2015 Hazard Mitigation Plan Update

Union County, New Jersey

Preliminary Draft

October 9th, 2015

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Section 1: Executive Summary

1.1 Overview and Purpose

On October 30, 2000, the President signed into law the Disaster Mitigation Act of 2000, also known as DMA 2000. Among its other features, DMA 2000 established a requirement that in order to remain eligible for federal disaster assistance and grant funds, local and state governments must develop and adopt hazard mitigation plans. On February 26, 2002, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule (IFR) that set forth the guidance and regulations under which such plans are supposed to be developed. The IFR provides detailed descriptions of both the planning process that states and localities are required to observe and the contents of the plan that emerges. In December 2010 the Union County Multi-Jurisdictional Hazard Mitigation Plan (the Plan) was developed to satisfy these requirements. The original plan was approved by FEMA and adopted by the County on December 8, 2010. In the spring of 2014 Union County initiated a Plan update to the 2010 version as part of the 5-year maintenance cycle required to keep the plan current. Of the 21 municipalities that lie within Union County, 20 participated in the Plan update. All participating municipalities are listed in Section 2.1.2.

The purpose of a mitigation plan is to rationalize the process of determining appropriate hazard mitigation actions. Hazard mitigation is often defined as actions taken to reduce the effects of natural hazards on a place and its population. Union County decided to develop the original 2010 Plan because of increasing awareness that natural hazards, especially flood and wind, have the potential to affect people, physical assets and operations in Union County. The 2015 Union County HMP update included a re-evaluation of the original hazards, the risk assessment, mitigation goals, strategies, and mitigation priorities. As part of the update process, these sections of the Plan were re-assessed to identify changes and updates that may have occurred since approval and adoption of the original Plan.

Although risk assessments have been completed for each hazard, the risk section of the Plan update focuses on six natural hazards and two technological/manmade hazards (hazards ranked high) with the highest potential for damaging physical assets, people, and operations in Union County. These hazards are flood, storm surge, high wind–straight-line winds, hazardous material releases–fixed sites, hazardous material releases–transportation, severe storm–winter weather, extreme temperatures–cold and extreme temperatures–heat. Both the risk assessment and mitigation action plan sections reflect this emphasis, which was the result of careful consideration by the 2015 Union County Hazard Mitigation Planning Steering Committee (HMPSC).

1.2 Organization of the Plan

The Plan is organized to parallel the structure provided in the IFR. The Plan has eight sections.

Section 1	Executive Summary
Section 2	County Profile
Section 3	Planning Process

Section 4	Hazard Identification and Risk Assessment
Section 5	Mitigation Action Strategy
Section 6	Approval and Adoption
Section 7	Plan Monitoring and Maintenance
Appendices 1-20	Municipalities

1.3 Planning Process

Section 3 provides details about the process that was used to develop this Plan update. The original process (and Plan update) closely followed the guidance in the FEMA *386* series of planning guidance, which recommend a four-stage process for developing mitigation plans.

- Step 1 Organize resources
- Step 2 Assess risks
- Step 3 Develop a mitigation plan
- Step 4 Implement the plan and monitor progress

Step 1, organizing resources, is described in Section 3 (Planning Process) and the individual municipality appendices. The section includes details about who was involved, the processes that were used to establish leadership and advisory groups, and public and other outreach and involvement efforts.

Step 2, the risk assessment is included as Section 5 of the Plan update. For each hazard this is included as part of the "Impact on Life and Property" subsection.

Step 3, development of the Mitigation Plan is described in Section 3 (Planning Process) and Section 6 (Mitigation Action Plan). Section 3 includes details about who was involved, the processes that were used, and the products that were developed. Section 7 includes specific details about the identification and development of mitigation goals, objectives, and actions based upon Section 5 (Risk Assessment) and Section 6 (Capability Assessment subsection).

Step 4, implementing the Plan, is described in the Mitigation Action Plan in Section 6, which includes details about who is responsible for implementation of specific strategies and actions; and in Section 8, the Plan Monitoring and Maintenance section, which describes long-term implementation through periodic updates and reviews.

1.4 Hazards and Risk

1.2.1 Hazards

Section 45 of this Plan update include detailed descriptions of the process that was used to assess and prioritize Union County's risks from natural hazards, quantitative risk assessments for Union County as a whole, and assessments that are more detailed for certain asset classes. A total of 18 hazards were

initially identified and profiled by the HMPSC. A list of these hazards can be found at the beginning of Section 4, Hazard Identification and Risk Assessment.

For each of these hazards, the profiles in Section 5 include:

- Description
- Geographical Extent
- Severity
- Impact on Life and Property (and Vulnerabilities and Risk)
- Occurrence (probability)

In its early meetings related to this HMP update, the HMPSC considered a total of 18 hazards that have potential to affect the County. The group reviewed these hazards and prioritized them as high, medium, or low based on the overall impact to the County. They considered factors such as how often the hazard occurred, degree of property and infrastructure damage, number of people impacted, and time of recovery. Those hazards prioritized as high or medium by the HMPSC include more extensive discussions about vulnerability and risk than those with lower rankings. A total of eight hazards were ranked high. The rankings for all 18 hazards can be found in Table 4-2 in Section 4.

In addition to ranking hazards at the county level, the municipality working groups also ranked each hazard as high medium and low. The county-wide assessment was supported by jurisdictional risk assessments for the hazards ranked high and medium by the municipal planning committees.

1.2.2 Risk

A risk calculation is a FEMA requirement. Risk is a numerical indication of potential future damages. Section 4 includes details about calculation methodologies and results of the countywide risk assessments. Additional risk calculations are included in the individual municipality appendices for hazards ranked as high and medium.

1.5 Goals Objectives and Actions

Section 5 of this Plan describes Union County's priorities for mitigation actions. The section divides the actions by priority, and describes the funding required, sources of funding, the level of support, and the timing of the action. The section also includes Union County hazard mitigation goals and objectives.

Goals are general guidelines that explain what Union County wants to achieve. Goals are expressed as broad policy statements representing desired long-term results. The broad goals of the 2015 Union County Hazard Mitigation Plan update are as follows:

- **Goal 1:** Improve EDUCATION AND OUTREACH efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact
- **Goal 2:** Improve DATA COLLECTION, USE, AND SHARING to reduce the impact of hazards

- **Goal 3:** Improve CAPABILITIES, COORDINATION, AND OPPORTUNITIES at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities
- **Goal 4:** Pursue OPPORTUNITIES TO MITIGATE repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Objectives are well-defined intermediate points in the process of achieving goals (*Objectives* are generally coterminous with *strategies*). Union County mitigation planning objectives for the 2015 Plan update can be found in Section 5.1.2. **Action Items** are the specific steps (projects, policies, and programs) that advance a given objective. They are highly focused, specific, and measurable. Union County mitigation planning objectives for the Plan update can be found in Section 5.4.2.

The municipality working groups supported the same goals as the county-wide plan update, and with a few exceptions generally included the same objectives. Please refer to Section 5 for more information on the goals, objectives, and action items for the 2015 Union County Hazard Mitigation Plan update.

1.6 Approval and Adoption

The Union County Office of Emergency Management (UCOEM), with the endorsement of the HMPSC was responsible for recommending plan approval to Union County Board of Chosen Freeholders. Consistent with that recommendation, the Union County Board of Chosen Freeholders approved the original Hazard Mitigation Plan on December 8, 2010. The 2015 Union County Hazard Mitigation Plan update was submitted to FEMA for approval on [insert date]. Upon approval by FEMA the Plan update was adopted by the Union County Board of Chosen Freeholders on [insert date]. Subsequently, all 20 participating municipalities also adopted the Plan, submitted their adoption resolutions to FEMA, and received their own approval notifications (see Municipality Appendices 1 - 20).

1.7 Monitoring and Updating the Plan

Section 8 (Plan Monitoring and Maintenance) describes the schedule and procedures for ensuring that the Plan update stays current. The section identifies when the Plan must be updated, who is responsible for monitoring the Plan, and ensuring that the update procedures are implemented. This section provides a combination of cyclical dates (oriented toward FEMA requirements) and triggering events that will initiate amendments and updates to the 2015 Plan. The Union County Office of Emergency Management is responsible for monitoring the Plan and initiating the cyclical update process.

Contact information for the Union County official submitting this Plan update is:

Ms. Salena Carroll
Bureau Chief, Domestic Preparedness
Union County Office of Emergency Management
300 North Avenue East
Westfield, NJ 07090
(908) 654-9881

Section 2: County Profile

The recommendations in the Union County HMP update are based in large part on identification of past and potential property losses and risk to life and safety due to natural and man-made hazards. As part of the process of identifying potential problems, it is useful to understand the physical characteristics of Union County. It is also important to understand any related planning efforts by the NJOEM, as well as requirements of the federal government regarding hazard mitigation plans. The following subsections (Section 2.2) provide the geography, climate, and population characteristics for Union County. This section is followed by a summary of the New Jersey State Hazard Mitigation Plan (Section 3.3) and the various federal mitigation grant programs and their planning requirements (Sections 3.4).

Figure 2-1: Map of North-Central New Jersey

2.1 Geography

Union County comprises 105 square miles, and is home to 21 municipalities. The Watchung Mountains cross the northwestern section of the county, with the highest elevations exceeding 500 feet above sea level in several locations. It is the third most densely populated county in New Jersey. Major roadways that traverse Union County include the New Jersey Turnpike (I-95), Interstates 78 and 278 and State Highways 1 and 9. Union County is home to several freight rail corridors, such as the Lehigh Line and the Chemical Coast–Secondary Line. Most freight lines in Union County are operated by Conrail Shared Assets Operations. Figure 2-2 is a map Union County.

Union County is located in the northeast section of New Jersey. The county is bordered by the Hudson County, the New York Stateline, and the Hudson River to the east, Essex County to the north, Morris County to the northwest, Somerset County to the southwest, and Middlesex County to the south. Figure 2-1 is a map of north-central New Jersey identifying the location of Union County.

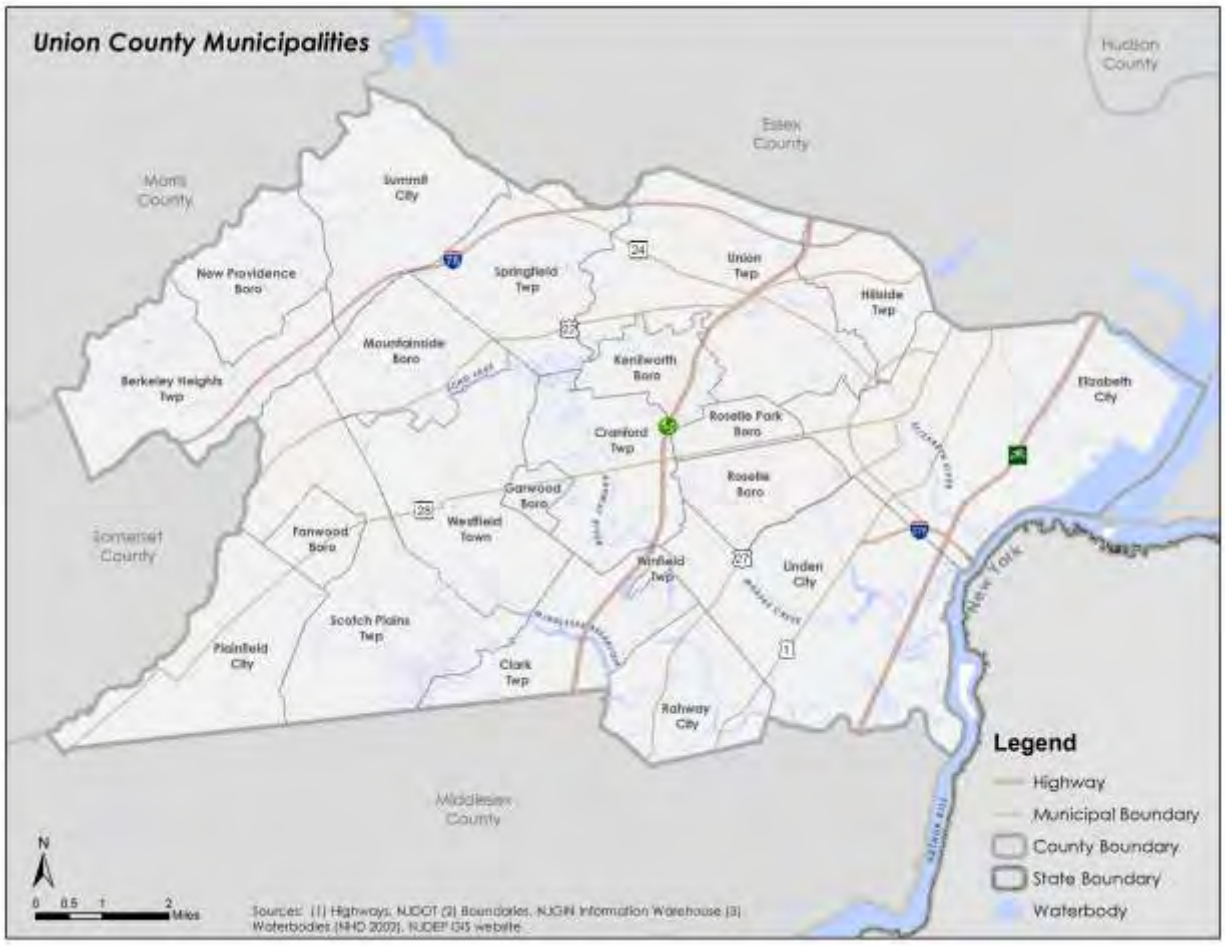
2.2 Climate

Union County's average high temperature arrives in July at 86°F. The low-average month (19.8°F) occurs in January. . The temperature is rarely below zero or above 100°F. Precipitation is evenly distributed throughout the year. Union County receives on average 50.94 inches of rain a year.1 Spring and

[1] Monthly Station Norms at Cranford. 12 October, 2008. Retrieved from: http://climate.rutgers.edu/stateclim_v1/norms/monthly/index.html

summer frontal systems can produce high rainfall amounts and spawn tornados. Tropical storm systems can affect the northern Atlantic seaboard from late summer to late fall.

Figure 2-2
Map of Union County
(Sources: NJDEP, NJDOT, NJGIN)



2.3 Population

The population of Union County has steadily increased over the past 20 years. As shown in Table 2-1, the population has increased from 493,819 in 1990 to an estimated 548,256 in 2013. Over this time period the population has increased by 54,237 or roughly 10%. There are a total of 21 incorporated areas within Union County. As mentioned earlier, 20 of the municipalities participated in the Plan update. The City of Elizabeth, the largest jurisdiction in the County with a population of 124,969, did not participate in the Plan update.

As of the 2010 US Census, population in the participating jurisdictions ranged from 1,417 to 56,642, accounted for a population of 411,530. Table 2-2 provides the population totals for all Union County jurisdictions. Figure 2-3 identifies the population density of Union County. The map shows the

population density by census tract (people per square mile) and shows the most populated area of the county is located in Elizabeth City.

A further breakdown of the population of Union County as collected by the 2010 US Census is compiled in the following tables. Most of the population statistics below are comparable to New Jersey with a few exceptions. One of the main differences is the number of residents over the age of 18. In Union County 75.5% of the population is over the age of 18, compared to only 36.7% for the State of

New Jersey. Also the population over 65 years old is significantly higher than the New Jersey average. In Union County 12.6% of the population is over 65, compared to 5.6% of the State population. This is an indication that there may be a fairly high percentage of vulnerable populations in the County.

Table 2-1: Union County, New Jersey Population
(Sources: US Census Bureau)

	1990	2000	2010	2013
Union County	493,819	522,541	536,499	548,256

Table 2-2: Population of Union County Municipalities
(Sources: US Census Bureau)

City/Town	Population
Elizabeth, City of [1]	124,969
Union, Township of	56,642
Plainfield, City of	49,808
Linden, City of	40,499
Westfield, Town of	30,316
Rahway, City of	27,346
Scotch Plains, Township of	23,510
Cranford, Township of	22,625
Summit, City of	21,457
Hillside, Township of	21,404
Roselle, Borough of	21,085
Springfield, Township of	15,817
Clark, Township of	14,756
Roselle Park, Borough of	13,297
Berkeley Heights, Township of	13,183
New Providence, Borough of	12,171
Kenilworth, Borough of	7,914
Fanwood, Borough of	7,318
Mountainside, Borough of	6,685
Garwood, Borough of	4,226
Winfield, Township of	1,471

Note: (1) The City of Elizabeth did not participate in the 2015 Plan update.

Figure 2-3
Population Density by Census Tract, Union County Map
(Sources: Population 2010 Decennial Census, U.S Census Bureau, NJDEP)

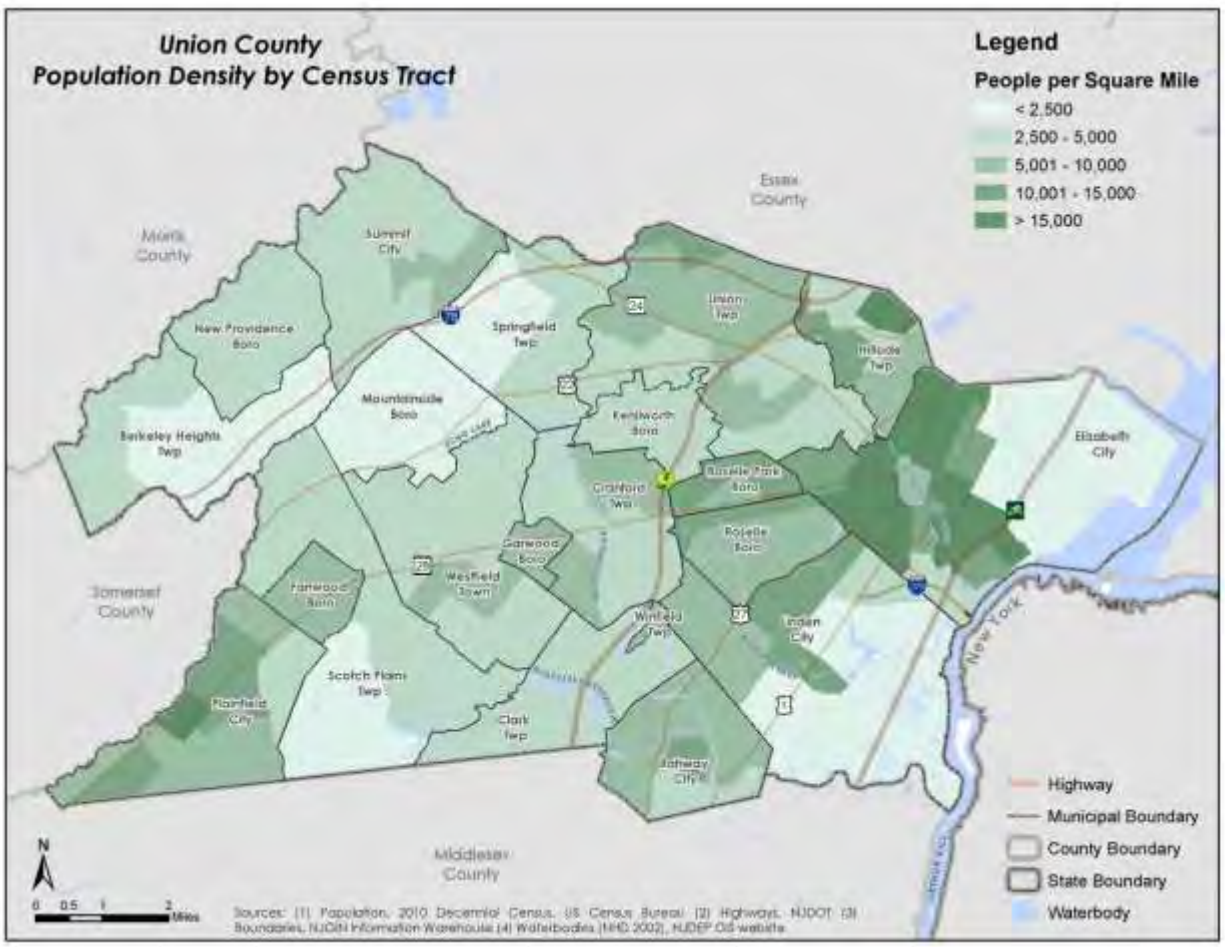


Table 2-3
Union County - Breakdown of Population Statistics for the Year 2010
(Source: 2010 U.S. Census, American Fact Finder)

General Characteristics	Union County Estimate	Union County Percent	New Jersey	New Jersey Percent
Total population	536,499	--	8,791,894	--
Male	259,932	48.4%	4,279,600	48.7%
Female	276,567	51.6%	4,512,294	51.3%
Median Age (years)	36.4	(X)	37.4	(X)
Under 5 years	35,783	6.7%	264,751	3.0%
18 years and over	405,241	75.5%	3,223,123	36.7%
65 years and over	67,761	12.6%	493,434	5.6%
One race	519,943	96.9%	8,551,591	97.3%
White	329,052	61.3%	6,029,248	68.6%
Black or African American	118,313	22.1%	1,204,826	13.7%
American Indian and Alaska Native	2,080	0.4%	29,026	0.3
Asian	24,839	4.6%	725,726	8.3%
Native Hawaiian and Other Pacific Islander	163	0.1%	3,043	0.1%
Some other race	45,496	8.5%	559,722	6.4%
Two or more races	16,556	3.1%	240,303	2.7%
Hispanic or Latino (of any race)	146,704	27.3%	1555,144	17.7%

Table 2-4
Union County - Breakdown of Housing Statistics, Estimate 2008-2012
(Source: U.S. Census Bureau, 2008 - 2012 American Community Survey, 5-year estimate)

General Characteristics	Union County Estimate	Union County Percent	New Jersey
Total housing units	199,758	---	---
Occupied housing units	184,743	92.5%	89.6%
Owner-occupied housing units	113,247	61.3%	66.2%
Renter-occupied housing units	71,496	38.7%	33.8%
Vacant housing units	15,015	7.5%	10.4%
Median value (dollars)	$373,700	(X)	$337,900
With a mortgage (dollars)	80,337	70.9%	70.8%
Not mortgaged (dollars)	32,912	29.1%	29.2%

Table 2-5
Social Characteristics, 2008 - 2012
(Source: U.S. Census Bureau, 2008 - 2012 American Community Survey, 5-Year Estimate)

Social Characteristics	Union County Estimate	Percent	New Jersey
Population 25 years and over	359,658	---	---
High school graduate or higher	109,736	30.5%	29.2%
Bachelor's degree or higher	69,495	19.3%	22.0%
Civilian Veterans (civilian population 18 years and over)	21,038	5.2%	6.8%
Foreign born	155,887	29.1%	20.8

Table 2-6
Economic Characteristics, 2008 - 2012
(Source: U.S. Census Bureau, 2008-2012 American Community Survey, 5-Year Estimate)

Economic Characteristics	Union County	New Jersey
In labor force (population 16 years and over)	290,919	4,672,338
Mean travel time to work in minutes (workers 16 years +)	28.7	30.3
Median household income (2012 inflation-adjusted dollars)	$69,347	$71,637
Median family income (in 2012 inflation-adjusted dollars)	$84,089	$87,389
Per capita income (in 2012 inflation-adjusted dollars)	$34,904	$35,928

2.2.3 Land Use and Development Trends

Union County is suburban residential county, with over 82 percent of the County covered by urban land uses, while less than 1 percent of the County is used for agricultural land. Approximately 14% of the land is covered by forests and wetlands, much of which is preserved in the through local, county, and state-owned lands. The County's Parks Department manages 36 parks, covering almost 6,200 acres. This includes the Watchung Reservation, which is 2,200 acres in the western part of the County. In addition to providing residents with the positive benefits of park land and open space, the County has prioritized parkland within the floodprone areas of the Rahway River. This approach protects towns like the Borough of Winfield, who has yet to join the NFIP, because all of its floodprone land falls within the County park, and thus it has minimal flood risk to its properties and residents.

