	2.6	This earthquake hit just before 9 a.m. and prompted numerous phone calls to police. No damages were reported. Many people in New Jersey reported having felt this earthquake. A 2.3 occurrence later in the day was also reported as having been felt by numerous people in New Jersey, and was most likely an aftershock.
06/06/2010	6 km Southeast of Sayreville, NJ	2.3	People reported having felt this earthquake throughout New Jersey.
08/23/2011	Central Virginia	5.8	A moderate earthquake occurred in central Virginia and was felt throughout most of the east, from Georgia to southern Canada and from Indiana to coastal Maine. It was followed by four aftershocks. In New Jersey, the intensity ranged from one to four (weak to light). Areas underlain by thick silt and clay felt a stronger ground motion than did those where rock was very close to the surface. The quake was felt in South Brunswick and residents were calling 911 wanting to know what happened; some thought it was an explosion. It was also felt in the offices of Alcatel-Lucent in Murray Hill (Union County). Ceiling tiles fell out at a Sears store in Middletown. In Plainfield (Union County), employees in the Park Madison building were evacuated after the tremor. Union County's administration building in Elizabeth reported continuous shaking. In New Brunswick (Middlesex County), employees were evacuated from the County administration building. Atlantic City (Atlantic County) went into emergency mode with evacuations of high rises, hospitals, schools, casinos, and hotels. The County OEM received reports of a crack in a wall in a house and broken water pipe in a building. There were minor scattered power outages reported throughout the state.
11/05/20112	3 km Southwest of Mahwah, NJ	2.0	People reported having felt this earthquake in various parts of New Jersey.
11/23/2012	Greater Philadelphia Area/New Jersey	2.2	Numerous reports of people having felt the earthquake in southwestern New Jersey.

Probability of Occurrence – Earthquake

The probability of significant, damaging earthquake events affecting Monmouth County is low. According to the United States Geological Survey (USGS), an earthquake with a 10 percent probability of exceedance over 50 years would have PGA values between 4%g and 5%g, which would result in light to moderate perceived shaking and damages ranging from none to very light. More destructive earthquakes are very rare, low probability events for Monmouth County with highly infrequent recurrence periods.

Figure 3a.17
Peak Ground Acceleration with a 10% Probability of Exceedance over 50 years



Landslide

Location – Landslide

The USGS has delineated areas throughout the country where large numbers of landslides have occurred and areas which are susceptible to land sliding, and this data confirms that the extreme northeast portion of Monmouth County is highly susceptible[12]). Mapped areas of high susceptibility are illustrated in **Figure 3a.18** along with the locations of historic landslide occurrences as recorded by the New Jersey Geological Survey (NJGS) and described further under "Historical Occurrences."

The NJGS mapping shows areas of high landslide susceptibility in seven communities: Atlantic Highlands, Fair Haven, Highlands, Little Silver, Middletown, Oceanport, and Rumson. The horizontal accuracy of the GIS file has a certain inherent degree of error which is presumed to be the reason why mapped landslide hazard areas are also showing in Sea Bright, Monmouth Beach, and Long Branch – areas where local knowledge suggests that landslide development would not be supported by the local topography. For planning purposes, landslides are, therefore, not considered to be a hazard in these three communities.

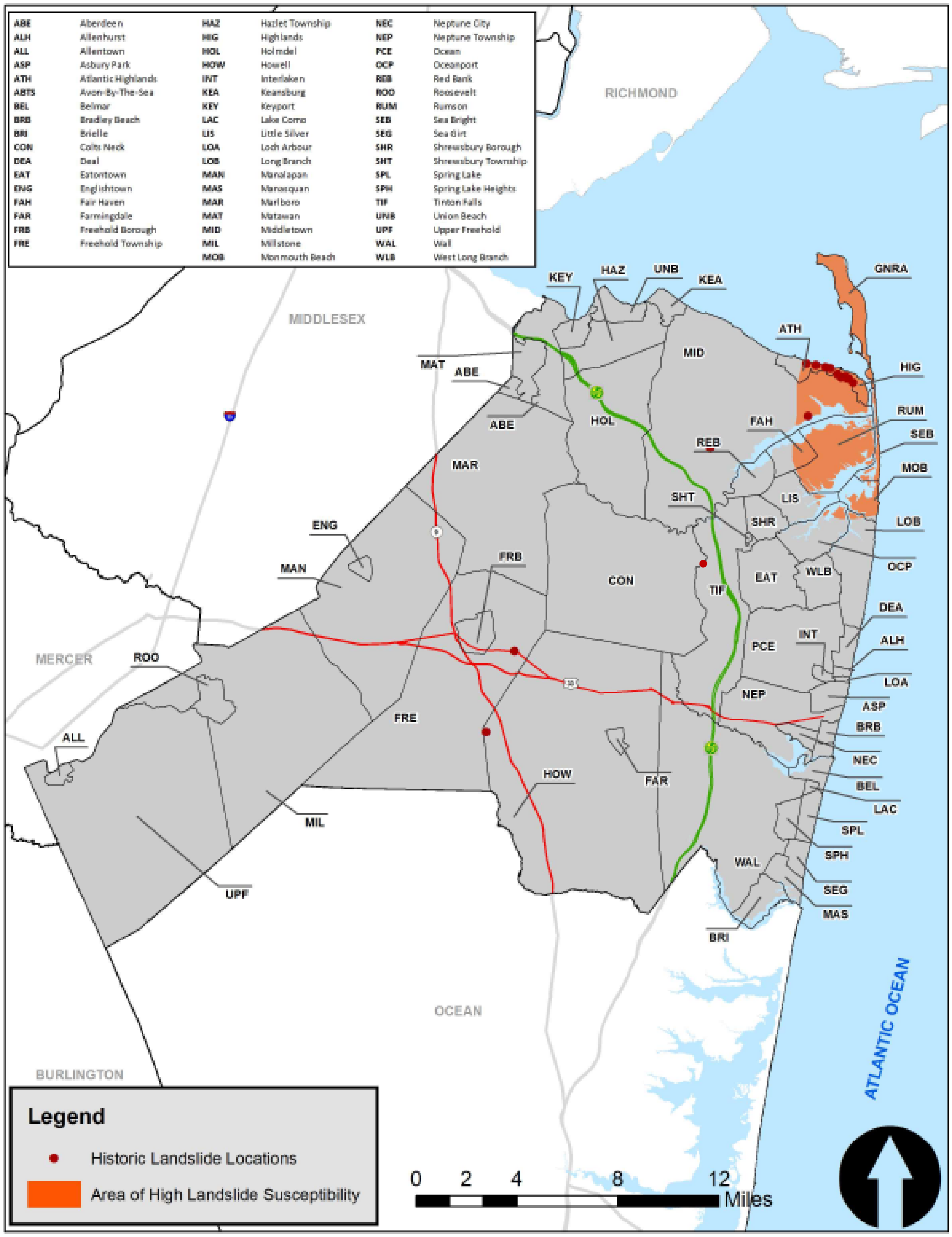
Three additional communities outside of mapped areas of high susceptibility have had historic occurrences: Freehold Township, Howell, and Tinton Falls and, therefore, landslides are considered to b a hazard for these communities as well.

Extent – Landslide

Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels and developed hillsides where leach-field septic systems are used. Slopes greater than 10 degrees are more likely to slide, as are slopes where the height from the top of the slope to its toe is greater than 40 feet. Slopes are also more likely to fail if vegetative cover is low and/or soil water content is high. Landslides occur when the slope or soil stability changes from stable to unstable, which may be caused by earthquakes, storms, volcanic eruptions, erosion, fire, or additional human-induced activities. Although in New Jersey landslides are not as common as in other areas of the United States, they are a geologic hazard in areas with steep to moderate slopes or geologic units prone to failure. According to the NJOEM, the largest landslide events in New Jersey occur in the form of slumping along the coastal bluffs of the Navesink Highlands area of Monmouth County (including the Boroughs of Atlantic Highlands and Highlands and Township of Middletown). While originally attributed to coastal erosion, slumping has reportedly begun anew in the last 30 years likely due to development at the bottom of slopes, an unusually high water table and changes in vegetative patterns.

[12] The horizontal accuracy of the USGS landslide hazard area GIS file has a certain degree of error, which places a very small portion of the hazard area within the municipal boundary of Sea Bright; however, this area has been discounted as it is over water.

Figure 3a.18
Landslide Susceptibility and Historical Incidents for Monmouth County



Source: NJDEP, Landslides in NJ

Historical Occurrences – Landslide

According to NJGS, 18 historical landslide events have occurred in Monmouth County, as listed in **Table 3a.21**. Most of these events were located in mapped areas of high landslide susceptibility, though three occurred outside of mapped hazard areas. These events caused minor property damages and three injuries.

Table 3a.21
Historical Landslide Events in Monmouth County

Event Date	Location	Type	Damage	Deaths	Injuries	Description
Unknown	Atlantic Highlands	Slump	No	0	0	Historic slump area, older landslide, probably hundreds of years old, estimated location.
April 1782	Highlands	Slump	No	0	0	1782 landslide from newspaper account possibly triggered by undercutting wave action, small landslide in 1972.
October 1903	Highlands	Debris flow	Yes	0	0	Big landslide reported at Waterwitch, just below the long pier, shut down the Central Railroad of NJ, estimated location.
1972	Highlands	Debris flow	No	0	0	Small landslide in 1972. No further details available.
November 1977	Highlands	Slump	No	0	0	Landslide after heavy rain.
January 1999	Highlands	Debris flow	Yes	0	2	Landslide, possibly due to fill material failure after heavy rain, one condominium unit destroyed, three others damaged.
September 1999	Middletown	Debris flow	No	0	1	A man digging for fossils in a 45 foot embankment along Big Brook was buried alive and seriously injured. Estimated location
August 2002	Middletown	Slump	No	0	0	Recent small slump in slump block possibly hundreds of years old on Navesink River bluff.
2003	Howell	Slump	Yes	0	0	River bank slumping on 26-foot high bank due to undercutting from the Manasquan River along 200 feet of Bergerville Road.Some road damage.
October 2005	Freehold Township	Debris flow	Yes	0	0	Landslide partially blocked road after heavy rain during road construction.
October 2005	Atlantic Highlands	Slump	Yes	0	0	Small backyard slump caused by water saturation after heavy rain, some property damage, estimated location.
April 2007	Highlands	Slump	Yes	0	0	Landslide on the bluff between Linden Avenue and Shore Drive, west of Waterwitch Drive in the Atlantic Highlands.
April 2010	Highlands	Debris flow	Yes	0	0	Triggered by nor'easter of March 31- April 1. Located on bluff between Linden Avenue and Shore Drive west of Waterwitch Drive. 50 feet wide 170 feet long. Deck and house threatened.
April 2010	Atlantic Highlands	Debris flow	Yes	0	0	Exact date unknown, first noticed in early April after back-to-back nor'easters of March/April.
April 2010	Atlantic Highlands	Debris flow	Yes	0	0	Exact date unknown, first noticed in early April after back-to-back nor'easters of March/April.
April 2010	Atlantic Highlands	Slump	No	0	0	Reactivation of old slump block.
August 2011	Highlands	Debris flow	Yes	0	0	Large landslide above condo complex triggered by heavy rain from Tropical Storm Irene damages condo complex.
August 2011	Highlands	Debris flow	Yes	0	0	Large landslide above condo complex triggered by heavy rain from Tropical Storm Irene damages condo complex. Reactivation of prior landslide.

Source: New Jersey Geological Survey

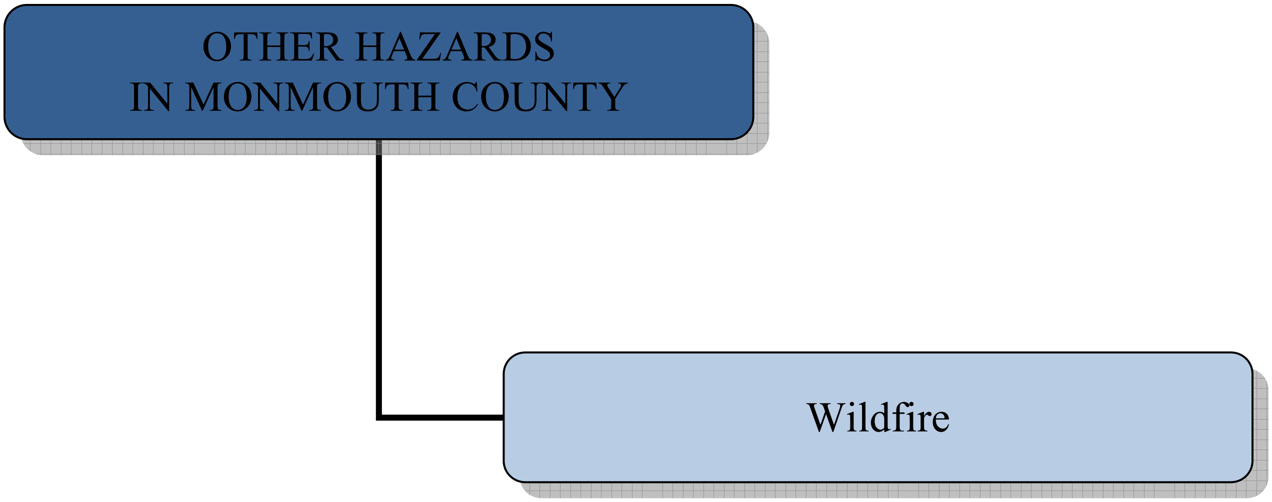
Other notable reports of historical landslide events include the following, as identified by the Planning Committee:

- The Borough of Atlantic Highlands and surrounding municipalities have been dealing with the fundamental problem of geologic instability, slope fragility and slumping for years. The problem in this high elevation area of Monmouth County has been so clearly established that it has a specific geological name: slump blocking. Slump blocking is characterized as an entire block of land slips downward, and there are numerous reports of large slump block occurrences in the area's recent geologic past, including those listed above. Specifically Mount Mitchill is an area of concern, but the extent of landslide risk has been described as the entire bluff along the south side of Sandy Hook Bay for a distance of four miles from Atlantic Highlands Yacht Harbor to the mouth of the Navesink River.
- The Borough of Highlands indicated that much of its hillside areas have suffered major erosion and smaller landslides are a common occurrence after most storms, occasionally causing property damage and frequently blocking roadways. Specifically, Bayside Drive (main road connecting Highlands to Atlantic Highlands) has been closed more often than not during the past 10 years due to erosion of the hillside and regular landslide activity.
- The Borough of Tinton Falls has an ongoing issue with areas of slumping along Water Street due to undercutting from the adjacent Pine Brook during periods of high flood flows along the Pine Brook. Most recently, in 2011, high floodwaters during Hurricane Irene caused Water Street's embankment to be undermined, causing slope failures and significant roadway damage in three areas. Photos of the damage and some of the repair work are shown immediately below. Road closures and detours were required as both temporary and permanent repairs were made over the following months. Local officials note similar issues along Jumping Brook.


Probability of Occurrence – Landslide

There is a high probability of future landslide events (primarily slumps and slump blocking) in the northeast portion of Monmouth County, including the municipalities of Atlantic Highlands, Fair Haven, Highlands, Little Silver, Long Branch, Middletown, Monmouth Beach, Rumson and Sea Bright. Particularly, slump blocking is highly likely to continue occurring along the coastal bluffs of Sandy Hook Bay and along the shore of the Navesink River. The probability of landslide events elsewhere in Monmouth County is low.

OTHER HAZARDS



Wildfire

Location – Wildfire

Areas typically prone to wildfire occurrence include large tracts of undeveloped wildlands containing heavier fuels with high continuity, steep slopes and far away from firefighting apparatus that would suppress the spread of wildfires once reported. The New Jersey Forest Fire Service (NJFFS) recently conducted a wildfire hazard assessment[13] for much of the state and has published a map of wildfire hazard areas in Monmouth County. **Figure 3a.19** illustrates this information and shows that the most significant wildfire hazard areas are located predominantly in the southern portions of the county.

Extent – Wildfire

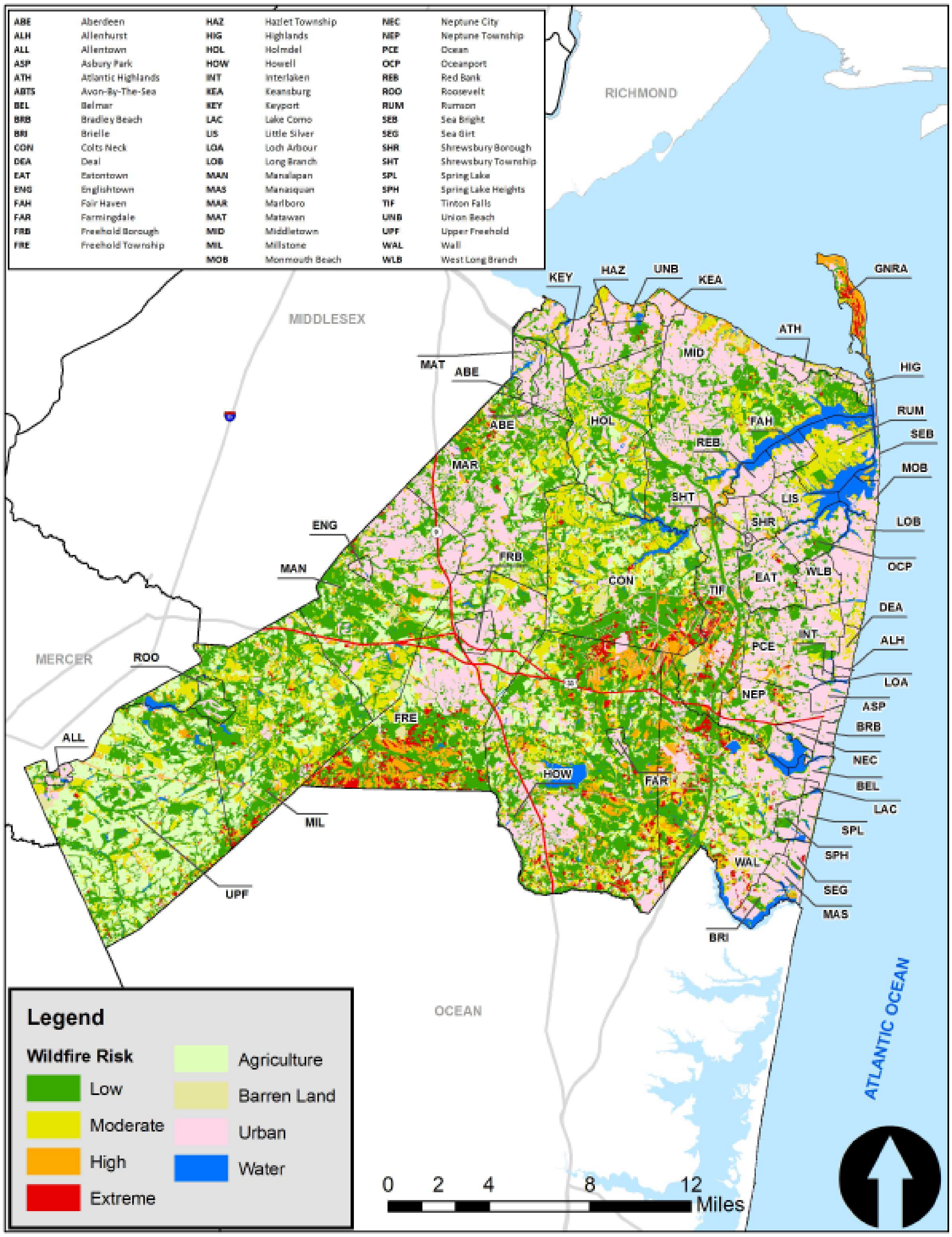
The extent (that is, magnitude or severity) of wildfires depends on weather and human activity. NJFFS uses two indices to measure and monitor dryness of forest fuels and the possibility of fire ignitions becoming wildfires. The State Plan notes that these indices include the National Fire Danger Rating System's Buildup Index, and the Keetch-Byram Drought Index. Both are used for fire preparedness planning, which includes the following: campfire and burning restrictions, fire patrol assignments, staffing of fire lookout towers, and readiness status for both observation and firefighting aircraft.

- 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).
- The **Keetch-Byram Drought Index (KBDI)** is a drought index designed for fire potential assessment as defined by the United States Department of Agriculture Forest Service. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. The index increases each day without rain and decreases when it rains. The scale ranges from zero (no moisture deficit) to 800 (maximum drought possible). The Florida Forest Service states that the range of the index is determined by assuming that 8 inches of moisture in a saturated soil 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.

There are also many other scales and fire weather indices that evaluate wildfire *potential* on any given day taking into account factors such as daily weather and vegetation condition information, fuel moisture, fuel hazard, moisture content in the lower atmosphere, etc.

[13] The methodological basis for the NJFFS wildfire risk assessment in Monmouth County was based on a correlation of fire risk to vegetation type as recorded in 1996 data for Land Use / Land Cover data.

Figure 3a.19
Wildfire Hazard Areas for Monmouth County



Source: NJDEP

Historical Occurrences – Wildfire

According to data made available through NJFFS, Monmouth County averages approximately 50 wildfire events per year though most of these are kept fairly small and are suppressed rather quickly (burning less than one acre). The 10-year average for number of wildfires in Monmouth County between 1993 and 2003 was 51 incidents per year, and the average number of acres burned was 35 per year (0.69 acres per fire). A sampling of notable events includes the following:

> **September 7-10, 1838.** The *New York Herald* reported a fire south and east of Bordentown in Burlington and Monmouth counties 14 miles wide by 20 miles long (approximately 179,200 acres). A good deal of property damage was reported, along with possible loss of life.
>
> **April 15, 1977.** A local newspaper reported that approximately 300 acres of woods were burned in Howell Township. The fire was fanned by winds of 15 mph which swept across Yellowbrook Road. Approximately 20 fire departments assisted. Yellowbrook Road and a portion of Route 33 were closed for several hours.
>
> **April 30, 2001.** The unseasonably dry weather during the second half of April continued to make it easy for brush and wildfires to begin and then spread quickly. Three such wildfires occurred during the afternoon and evening on the 30th across central New Jersey. In Port Monmouth, a four-acre fire consumed vegetation. No property damage was reported.
>
> **May 1, 2001.** The extremely dry and unseasonably warm weather of early May made New Jersey primed for wild and forest fires. In the Belford section of Middletown Township, a wildfire consumed four grassy acres before it was under control. One home's siding was damaged when the fire crept close to it. Two smaller brush fires occurred that afternoon within the township off of County Route 520 and Harbor Way. No damage or injuries were reported.
>
> **March 10, 2002.** A brush fire, largely exacerbated by strong gusty winds, scorched about 200 acres of brush in the Port Monmouth section of Middletown. The fire began near Main Street and Broadway. The strong winds fanned the fire and brought it close to several houses on Park Avenue, but none were damaged. About 100 firefighters fought the blaze. It was extinguished about two hours later.
>
> **February 19, 2011.** The combination of the strong west-northwest winds, low humidity levels, and recent dry weather helped cause the rapid spread of wildfires across New Jersey during the day on February 19. In all, 10 wildfires were reported across the State. In Manalapan, a brush fire reached 200 yards in length on Smithburg Road before it was contained. Other wildfires were reported in Sayreville and Old Bridge.

Other notable reports of historical wildfire events include the following, as identified by the Planning Committee:

- The Township of Ocean has several large wooded areas that are a part of the Green Acres Preserve and has a history of wildfires. Due to lightning or human-caused incidents, local fire departments respond to these areas several times on an annual basis. Many of these areas are not accessible by traditional fire apparatus.
- The Borough of Roosevelt is located next to Assunpink Wildlife Preserve which has several brush fires per year.

Probability of Occurrence – Wildfire

Wildfire probability depends on local weather conditions; outdoor activities such as camping, debris burning, and construction; and the degree of public cooperation with fire prevention measures. Wildfire events will continue to have a high probability of occurrence in Monmouth County, and the probability of future occurrences in Monmouth County is certain. However, these events are typically contained and extinguished rather quickly and those events causing major property damage or life/safety threats are much less likely to occur.

Sections 3B and 3C - VULNERABILITY ASSESSMENT

Overview

Sections 3B and 3C build upon the information provided in the *Hazard Profiles* section (3A) by identifying and characterizing an inventory of assets in Monmouth County, and then assessing the potential impact and amount of damages that can be expected to be caused by each identified hazard event. The primary objective of the vulnerability assessment is to quantify exposure and the potential loss estimates for each hazard, by jurisdiction. In so doing, Monmouth County and each of its municipalities may better understand their own unique risks to identified hazards and be better prepared to evaluate and prioritize unique hazard mitigation actions for their communities.

This section begins with a summary description of the asset inventory as compiled for Monmouth County through coordination with the Monmouth County Office of GIS, as well as an explanation of the methodology applied to complete the multi-jurisdictional vulnerability assessment. The remainder of this section focuses on the results of the vulnerability assessment and is organized by hazard in similar format to the *Hazard Profiles* section, and as listed below.

- **Atmospheric**
    - Extreme Temperatures
    - Extreme Wind
    - Hurricane and Tropical Storm
    - Lightning
    - Nor'easter
    - Tornado
    - Winter Storm
- **Hydrologic**
    - Coastal Erosion
    - Dam Failure
    - Drought
    - Flood
    - Storm Surge
    - Wave Action
- **Geologic**
    - Earthquake
    - Landslide
- **Wildfire**

3B - Identification and Characterization of Assets in Hazard Areas

An inventory of Monmouth County's georeferenced assets[1] was created in order to identify and characterize property and persons potentially at risk to the identified hazards. By understanding the type and number of assets that exist and where they are located in relation to known hazard areas, the relative risk and vulnerability for such assets can be assessed. Under this assessment, six categories of assets were created and then further assessed through geographic information systems (GIS) analysis. The six categories of assets include:

1. Improved Property: Includes all developed privately held properties according to local parcel data provided by Monmouth County. The information has been expressed in terms of the total assessed value of improvements[2] that may be exposed to the identified hazards.

2. Emergency Facilities: Includes emergency operations centers (EOCs), fire stations, police stations and hospitals. Schools that serve as Red Cross shelters are not included in this category but are addressed separately under "other critical facilities." Data for fire stations, police stations and hospitals was provided by Monmouth County; and EOC data was obtained from HAZUS-MH®. HAZUS defines EOCs as municipal government disaster operation and communication centers deemed (for design) to be vital in emergencies; they are dedicated facilities used for emergency operations, separately and distinctly from hospitals, fire stations, police stations, etc.

3. Critical Infrastructure and Utilities: Includes airports, ferry ports, potable water treatment facilities, wastewater treatment facilities and municipal public works buildings. Data for ferry ports, airports and municipal public works buildings was provided by Monmouth County, and data for potable water treatment facilities and wastewater treatment facilities was obtained from HAZUS-MH.

4. Other Critical Facilities: Includes schools (including those used as Red Cross Shelters), childcare facilities and senior care facilities according to data provided by Monmouth County. Additional childcare facilities as well as private schools were obtained from HAZUS-MH and NJGIN. These are non-emergency facilities but still provide critical services and functions for vulnerable sectors of the population.

5. Historic and Cultural Resources: Includes those historic properties and sites that are included in the New Jersey or National Registers of Historic Places, or that have been determined eligible for inclusion through Federal or state processes as administered by the New Jersey Historic Preservation Office.

6. Population: Includes the number of persons residing throughout Monmouth County as delineated by census block data from U.S. Census 2010.

The remainder of this subsection provides a more detailed breakdown, by jurisdiction, of georeferenced assets that have been identified for inclusion in the multi-jurisdictional vulnerability assessment.

[1] While potentially not all-inclusive for Monmouth County, "georeferenced" assets include those assets for which specific location data is readily available for connecting the asset to a specific geographic location for purposes of GIS analysis.

[2] Total assessed values for improvements is based on tax assessor records as provided by municipal jurisdictions to Monmouth County and joined to parcel data. It does not include dollar figures for tax-exempt improvements, such as publicly-owned facilities.

Improved Property

There is an estimated $55.1 billion in improved property value throughout Monmouth County. **Table 3b.1** lists the total number and percentage of improved parcels as well the total assessed value of their improvements by jurisdiction based on data provided through the Monmouth County Office of GIS.

Table 3b.1
Improved Property by Jurisdiction

Jurisdiction	Total Number of Parcels	Number of Improved Parcels	Percent of Improved Parcels	Total Assessed Value of Improvements
Aberdeen, Township of	7,174	6,430	89.63%	$1,057,910,200
Allenhurst, Borough of	347	334	96.25%	$163,629,600
Allentown, Borough of	700	654	93.43%	$128,744,000
Asbury Park, City of	4,565	3,669	80.37%	$822,648,930
Atlantic Highlands, Borough of	1,947	1,700	87.31%	$251,833,600
Avon-By-The-Sea, Borough of	1,084	1,048	96.68%	$346,002,100
Belmar, Borough of	2,909	2,669	91.75%	$507,354,100
Bradley Beach, Borough of	2,104	1,985	94.34%	$402,974,400
Brielle, Borough of	2,137	2,009	94.01%	$490,439,800
Colts Neck, Township of	3,966	3,422	86.28%	$1,679,133,600
Deal, Borough of	960	896	93.33%	$511,562,800
Eatontown, Borough of	3,474	3,082	88.72%	$1,158,392,100
Englishtown, Borough of	717	673	93.86%	$125,736,600
Fair Haven, Borough of	2,180	2,099	96.28%	$589,631,200
Farmingdale, Borough of	443	414	93.45%	$112,597,500
Freehold, Borough of	3,280	3,148	95.98%	$636,156,950
Freehold, Township of	13,369	11,914	89.12%	$3,944,416,100
Hazlet, Township of	6,954	6,640	95.48%	$1,212,072,900
Highlands, Borough of	2,611	2,229	85.37%	$282,777,500
Holmdel, Township of	6,088	5,675	93.22%	$2,086,402,399
Howell, Township of	25,517	17,527	68.69%	$3,182,248,300
Interlaken, Borough of	434	394	90.78%	$91,685,800
Keansburg, Borough of	3,473	3,213	92.51%	$349,667,700
Keyport, Borough of	2,401	2,200	91.63%	$422,424,400
Lake Como, Borough of	1,004	954	95.02%	$155,708,700
Little Silver, Borough of	2,609	2,461	94.33%	$747,827,900
Loch Arbour, Village of	148	142	95.95%	$39,039,500
Long Branch, City of	9,875	8,952	90.65%	$2,345,429,800
Manalapan, Township of	15,423	13,542	87.80%	$3,793,581,500
Manasquan, Borough of	3,281	3,059	93.23%	$723,654,300
Marlboro, Township of	14,391	13,241	92.01%	$3,947,148,000
Matawan, Borough of	2,757	2,481	89.99%	$501,846,200
Middletown, Township of	25,596	22,983	89.79%	$4,980,350,600
Millstone, Township of	4,284	3,325	77.61%	$994,523,937
Monmouth Beach, Borough of	1,676	1,494	89.14%	$452,626,900
Neptune City, Borough of	1,724	1,627	94.37%	$240,091,400
Neptune, Township of	12,230	10,250	83.81%	$1,522,988,600
Ocean, Township of	9,695	8,730	90.05%	$2,086,610,750
Oceanport, Borough of	2,280	2,050	89.91%	$518,615,000
Red Bank, Borough of	4,348	4,014	92.32%	$1,186,117,471

Table 3b.1
Improved Property by Jurisdiction

Jurisdiction	Total Number of Parcels	Number of Improved Parcels	Percent of Improved Parcels	Total Assessed Value of Improvements
Roosevelt, Borough of	376	330	87.77%	$40,634,100
Rumson, Borough of	2,653	2,509	94.57%	$1,411,914,600
Sea Bright, Borough of	1,304	1,135	87.04%	$238,003,600
Sea Girt, Borough of	1,335	1,239	92.81%	$469,081,700
Shrewsbury, Borough of	1,537	1,481	96.36%	$490,447,400
Shrewsbury, Township of	399	397	99.50%	$26,891,400
Spring Lake, Borough of	2,088	1,989	95.26%	$1,047,534,400
Spring Lake Heights, Borough of	2,459	2,196	89.30%	$454,145,300
Tinton Falls, Borough of	8,383	6,394	76.27%	$2,014,827,700
Union Beach, Borough of	2,513	2,207	87.82%	$255,879,500
Upper Freehold, Township of	3,278	2,489	75.93%	$810,887,400
Wall, Township of	10,818	9,909	91.60%	$2,302,913,200
West Long Branch, Borough of	2,655	2,454	92.43%	$785,971,500
Total	**249,954**	**218,058**	**87.24%**	**$55,141,734,937**

Source: Monmouth County Office of [redacted]

[redacted]

[redacted]

Critical Infrastructure and Utilities

There are 119 identified critical infrastructure and utility elements in Monmouth County, including 19 potable water treatment facilities, 19 wastewater treatment facilities, 49 municipal public works buildings, one significant airport and four ferry ports. **Table 3b.3** shows critical infrastructure and utilities by jurisdiction. Geographic coordinates (i.e., latitude and longitude) were used to determine the location of each facility within each jurisdiction.

[redacted]

[redacted]

Other Critical Facilities

There are 541 facilities which are considered non-emergency but still critical in Monmouth County, including 402 schools and child care facilities (including camps) and 139 senior care facilities. **Table 3b.4** shows these facilities by jurisdiction. Geographic coordinates (i.e., latitude and longitude) were used to determine the location of each facility within each jurisdiction.

Table 3b.4
Other Critical Facilities by Jurisdiction

Jurisdiction	Schools/Child Care Facilities	Senior Care Facilities
Aberdeen, Township of	11	3
Allenhurst, Borough of	4	0
Allentown, Borough of	0	0
Asbury Park, City of	14	10
Atlantic Highlands, Borough of	2	1
Avon-By-The-Sea, Borough of	1	0
Belmar, Borough of	5	1
Bradley Beach, Borough of	2	0
Brielle, Borough of	1	0
Colts Neck, Township of	6	1
Deal, Borough of	5	0
Eatontown, Borough of	15	1
Englishtown, Borough of	5	1
Fair Haven, Borough of	3	0
Farmingdale, Borough of	4	0
Freehold, Borough of	6	6
Freehold, Township of	23	8
Hazlet, Township of	16	5
Highlands, Borough of	4	1
Holmdel, Township of	10	6
Howell, Township of	28	6
Interlaken, Borough of	0	0
Keansburg, Borough of	4	5

Table 3b.4
Other Critical Facilities by Jurisdiction

Jurisdiction	Schools/Child Care Facilities	Senior Care Facilities
Keyport, Borough of	4	3
Lake Como, Borough of	1	12
Little Silver, Borough of	5	0
Loch Arbour, Village of	0	0
Long Branch, City of	20	0
Manalapan, Township of	20	4
Manasquan, Borough of	7	1
Marlboro, Township of	25	5
Matawan, Borough of	5	2
Middletown, Township of	39	12
Millstone, Township of	8	1
Monmouth Beach, Borough of	1	0
Neptune City, Borough of	1	2
Neptune, Township of	15	4
Ocean, Township of	12	3
Oceanport, Borough of	2	1
Red Bank, Borough of	7	6
Roosevelt, Borough of	1	0
Rumson, Borough of	6	0
Sea Bright, Borough of	0	0
Sea Girt, Borough of	1	0
Shrewsbury, Borough of	3	3
Shrewsbury, Township of	0	2
Spring Lake, Borough of	4	0
Spring Lake Heights, Borough of	2	0
Tinton Falls, Borough of	15	6
Union Beach, Borough of	1	0
Upper Freehold, Township of	2	0
Wall, Township of	23	9
West Long Branch, Borough of	6	1
Total	**402**	**139**

Sources: HAZUS-MH, Monmouth County Office of GIS

Historic and Cultural Resources

There are 103 georeferenced historic properties and sites/districts in Monmouth County which are included in the New Jersey or National Registers of Historic Places, or that have been determined eligible for inclusion through Federal or state processes as administered by the New Jersey Historic Preservation Office (HPO). These properties are listed in **Table 3b.5,** along with other properties considered to be of historic and/or cultural significance that have been identified by the individual jurisdictions. The data does not preclude the existence of other historic properties or sites not within this category or as yet to be identified. Further, HPO is still in the process of building the GIS database of historic and cultural resource properties and this data represents only a portion of the total number of properties.

Table 3b.5
Inventory of Historic Properties

Property Name	Location	Jurisdiction
Allenhurst Railroad Station	Main Street	Allenhurst Borough
Allenhurst Residential Historic District	(historic district)	Allenhurst Borough
Allentown Historic District	(historic district)	Allentown Borough
Allentown Mill	42 South Main Street	Allentown Borough
Asbury Park Convention Hall	Ocean Avenue	Asbury Park City
Asbury Park Post Office	801 Bangs Avenue	Asbury Park City
George Wurt's Summer Home	306 Eighth Avenue	Asbury Park City
Mayfair Theatre [Demolished]	Lake Avenue and Saint James Place	Asbury Park City
Palace Amusements Building [Demolished]	201-207 Lake Avenue	Asbury Park City
Steinbach/Cookman Building	Cookman Avenue	Asbury Park City
Winsor Building	400-420 Main Street	Asbury Park City
Bradley Beach Railroad Station	East of Memorial Parkway between LaReine and Brimley avenues	Bradley Beach Borough
Brielle Road Bridge over the Glimmer Glass (S.I. & A. #13000W9)	Brielle Road over Glimmer Glass	Brielle Borough
Probasco-Dittmar Homestead	61 Bucks Mill Road	Colts Neck Township
St. James Memorial Episcopal Church	69 Broad Street	Eatontown Borough
Village Inn (Davis Tavern)	13 Main Street	Englishtown Borough
Fisk Chapel	25 Cedar Avenue	Fair Haven Borough
Court Street School	Court Street at Holmes Terrace	Freehold Borough
General Clinton's Headquarters	150 West Main Street	Freehold Borough
George Taylor House	74 Broadway	Freehold Borough
St. Peter's Episcopal Church	31 Throckmorton Street	Freehold Borough
Walker-Combs-Hartshorne House	189 Wemrock Road	Freehold Township
Fort Hancock Life Saving Station	Gateway National Recreation Area	Gateway National Recreation Area
Fort Hancock and Sandy Hook Proving Ground Historic District	Gateway National Recreation Area	Gateway National Recreation Area
Sandy Hook Lighthouse	Sandy Hook	Gateway National Recreation Area
Twin Lights (Navesink Lighthouse)	Lighthouse Road	Highlands Borough
Dr. Robert W. Cooke Medical Office	67 McCampbell Road	Holmdel Township
Holmdel Dutch Reformed Church	41 Main Street	Holmdel Township
Holmes-Hendrickson House	Longstreet Road, adjacent to Holmdel Park	Holmdel Township
Horn Antenna	Off Garden State Parkway in Crawford Hill Facility	Holmdel Township
Kovenhoven House	Schank Road, east of NJ Route 34	Holmdel Township
Longstreet Farm	Longstreet Road at Roberts Road	Holmdel Township
Upper Meeting House of the Baptist Church of Middletown (Holmdel Community Church)	40 Main Street	Holmdel Township
Little Silver Railroad Station	Sycamore and Oceanport avenues	Little Silver Borough
Parker Farm	235 Rumson Road	Little Silver Borough
St. John's Episcopal Church	Little Silver Point Road	Little Silver Borough
364 Cedar Avenue	364 Cedar Avenue	Long Branch City
Church of the Presidents (St. James Church)	1260 Ocean Avenue	Long Branch City
Elberon Railroad Station	Lincoln Avenue	Long Branch City
Long Branch Post Office	60 Third Avenue	Long Branch City
North Long Branch School (Primary No. 3; Church Street School)	469 Church Street	Long Branch City
Anderson House [Demolished]	Route 33	Manalapan Township

Table 3b.5
Inventory of Historic Properties

Property Name	Location	Jurisdiction
Freehold & Jamesburg Agricultural Railroad Historic District	(historic district)	Manalapan Township
Monmouth Battlefield Historic District	(historic district)	Manalapan Township
Brielle Road Bridge over the Glimmer Glass (S.I. & A. #13000W9)	Brielle Road over Glimmer Glass	Manasquan Borough
Squan Beach Life-Saving Station #9	124 Ocean Avenue	Manasquan Borough
Old Kentucky	Pleasant Valley Road	Marlboro Township
Old Scots Burying Ground	Gordon's Corner Road	Marlboro Township
Major John Burrowes Mansion	94 Main Street	Matawan Borough
Matawan Railroad Station	Between Main and Atlantic avenues	Matawan Borough
All Saints Memorial Church Complex	Navesink, Stone Church Corner, Navesink Avenue and Locust Road	Middletown Township
Bowne House	Leonard Avenue	Middletown Township
Christ Episcopal Church	92 Kings Highway	Middletown Township
Grover House	940 West Front Street	Middletown Township
Middletown Village Historic District	(historic district)	Middletown Township
Navesink Historic District	(historic district)	Middletown Township
Seabrook-Wilson House (Spy House)	119 Port Monmouth Road	Middletown Township
Throckmorton Farm	Poricy Park, Oak Hill Road	Middletown Township
Union Schoolhouse/School Number Nine	Middletown-Lincroft Road and Dwight Road	Middletown Township
Water Witch	(historic district)	Middletown Township
Water Witch Club Casino	Corner of East Twin Road and West Twin Road	Middletown Township
Clarksburg Methodist Episcopal Church	512 Stagecoach Road (County Route 524)	Millstone Township
Clarksburg School	524 Stagecoach Road (County Route 524)	Millstone Township
U.S. Life-Saving Station #4	Seacrest Road and Ocean Avenue	Monmouth Beach Borough
Ocean Grove Camp Meeting Association Historic District	(historic district)	Neptune Township
Anthony Reckless Estate	164 Broad Street	Red Bank Borough
Monmouth Boat Club	Union Street	Red Bank Borough
North Shrewsbury Ice Boat and Yacht Club	9 Union Street	Red Bank Borough
Red Bank Passenger Station	Bridge and Monmouth streets	Red Bank Borough
River Street School	60 River Street	Red Bank Borough
Robert White House	20 South Street	Red Bank Borough
Shrewsbury Township Hall	51 Monmouth Street	Red Bank Borough
T. Thomas Fortune House	94 West Bergen Place	Red Bank Borough
Jersey Homesteads Historic District	(historic district)	Roosevelt Borough
First Presbyterian Church of Oceanic	East River Road at Park Avenue	Rumson Borough
Lauriston	91 Rumson Road	Rumson Borough
Saint George's-by-the River Episcopal Church	7 Lincoln Avenue	Rumson Borough
Seabright Lawn Tennis & Cricket Club	Rumson Road at Tennis Court Lane	Rumson Borough
Allen House	Broad Street and Sycamore Avenue	Shrewsbury Borough
Christ Church, Shrewsbury	Broad Street and Sycamore Avenue	Shrewsbury Borough
Shrewsbury Historic District	(historic district)	Shrewsbury Borough
Wardell House	419 Sycamore Avenue	Shrewsbury Borough
Audenried Cottage (Normandy Inn)	21 Tuttle Avenue	Spring Lake Borough
Frederick A. Duggan Memorial First Aid and Emergency Squad Building (Spring Lake First Aid & Emergency Squad Building)	311 Washington Avenue	Spring Lake Borough

Table 3b.5 Inventory of Historic Properties		
Property Name	**Location**	**Jurisdiction**
Holy Trinity Episcopal Church	Monmouth and Third Aves	Spring Lake Borough
Martin Maloney Cottage	101 Morris Avenue	Spring Lake Borough
Old Mill at Tinton Falls	1205 Sycamore Avenue	Spring Lake Borough
Tinton Falls Historic District	(historic district)	Tinton Falls Borough
Arneytown Historic District	(historic district)	Upper Freehold Township
Coward-Hendrickson House	Burlington Path Road	Upper Freehold Township
Coward-Smith House	Burlington Path Road	Upper Freehold Township
Imlaystown Historic District	(historic district)	Upper Freehold Township
Merino Hill House and Farm	Allentown-Clarksburg Road (County Route 524)	Upper Freehold Township
Salter's Mill	Imlaystown-Davis Station Road	Upper Freehold Township
Upper Freehold Baptist Meeting (Old Yellow Meetinghouse)	Yellow Meetinghouse and Red Valley roads	Upper Freehold Township
Walnford Historic District	(historic district)	Upper Freehold Township
Allgor-Barkalow Homestead	New Bedford Road	Wall Township
Camp Evans Historic District	(historic district)	Wall Township
Manasquan Friends Meetinghouse	NJ Route 35 at Manasquan Circle	Wall Township
Marconi Building	Marconi Road	Wall Township
Project Diana Site	Not provided	Wall Township
MacGregor-Tallman House	407 Monmouth Road	West Long Branch Borough
Murry Guggenheim Mansion	Cedar and Norwood Avenues	West Long Branch Borough
Shadow Lawn	Cedar and Norwood Avenues	West Long Branch Borough

Source: New Jersey Historic Preservation Office

Population

The Census Bureau estimates that the population of Monmouth County in 2010 was 630,380 persons, comprising 233,983 households. **Table 3b.6** shows population and household counts by jurisdiction.

Table 3b.6 Population and Households by Jurisdiction (2010 Census)				
Jurisdiction	**Population**		**Households**	
	Count	**% of County Total**	**Count**	**% of County Total**
Aberdeen, Township of	18,210	2.89%	6,876	2.94%
Allenhurst, Borough of	496	0.08%	217	0.09%
Allentown, Borough of	1,828	0.29%	704	0.30%
Asbury Park, City of	16,116	2.56%	6,725	2.87%
Atlantic Highlands, Borough of	4,385	0.70%	1,870	0.80%
Avon-by-the-Sea, Borough of	1,901	0.30%	901	0.39%
Belmar, Borough of	5,794	0.92%	2,695	1.15%
Bradley Beach, Borough of	4,298	0.68%	2,098	0.90%
Brielle, Borough of	4,774	0.76%	1,805	0.77%
Colts Neck, Township of	10,142	1.61%	3,277	1.40%
Deal, Borough of	750	0.12%	333	0.14%
Eatontown, Borough of	12,709	2.02%	5,319	2.27%
Englishtown, Borough of	1,847	0.29%	621	0.27%
Fair Haven, Borough of	6,121	0.97%	1,970	0.84%
Farmingdale, Borough of	1,329	0.21%	547	0.23%
Freehold, Borough of	12,052	1.91%	4,006	1.71%

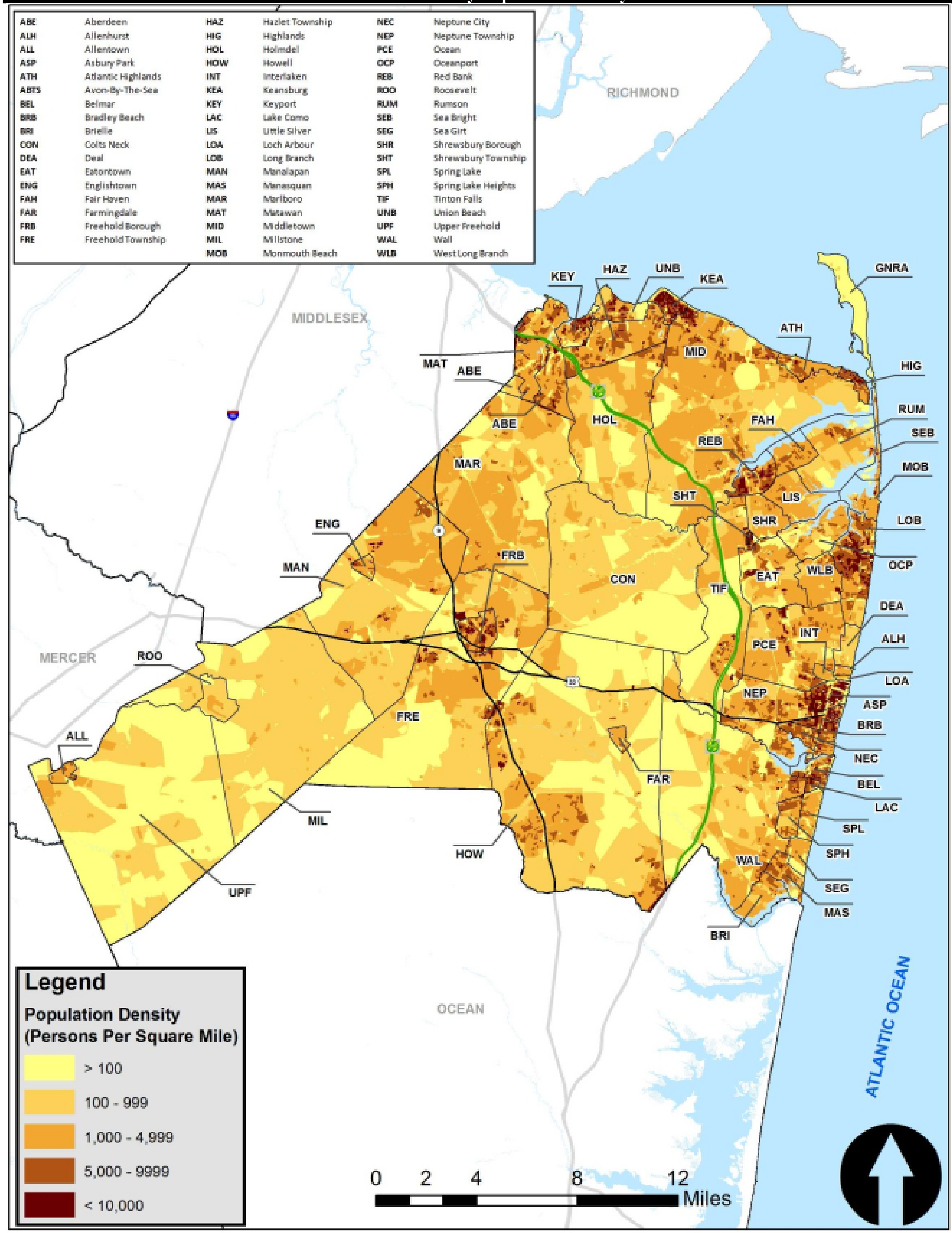
Table 3b.6
Population and Households by Jurisdiction (2010 Census)

Jurisdiction	Population		Households	
	Count	% of County Total	Count	% of County Total
Freehold, Township of	36,184	5.74%	12,577	5.38%
Hazlet, Township of	20,334	3.23%	7,140	3.05%
Highlands, Borough of	5,005	0.79%	2,623	1.12%
Holmdel, Township of	16,773	2.66%	5,584	2.39%
Howell, Township of	51,075	8.10%	17,260	7.38%
Interlaken, Borough of	820	0.13%	361	0.15%
Keansburg, Borough of	10,105	1.60%	3,805	1.63%
Keyport, Borough of	7,240	1.15%	3,067	1.31%
Lake Como, Borough of	1,759	0.28%	785	0.34%
Little Silver, Borough of	5,950	0.94%	2,146	0.92%
Loch Arbour, Village of	194	0.03%	82	0.04%
Long Branch, City of	30,719	4.87%	11,753	5.02%
Manalapan, Township of	38,872	6.17%	13,263	5.67%
Manasquan, Borough of	5,897	0.94%	2,374	1.01%
Marlboro, Township of	40,191	6.38%	13,001	5.56%
Matawan, Borough of	8,810	1.40%	3,358	1.44%
Middletown, Township of	66,522	10.55%	23,962	10.24%
Millstone, Township of	10,566	1.68%	3,301	1.41%
Monmouth Beach, Borough of	3,279	0.52%	1,494	0.64%
Neptune City, Borough of	4,869	0.77%	2,133	0.91%
Neptune, Township of	27,935	4.43%	11,201	4.79%
Ocean, Township of	27,291	4.33%	10,611	4.53%
Oceanport, Borough of	5,832	0.93%	2,227	0.95%
Red Bank, Borough of	12,206	1.94%	4,929	2.11%
Roosevelt, Borough of	882	0.14%	314	0.13%
Rumson, Borough of	7,122	1.13%	2,344	1.00%
Sea Bright, Borough of	1,412	0.22%	792	0.34%
Sea Girt, Borough of	1,828	0.29%	823	0.35%
Shrewsbury, Borough of	3,809	0.60%	1,261	0.54%
Shrewsbury, Township of	1,141	0.18%	583	0.25%
Spring Lake, Borough of	2,993	0.47%	1,253	0.54%
Spring Lake Heights, Borough of	4,713	0.75%	2,316	0.99%
Tinton Falls, Borough of	17,892	2.84%	8,355	3.57%
Union Beach, Borough of	6,245	0.99%	2,143	0.92%
Upper Freehold, Township of	6,902	1.09%	2,363	1.01%
Wall, Township of	26,164	4.15%	10,051	4.30%
West Long Branch, Borough of	8,097	1.28%	2,384	1.02%
Total	**630,380**	**100.00%**	**233,983**	**100.00%**

Source: U.S. Census Bureau

According to the 2010 Census, the median age in Monmouth County is 41.3 years (up from 37.7 years in 2000) and the average household size is 2.7 persons. In terms of population segments that may potentially be at higher risk in general, 5.5 percent of the total population is under the age of five (a total of 34,755 persons) and 13.8 percent is age 65 years and over (a total of 86,691 persons). Approximately 14 percent of households have incomes of less than $25,000 (32,826 households), and about 9 percent of persons age five and up hold disability status. Census data indicates that the population is growing and skewing older, with a rise in median age and number of older persons while numbers of young children and disabled individuals are decreasing. Notably, the population in the 45-64 year age group increased from 24.1% to 30.6% between 2000 and 2010. **Figure 3b.1** illustrates the residential population density across Monmouth County. Most of the county's population is located along or near coastal areas. There is also development along major thoroughfares including Route 33 and Route 9. Areas in the western portion of the county are less populated and include agricultural lands and undeveloped park lands.

Figure 3b.1
Monmouth County Population Density



Source: US Census, 2010

SECTION 3C - Damage Estimates

Methodology

This multi-jurisdictional vulnerability assessment was conducted with two distinct methodologies, utilizing GIS-based analysis and a statistical risk assessment methodology. Each approach provides estimates for the potential **impact** of hazards by using a common, systematic framework for evaluation, including historical occurrence information provided in the *Hazard Profiles* section. The results of the multi-jurisdictional vulnerability assessment are provided for each hazard immediately following the summary of information provided through the hazard identification and analysis, as listed above.

A GIS-based analysis was conducted for 10 hazards:

- hurricane and tropical storm;
- nor'easter;
- coastal erosion;
- dam failure;
- flood;
- storm surge;
- wave action;
- earthquake;
- landslide; and
- wildfire.

A statistical risk assessment approach was used to analyze six hazards:

- extreme temperatures;
- extreme wind;
- lightning;
- tornado;
- winter storm; and
- drought.

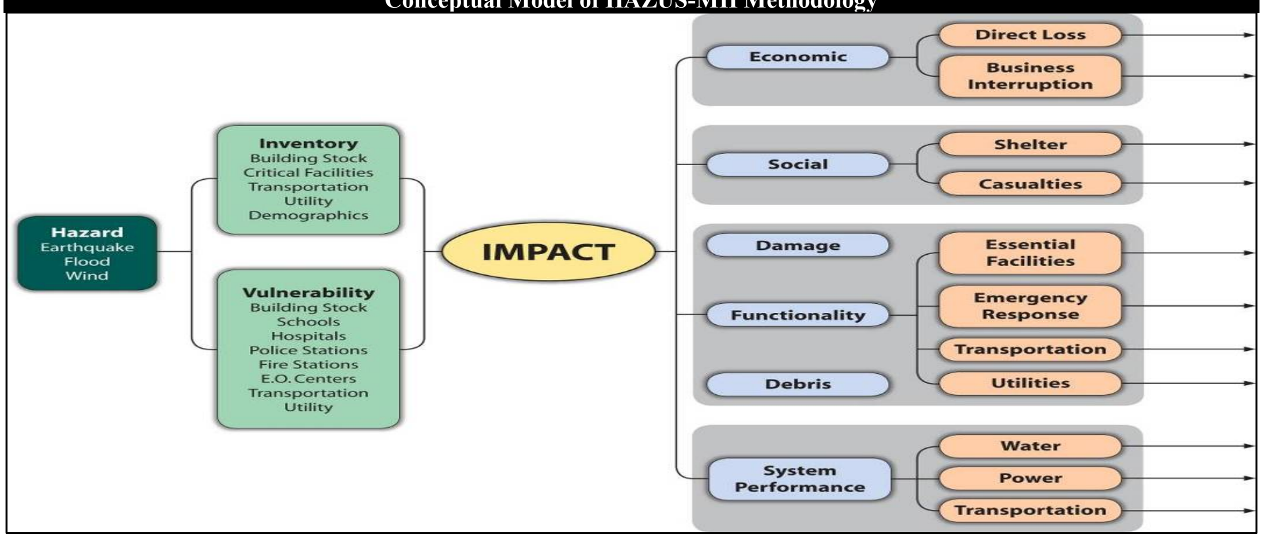
Below is a brief description of these approaches.

GIS-Based Analysis

For GIS-based assessment, digital data was collected from local, state and national sources. ESRI® ArcGIS™ 9.3 was used to assess risk utilizing digital data including local tax records for individual parcels and georeferenced point locations for buildings and critical facilities. Using these data layers, risk was assessed by estimating the assessed building value for buildings determined to be located in identified hazard areas. For the plan update, population estimates were refined using Census 2010 block level data where the population and value of improved property exposed were estimated to be proportional to the area exposed; and the value of exposed property was refined using updated (2012) improvement values. HAZUS-MH was used to model hurricane winds, riverine flood, storm surge, nor'easter winds and earthquakes and estimate potential losses for these hazards. The objective of the GIS-based analysis was to determine the estimated vulnerability of people, buildings and critical facilities to the identified hazards for Monmouth County using best available geospatial data. In so doing, local databases made available through Monmouth County such as local tax assessor records, parcel boundaries, building footprints and critical facilities data, were used in combination with digital hazard data as included and described in the *Hazard Profiles* section. Where only a portion of a parcel was found to lie within a given hazard area, the ratio of area in to area out of the hazard area was applied to the value of improvements on the parcel to estimate the dollars exposed. A similar process was undertaken to estimate population exposed, where the percentage of census block in the hazard area was applied to total census block population to estimate the population exposed to the hazard. The results of the analysis provided an estimated number of people, as well as the numbers and values of buildings and critical facilities determined to be potentially at risk to those hazards with delineable geographic hazard boundaries. These hazards included the flood, storm surge, wave action, coastal erosion, landslide, dam failure and wildfire hazards. A more specific description of the GIS-based analysis for each particular hazard is provided under the vulnerability assessment section of each respective hazard.

HAZUS-MH is FEMA's standardized loss estimation software program built upon an integrated GIS platform (**Figure 3c.1**) to conduct analysis at a regional level (i.e., not on a structure-by-structure basis). The HAZUS-MH risk assessment methodology is parametric, in that distinct hazard and inventory **parameters (i.e., wind speed and building types) were modeled using the HAZUS-MH software to determine the impact (i.e., damages and losses) on the built environment.** This risk assessment applied HAZUS-MH to produce countywide profiles and estimate losses for five hazards at the jurisdictional level. At the time initial analyses were completed for the 2009 Plan, HAZUS-MH MR-3 (September 2007) was used to estimate potential losses from hurricane winds, riverine flood, storm surge, nor'easter winds, and earthquake. For this 2014 Plan Update, analyses were re-run using the most recent HAZUS-MH 2.1 SP3 (Version 2.1 released in 2012, and Service Pack 3 released in 2014). Furthermore, HAZUS Level 1 analyses were conducted for the 2009 version of the plan. A Level 1 analysis yields a rough estimate based on the nationwide database and is a great way to begin the risk assessment process and prioritize high-risk communities." In contrast, the Level 2 analysis type used for the 2014 Plan Update produces more accurate loss estimates by including detailed information on local hazard conditions and/or by replacing the national default inventories with more accurate local inventories of buildings, essential facilities and other infrastructure.

Figure 3c.1
Conceptual Model of HAZUS-MH Methodology



The results of the HAZUS-MH model analysis include annualized loss estimates for each jurisdiction so that potential loss values may be compared to one another throughout Monmouth County. In generating loss estimates through HAZUS-MH, some data normalization was necessary to account for recognized differences between actual assessed building values as provided by Monmouth County and estimated replacement building value data as provided within HAZUS-MH. In order to account for the difference between modeled and actual values, the ratio of estimated losses produced by HAZUS-MH as compared to total HAZUS-MH building inventory was used to estimate percent damage. The percent damage ratio was then applied to the local assessed values of each jurisdiction to estimate potential losses and loss ratios in Monmouth County for this analysis.

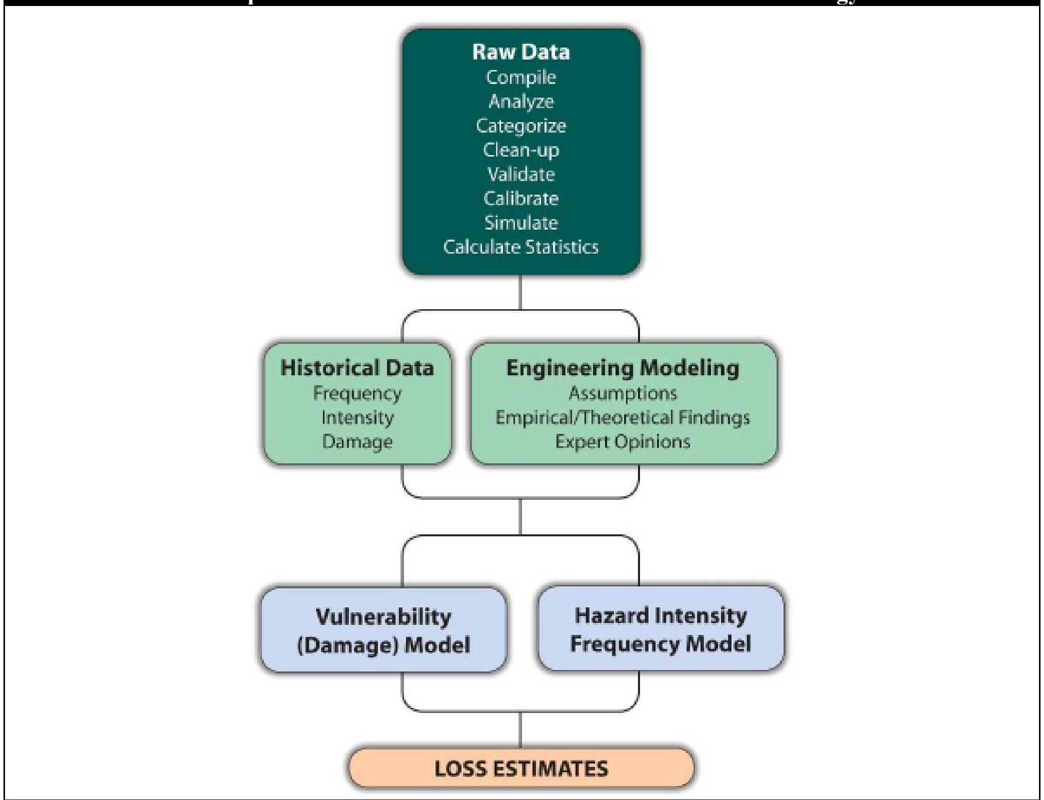
Statistical Risk Assessment Methodology

A statistical risk assessment methodology was applied to analyze hazards of concern that were outside the scope of HAZUS-MH and the GIS-based risk assessment. This methodology uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information (presented in the *Hazard Profiles* section). This methodology was used to assess risk to the extreme temperatures, lightning, tornado, and drought hazards. Historical data for each hazard as described in the *Hazard Profiles* section was used and statistical evaluations were performed using manual calculations. The general steps used in the statistical risk assessment methodology are summarized below:

1. Compile data from local, state and national sources, as well as literature;
2. Clean up data, including removal of duplicate records and update losses to account for inflation;
3. Identify patterns in frequency, intensity, vulnerability and loss
4. Statistically and probabilistically extrapolate the patterns[3]; and
5. Produce meaningful results, including the development of annualized loss estimates.

Figure 3c.2 illustrates a conceptual model of the statistical risk assessment methodology as applied to Monmouth County.

Figure 3c.2
Conceptual Model of the Statistical Risk Assessment Methodology



[3] In cases where historical events/losses were recorded for the county as a whole, losses were averaged across all jurisdictions in order to estimate losses by jurisdiction and calculate potential annualized losses by jurisdiction.

Risk (vulnerability) is presented in terms of potential annualized losses, whenever possible. In general, presenting results in the annualized form is useful in three ways:

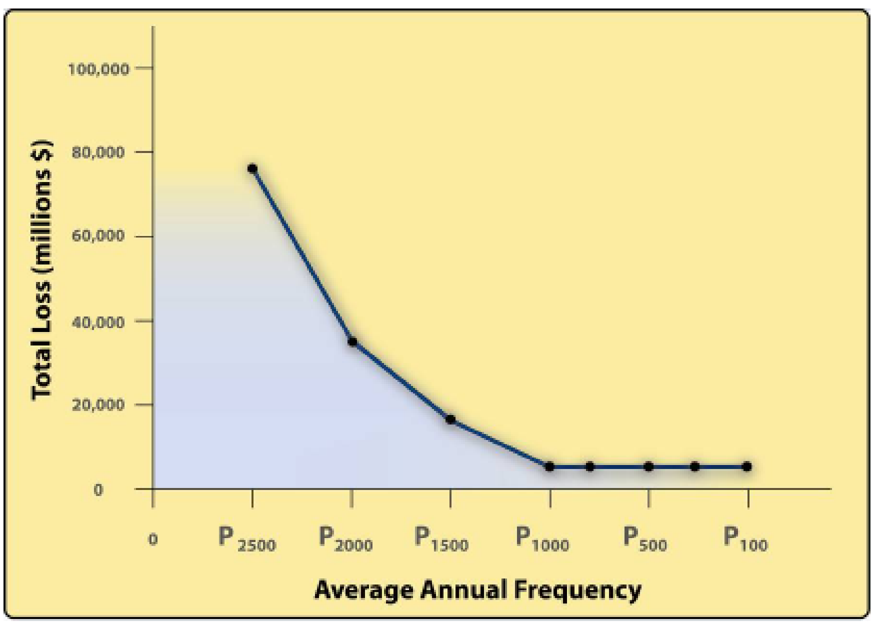
1. This approach accounts for the contribution of potential losses from all future disasters;
2. Annualized results for different hazards are readily comparable, thus easier to rank; and
3. The use of annualized losses is the most objective approach for evaluating mitigation alternatives.

Annualized losses for the hazards where the parametric approach was utilized were computed in a three-step process:

1. Compute/estimate losses for a number of scenario events with different return periods (i.e., 10-year, 100-year, 200-year, 500-year, etc.);
2. Approximate the Probability versus Loss Curve through curve fitting; and
3. Calculate the area under the fitted curve to obtain annualized losses.

This approach is illustrated graphically in **Figure 3c.3**. For other hazards where the statistical approach was used, the computations are based primarily on the observed historical losses.

Figure 3c.3
Graphical Representation of the Annualized Loss Methodology



The economic loss results are presented here using two interrelated risk indicators: Annualized Loss and Annualized Loss Ratio. The Annualized Loss is the estimated long-term weighted average value of losses to property in any single year in a specified geographic area (i.e., municipal jurisdiction). The Annualized Loss Ratio expresses estimated annualized loss normalized by assessed building value. The estimated Annualized Loss (AL) addresses the key idea of risk: the probability of the loss occurring in the study area (largely a function of building construction type and quality). By annualizing estimated losses, the AL factors in historic patterns of frequent smaller events with infrequent but larger events to provide a balanced presentation of the risk. The Annualized Loss Ratio (ALR) represents the AL as a fraction of the assessed value of the local inventory. This ratio is calculated using the following formula:

ALR = Annualized Losses / Total Exposure

The ALR gauges the relationship between average annualized loss and assessed values. This ratio can be used as a measure of vulnerability in the areas and, since it is normalized by assessed value, it can be directly compared across different geographic units such as metropolitan areas, counties or municipalities.

Loss estimates provided in this vulnerability assessment are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (i.e., incomplete inventories, demographics or economic parameters).

All conclusions are presented in "Conclusions on Hazard Risk" at the end of this section. Findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment that follows.

Extreme Temperatures

Impacts - Extreme Temperatures

Extreme temperatures are primarily a threat to human life and health, though they are also hazardous to livestock and agricultural crops and occasionally might threaten property and infrastructure, and disrupt transportation systems. They can also exacerbate the impact of other hazards such as severe weather events that cause widespread power outages. Emergency responders are often called upon to work with public officials/non-profit agencies for heating/cooling venues, and to transport vulnerable sectors of the population to such venues.

Extreme temperatures are likely to result in relatively minor impacts in Monmouth County, with very few injuries (if any), minor and sporadic property damage, and minimal disruption on quality of life. Temporary shutdown of critical facilities to reduce energy usage or due to the fact that employees may not be able to get to the facility is possible. Common impacts associated with extreme heat in Monmouth County include: injuries associated with swimming to escape extreme heat, and individuals seeking medical treatment for heat related illness (i.e., for heat stress, exhaustion, heat stroke, etc.), and power outages from an associated strain on electrical networks. Cooling centers are typically opened, and schools altering class schedules and/or activities to ensure student safety. Extreme heat events typically impact the elderly and disadvantaged most heavily. Primary impacts of concern for extreme cold temperatures include the life-threatening effects of overexposure hypothermia on people, particularly the elderly and disadvantaged. Other significant impacts include strains on livestock and agriculture.

Exposure and Damage Estimates – Extreme Temperatures

While all of Monmouth County is exposed to extreme temperatures, existing buildings, infrastructure, and critical facilities are not considered vulnerable to significant damage caused by extreme heat or cold events. Damages can occur when thermal tolerances of various systems are exceeded. Extreme cold can cause thermal cracking of paved surfaces, and freezing of pipes. Extreme heat can cause softening and traffic-related rutting of paved surfaces; and buckling of railway tracks. Extreme temperatures can place greater demand on utility systems, with possible associated power outages. While losses could be high for particular events, and could result in increased maintenance costs over time with frequent occurrences, average annual property losses associated with extreme temperatures are anticipated to be minimal across the planning area. Extreme temperatures do however present a significant life and safety threat to Monmouth County's population.

Heat casualties are usually caused by lack of adequate air conditioning or heat exhaustion. The most vulnerable population to heat casualties are the elderly or infirmed, who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being. Casualties resulting from extreme **cold** may result from a lack of adequate heat, carbon monoxide poisoning from unsafe heat sources and frostbite. The most vulnerable populations to cold casualties are the elderly or infirmed and low income households, as they may not be able to afford to operate a heat source on a regular basis and may not have immediate family or friends to look out for their well-being.

Given the lack of historical data and limited likelihood for structural losses resulting from extreme heat or cold occurrences in Monmouth County, annualizing potential structural losses over a long period of time would most likely yield a negligible annualized loss estimate for the entire county.

Extreme Wind

Impacts - Extreme Wind

Impacts associated with extreme wind in Monmouth County can be critical. Multiple deaths/injuries are possible, large portions of property in the affected area can be damaged or destroyed (depending on the nature of the event), and a complete shutdown of critical facilities for more than one week could all be possible, depending on the type of wind event and the nature of the event.

Some extreme wind events can be forecasted; others are completely unpredictable. Emergency responders are called up for evacuations, road closures, and attending to the injured. Flying debris, in extreme wind events, can cause secondary impacts. Trees can be downed, buildings can be damaged. High winds can directly damage private property as well as roads and bridges, schools, hospitals, and other types of critical facilities and utilities and communications facilities. In addition, impaired access to these facilities during extreme wind events can cause secondary, indirect damages.

Extreme winds may stem from other hazards, including hurricanes and tropical storms, nor'easter, and tornadoes; however, only reported extreme wind events not related to other hazards are considered in this analysis. Vulnerability to winds from hurricanes and tropical storms, nor'easter, and tornadoes are addressed individually in other sections.

Exposure and Damage Estimates – Extreme Wind

Because it cannot be predicted where extreme winds may occur, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. It is important to note that only reported extreme wind occurrences have been factored into this vulnerability assessment[4]. For the 2014 plan update, NCDC historical extreme wind loss data current as of September 2014 includes a total of 238 days with high wind, thunderstorm wind, and strong wind events between October 1968 and May 2014 (not including Hurricane Sandy). Of these, there are 51 event records in the database through and including the year 1999, and 333 event records from 2000 to 2014; and all event records prior to the year 2000 include $0 in damages – presumably due to database limitations as opposed to decades of non-damaging wind events. Therefore, to estimate jurisdictional losses due to extreme wind, expected annualized losses were calculated for the 14.5 year period of record between January 2000 and May 2014:

[4] It is possible that additional extreme wind events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

- NCDC losses were obtained for the entire county ($19,168,995 total; using a 14.5 year period of record, this yields expected annualized losses of $1,322,000).
- NCDC event records included specific loss histories in 11 jurisdictions totaling $3,001,000; and $16,167,995 for all other events countywide.
- Expected annualized losses of $1,322,000 were divided by 53 jurisdictions to get an average per community number of $24,943.
- Jurisdiction specific loss histories were greater than this average number for 3 jurisdictions, and less than this average number for 8 jurisdictions. Annual losses were reported as is for the 3 jurisdictions with actual loss histories greater than the average; the annual losses for these 3 jurisdictions combined ($172,414) was deducted from the total annual losses ($1,322,000) to get an average annual loss for distribution across the remaining 50 communities ($1,322,000-$172,414=$1,149,586/50=$22,922 average annual losses for the 50 communities for which specific jurisdictional data was either not available or was found to be less than the overall $24,943 average).

Table 3c.1 shows potential annualized property losses and percent loss ratio resulting from extreme wind for each jurisdiction in Monmouth County based on historic occurrences as reported by NCDC. For the plan update, population estimates were refined using Census 2010 block level data, and annualized expected property losses were based on updated (2012) improvement values.

Table 3c.1
Potential Annualized Losses from Extreme Wind by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)*	Annualized Expected Property Losses	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$22,992	0.00%
Allenhurst, Borough of	496	$163,629,600	$22,992	0.01%
Allentown, Borough of	1,828	$128,744,000	$22,992	0.02%
Asbury Park, City of	16,116	$822,648,930	$22,992	0.00%
Atlantic Highlands, Borough of	4,385	$251,833,600	$22,992	0.01%
Avon-by-the-Sea, Borough of	1,901	$346,002,100	$22,992	0.01%
Belmar, Borough of	5,794	$507,354,100	$34,483	0.01%
Bradley Beach, Borough of	4,298	$402,974,400	$22,992	0.01%
Brielle, Borough of	4,774	$490,439,800	$22,992	0.00%
Colts Neck, Township of	10,142	$1,679,133,600	$22,992	0.00%
Deal, Borough of	750	$511,562,800	$22,992	0.00%
Eatontown, Borough of	12,709	$1,158,392,100	$22,992	0.00%
Englishtown, Borough of	1,847	$125,736,600	$22,992	0.02%
Fair Haven, Borough of	6,121	$589,631,200	$22,992	0.00%
Farmingdale, Borough of	1,329	$112,597,500	$22,992	0.02%
Freehold, Borough of	12,052	$636,156,950	$68,966	0.01%
Freehold, Township of	36,184	$3,944,416,100	$22,992	0.00%
Hazlet, Township of	20,334	$1,212,072,900	$22,992	0.00%
Highlands, Borough of	5,005	$282,777,500	$22,992	0.01%
Holmdel, Township of	16,773	$2,086,402,399	$22,992	0.00%
Howell, Township of	51,075	$3,182,248,300	$22,992	0.00%
Interlaken, Borough of	820	$91,685,800	$22,992	0.03%
Keansburg, Borough of	10,105	$349,667,700	$22,992	0.01%
Keyport, Borough of	7,240	$422,424,400	$22,992	0.01%
Lake Como, Borough of	1,759	$155,708,700	$22,992	0.01%
Little Silver, Borough of	5,950	$747,827,900	$22,992	0.00%
Loch Arbour, Village of	194	$39,039,500	$22,992	0.06%

Table 3c.1
Potential Annualized Losses from Extreme Wind by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)*	Annualized Expected Property Losses	Annualized Percent Loss Ratio
Long Branch, City of	30,719	$2,345,429,800	$22,992	0.00%
Manalapan, Township of	38,872	$3,793,581,500	$22,992	0.00%
Manasquan, Borough of	5,897	$723,654,300	$22,992	0.00%
Marlboro, Township of	40,191	$3,947,148,000	$68,966	0.00%
Matawan, Borough of	8,810	$501,846,200	$22,992	0.00%
Middletown, Township of	66,522	$4,980,350,600	$22,992	0.00%
Millstone, Township of	10,566	$994,523,937	$22,992	0.00%
Monmouth Beach, Borough of	3,279	$452,626,900	$22,992	0.01%
Neptune City, Borough of	4,869	$240,091,400	$22,992	0.01%
Neptune, Township of	27,935	$1,522,988,600	$22,992	0.00%
Ocean, Township of	27,291	$2,086,610,750	$22,992	0.00%
Oceanport, Borough of	5,832	$518,615,000	$22,992	0.00%
Red Bank, Borough of	12,206	$1,186,117,471	$22,992	0.00%
Roosevelt, Borough of	882	$40,634,100	$22,992	0.06%
Rumson, Borough of	7,122	$1,411,914,600	$22,992	0.00%
Sea Bright, Borough of	1,412	$238,003,600	$22,992	0.01%
Sea Girt, Borough of	1,828	$469,081,700	$22,992	0.00%
Shrewsbury, Borough of	3,809	$490,447,400	$22,992	0.00%
Shrewsbury, Township of	1,141	$26,891,400	$22,992	0.09%
Spring Lake, Borough of	2,993	$1,047,534,400	$22,992	0.00%
Spring Lake Heights, Borough of	4,713	$454,145,300	$22,992	0.01%
Tinton Falls, Borough of	17,892	$2,014,827,700	$22,992	0.00%
Union Beach, Borough of	6,245	$255,879,500	$22,992	0.01%
Upper Freehold, Township of	6,902	$810,887,400	$22,992	0.00%
Wall, Township of	26,164	$2,302,913,200	$22,992	0.00%
West Long Branch, Borough of	8,097	$785,971,500	$22,992	0.00%
Total	**630,380**	**$55,141,734,937**	**$1,322,000**	**0.002%**

**Exposure calculated by GIS Analysis using local assessed values*

Hurricane and Tropical Storm

Impacts - Hurricanes and Tropical Storms

Hurricanes and tropical storms are capable of producing catastrophic impacts. A high number of deaths and/or injuries are possible, more than 50 percent of property in the affected area could be damaged or destroyed, and a complete shutdown of critical facilities would be possible for 30 days or more, depending on the nature of the event.

Historical records indicate that 11 hurricanes and 25 tropical storms have come within 75 miles of Monmouth County between 1851 and 2012. Recent events have caused significant wind, flood and coastal erosion related damages in Monmouth County.

Coastal areas of Monmouth County are particularly dynamic environments, and are quite susceptible to hazards associated with hurricanes and tropical storms. These susceptibilities are expected to increase over time due to the effects of sea level rise. Impacts of hurricanes and tropical storms are associated with damages as a result of flooding (riverine and coastal (back bay and oceanfront), as well as storm surge), high winds, damaging waves, and coastal erosion. It is possible for the entire county to be impacted by hurricanes and tropical storms, though in different ways. For example, wind impacts may be widespread but more severe in immediate coastal areas. Structures closest to the Atlantic Coast could suffer catastrophic damages from wind, surge, waves and beach erosion while impacts inland structures would be less substantial due to lower wind speeds and absence of surge impacts. Riverine flooding would be limited to riverine flood zones and being of slower velocities in most cases would cause less severe types of structure damages. Roads and bridges across the county would be susceptible to overtopping and damage from floodwaters. Beach erosion can often be severe during hurricanes and tropical storms; though beach restoration and maintenance activities are undertaken regularly to offset storm impacts. The Long Branch - Manasquan Project, between Sandy Hook and Manasquan Inlet, is one of the largest beach construction projects completed in the US with over 25 million cubic yards of sand placed on 25 miles of beaches.

Monmouth County is a tourist destination. With summer being the peak vacation time, coincident with hurricane season, the potential population at risk is at its peak during the time of year when Monmouth County is most likely to be impacted by a hurricane or tropical storm. Impacts to the general public include evacuation and sheltering needs, as well as emergency response for those who shelter in place or are injured during the event. All property types are impacted, with residential and commercial impacts being greatest due to their proximity to the coast. Roads, bridges, schools, hospitals and other types of critical facilities are susceptible to wind and water damage. Secondary impacts would be associated with flying debris, as well as drifting sand from storm surges. Sand covered roads and bridges would be common impacts. Beach erosion can be catastrophic depending on the particular area and the nature of the event. Transportation, communications, and governmental services may be severely impacted. Impacts would be exacerbated when coincident with high tides, or during prolonged types of events that extend across several tidal cycles. Sea level rise will increase impacts over time.

Table 3a.5 describes the damage that could be expected for each category of hurricane. Damage during hurricanes might also result from spawned tornadoes, storm surge and inland flooding associated with heavy rainfall that usually accompanies these storms.

Table 3c.2
Hurricane Damage Classifications

Storm Category	Damage Level	Description of Damages	Photo Example
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery and trees. Also, some coastal flooding and minor pier damage.	
2	MODERATE	Some roofing material, door and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings might break their moorings.	
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain might be flooded well inland.	
4	EXTREME	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain might be flooded well inland.	
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas might be required.	

Source: National Oceanic and Atmospheric Administration; Federal Emergency Management Agency

Exposure and Damage Estimates – Hurricanes and Tropical Storms

Hurricanes and tropical storms are complex combinations of discrete component hazards occurring simultaneously. Damages during these events result from the cumulative impacts of a wide range of hazards including flooding, storm surge, coastal erosion, wave action, and high winds. No two hurricanes or tropical storms are identical. Even hurricanes of the same category can bring with them wildly different impacts depending on whether they occur during a time of high tide or low tide. Variations in inland wind affects and precipitation amounts, for example, can vary widely. Thus, it is difficult to estimate total potential losses from these cumulative effects in a manner that would allow for the calculation of a meaningful annual 'hurricane and tropical storm' average annual loss estimate. **The current HAZUS-MH hurricane model only analyzes hurricane winds and is not capable of modeling and estimating cumulative losses from all hazards associated with hurricanes; therefore only hurricane wind losses are reported in this section.** This particular Hurricane and Tropical Storm subsection of the plan assesses vulnerability strictly with regard to hurricane winds. Vulnerability to the component hazards of hurricane and tropical storm events such as flooding, storm surge, coastal erosion, wave action, and high winds are addressed separately in this section.

As part of the plan update, a probabilistic scenario was created using HAZUS-MH to assess the vulnerability of Monmouth County to hurricane winds. Default HAZUS-MH wind speed data and damage functions, and methodology were used to determine the potential estimated losses for 50-, 100-, 200-, 500-, and 1000-year frequency events and annual expected loss at the census tract level. **Table 3c.2** shows estimated potential losses for 50-, 100-, 200-, 500- and 1000-year hurricane wind event scenarios by jurisdiction. **Table 3c.3** shows potential annualized property losses and percent loss ratios resulting from **hurricane wind** by jurisdiction as estimated using HAZUS. For the plan update, estimates were refined by using a HAZUS Level 2 analysis; population estimates were refined using Census 2010 data; and annualized expected property losses reflect updated (2012) improvement values.

Table 3c.2
Estimated Potential Losses from 50-, 100-, 200-, 500-, and 1000-year Hurricane Wind Events

Jurisdiction	Total Assessed Value of Improvements (Buildings)	Potential Total Building Losses from Hurricane Wind				
		50-Year Hurricane Wind Event	100-Year Hurricane Wind Event	200-Year Hurricane Wind Event	500-Year Hurricane Wind Event	1000-Year Hurricane Wind Event
Aberdeen, Township of	$1,057,910,200	$442,564	$1,063,522	$1,842,861	$13,141,545	$41,366,790
Allenhurst, Borough of	$163,629,600	$319,168	$874,923	$2,942,728	$5,573,396	$10,636,220
Allentown, Borough of	$128,744,000	$18,174	$55,265	$18,422	$4,368,481	$4,252,760
Asbury Park, City of	$822,648,930	$2,701,696	$9,418,305	$23,990,616	$38,464,087	$59,923,049
Atlantic Highlands, Borough of	$251,833,600	$335,093	$780,859	$1,502,876	$3,456,753	$12,865,024
Avon-By-The-Sea, Borough of	$346,002,100	$822,913	$2,709,844	$8,512,868	$15,846,344	$26,863,403
Belmar, Borough of	$507,354,100	$1,263,903	$4,421,045	$12,957,852	$24,740,487	$39,273,158
Bradley Beach, Borough of	$402,974,400	$1,220,777	$4,174,552	$11,909,078	$20,191,351	$33,916,914
Brielle, Borough of	$490,439,800	$1,427,081	$4,212,749	$11,184,055	$32,445,476	$45,408,934
Colts Neck, Township of	$1,679,133,600	$1,288,334	$2,932,832	$4,918,289	$34,939,878	$77,261,158
Deal, Borough of	$511,562,800	$1,189,486	$3,184,055	$9,893,347	$18,826,839	$38,467,876
Eatontown, Borough of	$1,158,392,100	$1,222,032	$3,731,228	$7,863,216	$22,131,067	$50,157,661
Englishtown, Borough of	$125,736,600	$21,372	$54,741	$62,853	$1,997,750	$4,044,603
Fair Haven, Borough of	$589,631,200	$925,983	$2,183,632	$3,987,744	$10,491,858	$35,263,327
Farmingdale, Borough of	$112,597,500	$91,552	$254,849	$521,394	$3,039,849	$4,743,428
Freehold, Borough of	$636,156,950	$310,786	$704,652	$920,903	$18,094,918	$33,359,914
Freehold, Township of	$3,944,416,100	$2,206,714	$4,599,533	$6,957,597	$123,723,006	$230,689,086
Hazlet, Township of	$1,212,072,900	$725,204	$1,683,718	$2,744,793	$14,249,824	$53,888,465
Highlands, Borough of	$282,777,500	$463,056	$1,285,873	$2,719,333	$5,553,849	$19,198,992

Table 3c.2
Estimated Potential Losses from 50-, 100-, 200-, 500-, and 1000-year Hurricane Wind Events

Jurisdiction	Total Assessed Value of Improvements (Buildings)	Potential Total Building Losses from Hurricane Wind				
		50-Year Hurricane Wind Event	100-Year Hurricane Wind Event	200-Year Hurricane Wind Event	500-Year Hurricane Wind Event	1000-Year Hurricane Wind Event
Holmdel, Township of	$2,086,402,399	$913,498	$2,227,669	$4,264,575	$23,091,538	$76,395,685
Howell, Township of	$3,182,248,300	$4,417,348	$10,574,866	$16,951,620	$146,895,196	$228,485,304
Interlaken, Borough of	$91,685,800	$211,750	$568,117	$1,555,276	$3,002,361	$5,330,582
Keansburg, Borough of	$349,667,700	$285,155	$629,955	$1,307,066	$5,457,682	$21,136,953
Keyport, Borough of	$422,424,400	$213,025	$466,481	$822,135	$5,974,295	$19,496,200
Lake Como, Borough of	$155,708,700	$377,358	$1,183,469	$3,562,908	$7,255,281	$11,549,083
Little Silver, Borough of	$747,827,900	$1,120,046	$2,717,194	$4,827,961	$14,530,857	$42,925,272
Loch Arbour, Village of	$39,039,500	$151,492	$437,268	$1,374,064	$2,501,569	$4,614,709
Long Branch, City of	$2,345,429,800	$6,605,915	$21,606,858	$56,214,985	$87,233,324	$198,206,580
Manalapan, Township of	$3,793,581,500	$1,247,530	$3,055,762	$4,570,535	$82,454,845	$178,923,483
Manasquan, Borough of	$723,654,300	$1,988,686	$6,379,541	$18,064,245	$50,429,489	$69,274,353
Marlboro, Township of	$3,947,148,000	$1,756,206	$4,053,338	$6,444,302	$72,171,007	$175,050,391
Matawan, Borough of	$501,846,200	$160,154	$394,011	$724,624	$6,000,718	$16,587,416
Middletown, Township of	$4,980,350,600	$4,999,227	$12,108,909	$21,763,378	$77,189,029	$270,035,471
Millstone, Township of	$994,523,937	$210,367	$535,566	$472,607	$30,286,592	$41,309,407
Monmouth Beach, Borough of	$452,626,900	$1,436,808	$4,708,952	$13,288,826	$22,488,870	$61,573,638
Neptune City, Borough of	$240,091,400	$625,052	$2,046,868	$5,508,112	$10,740,946	$18,511,051
Neptune, Township of	$1,522,988,600	$3,223,031	$10,184,484	$27,194,909	$60,240,436	$104,744,540
Ocean, Township of	$2,086,610,750	$3,650,555	$10,752,296	$25,477,681	$64,365,825	$121,819,146
Oceanport, Borough of	$518,615,000	$825,894	$2,267,829	$5,073,911	$12,981,923	$34,943,953
Red Bank, Borough of	$1,186,117,471	$1,258,250	$3,670,108	$6,655,141	$24,978,540	$67,165,171
Roosevelt, Borough of	$40,634,100	$1,947	$6,426	$4,958	$409,079	$551,005
Rumson, Borough of	$1,411,914,600	$2,962,983	$7,211,181	$14,004,336	$29,840,550	$108,159,900
Sea Bright, Borough of	$238,003,600	$986,118	$2,712,553	$9,641,913	$18,926,142	$47,281,244
Sea Girt, Borough of	$469,081,700	$1,325,114	$4,050,150	$11,622,645	$32,215,810	$44,366,069
Shrewsbury, Borough of	$490,447,400	$424,995	$1,053,230	$2,003,539	$6,461,336	$19,088,761
Shrewsbury, Township of	$26,891,400	$14,789	$45,978	$93,168	$275,517	$651,074
Spring Lake, Borough of	$1,047,534,400	$3,054,069	$9,407,017	$29,368,161	$66,106,038	$96,990,124
Spring Lake Heights, Borough of	$454,145,300	$1,265,546	$4,000,591	$11,531,997	$24,748,452	$33,949,675
Tinton Falls, Borough of	$2,014,827,700	$1,899,916	$5,228,907	$9,063,237	$34,976,406	$78,632,804
Union Beach, Borough of	$255,879,500	$213,663	$374,385	$638,267	$3,261,265	$16,287,089
Upper Freehold, Township of	$810,887,400	$242,861	$364,397	$322,186	$39,278,654	$46,185,651
Wall, Township of	$2,302,913,200	$4,874,594	$14,012,780	$37,151,410	$114,520,032	$170,085,322
West Long Branch, Borough of	$785,971,500	$1,069,888	$2,988,661	$6,584,619	$14,987,468	$37,987,815
Total	**$55,141,734,937**	**$71,009,717**	**$200,351,970**	**$473,600,121**	**$1,607,553,832**	**$3,289,875,680**

Source: HAZUS-MH

Table 3c.3
Potential Annualized Losses from Hurricane Wind by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Annualized Expected Property Losses – Hurricane Wind	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$192,253	0.02%
Allenhurst, Borough of	496	$163,629,600	$56,861	0.03%

Table 3c.3
Potential Annualized Losses from Hurricane Wind by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Annualized Expected Property Losses – Hurricane Wind	Annualized Percent Loss Ratio
Allentown, Borough of	1,828	$128,744,000	$22,968	0.02%
Asbury Park, City of	16,116	$822,648,930	$368,033	0.04%
Atlantic Highlands, Borough of	4,385	$251,833,600	$67,219	0.03%
Avon-By-The-Sea, Borough of	1,901	$346,002,100	$137,873	0.04%
Belmar, Borough of	5,794	$507,354,100	$200,896	0.04%
Bradley Beach, Borough of	4,298	$402,974,400	$186,761	0.05%
Brielle, Borough of	4,774	$490,439,800	$210,616	0.04%
Colts Neck, Township of	10,142	$1,679,133,600	$362,753	0.02%
Deal, Borough of	750	$511,562,800	$206,781	0.04%
Eatontown, Borough of	12,709	$1,158,392,100	$263,267	0.02%
Englishtown, Borough of	1,847	$125,736,600	$15,789	0.01%
Fair Haven, Borough of	6,121	$589,631,200	$183,331	0.03%
Farmingdale, Borough of	1,329	$112,597,500	$22,005	0.02%
Freehold, Borough of	12,052	$636,156,950	$136,490	0.02%
Freehold, Township of	36,184	$3,944,416,100	$888,347	0.02%
Hazlet, Township of	20,334	$1,212,072,900	$247,869	0.02%
Highlands, Borough of	5,005	$282,777,500	$97,893	0.03%
Holmdel, Township of	16,773	$2,086,402,399	$355,858	0.02%
Howell, Township of	51,075	$3,182,248,300	$952,503	0.03%
Interlaken, Borough of	820	$91,685,800	$31,450	0.03%
Keansburg, Borough of	10,105	$349,667,700	$94,745	0.03%
Keyport, Borough of	7,240	$422,424,400	$88,648	0.02%
Lake Como, Borough of	1,759	$155,708,700	$58,618	0.04%
Little Silver, Borough of	5,950	$747,827,900	$222,482	0.03%
Loch Arbour, Village of	194	$39,039,500	$25,212	0.06%
Long Branch, City of	30,719	$2,345,429,800	$1,108,803	0.05%
Manalapan, Township of	38,872	$3,793,581,500	$704,447	0.02%
Manasquan, Borough of	5,897	$723,654,300	$328,511	0.05%
Marlboro, Township of	40,191	$3,947,148,000	$765,167	0.02%
Matawan, Borough of	8,810	$501,846,200	$82,188	0.02%
Middletown, Township of	66,522	$4,980,350,600	$1,306,087	0.03%
Millstone, Township of	10,566	$994,523,937	$157,427	0.02%
Monmouth Beach, Borough of	3,279	$452,626,900	$302,583	0.07%
Neptune City, Borough of	4,869	$240,091,400	$96,232	0.04%
Neptune, Township of	27,935	$1,522,988,600	$547,352	0.04%
Ocean, Township of	27,291	$2,086,610,750	$681,029	0.03%
Oceanport, Borough of	5,832	$518,615,000	$175,600	0.03%
Red Bank, Borough of	12,206	$1,186,117,471	$335,903	0.03%
Roosevelt, Borough of	882	$40,634,100	$2,345	0.01%
Rumson, Borough of	7,122	$1,411,914,600	$563,024	0.04%
Sea Bright, Borough of	1,412	$238,003,600	$226,332	0.10%
Sea Girt, Borough of	1,828	$469,081,700	$219,029	0.05%
Shrewsbury, Borough of	3,809	$490,447,400	$93,189	0.02%
Shrewsbury, Township of	1,141	$26,891,400	$3,366	0.01%
Spring Lake, Borough of	2,993	$1,047,534,400	$489,452	0.05%

Table 3c.3
Potential Annualized Losses from Hurricane Wind by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Annualized Expected Property Losses – Hurricane Wind	Annualized Percent Loss Ratio
Spring Lake Heights, Borough of	*4,713*	*$454,145,300*	*$185,923*	*0.04%*
Tinton Falls, Borough of	17,892	$2,014,827,700	$395,579	0.02%
Union Beach, Borough of	6,245	$255,879,500	$66,513	0.03%
Upper Freehold, Township of	6,902	$810,887,400	$164,403	0.02%
Wall, Township of	26,164	$2,302,913,200	$811,167	0.04%
West Long Branch, Borough of	8,097	$785,971,500	$198,217	0.03%
Total	**630,380**	**$55,141,734,937**	**$15,707,386**	**0.03%**

Source: HAZUS-MH

Lightning

Impacts – Lightning

On average, 55 people are killed and hundreds are injured each year by lightning strikes in the United States. Lightning can strike communications equipment (i.e., radio or cell towers, antennae, satellite dishes, electrical transformers, etc.) and hamper communication and emergency response. Lightning strikes can also cause significant damage to buildings, critical facilities, and infrastructure, largely by igniting a fire. In addition, lightning can ignite vegetation to cause a wildfire.

Lightning's impacts can typically be characterized as minor in Monmouth County. Events are typically associated with very few injuries (if any), only minor property damage, and minimal disruption on quality of life. The shutdown of critical facilities, if at all, is typically only temporary in nature.

Historical impacts in Monmouth County have included direct health impacts to individuals struck by lightning, structure damages from fires caused by lightning, and impacts to emergency communications facilities when towers have been struck by lightning. Lightning occurs frequently in Monmouth County but damaging events are relatively few in number and limited in scope when they do occur. Building codes requiring buildings to be grounded work to decrease damages. Members of the general public who are outdoors are particularly vulnerable during an event. Lightning most typically occurs within 10 miles of a thunderstorm.

Exposure and Damage Estimates – Lightning

Because it cannot be predicted where lightning may strike, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. For the plan update, NCDC historical lightning data current as of September 2014 was queried. The data includes a total of 60 lightning events between May 1997 and August 2013, resulting in $2.42 million in damages, 7 deaths, and 13 injuries. The lack of event records prior to the year 1997 is due to database limitations as opposed to decades without lightning events. To estimate jurisdictional losses due to lightning, expected annualized losses were calculated as follows for the 16.25 year period of record between May 1997 and August 2013:

- NCDC losses were obtained for the entire county ($2,424,300 total; using a 16.25 year period of record, this yields expected annualized losses of $149,188).
- NCDC event records included specific loss histories in 19 jurisdictions totaling $2,189,300; and $235,000 for all other events countywide.

- Expected annualized losses of $149,188 were divided by 53 jurisdictions to get an average per community number of $2,815.
- Jurisdiction specific loss histories were greater than this average number for 6 jurisdictions, and less than this average number for 13 jurisdictions. Annual losses were reported as-is for the 6 jurisdictions with actual loss histories greater than the average; the annual losses for these 6 jurisdictions combined ($124,923) was deducted from the total annual losses ($149,188) to get an average annual loss for distribution across the remaining communities ($149,188-$124,923=$24,265/47=$516 average annual losses for each of the 47 communities for which specific jurisdictional data was either not available or was less than the overall $2,815 average).

Table 3c.4 shows potential annualized property losses and percent loss ratios resulting from the lightning hazard for each jurisdiction in Monmouth County based on historic occurrences as reported by NCDC. For the plan update, population estimates were refined using Census 2010 block level data; and annualized expected property losses reflect updated (2012) improvement values.

Table 3c.4
Potential Annualized Losses from Lightning by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$516	0.00%
Allenhurst, Borough of	496	$163,629,600	$516	0.00%
Allentown, Borough of	1,828	$128,744,000	$516	0.00%
Asbury Park, City of	16,116	$822,648,930	$516	0.00%
Atlantic Highlands, Borough of	4,385	$251,833,600	$516	0.00%
Avon-by-the-Sea, Borough of	1,901	$346,002,100	$516	0.00%
Belmar, Borough of	5,794	$507,354,100	$516	0.00%
Bradley Beach, Borough of	4,298	$402,974,400	$516	0.00%
Brielle, Borough of	4,774	$490,439,800	$516	0.00%
Colts Neck, Township of	10,142	$1,679,133,600	$6,154	0.00%
Deal, Borough of	750	$511,562,800	$516	0.00%
Eatontown, Borough of	12,709	$1,158,392,100	$516	0.00%
Englishtown, Borough of	1,847	$125,736,600	$516	0.00%
Fair Haven, Borough of	6,121	$589,631,200	$516	0.00%
Farmingdale, Borough of	1,329	$112,597,500	$516	0.00%
Freehold, Borough of	12,052	$636,156,950	$516	0.00%
Freehold, Township of	36,184	$3,944,416,100	$516	0.00%
Hazlet, Township of	20,334	$1,212,072,900	$516	0.00%
Highlands, Borough of	5,005	$282,777,500	$516	0.00%
Holmdel, Township of	16,773	$2,086,402,399	$516	0.00%
Howell, Township of	51,075	$3,182,248,300	$516	0.00%
Interlaken, Borough of	820	$91,685,800	$516	0.00%
Keansburg, Borough of	10,105	$349,667,700	$516	0.00%
Keyport, Borough of	7,240	$422,424,400	$516	0.00%
Lake Como, Borough of	1,759	$155,708,700	$6,154	0.00%
Little Silver, Borough of	5,950	$747,827,900	$516	0.00%
Loch Arbour, Village of	194	$39,039,500	$516	0.00%
Long Branch, City of	30,719	$2,345,429,800	$516	0.00%
Manalapan, Township of	38,872	$3,793,581,500	$61,538	0.00%
Manasquan, Borough of	5,897	$723,654,300	$516	0.00%

Table 3c.4 Potential Annualized Losses from Lightning by Jurisdiction				
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)**	**Annualized Expected Property Losses**	**Annualized Percent Loss Ratio**
Marlboro, Township of	40,191	$3,947,148,000	$516	0.00%
Matawan, Borough of	8,810	$501,846,200	$516	0.00%
Middletown, Township of	66,522	$4,980,350,600	$14,154	0.00%
Millstone, Township of	10,566	$994,523,937	$516	0.00%
Monmouth Beach, Borough of	3,279	$452,626,900	$516	0.00%
Neptune City, Borough of	4,869	$240,091,400	$516	0.00%
Neptune, Township of	27,935	$1,522,988,600	$516	0.00%
Ocean, Township of	27,291	$2,086,610,750	$516	0.00%
Oceanport, Borough of	5,832	$518,615,000	$6,154	0.00%
Red Bank, Borough of	12,206	$1,186,117,471	$516	0.00%
Roosevelt, Borough of	882	$40,634,100	$516	0.00%
Rumson, Borough of	7,122	$1,411,914,600	$516	0.00%
Sea Bright, Borough of	1,412	$238,003,600	$516	0.00%
Sea Girt, Borough of	1,828	$469,081,700	$516	0.00%
Shrewsbury, Borough of	3,809	$490,447,400	$516	0.00%
Shrewsbury, Township of	1,141	$26,891,400	$516	0.00%
Spring Lake, Borough of	2,993	$1,047,534,400	$516	0.00%
Spring Lake Heights, Borough of	4,713	$454,145,300	$516	0.00%
Tinton Falls, Borough of	17,892	$2,014,827,700	$516	0.00%
Union Beach, Borough of	6,245	$255,879,500	$516	0.00%
Upper Freehold, Township of	6,902	$810,887,400	$30,769	0.00%
Wall, Township of	26,164	$2,302,913,200	$516	0.00%
West Long Branch, Borough of	8,097	$785,971,500	$516	0.00%
Total	**630,380**	**$55,141,734,937**	**$149,188**	**0.0003%**

Nor'easter

Impacts - Nor'easters

Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding. There are two main components to a nor'easter: (1) a Gulf Stream low-pressure system (counter-clockwise winds) generated off the southeastern U.S. coast, gathering warm air and moisture from the Atlantic, and pulled up the East Coast by strong northeasterly winds at the leading edge of the storm; and (2) an Arctic high-pressure system (clockwise winds) which meets the low-pressure system with cold, arctic air blowing down from Canada. When the two systems collide, the moisture and cold air produce a mix of precipitation and have the potential for creating dangerously high winds and heavy seas. As the low-pressure system deepens, the intensity of the winds and waves will increase and cause serious damage to coastal areas as the storm moves northeast. Nor'easters can be extremely large (up to 1,000 miles in diameter) and their duration can last for days and multiple tidal cycles, often causing major coastal flooding, erosion and damages that might even exceed the impacts of shorter-term hurricane events.

Impacts from nor'easters are primarily associated with high winds, severe beach erosion and flood hazards (riverine and coastal flooding, storm surge). Their impacts are often quite similar to winter storms with significant snow accumulations, creating hazardous driving conditions, business/government office closures, potential for damage from snow accumulations on structures, etc. Nor'easters tend to have the greatest impacts in coastal communities, though all of the county has some exposure and past effects have been widespread. Monmouth County's shore is vital to the local economy but remains highly susceptible to the effects of major coastal storms, including nor'easters.

Similar to hurricanes and tropical storms, nor'easters are capable of producing catastrophic impacts, depending upon the nature of the storm, its intensity, and duration. Possible impacts can include high numbers of deaths/injuries, more than 50 percent of property in the affected area could be damaged or destroyed, and critical facilities could be shut down for 30 days or more.

Historical records indicate that 18 nor'easters have impacted Monmouth County since 1993. Recent events have caused significant wind, flood and coastal erosion related damages in Monmouth County. They have also resulted in power outages and hazardous driving conditions.

Coastal areas of Monmouth County are particularly dynamic environments, and are quite susceptible to hazards associated with nor'easters. These susceptibilities are expected to increase over time due to the effects of sea level rise. Impacts of nor'easters are associated with damages as a result of flooding (riverine and coastal (back bay and oceanfront) as well as storm surge), high winds, damaging waves, and coastal erosion. It is possible for the entire county to be impacted by nor'easters, though in different ways. For example, wind impacts may be widespread but more severe in immediate coastal areas. Structures close to the Atlantic Coast could suffer catastrophic damages from wind, surge, waves and beach erosion while impacts to inland structures would be less substantial due to lower wind speeds and absence of surge impacts. Riverine flooding would be limited to riverine flood zones and being of slower velocities in most cases would cause less severe types of structure damages than in coastal areas but could be more widespread geographically. Roads and bridges across the county would be susceptible to overtopping and damage from floodwaters. Beach erosion can often be severe during nor'easters; though beach restoration and maintenance activities are undertaken regularly to offset storm impacts. As noted earlier, the Long Branch - Manasquan Project, between Sandy Hook and Manasquan Inlet, is one of the largest beach construction projects completed in the US with over 25 million cubic yards of sand placed on 25 miles of beaches.

Monmouth County is a tourist destination. With summer being the peak vacation time – opposite the time of the typical nor'easter occurrences in winter, tourists are not generally impacted. Impacts to the general public include evacuation and sheltering needs, as well as emergency response for those who shelter in place or are injured during the event. All property types are impacted, with residential and commercial impacts being greatest due to their proximity to the coast. Roads, bridges, schools, hospitals and other types of critical facilities are susceptible to wind and water damage. Secondary impacts would be associated with flying debris, as well as drifting sand from storm surges. Sand covered roads and bridges would be common impacts. Beach erosion can be catastrophic depending on the particular area and the nature of the event. Transportation, communications, and governmental services may be severely impacted. Impacts would be exacerbated when coincident with high tides, or during prolonged types of events that extend across several tidal cycles. Sea level rise will increase impacts over time.

Exposure and Damage Estimates – Nor'easters

Because nor'easters often impact large areas and cross jurisdictional boundaries, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. Similar to hurricanes and tropical storms, nor'easters are complex combinations of discrete component hazards occurring simultaneously. Damages during these events result from the cumulative impacts of component hazards such as flooding, storm surge, coastal erosion, wave action, and high winds. No two nor'easters are identical. Even storms of the same magnitude and intensity can bring with them wildly different impacts depending on whether they occur during a time of high tide or low tide; and, since it is not uncommon for nor'easters to stall off of the coast, damages are often affected by the number of tidal cycles during which they occur. Variations in inland wind affects and precipitation amounts can also vary widely. Thus, it is difficult to estimate total potential losses from these cumulative effects in a manner that would allow for the calculation of a meaningful average annual loss estimate for nor'easters. However, because nor'easters are low pressure systems, the impacts from winds found in a strong nor'easter can be modeled using methodology similar to that used for hurricanes.

For this assessment, the HAZUS-MH hurricane model was used. **The current HAZUS-MH hurricane model only analyzes wind and is not capable of modeling and estimating cumulative losses from all hazards associated with nor'easters; therefore only nor'easter wind losses are reported here** and this subsection of the plan assesses vulnerability strictly with regard to wind. Vulnerability to the component hazards of a nor'easter are addressed individually throughout this Section 3c. HAZUS-MH was used to model two representative nor'easters which directly impacted Monmouth County in December 1992 and April 2007, and for which data was readily available. These two storms were chosen for analysis because wind speed data was available for georeferenced buoy points and varied in strength, with the 1992 storm identified by locals as one of the most memorable in several decades. Although this modeling does not account for increased duration or precipitation levels which may exceed those found in typical hurricanes, it can help quantify a conservative estimate of potential losses if these storms were to impact Monmouth County today. Due to these limitations and other uncertainties inherent in mathematical simulations such as this one, there remains the possibility that the modeled damage estimates may not closely reflect actual recorded damages in every case. To use the HAZUS-MH hurricane model to analyze nor'easter data, historical wind speed data for each storm for georeferenced buoys within range of Monmouth County was obtained (where available) from the National Data Buoy Center[5]. To model peak intensity, peak wind gusts measured on December 11, 1992 at 4 p.m. EST were used for the December 1992 storm analysis, and peak wind gusts measured on April 16, 2007 at 2 a.m. EST were used for the April 2007 storm analysis. Using known wind gust data normalized to 10-meter height for at least three georeferenced points (buoy locations), wind gust speeds were interpolated[6] to estimate wind gust speed at the centroid of each census tract, which was imported into HAZUS-MH for analysis and potential loss estimates.

Modeling of the April 2007 nor'easter estimates negligible damage resulting from nor'easter winds. Wind gusts in the county ranged from 23 to 56 mph, which is less than tropical-storm force. Modeling of the December 1992 nor'easter estimates over $36 million in damages countywide as a result of wind gusts ranging from 63 to 79 mph, which is comparable to Category 1 hurricane wind speeds in some areas of the county. **Table 3c.5** shows estimated potential wind losses for a nor'easter similar in strength to the December 1992 storm if it were to occur in the current built environment, by jurisdiction.

Table 3c.5
Potential Losses from Nor'easter Winds by Jurisdiction (December 11, 1992 storm model)

Jurisdiction	Total Assessed Value of Improvements (Buildings)	Modeled Nor'easter Wind Losses 12/11/1992 storm
Aberdeen, Township of	$1,057,910,200	$1,497,918
Allenhurst, Borough of	$163,629,600	$160,906
Allentown, Borough of	$128,744,000	$56,743
Asbury Park, City of	$822,648,930	$551,584
Atlantic Highlands, Borough of	$251,833,600	$405,776
Avon-By-The-Sea, Borough of	$346,002,100	$192,871
Belmar, Borough of	$507,354,100	$310,187
Bradley Beach, Borough of	$402,974,400	$227,830

[5] www.ndbc.noaa.gov
[6] This method assumes that the wind speeds are linear and can be interpolated with reasonable results.

Table 3c.5 Potential Losses from Nor'easter Winds by Jurisdiction (December 11, 1992 storm model)		
Jurisdiction	**Total Assessed Value of Improvements (Buildings)**	**Modeled Nor'easter Wind Losses 12/11/1992 storm**
Brielle, Borough of	$490,439,800	$167,364
Colts Neck, Township of	$1,679,133,600	$2,022,658
Deal, Borough of	$511,562,800	$606,451
Eatontown, Borough of	$1,158,392,100	$1,020,712
Englishtown, Borough of	$125,736,600	$80,376
Fair Haven, Borough of	$589,631,200	$954,556
Farmingdale, Borough of	$112,597,500	$56,167
Freehold, Borough of	$636,156,950	$476,898
Freehold, Township of	$3,944,416,100	$3,326,934
Hazlet, Township of	$1,212,072,900	$1,810,871
Highlands, Borough of	$282,777,500	$574,214
Holmdel, Township of	$2,086,402,399	$2,385,061
Howell, Township of	$3,182,248,300	$1,584,410
Interlaken, Borough of	$91,685,800	$74,885
Keansburg, Borough of	$349,667,700	$624,908
Keyport, Borough of	$422,424,400	$645,507
Lake Como, Borough of	$155,708,700	$68,529
Little Silver, Borough of	$747,827,900	$1,136,814
Loch Arbour, Village of	$39,039,500	$38,390
Long Branch, City of	$2,345,429,800	$2,964,932
Manalapan, Township of	$3,793,581,500	$3,164,397
Manasquan, Borough of	$723,654,300	$184,148
Marlboro, Township of	$3,947,148,000	$3,846,927
Matawan, Borough of	$501,846,200	$647,130
Middletown, Township of	$4,980,350,600	$7,665,185
Millstone, Township of	$994,523,937	$570,923
Monmouth Beach, Borough of	$452,626,900	$902,666
Neptune City, Borough of	$240,091,400	$145,535
Neptune, Township of	$1,522,988,600	$931,766
Ocean, Township of	$2,086,610,750	$1,602,620
Oceanport, Borough of	$518,615,000	$647,686
Red Bank, Borough of	$1,186,117,471	$1,472,848
Roosevelt, Borough of	$40,634,100	$20,931
Rumson, Borough of	$1,411,914,600	$2,584,529
Sea Bright, Borough of	$238,003,600	$756,345
Sea Girt, Borough of	$469,081,700	$163,438
Shrewsbury, Borough of	$490,447,400	$511,849
Shrewsbury, Township of	$26,891,400	$43,177
Spring Lake, Borough of	$1,047,534,400	$471,888
Spring Lake Heights, Borough of	$454,145,300	$223,560
Tinton Falls, Borough of	$2,014,827,700	$1,975,497
Union Beach, Borough of	$255,879,500	$411,028
Upper Freehold, Township of	$810,887,400	$273,281
Wall, Township of	$2,302,913,200	$711,376
West Long Branch, Borough of	$785,971,500	$831,669
Total	**$55,141,734,937**	**$55,025,149**

Source: HAZUS-MH

Nor'easters of the strength and magnitude of the December 1992 storm are not common and do not occur on a frequent basis. In the absence of a frequency level determination for this specific event, for the purposes of this analysis it is assumed using professional judgment that the probability of such a strong nor'easter causing this amount of damage could be 0.2 percent in any given year (i.e., a 500-year event frequency). This probability can be multiplied by the modeled losses from the 1992 storm to conservatively estimate potential annualized losses as shown in **Table 3c.6**. For the plan update, population estimates were refined using Census 2010 block level data, and annualized expected property losses are based on updated (2012) improvement values.

Table 3c.6
Potential Annualized Losses from Nor'easter Winds by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses – Nor'easter Winds	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$2,996	0.00028%
Allenhurst, Borough of	496	$163,629,600	$322	0.00020%
Allentown, Borough of	1,828	$128,744,000	$113	0.00009%
Asbury Park, City of	16,116	$822,648,930	$1,103	0.00013%
Atlantic Highlands, Borough of	4,385	$251,833,600	$812	0.00032%
Avon-By-The-Sea, Borough of	1,901	$346,002,100	$386	0.00011%
Belmar, Borough of	5,794	$507,354,100	$620	0.00012%
Bradley Beach, Borough of	4,298	$402,974,400	$456	0.00011%
Brielle, Borough of	4,774	$490,439,800	$335	0.00007%
Colts Neck, Township of	10,142	$1,679,133,600	$4,045	0.00024%
Deal, Borough of	750	$511,562,800	$1,213	0.00024%
Eatontown, Borough of	12,709	$1,158,392,100	$2,041	0.00018%
Englishtown, Borough of	1,847	$125,736,600	$161	0.00013%
Fair Haven, Borough of	6,121	$589,631,200	$1,909	0.00032%
Farmingdale, Borough of	1,329	$112,597,500	$112	0.00010%
Freehold, Borough of	12,052	$636,156,950	$954	0.00015%
Freehold, Township of	36,184	$3,944,416,100	$6,654	0.00017%
Hazlet, Township of	20,334	$1,212,072,900	$3,622	0.00030%
Highlands, Borough of	5,005	$282,777,500	$1,148	0.00041%
Holmdel, Township of	16,773	$2,086,402,399	$4,770	0.00023%
Howell, Township of	51,075	$3,182,248,300	$3,169	0.00010%
Interlaken, Borough of	820	$91,685,800	$150	0.00016%
Keansburg, Borough of	10,105	$349,667,700	$1,250	0.00036%
Keyport, Borough of	7,240	$422,424,400	$1,291	0.00031%
Lake Como, Borough of	1,759	$155,708,700	$137	0.00009%
Little Silver, Borough of	5,950	$747,827,900	$2,274	0.00030%
Loch Arbour, Village of	194	$39,039,500	$77	0.00020%
Long Branch, City of	30,719	$2,345,429,800	$5,930	0.00025%
Manalapan, Township of	38,872	$3,793,581,500	$6,329	0.00017%
Manasquan, Borough of	5,897	$723,654,300	$368	0.00005%
Marlboro, Township of	40,191	$3,947,148,000	$7,694	0.00019%
Matawan, Borough of	8,810	$501,846,200	$1,294	0.00026%
Middletown, Township of	66,522	$4,980,350,600	$15,330	0.00031%
Millstone, Township of	10,566	$994,523,937	$1,142	0.00011%
Monmouth Beach, Borough of	3,279	$452,626,900	$1,805	0.00040%
Neptune City, Borough of	4,869	$240,091,400	$291	0.00012%
Neptune, Township of	27,935	$1,522,988,600	$1,864	0.00012%

Table 3c.6
Potential Annualized Losses from Nor'easter Winds by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses – Nor'easter Winds	Annualized Percent Loss Ratio
Ocean, Township of	27,291	$2,086,610,750	$3,205	0.00015%
Oceanport, Borough of	5,832	$518,615,000	$1,295	0.00025%
Red Bank, Borough of	12,206	$1,186,117,471	$2,946	0.00025%
Roosevelt, Borough of	882	$40,634,100	$42	0.00010%
Rumson, Borough of	7,122	$1,411,914,600	$5,169	0.00037%
Sea Bright, Borough of	1,412	$238,003,600	$1,513	0.00064%
Sea Girt, Borough of	1,828	$469,081,700	$327	0.00007%
Shrewsbury, Borough of	3,809	$490,447,400	$1,024	0.00021%
Shrewsbury, Township of	1,141	$26,891,400	$86	0.00032%
Spring Lake, Borough of	2,993	$1,047,534,400	$944	0.00009%
Spring Lake Heights, Borough of	4,713	$454,145,300	$447	0.00010%
Tinton Falls, Borough of	17,892	$2,014,827,700	$3,951	0.00020%
Union Beach, Borough of	6,245	$255,879,500	$822	0.00032%
Upper Freehold, Township of	6,902	$810,887,400	$547	0.00007%
Wall, Township of	26,164	$2,302,913,200	$1,423	0.00006%
West Long Branch, Borough of	8,097	$785,971,500	$1,663	0.00021%
Total	**630,380**	**$55,141,734,937**	**$110,050**	**0.00020%**

Tornado

Impacts - Tornado

Tornados are nature's most violent storms. The most intense tornados can cause fatalities and catastrophic damage to both trees and the built environment in a matter of seconds. The number deaths, injuries, and dollar amount of damages can fluctuate drastically depending on the severity of the tornado and the degree and type of development in the damage path.

Emergency responders are called upon for search and rescue, to tend to the injured, assist in evacuations, and to close roads and direct traffic. Transportation, communications, and the general operation of government could be affected by an incident. Property damage can be significant within the tornado's path. Trees can be damaged or destroyed. Power outages can occur. These impacts tend to be felt in rather limited areas, due to the nature of the tornado hazard itself (tornados with limited widths and path lengths after touchdown).

The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings and particularly manufactured homes.

Exposure and Damage Estimates – Tornado

Historical evidence shows that Monmouth County is vulnerable to tornadic activity. This hazard can result from severe thunderstorm activity or may occur during a major tropical storm or hurricane. Because it cannot be predicted where a tornado may touch down, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. It is important to note that only reported tornadoes have been factored into this vulnerability assessment[7].

For the plan update, NCDC historical tornado data current as of September 2014 includes a total of 9 tornado events between August 1952 and September 2014, resulting in approximately $1.5 million in damages. To estimate jurisdictional losses due to tornados, expected annualized losses were calculated as follows for the 62 year period of record:

- NCDC losses were obtained for the entire county ($1,525,250 total; using a 62 year period of record, this yields expected annualized losses of $24,601).
- NCDC event records included specific loss histories in 4 jurisdictions totaling $1,225,000; and $300,250 for all other events countywide.
- Expected annualized losses of $24,601 were divided by 53 jurisdictions to get an average per community number of $464.
- Jurisdiction specific loss histories were greater than this average number for all 4 jurisdictions. Annual losses were reported as-is for these 4 jurisdictions based on actual loss histories. The annual losses for these 4 jurisdictions combined ($19,758) was deducted from the total annual losses ($24,601) to get an average annual loss for distribution across the remaining 49 communities ($24,601-$19,758=$4,843/49=$99 average annual losses for each of the 49 communities for which specific jurisdictional data was not available).

Table 3c.7 shows potential annualized property losses and percent loss ratios resulting from the tornado hazard for each jurisdiction in Monmouth County based on historic occurrence data. For the plan update, population estimates were refined using Census 2010 block level data; and annualized expected property losses reflect updated (2012) improvement values.

Table 3c.7
Potential Annualized Losses from Tornado by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$99	0.0000%
Allenhurst, Borough of	496	$163,629,600	$99	0.0001%
Allentown, Borough of	1,828	$128,744,000	$99	0.0001%
Asbury Park, City of	16,116	$822,648,930	$99	0.0000%
Atlantic Highlands, Borough of	4,385	$251,833,600	$99	0.0000%
Avon-By-The-Sea, Borough of	1,901	$346,002,100	$99	0.0000%
Belmar, Borough of	5,794	$507,354,100	$99	0.0000%
Bradley Beach, Borough of	4,298	$402,974,400	$99	0.0000%
Brielle, Borough of	4,774	$490,439,800	$99	0.0000%
Colts Neck, Township of	10,142	$1,679,133,600	$99	0.0000%
Deal, Borough of	750	$511,562,800	$99	0.0000%
Eatontown, Borough of	12,709	$1,158,392,100	$99	0.0000%
Englishtown, Borough of	1,847	$125,736,600	$99	0.0001%
Fair Haven, Borough of	6,121	$589,631,200	$99	0.0000%
Farmingdale, Borough of	1,329	$112,597,500	$99	0.0001%
Freehold, Borough of	12,052	$636,156,950	$99	0.0000%

7 It is possible that additional tornado events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

Table 3c.7
Potential Annualized Losses from Tornado by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses	Annualized Percent Loss Ratio
Freehold, Township of	36,184	$3,944,416,100	$99	0.0000%
Hazlet, Township of	20,334	$1,212,072,900	$99	0.0000%
Highlands, Borough of	5,005	$282,777,500	$806	0.0003%
Holmdel, Township of	16,773	$2,086,402,399	$99	0.0000%
Howell, Township of	51,075	$3,182,248,300	$99	0.0000%
Interlaken, Borough of	820	$91,685,800	$99	0.0001%
Keansburg, Borough of	10,105	$349,667,700	$99	0.0000%
Keyport, Borough of	7,240	$422,424,400	$99	0.0000%
Lake Como, Borough of	1,759	$155,708,700	$99	0.0001%
Little Silver, Borough of	5,950	$747,827,900	$99	0.0000%
Loch Arbour, Village of	194	$39,039,500	$1,210	0.0031%
Long Branch, City of	30,719	$2,345,429,800	$99	0.0000%
Manalapan, Township of	38,872	$3,793,581,500	$16,129	0.0004%
Manasquan, Borough of	5,897	$723,654,300	$99	0.0000%
Marlboro, Township of	40,191	$3,947,148,000	$99	0.0000%
Matawan, Borough of	8,810	$501,846,200	$99	0.0000%
Middletown, Township of	66,522	$4,980,350,600	$99	0.0000%
Millstone, Township of	10,566	$994,523,937	$1,613	0.0002%
Monmouth Beach, Borough of	3,279	$452,626,900	$99	0.0000%
Neptune City, Borough of	4,869	$240,091,400	$99	0.0000%
Neptune, Township of	27,935	$1,522,988,600	$99	0.0000%
Ocean, Township of	27,291	$2,086,610,750	$99	0.0000%
Oceanport, Borough of	5,832	$518,615,000	$99	0.0000%
Red Bank, Borough of	12,206	$1,186,117,471	$99	0.0000%
Roosevelt, Borough of	882	$40,634,100	$99	0.0002%
Rumson, Borough of	7,122	$1,411,914,600	$99	0.0000%
Sea Bright, Borough of	1,412	$238,003,600	$99	0.0000%
Sea Girt, Borough of	1,828	$469,081,700	$99	0.0000%
Shrewsbury, Borough of	3,809	$490,447,400	$99	0.0000%
Shrewsbury, Township of	1,141	$26,891,400	$99	0.0004%
Spring Lake, Borough of	2,993	$1,047,534,400	$99	0.0000%
Spring Lake Heights, Borough of	4,713	$454,145,300	$99	0.0000%
Tinton Falls, Borough of	17,892	$2,014,827,700	$99	0.0000%
Union Beach, Borough of	6,245	$255,879,500	$99	0.0000%
Upper Freehold, Township of	6,902	$810,887,400	$99	0.0000%
Wall, Township of	26,164	$2,302,913,200	$99	0.0000%
West Long Branch, Borough of	8,097	$785,971,500	$99	0.0000%
Total	**630,380**	**$55,141,734,937**	**$24,601**	**0.00004%**

Winter Storm

Impacts – Winter Storms

Winter storms can have tremendous impacts on Monmouth County. Though typically short in duration, winter storms can result in significant snow accumulations, with tremendous impacts on local transportation via road, rail, and air. Impacts are exacerbated with storms having an ice component, as snow loads are increased and driving conditions substantially worsen. Significant snow loads on roofs of buildings has the potential to compromise the structural integrity with possible collapse. On vegetation, snow and ice loads can result in downed trees and limbs – particularly during periods of high winds - which can result in outages when limbs fall on power lines and communication lines. Secondary impacts from power outages can include frozen pipes, business losses, negative impacts on people associated with trying to heat their homes using portable heat sources (i.e., kerosene) or stoves including carbon monoxide poisoning and fire risks. Secondary impacts from downed communication lines can hamper the response and recovery efforts due to lack of communication. The human impact of winter storms tends to be exacerbated in areas of social vulnerability (for example, low income, and a high proportion of the very young and/or very old).

Exposure and Damage Estimates – Winter Storms

Because winter storms often impact large areas and cross jurisdictional boundaries, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. For the plan update, NCDC historical winter storm data current as of September 2014 was queried for events categorized as: blizzards, heavy snow, ice storms, sleet, winter storms, and winter weather. The data includes a total of 136 winter weather days between January 1996[8] and September 2014, resulting in approximately $5 million in property damages. No event records are included prior to 1996. To estimate jurisdictional losses due to winter storms, expected annualized losses were calculated as follows for the 18 year period of record:

- NCDC losses were obtained for the entire county ($5,000,000 total; using an 18 year period of record, this yields expected annualized losses of $277,778).
- NCDC event records were all zone-based, without specific loss histories for any of the County's 53 jurisdictions.
- Expected annualized losses of $277,778 were divided by 53 jurisdictions to get an average per community number of $5,241.

It should be noted that the estimation of losses to winter storms was limited to documented structural damages and do not include other types of damages or economic impacts such as power outages, infrastructure repair and restoration, loss of business income and snow removal costs. In the absence of detailed historical data, it is difficult to model and quantify these other types of non-structural losses for winter storm at a jurisdictional level in Monmouth County. However, as described in the *Hazard Profiles* section, it should be recognized that such losses are indeed significant and their associated costs are most often borne by local government and the private sector.

Table 3c.7b shows potential annualized property losses and percent loss ratios resulting from the winter storm hazard for each jurisdiction in Monmouth County based on historic occurrences. For the plan update, population estimates were refined using Census 2010 block level data; and annualized expected property losses are based on updated (2012) improvement values.

[8] Events between 1950 and 1995 were not included in the NCDC database and, therefore, are not accounted for in this analysis.

Table 3c.7b
Potential Annualized Losses from Winter Storms by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$5,241	0.00%
Allenhurst, Borough of	496	$163,629,600	$5,241	0.00%
Allentown, Borough of	1,828	$128,744,000	$5,241	0.00%
Asbury Park, City of	16,116	$822,648,930	$5,241	0.00%
Atlantic Highlands, Borough of	4,385	$251,833,600	$5,241	0.00%
Avon-By-The-Sea, Borough of	1,901	$346,002,100	$5,241	0.00%
Belmar, Borough of	5,794	$507,354,100	$5,241	0.00%
Bradley Beach, Borough of	4,298	$402,974,400	$5,241	0.00%
Brielle, Borough of	4,774	$490,439,800	$5,241	0.00%
Colts Neck, Township of	10,142	$1,679,133,600	$5,241	0.00%
Deal, Borough of	750	$511,562,800	$5,241	0.00%
Eatontown, Borough of	12,709	$1,158,392,100	$5,241	0.00%
Englishtown, Borough of	1,847	$125,736,600	$5,241	0.00%
Fair Haven, Borough of	6,121	$589,631,200	$5,241	0.00%
Farmingdale, Borough of	1,329	$112,597,500	$5,241	0.00%
Freehold, Borough of	12,052	$636,156,950	$5,241	0.00%
Freehold, Township of	36,184	$3,944,416,100	$5,241	0.00%
Hazlet, Township of	20,334	$1,212,072,900	$5,241	0.00%
Highlands, Borough of	5,005	$282,777,500	$5,241	0.00%
Holmdel, Township of	16,773	$2,086,402,399	$5,241	0.00%
Howell, Township of	51,075	$3,182,248,300	$5,241	0.00%
Interlaken, Borough of	820	$91,685,800	$5,241	0.01%
Keansburg, Borough of	10,105	$349,667,700	$5,241	0.00%
Keyport, Borough of	7,240	$422,424,400	$5,241	0.00%
Lake Como, Borough of	1,759	$155,708,700	$5,241	0.00%
Little Silver, Borough of	5,950	$747,827,900	$5,241	0.00%
Loch Arbour, Village of	194	$39,039,500	$5,241	0.01%
Long Branch, City of	30,719	$2,345,429,800	$5,241	0.00%
Manalapan, Township of	38,872	$3,793,581,500	$5,241	0.00%
Manasquan, Borough of	5,897	$723,654,300	$5,241	0.00%
Marlboro, Township of	40,191	$3,947,148,000	$5,241	0.00%
Matawan, Borough of	8,810	$501,846,200	$5,241	0.00%
Middletown, Township of	66,522	$4,980,350,600	$5,241	0.00%
Millstone, Township of	10,566	$994,523,937	$5,241	0.00%
Monmouth Beach, Borough of	3,279	$452,626,900	$5,241	0.00%
Neptune City, Borough of	4,869	$240,091,400	$5,241	0.00%
Neptune, Township of	27,935	$1,522,988,600	$5,241	0.00%
Ocean, Township of	27,291	$2,086,610,750	$5,241	0.00%
Oceanport, Borough of	5,832	$518,615,000	$5,241	0.00%
Red Bank, Borough of	12,206	$1,186,117,471	$5,241	0.00%
Roosevelt, Borough of	882	$40,634,100	$5,241	0.01%
Rumson, Borough of	7,122	$1,411,914,600	$5,241	0.00%
Sea Bright, Borough of	1,412	$238,003,600	$5,241	0.00%

Table 3c.7b Potential Annualized Losses from Winter Storms by Jurisdiction				
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)**	**Annualized Expected Property Losses**	**Annualized Percent Loss Ratio**
Sea Girt, Borough of	1,828	$469,081,700	$5,241	0.00%
Shrewsbury, Borough of	3,809	$490,447,400	$5,241	0.00%
Shrewsbury, Township of	1,141	$26,891,400	$5,241	0.02%
Spring Lake, Borough of	2,993	$1,047,534,400	$5,241	0.00%
Spring Lake Heights, Borough of	4,713	$454,145,300	$5,241	0.00%
Tinton Falls, Borough of	17,892	$2,014,827,700	$5,241	0.00%
Union Beach, Borough of	6,245	$255,879,500	$5,241	0.00%
Upper Freehold, Township of	6,902	$810,887,400	$5,241	0.00%
Wall, Township of	26,164	$2,302,913,200	$5,241	0.00%
West Long Branch, Borough of	8,097	$785,971,500	$5,241	0.00%
Total	**630,380**	**$55,141,734,937**	**$277,778**	**0.001%**

Coastal Erosion

Impacts – Coastal Erosion

Death and injury are not typically associated with coastal erosion, as erosive processes along the coast occur over long durations during which people in the affected areas have sufficient times to evacuate; however, it can destroy buildings and infrastructure. Coastal erosion can also represent a major threat to the local economies of coastal communities that rely on the financial benefits of their recreational beaches.

Exposure and Damage Estimates – Coastal Erosion

Unlike other hazards, the coastal erosion hazard is best described as a relatively slow natural process occurring over the long term, with occasional major impacts wrought by episodic natural events such as hurricanes and nor'easters. Another complicating factor in accurately determining specific coastal erosion hazard areas is the continuous implementation of shoreline reinforcement or nourishment projects completed by federal, state and local government agencies. Typically, areas of high concern with regard to long term coastal erosion are addressed through shoreline hardening or stabilization projects, such as seawalls, breakwaters and beach nourishment. The ability to continue successfully mitigating the effects of coastal erosion hazards throughout Monmouth County will therefore depend on regular shoreline monitoring and the design and implementation of site-specific solutions, as has been done in the past.

The New Jersey Coastal Zone Management Rules (NJAC 7:7E) defines erosion hazard areas as extending inland from the edge of a stabilized upland area to the limit of the area likely to be eroded in 30 years for one to four unit dwelling structures, and 60 years for all other structures, including developed and undeveloped areas[9]. The extent of an erosion hazard area is calculated by multiplying the projected annual erosion rate at a site by 30 for the development of one to four unit dwelling structures and by 60 for all other developments. According to a study prepared by the Heinz Center[10], much of the coastline of New Jersey, including Monmouth County, experiences an average of three feet of erosion per year.

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[9] This distance is measured from the crest of a bluff for coastal bluff areas, the most seaward established dune crest for unvegetated dune areas, the first vegetation line from the water for established vegetated dune areas, and the landward edge of a beach or the eight foot North American Datum (NAD), 1983, contour line, whichever is farther inland, for non-dune areas.

[10] "*Evaluation of Erosion Hazards*" prepared by The H. John Heinz III Center for Science, Economics and the Environment, April 2000. www.heinzctr.org/NEW_WEB/PDF/erosnrpt.pdf#pagemode=bookmarks&view=Fit

To estimate exposure to the coastal erosion hazard, data on shoreline type (as classified by the New Jersey Department of Environmental Protection) was used to delineate areas potentially susceptible to the erosion hazard. For purposes of this analysis, these shoreline types were limited to (1) “beach,” which includes waterfront areas comprised of 100 percent sand; and (2) “erodible,” which includes any soft shoreline other than beach, rock, marsh, sea wall or earthen dike. The determination of value at-risk was calculated through GIS analysis by summing the total improved values for those parcels that were confirmed to have at least one building located within 200 feet of the identified beach or erodible shoreline types. The figure of 200 feet was determined to be a reasonable yet slightly more conservative estimate for defining erosion hazard areas based on the calculations recommended under NJAC 7:7E as described above (annual erosion rate of three feet per year x 60 years = 180 feet). According to the assessment, 30 jurisdictions have improved property within areas susceptible to coastal erosion.

Monmouth County and its jurisdictions have an active history of pursuing and implementing successful shoreline protection strategies, particularly through the nourishment of critically eroding beaches and for areas in which property is threatened by continued erosion. Due to these aggressively implemented beach nourishment projects and other mitigating factors, it appears likely that buildings in coastal erosion hazard areas would be protected from the hazard for at least a foreseeable 30-year planning window (through 2044). Average annual building damages directly attributable to the erosion hazard have been considered to be negligible for the purposes of this risk assessment, assuming that these ongoing beach nourishment and shoreline stabilization practices are expected to be maintained aggressively, implemented on an ongoing basis, and encouraged to continue.

Table 3c.8 shows exposure to the coastal erosion hazard by jurisdiction. To estimate exposure coastal erosion, the determination of value and population at-risk was calculated through GIS analysis by calculating the proportion of a parcel or census block lying within 200 feet of ‘beach’ or ‘erodible’ shoreline types, and applying that same ratio to the census block population and parcel value to estimate population at risk and value of improvements at risk.

As mentioned in the *Hazard Profiles* section, sea level rise will increase the risk of damages/losses due to future coastal erosion and flood events. Rising sea level over time will shorten the return period (increasing the frequency) of episodic coastal erosion. This increased probability clearly will have an effect on the estimation of annualized loss/damage, but one that is typically only analyzed during detailed feasibility studies for projects proposed by the US Army Corps of Engineers.

Table 3c.8
Exposure in Coastal Erosion Areas by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located Within 200 Feet of Beach/ Erodible Shoreline Types	Percent of Total Building Value Located Within 200 Feet of Beach/ Erodible Shoreline Types	Average Annual Building Damages Directly Attributable to Coastal Erosion Assuming Continued Beach Nourishment and Shoreline Stabilization Practices
Aberdeen, Township of	33	$1,057,910,200	$802,803	0.08%	Negligible
Allenhurst, Borough of	10	$163,629,600	$6,022,214	3.68%	Negligible
Allentown, Borough of	0	$128,744,000	$0	0.00%	$0
Asbury Park, City of	0	$822,648,930	$1,672,344	0.20%	Negligible
Atlantic Highlands, Borough of	92	$251,833,600	$7,263,314	2.88%	Negligible
Avon-By-The-Sea, Borough of	7	$346,002,100	$1,578,416	0.46%	Negligible

Table 3c.8
Exposure in Coastal Erosion Areas by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located Within 200 Feet of Beach/ Erodible Shoreline Types	Percent of Total Building Value Located Within 200 Feet of Beach/ Erodible Shoreline Types	Average Annual Building Damages Directly Attributable to Coastal Erosion Assuming Continued Beach Nourishment and Shoreline Stabilization Practices
Belmar, Borough of	42	$507,354,100	$2,978,624	0.59%	Negligible
Bradley Beach, Borough of	10	$402,974,400	$136,547	0.03%	Negligible
Brielle, Borough of	12	$490,439,800	$1,517,925	0.31%	Negligible
Colts Neck, Township of	0	$1,679,133,600	$0	0.00%	$0
Deal, Borough of	29	$511,562,800	$25,903,728	5.06%	Negligible
Eatontown, Borough of	0	$1,158,392,100	$0	0.00%	$0
Englishtown, Borough of	0	$125,736,600	$0	0.00%	$0
Fair Haven, Borough of	11	$589,631,200	$1,900,923	0.32%	Negligible
Farmingdale, Borough of	0	$112,597,500	$0	0.00%	$0
Freehold, Borough of	0	$636,156,950	$0	0.00%	$0
Freehold, Township of	0	$3,944,416,100	$0	0.00%	$0
Hazlet, Township of	0	$1,212,072,900	$0	0.00%	$0
Highlands, Borough of	326	$282,777,500	$18,539,523	6.56%	Negligible
Holmdel, Township of	0	$2,086,402,399	$0	0.00%	$0
Howell, Township of	0	$3,182,248,300	$0	0.00%	$0
Interlaken, Borough of	0	$91,685,800	$0	0.00%	$0
Keansburg, Borough of	12	$349,667,700	$22,672	0.01%	Negligible
Keyport, Borough of	80	$422,424,400	$2,883,941	0.68%	Negligible
Lake Como, Borough of	0	$155,708,700	$0	0.00%	$0
Little Silver, Borough of	176	$747,827,900	$35,453,645	4.74%	Negligible
Loch Arbour, Village of	0	$39,039,500	$376,114	0.96%	Negligible
Long Branch, City of	528	$2,345,429,800	$69,025,232	2.94%	Negligible
Manalapan, Township of	0	$3,793,581,500	$0	0.00%	$0
Manasquan, Borough of	32	$723,654,300	$3,445,163	0.48%	Negligible
Marlboro, Township of	0	$3,947,148,000	$0	0.00%	$0
Matawan, Borough of	0	$501,846,200	$0	0.00%	$0
Middletown, Township of	316	$4,980,350,600	$60,029,875	1.21%	Negligible
Millstone, Township of	0	$994,523,937	$0	0.00%	$0
Monmouth Beach, Borough of	325	$452,626,900	$47,475,287	10.49%	Negligible
Neptune City, Borough of	91	$240,091,400	$3,111,888	1.30%	Negligible
Neptune, Township of	229	$1,522,988,600	$6,362,848	0.42%	Negligible
Ocean, Township of	0	$2,086,610,750	$0	0.00%	$0
Oceanport, Borough of	209	$518,615,000	$26,288,523	5.07%	Negligible
Red Bank, Borough of	57	$1,186,117,471	$3,587,991	0.30%	Negligible
Roosevelt, Borough of	0	$40,634,100	$0	0.00%	$0
Rumson, Borough of	253	$1,411,914,600	$82,868,319	5.87%	Negligible
Sea Bright, Borough of	300	$238,003,600	$57,989,006	24.36%	Negligible
Sea Girt, Borough of	12	$469,081,700	$14,362,038	3.06%	Negligible
Shrewsbury, Borough of	18	$490,447,400	$1,096,747	0.22%	Negligible

Table 3c.8
Exposure in Coastal Erosion Areas by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located Within 200 Feet of Beach/ Erodible Shoreline Types	Percent of Total Building Value Located Within 200 Feet of Beach/ Erodible Shoreline Types	Average Annual Building Damages Directly Attributable to Coastal Erosion Assuming Continued Beach Nourishment and Shoreline Stabilization Practices
Shrewsbury, Township of	0	$26,891,400	$0	0.00%	$0
Spring Lake, Borough of	2	$1,047,534,400	$3,724,834	0.36%	Negligible
Spring Lake Heights, Borough of	0	$454,145,300	$0	0.00%	$0
Tinton Falls, Borough of	0	$2,014,827,700	$0	0.00%	$0
Union Beach, Borough of	129	$255,879,500	$6,753,526	2.64%	Negligible
Upper Freehold, Township of	0	$810,887,400	$0	0.00%	$0
Wall, Township of	146	$2,302,913,200	$14,881,391	0.65%	Negligible
West Long Branch, Borough of	0	$785,971,500	$0	0.00%	$0
Total	**3,487**	**$55,141,734,937**	**$508,055,401**	**0.92%**	**Negligible**

Dam Failure

[redacted]

[redacted]

[redacted]

Drought

Impacts – Drought

Droughts are slow onset hazards, but, over time, they can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions extend over a number of years, the direct and indirect economic impacts can be significant. High temperatures, high winds, and low humidity can worsen drought conditions and also make areas more susceptible to wildfire. In addition, human actions and demands for water resources can accelerate drought-related impacts.

Exposure and Damage Estimates – Drought

Because drought impacts large areas and crosses jurisdictional boundaries, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. However, drought impacts are mostly experienced in water shortages and crop losses on agricultural lands and have no impact on buildings. To estimate land exposure to drought, agricultural land acreage was acquired from 2006 land use classification data as provided by the Monmouth County Office of GIS[11]. **Table 3c.10** shows agricultural land acreage in Monmouth County by jurisdiction. Approximately 14 percent of land in Monmouth County is used for agriculture, orchards, and nurseries; located in 25 of the county's 53 communities.

Table 3c.10
Acreage of Agricultural Land by Jurisdiction

Jurisdiction	Total Acres	Agricultural Land (Acres)	Percentage of Total
Aberdeen, Township of	3,588	14	0.40%
Allenhurst, Borough of	162	0	0.00%
Allentown, Borough of	399	11	2.80%
Asbury Park, City of	955	0	0.00%
Atlantic Highlands, Borough of	782	0	0.00%
Avon-By-The-Sea, Borough of	292	0	0.00%
Belmar, Borough of	888	0	0.00%
Bradley Beach, Borough of	382	0	0.00%
Brielle, Borough of	1,521	0	0.00%
Colts Neck, Township of	20,713	3,600	17.40%

[11] Countywide land use classification data is still current as of 2006; the dataset has not been updated since the initial plan was prepared.

Table 3c.10
Acreage of Agricultural Land by Jurisdiction

Jurisdiction	Total Acres	Agricultural Land (Acres)	Percentage of Total
Deal, Borough of	759	0	0.00%
Eatontown, Borough of	3,765	16	0.40%
Englishtown, Borough of	373	9	2.50%
Fair Haven, Borough of	1,345	0	0.00%
Farmingdale, Borough of	338	10	3.10%
Freehold, Borough of	1,249	2	0.10%
Freehold, Township of	24,673	2,662	10.80%
Hazlet, Township of	3,682	16	0.40%
Highlands, Borough of	463	0	0.00%
Holmdel, Township of	11,419	1,761	15.40%
Howell, Township of	39,425	4,359	11.10%
Interlaken, Borough of	247	0	0.00%
Keansburg, Borough of	748	0	0.00%
Keyport, Borough of	937	0	0.00%
Lake Como, Borough of	158	0	0.00%
Little Silver, Borough of	2,133	9	0.40%
Loch Arbour, Village of	77	0	0.00%
Long Branch, City of	3,408	0	0.00%
Manalapan, Township of	19,777	3,191	16.10%
Manasquan, Borough of	983	0	0.00%
Marlboro, Township of	19,676	1,850	9.40%
Matawan, Borough of	1,510	0	0.00%
Middletown, Township of	25,829	982	3.80%
Millstone, Township of	23,910	6,279	26.30%
Monmouth Beach, Borough of	1,243	0	0.00%
Neptune City, Borough of	563	0	0.00%
Neptune, Township of	5,642	21	0.40%
Ocean, Township of	7,023	24	0.30%
Oceanport, Borough of	2,431	12	0.50%
Red Bank, Borough of	1,374	0	0.00%
Roosevelt, Borough of	1,251	323	25.80%
Rumson, Borough of	4,555	15	0.30%
Sea Bright, Borough of	651	0	0.00%
Sea Girt, Borough of	675	0	0.00%
Shrewsbury, Borough of	1,404	12	0.90%
Shrewsbury, Township of	62	0	0.00%
Spring Lake, Borough of	902	0	0.00%
Spring Lake Heights, Borough of	840	0	0.00%
Tinton Falls, Borough of	9,965	249	2.50%
Union Beach, Borough of	1,210	0	0.00%
Upper Freehold, Township of	30,134	16,660	55.30%
Wall, Township of	19,829	1,273	6.40%
West Long Branch, Borough of	1,842	18	1.00%
Total	**308,162**	**43,378**	**14.00%**

Source: Monmouth County Office of GIS

The USDA 2012 Census of Agriculture for Monmouth County was used to analyze the exposure of Monmouth County crops to drought. It was assumed that the exposure of crops was equal to the total value of crops sold ($67,185,000). This represents roughly a 20 percent decrease since the last version of the plan ($84,280,384).

For the 2009 Plan, to estimate losses due to drought, NCDC historical drought loss data for Monmouth County was used to develop a drought stochastic (probability) model. In this model: losses were obtained for each jurisdiction and scaled for inflation. For all events impacting the entire county (loss data not provided for specific jurisdictions), losses were averaged across all 53 jurisdictions. Average historic drought damageability was used to generate losses for historical drought events where losses were not reported. Expected annualized losses were calculated through a non-linear regression of historical data. Probabilistic losses were scaled to account for would-be losses where no exposure/instrument was present at the time of the event. Using this method based on historical losses and crop market value exposure for Monmouth County, county-wide annualized expected crop losses in the 2009 Plan were estimated at approximately $108,098, with an annualized percent loss ratio of 0.13 percent.

For the plan update, NCDC historical drought loss data was once again queried, this time for records up to September 2014. The data includes a total of 40 drought days between June 1997[12] and June 2014. However, the event records estimated $0 in both property and crop damages for these events. This was presumed to be a function of ongoing changes to the NCDC data set, as opposed to true zero dollar losses, because episode narratives did present descriptions of often significant losses for these same events, but not in a manner that would permit an accurate breakdown of losses by jurisdiction or even by county.

Given the lack of sufficiently detailed historical data on significant drought occurrences for Monmouth County, 2009 estimates were scaled to the present by assuming average annual damages would be the same ratio of losses to total crop value. In 2009, this ratio was 0.00128 ($108,098 average annual countywide losses/$84,280,384 total crop value); in 2014, using this same ratio applied to the 2012 crop value of $67,185,000 yields average annual losses of $85,997. Distributing across the 25 jurisdictions with land in agriculture would represent losses of $3,440 per jurisdiction, on average; though the exact number would vary significantly depending upon the specific type of crops planted and the acres of each crop in that community .Though unquantifiable, while any one event can have significant consequences, it is presumed that average annual crop losses are considered to be negligible (<$5,000) for each jurisdictions with land in agriculture.

Flood

Impacts – Flood

Near the Atlantic Ocean, Raritan Bay, Navesink River, Sandy Hook Bay, Shark River and Shrewsbury River, serious flooding problems are the result of high tidal surge and associated wave activity caused primarily by tropical storms, especially hurricanes. Other low-lying areas are vulnerable to severe flooding and flood-related damage due to the periodic flooding caused by the overflow of streams and lakes. Heavy rainfall can result in higher than normal stages of Deal Lake, affecting the Borough of Allenhurst, the City of Asbury Park, the Borough of Deal, and the Village of Loch Arbour, which frequently experiences property damage. Additional flooding in the Township of Aberdeen is attributed to tidal inundation and backwater from inadequate culverts. Due to high tidal stages on the Raritan Bay, the northern area of Aberdeen in the tidal plains of Matawan Creek, Mohingson Brook and Whale Creek is prone to flooding that affects Route 35

[12] Events between 1950 and 1997 were not included in the NCDC database and, therefore, are not accounted for in this analysis.

and properties near the shoreline. Areas adjacent to Mohingson Brook, Gravelly Run and Matawan Creek are prone to flooding due to inadequate culverts.
In the Borough of Deal, the lower portion of Poplar Brook is within the tidal range of the Atlantic Ocean. Runoff from severe rain periodically can cause the upper reach of Poplar Brook to overflow its banks. Residential properties will be affected by flooding on both stretches of Poplar Brook.

In the Borough of Eatontown, at times blockage by debris and refuse on Wampum Brook, Parkers Creek, Whale Pond Brook, Husky Brook, Crystal Brook and Turtle Mill Brook can cause severe restrictions of culverts and contribute to local flooding. Most local flooding occurs upstream of State Route 35 on Parkers Creek, upstream of State Route 35 near Clinton Avenue, upstream of State Route 71 on Husky Brook at the twin 48 inch culverts under the Duncan Thecker Associates Service Road, and along the Lewis Street Bridge over Wampum Brook.

In the Township of Freehold, flooding has occurred along Manasquan River Tributary B upstream of Elton Adelphia Road, to a distance of 100 feet beyond normal channel bank. During severe conditions, Coventry Drive, which parallels the stream, has become impassable due to flooding. Debois Creek causes localized flooding where roadways cross the stream. The Strickland Road crossing has been flooded to a depth of two feet above the road surface during severe storms. The adjacent floodplain has been inundated but with no extensive property damage. Debois Creek Tributary has experienced flooding during storm conditions due to constricted channel areas in the downstream portions of the stream. Extensive erosion in the channel of the tributary has been reported.

In the Township of Holmdel, flooding occurs upstream of State Route 34 and along South Street by Willow brook, as well as near Middle Road by Waackaack Creek.

In the Township of Howell, localized flooding problems have occurred in the area of Long Brook and Bannen Meadow Brook. Long Brook has caused flooding of adjacent property near Wyckoff Road and the State Route 33 crossing. Howell Road is prone to flooding during severe conditions. Bannen Meadow Brook has caused flooding of adjacent property near Fort Plains Road and Casino Drive. The Fort Plains Road crossing is also flooded during severe flooding conditions.

In the Township of Manalapan, considerable flooding occurs along Matchaponix Brook in the area of the corporate limits and at its junction with Pine Brook 2. Flood elevations along the lower reach of Pine Brook 2 area affected by backwater from the main branch of Matchaponix Brook. Flooding occurs along Pension Road near Clarks Mills. The housing development along Birmingham Drive, Tarrytown Road and Winthrop Drive is subject to flooding from Pine Brook 2. The area along Pine brook Road and Pease Road is flooded regularly when Pine Brook 2 Tributary C overflows its banks. Flooding problems also exist along Milford Brook in the area of Commack Lane, Pease Road and Tennant Road. Additional problems along Milford Brook arise during heavy rains in the area of Lafayette Mills and Lafayette Mills Road.

In the Borough of Matawan, flood gates are maintained by the community on Matawan Creek at the Lake Lefferts Dam. At times, when the flood gates were not opened quickly enough during severe storm conditions, Ravine Drive has flooded to a depth of eight inches. Gravelly Brook has flooded Mill Road to a depth of six inches. The Municipal Garage, located on the floodplain of Gravelly Brook upstream of Church Street, has been flooded to a depth of eight inches, and the Church Street crossing has been flooded by Gravelly Brook to a depth of four inches. Downstream of the confluence of Gravelly Brook with Matawan Creek, the triple culvert at the Railroad Bridge causes backwater flooding of Aberdeen Road to a depth of five feet.

In the Township of Marlboro, considerable flooding occurs along Deep Run in the area of the corporate limits and Old Texas Road, a relatively flat region. A wide floodplain also occurs at Deep Run's junction with Deep Run Tributary B. Additionally, backwater effects of the culvert on Milford Brook at State Route 18 cause flooding upstream of that structure.

In the Township of Middletown, the bayshore portion of the township lies in a poorly drained floodplain with abundant swamp and marshland. The low banks of the stream and the low relief of the surrounding terrain render this region extremely vulnerable to flooding. During periods of heavy precipitation, the creeks overtop their banks and spread their floodwaters over the broad floodplain.

In the Township of Neptune, there are several areas that experience flooding from assorted causes. In the Shark River Hills section, high tides, moon tides, and heavy rain produce flooding along low-lying roads and properties. There are residential properties and critical infrastructure (pump stations) in this area that experience flooding. The area along South Concourse Avenue also experiences flooding due to high tides, winds, moon tides, and heavy rains. The flooding impacts businesses, residents, and critical infrastructure (pump stations) in this area, and residents frequently have to be evacuated. In the Ocean Grove section of the Township, the area around Fletcher Lake frequently floods during heavy rains and high tides.

In the Township of Ocean, inland flow of the ocean tidal surges in restricted by weirs in the streams flowing to the ocean, as well as by lake storage. Flooding in the township is caused mostly by local rainstorms.

In the Borough of Spring Lake Heights, flooding occurs along Wreck Pond Brook, Wreck Pond North Branch and Poly Pond Brook. In general, localized flooding may occur under severe storm conditions due to poor surface drainage.