The most significant land use within the County is residents. The Census estimated in 2013 that there are 200,061 housing units within the County, 92.7% of which are occupied. According to this survey, approximately, 76% of these houses were built before 1979 (Union County's initial FIRM was adopted in 1978). While it is not certain how many of these houses were built in floodprone areas, it stands to reason that the County has a number of residents that pre-date the FIRM. Many of these properties may be targeted for mitigation efforts in the future.

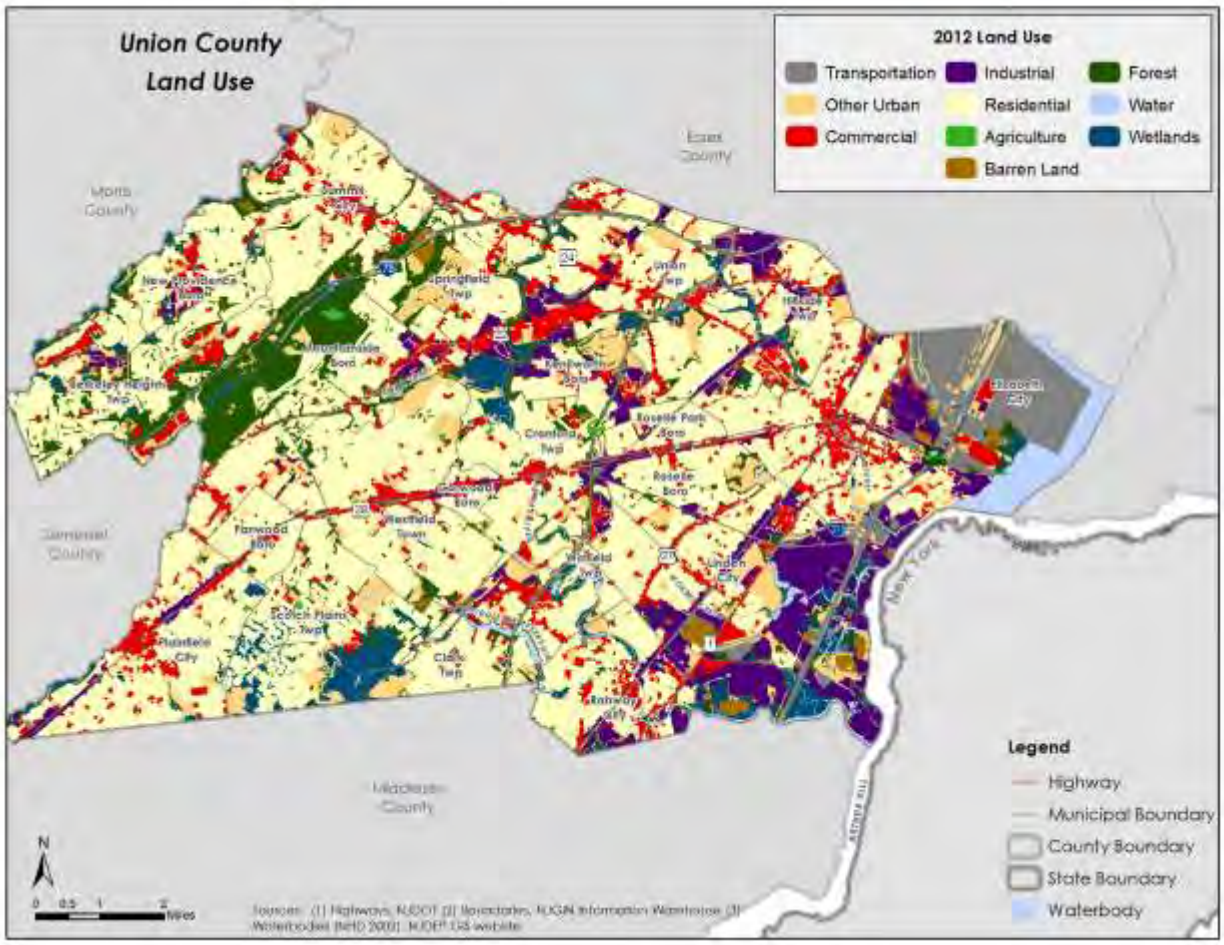
While residential is the most common land use, the eastern region of the county, as seen in Figure 2-4, has significant industrial properties. The heavy industrial uses in this area include facilities that generate or handle hazardous materials. The County has identified this as a potential hazard and works within its Emergency Management procedures to minimize the risk to residents and businesses within the County. The remainder of the County

The land use within the County has remained relatively consistent in the past 5-10 years. According to the land cover classification data created by NJDEP, Union County has only increased its urban footprint by less than 1%. Much of the development that communities have seen in the past 5-10 years is isolated infill projects. Local and state protections ensure that this type of development does not increase flood, wind, or earthquake risk to existing or new property owners.

Table 2-7
Land Cover Changes since 2002 in Union County
(Source: NJDEP)

Land Cover Type	2002 (Acres)	2012 (Acres)	Percent Change
Agriculture	137.02	86.15	-37.13%
Barren Land	524.70	627.15	19.53%
Forest	6,635.12	6,151.00	-7.30%
Urban	55,288.25	55,757.87	0.85%
Water	1,854.50	1,906.01	2.78%
Wetlands	3,001.53	2,912.95	-2.95%

Figure 2-4
Union County Land Use/Land Cover Map
(Source: NJDEP, Union County)



2.2.4 Building Permits

Building permit data can also provide an indication of historical development trends. Table 2-8 identifies residential building permits authorized for housing units reported by the State of New Jersey Department of Community Affairs for each municipality in Union County between year 2000 and 2012. The table is ordered by the total number of building permits and shows that during this time period the City of Elizabeth has had the most building permits issued with 4,844. The table also shows that building permits peaked in Union County in 2006 at 1,643. The fewest permits issued in Union County during this time period was in 2011 when only 347 housing permits were issued.

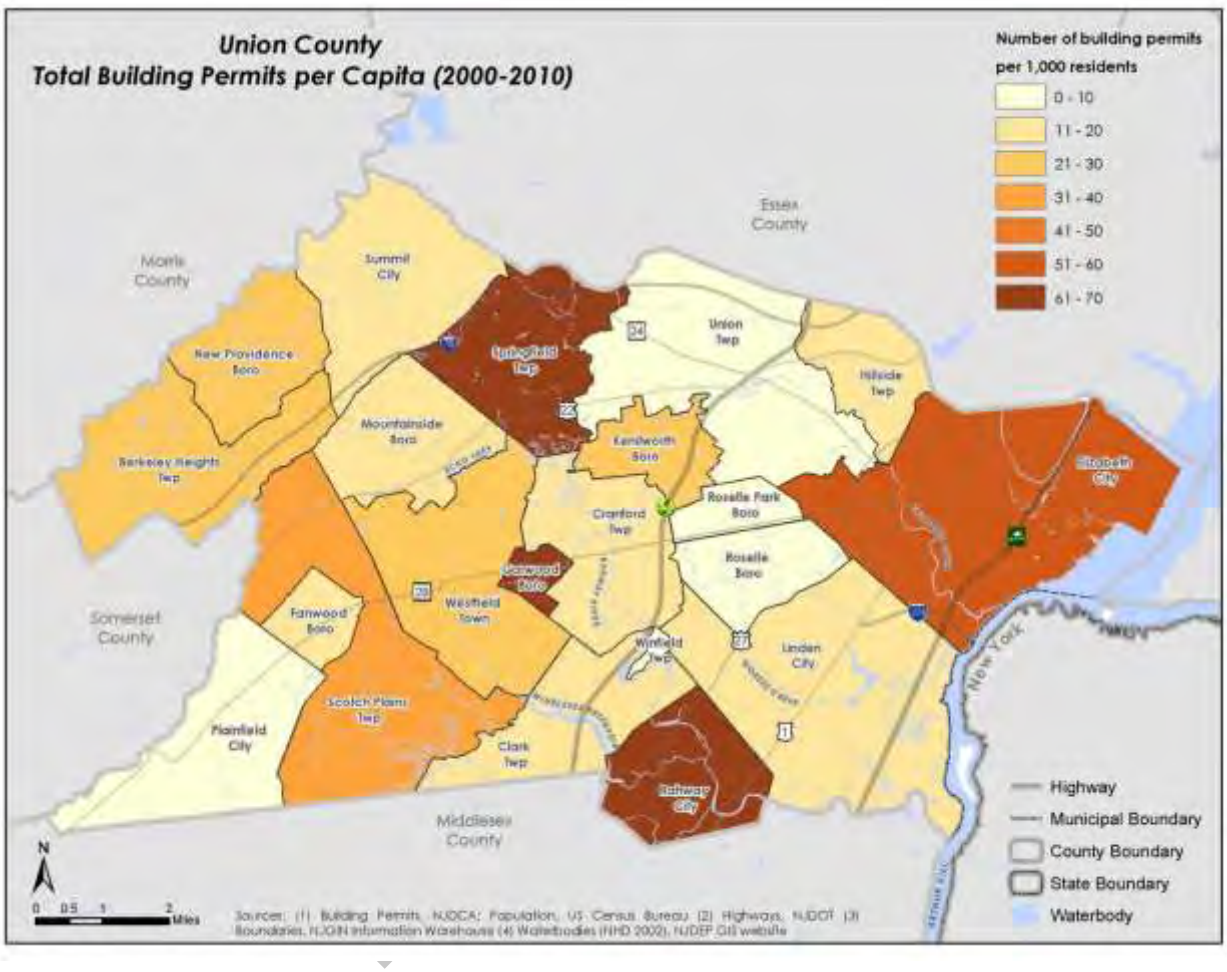
Table 2-8
Union County Residential Building Permits, Yearly Summary (2000 - 2012)
(Source: State of New Jersey Department of Community Affairs)

The table above summarizes the total building permit data in Union

	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	Totals
Elizabeth	157	58	182	120	133	455	588	549	847	649	290	432	384	4,844
Rahway	173	3	4	140	115	59	316	132	171	302	15	38	34	1,502
Springfield	58	77	315	3	197	0	96	53	2	62	43	110	14	1,030
Linden	87	12	13	10	58	37	117	32	129	75	38	22	71	701
Westfield	37	23	23	18	49	50	88	92	51	55	76	30	25	617
Scotch Plains	17	21	20	29	37	34	71	70	139	46	29	37	53	603
Union	20	12	3	8	13	12	28	26	29	22	27	22	145	367
Cranford	60	56	6	3	21	25	47	21	70	13	7	11	6	346
Summit	11	25	38	9	64	12	11	23	42	11	32	14	8	300
Berkeley Heights	23	5	8	4	8	15	38	50	19	14	17	8	26	235
Clark	66	5	4	6	5	16	17	46	13	5	5	10	10	208
New Providence	1	2	2	0	16	6	54	64	6	8	2	3	7	171
Hillside	13	0	5	0	8	10	27	38	11	19	16	10	9	166
Garwood	1	1	0	8	4	23	45	52	3	4	5	2	2	150
Plainfield	2	4	3	3	8	11	21	17	18	12	17	12	14	142
Kenilworth	10	12	5	3	9	10	18	18	17	19	5	4	4	134
Fanwood	2	26	9	0	0	3	41	8	8	5	9	10	6	127
Mountainside	5	3	3	5	4	9	5	15	7	6	4	6	4	76
Roselle	0	1	2	4	0	3	4	2	9	2	6	3	26	62
Roselle Park	1	1	4	5	4	8	11	6	6	0	3	6	1	56
Winfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Building Permits	744	347	649	378	753	798	1,643	1,314	1,597	1,329	646	790	849	11,837

County over the last 12 years. Review of this data provides one indication of where recent residential development has occurred. To further analyze the data and adjust for the different municipality sizes, the building permits were averaged based the number of building permits per 1,000 residents. Figure 2-5 identifies the total building permits per capita for Union County between years 2000 and 2010.

Figure 2-5
Union County Total Building Permits Per Capita (2000-2010)
(Source: State of New Jersey Department of Community Affairs)



Section 3: Planning Process

3.1 Federal Mitigation Planning Requirements

According to the federal rules describing the Disaster Mitigation Act of 2000 (FR 8848, Feb. 26, 2002, as amended at 67 FR 61515, Oct. 1, 2002), "The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards." Local plans serve "as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the state to provide technical assistance and to prioritize project funding."

Relevant federal planning requirements include establishing minimum standards for grant program eligibility and outlining a planning process.

3.1.1 Grant Program Eligibility

The various federal mitigation grant programs and their planning requirements are listed below:

Hazard Mitigation Grant Program (HMGP). The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. According to 44 CFR §201.3, " For disasters declared after November 1, 2004, a local government must have a mitigation plan approved pursuant to this section in order to receive HMGP project grants."

Pre-Disaster Mitigation Grant Program (PDM). The PDM program provides funds for hazard mitigation planning and projects on an annual basis. The PDM program was set in place to reduce overall risk to people and structures, while at the same time, also reducing reliance on federal funding if an actual disaster were to occur. According to 44 CFR §203, "By November 1, 2003, local governments must have a mitigation plan approved pursuant to this section in order to receive a project grant through the PDM program, authorized under Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5133. PDM planning grants will continue to be made available to all local governments after this time to enable them to meet the requirements of this section."

Flood Mitigation Assistance Program (FMA). To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a Flood Mitigation Plan. The Plan must include specific elements and be prepared following the process outlined in the NFIP's Community Rating System. According to 44 CFR §78.4, " To be eligible for Project Grants, an eligible applicant will develop, and have approved by the FEMA Regional Director, a Flood Mitigation Plan in accordance with §78.5."

Public Assistance (PA). Through the PA Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future

events by providing assistance for hazard mitigation measures during the recovery process. State and local governments are eligible to receive assistance in the emergency categories of the PA program (Categories A and B). However, an approved state hazard mitigation plan is required for any applicant, state, or local, to be eligible to obtain funding assistance for any categories of "permanent work" under the FEMA Public Assistance Program [Categories C through G].

3.1.2 Planning Process Requirements

The following excerpts from the Interim Final Rule (IFR) outline the required planning process. The process used to develop this Plan update for Union County is consistent with these requirements. The 2015 Union County Hazard Mitigation Plan further details and explicates federal requirements for each section or element of the Plan update by quoting the requirements in their entirety at the start of each relevant section.

"Multi-jurisdictional plans may be accepted … as long as each jurisdiction has participated in the process and has officially adopted the plan. Statewide plans will not be accepted as multi-jurisdictional plans."

"In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
2) An opportunity for neighboring communities, local, and regional agencies, … businesses, academia, and other private and non-profit interests to be involved in the planning process; and
3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information."
4) "The plan shall include the following:
    (1) Documentation of the planning process [see Section 4.3, Description of the Planning Process, plus appendices] used to develop the plan …
    (2) A risk assessment [see Sections 5 of this Union County Plan update, plus appendices] that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. … The risk assessment shall include:
        (i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. …
        (ii) A description of the jurisdiction's vulnerability to the hazards described. …
        (iii) For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.
    (3) A mitigation strategy [see Section 6 of this Union County Plan update, plus appendices] that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment. … This section shall include:
        (i) A description of mitigation goals, …
        (ii) A section that identifies and analyzes a comprehensive range of specific

mitigation actions and projects, …

(iii) An action plan describing how the actions … will be prioritized, implemented, and administered by the local jurisdiction. …

(iv) For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

5) A plan maintenance process [see Section 8 of this Union County Plan update, plus appendices] that includes:
   (1) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
   (2) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms …
   (3) Discussion on how the community will continue public participation in the plan maintenance process. [see Section 4.3, Involvement By the Public and Other Interested Parties]
6) Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan … For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted. [see Appendix X of the Plan update]
7) The federal requirements continue, "Plans must be submitted to the State Hazard Mitigation Officer for initial review and coordination. The state will then send the plan to [the FEMA Region II office] for formal review and approval. The regional review will be completed within 45 days after receipt from the state, whenever possible.

"Plans must be reviewed, revised if appropriate, and resubmitted for approval within five years in order to continue to be eligible for HMGP funding."

3.2 Description of the Planning Process

3.2.1 How the Plan was Prepared and Updated

The Union County Multi-Jurisdictional Hazard Mitigation Plan update was prepared in accordance with the process established in the State and Local Mitigation Planning How-to Guides (FEMA Publication Series 386) produced by the Federal Emergency Management Agency (FEMA), and the requirements of the February 26, 2002 Interim Final Rule (IFR). In addition to the How-To-Guides, the Local Mitigation Planning Handbook (March, 2013) was also used as a guide to assist with developing the Plan update. The process established in the FEMA 386 guides includes four basic steps.

- **Step 1:** Organize resources
- **Step 2:** Assess risks
- **Step 3:** Develop a mitigation plan
- **Step 4:** Implement the plan and monitor progress

The How-To guides provided the process that was used to develop the original Plan (HMP). Other

sections of this Plan include details about how the IFR requirements were met, and the process that was used to obtain and interpret data, and eventually make decisions in such areas as mitigation goals, as well as project and action priorities. These are discussed only generally in this section.

As part of the 2015 update, certain elements of the original Plan have been retained, while outdated information has been either summarized or removed. In some cases the updated HMP includes cross references to information in the original 2010 version. This version meets all applicable state and federal requirements, such as incorporating new hazard information, updating the risk assessment, providing status for actions listed in the original plan and identifying new actions. In addition to meeting these standard planning requirements, the update process focuses on developing detailed jurisdiction-specific appendices that better characterize risks and mitigation activities on a local level. (See appendices X-X).

3.2.2 Step 1: Organize Resources

The Union County Office of Emergency Management was the lead agency for the development of the Plan update. At the beginning of the process, a consultant firm, Princeton Hydro, was hired to provide technical support to Union County. In addition, several individuals and organizations worked together to develop the Plan update. These participants were organized into three tiers of stakeholders who had several opportunities to review and provide comments on plan components. The Core Group (Tier 1) also known as the 2015 Union County Hazard Mitigation Plan Steering Committee (HMPSC) had direct responsibility for much of the plan update development, with technical support from the consultants. This group guided the planning process and made executive decisions about the plan content and development.

The HMPSC made key decisions about many aspects of the process and the document, including the composition of the Committee and the Stakeholder groups (Tiers 1 -3), the structure of the HMP update, and the schedule for developing the document, the hazards that are included in the update, and prioritized mitigation strategies and actions. The group met XX times during the update process, was provided copies of the draft document, and given detailed briefings about the status of the document, including in particular various technical elements such as the risk assessment. Table 5.2-X lists the membership of the 2015 Union County HMPSC.

Table 3-1
2015 Union County Hazard Mitigation Planning Steering Committee (HMPSC) Members

Name	Organization	Title
Christopher Scaturo	Union County OEM	Director
Salena Carroll	Union County OEM, Office of Domestic Preparedness	Bureau Chief
William Kane	Union County OEM	Deputy Director
Thomas O. Mineo, PE	Union County, Department of Engineering	County Engineer

Jessica Jahre	Princeton Hydro	Consultant
Steve Pardue	Antares Planning Group	Consultant
Ranko Pudar	Pudar Mitigation Consulting	Consultant
Rick Becker	Epona Engineering	Consultant

Tier 2 was the Core Group and each point of contact from all the participating municipalities. This group made decisions about municipality specific plan content and reviewed all components of the municipality appendices. See Table X below for a list of all participating municipalities and point of contacts. Tier 3 was the Core Group, comprised of municipal and non-government representatives and other interested parties. The purpose of this group was to ensure participation from vested stakeholders. This group had several opportunities to review the Plan update. Members of the Tier 3 are listed in the individual municipality appendices.

20 of 21 municipalities in Union County participated in the Plan update. The original Plan included 13 municipalities; 7 additional municipalities participated in the Plan update. As part of the planning process, Union County OEM prepared a written letter to the mayor's office of each participating municipality and requested they provide a point of contact for the update process. A copy of the letter is included in Appendix B. All participating municipalities and contact names are listed in Table 3-3 below. The additional municipalities are identified in the table with an asterisk. The City of Elizabeth was the only municipality that did not participate in the Plan update, as they have decided to create a local plan. These municipalities and Union County OEM participated in the Plan update by taking an active part in the planning process, identifying mitigation actions, and adopting the Plan update.

Table 3-2
Union County: Participating Municipalities and Contacts

City/Town	Contact Name	Title
Berkeley Heights, Township of	Mr. Robert Bocchino	Engineering/DPW
Clark, Township of*	Mr. Jerry Fewkes	OEM
Cranford, Township of	Mr. Carl O'Brien	Engineering Consultant
Fanwood, Borough of*	Mr. Peter Bondar	Engineering Consultant
Garwood, Borough of	Mr. Emmit Garner	OEM
Hillside, Township of	Mr. Douglas Ferrigno	Fire Department
Kenilworth, Borough of*	Mr. Robert Schielke	OEM

City/Town	Contact Name	Title
Linden, City of	Ms. Kathy Colgan	OEM
Mountainside, Borough of*	Mr. Ron Romak / Mr. James Debbie	Engineering PD
New Providence, Borough of	Mr. Anthony Buccelli	OEM
Plainfield, City of	Mr. James Abney	OEM
Rahway, City of	Ms. Jacqueline Dirmann / Mr.James Housten	Engineering Consultant
Roselle Park, Borough of	Mr. Mark Demareski	Engineering Consultant
Roselle, Borough of*	Mr. Richard Cocca	Police Department
Scotch Plains, Township of*	Mr. Brian Mahoney	Police Department
Springfield, Township of	Mr. Scott Seidel	OEM
Summit, City of	Mr. Aaron Schrager	City Engineer
Union, Township of	Mr. Phil Haderer	Engineering
Westfield, Town of	Mr. Daniel Kelly	OEM
Winfield, Township of*	Mr. Frank Mazzarella	OEM

Note: **Indicates Municipality did not participate in the 2010 Plan Update*

The general work flow for the project consisted of the following steps:

- Data collection - A Request for Information (RFI) of desired information was provided by Princeton Hydro to the HMPSC. A copy of the RFI is included in Appendix X. The HMPSC members were asked via the RFI to provide updated information and other recent data available after adoption of the original plan in 2010. In addition GIS data was collected from open sources such as the New Jersey Department of Environmental Protection (NJDEP), the FEMA Map Service Center, and the New Jersey Geographic Information Network.

- Municipality meetings – Princeton Hydro held kickoff meetings with the jurisdictions to provide an overview of the planning process. The meetings provided an overview of the plan update effort and established the process that would be used to collect data from the municipalities.

- Princeton Hydro developed preliminary versions of documents and plan sections for review by the HMPSC. The documents were presented in approximately the same sequence as the information is presented in the Plan.

- The HMPSC and stakeholders reviewed the preliminary versions and provided comments to Princeton Hydro to make revisions in the documents and plan sections.

- Princeton Hydro held workshop sessions with each municipality to develop the municipality appendices. At least one meeting was held with each municipality to collect data, identify hazards of concern, and prepare risk assessments (and in some cases benefit-cost analyses), update existing mitigation actions, and identify mitigation actions.

- A Final Draft Plan was provided by Princeton Hydro to the HMPSC for review and comment.

- The HMPSC reviewed and commented on the Final Draft Plan. Comments were provided to Princeton Hydro to make any revisions prior to submittal to NJOEM and FEMA for review.

Typical meetings between the consultant and the HMPSC included updates related to work in progress for aspects of the plan (e.g., preliminary versions of the hazard identification list, risk assessment, goals and objectives, mitigation action items, etc.). Deliverables were provided in advance so that the HMPSC members could review and come to the meetings prepared to comment and direct Princeton Hydro to make revisions or additions. Princeton Hydro then revised materials accordingly.

The duties and responsibilities of the HMPSC consisted of: representing their communities' interests, serving as the point of contact for their communities, and completing necessary planning tasks, including:

- Identification of local mitigation actions – Princeton Hydro conducted small group working sessions with municipality local coordinators and in some cases, other municipal stakeholders to identify and document specific mitigation actions (see Table X).

- Review of the Plan products – As noted above, a total of XX meetings was held with the HMPSC to review work-in-progress and secure agreement with and/or revisions to the recommendations made by Princeton Hydro. For example, the HMPSC met on July 14, 2014 to

prioritize the hazards ranking each as high, medium and low priorities. In addition, Tier 2 members (Core Group and the municipality Point of Contacts) were responsible for reviewing their individual municipality's mitigation actions included in each of the municipality appendices.