In the Borough of Tinton Falls, low-lying areas are subject to periodic flooding caused by the overflow of Swimming River, Pine Brook 1 and Jumping Brook 2. The most severe flooding occurs at the junction of Pine Brook 1 and Swimming River.

The Borough of Union Beach lies in a poorly drained floodplain with abundant swamps and marshland. The flat gradient of the streams and low relief of the surrounding terrain makes the area extremely vulnerable to flooding. During periods of heavy rainfall, streams within the Borough can overtop and spread floodwaters across the broad floodplain.

In the Township of Wall, flooding in the eastern section and remaining parts of the Township is caused by streams overflowing their banks. The non-tidal sections of Shark River, Manasquan River and Wreck Pond flow in wide, meandering channels. Urbanization in the areas of Watson Creek, Judas Creek (Upstream Reach), Roberts Swamp Brook (Upstream Reach), Poly Pond Brook and Heroys Pond Brook increase the runoff to these streams. Flooding can be aggravated by the accumulation of debris at culverts and bridges.

Exposure and Damage Estimates – Flooding

In order to assess flood risk, a GIS-based analysis was used to estimate exposure to flood events using FEMA's DFIRMs in combination with local tax assessor records. To estimate exposure to flooding, the determination of value and population at-risk was calculated through GIS analysis by calculating the proportion of a parcel or census block lying within an identified flood zone (A/AE and VE), and applying that same ratio to the census block population and parcel value to estimate population at risk and value of improvements at risk, as presented in **Table 3c.11**. The assessment for this plan update represents an improvement over the prior version of the plan through use of more recent assessed values (2012), in addition to more recent and more accurate flood data (2013 preliminary DFIRMs as opposed to the earlier Q3 data, which had a much higher potential margin of error). Due to the reassessment, total assessed values in this plan update are approximately 50 percent higher than they were at the time the initial version of this plan was prepared.

Table 3c.11
Exposure in Flood Zones by Jurisdiction

Jurisdiction	Total Assessed Value of Improvements (Buildings)	Buildings Located in A/AE Zones		Buildings Located in VE Zone		Buildings Located in All Flood Zone (A/AE and VE)	
		Value At-Risk	Percent	Value At-Risk	Percent	Value At-Risk	Percent
Aberdeen, Township of	$1,057,910,200	$41,259,408	3.90%	$2,846,375	0.27%	$44,105,783	4.17%
Allenhurst, Borough of	$163,629,600	$1,346,317	0.82%	$139,403	0.09%	$1,485,720	0.91%
Allentown, Borough of	$128,744,000	$4,704,817	3.65%	$0	0.00%	$4,704,817	3.65%
Asbury Park, City of	$822,648,930	$20,575,565	2.50%	$2,656,807	0.32%	$23,232,372	2.82%
Atlantic Highlands, Borough of	$251,833,600	$20,863,730	8.28%	$2,181,515	0.87%	$23,045,245	9.15%
Avon-By-The-Sea, Borough of	$346,002,100	$85,421,108	24.69%	$852,093	0.25%	$86,273,201	24.93%
Belmar, Borough of	$507,354,100	$99,565,169	19.62%	$3,826,485	0.75%	$103,391,654	20.38%
Bradley Beach, Borough of	$402,974,400	$11,492,484	2.85%	$0	0.00%	$11,492,484	2.85%
Brielle, Borough of	$490,439,800	$80,887,098	16.49%	$3,429,507	0.70%	$84,316,605	17.19%
Colts Neck, Township of	$1,679,133,600	$57,942,297	3.45%	$0	0.00%	$57,942,297	3.45%
Deal, Borough of	$511,562,800	$14,041,176	2.74%	$6,195,372	1.21%	$20,236,548	3.96%
Eatontown, Borough of	$1,158,392,100	$22,293,812	1.92%	$0	0.00%	$22,293,812	1.92%
Englishtown, Borough of	$125,736,600	$9,432,642	7.50%	$0	0.00%	$9,432,642	7.50%
Fair Haven, Borough of	$589,631,200	$5,298,003	0.90%	$11,087,814	1.88%	$16,385,817	2.78%
Farmingdale, Borough of	$112,597,500	$11,877,164	10.55%	$0	0.00%	$11,877,164	10.55%
Freehold, Borough of	$636,156,950	$44,934	0.01%	$0	0.00%	$44,934	0.01%
Freehold, Township of	$3,944,416,100	$36,459,113	0.92%	$0	0.00%	$36,459,113	0.92%
Hazlet, Township of	$1,212,072,900	$102,209,074	8.43%	$0	0.00%	$102,209,074	8.43%
Highlands, Borough of	$282,777,500	$141,396,231	50.00%	$1,955,287	0.69%	$143,351,518	50.69%
Holmdel, Township of	$2,086,402,399	$18,624,211	0.89%	$0	0.00%	$18,624,211	0.89%
Howell, Township of	$3,182,248,300	$52,062,146	1.64%	$0	0.00%	$52,062,146	1.64%
Interlaken, Borough of	$91,685,800	$4,762,326	5.19%	$0	0.00%	$4,762,326	5.19%
Keansburg, Borough of	$349,667,700	$295,473,849	84.50%	$2,853,529	0.82%	$298,327,378	85.32%
Keyport, Borough of	$422,424,400	$33,159,512	7.85%	$6,033,976	1.43%	$39,193,488	9.28%
Lake Como, Borough of	$155,708,700	$10,948,375	7.03%	$0	0.00%	$10,948,375	7.03%
Little Silver, Borough of	$747,827,900	$109,493,251	14.64%	$0	0.00%	$109,493,251	14.64%
Loch Arbour, Village of	$39,039,500	$13,371,354	34.25%	$249,749	0.64%	$13,621,103	34.89%
Long Branch, City of	$2,345,429,800	$141,205,618	6.02%	$6,226,383	0.27%	$147,432,001	6.29%
Manalapan, Township of	$3,793,581,500	$65,492,713	1.73%	$0	0.00%	$65,492,713	1.73%
Manasquan, Borough of	$723,654,300	$329,324,402	45.51%	$44,728,931	6.18%	$374,053,333	51.69%
Marlboro, Township of	$3,947,148,000	$66,094,578	1.67%	$0	0.00%	$66,094,578	1.67%
Matawan, Borough of	$501,846,200	$9,570,696	1.91%	$0	0.00%	$9,570,696	1.91%
Middletown, Township of	$4,980,350,600	$423,277,030	8.50%	$18,483,329	0.37%	$441,760,359	8.87%
Millstone, Township of	$994,523,937	$16,813,941	1.69%	$0	0.00%	$16,813,941	1.69%
Monmouth Beach, Borough of	$452,626,900	$290,320,994	64.14%	$252,777	0.06%	$290,573,771	64.20%
Neptune City, Borough of	$240,091,400	$9,788,749	4.08%	$902,920	0.38%	$10,691,669	4.45%
Neptune, Township of	$1,522,988,600	$81,799,320	5.37%	$2,659,451	0.17%	$84,458,771	5.55%
Ocean, Township of	$2,086,610,750	$72,913,925	3.49%	$0	0.00%	$72,913,925	3.49%
Oceanport, Borough of	$518,615,000	$144,804,733	27.92%	$0	0.00%	$144,804,733	27.92%
Red Bank, Borough of	$1,186,117,471	$38,704,927	3.26%	$15,534,912	1.31%	$54,239,839	4.57%
Roosevelt, Borough of	$40,634,100	$36,743	0.09%	$0	0.00%	$36,743	0.09%
Rumson, Borough of	$1,411,914,600	$266,870,353	18.90%	$9,512,060	0.67%	$276,382,413	19.58%
Sea Bright, Borough of	$238,003,600	$178,990,466	75.20%	$5,437,378	2.28%	$184,427,844	77.49%
Sea Girt, Borough of	$469,081,700	$38,527,608	8.21%	$7,457,753	1.59%	$45,985,361	9.80%

Table 3c.11 Exposure in Flood Zones by Jurisdiction							
Jurisdiction	**Total Assessed Value of Improvements (Buildings)**	**Buildings Located in A/AE Zones**		**Buildings Located in VE Zone**		**Buildings Located in All Flood Zone (A/AE and VE)**	
		Value At-Risk	**Percent**	**Value At-Risk**	**Percent**	**Value At-Risk**	**Percent**
Shrewsbury, Borough of	$490,447,400	$8,286,740	1.69%	$0	0.00%	$8,286,740	1.69%
Shrewsbury, Township of	$26,891,400	$0	0.00%	$0	0.00%	$0	0.00%
Spring Lake, Borough of	$1,047,534,400	$108,869,440	10.39%	$898,261	0.09%	$109,767,701	10.48%
Spring Lake Heights, Borough of	$454,145,300	$21,571,977	4.75%	$0	0.00%	$21,571,977	4.75%
Tinton Falls, Borough of	$2,014,827,700	$79,953,824	3.97%	$0	0.00%	$79,953,824	3.97%
Union Beach, Borough of	$255,879,500	$192,192,106	75.11%	$9,672,322	3.78%	$201,864,428	78.89%
Upper Freehold, Township of	$810,887,400	$21,947,483	2.71%	$0	0.00%	$21,947,483	2.71%
Wall, Township of	$2,302,913,200	$67,920,155	2.95%	$2,686,837	0.12%	$70,606,992	3.07%
West Long Branch, Borough of	$785,971,500	$13,878,912	1.77%	$0	0.00%	$13,878,912	1.77%
Total	**$55,141,734,937**	**$3,994,162,599**	**7.24%**	**$168,761,226**	**0.31%**	**$4,162,923,825**	**7.55%**

NOTES: Exposure calculated by GIS Analysis using local assessed values

To estimate potential losses resulting from the flood hazard, a basic HAZUS-MH analysis was conducted for both riverine and coastal flooding. After attempting to use the model to analyze coastal flooding, it was determined that the current model does not sufficiently address coastal flooding in Monmouth County. Coastal flooding potential is addressed in the storm surge section of this document, but it should be noted that an analysis for ordinary coastal flooding events not associated with hurricanes could not be modeled in this risk assessment. As better data and modeling tools become available to assess coastal flooding, future plan updates should expand the assessment of coastal flooding in Monmouth County. Thus, only riverine flood impacts are analyzed in this section.

HAZUS-MH was used to estimate potential losses in Monmouth County resulting from potential riverine flood events. A custom Digital Elevation Model DEM based on 2 foot contours was used for input and flood depth was estimated at the pixel level for affected areas, along with the proportion of the area affected within the census block. HAZUS-MH was utilized to estimate floodplain boundaries, potential exposure for each event frequency, and loss estimates based on probabilistic scenarios for 10-, 50-, 100-, 200-, 500-year and annualized flood events using a Level 2 analysis13. **Table 3c.12** shows estimated potential losses for 10-, 50-, 100-, 200-, and 500-year riverine flood; and **Table 3c.13** shows estimated annualized riverine flood event scenarios.

Table 3c.12 Estimated Potential Losses From 10-, 50-, 100-, 200- and 500-year Riverine Flood Events					
	Potential Total Building Losses[14]				
Jurisdiction	**10-Year Riverine Flood Event**	**50-Year Riverine Flood Event**	**100-Year Riverine Flood Event**	**200-Year Riverine Flood Event**	**500-Year Riverine Flood Event**
Aberdeen, Township of	$108,630	$157,674	$226,740	$285,122	$2,338,206
Allenhurst, Borough of	N/A	N/A	N/A	N/A	N/A
Allentown, Borough of	$354,624	$454,619	$557,491	$702,708	$1,547,706
Asbury Park, City of	N/A	N/A	N/A	N/A	N/A

[13] According to FEMA's HAZUS Web site, "a Level 1 analysis yields a rough estimate based on the nationwide database and is a great way to begin the risk assessment process and prioritize high-risk communities." Level 1 analyses were done for the 2009 version of the plan. In contrast, the Level 2 analysis type used for the 2014 Plan Update, "[produces more accurate loss estimates] by including detailed information on local hazard conditions and/or by replacing the national default inventories with more accurate local inventories of buildings, essential facilities and other infrastructure.

[14] N/A = Riverine flooding is not applicable for this community and therefore building losses attributable to riverine flooding are $0.

Table 3c.12					
Estimated Potential Losses From 10-, 50-, 100-, 200- and 500-year Riverine Flood Events					
	Potential Total Building Losses[14]				
Jurisdiction	**10-Year Riverine Flood Event**	**50-Year Riverine Flood Event**	**100-Year Riverine Flood Event**	**200-Year Riverine Flood Event**	**500-Year Riverine Flood Event**
Atlantic Highlands, Borough of	N/A	N/A	N/A	N/A	N/A
Avon-By-The-Sea, Borough of	N/A	N/A	N/A	N/A	N/A
Belmar, Borough of	N/A	N/A	N/A	N/A	N/A
Bradley Beach, Borough of	N/A	N/A	N/A	N/A	N/A
Brielle, Borough of	N/A	N/A	N/A	N/A	N/A
Colts Neck, Township of	$7,259,073	$9,031,963	$10,348,734	$11,850,398	$27,192,447
Deal, Borough of	$41,492	$47,803	$64,342	$113,740	$323,928
Eatontown, Borough of	$210,918	$278,507	$318,679	$500,876	$2,674,370
Englishtown, Borough of	$1,218,116	$1,579,589	$1,903,519	$2,289,467	$6,110,974
Fair Haven, Borough of	N/A	N/A	N/A	N/A	N/A
Farmingdale, Borough of	$1,247,021	$1,553,509	$1,771,187	$1,978,768	$3,580,165
Freehold, Borough of	N/A	N/A	N/A	N/A	N/A
Freehold, Township of	$5,487,205	$7,207,418	$9,264,420	$11,491,581	$19,059,459
Hazlet, Township of	$1,263,470	$1,842,221	$2,309,436	$2,999,804	$5,415,345
Highlands, Borough of	N/A	N/A	N/A	N/A	N/A
Holmdel, Township of	$3,799,779	$5,201,558	$6,624,609	$8,151,284	$17,223,743
Howell, Township of	$15,779,152	$19,195,836	$21,764,159	$24,854,567	$44,975,701
Interlaken, Borough of	$4,412	$5,042	$6,303	$6,933	$8,824
Keansburg, Borough of	$2,707,854	$3,274,427	$3,662,831	$4,190,210	$7,211,529
Keyport, Borough of	$123,279	$149,218	$173,584	$203,368	$896,666
Lake Como, Borough of	N/A	N/A	N/A	N/A	N/A
Little Silver, Borough of	$1,095	$2,190	$3,832	$6,022	$23,910
Loch Arbour, Village of	N/A	N/A	N/A	N/A	N/A
Long Branch, City of	$594,884	$704,587	$6,538,584	$870,643	$3,832,295
Manalapan, Township of	$18,676,052	$23,130,574	$26,985,770	$31,444,223	$54,543,853
Manasquan, Borough of	N/A	N/A	N/A	N/A	N/A
Marlboro, Township of	$1,478,247	$1,764,323	$2,079,824	$2,392,823	$5,565,274
Matawan, Borough of	$229,758	$2,819,248	$3,101,947	$3,505,195	$4,565,925
Middletown, Township of	$12,490,855	$15,200,536	$18,233,083	$21,092,102	$40,399,051
Millstone, Township of	$5,893,812	$7,248,802	$8,193,967	$9,249,965	$14,486,997
Monmouth Beach, Borough of	N/A	N/A	N/A	N/A	N/A
Neptune City, Borough of	N/A	N/A	N/A	N/A	N/A
Neptune, Township of	$3,875,937	$4,609,856	$5,153,091	$5,741,811	$7,688,907
Ocean, Township of	$233,628	$322,754	$536,484	$750,963	$6,788,080
Oceanport, Borough of	$431,938	$500,305	$2,094,448	$595,084	$3,320,065
Red Bank, Borough of	$4,098,233	$4,625,773	$5,806,063	$6,318,614	$15,938,062
Roosevelt, Borough of	$15,602	$18,263	$20,306	$22,905	$324,973
Rumson, Borough of	N/A	N/A	N/A	N/A	N/A
Sea Bright, Borough of	N/A	N/A	N/A	N/A	N/A
Sea Girt, Borough of	$293,832	$296,003	$288,042	$327,183	$1,475,261
Shrewsbury, Borough of	$147,994	$203,582	$271,466	$378,915	$1,951,128
Shrewsbury, Township of	N/A	N/A	N/A	N/A	N/A
Spring Lake, Borough of	$420,721	$1,009,656	$1,065,571	$1,099,120	$779,608
Spring Lake Heights, Borough of	$971,124	$1,239,132	$1,451,503	$1,654,996	$4,160,170

Table 3c.12 Estimated Potential Losses From 10-, 50-, 100-, 200- and 500-year Riverine Flood Events					
	Potential Total Building Losses[14]				
Jurisdiction	**10-Year Riverine Flood Event**	**50-Year Riverine Flood Event**	**100-Year Riverine Flood Event**	**200-Year Riverine Flood Event**	**500-Year Riverine Flood Event**
Tinton Falls, Borough of	$2,363,878	$4,456,369	$5,399,551	$6,314,565	$28,667,436
Union Beach, Borough of	$0	$0	$0	$0	$992
Upper Freehold, Township of	$3,050,985	$3,601,242	$4,169,746	$4,775,425	$11,077,601
Wall, Township of	$2,702,423	$3,343,179	$3,898,482	$4,624,043	$13,466,613
West Long Branch, Borough of	$35,603	$51,580	$101,244	$117,950	$6,848,734
Total	**$97,611,625**	**$125,127,336**	**$154,389,037**	**$170,901,372**	**$179,370,442**

Source: HAZUS-MH

Table 3c.13 shows potential annualized property losses calculated by HAZUS-MH as well as percent loss ratios resulting from **riverine flooding** for each jurisdiction in Monmouth County.

Table 3c.13 Potential Annualized Losses from Riverine Flooding by Jurisdiction				
Jurisdiction	**Estimated Population At Risk[15]**	**Total Assessed Value of Improvements (Buildings)**	**Annualized Total Building Losses Riverine Flood[16]**	**Annualized Percent Loss Ratio Riverine Flood**
Aberdeen, Township of	1,429	$1,057,910,200	$17,840	0.00%
Allenhurst, Borough of	13	$163,629,600	N/A	N/A
Allentown, Borough of	163	$128,744,000	$50,233	0.04%
Asbury Park, City of	869	$822,648,930	N/A	N/A
Atlantic Highlands, Borough of	410	$251,833,600	N/A	N/A
Avon-By-The-Sea, Borough of	507	$346,002,100	N/A	N/A
Belmar, Borough of	1,246	$507,354,100	N/A	N/A
Bradley Beach, Borough of	185	$402,974,400	N/A	N/A
Brielle, Borough of	611	$490,439,800	N/A	N/A
Colts Neck, Township of	732	$1,679,133,600	$904,792	0.05%
Deal, Borough of	38	$511,562,800	$4,207	0.00%
Eatontown, Borough of	234	$1,158,392,100	$31,418	0.00%
Englishtown, Borough of	311	$125,736,600	$165,326	0.13%
Fair Haven, Borough of	154	$589,631,200	N/A	N/A
Farmingdale, Borough of	317	$112,597,500	$157,891	0.14%
Freehold, Borough of	1	$636,156,950	N/A	N/A
Freehold, Township of	1,073	$3,944,416,100	$771,972	0.02%
Hazlet, Township of	2,650	$1,212,072,900	$199,420	0.02%
Highlands, Borough of	2,641	$282,777,500	N/A	N/A
Holmdel, Township of	445	$2,086,402,399	$554,597	0.03%
Howell, Township of	3,390	$3,182,248,300	$1,999,260	0.06%
Interlaken, Borough of	33	$91,685,800	$630	0.00%
Keansburg, Borough of	8,946	$349,667,700	$326,653	0.09%
Keyport, Borough of	1,027	$422,424,400	$16,614	0.00%
Lake Como, Borough of	95	$155,708,700	N/A	N/A
Little Silver, Borough of	784	$747,827,900	$414	0.00%
Loch Arbour, Village of	75	$39,039,500	N/A	N/A

[15] Population reflects an estimate of all people living in the 100 year floodplain, riverine and coastal A, AE, and V zones
[16] N/A = Riverine flooding is not applicable for this community and therefore building losses attributable to riverine flooding are $0

Table 3c.13 Potential Annualized Losses from Riverine Flooding by Jurisdiction				
Jurisdiction	**Estimated Population At Risk[15]**	**Total Assessed Value of Improvements (Buildings)**	**Annualized Total Building Losses Riverine Flood[16]**	**Annualized Percent Loss Ratio Riverine Flood**
Long Branch, City of	3,301	$2,345,429,800	$154,302	0.01%
Manalapan, Township of	1,881	$3,793,581,500	$2,442,886	0.06%
Manasquan, Borough of	2,440	$723,654,300	N/A	N/A
Marlboro, Township of	1,100	$3,947,148,000	$186,631	0.00%
Matawan, Borough of	500	$501,846,200	$218,788	0.04%
Middletown, Township of	10,246	$4,980,350,600	$1,578,497	0.03%
Millstone, Township of	377	$994,523,937	$735,757	0.07%
Monmouth Beach, Borough of	2,132	$452,626,900	N/A	N/A
Neptune City, Borough of	273	$240,091,400	N/A	N/A
Neptune, Township of	1,627	$1,522,988,600	$470,389	0.03%
Ocean, Township of	1,972	$2,086,610,750	$58,049	0.00%
Oceanport, Borough of	1,499	$518,615,000	$77,159	0.01%
Red Bank, Borough of	663	$1,186,117,471	$494,282	0.04%
Roosevelt, Borough of	17	$40,634,100	$1,852	0.00%
Rumson, Borough of	1,360	$1,411,914,600	N/A	N/A
Sea Bright, Borough of	1,254	$238,003,600	N/A	N/A
Sea Girt, Borough of	125	$469,081,700	$28,646	0.01%
Shrewsbury, Borough of	99	$490,447,400	N/A	N/A
Shrewsbury, Township of	0	$26,891,400	$5,251	0.02%
Spring Lake, Borough of	360	$1,047,534,400	$97,451	0.01%
Spring Lake Heights, Borough of	325	$454,145,300	$127,076	0.03%
Tinton Falls, Borough of	736	$2,014,827,700	$439,874	0.02%
Union Beach, Borough of	4,991	$255,879,500	$0	0.00%
Upper Freehold, Township of	315	$810,887,400	$378,509	0.05%
Wall, Township of	1,170	$2,302,913,200	$336,078	0.01%
West Long Branch, Borough of	107	$785,971,500	$9,650	0.00%
Total	**67,249**	**$55,141,734,937**	**$1,393,894**	**0.00%**

Source: HAZUS-MH
**Exposure calculated by GIS Analysis using local assessed values*

As noted above, this analysis estimates damages from riverine sources, therefore the risks and damages in this section for coastal communities may appear underestimated when read in isolation from the accompanying sections estimating damages from storm surge, wave action, and erosion.

For the subset of structures identified as Repetitive Loss Properties (see Section 3a), a simple review of the history of paid claims suggests an annualized loss of approximately $5.6 million for these 1,618 properties. Without efforts to mitigate these and other individual properties at risk from frequent flooding, annual repetitive losses can be expected to remain at this order of magnitude, and even to increase, as structures that have up until now only been flooded once become flooded repeatedly and hence meet the definition of “Repetitive Loss Property”. A more detailed assessment of potential future losses suffered by these properties would require a comprehensive survey of each individual repetitive loss property, which was outside the scope of this plan. However, since the last plan was prepared, many more communities maintain a detailed inventory of repetitive loss properties, and targeted mitigation is something that has been considered by many jurisdictions for this first plan update.

In accordance with FEMA guidance, all analyses in this plan have been conducted using the best readily available data. However, in the opinion of some members of the planning committee, in particular County

Engineering staff, the extent of property damage or risk due to potential stream flooding may be underestimated by this level of analysis, for the following reasons:

> With a few exceptions, the countywide Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) are primarily based on hydrologic and hydraulic analyses completed for each municipality during the late 1970s/early 1980s. For many municipalities, these analyses were conducted before the intense development of the 1980s and 1990s occurred. The analyses assume uniform conveyance throughout the stream corridor and do not necessarily account for changes in channel width or depth caused by siltation. Encroachments into the floodplain and or floodway could increase the flood elevation and therefore, widen the delineations of the 1%, 0.2% annual chance floodplains and 1% annual chance floodway depicted on the FIRMs.

Since the initial FEMA FIS, the State's the Flood Hazard Area and Freshwater Wetlands rules have regulated development in floodplains and floodways. While these regulations have served to guide appropriate development trends within these sensitive areas, they have been considered by some to be an obstacle for many local government agencies in implementing systematic stream-cleaning and maintenance of stormwater facilities. As a result, many stream segments throughout Monmouth County are silted in and or blocked by debris and flood control basins are not functioning as designed.

Sea Level Rise

In addition to storm surge, HAZUS analysis was also conducted to estimate potential losses due to Sea Level Rise (SLR). NOAA, in partnership with FEMA, USACE, and several other federal agencies created in 2012 SLR mapping to support stakeholders in New Jersey and New York consider risks from future sea level rise in planning for reconstruction following Hurricane Sandy. This SLR mapping integrated FEMA's best available special flood hazard area (SFHA) with four scenarios of sea level rise (referred to as lowest, intermediate-low, intermediate-high, and highest). These scenarios provide estimates of global sea level rise by the year 2050 and 2100 based on the best available science synthesized by a panel of scientists from multiple federal agencies and academic institutions to provide to the U.S. National Climate Assessment. These four scenarios address different factors known to affect future sea level rise risk, including ocean warming and melting of mountain glaciers and ice sheets. The HAZUS analysis used the "Highest" 2050 scenario, which represents 2.0 ft. additional flood depth above the best available SFHA Base Flood Elevations. Flood depth raster data were created from the same NOAA ground terrain data used by NOAA to create SLR mapping. The flood depth raster was used as part of a HAZUS Level 2 Flood analysis to estimate flood losses for Monmouth County as detailed in **Table 3c.14**. Note that the flood elevations associated with the Highest 2050 SLR scenario fell generally between the elevations associated with coastal Category 1 and Category 2 flooding. Therefore, the loss estimates this SLR scenario generated also fell between the losses associated with the coastal Category 1 and Category 2 flooding as shown earlier. **Appendix 3a.1** shows areas in each community that could potentially see increases in the footprint of their SFHAs under moderate and high estimates of sea level rise by 2050. These figures also highlight key asset categories for planning purposes and to facilitate the identification of hazard mitigation measures.

Table 3c.14
Estimated Potential Losses from 2050 with SLR (highest, 2 feet above SFHA)

Jurisdiction	Total Assessed Value of Improvements (Buildings)	Estimated Potential Losses
		2050 with SLR (highest, 2 ft. above SFHA)
Aberdeen Township	$1,057,910,200	$16,103,410.15
Allenhurst Borough	$163,629,600	$1,205,572.38
Allentown Borough	$128,744,000	$0.00

Table 3c.14
Estimated Potential Losses from 2050 with SLR (highest, 2 feet above SFHA)

Jurisdiction	Total Assessed Value of Improvements (Buildings)	Estimated Potential Losses
		2050 with SLR (highest, 2 ft. above SFHA)
Asbury Park City	$822,648,930	$12,123,920
Atlantic Highlands Borough	$251,833,600	$3,913,604
Avon-By-The-Sea Borough	$346,002,100	$17,567,150
Belmar Borough	$507,354,100	$20,293,194
Bradley Beach Borough	$402,974,400	$5,566,465
Brielle Borough	$490,439,800	$16,807,716
Colts Neck Township	$1,679,133,600	$28,401
Deal Borough	$511,562,800	$5,569,884
Eatontown Borough	$1,158,392,100	$289,042
Englishtown Borough	$125,736,600	$0
Fair Haven Borough	$589,631,200	$5,192,703
Farmingdale Borough	$112,597,500	$0.00
Freehold Borough	$636,156,950	$0.00
Freehold Township	$3,944,416,100	$0.00
Hazlet Township	$1,212,072,900	$44,390,382
Highlands Borough	$282,777,500	$30,510,370
Holmdel Township	$2,086,402,399	$1,393,869
Howell Township	$3,182,248,300	$0
Interlaken Borough	$91,685,800	$1,186,812
Keansburg Borough	$349,667,700	$91,023,415
Keyport Borough	$422,424,400	$16,438,040
Lake Cumo Borough	$155,708,700	$1,818,759
Little Silver Borough	$747,827,900	$19,223,946
Loch Arbour Village	$39,039,500	$1,477,363
Long Branch City	$2,345,429,800	$110,055,549.23
Manalapan Township	$3,793,581,500	$0
Manasquan Borough	$723,654,300	$72,445,247
Marlboro Township	$3,947,148,000	$0
Matawan Borough	$501,846,200	$5,194,637
Middletown Township	$4,980,350,600	$189,702,838
Millstone Township	$994,523,937	$0
Monmouth Beach Borough	$452,626,900	$59,857,736
Neptune City Borough	$240,091,400	$3,927,233
Neptune Township	$1,522,988,600	$19,081,370
Ocean Township	$2,086,610,750	$3,765,189
Oceanport Borough	$518,615,000	$28,545,957
Red Bank Borough	$1,186,117,471	$9,980,306
Roosevelt Borough	$40,634,100	$0
Rumson Borough	$1,411,914,600	$22,305,629
Sea Bright Borough	$238,003,600	$33,833,404
Sea Girt Borough	$469,081,700	$27,167,506
Shrewsbury Borough	$490,447,400	$2,242,785
Shrewsbury Township	$26,891,400	$782,528
Spring Lake Borough	$1,047,534,400	$19,354,408
Spring Lake Heights Borough	$454,145,300	$2,479,714

Table 3c.14 Estimated Potential Losses from 2050 with SLR (highest, 2 feet above SFHA)		
Jurisdiction	**Total Assessed Value of Improvements (Buildings)**	**Estimated Potential Losses**
		2050 with SLR (highest, 2 ft. above SFHA)
Tinton Falls Borough	$2,014,827,700	$5,327,687
Union Beach Borough	$255,879,500	$48,013,620
Upper Freehold Township	$810,887,400	$0
Wall Township	$2,302,913,200	$9,989,662
West Long Branch Borough	$785,971,500	$179,903
Total:	**$55,141,734,937**	**$986,356,941**

Storm Surge

Impacts – Storm Surge

Storm surge can be devastating to coastal regions, causing flooding, severe beach erosion, and property damage along the immediate coast. Furthermore, water can rise very rapidly due to storm surge, posing a serious threat to people remaining in inundation areas.

Exposure and Damage Estimates – Storm Surge

Storm surge is a flood hazard which is related to hurricanes, which differs from coastal flood events. Only storm surge related to hurricanes is analyzed in this section. Due to data limitations, analysis for ordinary coastal flooding events not associated with hurricanes could not be modeled in this risk assessment. In order to assess storm surge risk, two distinct vulnerability assessment approaches were applied for Monmouth County in order to assess exposure and potential losses to storm surge hazard events. This includes a GIS-based analysis to estimate exposure and HAZUS-MH to estimate potential losses for storm surge events.

Coastal flood inundation zone maps were derived from georeferenced data produced by the National Oceanic and Atmospheric Administration (NOAA). Storm surge data was provided from NOAA Sea, Lake and Overland Surges from Hurricanes (SLOSH) data (2006). SLOSH is a modeling tool used to estimate storm surge resulting from historical, hypothetical or predicted hurricanes. In this analysis, color-coded storm surge inundation areas were created and overlaid with parcel and census block data, defining the potential maximum surge for coastal locations in Monmouth County. For Monmouth County, the New York (NY2) SLOSH basin was used.

To estimate exposure to storm surge, the determination of value and population at-risk was calculated through GIS analysis by calculating the proportion of a parcel or census block lying within an identified storm surge zone (Category 1-4 storm events), and applying that same ratio to the census block population and parcel value to estimate population at risk and value of improvements at risk, as presented in **Table 3c.15**. Five jurisdictions are 100 percent exposed to storm surge: Keansburg, Loch Arbour, Monmouth Beach, Sea Bright, and Union Beach. Twelve jurisdictions have no improved property exposed to storm surge.

Table 3c.15 Exposure in Storm Surge Areas by Jurisdiction				
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)**	**Total Assessed Value of Buildings Located in Category 1-4 Storm Surge Areas***	**Percent of Total Building Value Exposed to Surge**
Aberdeen, Township of	2,044	$1,057,910,200	$37,766,100	3.57%
Allenhurst, Borough of	403	$163,629,600	$92,697,900	56.65%
Allentown, Borough of	0	$128,744,000	$0	0.00%
Asbury Park, City of	11,274	$822,648,930	$518,187,630	62.99%
Atlantic Highlands, Borough of	1,236	$251,833,600	$72,636,600	28.84%
Avon-By-The-Sea, Borough of	1,829	$346,002,100	$340,474,700	98.40%
Belmar, Borough of	5,750	$507,354,100	$503,293,200	99.20%
Bradley Beach, Borough of	3,788	$402,974,400	$356,013,600	88.35%
Brielle, Borough of	2,181	$490,439,800	$225,783,200	46.04%
Colts Neck, Township of	0	$1,679,133,600	$0	0.00%
Deal, Borough of	136	$511,562,800	$108,728,600	21.25%
Eatontown, Borough of	1,223	$1,158,392,100	$167,270,900	14.44%
Englishtown, Borough of	0	$125,736,600	$0	0.00%
Fair Haven, Borough of	1,011	$589,631,200	$101,214,400	17.17%
Farmingdale, Borough of	0	$112,597,500	$0	0.00%
Freehold, Borough of	0	$636,156,950	$0	0.00%
Freehold, Township of	0	$3,944,416,100	$0	0.00%
Hazlet, Township of	6,736	$1,212,072,900	$327,989,700	27.06%
Highlands, Borough of	2,779	$282,777,500	$158,158,800	55.93%
Holmdel, Township of	315	$2,086,402,399	$4,378,200	0.21%
Howell, Township of	473	$3,182,248,300	$197,800	0.01%
Interlaken, Borough of	649	$91,685,800	$69,583,300	75.89%
Keansburg, Borough of	10,105	$349,667,700	$349,667,700	100.00%
Keyport, Borough of	3,548	$422,424,400	$162,876,900	38.56%
Lake Como, Borough of	1,609	$155,708,700	$144,999,600	93.12%
Little Silver, Borough of	3,090	$747,827,900	$399,271,700	53.39%
Loch Arbour, Village of	194	$39,039,500	$39,039,500	100.00%
Long Branch, City of	18,701	$2,345,429,800	$1,356,645,100	57.84%
Manalapan, Township of	0	$3,793,581,500	$0	0.00%
Manasquan, Borough of	4,862	$723,654,300	$631,661,000	87.29%
Marlboro, Township of	0	$3,947,148,000	$0	0.00%
Matawan, Borough of	484	$501,846,200	$6,330,000	1.26%
Middletown, Township of	17,876	$4,980,350,600	$849,725,900	17.06%
Millstone, Township of	0	$994,523,937	$0	0.00%
Monmouth Beach, Borough of	3,279	$452,626,900	$452,626,900	100.00%
Neptune City, Borough of	2,649	$240,091,400	$124,717,700	51.86%
Neptune, Township of	9,413	$1,522,988,600	$565,384,400	37.12%
Ocean, Township of	1,686	$2,086,610,750	$88,316,600	4.23%
Oceanport, Borough of	4,721	$518,615,000	$443,788,800	85.57%
Red Bank, Borough of	858	$1,186,117,471	$61,438,000	5.18%
Roosevelt, Borough of	0	$40,634,100	$0	0.00%
Rumson, Borough of	3,970	$1,411,914,600	$786,585,200	55.71%
Sea Bright, Borough of	1,414	$238,003,600	$238,003,600	100.00%
Sea Girt, Borough of	1,520	$469,081,700	$429,052,800	91.47%

Table 3c.15 Exposure in Storm Surge Areas by Jurisdiction				
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)**	**Total Assessed Value of Buildings Located in Category 1-4 Storm Surge Areas***	**Percent of Total Building Value Exposed to Surge**
Shrewsbury, Borough of	891	$490,447,400	$91,036,200	18.56%
Shrewsbury, Township of	0	$26,891,400	$0	0.00%
Spring Lake, Borough of	2,060	$1,047,534,400	$765,436,300	73.07%
Spring Lake Heights, Borough of	1,474	$454,145,300	$125,735,300	27.69%
Tinton Falls, Borough of	430	$2,014,827,700	$12,390,100	0.61%
Union Beach, Borough of	6,245	$255,879,500	$255,879,500	100.00%
Upper Freehold, Township of	0	$810,887,400	$0	0.00%
Wall, Township of	1,646	$2,302,913,200	$77,072,100	3.35%
West Long Branch, Borough of	1,513	$785,971,500	$134,624,200	17.13%
Total	**142,143**	**$55,141,734,937**	**$11,671,588,730**	**21.18%**

**Exposure calculated by GIS Analysis using local assessed values*

To analyze potential losses, color-coded storm surge inundation areas were created and overlaid with census block data, defining the potential maximum surge for coastal locations for each category of hurricane, as well as exposed structures located in those areas. A GIS analysis was conducted to verify that the surge boundaries and depths estimated reasonably correspond with the boundaries in the NOAA data, and HAZUS-MH inventory was used to estimate potential losses.

For developing the depth grid files, the SLOSH data was used in combination with ground elevation data from the USGS National Elevation Dataset (NED). The MOM value (Maximum of the Maximum Envelopes of Water; a composite measure that expresses the maximum flood elevation) for Categories 1, 2, 3 and 4 from the SLOSH data was used to determine the “surge” or water elevation. A GRID digital map of flood elevation was produced from the SLOSH shapefile data. A simple GIS operation of subtraction was performed with the ground elevation data set to determine the water depth.

HAZUS-MH was used to estimate potential losses in Monmouth County resulting from potential storm surge events. The flood depth estimates from the SLOSH shapefile data were imported into HAZUS to conduct a Level 2 HAZUS analysis. **Table 3c.16** shows estimated potential losses for Category 1, 2, 3 and 4 storm surge event scenarios for each jurisdiction. Similar to other HAZUS analysis, the values from HAZUS were adjusted to reflect the current assessed values for structures in each of the communities.

Table 3c.16 Estimated Potential Losses from Category 1, 2, 3 and 4 Storm Surge Events				
	Potential Total Building Losses			
Jurisdiction	**Category 1 Event**	**Category 2 Event**	**Category 3 Event**	**Category 4 Event**
Aberdeen, Township of	$7,366,800	$13,711,700	$23,064,600	$37,766,100
Allenhurst, Borough of	$7,000	$11,486,300	$37,675,100	$92,697,900
Allentown, Borough of	N/A	N/A	N/A	N/A
Asbury Park, City of	$12,646,600	$151,098,980	$350,770,014	$518,187,630
Atlantic Highlands, Borough of	$17,590,700	$38,204,100	$58,131,800	$72,636,600
Avon-By-The-Sea, Borough of	$75,631,000	$210,524,800	$321,506,100	$340,474,700
Belmar, Borough of	$74,702,200	$348,706,200	$486,259,100	$503,293,200
Bradley Beach, Borough of	$7,939,800	$99,655,700	$246,721,200	$356,013,600
Brielle, Borough of	$90,439,600	$148,777,800	$190,174,100	$225,783,200
Colts Neck, Township of	$0	$0	$0	$0
Deal, Borough of	$1,483,900	$9,624,800	$42,761,100	$108,728,600

Table 3c.16
Estimated Potential Losses from Category 1, 2, 3 and 4 Storm Surge Events

Jurisdiction	Potential Total Building Losses			
	Category 1 Event	Category 2 Event	Category 3 Event	Category 4 Event
Eatontown, Borough of	$394,600	$633,700	$10,252,300	$167,270,900
Englishtown, Borough of	N/A	N/A	N/A	N/A
Fair Haven, Borough of	$8,219,600	$22,152,400	$45,270,000	$101,214,400
Farmingdale, Borough of	N/A	N/A	N/A	N/A
Freehold, Borough of	N/A	N/A	N/A	N/A
Freehold, Township of	N/A	N/A	N/A	N/A
Hazlet, Township of	$58,407,300	$103,165,800	$207,853,300	$327,989,700
Highlands, Borough of	$141,028,800	$154,513,600	$155,619,700	$158,158,800
Holmdel, Township of	$311,300	$626,900	$1,785,900	$4,378,200
Howell, Township of	N/A	N/A	N/A	N/A
Interlaken, Borough of	$4,014,900	$15,151,600	$42,278,500	$69,583,300
Keansburg, Borough of	$267,715,300	$339,490,700	$348,994,800	$349,667,700
Keyport, Borough of	$15,754,700	$37,693,800	$80,824,100	$162,876,900
Lake Como, Borough of	$11,647,300	$33,033,100	$91,046,000	$144,999,600
Little Silver, Borough of	$155,888,500	$238,266,900	$316,885,500	$399,271,700
Loch Arbour, Village of	$7,527,300	$24,924,900	$33,816,800	$39,039,500
Long Branch, City of	$338,810,000	$616,152,900	$841,269,500	$1,356,645,100
Manalapan, Township of	N/A	N/A	N/A	N/A
Manasquan, Borough of	$335,360,600	$453,551,300	$544,900,200	$631,661,000
Marlboro, Township of	N/A	N/A	N/A	N/A
Matawan, Borough of	$0	$916,300	$5,515,400	$6,330,000
Middletown, Township of	$ 361,673,900	$524,979,400	$701,829,600	$849,725,900
Millstone, Township of	N/A	N/A	N/A	N/A
Monmouth Beach, Borough of	$391,913,600	$436,469,700	$452,626,900	$452,626,900
Neptune City, Borough of	$6,143,000	$38,227,700	$87,497,100	$124,517,700
Neptune, Township of	$57,600,900	$152,949,800	$366,325,900	$565,384,400
Ocean, Township of	$2,126,000	$9,069,000	$38,760,500	$88,316,600
Oceanport, Borough of	$227,760,300	$311,307,100	$409,386,400	$443,788,800
Red Bank, Borough of	$23,755,600	$32,008,400	$52,190,800	$61,438,000
Roosevelt, Borough of	N/A	N/A	N/A	N/A
Rumson, Borough of	$327,508,900	$490,550,800	$659,614,600	$786,585,200
Sea Bright, Borough of	$217,949,500	$237,826,700	$238,003,600	$238,003,600
Sea Girt, Borough of	$21,576,200	$121,394,100	$309,985,500	$429,052,800
Shrewsbury, Borough of	$8,127,200	$26,721,000	$56,317,600	$91,036,200
Shrewsbury, Township of	N/A	N/A	N/A	$5,779
Spring Lake, Borough of	$104,493,500	$215,411,900	$434,974,800	$765,436,300
Spring Lake Heights, Borough of	$3,936,900	$26,901,500	$70,138,500	$125,735,300
Tinton Falls, Borough of	$700,700	$1,460,800	$5,375,600	$12,390,100
Union Beach, Borough of	$127,431,500	$222,500,700	$251,455,900	$255,879,500
Upper Freehold, Township of	N/A	N/A	N/A	N/A
Wall, Township of	$8,154,300	$15,792,600	$33,022,800	$77,072,100
West Long Branch, Borough of	$3,761,200	$8,800,800	$32,720,200	$134,624,200
Total	**$3,524,710,000**	**$5,944,436,280**	**$8,683,601,414**	**$11,676,479,730**

Source: HAZUS-MH

Table 3c.17 shows potential annualized property losses and percent loss ratios resulting from storm surge by jurisdiction.

Table 3c.17
Potential Annualized Losses from Storm Surge by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Buildings Exposed to Surge*	Total Annualized Expected Property Losses**	Annualized Percent Loss Ratio
Aberdeen, Township of	2,044	$37,766,100	$56,649	0.15%
Allenhurst, Borough of	403	$92,697,900	$750,853	0.81%
Allentown, Borough of	0	$0	$0	0.00%
Asbury Park, City of	11,274	$518,187,630	$1,399,107	0.27%
Atlantic Highlands, Borough of	1,236	$72,636,600	$145,273	0.20%
Avon-By-The-Sea, Borough of	1,829	$340,474,700	$4,664,503	1.37%
Belmar, Borough of	5,750	$503,293,200	$5,888,530	1.17%
Bradley Beach, Borough of	3,788	$356,013,600	$1,780,068	0.50%
Brielle, Borough of	2,181	$225,783,200	$2,483,615	1.10%
Colts Neck, Township of	0	$0	$0	0.00%
Deal, Borough of	136	$108,728,600	$402,296	0.37%
Eatontown, Borough of	1,223	$167,270,900	$16,727	0.01%
Englishtown, Borough of	0	$0	$0	0.00%
Fair Haven, Borough of	1,011	$101,214,400	$121,457	0.12%
Farmingdale, Borough of	0	$0	$0	0.00%
Freehold, Borough of	0	$0	$0	0.00%
Freehold, Township of	0	$0	$0	0.00%
Hazlet, Township of	6,736	$327,989,700	$1,147,964	0.35%
Highlands, Borough of	2,779	$158,158,800	$2,941,754	1.86%
Holmdel, Township of	315	$4,378,200	$0	0.00%
Howell, Township of	473	$197,800	$0	0.00%
Interlaken, Borough of	649	$69,583,300	$459,250	0.66%
Keansburg, Borough of	10,105	$349,667,700	$15,909,880	4.55%
Keyport, Borough of	3,548	$162,876,900	$879,535	0.54%
Lake Como, Borough of	1,609	$144,999,600	$855,498	0.59%
Little Silver, Borough of	3,090	$399,271,700	$1,237,742	0.31%
Loch Arbour, Village of	194	$39,039,500	$316,220	0.81%
Long Branch, City of	18,701	$1,356,645,100	$6,104,903	0.45%
Manalapan, Township of	0	$0	$0	0.00%
Manasquan, Borough of	4,862	$631,661,000	$14,086,040	2.23%
Marlboro, Township of	0	$0	$0	0.00%
Matawan, Borough of	484	$6,330,000	$0	0.00%
Middletown, Township of	17,876	$849,725,900	$2,974,041	0.35%
Millstone, Township of	0	$0	$0	0.00%
Monmouth Beach, Borough of	3,279	$452,626,900	$7,106,242	1.57%
Neptune City, Borough of	2,649	$124,517,700	$236,584	0.19%
Neptune, Township of	9,413	$565,384,400	$1,639,615	0.29%
Ocean, Township of	1,686	$88,316,600	$52,990	0.06%
Oceanport, Borough of	4,721	$443,788,800	$2,618,354	0.59%
Red Bank, Borough of	858	$61,438,000	$215,033	0.35%
Roosevelt, Borough of	0	$0	$0	0.00%
Rumson, Borough of	3,970	$786,585,200	$8,731,096	1.11%

Table 3c.17
Potential Annualized Losses from Storm Surge by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Buildings Exposed to Surge*	Total Annualized Expected Property Losses**	Annualized Percent Loss Ratio
Sea Bright, Borough of	1,414	$238,003,600	$9,258,340	3.89%
Sea Girt, Borough of	1,520	$429,052,800	$1,115,537	0.26%
Shrewsbury, Borough of	891	$91,036,200	$63,725	0.07%
Shrewsbury, Township of	0	$0	$0	0.00%
Spring Lake, Borough of	2,060	$765,436,300	$6,429,665	0.84%
Spring Lake Heights, Borough of	1,474	$125,735,300	$339,485	0.27%
Tinton Falls, Borough of	430	$12,390,100	$0	0.00%
Union Beach, Borough of	6,245	$255,879,500	$11,565,753	4.52%
Upper Freehold, Township of	0	$0	$0	0.00%
Wall, Township of	1,646	$77,072,100	$61,658	0.08%
West Long Branch, Borough of	1,513	$134,624,200	$0	0.00%
Total	**142,143**	**$11,676,479,730**	**$114,055,983**	**0.98%**

Source: HAZUS-MH
** Exposure calculated by GIS Analysis using local assessed values of buildings in Category 1 through 4 SLOSH zones.*
*** Annualized expected losses for the 2014 plan update were calculated by applying the annualized percent loss ratios to the 2012 assessed value of buildings exposed.*

Impact of Sea Level Rise on Storm Surge Inundation for Category 1-4 Hurricanes

While this plan has evaluated the impact of long-term sea level rise on 100-year flood damages based on readily-available GIS mapping prepared by NOAA in 2012 (in partnership with FEMA, USACE, and several other federal agencies; showing the projected future special flood hazard in year 2050), similar mapping for potential future Category 1, 2, 3 and 4 storm surge inundation areas (with sea level rise) was not available at the time of this plan update. While the impact of long-term sea level rise can be expected to increase the annual occurrence probability of significant storm surge events and hence the future expected annual losses in Monmouth County, quantifying this increase in damages would require mapping from other sources, or significant amounts of hydrologic data to perform detailed analyses which are typically only undertaken at the feasibility stage during the planning for specific coastal flood and erosion protection projects, and hence is outside the scope of this current plan.

Wave Action

Impacts – Wave Action

Wave action is a significant hazard to buildings and infrastructure located in coastal areas. Large, fast moving waves can cause extreme erosion and scour and their impact on buildings can cause severe damage. Storm surge and wind increase the destructiveness of waves and cause them to reach higher elevations and penetrate further inland.

Exposure and Damage Estimates – Wave Action

To estimate exposure to wave action, it is assumed that vulnerable areas are located in the VE flood zone, which experiences coastal flood with velocity hazard (wave action). To estimate exposure to wave action, the determination of value and population at-risk was calculated through GIS analysis by calculating the proportion of a parcel or census block lying within VE zones, and applying that same ratio to the census block population and parcel value to estimate population at risk and value of improvements at risk. **Table 3c.18** shows exposure to wave action by jurisdiction. A total of 28 jurisdictions have property exposed to wave action. Many of the results in Table 3c.17 are observed to have decreased from the prior version of the plan; in part due to more accurate DFIRMs available now as compared to Q3 data used for the 2009 plan. As well as a methodology which in 2009, summed 100% of the population and value of impacted parcels, whereas the refined methodology for this version of the plan applies a percentage to block population and parcel value based on the area covered by the wave zone.

Table 3c.18
Exposure to Wave Action by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located in VE Flood Zone*	Percent of Total Building Value Exposed to Wave Action
Aberdeen, Township of	420	$1,057,910,200	$2,846,375	0.27%
Allenhurst, Borough of	3	$163,629,600	$139,403	0.09%
Allentown, Borough of	0	$128,744,000	$0	0.00%
Asbury Park, City of	0	$822,648,930	$2,656,807	0.32%
Atlantic Highlands, Borough of	55	$251,833,600	$2,181,515	0.87%
Avon-By-The-Sea, Borough of	0	$346,002,100	$852,093	0.25%
Belmar, Borough of	59	$507,354,100	$3,826,485	0.75%
Bradley Beach, Borough of	0	$402,974,400	$0	0.00%
Brielle, Borough of	2	$490,439,800	$3,429,507	0.70%
Colts Neck, Township of	0	$1,679,133,600	$0	0.00%
Deal, Borough of	12	$511,562,800	$6,195,372	1.21%
Eatontown, Borough of	0	$1,158,392,100	$0	0.00%
Englishtown, Borough of	0	$125,736,600	$0	0.00%
Fair Haven, Borough of	92	$589,631,200	$11,087,814	1.88%
Farmingdale, Borough of	0	$112,597,500	$0	0.00%
Freehold, Borough of	0	$636,156,950	$0	0.00%
Freehold, Township of	0	$3,944,416,100	$0	0.00%
Hazlet, Township of	0	$1,212,072,900	$0	0.00%
Highlands**, Borough of	96	$282,777,500	$1,955,287	0.69%
Holmdel, Township of	0	$2,086,402,399	$0	0.00%
Howell, Township of	0	$3,182,248,300	$0	0.00%
Interlaken, Borough of	0	$91,685,800	$0	0.00%
Keansburg, Borough of	65	$349,667,700	$2,853,529	0.82%
Keyport, Borough of	185	$422,424,400	$6,033,976	1.43%
Lake Como, Borough of	0	$155,708,700	$0	0.00%
Little Silver, Borough of	0	$747,827,900	$0	0.00%
Loch Arbour, Village of	0	$39,039,500	$249,749	0.64%
Long Branch, City of	119	$2,345,429,800	$6,226,383	0.27%
Manalapan, Township of	0	$3,793,581,500	$0	0.00%
Manasquan, Borough of	142	$723,654,300	$44,728,931	6.18%
Marlboro, Township of	0	$3,947,148,000	$0	0.00%
Matawan, Borough of	0	$501,846,200	$0	0.00%
Middletown, Township of	234	$4,980,350,600	$18,483,329	0.37%
Millstone, Township of	0	$994,523,937	$0	0.00%
Monmouth Beach, Borough of	1	$452,626,900	$252,777	0.06%
Neptune City, Borough of	16	$240,091,400	$902,920	0.38%
Neptune, Township of	157	$1,522,988,600	$2,659,451	0.17%

Table 3c.18
Exposure to Wave Action by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located in VE Flood Zone*	Percent of Total Building Value Exposed to Wave Action
Ocean, Township of	0	$2,086,610,750	$0	0.00%
Oceanport, Borough of	0	$518,615,000	$0	0.00%
Red Bank, Borough of	18	$1,186,117,471	$15,534,912	1.31%
Roosevelt, Borough of	0	$40,634,100	$0	0.00%
Rumson, Borough of	54	$1,411,914,600	$9,512,060	0.67%
Sea Bright, Borough of	37	$238,003,600	$5,437,378	2.28%
Sea Girt, Borough of	4	$469,081,700	$7,457,753	1.59%
Shrewsbury, Borough of	0	$490,447,400	$0	0.00%
Shrewsbury, Township of	0	$26,891,400	$0	0.00%
Spring Lake, Borough of	0	$1,047,534,400	$898,261	0.09%
Spring Lake Heights, Borough of	0	$454,145,300	$0	0.00%
Tinton Falls, Borough of	0	$2,014,827,700	$0	0.00%
Union Beach, Borough of	519	$255,879,500	$9,672,322	3.78%
Upper Freehold, Township of	0	$810,887,400	$0	0.00%
Wall, Township of	40	$2,302,913,200	$2,686,837	0.12%
West Long Branch, Borough of	0	$785,971,500	$0	0.00%
Total	**2,330**	**$55,141,734,937**	**$168,761,226**	**0.31%**

**Exposure calculated by GIS Analysis using local assessed values of buildings located in VE zones*

Given the lack of readily available historical loss data on significant wave action occurrences in Monmouth County, it is assumed that while one major event (i.e., hurricane or nor'easter) may result in significant losses due to wave action, annualizing structural losses over a long period of time would most likely yield a negligible annualized loss estimate in each jurisdiction exposed to this hazard. However, it should also be noted that over the long term, anticipated sea level rise will increase the risk of damages/losses to future wave action events.

Earthquake

Impacts – Earthquake

Most earthquake-related property damage and deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the extent and duration of the shaking. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (in mountain regions and along hillsides), and liquefaction.

Exposure and Damage Estimates – Earthquake

Because earthquakes often impact large areas and cross jurisdictional boundaries, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted.

To assess the vulnerability of Monmouth County to earthquakes, probabilistic scenarios of various potential events were created using HAZUS-MH. HAZUS-MH default ground shaking data, inventory and damage functions, and methodology was used to determine the potential estimated losses for 100-, 500-, 1000-, and 2500-year frequency events and annual expected loss at the census tract level, as well as exceeding probability curves. **Table 3c.19** lists the expected peak ground acceleration (PGA) for 100- and 500-year earthquake events by jurisdiction.

Table 3c.19
Peak Ground Acceleration (Ground Motion) for 100- and 500-Year Earthquake Events

Jurisdiction	100-year PGA	500-year PGA
Aberdeen, Township of	0.0084	0.0443
Allenhurst, Borough of	0.0084	0.0408
Allentown, Borough of	0.0084	0.0414
Asbury Park, City of	0.0084	0.0402
Atlantic Highlands, Borough of	0.0084	0.0441
Avon-By-The-Sea, Borough of	0.0084	0.0396
Belmar, Borough of	0.0084	0.0390
Bradley Beach, Borough of	0.0084	0.0396
Brielle, Borough of	0.0078	0.0378
Colts Neck, Township of	0.0084	0.0427
Deal, Borough of	0.0084	0.0408
Eatontown, Borough of	0.0084	0.0419
Englishtown, Borough of	0.0084	0.0426
Fair Haven, Borough of	0.0084	0.0432
Farmingdale, Borough of	0.0084	0.0408
Freehold, Borough of	0.0084	0.0422
Freehold, Township of	0.0084	0.0423
Hazlet, Township of	0.0084	0.0449
Highlands, Borough of	0.0084	0.0440
Holmdel, Township of	0.0084	0.0442
Howell, Township of	0.0084	0.0405
Interlaken, Borough of	0.0084	0.0408
Keansburg, Borough of	0.0084	0.0456
Keyport, Borough of	0.0084	0.0447
Lake Como, Borough of	0.0084	0.0387
Little Silver, Borough of	0.0084	0.0432
Loch Arbour, Village of	0.0084	0.0408
Long Branch, City of	0.0084	0.0418
Manalapan, Township of	0.0084	0.0426
Manasquan, Borough of	0.0078	0.0378
Marlboro, Township of	0.0084	0.0435
Matawan, Borough of	0.0084	0.0444
Middletown, Township of	0.0084	0.0440
Millstone, Township of	0.0084	0.0415
Monmouth Beach, Borough of	0.0084	0.0428
Neptune City, Borough of	0.0084	0.0396
Neptune, Township of	0.0084	0.0397

Table 3c.19 Peak Ground Acceleration (Ground Motion) for 100- and 500-Year Earthquake Events		
Jurisdiction	**100-year PGA**	**500-year PGA**
Ocean, Township of	0.0084	0.0407
Oceanport, Borough of	0.0084	0.0422
Red Bank, Borough of	0.0084	0.0431
Roosevelt, Borough of	0.0084	0.0416
Rumson, Borough of	0.0084	0.0432
Sea Bright, Borough of	0.0084	0.0432
Sea Girt, Borough of	0.0082	0.0382
Shrewsbury, Borough of	0.0084	0.0425
Shrewsbury, Township of	0.0084	0.0420
Spring Lake, Borough of	0.0084	0.0386
Spring Lake Heights, Borough of	0.0084	0.0384
Tinton Falls, Borough of	0.0084	0.0416
Union Beach, Borough of	0.0084	0.0453
Upper Freehold, Township of	0.0084	0.0417
Wall, Township of	0.0082	0.0393
West Long Branch, Borough of	0.0084	0.0416

Source: HAZUS-MH

Earthquakes with higher levels of PGA cause more damage, but have a low probability of occurrence. Conversely, earthquakes with low PGA levels such as those which could potentially impact Monmouth County, have a higher probability of occurrence but would only cause negligible to minor damage due to light shaking. In comparison to PGA levels above 0.25g which can cause strong to violent shaking and major damage, expected PGA levels for Monmouth County will likely only cause negligible to light shaking and negligible to minor damage. Estimated losses for a 100-year earthquake event in Monmouth County are considered to be negligible. **Table 3c.20** shows estimated potential losses for 500-, 1000-, and 2500-year events as estimated using HAZUS-MH.

Table 3c.20 Estimated Potential Losses From 500-, 1000- and 2500-year Earthquake Events				
Jurisdiction	**Total Assessed Value of Improvements**	**Potential Total Building Losses**		
		500-Year Event	**1000-Year Event**	**2500-Year Event**
Aberdeen, Township of	$1,057,910,200	$129,379	$492,159	$1,970,820
Allenhurst, Borough of	$163,629,600	$13,586	$54,764	$213,340
Allentown, Borough of	$128,744,000	$12,912	$51,145	$191,728
Asbury Park, City of	$822,648,930	$87,953	$340,073	$1,322,875
Atlantic Highlands, Borough of	$251,833,600	$26,496	$99,610	$400,761
Avon-By-The-Sea, Borough of	$346,002,100	$31,223	$123,766	$486,488
Belmar, Borough of	$507,354,100	$41,532	$165,077	$645,010
Bradley Beach, Borough of	$402,974,400	$40,574	$160,134	$624,293
Brielle, Borough of	$490,439,800	$40,454	$151,960	$640,939
Colts Neck, Township of	$1,679,133,600	$183,038	$709,764	$2,769,622
Deal, Borough of	$511,562,800	$43,412	$177,245	$680,107
Eatontown, Borough of	$1,158,392,100	$128,819	$480,732	$1,897,938
Englishtown, Borough of	$125,736,600	$12,432	$46,978	$184,542
Fair Haven, Borough of	$589,631,200	$58,584	$235,055	$914,364
Farmingdale, Borough of	$112,597,500	$11,994	$47,274	$189,752
Freehold, Borough of	$636,156,950	$84,408	$322,372	$1,257,837

Table 3c.20 Estimated Potential Losses From 500-, 1000- and 2500-year Earthquake Events				
Jurisdiction	**Total Assessed Value of Improvements**	**Potential Total Building Losses**		
		500-Year Event	**1000-Year Event**	**2500-Year Event**
Freehold, Township of	$3,944,416,100	$449,978	$1,770,684	$6,863,898
Hazlet, Township of	$1,212,072,900	$167,178	$624,803	$2,538,854
Highlands, Borough of	$282,777,500	$27,676	$105,721	$418,015
Holmdel, Township of	$2,086,402,399	$260,478	$965,480	$3,941,249
Howell, Township of	$3,182,248,300	$364,911	$1,450,745	$5,730,176
Interlaken, Borough of	$91,685,800	$6,825	$28,149	$107,615
Keansburg, Borough of	$349,667,700	$50,338	$185,802	$756,746
Keyport, Borough of	$422,424,400	$58,227	$215,113	$869,069
Lake Como, Borough of	$155,708,700	$12,177	$47,280	$194,928
Little Silver, Borough of	$747,827,900	$83,280	$329,759	$1,303,196
Loch Arbour, Village of	$39,039,500	$5,750	$23,081	$89,699
Long Branch, City of	$2,345,429,800	$266,484	$1,042,212	$3,975,850
Manalapan, Township of	$3,793,581,500	$449,322	$1,771,690	$6,869,942
Manasquan, Borough of	$723,654,300	$62,697	$234,268	$988,284
Marlboro, Township of	$3,947,148,000	$505,417	$1,972,806	$7,721,463
Matawan, Borough of	$501,846,200	$65,341	$244,335	$983,363
Middletown, Township of	$4,980,350,600	$669,946	$2,563,231	$10,296,474
Millstone, Township of	$994,523,937	$107,108	$421,329	$1,613,301
Monmouth Beach, Borough of	$452,626,900	$50,427	$195,179	$757,095
Neptune City, Borough of	$240,091,400	$25,450	$101,766	$401,160
Neptune, Township of	$1,522,988,600	$155,226	$618,658	$2,435,900
Ocean, Township of	$2,086,610,750	$225,464	$893,407	$3,444,636
Oceanport, Borough of	$518,615,000	$44,664	$177,758	$684,846
Red Bank, Borough of	$1,186,117,471	$160,618	$605,513	$2,426,209
Roosevelt, Borough of	$40,634,100	$2,098	$8,354	$31,886
Rumson, Borough of	$1,411,914,600	$169,908	$666,282	$2,592,636
Sea Bright, Borough of	$238,003,600	$27,123	$103,774	$407,156
Sea Girt, Borough of	$469,081,700	$38,121	$148,707	$616,317
Shrewsbury, Borough of	$490,447,400	$53,473	$206,691	$836,536
Shrewsbury, Township of	$26,891,400	$1,137	$4,316	$16,243
Spring Lake, Borough of	$1,047,534,400	$88,287	$343,070	$1,424,262
Spring Lake Heights, Borough of	$454,145,300	$37,092	$143,158	$589,363
Tinton Falls, Borough of	$2,014,827,700	$158,451	$626,787	$2,427,341
Union Beach, Borough of	$255,879,500	$37,104	$139,332	$571,925
Upper Freehold, Township of	$810,887,400	$96,347	$384,651	$1,564,425
Wall, Township of	$2,302,913,200	$255,749	$981,070	$4,018,327
West Long Branch, Borough of	$785,971,500	$67,794	$267,282	$1,029,926
Total	$55,141,734,937	$6,254,462	$24,270,350	$95,928,727

Source: HAZUS-MH

Table 3c.21 shows potential annualized property losses and percent loss ratios resulting from earthquake for each jurisdiction in Monmouth County.

Table 3c.21
Potential Annualized Losses from Earthquake by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)*	Total Annualized Expected Property Losses	Annualized Percent Loss Ratio
Aberdeen, Township of	18,210	$1,057,910,200	$1,993	0.00%
Allenhurst, Borough of	496	$163,629,600	$221	0.00%
Allentown, Borough of	1,828	$128,744,000	$198	0.00%
Asbury Park, City of	16,116	$822,648,930	$1,413	0.00%
Atlantic Highlands, Borough of	4,385	$251,833,600	$413	0.00%
Avon-By-The-Sea, Borough of	1,901	$346,002,100	$499	0.00%
Belmar, Borough of	5,794	$507,354,100	$668	0.00%
Bradley Beach, Borough of	4,298	$402,974,400	$643	0.00%
Brielle, Borough of	4,774	$490,439,800	$612	0.00%
Colts Neck, Township of	10,142	$1,679,133,600	$2,912	0.00%
Deal, Borough of	750	$511,562,800	$691	0.00%
Eatontown, Borough of	12,709	$1,158,392,100	$2,111	0.00%
Englishtown, Borough of	1,847	$125,736,600	$201	0.00%
Fair Haven, Borough of	6,121	$589,631,200	$934	0.00%
Farmingdale, Borough of	1,329	$112,597,500	$205	0.00%
Freehold, Borough of	12,052	$636,156,950	$1,375	0.00%
Freehold, Township of	36,184	$3,944,416,100	$7,319	0.00%
Hazlet, Township of	20,334	$1,212,072,900	$2,606	0.00%
Highlands, Borough of	5,005	$282,777,500	$434	0.00%
Holmdel, Township of	16,773	$2,086,402,399	$4,070	0.00%
Howell, Township of	51,075	$3,182,248,300	$5,983	0.00%
Interlaken, Borough of	820	$91,685,800	$108	0.00%
Keansburg, Borough of	10,105	$349,667,700	$776	0.00%
Keyport, Borough of	7,240	$422,424,400	$917	0.00%
Lake Como, Borough of	1,759	$155,708,700	$193	0.00%
Little Silver, Borough of	5,950	$747,827,900	$1,366	0.00%
Loch Arbour, Village of	194	$39,039,500	$93	0.00%
Long Branch, City of	30,719	$2,345,429,800	$4,279	0.00%
Manalapan, Township of	38,872	$3,793,581,500	$7,166	0.00%
Manasquan, Borough of	5,897	$723,654,300	$950	0.00%
Marlboro, Township of	40,191	$3,947,148,000	$7,927	0.00%
Matawan, Borough of	8,810	$501,846,200	$1,019	0.00%
Middletown, Township of	66,522	$4,980,350,600	$10,448	0.00%
Millstone, Township of	10,566	$994,523,937	$1,702	0.00%
Monmouth Beach, Borough of	3,279	$452,626,900	$789	0.00%
Neptune City, Borough of	4,869	$240,091,400	$423	0.00%
Neptune, Township of	27,935	$1,522,988,600	$2,544	0.00%
Ocean, Township of	27,291	$2,086,610,750	$3,660	0.00%
Oceanport, Borough of	5,832	$518,615,000	$727	0.00%
Red Bank, Borough of	12,206	$1,186,117,471	$2,668	0.00%
Roosevelt, Borough of	882	$40,634,100	$33	0.00%
Rumson, Borough of	7,122	$1,411,914,600	$2,667	0.00%
Sea Bright, Borough of	1,412	$238,003,600	$433	0.00%
Sea Girt, Borough of	1,828	$469,081,700	$611	0.00%
Shrewsbury, Borough of	3,809	$490,447,400	$914	0.00%
Shrewsbury, Township of	1,141	$26,891,400	$17	0.00%
Spring Lake, Borough of	2,993	$1,047,534,400	$1,423	0.00%

Table 3c.21 Potential Annualized Losses from Earthquake by Jurisdiction				
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)***	**Total Annualized Expected Property Losses**	**Annualized Percent Loss Ratio**
Spring Lake Heights, Borough of	4,713	$454,145,300	$591	0.00%
Tinton Falls, Borough of	17,892	$2,014,827,700	$2,575	0.00%
Union Beach, Borough of	6,245	$255,879,500	$578	0.00%
Upper Freehold, Township of	6,902	$810,887,400	$1,690	0.00%
Wall, Township of	26,164	$2,302,913,200	$4,225	0.00%
West Long Branch, Borough of	8,097	$785,971,500	$1,111	0.00%
Total	**630,380**	**$55,141,734,937**	**$100,122**	**0.00%**

Source: HAZUS-MH

Landslide

Impacts – Landslide

Potential impacts of landslides include environmental disturbance, property and infrastructure damage, and injuries or fatalities. Landslide impacts are typically limited to those areas immediately surrounding the slope failure. The structural integrity of buildings in the affected area can be compromised, or the entire building can be destroyed. Roadways and drainage systems in affected areas can be damaged or destroyed as well. Because landslides happen without warning, loss of life and injuries in affected areas are also possible.

Exposure and Damage Estimates - Landslide

To estimate exposure to landslide, the determination of value and population at-risk was calculated through GIS analysis by calculating the proportion of a parcel or census block lying within an area mapped as having high landslide susceptibility, and applying that same ratio to the census block population and parcel value to estimate population at risk and value of improvements at risk. Seven jurisdictions in Monmouth County have land areas mapped as having high landslide susceptibility, with roughly five percent of total assessed improvements in the county located in these hazard areas. Three additional communities are not within mapped hazard areas, but do have records of historic occurrences which suggest some level of risk in these jurisdictions as well. **Table 3c.22** shows exposure to landslide by jurisdiction.

Table 3c.22 Exposure to Landslide by Jurisdiction				
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)**	**Total Assessed Value of Buildings Located in Areas Mapped as Having High Landslide Susceptibility***	**Percent of Total Building Value Exposed to Landslide**
Aberdeen, Township of	0	$1,057,910,200	$0	0.00%
Allenhurst, Borough of	0	$163,629,600	$0	0.00%
Allentown, Borough of	0	$128,744,000	$0	0.00%
Asbury Park, City of	0	$822,648,930	$0	0.00%
Atlantic Highlands, Borough of	1,722	$251,833,600	$101,128,225	40.16%
Avon-By-The-Sea, Borough of	0	$346,002,100	$0	0.00%
Belmar, Borough of	0	$507,354,100	$0	0.00%

Table 3c.22
Exposure to Landslide by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located in Areas Mapped as Having High Landslide Susceptibility*	Percent of Total Building Value Exposed to Landslide
Bradley Beach, Borough of	0	$402,974,400	$0	0.00%
Brielle, Borough of	0	$490,439,800	$0	0.00%
Colts Neck, Township of	0	$1,679,133,600	$0	0.00%
Deal, Borough of	0	$511,562,800	$0	0.00%
Eatontown, Borough of	0	$1,158,392,100	$0	0.00%
Englishtown, Borough of	0	$125,736,600	$0	0.00%
Fair Haven, Borough of	2,781	$589,631,200	$265,542,039	45.04%
Farmingdale, Borough of	0	$112,597,500	$0	0.00%
Freehold, Borough of	0	$636,156,950	$0	0.00%
Freehold, Township of**	Potential for >0	$3,944,416,100	Potential for > $0	0.00%
Hazlet, Township of	0	$1,212,072,900	$0	0.00%
Highlands, Borough of	5,005	$282,777,500	$282,777,500	100.00%
Holmdel, Township of	0	$2,086,402,399	$0	0.00%
Howell, Township of**	Potential for >0	$3,182,248,300	Potential for > $0	0.00%
Interlaken, Borough of	0	$91,685,800	$0	0.00%
Keansburg, Borough of	0	$349,667,700	$0	0.00%
Keyport, Borough of	0	$422,424,400	$0	0.00%
Lake Como, Borough of	0	$155,708,700	$0	0.00%
Little Silver, Borough of	71	$747,827,900	$23,939,127	3.20%
Loch Arbour, Village of	0	$39,039,500	$0	0.00%
Long Branch, City of**	0	$2,345,429,800	$0	0.00%
Manalapan, Township of	0	$3,793,581,500	$0	0.00%
Manasquan, Borough of	0	$723,654,300	$0	0.00%
Marlboro, Township of	0	$3,947,148,000	$0	0.00%
Matawan, Borough of	0	$501,846,200	$0	0.00%
Middletown, Township of	3,243	$4,980,350,600	$296,432,236	5.95%
Millstone, Township of	0	$994,523,937	$0	0.00%
Monmouth Beach, Borough of**	0	$452,626,900	0	0.00%
Neptune City, Borough of	0	$240,091,400	$0	0.00%
Neptune, Township of	0	$1,522,988,600	$0	0.00%
Ocean, Township of	0	$2,086,610,750	$0	0.00%
Oceanport, Borough of	563	$518,615,000	$57,381,713	11.06%
Red Bank, Borough of	0	$1,186,117,471	$0	0.00%
Roosevelt, Borough of	0	$40,634,100	$0	0.00%
Rumson, Borough of	7,077	$1,411,914,600	$1,398,403,729	99.04%
Sea Bright, Borough of***	0	$238,003,600	$0	0.00%
Sea Girt, Borough of	0	$469,081,700	$0	0.00%
Shrewsbury, Borough of	0	$490,447,400	$0	0.00%
Shrewsbury, Township of	0	$26,891,400	$0	0.00%
Spring Lake, Borough of	0	$1,047,534,400	$0	0.00%
Spring Lake Heights, Borough of	0	$454,145,300	$0	0.00%
Tinton Falls, Borough of**	Potential for >0	$2,014,827,700	Potential for >$0	0.00%
Union Beach, Borough of	0	$255,879,500	$0	0.00%

Table 3c.22
Exposure to Landslide by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located in Areas Mapped as Having High Landslide Susceptibility*	Percent of Total Building Value Exposed to Landslide
Upper Freehold, Township of	0	$810,887,400	$0	0.00%
Wall, Township of	0	$2,302,913,200	$0	0.00%
West Long Branch, Borough of	0	$785,971,500	$0	0.00%
Total	**20,462**	**$55,141,734,937**	**$2,425,604,569**	**4.40%**

**Exposure calculated by GIS Analysis using local assessed values in High Landslide Susceptibility Areas. Due to limitations in the horizontal accuracy of the USGS GIS data used for mapping, actual exposure is likely to be very different from the estimates above (higher in some areas, and lower in others). Future updates of the plan should use any new USGS landslide hazard area mapping as it becomes available.*

*** **Freehold and Howell Townships and the Borough of Tinton Falls**: The USGS does not include mapped areas of high landslide susceptibility in Freehold or Howell Townships, or the Borough of Tinton Falls; therefore, GIS analyses of exposure of people and property to the hazard yields zero results. However, because landslides are more likely to occur in locations where they have happened previously, the presence of historic occurrences in all three jurisdictions would suggest some potential exposure of people and property that are not able to be captured or estimated using best available data and analysis methodologies.*

******Long Branch, Monmouth Beach, and Sea Bright**: The USGS mapping of areas of high landslide susceptibility does include mapped areas in the majority of Monmouth Beach; the entirety of Sea Bright; and a portion of Long Branch. Therefore, GIS analyses of exposure results in an estimate of 3,087 people and $412,311,911 of improved property in Monmouth Beach; 1,412 people and $238,003,600 in improved property in Sea Bright; and 479 people and $43,090,959 in Long Branch. However, due to the nature of the local topography in these three communities, this is caused by limitations in the horizontal accuracy of the data itself as opposed to any real landslide hazard and so, for the purpose of this plan, any GIS calculated exposures for Long Branch, Monmouth Beach, and Sea Bright have been manually zeroed out.*

Any damage resulting from a landslide would most likely be localized, and it is unlikely that all areas of high landslide susceptibility in the county would experience landslide impacts at the same time. Therefore, it is difficult to estimate potential losses in a landslide event. Given the lack of historical loss data on significant landslide occurrences in Monmouth County, it is assumed that while one major event may result in significant losses, annualizing structural losses over a long period of time would most likely yield a negligible annualized loss estimate for all jurisdictions exposed to this hazard.

Wildfire

Impacts – Wildfires

Wildfires have the potential to destroy large portions of a community. Firefighters are at risk during the time that they are trying to contain and control the blaze. Loss of life and injuries are possible for people living, working, or traveling through an impacted area. Beyond the loss of vegetation that wildfires leave in their wake, structures in the wildland/urban interface can be severely damaged or destroyed. Following a large wildfire, the possibility exists for significant increases in stormwater runoff and landslides which can lead to downstream flooding. Depending on the scale of the impacted area and the type and numbers of buildings and infrastructure impacted, secondary effects are possible on local economies and the social fabric of communities following the event.

Exposure and Damage Estimates - Wildfires

To estimate exposure to wildfire, the determination of value and population at-risk was calculated through GIS analysis by calculating the proportion of a parcel or census block located within areas of wildfire susceptibility (low/moderate and high/extreme), and applying that same ratio to the census block population and parcel value to estimate population at risk and value of improvements at risk. Over 28 percent of total assessed improvements in the county are located in wildfire hazard areas; however, only about two percent is located in high or extreme susceptibility areas. **Table 3c.23** shows exposure to wildfire by jurisdiction.

Table 3c.23
Exposure to Wildfire by Jurisdiction

Jurisdiction	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Total Assessed Value of Buildings Located in Low/Moderate Susceptibility Areas	Total Assessed Value of Buildings Located in High/Extreme Susceptibility Areas	Total Assessed Value of Buildings Located in All Wildfire Susceptibility Areas	Percent of Total Building Value Exposed to Wildfire
Aberdeen, Township of	4,807	$1,057,910,200	$101,984,252	$13,034,899	$115,019,151	10.87%
Allenhurst, Borough of	41	$163,629,600	$5,467,755	$0	$5,467,755	3.34%
Allentown, Borough of	331	$128,744,000	$12,063,986	$270,649	$12,334,635	9.58%
Asbury Park, City of	50	$822,648,930	$4,003,141	$56,481	$4,059,622	0.49%
Atlantic Highlands, Borough of	530	$251,833,600	$20,432,257	$970,078	$21,402,335	8.50%
Avon-By-The-Sea, Borough of	33	$346,002,100	$1,791,070	$0	$1,791,070	0.52%
Belmar, Borough of	162	$507,354,100	$5,652,067	$28,686	$5,680,753	1.12%
Bradley Beach, Borough of	73	$402,974,400	$237,338	$0	$237,338	0.06%
Brielle, Borough of	569	$490,439,800	$35,509,591	$7,503,955	$43,013,546	8.77%
Colts Neck, Township of	7,132	$1,679,133,600	$1,278,006,089	$30,977,564	$1,308,983,653	77.96%
Deal, Borough of	172	$511,562,800	$154,329,663	$1,147,177	$155,476,840	30.39%
Eatontown, Borough of	2,627	$1,158,392,100	$154,497,686	$8,867,231	$163,364,917	14.10%
Englishtown, Borough of	373	$125,736,600	$9,412,608	$4,960,149	$14,372,757	11.43%
Fair Haven, Borough of	963	$589,631,200	$71,792,042	$969,705	$72,761,747	12.34%
Farmingdale, Borough of	241	$112,597,500	$8,400,438	$0	$8,400,438	7.46%
Freehold, Borough of	970	$636,156,950	$39,251,655	$0	$39,251,655	6.17%
Freehold, Township of	10,122	$3,944,416,100	$751,835,774	$85,350,618	$837,186,392	21.22%
Hazlet, Township of	2,744	$1,212,072,900	$73,465,225	$12,576,944	$86,042,169	7.10%
Highlands, Borough of	893	$282,777,500	$18,200,700	$1,229,260	$19,429,960	6.87%
Holmdel, Township of	8,373	$2,086,402,399	$887,689,179	$21,894,184	$909,583,363	43.60%
Howell, Township of	24,032	$3,182,248,300	$681,867,016	$107,697,014	$789,564,030	24.81%
Interlaken, Borough of	78	$91,685,800	$7,015,721	$0	$7,015,721	7.65%
Keansburg, Borough of	506	$349,667,700	$8,347,422	$1,956,425	$10,303,847	2.95%
Keyport, Borough of	764	$422,424,400	$10,843,036	$5,974,671	$16,817,707	3.98%
Lake Como, Borough of	20	$155,708,700	$584,612	$0	$584,612	0.38%
Little Silver, Borough of	1,637	$747,827,900	$181,259,335	$3,603,982	$184,863,317	24.72%
Loch Arbour, Village of	0	$39,039,500	$2,719	$0	$2,719	0.01%
Long Branch, City of	1,939	$2,345,429,800	$147,227,653	$2,312,818	$149,540,471	6.38%
Manalapan, Township of	12,752	$3,793,581,500	$867,720,239	$47,189,338	$914,909,577	24.12%
Manasquan, Borough of	347	$723,654,300	$16,260,518	$1,408,823	$17,669,341	2.44%
Marlboro, Township of	15,752	$3,947,148,000	$934,947,472	$48,192,135	$983,139,607	24.91%
Matawan, Borough of	1,929	$501,846,200	$45,665,441	$1,154,190	$46,819,631	9.33%
Middletown, Township of	16,794	$4,980,350,600	$1,040,518,685	$81,006,429	$1,121,525,114	22.52%
Millstone, Township of	8,419	$994,523,937	$761,638,265	$37,837,471	$799,475,736	80.39%
Monmouth Beach, Borough of	392	$452,626,900	$23,329,209	$6,741,810	$30,071,019	6.64%
Neptune City, Borough of	351	$240,091,400	$6,391,065	$318,058	$6,709,123	2.79%
Neptune, Township of	3,505	$1,522,988,600	$75,932,137	$24,729,877	$100,662,014	6.61%
Ocean, Township of	4,995	$2,086,610,750	$234,766,559	$67,003,788	$301,770,347	14.46%

Table 3c.23 Exposure to Wildfire by Jurisdiction						
Jurisdiction	**Estimated Population At Risk**	**Total Assessed Value of Improvements (Buildings)**	**Total Assessed Value of Buildings Located in Low/Moderate Susceptibility Areas**	**Total Assessed Value of Buildings Located in High/Extreme Susceptibility Areas**	**Total Assessed Value of Buildings Located in All Wildfire Susceptibility Areas**	**Percent of Total Building Value Exposed to Wildfire**
Oceanport, Borough of	1,084	$518,615,000	$123,089,626	$2,602,078	$125,691,704	24.24%
Red Bank, Borough of	788	$1,186,117,471	$27,085,061	$4,164,887	$31,249,948	2.63%
Roosevelt, Borough of	499	$40,634,100	$9,517,785	$244,286	$9,762,071	24.02%
Rumson, Borough of	3,501	$1,411,914,600	$922,224,206	$13,326,735	$935,550,941	66.26%
Sea Bright, Borough of	174	$238,003,600	$9,538,563	$6,499	$9,545,062	4.01%
Sea Girt, Borough of	66	$469,081,700	$13,615,315	$2,286,209	$15,901,524	3.39%
Shrewsbury, Borough of	1,113	$490,447,400	$99,909,387	$2,119,951	$102,029,338	20.80%
Shrewsbury, Township of	65	$26,891,400	$33,276	$0	$33,276	0.12%
Spring Lake, Borough of	93	$1,047,534,400	$20,227,803	$8,881	$20,236,684	1.93%
Spring Lake Hts., Borough of	569	$454,145,300	$11,520,691	$216,281	$11,736,972	2.58%
Tinton Falls, Borough of	6,207	$2,014,827,700	$363,881,070	$119,484,253	$483,365,323	23.99%
Union Beach, Borough of	931	$255,879,500	$21,976,562	$6,771,687	$28,748,249	11.24%
Upper Freehold, Township of	4,521	$810,887,400	$427,179,945	$18,628,913	$445,808,858	54.98%
Wall, Township of	7,295	$2,302,913,200	$535,388,671	$78,107,672	$613,496,343	26.64%
West Long Branch, Borough of	979	$785,971,500	$71,007,535	$16,808,807	$87,816,342	11.17%
Total	**163,328**	**$55,141,734,937**	**$11,334,535,116**	**$891,741,548**	**$12,226,276,664**	**22.17%**

NOTE: Exposure calculated by GIS Analysis using local assessed values

Given the lack of historical loss data on significant wildfire occurrences resulting in large-scale structural losses in Monmouth County, it is assumed that while one major event may result in significant losses, annualizing structural losses over a long period of time would most likely yield a negligible annualized loss estimate in each jurisdiction exposed to this hazard.

Vulnerability of Assets

The Asset Inventory presented earlier in this document presented six categories of assets, including improved property, emergency facilities, critical infrastructure and utilities, other critical facilities, historic and cultural resources, and population. The preceding sections of this vulnerability assessment have addressed improved property and population for each hazard. This section will specifically address the vulnerability of the other asset categories.

To analyze vulnerability of specific assets located in Monmouth County, facilities were grouped as follows:

- Critical Facilities:
  - Airports/Ferry Ports
  - Emergency Operations Centers/Fire Stations/Police Stations
  - Hospitals
  - Public Works Buildings/Wastewater Treatment Facilities
  - Schools/Child Care Facilities (including camps)
  - Senior Care Facilities
- Historical and Cultural Resources

All assets throughout Monmouth County are exposed to extreme temperatures, extreme winds, hurricanes and tropical storms, lightning, nor'easters, tornadoes, winter storms, drought and earthquakes. For the seven hazards with delineable hazard areas (i.e., flood, wave action, storm surge, coastal erosion, dam failure, landslide and wildfire), **Table 3c.24** shows exposure of Monmouth County's critical facilities by jurisdiction. Only those jurisdictions which have at least one facility exposed to at least one of the seven delineable hazards are included in the table. Also, only those facility types which have at least one facility exposed to at least one of the seven hazards are included in the table. Exposure of these assets was determined through GIS analysis of hazard areas using georeferenced point locations for critical facilities, which were aggregated by facility type. A full list of exposed critical facilities by delineable hazard is provided in **Appendix 3c.1**. In summary:

- 0 critical facilities are in areas mapped as susceptible to coastal erosion[17] or wave action[18];
- 71 critical facilities are in the 100-year floodplain[19] (an additional 33 critical facilities fall within the mapped 2050 flood hazard area assuming high estimates of sea level rise[20]; of these, 28 facilities fall within the mapped 2050 flood hazard area assuming moderate levels of sea level rise);
- 5 critical facilities are in mapped areas of high to extreme wildfire hazard[21];
- 221 critical facilities are in mapped surge hazard areas[22];
- 37 critical facilities are in areas mapped as susceptible to landslides[23];
- 1 wastewater treatment facility could potentially be impacted by dam failure[24];

[17] Within 200 feet of shoreline types classified by NJDEP as "beach" or "erodible".
[18] FEMA V-zones
[19] FEMA A, AE, and V-zones
[20] NOAA 2012, where the 100 year floodplain in 2050 with High estimates of sea level rise was mapped assuming 2 feet of rise; and the 100 year floodplain in 2050 with Moderate estimates of sea level rise was mapped assuming between 0.7 and 1.3 feet of rise by the year 2050.
[21] An additional 124 facilities are in mapped areas of low to moderate wildfire hazard, though this is likely to be an overestimate because many of the low to moderate hazard areas are mapped in urban centers near small pockets of vegetation such as local parks or small clusters of trees).
[22] This reflects facilities in mapped SLOSH zones for Category 1 through 4 hurricanes, as per NOAA Sea, Lake and Overland Surges from Hurricanes (SLOSH) data (2006).
[23] It should be noted that this number is substantially overestimated as a result of significant limitations in the horizontal accuracy of the data.

Three jurisdictions do not have any critical facilities exposed to these hazards, including Borough of Deal, Village of Loch Arbour, Township of Shrewsbury. The jurisdictions with the highest number of critical facilities determined to be exposed to these hazards include the City of Long Branch (43), Township of Middletown (40), City of Asbury Park (30), Borough of Keansburg (27), and Borough of Highlands (25).

Table 3c.25 shows exposure of historic and cultural resources for seven delineable hazards (i.e., flood, wave action, storm surge, coastal erosion, dam failure, landslide and wildfire). Only those historic property locations which intersect with at least one of the seven hazards are included in the table. Exposure of historic properties was determined through GIS analysis of hazard areas using georeferenced locations for historic properties provided by the New Jersey Historic Preservation Office. A full list of exposed historic and cultural resources by delineable hazard is provided in **Appendix 3c.2**.

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[24] Dam inundation hazard area maps were not available at the time of the plan update; therefore, best estimates of potentially impacted areas were made based on local topography and dam characteristics.

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area									
	Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Aberdeen, Township of										
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	5	0	0	0
Total	**0**	**0**	**1**	**0**	**0**	**0**	**6**	**0**	**0**	**0**
Allenhurst, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	2	0	0	0	0	0	0	0
Total	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Allentown, Borough of										
Public Works Buildings/Water/Wastewater Treatment	1	0	0	0	0	0	1	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Asbury Park, City of										
Emergency Centers/Fire Stations/Police Stations	0	0	2	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	2	0	0	0	1	0	1	1
Schools/Child Care Facilities	1	0	10	0	0	0	2	0	1	0
Senior Care Facilities	1	0	9	0	0	0	0	0	0	0
Total	**2**	**0**	**23**	**0**	**0**	**0**	**3**	**0**	**2**	**1**
Atlantic Highlands, Borough of										
Airports/Heliports/Ferry Ports	1	0	1	0	0	0	1	0	0	0
Emergency Centers/Fire Stations/Police Stations	0	0	2	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	2	0	2	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Senior Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**3**	**0**	**7**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Avon-By-The-Sea, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	2	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	1	0	1	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**1**	**0**	**4**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Belmar, Borough of										
Emergency Centers/Fire Stations/Police Stations	1	0	5	0	0	0	0	0	4	3
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	0	0	0	0
Schools/Child Care Facilities	1	0	5	0	0	0	0	0	1	0
Senior Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**2**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**5**	**3**
Bradley Beach, Borough of										
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	0	0	0	0

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area									
	Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Schools/Child Care Facilities	0	0	2	0	0	0	0	0	0	0
Total	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Brielle, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	2	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**3**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Colts Neck, Township of										
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	2	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
Eatontown, Borough of										
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	2	0	0	0	1	0	0	0
Total	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
Englishtown, Borough of										
Emergency Centers/Fire Stations/Police Stations	1	0	0	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Fair Haven, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	1	0	0	1	1	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	1	0	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	2	0	0	0	0
Total	**0**	**0**	**1**	**0**	**0**	**4**	**1**	**0**	**0**	**0**
Farmingdale, Borough of										
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Freehold, Borough of										
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Freehold, Township of										
Airports/Heliports/Ferry Ports	0	0	0	0	0	0	1	0	0	0
Public Works Buildings/Water/Wastewater Treatment	1	0	0	0	0	0	3	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	4	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**0**

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area									
	Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Hazlet, Township of										
Airports/Heliports/Ferry Ports	0	0	0	0	0	0	1	0	0	0
Emergency Centers/Fire Stations/Police Stations	1	0	1	0	0	0	1	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	4	0	0	0	0	0	2	2
Senior Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**1**	**0**	**6**	**0**	**0**	**0**	**3**	**0**	**2**	**2**
Highlands, Borough of										
Airports/Heliports/Ferry Ports	2	0	2	0	0	2	2	0	0	0
Emergency Centers/Fire Stations/Police Stations	2	0	2	0	0	2	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	1	0	1	0	0	1	1	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	4	0	0	0	0
Senior Care Facilities	0	0	1	0	0	1	0	0	1	1
Total	**5**	**0**	**6**	**0**	**0**	**10**	**3**	**0**	**1**	**1**
Holmdel, Township of										
Airports/Heliports/Ferry Ports	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	1	0	0	0	0	0	1	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
Howell, Township of										
Airports/Heliports/Ferry Ports	0	0	0	0	0	0	2	0	0	0
Schools/Child Care Facilities	2	0	0	0	0	0	7	0	0	0
Senior Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**2**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**0**	**0**
Interlaken, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	1	0	0	0	1	0	1	1
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**1**	**1**
Keansburg, Borough of										
Emergency Centers/Fire Stations/Police Stations	3	0	3	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	2	0	0	0	2	0	0	0
Schools/Child Care Facilities	2	0	4	0	0	0	1	0	1	1
Senior Care Facilities	3	0	5	0	0	0	0	0	1	1
Total	**8**	**0**	**14**	**0**	**0**	**0**	**3**	**0**	**2**	**2**
Keyport, Borough of										
Emergency Centers/Fire Stations/Police Stations	2	0	6	0	0	0	0	0	0	0

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area: Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Senior Care Facilities	1	0	1	0	0	0	0	0	0	0
Total	**3**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lake Como, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	2	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Little Silver, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	1	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	0	0	1	1
Schools/Child Care Facilities	0	0	2	0	0	0	0	0	0	0
Total	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
Long Branch, City of										
Emergency Centers/Fire Stations/Police Stations	1	0	7	0	0	0	0	0	1	1
Hospitals	0	0	1	0	0	0	0	0	1	1
Public Works Buildings/Water/Wastewater Treatment	1	0	1	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	11	0	0	0	3	0	4	4
Senior Care Facilities	3	0	8	0	0	0	1	0	2	2
Total	**5**	**0**	**28**	**0**	**0**	**0**	**5**	**0**	**8**	**8**
Manalapan, Township of										
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	3	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	5	0	0	0
Senior Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**
Manasquan, Borough of										
Emergency Centers/Fire Stations/Police Stations	1	0	4	0	0	0	1	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	2	0	0	0	1	0	0	0
Schools/Child Care Facilities	1	0	3	0	0	0	2	1	0	0
Total	**2**	**0**	**9**	**0**	**0**	**0**	**4**	**1**	**0**	**0**
Marlboro, Township of										
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	2	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	3	1	0	0
Senior Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**1**	**0**	**0**
Matawan, Borough of										
Emergency Centers/Fire Stations/Police Stations	1	0	1	0	0	0	0	1	0	0

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area									
	Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Total	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
Middletown, Township of										
Airports/Heliports/Ferry Ports	2	0	1	0	0	0	1	0	0	0
Emergency Centers/Fire Stations/Police Stations	2	0	4	0	0	1	1	0	2	2
Public Works Buildings/Water/Wastewater Treatment	2	0	2	0	0	0	3	0	0	0
Schools/Child Care Facilities	4	0	5	0	0	1	4	0	0	0
Senior Care Facilities	0	0	1	0	0	2	1	0	1	1
Total	**10**	**0**	**13**	**0**	**0**	**4**	**10**	**0**	**3**	**3**
Millstone, Township of										
Emergency Centers/Fire Stations/Police Stations	0	0	0	0	0	0	0	1	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
Monmouth Beach, Borough of										
Emergency Centers/Fire Stations/Police Stations	2	0	2	0	0	2	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	1	0	2	0	0	2	0	0	1	1
Schools/Child Care Facilities	1	0	1	0	0	1	0	0	0	0
Total	**4**	**0**	**5**	**0**	**0**	**5**	**0**	**0**	**1**	**1**
Neptune City, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	3	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**3**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Neptune, Township of										
Emergency Centers/Fire Stations/Police Stations	0	0	3	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	5	0	2	1	1	0	2	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Senior Care Facilities	0	0	2	0	0	0	0	0	1	1
Total	**5**	**0**	**7**	**1**	**1**	**0**	**3**	**0**	**1**	**1**
Ocean, Township of										
Emergency Centers/Fire Stations/Police Stations	0	0	1	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	2	0	0	0
Senior Care Facilities	1	0	1	0	0	0	1	0	0	0
Total	**1**	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**0**	**0**

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area									
	Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Oceanport, Borough of										
Airports/Heliports/Ferry Ports	0	0	1	0	0	0	0	0	1	0
Emergency Centers/Fire Stations/Police Stations	2	0	4	0	0	0	0	0	1	1
Public Works Buildings/Water/Wastewater Treatment	1	0	1	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Senior Care Facilities	0	0	1	0	0	0	0	0	1	1
Total	**3**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**3**	**2**
Red Bank, Borough of										
Schools/Child Care Facilities	1	0	1	0	0	0	0	0	0	0
Senior Care Facilities	1	0	2	0	0	0	0	0	0	0
Total	**2**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Roosevelt, Borough of										
Public Works Buildings/Water/Wastewater Treatment	1	0	0	0	0	0	2	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
Rumson, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	1	0	0	3	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	1	0	1	0	0	1	1	0	0	0
Schools/Child Care Facilities	0	0	3	0	0	6	3	0	0	0
Total	**1**	**0**	**5**	**0**	**0**	**10**	**4**	**0**	**0**	**0**
Sea Bright, Borough of										
Emergency Centers/Fire Stations/Police Stations	2	0	3	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	1	0	1	0	0	0	0	0	0	0
Total	**3**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Sea Girt, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	3	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Shrewsbury, Borough of										
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Shrewsbury, Township of										
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Spring Lake, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	3	0	0	0	0	0	0	0

Table 3c.24
Exposure of Georeferenced Critical Facility Types by Jurisdiction

Facility Type by Jurisdiction	Number of Exposed Critical Facilities by Hazard Area									
	Flood (A/AE/V)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/Mod)	Wildfire (High/Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Public Works Buildings/Water/Wastewater Treatment	1	0	2	0	0	0	2	0	0	0
Schools/Child Care Facilities	0	0	2	0	0	0	1	0	2	1
Total	**1**	**0**	**7**	**0**	**0**	**0**	**3**	**0**	**2**	**1**
Spring Lake Heights, Borough of										
Emergency Centers/Fire Stations/Police Stations	0	0	1	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Tinton Falls, Township of										
Emergency Centers/Fire Stations/Police Stations	0	0	0	0	0	0	1	0	0	0
Public Works Buildings/Water/Wastewater Treatment	0	0	0	0	0	0	1	0	0	0
Schools/Child Care Facilities	0	0	0	0	0	0	5	0	0	0
Senior Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**0**
Union Beach, Borough of										
Airports/Heliports/Ferry Ports	1	0	1	0	0	0	1	0	0	0
Emergency Centers/Fire Stations/Police Stations	5	0	6	0	0	0	0	0	0	0
Public Works Buildings/Water/Wastewater Treatment	2	0	2	0	0	0	2	0	0	0
Schools/Child Care Facilities	1	0	1	0	0	0	0	0	0	0
Total	**9**	**0**	**10**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
Upper Freehold, Township of										
Schools/Child Care Facilities	0	0	0	0	0	0	1	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Wall, Township of										
Public Works Buildings/Water/Wastewater Treatment	0	0	1	0	0	0	0	0	1	1
Schools/Child Care Facilities	0	0	1	0	0	0	2	1	0	0
Total	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**1**	**1**	**1**
West Long Branch, Borough of										
Airports/Heliports/Ferry Ports	0	0	1	0	0	0	0	0	0	0
Schools/Child Care Facilities	0	0	2	0	0	0	0	0	0	0
Senior Care Facilities	0	0	1	0	0	0	0	0	0	0
Total	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Monmouth County Total	**71**	**0**	**222**	**0**	**1**	**37**	**125**	**5**	**33**	**28**

NOTE: Exposure calculated by GIS Analysis using georeferenced locations

Table 3c.25
Exposure of Historic Properties by Hazard

Property Name	Location	Jurisdiction	Flood (A/AE / VE)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/ Mod)	Wildfire (High/ Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Allenhurst Railroad Station	Main Street	Allenhurst Borough			•				•			
Allenhurst Residential Historic District	Not Provided	Allenhurst Borough	•	•	•				•		•	•
Allentown Historic District	Not Provided	Allentown Borough	•						•	•		
Allentown Mill	42 South Main Street	Allentown Borough	•						•			
Asbury Park Convention Hall	Ocean Avenue	Asbury Park City	•	•	•							
Asbury Park Post Office	801 Bangs Avenue	Asbury Park City			•							
George Wurt's Summer Home	306 Eighth Avenue	Asbury Park City			•							
Mayfair Theatre [Demolished]	Lake Avenue and Saint James Place	Asbury Park City	•		•						•	•
Palace Amusements Building [Demolished]	201-207 Lake Avenue	Asbury Park City	•		•							
Steinbach/Cookman Building	Cookman Avenue	Asbury Park City			•							
Bradley Beach Railroad Station	East of Memorial Drive between LaReine and Brimley Avenues	Bradley Beach Borough			•				•			
Brielle Road Bridge over the Glimmer Glass (S.I. & A. #13000W9)	Brielle Road over Glimmer Glass	Brielle Borough	•		•				•			
Probasco-Dittmar Homestead	61 Bucks Mill Road	Colts Neck Township	•						•	•		
Fisk Chapel	25 Cedar Avenue	Fair Haven Borough			•							
Walker-Combs-Hartshorne House	189 Wemrock Road	Freehold Township							•	•		

Table 3c.25
Exposure of Historic Properties by Hazard

Property Name	Location	Jurisdiction	Flood (A/AE / VE)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/ Mod)	Wildfire (High/ Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Fort Hancock and Sandy Hook Proving Ground Historic District	Not Provided	Gateway Nat'l Rec Area									•	•
Fort Hancock Life Saving Station	Gateway National Recreation Area	Gateway Nat'l Rec Area									•	•
Sandy Hook Lighthouse	Sandy Hook	Gateway Nat'l Rec Area									•	•
Twin Lights (Navesink Lighthouse)	Lighthouse Road	Highlands Borough						•	•			
Dr. Robert W. Cooke Medical Office	67 McCampbell Road	Holmdel Township							•			
Holmes-Hendrickson House	Longstreet Road, adjacent to Holmdel Park	Holmdel Township							•	•		
Horn Antenna	Off Garden State Parkway in Crawford Hill Facility	Holmdel Township							•			
Kovenhoven House	Schank Road, east of NJ Route 34	Holmdel Township							•			
Longstreet Farm	Longstreet Road at Roberts Road	Holmdel Township							•			
Upper Meeting House of the Baptist Church of Middletown (Holmdel Community Church)	40 Main Street	Holmdel Township							•			
Little Silver Railroad Station	Sycamore and Oceanport avenues	Little Silver Borough			•				•			
Parker Farm	235 Rumson Road	Little Silver Borough	•		•				•			

Table 3c.25
Exposure of Historic Properties by Hazard

Property Name	Location	Jurisdiction	Flood (A/AE / VE)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/ Mod)	Wildfire (High/ Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
St. John's Episcopal Church	Little Silver Point Road	Little Silver Borough	•		•				•	•	•	•
Church of the Presidents (St. James Church)	1260 Ocean Avenue	Long Branch City			•						•	•
Elberon Railroad Station	Lincoln Avenue	Long Branch City			•				•			
North Long Branch School (Primary No. 3; Church Street School)	469 Church Street	Long Branch City	•		•						•	•
Anderson House [Demolished]	Route 33	Manalapan Township							•			
Freehold & Jamesburg Agricultural Railroad Historic District	Not Provided	Manalapan Township	•						•			
Monmouth Battlefield Historic District	Not Provided	Manalapan Township	•						•	•		
Squan Beach Life-Saving Station #9	124 Ocean Avenue	Manasquan Borough	•		•							
Old Kentuck	Pleasant Valley Road	Marlborough Township							•			
Old Scots Burying Ground	Gordon's Corner Road	Marlborough Township							•			
Major John Burrowes Mansion	94 Main Street	Matawan Borough	•		•				•	•		
Matawan Railroad Station	Between Main and Atlantic avenues	Matawan Borough							•			
All Saints Memorial Church Complex	Navesink, Stone Church Corner, Navesink Avenue and Locust Road	Middletown Township						•	•			
Bowne House	Leonard Avenue	Middletown Township	•		•				•		•	•

Table 3c.25
Exposure of Historic Properties by Hazard

Property Name	Location	Jurisdiction	Flood (A/AE / VE)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/ Mod)	Wildfire (High/ Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Grover House	940 West Front Street	Middletown Township							•			
Middletown Village Historic District	Not Provided	Middletown Township							•	•		
Navesink Historic District	Not Provided	Middletown Township						•	•			
Seabrook-Wilson House (Spy House)	119 Port Monmouth Road	Middletown Township	•	•	•				•	•	•	•
Throckmorton Farm	Poricy Park, Oak Hill Road	Middletown Township	•		•				•	•		
Water Witch	Not Provided	Middletown Township						•	•	•		
Water Witch Club Casino	Corner of East Twin Road and West Twin Road	Middletown Township						•	•			
Clarksburg School	524 Stagecoach Road (County Route 524)	Millstone Township							•			
U.S. Life-Saving Station #4	Seacrest Road and Ocean Avenue	Monmouth Beach Borough	•		•			•				
Ocean Grove Camp Meeting Association Historic District	From the Atlantic Ocean on the east to Hwy 71 to the west; Fletcher Lake to the south and Wesley Lake to the north	Neptune Township	•	•	•	•					•	•
Monmouth Boat Club	Union Street	Red Bank Borough	•		•				•			
North Shrewsbury Ice Boat and Yacht Club	9 Union Street	Red Bank Borough	•		•				•			
Red Bank Passenger Station	Bridge and Monmouth streets	Red Bank Borough							•			
Jersey Homesteads Historic District	Not Provided	Roosevelt Borough	•						•	•		
First Presbyterian Church of Oceanic	East River Road at Park Avenue	Rumson Borough			•			•	•			
Lauriston	91 Rumson Road	Rumson Borough			•			•	•			

Table 3c.25
Exposure of Historic Properties by Hazard

Property Name	Location	Jurisdiction	Flood (A/AE / VE)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/ Mod)	Wildfire (High/ Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Saint George's-by-the River Episcopal Church	7 Lincoln Avenue	Rumson Borough	•		•	•		•			•	•
Seabright Lawn Tennis & Cricket Club	Rumson Road at Tennis Court Lane	Rumson Borough			•			•	•		•	•
Christ Church, Shrewsbury	Broad Street and Sycamore Avenue	Shrewsbury Borough							•			
Shrewsbury Historic District	Not Provided	Shrewsbury Borough							•			
Wardell House	419 Sycamore Avenue	Shrewsbury Borough							•			
Audenried Cottage (Normandy Inn)	21 Tuttle Avenue	Spring Lake Borough			•						•	
Frederick A. Duggan Memorial First Aid and Emergency Squad Building (Spring Lake First Aid & Emergency Squad Building)	311 Washington Avenue	Spring Lake Borough			•							
Holy Trinity Episcopal Church	Monmouth and Third avenues	Spring Lake Borough			•							
Martin Maloney Cottage	101 Morris Avenue	Spring Lake Borough			•							
Old Mill at Tinton Falls	1205 Sycamore Avenue	Tinton Falls Borough	•		•				•			
Tinton Falls Historic District	Not Provided	Tinton Falls Borough	•		•				•			
Arneytown Historic District	Not Provided	Upper Freehold Township							•	•		
Coward-Hendrickson House	Burlington Path Road	Upper Freehold Township							•			
Coward-Smith House	Burlington Path Road	Upper Freehold Township							•	•		

Table 3c.25
Exposure of Historic Properties by Hazard

Property Name	Location	Jurisdiction	Flood (A/AE / VE)	Wave Action (VE)	Storm Surge (Cat 1-4)	Coastal Erosion	Dam Failure	Landslide (High)	Wildfire (Low/ Mod)	Wildfire (High/ Ext)	Added if High Sea Level Rise by 2050	Added if Moderate Sea Level Rise by 2050
Imlaystown Historic District	Not Provided	Upper Freehold Township	•						•			
Merino Hill House and Farm	Allentown-Clarksburg Road (County Route 524)	Upper Freehold Township							•			
Salter's Mill	Imlaystown-Davis Station Road	Upper Freehold Township	•						•			
Upper Freehold Baptist Meeting (Old Yellow Meetinghouse)	Yellow Meetinghouse and Red Valley roads	Upper Freehold Township							•			
Walnford Historic District	Not Provided	Upper Freehold Township	•						•			
Allgor-Barkalow Homestead	New Bedford Road	Wall Township							•			
Camp Evans Historic District	Not Provided	Wall Township			•	•	•		•		•	•
Manasquan Friends Meetinghouse	NJ Route 35 at Manasquan Circle	Wall Township							•			
Project Diana Site		Wall Township							•	•		
MacGregor-Tallman House	407 Monmouth Road	West Long Branch Borough							•			
Murry Guggenheim Mansion	Cedar and Norwood avenues	West Long Branch Borough							•			
Shadow Lawn	Cedar and Norwood avenues	West Long Branch Borough	•		•				•			

NOTE: Exposure calculated by GIS Analysis using georeferenced locations

Conclusions on Hazard Risk

The results of this vulnerability assessment are useful in at least three ways:

- Improving our understanding of the risk associated with the natural hazards in Monmouth County through better understanding of the complexities and dynamics of risk, how levels of risk can be measured and compared, and the myriad of factors that influence risk. An understanding of these relationships is critical in making balanced and informed decisions on managing the risk.
- Providing a baseline for policy development and comparison of mitigation alternatives. The data used for this analysis presents a current picture of risk in Monmouth County. Updating this risk "snapshot" with future data will enable comparison of the changes in risk with time. Baselines of this type can support the objective analysis of policy and program options for risk reduction in the region.
- Comparing the risk among the natural hazards addressed. The ability to quantify the risk to all these hazards relative to one another helps in a balanced, multi-hazard approach to risk management at each level of governing authority. This ranking provides a systematic framework to compare and prioritize the very disparate natural hazards that are present in Monmouth County. This final step in the risk assessment provides the necessary information for local officials to craft a mitigation strategy to focus resources on only those hazards that pose the most threat to the county.

Exposure to hazards can be an indicator of vulnerability. Economic exposure can be identified through locally assessed values for improvements (buildings), and social exposure can be identified by estimating the population exposed to each hazard. This information is especially important for decision-makers to use in planning for evacuation or other public safety related needs. A summary of the value of buildings at-risk (exposed) to each hazard is presented in **Table 3c.26,** and a summary of population exposure is presented in **Table 3c.27**. Using the previously described methodology, economic results were estimated for the different hazards profiled earlier in this section. The economic loss results are summarized in **Table 3c.28** using Annualized Loss (AL), which is the estimated long-term value of losses to the general building stock in any single year in a specified geographic area (i.e., jurisdiction). The estimated AL addresses the two key components of risk: the probability of the hazard occurring in the jurisdiction and the consequences of the hazard, largely a function of building construction type and quality, and of the intensity of the hazard event. By annualizing estimated losses, the AL factors in historic patterns of frequent smaller events with infrequent but larger events to provide a balanced presentation of the risk.

A summary of the annualized loss ratio (ALR) results is presented in **Table 3c.29**. The ALR represents the AL as a fraction of the local assessed value of improvements (calculated as annualized losses divided by the total exposure at risk). The annualized loss ratio gauges the relationship between average annualized loss and assessed value. This ratio can be used as a measure of vulnerability in the areas and, since it is normalized by assessed value, it can be directly compared across different jurisdictions.

In order to illustrate composite vulnerability, four hazards[25] (i.e., flood, storm surge, landslide and wildfire) were mapped for the county and each jurisdiction using overlays to show areas which are vulnerable (indicated by shading scaled so that darker tones indicate vulnerability to multiple hazards). It should be noted that some jurisdictions may not be exposed to all four hazards. **Figure 3c.4** shows Monmouth County's composite vulnerability.

[25] Delineable hazards are: coastal erosion, flood, surge, wave action, landslide, and wildfire. Wave action is included within the VE portion of the flood layer. Coastal erosion is not mapped at this scale because it is assumed that beach nourishment will be ongoing to prevent long term erosion of 200 feet and short term remains on shoreline.

[redacted]

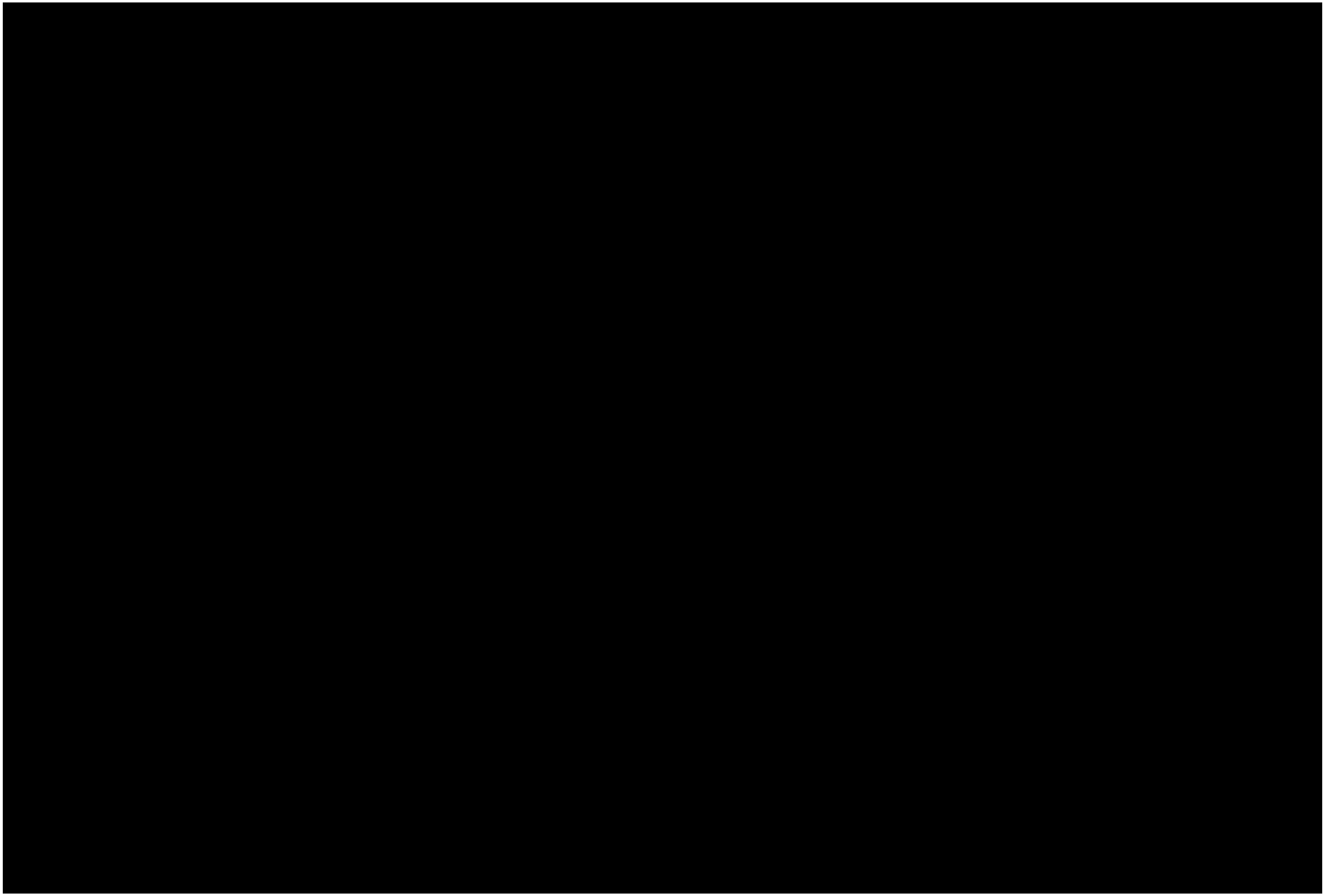


Table 3c.27
Population Exposure by Hazard by Jurisdiction

Jurisdiction	Extreme Temps	Extreme Wind	Hurricane & Trop. Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Aberdeen, Township of	18,210	18,210	18,210	18,210	18,210	18,210	18,210	33	0	18,210	1,429	2,044	420	18,210	0	4,807
Allenhurst, Borough of	496	496	496	496	496	496	496	10	0	496	13	403	3	496	0	41
Allentown, Borough of	1,828	1,828	1,828	1,828	1,828	1,828	1,828	0	0	1,828	163	0	0	1,828	0	331
Asbury Park, City of	16,116	16,116	16,116	16,116	16,116	16,116	16,116	0	0	16,116	869	11,274	0	16,116	0	50
Atlantic Highlands, Borough of	4,385	4,385	4,385	4,385	4,385	4,385	4,385	92	0	4,385	410	1,236	55	4,385	1,722	530
Avon-By-The-Sea, Borough of	1,901	1,901	1,901	1,901	1,901	1,901	1,901	7	0	1,901	507	1,829	0	1,901	0	33
Belmar, Borough of	5,794	5,794	5,794	5,794	5,794	5,794	5,794	42	0	5,794	1,246	5,750	59	5,794	0	162
Bradley Beach, Borough of	4,298	4,298	4,298	4,298	4,298	4,298	4,298	10	0	4,298	185	3,788	0	4,298	0	73
Brielle, Borough of	4,774	4,774	4,774	4,774	4,774	4,774	4,774	12	0	4,774	611	2,181	2	4,774	0	569
Colts Neck, Township of	10,142	10,142	10,142	10,142	10,142	10,142	10,142	0	1	10,142	732	0	0	10,142	0	7,132
Deal, Borough of	750	750	750	750	750	750	750	29	0	750	38	136	12	750	0	172
Eatontown, Borough of	12,709	12,709	12,709	12,709	12,709	12,709	12,709	0	0	12,709	234	1,223	0	12,709	0	2,627
Englishtown, Borough of	1,847	1,847	1,847	1,847	1,847	1,847	1,847	0	0	1,847	311	0	0	1,847	0	373
Fair Haven, Borough of	6,121	6,121	6,121	6,121	6,121	6,121	6,121	11	0	6,121	154	1,011	92	6,121	2,781	963
Farmingdale, Borough of	1,329	1,329	1,329	1,329	1,329	1,329	1,329	0	0	1,329	317	0	0	1,329	0	241
Freehold, Borough of	12,052	12,052	12,052	12,052	12,052	12,052	12,052	0	0	12,052	1	0	0	12,052	0	970
Freehold, Township of	36,184	36,184	36,184	36,184	36,184	36,184	36,184	0	0	36,184	1,073	0	0	36,184	Potential for >0	10,122
Hazlet, Township of	20,334	20,334	20,334	20,334	20,334	20,334	20,334	0	0	20,334	2,650	6,736	0	20,334	0	2,744
Highlands, Borough of	5,005	5,005	5,005	5,005	5,005	5,005	5,005	326	0	5,005	2,641	2,779	96	5,005	5,005	893
Holmdel, Township of	16,773	16,773	16,773	16,773	16,773	16,773	16,773	0	0	16,773	445	315	0	16,773	0	8,373
Howell, Township of	51,075	51,075	51,075	51,075	51,075	51,075	51,075	0	104	51,075	3,390	473	0	51,075	Potential for >0	24,032
Interlaken, Borough of	820	820	820	820	820	820	820	0	0	820	33	649	0	820	0	78
Keansburg, Borough of	10,105	10,105	10,105	10,105	10,105	10,105	10,105	12	0	10,105	8,946	10,105	65	10,105	0	506
Keyport, Borough of	7,240	7,240	7,240	7,240	7,240	7,240	7,240	80	0	7,240	1,027	3,548	185	7,240	0	764
Lake Como, Borough of	1,759	1,759	1,759	1,759	1,759	1,759	1,759	0	0	1,759	95	1,609	0	1,759	0	20
Little Silver, Borough of	5,950	5,950	5,950	5,950	5,950	5,950	5,950	176	0	5,950	784	3,090	0	5,950	71	1,637
Loch Arbour, Village of	194	194	194	194	194	194	194	0	0	194	75	194	0	194	0	0
Long Branch, City of	30,719	30,719	30,719	30,719	30,719	30,719	30,719	528	0	30,719	3,301	18,701	119	30,719	0	1,939

Table 3c.27
Population Exposure by Hazard by Jurisdiction

Jurisdiction	Extreme Temps	Extreme Wind	Hurricane & Trop. Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Manalapan, Township of	38,872	38,872	38,872	38,872	38,872	38,872	38,872	0	0	38,872	1,881	0	0	38,872	0	12,752
Manasquan, Borough of	5,897	5,897	5,897	5,897	5,897	5,897	5,897	32	0	5,897	2,440	4,862	142	5,897	0	347
Marlboro, Township of	40,191	40,191	40,191	40,191	40,191	40,191	40,191	0	0	40,191	1,100	0	0	40,191	0	15,752
Matawan, Borough of	8,810	8,810	8,810	8,810	8,810	8,810	8,810	0	0	8,810	500	484	0	8,810	0	1,929
Middletown, Township of	66,522	66,522	66,522	66,522	66,522	66,522	66,522	316	214	66,522	10,246	17,876	234	66,522	3,243	16,794
Millstone, Township of	10,566	10,566	10,566	10,566	10,566	10,566	10,566	0	0	10,566	377	0	0	10,566	0	8,419
Monmouth Beach, Borough of	3,279	3,279	3,279	3,279	3,279	3,279	3,279	325	0	3,279	2,132	3,279	1	3,279	0	392
Neptune City, Borough of	4,869	4,869	4,869	4,869	4,869	4,869	4,869	91	0	4,869	273	2,649	16	4,869	0	351
Neptune, Township of	27,935	27,935	27,935	27,935	27,935	27,935	27,935	229	288	27,935	1,627	9,413	157	27,935	0	3,505
Ocean, Township of	27,291	27,291	27,291	27,291	27,291	27,291	27,291	0	0	27,291	1,972	1,686	0	27,291	0	4,995
Oceanport, Borough of	5,832	5,832	5,832	5,832	5,832	5,832	5,832	209	0	5,832	1,499	4,721	0	5,832	563	1,084
Red Bank, Borough of	12,206	12,206	12,206	12,206	12,206	12,206	12,206	57	0	12,206	663	858	18	12,206	0	788
Roosevelt, Borough of	882	882	882	882	882	882	882	0	0	882	17	0	0	882	0	499
Rumson, Borough of	7,122	7,122	7,122	7,122	7,122	7,122	7,122	253	0	7,122	1,360	3,970	54	7,122	7,077	3,501
Sea Bright, Borough of	1,412	1,412	1,412	1,412	1,412	1,412	1,412	300	0	1,412	1,254	1,414	37	1,412	0	174
Sea Girt, Borough of	1,828	1,828	1,828	1,828	1,828	1,828	1,828	12	0	1,828	125	1,520	4	1,828	0	66
Shrewsbury, Borough of	3,809	3,809	3,809	3,809	3,809	3,809	3,809	18	0	3,809	99	891	0	3,809	0	1,113
Shrewsbury, Township of	1,141	1,141	1,141	1,141	1,141	1,141	1,141	0	0	1,141	0	0	0	1,141	0	65
Spring Lake, Borough of	2,993	2,993	2,993	2,993	2,993	2,993	2,993	2	0	2,993	360	2,060	0	2,993	0	93
Spring Lake Hts., Borough of	4,713	4,713	4,713	4,713	4,713	4,713	4,713	0	0	4,713	325	1,474	0	4,713	0	569
Tinton Falls, Borough of	17,892	17,892	17,892	17,892	17,892	17,892	17,892	0	464	17,892	736	430	0	17,892	Potential for >0	6,207
Union Beach, Borough of	6,245	6,245	6,245	6,245	6,245	6,245	6,245	129	0	6,245	4,991	6,245	519	6,245	0	931
Upper Freehold, Township of	6,902	6,902	6,902	6,902	6,902	6,902	6,902	0	0	6,902	315	0	0	6,902	0	4,521
Wall, Township of	26,164	26,164	26,164	26,164	26,164	26,164	26,164	146	120	26,164	1,170	1,646	40	26,164	0	7,295
West Long Branch, Borough of	8,097	8,097	8,097	8,097	8,097	8,097	8,097	0	0	8,097	107	1,513	0	8,097	0	979
Total	**630,380**	**630,380**	**630,380**	**630,380**	**630,380**	**630,380**	**630,380**	**3,487**	**1,173**	**630,380**	**67,249**	**142,143**	**2,330**	**630,380**	**20,462**	**163,328**
Percent of Total Population	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**0.6%**	**0.2%**	**100%**	**10.7%**	**22.6%**	**0.4%**	**100%**	**3.3%**	**25.9%**

Table 3c.28
Annualized Building Losses by Hazard by Jurisdiction

Jurisdiction	Extreme Temperatures	Extreme Wind	Hurricane & Tropical Storm *(Hurricane Wind Only)*	Lightning	Nor'easter *(Wind Only)*	Tornado	Winter Storm	Coastal Erosion**	Dam Failure	Drought* *(Crop Losses Only)*	Flood *(Riverine Only)*	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Aberdeen, Township of	UTD$_N$	$22,992	$192,253	$516	$2,996	$99	$5,241	UTD$_N$	$0	UTD$_N$	$17,840	$56,649	UTD$_N$	$1,993	$0	UTD$_N$
Allenhurst, Borough of	UTD$_N$	$22,992	$56,861	$516	$322	$99	$5,241	UTD$_N$	$0	$0	$0	$750,853	UTD$_N$	$221	$0	UTD$_N$
Allentown, Borough of	UTD$_N$	$22,992	$22,968	$516	$113	$99	$5,241	$0	$0	UTD$_N$	$50,233	$0	$0	$198	$0	UTD$_N$
Asbury Park, City of	UTD$_N$	$22,992	$368,033	$516	$1,103	$99	$5,241	UTD$_N$	$0	$0	$0	$1,399,107	UTD$_N$	$1,413	$0	UTD$_N$
Atlantic Highlands, Borough of	UTD$_N$	$22,992	$67,219	$516	$812	$99	$5,241	UTD$_N$	$0	$0	$0	$145,273	UTD$_N$	$413	UTD$_N$	UTD$_N$
Avon-By-The-Sea, Borough of	UTD$_N$	$22,992	$137,873	$516	$386	$99	$5,241	UTD$_N$	$0	$0	$0	$4,664,503	UTD$_N$	$499	$0	UTD$_N$
Belmar, Borough of	UTD$_N$	$34,483	$200,896	$516	$620	$99	$5,241	UTD$_N$	$0	$0	$0	$5,888,530	UTD$_N$	$668	$0	UTD$_N$
Bradley Beach, Borough of	UTD$_N$	$22,992	$186,761	$516	$456	$99	$5,241	UTD$_N$	$0	$0	$0	$1,780,068	$0	$643	$0	UTD$_N$
Brielle, Borough of	UTD$_N$	$22,992	$210,616	$516	$335	$99	$5,241	UTD$_N$	$0	$0	$0	$2,483,615	UTD$_N$	$612	$0	UTD$_N$
Colts Neck, Township of	UTD$_N$	$22,992	$362,753	$6,154	$4,045	$99	$5,241	$0	$0	UTD$_N$	$904,792	$0	$0	$2,912	$0	UTD$_N$
Deal, Borough of	UTD$_N$	$22,992	$206,781	$516	$1,213	$99	$5,241	UTD$_N$	$0	$0	$4,207	$402,296	UTD$_N$	$691	$0	UTD$_N$
Eatontown, Borough of	UTD$_N$	$22,992	$263,267	$516	$2,041	$99	$5,241	$0	$0	UTD$_N$	$31,418	$16,727	$0	$2,111	$0	UTD$_N$
Englishtown, Borough of	UTD$_N$	$22,992	$15,789	$516	$161	$99	$5,241	$0	$0	UTD$_N$	$165,326	$0	$0	$201	$0	UTD$_N$
Fair Haven, Borough of	UTD$_N$	$22,992	$183,331	$516	$1,909	$99	$5,241	UTD$_N$	$0	$0	$0	$121,457	UTD$_N$	$934	UTD$_N$	UTD$_N$
Farmingdale, Borough of	UTD$_N$	$22,992	$22,005	$516	$112	$99	$5,241	$0	$0	UTD$_N$	$157,891	$0	$0	$205	$0	UTD$_N$
Freehold, Borough of	UTD$_N$	$68,966	$136,490	$516	$954	$99	$5,241	$0	$0	UTD$_N$	$0	$0	$0	$1,375	$0	UTD$_N$
Freehold, Township of	UTD$_N$	$22,992	$888,347	$516	$6,654	$99	$5,241	$0	$0	UTD$_N$	$771,972	$0	$0	$7,319	UTD$_N$	UTD$_N$
Hazlet, Township of	UTD$_N$	$22,992	$247,869	$516	$3,622	$99	$5,241	$0	$0	UTD$_N$	$199,420	$1,147,964	$0	$2,606	$0	UTD$_N$
Highlands, Borough of	UTD$_N$	$22,992	$97,893	$516	$1,148	$806	$5,241	UTD$_N$	$0	$0	$0	$2,941,754	UTD$_N$	$434	UTD$_N$	UTD$_N$
Holmdel, Township of	UTD$_N$	$22,992	$355,858	$516	$4,770	$99	$5,241	$0	$0	UTD$_N$	$554,597	$0	$0	$4,070	$0	UTD$_N$
Howell, Township of	UTD$_N$	$22,992	$952,503	$516	$3,169	$99	$5,241	$0	UTD$_N$	UTD$_N$	$1,999,260	$0	$0	$5,983	UTD$_N$	UTD$_N$
Interlaken, Borough of	UTD$_N$	$22,992	$31,450	$516	$150	$99	$5,241	$0	$0	$0	$630	$459,250	$0	$108	$0	UTD$_N$
Keansburg, Borough of	UTD$_N$	$22,992	$94,745	$516	$1,250	$99	$5,241	UTD$_N$	$0	$0	$326,653	$15,909,880	UTD$_N$	$776	$0	UTD$_N$
Keyport, Borough of	UTD$_N$	$22,992	$88,648	$516	$1,291	$99	$5,241	UTD$_N$	$0	$0	$16,614	$879,535	UTD$_N$	$917	$0	UTD$_N$
Lake Como, Borough of	UTD$_N$	$22,992	$58,618	$6,154	$137	$99	$5,241	$0	$0	$0	$0	$855,498	$0	$193	$0	UTD$_N$
Little Silver, Borough of	UTD$_N$	$22,992	$222,482	$516	$2,274	$99	$5,241	UTD$_N$	$0	UTD$_N$	$414	$1,237,742	$0	$1,366	UTD$_N$	UTD$_N$
Loch Arbour, Village of	UTD$_N$	$22,992	$25,212	$516	$77	$1,210	$5,241	UTD$_N$	$0	$0	$0	$316,220	UTD$_N$	$93	$0	UTD$_N$
Long Branch, City of	UTD$_N$	$22,992	$1,108,803	$516	$5,930	$99	$5,241	UTD$_N$	$0	$0	$154,302	$6,104,903	UTD$_N$	$4,279	$0	UTD$_N$
Manalapan, Township of	UTD$_N$	$22,992	$704,447	$61,538	$6,329	$16,129	$5,241	$0	$0	UTD$_N$	$2,442,886	$0	$0	$7,166	$0	UTD$_N$
Manasquan, Borough of	UTD$_N$	$22,992	$328,511	$516	$368	$99	$5,241	UTD$_N$	$0	$0	$0	$14,086,040	UTD$_N$	$950	$0	UTD$_N$

Table 3c.28
Annualized Building Losses by Hazard by Jurisdiction

Jurisdiction	Extreme Temperatures	Extreme Wind	Hurricane & Tropical Storm *(Hurricane Wind Only)*	Lightning	Nor'easter *(Wind Only)*	Tornado	Winter Storm	Coastal Erosion**	Dam Failure	Drought* *(Crop Losses Only)*	Flood *(Riverine Only)*	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Marlboro, Township of	UTD$_N$	$68,966	$765,167	$516	$7,694	$99	$5,241	$0	$0	UTD$_N$	$186,631	$0	$0	$7,927	$0	UTD$_N$
Matawan, Borough of	UTD$_N$	$22,992	$82,188	$516	$1,294	$99	$5,241	$0	$0	$0	$218,788	$0	$0	$1,019	$0	UTD$_N$
Middletown, Township of	UTD$_N$	$22,992	$1,306,087	$14,154	$15,330	$99	$5,241	UTD$_N$	UTD$_N$	UTD$_N$	$1,578,497	$2,974,041	UTD$_N$	$10,448	UTD$_N$	UTD$_N$
Millstone, Township of	UTD$_N$	$22,992	$157,427	$516	$1,142	$1,613	$5,241	$0	$0	UTD$_N$	$735,757	$0	$0	$1,702	$0	UTD$_N$
Monmouth Beach, Borough of	UTD$_N$	$22,992	$302,583	$516	$1,805	$99	$5,241	UTD$_N$	$0	$0	$0	$7,106,242	UTD$_N$	$789	0	UTD$_N$
Neptune City, Borough of	UTD$_N$	$22,992	$96,232	$516	$291	$99	$5,241	UTD$_N$	$0	$0	$0	$236,584	UTD$_N$	$423	$0	UTD$_N$
Neptune, Township of	UTD$_N$	$22,992	$547,352	$516	$1,864	$99	$5,241	UTD$_N$	UTD$_N$	UTD$_N$	$470,389	$1,639,615	UTD$_N$	$2,544	$0	UTD$_N$
Ocean, Township of	UTD$_N$	$22,992	$681,029	$516	$3,205	$99	$5,241	$0	$0	UTD$_N$	$58,049	$52,990	$0	$3,660	$0	UTD$_N$
Oceanport, Borough of	UTD$_N$	$22,992	$175,600	$6,154	$1,295	$99	$5,241	UTD$_N$	$0	UTD$_N$	$77,159	$2,618,354	$0	$727	UTD$_N$	UTD$_N$
Red Bank, Borough of	UTD$_N$	$22,992	$335,903	$516	$2,946	$99	$5,241	UTD$_N$	$0	$0	$494,282	$215,033	UTD$_N$	$2,668	$0	UTD$_N$
Roosevelt, Borough of	UTD$_N$	$22,992	$2,345	$516	$42	$99	$5,241	$0	$0	UTD$_N$	$1,852	$0	$0	$33	$0	UTD$_N$
Rumson, Borough of	UTD$_N$	$22,992	$563,024	$516	$5,169	$99	$5,241	UTD$_N$	$0	UTD$_N$	$0	$8,731,096	UTD$_N$	$2,667	UTD$_N$	UTD$_N$
Sea Bright, Borough of	UTD$_N$	$22,992	$226,332	$516	$1,513	$99	$5,241	UTD$_N$	$0	$0	$0	$9,258,340	UTD$_N$	$433	$0	UTD$_N$
Sea Girt, Borough of	UTD$_N$	$22,992	$219,029	$516	$327	$99	$5,241	UTD$_N$	$0	$0	$28,646	$1,115,537	UTD$_N$	$611	$0	UTD$_N$
Shrewsbury, Borough of	UTD$_N$	$22,992	$93,189	$516	$1,024	$99	$5,241	UTD$_N$	$0	UTD$_N$	$0	$63,725	$0	$914	$0	UTD$_N$
Shrewsbury, Township of	UTD$_N$	$22,992	$3,366	$516	$86	$99	$5,241	$0	$0	$0	$5,251	$0	$0	$17	$0	UTD$_N$
Spring Lake, Borough of	UTD$_N$	$22,992	$489,452	$516	$944	$99	$5,241	UTD$_N$	$0	$0	$97,451	$6,429,665	UTD$_N$	$1,423	$0	UTD$_N$
Spring Lake Hts., Borough of	UTD$_N$	$22,992	$185,923	$516	$447	$99	$5,241	$0	$0	$0	$127,076	$339,485	$0	$591	$0	UTD$_N$
Tinton Falls, Borough of	UTD$_N$	$22,992	$395,579	$516	$3,951	$99	$5,241	$0	UTD$_N$	UTD$_N$	$439,874	$0	$0	$2,575	UTD$_N$	UTD$_N$
Union Beach, Borough of	UTD$_N$	$22,992	$66,513	$516	$822	$99	$5,241	UTD$_N$	$0	$0	$0	$11,565,753	UTD$_N$	$578	$0	UTD$_N$
Upper Freehold, Township of	UTD$_N$	$22,992	$164,403	$30,769	$547	$99	$5,241	$0	$0	UTD$_N$	$378,509	$0	$0	$1,690	$0	UTD$_N$
Wall, Township of	UTD$_N$	$22,992	$811,167	$516	$1,423	$99	$5,241	UTD$_N$	UTD$_N$	UTD$_N$	$336,078	$61,658	UTD$_N$	$4,225	$0	UTD$_N$
West Long Branch, Borough of	UTD$_N$	$22,992	$198,217	$516	$1,663	$99	$5,241	$0	$0	UTD$_N$	$9,650	$0	$0	$1,111	$0	UTD$_N$
Total	**UTD**	**$1,322,000**	**$15,707,386**	**$149,188**	**$110,050**	**$24,601**	**$277,778**	**UTD**	**UTD**	**$85,997**	**$1,393,894**	**$40,867,679**	**UTD**	**$100,122**	**UTD**	**UTD**

**Potential Crop Losses Only; Data allowed for estimate of a county-wide total but not a jurisdiction specific estimate. Communities with USDA reported 0 acres in agriculture were assigned $0 average annual crop losses for planning purposes.*
UTD$_N$ = Unable to Determine presumably negligible (less than $5,000 annual average damage)
*** Average Annual Building Damages Directly Attributable to Coastal Erosion Assuming Continued Beach Nourishment and Shoreline Stabilization Practices*

Table 3c.29
Annualized Loss Ratios by Hazard by Jurisdiction

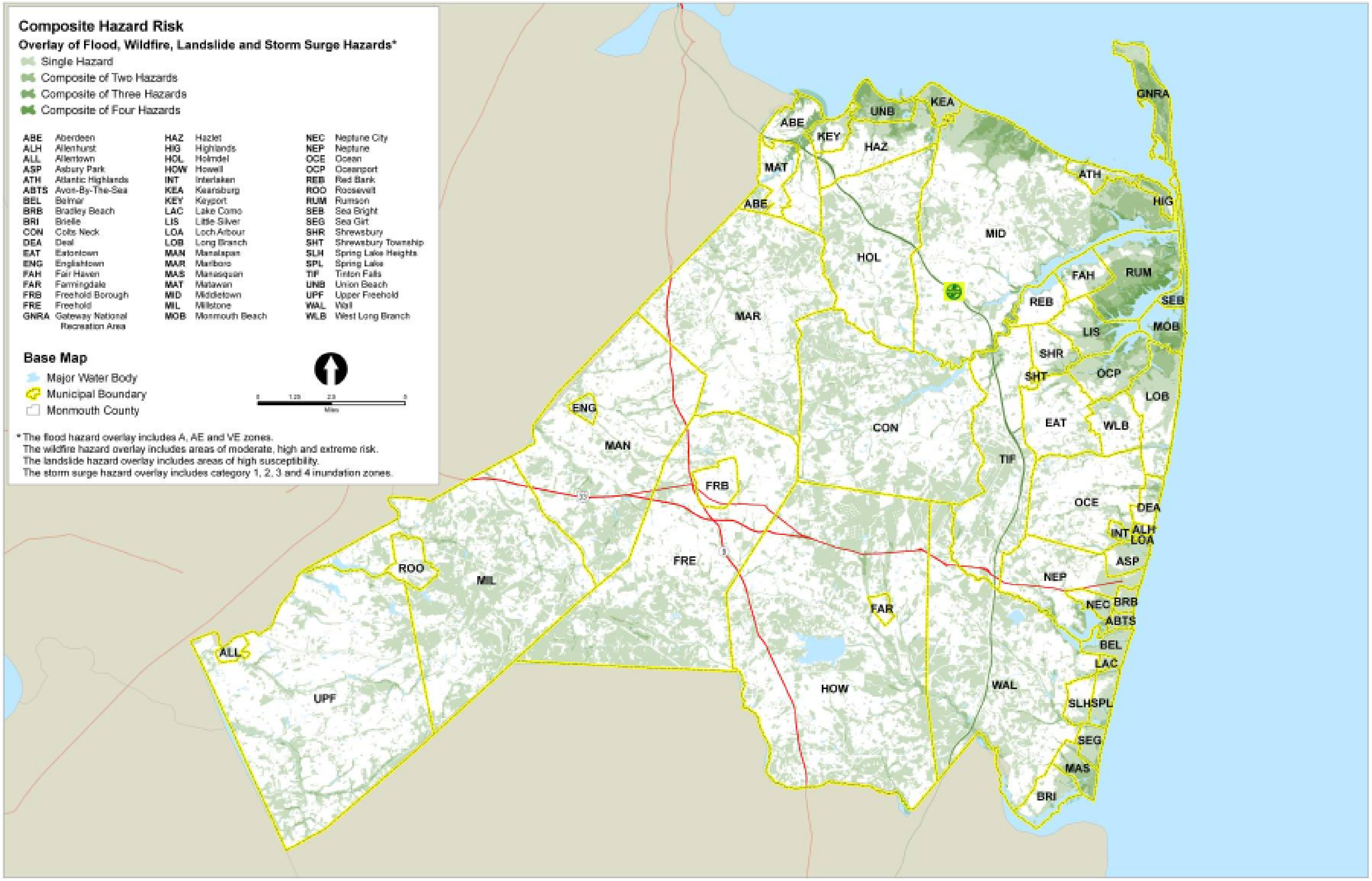
Jurisdiction	Extreme Temperatures	Extreme Wind	Hurricane & Tropical Storm *(Hurricane Wind Only)*	Lightning	Nor'easter *(Wind Only)*	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought* *(Crop Losses Only)*	Flood *(Riverine Only)*	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Aberdeen, Township of	0.00%	0.00%	0.02%	0.00%	0.00028%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	0.00%	0.00%	0.00%	0.00%
Allenhurst, Borough of	0.00%	0.01%	0.04%	0.00%	0.00020%	0.0001%	0.00%	0.00%	0.00%	0.00%	0.00%	0.81%	0.00%	0.00%	0.00%	0.00%
Allentown, Borough of	0.00%	0.02%	0.03%	0.00%	0.00009%	0.0001%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%
Asbury Park, City of	0.00%	0.00%	0.04%	0.00%	0.00013%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.27%	0.00%	0.00%	0.00%	0.00%
Atlantic Highlands, Borough of	0.00%	0.01%	0.04%	0.00%	0.00032%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%	0.00%	0.00%	0.00%	0.00%
Avon-By-The-Sea, Borough of	0.00%	0.01%	0.05%	0.00%	0.00011%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	1.37%	0.00%	0.00%	0.00%	0.00%
Belmar, Borough of	0.00%	0.01%	0.04%	0.00%	0.00012%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	1.17%	0.00%	0.00%	0.00%	0.00%
Bradley Beach, Borough of	0.00%	0.01%	0.02%	0.00%	0.00011%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.50%	0.00%	0.00%	0.00%	0.00%
Brielle, Borough of	0.00%	0.00%	0.04%	0.00%	0.00007%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	1.10%	0.00%	0.00%	0.00%	0.00%
Colts Neck, Township of	0.00%	0.00%	0.02%	0.00%	0.00024%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%
Deal, Borough of	0.00%	0.00%	0.01%	0.00%	0.00024%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.37%	0.00%	0.00%	0.00%	0.00%
Eatontown, Borough of	0.00%	0.00%	0.03%	0.00%	0.00018%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Englishtown, Borough of	0.00%	0.02%	0.02%	0.00%	0.00013%	0.0001%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%
Fair Haven, Borough of	0.00%	0.00%	0.02%	0.00%	0.00032%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12%	0.00%	0.00%	0.00%	0.00%
Farmingdale, Borough of	0.00%	0.02%	0.02%	0.00%	0.00010%	0.0001%	0.00%	0.00%	0.00%	0.00%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%
Freehold, Borough of	0.00%	0.01%	0.02%	0.00%	0.00015%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Freehold, Township of	0.00%	0.00%	0.03%	0.00%	0.00017%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
Hazlet, Township of	0.00%	0.00%	0.02%	0.00%	0.00030%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.02%	0.35%	0.00%	0.00%	0.00%	0.00%
Highlands, Borough of	0.00%	0.01%	0.03%	0.00%	0.00041%	0.0003%	0.00%	0.00%	0.00%	0.00%	0.00%	1.86%	0.00%	0.00%	0.00%	0.00%
Holmdel, Township of	0.00%	0.00%	0.03%	0.00%	0.00023%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%
Howell, Township of	0.00%	0.00%	0.03%	0.00%	0.00010%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%
Interlaken, Borough of	0.00%	0.03%	0.02%	0.00%	0.00016%	0.0001%	0.01%	0.00%	0.00%	0.00%	0.00%	0.66%	0.00%	0.00%	0.00%	0.00%
Keansburg, Borough of	0.00%	0.01%	0.04%	0.00%	0.00036%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.09%	4.55%	0.00%	0.00%	0.00%	0.00%
Keyport, Borough of	0.00%	0.01%	0.03%	0.00%	0.00031%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.54%	0.00%	0.00%	0.00%	0.00%
Lake Como, Borough of	0.00%	0.01%	0.06%	0.00%	0.00009%	0.0001%	0.00%	0.00%	0.00%	0.00%	0.00%	0.59%	0.00%	0.00%	0.00%	0.00%
Little Silver, Borough of	0.00%	0.00%	0.05%	0.00%	0.00030%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.31%	0.00%	0.00%	0.00%	0.00%
Loch Arbour, Village of	0.00%	0.06%	0.02%	0.00%	0.00020%	0.0031%	0.01%	0.00%	0.00%	0.00%	0.00%	0.81%	0.00%	0.00%	0.00%	0.00%
Long Branch, City of	0.00%	0.00%	0.05%	0.00%	0.00025%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.01%	0.45%	0.00%	0.00%	0.00%	0.00%

Table 3c.29
Annualized Loss Ratios by Hazard by Jurisdiction

Jurisdiction	Extreme Temperatures	Extreme Wind	Hurricane & Tropical Storm *(Hurricane Wind Only)*	Lightning	Nor'easter *(Wind Only)*	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought* *(Crop Losses Only)*	Flood *(Riverine Only)*	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Manalapan, Township of	0.00%	0.00%	0.02%	0.00%	0.00017%	0.0004%	0.00%	0.00%	0.00%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%
Manasquan, Borough of	0.00%	0.00%	0.02%	0.00%	0.00005%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	2.23%	0.00%	0.00%	0.00%	0.00%
Marlboro, Township of	0.00%	0.00%	0.03%	0.00%	0.00019%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Matawan, Borough of	0.00%	0.00%	0.02%	0.00%	0.00026%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%
Middletown, Township of	0.00%	0.00%	0.07%	0.00%	0.00031%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.03%	0.35%	0.00%	0.00%	0.00%	0.00%
Millstone, Township of	0.00%	0.00%	0.04%	0.00%	0.00011%	0.0002%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%
Monmouth Beach, Borough of	0.00%	0.01%	0.04%	0.00%	0.00040%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	1.57%	0.00%	0.00%	0.00%	0.00%
Neptune City, Borough of	0.00%	0.01%	0.03%	0.00%	0.00012%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%	0.00%	0.00%	0.00%	0.00%
Neptune, Township of	0.00%	0.00%	0.03%	0.00%	0.00012%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.03%	0.29%	0.00%	0.00%	0.00%	0.00%
Ocean, Township of	0.00%	0.00%	0.03%	0.00%	0.00015%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%
Oceanport, Borough of	0.00%	0.00%	0.01%	0.00%	0.00025%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.01%	0.59%	0.00%	0.00%	0.00%	0.00%
Red Bank, Borough of	0.00%	0.00%	0.04%	0.00%	0.00025%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.04%	0.35%	0.00%	0.00%	0.00%	0.00%
Roosevelt, Borough of	0.00%	0.06%	0.10%	0.00%	0.00010%	0.0002%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rumson, Borough of	0.00%	0.00%	0.05%	0.00%	0.00037%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	1.11%	0.00%	0.00%	0.00%	0.00%
Sea Bright, Borough of	0.00%	0.01%	0.02%	0.00%	0.00064%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	3.89%	0.00%	0.00%	0.00%	0.00%
Sea Girt, Borough of	0.00%	0.00%	0.01%	0.00%	0.00007%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.01%	0.26%	0.00%	0.00%	0.00%	0.00%
Shrewsbury, Borough of	0.00%	0.00%	0.05%	0.00%	0.00021%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%
Shrewsbury, Township of	0.00%	0.09%	0.04%	0.00%	0.00032%	0.0004%	0.02%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
Spring Lake, Borough of	0.00%	0.00%	0.02%	0.00%	0.00009%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.01%	0.84%	0.00%	0.00%	0.00%	0.00%
Spring Lake Hts., Borough of	0.00%	0.01%	0.03%	0.00%	0.00010%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.03%	0.27%	0.00%	0.00%	0.00%	0.00%
Tinton Falls, Borough of	0.00%	0.00%	0.02%	0.00%	0.00020%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
Union Beach, Borough of	0.00%	0.01%	0.04%	0.00%	0.00032%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	4.52%	0.00%	0.00%	0.00%	0.00%
Upper Freehold, Township of	0.00%	0.00%	0.03%	0.00%	0.00007%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%
Wall, Township of	0.00%	0.00%	0.03%	0.00%	0.00006%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.01%	0.08%	0.00%	0.00%	0.00%	0.00%
West Long Branch, Borough of	0.00%	0.00%	0.02%	0.00%	0.00021%	0.0000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total	**0.00%**	**0.002%**	**0.04%**	**0.0003%**	**0.0002%**	**0.00004%**	**0.001%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.98%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**

Note: All ALRs exceeding 0.00% are indicated in red.

Figure 3c.4
Monmouth County Composite Map of Vulnerability



Section 3d - Land Use and Development Trends

Historic Context

Prior to the arrival of the first European settlers of Monmouth County – and of New Jersey, as a whole – in Middletown in 1613, the Lenape Indians were the sole inhabitants of present day Monmouth County. In its early years, the County was largely dedicated to agriculture. The Industrial Revolution brought notable changes as tourists arriving at the railroad pier in Atlantic Highlands (via steamboat from New York City) were able to ride the County's first railroads to growing seaside resort communities such as Highlands, Long Branch, and Asbury Park. From 1850 to 1885, the combined population of Monmouth, Ocean, Atlantic and Cape May counties doubled from 55,700 in 1850 to 111,000 by 1885. In fact, well into the early 20^{th} century, most of the County's inland areas remained farmland and most of its housing stock remained as summer homes. The effects of the post-World War II baby boom coupled with the completion of the Garden State Parkway in 1954 resulted in a marked increase in suburban development in inland areas in the second half of the 20^{th} century. Today, two-thirds of Monmouth County's population lives within a five mile corridor along the Bayshore and Atlantic Ocean coastlines[1] and less than 15 percent of the County's total land area remains dedicated to agriculture.

Section Overview

Monmouth County has a total land area of 472 square miles, much of which has already been developed (particularly in the eastern coastal areas and along major thoroughfares such as Route 9 and Route 33). However, a large amount of land remains undeveloped. Future development may affect hazard vulnerability. This section will provide information for communities to better understand the potential implications of future growth and development with regard to hazard vulnerability, and how community resiliency can be increased by integrating hazard mitigation practices and principles in local decision making processes regulating land use and new development.

Land Use

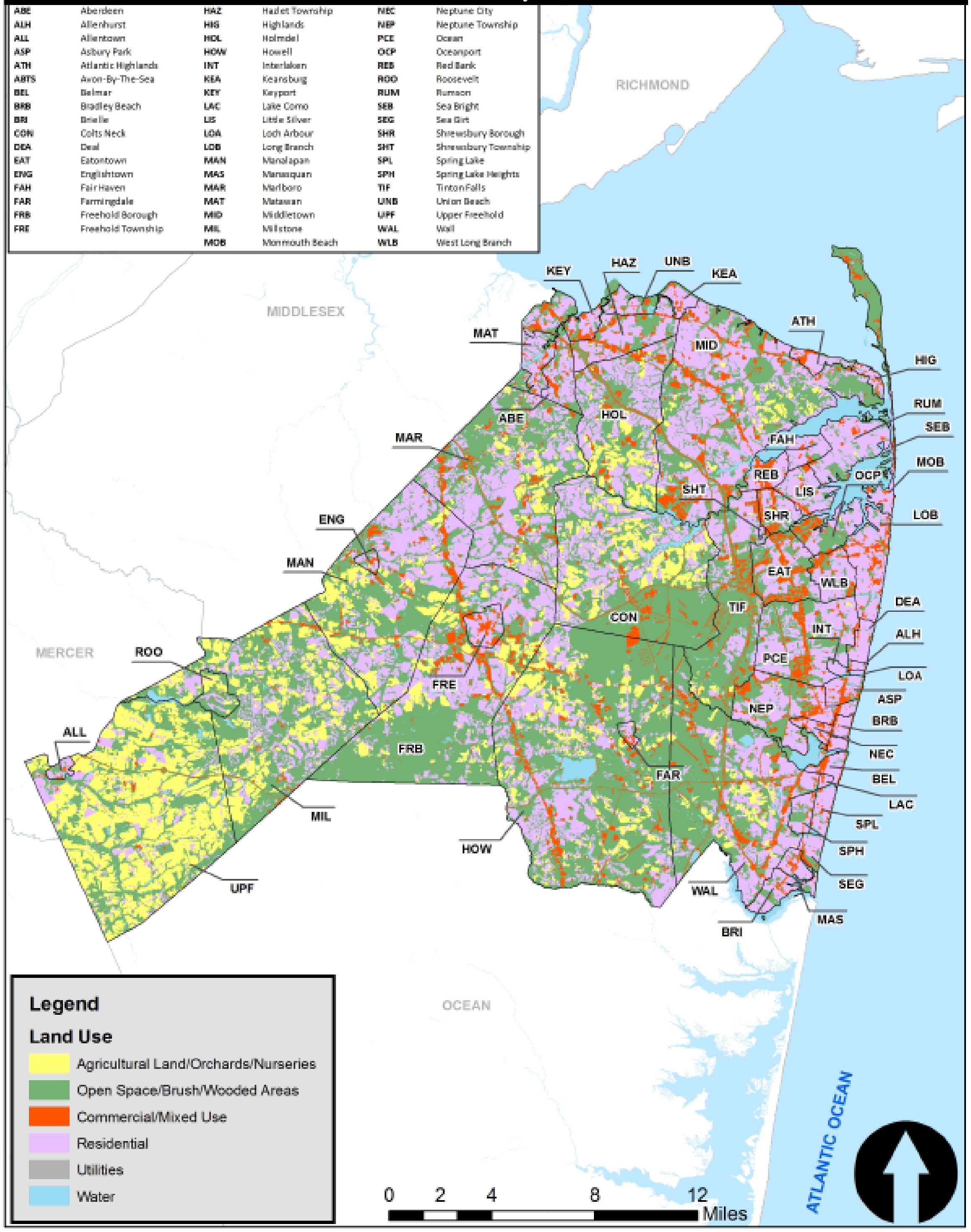
Land use, as compiled from Monmouth County GIS records, is presented graphically in **Figure 3d.1** and tabulated by jurisdiction in **Appendix 3d.1, Table 3d.1-1**. The figure and table show that more than half the County is essentially undeveloped, with agricultural land, woodland, and open space accounting for 57 percent of the County's land area. However, the majority of the municipalities in Monmouth County are considerably developed, with 35 out of 53 municipalities having 60 percent or more of their land areas covered by residential and commercial development. Of these, 16 have 75 percent or more covered by these land use categories, of which three (the Boroughs of Bradley Beach, Neptune City, and Lake Como) are more than 90 percent developed. At the opposite end of the spectrum, only four municipalities (the Townships of Howell, Millstone, and Upper Freehold, and the Borough of Roosevelt) are less than 25 percent developed. In all 53 municipalities, residential is the dominant developed land use category.