2015 Plan Update Meeting Schedule

During the development of the Plan update there were total XX HMPSC meetings. The meetings focused primarily on the review of work-in-progress for the development of the Plan update. The meetings are summarized in Table X. Documentation of these meetings including agendas, sign-in sheets, presentation materials, and meeting notes are included in Appendix X.

Table 3-3
HMPSC Meeting Schedule

Date	Description	Attendees
March 18, 2014	Kickoff meeting to formally start the Plan Update process and establish the HMPSC.	HMPSC, Princeton Hydro
July 14, 2014	Review status of county and jurisdictional RFIs, prioritize hazards, GIS data collection, and FEMA Public Assistance records	HMPSC, Princeton Hydro
To Be Entered	Review of Hazard Identification Section	HMPSC, Princeton Hydro
To Be Entered	Review of Mitigation Action Strategy	HMPSC, Princeton Hydro
May 7th, 2015	Review of plan progress and municipal appendix development	HMPSC, Princeton Hydro

Members of the HMPSC also held a series of meetings with all participating municipalities. During the initial planning process the HMPSC sent a letter to the Mayor of each municipality within the County. The Mayors and local officials selected a single individual to represent the town and participate in the 2015 Plan update process. This person was the municipality point of contact for the plan update, but worked with other municipal employees, consultants, volunteers, and other stakeholders throughout the planning process. These participants were considered the Local Planning Committee and were responsible for overseeing the individual municipality planning process and development of the municipality appendices.

During the planning process a total of three meetings were held with each municipality between May 2014 and March, 2015. The planning team first met with the municipalities from May 18-21, 2014. The 20 municipalities were divided into three separate meetings where the same information was presented over a period of two days. The purpose of the first round of meetings was to introduce the planning process and start the data collection required to complete the individual municipality risk assessments. A second workshop with each municipality was held in late July, 2014 when members of the planning

team visited with the Point of Contact from each municipality. During these meetings the status of the RFI was reviewed and additional data was collected to complete the municipality appendices. A final workshop was held on February 24 – 26, 2015 at the Union County OEM. The purpose of the meeting was to review the draft municipality appendix developed for jurisdiction and collect data for any remaining items from the RFI. Table X provides a summary of these meeting. See Appendix X for documentation of the meetings, including agendas, sign-in sheets, and presentation materials.

Table 3-4
Municipality Meeting Schedule

Dates	Description	Attendees
May 19-21, 2014	Initial meeting to introduce planning team and start the data collection process for municipality risk assessments.	Princeton Hydro, Select HMPSC members, All Municipality POC's
July – August, 2014	Workshop held with each municipality to review jurisdictional RFI status with each municipality and identify any additional data need for the municipality appendix.	Princeton Hydro, members from each municipality
February 23-26, 2015	Over a period of three days all 20 participating municipalities were invited to a workshop at the Union County OEM. Of the 20 municipalities invited a total of 12 attended the workshop. At the workshop, incomplete data from the RFI was reviewed and requested. Draft municipality appendices were also reviewed with each of the POCs. The eight municipalities that were unable to attendance were later contacted and meetings scheduled to review the draft, including identifying any missing data. Telephone conference calls were held for those municipalities unable to attend a meeting.	Union County OEM, Princeton Hydro, and members from each municipality

3.2.3 Step 2: Assess Risks

In accordance with general mitigation planning practice, as well as the process FEMA established in its How-to Guides, the risk assessment forms the basis for this Plan by quantifying and rationalizing information about how natural and manmade hazards affect Union County and the participating municipalities.

The processes used to complete the hazard identification and risk assessments, and the results of these

activities, are described in Sections 5 and 6 and Appendices X – X of this Plan update. The assessment determined several aspects of the risks of hazards faced by the county and the participating municipalities:

- The natural hazards that are most likely to affect Union County
- How often hazards are expected to impact Union County
- The expected severity of the hazards
- What areas of Union County are likely to be affected by hazards
- How Union County's assets, operations, people, and infrastructure may be impacted by hazards
- How private and commercial assets, operations, and infrastructure may be impacted by hazards
- The expected future losses if the risk is not mitigated

The HMPSC first reviewed the hazards that were included in the original 2010 Plan update and determined that the hazards from 2010 would be profiled as part of the 2015 Plan update. After updating the profiles for each hazard and incorporating new data as appropriate, the hazards were prioritized as high, medium, or low for both the main body of the Plan update and the jurisdictional appendices. When deciding how to prioritize the hazards, factors were considered such as how often the hazard has occurred in the past, how bad damages were, how many people affected, and how difficult it was to recover from the event(s). Using this approach, the HMPSC was able to make qualitative determinations that allowed the process to focus more closely on the hazards that are most significant to the County and jurisdictions. For the County, these include the following:

The high hazards are listed below.

- Flood
- Storm Surge
- High Wind–Straight-Line Winds
- Flooding due to Dam Failure
- Severe Storm–Winter Weather
- Hazardous Materials Release – Fixed Sites
- Hazardous Materials Release – Transportation
- Extreme Temperature – Cold
- Extreme Temperature - Heat

A total of five hazards were considered medium hazards of concern. These hazards are listed below.

- Dam Failure
- Drought
- Hail
- Erosion

- High Wind - Tornado

This same process was used to rank the hazards for each municipality. The hazard ranking tables for each jurisdiction can be found in the municipality appendices. As described in the appendices, the local planning committees or their representatives prioritized those hazards.

Hazards rated as high priority were the subject of more detailed risk assessments, i.e. estimates of likely future damages based on empirical data, engineering data, statistics, or all three. Less detailed vulnerability/risk assessments were completed for hazards ranked as medium priorities. Those hazards ranked low or none (i.e. negligible) priority were noted as such, and included some supplemental information where possible, although the effects of those hazards were generally addressed in the hazard profile subsections.

The results of the risk assessment were made available to the public during the public presentations (see Section 4.4). The full process and results of this work is presented in Section 5, Hazard Identification and Risk Assessment, portion of this Plan update.

3.2.4 Step 3: Develop the Mitigation Plan or Update

As part of the original plan, the HMPSC developed a series of goals and objectives in response to the results of the risk assessment. The original plan also included a capability assessment that was conducted to help determine the capacity of Union County and the participating municipalities to implement hazard mitigation projects. In addition, the HMPSC and the consultant worked with the participating municipalities, on an individual basis, to identify potential problems and hazard mitigation project solutions that were included in the Mitigation Action Plan.

The process employed to develop the original Union County Plan was based on the FEMA 386-series of guides that describe mitigation planning procedures. In addition to being based on the How-To guidance, the 2015 process mirrors the one described in the FEMA guidance entitled Local Multi-Hazard Mitigation Planning Guidance (October 1, 2011). This document describes the Local Hazard Mitigation Plan regulations from the 44 Code of Federal Regulations (CFR) Part 201, and is FEMA's official source for defining the requirements for original and updated local hazard mitigation plans. Throughout the Plan update, cross references to the Interim Final Rule (IFR) related to mitigation planning and the FEMA Local Mitigation Plan Review Tool have been added to clarify the requirements being addressed. The mitigation planning regulation at 44 CFR 201.6 (d) (3) states:

A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and re-submit it for approval within five years in order to continue to be eligible for mitigation project grant funding.

Early in the planning process, the HMPSC and the consultant planning team completed a detailed review of every section of the existing plan, and prepared a comprehensive Request for information (RFI). The purpose of RFI was to identify all subject areas in the 2010 HMP where specific updates were required. For example, census figures, the numbers and locations of County-owned buildings (and those owned by the various jurisdictions), impacts of recent hazard events such as Hurricane Sandy, Hurricane Irene, several severe winter storms and so forth. The second purpose of the RFI was to identify and assign

tasks identified for the Plan update.

As part of the 2015 Plan update, the main body was supplemented by individual municipality appendices that were prepared for each of the 20 participating jurisdictions. These appendices included all municipality specific data including risk assessments completed for hazards identified as a high or medium concern. In addition to the RFI developed for each section of the main plan, a separate RFI was also developed for the municipalities. The municipality RFI was distributed to the POCs and reviewed during the initial meetings held between May 19 -21, 2014.

As mentioned earlier in this section, the HMPSC met XX times during the update process. The first meeting took place on March 18, 2014. The purpose of the meeting was to begin the planning process, to make decisions about contents of the Plan update, and to assign specific tasks to County and local staff and consultants. The MPC used the RFI to outline the update process and tasks. Each section of the original plan was reviewed and analyzed to determine which areas required updating. This included areas of the Plan update such as the hazards profiled (and hazard data), the risk assessment, goals and objectives, maps, and the action items from the original plan. As reported in the minutes of the meeting, the group reviewed the structure of the original plan, and agreed the focus of the Plan update would be on risk at the municipality level and the main body of the plan would be significantly reduced. Only information that is still current and applicable to the County or municipalities would remain in the main body of the Plan update.

A second MPC meeting was held on July 14, 2014. The purpose of the meeting was to review the request for information (RFI) predominately related to county-wide data needs. In addition the HMPSC also ranked the hazards profiled in the main body of the Plan update. Additional meeting topics included collecting any remaining data and integrating the information into the plan update, the status of the jurisdictional RFI, and progress made on the draft HMP update. A third MPC meeting was held on [insert date]. The purpose of the meeting was to [insert summary]. Each attendee was provided a printed and electronic copy of the latest version of the Plan update.

The Plan update process took place in these steps:

1. Detailed review of the 2010 version of the County HMP/RFI
2. Update planning process and non-technical sections
3. Update technical sections for main body of the Plan update
4. Prepare detailed jurisdictional appendices
5. Review of complete first draft
6. Modifications based on review, Stakeholder feedback
7. Presentation to public
8. Compile and incorporate feedback from public
9. Prepare final draft
10. Final draft is posted on County website and at the County OEM
11. Compile and incorporate feedback from public
12. Prepare and submit final draft to New Jersey Office of Emergency Management
13. Modifications based on State review

14. Re-submit to State to verify changes
15. Submit to FEMA Region 2 for review and comment
16. Modifications based on FEMA review
17. Secure Letter of Approvability from FEMA
18. Final approval and adoption

The 2015 Plan update was submitted to NJOEM on March 16, 2015 for a preliminary review. NJOEM provided preliminary comments and suggestions for improving the document. The HMPSC and its consultant reviewed the comments and incorporated these changes prior to submitting the final draft plan to NJOEM in [insert date].

3.2.5 Step 4: Implement the Plan and Monitor Progress

As mentioned elsewhere, the 2015 County HMP must be updated every five years in order for the County to maintain its eligibility for various FEMA grant programs. The 2010 HMPSC established a process for on-going monitoring and revisions to the original Plan for the period between 2010 and 2015. This process remains unchanged for the 2015 Plan update. Section 10 of the Plan update details the monitoring, evaluation, and plan update procedures.

During this five year period, the Plan will be periodically reviewed to ensure compliance with FEMA and the State of New Jersey requirements for Plan maintenance. The procedures for these reviews are described in Section 10, Plan Monitoring and Maintenance. After the 2015 Plan update is approved, the County will implement specific actions to achieve the goals and objectives described in Section 9 (Mitigation Strategy) and the individual jurisdictional Action Plans. In addition to listing the mitigation strategies and actions the County is pursuing, these sections describe the progress the County has made towards reaching the individual goals since the Plan was originally adopted.

3.3 Involvement by the Public and Other Interested Parties

The County focused its efforts on active engagement from all municipalities, regional stakeholders and members of the public. Each municipality was asked to identify local stakeholders and interest groups to participate in the planning process. These groups, in addition to other entities determined by the Public Information Office of the County, were given notification about the plan's development and public comment period. Notification was also sent to neighboring communities when the draft was posted for public comment on October 9, 2015.

Future outreach by Union County and municipal coordinators, including proposed public education and work with stakeholders and other interested parties over the next five years will improve public involvement for the next Plan update.

3.4 Review and Incorporation of Plans, Studies, and Reports

Other planning documents can be used as a valuable resource for integrating information related to hazard mitigation into the HMP. The 2010 version of the HMP included the review and incorporation of other Plans, studies, and reports that are applicable to the hazards discussed in the Plan. These documents were reviewed again as part of the Plan Update and any new information or changes have been incorporated into the 2015 HMP update. A search was also conducted to identify additional Plans or studies that may have been completed since the release of the original Plan.

The following Plans and other documents were considered during the 2015 Hazard Mitigation Plan update. The specific Plans, Studies and Reports are listed below in Table X along with a discussion on how they were incorporated into the HMP Update. The table is organized into three categories that include Federal, State, and County plans.

The County and its consultant requested from the municipalities a range of documents, data sources, maps, studies, Emergency Operations Plans, land use data, laws, and ordinances. The HMPSC and UCOEM regularly provided guidance and support in this gathering effort through the use of e-mail inquiries, phone contact, and agenda items at meetings and workshops. Municipality specific documents are included in the individual jurisdictional appendices.

Table 3-6
Federal, State and County Documents and Data Utilized for the 2015 Plan Update

Existing Program/Policy/Technical Documents	Method of incorporation into the Plan
Federal Documents	
FEMA Disaster Declarations database and other general hazard data	Hazard identification and risk assessment (HIRA);history of loss data for multiple hazards
FEMA/ Digital Flood Insurance Rate Maps (DFIRM), Effective September 20, 2006	HIRA, strategies, and mitigation actions
FEMA, Union County Flood Insurance Study (FIS), Effective September 20, 2006	HIRA, Flood hazard section
FEMA Region II Coastal Analysis and Mapping - Advisory Base Flood Elevation (ABFE) GIS data, February, 2013	HIRA, Flood hazard section
FEMA Union County New Jersey Flood Insurance Fact Sheet	HIRA, Flood hazard section
FEMA Benefit Cost Analysis module (version 4.8)	HIRA and loss history
FEMA Community Status Book, Community Rating System Eligible Communities	Capability assessments and mitigation actions

Existing Program/Policy/Technical Documents	Method of incorporation into the Plan
FEMA Tornado Activity in the United States	HIRA and history of loss data
FEMA Coastal Flood Loss Atlas (SLOSH Model)	HIRA, strategies, and mitigation actions
FEMA NFIP Claims including Repetitive Loss and Severe Repetitive Loss data	HIRA, Flood hazard section
FEMA Modeling Task Force – Hurricane Sandy Impact Analysis	HIRA, Flood, Storm Surge
National Oceanic and Atmospheric Administration (NOAA)/National Climatic Data Center database	History and description of major hazard events for multiple hazards
NOAA Coastal Service Center-Historic Hurricane Tracks Database	HIRA, strategies, and mitigation actions
NOAA National Hurricane Center-Hurricane Preparedness, Storm Surge	HIRA, strategies, and mitigation actions
NOAA – Sea Level Rise (SLR) Global Scenarios. Geo Platform SLR Planning Tool	HIRA, Flood Hazard
United States Census Bureau data	Data included as part of establishing planning context and risk assessments
United States Department of Agriculture-New Jersey Eligible Communities	Special Circumstance Communities
Unite States Geological Survey (USGS), 2014 National Hazard Seismic Maps	HIRA, Earthquake Hazard
United States Environmental Protection Agency Toxic Release Inventory	hazard identification (Hazardous Materials), strategies, and mitigation actions
United States Department of Transportation Hazardous Materials Incident Data	Used in developing hazard identification (Hazardous Materials), strategies, and mitigation actions
USDA Forest Service Northern Research	Wildfire Hazard (HIRA), Wildland Urban Interface (WUI)
State Documents	
New Jersey Administrative Code-Dam Safety Standards (NJAC: 7-20), Dam Classifications	Dam Failure section of Hazard Identification and Risk Assessment (HIRA)

Existing Program/Policy/Technical Documents	Method of incorporation into the Plan
New Jersey Geological Survey (NJGS) Map of Landslides in New Jersey	Hazard profiling and loss estimation
New Jersey Division of Community Affairs (NJDCA), Division of Codes and Standards-Bulletin No. 3-4 Wind Speed Map	HIRA, strategies, and mitigation actions
NJDCA-State Development and Redevelopment Plan, November 14, 2011.	Future development analysis
NJDCA, Office of Smart Growth-Geographic Information System (GIS) data.	Future development analysis, development of HIRA and strategies
New Jersey Department of Environmental Protection (NJDEP), Department of Dam Safety and Flood Control data	Developing dam failure hazard section of HIRA (Section 5) including dam inventory and loss history
NJDEP-Landslides in New Jersey report, Landslide Susceptibility/Incidence maps and geodata	Used in developing loss history and HIRA
NJDEP-County Land Use Land Cover data	Hazard profiling and loss estimation
New Jersey Forest Fire Service (NJFFS) -wildfire mapping and data	Wildfire Hazard (HIRA), Risk Maps and Fuel Hazard maps
NJOEM Summary of Presidentially Declared Disasters 1992-2000	Hazard profiling and loss estimation
NJOEM-Hazard Analysis New Jersey	Hazard profile
New Jersey Office of the State Climatologist (at Rutgers University)	Hazard profile, Extreme Temperatures Cold/Heat , High Winds – Straight Line Winds, Winter Storm
NJGS-2002 Earthquake Loss Estimation Study for Union County	Hazard profile and loss estimation
Northeast Regional Climate Center	Hazard profile, Drought hazard – past drought events
Resilience: Preparing New Jersey for Climate Change. A Gap Analysis from the New Jersey Climate Adaption Alliance, December, 2013	Hazard Profile, Flood hazard and sea level rise.
State of New Jersey Department of Community Affairs, Building Permit Data	Planning background (Section 3) and to validate future development analysis

Existing Program/Policy/Technical Documents	Method of incorporation into the Plan
County Documents	
County GIS data including important buildings, zoning, building footprints, and public buildings	Used as part of risk assessment and future development analysis
Cross-Acceptance Report (2005)	Used to validate data used in future development analysis
Emergency Operations Plan	Used in hazard identification

3.4.1 New Jersey State 2014 Hazard Mitigation Plan Update

It is NJOEM's intent to use the SHMPU as a way to provide data to local and regional governments to support their mitigation planning processes, and to provide guidance on best practices. For each on-going plan development effort, NJOEM attends at least one mitigation core team meeting, one stakeholder meeting, and one public meeting to be a resource to the municipality or county, to answer any questions and to direct planners to state resources or tools. NJOEM staff also is available during the draft plan development to answer any questions or provide guidance and assistance.

The statewide mitigation strategies, goals, and objectives, methods of incorporating a varied cross section of relevant disciplines, hazard specific information, and specific data sources are present within the SHMPU and were utilized in the development of the Union County Multi-Jurisdictional Hazard Mitigation Plan.

Section 4: Hazard Identification and Risk Assessment

4.1 Hazard Identification and Prioritization

In accordance with IFR requirements, and as part of its efforts to support and encourage hazard mitigation initiatives, the 2015 Union County Hazard Mitigation Plan Steering Committee (HMPSC) prepared this general assessment of the hazards that have potential to impact the County. The following subsections provide an overview of past hazard events in the County and brief descriptions of the potential for future losses. At the end of this section (Section 4.4) the hazards are ranked (high, medium, or low) based on the overall impact to the County considering such factors as how often the hazard occurred, amount of property and infrastructure damages, number of people impacted, and time of recovery. In addition, jurisdiction specific hazards have been identified and profiled for each participating municipality in Appendices 1-20. A subset of hazards from the main plan was selected for each jurisdiction. These hazards were identified by municipality point of contacts after a series of meetings and workshops held with each participating jurisdiction. See Section 4 of the Plan update and the municipality appendices for additional details about the process for selecting these hazards and the hazard identified for each jurisdiction.

During the 2015 Plan update many parts of the original County HMP were preserved. Where applicable, portions of the historical hazard data have been retained. As required by federal planning guidelines, one of the key elements of the 2015 HMP update was to describe the events and effects of natural hazards on the County since the original version of the Plan was developed and adopted.

Each of the hazard-specific sections noted above has four subsections: ***Description of the Hazard; Location of the Hazard; Severity and Extent of the Hazard, and; Impact of the Hazard on Life and Property***. These subsections address FEMA checklist requirements. For the 18 hazards profiled, links to websites have been included at the end of the *Description of the Hazard* subsection. These links provide additional information related to the general description of each hazard that can affect Union County. Note that Appendix A includes general descriptions of all hazards that can affect Union County. This section addresses the specific requirements of the Interim Final Rule (IFR) with regard to hazards in the planning area.

The term “planning area” is used frequently in this section. This term refers to the jurisdictional limits of Union County. The Risk Assessment section (Section 6) addresses the potential future damages from hazards on Union County and its citizens.

4.1.1 Overview of Union County’s History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with natural hazards. However, no single source offers a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The U.S. Army Corps of Engineers and the Natural Resources Conservation Service collect

data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) and Spatial Hazard Events and Losses Database for the United States (SHELDUS) database collect and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and costs.

In the absence of definitive data on some of the hazards that may occur in Union County, illustrative examples are useful. Table 4.2-1 provides brief descriptions of particularly significant hazard events occurring in the county's recent history. This list is not meant to capture every event that has affected the area, but rather to lists some of the more significant events that have occurred here in the past.

Union County has received 13 major Presidential Disaster Declarations and eight Emergency Declarations since 1950. Seven of the 13 major disaster declarations were the result of significant flooding. The more recent major and emergency declarations (and one non-declared event) are included as part of the summary in Table 4.2-1 below.

Table 4-1: Recent Hazards and Declared Emergency and Major Disasters in Union County, New Jersey (1992-2014) (Sources: NOAA/NCDC; FEMA; and the NJ Office of Emergency Management)

Date and Disaster (DR)	Nature of Event
12/18/1992 (DR-973)	SEVERE STORMS AND INLAND AND COASTAL FLOODING-A major winter storm (Nor'easter) that caused considerable coastal flooding and beach erosion. A total of 12 counties in New Jersey included as part of the Presidentially Declared Disaster.
3/13/1993 (DR-3106)	SEVERE STORMS AND FLOODING (Emergency Declaration)-Event known as the "Storm of the Century" affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever affect the United States. The "Storm of the Century" label was given to the event due to the record low pressure, wind speeds, temperature, and snowfall. All 21 counties in New Jersey were included in the Presidentially Declared Disaster.
1/7/1996 (DR-1088)	BLIZZARD-A State of Emergency was declared for the blizzard that hit the state. Road conditions were dangerous due to the high winds and drifts. Both government and contract snow plowing operations were running at a maximum. Local roads were impassable. This blizzard also brought on coastal flooding with the high tides on Sunday evening and Monday morning, and there were reports of damage to dunes and beaches from the heavy wave activity. More than 400 National Guard personnel were activated for transport assistance, primarily for medic missions. In Union County, snowfall totals ranged from 20"-30".
10/19/1996 (DR 1145)	FLASH FLOOD-Flooding temporarily closed parts of US 1 and 9, several state routes, and the Garden State Parkway. Union County received 5"-7" of rainfall. In Union County, the flooding caused an estimated $4 million in residential property damages and $300,000 in infrastructure damages.