The 2006 land use GIS data that was used for this 2014 version of the plan and its predecessor of 2009 is still the most current land use GIS data that the County has available and, therefore, no changes in land use in the last five years are directly calculable. Anecdotally, however, most recent development has been redevelopment and infill development (as opposed to greenfield development) so, in general, these 2006 classifications are still expected to be generally applicable today for most communities. When the land use mapping is updated, comparisons of old and new uses can be used to attempt to quantify changes in development in each community since the last version of the plan was prepared.

[1] Source: *Natural and Cultural Features of Monmouth County*, Monmouth County Health Department, April 13, 2010.

Figure 3d.1

Monmouth County Land Use

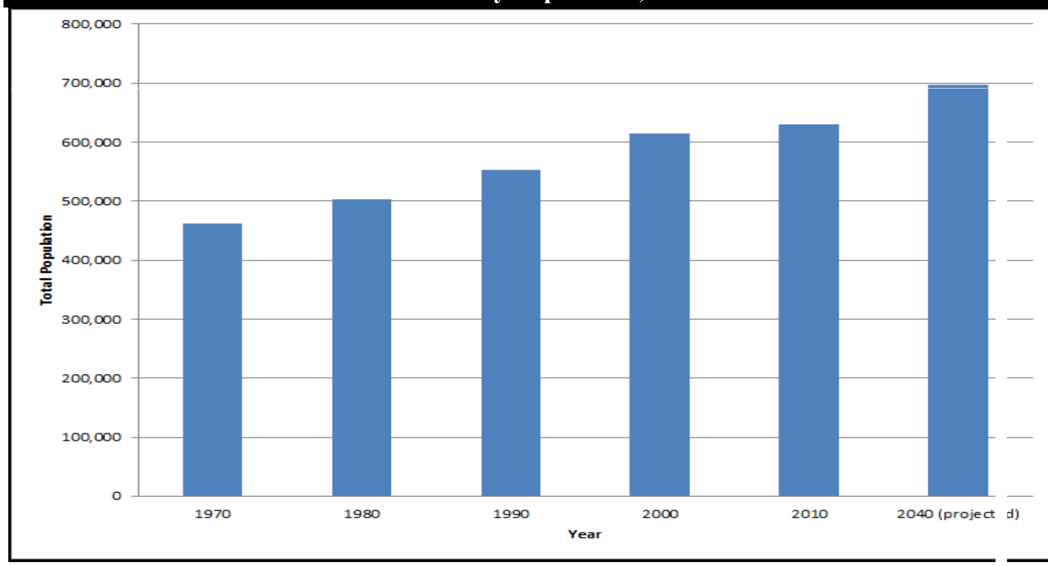


Source: Monmouth County GIS, Land Use, 2006

Changes in Population

As population increases, more residential and commercial buildings, infrastructure, public facilities and other assets will be constructed to support such growth, likely increasing a jurisdiction's overall exposure to natural hazards. Therefore, population growth is considered a general indicator of potential future hazard vulnerability. Prior to 1970, the County's greatest rate of population growth was observed between 1950 and 1970, following the post war boom and the opening of the Garden State Parkway in 1954. In this window, Monmouth County's population more than doubled from 225,337 in 1950 to 461,489 in 1970.[2] **Figure 3d.2** illustrates historic and projected population growth from 1970 to 2040.

Figure 3d.2
Monmouth County Population, 1970 to 2040



The last version of this Plan reported Census 2000 data. Census 2010 data is now available. While not an exact representation of the increase in population in the five years since the plan was prepared, a straight line interpolation and extrapolation was done to estimate the population in 2014 and 2009, to generate a rough estimate of the population change since the last version of this Plan was prepared (**Table 3d.1**) **-** an increase of about 7,500 people county-wide. The two communities growing the most since the last version of the plan was prepared were Manalapan and Freehold, each increasing on the order of about 2,500 persons.

Table 3d.1
Estimated Change in Population Since the Last Version of the Plan (2009-2014)

Jurisdiction	Population 2010 (Census)	Population 2000 (Census)	Population Estimate 2009*	Population Estimate 2014*	Approximate Change Since Last Version of Plan 2009-2014
Aberdeen, Township of	18,210	17,454	18,134.4	18,512.4	378.0
Allenhurst, Borough of	496	718	518.2	407.2	-111.0
Allentown, Borough of	1,828	1,882	1,833.4	1,806.4	-27.0
Asbury Park, City of	16,116	16,930	16,197.4	15,790.4	-407.0
Atlantic Highlands, Borough of	4,385	4,705	4,417.0	4,257.0	-160.0
Avon-by-the-Sea, Borough of	1,901	2,244	1,935.3	1,763.8	-171.5
Belmar, Borough of	5,794	6,045	5,819.1	5,693.6	-125.5

[2] Source: *Natural and Cultural Features of Monmouth County*, Monmouth County Health Department, April 13, 2010.

Table 3d.1 Estimated Change in Population Since the Last Version of the Plan (2009-2014)					
Jurisdiction	**Population 2010 (Census)**	**Population 2000 (Census)**	**Population Estimate 2009***	**Population Estimate 2014***	**Approximate Change Since Last Version of Plan 2009-2014**
Bradley Beach, Borough of	4,298	4,793	4,347.5	4,100.0	-247.5
Brielle, Borough of	4,774	4,893	4,785.9	4,726.4	-59.5
Colts Neck, Township of	10,142	11,179	10,245.7	9,727.2	-518.5
Deal, Borough of	750	1,070	782.0	622.0	-160.0
Eatontown, Borough of	12,709	14,008	12,838.9	12,189.4	-649.5
Englishtown, Borough of	1,847	1,764	1,838.7	1,880.2	41.5
Fair Haven, Borough of	6,121	5,937	6,102.6	6,194.6	92.0
Farmingdale, Borough of	1,329	1,587	1,354.8	1,225.8	-129.0
Freehold, Borough of	12,052	10,976	11,944.4	12,482.4	538.0
Freehold, Township of	**36,184**	**31,537**	**35,719.3**	**38,042.8**	**2,323.5**
Hazlet, Township of	20,334	21,378	20,438.4	19,916.4	-522.0
Highlands, Borough of	5,005	5,097	5,014.2	4,968.2	-46.0
Holmdel, Township of	16,773	15,781	16,673.8	17,169.8	496.0
Howell, Township of	51,075	48,903	50,857.8	51,943.8	1,086.0
Interlaken, Borough of	820	900	828.0	788.0	-40.0
Keansburg, Borough of	10,105	10,732	10,167.7	9,854.2	-313.5
Keyport, Borough of	7,240	7,568	7,272.8	7,108.8	-164.0
Lake Como, Borough of	1,759	1,806	1,763.7	1,740.2	-23.5
Little Silver, Borough of	5,950	6,170	5,972.0	5,862.0	-110.0
Loch Arbour, Village of	194	280	202.6	159.6	-43.0
Long Branch, City of	30,719	31,340	30,781.1	30,470.6	-310.5
Manalapan, Township of	**38,872**	**33,423**	**38,327.1**	**41,051.6**	**2,724.5**
Manasquan, Borough of	5,897	6,310	5,938.3	5,731.8	-206.5
Marlboro, Township of	40,191	36,398	39,811.7	41,708.2	1,896.5
Matawan, Borough of	8,810	8,910	8,820.0	8,770.0	-50.0
Middletown, Township of	66,522	67,479	66,617.7	66,139.2	-478.5
Millstone, Township of	10,566	8,970	10,406.4	11,204.4	798.0
Monmouth Beach, Borough of	3,279	3,595	3,310.6	3,152.6	-158.0
Neptune City, Borough of	4,869	5,218	4,903.9	4,729.4	-174.5
Neptune, Township of	27,935	27,690	27,910.5	28,033.0	122.5
Ocean, Township of	27,291	26,959	27,257.8	27,423.8	166.0
Oceanport, Borough of	5,832	5,807	5,829.5	5,842.0	12.5
Red Bank, Borough of	12,206	11,844	12,169.8	12,350.8	181.0
Roosevelt, Borough of	882	933	887.1	861.6	-25.5
Rumson, Borough of	7,122	7,137	7,123.5	7,116.0	-7.5
Sea Bright, Borough of	1,412	1,818	1,452.6	1,249.6	-203.0
Sea Girt, Borough of	1,828	2,148	1,860.0	1,700.0	-160.0
Shrewsbury, Borough of	3,809	3,590	3,787.1	3,896.6	109.5
Shrewsbury, Township of	1,141	1,098	1,136.7	1,158.2	21.5
Spring Lake, Borough of	2,993	3,567	3,050.4	2,763.4	-287.0
Spring Lake Heights, Borough of	4,713	5,227	4,764.4	4,507.4	-257.0
Tinton Falls, Borough of	17,892	15,053	17,608.1	19,027.6	1,419.5
Union Beach, Borough of	6,245	6,649	6,285.4	6,083.4	-202.0
Upper Freehold, Township of	6,902	4,282	6,640.0	7,950.0	1,310.0
Wall, Township of	26,164	25,261	26,073.7	26,525.2	451.5
West Long Branch, Borough of	8,097	8,258	8,113.1	8,032.6	-80.5
Total	**630,380**	**615,301**	**628,872.1**	**636,411.6**	**7,539.5**

** 2009 and 2014 population estimates are based on Census 2000 and 2010, with 2009 values being estimated via interpolation and 2014 values being estimated via extrapolation and, therefore, are not indicative of any impacts Hurricane Sandy may have had on the planning area.*

Table 3d.1-2 in Appendix 3d.1 lists the Census 2010 population along with the County Planning Department's projected 2040 population counts[3] and densities for each of Monmouth County's municipal jurisdictions. According to the data, the following 15 jurisdictions are projected to experience the highest growth rates during this period: Borough of Oceanport (35.9 percent), Borough of Tinton Falls (35.4 percent), City of Asbury Park (29.0 percent), Township of Colts Neck (21.2 percent), Borough of Eatontown (21.0 percent), Township of Holmdel (20.5 percent), Township of Wall (17.5 percent), Township of Freehold (16.3 percent), Township of Howell (12.1 percent), Borough of Shrewsbury (11.8 percent), Township of Neptune (11.6 percent), Townships of Aberdeen and Marlboro (10.8 percent each), Borough of Red Bank (10.1 percent), and Township of Manalapan (10.0 percent). All of the remaining jurisdictions are anticipated to experience growth rates of less than 10 percent during this period.

Population is projected to increase by 66,540 people between 2010 and 2040, of which 31.7 percent are expected to be in the Western Region, 31.1 percent in the Central Region, 29.0 percent in the Coastal Region, 6.7 percent in the Bayshore Region, and 1.6 percent in the Panhandle Region. Sixty-five percent of all new residents are expected in only nine of the County's 53 jurisdictions: Tinton Falls (9.5 percent), Howell (9.3 percent), Freehold Township (8.9 percent), Asbury Park (7.0 percent), Wall (6.9 percent), Marlboro (6.5 percent), Middletown (6.2 percent), Manalapan (95.8 percent), and Holmdel (5.2 percent). The absolute change in population from 2010 to 2040 ranges from a low of six people in Avon-by-the-Sea to a high of 6,340 in the Borough of Tinton Falls. Using the County's 2040 population projections as a guide to estimate future development trends and exposure, the County's population is estimated to increase by 66,540 people (10.6 percent), with a near equal proportion expected in the Western, Central, and Coastal Regions (roughly 20,000 in each) and the balance in the Panhandle and Bayshore Regions. Moderate increases in population (of between 1,000 and 5,000 persons) are likely in the following 15 communities: Aberdeen, Asbury Park, Colts Neck, Eatontown, Hazlet, Holmdel, Long Branch, Manalapan, Marlboro, Middletown, Neptune Township, Ocean, Oceanport, Red Bank, and Wall. High increases in population (of more than 5,000) persons are likely in Freehold Township (5,916), Howell (6,174), and Tinton Falls (6,340). By unit area, the greatest increase in overall population density is expected to be observed in Asbury Park. Here, population density is expected to increase by 3,287 people per square mile by 2040; this is a full order of magnitude greater than any other municipality in the County (where the average increase in population density is 142 people per square mile County-wide).

Visitors to Monmouth County's tourist attractions significantly increase coastal populations during the summer months. A 2008 Division of Planning study[4] determined the average summer population of the shore region to be 761,528 – a 73 percent increase over the shore region's Census reported year-round population (which, at that time, was 439,331). On peak weekends and summer holidays, the shore population is estimated to reach approximately 907,857.

Based on historic population trends and projections, Monmouth County's overall population growth represents an increase in exposure and potential vulnerability of people to natural hazards – particularly during the summer months when the County's population swells with visitors. This is true for all of the municipalities in the County as well, though to vastly different degrees (where municipal population increases range from as low as the single digits in some communities, to as high as several thousand in other communities.

[3] Population projections were prepared by the County in 2012 and did not take into account current or potential future growth changes that may be associated with the aftermath of Hurricane Sandy.
[4] *Monmouth County Summer Coastal Population Study*, Monmouth County Planning Board, 2008.

Changes in Residential Construction

Another general indicator of development since the 2009 plan is the quantity of new, privately owned residential housing units that were authorized to be built in that time period. The Monmouth County Planning Department was able to provide data for planning purposes for the years 2009, 2010, 2011, and 2012 (**see Appendix 3d.1, Table 3d.1-3**). Given the state of the economy, only 3,782 residential construction permits were approved from the years 2009 to 2012. Roughly 70 percent were single family units and 30 percent were multi-family units. The total number of units approved was greatest in Howell and Middletown, with 444 and 413 total units, respectively, representing 22.6 percent of all units approved county-wide. Nearly 34 percent of the permits approved in Middletown were multi-family units and just over 27 percent of units approved in Howell were for multi-family units. County-wide, multi-family units as a percentage of all units approved in the jurisdiction was more than 50 percent in Neptune (58.6 percent), Eatontown (77.4 percent), Freehold Township (91.1 percent), and West Long Branch (94.9 percent). Overall, most new residential units were approved in the Coastal Region (48 percent). An additional 31 percent were approved in the Western Region. Central, Bayshore, and Panhandle Regions contributed 13, 6 and 1 percent of the County total, respectively. While overall exposure is increased with more units present, it is not likely that overall vulnerability has increased because development in hazard areas would have been built to codes and standards that would offer protection from hazard events.

Changes in Protected Open Space

While the majority of land in Monmouth County is already developed or zoned for residential and commercial uses, the 2012 Monmouth County Profile[5] estimated that approximately 20.7 percent of the County's total land area is classified as public open space or protected farmland. This represents an increase of 2.8 percent since the last version of this Hazard Mitigation Plan. Many of these lands are located in identified natural hazard zones and will remain vacant and free from any future development. **Table 3d.2** lists the various types and amounts of protected open space as reported by the Monmouth County Planning Board in its County Profile of 2012[6]. As indicated in the table, more than 15,700 acres of open space have been preserved as part of the Monmouth County Park System. The Park System's ultimate goal is to preserve over 20,000 acres to meet the county's park, recreation, conservation, and open space needs of the future[7].

Table 3d.2
Protected Open Space in Monmouth County

Open Space Classification	Approximate Acres	Percent of Total Land Area
County-owned Parkland, Conservation Areas and Golf Courses	15,700	5.2%
State Parks, Natural Areas and Watershed Protection Areas	15,700	5.2%
Sandy Hook Unit of the Gateway National Recreation Area	1,700	0.6%
Municipal Land Reserved for Open Space	15,400	5.1%
Preserved Farmland	14,000	4.7%
Total Acres of Protected Open Space	**62,500**	**20.7%**

According to the 2007 Census of Agriculture[8], there are 932 farms in Monmouth County with nearly 69 square miles of farmland (approximately 15 percent of the county's total land area). While the total number of farms has increased by about 4 percent since 2002, the total acreage of land in farms has decreased by about 7 percent over that same time frame. Monmouth County has a robust Farmland

[5] At the time of the plan update, the 2012 Monmouth County Profile was the most current version available.
[6] Data in the 2012 Profile is current as of 2011.
[7] http://www.monmouthcountyparks.com/page.aspx?Id=2588
[8] The Monmouth County Census of Agriculture for 2012 was not available at the time this section was drafted. At the time this plan section was drafted (January 2013), the 2012 Census of Agriculture is not projected for release until early 2014.

Preservation Program. As of February 2, 2012[9], through the efforts of the Farmland Preservation Program, the County has preserved 182 farms from future development, totaling approximately 14,000 acres. This represents an increase of about 31 percent since the time this initial plan was prepared. The majority of preserved farmland is located in the County's Panhandle Region.

The identification and acquisition of land to be maintained as protected open space presents a significant opportunity for jurisdictions to minimize future hazard exposures and vulnerability. In addition to County, State and Federal open spaces, municipal jurisdictions in Monmouth County have collectively protected nearly 30,000 acres of open space through their own local preservation measures (municipal land reserved for open space plus preserved farmland). Though often done for conservation, recreation or other community purposes, protecting lands located in identified natural hazard zones can help jurisdictions meet complementary hazard mitigation objectives and can qualify the communities for additional points under the community rating system (CRS). It is often found that those natural areas deemed targets for open space protection are often also identified as potential hazard zones (i.e., environmentally-sensitive lands such as wetlands, floodplains, etc.).

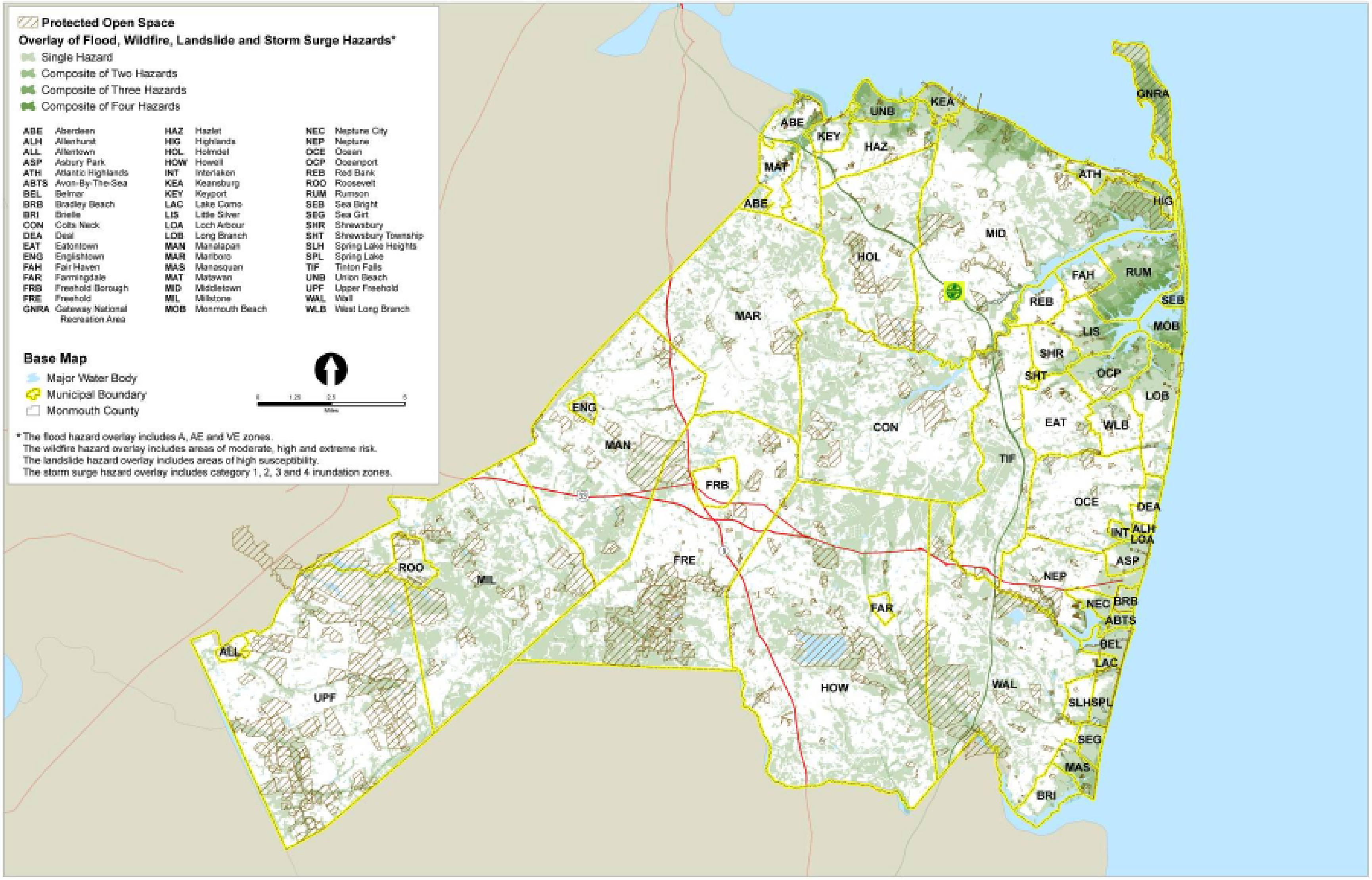
Table 3d.1-4 in Appendix 3d.1 lists the amount of existing municipal land reserved for open space in Monmouth County as compiled and reported by the Monmouth County Park System (using data provided by municipal officials) in the 2006 Open Space Plan[10]. The table also includes each jurisdiction's identified "target" numbers for protected open space through future land use, development and preservation practices. According to the data, sixteen jurisdictions have existing deficits of open space while the rest are currently at or above their established targets. Of those below their targets, the following jurisdictions have the greatest deficits (representing possible hazard mitigation opportunities through future open space protection efforts): Township of Upper Freehold (3.3 percent of target / 881 acre deficit); Borough of Englishtown (7.3 percent of target / 10 acre deficit); Borough of Sea Bright (39.9 percent of target / 7 acre deficit); Borough of Keyport (41.4 percent of target / 15 acre deficit); Township of Freehold (53.6 percent of deficit / 329 acre deficit). It should also be noted that those jurisdictions listed with existing surpluses of open space can capitalize on similar hazard mitigation opportunities by targeting identified hazard zones for continued protection from future development.

Figure 3d.3 illustrates the locations of protected open space in Monmouth County as provided by the Monmouth County Office of GIS in relation to the overlay of the four key hazard zones (flood, wildfire, landslide and storm surge). As can be seen in the figure, there are a number of large areas of protected open space that intersect with these identified hazard zones.

[9] Data most current at the time this Plan Update section was drafted (March 2013).

[10] The Monmouth County Open Space Plan is current as of 2006 and has not been updated since the initial Hazard Mitigation Plan was prepared.

Figure 3d.3
Protected Open Space



Land Use Planning in Monmouth County

The Monmouth County Division of Planning serves a coordination function for land use planning elements that are best served on a regional level, as follows:

- The *Office of Community Development* is responsible for community development and HUD grants, affordable housing programs, emergency shelter and homeless programs, etc.
- The *Development Review Section* reviews development applications that are submitted to the Planning Board and serves in an advisory capacity to the Monmouth County Development Review Committee which is empowered to take action on behalf of the Planning Board regarding approval of subdivisions and site plans affecting county roads and drainage facilities.
- The *Environmental Planning Section* works closely with the municipalities to improve the regional preservation, protection and improvement of valuable regional resources. The Section provides staff support to the Monmouth County Environmental Council, the Monmouth County Agricultural Development Board, the Areawide Water Quality Management Planning Agency Amendment Review Committee, the Stormwater Technical Advisory Committee, Greenhouse Gas Reduction Advisory Committee, Right to Farm Subcommittee, several watershed management partnerships, and other county agencies interested in environmental issues.
- The *Geographic Information Systems (GIS) Section* provides software, data, training, analysis, application and mapping assistance for County Departments and Municipal Partners.
- The *Long Range Planning Section* is responsible for the preparation, adoption and implementation of plans and policies used to guide decisions concerning Monmouth County's future physical development. Some of the specific tasks of the Long Range Planning Section include, but are not limited to: maintaining the Monmouth County Growth Management Guide; reviewing and providing input on proposed municipal master plans, zoning ordinances and land development regulations; encouraging and promoting consistency and coordination between municipal, county, regional and state plans and programs; providing technical assistance to municipalities on land use planning matters; sponsoring seminars or workshops on planning education and other land use planning issues; promoting public participation in the planning process; reviewing and commenting on projects and programs submitted for county review through the State Review Process; and reviewing and commenting on proposed and amended Regional Contribution Agreements.
- The *Research & Special Studies Section* prepares, analyzes and disseminates demographic, economic, and land-use data for municipalities, government agencies, businesses, non-profit organizations, hospitals, the media, libraries, schools, universities, and local citizens. An ongoing responsibility of this Section is to serve as the County liaison for Census 2010.
- The *Transportation Planning Section* studies the interaction of transportation and land use issues affecting Monmouth County. The section compiles data; conducts studies to analyze the use and performance of highway and transit systems; facilitates public outreach and coordination on selected transportation issues; and maintains a close working relationship with local, state, and regional transportation planners and agencies.

Influences on Future Development in Monmouth County

Future development in Monmouth County is influenced by guiding principles at the State, County and municipal levels, including:

- **New Jersey State Development and Redevelopment Plan.** The management of New Jersey's lands plays an important role in the state's overall environmental protection strategy. Land use planning in the State of New Jersey is primarily a function of local communities. However, the State (NJDEP) regulates activities proposed in the Highlands, the State's coastal areas, wetlands, floodplains and other environmentally-sensitive, "special areas". The *New Jersey State*

Development and Redevelopment Plan[11] (State Plan) provides a vision for the future that will preserve and enhance the quality of life for all residents of New Jersey. The purpose of the State Plan is to coordinate municipal, county, and regional planning activities through a process known as cross-acceptance[12] to establish Statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic preservation, public facilities and services, and intergovernmental coordination (N.J.S.A. 52:18A-200(f)). In New Jersey, Smart Growth[13] supports development and redevelopment in recognized Centers—a compact form of development—as outlined in the State Development and Redevelopment Plan, with existing infrastructure that serves the economy, the community and the environment.[14] The State Plan provides a balance between growth and conservation by designating planning areas that share common conditions with regard to development and environmental features:

- *Areas for Growth*: Metropolitan Planning areas (Planning Area 1), Suburban Planning Areas (Planning Area 2) and Designated Centers in any planning area.

- *Areas for Limited Growth/Conservation*: Fringe Planning Areas (Planning Area 3), Rural Planning Areas (Planning Area 4), and Environmentally Sensitive Planning Areas (Planning Area 5). In these planning areas, planning should promote a balance of conservation and limited growth—environmental constraints affect development and preservation is encouraged in large contiguous tracts.

The Smart Growth areas of Monmouth County are shown in **Figure 3d.4.**

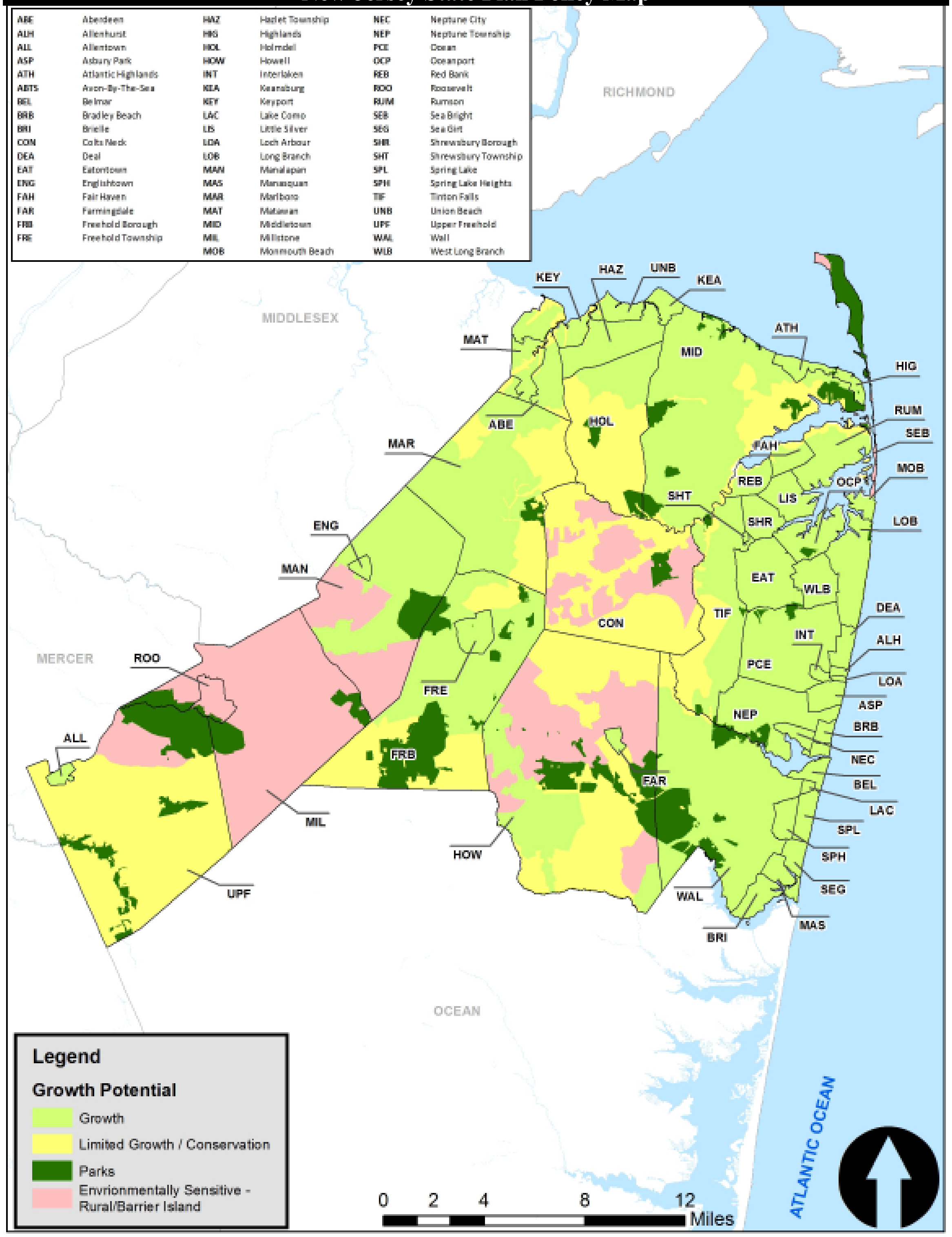
[11] http://nj.gov/state/planning/plan.html

[12] Cross-acceptance is a bottom-up approach to planning, designed to encourage consistency between municipal, county, regional, and state plans to create a meaningful, up-to-date and viable State Development and Redevelopment Plan. The last Cross Acceptance Report for Monmouth County was completed in 2004.

[13] Smart Growth is the term used to describe well-planned, well-managed growth that adds new homes and creates new jobs, while preserving open space, farmland, and environmental resources. Smart Growth supports livable neighborhoods with a variety of housing types, price ranges and multi-modal forms of transportation. Smart Growth is an approach to land-use planning that targets the State's resources and funding in ways that enhance the quality of life for residents in New Jersey. Smart Growth principles include mixed-use development, walkable town centers and neighborhoods, mass transit accessibility, sustainable economic and social development and preserved green space.

[14] http://nj.gov/state/planning/smart.html

Figure 3d.4
New Jersey State Plan Policy Map



Source: NJ Department of State, State Plan Policy Map, 2013

- **Monmouth County Growth Management Guide.** The Monmouth County Growth Management Guide[15], adopted by the Monmouth County Planning Board in 1995 and still in use, represents the County's official Master Plan. (Note: The County Master Plan Update will eventually replace the County Growth Management Guide). The Guide is a broad policy document that includes ten elements focused on air resources; centers (mixed-use); comprehensive planning; economic development; farmland preservation and agriculture development; historic, cultural, natural and scenic resources; housing; solid waste; transportation; and water resources. Hazard mitigation is not addressed as its own element of the plan, though there are a number of policies that are consistent with the principles of hazard mitigation (i.e., encourage the preservation of floodplains, wetlands and stream corridors). The Growth Management Guide sets forth various policies to achieve ten broader goals for future development in Monmouth County. The goals are:

  I. **Air Resources** - Promote land use planning that encourages the use of transit, walking and cycling, and the creation of centers in order to improve air quality by reducing automobile trips and congestion.
  II. **Centers** - Promote new and revitalize older urban areas into well designed mixed use centers with an easily accessible compact but varied core of residential, commercial, and community services which provide employment and create a specific identity.
  III. **Comprehensive Planning** - To promote comprehensive planning among all levels of government as well as the private sector by sharing information and developing a continuing dialogue on regulations, plans, policies, and issues.
  IV. **Economic Development** - To promote managed growth by providing a suitable long term economic climate and preserving and enhancing the quality of life in Monmouth County for the attraction of new businesses and the retention of existing businesses.
  V. **Farmland Preservation and Agriculture Development** - To promote and preserve the agricultural industry, and to assist in farmland preservation.
  VI. **Historic, Cultural, Natural and Scenic Resources** - To preserve the valuable historic, cultural, natural and scenic resources of Monmouth County.
  VII. **Housing** - To provide housing opportunities for all residents of Monmouth County.
  VIII. **Solid Waste** - To provide environmental and economically sound long term disposal capacity for all Monmouth County municipalities, while conserving existing landfill space through cost-effective waste prevention and recycling programs.
  IX. **Transportation** - To plan for a comprehensive and reliable intermodal transportation system which properly provides for public safety and meets the needs of the County's workers, residents and visitors as well as respects the environment.
  X. **Water Resources** - To provide all of Monmouth County with a safe and pollution-free water environment, and conserve valuable water-oriented resources.

- **Regional Plans.** Since the adoption of the Growth Management Guide in 1995, there have been several more key planning and growth management efforts which help to identify Monmouth County's land use and development issues of concern on a regional level.

  - The 2004 *Western Monmouth Development Plan* focuses on seven municipalities in Western Monmouth County tied together by their common dependence on U.S. Route 9 as the major north-south arterial. The need for this separate plan stemmed from the rapid development of this particular region, as reflected in sprawling suburban development on farms and fields, the corresponding loss of open space, and an increase in traffic congestion. The document, adopted by the Monmouth County Planning Board in August 2004, is intended to serve as a "smart growth" plan for the

[15] Monmouth County Growth Management Guide, Monmouth County Planning Board, 1995.

study area; one that will encourage the formation of more livable communities and better preserve the natural resources currently being consumed by suburban sprawl.

- The 2011 *Panhandle Region Plan*, develops a vision for the future of the four municipalities in the Panhandle Region. It was adopted by the Monmouth County Planning Board on September 19, 2011. The Plan is intended to help its municipalities in managing their remaining development potential while safeguarding local natural and cultural resources, protecting open space, and preserving farmland.
- The 2006 *Bayshore Region Strategic Plan* focuses on nine municipalities in the Raritan Bay and Atlantic Highlands region. The plan lays out a strategy for communities in this region to recognize economic growth through revitalization efforts to create an attractive destination for tourism and to preserve and enhance the area's unique and sensitive natural resources.
- The 2010 *Coastal Monmouth Plan* creates a Vision and Planning Strategy for the Coastal Monmouth Region (CMR) by cooperatively addressing development issues on a regional scale in a manner that is sensitive to the region's unique coastal setting, diverse community character, and critical environmental, cultural and aesthetic resources. The plan is aiming to help communities prepare, collectively and individually, for sustainable growth, while protecting environmental resources and maintaining their unique coastal character. Revitalization, redevelopment, and renovation are key themes of the coastal region's vision.

- **Monmouth County Open Space Plan**. The 2006 *Monmouth County Open Space Plan* serves as the Monmouth County Park System's strategic plan for land acquisition and preservation[16]. The Plan states that pressure to develop and redevelop land in Monmouth County remains strong and the challenges to maintaining quality of life for present and future generations that the Freeholders faced in 1961 – a growing population, competition for diminishing land resources, escalating property values, and increasing public demand for control of growth and provision of recreation services – are even greater today.

- **Municipal Regulatory Tools.** State and County plans are supplemented by various municipal regulatory tools. As part of the initial hazard mitigation plan development process, participating jurisdictions were asked to complete a questionnaire in order to provide URS with information regarding land use regulatory capabilities in each municipality. Responses were brought up-to-date as part of the 2014 Plan Update. Out of a total of 54 jurisdictions participating in the planning process (Monmouth County plus 53 municipalities), 98 percent of the jurisdictions (53 out of 54) reported having building codes and zoning statutes. A total of 96 percent (52 out of 54) reported having subdivision statues, and 100 percent reported having comprehensive or master plans. Municipal responses are current as of December 2013 and are summarized in **Table 3d.3**.

Table 3d.3
Communities with Land Use Regulations

Municipality	Building Code	Zoning Statutes	Subdivision Statutes	Comprehensive Plans
Monmouth, County of			√	√
Aberdeen, Township of	√	√	√	√
Allenhurst, Borough of	√	√	√	√
Allentown, Borough of	√	√	√	√
Asbury Park, City of	√	√	√	√
Atlantic Highlands, Borough of	√	√	√	√
Avon-By-The-Sea, Borough of	√	√	√	√

[16] The Plan was adopted by the Planning Board as added element to the 1995 Growth Management Guide.

Table 3d.3
Communities with Land Use Regulations

Municipality	Building Code	Zoning Statutes	Subdivision Statutes	Comprehensive Plans
Belmar, Borough of	√	√	√	√
Bradley Beach, Borough of	√	√	√	√
Brielle, Borough of	√	√	√	√
Colts Neck, Township of	√	√	√	√
Deal, Borough of	√	√	√	√
Eatontown, Borough of	√	√	√	√
Englishtown, Borough of	√	√	√	√
Fair Haven, Borough of	√	√	√	√
Farmingdale, Borough of	√	√	√	√
Freehold, Borough of	√	√	√	√
Freehold, Township of	√	√	√	√
Hazlet, Township of	√	√	√	√
Highlands, Borough of	√	√	√	√
Holmdel, Township of	√	√	√	√
Howell, Township of	√	√	√	√
Interlaken, Borough of	√	√	√	√
Keansburg, Borough of	√	√	√	√
Keyport, Borough of	√	√	√	√
Lake Como, Borough of	√	√	√	√
Little Silver, Borough of	√	√	√	√
Loch Arbour, Village of	√	√		√
Long Branch, City of	√	√	√	√
Manalapan, Township of	√	√	√	√
Manasquan, Borough of	√	√	√	√
Marlboro, Township of	√	√	√	√
Matawan, Borough of	√	√	√	√
Middletown, Township of	√	√	√	√
Millstone, Township of	√	√	√	√
Monmouth Beach, Borough of	√	√	√	√
Neptune, Township of	√	√	√	√
Neptune City, Borough of	√	√	√	√
Ocean, Township of	√	√	√	√
Oceanport, Borough of	√	√	√	√
Red Bank, Borough of	√	√	√	√
Roosevelt, Borough of	√	√	√	√
Rumson, Borough of	√	√	√	√
Sea Bright, Borough of	√	√	√	√
Sea Girt, Borough of	√	√	√	√
Shrewsbury, Borough of	√	√	√	√
Shrewsbury, Township of	√	√		√
Spring Lake, Borough of	√	√	√	√
Spring Lake Heights, Borough of	√	√	√	√
Tinton Falls, Borough of	√	√	√	√
Union Beach, Borough of	√	√	√	√
Upper Freehold, Township of	√	√	√	√
Wall, Township of	√	√	√	√
West Long Branch, Borough of	√	√	√	√

Development Trends

Monmouth County's economy is strong and its tax base continues to grow at a strong rate for more than a decade. Monmouth County has outpaced both the State of New Jersey and the nation as a whole in terms of total employment growth. Similarly, incomes are rising faster than state and national averages. Monmouth County's quality of life includes strong job prospects both within Monmouth County and in other parts of the tri-state region. These gains in population are fueling increases in local construction and retail trade employment. Transportation improvements are providing better access to and within the County for both commuters and tourists, and improved ferry service to Manhattan makes Monmouth County attractive to commuters. The Monmouth County Planning Board estimates that Monmouth County is currently growing and the major factors that generate growth are sustainable in the near term and are expected to simulate growth in the long-term.

Based on a review of the Monmouth County Profile and the Monmouth County Cross Acceptance Report, the following recent development trends are expected to continue in the future, with the focus on striking a balance between development and natural resource preservation efforts:

New development is projected to be concentrated in the Western and Central Regions of Monmouth County (with the Western Region being strongest and the Central Region being second strongest). County-wide, the proportion of residential building permits in urban centers has been increasing since 2000. Recent planning studies have indicated a gradual slowing of this region's growth in favor of development in the coastal regions, which have existing transportation and sewerage infrastructure, allowing for higher-density construction.

The seven communities of Western Monmouth County have been the most rapidly developing area of the County over the last twenty years, with considerable increases in population, employment and residential development. It is also one of the fastest-growing regions in the state. The *Western Monmouth Development Plan* outlines goals to improve congestion on Route 9 (the region's major transportation corridor), apply smart growth principles, and to designate specific areas for growth and preservation.

Most of the municipalities along the Coastal and Bayshore Regions of Monmouth County are undergoing redevelopment. Commercial facades are being upgraded, streetscapes are being improved, vacant building/lots are being converted into mixed-use developments and small vacation homes are being replaced with new larger structures. This trend has been exacerbated in the recent aftermath of Superstorm Sandy (2012) as damaged structures are, for the most part, repaired/rebuilt[17]. The focus toward redevelopment projects in waterfront communities signals a continued shift in Monmouth County development patterns.

The Bayshore Region includes municipalities linked by their proximity to Raritan Bay and Routes 35 and 36. The *Bayshore Region Strategic Plan* contains strategies for marketing, branding and economic development of the region.

Monmouth County's Coastal Region includes 30 municipalities, encompassing roughly 40 percent of the county's total population. Communities in this region are all, in some way, affected by seasonal shore tourism. The *Coastal Monmouth Plan* outlines a future vision for the Coastal Region, preparing for sustainable growth while protecting environmental resources and preserving each community's unique coastal character. These coastal redevelopment projects mark a turning point for Monmouth County. Since 1970 development had been concentrated in the western half of the county while parts of the coastal area languished. Revitalization of the coastal areas boosts the County's economy in places where there

[17] Though some scattered acquisitions of individual flood-prone *properties* have occurred post-Sandy, there has not been a larger-scale acquisition of groups of properties in larger, flood-prone *areas*.

currently exists public transportation, existing infrastructure, and until recently high unemployment. This comes at a time that Monmouth County's overall population growth is slowing and western Monmouth County is past its peak growth (i.e., the County's population doubled in the post-war boom of the 1950's to the 1970's). The Monmouth County Planning Board estimates that in the future, the financial health of the county will come more from the eastern and northern areas.[18]

Monmouth County has received Smart Growth Grants to conduct regional studies aimed at managing growth and development in certain regions within Monmouth County. To-date, plans have been completed for Western Monmouth County, the Bayshore region, and Coastal regions.

Waterfront and downtown redevelopment is most prominent in Long Branch, Asbury Park, and Neptune. In Long Branch, the city's redevelopment efforts are focused primarily on converting underutilized beachfront into new homes, shops and restaurants. Plans center around the mixed-use Pier Village development. The first two phases of this project are complete. With completion of the third, there will be more than 1,500 new residential units and numerous commercial establishment within the oceanfront area and a hope for spurred redevelopment along Broadway. Long Branch officials are working toward the establishment of an oceanfront pier and ferry terminal in the hope of encouraging New York bound commuters to consider Long Branch as a year-round residential location. Asbury Park continues its revitalization efforts along the waterfront and surrounding areas. A recent agreement between two major developers is anticipated to accelerate beachfront redevelopment. In July 2012, the 27,500 square foot Springwood Center opened, including a senior center, business incubator office, residential units, and ground floor commercial and retail space. Neptune, while not having coastal frontage, continues to work on several redevelopment initiatives. The township is dedicated to reestablishing the West Lake Corridor area as a vibrant center for commercial growth and community life. The MidTown Commons, a 51,000 square foot office/health center complex on West Lake Avenue, opened in 2010. A planned second phase of this mixed-use redevelopment project will include 22 affordable rental units and an additional 97 rental units. The area adjacent to the Bradley beach train station is an industrial and commercial area which is expected to be rezoned to accommodate more transit-oriented neighborhood development. Neighboring Neptune City continues with its redevelopment initiatives including the Steiner Avenue Scattered Sites Plan for new townhomes and retail space within a roughly 6 acre zone to promote a mixture of uses that are compatible with the borough's surrounding neighborhoods.

The Panhandle Region is located in the westernmost portion of the County and includes the municipalities of Allentown, Upper Freehold, Roosevelt, and Millstone, westward of the more suburbanized Western Monmouth Municipalities. The region encompasses 18.5 percent of the County's total land area but only 3.2 percent of its population. Through a collaborative regional effort, a set of planning alternatives was established to provide a cohesive policy framework to assist in future development choices. This is documented in the *Panhandle Region Plan*. The plan addresses issues such as agriculture and open space preservation, marketing and funding for historic resources, protection of natural resources, meeting affordable housing requirements, traffic management issues (congestion and safety), as well as various quality of life issues.

Fort Monmouth officially closed in September 2011. The Fort Monmouth Economic Revitalization Authority is overseeing property redevelopment. The authority aims to foster an environment that will attract a diverse network of small, medium, and large employers.

Hurricane Sandy's Impact

Hurricane Sandy devastated significant areas of Monmouth County's coastline in 2012. Much of the highly vulnerable Bayshore and coastal communities are already developed. Local officials have not

[18] It is unclear at this time if, or how, this is impacted as a result of Hurricane Sandy.

considered retreat to be a feasible alternative, primarily due to the sheer lack of developable land outside of the coastal flood hazard area. While some property acquisitions have occurred on a relatively small scale in certain locations, the observed impact of this disaster on land uses and development trends is generally that communities have tended toward building back damaged and destroyed structures in their previous locations to higher codes and standards, as opposed to precluding new development or substantial improvements in these areas. This more disaster-resistant building stock, along with the many hazard mitigation initiatives being undertaken (i.e., acquisitions, elevations, beach and dune restoration projects, bulkheading, etc.) has the effect of increasing the level of resilience, and decreasing vulnerability for many such communities during future events of this nature.

Re-assessment of Local Land Uses and Development Trends

The Core Planning Group was asked to supplement information presented in the Monmouth County Profile and Cross Acceptance Report with responses to a Land Uses and Development Trends Worksheet for their individual jurisdictions. The worksheet consisted of the following two questions:

1. Please describe development trends occurring within your jurisdiction, such as the predominant types of development occurring, location, expected intensity, and pace by land use. While details are preferred, it is ok if your feedback is qualitative and quite general, such as "*high-occupancy, high-density residential development is occurring near the waterfront*".
2. Does your jurisdiction enforce regulations/ordinances/codes to protect new development from the effects of natural hazards? (Some examples might be floodplain management ordinances enforcing FEMA's NFIP for new development or substantial improvements in the floodplain; steep slope ordinances for community's which may have landslide hazards; earthquake resistant design criteria and/or high wind design criteria; or buffer zones in wildfire hazard areas.) If so, please describe.

Responses were updated as part of the 2014 Plan Update, and are reported in **Table 3d.4**.[19] Copies of each jurisdiction's worksheet response can be found in **Appendix1.5**.

[19] As part of the 2014 Plan Update, municipalities were asked to review their prior responses (as submitted during the development of the initial plan) and either (a) certify that they still hold true unchanged, or (b) identify any changes that have occurred since that time. Their responses have been incorporated into Table 3d.6.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
Aberdeen, Township of	The Township of Aberdeen has very little remaining vacant land available and suitable for development. Therefore, the predominant development occurring in the Township in the recent years is on single, small lots with in-fill development or the redevelopment of existing sites, both for residential and non-residential uses. The Township has identified a number of larger areas for redevelopment, some of which have been designated as Redevelopment Areas under the Local Redevelopment And Housing Law. The areas either identified or designated are as follows: • A "Commerce & Transportation Center" Redevelopment Area has been designated on lands in the vicinity of the Aberdeen/Matawan Train Station. Since the last version of the Hazard Mitigation Plan, the Redeveloper has been designated and the Redevelopment Plan proposes two – phased construction of a total of 8000sf retail, 6050sf resident amenity center and 232 residential units of which 23 are affordable. • A "Planned Adult Community Redevelopment Area" as a Redevelopment Area has been designated on lands (approx. 183 acres) in the Freneau portion of the Township where public sewer and water service are proposed to be extended to serve both the existing and proposed developments. Development approvals under the enabling ordinances have been granted for the redevelopment of this area for 521 age-restricted dwelling units plus 68 non-age restricted affordable housing units; however, the developments have yet to be built. Since the last version of the Hazard Mitigation Plan was prepared, 22 acres have been acquired for Open Space, 20 additional acres are under negotiation for acquisition, and the remaining area is being considered for limitation of development to 240 residential units on 40 acres +/- with the remainder of the lands as conservation easement. • A designated "Age-Restricted Affordable Housing" zoning district was created for a 13.8 acre brownfield site formerly owned by the South River Metal Products Company which permits the municipally sponsored development of up to 154 age-restricted apartments; and • A Redevelopment Area has been designated on the Anchor Glass Manufacturing Facility of 50.55 acres for a Planned Unit Development. When the last version of the Plan was prepared, the vision was for up to approximately 200,000 square feet of retail/office space, 750 dwelling units and a hotel. Today, plans are for up to approximately 80,000 square feet of retail/office space, 500 dwelling units, a hotel, and a movie theatre. Plans are being submitted to the Planning Board for the June 2013 meeting.	The Land Development Ordinance (LDO) of the Township of Aberdeen contains specific provisions to protect environmentally critical areas from the negative effects of development, as follows: 1. A "Conservation/Recreation" zoning district (Section 408) has been established in the Township for most of the marshland and wetlands of the Raritan Bay and associated stream corridors of Whale, Long Neck and Matawan creeks. This zoning district limits the types of permitted development to farms, boat yards and other similar marina uses, restaurants, and conservation areas, public parks and other similar public purpose uses. All permitted land uses must have a "definite relationship to the estuarial zone" and be approved by NJDEP, where required. 2. All residential development is required to be located a minimum of 100 feet from any existing or proposed detention or retention basin, pond, lake or other water body or course, as measured from the highest topographic grade of said water body or course (Section 401 G.). 3. Section 514 of the LDO regulates retaining walls, embankment slopes and bulkheads. Slope returns for embankments are limited to a 3 to 1 slope. Bulkheads or other appropriate permanent bank stabilization acceptable to the Board are required for all development on or along waterways, and the design must be approved by the Township Engineer. 4. Section 523 of the LDO regulates Surface Water Management and Section 524 regulates Stormwater Management consistent with the new NJDEP regulations. 5. Section 608 of the LDO regulates and protects "Critical Areas" which are defined by ordinance as 100-year flood plains, freshwater wetlands, wetlands transition areas or steep slopes 15 percent or greater. Stream corridors with buffer strips of 100 feet in width from the top of the channel banks or the flood plain area, if larger, also are regulated and protected from most types of development. All development in the Township is subject to the provisions of this section of the LDO. Design or performance standards are included within the regulations for those developments that are permitted when variances or waivers are granted. 6. In addition to the specific LDO regulations, the Township of Aberdeen has adopted Master Plan documents which recommend the protection of environmentally sensitive areas and the provision for open spaces and recreation areas. When variances from the LDO are sought, an applicant must show that there is no substantial detriment to the intent and purpose (negative criteria) of these Master Plan documents.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
Allenhurst, Borough of ***Certified no change since 2009 assessment***	Little development has taken place for nearly 70+ years. The Borough can best be described as low-occupy and low density. JCP&L has had a large facility within the Borough but has recently relocated and redevelopment is in the works. The new development will consist of mix residential and commercial and will conform with the Borough's current occupancy and density make up.	The Borough complies with all state and federal regulations.
Allentown, Borough of ***Certified no change since 2009 assessment***	The Borough of Allentown is almost totally developed. The land that is not used for commercial or residential buildings is protected land under "Green Acres".	Any development that is occurring within the Borough of Allentown is being done in existing residential areas. Most are rehabs or lots next to existing structures. To my knowledge none of the areas of development apply to the question asked.
Asbury Park, City of ***Certified no change since 2009 assessment***	Redevelopment of oceanfront consisting of 4 to 6 story combined commercial / residential, 1 to 2 story commercial and up to 25 story residential high-rise throughout oceanfront area. Redevelopment of south west portion of the city consisting of 2 to 4 story commercial / multi-family. Scattered throughout the city 2 to 6 story residential new construction and rehabilitations.	Our city complies with all applicable building codes concerning hurricane resistance and all requirements of the Uniform Fire Code.
Atlantic Highlands, Borough of	For the most part, Atlantic Highlands is "Built-Out" community. The Borough has the same 2 waterfront properties still undeveloped since the last version of the plan, although they are currently used for commercial purposes. 1) McConnell Property - Former site of a fuel farm. Two huge Esso tanks were on property and dismantled in 1986. Since the last version of the plan, this contaminated property has been remediated. It is still zoned for 19 single family homes, but the Borough continues to explore funding options to purchase the property and preserve for open space and extension of current beach area (estimated $6 million). 2) Guiliani Property- Former home of a contracting company. Property is possibly contaminated from 1920's Coal Manufacturing plant that is owned by NJ Natural Gas Co. Now a boat storage facility. At one point (pre-2009), KHOV wanted to build 80 condos but this application was withdrawn. Also pre-2009, Borough wanted to buy the property to extend the Borough-owned Municipal Harbor, but had restraints against the purchase from COAH. Since the last version of the plan, the property was recently purchased by SeaStreak, LLC., the local fast ferry company that transports people to New York City and back daily. Other areas along the waterfront continue to be not buildable. Since the last version of the plan, some buyers continue to take down smaller homes and build larger homes on the property. Biggest issue for the Borough continues to be water runoff/erosion. New or old - this is the real challenge. Borough continues to have 7 condo/high density apartment complexes. As reported in the last version of the plan, anything built in the hills still must meet steep slope ordinance requirements. Since the last version of the plan 1 former restaurant parcel (about 3 acres) was replaced with two new homes.	1) Steep slope ordinance. Upheld by Supreme Court in challenges 3 times. 2) Land use regulations. 3) Stormwater Management Ordinance 4) *New since the last version of the plan* - Atlantic Highlands has adopted the ABFE's post-Sandy, and revised their floodplain management ordinance.
Avon-by-the-Sea, Borough of ***Certified no change since 2009 assessment***	Avon-By-The-Sea is fully developed, with less than 10 lots to be built upon. All but one have been created by demolishing existing structures on the sites. The predominant development is older structures are demolished to be replaced by new, modern single-family homes, with one multi-family (nine unit) building under construction on the site of a former commercial building.	Floodplain management is addressed by the building department for all new construction. In addition, the current construction code requires wind-storm resistant windows and other structural elements to address the coastal high wind concerns associated with our municipality.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
Belmar, Borough of	Belmar is a one square mile summer resort community with a year round population of about 6,000. The community consists mostly of single family homes. The Borough is currently updating its Business Zone by rebuilding and redesigning a 6 block area	Belmar participates in the NFIP and enforces codes and ordinances regarding same. Belmar has adopted the ABFE maps (2013) and has adopted modifications to our residential home height ordinance to encourage home elevations. All building regulations pertaining to wind, flood and hurricane are enforced by the building department.
Bradley Beach, Borough of ***Certified no change since 2009 assessment***	Bradley Beach is primarily a residential community with mixed use retail / residential and office / residential along the Main Street Corridor at the west edge of the Borough. The majority of the Borough is zoned single family residential except for the aforementioned mixed use zone and townhouse and apartment used permitted along the beachfront block. The Borough is fully developed with no vacant property available for development. Development is limited to demolition and construction of wither single family homes throughout the Borough or small condominium projects or larger lots in the beachfront area.	The Borough of Bradley Beach enforces floodplain management regulations and all FEMA regulations regarding natural hazards. There are no steep slopes or potential earthquake or landslide areas in the Borough. Building regulations related to high winds and hurricanes design standards are enforced by the Borough's Building Department.
Brielle, Borough of ***Certified no change since 2009 assessment***	Brielle is 1.3 square miles and there is little room for development. The trend is toward minor subdivisions, in particular in the area east of Union Land, between Old Bridge Road and Green Avenue, where the required frontage is 75 feet and the trend is for the division of 100 foot lots into 50 foot lots. The trend is distressing, but hard to stop. The few remaining commercial areas, i.e. marinas, are in danger of going condominium. While the increase in density is manageable; it cannot but help to adversely impact the overall quality of life.	The Borough has enacted a Flood Plain Management Ordinance and has supplemented it with a Stormwater Management Ordinance and Soil Removal.
Colts Neck, Township of	Historically development in the Township of Colts Neck consists of agriculture and detached single family dwellings. The A-1 Agriculture/ Residential Zone is a two acre zone with a density of 0.5 dwellings per acre. The AG Agricultural zone is a 10 acre zone with a density of 0.1 units per acre. Over the past five years the Township has issued 55 certificates of occupancy and 21 demolition permits for a net gain of 34 new dwellings. This averages 6.8 dwellings per year and is less than half of the new growth experienced in the previous five years. This declining trend is anticipated to continue in the near future, due to a lack of vacant land and current market conditions. The only multifamily development plan is The Manor Homes at Colt Neck. A 48 unit inclusionary development proposed in Route 537. Commercial development is limited to the Route 34 corridor between Artisan Place and Route 18. Due to a reliance of on-site well and septic systems, the density of the commercial zone is kept low with a 0.15 floor area ratio.	The Township Code Enforcement Officer enforces the Township's local ordinances published in Chapter 102 - Development Regulations of the Township of Colts Neck. The Construction Official enforces building code though compliance with the Universal Construction Code (UCC). The State of New Jersey oversees State regulations including the Freshwater Wetlands, Flood Hazard Regulations, Highway Access, Stormwater Management, Residential Site Improvement Standards and other State permits. While Federal regulations such as FEMA and Soil Erosion and Sediment Control Plans are administered by Federal Agencies. Compliance with these outside agencies requirements are addressed as part of the planning process within each individual Planning Board Application.
Deal, Borough of ***Certified no change since 2009 assessment***	Development in the Borough of Deal is limited to single family residential dwellings. We have only one multiple family condo on the oceanfront and do not have the potential for additional multiple family residential units near the ocean front.	The Borough of Deal enforces the laws of New Jersey regarding the protection of wet lands, streams, lakes, ocean front, etc. through zoning regulations. Among the factors limiting development is a 40 percent impervious restriction on development.
Eatontown, Borough of ***Certified no change since 2009 assessment***	1) Multi-family Townhouse developments – upward of 300 units with 1,000 new residents 2) Expansion of regional shopping mall 50,000 square ft. Type 1 construction. Population will vary on times of years. 3) New business in Industrial Park Area - 2 business complexes Type 1 100,000+ sq ft.; 1 medical office/Operating Room 25,000 sq ft Type 1 4) approval on new Rt 35 - Rt 36 Construction to soon facilitate movement of traffic.	Eatontown uses the following to protect new development from natural hazards: DEP Standards, NJ Building Code, NEPA Standards, OSHA, Borough of Eatontown Codes, Stormwater Management of NJ DEP, Electrical codes, State DOT.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
Englishtown, Borough of	Englishtown is a half-square mile community that is still, for the most part, completely built. Since the 2009 assessment, plans for four to six single family homes moved forward; six are currently under construction. In addition, the plans for 8 apartment buildings with a total of 134 apartments have also moved forward since the prior assessment, and the project is recently completed.	Since the last version of the plan, the Borough notes that their CON Zone is intended to save the Borough's natural open space, and also prevent construction in natural hazard, i.e., flood zone, wetlands, areas.
Fair Haven, Borough of ***Certified no change since 2009 assessment***	At this time the only land available is lots that 1 or 2 houses can be built on. No major building is expected.	Yes, if the building were to affect an area.
Farmingdale, Borough of ***Certified no change since 2009 assessment***	Farmingdale is a very small (1.5 sq. mile) Borough with limited development. Spot lot residential and limited commercial construction takes place sporadically.	Within our limited development, yes.
Freehold, Borough of	The Borough of Freehold continues to be approximately 95 percent built out. At the present time there are two residential developments proposed both are located on Orchard Street in the southeast area of the municipality. One development has already been approved and is in the process of being built - Liberty Crossing 1 consists of 12 two story single family homes to be built on the west side of Orchard Street. At the time the last Plan was prepared, Liberty Crossing II was before the Borough of Freehold Planning Board, consisting of a four story age restricted condominiums. Level 1 was to be used as a parking garage and levels 2, 3 &4 as 30 condominiums. This project was approved by the Board, but has since been terminated. Presently, Orchard Place at Freehold is before the Planning Board for this site. It consists of seven, 2-family homes and one 1-family home. In terms of commercial development since the last plan was prepared, the three story office building at 83 South Street has been completed. Another three story office building has been completed at 42 East Main Street. Previous plans for a two story commercial building (first floor retail, second floor office) at 63 East Main Street (corner of Spring Street) were approved at the time the initial plans were prepared, but the project has since been terminated.	The Borough of Freehold does not appear on any FEMA Flood Maps due to the fact that it is located 178 feet above sea level and there are no streams, rivers or lakes in the Borough. The only flooding problems are localized during times of extremely heavy rainfall because of an antiquated storm drainage system in some areas. The Borough of Freehold enforces the State Uniform Construction Code which currently adopts the 2009 International Building Code and has provisions for earthquake resistant design criteria and high wind design criteria. There are no wildfire hazard areas located in the Borough of Freehold. In September of 2009 the Borough of Freehold adopted a Flood Damage Prevention Ordinance, and has recently sent in its application for participation in FEMA's National Flood Insurance Program.
Freehold, Township of ***Certified no change since 2009 assessment***	Although the Township has experienced significant growth over the last three decades, a recent Build-Out Analysis indicated that the Township is at approximately 94 percent build out, development is expected along Route 9 and Route 537 corridors.	The Land Use Ordinance discourages development in critical Areas: 100 Year Floodplain; Wetlands; Wetland Buffers; Slopes Greater than 15 percent; Lands that are Highly Erodable (USDA factor "K"); Land with a Seasonal High Water Table of 24" or Less; Lands within Conservation Easements. In the Southern portion of the Township some land is located within a NJ Forest Fire Service Area. The Freehold Township Fire Prevention Bureau follows the policies of the NJ State Forest Fire Services in that area.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
Hazlet, Township of ***Certified no change since 2009 assessment***	Many various projects approved or pending and under construction currently; Details provided by Sharon A. Keegan, Zoning Official.	The Township utilizes a Development Review Ordinance that regulates all property within its boundaries. The intent of the ordinances is to guide the appropriate use of development of all lands in a manner that promotes the public health, safely, morals and general welfare. To secure safety from fire, panic and other natural or manmade disasters. The following ordinances are some of the ways the township regulates new development from the effects of a natural hazard. 1. Section 412 - Flood Hazard Regulations-designed to regulate development of lands within the defined flood hazard areas. 2. Section 500 - Performance $ Design Standards - designed to promote the creation of functional and attractive development that shall promote to the health, safety, general welfare, morals, efficiency, economy, maintenance of property values and the character of the Township. To minimize adverse impacts of flooding, drainage, erosion vehicular traffic, pedestrian movement, parking, vibration, lighting and glare, noise, odor, solid waste disposal and litter. 3. Section 508 Land Use Restrictions and Easements, such as drainage easements, sight triangle easements and utility easements. 4. Section 525 Storm Water Management Control. 5. Section 526 Stream Setback, No activity shall be permitted within 100 feet of the top of the bank of a stream or other body of water. No building shall be constructed within the 100 year flood plain.
Highlands, Borough	Near the waterfront: Single family residential units are being renovated, older single and multi-family housing units are being demolished and replaced with single and multi-family housing units. Some pre-existing high density areas have been rezoned into “MXD” areas and are currently awaiting redevelopment. Pre-existing open areas are being developed and are becoming, single and multi-family housing units. Much of the waterfront business area zones has already been developed with restaurants or marinas. Older restaurants are being renovated and re-opened as restaurants as business thru-out the town continues to increase.	The borough has developed, adopted and enforces: Flood plain ordinances, Steep slope ordinances, storm water management plans. Additionally the borough follows the FEMA NFIP program and has adopted the current edition of the International Code Council (ICC) construction codes and the current edition of the New Jersey Residential Construction Code. The Borough has recently adopted more stringent regulations for developing within a steep slope area and has currently revised its Flood Damage Prevention Ordinance. Further, the Borough is currently pursuing enrollment in the NFIP Community Rating System.
Holmdel, Township of	The analysis concluded that the 2003 population of the Township was approximately 17,487 and that with current zoning the population at total build-out would be about 19,608. Most of the undeveloped properties are in residential zones with the largest properties zoned for single-family homes in clustered developments with a maximum density of 0.2 units per acre. Some of the undeveloped properties have received development approvals from the Planning Board. Given the state of the real estate market the actual development of these properties is at present proceeding very slowly. There are two clusters of undeveloped properties along Route 35. Each of these has about 25 acres and they are currently zoned for commercial/retail use. There are no currently known development plans for either of these properties. The largest development uncertainty in the Township is the potential redevelopment of the 472-acre property owned by Alcatel-Lucent that formerly housed research and development facilities of Bell Laboratories. On this property is an approximately 2,000,000 sq. ft building that was designed by Aero Saarinen for Bell Laboratories and is now vacant. Six to eight years ago there were 6-7,000 employees working in the building. A	Holmdel Township includes in its Development Regulations Section 30-116, Resource Management Regulations. These regulations limit development within stream corridors including floodplains, on steep slopes, and around water bodies and limit tree and woodland removal on properties proposed for development. The regulations require that buffers be placed in conservation easements.

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Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	redevelopment company has a contract to purchase the property. However, the sale has not closed. Some of the possibilities for the redevelopment include the partial or complete demolition of the existing building, the re-use of a portion of the building, the construction of new buildings for professional and office use, the construction of a 350,000 sq. ft. data center, the construction of age-restricted residences, some municipal facilities, and some combination of all of these and other possibilities. The Township Committee has appointed an Advisory Committee to advise it on the options. Because of the poor state of the commercial real estate market in Monmouth County and New Jersey, the lack of population and employment growth in New Jersey, and the lack of identified or contracted tenants, the ultimate plan for the development of this property is unknown at this time. In May, 2012 Holmdel Township approved the Alcatel-Lucent Redevelopment Plan. In March, 2013, Somerset Development won initial approval to proceed with their plans but although under contract to purchase the site have not yet closed on the purchase.	
Howell, Township of ***Certified no change since 2009 assessment***	Large "McMansion" development continues within areas of previously farmed land. A large area of the Township continues to maintain a rural character. Most of the Township's development remains scattered throughout rural locations and located at previously farmed areas and wetland areas. Agricultural Rural Estate zone districts continue to be used within the Township and prevent the impacts of development in areas located outside of centers that are identified in the Township's Master Plan. Agricultural uses and low density development are encouraged within the ARE zone districts. High density residential development within the Township are located within the residential zone districts and located in the vicinity of well-traveled roadways. Commercial development within the Township can be found along the Rt. 9 and Rt. 33 corridors.	Yes, the Township has a 300 foot Riparian Buffer Ordinance (188-34). A 300 foot buffer is required adjacent to all streams, lakes, ponds within the Township. The buffer is measured as a line extending perpendicularly from the 100-year flood plan delineation. If there is no 100 year flood line delineated, the distance shall be measured outward from the top of the bank. This ordinance protects communities from potential flood hazard occurrences.
Interlaken, Borough of ***Certified no change since 2009 assessment***	The Borough of Interlaken is unique in that the municipality is completely single-family residential. The only non-residential land use is borough-owned property such as Borough Hall, a park and an arboretum. The Borough's goal is to retain the current character of the community and this is reinforced in its Master Plan and Zoning Ordinance. The Borough is concerned about preserving its Deal Lake frontage as well as environmental stabilization of the Deal Lake itself.	The Borough of Interlaken does enforce a Flood Hazard Prevention Ordinance and a full circuit of Storm water management ordinances. The Borough of Interlaken also has an arboretum along Deal Lake and has steep slope easement and conservation easement in place to preserve stream corridors.
Keansburg, Borough of ***Certified no change since 2009 assessment***	Town House/ Condo Development and retail development near our waterfront areas; feasibility study being conducted for a marina.	The Borough has enacted a Floodplain Management Ordinance, most recently amended on March 27, 2013, that establishes an area of Coastal Hazards and Coastal High Hazards, institutes the need for a permit for any development within any area of special flood hazard, and lists provisions for flood hazard reduction relating to anchoring, construction materials and methods, utilities, subdivisions and enclosures. The Ordinance sets specific requirements, including minimum elevations and other such building standards for Residential and Non-Residential Construction to the most restrictive current standards. The Borough is currently moving forward with DCA-funded updates to the current Floodplain Management Ordinance.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
Keyport, Borough of	Residential development 50 yards from waterfront continues; 10 new homes within last 5 years; Future Project: Multi Condo project along a creek bed. Recent additional approvals since the last version of the plan include 26 condo units along creek bed. Inquiry by developers continues, requesting approvals for waterfront multi-family units.	The jurisdiction continues to enforces or regulates development by enforcement of CAFRA regulations and floodplain management best practices along Raritan Bay and along our two creeks. Also, added / new or development along the Bay has high wind criteria.
Lake Como, Borough of	At the time the initial plan was prepared, there were a number of recently approved and soon-to-be proposed "high-density residential over commercial" projects on Main Street, ranging from 4 to 25 residential units each with a maximum potential for about 8 to 10 such projects to ultimately be built pending on further economic growth. The remainder of the town is completely developed with most work being confined to additions and alterations and or replacement of existing single-family residences (usually small bungalows being replaced with new larger homes). Due to the recent superstorm (Sandy), the Borough has focused more on the new ABFE maps and the Planning and Construction offices have been working with the homeowners to ensure compliance with the new guidelines for floodplain elevation in the A zone.	Yes, the Borough continues to enforce State and Federal flood plain, wind design and general building code requirements.
Little Silver, Borough of	Little Silver is largely residential, continuing to develop slowly since the last version of the Plan, in accordance with its current zoning. Development continues to be mostly renovation of existing homes except for one age restricting housing development that had been approved by the Planning Board as the last version of the Plan was being prepared.	The Borough continues its enforcement of an Ordinance restricting all development below the six foot contour (along stream corridors) and ordinances prohibiting the use of steep slopes and environmentally sensitive areas for lit area calculations. In 2013, the Borough adopted the Revised State Model Flood Damage Prevention Ordinance adopting the Advisory Base Flood Elevation with the recommended 3 feet of freeboard for all new construction.
Loch Arbour, Village of	Village of Loch Arbour is fully developed, primarily single family residential. Development since the last version of the Plan continues to be usually in the form of knock-downs and rebuilds.	Yes, floodplain management, high wind design criteria apply in the Village. No other criteria are necessary. Since the last version of the Plan was prepared, the Village has adopted a Flood Damage Prevention Ordinance addressing residential and non-residential construction in accordance with the State model ordinance.
Long Branch, City of ***Certified no change since 2009 assessment***	For more than 10 years, the City of Long Branch has been developing and implementing an extremely progressive redevelopment program. This was the case at the time of the initial plan's development and it is a trend that continues today. The Oceanfront development has already begun with Beachfront North – a high-density residential development and Pier Village – a high-density residential/commercial mix. In the near future the city will begin the next four phases of their development plan, which includes Broadway Corridor, Broadway Gateway, Hotel Campus and Beachfront South. Broadway Corridor is a high-density residential/retail mix with an emphasis on the arts. Broadway Gateway is a mix of commercial and big box retail. Hotel Campus is another beachfront project, which includes a large expansion of an existing hotel and added high-density residential/dormitories. The final project is Beachfront South, which is expected to also include high density residential with improvements to the public boardwalk.	The City of Long Branch follows FEMA's National Flood Insurance Program, the State of New Jersey Uniform Construction Code, the State of New Jersey Municipal Land Use Laws and Monmouth County Freehold Soil Conservation. The City has also adopted several ordinances on a local level to help protect new development and give local officials guidance. These ordinances include Land Use Procedures, Environmental Commission, Urban Enterprise Zone, Property Maintenance, Flood Damage Prevention, Public Property, Redevelopment, Soil Removal and Zoning. Although each of the above listed ordinances may not individually affect each project the combination of several will benefit a large majority of our development.
Manalapan, Township of	The township continues to grow and develop both residential and non-residential uses. Master Plan Reexamination. Development pressures within the Township have generally corresponded to economic cycles. Over the last decade, the Township has experienced a strong demand for residential development and increasing land values. The Township has also experienced a demand for non-residential development for retail office, and office-warehouse uses. Since the	All development and building within the Township is regulated pursuant to the development regulations of the Township of Manalapan, the State Residential Site Improvement Standards, the State Uniform Construction Code, and any other applicable State or County regulations. Township development regulations are enforced through the Township development review and approval process and by the Township agencies, including the Planning Board and Board of Adjustement,

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	recession of 2008, development has slowed significantly and land values stabilized but a substantial amount of developable lands still exist in the Township.	and officials responsible for the administration of the regulations and the issuance of development permits. Township development regulations include: • a Flood Hazard Area Overlay zone which prohibits most types of development in the 100-year floodplain, irrespective of the underlying zone district. The objective is to conserve the natural floodplain, The regulations also include building setback requirements from the floodplain. Any permitted development in the floodplain must comply with the Flood Damage Prevention Regulations of the Township Code which incorporates FEMA standards. • provisions to regulate development activities along streams and within stream corridors. The regulation is also applicable to any pond, lake, or perennial or intermittent waterway as shown by USGS maps, the Monmouth County Soils Survey, or the Natural Resource Inventory for Manalapan Township. • standards for the development on steep slopes. The standards restrict development on slopes of 10 percent or greater. Disturbance of slopes 20 percent or greater is only permitted if the disturbance is essential to the reasonable use of the property. The Township alsohas an active open space and farmland preservation program to retain significant areas of the Township in farm and open space use.
Manasquan, Borough of ***Certified no change since 2009 assessment***	Manasquan is a built-out year-round shore community consisting of approximately 6,400 residents. Since the last version of the plan, most development continues to consist of razing older, smaller homes and replacement with larger, 2 to 3 story homes, especially along the oceanfront.	The Borough of Manasquan continues to enforce the following: Wind Design Criteria: Uniform Construction Code (UCC); Flood Plain Ordinance NJSA 58:16A.57 (required by the State); Borough Ordinance Chapter # 29 (Flood Prevention & Construction Design)
Marlboro, Township of	The Township is seeing a combination of high-density high-occupancy residential, commercial and low-density residential on lots of 1 acre or larger. Ten commercial properties include a big-box retail store, 2 banks, 2 office buildings, 2 combination office buildings/warehouses, one house of worship, a drive-thru pharmacy and an indoor tennis & training facility. Six pending residential developments include one with a combination of single family homes and 2 Multi-family dwellings, one multi-unit single family attached dwelling, and 4 single family dwelling Developments with lot sizes ranging from ¼ acre to 2+ acres.	The Zoning and/or Engineering Departments enforce the following sections of the Township Code: (1) General Provisions 220-46D (1)[a]: "No structure shall be built within 100' of top-of-bank of a Stream or other body of water or within any drainage or conservation easement….No building shall be constructed within the 100 year flood plain of any stream or watercourse…"; (2) Flood Damage Prevention, 220-46 and NJSA 40:48-1 et seq; (3) Storm Water Management, 220-150; (4) Floodplain Regulations, 220-161 84-1095; (5) Soil Removal, 220-23; and (6) Grading & Clearing, 220-23.
Matawan, Borough of	As of 2013, the Borough has mostly been developed to capacity. The development (The Preserve at Matawan) encompasses an approximate sixteen acre tract of land formally used as both a residence and retail business, with the undeveloped acres remaining wooded and wetland areas. It is located between State Highway 79 and Mill Road and borders Gravelly Brook and Gravelly Brook Park. The Preserve at Matawan encompasses 126 luxury condominiums and contains an active adult component as well as a low income component of 31 units. A portion of the site remains undeveloped due to wetland restrictions. Matawan is in the initial stages of a large scale re-development for the entire area of the Matawan-Aberdeen Train Station with a combination of retail, commercial, and residential development. The area has been approved as a Transit Village by New Jersey Transit. The entire re-development process was a joint venture with neighboring Aberdeen Township. The process was stalled due to ongoing litigation but is once again active. Broad Street Plaza, a proposed project to be built adjacent to the Matawan Municipal	The Borough of Matawan regulates new development in accordance with the Uniform Construction Code in addition to current Borough Ordinances governing floodplain and stormwater management.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	Community Center (at the intersection of Broad Street and State Highway 34) has been presented to the Planning Board for review. The project proposes the construction of 130 apartments; 26,900 square feet of retail space; and a 1,600 square foot fitness center.	
Middletown, Township of	Development trends in recent years have essentially been a continuation of the trends and patterns of the past. Since the last version of the plan, new development has consisted largely of single family homes in subdivisions and multi-family site plans. Typical subdivision applications at the time of the last plan ranged in size from 2-12 lots; in recent years they have been more from 5-25 lots and there have been larger developments approved recently. More multi-family developments, both rental and for sale, have been occurring in the past 10 years and will likely continue. This is primarily due to the Township's efforts in complying with State mandated affordable housing obligations. More than 1,100 new units have been approved and/or built in the past decade and another 500-750 hundred are likely in the next 10 years. Densities typically range from 3-10 units per acre for single family developments, with project sizes ranging from 12-150 units. Multifamily tends to have higher densities at 8-12 units per acre, sometimes higher. Some multi-family development has occurred near the waterfront. There is also an area of 10-15 acres near the waterfront that is adjacent to the commercial fishing cooperative that is slated for redevelopment in the next few years. Other than that the Bayshore area is mostly built out, with some infill development possibilities. Commercial development continues steadily, although the scale of commercial projects is somewhat smaller. Nearly all of our major shopping centers have been fully rehabilitated within the past 10-15 years. Scattered smaller commercial and retail developments (5,000-10,000 sf) continue to take place. The only major land uses not occurring much are large office developments and industrial development.	The Township participates extensively in the FEMA National Flood Insurance Rate Map Program. Properties are regularly reviewed to determine if they are located in flood hazard areas. If they are, special design and development standards are imposed and a Floodplain Encroachment Permit process is implemented, via Township Ordinance. Design and development standards relative to earthquakes and high winds are implemented via state regulated uniform construction standards. Landslide hazards and wildfire hazards are typically not applicable here. The Township does have steep slope regulations that limit and in some cases even prohibit developments that disturb sloped areas.
Millstone, Township of ***Certified no change since 2009 assessment***	Millstone Township is considered a Low Density rural residential. Development is permitted along stream corridors and limited areas of commercial development.	Millstone strictly enforces various township ordinances that protect new development from various natural hazards. We have in place Steep slopes, soil contamination, flood plain, conservation Easement and Storm water management ordinances.
Monmouth Beach, Borough of ***Certified no change since 2009 assessment***	Redevelopment of existing property to meet newer codes. US Coast Guard Life Saving Station reconstructed into Monmouth Beach Cultural Center. Flood Plain Management enacted.	Borough complies with stormwater management rules; Drainage and road improvements for active flooding; Land disturbance ordinance enacted to prevent flooding encroachment; Seawall reconstruction to prevent encroaching ocean tides.
Neptune City, Borough of	Neptune City is 96 percent developed with majority of that as single family homes. It has some apartment complexes and commercial areas. There is a five acre redevelopment area of which two acres just received approval for the construction of 36 townhomes. The Borough has two State Highways and is located near the hospital, so there is construction of many office buildings.	All new development is by the Uniform Construction Code. The Borough has a Stormwater Management Ordinance and Land Use Board provisions if applicable.
Neptune, Township of	For this plan update, the Township noted that some of the areas designated as special hazard areas are already fully developed; for example, portion of Ocean Grove and Shark River Hills. The remainder of the 2009 assessment remains unchanged. Development trends vary depending on the area of Neptune Township.	All buildings are designed for 120 mph winds due to the proximity to the Atlantic Ocean and potential hurricanes. Other building requirements include flood vents and hurricane clips. These are ICC codes that are enforced by the Township's building department. The local zoning ordinance has a section for steep slopes. Although Neptune Township is a coastal community, there are sections of town

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	In Western Neptune: Medical office: 15,000- 30,000 sf. Big Box Retail, including pad sites for restaurants, banks, pharmacies, and other retail, Major Subdivisions - not exceeding 20 lots. In Eastern Neptune: In-fill residential, smaller lots. West Lake Ave. redevelopment area - dense mixed use including residential retail and office Former Ridge Ave. School Site redevelopment area - dense residential including single-family townhouses, and apartments. Other Areas: In-fill residential mainly including 2-lot minor subdivisions. Large expansion of regional hospital. Potential Redevelopment Areas: Transit Village - dense mixed use near railroad station. Shark River Waterfront- moderate dense residential with a portion of retail and hotel. Existing highway corridors - possible in-fill and new development.	with steep slopes. The ordinance requires individuals proposing excavation and construction in areas greater than 25 percent slope to obtain variances, which require review by the planning or zoning board and board engineer. The Township has a flood plain ordinance. All applicable development has to also comply with stormwater regulations.
Ocean, Township of	There is substantial redevelopment of commercial space along State Highway 35. Residential Development is basically of 3 kinds: 1- Infill. Undeveloped parcels in the middle of an otherwise developed neighborhood. Usually large new homes on small lots. This is a small percentage of the new construction. 2- Age Restricted Adult Communities. Continuing construction on two large projects, while a third was recently completed. Since the last version of the Plan, there is a fourth project being developed due to two mitigation grants received. 3- Since the last version of the Plan, there are three new developments being established or exploring their options within the township.	We use the FEMA maps and also have a generally more restrictive local flood plain study. Any construction in a flood hazard area requires a variance from the Zoning Board of Adjustment. Variances are only granted after review by the Board Engineer. All applicable flood construction standards must be maintained.
Oceanport, Borough of	<u>Since the last version of the Plan</u>: • A 44 home development that was under construction off Port-au-Peck Ave between Oceanport Ave and East Main St has been completed. This is an over 50 complex and there is a retention pond on site. • A commercial complex with rental units on the second level, across from the above development, that was in the planning stages at the time of the last Plan, is under construction. • A 12 lot sub-division (single family homes, off Port-au-Peck Ave between Branchport Ave and Myrtle Ave) is currently on hold due to stormwater management concerns, and asbestos was found on the property. • The 4 unit townhouse complex that was slated for Main St and Oceanport Ave (waterfront) at the time of the last Plan has been completed. • No further action on six affordable housing units that were being considered for Main St (waterfront border, but over 125 feet set back); also no further action on a 36 unit three story condo on East Main St (waterfront). • A six story, 60 unit high rise complex on water front property along the Shrewsbury River (Morris Place and River St) was defeated. <u>Pending activities include</u>: • Fort Monmouth- consisting of about 419 acres, almost 25 percent more in area to town.	Yes, Floodplain. All new development and over 50 percent improvement based on the assessed value will require an elevation to the BFE plus 2 feet.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	• Education-Medical campus mixed-income housing • McAfee Center & Squier Hall reuse green industry technology cluster • Historic housing reuse • Oceanport municipal center marina, retail, mixed-income housing • Elevations – 200 homes have indicated the need to elevate	
Red Bank, Borough of	Five major projects under construction, including mixed-use structures, the largest of which includes more than 83,000 sf office space and a three-story parking garage. 10 significant projects approved for construction, several more pending board approval. (Full details were provided by the Planning and Zoning Dept.). Although there are several ongoing projects concerning Residential and Commercial development, since the last version of the plan was prepared, there has been only one developed area from what used to be vacant. LI Zone, 36 unit, affordable housing.	The planning and zoning process enforces stormwater regulations in accordance with the Borough Stormwater Ordinance. Where appropriate, we require applicants for development apply to the appropriate State agencies to gain approval for applicable floodplain requirements, CAFRA and waterfront development permits, including coastal bluff. Applicants are required, as a condition of Borough approvals, to obtain all required NJDEP permits. Refer to the building department for earthquake resistant design criteria and other building issues.
Roosevelt, Borough of ***Certified no change since 2009 assessment***	Due to the historical restrictions and open space preservation efforts, very little development is going on in Roosevelt at this time. The last large-scale residential development that was proposed was vehemently opposed and eventually turned down. The last spurt of residential development happened in the 1970s, with a house being built every few years since then. We have a very small industrial zone, which has little to no development happening or planned, as well as a very small commercial zone which also has little to no development happening or planned.	Floodplain management ordinance. Construction permits cannot be issued for structures that are in a floodplain. As a practical matter, this is not a problem, since all mapped flood plains are in publicly-owned open space that cannot be developed.
Rumson, Borough of ***Certified no change since 2009 assessment***	The Borough of Rumson is basically fully developed. New households (approximately four per year) are the result of the demolition of an existing house and the building of two homes to replace the former residence. The two new homes that are built are generally larger than the original home. Many smaller ranch homes are being demolished and replaced with larger, two-story homes.	The Borough of Rumson follows State conservation guidelines and codes for all new houses built in the Borough. The Borough of Rumson follows all FEMA guidelines for construction and development in flood areas. In addition, our construction official and zoning officers utilize our Borough Engineer for compliance testing for all applications submitted to the Borough.
Sea Bright, Borough of	Sea Bright is near fully developed. Any development proposed is typically rehabilitation or small scale redevelopment site. Downtown redevelopment is occurring on a small scale as well with some new businesses moving in and older, small bungalows being demolished, rebuilt, or raised out of flood zone. Waterfront development is minimal and regulated by CAFRA.	We have a flood damage prevention Ordinance as well as a new Stormwater Management Ordinance. We also have a Beach Preservation Ordinance and an established Coastal Protection Zone, running along the beachfront. We have established new building codes that require all building to be a minimum of two feet above the BFE as well as adjusting height to compensate for the elevation of existing structures.
Sea Girt, Borough of ***Certified no change since 2009 assessment***	Sea Girt is a predominately a fully built up community. There is no or virtually no, open land for building. Residents that have double lots often break them up into two lots and sell them off. The impact of this type building is negligible on our infrastructure as well as our school system. Many homes being built in this manner, or new homes in general, belong to summer residents or part time residents in that make Sea Girt their home part of the year. The summer season, say from mid-April to mid-October is when the community is at its peak with residents and visitors. The town is almost 1.1 square miles.	All homes built within the mile zone of the ocean are required to either have hurricane proof glass or regular windows with plywood storm panels for each individual window. Residents in the zero one hundred block are recommended to install hurricane shutters on their east facing windows and are also advised to utilize high wind building design. Recently The Borough rebuilt the Lifeguard Headquarters and Beachfront pavilion and during the process which I was intimately involved in – for example – the Borough took the lead in using some of the above mentioned items for storm and natural hazard protection both at the recommendation of the Borough Engineer and the residents.
Shrewsbury, Borough of ***Certified no change since 2009 assessment***	Development patterns in the Borough of Shrewsbury have trended towards infill development, as well as commercial re-development. A recent vacant land development analysis undertaken by the Borough revealed that there are no vacant parcels that are suited for development. The majority of future land development applications are expected to be largely made up of re-development initiatives of	The Borough of Shrewsbury has enacted certain ordinances to protect against hazards due to natural disasters, including the following: §122 Flood Hazard Areas §94-5.13 Preservation of Natural Features §94-8.39 Stormwater Control.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	commercial properties along Broad Street (Hwy 35) and secondary arterials which are situated in commercial zones. It is also expected that mixed use residential & commercial development shall occur in non-residential zones as part of the Borough's Fair-Share Affordable Housing Plan, to create real opportunities for affordable housing in the Borough.	
Shrewsbury, Township of ***Certified no change since 2009 assessment***	Shrewsbury Township does not have growth capacity to develop any of our land. To put simply, we do not have any room to grow as a community.	We do not see these types of codes essential to our emergency management growth and development plan.
Spring Lake, Borough of ***Certified no change since 2009 assessment***	Spring Lake Borough land area is approximately 1.3 sq. miles, with the Atlantic on the East and bordered by the communities of Lake Como, Spring Lake Heights and Sea Girt and Wall. It is a fully developed community with mature settlement patterns and little vacant land (identified by the state as part of the Metropolitan Planning Area). Spring Lake developed a 1974 Zoning and Land Use Plan in 1974 when it developed its current Master Plan. That Plan has been reviewed periodically. In 2007 the Borough is conducting a "Comprehensive Master Plan Update". This Master Plan Update will be consistent with the Monmouth County Growth Management Guide/Coastal Monmouth Plan (1995). The Borough has undergone a transformation from a resort community to a more year round bedroom community. Most construction today involves either renovation of older homes or the tear down of older homes and construction of new, significantly larger homes on existing lots. The Borough currently owns 119.45 acres of open space and 80.89 acres of land available to the public for active or passive recreational use. This land percentage compares favorably with National Recreation and Park Association standards. The Master Plan Update objectives for Land Use focus on maintaining the quality of residential neighborhoods, encouraging the development of the business district and maintaining the traditional elements of neighborhoods such as sidewalks, alleys, front porches, public spaces, green spaces and street trees.	The town does not have specific regulations or ordinances specific for the protection of new development from the effects of natural hazards. However the Borough has taken the steps to develop a Stormwater Management Plan; the Borough is a member of a County managed watershed working group for Wreck Pond that addresses a multitude of issues related to the watershed and water management. The Borough is considering steps to mitigate the risk of damage from floods in flood prone areas by allowing variances in zoning for persons desiring to elevate homes. It is also reviewing maximum lot coverage and maximum impervious coverage with consideration to storm runoff and management. The Borough will include a Land Use Element in the 2007 Master Plan Update.
Spring Lake Heights, Borough of ***Certified no change since 2009 assessment***	The Borough of Spring Lake Heights enforces Zoning Ordinance Section 22-513 Flood Plain Regulations which restricts development in the flood plain. The Borough of Spring Lakes enforces Zoning Ordinance Section 22-513.2 Elevations which restricts development below the 100 year flood hazard elevation. The Borough of Spring Lake Heights currently enforces all applicable codes and regulations for building construction required by the State of New Jersey, namely the Uniform Construction Code which regulated high wind design criteria.	The Borough of Spring Lake Heights is essentially built out. There is approximately 5 percent or less of vacant/undeveloped land available in the Borough. The majority of development is residential in nature and occurs as part of home additions and renovations. Records indicate the Borough of Spring Lake Heights has not issued a multi-family building permit from 2000 to 2006. The Borough issued a total of 23 single-family building permits in 2006 of which the majority were home additions and improvements. There were a total number of 133 single-family residential building permits issued in the Borough of Spring Lake Heights from 2000 thru 2006.
Tinton Falls, Borough of	Residential: Recent residential development trends in Tinton Falls have been in line with existing zoning, and include several approved higher density developments with an affordable housing component (i.e., Rose Glen @ Tinton Falls, Meadowbrook II, and Heather Glenn @ Tinton Falls (Former CECOM Site)). These developments will result in well over 600 new residential units. Greenbriar Falls, a new active adult community currently in its final stage of construction, will	The Borough currently takes several different approaches to protect new development from natural hazards in its Land Development Ordinance. One approach is to exclude critical areas from building areas, yard and buffer requirements. The Borough has also adopted FEMA Flood Hazard Prevention Ordinance to regulate areas within Special Flood Hazard areas. All approvals are subject to NJDEP permits as applicable.

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	contain 168 residential units. In addition, many of the larger residential developments in the Borough, such as Fox Chase, The Pines, and Seabrook, have reached their full built-out potential. There is also a steady flow of smaller subdivisions that have been approved under the Borough's zoning standards. Non-Residential: By far the largest non-residential development planned in Tinton Falls is the redevelopment of Fort Monmouth. Currently CommVault is under construction on 55 acres and will consist of three phases of high-tech research and development offices. The initial phase will be 250,000 square feet with an ultimate build-out of nearly 700,000 square feet. Additional parcels within Fort Monmouth will be redeveloped in accordance with the FMERA Plan. The only other sizable non-residential construction recently completed is the 100-acre solar farm along Shafto Road. This development offset the development of 300+ single family homes and now generates an equivalent amount of solar energy. There are a number of other smaller-scale non-residential developments that have recently been approved, including a day care facility in the existing Tinton Falls Centre. A number of construction projects have recently been completed including a Wawa convenience store with fuel, Johnstone HVAC Supply, and Sonic Restaurant. In general, there is a steady stream of smaller-scale non-residential development (e.g. office, warehousing) being approved in Tinton Falls, particularly within the MFG and IOP zones along Shafto Road.	
Union Beach, Borough of	Prior to Sandy, the Borough of Union Beach is a predominantly developed suburban community with single-family housing located on lots ranging from 2,000 square feet to 75,620 square feet. The Borough is nearly fully developed with very little land that is not impacted by environmental constraints available for development. Most of the development in the Borough is redevelopment, rehabilitation of older housing or infill development in established neighborhoods with the exception of a portion of the shorefront area. The area along the shorefront north of Brook Avenue extending west to the intersection of Front Street and Union Avenue. This area has been re-zoned as the townhouse district with townhouses as a principal permitted use having a density not to exceed ten units per acre (medium-density residential). After Sandy, the Borough has several areas that will need to reconstructed with residential housing and their waterfront will need to be reconstructed.	The Borough Council adopted a Floodplain Mitigation Plan on July 18, 2003 as part of the National Flood Insurance Community Rating Program. In addition, the Borough's Floodplain Management Ordinance requires all new development to conform to the Regulations of State and Federal Flood Insurance Program. The Borough adopted the FEMA ABFE and modified their ordinances including the height ordinance to accommodate these new ABFE.
Upper Freehold, Township of ***Certified no change since 2009 assessment***	Upper Freehold Township's number one goal is preserving farmland and open space and we currently have in excess of 7,000 acres in the farmland preservation program. The type of residential development that we do have is generally subdivisions of 49 lots and under; these occur in all areas of the township and several are located near neighboring Allentown Borough. Approximately 13 developments have been approved in the last 3-4 years resulting in approximately 475 single-family homes, when built out has been completed which may take many years. Several of these sub-divisions only have preliminary approval; therefore, no building has begun. We also have a small amount of commercial development	Upper Freehold Township has adopted and enforces the following: 35-604 Flood plain areas (Flood Plain Management) 35-502 Storm Water Management 15 percent Steep Slope 2006 International Residential and Commercial Code 100 mph wind load 20 lb. live/10 lb dead snow land

Table 3d.4
Municipal Development Patterns

Community	Land Uses and Development Trends in Hazard Areas	Regulations/Codes/Ordinances To Protect New Development From Natural Hazards
	within the Township such as small plazas with allowable retail uses (i.e. hair salons, convenience stores, doctor/professional offices, nursery schools, etc.)	
Wall, Township of	Single family residential development increased moderately as developers of previously approved subdivisions have begun to act on projects that had been stagnant for some time. Renovations and single family tear downs and rebuilds have continued to increase. Commercial development is steady, with rehabilitation of existing office and retail spaces predominating. There are no new high density residential developments being considered. One large scale medium density residential development is currently pending before the Zoning Board of Adjustment. There are no major waterfront developments and no major developments proposed within Flood Hazard Areas. The majority of Flood Hazard Areas within the Township are along corridors that are predominantly zoned for open space or single family residential development.	Building design criteria follows current regulations with regards to earthquake and high wind design criteria. All development is reviewed with respect to impacts of floodplains through the township's floodplain Management Ordinance. Natural features such as steep slopes, wetlands etc., are preserved per state regulations and local ordinances.
West Long Branch, Borough of ***Certified no change since 2009 assessment***	Development in West Long Branch is minimal as the municipality is somewhat developed to the maximum. There are some minor sub-divisions planned for the last remaining open space parcels which will amount to a dozen or so home and a planned residential townhouse project.	Our Zoning and Planning Boards enforce the Land Use Code and Monitor any specific hazards. There are no obvious potentials such as landslides or wildfires. There are some minor flooding areas.

Potential for Future Development in Hazard Areas

While future development patterns are subject to many regulatory and market-driven factors, it is possible to prepare general estimates of the relative potential for future development in those four key delineable hazard areas identified for Monmouth County through GIS analysis using data layers provided by the Monmouth County Office of GIS. These data layers include tax parcel records, building footprints and protected open space in combination with the geographically delineable hazard areas identified for the risk assessment purposes of this plan (coastal erosion, dam failure, flood, storm surge, wave action, landslide, and wildfire[20]). **Table 3d.5** lists the estimated number of potentially developable vacant parcels throughout Monmouth County in hazard areas, as well as the percentage identified for growth, limited growth, or conservation. Potentially developable vacant parcels were defined as those vacant parcels not located inside areas designated as protected open space.

It is estimated that there are 22,762 vacant parcels in Monmouth County with a total land area of about 133 square miles acres (or 28 percent of the County's overall land area)[21]. Most of the County's vacant land is generally found in far western areas where agriculture is still the primary land use. About 51 percent of vacant parcels (11,604) are located in delineable hazard areas. Of these, 21 percent (2,476 parcels) already classified as preserved or otherwise protected open space while the remaining 79 percent (9,128 parcels) are considered to be "potentially developable". Of the 9,128 potentially developable vacant parcels in delineable hazard areas, the New Jersey State Development and Redevelopment Plan classifies 69 percent (6,294 parcels) as areas identified for Growth, and the remaining 31 percent (2,834 parcels) in areas identified for Limited Growth or Conservation.

Potentially developable vacant parcels in delineable hazard areas would be good places to consider designating as open space in perpetuity to ensure that people and property do not become exposed in the future. Future losses can be reduced in cases where local communities can work to avoid or minimize development in known hazard areas. In cases where development in hazard areas is unavoidable, future losses can be reduced with the community's stringent enforcement of codes and standards to ensure hazard-resistant construction practices.

Together, Monmouth County's 53 municipalities have approximately 133 square miles of vacant land, potentially developable land – about 28 percent of the County's total land area. The paragraphs below analyze the likelihood for future development in each of the identified hazard areas to incorporate hazard-resistant design. Overall, while new development is expected to result in an increasing number of structures present in Monmouth County, codes and standards in place today will require that they be designed to provide a certain degree of protection from the hazards to which the County and its municipalities are susceptible.

[20] Flood hazard areas include the 100 year floodplain; wildfire areas include zones of high or extreme risk; landslide areas include zones of high landslide susceptibility; and storm surge areas include Category 1-4 inundation zones.

[21] Vacant parcels were defined as: (1) County Open Space and Recreation Areas in New Jersey (GIS files provided by NJDEP); (2) State Owned, Protected Open Space and Recreation Areas in New Jersey (GIS files provided by NJDEP); (3) Municipal Owned Open Space (GIS files provided by Monmouth County GIS); (4) Preserved Farmland in the County's Farmland Preservation Program (GIS files provided by Monmouth County GIS); and (5) parcels classified as vacant in the Monmouth County GIS parcel database (parcel class "1" and parcel class "null" where no improvement value was recorded, no building footprint was recorded, and where the parcel area was greater than 50 square feet, in order to eliminate 'sliver polygons' from misaligned layers). It is notable that the number of vacant parcels tabulated for the 2014 plan update (22,762) is substantially less than that which was calculated for the 2009 plan (32,835). This does not mean that the difference of 10,073 parcels is reflective of the number of parcels that have been built upon in the last several years but rather, a slight change in the methodology applied to capturing vacant parcels as well as changes to the source data sets since the last plan was prepared.

Table 3d.5
Potentially Developable Vacant Land in Identified Hazard Areas, by Jurisdiction

Jurisdiction	Total Estimated Number of Vacant Parcels	Vacant Parcels in Delineable Hazard Areas	Vacant Parcels in Delineable Hazard Areas Protected as Open Space	Potentially Developable Vacant Parcels in Delineable Hazard Areas	Percent of Potentially Developable Vacant Parcels in Delineable Hazard Areas Identified for Growth	Percent of Potentially Developable Vacant Parcels in Delineable Hazard Areas Identified for Limited Growth/ Conservation
Aberdeen, Township of	542	163	58	105	60%	40%
Allenhurst, Borough of	9	9	0	9	100%	0%
Allentown, Borough of	40	16	7	9	89%	11%
Asbury Park, City of	498	393	91	302	100%	0%
Atlantic Highlands, Borough of	237	221	41	180	59%	41%
Avon-By-The-Sea, Borough of	32	32	5	27	96%	4%
Belmar, Borough of	212	212	18	194	100%	0%
Bradley Beach, Borough of	112	100	17	83	100%	0%
Brielle, Borough of	109	88	4	84	100%	0%
Colts Neck, Township of	270	145	67	78	0%	100%
Deal, Borough of	60	37	0	37	100%	0%
Eatontown, Borough of	276	92	32	60	100%	0%
Englishtown, Borough of	37	21	7	14	100%	0%
Fair Haven, Borough of	68	50	10	40	78%	23%
Farmingdale, Borough of	26	8	0	8	100%	0%
Freehold, Borough of	83	0	0	0	0%	0%
Freehold, Township of	1,092	544	333	211	39%	61%
Hazlet, Township of	224	136	32	104	98%	2%
Highlands, Borough of	355	355	29	326	100%	0%
Holmdel, Township of	284	63	18	45	73%	27%
Howell, Township of	3,431	1,486	299	1,187	11%	89%
Interlaken, Borough of	17	17	0	17	100%	0%
Keansburg, Borough of	201	201	16	185	100%	0%
Keyport, Borough of	151	90	11	79	76%	24%
Lake Como, Borough of	45	44	8	36	100%	0%
Little Silver, Borough of	138	100	24	76	99%	1%
Loch Arbour, Village of	5	5	0	5	100%	0%
Long Branch, City of	788	550	78	472	100%	0%
Manalapan, Township of	1,773	299	71	228	79%	21%
Manasquan, Borough of	180	166	31	135	100%	0%
Marlboro, Township of	716	261	65	196	74%	26%
Matawan, Borough of	222	96	30	66	29%	71%
Middletown, Township of	2,316	1,194	291	903	91%	9%
Millstone, Township of	574	259	92	167	0%	100%
Monmouth Beach, Borough of	145	145	25	120	76%	24%
Neptune City, Borough of	78	51	0	51	100%	0%
Neptune, Township of	1,801	1,008	87	921	100%	0%
Ocean, Township of	788	338	48	290	100%	0%
Oceanport, Borough of	207	194	23	171	100%	0%
Red Bank, Borough of	288	44	9	35	100%	0%
Roosevelt, Borough of	32	15	11	4	0%	100%
Rumson, Borough of	122	122	35	87	76%	24%
Sea Bright, Borough of	174	174	0	174	0%	100%
Sea Girt, Borough of	76	73	0	73	100%	0%
Shrewsbury, Borough of	54	19	8	11	100%	0%
Shrewsbury, Township of	1	0	0	0	0%	0%
Spring Lake, Borough of	97	90	31	59	100%	0%

Table 3d.5
Potentially Developable Vacant Land in Identified Hazard Areas, by Jurisdiction

Jurisdiction	Total Estimated Number of Vacant Parcels	Vacant Parcels in Delineable Hazard Areas	Vacant Parcels in Delineable Hazard Areas Protected as Open Space	Potentially Developable Vacant Parcels in Delineable Hazard Areas	Percent of Potentially Developable Vacant Parcels in Delineable Hazard Areas Identified for Growth	Percent of Potentially Developable Vacant Parcels in Delineable Hazard Areas Identified for Limited Growth/ Conservation
Spring Lake Heights, Borough	264	49	8	41	100%	0%
Tinton Falls, Borough of	1,900	939	32	907	21%	79%
Union Beach, Borough of	263	263	117	146	95%	5%
Upper Freehold, Township of	493	215	156	59	0%	100%
Wall, Township of	698	326	92	234	97%	3%
West Long Branch, Borough of	157	85	8	77	100%	0%
Total	**22,762**	**11,604**	**2,476**	**9,128**	**69%**	**31%**

Source: Calculated by GIS Analysis using data provided by various state, federal and county sources. Data years vary, and figures in this table should be considered general estimates only.

Potential for Future Development to Impact Vulnerability for Non-delineable Hazards

Some hazards have discrete, delineable hazard areas associated with them. In other words, lines can be drawn on a map to show approximate areas that are potentially susceptible to the hazard versus those that are not. Delineable hazards identified in this plan include coastal erosion, dam failure, flooding, storm surge, wave action, landslides, and wildfires. In this section, we will address the potential for future development trends to impact vulnerability for non-delineable hazards. These hazards could impact any location – their geographic footprint is county-wide. **Non-delineable hazards identified in this plan include extreme temperatures, extreme wind, lightning, tornados, drought, earthquakes; and severe storms such as hurricanes, tropical storms, nor'easters, and winter storms.** Because these hazard areas cover the entirety of Monmouth County and each of its municipalities, future development trends in non-delineable hazard areas would be the same as those observed county-wide.

As a whole, Monmouth County is a county characterized by growth. Development is occurring throughout the county, and population is growing. Many communities, particularly in the Coastal and Bayshore Regions, are rebuilding in the wake of Hurricane Sandy. As population increases and more residential and commercial buildings, infrastructure, public facilities and other assets are constructed to support such growth, potential future hazard vulnerability is likely to increase. In general, more people, buildings, and infrastructure will be exposed to natural hazards over time. If current demographic trends continue, the proportion of the population representing young children, the elderly, and those with other special needs is likely to increase somewhat in the foreseeable future. Monmouth County is cognizant of the risks that it faces due to the impacts of natural hazards. Management of risk in the midst of growth is of paramount importance in each community's overall attainment of sustainability and disaster resiliency. Many municipalities have programs in place today which address certain natural hazards – whether it is a comprehensive or master plan, floodplain management ordinance, or erosion hazard area construction limitations. Together, Monmouth County's municipalities have a total of about 133 square miles of vacant, potentially developable land – about 28 percent of the County's total land area. New development on vacant parcels will increase exposure to natural hazards – though many impacts are expected to be reduced or eliminated because they are built to codes and standards which, in many cases, offer a certain degree of protection from future damages. In addition to development of vacant parcels, Monmouth County's more densely populated areas (particularly in the Coastal and Bayshore communities that are essentially built-out) are undergoing significant redevelopment. Older buildings (built before current codes and standards were adopted) are being demolished and replaced with new buildings built to current codes and standards. This trend has been observed in Monmouth County in recent years, and it has been exacerbated due to the recovery process from the devastating impacts of Hurricane Sandy. This type of development in hazard areas is actually working to somewhat reduce overall vulnerabilities for those parcels due to the fact that the redeveloped structures are being built to higher codes and standards than the previous structures had been.

In terms of conditions affecting vulnerability, redevelopment would likely offer some reduction in community vulnerability with substantial improvements bringing pre-existing building stock into compliance with current codes and standards, thus offering a certain degree of protection from future events. Greenfield development, on the other hand (that development that occurs on previously undeveloped parcels), is more likely to result in an increase in a community's vulnerability to the hazards because it represents an increase in exposure of people and property. **Table 3d.6** uses relative population trends, potentially developable vacant parcels, and local assessments of development trends to assess the potential for a substantial increase in future hazard vulnerability for countywide (non-delineable) hazards, and then documents applicable jurisdictional initiatives selected for the next plan maintenance phase to reduce risk for future development.

Table 3d.6
Potential for Future Development to Impact Vulnerability for Non-delineable Hazards[22]

Jurisdiction	Relative Population Trend[23] (2010-2040)	Number of Potentially Developable Vacant Parcels	Number of Potentially Developable Vacant Parcels in Areas Identified for Growth[24]	Local Characterization of Development Trends[25]	Potential for a Substantial Increase In Future Hazard Vulnerability Under Existing Conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[26]								
						Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Aberdeen, Township of	Substantial increase	459	63	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	•
Allenhurst, Borough of	Negligible increase	9	9	Little if any development expected		•	•	•		•	•	•	•
Allentown, Borough of	Negligible increase	26	8	Little if any development expected		•	•			•			
Asbury Park, City of	Substantial increase	370	302	Mix of greenfield development, infill and redevelopment	•		•		•	•			
Atlantic Highlands, Borough of	Moderate increase	196	107	Mix of greenfield development, infill and redevelopment	•	•	•		•	•	•	•	•
Avon-by-the-Sea, Borough of	Negligible increase	27	26	Little if any development expected		•	•		•	•			
Belmar, Borough of	Low level increase	194	194	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	•

22 Non-delineable hazards have hazard areas which cannot be delineated on a map; they can occur anywhere in the County. **Non-delineable hazards identified in this plan include: extreme temperatures, extreme wind, lightning, tornados, drought, earthquakes; and severe storms such as hurricanes, tropical storms, nor'easters, and winter storms.**

23 Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.

24 As per the *New Jersey State Development and Redevelopment Plan*

25 Local characterization of development trends based on municipal worksheet assessment

26 As per returned Plan Integration Worksheets

Table 3d.6
Potential for Future Development to Impact Vulnerability for Non-delineable Hazards[22]

Jurisdiction	Relative Population Trend[23] (2010-2040)	Number of Potentially Developable Vacant Parcels	Number of Potentially Developable Vacant Parcels in Areas Identified for Growth[24]	Local Characterization of Development Trends[25]	Potential for a Substantial Increase In Future Hazard Vulnerability Under Existing Conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[26]							
						Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Bradley Beach, Borough of	Moderate increase	94	83	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•			
Brielle, Borough of	Low level increase	105	84	Mix of greenfield development, infill and redevelopment	•	•	•			•			•
Colts Neck, Township of	Low level increase	143	0	Predominantly greenfield development		•	•			•			•
Deal, Borough of	Negligible increase	60	37	Little if any development expected		•	•	•	•	•	•		•
Eatontown, Borough of	Substantial increase	230	60	Mix of greenfield development, infill and redevelopment	•		•						
Englishtown, Borough of	Substantial increase	29	14	Mix of greenfield development, infill and redevelopment	•	•	•			•	•		
Fair Haven, Borough of	Low level increase	58	31	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	•
Farmingdale, Borough of	Substantial increase	26	8	Mix of greenfield development, infill and redevelopment	•		•	•	•	•	•	•	•
Freehold, Borough of	Substantial increase	74	0	Mix of greenfield development, infill and redevelopment		•	•	•	•	•	•	•	•

Table 3d.6
Potential for Future Development to Impact Vulnerability for Non-delineable Hazards[22]

Jurisdiction	Relative Population Trend[23] (2010-2040)	Number of Potentially Developable Vacant Parcels	Number of Potentially Developable Vacant Parcels in Areas Identified for Growth[24]	Local Characterization of Development Trends[25]	Potential for a Substantial Increase In Future Hazard Vulnerability Under Existing Conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[26]								
						Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Freehold, Township of	Substantial increase	700	83	Predominantly greenfield development	•		•	•		•	•	•	
Hazlet, Township of	Substantial increase	172	102	Mix of greenfield development, infill and redevelopment	•	•	•			•			
Highlands, Borough of	Moderate increase	326	326	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	•
Holmdel, Township of	Substantial increase	236	33	Predominantly greenfield development	•	•	•	•	•	•	•	•	•
Howell, Township of	Moderate increase	2,922	132	Mix of greenfield development, infill and redevelopment	•		•	•	•	•	•	•	•
Interlaken, Borough of	Negligible increase	17	17	Little to no development expected		•	•	•	•	•	•	•	•
Keansburg, Borough of	Substantial increase	185	185	Mix of greenfield development, infill and redevelopment	•	•	•	•	•		•	•	•
Keyport, Borough of	Substantial increase	139	60	Mix of greenfield development, infill and redevelopment	•	•	•			•			
Lake Como, Borough of	Negligible increase	37	36	Little to no development expected		•	•	•	•	•	•	•	•
Little Silver, Borough of	Moderate increase	93	75	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•		•

Table 3d.6
Potential for Future Development to Impact Vulnerability for Non-delineable Hazards[22]

Jurisdiction	Relative Population Trend[23] (2010-2040)	Number of Potentially Developable Vacant Parcels	Number of Potentially Developable Vacant Parcels in Areas Identified for Growth[24]	Local Characterization of Development Trends[25]	Potential for a Substantial Increase In Future Hazard Vulnerability Under Existing Conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[26]							
						Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Loch Arbour, Village of	Low level increase	5	5	Little to no development expected		•	•	•	•	•	•		•
Long Branch, City of	Substantial increase	707	472	Mix of greenfield development, infill and redevelopment	•	•	•			•			•
Manalapan, Township of	Moderate increase	1,619	179	Predominantly greenfield development	•	•	•	•	•	•	•	•	•
Manasquan, Borough of	Moderate increase	147	135	Mix of greenfield development, infill and redevelopment	•	•	•			•	•	•	•
Marlboro, Township of	Moderate increase	588	145	Predominantly greenfield development	•	•	•	•		•			
Matawan, Borough of	Substantial increase	179	19	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	•
Middletown, Township of	Moderate increase	1,916	825	Mix of greenfield development, infill and redevelopment	•	•	•			•			•
Millstone, Township of	Negligible increase	408	0	Predominantly greenfield development		•	•	•	•	•	•		•
Monmouth Beach, Borough of	Negligible increase	120	91	Mix of greenfield development, infill and redevelopment			•			•			

Table 3d.6
Potential for Future Development to Impact Vulnerability for Non-delineable Hazards[22]

Jurisdiction	Relative Population Trend[23] (2010-2040)	Number of Potentially Developable Vacant Parcels	Number of Potentially Developable Vacant Parcels in Areas Identified for Growth[24]	Local Characterization of Development Trends[25]	Potential for a Substantial Increase In Future Hazard Vulnerability Under Existing Conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[26]							
						Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Neptune City, Borough of	Substantial increase	78	51	Mix of greenfield development, infill and redevelopment	•	•	•	Awaiting municipal feedback		•	•	•	•
Neptune, Township of	Substantial increase	1,689	921	Mix of greenfield development, infill and redevelopment	•	•	•		•	•			•
Ocean, Township of	Moderate increase	722	290	Mix of greenfield development, infill and redevelopment	•	•	•						
Oceanport, Borough of	Substantial increase	182	171	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	
Red Bank, Borough of	Substantial increase	259	35	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•			
Roosevelt, Borough of	Negligible increase	10	0	Little to no development expected		•	•			•			
Rumson, Borough of	Low level increase	87	66	Mix of greenfield development, infill and redevelopment	•	•	•	•	•	•	•	•	•
Sea Bright, Borough of	Moderate increase	174	0	Mix of greenfield development, infill and redevelopment	•	•	•			•			•
Sea Girt, Borough of	Negligible increase	76	73	Little to no development expected		•	•	•	TBD	•	•	•	•
Shrewsbury, Borough of	Substantial increase	41	11	Mix of greenfield development, infill and redevelopment	•	•	•			•	•	•	•

Table 3d.6
Potential for Future Development to Impact Vulnerability for Non-delineable Hazards[22]

Jurisdiction	Relative Population Trend[23] (2010-2040)	Number of Potentially Developable Vacant Parcels	Number of Potentially Developable Vacant Parcels in Areas Identified for Growth[24]	Local Characterization of Development Trends[25]	Potential for a Substantial Increase In Future Hazard Vulnerability Under Existing Conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[26]							
						Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Shrewsbury, Township of	Substantial increase	1	0	Little to no development expected			•			•			
Spring Lake, Borough of	Negligible increase	66	59	Mix of greenfield development, infill and redevelopment	•	•	•			•			•
Spring Lake Heights, Borough of	Low level increase	255	41	Little to no development expected		•	•	•		•	•	•	•
Tinton Falls, Borough of	Substantial increase	1,843	186	Predominantly greenfield development	•	•	•	•	•	•	•	•	•
Union Beach, Borough of	Low level increase	146	139	Mix of greenfield development, infill and redevelopment	•		•		•				•
Upper Freehold, Township of	Negligible increase	178	0	Predominantly greenfield development	•	•	•	•	•		•	•	•
Wall, Township of	Moderate increase	555	228	Predominantly greenfield development	•	•	•			•			•
West Long Branch, Borough of	Substantial increase	145	77	Mix of greenfield development, infill and redevelopment	•	•	•			•			•
Monmouth, County of:	**Moderate increase**	**19,123**	**6,294**	**Mix of greenfield development, infill and redevelopment**	•	•	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**

Potential for Future Development to Impact Coastal Erosion Hazard Vulnerability

Infill development and redevelopment would not be likely to substantially increase a jurisdiction's overall exposure to coastal erosion because existing structures would be replaced with new structures, and the new structures would be built to higher codes and standards offering a certain degree of protection from the hazard. Greenfield development would be more likely, however, to have the potential to substantially increase a jurisdiction's overall vulnerability to the hazard because a new structure would be placed on previously undeveloped land.

Twenty-eight of Monmouth County's communities have mapped coastal erosion hazard areas. Of these, twelve communities have potentially developable vacant parcels in mapped coastal erosion hazard areas. The total area of these parcels is approximately 531 acres. In other words, nearly two percent of the County's potentially developable vacant land is in areas potentially susceptible to coastal erosion.

Any new construction on parcels in coastal erosion hazard areas would be built at least in accordance with current regulations as related to coastal erosion. New Jersey's Department of Environmental Protection manages coastal development. The regulated coastal zone is an irregularly shaped zone that covers the entire state coastline (although some inland tidal waters are not covered). A permit[27] is required to construct any structure on a beach or dune or within a certain distance of the coast. This distance depends on the structure's size and use. A single family residential home must be at least 150 feet from the mean high water line of any tidal waters or the landward limit of a beach or dune, whichever is most landward. The distance for commercial developments depends on the amount of necessary parking spaces (http://www.nj.gov/dep/cmp/). Developers do not need a permit to reconstruct any development that legally existed before July 19, 1994 and subsequently was damaged or destroyed, in whole or in part, by fire, storm, natural hazard or act of God. But any such reconstruction must (1) comply with existing law and (2) not enlarge the development (N.J. Administrative Code § 7:7-2.1).

Furthermore, the USACE has two ongoing projects in the planning area. The USACE Sea Bright to Manasquan, New Jersey, Beach Erosion Control Project; and the USACE Raritan Bay and Sandy Hook Bay, New Jersey, Beach Erosion and Hurricane Protection Project. These provide some level of erosion protection for many of Monmouth County's' communities. **Table 3d.7** presents a snapshot of the coastal erosion hazard, future development trends, the acreage of potentially developable parcels subject to coastal erosion, and the potential for future development of vacant parcels to substantially increase coastal erosion hazard vulnerability under existing conditions.

Jurisdictions with a potential for future development to substantially increase coastal erosion hazard vulnerability under existing conditions should: (a) include coastal erosion mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

[27] There are two linked Rules which govern the review of all coastal project proposals. The Coastal Permit Program Rules at N.J.A.C. 7:7E provide the processes for permit reviews. It includes details on what activities need permits; the qualifications for general permits or permits-by-rule; the details for pre-application meetings, contents and fees; review procedures and deadlines; permit appeals; and enforcement of the coastal laws and rules. The second rule is the Coastal Zone Management Rules (CZM Rules) at N.J.A.C. 7:7E. This rule defines Special Areas of environmental interest, details requirements for development projects and sets forth the compliance criteria for permit approval. Certain general permits require compliance of specific sections of the CZM Rule, for example "dunes" or "shellfish habitat." Individual Permit applications must address and demonstrate compliance with each applicable component of the CZM rules for the specific site and regulated activity to be approved. "Coastal Permit" or "permit" means a permit or an authorization, including a Federal Consistency determination and Water Quality Certificate, issued by the Department under this chapter pursuant to any of the following statutes: the Coastal Area Facility Review Act (CAFRA), N.J.S.A. 13:19-1 et seq., the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., the Waterfront Development Law, N.J.S.A. 12:5-3; Section 307 of the Federal Coastal Zone Management Act, 16 U.S.C. §§ 1451 et seq.; or Section 401 of the Federal Water Pollution Control Act, 33 U.S.C. §§ 1251 et seq.

Table 3d.7
Future Development and Coastal Erosion Hazard Area Vulnerability

Jurisdiction	Coastal Erosion Hazard Ranking	Relative Population Trend[28] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Coastal Erosion Hazard Areas	Percent of Potentially Developable Vacant Parcels in Coastal Erosion Hazard Areas	Local Characterization of Development Trends[29]	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas	Is the jurisdiction part of a USACE beach nourishment program? If so, this will offer some degree of protection	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas to substantially increase coastal erosion hazard vulnerability under existing conditions
Aberdeen, Township of	M	Substantial increase	415	0	0.0%	Mix of greenfield development, infill and redevelopment			
Allenhurst, Borough of	M	Negligible increase	4	0	0.0%	Little if any development expected			
Asbury Park, City of	M	Substantial increase	39	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Atlantic Highlands, Borough of	M	Moderate increase	60	2	3.0%	Mix of greenfield development, infill and redevelopment	•		
Avon-by-the-Sea, Borough of	M	Negligible increase	7	0	0.0%	Little if any development expected		•	
Belmar, Borough of	M	Low level increase	13	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Bradley Beach, Borough of	M	Moderate increase	14	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Brielle, Borough of	M	Low level increase	131	53	40.3%	Mix of greenfield development, infill and redevelopment	•		•
Deal, Borough of	M	Negligible increase	40	0	0.0%	Little if any development expected			
Fair Haven, Borough of	M	Low level increase	0.2	0	0.6%	Mix of greenfield development, infill and redevelopment	•		
Highlands, Borough of	M	Moderate increase	58	0	0.0%	Mix of greenfield development, infill and redevelopment			
Keansburg, Borough of	M	Substantial increase	85	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Keyport, Borough of	M	Substantial increase	68	0	0.0%	Mix of greenfield development, infill and redevelopment			
Little Silver, Borough of	M	Moderate increase	54	3	6.2%	Mix of greenfield development, infill and redevelopment	•		
Loch Arbour, Village of	M	Low level increase	2	0	0.0%	Little to no development expected			
Long Branch, City of	M	Substantial increase	288	0	0.0%	Mix of greenfield development, infill and redevelopment		•	

[28] Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.

[29] Local characterization of development trends based on municipal worksheet assessment

Table 3d.7
Future Development and Coastal Erosion Hazard Area Vulnerability

Jurisdiction	Coastal Erosion Hazard Ranking	Relative Population Trend[28] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Coastal Erosion Hazard Areas	Percent of Potentially Developable Vacant Parcels in Coastal Erosion Hazard Areas	Local Characterization of Development Trends[29]	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas	Is the jurisdiction part of a USACE beach nourishment program? If so, this will offer some degree of protection	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas to substantially increase coastal erosion hazard vulnerability under existing conditions
Manasquan, Borough of	M	Moderate increase	39	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Middletown, Township of	M	Moderate increase	2,313	97	4.2%	Mix of greenfield development, infill and redevelopment	•	•	
Monmouth Beach, Borough of	M	Negligible increase	57	19	32.6%	Mix of greenfield development, infill and redevelopment	•	•	
Neptune City, Borough of	M	Substantial increase	38	12	30.5%	Mix of greenfield development, infill and redevelopment	•		•
Neptune, Township of	M	Substantial increase	833	40	4.9%	Mix of greenfield development, infill and redevelopment	•	•	
Oceanport, Borough of	M	Substantial increase	218	75	34.5%	Mix of greenfield development, infill and redevelopment	•		•
Red Bank, Borough of	L	Substantial increase	79	3	3.2%	Mix of greenfield development, infill and redevelopment	•		
Rumson, Borough of	M	Low level increase	126	34	27.3%	Mix of greenfield development, infill and redevelopment	•		•
Sea Bright, Borough of	M	Moderate increase	38	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Sea Girt, Borough of	M	Negligible increase	20	0	0.0%	Little to no development expected		•	
Spring Lake, Borough of	M	Negligible increase	17	0	0.0%	Mix of greenfield development, infill and redevelopment		•	
Union Beach, Borough of	M	Low level increase	278	169	60.8%	Mix of greenfield development, infill and redevelopment	•	•	
Wall, Township of	M	Moderate increase	2,446	24	1.0%	Predominantly greenfield development	•		•
Monmouth, County of:	**H**	**Moderate increase**	**32,323**	**531**	**1.6%**	**Mix of greenfield development, infill and redevelopment**	•	•	•

[redacted]

[redacted]

Potential for Future Development to Impact Flood Hazard Vulnerability
- Under Existing Conditions and Future Conditions (Sea Level Rise)

Infill development and redevelopment would not be likely to substantially increase a jurisdiction's overall exposure to flooding because existing structures would be replaced with new structures, and the new structures would be built to higher codes and standards offering a certain degree of protection from the hazard. Greenfield development would be more likely, however, to have the potential to substantially increase a jurisdiction's overall vulnerability to the hazard because a new structure would be placed on previously undeveloped land.

All of Monmouth County's jurisdictions have mapped flood hazard areas; and 51 have potentially developable vacant parcels in mapped flood hazard areas. The total area of these parcels is approximately 11,266 acres. In other words, nearly 35 percent of the County's potentially developable vacant land is in areas potentially susceptible to flooding under existing conditions. By 2050, sea level rise could increase this acreage by about one percent to 11,577 acres. **Table 3d.9** presents a snapshot of the flood hazard, future development trends, the acreage of potentially developable parcels subject to flooding under existing conditions, the acres of potentially developable vacant parcels that could affected by sea level rise by the year 2050, and the potential for future development of vacant parcels to substantially increase flood hazard vulnerability under existing and future conditions.

Jurisdictions with a potential for future development trends to substantially increase flood hazard vulnerability under existing conditions should: (a) include flood mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

Jurisdictions with a potential for future development trends to substantially increase flood hazard vulnerability under future conditions (with sea level rise) should: (a) include sea level rise mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

Table 3d.9
Potential for Future Development to Impact Flood Hazard Vulnerability

Jurisdiction	Flood Hazard Areas Present	Relative Population Trend[32] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas[33]	Percent of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas	Acres of Potentially Developable Vacant Parcels Affected by Sea Level Rise[34]	Local Characterization of Development Trends[35]	Potential for Future Development on Vacant Parcels in Mapped Flood Hazard Areas	Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA	Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under SFHA 2050
Aberdeen Township	H	Substantial increase	415	185	44.7%	2	Mix of greenfield development, infill and redevelopment	●	●	●
Allenhurst Borough	H	Negligible increase	4	1	17.9%	1	Little if any development expected	●		
Allentown Borough	H	Negligible increase	6	4	61.4%	0	Little if any development expected	●		
Asbury Park City	H	Substantial increase	39	6	14.6%	6	Mix of greenfield development, infill and redevelopment	●		●
Atlantic Highlands Borough	H	Moderate increase	60	10	16.9%	8	Mix of greenfield development, infill and redevelopment	●	●	●
Avon-By-The-Sea Borough	H	Negligible increase	7	5	65.5%	1	Little if any development expected	●		
Belmar Borough	H	Low level increase	13	3	23.2%	6	Mix of greenfield development, infill and redevelopment	●		
Bradley Beach Borough	H	Moderate increase	14	0.5	3.5%	7	Mix of greenfield development, infill and redevelopment	●		
Brielle Borough	H	Low level increase	131	70	53.3%	2	Mix of greenfield development, infill and redevelopment	●	●	●
Colts Neck Township	H	Low level increase	793	209	26.4%	0	Predominantly greenfield development	●	●	●
Deal Borough	H	Negligible increase	40	11	28.2%	7	Little if any development expected	●	●	●
Eatontown Borough	H	Substantial increase	347	69	19.8%	0	Mix of greenfield development, infill and redevelopment	●	●	●
Englishtown Borough	H	Substantial increase	77	53	68.7%	0	Mix of greenfield development, infill and redevelopment	●	●	●

[32] Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.

[33] SFHA = Special Flood Hazard Areas

[34] SFHA2050 = Special Flood Hazard Areas modeled for year 2050 with Sea Level Rise incorporated (high)

[35] Local characterization of development trends based on municipal worksheet assessment

Table 3d.9
Potential for Future Development to Impact Flood Hazard Vulnerability

Jurisdiction	Flood Hazard Areas Present	Relative Population Trend[32] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas[33]	Percent of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas	Acres of Potentially Developable Vacant Parcels Affected by Sea Level Rise[34]	Local Characterization of Development Trends[35]	Potential for Future Development on Vacant Parcels in Mapped Flood Hazard Areas	Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA	Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under SFHA 2050
Fair Haven Borough	H	Low level increase	25	8	32.1%	0	Mix of greenfield development, infill and redevelopment	•		
Farmingdale Borough	H	Substantial increase	69	54	78.2%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Freehold Township	H	Substantial increase	2,622	862	32.9%	0	Predominantly greenfield development	•	•	•
Hazlet Township	H	Substantial increase	249	151	60.5%	5	Mix of greenfield development, infill and redevelopment	•	•	•
Highlands Borough	H	Moderate increase	58	31	53.1%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Holmdel Township	H	Substantial increase	593	123	20.7%	0	Predominantly greenfield development	•	•	•
Howell Township	H	Moderate increase	6,606	2,245	34.0%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Interlaken Borough	H	Negligible increase	7	3	50.7%	0	Little to no development expected	•		
Keansburg Borough	H	Substantial increase	85	70	82.5%	15	Mix of greenfield development, infill and redevelopment	•	•	•
Keyport Borough	H	Substantial increase	68	51	74.9%	1	Mix of greenfield development, infill and redevelopment	•	•	•
Lake Como Borough	H	Negligible increase	8	2	27.5%	1	Little to no development expected	•		
Little Silver Borough	H	Moderate increase	54	21	38.5%	2	Mix of greenfield development, infill and redevelopment	•	•	•
Loch Arbour Village	H	Low level increase	2	2	85.7%	0	Little to no development expected	•		
Long Branch City	H	Substantial increase	288	101	34.9%	69	Mix of greenfield development, infill and redevelopment	•	•	•
Manalapan Township	H	Moderate increase	3,194	964	30.2%	0	Predominantly greenfield development	•	•	•
Manasquan Borough	H	Moderate increase	39	31	79.6%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Marlboro Township	H	Moderate increase	2,014	722	35.9%	0	Predominantly greenfield development	•	•	•
Matawan Borough	H	Substantial increase	140	85	60.4%	0	Mix of greenfield development, infill and redevelopment	•	•	•

Table 3d.9
Potential for Future Development to Impact Flood Hazard Vulnerability

Jurisdiction	Flood Hazard Areas Present	Relative Population Trend[32] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas[33]	Percent of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas	Acres of Potentially Developable Vacant Parcels Affected by Sea Level Rise[34]	Local Characterization of Development Trends[35]	Potential for Future Development on Vacant Parcels in Mapped Flood Hazard Areas	Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA	Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under SFHA 2050
Middletown Township	H	Moderate increase	2,313	877	37.9%	23	Mix of greenfield development, infill and redevelopment	•	•	•
Millstone Township	H	Negligible increase	3,169	1,107	34.9%	0	Predominantly greenfield development	•	•	•
Monmouth Beach Borough	H	Negligible increase	57	55	95.9%	1	Mix of greenfield development, infill and redevelopment	•	•	•
Neptune City Borough	M	Substantial increase	38	15	38.4%	2	Mix of greenfield development, infill and redevelopment	•	•	•
Neptune Township	H	Substantial increase	833	286	34.3%	14	Mix of greenfield development, infill and redevelopment	•	•	•
Ocean Township	H	Moderate increase	1,009	390	38.6%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Oceanport Borough	H	Substantial increase	218	180	82.4%	8	Mix of greenfield development, infill and redevelopment	•	•	•
Red Bank Borough	M	Substantial increase	79	14	17.7%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Roosevelt Borough	L	Negligible increase	65	11	17.4%	0	Little to no development expected	•	•	•
Rumson Borough	H	Low level increase	126	67	53.2%	10	Mix of greenfield development, infill and redevelopment	•	•	•
Sea Bright Borough	H	Moderate increase	38	38	99.5%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Sea Girt Borough	H	Negligible increase	20	2	8.1%	4	Little to no development expected	•		
Shrewsbury Borough	H	Substantial increase	126	40	31.4%	0	Mix of greenfield development, infill and redevelopment	•	•	•
Shrewsbury Township	L	Substantial increase	0	0	0.0%	0	Little to no development expected			
Spring Lake Borough	H	Negligible increase	17	4	26.7%	5	Mix of greenfield development, infill and redevelopment	•		
Spring Lake Heights Borough	M	Low level increase	113	7	6.2%	0	Little to no development expected	•		
Tinton Falls Borough	M	Substantial increase	1,670	475	28.5%	0	Predominantly greenfield development	•	•	•
Union Beach Borough	H	Low level increase	278	277	99.4%	1	Mix of greenfield development, infill and redevelopment	•	•	•

Table 3d.9 Potential for Future Development to Impact Flood Hazard Vulnerability										
Jurisdiction	**Flood Hazard Areas Present**	**Relative Population Trend[32] (2010-2040)**	**Acres of Potentially Developable Vacant Parcels**	**Acres of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas[33]**	**Percent of Potentially Developable Vacant Parcels in Mapped Flood Hazard Areas**	**Acres of Potentially Developable Vacant Parcels Affected by Sea Level Rise[34]**	**Local Characterization of Development Trends[35]**	**Potential for Future Development on Vacant Parcels in Mapped Flood Hazard Areas**	**Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA**	**Potential for Future Development on Vacant Parcels in mapped Flood Hazard Areas to substantially increase flood hazard vulnerability under SFHA 2050**
Upper Freehold Township	H	Negligible increase	1,508	530	35.1%	0	Predominantly greenfield development	●	●	●
Wall Township	M	Moderate increase	2,446	706	28.9%	110	Predominantly greenfield development	●	●	●
West Long Branch Borough	M	Substantial increase	84	37	43.6%	0	Mix of greenfield development, infill and redevelopment	●	●	●
Monmouth County of	**H**	**Moderate increase**	**32,323**	**11,266**	**34.9%**	**311**	**Mix of greenfield development, infill and redevelopment**	●	●	●

Potential for Future Development to Impact Storm Surge Hazard Vulnerability

Infill development and redevelopment would not be likely to substantially increase a jurisdiction's overall exposure to storm surge because existing structures would be replaced with new structures, and the new structures would be built to higher codes and standards offering a certain degree of protection from the hazard. Greenfield development would be more likely, however, to have the potential to substantially increase a jurisdiction's overall vulnerability to the hazard because a new structure would be placed on previously undeveloped land.

Out of the 41 jurisdictions in Monmouth County with mapped storm surge hazard areas, all 41 have potentially developable vacant parcels in mapped storm surge hazard areas. The total area of these parcels is approximately 3,804 acres. In other words, nearly 12 percent of the County's potentially developable vacant land is in areas potentially susceptible to storm surge. **Table 3d.10** presents a snapshot of the storm surge hazard, future development trends, the acreage of potentially developable parcels subject to storm surge, and the potential for future development of vacant parcels to substantially increase storm surge hazard vulnerability under existing conditions.

Jurisdictions with a potential for future development to substantially increase storm surge hazard vulnerability under existing conditions should: (a) include storm surge mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

Table 3d.10
Potential for Future Development to Impact Storm Surge Hazard Vulnerability

Jurisdiction	Storm Surge Hazard Areas Present	Relative Population Trend[36] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Storm Surge Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Storm Surge Hazard Areas	Local Characterization of Development Trends[37]	Potential for Future Development on Vacant Parcels in Mapped Storm Surge Hazard Areas	Potential for future development on vacant parcels in mapped storm surge hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Aberdeen, Township of	H	Substantial increase	415	190	45.9%	Mix of greenfield development, infill and redevelopment	•	•
Allenhurst, Borough of	H	Negligible increase	4	4	100.0%	Little if any development expected	•	
Asbury Park, City of	H	Substantial increase	39	32	81.3%	Mix of greenfield development, infill and redevelopment	•	•
Atlantic Highlands, Borough of	H	Moderate increase	60	27	44.6%	Mix of greenfield development, infill and redevelopment	•	•
Avon-By-The-Sea, Borough of	H	Negligible increase	7	7	100.0%	Little if any development expected	•	
Belmar, Borough of	H	Low level increase	13	13	100.0%	Mix of greenfield development, infill and redevelopment	•	•
Bradley Beach, Borough of	H	Moderate increase	14	13	96.6%	Mix of greenfield development, infill and redevelopment	•	•
Brielle, Borough of	H	Low level increase	131	108	82.1%	Mix of greenfield development, infill and redevelopment	•	•
Deal, Borough of	H	Negligible increase	40	26	64.2%	Little if any development expected	•	•
Eatontown, Borough of	H	Substantial increase	347	53	15.4%	Mix of greenfield development, infill and redevelopment	•	•
Fair Haven, Borough of	H	Low level increase	25	14	55.7%	Mix of greenfield development, infill and redevelopment	•	•

36 Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.
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Table 3d.10
Potential for Future Development to Impact Storm Surge Hazard Vulnerability

Jurisdiction	Storm Surge Hazard Areas Present	Relative Population Trend[36] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Storm Surge Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Storm Surge Hazard Areas	Local Characterization of Development Trends[37]	Potential for Future Development on Vacant Parcels in Mapped Storm Surge Hazard Areas	Potential for future development on vacant parcels in mapped storm surge hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Hazlet, Township of	H	Substantial increase	249	156	62.6%	Mix of greenfield development, infill and redevelopment	●	●
Highlands, Borough of	H	Moderate increase	58	35	60.5%	Mix of greenfield development, infill and redevelopment	●	●
Holmdel, Township of	M	Substantial increase	593	68	11.4%	Predominantly greenfield development	●	●
Howell, Township of	M	Moderate increase	6,606	181	2.7%	Mix of greenfield development, infill and redevelopment	●	●
Interlaken, Borough of	H	Negligible increase	7	7	100.0%	Little to no development expected	●	
Keansburg, Borough of	H	Substantial increase	85	85	100.0%	Mix of greenfield development, infill and redevelopment	●	●
Keyport, Borough of	H	Substantial increase	68	57	83.7%	Mix of greenfield development, infill and redevelopment	●	●
Lake Como, Borough of	H	Negligible increase	8	8	99.4%	Little to no development expected	●	
Little Silver, Borough of	H	Moderate increase	54	47	87.6%	Mix of greenfield development, infill and redevelopment	●	●
Loch Arbour, Village of	H	Low level increase	2	2	100.0%	Little to no development expected	●	
Long Branch, City of	H	Substantial increase	288	211	73.3%	Mix of greenfield development, infill and redevelopment	●	●
Manasquan, Borough of	H	Moderate increase	39	38	95.9%	Mix of greenfield development, infill and redevelopment	●	●
Matawan, Borough of	H	Substantial increase	140	65	46.7%	Mix of greenfield development, infill and redevelopment	●	●

Table 3d.10
Potential for Future Development to Impact Storm Surge Hazard Vulnerability

Jurisdiction	Storm Surge Hazard Areas Present	Relative Population Trend[36] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Storm Surge Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Storm Surge Hazard Areas	Local Characterization of Development Trends[37]	Potential for Future Development on Vacant Parcels in Mapped Storm Surge Hazard Areas	Potential for future development on vacant parcels in mapped storm surge hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Middletown, Township of	H	Moderate increase	2,313	808	35.0%	Mix of greenfield development, infill and redevelopment	●	●
Monmouth Beach, Borough of	H	Negligible increase	57	57	98.6%	Mix of greenfield development, infill and redevelopment	●	●
Neptune City, Borough of	H	Substantial increase	38	22	56.3%	Mix of greenfield development, infill and redevelopment	●	●
Neptune, Township of	H	Substantial increase	833	152	18.2%	Mix of greenfield development, infill and redevelopment	●	●
Ocean, Township of	H	Moderate increase	1,009	72	7.2%	Mix of greenfield development, infill and redevelopment	●	●
Oceanport, Borough of	H	Substantial increase	218	214	98.0%	Mix of greenfield development, infill and redevelopment	●	●
Red Bank, Borough of	M	Substantial increase	79	15	18.7%	Mix of greenfield development, infill and redevelopment	●	●
Rumson, Borough of	H	Low level increase	126	103	82.3%	Mix of greenfield development, infill and redevelopment	●	●
Sea Bright, Borough of	H	Moderate increase	38	38	99.2%	Mix of greenfield development, infill and redevelopment	●	●
Sea Girt, Borough of	H	Negligible increase	20	19	96.8%	Little to no development expected	●	
Shrewsbury, Borough of	H	Substantial increase	126	99	78.4%	Mix of greenfield development, infill and redevelopment	●	●
Spring Lake, Borough of	H	Negligible increase	17	16	92.7%	Mix of greenfield development, infill and redevelopment	●	●

Table 3d.10 Potential for Future Development to Impact Storm Surge Hazard Vulnerability								
Jurisdiction	**Storm Surge Hazard Areas Present**	**Relative Population Trend[36] (2010-2040)**	**Acres of Potentially Developable Vacant Parcels**	**Acres of Potentially Developable Vacant Parcels in Mapped Storm Surge Hazard Areas**	**Percent of Potentially Developable Vacant Land in Mapped Storm Surge Hazard Areas**	**Local Characterization of Development Trends[37]**	**Potential for Future Development on Vacant Parcels in Mapped Storm Surge Hazard Areas**	**Potential for future development on vacant parcels in mapped storm surge hazard areas to substantially increase storm surge hazard vulnerability under existing conditions**
Spring Lake Heights, Borough of	H	Low level increase	113	104	92.2%	Little to no development expected	●	●
Tinton Falls, Borough of	M	Substantial increase	1,670	95	5.7%	Predominantly greenfield development	●	●
Union Beach, Borough of	H	Low level increase	278	278	100.0%	Mix of greenfield development, infill and redevelopment	●	●
Wall, Township of	H	Moderate increase	2,446	218	8.9%	Predominantly greenfield development	●	●
West Long Branch, Borough of	H	Substantial increase	84	49	57.9%	Mix of greenfield development, infill and redevelopment	●	●
Monmouth, County of	**H**	**Moderate increase**	**32,323**	**3,804**	**11.8%**	**Mix of greenfield development, infill and redevelopment**	●	●

Potential for Future Development to Impact Wave Action Hazard Vulnerability

Infill development and redevelopment would not be likely to substantially increase a jurisdiction's overall exposure to wave action because existing structures would be replaced with new structures, and the new structures would be built to higher codes and standards offering a certain degree of protection from the hazard. Greenfield development would be more likely, however, to have the potential to substantially increase a jurisdiction's overall vulnerability to the hazard because a new structure would be placed on previously undeveloped land.

Out of the 29 jurisdictions in Monmouth County with mapped wave action hazard areas, 22 have potentially developable vacant parcels in mapped wave action hazard areas. The total area of these parcels is approximately 464 acres. In other words, between 1 and 2 percent of the County's potentially developable vacant land is in areas potentially susceptible to wave action. **Table 3d.11** presents a snapshot of the wave action hazard, future development trends, the acreage of potentially developable parcels subject to wave action, and the potential for future development of vacant parcels to substantially increase wave action hazard vulnerability under existing conditions.

Jurisdictions with a potential for future development to substantially increase wave action hazard vulnerability under existing conditions should: (a) include wave action mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

Table 3d.11
Potential for Future Development to Impact Wave Action Hazard Vulnerability

Jurisdiction	Wave Action Hazard Areas Present	Relative Population Trend[38] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Wave Action Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Wave Action Hazard Areas	Local Characterization of Development Trends[39]	Potential for Future Development on Vacant Parcels in mapped Wave Action Hazard Areas	Potential for future development on vacant parcels in mapped wave action hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Aberdeen Township	M	Substantial increase	415	10	2.5%	Mix of greenfield development, infill and redevelopment	•	•
Allenhurst Borough	M	Negligible increase	4	0	0.0%	Little if any development expected		
Asbury Park City	M	Substantial increase	39	0	0.0%	Mix of greenfield development, infill and redevelopment		
Atlantic Highlands Borough	M	Moderate increase	60	0.4	0.6%	Mix of greenfield development, infill and redevelopment	•	
Avon-By-The-Sea Borough	M	Negligible increase	7	0	0.0%	Little if any development expected		
Belmar Borough	M	Low level increase	13	0	0.0%	Mix of greenfield development, infill and redevelopment		
Bradley Beach Borough	M	Moderate increase	14	0	0.0%	Mix of greenfield development, infill and redevelopment		
Brielle Borough	M	Low level increase	131	1	0.7%	Mix of greenfield development, infill and redevelopment	•	
Deal Borough	M	Negligible increase	40	8	19.2%	Little if any development expected	•	
Fair Haven Borough	M	Low level increase	25	5	22.1%	Mix of greenfield development, infill and redevelopment	•	
Highlands Borough	M	Moderate increase	58	10	17.2%	Mix of greenfield development, infill and redevelopment	•	•
Keansburg Borough	M	Substantial increase	85	9	10.6%	Mix of greenfield development, infill and redevelopment	•	

[38] Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.
[39] Local characterization of development trends based on municipal worksheet assessment

Table 3d.11
Potential for Future Development to Impact Wave Action Hazard Vulnerability

Jurisdiction	Wave Action Hazard Areas Present	Relative Population Trend[38] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Wave Action Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Wave Action Hazard Areas	Local Characterization of Development Trends[39]	Potential for Future Development on Vacant Parcels in mapped Wave Action Hazard Areas	Potential for future development on vacant parcels in mapped wave action hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Keyport Borough	M	Substantial increase	68	5	7.9%	Mix of greenfield development, infill and redevelopment	●	
Loch Arbour Village	M	Low level increase	2	1	55.0%	Little to no development expected	●	
Long Branch City	M	Substantial increase	288	22	7.6%	Mix of greenfield development, infill and redevelopment	●	●
Manasquan Borough	M	Moderate increase	39	2	4.6%	Mix of greenfield development, infill and redevelopment	●	
Middletown Township	M	Moderate increase	2,313	80	3.4%	Mix of greenfield development, infill and redevelopment	●	●
Monmouth Beach Borough	M	Negligible increase	57	2	2.8%	Mix of greenfield development, infill and redevelopment	●	
Neptune City Borough	M	Substantial increase	38	12	30.5%	Mix of greenfield development, infill and redevelopment	●	●
Neptune Township	M	Substantial increase	833	37	4.4%	Mix of greenfield development, infill and redevelopment	●	●
Oceanport Borough	M	Substantial increase	218	0	0.0%	Mix of greenfield development, infill and redevelopment		
Red Bank Borough	M	Substantial increase	79	1	0.9%	Mix of greenfield development, infill and redevelopment	●	
Rumson Borough	M	Low level increase	126	30	23.5%	Mix of greenfield development, infill and redevelopment	●	●
Sea Bright Borough	M	Moderate increase	38	10	26.1%	Mix of greenfield development, infill and redevelopment	●	●
Sea Girt Borough	M	Negligible increase	20	0.5	2.4%	Little to no development expected	●	
Spring Lake Borough	M	Negligible increase	17	0.4	2.4%	Mix of greenfield development, infill and redevelopment	●	
Union Beach Borough	M	Low level increase	278	216	77.5%	Mix of greenfield development, infill and redevelopment	●	●
Wall Township	M	Moderate increase	2,446	3	0.1%	Predominantly greenfield development	●	
Monmouth County of	**H**	**Moderate increase**	**32,323**	**464**	**1.4%**	**Mix of greenfield development, infill and redevelopment**	●	

Potential for Future Development to Impact Landslide Hazard Vulnerability

Infill development and redevelopment would not be likely to substantially increase a jurisdiction's overall exposure to landslides because existing structures would be replaced with new structures, and the new structures would be built to higher codes and standards offering a certain degree of protection from the hazard. Greenfield development would be more likely, however, to have the potential to substantially increase a jurisdiction's overall vulnerability to the hazard because a new structure would be placed on previously undeveloped land.

Out of the 10 jurisdictions in Monmouth County with landslide hazard susceptibility, 7 have potentially developable vacant parcels in mapped landslide hazard areas. The total area of these parcels is approximately 521 acres. In other words, between one and two percent of the County's potentially developable vacant land is in areas potentially susceptible to landslides. **Table 3d.12** presents a snapshot of the landslide hazard, future development trends, the acreage of potentially developable parcels subject to landslides, and the potential for future development of vacant parcels to substantially increase landslide hazard vulnerability under existing conditions.

Jurisdictions with a potential for future development to substantially increase landslide hazard vulnerability under existing conditions should: (a) include landslide mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

Table 3d.12
Potential for Future Development to Impact Landslide Hazard Vulnerability

Jurisdiction	Landslide Hazard Areas Present	Relative Population Trend[40] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Landslide Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Landslide Hazard Areas	Local Characterization of Development Trends[41]	Potential for Future Development on Vacant Parcels in mapped Landslide Hazard Areas	Potential for future development on vacant parcels in mapped landslide hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Atlantic Highlands, Borough of	H	Moderate increase	60	39	65.1%	Mix of greenfield development, infill and redevelopment	•	•
Fair Haven, Borough of	M	Low level increase	25	9	35.4%	Mix of greenfield development, infill and redevelopment	•	
Freehold, Township of	L	Substantial increase	2,622	0	0.0%	Predominantly greenfield development		
Highlands, Borough of	H	Moderate increase	58	58	100.0%	Mix of greenfield development, infill and redevelopment	•	•
Howell, Township of	L	Moderate increase	6,606	0	0.0%	Mix of greenfield development, infill and redevelopment		
Little Silver, Borough of	M	Moderate increase	54	1	2.8%	Mix of greenfield development, infill and redevelopment	•	

40 Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.

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Table 3d.12
Potential for Future Development to Impact Landslide Hazard Vulnerability

Jurisdiction	Landslide Hazard Areas Present	Relative Population Trend[40] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Landslide Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Landslide Hazard Areas	Local Characterization of Development Trends[41]	Potential for Future Development on Vacant Parcels in mapped Landslide Hazard Areas	Potential for future development on vacant parcels in mapped landslide hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Middletown, Township of	M	Moderate increase	2,313	180	7.8%	Mix of greenfield development, infill and redevelopment	●	●
Oceanport, Borough of	L	Substantial increase	218	5	2.3%	Mix of greenfield development, infill and redevelopment	●	
Rumson, Borough of	M	Low level increase	126	126	100.0%	Mix of greenfield development, infill and redevelopment	●	●
Tinton Falls, Borough of	M	Substantial increase	1,670	0	0.0%	Predominantly greenfield development		
Monmouth, County of:	**M**	**Moderate increase**	**32,323**	**521**	**1.6%**	**Mix of greenfield development, infill and redevelopment**	●	●

Potential for Future Development to Impact Wildfire Hazard Vulnerability

Infill development and redevelopment would not be likely to substantially increase a jurisdiction's overall exposure to wildfire because existing structures would be replaced with new structures, and the new structures would be built to higher codes and standards offering a certain degree of protection from the hazard. Greenfield development would be more likely, however, to have the potential to substantially increase a jurisdiction's overall vulnerability to the hazard because a new structure would be placed on previously undeveloped land.

All 53 jurisdictions in Monmouth County have mapped wildfire hazard areas; 40 have potentially developable vacant parcels in mapped wildfire hazard areas (high or extreme). The total area of these parcels is approximately 16,940 acres. In other words, between one and two percent of the County's potentially developable vacant land is in areas potentially susceptible to wildfires. **Table 3d.13** presents a snapshot of the wildfire hazard, future development trends, the acreage of potentially developable parcels subject to wildfires, and the potential for future development to substantially increase wildfire hazard vulnerability under existing conditions.

Jurisdictions with a potential for future development to substantially increase wildfire hazard vulnerability under existing conditions should: (a) include wildfire mitigation measures in their mitigation strategies; and/or (b) select jurisdictional plan integration initiatives for the next plan maintenance phase that can potentially reduce risk for future development.

Table 3d.13
Potential for Future Development to Impact Wildfire Hazard Vulnerability

Jurisdiction	Wildfire Hazard Areas Present	Relative Population Trend[42] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Wildfire Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Wildfire Hazard Areas	Local Characterization of Development Trends[43]	Potential for Future Development on Vacant Parcels in mapped Wildfire Hazard Areas	Potential for future development on vacant parcels in mapped wildfire hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Aberdeen, Township of	L	Substantial increase	415	129	31.2%	Mix of greenfield development, infill and redevelopment	•	•
Allenhurst, Borough of	L	Negligible increase	4	0	0.0%	Little if any development expected		
Allentown, Borough of	H	Negligible increase	6	0.4	5.7%	Little if any development expected	•	
Asbury Park, City of	L	Substantial increase	39	0	0.0%	Mix of greenfield development, infill and redevelopment		
Atlantic Highlands, Borough of	L	Moderate increase	60	20	33.5%	Mix of greenfield development, infill and redevelopment	•	•
Avon-by-the-Sea, Borough of	L	Negligible increase	7	0	0.0%	Little if any development expected		
Belmar, Borough of	L	Low level increase	13	0	0.0%	Mix of greenfield development, infill and redevelopment		
Bradley Beach, Borough of	L	Moderate increase	14	0	0.0%	Mix of greenfield development, infill and redevelopment		
Brielle, Borough of	L	Low level increase	131	93	70.6%	Mix of greenfield development, infill and redevelopment	•	•
Colts Neck, Township of	M	Low level increase	793	408	51.4%	Predominantly greenfield development	•	•
Deal, Borough of	L	Negligible increase	40	2	5.0%	Little if any development expected	•	
Eatontown, Borough of	L	Substantial increase	347	54	15.4%	Mix of greenfield development, infill and redevelopment	•	•
Englishtown, Borough of	L	Substantial increase	77	43	56.1%	Mix of greenfield development, infill and redevelopment	•	•
Fair Haven, Borough of	L	Low level increase	25	7	27.4%	Mix of greenfield development, infill and redevelopment	•	
Farmingdale, Borough of	L	Substantial increase	69	0	0.0%	Mix of greenfield development, infill and redevelopment		

[42] Relative population trend, where: negligible is defined as an increase of 0 to 50 people per square mile; low is defined as an increase of 50 to 100 people per square mile; moderate is defined as an increase of 100 to 150 people per square mile; and high is defined as an increase of over 150 people per square mile.