Date and Disaster (DR)	Nature of Event
9/16/1999 (DR-3148)	HURRICANE FLOYD (Emergency Declaration)-This downgraded fall hurricane put the entire Eastern Seaboard on flood watch, including every county in New Jersey. Although downgraded from a hurricane by the time it hit New Jersey, the storm lasted approximately 18 hours resulting in rainfall totals of 11.90" within Union Township in Union County. The Rahway River at Springfield was above its flood stage of 5.5' from 11:00am on the September 16 until 12:45pm on the September 17. The crest stage of 10.67' occurred around 10:00pm on the September 16.
2/16/2003 (DR-3181)	HEAVY SNOW (Emergency Declaration)-The most powerful storm to affect New Jersey since the Blizzard of 1996. The combination of the very cold temperatures and the approach of a strong storm system caused widespread snow to break out, starting before sunrise on Sunday, February 16. Snow continued during the day Sunday, heavy at times, and continued into Sunday night. Precipitation continued on Monday, before finally coming to an end on Tuesday. Total snowfall in Union County ranged from 18.5" to 23.5". New Jersey requested and was granted a Snow Emergency Declaration for all 21 counties. The President's Day snowstorm tied or set records in all 21 New Jersey counties including Union County. Statewide, the event resulted in damages estimated at approximately $30.2 million.
8/5/2003	SEVERE STORMS AND FLOODING-Torrential rain resulted in widespread flash flooding of streets, low lying and poor drainage areas, mainly along a line extending northeast across Southwest Union County into South Central Bergen County. The highest estimated rainfall rates were between 2" and 3" per hour across southwest Union County, where the flooding was most severe. The Plainfield Township police reported numerous streets flooded: Rock Avenue, West Front and South Second Streets, Watchung Avenue, and East Third Street, George and Johnson Avenues, Randolph Road, and Cedarbrook Park, and a section of Route 22 flooded in Scotch Plains.
4/15/2007 (DR 1694)	SEVERE STORMS AND INLAND AND COASTAL FLOODING - A seven day Nor'easter deluged New Jersey with over 9" of rain, causing millions of dollars of damage and killing three residents. Statewide damage was estimated at $180 million dollars. Street flooding was reported along Route 1 south bound near Lawrence Street. Union County rainfall ranged from 2.16" at Canoe Brook to 7.31" at Cranford.
04/02/2010 (DR 1897)	SEVERE STORMS AND FLOODING A slow moving storm moving north along the Atlantic coast produced heavy rains from March 12 - 15, 2010. Rainfall amounts were greatest in central and northeastern New Jersey. One of the highest rainfall totals was reported at USGS gage in Mountainside, New Jersey.

Date and Disaster (DR)	Nature of Event
12/26/2010 (DR 1954)	SEVERE WINTER STORM AND SNOWSTORM – A rapidly intensifying low pressure system tracked from off the Southeast US coast on Christmas Day and then past the Mid Atlantic Coast on Sunday December 26th. Bands of heavy snow plus embedded thunderstorms and very strong winds affecting the region Sunday afternoon through Sunday night. The powerful blizzard brought a widespread area of 20 to 30 inches of snow across Northeast New Jersey. The heavy snow was accompanied by area wide winds of 25 to 40 mph and gusts in excess of 60 mph Sunday afternoon into Sunday night, resulting in near whiteout conditions with blowing and drifting snow and making all forms of travel extremely difficult to nearly impossible. Major Disaster Declaration Declared on February 4, 2011.
10/29/2011 (DR-4048)	SEVERE WINTER STORM AND SNOWSTORM – A historic and unprecedented early-season winter storm impacted the area on Saturday, October 29, with more than one foot of heavy wet snow falling on interior portions of northeast New Jersey. This is the first time a winter storm of this magnitude has ever occurred in October. The heaviest snow fell across interior northeast New Jersey, with up to 18 inches of snowfall across higher elevations. Thousands of people across northeast New Jersey lost power during this event as heavy snow accumulated on trees that still had partial to full foliage during mid-autumn. This caused extensive felling of trees and limbs across the region and damage to power lines. In Union County a significant number of trees came down due to the heavy wet snow.
08/31/2011 (DR 4021)	HURRICANE IRENE - Hurricane Irene made landfall along the Outer Banks of North Carolina on August 27, 2011 as a Category 1 hurricane. The storm re-emerged over the Atlantic and made a second landfall as a tropical storm on August 28th in the Little Egg Inlet in southeastern New Jersey. Large portions of the county experienced flooding, with the most severe occurring in the municipalities of Cranford, Springfield, and Rahway. These areas were mainly impacted by flooding from the Rahway River. The storm flooded thousands of residential homes in Cranford including the downtown area.In other areas of the county, police used boats to rescue nearly 90 people from their homes on flooded streets in Rahway and Springfield. In Rahway significant flooding occurred along West Grand Avenue and Rahway Avenue. An estimated 30,000 Union County residents were left without power.
10/30/2012 (DR 4086)	HURRICANE SANDY – In late October of 2012, Union County was impacted by Hurricane Sandy, a late season hurricane. Sandy reached a peak intensity of 85 knott while it turned northwestward toward the mid-Atlantic states. Sandy weakened somewhat and then made landfall as a post-tropical cyclone near Brigantine, New Jersey with 70-knott maximum sustained winds. Because of its tremendous size, however, Sandy drove a catastrophic storm surge into the New Jersey and New York coastlines. In Union County, the storm produced 3 to 6 feet of inundation along the Arthur Kill and in the Elizabeth Port Authority Marine Terminal along Newark Bay in eastern Union County. This inundation caused areas of moderate to major damage to industrial complexes, such as the Bayway refinery.

4.1.2 Methodology for Prioritization

In its early meetings related to this HMP update, the HMPSC considered a total of 18 hazards that have potential to affect the County. The group reviewed these hazards and prioritized them as high, medium, or low based on the overall impact to the County. They considered factors such as how often the hazard occurred, degree of property and infrastructure damage, number of people impacted, and time of recovery.

The hazard prioritization table is provided below and describes the rationale for the hazard ranking. It also shows sources of information that were consulted for the determination. Although all 18 of the hazards are profiled in this section, the prioritization was used as a basis to focus vulnerability and risk assessment activities on those hazards with the most potential to negatively affect the County. Those hazards prioritized as high or medium by the HMPSC include more extensive discussions about vulnerability and risk than those with lower rankings.

It should be understood that the overall HMP is structured to emphasize jurisdictional hazards and vulnerabilities, so this County-level section of the document is necessarily less detailed in this regard. There is more information about location-specific hazards and vulnerabilities in the jurisdictional appendices.

Table 4-2
Union County (County-wide) Hazard Ranking Table

Hazard	Level of Concern	Rationale	Sources
Flood	High	Widespread impacts, history of occurrences in the county, significant annual damages	FEMA Flood Insurance Studies, FEMA Flood Insurance Rate Maps, FEMA Public Assistance records, FEMA National Flood Insurance Program claims data, US Army Corps of Engineers (USACE), and National Oceanographic and Atmospheric Administration (NOAA), studies and records.
Storm Surge	High	Moderate probability, potential for significant impacts to eastern coastal areas.	NOAA-NCDC,HAZUS, USACE

Hazard	Level of Concern	Rationale	Sources
High Wind – Straight-line Winds	High	Hurricanes: Relatively low historic probability; potential for widespread impacts; Tropical Storms: Low to moderate probability; potential for widespread impacts; Nor'easters: Moderate probability of more extreme events, potential for moderately widespread impacts; Severe Storms: High probability of occurrences, but losses are typically limited.	NOAA and National Climatic Data Center (NCDC) records, New Jersey Department of Community Affairs - Division of Codes and Standards, New Jersey State Climatologist (Rutgers)
Severe Storm – Winter Weather	High	High annual probability, widespread impacts, but losses generally limited except in most extreme events.	NOAA-NCDC, National Weather Service (NWS), New Jersey State Climatologist (Rutgers)
Hazardous Materials Release – Fixed Site	High	High annual probability with impacts potentially severe in site-specific areas.	US Environmental Protection Agency, FEMA HAZUS (Hazards US) software, the Right-to - Know (RTK) Network, US Environmental Protection Agency (EPA).
Hazardous Materials Release – Transportation	High	Moderate to high annual probability, but impacts limited in severity and area.	The RTK Network - Emergency Response Notification System (ERNS)
Extreme Temperature – Cold	High	Relatively high annual probability, but impacts are limited.	NOAA-NCDC, New Jersey State Climatologist (Rutgers), National Weather Service
Extreme Temperature – Heat	High	Relatively high annual probability, but impacts are limited.	NOAA-NCDC, New Jersey State Climatologist (Rutgers), National Weather Service
Dam Failure	Medium	Low annual probability based on historical data, but impacts potentially significant in site-specific areas.	New Jersey Department of Environmental Protection (NJDEP) - Dam Safety and Flood Control.
Drought	Medium	High annual probability, but impacts generally limited.	NOAA-NCDC; New Jersey State Department of Agriculture NJDEP
Hail	Medium	High annual probability but impacts are limited in severity and area.	NOAA-NCDC, New Jersey State Climatologist (Rutgers), National Weather Service

Hazard	Level of Concern	Rationale	Sources
Erosion	Medium	Relatively high annual probability, but impacts are limited to northeastern coastal areas.	NOAA, The New Jersey Beach Profile Network (NJBPN), USACE
High Wind – Tornado	Medium	Moderate to high annual probability, widespread impacts, but losses generally limited except in most extreme events.	NOAA-NCDC, New Jersey State Climatologist (Rutgers), National Weather Service
Earthquake / Geological	Low	Very low probability	United States Geologic Survey (USGS), New Jersey Geologic Survey (NJGS).
Ice Storm*	Low	Low to moderate annual probability with impacts relatively limited.	NOAA-NCDC, New Jersey State Climatologist (Rutgers), National Weather Service
Landslide* (non-seismic)	Low	Low probability with losses typically limited.	NJGS
Severe Storm* – Lightning	Low	High annual probability, but impacts generally limited.	NOAA-NCDC, New Jersey State Climatologist (Rutgers), National Weather Service.
Wildfire*	Low	High annual probability of site-specific events, but impacts generally limited.	NOAA, New Jersey Forest Fire Service, NJDEP.

Note: The data in this table is intended only to give a general sense of the significance of hazards in the county, relative to each other. See Appendix A for a complete listing of all sources. *These hazards were determined to have limited risk and thus no risk assessment was conducted.

4.1.3 Hazards Summary

The 2015 HMPSC identified eight of the 18 hazards profiled as multi-jurisdictional or county-wide hazards of high concern. These are significant hazards that have the potential to impact at least two of the 20 jurisdictions participating in the Plan update. As the regulations indicate, all of these identified hazards must be profiled, their vulnerability assessed, and mitigation actions developed for them.

The high hazards are listed below.

- **Flood**
- **Storm Surge**
- **High Wind–Straight-Line Winds**

- **Flooding due to Dam Failure**
- **Severe Storm–Winter Weather**
- **Hazardous Materials Release – Fixed Sites**
- **Hazardous Materials Release – Transportation**
- **Extreme Temperature – Cold**
- **Extreme Temperature – Heat**

A total of five hazards were considered medium hazards of concern. These hazards are listed below.

- **Dam Failure**
- **Drought**
- **Hail**
- **Erosion**
- **High Wind - Tornado**

The remaining hazards were considered low hazards of concern. These hazards included

- **Earthquake / Geologic**
- **Ice Storm**
- **Landslide (Non-Seismic)**
- **Severe Storm - lightning**
- **Wildfire**

In addition to the hazards selected for the multi-jurisdictional or county-wide risk assessments, a subset of the 18 hazards included in the Plan update were also identified, profiled, and in some cases risk assessments completed for each participating municipality. The hazards selected for the risk assessment were identified by the same process as the one described above. See municipality specific appendices (Appendix 1-20) for detailed hazard identification and risk assessments for select hazards of concern for each jurisdiction.

4.1.4 Consistency with the New Jersey State Hazard Mitigation Plan

As part of the process of developing the Union County Hazard Mitigation Plan Update, the planning team carefully reviewed the 2014 New Jersey State Hazard Mitigation Plan Update (SHMPU), with the goal of ensuring consistency between the two documents, primarily in the areas of hazard identification, risk assessment and mitigation strategy. The SHMPU comprises a shorter list of hazards (and does not include hazardous materials), but the most significant hazards statewide are part of both documents, and are generally prioritized in the same way.

4.1.5 Summary Description of the County's Vulnerability to Hazards

The DMA 2000 legislation and related FEMA planning guidance require mitigation plans to include

discussion of community vulnerability to natural hazards. Vulnerability is generally defined as the damage (including direct damages and loss of function) that would occur when various levels of hazards impact a structure, operation or population. For example vulnerability can be expressed as the percent damage to a building when it is flooded, or the number of days that a government office will be shut down after a wind storm, etc., assuming there is sufficient detailed data available to support the calculations.

Because this Plan includes many jurisdictions and data is often not detailed, it is not practical to complete vulnerability assessments on the many individual assets, operations and populations in individual jurisdictions. However, it is appropriate for participating municipalities to embark on a program of addressing these data deficiencies over the next five years in anticipation of the next Plan update.

As illustrated in the present section of the HMP, Union County is subject to numerous natural and manmade hazards, although in some cases the hazards have rarely impacted the area, or their effects have been relatively minor. As is the case with many parts of the mid-Atlantic, although relatively localized, flooding is the most frequent and most damaging natural hazard in central New Jersey and Union County, However, it is important to recognize that several other hazards present significant risks (i.e. potential for future losses) to the County, even though they have occurred infrequently in the past, or have not caused much damage.

In particular, earthquakes (although improbable) present risks to various communities in the County because there are many relatively old structures that may be prone to failure if shaken by an earthquake. In order to accurately characterize vulnerabilities (and hence risks) at a local level, it will be necessary to study assets on a site-specific basis. There is also some vulnerability to wind in the County, mainly from hurricanes and tropical storms. While severe hurricanes are rare events in this area of the country, tropical storms and nor'easters are fairly common, and many structures in the communities are vulnerable to high winds. Most of the other hazards are either localized or improbable, and therefore, while various elements in the communities may be vulnerable to such hazards, the likelihood of them occurring in any specific location is very small.

Section 4.2 Overview of the Type and Location of Hazards

In the initial phase of the planning process, Union County's 2015 HMPSC reviewed the hazards profiled in the 2010 Hazard Mitigation Plan. The HMPSC determined that the same 18 hazards posed the greatest threat to Union County. The following hazards were selected for inclusion in this Plan update by the HMPSC.

1. Dam Failure
2. Drought
3. Earthquake/Geological
4. Erosion–Hurricane/Nor'easter/Coastal Storm

5. Extreme Temperature–Cold
6. Extreme Temperature–Heat
7. Flood
8. Hail
9. Hazardous Materials Release–Fixed Site
10. Hazardous Materials Release–Transportation
11. High Wind–Straight-Line Winds
12. High Wind–Tornado
13. Ice Storm
14. Landslide (non-seismic)
15. Severe Storm –Lightning
16. Severe Storm–Winter Weather
17. Storm Surge–Hurricane / Nor'easter / Tropical Storm
18. Wildfire

The following section profiles each of the 18 hazards listed above and includes a description of the hazard, location and extent of the hazard, severity of the hazard, impact on life and property, and past occurrences of the hazard.

4.3 Dam Failure

4.3.1 Description of the Dam Failure Hazard

A dam is defined by the New Jersey Department of Environmental Protection (NJDEP) as any artificial dike, levee, or other barrier that 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.[2]

Dam failures can result from a variety of causes including lack of maintenance, seismic activity, improper design or construction, or the effects of large storms. Significant rainfall can quickly inundate an area and cause floodwaters to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows and failure may occur.[3] See Appendix A for a more detailed description and definition of the dam failure hazard.

To prevent, or reduce the probability of a failure, existing dams are periodically inspected by professional engineers. Table4-X summarizes the dam inspection schedule for New Jersey, including Union County.

[2] New Jersey Department of Environmental Protection (NJDEP)

[3] NJDEP

Table 4-3
New Jersey Dam Inspection Schedule
(Source: NJDEP – Dam Safety and Flood Control)

Dam Class	Regular Inspection	Formal Inspection
Class I Large Dam	annually	once every three years
Class I Dam	once every two years	once every six years
Class II Dam	once every two years	once every 10 years
Class III Dam	once every four years	only as required
Class IV Dam	once every four years	only as required

Dams are typically ranked by hazard classification, which is determined by the potential for infrastructure and property damages downstream if a dam failure were to occur. The three hazard classifications include high hazard, significant, and low and are defined as follows:

High hazard potential dams are those whose failure or operational failure will probably cause loss of life and/or significant infrastructure losses.

Significant hazard potential dams are those whose failure or operational problems are unlikely to cause loss of human life, but can cause economic loss, environmental damage, disruption of lifelines, or other concerns.

Low hazard potential dams are those whose failure would probably cause no loss of human life and only low economic and/or environmental losses, which would typically be limited to the dam owner's property.

4.3.2 Location of the Dam Failure Hazard

According to the NJDEP there are a total of 31 dams in Union County as of June, 2014. Of the 31 dams, data from the NJDEP indicates that eight are no longer in existence or have been removed. This reduces the total number of dams in Union County to 23. The NJDEP – Bureau of Dam Safety separates New Jersey dams into three hazard classifications. These hazard classifications include high hazard, significant, and low and are based upon the guidelines outlined in the *New Jersey Administrative Code – Dam Safety Standards (NJAC: 7-20): Dam Classifications*. The following table lists the dams, including the municipality name, hazard classification, the river or stream the dam is located along, the last inspection date and the name of the dam. The table is ordered by hazard classification that ranks the potential for loss of life and infrastructure and property damages downstream if a dam failure were to occur. The three hazard classifications include high hazard (H), significant (S), and low (L); these are defined at the bottom of the table.

In Union County three dams are classified as high hazard by the NJDEP-Bureau of Dam Safety and Flood

Control; Shackamaxon Dam, Clearwater Detention Dam, and Robinson's Branch Reservoir Dam. The New Jersey Department of Environmental Protection database does not include the data points listed as "na" in the table.

Table 4-4
Inventory of Union County Dams, ordered by Hazard Classification
(Source: NJDEP–Bureau of Dam Safety and Flood Control, June 2014)

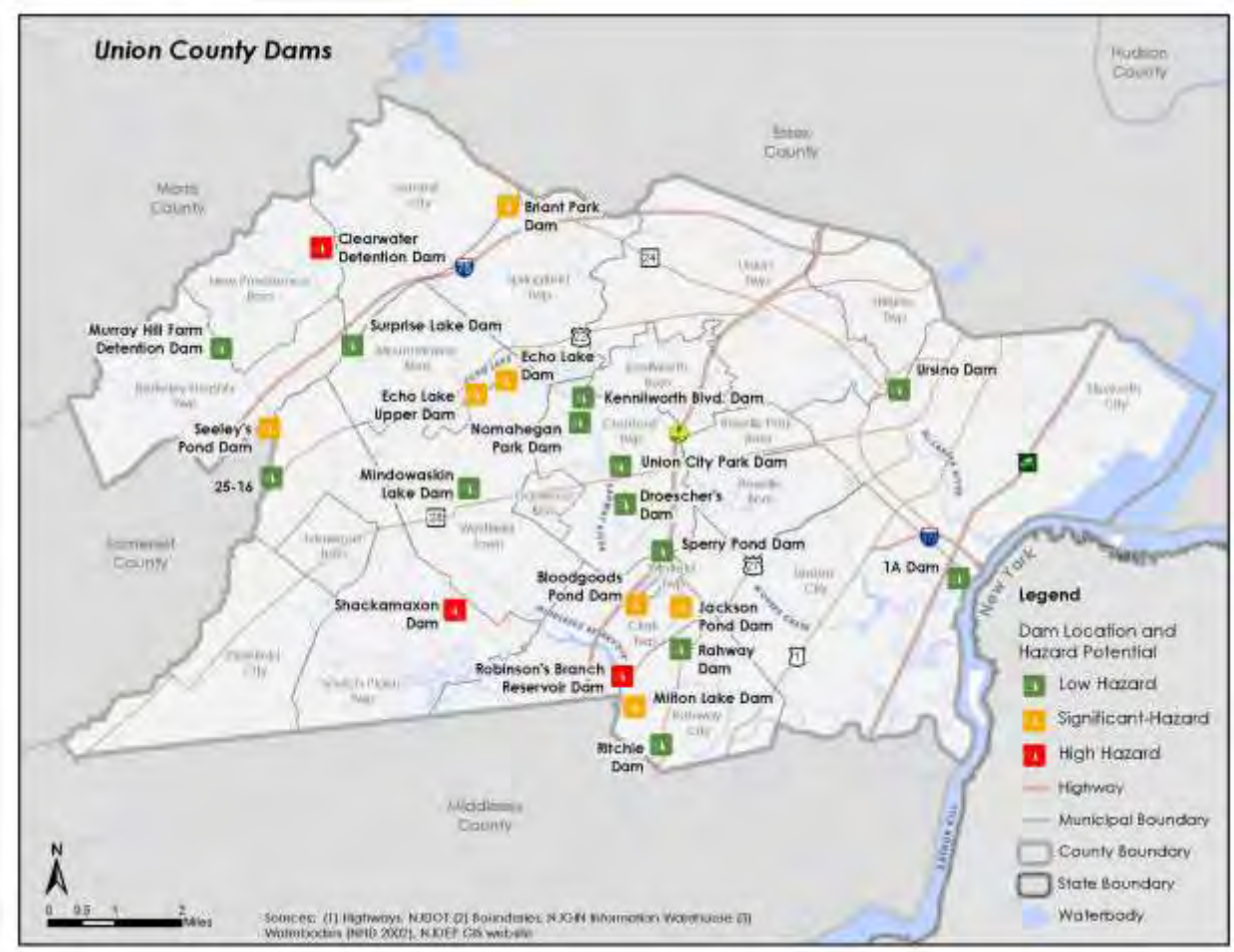
Municipality Name	Dam Name	Hazard Class	River/Stream	Height (feet)	Length (feet)
Scotch Plains Township	Shackamaxon Dam	H	Lambert's Run	24.1	275
New Providence Borough	Clearwater Detention Dam	H	Salt Brook	22	1,275
Clark Township	Robinson's Branch Reservoir Dam	H	Robinsons Branch	27	425
Scotch Plains Township	Seeley's Pond Dam	S	Green Brook	20.2	850
Mountainside Borough	Echo Lake Dam	S	Nomahegan Brook	20	130
Kenilworth Borough	Echo Lake Upper Dam	S	Nomahegan Creek	17	120
Springfield Township	Briant Park Dam	S	Van Winkle Brook	15.5	280
Rahway City	Milton Lake Dam	S	Robins Branch Rahway River	10	204
Clark Township	Jackson Pond Dam	S	Rahway River	14.9	276
Clark Township	Bloodgoods Pond Dam	S	Rahway River	14	450
Scotch Plains Township	No Name Dam	L	Green Brook Raritan River	3	40
Berkeley Heights Township	Murray Hill Farm Detention Dam	L	Passaic River-TR	11	na
Mountainside Borough	Surprise Lake Dam	L	Blue Brook	20	200

Municipality Name	Dam Name	Hazard Class	River/Stream	Height (feet)	Length (feet)
Westfield Town	Mindowaskin Lake Dam	L	Rahway River	4	200
Cranford Township	Sperry Pond Dam	L	Rahway River		100
Elizabeth City	Ursino Dam	L	Elizabeth River	13.3	104
Rahway City	Ritchie Dam	L	Rahway River	2	15
Cranford Township	Union City Park Dam	L	Rahway River	Na	90
Cranford Township	Kenilworth Blvd. Dam	L	Nomahegan Brook	2.3	30
Linden City*	Draesher Dam	L	Morse Creek	3	250
Linden City	1A Dam	L	Morses Creek	5.08	165
Rahway City	Rahway Dam	L	Rahway River-TR	5	30
Cranford Township	Nomahegan Park Dam	L	Rahway River-TR	5	29
Cranford Township	Droescher's Dam	N/A	unknown	unknown	unknown
Union Township*	Faitoute Dam	N/A	Elizabeth River	12	800
Union Township*	Salem Dam	N/A	Elizabeth River	7	150
Berkeley Heights Township*	Horseshoe Road Detention Basin Dam	N/A	unknown	unknown	unknown
Watchung Borough*	Seeley's Mill Pond Dam	N/A	unknown	unknown	unknown
New Providence Borough*	Murray Hill Estates Dam	N/A	Passaic River	Na	360
Berkeley Heights Township*	John Runnels Hospital Dam	N/A	unknown	unknown	unknown
Berkeley Heights Township*	Bonnie Burn Dam	N/A	unknown	unknown	unknown

Municipality Name	Dam Name	Hazard Class	River/Stream	Height (feet)	Length (feet)
Hazard Classes (Source: New Jersey Administrative Code - Dam Safety Standards (NJAC: 7-20): Dam Classifications) H = High Hazard: Loss of life likely (if failure were to occur) S = Significant Hazard: Loss of life not likely but the potential for significant property damage L = Low Hazard: Loss of life not likely and minimal infrastructure or property damage other than the structure itself					

The following map identifies the location of the 23 dams identified in Union County as of June 2014. The inventory of dams was provided by the NJDEP-Bureau of Dam Safety and Flood Control.

Figure 4-1
Union County Dams
(Source: NJDEP–Bureau of Dam Safety and Flood Control)



Severity (Extent) of the Dam Failure Hazard

In 1921, the New Jersey Legislature created the Bureau of Dam Safety and Flood Control, which instituted laws relating to the construction, repair, and inspection of existing and proposed dam structures. The law was amended in 1981, and became known as the Safe Dam Act. New Jersey's Dam Safety program is administered by NJDEP's Division of Engineering and Construction, Dam Safety Section.[4] The severity of a dam failure event can depend on various aspects related to the size of the dam, the extent of the failure, the velocity of the floodwaters released, and the intensity of the downstream development.

[4] NJDEP - Bureau of Dam Safety and Flood Control

Impact on Life and Property (Vulnerabilities and Risk)

According to the United States Army Corp of Engineers (USACE) National Inventory of Dams (NID), as of 2014 there were 87,359 dams in the United States. Of this total, there were 825 dams in New Jersey. A total of 561 or 68% of the dams are categorized as either high hazard or significant hazard dams and pose a risk to life and property. Dam failure has the potential for catastrophic impact on life and property. This risk can be reduced by proper design, construction, and routine maintenance and inspection.

The dam failure hazard was prioritized by the HMPSC as *medium.* The County-wide potential impact of the dam failure hazard is mostly limited to the areas immediate adjacent to and downstream from dams. See the applicable jurisdictional appendices for a more detailed analysis of vulnerabilities and potential impacts of this hazard. Although accurately predicting the probability of dam failure is impractical, where possible, the jurisdictional appendices include projected losses on downstream communities and structures.

The following tables present summary exposure data for census blocks intersecting 500-ft wide stream buffer downstream from the high hazard dams. The data includes land use classification of the exposed land area, as well as the housing unit count and exposed population, based on 2010 Census data.

Municipality Name	Dam Name	Commercial (Acres)	Other (Acres)	Residential (Acres)	Total (Acres)
Clark Township/Rahway	Robinson's Branch Reservoir Dam	7.85	75.24	112.40	195.49
New Providence Borough	Clearwater Detention Dam	18.06	29.21	109.30	156.57
Scotch Plains Township	Shackamaxon Dam	5.29	150.55	209.49	365.33
GRAND TOTAL		31.20	255.00	431.19	717.39

Municipality Name	Dam Name	Population	Housing Units
Clark Township/Rahway	Robinson's Branch Reservoir Dam	1,258	477
New Providence Borough	Clearwater Detention Dam	1,118	393

Municipality Name	Dam Name	Population	Housing Units
Scotch Plains Township	Shackamaxon Dam	1,812	987
GRAND TOTAL		4,188	1,857

Occurrences of the Dam Failure Hazard

The NJDEP indicates there have been no previous catastrophic dam failures in New Jersey, but the number of small failures has risen over the past few years. This has been primarily due to a combination of lack of inspection and the number of dams nearing the end of their design life.[5] While not considered a failure, The City of Linden has reported that several times a year, water exceeds the limits of the Jackson Pond and Bloodgoods Dams.

The NJDEP–Bureau of Dam Safety and Flood Control lists dam failures in New Jersey from several major flooding events including Hurricane Floyd in September of 1999 and the Sparta storm in 2000. Review of these floods indentified three dam failures in Union County. The Shackamaxon Dam, Seeley's Pond Dam, and Bloodgoods Dam all partially failed after Hurricane Floyd.[6] The partial dam failures are described below.

Shackamaxon Dam (Scotch Plains Township). This dam partially failed after floodwaters eroded the discharge channel.

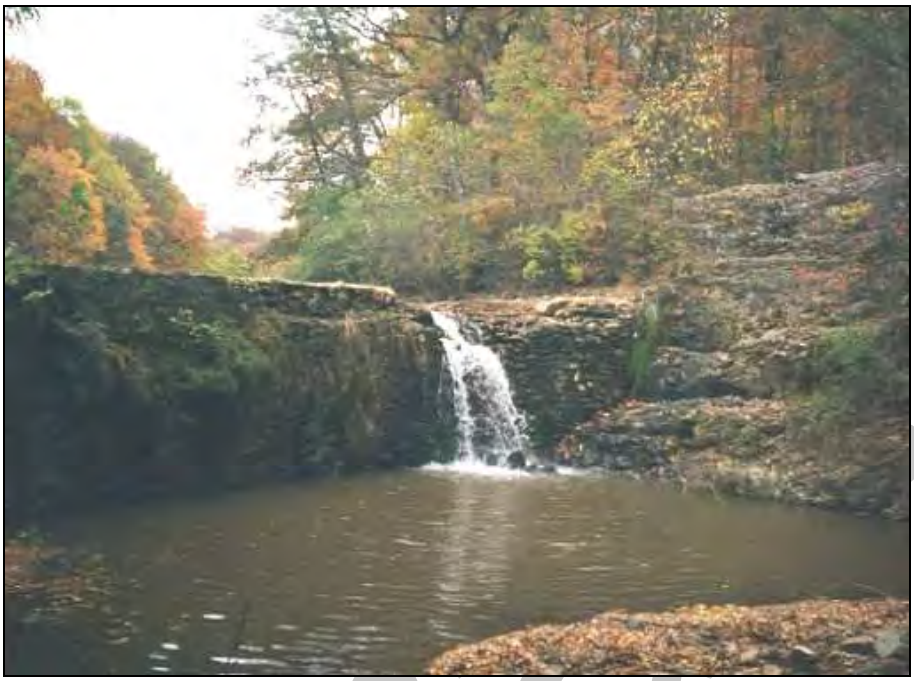
Seeley's Pond Dam (Scotch Plains Township). Floodwaters partially destroyed the masonry spillway cap and the upper portion of the dam.

Bloodgoods Dam (Clark Township). The NJDEP–Dam Safety and Flood Control Site does not provide a description for this failure.

As part of the 2015 Plan update, additional dam failure events were researched for Union County. No additional significant failures were identified from flood events between 2009 and 2013.

[5] NJDEP - Bureau of Dam Safety and Flood Control
[6] NJDEP - Bureau of Dam Safety and Flood Control

Figure 4-2
Seeley's Pond Dam Partial Failure after Hurricane Floyd in 1999
(Source: NJDEP–Bureau of Dam Safety and Flood Control)



With a total of three previous dam failure events in Union County between 1950 and 2014, the County experiences a dam failure event on average slightly more than once every 20 years. With one event every 20 years, there is roughly a 5% annual probability of a future dam failure event occurring in Union County. Considering the three past events, the 2015 Union County HMPSC ranked dam failure as a medium risk hazard (See Table 4-2 for a complete list of hazard rankings). As a medium risk hazard, the HMPSC determined that the three high-hazard dams should be addressed in the risk assessment (Section 6) of this Plan update. See the applicable jurisdictional appendices for a more detailed analysis of the high hazard dams: Shackamaxon Dam, Clearwater Detention Dam, and Robinson's Branch Reservoir Dam, and the potential impacts of the hazard in specific areas.

4.3.2 Drought

Description of the Drought Hazard

A drought is an extended dry climate condition when there is not enough water to support urban, agricultural, human, or environmental water needs. It usually refers to a period of below-normal rainfall, but can also be caused by drying bores or lakes, or anything that reduces the amount of liquid water available. Drought is a recurring feature of nearly all the world's climatic regions. See Appendix A for a more detailed description and definition of the drought hazard.

Location of the Drought Hazard

Droughts may occur anywhere in the United States, and is possible throughout the planning area. Effects seen in different regions vary depending on normal meteorological conditions such as precipitation and temperature, as well as geological conditions such as soil type and subsurface water levels. The State of New Jersey is divided into six drought regions that provide a regulatory basis for coordinating local responses to regional water-supply shortages. The six drought regions are based on watershed and water-supply considerations and coincide with municipal boundaries. Each municipality in New Jersey is assigned to a drought region based on the watershed covering and supplying water to the municipality. The most recent version (Version 3.0, released in May, 2004) shows that all of Union County is located in the Central Drought Region.[7]

Figure 4-3
New Jersey Drought Regions
(Source: NJDEP)

Severity (Extent) of the Drought Hazard

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. The severity of drought can be

[7] New Jersey Department of Environmental Protection (NJDEP), Division of Water Supply and Geoscience.

aggravated by other climatic factors, such as prolonged high winds and low relative humidity.[8] Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

One method used by scientists to calculate the severity and duration of a drought is the Palmer Drought Severity Index (PDSI). The PDSI indicates the prolonged and abnormal moisture deficiency or excess and indicate general conditions, not local variations caused by isolated rain. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather.[9]

The equation for the PDSI was empirically derived from the monthly temperature and precipitation scenarios of 13 instances of extreme drought in western Kansas and central Iowa and by assigning an index value of -4 for these cases. Conversely, a +4 represents extremely wet conditions. From these values, 7 categories of wet and dry conditions can be defined. Table 4-X identifies the values used to define the PDSI.[10]

Table 4-5
Palmer Drought Severity Index (PDSI)
(Source: NOAA, National Weather Service - Climate Prediction Center)

Palmer Drought Severity Index
-4.0 or less (Extreme Drought)
-3.0 or -3.9 (Severe Drought)
-2.0 or -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 or +2.9 (Unusual Moist Spell)
+3.0 or +3.9 (Very Moist Spell)
+4.0 or above (Extremely Moist)

Impact on Life and Property (Vulnerabilities and Risk)

Droughts have the ability impact many sectors of the economy, and reaches well beyond the area experiencing physical drought. Drought impacts are commonly referred to as direct or indirect. Reduced crop productivity, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat are a few examples of direct impacts. Drought can cause extensive damage to commercial and residential structure foundations, framing and walls, levees, roads, bridges, pipelines and other integral infrastructure. Indirect impacts of drought include increased prices for food, unemployment, and reduced tax revenues because of reduced supplies of agriculture products dependent upon on rainfall.

[8] FEMA, 1997
[9] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.
[10] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.

While all residents of Union County could be adversely affected by drought conditions, which could limit water supplies and present health threats, during summer drought, or hot and dry, conditions elderly persons, small children, infants and the chronically ill who do not have adequate cooling units in their homes may become more vulnerable to injury and/or death. However, the NCDC reported no known deaths, injuries or property damage from droughts in the planning area from any of the past events identified.

The drought hazard was prioritized by the HMPSC as *medium.* The County-wide potential impact of the drought hazard is very small, as the most significant impacts related to all but the most severe droughts are limited to damage to agricultural concerns. There is little or no agriculture in Union County, so the risks are minimal. See the applicable jurisdictional appendices for a more detailed analysis of vulnerabilities and potential impacts of this hazard. Although accurately predicting the probability of drought is impractical, where possible the jurisdictional appendices include projected losses to agriculture. There are no significant vulnerabilities to structures from the drought hazard.

Occurrences of the Drought Hazard

According to the NCDC database, Union County has experienced 11 drought events in the period from 1950 to 2013. No additional events were identified from the NCDC or SHELDUS database between 2008 and 2013 [search for other events]. All 11 events were between 2001 and 2002. The database provides no indication as to why there are no events prior to 2001, although presumably occurrences follow the same pattern and frequency as shown in the NCDC list. The events are listed by month. For example, if a drought lasts several continuous months, it is listed in the database as separate events. If the continuous months are combined into single events, the number of events is reduced from 11 to two.

In addition to the NCDC, data from the Northeast Regional Climate Center was also reviewed to identify past drought events in Northern New Jersey. The climate center provides historical data for severe and extreme droughts that are divided into three categories that include the Northern Climate Division, Southern Climate Division, and Coastal Climate Division. Considering the widespread impacts associated with droughts, the events listed for the Northern Climate Division were considered to also impact Union County. Table X below shows northern New Jersey droughts that were classified with a PSDI of severe or extreme (-3.0 to -4.0) for a period of two months or greater from 1950 – 2013. The table shows there have been nine events between 1949 and 2013. The events listed also capture the two events identified above from the NCDC.

Table 4-6
Reported Droughts, Northern New Jersey (Including Union County), 1949–2013
(Source: NOAA/NCDC, Northeast Regional Climate Center, Cornell University)

Drought Periods	Duration	Lowest PDSI	Lowest PDSI Month	Source
11/1949 - 1/1950	3 months	-3.67 in	12/1949	NRCC
9/1957 - 11/1957	3 months	-3.12 in	11/1957	NRCC
8/1964 - 8/1966	25 months	-5.51 in	8/1966	NRCC
12/1980 - 1/1981	2 months	-3.77 in	1/1981	NRCC
3/1985 - 4/1985	2 months	-3.82 in	4/1985	NRCC
8/1995 - 9/1995	2 months	-3.43 in	8/1995	NRCC
7/1999 - 8/1999	2 months	-4.15 in	7/1999	NRCC
12/2001 – 5/2002	6 months	-4.57	2/2002	NCDC/NRCC
7/2002 – 9/2002	3 months	-3.28	8/2002	NCDC/NRCC

With a total of nine previous drought events in Union County between 1949 and 2013, the County experiences a drought event on average slightly more than once every seven years. With one event every seven years, there is roughly an 11% annual probability of a future drought events occurring in Union County. Considering the impacts from the nine past events, the 2015 Union County HMPSC ranked droughts as a medium risk hazard (See Table X for a complete list of hazard rankings). As a medium risk hazard, the HMPSC determined that drought would be included as part of the more detailed risk assessment.

4.3.3 Earthquake/Geological

(Includes surface faulting, ground shaking, earthquake induced landslide, and liquefaction)

Description of the Earthquake Hazard

An earthquake is a sudden release of energy from the earth's crust that creates seismic waves. Tectonic plates become stuck, putting a strain on the ground. When the strain becomes so great that rocks give way, fault lines occur. At the Earth's surface, earthquakes may manifest themselves by a shaking or displacement of the ground, which may lead to loss of life and destruction of property. Size of an earthquake is expressed quantitatively as magnitude and local strength of shaking as intensity. The inherent size of an earthquake is commonly expressed using a magnitude. See Appendix A for a more detailed description of the earthquake hazard.

Location of the Earthquake Hazard

Review of the State of New Jersey 2014 Hazard Mitigation Plan and other sources indicates that earthquakes are most likely to occur in the northern parts of the State (including Union County), where significant faults are concentrated. The entire planning area is susceptible to the effects of earthquakes.

In 1996, the USGS produced probabilistic Seismic Hazard Maps for the United States. The USGS revises these maps roughly every six years or so to reflect newly published or thoroughly reviewed earthquake science and to keep pace with regular updates of the building code. The USGS maps were updated in 2002 and 2008 with revision incorporated in 2010. The 2010 USGS National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. This update of the maps incorporates new findings on earthquake ground shaking, faults, seismicity, and geodesy. The resulting maps are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the frequency of exceeding a set of ground motions.[11]

The original 2010 plan included a USGS seismic hazard map from October, 2002 showing peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years. Figure X displays the most recent USGS National Seismic Hazard Map produced in 2014. The map shows peak ground acceleration (pga) with a 2% chance of being exceeded over 50 years. The map shows that the pga is highest in northeastern New Jersey (0.14 - .2%g) and decreases to the south (0.06 – 0.1%g). The map shows that the pga in Union County ranges from 0.14 – 0.2%g (shaded olive green).

In comparison to the 2008 Seismic Hazard Map, the 2014 version indicates a slight increase in risk in north-central New Jersey. Figure X is the 2008 USGS seismic hazard map for the central and eastern United States showing pga with a 2% chance of being exceeded over 50 years. The 2008 version shows Union County in the 0.12g to 0.20g peak acceleration range. In Union County, the lower range of the 2014 Seismic Hazard Map begins at 0.14g, a 0.02g increase from the 2008 version.

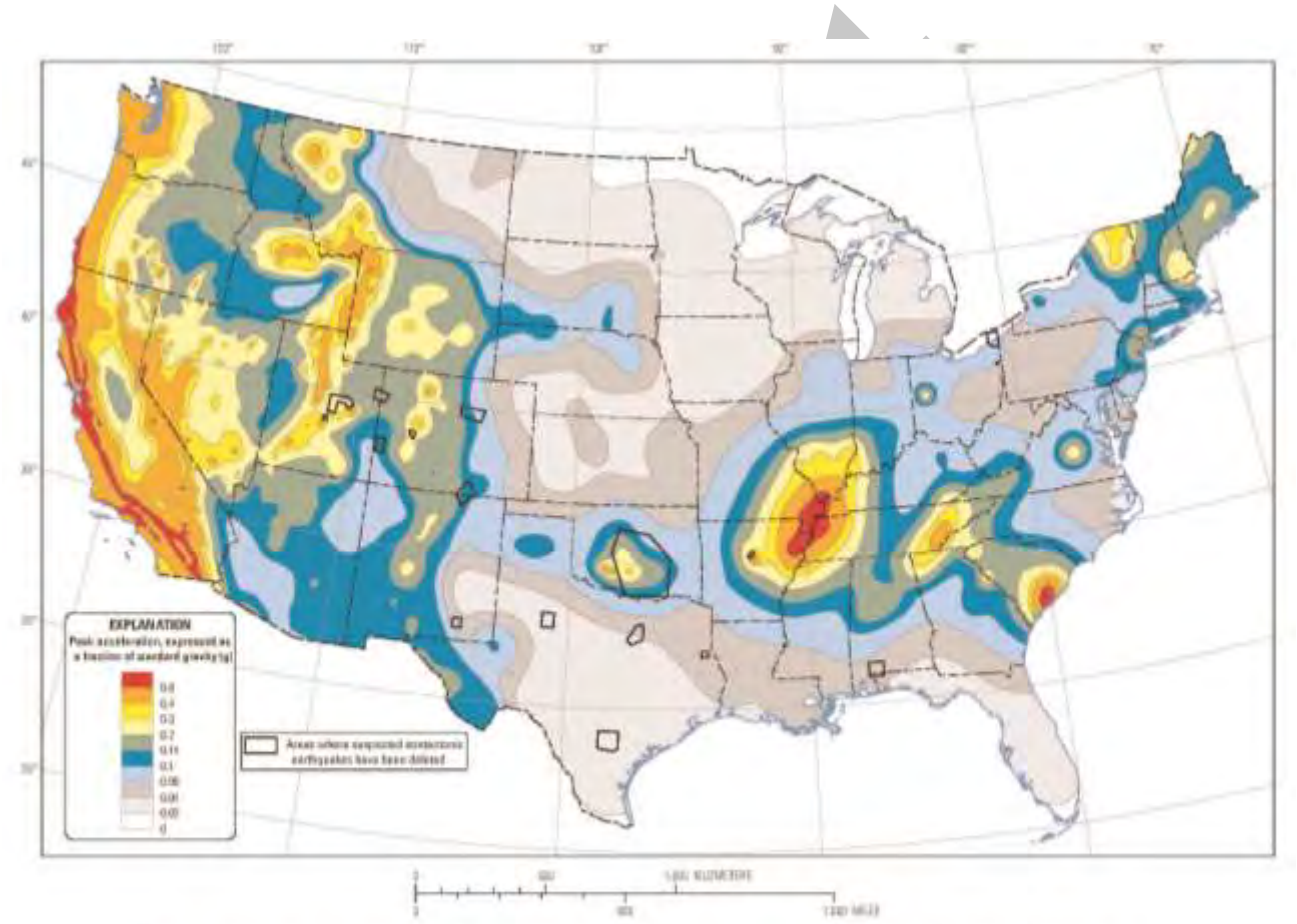
In 2002, the New Jersey Geologic Survey (NJGS) completed an *Earthquake Loss Estimation Study for Union County.* The NJGS acquired and analyzed geologic, topographic, and test-boring data in order to map seismic soil class, liquefaction susceptibility, and landslide susceptibility for Union County. The soil class, liquefaction, and landslide susceptibility were then entered into the FEMA HAZUS (Hazards U.S.) model for each census track in the county.

The Study completed by the NJGS identified and mapped the distribution and thickness of 12 surface materials for Union County. Mapping the soil type for each census track identifies areas that are susceptible to soil liquefaction. Figure 4-X below is a soil liquefaction map for Union County. The map identifies the eastern coastal region as the main area of high susceptibility for soil liquefaction. As part

[11] USGS. Documentation for the 2008 Update of the U.S. National Seismic Hazard Maps. Open File Report (2008-1128)

of the 2015 Plan update this study and data was reviewed and determined to be the most recent earthquake study data available from the NJGS

Figure 4-3
2014 US National Seismic Hazard Map, showing Peak Ground Acceleration in Percent of *g*, with 2% Probability of Exceedance in 50 Years
(Source: USGS, 2014 Update of the U.S. National Seismic Hazard Map)



Two-percent probability of exceedance in 50 years map of peak ground acceleration

Figure 4-4
2008 US Seismic Hazard Map, showing Peak Ground Acceleration in Percent of *g*,
with 2% exceedence in 50 Years
(Source: USGS, 2008)