[43] Local characterization of development trends based on municipal worksheet assessment

Table 3d.13 Potential for Future Development to Impact Wildfire Hazard Vulnerability								
Jurisdiction	**Wildfire Hazard Areas Present**	**Relative Population Trend[42] (2010-2040)**	**Acres of Potentially Developable Vacant Parcels**	**Acres of Potentially Developable Vacant Parcels in Mapped Wildfire Hazard Areas**	**Percent of Potentially Developable Vacant Land in Mapped Wildfire Hazard Areas**	**Local Characterization of Development Trends[43]**	**Potential for Future Development on Vacant Parcels in mapped Wildfire Hazard Areas**	**Potential for future development on vacant parcels in mapped wildfire hazard areas to substantially increase storm surge hazard vulnerability under existing conditions**
Freehold, Borough of	L	Substantial increase	50	0	0.0%	Mix of greenfield development, infill and redevelopment		
Freehold, Township of	L	Substantial increase	2,622	1,432	54.6%	Predominantly greenfield development	•	•
Hazlet, Township of	L	Substantial increase	249	150	60.3%	Mix of greenfield development, infill and redevelopment	•	•
Highlands, Borough of	L	Moderate increase	58	20	33.8%	Mix of greenfield development, infill and redevelopment	•	•
Holmdel, Township of	M	Substantial increase	593	147	24.8%	Predominantly greenfield development	•	•
Howell, Township of	H	Moderate increase	6,606	4,024	60.9%	Mix of greenfield development, infill and redevelopment	•	•
Interlaken, Borough of	L	Negligible increase	7	0	0.0%	Little to no development expected		
Keansburg, Borough of	L	Substantial increase	85	21	24.9%	Mix of greenfield development, infill and redevelopment	•	•
Keyport, Borough of	L	Substantial increase	68	36	52.7%	Mix of greenfield development, infill and redevelopment	•	•
Lake Como, Borough of	L	Negligible increase	8	0	0.0%	Little to no development expected		
Little Silver, Borough of	L	Moderate increase	54	9	16.7%	Mix of greenfield development, infill and redevelopment	•	
Loch Arbour, Village of	L	Low level increase	2	0	0.0%	Little to no development expected		
Long Branch, City of	L	Substantial increase	288	15	5.3%	Mix of greenfield development, infill and redevelopment	•	•
Manalapan, Township of	L	Moderate increase	3,194	1,452	45.5%	Predominantly greenfield development	•	•
Manasquan, Borough of	L	Moderate increase	39	2	5.2%	Mix of greenfield development, infill and redevelopment	•	
Marlboro, Township of	L	Moderate increase	2,014	1,237	61.4%	Predominantly greenfield development	•	•
Matawan, Borough of	L	Substantial increase	140	11	7.6%	Mix of greenfield development, infill and redevelopment	•	•
Middletown, Township of	L	Moderate increase	2,313	703	30.4%	Mix of greenfield development, infill and redevelopment	•	•

Table 3d.13
Potential for Future Development to Impact Wildfire Hazard Vulnerability

Jurisdiction	Wildfire Hazard Areas Present	Relative Population Trend[42] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Wildfire Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Wildfire Hazard Areas	Local Characterization of Development Trends[43]	Potential for Future Development on Vacant Parcels in mapped Wildfire Hazard Areas	Potential for future development on vacant parcels in mapped wildfire hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Millstone, Township of	M	Negligible increase	3,169	1,743	55.0%	Predominantly greenfield development	•	•
Monmouth Beach, Borough of	L	Negligible increase	57	20	34.8%	Mix of greenfield development, infill and redevelopment	•	•
Neptune City, Borough of	L	Substantial increase	38	11	28.6%	Mix of greenfield development, infill and redevelopment	•	•
Neptune, Township of	L	Substantial increase	833	478	57.4%	Mix of greenfield development, infill and redevelopment	•	•
Ocean, Township of	L	Moderate increase	1,009	544	53.9%	Mix of greenfield development, infill and redevelopment	•	•
Oceanport, Borough of	L	Substantial increase	218	108	49.7%	Mix of greenfield development, infill and redevelopment	•	•
Red Bank, Borough of	L	Substantial increase	79	9	11.1%	Mix of greenfield development, infill and redevelopment	•	
Roosevelt, Borough of	H	Negligible increase	65	48	74.0%	Little to no development expected	•	•
Rumson, Borough of	M	Low level increase	126	43	33.9%	Mix of greenfield development, infill and redevelopment	•	•
Sea Bright, Borough of	L	Moderate increase	38	5	14.0%	Mix of greenfield development, infill and redevelopment	•	
Sea Girt, Borough of	L	Negligible increase	20	0	0.0%	Little to no development expected		
Shrewsbury, Borough of	L	Substantial increase	126	46	36.4%	Mix of greenfield development, infill and redevelopment	•	•
Shrewsbury, Township of	L	Substantial increase	0	0	0.0%	Little to no development expected		
Spring Lake, Borough of	L	Negligible increase	17	0	0.0%	Mix of greenfield development, infill and redevelopment		
Spring Lake Heights, Borough of	L	Low level increase	113	1	1.3%	Little to no development expected	•	
Tinton Falls, Borough of	M	Substantial increase	1,670	943	56.4%	Predominantly greenfield development	•	•
Union Beach, Borough of	L	Low level increase	278	247	88.8%	Mix of greenfield development, infill and redevelopment	•	•
Upper Freehold, Township of	L	Negligible increase	1,508	866	57.4%	Predominantly greenfield development	•	•

Table 3d.13
Potential for Future Development to Impact Wildfire Hazard Vulnerability

Jurisdiction	Wildfire Hazard Areas Present	Relative Population Trend[42] (2010-2040)	Acres of Potentially Developable Vacant Parcels	Acres of Potentially Developable Vacant Parcels in Mapped Wildfire Hazard Areas	Percent of Potentially Developable Vacant Land in Mapped Wildfire Hazard Areas	Local Characterization of Development Trends[43]	Potential for Future Development on Vacant Parcels in mapped Wildfire Hazard Areas	Potential for future development on vacant parcels in mapped wildfire hazard areas to substantially increase storm surge hazard vulnerability under existing conditions
Wall, Township of	H	Moderate increase	2,446	1,796	73.4%	Predominantly greenfield development	●	●
West Long Branch, Borough of	L	Substantial increase	84	18	21.8%	Mix of greenfield development, infill and redevelopment	●	●
Monmouth, County of:	**M**	**Moderate increase**	32,323	16,940	52.4%	**Mix of greenfield development, infill and redevelopment**	●	●

Conclusion

Table 3d.14 presents a summary of information presented on the previous pages regarding the potential for future development to substantially impact hazard vulnerability for the subset of delineable hazards, and then documents initiatives that have been selected by each jurisdiction for the next plan maintenance phase to reduce risk for future development.

Note that, new construction today must comply with more stringent building codes than those that existed in decades past. Therefore, any substandard housing units replaced by new units through infill or redevelopment would be required to be built to higher codes and standards which in many cases would incorporate various levels of disaster resistance (for example: replacing a pre-FIRM residential structure with a building elevated above the BFE). This could have the effect of providing a certain increase in resiliency and decrease in vulnerability. However, at the same time, when parcels are redeveloped with higher value and larger structures (i.e. going from a two bedroom cottage to a four bedroom house), these factors would contribute to an increase in vulnerability at that same site. For the purposes of this planning level assessment, it has generally been assumed that infill and redevelopment would not typically result in a significant increase in a community's overall vulnerability. This assumption should be re-evaluated by the County Planning Department based on present-day conditions at the time of each future plan update.

Table 3d.14
Potential for Future Development to Impact Vulnerability for Delineable Hazards[44]

Jurisdiction	Coastal Erosion Hazard Ranking	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas to substantially increase coastal erosion hazard vulnerability under existing conditions	Dam Failure Hazard Ranking	Potential for Future Development on Vacant Parcels in Dam Failure Hazard Areas to substantially increase dam failure hazard vulnerability under existing conditions	Flood Hazard Ranking	Potential for Future Development on Vacant Parcels in Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA	Potential for Future Development on Vacant Parcels in Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA 2050	Storm Surge Hazard Ranking	Potential for Future Development on Vacant Parcels in Surge Hazard Areas to substantially increase surge hazard vulnerability under existing conditions	Wave Action Hazard Ranking	Potential for Future Development on Vacant Parcels in Wave Action Hazard Areas to substantially increase wave action hazard vulnerability under existing conditions	Landslide Hazard Ranking	Potential for Future Development on Vacant Parcels in Landslide Hazard Areas to substantially increase landslide hazard vulnerability under existing conditions	Wildfire Hazard Ranking	Potential for Future Development on Vacant Parcels in Wildfire Hazard Areas to substantially increase wildfire hazard vulnerability under existing conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[45]: Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Aberdeen, Township of	M		N/A		H	•	•	H	•	M	•	N/A		L	•	•	•	•	•	•	•	•	•
Allenhurst, Borough of	M		N/A		H			H		M		N/A		L		•	•	•		•	•	•	•
Allentown, Borough of	N/A		L		H			N/A		N/A		N/A		H		•	•			•			
Asbury Park, City of	M		N/A		H		•	H	•	M		N/A		L			•		•	•			
Atlantic Highlands, Borough of	M		N/A		H	•	•	H	•	M		H	•	L	•	•	•		•	•	•	•	•
Avon-by-the-Sea, Borough of	M		N/A		H			H		M		N/A		L		•	•		•	•			
Belmar, Borough of	M		N/A		H			H	•	M		N/A		L		•	•	•	•	•	•	•	•
Bradley Beach, Borough of	M		N/A		H			H	•	M		N/A		L		•	•	•	•	•			
Brielle, Borough of	M	•	N/A		H	•	•	H	•	M		N/A		L	•	•	•			•			•
Colts Neck, Township of	N/A		L		H	•	•	N/A		N/A		N/A		M	•	•	•			•			•
Deal, Borough of	M		N/A		H	•	•	H	•	M		N/A		L		•	•	•	•	•	•		•
Eatontown, Borough of	N/A		N/A		H	•	•	H	•	N/A		N/A		L	•		•						
Englishtown, Borough of	N/A		L		H	•	•	N/A		N/A		N/A		L	•	•	•			•	•		
Fair Haven, Borough of	M		N/A		H			H	•	M		M		L		•	•	•	•	•	•	•	•
Farmingdale, Borough of	N/A		N/A		H	•	•	N/A		N/A		N/A		L			•	•	•	•	•	•	•
Freehold, Borough of	N/A		N/A					N/A		N/A		N/A		L		•	•	•	•	•	•	•	•
Freehold, Township of	N/A		L		H	•	•	N/A		N/A		L		H	•		•	•		•	•	•	

[44] Color key: Red = High Potential (H); Orange = Moderate Potential (M); Yellow = Low Potential (L)
[45] As per returned Plan Integration Worksheets (see Appendix 1.8).

Table 3d.14
Potential for Future Development to Impact Vulnerability for Delineable Hazards[44]

Jurisdiction	Coastal Erosion Hazard Ranking	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas to substantially increase coastal erosion hazard vulnerability under existing conditions	Dam Failure Hazard Ranking	Potential for Future Development on Vacant Parcels in Dam Failure Hazard Areas to substantially increase dam failure hazard vulnerability under existing conditions	Flood Hazard Ranking	Potential for Future Development on Vacant Parcels in Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA	Potential for Future Development on Vacant Parcels in Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA 2050	Storm Surge Hazard Ranking	Potential for Future Development on Vacant Parcels in Surge Hazard Areas to substantially increase surge hazard vulnerability under existing conditions	Wave Action Hazard Ranking	Potential for Future Development on Vacant Parcels in Wave Action Hazard Areas to substantially increase wave action hazard vulnerability under existing conditions	Landslide Hazard Ranking	Potential for Future Development on Vacant Parcels in Landslide Hazard Areas to substantially increase landslide hazard vulnerability under existing conditions	Wildfire Hazard Ranking	Potential for Future Development on Vacant Parcels in Wildfire Hazard Areas to substantially increase wildfire hazard vulnerability under existing conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[45]: Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Hazlet, Township of	N/A		N/A		H	•	•	H	•	N/A		N/A		L	•	•	•			•			
Highlands, Borough of	M		N/A		H	•	•	H	•	M	•	H	•	L	•	•	•	•	•	•	•	•	•
Holmdel, Township of	N/A		N/A		H	•	•	M	•	N/A		N/A		M	•	•	•	•	•	•	•	•	•
Howell, Township of	N/A		L	•	H	•	•	M	•	N/A		L		H	•		•	•	•	•	•	•	•
Interlaken, Borough of	N/A		N/A		H			H		N/A		N/A		L		•	•	•	•	•	•	•	•
Keansburg, Borough of	M		N/A		H	•	•	H	•	M		N/A		L	•	•	•	•	•	•	•	•	•
Keyport, Borough of	M		N/A		H	•	•	H	•	M		N/A		L	•	•	•			•			
Lake Como, Borough of	N/A		N/A		H			H		N/A		N/A		L		•	•	•	•	•	•	•	•
Little Silver, Borough of	M		N/A		H	•	•	H	•	N/A		M		L		•	•	•	•	•	•		•
Loch Arbour, Village of	M		N/A		H			H		M		N/A		L		•	•	•	•	•	•		•
Long Branch, City of	M		N/A		H	•	•	H	•	M	•	N/A		L	•	•	•			•			•
Manalapan, Township of	N/A		L		H	•	•	N/A		N/A		N/A		L	•	•	•	•	•	•	•	•	•
Manasquan, Borough of	M		N/A		H	•	•	H	•	M		N/A		L		•	•			•	•	•	•
Marlboro, Township of	N/A		N/A		H	•	•	N/A		N/A		N/A		L	•	•	•	•		•			
Matawan, Borough of	N/A		L		H	•	•	H	•	N/A		N/A		L	•	•	•	•	•	•	•	•	•
Middletown, Township of	M		L	•	H	•	•	H	•	M	•	M	•	L	•	•	•			•			•
Millstone, Township of	N/A		L		H	•	•	N/A		N/A		N/A		M	•	•	•	•	•	•	•		•
Monmouth Bch, Borough of	M		N/A		H	•	•	H	•	M		N/A		L	•		•			•			
Neptune City, Borough of	M	•	N/A		M	•	•	H	•	M	•	N/A		L	•	•	•	Awaiting municipal feedback		•	•	•	•

Table 3d.14
Potential for Future Development to Impact Vulnerability for Delineable Hazards[44]

Jurisdiction	Coastal Erosion Hazard Ranking	Potential for Future Development on Vacant Parcels in Coastal Erosion Hazard Areas to substantially increase coastal erosion hazard vulnerability under existing conditions	Dam Failure Hazard Ranking	Potential for Future Development on Vacant Parcels in Dam Failure Hazard Areas to substantially increase dam failure hazard vulnerability under existing conditions	Flood Hazard Ranking	Potential for Future Development on Vacant Parcels in Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA	Potential for Future Development on Vacant Parcels in Flood Hazard Areas to substantially increase flood hazard vulnerability under existing SFHA 2050	Storm Surge Hazard Ranking	Potential for Future Development on Vacant Parcels in Surge Hazard Areas to substantially increase surge hazard vulnerability under existing conditions	Wave Action Hazard Ranking	Potential for Future Development on Vacant Parcels in Wave Action Hazard Areas to substantially increase wave action hazard vulnerability under existing conditions	Landslide Hazard Ranking	Potential for Future Development on Vacant Parcels in Landslide Hazard Areas to substantially increase landslide hazard vulnerability under existing conditions	Wildfire Hazard Ranking	Potential for Future Development on Vacant Parcels in Wildfire Hazard Areas to substantially increase wildfire hazard vulnerability under existing conditions	Jurisdictional Initiatives Selected for the Next Plan Maintenance Phase to Reduce Risk for Future Development[45]: Incorporate hazard mitigation for natural hazards in the next update of your master, general or comprehensive plan.	FEMA NFIP/CRS	Steer growth and development away from high risk locations by using the risk assessment from the hazard mitigation plan as a tool to monitor future updates of community land use plans, zoning and subdivision codes and the development review process.	Add hazard vulnerability to subdivision and site plan review criteria.	Adopt (or continue to enforce) a local stormwater management plan/ordinance.	Protect life and property in high hazard areas by limiting densities of new development.	Increase resilience by limiting the extension of public infrastructure in high hazard areas.	Reduce the vulnerability of future development in high hazard areas by reviewing development regulations, and modifying where needed.
Neptune, Township of	M		L	•	H	•	•	H	•	M	•	N/A		L	•	•	•		•	•			•
Ocean, Township of	N/A		N/A		H	•	•	H	•	N/A		N/A		L	•	•	•						
Oceanport, Borough of	M	•	N/A		H	•	•	H	•	M		L		L	•	•	•	•	•	•	•	•	
Red Bank, Borough of	L		N/A		M	•	•	M	•	M		N/A		L		•	•	•	•	•			
Roosevelt, Borough of	N/A		N/A		L	•	•	N/A		N/A		N/A		H	•	•	•			•			
Rumson, Borough of	M	•	N/A		H	•	•	H	•	M	•	M	•	M	•	•	•	•	•	•	•	•	•
Sea Bright, Borough of	M		N/A		H	•	•	H	•	M	•	N/A		L		•	•			•			•
Sea Girt, Borough of	M		N/A		H			H		M		N/A		L		•	•	•	TBD	•	•	•	•
Shrewsbury, Borough of	N/A		N/A		H	•	•	H	•	N/A		N/A		L	•	•	•			•	•	•	•
Shrewsbury, Township of	N/A		N/A		L			N/A		N/A		N/A		L			•			•			
Spring Lake, Borough of	M		N/A		H			H	•	M		N/A		L		•	•			•			•
Spring Lake Hts, Borough of	N/A		N/A		M			H	•	N/A		N/A		L		•	•	•		•	•	•	•
Tinton Falls, Borough of	N/A		L	•	M	•	•	M	•	N/A		M		M	•	•	•	•	•	•	•	•	•
Union Beach, Borough of	M		N/A		H	•	•	H	•	M	•	N/A		L	•		•		•				•
Upper Freehold, Township of	N/A		L		H	•	•	N/A		N/A		N/A		L	•	•	•	•	•		•	•	•
Wall, Township of	M	•	L	•	M	•	•	H	•	M		N/A		H	•	•	•			•			•
West Long Branch, Borough of	N/A		N/A		M	•	•	H	•	N/A		N/A		L	•	•	•			•			•
Monmouth, County of:	H	•	L	•	H	•	•	H	•	H		M	•	M	•	•	n/a	n/a	n/a	n/a	n/a	n/a	n/a

SECTION 3E – CONCLUSIONS ON HAZARD RISK

Priority Risk Index

The hazard profiles presented in this section were developed using best available data and result in what may be considered principally a qualitative assessment as recommended by FEMA in its guidance document entitled *Local Mitigation Planning Handbook*. It relies heavily on historical and anecdotal data, stakeholder input, and professional and experienced judgment regarding observed and/or anticipated hazard impacts; and carefully considers the findings in other relevant plans, studies and technical reports.

In order to draw some meaningful planning conclusions on hazard risk for Monmouth County as a whole and each participating jurisdiction, the hazard profiling and risk assessment processes were used to generate hazard classifications according to a "Priority Risk Index" (PRI) - a tool used to measure the degree of risk for identified hazards in a particular planning area. The purpose of the PRI, described further below, is to categorize and prioritize all potential hazards as high, moderate or low risk. The PRI is used to assist the Monmouth County Planning Committee in gaining consensus on the determination of those hazards that pose the most significant threat to Monmouth County based on a variety of factors. The PRI is not scientifically based, but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in Monmouth County based on standardized criteria. Combined with the asset inventory and quantitative vulnerability assessment provided in the previous sections, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes, and more specifically, the identification of hazard mitigation opportunities for Monmouth County jurisdictions to consider as part of their proposed mitigation strategies. Each jurisdiction focused on the identification of mitigation actions that will reduce or eliminate their own unique hazard risks.

The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor[1], as summarized in **Table 3a.21**. To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below. According to the weighting scheme applied for Monmouth County, the highest possible PRI value is 4.0.

PRI VALUE = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

As part of the 2014 Plan Update, the application of the PRI was redone for *every* participating jurisdiction. PRI scores and risk rankings were found to change in many communities, as a result of what the planning team feels is a more realistic assessment of the level estimated for each hazard's PRI categories. Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the CPG.

[1] The Monmouth County Planning Committee, based upon any unique concerns or factors for the planning area, may adjust the PRI weighting scheme during future plan updates.

Table 3e.1
Priority Risk Index for Monmouth County

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self-explanatory	1	10%
	12 to 24 hours	Self-explanatory	2	
	6 to 12 hours	Self-explanatory	3	
	Less than 6 hours	Self-explanatory	4	
Duration	Less than 6 hours	Self-explanatory	1	10%
	Less than 24 hours	Self-explanatory	2	
	Less than one week	Self-explanatory	3	
	More than one week	Self-explanatory	4	

PRI Results

The application of the PRI was done separately for each jurisdiction in Monmouth County, and for the County as a whole. Assigned risk levels were based on the detailed hazard profiles developed for this section, as well as input from the Planning Committee and results of the vulnerability assessment. The results were then used in calculating PRI values and making final determinations for the risk assessment.

Table 3e.2 summarizes the degree of risk assigned to each category for all identified hazards based on the application of the PRI for Monmouth County, as a whole.

Table 3e.3 presents an overview of the PRI Results for each jurisdiction.

Detailed tables for each jurisdiction (similar to Table 3e.2) are included in **Appendix 3e.1**.

Table 3e.2
Summary of PRI Results for Monmouth County

Hazard	Category/Degree of Risk										
	Probability	PROBABILITY INDEX VALUE	Impact	IMPACT INDEX VALUE	Spatial Extent	SPATIAL INDEX VALUE	Warning Time	WARNING INDEX VALUE	Duration	DURATION INDEX VALUE	PRI Score
Atmospheric Hazards											
Extreme Temperatures	Highly Likely	4	Minor	1	Large	4	More than 24 hours	1	Less than one week	3	**2.7**
Extreme Wind	Highly Likely	4	Limited	2	Large	4	More than 24 hours	1	Less than 24 hours	2	**2.9**
Hurricane & Tropical Storm	Likely	3	Catastrophic	4	Large	4	More than 24 hours	1	Less than one week	3	**3.3**
Lightning	Highly Likely	4	Minor	1	Negligible	1	Less than 6 hours	4	Less than 6 hours	1	**2.2**
Nor'easter	Highly Likely	4	Limited	2	Large	4	More than 24 hours	1	Less than one week	3	**3.0**
Tornado	Likely	3	Catastrophic	4	Negligible	1	Less than 6 hours	4	Less than 6 hours	1	**2.8**
Winter Storm	Highly Likely	4	Minor	1	Large	4	More than 24 hours	1	Less than one week	3	**2.7**
Hydrologic Hazards											
Coastal Erosion	Highly Likely	4	Catastrophic	4	Negligible	1	More than 24 hours	1	Less than one week	3	**3.0**
Dam Failure	Unlikely	1	Catastrophic	4	Negligible	1	Less than 6 hours	4	Less than 6 hours	1	**2.2**
Drought	Possible	2	Minor	1	Large	4	More than 24 hours	1	More than one week	4	**2.2**
Flood	Highly Likely	4	Critical	3	Moderate	3	6 to 12 hours	3	Less than one week	3	**3.3**
Storm Surge	Likely	3	Catastrophic	4	Moderate	3	More than 24 hours	1	Less than one week	3	**3.1**
Wave Action	Highly Likely	4	Catastrophic	4	Negligible	1	More than 24 hours	1	Less than one week	3	**3.0**
Geologic Hazards											
Earthquake	Unlikely	1	Minor	1	Large	4	Less than 6 hours	4	Less than 6 hours	1	**1.9**
Landslide	Possible	2	Catastrophic	4	Negligible	1	Less than 6 hours	4	Less than 6 hours	1	**2.5**
Other Natural Hazards											
Wildfire	Highly Likely	4	Minor	1	Moderate	3	Less than 6 hours	4	Less than one week	3	**2.8**

Table 3e.3
PRI Results for Each Jurisdiction[2]

Jurisdiction	Atmospheric							Hydrologic						Geologic		Wildfire
	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	
MONMOUTH COUNTY	**2.7**	**2.9**	**3.3**	**2.2**	**3.0**	**2.8**	**2.7**	**3.0**	**2.2**	**2.2**	**3.3**	**3.1**	**3.0**	**1.9**	**2.5**	**2.8**
Aberdeen, Township of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Allenhurst, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Allentown, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	N/A	N/A	1.9	N/A	3.1
Asbury Park, City of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Atlantic Highlands, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	3.1	1.7
Avon-By-The-Sea, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Belmar, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Bradley Beach, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Brielle, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Colts Neck, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	N/A	N/A	1.9	N/A	2.8
Deal, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Eatontown, Borough of	2.7	2.9	3.0	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	3.1	N/A	1.9	N/A	1.7
Englishtown, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	N/A	N/A	1.9	N/A	2.2
Fair Haven, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	2.5	2.0
Farmingdale, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	N/A	N/A	1.9	N/A	2.2
Freehold, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	N/A	N/A	N/A	1.9	N/A	2.0
Freehold, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	N/A	N/A	1.9	2.2	3.1
Hazlet, Township of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	3.1	N/A	1.9	N/A	2.0
Highlands, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	3.1	1.7
Holmdel, Township of	2.7	2.9	3.0	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	2.7	N/A	1.9	N/A	2.8
Howell, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	2.7	N/A	1.9	2.2	3.1
Interlaken, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	3.1	N/A	1.9	N/A	1.7
Keansburg, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.2	3.3	2.7	1.9	N/A	1.7
Keyport, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	2.0
Lake Como, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	3.3	N/A	1.9	N/A	1.5
Little Silver, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.3	N/A	1.9	2.5	2.0
Loch Arbour, Village of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.3	2.7	1.9	N/A	1.5
Long Branch, City of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	N/A	1.7
Manalapan, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	N/A	N/A	1.9	N/A	2.2
Manasquan, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.3	2.7	1.9	N/A	1.7
Marlboro, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	N/A	N/A	1.9	N/A	2.2
Matawan, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	3.1	N/A	1.9	N/A	2.0
Middletown, Township of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	2.2	2.2	3.0	3.1	2.7	1.9	2.5	2.2
Millstone, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.0	N/A	N/A	1.9	N/A	2.5
Monmouth Beach, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.2	3.1	2.7	1.9	N/A	1.7
Neptune City, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	2.8	3.1	2.7	1.9	N/A	1.7
Neptune, Township of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	2.2	2.2	3.0	3.1	2.7	1.9	N/A	2.2
Ocean, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	3.1	N/A	1.9	N/A	1.7
Oceanport, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.3	2.7	1.9	2.2	1.7
Red Bank, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	2.1	N/A	2.2	2.8	2.9	2.7	1.9	N/A	1.7
Roosevelt, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	2.2	N/A	N/A	1.9	N/A	3.0
Rumson, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.1	2.7	1.9	2.5	2.8
Sea Bright, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.2	3.3	2.7	1.9	N/A	1.5
Sea Girt, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.3	2.7	1.9	N/A	1.7

[2] N/A = The hazard was not identified as a significant hazard of concern for the jurisdiction.

Table 3e.3
PRI Results for Each Jurisdiction[2]

Jurisdiction	Atmospheric							Hydrologic						Geologic		Wildfire
	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	
Shrewsbury, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	N/A	N/A	2.2	3.0	3.1	N/A	1.9	N/A	1.9
Shrewsbury, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	2.0	N/A	N/A	1.9	N/A	1.9
Spring Lake, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.0	3.3	2.7	1.9	N/A	1.7
Spring Lake Hts., Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	2.8	3.1	N/A	1.9	N/A	1.7
Tinton Falls, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	2.2	2.2	2.8	2.9	N/A	1.9	2.8	2.8
Union Beach, Borough of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	2.7	N/A	2.2	3.2	3.3	2.9	1.9	N/A	1.9
Upper Freehold, Township of	2.7	2.9	3.3	2.2	3.0	2.8	2.7	N/A	2.2	2.2	3.3	N/A	N/A	1.9	N/A	2.2
Wall, Township of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	2.7	2.2	2.2	2.8	3.1	2.7	1.9	N/A	3.1
West Long Branch, Borough of	2.7	2.9	2.7	2.2	3.0	2.8	2.7	N/A	N/A	2.2	2.8	3.1	N/A	1.9	N/A	1.7

Final Determinations

The conclusions drawn from the application of the PRI process for Monmouth County, including the PRI results and input from the Planning Committee, resulted in the classification of risk for each identified hazard according to three categories: High Risk, Moderate Risk and Low Risk. Hazards with a PRI of 3.0 or more were deemed "high risk"; hazards with a PRI between 2.4 and 2.9 were deemed "moderate risk"; and hazards with a PRI of 2.3 or less were deemed "low risk". For purposes of these classifications, risk is expressed in relative terms according to the estimated impact that a hazard will have on human life and property throughout all of Monmouth County. It should be noted that although some hazards are classified below as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases and their assigned classification will continue to be evaluated during future plan updates[3]. **Table 3e.4** presents conclusions on hazard risk for the County as a whole, based on the PRI scores for each hazard in the County. **Table 3e.5** presents an overview of the resultant hazard risk rankings for each jurisdiction. Detailed tables for each jurisdiction are included in **Appendix 3e.1**.

Table 3e.4
Hazard Risk Rankings for Monmouth County

HIGH RISK **PRI ≥ 3.0**	Hurricane and Tropical Storm Nor'easter Coastal Erosion Flood Storm Surge Wave Action
MODERATE RISK **2.4 ≤ PRI ≤ 2.9**	Extreme Temperatures Extreme Wind Tornado Winter Storm Landslide Wildfire
LOW RISK **PRI ≤ 2.3**	Lightning Dam Failure Drought Earthquake

[3] Overall conclusions on hazard risk were re-evaluated as part of the first plan update for every participating jurisdiction.

Table 3e.5
Hazard Risk Rankings for Each Jurisdiction[4]

Jurisdiction	Atmospheric							Hydrologic						Geologic		Wildfire
	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	
MONMOUTH COUNTY	M	M	H	L	H	M	M	H	L	L	H	H	H	L	M	M
Aberdeen, Township of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Allenhurst, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Allentown, Borough of	M	M	M	L	H	M	M	N/A	L	L	H	N/A	N/A	L	N/A	H
Asbury Park, City of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Atlantic Highlands, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	H	L
Avon-By-The-Sea, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Belmar, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Bradley Beach, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Brielle, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Colts Neck, Township of	M	M	M	L	H	M	M	N/A	L	L	H	N/A	N/A	L	N/A	M
Deal, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Eatontown, Borough of	M	M	H	L	H	M	M	N/A	N/A	L	H	H	N/A	L	N/A	L
Englishtown, Borough of	M	M	M	L	H	M	M	N/A	L	L	H	N/A	N/A	L	N/A	L
Fair Haven, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	M	L
Farmingdale, Borough of	M	M	M	L	H	M	M	N/A	N/A	L	H	N/A	N/A	L	N/A	L
Freehold, Borough of	M	M	M	L	H	M	M	N/A	N/A	L	N/A	N/A	N/A	L	N/A	L
Freehold, Township of	M	M	M	L	H	M	M	N/A	L	L	H	N/A	N/A	L	L	H
Hazlet, Township of	M	M	H	L	H	M	M	N/A	N/A	L	H	H	N/A	L	N/A	L
Highlands, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	H	L
Holmdel, Township of	M	M	H	L	H	M	M	N/A	N/A	L	H	M	N/A	L	N/A	M
Howell, Township of	M	M	M	L	H	M	M	N/A	L	L	H	M	N/A	L	L	H
Interlaken, Borough of	M	M	H	L	H	M	M	N/A	N/A	L	H	H	N/A	L	N/A	L
Keansburg, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Keyport, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Lake Como, Borough of	M	M	H	L	H	M	M	N/A	N/A	L	H	H	N/A	L	N/A	L
Little Silver, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	N/A	L	M	L
Loch Arbour, Village of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Long Branch, City of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Manalapan, Township of	M	M	M	L	H	M	M	N/A	L	L	H	N/A	N/A	L	N/A	L
Manasquan, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Marlboro, Township of	M	M	M	L	H	M	M	N/A	N/A	L	H	N/A	N/A	L	N/A	L
Matawan, Borough of	M	M	M	L	H	M	M	N/A	L	L	H	H	N/A	L	N/A	L
Middletown, Township of	M	M	H	L	H	M	M	M	L	L	H	H	M	L	M	L
Millstone, Township of	M	M	M	L	H	M	M	N/A	L	L	H	N/A	N/A	L	N/A	M
Monmouth Beach, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Neptune City, Borough of	M	M	H	L	H	M	M	M	N/A	L	M	H	M	L	N/A	L
Neptune, Township of	M	M	H	L	H	M	M	M	L	L	H	H	M	L	N/A	L
Ocean, Township of	M	M	M	L	H	M	M	N/A	N/A	L	H	H	N/A	L	N/A	L
Oceanport, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	L	L
Red Bank, Borough of	M	M	M	L	H	M	M	L	N/A	L	M	M	M	L	N/A	L
Roosevelt, Borough of	M	M	M	L	H	M	M	N/A	N/A	L	L	N/A	N/A	L	N/A	H
Rumson, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	M	M
Sea Bright, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Sea Girt, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Shrewsbury, Borough of	M	M	H	L	H	M	M	N/A	N/A	L	H	H	N/A	L	N/A	L

4 N/A = The hazard was not identified as a significant hazard of concern for the jurisdiction.

Table 3e.5
Hazard Risk Rankings for Each Jurisdiction[4]

Jurisdiction	Atmospheric							Hydrologic						Geologic		
	Extreme Temperatures	Extreme Wind	Hurricane and Tropical Storm	Lightning	Nor'easter	Tornado	Winter Storm	Coastal Erosion	Dam Failure	Drought	Flood	Storm Surge	Wave Action	Earthquake	Landslide	Wildfire
Shrewsbury, Township of	M	M	M	L	H	M	M	N/A	N/A	L	L	N/A	N/A	L	N/A	L
Spring Lake, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Spring Lake Hts., Borough of	M	M	M	L	H	M	M	N/A	N/A	L	M	H	N/A	L	N/A	L
Tinton Falls, Borough of	M	M	M	L	H	M	M	N/A	L	L	M	M	N/A	L	M	M
Union Beach, Borough of	M	M	H	L	H	M	M	M	N/A	L	H	H	M	L	N/A	L
Upper Freehold, Township of	M	M	H	L	H	M	M	N/A	L	L	H	N/A	N/A	L	N/A	L
Wall, Township of	M	M	M	L	H	M	M	M	L	L	M	H	M	L	N/A	H
West Long Branch, Borough of	M	M	M	L	H	M	M	N/A	N/A	L	M	H	N/A	L	N/A	L

Key Risk Findings

Key Risk Findings are problem statements developed from the risk assessment by each participating jurisdiction. Each jurisdiction was encouraged to consider different types of mitigation actions for addressing their highest hazards and Key Risk Findings.

Key Risk Findings for Monmouth County are presented in **Table 3e.6**. Key Risk Findings for each particular jurisdiction are included in **Appendix 3e.1**.

Table 3e.6 **Key Risk Findings for Monmouth County**
- The CRS program, which is run by FEMA through the National Flood Insurance Program (NFIP), scores communities on their effectiveness in dealing with flood plain management and development. Towns that take action steps to increase their resiliency to future storm events can help residents and businesses increase their eligibility for policy holder discounts. The program differentiates amongst ten classes. Communities enter at Class 10, and then as additional activities undertaken, they accumulate points toward moving up into the next higher class and achieving an associated decrease in insurance premiums for policyholders in their jurisdiction. Currently, there are eight Monmouth County towns that are part of the CRS program. Many communities in the County lack the resources to undertake the more technical aspects of the program in-house. In turn, many communities have either not accessed the program at all, or have entered at only the lowest levels. Many homeowners and businesses in Monmouth County may see an increases in their flood insurance premiums as the new FEMA Flood Maps are adopted. Currently the eight communities actively participating in the CRS program are the Township of Aberdeen, the Borough of Bradley Beach, the Township of Hazlet, the Borough of Manasquan, the Township of Middletown, the Borough of Oceanport, the Borough of Spring Lake, and the Borough of Union Beach.
- All communities in Monmouth County participate in FEMA's NFIP. Many communities and residents suffer from flooding events on a regular basis, and incur significant damages and costs associated with preparation, response, and recovery from these events. There is a disconnect in some communities between local master plans and floodplain management issues.
- Many local officials in Monmouth County lack direct access to mapping services (i.e., GIS). This creates a gap in their full understanding of natural hazards in their communities; significant costs are incurred each year for hazard response, recovery, and damage repair. Lack of access to mapping services such as GIS creates a situation in some communities where mitigation project development is sometimes hindered, and public education/warning programs are not as efficient/targeted as they could be. Having more direct access to mapping services tools could facilitate local communities efforts to guide development away from hazard areas, improve public education/warning for their residents in hazard areas, and enhance their mitigation project development.
- Monmouth County has an active history of hurricanes and tropical storms. Implementation of evacuation orders related to an impending hurricane would have a significant impact on travel patterns and operating conditions on the area's transportation system. For example, prevailing directional patterns would be altered substantially as westbound and coastal residents and visitors traveling away from the coast to higher ground would heavily utilize northbound travel lanes. Congestion levels at locations that already have constrained service rate issues, such as merge junctions, ramps, and signalized major intersections would be exacerbated. The timing of an evacuation order would have a significant effect on traffic flows, the shorter the timeframe, the more intense delays and

Table 3e.6 **Key Risk Findings for Monmouth County**
queuing potential. Operational, physical and long term improvements (either by route or by type) would greatly enhance to capacity of these evacuation routes during an evacuation order.
-The general public's understanding of natural hazards and mitigation possibilities could be improved. The community's overall level of disaster resistance would increase if a greater number of households undertook low-cost or no-cost, small-scale mitigation activities.
- A section of the Henry Hudson Trail located in Atlantic Highlands along Sandy Hook Bay was destroyed by Superstorm Sandy. The adjacent coastal bluff experienced erosion at the base of the slope from wave action and storm surge. Above the trail, located on the bluff, there are numerous high value residences that have taken advantage of the unique location. The bluff is subject to slump block failure usually associated with a rain event and disruption of the slope.
- Within Hartshorne Woods Park (Middletown) there are two unique sites; Claypit Creek and Portland Place. The sites are protected by coastal river-edge bluffs which were severely eroded during the Superstorm Sandy event. Both sites offer passive recreation activities for County residents and have a south-eastern orientation steep bluff, which received the most direct exposure of winds, flooding and wave action from the storm.
- The County Park System acquires land for open space preservation, public park & recreation purposes and natural resources conservation. Some of the properties that are identified for acquisition are ones that are subject to flooding, winter storms or associated storm surges. These properties may be located in coastal zones or located along stream and river corridors throughout the county. When many properties along a watercourse are acquired, they form a protected greenway along the stream or river. By purchasing these properties, any buildings located in the flood zone are removed and the land is restored to a natural condition. Protected lands adjacent to coastal zones and river courses helps to reduce regional flooding by not increasing impervious cover and also allows natural systems of forests and marshes to mitigate some of the effects of flooding.
- Fisherman's Cove Conservation Area, Seven Presidents Oceanfront Park, Henry Hudson Trail - Popamora Point, and Bayshore Waterfront Park have all experienced some coastal dunes loss, erosion of coastal zone open space real estate, sedimentation of adjacent channels, and/or loss of protective features for adjacent private properties.
- *Pine Brook (Pine Brook Golf Course, Manalapan) and Ramanessin Brook (Holmdel Park, Holmdel) stream bank stabilization, Manasquan River (Turkey Swamp Park, Freehold) floodplain restoration.* The Manasquan River has been increasingly more flood prone and suffers potable water quality issues related to increased watershed development and past stream channel straightening impacts. A proposal has been in the planning phase for many years to re-introduce stream form and function in the upper reaches of the watershed where extensive straightening occurred in the past. This will result in more stream stability and improved water quality with improve stream function.
- Certain wild-lands and urban interface areas pose a risk to losses by fire. Fisherman's Cove Conservation Area (Manasquan Borough), Turkey Swamp Park (Freehold Township) and Bayshore Waterfront Park (Middletown Township) are all park areas that have been subject to wildfires, which have potential to destroy adjacent residential properties as well as park building infrastructure.
- Lack of fuel supply in a key location of Monmouth County (Highway District Yard #6 in the Borough of Eatontown), which is detrimental to operational and emergency services provided during a time of disaster or crisis.
- Telecommunication and electrical systems at key Monmouth County Operational Buildings are negatively impacted during periods of Power Failure (interruption or loss of electrical service caused by disruption of power transmission caused by accident, sabotage, natural hazards, or equipment failure).
-*Capacity and integrity issues of NJDEP defined Class 1 dams (those structures which, should they fail, would likely cause loss of life) and Class 2 dams (those structures which, should they fail, would likely cause substantial downstream property damage but are not considered to be a threat to life) as well as the associated bridge, bridge approaches and roadways.* Locations include, but are not limited to, the following: 1) Lake Lefferts Dam, County Bridge MA-9, Ravine Dr. (CR 6A), Matawan; 2) Matawan Lake Dam, County Bridge MA-13, Main St. (CR 516), Matawan; 3) Perrineville Dam, County Bridge MS-48, Perrineville Rd. (CR 1), Millstone; 4) Shadow Lake Dam, County Bridges MT-30 & MT-45, Hubbard Ave. (CR 12), Middletown; 5) Indian Dam, County Bridge U-18, Church St. (CR 526), Allentown; 6) Hurley Pond Dam, County Bridge W-18, Allenwood Rd., Wall
- Roadways and bridges below base elevation incur flooding. Locations include, but are not limited to: County Bridge H-5 & H-5A, Palmer Ave. (CR 7), Holmdel & Middletown; County Bridges ML-17, ML-18, & ML-19, Station Rd., Marlboro; County Bridge R-5, Florence Ave. (CR 39), Union Beach; and Union Ave.(CR 39), Union Beach. Road flooding, resulting in damage to infrastructure reduced safe passage, and isolation of neighborhoods by flood waters.
- Storm events and subsequent flooding wash substantial amounts of debris and sedimentation in creeks and waterways, compounding the effects of natural siltation and buildup of debris and fallen trees, which obstruct the natural flow of some surface waters, resulting in increased inland and coastal flooding.
- Structural integrity of bridges that are exposed to wave, tidal, and storm surges. These bridges may carry coastal evacuation routes and any damage to the bridge or their approach roads may impair safe passage, ultimately jeopardizing human life.
- Monmouth County's population is growing modestly; it is projected to have a population increase 10.6% of 2010 values by the year 2040.
- Sea level rise and climate change will contribute to more frequent and severe flooding and surge events over a larger area.
-Climate change will contribute to more frequent and severe weather events.
- Monmouth County has established a large County evacuation center at Brookdale Community College. The building although structurally sound does have some exterior windows and doors that could become compromised during a wind generating event.

SECTION 4 - CAPABILITIES AND RESOURCES

Performing a Capability Assessment is one step of a FEMA-approved hazard mitigation plan update. A mitigation planning Capability Assessment consists of taking an in-depth look at community mechanisms (such as plans, codes, ordinances, staffing, etc.) that can affect hazard mitigation activities. Performing the Capability Assessment helps communities identify the regulatory, administrative, technical, and fiscal capacities and capabilities of their jurisdiction and consider ways that these tools can be used to further hazard mitigation and disaster resiliency goals.

Capability Assessments were undertaken by each participating jurisdiction as part of the development of the first edition of the Hazard Mitigation Plan in 2009. At that time, URS distributed worksheets[1] to the Monmouth County Office of Emergency Management and the Core Planning Group in order to initiate this capability assessment. The worksheets requested information pertaining to existing plans, polices, and regulations that contribute to or hinder the ability to implement hazard mitigation actions. They also requested information pertaining to the legal and regulatory capability, technical and administrative capacity, and fiscal capability of each jurisdiction. Completed worksheets were received in 2008 from Monmouth County, 49 municipalities, and Monmouth University, illustrating each jurisdiction's capabilities to implement a hazard mitigation strategy.

For the 2014 Plan Update, each JAT was asked to review their prior feedback, and identify any changes that have occurred since the initial plan was developed. Each JAT either: (a) reviewed their prior feedback and certified that all information previously provided was still current, or (b) reviewed their prior feedback and provided markups to the consultant noting any changes in capabilities that have occurred since that time. Jurisdictions that had not performed a local capability assessment during the development of the initial plan were required to do so during the plan update. During the 2014 Plan Update, each JAT also provided an assessment of their overall legal and regulatory, technical and administrative, and fiscal capabilities; and then identified opportunities for bridging recognized gaps in capabilities to ensure that they are in line with jurisdictional mitigation actions and goals. Each jurisdiction documented their assessment of capabilities on Worksheet 3 – Capability Assessment Update. The consultant used worksheet responses to update this plan section to reflect each jurisdiction's assessment of their current capabilities. All capability assessment updates are included in **Appendix 1.7**.

This section describes the activities currently reported to be underway which contribute to or can be utilized for hazard mitigation. This assessment of capabilities emphasizes the technical and financial resources available at the State and Federal levels, which the County can access to effectively implement a hazard mitigation program.

Capabilities and Resources – Monmouth County and Participating Jurisdictions

Legal and Regulatory Capability

As indicated in **Table 4.2**[2], Monmouth County and its incorporated jurisdictions have several policies, programs, and capabilities, which help to prevent and minimize future damages resulting from hazards. These tools are valuable instruments in pre- and post-disaster mitigation as they facilitate the implementation of mitigation activities through the current legal and regulatory framework. The checkmark (√) indicates that the local government reported to have that particular code, ordinance, or plan. In New Jersey, each community is required to enforce a building code and have a master plan and capital improvements plan.

1 During the initial plan development process, URS distributed FEMA's Capability Assessment Worksheet to each jurisdiction ("Worksheet Job Aid #2: Local Hazard Mitigation Capabilities", as included in the FEMA How-To #3 *Developing the Mitigation Plan,* online at http://www.fema.gov/media-library-data/20130726-1521-20490-5373/howto3.pdf) .

2 A description of each legal and regulatory capability that was considered can be found in Appendix 4-1.

Table 4.1 - Jurisdictional Legal and Regulatory Capabilities

Jurisdiction	Building Code	Zoning Ordinance	Subdivision Ordinance	Special Purposes Ordinance	Growth Management Ordinance	Site Plan Review Requirements	Comprehensive/Master Plan	Capital Improvements Plan	Economic Development Plan	Emergency Response Plan	Post-Disaster Recovery Plan	Post-Disaster Recovery Ordinance	Real Estate Disclosure Ordinance	Overall legal and regulatory capability to implement hazard mitigation strategies*
Monmouth County	√		√	√		√	√	√	√	√				M
Aberdeen, Township of	√	√	√	√		√	√	√	√	√	√	√		H
Allenhurst, Borough of	√	√	√			√	√	√	√	√			√	M
Allentown, Borough of	√	√	√	√		√	√	√	√	√				H
Asbury Park, City of	√	√	√	√		√	√	√	√	√	√		√	H
Atlantic Highlands, Borough of	√	√	√	√	√	√	√	√	√	√	√			M
Avon-by-the-Sea, Borough of	√	√	√	√	√	√	√	√		√	√		√	M
Belmar, Borough of	√	√	√	√		√	√	√	√	√	√	√	√	H
Bradley Beach, Borough of	√	√	√			√	√	√		√	√	√		H
Brielle, Borough of	√	√	√	√		√	√	√		√			√	H
Colts Neck, Township of	√	√	√	√		√	√	√	√	√			√	M
Deal, Borough of	√	√	√	√		√	√	√		√	√	√		M
Eatontown, Borough of	√	√	√	√		√	√	√	√	√	√			M
Englishtown, Borough of	√	√	√	√		√	√	√						H
Fair Haven, Borough of	√	√	√	√		√	√	√		√				M
Farmingdale, Borough of	√	√	√	√	√	√	√	√		√	√		√	M
Freehold, Borough of	√	√	√	√		√	√	√		√	√		√	M
Freehold, Township of	√	√	√	√		√	√	√	√	√		√	√	H
Hazlet ,Township of	√	√	√	√		√	√	√	√	√			√	M
Highlands, Borough of	√	√	√	√		√	√	√	√	√	√			H
Holmdel, Township of	√	√	√	√		√	√	√	√	√	√	√	√	H
Howell, Township of	√	√	√	√	√	√	√	√	√	√	√		√	M
Interlaken ,Borough of	√	√	√	√	√	√	√	√	√	√	√		√	M
Keansburg, Borough of	√	√	√	√	√	√	√	√	√	√	√	√	√	M
Keyport, Borough of	√	√	√	√		√	√	√	√	√	√	√	√	H
Lake Como, Borough of	√	√	√	√		√	√	√	√	√	√	√		H
Little Silver, Borough of		√	√	√	√	√	√		√	√		√	√	H
Loch Arbour, Village of	√	√				√	√	√						H
Long Branch, City of	√	√	√	√		√	√	√	√	√	√		√	H
Manalapan, Township of	√	√	√			√	√	√		√				H
Manasquan, Borough of	√	√	√	√		√	√	√		√	√	√	√	H
Marlboro, Township of	√	√	√	√	√	√	√	√	√	√	√	√	√	H
Matawan, Borough of	√	√	√	√	√	√	√	√	√	√				M
Middletown, Township of	√	√	√			√	√	√	√	√	√			H
Millstone, Township of	√	√	√	√		√	√	√	√	√	√	√	√	M
Monmouth Beach, Borough of	√	√	√	√		√	√	√		√	√			H

Table 4.1 - Jurisdictional Legal and Regulatory Capabilities

Jurisdiction	Building Code	Zoning Ordinance	Subdivision Ordinance	Special Purposes Ordinance	Growth Management Ordinance	Site Plan Review Requirements	Comprehensive/Master Plan	Capital Improvements Plan	Economic Development Plan	Emergency Response Plan	Post-Disaster Recovery Plan	Post-Disaster Recovery Ordinance	Real Estate Disclosure Ordinance	Overall legal and regulatory capability to implement hazard mitigation strategies*
Neptune, Township of	√	√	√	√	√	√	√	√	√	√				**H**
Neptune City, Borough of	√	√	√	√		√	√	√		√				**M**
Ocean, Township of	√	√	√	√	√	√	√	√	√	√	√		√	**M**
Oceanport, Borough of	√	√	√	√	√	√	√	√	√	√	√	UR	√	**H**
Red Bank, Borough of	√	√	√	√	√	√	√	√		√				**H**
Roosevelt, Borough of[3]	√	√	√			√	√			√	√			**M**
Rumson, Borough of	√	√	√	√		√	√	√						**M**
Sea Bright, Borough of	√	√	√	√		√	√	√		√	√			**M**
Sea Girt, Borough of	√	√	√	√	√	√	√	√	√	√	√	√	√	**M**
Shrewsbury, Borough of	√	√	√	√		√	√	√	√	√	√	√	√	**H**
Shrewsbury, Township of	√	√					√	√						**L**
Spring Lake, Borough of	√	√	√	√	√	√	√	√	√	√	√			**M**
Spring Lake Heights, Borough of	√	√	√	√		√	√	√		√				**M**
Tinton Falls, Borough of	√	√	√	√	√	√	√	√		√	√	√	√	**H**
Union Beach, Borough of	√	√	√	√	√	√	√	√		√				**M**
Upper Freehold ,Township of	√	√	√	√	√	√	√	√	√	√	√	√	√	**M**
Wall, Township of	√	√	√	√	√	√	√	√	√	√	√	√		**M**
West Long Branch, Borough of	√	√	√	√	√	√	√	√		√	√		√	**M**

* H=High, M=Moderate, L=Low
UR = Under Review

Administrative and Technical Capability

The ability of a local government to develop and implement mitigation projects, policies, and programs is contingent upon its staff and resources. Administrative capability is determined by evaluating whether there are an adequate number of personnel to complete mitigation activities. Similarly, technical capability can be evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in surveying and Geographic Information Systems.

Table 4.2 provides a summary of the administrative and technical capabilities currently in place in each participating jurisdiction. The checkmark (√) indicates that the local government reported that they maintain a staff member for the given function.

[3] Roosevelt is not presently contemplating any capital improvements at this time, other than road resurfacing when DOT grants are received and reports that they do not have a capital improvements plan in place at this time.

Table 4.2 - Jurisdictional Administrative and Technical Capabilities												
Jurisdiction	**Planner(s) or Engineer(s) with knowledge of land development and management practices**	**Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure**	**Planner(s) or Engineer(s) with an understanding of natural and/or human caused hazards**	**Floodplain manager**	**Surveyors**	**Staff with education or expertise to assess the community's vulnerability to hazards**	**Personnel skilled in GIS and/or HAZUS**	**Scientists familiar with the hazards of the community**	**Emergency Manager**	**Grant Writers**	**Overall technical capability to implement hazard mitigation strategies**	**Overall administrative capability to implement hazard mitigation strategies**
Monmouth County	√	√	√		√	√	√		√	√	H	**H**
Aberdeen, Township of	√	√	√	√	√	√	√		√		H	**H**
Allenhurst, Borough of	√	√	√	√	√	√			√	√	H	**H**
Allentown, Borough of		√	√	√					√	√	H	**H**
Asbury Park, City of	√	√	√	√	√	√	√		√	√	H	**H**
Atlantic Highlands, Borough of	√	√	√	√	√	√	√	√	√	√	M	**M**
Avon-by-the-Sea, Borough of	√	√	√	√	√	√		√	√	√	M	**M**
Belmar, Borough of	√	√	√	√	√	√			√	√	H	**H**
Bradley Beach, Borough of	√	√	√	√		√	√		√		M	**H**
Brielle, Borough of	√	√	√	√	√				√	√	H	**H**
Colts Neck, Township of	√	√	√	√					√		M	**M**
Deal, Borough of	√	√		√	√				√	√	M	**L**
Eatontown, Borough of	√	√	√	√	√	√	√		√		L	**M**
Englishtown, Borough of	√	√	√	√	√	√	√	√	√	√	H	**M**
Fair Haven, Borough of	√	√		√					√	√	L	**M**
Farmingdale, Borough of	√			√		√			√		M	**L**
Freehold, Borough of	√	√		√		√			√	√	H	**H**
Freehold, Township of	√	√	√	√	√	√	√	√	√	√	H	**H**
Hazlet, Township of	√	√	√	√		√			√		M	**H**
Highlands, Borough of	√	√	√	√	√	√	√	√	√	√	H	**H**
Holmdel, Township of	√	√	√	√	√	√		√	√	√	H	**H**
Howell, Township of	√	√	√	√		√	√		√		M	**M**
Interlaken, Borough of		√		√					√		M	**L**
Keansburg, Borough of	√	√	√	√	√	√	√	√	√	√	M	**M**
Keyport, Borough of	√	√	√	√	√	√	√	√	√	√	H	**M**
Lake Como, Borough of	√	√	√	√	√	√			√	√	H	**H**
Little Silver, Borough of	√	√	√	√	√	√	√	√	√	√	H	**H**
Loch Arbour, Village of	√	√	√	√	√	√	√			√	H	**H**
Long Branch, City of	√	√	√	√	√	√	√		√	√	M	**M**
Manalapan, Township of	√	√	√	√		√			√		H	**H**
Manasquan, Borough of	√	√	√	√	√	√		√	√	√	L	**L**
Marlboro, Township of	√	√	√	√	√	√	√		√	√	H	**H**
Matawan, Borough of	√	√	√	√	√	√	√		√	√	M	**H**
Middletown, Township of	√	√	√	√	√	√	√		√	√	H	**H**

Table 4.2 - Jurisdictional Administrative and Technical Capabilities												
Jurisdiction	**Planner(s) or Engineer(s) with knowledge of land development and management practices**	**Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure**	**Planner(s) or Engineer(s) with an understanding of natural and/or human caused hazards**	**Floodplain manager**	**Surveyors**	**Staff with education or expertise to assess the community's vulnerability to hazards**	**Personnel skilled in GIS and/or HAZUS**	**Scientists familiar with the hazards of the community**	**Emergency Manager**	**Grant Writers**	**Overall technical capability to implement hazard mitigation strategies**	**Overall administrative capability to implement hazard mitigation strategies**
Millstone, Township of	√	√	√	√	√	√	√		√	√	M	**M**
Monmouth Beach ,Borough of	√	√	√	√	√	√	√		√	√	H	**H**
Neptune, Township of	√	√	√	√	√	√	√	√	√	√	H	**H**
Neptune City, Borough of	√	√	√	√		√	√		√		H	**H**
Ocean, Township of	√	√	√	√	√	√	√		√	√	M	**M**
Oceanport, Borough of	√	√	√	√	√	√	√	√	√	√	H	**H**
Red Bank, Borough of	√	√	√	√	√	√	√	√	√	√	M	**H**
Roosevelt, Borough of	√	√	√	√					√		M	**L**
Rumson, Borough of	√	√	√	√	√	√	√		√	√	H	**H**
Sea Bright, Borough of	√	√	√	√	√			√	√	√	M	**H**
Sea Girt, Borough of	√	√	√	√	√	√		√	√	√	M	**H**
Shrewsbury, Borough of	√	√	√	√	√	√	√		√	√	M	**H**
Shrewsbury, Township of	√	√	√	√	√	√	√		√	√	M	**M**
Spring Lake, Borough of	√	√	√	√		√	√	√	√	√	M	**H**
Spring Lake Heights, Borough of	√	√	√	√	√	√	√		√		M	**L**
Tinton Falls, Borough of	√	√	√	√	√	√	√		√	√	M	**H**
Union Beach, Borough of	√	√	√	√	√	√	√	√	√	√	H	**M**
Upper Freehold, Township of	√	√	√	√	√	√	√		√		M	**M**
Wall, Township of	√	√	√	√	√	√	√		√	√	M	**M**
West Long Branch, Borough of	√	√	√	√	√				√	√	M	**M**

* H=High, M=Moderate, L=Low

Fiscal Capability

The ability of a local government to implement mitigation activities is also associated with the funding available for policies and projects. Funding for such initiatives is often locally based revenue and financing, as well as outside grants. Costs associated with mitigation activities range from staffing and administrative costs to the actual cost of the mitigation project.

Table 4.3 provides a summary of the fiscal capabilities currently in place in each participating jurisdiction. The checkmark (√) indicates that the financial resource was reported to be available in the local jurisdiction for mitigation purposes.

Table 4.3 - Jurisdictional Fiscal Capabilities											
Jurisdiction	**Community Development Block Grants (CDBG)**	**Capital Improvements Project Funding**	**Authority to Levy Taxes for Specific Purposes**	**Fees for Water, Sewer, Gas, or Electric Service**	**Impact Fees for Homebuyers or Developers for New Developments/Homes**	**Incur Debt through General Obligation Funds**	**Incur Debt through Special Tax and Revenue Bonds**	**Incur Debt through Private Activity Bonds**	**Withhold Spending in Hazard-Prone Areas**	**Other**	**Overall fiscal capability to implement hazard mitigation strategies***
Monmouth County	√	√	√		√	√	√				**M**
Aberdeen, Township of	√	√	√	√	√	√	√	√	√	√	**M**
Allenhurst, Borough of	√	√	√	√	√	√	√				**M**
Allentown, Borough of	√	√	√	√		√					**L**
Asbury Park, City of	√	√	√	√	√	√	√	√	√		**L**
Atlantic Highlands, Borough of	√	√	√	√	√	√	√		√		**M**
Avon-by-the-Sea, Borough of	√	√	√	√		√	√		√		**M**
Belmar, Borough of	√	√	√	√	√	√	√				**H**
Bradley Beach, Borough of	√	√	√	√		√	√				**L**
Brielle, Borough of	√	√	√	√	√	√	√				**M**
Colts Neck Township		√	√		√	√	√				**L**
Deal, Borough of	√	√	√	√		√	√				**M**
Eatontown, Borough of	√	√	√	√	√	√	√				**L**
Englishtown, Borough of	√	√		√		√			√		**L**
Fair Haven, Borough of	√	√					√				**M**
Farmingdale, Borough of	√	√	√	√		√	√				**M**
Freehold, Borough of	√	√	√	√		√	√	√			**M**
Freehold, Township of	√	√	√	√	√	√					**M**
Hazlet, Township of	√	√	√		√	√					**M**
Highlands, Borough of	√	√	√	√	√	√	√	√			**L**
Holmdel, Township of		√	√	√	√	√					**H**
Howell, Township of	√	√	√	√		√	√				**L**
Interlaken, Borough of		√	√	√		√	√				**M**
Keansburg, Borough of	√	√	√	√	√	√	√	√	√	√	**L**
Keyport, Borough of	√	√	√	√	√	√	√				**M**
Lake Como, Borough of	√	√	√	√		√					**M**
Little Silver, Borough of		√				√					**H**
Loch Arbour, Village of	√	√									**M**
Long Branch, City of	√	√	√		√	√	√				**L**
Manalapan, Township of	√	√	√		√	√	√				**M**
Manasquan, Borough of		√	√	√		√	√				**L**
Marlboro, Township of	√	√	√		√	√	√	√	√	√	**H**
Matawan, Borough of	√	√	√	√	√	√	√	√	√		**L**
Middletown, Township of	√	√			√	√	√	√			**M**
Millstone, Township of	√	√	√		√	√					**M**

Table 4.3 - Jurisdictional Fiscal Capabilities											
Jurisdiction	**Community Development Block Grants (CDBG)**	**Capital Improvements Project Funding**	**Authority to Levy Taxes for Specific Purposes**	**Fees for Water, Sewer, Gas, or Electric Service**	**Impact Fees for Homebuyers or Developers for New Developments/Homes**	**Incur Debt through General Obligation Funds**	**Incur Debt through Special Tax and Revenue Bonds**	**Incur Debt through Private Activity Bonds**	**Withhold Spending in Hazard-Prone Areas**	**Other**	**Overall fiscal capability to implement hazard mitigation strategies***
Monmouth Beach, Borough of	√	√	√			√					**M/L**
Neptune, Township of	√	√	√	√	√	√	√	√			**M**
Neptune City, Borough of	√	√	√	√	√						**M**
Ocean, Township of	√	√		√	√	√					**L**
Oceanport, Borough of	√	√	√		√	√	√				**M**
Red Bank, Borough of	√	√	√	√	√	√	√				**M**
Roosevelt, Borough of				√		√					**L**
Rumson, Borough of	√	√	√	√	√	√	√		√		**M**
Sea Bright, Borough of						√					**L**
Sea Girt, Borough of	√	√	√	√	√	√	√	√	√	√	**M**
Shrewsbury, Borough of		√	√		√						**M**
Shrewsbury, Township of	√	√	√			√					**L**
Spring Lake, Borough of	√	√	√	√		√	√				**H**
Spring Lake Heights, Borough of	√	√	√	√		√	√				**L**
Tinton Falls, Borough of	√	√	√	√	√	√	√	√	√	√	**L**
Union Beach, Borough of	√	√	√	√	√	√	√				**L**
Upper Freehold, Township of	√		√		√	√					**M**
Wall, Township of	√	√		√		√	√				**M**
West Long Branch, Borough of	√	√	√			√	√				**M**

* H=High, M=Moderate, L=Low

Conclusion

This capability assessment finds that Monmouth County and its participating jurisdictions which submitted completed capability assessment worksheets collectively have a significant level of legal, technical, and fiscal tools and resources necessary to implement hazard mitigation strategies. As shown in the preceding tables, legal and regulatory capabilities to implement hazard mitigation strategies were considered to be moderate to high in 98% of the responding jurisdictions. Similarly, technical capabilities were considered to be moderate to high in 94% of the responding jurisdictions; and administrative capabilities were considered to be moderate to high in 89% of the responding jurisdictions. Fiscal capabilities to implement hazard mitigation strategies were considered to be moderate to high by far fewer respondents, with only 63% of the responding jurisdictions. About 98% of the responding jurisdictions considered their political leadership's willingness to enact policies and programs that reduce hazard vulnerabilities as moderate or high - even if met with opposition. Each jurisdiction also considered ways of improving their capabilities to ensure that they are in-line with their mitigation actions and goals. Local responses are provided in **Table 4.4**. This table also shows that municipalities have identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals.

Table 4.4
Opportunities for Improving Local Capabilities

Jurisdiction	Overall Legal & Regulatory Capability	Overall Technical Capability	Overall Admin Capability	Overall Fiscal Capability	Overall Level of Political Willingness	Locally identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals
Monmouth County	M	H	H	M	M	Engage county officials in the planning process and in identification of actions and goals.
Aberdeen, Township of	H	H	H	M	M	(1) Township is currently reviewing its ordinances to address FEMA elevations and to limit potential for development in flood prone areas; (2) Township retains engineers and planners who are trained to address flood impacted infrastructure and buildings so as to minimize future damages; (3) Further, the Township has and will pursue any and all grants to minimize adverse budgetary impacts; and (4) The Township's administration and political leadership recognize the vulnerabilities associated with development in identified hazard areas and have already adopted restrictive ordinances and are pursuing planning grants to further modify said ordinances as necessary to minimize future development.
Allenhurst, Borough of	M	H	H	M	H	Hurricane Sandy pointed out that our "on beach" structures were vulnerable. They were elevated and were made portable. A large front end loader was bought to remove these large structures. As the town is 17 feet able sea level and the homes were very sound we found no problems in building requirements. As for gaps, there really weren't any major deficiencies and we found that the Borough was up to the task. As mentioned in another document we did create a specific storm annex in our OEM basic plan.
Allentown, Borough of	H	H	H	L	H	Our community has an active and experienced group of political leaders. They delegate much of their technical work to outside agencies both public and private. When a problem is revealed it's correctly aggressively.
Asbury Park, City of	H	H	H	L	M	Political leadership's willingness to enact policies and programs that reduce hazard vulnerabilities in our community is subject to change drastically with changes in the administration. Unfortunately, due to severe annual budget constraints and receipt of Transitional Aid from the State of New Jersey, we are severely limited in our overall fiscal capability to implement hazard mitigation strategies.
Atlantic Highlands, Borough of	M	M	M	M	M	Public education; Communications with all concerned via web site, newsletter, sign board, etc.; Discussion at Mayor and Council Meetings; Appoint Committee to listen and recommend a course of action to help recognize issues and bring them forward; Develop a 5 year plan and keep updated
Avon-by-the-Sea, Borough of	M	M	M	M	M	Improved management of our floodplain is a high priority as the impacts of recent flooding from Sandy highlighted and area where additional expertise is needed.
Belmar, Borough of	H	H	H	H	H	The Borough of Belmar continues to pursue grant funding at the State and Federal level to implement hazard mitigation projects. Our ongoing partnerships with FEMA, Army Corps of Engineers, NJDEP, NJDOT and Monmouth County are vital to obtaining the resources needed to implement our mitigation projects.
Bradley Beach, Borough of	H	M	H	L	H	Secure funding in order to follow through with planned mitigation operations.
Brielle, Borough of	H	H	H	M	M	Maximize familiarity and awareness of mitigation grant programs and other mitigation initiatives. Develop synergies of funding source to maximize the breadth and extent of mitigation projects and programs. Look to form regional or sub-regional partnerships to maximize the effectiveness of partners expertise to the benefit of individual municipalities.
Colts Neck Township	M	M	M	L	H	Funding constraints are a big hurdle in implementing mitigation projects. Gaps in fiscal capabilities can be bridged by: (a) training Township staff to write grants; (2) applying for more grants; (3) working with local volunteer groups and organizations to obtain their assistance in obtaining donation funding; and (4) considering a nominal tax increase to set aside a fund specifically for mitigation projects.

Table 4.4
Opportunities for Improving Local Capabilities

Jurisdiction	Overall Legal & Regulatory Capability	Overall Technical Capability	Overall Admin Capability	Overall Fiscal Capability	Overall Level of Political Willingness	Locally identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals
Deal, Borough of	M	M	L	M	H	Shared service agreements along with partnerships with regional and private firms increases our ability to meet the technical demands while keeping costs low.
Eatontown, Borough of	M	L	M	L	L	It is always a problem due to the financial status of the town, we are looking at the possibility of Joint Services to assist and also using other programs like Government excess equipment programs. All department managers are in the process of updating their ordnances including with identifying all of the new Federal and State regulations.
Englishtown, Borough of	H	H	M	L	H	Englishtown Borough would require grants to fund the implementation of hazard mitigation strategies.
Fair Haven, Borough of	M	L	M	M	H	Political leadership would be willing, but would need training to better identify these areas. More training is needed for officials to understand the risks.
Farmingdale, Borough of	M	M	L	M	H	More funding and efforts should be made to increase clarification and responsibility with overlapping jurisdictions. As an example, flooding may occur in a municipal right-of-way or residence or business upstream from a blocked stream, culvert or storm sewer whose ownership responsibility is not clear.
Freehold, Borough of	M	H	H	M	H	Jurisdictional Legal and Regulatory Capabilities -The Borough of Freehold will investigate the development and instituting of a Growth Management Ordinance, Post Disaster Recovery Ordinance and an Economic Development Plan. Jurisdictional Fiscal Capabilities - The Borough of Freehold is 98% developed but will investigate the possibility of developing procedures for Impact Fees For Homeowners or Developers for New Developments/Homes. The Borough will investigate and identify hazard prone areas and if it is possible withhold any future spending in these areas.
Freehold, Township of	H	H	H	M	H	Efforts should be made to increase clarification and responsibility with overlapping jurisdictions. As an example, flooding may occur in a municipal right-of-way or residence or business upstream from a blocked stream, culvert or storm sewer whose ownership responsibility is not clear.
Hazlet, Township of	M	M	H	M	M	Ways of bridging gaps in our local capabilities would be: More involvement from local officials. More help from the local officials in identifying our vulnerabilities. Need to attend more planning meetings and get involved.
Highlands, Borough of	H	H	H	L	H	Need to rely upon financial assistance from outside agencies to implement hazard mitigation strategies and related capital improvement projects. Tax base suffered significant adverse impacts due to Superstorm Sandy.
Holmdel, Township of	H	H	H	H	H	Identify all available funding sources to enable the township to implement mitigation strategies where necessary. Continue to make elected officials aware of the necessity of the importance of hazard reduction within the township. Continue outreach to the community to explain the importance of hazard reduction to deflect potential opposition.
Howell, Township of	M	M	M	L	H	Updating any relative ordinances and applying for any and all grant funds available. Identified gaps are lack of funding and sufficient staff. Ways of bridging gaps include seeking grant funding, shared service agreements with other municipalities, public-private partnerships, and technical assistance programs from other levels of government.

Table 4.4
Opportunities for Improving Local Capabilities

Jurisdiction	Overall Legal & Regulatory Capability	Overall Technical Capability	Overall Admin Capability	Overall Fiscal Capability	Overall Level of Political Willingness	Locally identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals
Interlaken, Borough of	M	M	L	M	H	The Borough consists of under 400 properties and is fully built out. The Borough's only source of funding is currently through tax ratables. The Borough will continue to seek grant funding to supplement a limited local budget in order to implement its hazard mitigation projects. While the political leadership itself has a high willingness and desire to mitigate, the ultimate dedication of limited funds tends to be toward projects with the highest level of public support, so bridging this gap would be bridged by incorporating hazard mitigation into discussions at regular council meetings. There are only 6 full time employees in the entire Borough; bridging identified Administrative gaps involves heavy reliance on use of shared services with Deal and Allenhurst. Shared service agreements along with partnerships with regional and private firms increases our ability to meet the technical demands while keeping costs low.
Keansburg, Borough of	M	M	M	L	M	Communication with our Mayor and Council at their monthly meetings, public outreach, and relying on outside agencies for funding for capital improvements.
Keyport, Borough of	H	H	M	M	M	Most major roadways and thoroughfares are City or State operated. Improvements to culverts, bridges and elevation of roadways are multi-jurisdictional programs. Cooperation between County and municipality is needed. Spring 2013 public awareness meetings were held prior to adoptions of the new flood ABFEs.
Lake Como, Borough of	H	H	H	M	H	The Borough of Lake Como's biggest gap would be in the fiscal capability of implementing the hazard mitigation strategies. The Borough has partnered with the Boroughs of Spring Lake and Belmar and the South Monmouth Regional Sewerage Authority to apply for funding for flood mitigation measures at Como Lake. The mitigation involves replacing the current outfall pipe, installation of pipes to install permanent pumps that would lower the lake level during times of storms. In addition, we have all met and agreed to split the costs for the percentage that the towns have to match to any grants approved for projects in the flood zones.
Little Silver, Borough of	H	H	H	H	H	In review of the capability assessment, the Borough has classified all community responses as high. The Borough has actively pursued mitigation activities and has completed Action 4E (outfall and drainage improvements at Howard's Beach) as outlined within the Borough's mitigation action section of the 2009 County Mitigation Plan. The Borough is committed to protecting its residents and shoreline from future storm events. To help protect future residents, the Borough in 2013 has adopted the revised State Model Flood Damage Prevention Ordinance adopting the Advisory Base Flood Elevation with the recommended three feet of freeboard for all new construction. To help eliminate possible storm surge damage along the shoreline, the Borough is actively working with the State to clean up debris within streams left by Superstorm Sandy. This activity is in line with mitigation action goal 4F, as outlined within the Borough's mitigation action section of the 2009 County Mitigation Plan.
Loch Arbour, Village of	H	H	H	M	H	In review of the capability assessment, the Village has classified all community response as moderate to high. The Village has actively worked to protect the shoreline along Edgemont Drive (bulkhead replacement). To help protect future construction and residents, the Borough has adopted the State Model Flood Damage Prevention Ordinance.
Long Branch, City of	H	M	M	L	H	The major issue for our community is financial. If a funding source were identified and secured our community would be able to implement several identified projects.

Table 4.4
Opportunities for Improving Local Capabilities

Jurisdiction	Overall Legal & Regulatory Capability	Overall Technical Capability	Overall Admin Capability	Overall Fiscal Capability	Overall Level of Political Willingness	Locally identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals
Manalapan, Township of	H	H	H	M	H	Manalapan Township intends on bridging the gaps in our local capabilities by conducting a comprehensive educational program between all the departments involved with pre- and post-disaster mitigation to ensure the goals and objectives of the hazard mitigation plan are known to all parties. This will include establishing leadership roles and liaisons who can coordinate between the different departments to ensure task activities are not duplicated nor missed.
Manasquan, Borough of	H	L	L	L	M	Manasquan has the regulatory capability and has well-trained staff that possess both a working and technical knowledge of flood hazards. However, Manasquan lacks the necessary technical infrastructure & training (i.e., GIS/HAZUS), minimal fiscal funds, especially in light of lost tax/ratable income in the wake of Hurricane Sandy, and lacks administrative capability (staff) to implement the hazard mitigation plan to its fullest. Manasquan will a pursue grants that can assist with mitigation activities including technical infrastructure and technical assistance & training. Manasquan will work with Monmouth County GIS to possibly incorporate Manasquan's requirements into the County GIS system. Manasquan is in the process of appointing a part-time Hazard Mitigation Coordinator position to provide the necessary administrative capabilities required.
Marlboro, Township of	H	H	H	H	H	Goals and objectives are established to remain within known capabilities and legal authorities. Any issues requiring multi-jurisdictional response or action are dealt with through the appropriate memorandum of understanding or memorandum of agreement and all applicable rules and standards are followed. Specific issues arising are managed on a case-by-case basis depending on the severity or potential hazard related to the issue. Resolutions and emergency funding can be made available in the event of an immediate hazard. Technical guidance for specific issues is available through our engineer's office.
Matawan, Borough of	M	M	H	L	H	To increase the Borough of Matawan's regulatory capabilities to ensure that they are in line with our mitigation actions and goals, the Borough may need to review the current municipal ordinances and determine what, if any, changes should be made. To increase the Borough's technical capabilities to implement hazard mitigation strategies, the Borough may need to review their current staffing and determine if more full-time dedicated personnel would benefit such an implementation. To increase the Borough's fiscal capabilities, the Borough may need to dedicate an individual or individuals solely to the grant writing process. Being a small, mostly residential community with a high tax rate, Matawan does not have the ratables as many larger towns.
Middletown, Township of	H	H	H	M	H	Identified gaps are lack of funding and sufficient staff. Ways of bridging gaps include seeking grant funding, shared service agreements with other municipalities, public-private partnerships, and technical assistance programs from other levels of government.
Millstone, Township of	M	M	M	M	H	Gaps in local capabilities can be bridged to ensure that they are in-line with mitigation actions and goals by engaging municipal officials in the mitigation planning process. Funding of the mitigation plan should be reviewed on a regular basis to ensure budgeted line items are sufficient to accomplish actions and goals set forth in the plan. Communication among all officials, departments, boards and commissions identified as members of the core planning group in the mitigation plan are also vital to ensuring mitigation actions and goals are in-line with local capabilities.