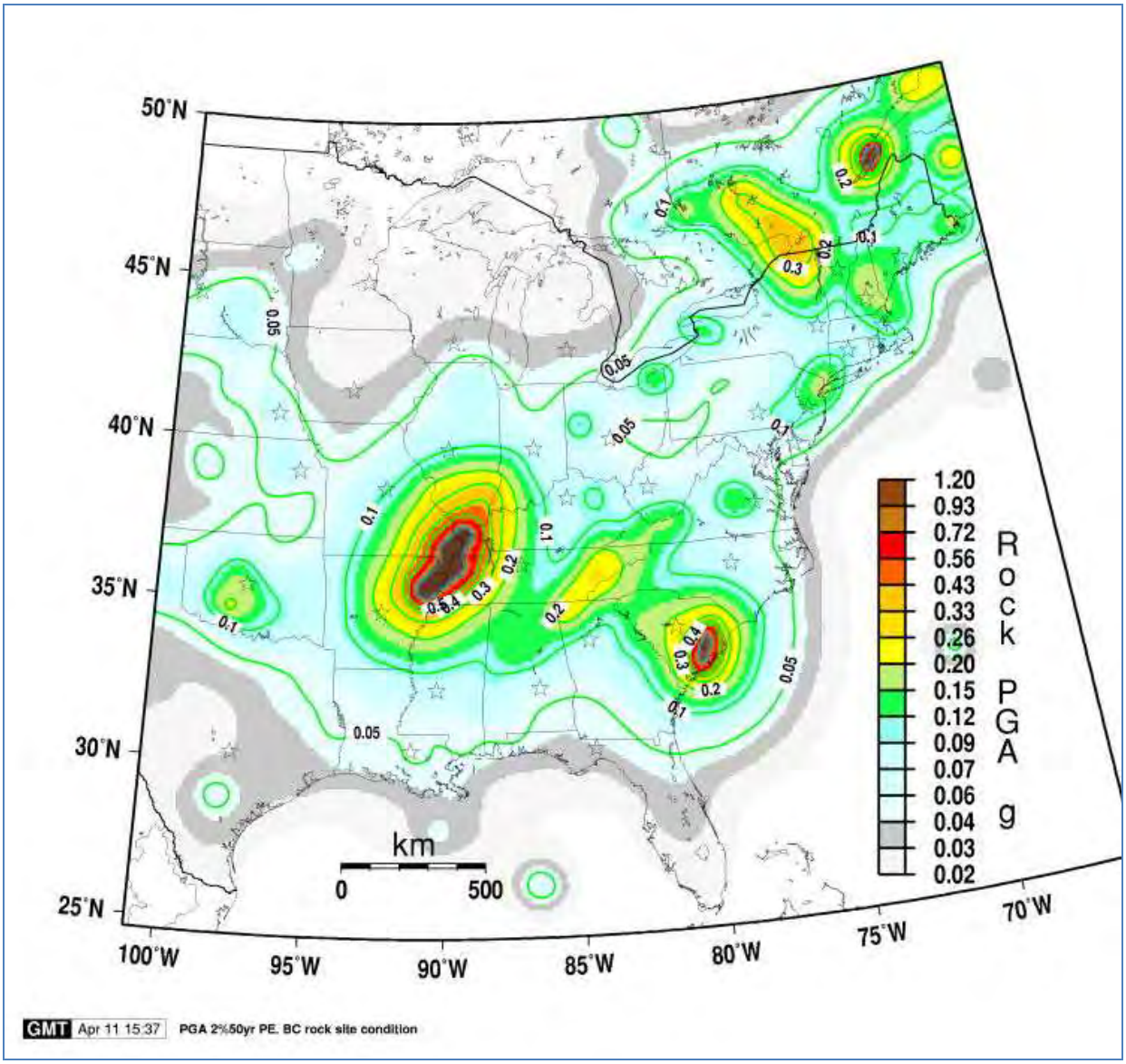


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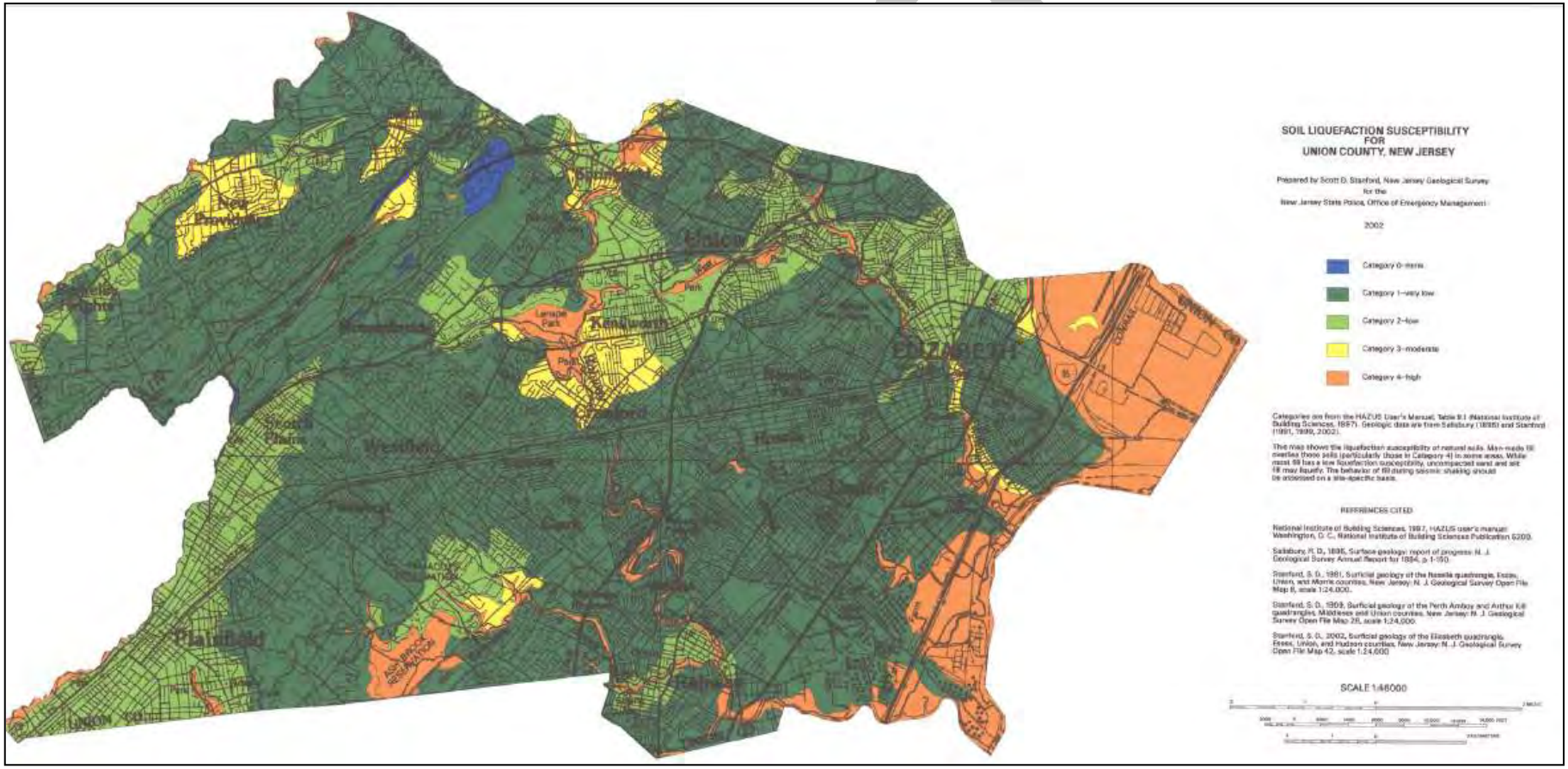
Figure 4-5
Union County, New Jersey Soil Liquefaction Susceptibility
(Source: Earthquake Loss Estimation Study for Union County, New Jersey: Geologic Component
New Jersey Geologic Survey, 2002)



Severity (or Extent) of the Earthquake Hazard

Over the past 200 or more years, seismic events in Union County have been relatively low on magnitude and intensity scales. Union County has experienced few and minor earthquakes, on average, over the past 200-plus years.[12] As shown in Figure 4-X, the probability of any severe earthquake in the area is low to moderate. As discussed in Appendix A, the severity of earthquakes is influenced by several factors, including the depth of the quake, the geology in the area, and the soils. The severity of soil liquefaction is dependent on the soils grain size, thickness, compaction, and degree of saturation.[13]

Impact on Life and Property (Vulnerabilities and Risk)

The primary cause of earthquake damage to man-made structures is ground shaking. Depending on the severity of ground shaking, debris and falling building material can create a threat to life and property. Severe enough ground shaking, particularly for longer periods, can result in the complete collapse of some unreinforced or lightly engineered structures. The amount of ground-shaking depends on how soft and how deep the soil is, and on the type of bedrock lying beneath it. Also important is whether the soil type will lose strength, liquefy or slide downhill when shaken.

Damage can be increased when soft soils amplify ground shaking. FEMA's National Earthquake Hazard Reduction Program (NEHRP) developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, as noted in Table 4-X, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses.

Table 4-7
NEHRP Soil Classifications
(Source: FEMA)

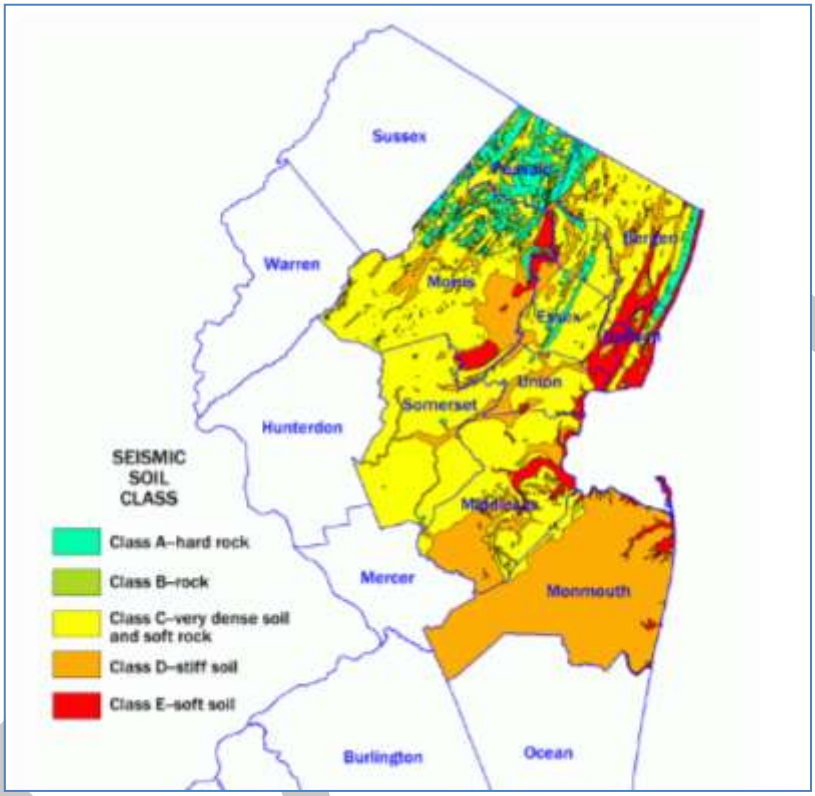
Soil Classification	Description
A	Hard Rock
B	Rock
C	Very Dense soil and soft rock
D	Stiff soils
E	Soft soils

Figure 4-6 identifies the NEHRP soils for New Jersey counties located in the northeast quadrant the State. The map was produced by the New Jersey Geologic and Water Survey (NJGWS) as part of the Earthquake Loss Estimation Study for New Jersey. The majority of Union County falls within Class C – Very Dense Soil and Soft Rock (shaded yellow). Approximately 20% of the area is located within Class D

[12] USGS and NJGS – New Jersey earthquake history
[13] NJGS

– Stiff Soil (shaded orange). The far eastern part of the County is located within Class E – Soft Soil (shaded red).

Figure 4-6
Seismic Soils in Northeastern New Jersey
(Source: New Jersey Geological and Water Survey)



There are no known deaths or injuries from earthquakes in Union County. Some of the past earthquake events were severe enough to cause minor property damage such as broken windows or contents falling from shelves. Although the probability of a significant earthquake occurring in this region is relatively small, the effects on life and property in the area could be significant, so a risk assessment is included following the *Occurrences of the Earthquake Hazard* subsection. The Mitigation Strategies in Section X also includes specific actions related to earthquake risk.

Earthquake vulnerabilities are primarily related to the *fragility* of structures and infrastructure. Fragility is the tendency of a structure to be damaged when subjected to shaking. When structures or infrastructure are damaged or fail under such loads, there is also a high potential for interrupted services, deaths and injuries.

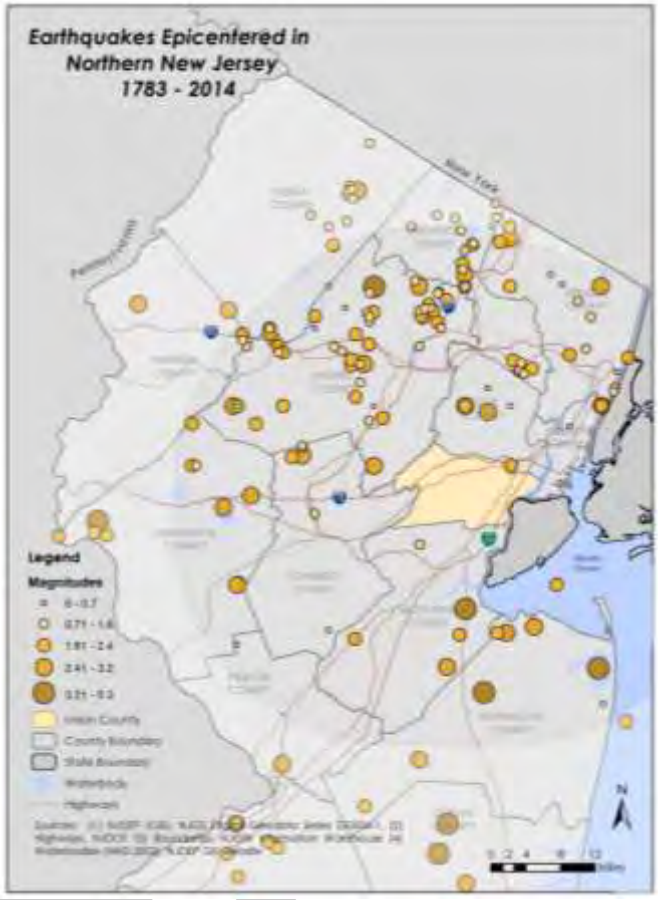
The earthquake hazard was prioritized by the HMPSC as *low,* so it is not the subject of more detailed assessment in this section or the jurisdictional appendices. The County-wide potential impact from the

earthquake hazard is relatively small because of the low probability of significant shaking. However, if the area were subject to intense or long-duration ground shaking, there would be high potential for failure of vulnerable structures, such as those comprised of unreinforced masonry construction.

Occurrences of the Earthquake Hazard

To identify past earthquake occurrences that have potentially impacted Union County, earthquake data from the NJDEP, New Jersey Geological and Water Survey (NJGWS) was reviewed. The NJGWS earthquake data indicates there have been 180 earthquakes with epicenters in New Jersey between 1783 and June, 2013. During this 230 year time period most have been minor with magnitudes ranging from 0.4 to 5.3 and depths up to 25 km below sea level. Of the 180 earthquakes, none had an epicenter in Union County. Figure 4-X displays historical earthquakes with epicenters in northern New Jersey during this time period between 1783 and May, 2014. The map also highlights earthquakes that have occurred within a 25 mile buffer extending out from Union County. These earthquake epicenters are included within the area circled on the map. A total of 122 earthquake epicenters have occurred within this 25 mile buffer.

Figure 4-7: Earthquake Epicenters In Northern New Jersey
(Sources: NJDEP, New Jersey Geological and Water Survey, June 2014)



Note: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

The following table (Tables X) shows the five most recent earthquakes within a 25 mile buffer of Union County. The most recent event near Union County occurred on May 31, 2014 when a 1.9 magnitude earthquake occurred in Boonton, New Jersey. Table X identifies the top five magnitude events within a 25 mile buffer of Union County between 1783 and 2014. The table shows the largest earthquake within this radius was a 5.3 magnitude event with an epicenter in Franklin, New Jersey. Table X includes the three closest earthquakes to Union County between 1783 and 2014. The closest earthquake epicenter to Union County was a 2.4 magnitude event that occurred on March 5, 1861 in Newark, New Jersey.

Table 4-8
Five Most Recent Earthquakes Within a 25 mile Buffer of Union County
(Sources: NJDEP, New Jersey Geological and Water Survey, May 2014)

Event Date	Epicenter	Magnitude
05/31/2014	Boonton	1.9
06/23/2013	Dover	2.1
07/18/2012	Dover	1.1
07/17/2012	Dover	1.1
11/05/2012	Ramsey	2.0

Table 4-9
Top 5 Magnitude Earthquake Events within A 25 Mile Buffer of Union County, 1783- 2014
(Sources: NJDEP, New Jersey Geological and Water Survey, May 2014)

Event Date	Epicenter	Magnitude
11/30/1783	Franklin	5.3
09/01/1895	South Amboy	4.1
06/01/1927	Long Branch	3.9
01/30/1979	Freehold	3.5
08/17/1953	Weehawken	3.2

Table 4-10
The Three Closest Earthquakes to Union County, 1783 - 2014
(Sources: NJDEP, New Jersey Geological and Water Survey, May 2014)

Event Date	Epicenter	Magnitude
03/05/1861	Newark	2.4
03/10/1979	Bernardsville	3.1
06/09/2011	Edison	1.6

With a total of 122 previous earthquakes having epicenters within 25 miles of Union County between 1783 and 2013, the County experiences an earthquake event on average slightly less than once every two years. With one event roughly every two years, there is a 53% annual probability of a future earthquake events occurring in Union County. Considering the impacts from the 122 past events have all been relatively minor, the 2015 Union County HMPSC ranked earthquakes as a low risk hazard (See Table X for a complete list of hazard rankings).

Complementary to calculations presented in 2010 Plan, the seismic risk analysis presented herein concentrated on applying updated HAZUS analysis on an annual level exposure. Calculations were performed using HAZUS-MH v. 2.1 (fall 2014) with general Level I analysis with slight modification of the soil map (instead of default value at Category D, the prevalent Category C soils were used instead).

While the 2010 analysis used deterministic scenarios, 2015 HAZUS calculations used probabilistic scenario for annualized direct building losses. Loss projections were calculated for 50-year and 100-year horizons, using 7% discount rate and pertinent multipliers of 13.80 and 14.27, respectively.

On a county level, the 50-year and the 100-year seismic losses were projected at:

Annualized	50-year horizon	100-year horizon
$1,208,870	$16,682,406	$17,250,575

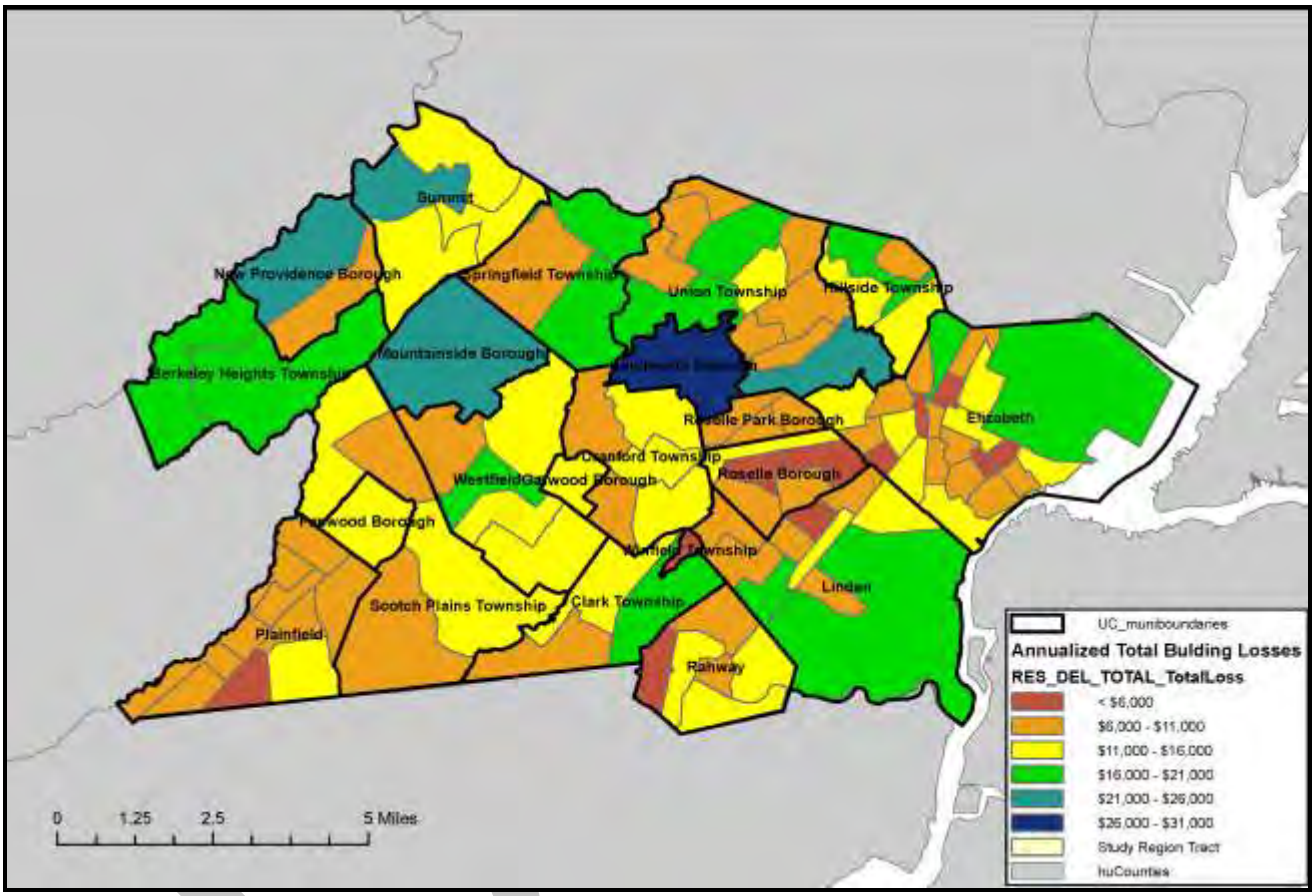
The table and the map below present distribution of annualized building losses for every municipality in Union County. The calculation did not include loss of life and risk to underground infrastructure.

Union County Annualized total

building losses by municipality
(Source HAZUS-MH 2.1 fall 2014)

MUNICIPALITY	Structural Damage	Non-Structural Damage	Building Damage	Contents Damage	Inventory Loss	Relocation Cost	Income Loss	Rental Income Loss	Wage Loss	Total Loss
Elizabeth	$26,420	$117,520	$143,960	$48,320	$1,670	$15,790	$5,600	$12,560	$7,810	$235,650
Hillside Township	$6,270	$25,410	$31,670	$11,770	$570	$3,590	$1,070	$2,090	$1,380	$52,130
Union Township	$15,880	$64,230	$80,140	$28,420	$1,100	$8,850	$3,640	$4,970	$5,090	$132,150
Kenilworth Borough	$3,680	$13,820	$17,500	$7,070	$540	$1,960	$880	$1,120	$990	$30,070
Roselle Park Borough	$3,000	$12,890	$15,890	$5,180	$120	$1,610	$550	$1,030	$760	$25,170
Roselle Borough	$4,520	$20,000	$24,510	$8,380	$350	$2,480	$730	$1,470	$980	$38,880
Linden City	$12,910	$49,870	$62,810	$22,280	$1,000	$7,370	$2,500	$5,150	$3,010	$104,110
Rahway City	$6,970	$30,200	$37,190	$13,280	$420	$4,340	$1,930	$2,520	$2,950	$62,580
Winfield Township	$180	$950	$1,140	$320	$0	$130	$0	$100	$10	$1,700
Clark Township	$4,580	$18,710	$23,290	$8,250	$230	$2,480	$1,150	$1,330	$1,470	$38,210
Westfield Township	$8,520	$35,570	$44,090	$14,460	$130	$4,480	$1,900	$2,400	$2,560	$70,000
Garwood Borough	$1,320	$5,640	$6,960	$2,560	$140	$800	$510	$520	$550	$12,020
Cranford Township	$7,440	$30,820	$38,260	$13,500	$340	$4,150	$1,440	$2,080	$2,000	$61,790
Springfield Township	$5,690	$21,990	$27,680	$9,930	$270	$3,270	$1,260	$1,850	$1,770	$46,020
Summit City	$6,740	$28,590	$35,320	$12,140	$230	$3,740	$1,930	$2,200	$2,900	$58,470
New Providence Borough	$4,040	$16,270	$20,310	$7,270	$270	$1,970	$800	$1,000	$960	$32,570
Berkeley Heights Township	$4,510	$17,760	$22,260	$7,320	$150	$2,010	$770	$980	$1,100	$34,580
Mountainside Borough	$3,060	$12,190	$15,260	$5,710	$220	$1,550	$930	$760	$1,150	$25,580
Scotch Plains Township	$6,090	$25,390	$31,490	$10,120	$130	$2,950	$1,380	$1,550	$1,710	$49,320
Fanwood Borough	$1,770	$7,350	$9,110	$2,900	$30	$830	$230	$360	$340	$13,810
Plainfield City	$9,920	$42,330	$52,220	$17,200	$330	$5,920	$1,860	$3,610	$2,920	$84,060
TOTAL UNION COUNTY	$143,510	$597,500	$741,060	$256,380	$8,240	$80,270	$31,060	$49,650	$42,410	$1,208,870

Estimated Seismic Risk to Union County
Total Annualized Losses per Census Tract
(Source: HAZUS-MH 2.1 Earthquake Module, Fall 2014



4.3.4 Erosion (Including Hurricane/Nor'easter/Tropical Storm)

Description of the Erosion Hazard

Coastal erosion is a dynamic process that is constantly occurring at varying rates along the coasts and shorelines of the U.S. Numerous factors can influence the severity and rate of coastal erosion including human activities, tides, the possibility of rising sea levels, and the frequency and intensity of hurricanes. Strong storms and hurricanes can erode large sections of coastline with a single event. The process of coastal erosion results in permanent changes to the shape and structure of the coastline. Human activities such as poor land use practices and boating activities can also accelerate the process of coastal erosion. See Appendix A for a more detailed description and definition of the erosion hazard.

Location of the Erosion Hazard

The State of New Jersey has over 130 miles of coastline, most of which is within close proximity to major metropolitan centers of the mid-Atlantic. Beach restoration and maintenance is an ongoing process for New Jersey. The state legislature provides $25 million annually for beach restoration, and every beach on the Atlantic is currently under either a design, engineering, or a construction phase, for this purpose. In Union County the erosion problem is predominately concentrated along the Arthur Kill River (16 kilometers of shoreline) and Newark Bay (nine kilometers of shoreline), which are located along the far eastern portion of the Cities of Elizabeth and Linden. Specific areas susceptible to erosion include Eddy Avenue Park and a portion of the Peach Orchard Brook in the City of Linden experience fairly significant erosion problems.

Severity (Extent) of the Erosion Hazard

Episodic storm erosion generates the most significant erosion along the New Jersey coast. Typically, these storms can impact the coast over periods of hours (tropical cyclones) to several days (nor'easters). Although the storm events are short-lived, the resulting erosion can be equivalent to decades of long-term coastal change. The actual quantity of sediment eroded from the coast is a function of storm tide elevation relative to land elevation, the duration of the storm and the characteristics of the storm waves. During severe coastal storms, it is not uncommon for the entire berm and part of the dune to be removed from the beach. The amount of erosion is also dependent on the pre-storm width and elevation of the beach. If the beach has been left vulnerable to erosion due to the effects of recent storms, increased erosion is likely. The time necessary for the beach to naturally recover from significant erosion can often be on the order of years to decades.

According to FEMA, coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline a period of time. Review of the *State of New Jersey 2014 Hazard Mitigation Plan Update (draft)* indicates a number of factors can determine whether a community experiences vulnerable to greater long-term erosion or accretion:

- Exposure to high-energy storm waves;
- Sediment size and composition of eroding coastal landforms feeding adjacent beaches;
- Near-shore bathymetric variations which direct wave approach;
- Alongshore variations in wave energy and sediment transport rates;
- Relative sea level rise;
- Frequency and severity of storm events; and
- Human interference with sediment supply (e.g. revetments, seawalls, jetties) (Woods Hole Sea 2003).[14]

[14] *State of New Jersey 2014 Hazard Mitigation Plan Update (draft), Section 5.2 Coastal Erosion and Sea Level Rise*

Impact on Life and Property (Vulnerabilities and Risk)

Erosion from coastal storms has the potential to cause significant property damage particularly to more densely populated beach communities on the Atlantic coast. Potentially billions of dollars of coastal development may be damaged or destroyed by the effects of erosion. Additionally, the loss of beach shoreline can also have a negative impact on a community due to the potential loss of tourism. The coastal erosion problem has been studied by various federal, state and local agencies and organizations. The New Jersey Beach Profile Network (NJBPN) has been monitoring and surveying beach erosion along the New Jersey coastline since 1986. The survey data produced by the NJBPN includes cross-sectional profiles and quantitative measurements of volumetric changes along the profiles over time.

Although specific river and stream corridors within Union County periodically experience erosion, the most significant potential for this hazard to affect structures, infrastructure and people occurs in the two easternmost jurisdictions, Linden and Rahway. The erosion hazard was prioritized by the HMPSC as *medium.* The County-wide potential impact of the erosion hazard is small, as impacts related to all but the most severe events are limited to areas in the eastern County that are not highly populated or built. See the applicable jurisdictional appendices for a more detailed analysis of vulnerabilities and potential impacts of this hazard.

Occurrences of the Erosion Hazard

Table 4-X highlights some of the major events that have caused coastal erosion in Union County. In addition to these larger events described below, minor coastal erosion occurred from storm events in 1994, 1998, 2002, and 2012.

Table 4-11
Major Coastal Erosion Events impacting Union County (1990–2012)

(Source: NOAA/NCDC)

Event date & Disaster (DR)	Erosion Event
12/1992 (DR-973)	SEVERE STORMS AND INLAND AND COASTAL FLOODING-A major winter storm (Nor'easter) that caused considerable coastal flooding and beach erosion. A total of 12 counties in New Jersey included as part of the Presidentially Declared Disaster.

Event date & Disaster (DR)	Erosion Event
3/16/1993 (DR-3106)	SEVERE STORMS AND INLAND AND COASTAL FLOODING-Event known as the "Storm of the Century" affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States caused moderate coastal erosion along the New Jersey coastline. All 21 counties in New Jersey were included in the Presidentially Declared Disaster.
1/19/1996 (DR-1088)	SEVERE STORMS AND INLAND AND COASTAL FLOODING -A low pressure system moving northward along the Atlantic coast brought some very heavy snow to the area. The heavy rain and melting snowpack from the blizzard a few days earlier caused extensive and serious flooding problems. Snowfall totals ranged for the most part between seven and nine inches.
10/19/96 (DR-1145)	SEVERE STORMS AND INLAND AND COASTAL FLOODING- A Nor'easter produced strong gusty east winds and heavy rain across the region. Peak wind gusts from 40 to around 55 mph combined with torrential rain to down numerous trees and power lines region-wide. Union County: 44 mph at Elizabeth.
9/6/99 (DR1295)	SEVERE STORMS AND INLAND AND COASTAL FLOODING- Torrential record rainfall, which caused serious widespread urban, small stream, and river flooding, preceded the remnants of Hurricane Floyd causing serious widespread flooding of low-lying and poor drainage areas. This caused significant short- and long-term flooding for many communities.
2/12/2006	SEVERE STORMS AND INLAND AND COASTAL FLOODING-A major winter storm (Nor'easter) that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion.
9/1/2006	TROPICAL STORM ERNESTO-The combination of the remnants of Tropical Storm Ernesto and a large high pressure system over eastern Canada produced heavy rain, tidal flooding, and beach erosion in New Jersey.
4/15/07 Nor'easter	SEVERE STORMS AND INLAND AND COASTAL FLOODING- A Nor'easter occurred during Sunday and Monday, April 15th and 16th. It brought heavy rain that caused widespread and significant river, stream, and urban flooding of low lying and poor drainage areas. Significant river flooding lasted through April 23rd.
11/3/2007	HURRICANE NOEL-The remnants of Hurricane Noel caused strong winds, minor tidal flooding, and beach erosion along the New Jersey coast. In neighboring Middlesex County, a four foot high dune was cut at its base for one-quarter of a mile from the municipal building to the police station in Old Bridge Township.
11/12/2009	NOR'EASTER - 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 from November 12th through the 14th. Initial damage estimates were placed at $180 million. By several measures this was one of the worst Nor'Easters to affect New Jersey since 1991.

Event date & Disaster (DR)	Erosion Event
08/31/2011 (DR 4021)	HURRICANE IRENE - Hurricane Irene made landfall (second landfall) as a tropical storm on August 28th in the Little Egg Inlet in southeastern New Jersey. A storm surge of 3-5 feet along the New Jersey shores caused moderate to severe tidal flooding with extensive beach erosion.
10/29/2012	HURRICANE SANDY - In late October of 2012, Union County was impacted by Hurricane Sandy, a late season hurricane. Sandy made landfall as a post-tropical cyclone near Brigantine, New Jersey with 70-knott maximum sustained winds. Because of its tremendous size Sandy drove a catastrophic storm surge into the New Jersey and New York coastlines. In New Jersey many areas that had been hit by Hurricane Irene in August 2011 were again battered by strong waves and surge. The barrier islands were breached in a number of places and erosion of the beach and dunes occurred all along the Mid-Atlantic coast. This was the most destructive storm to impact this coastline since an extremely powerful nor'easter in December of 1992. In Union County, the storm produced 3 to 6 feet of inundation along the Arthur Kill and in the Elizabeth Port Authority Marine Terminal along Newark Bay in eastern Union County.

As mentioned above, the erosion problem is an ongoing problem along many areas of the Union County shoreline along the Arthur Kill. It is difficult, if not impossible, to assign a probability to the near constant small ongoing erosion that may occur over a continuous period of time. However, a probability can be assigned to larger storm events such as nor'easters, hurricanes and coastal storms that can result in significant storm induced coastal erosion.

4.3.5 Extreme Temperature–Cold

Description of the Extreme Temperature (Cold) Hazard

Temperatures that are significantly below normal are considered extreme cold temperatures. What constitutes extreme cold and its effect varies across different areas of the United States. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Freezing temperatures can cause severe damage to citrus fruit crops and other vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. In the northeast, below zero temperatures may be considered as "extreme cold".[15] The consequences of extreme cold on humans are intensified by high winds that increase the rate of heat loss and has the effect of making it feel colder than the actual air temperature. Extreme cold temperatures combined with high winds can lead to frostbite, permanent damage to the body, or even death. See Appendix A for a more detailed description and definition of the extreme cold hazard.

[15] NOAA–Winter Storms…The Deceptive Killers

Location of the Extreme Temperature (Cold) Hazard

The entire planning area is subject to the hazards associated with extreme cold temperatures.

Severity (or Extent) of Extreme Temperature (Cold)

The severity of extreme cold temperature events are measured by temperature, duration, and humidity. Most events are of less than a week in duration but can occasionally last for longer periods up to several weeks.

Impact on Life and Property (Vulnerabilities and Risk)

The structure of the NCDC database combines the extreme cold and extreme heat into temperature extremes. The database indicates there have been no deaths and no injuries from two extreme cold events in Union County. Damages from extreme cold temperatures are generally confined to effects on humans, although occasionally there may be relatively minor effects on infrastructure such as freezing pipes or electric grids.

While all residents of Union County could be adversely affected by extreme cold conditions, with rare exceptions there are no significant or long-term damages associated with this hazard. This hazard was prioritized by the HMPSC as *high*, mostly because the hazard occurs regularly and affects nearly everyone in the County. The County-wide potential impact of the extreme cold hazard is very small, as evidenced by historical records, which show little or no specific damage from cold (as opposed to winter storms and snow). There are no significant vulnerabilities to structures from the cold hazard, and no expected recurrent losses.

In addition to traffic accidents (which are discussed elsewhere in this section of the Plan) and freezing damage to infrastructure, perhaps the most significant winter storm/cold related risk in Union County is hypothermia. Although there are no readily-available open-source records of hypothermia deaths in the County, expected figures may be derived from national statistics on hypothermia found in a *National Health Statistics Report* entitled *Deaths Attributed to Heat, Cold and other Weather Events in the United States, 2006 to 2010.* The publication is produced by the U.S. Department of Health and Human Services Centers for Disease Control and Prevention. In the date range indicated in the title, there were 6,652 deaths nationwide related to exposure to cold, including other contributing factors. This translates to an annual national figure of 1,330. Jurisdiction-level risks from hypothermia are then derived as a proportion to the national statistics, based on population. In Table X-X below, the annual risk figure is estimated using the FEMA value of life (see documentation supporting the Benefit-Cost Analysis Re-Engineering, entitled *Standard Economic Values*), inflated to 2015 value using the Consumer Price Index. The 50-year and 100-year risk calculations in the table are completed using a standard present value coefficient that incorporates the required 7% discount rate.

Table 4-12:
Estimated Hypothermia Risk in Union County, by Jurisdiction

Jurisdiction	Population	% of U.S.	Annual Risk	50-year Risk	100-Year Risk
Berkeley Heights	13,183	0.0042%	$355,726	$4,909,025	$5,076,216
Clark	14,756	0.0047%	$398,172	$5,494,771	$5,681,912
Cranford	22,625	0.0072%	$610,507	$8,424,993	$8,711,932
Fanwood	7,318	0.0023%	$197,467	$2,725,043	$2,817,853
Garwood	4,226	0.0013%	$114,033	$1,573,658	$1,627,254
Hillside	21,404	0.0068%	$577,560	$7,970,323	$8,241,776
Kenilworth	7,914	0.0025%	$213,549	$2,946,979	$3,047,347
Linden	40,499	0.0128%	$1,092,814	$15,080,831	$15,594,454
Mountainside	6,685	0.0021%	$180,386	$2,489,330	$2,574,111
New Providence	12,171	0.0038%	$328,419	$4,532,181	$4,686,538
Plainfield	49,808	0.0158%	$1,344,005	$18,547,274	$19,178,957
Rahway	27,346	0.0086%	$737,897	$10,182,978	$10,529,789
Roselle	21,085	0.0067%	$568,952	$7,851,535	$8,118,943
Roselle Park	13,297	0.0042%	$358,803	$4,951,476	$5,120,113
Scotch Plains	23,510	0.0074%	$634,387	$8,754,546	$9,052,708
Springfield	15,817	0.0050%	$426,802	$5,889,862	$6,090,458
Summit	21,457	0.0068%	$578,990	$7,990,059	$8,262,184
Union	56,642	0.0179%	$1,528,412	$21,092,088	$21,810,441
Westfield	30,316	0.0096%	$818,039	$11,288,933	$11,673,411
Winfield	1,471	0.0005%	$39,693	$547,764	$566,420

Occurrences of Extreme Temperature (Cold)

The NCDC database indicates there have been four recorded extreme cold temperature events in Union County during the period 1950-2013. Although the query results begin in 1950, the first reported event was in 2000. Three of the four events listed in the database occurred within a 10-day period in January

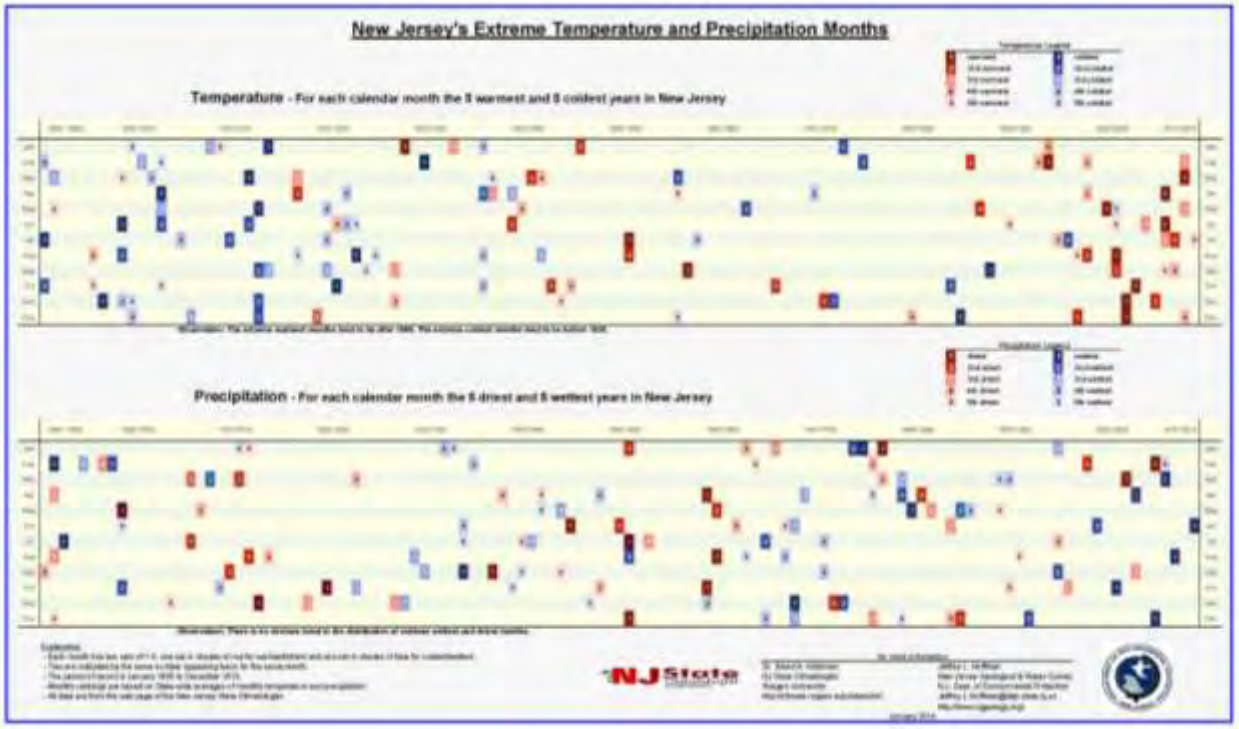
of 2000. These three events were most likely from one cold air mass lingering over the area for an extended period of time and can be combined into a single event. If the January 2000 cold spell is considered one event, the number of events identified in the NCDC database is reduced to two. There are most likely additional extreme cold events prior to 2000 that are not captured in the database. No indication is given in the database as to why there are no events identified prior to 2000, although the pattern is most likely similar with a couple of extreme cold temperature events occurring about every five years. Table 4-X lists the extreme temperature events from the NCDC for Union County. Periodically throughout Section 4.3, the output from the NCDC and SHELDUS database queries has been included to summarize past events for specific hazards.

Table 4-13: Reported Extreme Cold Events, Union County, 1950–2013
(Source: NOAA/NCDC)

Location	Date	Hazard Type	Injuries	Deaths	Property Damage	Source
County-wide	1/17/2000 - 01/27/2000	Extreme Cold / Wind Chill	0	0	0	NCDC
County-wide	1/15/2004	Extreme Cold / Wind Chill	0	0	0	NCDC
Total	----	----	0	0	$0	----

In addition to querying the NCDC for past extreme cold events in NJ, data from the Office of the New Jersey State Climatologist was also reviewed. Figure X below shows months with both hot and cold temperature extremes over the 100-years for the State of New Jersey. The data shows that the extreme cold months over the past 100-years tend to occur before 1930.

Figure 4-8
New Jersey's Extreme Temperature and Precipitation Months, 1895–2013
(Source: Office of the New Jersey State Climatologist (ONJSC))



Based on the two events between 2000 and 2013, an extreme cold temperature event occurs on average approximately once every six years. With one event every six years, there is roughly a 15% annual probability of a extreme temperature (cold) event occurring in Union County. Although there have only been a few events documented in the NCDC database, the 2015 Union County HMPSC ranked extreme temperature (cold) as a high risk hazard (See Table X for a complete list of hazard rankings).

4.3.6 Extreme Temperature–Heat

Description of the Extreme Temperature (Heat) Hazard

Temperatures that are significantly above normal are considered extreme temperatures. There is no specific point when air temperatures are defined as significantly above normal. However, the National Weather Service (NWS) will initiate alert procedures such as special weather statements when the heat index is expected to exceed 105°F-110°F (depending on local climate), for at least two consecutive

days.[16] Heat stress can be indexed by combining the effects of temperature and humidity. See Appendix A for a more detailed description and definition of the extreme heat hazard.

Location of the Extreme Temperature (Heat) Hazard

The entire planning area is subject to the hazards associated with extreme temperatures from high heat.

Severity (Extent) of the Extreme Temperature (Heat) Hazard

The severity of extreme heat events are measured by temperature, duration, and humidity. Most events are less than a week in duration. In the northeastern U.S., periods of warmer than normal temperatures typically occur several times a summer. Extreme heat waves may occur about once every five years or so where maximum daily temperatures exceed 100°F for an extended period of time. The passing of a cold front usually moderates temperatures after a few days to a week.

Heat kills by pushing the body beyond its limits. Under normal conditions an internal thermostat produces perspiration that evaporates and cools the body. The human body dissipates heat by varying the rate and depth of blood circulation, by losing water through the skin and sweat glands, and as a last resort, by panting, when blood is heated above 98.6°F. Sweating cools the body through evaporation. However, high relative humidity retards evaporation, robbing the body of its ability to cool itself. When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop.

Most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition. The Heat Index (HI) is the temperature the body feels when heat and humidity are combined. Tables 4-X and 4-X illustrate the heat index and its potential effects on the human body.

[16] NOAA - Heat Wave Description

Table 4-14
Temperature Versus Relative Humidity
(Source: National Weather Service)

Temperature (F)	Relative Humidity (%)					
	90%	80%	70%	60%	50%	40%
80	85°	84°	82°	81°	80°	79°
85	101°	96°	92°	90°	86°	84°
90	121°	113°	105°	99°	94	90°
95		133°	122°	113°	105°	98°
100			142°	129°	118°	109°
105				148°	133°	121°
110						135°
*This chart is based upon shady, light wind conditions; exposure to direct sunlight can increase the HI by up to 15°F. ** Due to the nature of the heat index calculation, the values in the table has an error +/- 1.3F.						
Source: National Weather Service: http://www.crh.noaa.gov/pub/heat.htm						

Table 4-15
Heat Index Versus Possible Effects
(Source: National Weather Service)

Hi Temperature	Possible Heat Disorder
80°F - 90°F	Fatigue possible with prolonged exposure and physical activity.
90°F - 105°F	Sunstroke, heat cramps and heat exhaustion possible.
105°F - 130°F	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
130°F or greater	Heat stroke highly likely with continued exposure.
Source: National Weather Service: http://www.crh.noaa.gov/pub/heat.htm	

Impact on Life and Property (Vulnerabilities and Risk)

The structure of the NCDC database combines the extreme cold and extreme heat into temperature extremes. The database indicates there have been 12 deaths and no injuries in Union County from excessive heat-related events. Ten of the 12 reported deaths were from one event that occurred from July 4–6, 1999. From the description provided in the NCDC database, the 12 deaths appear to cover all parts of New Jersey impacted by the event, not just Union County. During the July 4–6 heat wave, the NCDC database indicates three deaths occurred in Union County. The combination of the temperature and humidity during this event produced heat indices of around 110°F during the afternoon of each

day. Damages from the extreme high temperature hazard are generally confined to effects on humans, although occasionally there may be relatively minor effects on infrastructure such as electric grids.

While all residents of Union County could be adversely affected by extreme heat conditions, with rare exceptions there are no significant or long-term damages associated with this hazard. The extreme heat hazard was prioritized by the HMPSC as *high*, mostly because the hazard occurs regularly and affects nearly everyone in the County. The County-wide potential impact of the extreme heat hazard is very small, as evidenced by historical records, which show little or no specific damage from heat. There are no significant vulnerabilities to structures from the heat hazard, and no expected recurrent losses.

As indicated above, excessive heat is not a major health threat in the northeastern U.S. However, it is possible to estimate risks in Union County by deriving national-level information. Although there are no readily-available open-source records of excessive heat-related deaths in the County, expected figures may be derived from national statistics on hypothermia found in a *National Health Statistics Report* entitled *Deaths Attributed to Heat, Cold and other Weather Events in the United States, 2006 to 2010.* The publication is produced by the U.S. Department of Health and Human Services Centers for Disease Control and Prevention. In the date range indicated in the title, there were 3,332 deaths nationwide related to excessive heat. This translates to an annual national figure of 476. Jurisdiction-level risks from excessive heat are then derived as a proportion to the national statistics, based on population. In Table X-X below, the annual risk figure is estimated using the FEMA value of life (see documentation supporting the Benefit-Cost Analysis Re-Engineering, entitled *Standard Economic Values*), inflated to 2015 value using the Consumer Price Index. The 50-year and 100-year risk calculations in the table are completed using a standard present value coefficient that incorporates the required 7% discount rate.

Table 4-16
Estimated Heat Exposure Risk in Union County, by Jurisdiction

Jurisdiction	Population	% of U.S.	Annual Risk	50-year Risk	100-Year Risk
Berkeley Heights	13,183	0.00417%	0.0198486	$127,274	$1,756,386
Clark	14,756	0.00467%	0.0222169	$142,461	$1,965,959
Cranford	22,625	0.00716%	0.0340647	$218,432	$3,014,356
Fanwood	7,318	0.00231%	0.0110181	$70,651	$974,985
Garwood	4,226	0.00134%	0.0063627	$40,800	$563,034
Hillside	21,404	0.00677%	0.0322263	$206,644	$2,851,681
Kenilworth	7,914	0.00250%	0.0119155	$76,405	$1,054,391
Linden	40,499	0.01281%	0.0609761	$390,995	$5,395,728
Mountainside	6,685	0.00211%	0.0100651	$64,540	$890,650
New Providence	12,171	0.00385%	0.0183249	$117,504	$1,621,557
Plainfield	49,808	0.01575%	0.0749919	$480,868	$6,635,977
Rahway	27,346	0.00865%	0.0411727	$264,010	$3,643,339
Roselle	21,085	0.00667%	0.0317460	$203,564	$2,809,177

Jurisdiction	Population	% of U.S.	Annual Risk	50-year Risk	100-Year Risk
Roselle Park	13,297	0.00421%	0.0200202	$128,375	$1,771,575
Scotch Plains	23,510	0.00744%	0.0353971	$226,976	$3,132,265
Springfield	15,817	0.00500%	0.0238144	$152,704	$2,107,316
Summit	21,457	0.00679%	0.0323061	$207,155	$2,858,740
Union	56,642	0.01792%	0.0852811	$546,845	$7,546,462
Westfield	30,316	0.00959%	0.0456444	$292,684	$4,039,035
Winfield	1,471	0.00047%	0.0022148	$14,202	$195,983

Occurrences of Extreme Temperature (Heat)

The NCDC database indicates there have been 12 recorded extreme temperature events related to high heat in Union County during the period 1950–2013. Although the query results begin in 1950, the first reported event was in 1995. There are most likely additional extreme heat events prior to 1995 that are not captured in the NCDC database. The database provides no indication as to why there are no events prior to 1995, although presumably occurrences follow the same pattern and frequency as shown in the NCDC list. Table 4-X lists the extreme heat events from the NCDC for Union County. The events are divided into the category type of excessive heat or heat wave. Note that a heat wave is defined by NOAA as a period of abnormally and uncomfortably hot and unusually humid weather with temperatures of at least 90 degrees for at least three consecutive days. Excessive heat watches and warnings are issued when heat index values are forecast to reach or exceed 105 degrees for at least two consecutive hours.