Table 4.4
Opportunities for Improving Local Capabilities

Jurisdiction	Overall Legal & Regulatory Capability	Overall Technical Capability	Overall Admin Capability	Overall Fiscal Capability	Overall Level of Political Willingness	Locally identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals
Monmouth Beach, Borough of	H	H	H	M/L	H	The Borough will seek additional grant funding to supplement fiscal gaps. The Borough is financially capable of bonding to contribute to mitigation projects. They will seek alternative measures through ordinances or fundraising (including fees/taxes to levy on developers that will be dedicated specifically to mitigation projects). The Borough has a demonstrated track record of cooperating and providing technical and legal support to large projects for the protection of its shore and, specifically, easements required for seawall and beach replenishment projects.
Neptune, Township of	H	H	H	M	M	In order to bridge the gaps in certain capabilities, the Township of Neptune committee would have to review the Hazard Mitigation Plan and those yet unfunded initiatives. Additional grant monies would need to be applied for or capitol monies set aside to meet some of the implementation goals of the Township. With respect to policies and programs to reduce hazards vulnerabilities in the community the Township is working toward minimizing the gap by moving forward with a new classification in the CRS Program. This will result in more review and permitting of and regulated activities in the Special Flood Hazard Area.
Neptune City, Borough of	M	H	H	M	H	The City Council could enact an ordinance for post-disaster recovery and establish a post-disaster recovery plan in conjunction with the ordinance. We could also establish an Economic Development Plan. To help us with our fiscal capability. We need to pursue more grants and also possibly into bonds.
Ocean, Township of	M	M	M	L	H	Looking to update and change ordinances for land development and to try to obtain more grants.
Oceanport, Borough of	H	H	H	M	H	Funding to do projects and manpower to manage the project.
Red Bank, Borough of	H	M	H	M	H	The Red Bank mitigation action plan will be an added agenda item to our quarterly OEM committee meetings so it is discussed, and reported on so that all involved are aware of the mitigation strategy. Also, reporting the current status of the mitigation goals at monthly department head meetings will allow for constant and open communication among Red Bank officials. Meeting minutes will be submitted to the elected liaison for reporting at the bi-monthly Town Council meeting that follows ensuring that Red Bank officials as well as the public are aware of the mitigation strategy.
Roosevelt, Borough of	M	M	L	L	H	I don't know what gaps we have that we are able to mitigate. Ours is a small municipality with very limited resources. We do the best we can to mobilize volunteers to deal with emergencies and hire contractors as needed.
Rumson, Borough of	M	H	H	M	H	Grants and other funding would help the Borough of Rumson bridge gaps in Mitigation actions.
Sea Bright, Borough of	M	M	H	L	H	Funding and community cooperation are our most challenging issues. More public assistance is imperative.
Sea Girt, Borough of	M	M	H	M	H	After Sandy – the Borough of Sea Girt, because of its mitigation plan implementation to date, fared better than most neighboring communities. We have identified 7 areas of concern for which we submitted grant applications to ensure better protection and increased mitigation of problems identified during this past storm. Funding these programs is an issue for which Sea Girt has committed its own resources and actively seeks a partnership via federal and State grant applications. We have identified weak areas within the Borough and are working to educate the public as well as present the Borough's case for improving infrastructure for these at-risk residents.
Shrewsbury, Borough of	H	M	H	M	M	The Borough has retained an engineer as a zoning officer/floodplain manager with education and expertise to assess the community's vulnerability to hazards.

Table 4.4
Opportunities for Improving Local Capabilities

Jurisdiction	Overall Legal & Regulatory Capability	Overall Technical Capability	Overall Admin Capability	Overall Fiscal Capability	Overall Level of Political Willingness	Locally identified opportunities to bridge recognized gaps in capabilities to ensure that they are in-line with jurisdictional mitigation actions and goals
Shrewsbury, Township of	L	M	M	L	M	The Township will budget, yearly, sufficient funds to implement, in phases, hazard mitigation strategies.
Spring Lake, Borough of	M	M	H	H	H	Overall, the Borough's capabilities to ensure that local mitigation actions and goals are in-line. Legal/regulatory and technical capabilities are improving by scheduling quarterly meetings to discuss overall strategies and implementing various action plans.
Spring Lake Heights, Borough of	M	M	L	L	M/H	Action plans, increased funding, meetings, and education are areas in which the Borough is planning to focus in the future to strengthen our Hazard Mitigation Strategies.
Tinton Falls, Borough of	H	M	H	L	H	The Borough of Tinton Falls has sufficient professionals to provide the legal and regulatory capabilities, as well as strong overall administration personnel capable of implementing hazard mitigation strategies. The Borough's Mayor and Council Members are particularly accepting of hazard mitigation proposals. The gaps identified in the Borough's capabilities to achieve mitigation actions and goals include; overall technical capability and fiscal capability. Technical capability to implement strategy is predominately contingent on fiscal capabilities. Allocating finances to mitigation projects are challenging at the Municipal level. There is typically a significant cost associated with hazard mitigation projects. In addition to physical construction costs, many hazard mitigation projects are complex in nature and require extensive permits from NJDEP, USACE, SESC, etc. or may require property and right-of-way acquisition all of which drive soft costs up. Even applications to obtain hazard mitigation grant funds are a costly endeavor. Ways of bridging gaps include seeking grant funding, shared service agreements with other municipalities, public-private partnerships, and technical assistance programs from other levels of government.
Union Beach, Borough of	M	H	M	L	H	The economic development plan, post disaster recovery plan, post disaster recovery ordinance and real estate disclosures might change in the future based upon the outcome of Sandy. The Borough of Union Beach has implemented several projects listed within the 2008 Monmouth County Multi-Jurisdictional Hazard Mitigation Plan. However, the Borough has been limited in their ability to complete all projects due to funding. The Borough will continue to apply to FEMA and local programs to implement these initiatives while budget project that the Borough can reasonably accomplish.
Upper Freehold, Township of	M	M	M	M	M	The current mitigation actions and goals are capable of being adequately addressed and managed by the resources available.
Wall, Township of	M	M	M	M	M	Continue to encourage key stakeholders to identify the professional skills within our community and competencies needed now and in the future and to align them to reduce hazard vulnerabilities within our community.
West Long Branch, Borough of	M	M	M	M	M	Continue with Mitigation Planning process to include; program participation, progress monitoring and financial improvements.

Capabilities and Resources – State of New Jersey

The State's Plan includes an evaluation of the State's overall pre and post hazard mitigation policies, programs, and capabilities; the policies related to development in hazard prone areas; and the State's funding capabilities. The Monmouth County Multi-Jurisdictional Hazard Mitigation Plan incorporates many of the resources identified in the State Plan to demonstrate the capabilities present for local jurisdictions to consider in the development of local hazard mitigation. Please refer to **Appendix 4.2** for additional information, including but not limited to State grant and loan funding sources with the potential to address hazard mitigation projects that can be accessed by local jurisdictions. It provides an overview of these funding sources, potential availability, applicability of pre- or post- disaster requirements, and the type of funding that is available. The State Plan should be referred to directly for more specifics (on the web at www.state.nj.us/njoem/).

This capability assessment finds that the State of New Jersey's various departments collectively have a significant level of legal, technical, and fiscal tools and resources necessary for implementation of hazard mitigation strategies.

Capabilities and Resources – Federal

The Federal government offers a wide range of funding and technical assistance programs to help make communities more disaster resistant and sustainable. Additional information – including a partial list of documents, websites, and funding and technical assistance programs that communities can access to assist in their long-term recovery – can be found in **Appendix 4.3**. Further information on these and other Federal programs can be found in the Catalog of Federal Domestic Assistance (CFDA) available on online at www.cfda.gov.

This capability assessment finds that the various Federal agencies collectively have a significant level of resources necessary to support local implementation of hazard mitigation strategies.

SECTION 5 - MITIGATION GOALS

Goals were developed by taking into consideration both state and jurisdictional goals for mitigation. The goals or actions in this County plan are broadly aligned with the goals of the State Hazard Mitigation Plan. None of the goals or actions in this County plan contradicts the goals of the State Hazard Mitigation Plan. In fact, the Monmouth County Multi-Jurisdictional Hazard Mitigation Plan Goals are in support of furthering the State's goals in many ways.

New Jersey State Hazard Mitigation Plan Goals

As outlined in the New Jersey State Hazard Mitigation Plan (2014), the State's goals are:

1. Protect life
2. Protect property and ensure continuity of operations
3. Increase public preparedness
4. Develop and maintain and understanding of risks from natural hazards
5. Enhance the capability of NJOEM to continuously make New Jersey less vulnerable to hazards
6. Continue to enhance and strengthen local mitigation capabilities.

In addition to the stated mitigation goals and incorporated throughout the strategy to accomplish the State goals, New Jersey will use the following approach:

a) Recognize flooding as the major disaster threat facing the state and use acquisition between a voluntary seller and a public agency as the primary means to accomplish all of the goals and objectives (with additional Repetitive Loss Strategy information below).
b) Offer, as a secondary means of accomplishing the state goals, assistance in the elevation of homes where or when acquisition is not an option.
c) Work with both county and municipal governments that have an approved local mitigation plan and those whose plans are nearing completion to develop sound and beneficial projects to alleviate the impacts of all natural disasters, including but not limited to flooding.
d) Undertake cooperative, focused efforts to address energy and retail fuel resiliency, and continuity of operations.
e) Pursue coordinated funding efforts.

<u>New Jersey Repetitive Loss Strategy</u>: The State's strategy to reduce the number of repetitive loss and severe repetitive loss properties is:

- Use available state financial resources to acquire, demolish and use such properties for permanent state-owned open space.
- Provide matching Green Acres acquisition funds to county and local governments to purchase flood prone properties.
- Provide "Payments in Lieu of Taxes" to municipalities when repetitive and severe repetitive loss properties are acquired by the state and the lands are set aside for permanent open space.
- Award repetitive and severe repetitive loss property acquisition and elevation projects specific points in project ranking scoring.
- Require that all county and municipal hazard mitigation plans include strategies to ensure actions to reduce the number of these properties.
- Develop and disseminate information on FEMA's Repetitive Flood Claim and Severe Repetitive Loss programs.

Monmouth County Multi-Jurisdictional Hazard Mitigation Plan Goals

Hazard Mitigation Plan Goals 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 apply to each jurisdiction adopting the plan (and its updates).

Monmouth County and its participating jurisdictions will continually aim to reduce deaths, injuries, and economic losses stemming from natural hazards, and to lead by example in fostering community resilience and protecting the environment in the face of future natural events to improve the lives of the people of the County.

As part of the 2014 Plan Update process, the 2009 Plan goals were reconsidered and were considered to still be relevant. Therefore, Monmouth County's 2014 State Plan Goals are as follows:

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 associated with coastal and inland floods, hurricanes, and nor'easters.
5. Reduce the possibility of damage and losses due to earthquakes.
6. Reduce the possibility of damage and losses due to lightning strikes.
7. Reduce the possibility of damage and losses due to coastal erosion and wave action.
8. Reduce the possibility of damage and losses due to dam failure.
9. Reduce the possibility of damage and losses due to landslides.
10. Reduce the possibility of damage and losses due to wildfires.
11. Reduce the possibility of damage and losses due to winter storms.
12. Reduce the possibility of damage and losses due to extreme temperatures.
13. Reduce the possibility of damage and losses due to high winds associated with tornados, windstorms, tropical storms, hurricanes, and nor'easters.
14. Reduce the possibility of damages to emergency and critical facilities from damage due to flooding, storm surge, wildfires, and extreme winds.
15. Promote disaster-resistance by incorporating mitigation actions into other planning mechanisms.

SECTION 6 – MITIGATION STRATEGIES

Overview

Each jurisdiction that participated in the 2009 Plan developed a unique mitigation strategy – an action plan describing how their mitigation actions would be implemented, prioritized, administered, and incorporated into the community's existing planning mechanisms. Each jurisdiction developed an action plan unique to their community and its specific vulnerabilities and capabilities.

As part of the 2014 Plan Update, participants were required to provide updated mitigation strategies. This was done using a two-step process.

1. First, each participating jurisdiction provided updates regarding the status and relevance of each action previously included in the 2009 Plan, along with a determination of which measures to would be carried forward to the updated 2014 Plan mitigation strategies, and which would be omitted. They also described changes in local priorities since the last plan was approved. Documentation of this step can be found in **Appendix 1.7**.
2. Next, each participating jurisdiction considered updated risk information to add new mitigation measures to their local strategies.

To jumpstart the process of updating local mitigation strategies, FEMA hosted four, half-day Mitigation Strategy Workshops at the MCOEM on April 2-5, 2013. Each interactive workshop ran from 9 am to approximately 1:30 pm, with one day for each of four geographic regions (Bayshore, Western Monmouth, Mid Monmouth, and South Monmouth). Representatives from 23 municipalities and the County took advantage of this unique opportunity. At the workshops, communities were reminded that their hazard mitigation strategies represent the heart of the overall hazard mitigation plan, and FEMA provided information on how to develop or update a local mitigation strategy. FEMA's workshops presented attendees with a chance to begin to:

- Develop actions to reduce risk and make your community more disaster-resilient
- Develop cost-effective actions that save you money in the long run
- Build a strategy for the successful implementation of your mitigation action plan
- Coordinate with other local officials, planners and stakeholders on potential hazard mitigation ideas and projects
- Use worksheets, examples and other tools to help you and your community build a mitigation strategy that makes a connection between natural hazard risk, action and implementation
- Communicate directly with FEMA planners to understand how to develop an effective and worthwhile Hazard Mitigation Plan.

Communities evaluated a range of mitigation actions to address their greatest vulnerabilities and key risk findings. In the CPG, members often referred to developing mitigation strategies for what they considered their "highest hazards" – those of greatest concern due to high average annual damages and/or isolated key risk findings where the level of risk was deemed to be unacceptable. Mitigation actions were not considered for hazards that were not identified for a given community. "Lesser hazards" – those of least concern due to low average annual damages and/or risk findings where the identified risk was deemed to be acceptable – were typically addressed via less tangible measures, often via education and awareness programs.

Range of Actions and Projects

Mitigation actions are specific actions, projects, activities, or processes taken to reduce or eliminate long-term risk to people and property from the hazards and their impacts. Implementing mitigation actions helps achieve the plan's goals. The actions to reduce vulnerability to threats and hazards form the core of the plan and are a key outcome of the planning process. In general, the primary types of mitigation actions that were considered by the participating communities to reduce their long-term vulnerability include:

- local plans and regulations;
- structure and infrastructure projects;
- natural systems protection; and
- education and awareness programs.

As part of the hazard mitigation plan update, each participating jurisdiction identified and analyzed a comprehensive range of specific mitigation actions and projects to reduce the impacts of the hazards identified in the risk assessment. The comprehensive range means that jurisdictions analyzed, or evaluated, different types of mitigation actions (i.e., a mix of structural and non-structural approaches). Emphasis was placed on mitigating the impacts or vulnerabilities identified in the risk assessment, not on the hazards themselves. These impacts and vulnerabilities were summarized in **Section 3E** of this plan which documents each community's identified hazards, their subset of highest hazards for mitigation consideration, and key risk findings.

To identify potential mitigation actions, each jurisdiction started with the problem statements identified from the risk assessment (**Section 3E**), and developed mitigation actions for addressing those problems. The mitigation actions ultimately selected by each jurisdiction were a function of each jurisdiction's particular range of capabilities for implementing hazard mitigation projects (as outlined in **Section 4**).

A subset of the typical types of actions that were considered by the jurisdictions (in 2009 and 2014) is listed and described in **Table 6.1**, and is organized according to the Mitigation Goal the action is intended to help achieve. In addition to these general types of mitigation actions, the Core Planning Group and JATs also considered a much broader range of more specific mitigation actions that had been identified throughout the course of the planning process as specific problems and/or problem areas were brought to light in their community; and used the actions and projects included in **FEMA's "*Mitigation Ideas*"** document ("*Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, January 2013",* online at www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf) to further broaden the scope of items for consideration.

Table 6.1
Subset of Action Types Considered to Achieve Mitigation Goals

Goals		Actions	
Goal Number	**Description**	**Action Number**	**Description**
1	Promote disaster-resistant development.	1.A	Join the National Flood Insurance Program (for non-participating or suspended communities).
		1.B	For NFIP-participating communities, pursue actions necessary to be recognized by Community Rating System, a voluntary incentive program that encourages community floodplain management activities that exceed the minimum NFIP requirements. Recognition by CRS allows a community to be eligible for benefits such as reductions in NFIP premiums.
		1.C	Ensure that local comprehensive plans incorporate natural disaster mitigation techniques by requiring a courtesy- review of draft plans by the County Emergency Management Agency.
		1.D	Explore the need for hazard zoning and high-risk hazard land use ordinances.
		1.E	Organize an annual event / fair for homeowners, builders and county and local jurisdictions that includes sale of NOAA weather radios, dissemination of information brochures about disasters and building retrofits, demonstration of "defensible-space" concept and fire resistant construction materials (for roofs/exterior finishes and inflammable coverings for openings like chimneys and attics) etc.
		1.F	Develop a stormwater management plan that includes subdivision regulations to control run-off; both for flood reduction and to minimize saturated soils on steep slopes that can cause landslides.
2	Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.	2.A	Expand and disseminate GIS and other hazard information on the internet.
		2.B	Create a mitigation outreach program that helps residents prepare for disasters.
		2.C	Develop a plan and seek funding for backup electric and telecommunications systems in local government-owned critical facilities.
		2.D	Support and fund Community Emergency Response Team (CERT) programs that also include a mitigation component.
		2.E	Create a virtual and physical library that contains all technical studies, particularly natural resources.
		2.F	Expand GIS to collect and develop more sophisticated hazard mapping. Use information to update plan. Ensure information will be available to the public and to relevant communities and agencies.
		2.G	Provide training for inspection and enforcement of adopted codes and ordinances.
3	Reduce the possibility of damage and losses due to drought.	3.A	Encourage citizens to implement water conservation measures by distributing water saving kits which include replacement shower heads, flow restrictors, and educational pamphlets which describe water saving techniques. Also encourage conservation by offering rebates for ultra-low-flow toilets.
		3.B	Modify rate structure to influence consumer water use including: increasing rates during summer months and imposing excess use charges during times of water shortage.

Table 6.1 Subset of Action Types Considered to Achieve Mitigation Goals			
Goals		**Actions**	
Goal Number	**Description**	**Action Number**	**Description**
		3.C	Reduce water use for landscaping by imposing mandatory water-use restrictions during times of water shortage. Also, develop demonstration rain gardens to exhibit water conservation techniques.
		3.D	Publish and distribute pamphlets on water conservation techniques and drought management strategies.
		3.E	Develop and adopt an emergency water allocation strategy to be implemented during severe drought.
		3.F	Implement water metering and leak detection programs followed by water main repair/replacement to reduce losses.
		3.G	Encourage beneficial re-use of treated wastewater effluent through cooperative projects with dischargers, agriculture and other major water users to distribute or provide this alternative source of water.
4	Reduce the possibility of damage and losses due to flooding caused by floods, hurricanes, and nor'easters.	4.A	Join the National Flood Insurance Program. As a participant, floodplains within the participating community will be identified and mapped. In return, the participating community will become eligible for flood insurance as long as the local governing body adopts and enforces a floodplain ordinance.
		4.B	Limit uses in floodways to those tolerant of occasional flooding, including but not limited to agriculture, outdoor recreation, and natural resource areas.
		4.C	Develop a Countywide gauging and warning system for flash and riverine flooding.
		4.D	Continue to implement best management practices for floodplain areas.
		4.E	Identify and document repetitively flooded properties. Explore mitigation opportunities for repetitively flooded properties, and if necessary, carry out acquisition, relocation, elevation, and flood-proofing measures to protect these properties.
		4.F	Conduct a routine stream maintenance program (for currently non-participating communities) and seek financial assistance to clean-out stream segments with heavy sediment deposits. (i.e., this could be through participating in the Monmouth County/ Bridge Commission routine stream maintenance program)
		4.G	Develop specific mitigation solutions for flood-prone roadways and intersections in conjunction with State DOT. Develop a work plan for when sites will be surveyed and what role can the local government play in selection and implementation of mitigation activities (e.g. any monetary or contextual support through the local capital improvement plan).
		4.H	Implement identified stormwater recharge, rate or volume projects identified in Municipal Stormwater Management Plans and Regional Stormwater Management Plans to decrease "flash" in streams during/after storm events.

Table 6.1
Subset of Action Types Considered to Achieve Mitigation Goals

Goals		Actions	
Goal Number	**Description**	**Action Number**	**Description**
5	Reduce the possibility of damage and losses due to earthquakes.	5.A	Retrofit old/dilapidated critical facilities.
		5.B	Public awareness through video/brochures about simple steps homeowners can take to mitigate damage.
		5.C	Examine provisions for earthquake resistant retrofits for existing structures and infrastructure, paying particular attention to unreinforced masonry structures built prior to the 1977 adoption of building codes requiring earthquake resistant design for new construction.
6	Reduce the possibility of damage and losses due to lightning strikes	6.A	Carry out inventory of compliance with existing local codes/standards, especially for critical facilities.
		6.B	Adopt building safety codes such as National Fire Protection Association (NFPA) -780 Standards for the Installation of Lightning Protection Systems (1997).
		6.C	Public awareness/outreach regarding use of ground outlets and surge protectors in homes and businesses.
7	Reduce the possibility of damages and losses due to coastal erosion and wave action.	7.A	Establish an erosion setback line which is located landward of the first stable natural vegetation at a specified distance based on the long-term rate of erosion.
		7.B	Implement V Zone construction requirements for new development located in Coastal A Zones (for communities not currently implementing these requirements)
8	Reduce the possibility of damage and losses due to dam failures.	8.A	Enforce participation in/compliance with National and NJDEP Dam Safety Programs.
		8.B	Investigate sources of funding to assist private dam owners to complete required repairs/maintenance. Investigate low interest loans to owners and/or jurisdiction acting as guarantor of private owners' loans.
		8.C	Notify owners of property in dam break inundation areas of risks, implement restrictions for new development and substantial improvement in these areas.
9	Reduce the possibility of damage and losses due to landslides.	9.A	Create comprehensive geological mapping for areas prone to landslides and rockslides.
		9.B	Locally identify and map specific areas of potential slope failure and limit future development in these areas.
		9.C	Develop a public outreach program that addresses the economic impacts of landslides on personal property.
		9.D	Consider adopting a steep slope ordinance, if one is not already in place, to regulate development on these higher risk areas.
		9.E	Develop a vegetation management plan. Proper vegetation can supply slope-stabilizing root strength, and facilitate in intercepting precipitation. Establishing and maintaining appropriate vegetation of areas above the bluff slope may be the single most important and cost-effective mitigation measure available.

Table 6.1
Subset of Action Types Considered to Achieve Mitigation Goals

Goals		Actions	
Goal Number	**Description**	**Action Number**	**Description**
10	Reduce the possibility of damage and losses due to wildfires	10.A	In consultation with NJFFS and local Forest Firewardens, develop mapping of wildland/urban interface areas.
		10.B	Develop inventory of addresses for route alerting during wildfire emergencies that require public warning and information.
		10.C	In consultation with NJFFS and local Forest Firewardens, review local EOPs for possible wildfire components regarding Fire-Rescue, Alert Warning Communications, and Evacuation.
		10.D	Schedule prescribed burning for hazard reduction.
		10.E	Initiate a public outreach program for homeowners.
		10.F	Retrofit buildings with fire resistant materials.
		10.G	Compel community brush and debris removal and hazard fuels reduction.
		10.H	Encourage Firewise landscaping in higher risk areas.
		10.I	Mitigation for streets, highways, and roads that provide key fire access and fuelbreaks.
11	Reduce the possibility of damage and losses due to winter storms.	11.A	Promote (or purchase, for critical facilities) NOAA weather radios.
		11.B	Educate residents about driving in winter storms and handling winter-related health effects
		11.C	Plant ice and windstorm-resistant trees and encourage landscaping practices to reduce tree-related hazards
		11.D	Bury utility lines to avoid power outage due to winter storms (if risk is very high then only this action might be cost-effective)
12	Reduce the possibility of damage and losses due to extreme temperatures.	12.A	Develop and distribute outreach tools for homeowners and building permit applicants on protection of structures against cold weather damage and proper maintenance of heating/cooling systems.
		12.B	Review existing emergency response plans for enhancement opportunities: work with social support agencies, homeowners associations and general public to develop and implement monitoring and warning systems focused on vulnerable populations and provision of adequate shelter facilities.
13	Reduce the possibility of damage and losses due to tornadoes and high winds caused by windstorms, hurricanes and nor'easters.	13.A	Adopt an ordinance to require safe rooms in mobile home parks
		13.B	Provide low interest loans (or other form of financial assistance) for building safe rooms.
		13.C	Provide technical assistance for building safe rooms.
		13.D	Adopt an ordinance to require hurricane clips on new construction.
		13.E	Install hurricane clips and wind shutters on existing development-particularly emergency facilities and shelters built before existing codes were adopted to offer a degree of wind protection in compliance with the applicable codes and standards.

Table 6.1
Subset of Action Types Considered to Achieve Mitigation Goals

Goals		Actions	
Goal Number	**Description**	**Action Number**	**Description**
14	Reduce the possibility of damages to emergency facilities from flooding, wind damage and wildfire damage.	14.A	Conduct a study to determine the year-built and level of protection (flood, surge, wind) for each emergency facility.
		14.B	On completion of 14.A, seek funding for mitigation projects for emergency facilities not currently designed for protection from flooding and high wind.

Due to the effects of recent disasters, Monmouth County has also identified several hazard mitigation actions for the county and its corresponding municipalities. These were identified during the LOI (letter of intent) process, which included input from representatives of several governmental agencies and organizations, local businesses, and private citizens. Examples include post-Sandy LOIs (see **Appendix 6.1**). Monmouth County and its municipalities will always consider those actions they believe to be the most important during the recovery process, in addition to those actions and project types that have been specifically listed per county and municipality. As a result, the county and municipalities have decided to amend the plan to include the following mitigation actions and project types:

Flood Mitigation Actions. Retrofitting structures prone to periodic flooding is an effective mitigation technique to reduce the flood loss of property and is consistent with all of the goals. Techniques include the elevation of structures, acquisition, mitigation reconstruction, dry flood proofing, wet flood proofing, and drainage improvements and installation of generators.

- Elevation: involves raising a structure on a new foundation so that the lowest floor is above the Base Flood Elevation (BFE). Almost any type and size of structure can be elevated (depending on the location of the structure – the stricter regulations governing construction in A zones such as higher BFEs may preclude the elevation of certain types of structure in coastal areas).

- Acquisition of structures: or "buyout" option is the most effective mitigation technique to reduce the loss of property due to flooding. The owners of repetitive flood loss structures sell their structure to the community on a cost share basis for the fair market value of the structure prior to the last flood event. The structure is demolished and removed with a deed restriction placed on the property for perpetuity, thus eliminating the structure from future flood damage. This approach is most effective when flood prone structures located within the same vicinity are grouped together and acquired. The remaining property can be converted into usable recreational space with minor structure restrictions. It should be noted that owners of repetitive loss structures may be required to pay higher flood insurance rates if they fail to mitigate the structure.

- Mitigation Reconstruction: is a component of the Severe Repetitive Loss (SRL) grant program that allows demolition and reconstruction of structures when traditional elevation cannot be implemented. This activity can be used for structures that were substantially damaged or destroyed. Currently this is a pilot program utilized mainly on the gulf coast but can be considered a potential approach to mitigation activities.

- Dry flood proofing: techniques include the building of floodwalls adjacent to existing walls, the installation of special doors to seal out floodwaters, and special backflow valves for water and sewer lines. Wet flood proofing includes low cost mitigation measures such as raising air conditioners, heat pumps, and hot water heaters on platforms above the BFE.

- Wet flood proofing: includes measures applied to a structure that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protection of mechanical and utility equipment, and use of openings or breakaway walls. Application of wet flood proofing as a flood protection technique under the NFIP is limited to enclosures below elevated residential and non-residential structures and to accessory and agricultural structures that have been issued variances by the community.

- Drainage: Improving the drainage capacity around roads and low-lying areas is a time-tested technique to mitigate flood damage. Maintenance of drainage canals and laterals is essential to maximize their efficiency and continued long term effectiveness. Actions in general to reduce the effects of flooding are widening and deepening the earthen canals, cleaning of existing ditches, and replacing existing culverts, upgrading pumps, and installing check valves and inverts in certain culverts. Maintaining and improving drainage serves to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms/lightning/high winds.

- Generators: Another cost effective retrofitting technique includes the installation of generators. By providing power with generators during and after severe storms many critical facilities may continue to provide necessary services to the community. The installation of generators serves to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms/lightning/high winds.

Wind Mitigation Actions. Retrofits to protect against wind damage are an effective mitigation technique to reduce property losses due to wind and are consistent with all of the goals. Techniques include retrofits to existing structures, and burying electric power lines..

- Structural Retrofits. Structures can be retrofitted to withstand high winds by installing hurricane shutters, roof tie-downs and other storm protection features. The exterior integrity is maintained by protecting the interior of the structure and providing stability against wind hazards associated with hurricanes. These types of measures can be relatively inexpensive and simple to put in place.

- Burying Power Lines. Another retrofitting technique is to bury electric power lines to avoid tree limbs falling on them or from wind damage resulting in a break in service to the consumer. Burying electric power lines serves to assist the communities with problems experienced from floods, hurricanes, ice, tornadoes and thunderstorms/lightning/high winds.

Early Warning Systems. Early warning systems serve to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms/lightning/high winds as well as other lower priority hazards. With sufficient warning of a flood, a community and its residents can take protective measures such as moving personal property, cars, and people out of harm's way. When a flood threat recognition system is combined with an emergency response plan that addresses the community's flood problems, considerable flood damage can be prevented. This system must be coupled with warning the general public, carrying out appropriate tasks, and coordinating the flood response plan with operators of critical facilities. A comprehensive education and outreach program is critical to the success of early warning systems so that the general public, operators of critical facilities, and emergency response personnel will know what actions to take when warning is disseminated. Monmouth County would like to improve its public notification system to alert citizens of the county regarding the possibility of impending flooding caused by hurricanes, tropical storms, and heavy rains resulting from prolonged thunderstorms. A warning period is available for most emergency situations, although the amount of lead time may vary from hazard to hazard. Proper use of this warning period will save lives, reduce injuries, and protect property.

Earthquake Mitigation Actions. Significant seismic events, while not common to the region, do pose a potentially significant threat to Monmouth County and the surrounding area. The most practical preventative actions to be considered concerns appropriate building code enforcement. While this is not necessarily practical for existing structures except for renovations or reconstruction, there are activities that can be taken to mitigate further exposure to risk.

- Building Retrofit: The use of reinforced concrete materials in combination with cross ties is a proven technique to provide current structures with additional stabilization. The addition of seismic stabilizer platforms for important critical mechanicals within buildings will significantly reduce adverse impacts.

Mitigation Action Plans for Each Jurisdiction

Each jurisdiction documented their local evaluation process using FEMA Region 2's Mitigation Action Worksheet[1]. Mitigation Action Worksheets completed by each JAT are included in Appendix 1.9 (with one worksheet per mitigation action). Each community's collection of projects in Appendix 1.9 is referred to as their local "Mitigation Action Plan" or "Mitigation Strategy".

The action worksheets document each jurisdiction's analysis of actions and/or projects considered to reduce the impacts of hazards identified in the risk assessment, and identify the actions and/or projects that each jurisdiction intends to implement. Action evaluation criteria are shown in **Table 6.2.** Special emphasis was placed on the extent to which benefits would be maximized according to a planning level assessment of whether the costs appeared to be reasonable as compared to the anticipated benefits. Worksheets also document how the actions identified will be prioritized, implemented, and administered by each jurisdiction. Priorities (how important the action is) are generally identified as high, medium, or low priority based on each jurisdiction's own assessment of action evaluation criteria. Responsible agencies are documented, along with potential resources for implementation (i.e., staff, funding, materials, etc.) and an estimated timeframe for completion.

[1] FEMA Region 2's "Mitigation Action Worksheets", as distributed at the four, FEMA-hosted Mitigation Strategy Workshops at the MCOEM on April 2-5, 2013. As per this workshop, priority indicated as high, medium, or low with 9no need to rank.

Table 6.2 - Action Evaluation Criteria	
Cost Effectiveness	
Losses avoided (i.e., benefits)	- How effective will the action be at protecting lives and preventing injuries? - How significant will the action be at reducing damage to structures and infrastructure?
Cost estimate	- How much do you estimate it will cost to implement the action?
Cost effectiveness (i.e., benefit/cost)	- Do the losses avoided outweigh the cost of the action? - In other words, will it save your community money in the long term? - Eliminate actions that are not cost effective
Other Factors	
Technical	- Is the mitigation action technically feasible? - Eliminate actions that are not.
Political	- Is there overall public support for the mitigation action? - Is there the political will to support it?
Legal	- Does the community have the authority to implement the action?
Environmental	- What are the potential environmental impacts of the action? - Will it comply with environmental regulations?
Social	- Will the proposed action affect one segment of the population? - Will it disrupt established neighborhoods, break up voting districts or cause the relocation of lower income people?
Administrative capability	- Does the community have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?
Local champion	- Is there a strong advocate for the action among local departments and agencies that will support its implementation?
Other community objectives	- Does the action further other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation?

Unique action items are included for each jurisdiction requesting approval of the plan. Mitigation action plans were developed uniquely by each jurisdiction participating in this plan, with no competition between jurisdictions.

Not all of the actions initially considered were ultimately selected for community action plans based on existing local conditions such as technical feasibility, political acceptance, lack of funding, or other constraints. The actions locally-deemed to be most suitable for the jurisdiction to implement were carried over for detailed evaluation and prioritization. The community and County action plans that were ultimately developed, together with action items spearheaded at the County level with local participation, include action items to address every hazard profiled in this mitigation plan. Communities will consider widening the scope of their mitigation strategies at each update to encompass a greater range of hazards, following progress or completion of the actions in their initial strategies.

Table 6.3 is an overview-level summary of the general types and numbers of projects comprising each local mitigation action plan. **Please refer to Appendix 1.9 for detailed information about each action.** Together, Monmouth County and its jurisdictions intend to implement 339 hazard mitigation actions or projects to reduce risk from natural disasters.

Note that some jurisdictions have opted to include emergency response and preparedness actions in their local mitigation action plans. While these types of actions may be included herein as part of a local action plan, they are not credited toward meeting the plan's mitigation action requirement.

Table 6.3 – Overview of Local Mitigation Strategies

Jurisdiction	Highest hazards - at a minimum - are addressed in the mitigation strategy?	Key risk findings addressed?	Number of Actions Identified	Mitigation Action Types				
				Local Planning / Regulations	Structure and Infrastructure Projects	Natural Systems Protection	Education / Awareness Programs	Preparedness / Response Activities
Monmouth, County of	**Highest hazards - at a minimum - addressed in mitigation strategy**	**Key risk findings addressed**	**20**	■	■	■	■	
Aberdeen, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6	■	■		■	
Allenhurst, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6	■	■			
Allentown, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	2		■			
Asbury Park, City of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6		■	■		
Atlantic Highlands, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7		■			
Avon-by-the-Sea, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	5	■	■	■	■	
Belmar, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	5		■			
Bradley Beach, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7		■	■	■	
Brielle, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	2		■			
Colts Neck, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6	■	■		■	
Deal, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	3		■			
Eatontown, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	3	■	■			
Englishtown, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	3		■	■		
Fair Haven, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	4		■			
Farmingdale, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6		■		■	
Freehold, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	4	■		■	■	■
Freehold, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	8	■	■	■	■	
Hazlet, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	4		■	■		

Table 6.3 – Overview of Local Mitigation Strategies

Jurisdiction	Highest hazards - at a minimum - are addressed in the mitigation strategy?	Key risk findings addressed?	Number of Actions Identified	Mitigation Action Types				
				Local Planning / Regulations	Structure and Infrastructure Projects	Natural Systems Protection	Education / Awareness Programs	Preparedness / Response Activities
Highlands, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	8	■	■	■		
Holmdel, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	2		■			
Howell, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6				■	
Interlaken, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	2		■			
Keansburg, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	12	■	■		■	
Keyport, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	10		■	■		
Lake Como, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	8		■			
Little Silver, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	4		■			
Loch Arbour, Village of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	5		■			
Long Branch, City of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	9	■	■	■		
Manalapan, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	1		■			
Manasquan, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	18	■	■	■	■	■
Marlboro, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6		■		■	
Matawan, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	4		■			
Middletown, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6		■	■		
Millstone, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	2		■	■		
Monmouth Beach, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7		■			
Neptune City, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7	■	■			
Neptune, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	13	■	■	■	■	

Table 6.3 – Overview of Local Mitigation Strategies

Jurisdiction	Highest hazards - at a minimum - are addressed in the mitigation strategy?	Key risk findings addressed?	Number of Actions Identified	Mitigation Action Types				
				Local Planning / Regulations	Structure and Infrastructure Projects	Natural Systems Protection	Education / Awareness Programs	Preparedness / Response Activities
Ocean, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	15		■	■		■
Oceanport, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	10		■	■		
Red Bank, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	5		■		■	
Roosevelt, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	3			■		■
Rumson, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	21	■	■	■	■	
Sea Bright, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	6		■	■		
Sea Girt, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	8		■		■	■
Shrewsbury, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7		■		■	
Shrewsbury, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	3	■	■			
Spring Lake, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7		■			
Spring Lake Heights, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7	■	■		■	
Tinton Falls, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	10	■	■	■	■	
Union Beach, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	13		■	■	■	
Upper Freehold, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	7		■	■	■	
Wall, Township of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	5		■	■		
West Long Branch, Borough of	Highest hazards - at a minimum - addressed in mitigation strategy	Key risk findings addressed	3		■	■		
Total Number of Actions County-wide:			**367**	■	■	■	■	

SECTION 7 - PLAN MAINTENANCE AND INTEGRATION

A formal plan maintenance process for monitoring, evaluating, and updating the Hazard Mitigation Plan must take place to ensure that the Plan – and specifically the mitigation strategy - remains current and relevant. Updates are required every five years from the date the plan is approved[1]. Regularly scheduled evaluations during the five-year cycle are important to assess the effectiveness of the program and to reflect changes that may affect mitigation priorities, and a process must be undertaken to keep the public engaged throughout the plan's ongoing implementation. As part of the 2014 Plan Update, MCOEM and the County Steering Committee have reviewed the 2009 to 2014 plan maintenance procedure, and have opted to pursue a very similar strategy for the next five years (2014 to 2019) though some changes have been made to account for both expressed municipal preferences for a slightly modified approach in some areas, and minor differences in the FEMA guidance since the initial plan was prepared.

The MCOEM will continue to take the lead role in coordinating the overall plan maintenance effort, with ongoing support and feedback from the County Steering Committee. Mr. Michael Oppegaard, Acting Director of the MCOEM and Coordinator for the 2014 Plan update, will oversee the overall plan maintenance process with direct assistance from Ms. Margaret Murnane-Brooks, Deputy Coordinator, who has been directly involved in the County's hazard mitigation planning efforts since 2007. Each CPG member will take the lead role on plan maintenance activities for their respective jurisdiction[2]. **Details of County and municipal responsibilities with regard to plan maintenance and integration are described in the remainder of this section.**[3]

Monitoring the Plan

An important step in any mitigation planning process is to document the method by which the Core Planning Group will monitor the plan's implementation throughout the five-year period of record. The lead entity in each jurisdiction coordinates with other departments/agencies responsible for implementing hazard mitigation actions identified in the plan in order to maximize the opportunities to implement actions, track progress of actions, identify and address any barriers to implementation of the actions, and to take advantage of grant funding opportunities. Monitoring the plan, therefore, becomes part of the regular function of the office and position to which it is assigned.

Approach. The plan monitoring approach outlined in the 2009 Plan (as developed by the Steering Committee on March 19, 2008) and shown below was reselected for the next 5 year cycle. However, MCOEM and the municipalities requested that reference to the old FEMA How-To #4, Worksheet #1 Progress Monitoring Report be replaced by something more user-friendly and tailored to some specific requests of the participants, as the old worksheet had been found to be fairly intimidating during the first plan maintenance phase. The CPG began using a new worksheet in 2012. Additional details are presented below.

The Steering Committee has elected to have **Annual Work Progress Monitoring Reports** prepared by the County and each participating jurisdiction to track the progress of each of their respective hazard mitigation actions. Annual Work Progress Monitoring Reports shall be prepared by the team members

[1] After FEMA completes its plan review and determines that all requirements have been adequately addressed, it issues a determination of "Approvable Pending Adoption". Participating jurisdictions then each move forward with formally adopting the plan. For multi-jurisdictional plans, FEMA considers the plan approval date to be the date of the first jurisdictional adoption.

[2] Many jurisdictions have more than one individual CPG member. In completing the Statement of Authority to Participate (discussed in Section 1), each jurisdiction designated a primary CPG representative as well as an alternate. For plan maintenance purposes, it is the person designated as the 'primary representative' who is responsible for shepherding plan maintenance activities.

[3] Feedback was solicited on a draft of this plan section as follows: (1) distributed via email from URS to MCOEM on August 1, 2012; (2) posted by URS onto the project SharePoint site on January 31, 2013 for all CPG members to review; and (3) distributed via email from MCOEM to CPG members on March 4, 2013. No feedback was received.

listed in **Appendix 1.2** for each participating jurisdiction and submitted on an annual basis to both MCOEM and their local governing body at this same time to demonstrate local progress or changes to-date, beginning one year from the date of FEMA's approval of the Final plan. MCOEM will maintain a central repository of responses. A blank Annual Work Progress Monitoring Report is included at the end of this subsection. The Annual Work Progress Monitoring Reports provide an overview of the hazard mitigation action(s), responsible and supporting agencies/entities responsible for implementation, a delineation of the various project milestones, the current status of the project, any issues that may hinder implementation; and next steps.

Annual Work Progress Monitoring Reports are to be completed by each municipality once per year for each project in their mitigation strategy, beginning one year from the date of FEMA's approval of the Final plan.

<u>Past Progress</u>. The 2009 Plan was approved by FEMA on March 20, 2009; therefore, according to the process outlined above, Annual Work Progress Monitoring Reports were targeted for municipal completion and submittal to MCOEM in March of 2010, 2011, 2012, 2013 and 2014. Each of the jurisdictions attempted some progress in implementing their hazard mitigation initiatives. However, additional project progress as well as project tracking and monitoring were hampered by lack of funds and lack of staff. MCOEM has records of partial submittal of Annual Work Progress Monitoring Reports being completed or submitted to their office during Cycle 1 (2009-2014) in 2010 and 2012. Monitoring of progress in 2013 was hampered by Hurricane Sandy, following which many communities found that all available resources were dedicated to urgent recovery efforts. This highlighted a need for increased vigilance at the local level to both implement mitigation strategies and monitor progress accordingly.

- <u>2010</u> – Annual Work Progress Monitoring Reports were submitted to MCOEM by 29 of the 52 participating jurisdictions. Each of these participating jurisdictions attempted some progress in implementing their initiatives, although additional progress was hampered by lack of funds and lack of staff.
- <u>2011</u> – Annual Work Progress Monitoring Reports were not completed, due to funding and staffing issues as well as the impacts of Hurricane Irene.
- <u>2012</u> – The Annual Work Progress Monitoring Report template was revamped in order to address local concerns that the prior version (from the 2009 Plan, a FEMA sample worksheet) was too cumbersome and intimidating. URS prepared a revised Annual Work Progress Monitoring Report to address expressed concerns, which MCOEM distributed to municipalities. Some responses were received, but responses were not solicited in full due to Hurricane Sandy, and MCOEM's knowledge that this information would be requested from the municipalities as part of the plan update's upcoming Worksheet 5.
- <u>2013 to 2014</u>- As part of this hazard mitigation plan update, project progress was tracked via Worksheet #5, for all progress made on mitigation projects over the whole of the first planning cycle. Detailed tracking (worksheet copies for each jurisdiction) is provided in **Appendix 1.7**, and additional information may be obtained by contacting members of the relevant County or municipal JAT as listed in **Appendix 1.2**.

Annual Work Progress Monitoring Report

Municipality:		Progress Report Period:		Date Prepared:	

Mitigation Action Project Title:

Brief Project Description:			
Risk Addressed:			
Who is responsible for implementing the action?		**Contact Person** *(include name, title, department, phone, email)*:	
Has the project been initiated (check one): __yes ___no *If yes, when?* *If no, why not?*		**List Supporting Agencies and Contacts** *(if any)*:	
Status (check one): __on schedule __completed __delayed* ** If delayed subsequent to initiation, explain here:*		**Original target date for completion:**	**Current estimated target date for completion:**
Original cost estimate:	**Cost Status (check one): __ unchanged __overrun _underrun** *If overrun/underrun, explain here:*	**Anticipated overrun amount:**	**Anticipated underrun amount:**

Description of the Project *(fill in table with a description of each phase, if applicable, and the time frame for completing each phase)*:

Project Milestones *(e.g. grant application, approval, design, permitting, construction, etc.)*	**Complete? (y/n)**	**Projected Completion Date**

Annual Work Progress Monitoring Report

Municipality:		Progress Report Period:		Date Prepared:	

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Mitigation Action Project Title:

<u>Indicator of Success</u>: *In most cases, you will describe any damages/losses that have been avoided as a result of the project. Leave blank if project is not completed. In cases where it is difficult to quantify the benefits in dollar amounts, you will use other indicators, such as the number of people who now know about mitigation or who are taking mitigation actions to reduce their vulnerability to hazards.*
What was accomplished during this reporting period?
What obstacles, problems, or delays did you encounter, if any? *(i.e., Was there political support for the action? Were enough funds available? Were workloads equitably or realistically distributed? Was new information discovered about the risks or community that made implementation difficult or no longer sensible? Was the estimated time of implementation reasonable? Were sufficient resources (funds, personnel) available?)*
How was each problem resolved?
What is/are the next step(s) to be accomplished over the next reporting period?
If the action has been completed, were the outcomes as expected?
Other comments:

Evaluating the Plan

After a mitigation plan is formally approved by FEMA and adopted by participating jurisdictions, it should be evaluated on a regular basis in order to assess the effectiveness of the plan at achieving its stated purpose and goals.

Approach. The plan evaluation approach outlined in the 2009 Plan (as developed by the Steering Committee on March 19, 2008) and shown below was reselected for the 2014 Plan Update.

The Core Planning Group will convene once per year for an **Annual Plan Evaluation Meeting**. Annual Plan Evaluation Meetings will be led by MCOEM and will be conducted within three months after each annual batch of Annual Work Progress Monitoring Reports are due (see "Monitoring", above). At each meeting, the Core Planning Group will review the Annual Work Progress Monitoring Reports, and use the following criteria as points for group discussion to evaluate the effectiveness of the plan at achieving its stated purpose and goals:

- Do the goals and objectives address current and expected conditions?
- Has the nature and magnitude of risks changed?
- Are the current resources appropriate for implementing the plan?
- Are there any implementation problems (such as technical, political and/or legal), or coordination issues with the other agencies and/or Committee members?
- Have the outcomes occurred as expected?
- Have the agencies and other Committee partners participated as proposed?
- Where shortcomings are identified, what can be done to bring things back on track?
- What is the current progress with regard to plan integration?
- Have any comments been received on the plan from municipalities/public/stakeholders?

Following each Annual Plan Evaluation Meeting, the MCOEM will prepare meeting minutes that will document, at a minimum, the Group's consensus responses to the topics above. MCOEM will distribute meeting minutes to all Core Planning Group members via email, and will post meeting minutes on the web site.

Past Progress. The 2009 Plan was approved by FEMA on March 20, 2009. According to the process above, Annual Plan Evaluation Meetings were targeted for June of 2010, 2011, 2012, 2013 and 2014.

- 2010 - No Annual Plan Evaluation Meeting was conducted with the larger planning group; the Steering Committee did, however, conduct an Annual Evaluation Meeting of its own on July 21, 2010. At the Annual Evaluation meeting, the Steering Committee reviewed the action plan of each participating jurisdiction to attempt to determine the status of each initiative. Of 52 participating jurisdictions, 29 submitted a progress report. Each of these participating jurisdictions attempted some progress in implementing their initiatives, although additional progress was noted to be hampered by lack of funds and lack of staff.

- 2012 - An Annual Plan Evaluation Meeting of the CPG was conducted on July 31, 2012 – the midway point of the first plan maintenance cycle. This meeting was led by MCOEM and facilitated by URS. Two identical sessions were conducted (one at 2 pm, and the other at 7 pm) in order to allow municipal representatives the greatest amount of flexibility to attend at a convenient time given their other commitments. At the meeting sessions, URS discussed: the importance of regular plan maintenance; a recap of the 2009 Plan maintenance goals for monitoring, evaluation, updates, and public participation; local progress in plan maintenance activities; the future vision; and local mitigation success stories. FEMA was also present and shared some of their perspectives with regard to plan maintenance. This meeting was attended by a total of 34 of the 53 municipalities, the County, and seven stakeholder groups (afternoon and evening sessions combined attendance). Many of the participating jurisdictions did not actively contribute to discussions of municipal activities or their perspectives regarding the bulleted questions above, particularly those who were present in the afternoon session. The meeting served as an indicator of various shortcomings in carrying through with the prescribed plan maintenance and implementation approach.

Updating the Plan

As part of the process to maintain FEMA mitigation funding eligibility, a plan update must always be submitted to NJOEM/FEMA for their review. This must occur within five years of the plan's approval by FEMA (and during subsequent five-year cycles thereafter).

Approach. The plan update approach outlined in the 2009 Plan was expanded upon and slightly modified for the 2014 Plan Update.

The Monmouth County Hazard Mitigation Plan was first approved by FEMA on March 20, 2009. This 2014 plan update represents the first required update of the document. MCOEM has taken the lead on Plan development and updates, and will continue to do so in the future. MCOEM shall be responsible for ensuring that the plan is maintained in accordance with all applicable guidance and regulations.

The Update Process Itself. Regardless of whether or not the plan update is grant funded[4], the following must occur within 5 years from the date that the plan is adopted by the first of its participating jurisdictions:

- An updated planning process must be undertaken.
- An updated plan document must be prepared.
- The updated document must be resubmitted to FEMA (through NJOEM).
- The updated plan must be reviewed by FEMA, who will provide formal comments indicating both required and recommended revisions.
- At a minimum, all required revisions must be addressed.
- The revised document needs to be routed back to FEMA, who will review to ensure that all required revisions have been satisfactorily addressed. If so, they will deem the plan "approvable pending adoption."
- The plan must then be adopted by participating jurisdictions.

Allowing one year for the update process, and one year for the review/approval/adoption process has historically been observed. That having been said, it is recommended that the County initiate each

[4] Funding the Updates. In the past, Monmouth County has sought out grant funding to offset the fairly significant costs associated with both the initial plan development and the first plan update. Should the County wish to do so in the future, FEMA's Hazard Mitigation Grant Program (HMGP) or Pre-disaster Mitigation Program (PDM) would continue to be the most applicable funding sources. The HMGP is a post-disaster program. Under this program, funds become available state-wide for applicants with approved hazard mitigation plans in place each time there is a Federal disaster declaration anywhere in the state. A certain portion of HMGP disaster funds are set aside for projects; the remainder is set aside for planning. The PDM program is a pre-disaster program. Under this program, funds are appropriated annually and are competitive at a national level. Annual appropriation amounts tend to vary widely, and its availability in the future is not guaranteed. If the MCOEM is interested in obtaining grant funds for the next required plan update (2014 to 2019) then a grant application should be submitted for the first opportunity after the plan is adopted. This would allow for the possibility of the application not being approved on the first pass, and would allow sufficient time for an alternate approach to be taken within the requisite 5-year window. If grant funding is selected as the primary funding source for any given update cycle, the County should be keenly aware of grant application review times, as well as applicable County procurement rules, when moving forward. It is not uncommon for grant submittal, review, approval, RFP issuance, review of proposals, selection of a contractor, and contract negotiations and contract execution to take one to two years out of the 5-year cycle. In addition, grant funding is not guaranteed so the County should be prepared with a backup funding source for meeting requirements if outside assistance does not materialize.

requisite plan update no later than three years after the plan's approval date[5]. If grant funding is sought, applications should be submitted at the first opportunity following the plan's approval date (and no later than two years after the plan is approved).

The plan update involves a comprehensive review and evaluation of each section of the plan, and also discusses the results of evaluation and monitoring activities detailed in the Plan Maintenance section of the previously approved plan. Plan updates may validate the information in the previously approved plan, or may involve a major plan rewrite. A plan update cannot be an annex referring to the previously approved plan; it must stand on its own as a complete and current plan. Plans are required to be updated to reflect changes in development, progress in local mitigation actions, and changes in priorities. Other criteria considered during the update included:

- if changing situations have modified goals/objectives/actions and/or hazards;
- if additional information is available to perform more accurate vulnerability assessments;
- if it is determined that participating jurisdictions wish to be added to and/or removed from the Plan; or
- if it is determined that the Plan no longer addresses current and expected future conditions.

At the time of each update, MCOEM shall consult with NJOEM and FEMA for the latest Guidance in place regarding plan updates to ensure that the latest criteria are addressed in the update process. Plan updates will be posted on the County web site, and made available in hard copy at the MCOEM offices.

Past Progress. The 2009 Plan was approved by FEMA on March 20, 2009. MCOEM applied for HMGP funds to offset the cost of the update. The County released a Request for Proposal (RFP) on February 8, 2012, for consultant services to prepare the updated document. URS was approved via Freeholder Resolution #2012-0270 of March 22, 2012. A contract was executed on May 29, 2012, with URS receipt of a notice to proceed on May 31, 2012. Update proceedings at the municipal level were put on hold following Hurricane Sandy. This document represents the first plan update.

Public Participation in Plan Maintenance

The public and other stakeholders must be given opportunities to become involved during the Plan's regular maintenance and implementation. It is important to understand perceptions of the plan's effectiveness and degree of success to help maintain support for the plan and provide accountability for those responsible for its maintenance and implementation.

Approach. The following array of activities was selected by the Steering Committee during the March 19, 2008 meeting. These activities were reviewed as part of the 2014 Plan Update and selected again for the 2014 to 2019 planning cycle:

- MCOEM will continue to maintain the mitigation planning website.
- Each participating jurisdiction will maintain a link on their jurisdiction's web page to the County mitigation planning website, if they have not already done so.
- MCOEM will prepare an annual fact sheet on the plan. This fact sheet will be submitted via email to Core Planning Group members for posting on community notice boards, at a minimum, and preferably supplemented with distribution at meetings as applicable. MCOEM will post the fact sheet on the County mitigation plan web site.
- Participating jurisdictions will conduct annual interviews and/or smaller meetings with civic groups, the public and other stakeholders. This will be accomplished through incorporating discussion of the mitigation plan into other regularly attended meetings.

[5] After FEMA completes its plan review and determines that all requirements have been adequately addressed, it issues a determination of "Approvable Pending Adoption". Participating jurisdictions then each move forward with formally adopting the plan. For multi-jurisdictional plans, FEMA considers the plan approval date to be the date of the first jurisdictional adoption.

- o Participating jurisdictions will consider annual flyers, newsletters, newspaper advertisements, and Radio/TV announcements to supplement annual interviews/meetings, and will implement some or all of these at the discretion of the jurisdiction. At a minimum, the County will issue an annual press release.
- o Participating jurisdictions are responsible for keeping track of any comments they receive on the plan, and bringing these forward for discussion at the Annual Plan Evaluation Meetings.

Past Progress. The following progress was made in continued outreach to the public and other stakeholders over the first plan maintenance cycle:

- o MCOEM has successfully continued to maintain the mitigation planning website. In addition, during the first plan update, a SharePoint website was set up for access by all CPG members and key stakeholders for more detailed information and updates.
- o Beginning in 2012, all participating jurisdictions conducted regular outreach to the public and other stakeholders regarding the plan update. Their activities are summarized in the jurisdictional Outreach Logs for all jurisdictions which are included in **Appendix 1.10.**

Plan Integration

For a participating jurisdiction to succeed in reducing risk in the long term, the information and recommendations of the hazard mitigation plan must be integrated into day-to-day local government operations. Throughout the planning process, partnerships are formed between departments and agencies, and sustained actions between these partners will increase the community's resilience to disasters. "Plan integration" can be thought of as the process whereby each participating jurisdiction will incorporate the mitigation plan findings and projects into other planning mechanisms (local governance structures that are used to manage local land use development and community decision making).

Approach. The overall approach of the 2009 Plan included various plan integration options for municipalities to choose from during the plan maintenance phase. It was not specific as to which jurisdictions would undertake which activities. However, the latest FEMA guidance requires multi-jurisdictional plans to be more specific, identifying what particular activities will be undertaken by each specific jurisdiction. To this end, as part of the 2014 Plan update process, municipalities were asked to consider a range of possible plan integration activities, and by completing a worksheet, select a series of jurisdiction-specific activities from this pick list of options. A wide range of possibilities was considered, such as: protecting life and property in high hazard areas by limiting densities of new development; increasing resilience by limiting the extension of public infrastructure in high hazard areas; and adding a specific hazard mitigation element to the next update of local master, general or comprehensive plans - to name a few. **Table 7.1** documents the full range of plan integration options that were considered, as well as each jurisdiction's selected plan integration activities that will be undertaken during the 2014 to 2019 plan maintenance cycle.

Past Progress. As part of the 2014 Plan Update, the targeted plan integration activities from the last version of the plan were put into tabular form on a worksheet, and each jurisdiction was asked to complete the worksheet to indicate their respective accomplishments. A summary of Plan Integration activities that were undertaken during the first planning cycle is provided in **Table 7.2**.

Table 7.1 - Multi-Jurisdictional Plan Integration Approach (2014-2019)

Jurisdiction	1-CPG member will issue a letter to each department head to solicit their support and explore opportunities for further integration of hazard mitigation into the daily activities of the community as a whole.	2a-Incorporate hazard mitigation for natural hazards in the next update of the local master, general or comprehensive plan.	2b-Add a specific hazard mitigation element to the next update of the local master, general, or comprehensive plan.	3 – Adopt and enforce the minimum building standards established in the current State-adopted IBC (NJ edition).	4a- Maintain community participation in FEMA's National Flood Insurance Program (or join the NFIP, if you are not currently participating).	4b-Enforce codes and standards beyond FEMA minimum requirements.	4c-Join (or continue to maintain participation in) the NFIP's Community Rating System.	5-Guide growth and development away from high risk locations by using the risk assessment to inform future updates of community land use plans, zoning and subdivision codes and the development review process.	6-Modify work plans, policies or procedures to include hazard mitigation concepts/activities.	7-Revise job descriptions to include mitigation-related duties to further institutionalize mitigation.	8-Revise capital or operating budgets to include a line item for mitigation project funding.	9-Issue directives to require departments/agencies in the community to carry out certain hazard mitigation activities.	10-Require the Department of Public Works to inspect and clean debris from streams and ditches more frequently.	11-Add hazard vulnerability to subdivision and site plan review criteria.	12-Perform inventories of historic sites in hazard areas in your community to identify where special treatment may be needed to protect them from specific natural hazards.	13-Reach out to state agencies for assistance with natural hazard mitigation activities.	14-Reach out to colleges and universities for technical assistance with natural hazard mitigation activities.	15-Adopt (or continue to enforce) a local stormwater management plan/ordinance.	16-Protect life and property in high hazard areas by limiting densities of new development.	17-Increase resilience by limiting the extension of public infrastructure in high hazard areas.	18-Reduce the vulnerability of future development in high hazard areas by reviewing development regulations.	19-Use the risk assessment to inform future updates of the community emergency operations plan, evacuation plan, and/or post disaster recovery plan.	20-Implement hazard mitigation activities through existing plans and policies.	21 Sponsor training on best practices for hazard mitigation for local government staff.
Monmouth County	■	■	■	N/A	N/A	N/A	■	N/A	■	■		N/A	N/A	N/A	■	■	■	N/A	N/A	N/A	N/A	■		■
Aberdeen, Township of	■	■	■	■	■	■	■	■			■		■	■		■	■	■	■		■	■	■	
Allenhurst, Borough of	■	■	■	■	■	■	■	■	■	■	■	■	■					■	■	■	■	■	■	
Allentown, Borough of		■	■		■				■			■	■		■	■		■				■	■	
Asbury Park, City of	■			■	■		■		■				■	■	■	■		■				■	■	■
Atlantic Highlands, Borough of	■	■	■	■	■	■	■		■	■		■	■	■	■	■	■	■	■	■	■	■	■	■
Avon-By-The-Sea, Borough of	■	■	■	■	■	■			■	■		■	■	■		■	■	■				■	■	■
Belmar, Borough of	■	■		■	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Bradley Beach, Borough of	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■		■	■	■		■	■	■
Brielle, Borough of		■		■	■		■						■			■		■			■	■	■	
Colts Neck, Township of		■			■				■		■	■	■			■		■			■	■	■	
Deal, Borough of		■		■	■			■	■	■		■	■	■		■		■	■		■	■	■	■
Eatontown, Borough of									■													■	■	
Englishtown, Borough of		■		■	■				■				■					■	■			■	■	
Fair Haven, Borough of	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■		■	■	■	■	■	■	■
Farmingdale, Borough of	■							■	■			■	■	■	■	■		■	■	■	■	■	■	
Freehold, Borough of	■	■	■	■	■	■	■	■	■			■	■	■	■	■		■	■	■	■	■	■	■
Freehold, Township of	■			■	■	■		■								■		■	■	■		■	■	
Hazlet, Township of	■	■	■		■						■		■					■				■	■	■
Highlands, Borough of	■	■	■	■	■	■		■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■
Holmdel, Township of	■	■		■	■			■	■	■		■	■	■	■			■	■	■	■	■	■	■
Howell, Township of	■		■		■			■	■		■	■	■	■	■	■		■	■	■	■	■	■	■
Interlaken, Borough of		■		■	■			■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■
Keansburg, Borough of	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Keyport, Borough of	■	■		■	■	■			■			■	■			■		■				■	■	
Lake Como, Borough of	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■
Little Silver, Borough of		■		■	■		■	■	■	■			■	■		■		■	■		■	■	■	■
Loch Arbour, Village of		■		■	■			■	■	■			■	■		■		■	■		■	■	■	■
Long Branch, City of	■	■		■	■		■		■			■	■		■	■	■	■			■	■	■	
Manalapan, Township of	■	■	■	■				■	■		■	■	■	■	■	■		■	■	■	■	■	■	■
Manasquan, Borough of	■	■	■	■	■		■		■	■	■	■	■		■	■	■	■	■		■	■	■	■
Marlboro, Township of	■	■			■			■					■					■				■	■	
Matawan, Borough of	■	■	■	■	■	■	■	■	■		■	■		■		■		■	■	■	■	■	■	■
Middletown, Township of	■	■		■	■		■		■				■			■	■	■			■	■	■	

Table 7.1 - Multi-Jurisdictional Plan Integration Approach (2014-2019)

Jurisdiction	1-CPG member will issue a letter to each department head to solicit their support and explore opportunities for further integration of hazard mitigation into the daily activities of the community as a whole.	2a-Incorporate hazard mitigation for natural hazards in the next update of the local master, general or comprehensive plan.	2b-Add a specific hazard mitigation element to the next update of the local master, general, or comprehensive plan.	3 – Adopt and enforce the minimum building standards established in the current State-adopted IBC (NJ edition).	4a- Maintain community participation in FEMA's National Flood Insurance Program (or join the NFIP, if you are not currently participating).	4b-Enforce codes and standards beyond FEMA minimum requirements.	4c-Join (or continue to maintain participation in) the NFIP's Community Rating System.	5-Guide growth and development away from high risk locations by using the risk assessment to inform future updates of community land use plans, zoning and subdivision codes and the development review process.	6-Modify work plans, policies or procedures to include hazard mitigation concepts/activities.	7-Revise job descriptions to include mitigation-related duties to further institutionalize mitigation.	8-Revise capital or operating budgets to include a line item for mitigation project funding.	9-Issue directives to require departments/agencies in the community to carry out certain hazard mitigation activities.	10-Require the Department of Public Works to inspect and clean debris from streams and ditches more frequently.	11-Add hazard vulnerability to subdivision and site plan review criteria.	12-Perform inventories of historic sites in hazard areas in your community to identify where special treatment may be needed to protect them from specific natural hazards.	13-Reach out to state agencies for assistance with natural hazard mitigation activities.	14-Reach out to colleges and universities for technical assistance with natural hazard mitigation activities.	15-Adopt (or continue to enforce) a local stormwater management plan/ordinance.	16-Protect life and property in high hazard areas by limiting densities of new development.	17-Increase resilience by limiting the extension of public infrastructure in high hazard areas.	18-Reduce the vulnerability of future development in high hazard areas by reviewing development regulations.	19-Use the risk assessment to inform future updates of the community emergency operations plan, evacuation plan, and/or post disaster recovery plan.	20-Implement hazard mitigation activities through existing plans and policies.	21 Sponsor training on best practices for hazard mitigation for local government staff.
Millstone, Township of		■		■	■			■	■	■	■	■	■	■		■		■	■		■	■	■	■
Monmouth Beach, Borough of	■	■		■	■	■	■		■	■			■	■		■		■				■	■	
Neptune City, Borough of	N/A															•								
Neptune, Township of		■	■	■	■	■	■		■				■	■		■		■			■	■	■	■
Ocean, Township of		■	■	■	■		■		■	■			■		■	■						■	■	■
Oceanport, Borough of		■	■	■	■	■	■	■					■	■		■	■	■	■	■		■	■	■
Red Bank, Borough of	■	■	■		■	■	■	■	■		■	■	■	■		■		■				■	■	■
Roosevelt, Borough of			■		■		■									■		■						
Rumson, Borough of	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■		■	■	■	■	■	■	■
Sea Bright, Borough of	■	■	■	■	■	■	■				■	■				■	■	■			■	■	■	
Sea Girt, Borough of	■	■	■	■	■		■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■
Shrewsbury, Borough of	■	■	■	■	■													■	■	■	■	■	■	
Shrewsbury, Township of				■	■													■					■	■
Spring Lake, Borough of		■	■	■	■		■		■			■	■			■	■	■			■	■	■	■
Spring Lake Heights, Borough of		■	■	■	■		■	■	■		■	■	■			■		■	■	■	■	■	■	■
Tinton Falls, Borough of	■	■		■	■		■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■
Union Beach, Borough of					■	■	■		■					■		■					■		■	■
Upper Freehold, Township of	■	■		■	■			■	■					■	■	■			■	■	■	■	■	■
Wall, Township of	■	■	■	■														■			■	■	■	■
West Long Branch, Borough of		■		■			■		■			■	■			■	■	■			■	■	■	

Table 7.2 – Past Progress, Plan Integration (2009-2014)

Jurisdiction	1-CPG member (or predecessor) issued a letter to each of the community's department heads to solicit their support and explore opportunities for integrating hazard mitigation planning objectives into daily activities.	2a-CPG member (or predecessor) worked with local planning department to educate them on the Hazard Mitigation Plan and encourage that on the next update of the local master, general or comprehensive plan, hazard mitigation for natural hazards is addressed.	2b-Jurisdiction does not have a master, general or comprehensive plan.	2c-Local master, general or comprehensive plan was updated since 2008.	2d- If there was an update to the master, general, or comprehensive plan, natural hazard risk/mitigation was incorporated in some way.	2e-If there was an update to the master, general, or comprehensive plan, a specific hazard mitigation element was added to the document.	3-CPG member (or predecessor) coordinated with local building department to ensure that they adopted and are enforcing the minimum standards established in the current State-adopted IBC (NJ edition).	4a-Continued participation in FEMA NFIP.	4b-If community participates in NFIP but was only enforcing minimum requirements at the time of the first plan's adoption, CPG member (or predecessor) coordinated with local Floodplain Administrator to determine if standards beyond FEMA minimum requirements should be enforced.	4c-Community was already enforcing beyond FEMA minimum requirements at time of plan's first adoption.	4e-Community has maintained its participation in the CRS.	4f-Community has joined the CRS since 2009.	4g-Community has dropped out of the CRS since 2009.	5a-Community has local zoning ordinances.	5b-CPG member (or predecessor) worked with local zoning board to educate them on the Hazard Mitigation Plan and encourage consideration of low occupancy, low-density zoning in hazard areas, when practicable.	6a-Work plans, policies or procedures were changed to include hazard mitigation concepts/activities.	7a- Job descriptions were revised to include mitigation-related duties to further institutionalize mitigation.	8a-Capital or operating budgets were revised to include a line item for mitigation project funding.	8b-Capital or operating budgets already included a line item for mitigation project funding when the plan was first approved.	9-Governing body or local executive issued directives to require departments/agencies to carry out certain hazard mitigation activities.	10-Department of Public Works has adopted more rigorous procedures for inspecting and cleaning debris from streams and ditches (i.e., more frequently).	11-Planning Department has added hazard vulnerability to subdivision and site plan review criteria.	12-Inventories of historic sites in hazard areas have been performed to identify where special treatment may be needed to protect them from natural hazards.	13-Community has reached out to State agencies for assistance with natural hazard mitigation activities.	14-Community has reached out to colleges and universities for technical assistance with natural hazard mitigation activities.	15a-Community has a stormwater management plan.	15b-Community has a stormwater management ordinance.
Monmouth County		■		■	■	■	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	■	■		■	■	■	■	■	■	●	■	N/A
Aberdeen, Township of								■		■	■			■	■	■						■		■	●	■	■
Allenhurst, Borough of								■	■					■		■										■	■
Allentown, Borough of	■		■	■				■						■							■					■	
Asbury Park, City of							■	■						■		■					■	■		■		■	■
Atlantic Highlands, Borough of	■	■					■	■		■	■	■		■	■		■		■		■			■	●	■	■
Avon-By-The-Sea, Borough of	■	■					■	■	■			■		■	■						■					■	■
Belmar, Borough of	■	■					■	■	■			■		■	■	■				■	■			■		■	
Bradley Beach, Borough of		■		■	■	■	■	■	■		■			■					■		■			■		■	■
Brielle, Borough of		■					■	■	■		•			■										■		■	■
Colts Neck, Township of		■						■						■								■				■	■
Deal, Borough of		■					■	■						■			■			■	■	■		■		■	■
Eatontown, Borough of	■						■	■						■													
Englishtown, Borough of							■	■						■							■					■	■
Fair Haven, Borough of	■		■				■	■			■	■		■				■			■	■				■	■
Farmingdale, Borough of							■	■						■										■		■	
Freehold, Borough of							■							■		■										■	■
Freehold, Township of								■						■							■					■	■
Hazlet, Township of	■		■					■						■							■					■	
Highlands, Borough of		■	■	■	■		■	■	■	■				■							■	■		■		■	■
Holmdel, Township of		■		■			■	■						■	■						■	■				■	■
Howell, Township of							■	■						■				■						■		■	■
Interlaken, Borough of		■					■	■						■		■	■				■	■		■		■	■

Table 7.2 – Past Progress, Plan Integration (2009-2014)

Jurisdiction	1-CPG member (or predecessor) issued a letter to each of the community's department heads to solicit their support and explore opportunities for integrating hazard mitigation planning objectives into daily activities.	2a-CPG member (or predecessor) worked with local planning department to educate them on the Hazard Mitigation Plan and encourage that on the next update of the local master, general or comprehensive plan, hazard mitigation for natural hazards is addressed.	2b-Jurisdiction does not have a master, general or comprehensive plan.	2c-Local master, general or comprehensive plan was updated since 2008.	2d- If there was an update to the master, general, or comprehensive plan, natural hazard risk/mitigation was incorporated in some way.	2e-If there was an update to the master, general, or comprehensive plan, a specific hazard mitigation element was added to the document.	3-CPG member (or predecessor) coordinated with local building department to ensure that they adopted and are enforcing the minimum standards established in the current State-adopted IBC (NJ edition).	4a-Continued participation in FEMA NFIP.	4b-If community participates in NFIP but was only enforcing minimum requirements at the time of the first plan's adoption, CPG member (or predecessor) coordinated with local Floodplain Administrator to determine if standards beyond FEMA minimum requirements should be enforced.	4c-Community was already enforcing beyond FEMA minimum requirements at time of plan's first adoption.	4e-Community has maintained its participation in the CRS.	4f-Community has joined the CRS since 2009.	4g-Community has dropped out of the CRS since 2009.	5a-Community has local zoning ordinances.	5b-CPG member (or predecessor) worked with local zoning board to educate them on the Hazard Mitigation Plan and encourage consideration of low occupancy, low-density zoning in hazard areas, when practicable.	6a-Work plans, policies or procedures were changed to include hazard mitigation concepts/activities.	7a- Job descriptions were revised to include mitigation-related duties to further institutionalize mitigation.	8a-Capital or operating budgets were revised to include a line item for mitigation project funding.	8b-Capital or operating budgets already included a line item for mitigation project funding when the plan was first approved.	9-Governing body or local executive issued directives to require departments/agencies to carry out certain hazard mitigation activities.	10-Department of Public Works has adopted more rigorous procedures for inspecting and cleaning debris from streams and ditches (i.e., more frequently).	11-Planning Department has added hazard vulnerability to subdivision and site plan review criteria.	12-Inventories of historic sites in hazard areas have been performed to identify where special treatment may be needed to protect them from natural hazards.	13-Community has reached out to State agencies for assistance with natural hazard mitigation activities.	14-Community has reached out to colleges and universities for technical assistance with natural hazard mitigation activities.	15a-Community has a stormwater management plan.	15b-Community has a stormwater management ordinance.
Keansburg, Borough of	■	■		■	■		■	■	■					■			■				■		■	■		■	
Keyport, Borough of				■			■	■		■			■	■		■	■				■	■		■		■	■
Lake Como, Borough of	■	■		■			■	■	■					■	■				■	■	■	■				■	■
Little Silver, Borough of		■		■			■	■		■				■		■	■			■		■				■	■
Loch Arbour, Village of		■		■	■	■	■	■						■		■	■			■	■	■		■		■	■
Long Branch, City of	■			■			■	■						■	■											■	■
Manalapan, Township of	■	■	■	■			■	■	■					■	■	■				■	■	■		■		■	■
Manasquan, Borough of	■			■	■		■	■		■	■			■	■	■	■	■		■				■	■	■	■
Marlboro, Township of	■			■			■	■	■					■	■			■			■					■	■
Matawan, Borough of								■						■				■				■		■		■	■
Middletown, Township of							■	■	■		■	■		■										■		■	■
Millstone, Township of		■		■	■	■	■	■						■		■	■	■		■		■				■	■
Monmouth Beach, Borough of		■		■	■		■	■	■					■				■			■			■		■	■
Neptune City, Borough of			■	■				■						■							■			■		■	■
Neptune, Township of	■	■		■	■		■	■	■		■			■		■		■			■	■		■		■	■
Ocean, Township of	■		■				■	■	■					■	■		■				■			■	■	■	■
Oceanport, Borough of		■		■			■	■	■	■	■	■		■	■	■		■			■	■		■	■	■	■
Red Bank, Borough of	■			■				■								■			■	■	■		■	■		■	■
Roosevelt, Borough of														■													
Rumson, Borough of	■	■		■			■	■						■			■	■	■		■	■		■		■	■
Sea Bright, Borough of				■			■	■						■		■	■							■	■	■	
Sea Girt, Borough of	■	■		■			■	■						■	■	■	■			■	■	■	■	■	■	■	
Shrewsbury, Borough of		■					■	■						■							■					■	■
Shrewsbury, Township of			■					■						■												■	■

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Spring Lake, Borough of	■	■					■	■			■			■				■			■			■	■	■	■
Spring Lake Heights,Borough of							■	■						■				■			■	■	■	■		■	■
Tinton Falls, Borough of		■		■			■	■						■							■					■	■
Union Beach, Borough of	■	■		■	■	■	■	■		■	■			■	■	■					■			■		■	■
Upper Freehold, Township of	■	■		■			■	■						■												■	■
Wall, Township of	■	■	■	■			■	■						■	■											■	■
West Long Branch, Borough of				■			■							■		■				■	■	■		■	■	■	■

SECTION 8 - FOR MORE INFORMATION

If you have any questions or comments on the Multi-Jurisdictional Hazard Mitigation Plan for Monmouth County, New Jersey, additional information can be obtained by contacting:

Michael Oppegaard
Coordinator
Monmouth County Office of Emergency Management
300 Halls Mills Road
Freehold, New Jersey 07728
Phone: 732-431-7400
Fax: 732-409-7532
E-Mail: moppegaard@mcsonj.org

Margaret Murnane Brooks
Deputy Coordinator
Monmouth County Office of Emergency Management
300 Halls Mills Road
Freehold, New Jersey 07728
Phone: 732-431-7400
Fax: 732-409-7532
E-Mail: mmurnane@mcsonj.org

For jurisdiction specific information, it is recommended that the individuals identified as representatives of the jurisdictions in **Appendix 1.2** of this plan be contacted.

Plan information is also maintained continuously on the County web site at:

http://www.monmouthsheriff.org/Sections-read-144.html

APPENDIX CD

Appendices for the
Monmouth County Multi-jurisdictional Hazard Mitigation Plan
are included herein on CD only.

Appendices

Appendix 1.1 – Statements of Authority to Participate
Appendix 1.2 – Worksheet 1: Planning Committee Membership Information
Appendix 1.3 – Meeting Materials
Appendix 1.4 – Worksheet 2: NFIP Participation
Appendix 1.5 – Worksheet 3: Land Uses and Development Trends
Appendix 1.6 – Worksheet 4: Capability Assessments
Appendix 1.7 – Worksheet 5: Status of Past Projects
Appendix 1.8 – Worksheet 6: Plan Integration
Appendix 1.9 – Worksheet 7: Action Worksheets
Appendix 1.10 – Outreach Logs
Appendix 1.11 – County Press Releases and Articles in Local News Media
Appendix 1.12 – Jurisdictional Website Coverage of the Plan
Appendix 1.13 – MCOEM Natural Hazards Survey Results
Appendix 1.14 – Comments Received on the Draft – 2014 Plan Update