Table 4-17
Reported Extreme Heat Events, Union County, 1950–2013
(Source: NOAA/NCDC, SHELDUS)

Location	Date	Hazard Type	Injuries	Deaths	Property Damage	Source
County-wide	7/4/1993	Excessive Heat	0	0	0	SHELDUS
County-wide	7/25/1995	Heat Wave	0	0	0	NCDC
County-wide	8/25/1995	Heat Wave	0	0	0	NCDC
County-wide	7/4/1999	Excessive Heat	0	10	0	NCDC
County-wide	8/7/2001	Excessive Heat	0	0	0	NCDC
County-wide	7/2/2002	Excessive Heat	0	0	0	NCDC
County-wide	07/29/2002	Excessive Heat	0	0	0	NCDC
County-wide	8/1/2006	Excessive Heat	0	2	0	NCDC
County-wide	7/21/2011	Excessive Heat	0	0	0	NCDC
County-wide	7/18/2012	Excessive Heat	0	0	0	NCDC
County-wide	7/19/2013	Excessive Heat	0	0	0	NCDC

Location	Date	Hazard Type	Injuries	Deaths	Property Damage	Source
Eastern County	9/11/2013	Excessive Heat	0	0	0	NCDC
Total	----	----	0	12	$0	----

As mentioned above, one of the worst extreme heat-related events occurred in July 1999. A very strong and oppressive high pressure system that extended from the surface to aloft gave New Jersey a brutal heat wave that included the entire Independence Day weekend. High temperatures reached the 90s for the first time on the July 3, but sweltering humidity and record breaking maximum temperatures of around 100°F degrees occurred from Independence Day through the July 6 of the month.[17]

As mentioned in the Occurrences subsection of the Extreme Temperature (Cold) section, data from the Office of the New Jersey State Climatologist was also reviewed to identify historical heat events. Figure X (on page 4-X) shows months with both hot and cold temperature extremes over the 100-years for the State of New Jersey. The data shows that the extreme warm months over the past 100-years tend to occur after 1990. This New Jersey trend is consistent with scientific evidence of rising global temperature averages over the past 20 years.

Based on the 12 events between 1995 and 2013, on average, an extreme heat event occurs approximately once every 1.5 years. Based on the historical data from the NCDC and SHELDUS databases, extreme heat events will continue to occur in the county about every one to two years. With one event every 1.5 years, there is roughly a 66% annual probability of a future extreme heat event occurring in Union County. Considering the 12 past events over the past 18 years, the 2015 Union County HMPSC ranked extreme temperature (heat) as a high risk hazard (See Table X for a complete list of hazard rankings).

[17] NOAA/NCDC database

4.3.7 Flood (Includes Tidal, Flash, and Riverine Flooding)

Description of the Flood Hazard

Flooding is defined as a condition of partial or complete inundation of normally dry land, typically in a floodplain, due to a variety of conditions. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding.

Hundreds of floods occur each year in the United States, including overbank flooding of rivers and streams and shoreline inundation along lakes and coasts. Flooding typically results from large-scale weather systems generating prolonged rainfall. Flooding in Union County can be the result of the following weather events: hurricanes, thunderstorms (convectional and frontal), flash flood, storm surge, or severe winter storms. See Appendix D for more detailed descriptions and definitions of the flood hazard.

Location of the Flood Hazard

Union County is partially bordered by the Passaic River to the west, Newark Bay and the Arthur Kill to the east. The county is bordered by the Rahway River to the southeast, and the Green Brook River to the southwest. The topography of the county is generally flat to gentle rolling, with elevations increasing from east to west, but is marked by low parallel ridges generally running a northeast direction. The Watchung Mountains, in the extreme western portion of the county, comprise the largest of these ridges. Elevations in the county range from less than ten feet in the marshes of the east, along Arthur Kill, to greater than 500 feet in the Watchung Mountains.[18]

Numerous areas within Union County are susceptible to localized flooding from excess rain events, stormwater runoff, local drainage problems, overbank flooding, and other sources. All of the municipalities within the county experience some degree of flooding. This section highlights several of the significant flood areas throughout Union County.

One of the best sources for determining flood risk for an area is review of the Flood Insurance Rate Maps (FIRMs) produced by FEMA. The FIRM is the official map of a community on which FEMA has delineated both the special flood hazard areas (1% annual chance of flooding) and the risk premium zones applicable to the community.[19] Flood mapping and analyses in Sections 5, 6 and 7 of this Plan update utilized a combination of FEMA Digital Flood Insurance Rate Map (DFIRM) floodplain data (effective September 20, 2006) and Advisory Base Flood Elevation (ABFE) data released by FEMA in February, 2013. The effective FIRM is the official map of a community on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community. The DFIRM data released in 2006 included updates to the Flood Insurance Study (FIS) based on revised hydrologic

[18] Union County FEMA - Flood Insurance Study (FIS), September 20, 2006.

[19] FEMA online - Floodplain Management. Flood Insurance Rate Map (FIRM) definition

and hydraulic analysis for the Rahway River that was completed in March 2006. In addition updated hydraulic information for the Elizabeth River in Hillside Township was developed by the USACE – New York District. Previous flood studies in Union County were completed in the 1970's and 1980's.

Figure X shows various flood zones in Union County from the effective FIRM. The flood zone designations are defined as follows:

Zone A (1 % annual chance of flooding). Shaded purple. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.

Zone AE (1 % annual chance of flooding). Shaded dark blue. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

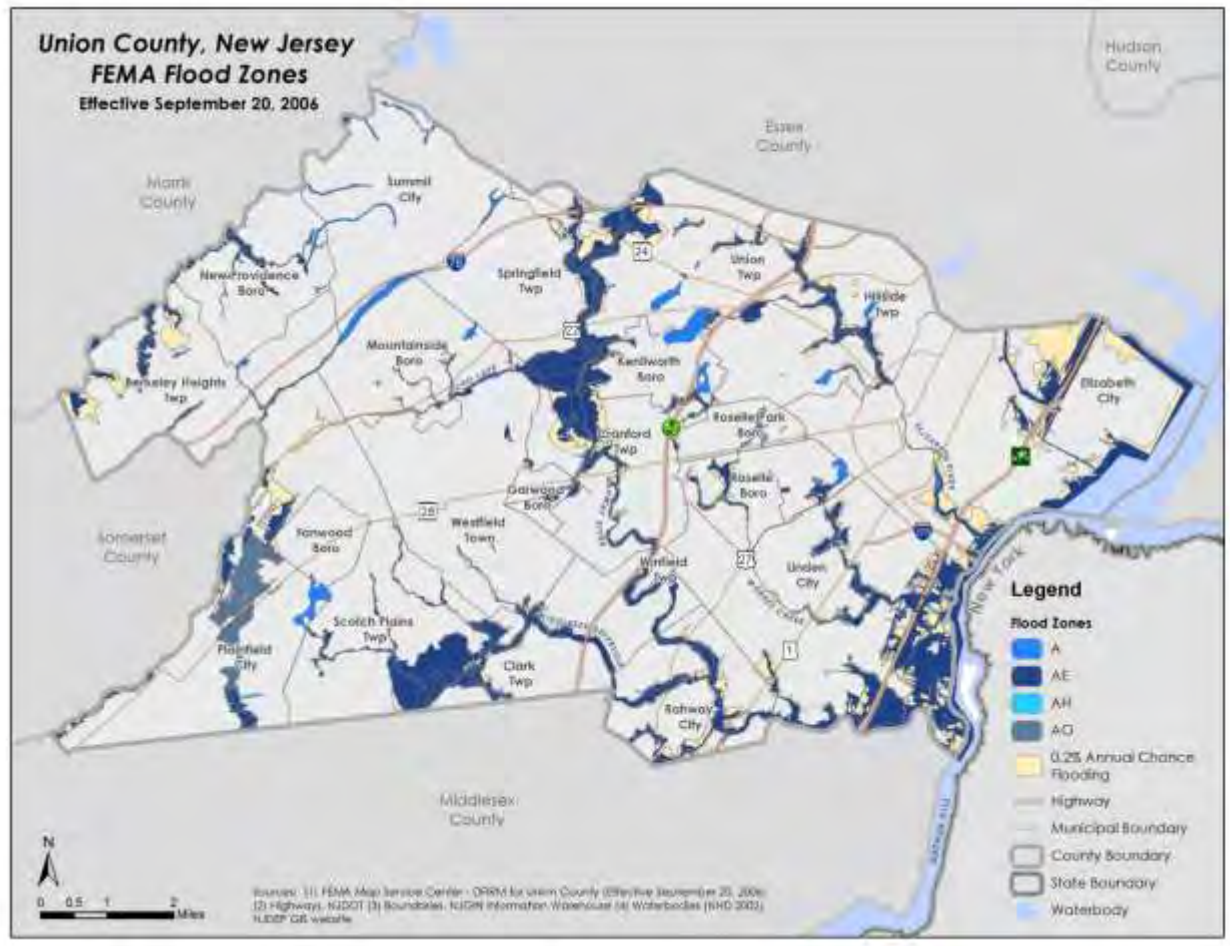
Zone AH (1 % annual chance of flooding). Shaded red. Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1' and 3'.

Zone AO (1 % annual chance of flooding). Shaded brown. Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1' and 3'.

X500 (0.2 % annual chance of flooding). Shaded green. Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.[20]

[20] FEMA – Flood Zone Designations

Figure 4-X
Floodplain Map of Union County
(Sources: FEMA Map Service Center, Effective FIRM September, 20, 2006, and NJDEP)



The 100-year floodplain includes areas with a 1% annual chance of flooding and includes zones A, AE, AH and AO. The 1% annual chance flooding covers XX percent of the County. In Figure X the A zones are colored various shades of blue. The majority of the 1% annual chance flooding areas follow the major rivers in Union County including the Arthur Kill, Newark Bay, the Rahway River, Passaic River, and the Green Brook River. The 500-year floodplain includes areas with a 0.2% annual chance of flooding. The 0.2% annual chance flooding is shown on the map below in yellow and represents the areas between the limits of the 100-year and 500-year floodplains. Flood maps identifying the effective FIRM for each participating municipality can be found in the individual municipality risk assessment appendices (See Appendices X – X).

During its fiscal year 2009, FEMA began transitioning to a new approach to floodplain mapping. The Risk Mapping, Assessment, and Planning (Risk MAP) activities built on the pre-existing map

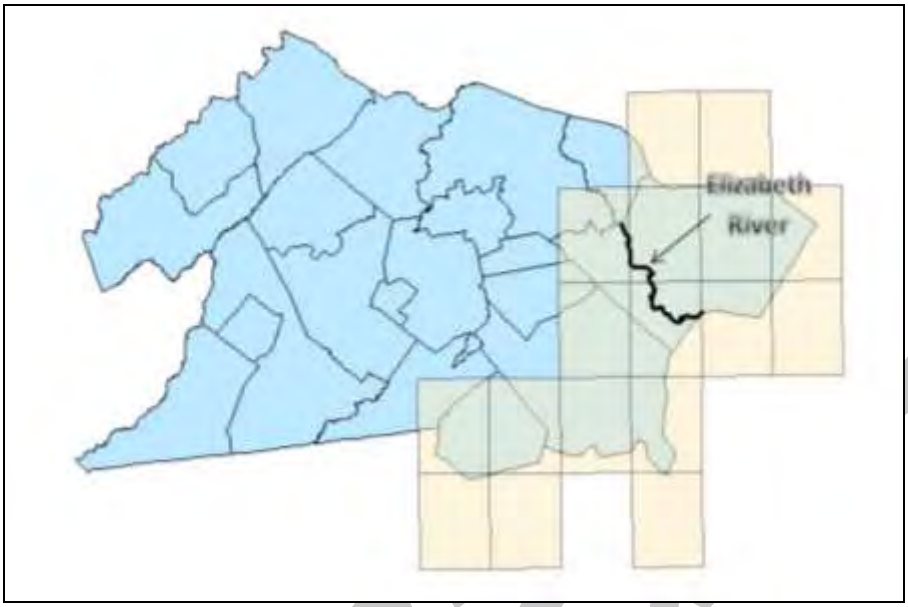
modernization program to leverage state, local, and tribal expertise to enhance quality data and further public awareness. Prior to Sandy in 2012, FEMA had begun a coastal flood study to update Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) reports for portions of New York and New Jersey, including Union County, using improved methods and data to better reflect coastal flood risk. The re-study will include new analyses, GIS mapping, creating a new Digital Flood Insurance Rate Map (DFIRM) and an updated Flood Insurance Study (FIS) for the county. The project includes at least a portion of the following eight municipalities in Union County.

- Union, Township of
- Hillside, Township of
- Elizabeth, City of
- Roselle Park, Borough of
- Roselle, Borough of
- Linden, City of
- Rahway, City of
- Clark, Township of

Figure X below identifies the areas of eastern Union County included in the study. The project also includes the acquisition of the effective countywide mapping data, incorporation of approximately four miles of detailed analysis for the Elizabeth River for Union County, and the restudy of the coastal flood hazards along the Atlantic Ocean coastline[21]

[21] Union County, New Jersey Flood Insurance Fact Sheet, Updated September 8, 2011

Figure 4-X
Location of the Streams and the FIRM Panels affected by Union County Revision
(Source: Union County, New Jersey Flood Insurance Study Fact Sheet)



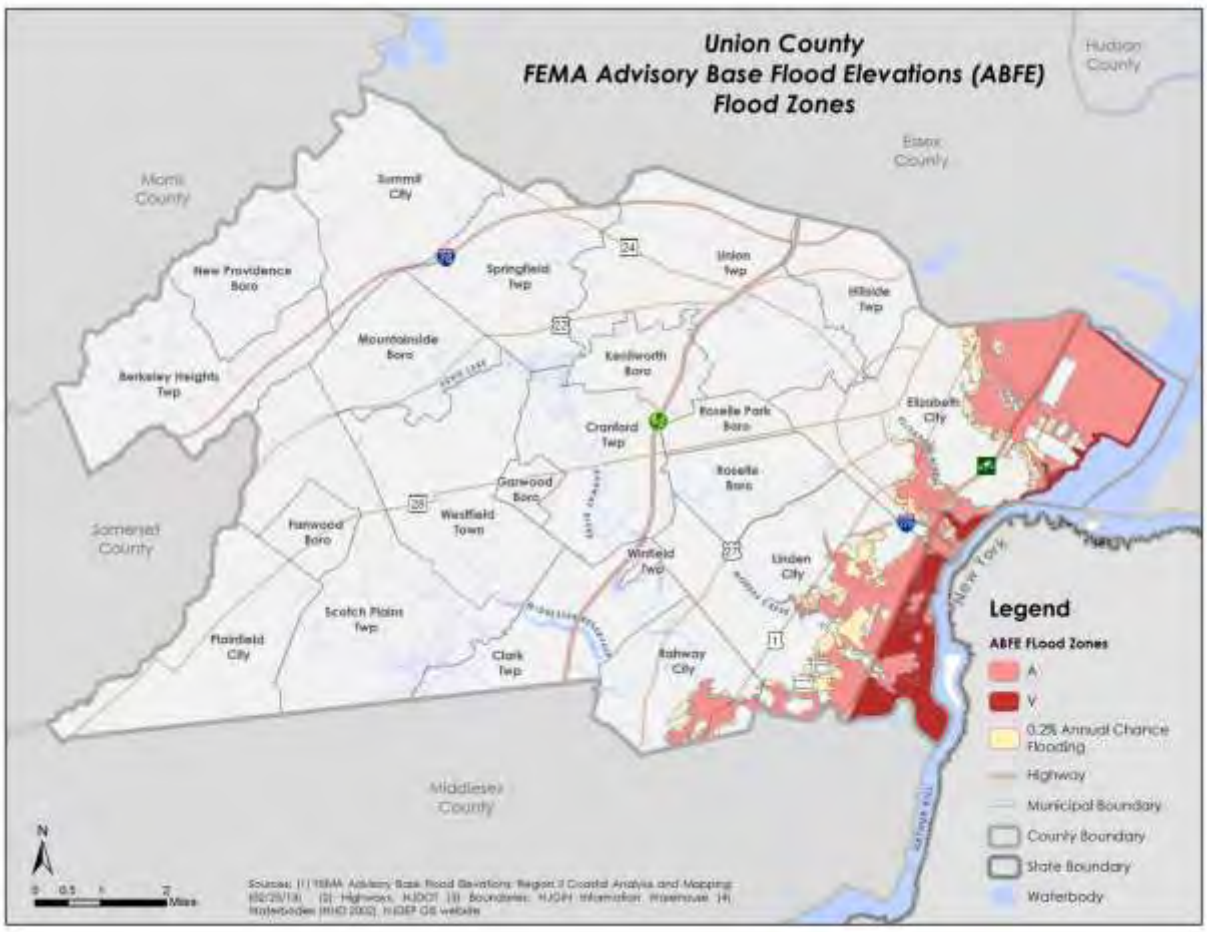
After Sandy, FEMA released *Advisory Base Flood Elevation (ABFE) maps* for certain communities based on the partially completed flood study that were designed to help with rebuilding and recovery efforts. The ABFEs are updated estimates of the 1% chance flood elevations derived from new coastal flood analysis and data. As part of the ongoing flood study the flood hazard maps are updated in several phases. Prior to release of the final updated FIRMs for a community, the phases include (1) ABFE maps, (2) Preliminary Work Maps (PWMs), and (3) Preliminary FIRMs. In Union County, the effective FIRMs are currently dated September 20, 2006. The most current flood hazard data available along the coastal (eastern section) of the County is the Advisory Base Flood Elevation (ABFE) maps released in February, 2013. In Union County several of the ABFE panels were revised again in June, 2013. Figure X identifies the historical ABFE panels (original and revised) for eastern Union County.

Figure 4-X
Historic Advisory Base Flood Elevations (ABFE) Map
(Source: FEMA Region II, Coastal Analysis and Mapping)

Figure X identifies the ABFE flood zones for the coastal communities in Union County. This map includes three flood zones including Zone A, V Zone, and 0.2% annual chance flooding (500-year floodplain). The V Zone, a zone currently not included as part of the effective FIRM, includes areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. The map indicates that the new ABFE flood zones include a portion of the cities of Elizabeth, Linden and Rahway. The ABFEs in Union County range from a minimum of 11 feet to a maximum of 17 feet (NAVD88).[22] More detailed flood maps identifying the ABFE for the City of Linden and City of Rahway can be found in the municipality risk assessment appendices for these cities (Appendices X and X).

[22] FEMA. New York/New Jersey Coastal Advisory Flood Hazard Information Development. Final Report. August 30, 2013. Risk Assessment Mapping And Planning (RAMPP)

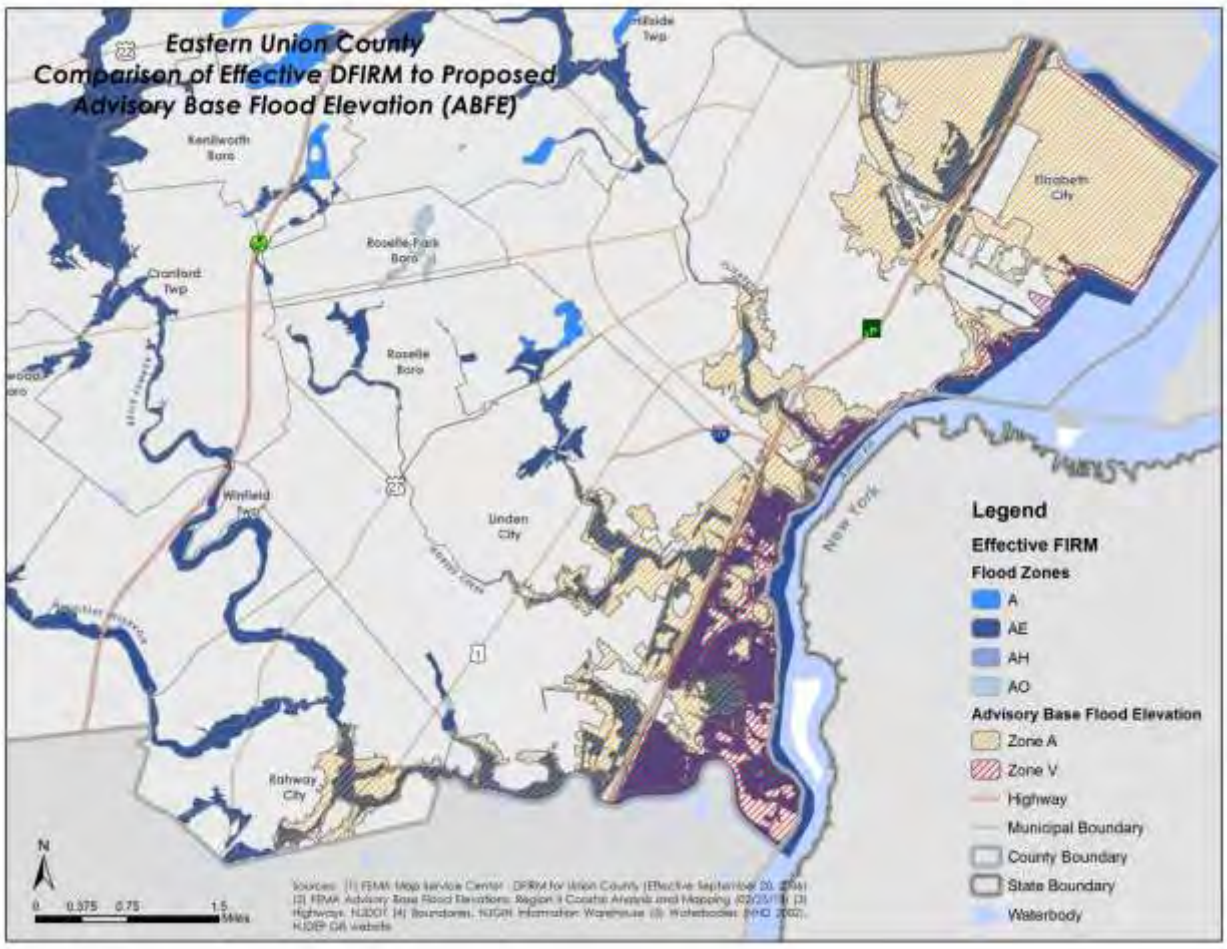
Figure 4-X
Union County Advisory Base Flood Elevations (ABFE) Map
(Source: FEMA Region II, Coastal Analysis and Mapping, February, 2013)



As with other counties in New Jersey, the updated coastal flood zones in Union County extend further inland with higher flood elevations than the Special Flood Hazard Areas (SFHA) shown on the current effective FIRMs. The ABFE proposes significant expansion of the SFHA along the Arthur Kill River, particularly in northeastern Elizabeth City and the eastern part of Linden. In addition, the ABFE map proposes changing the majority of the flood zone along the eastern area of Linden from Flood Zone AE to a V Zone. This can be seen in Figure X, which compares the effective FIRM for Union County to the proposed ABFE. Once effective, the proposed ABFE will increase the 1% annual chance flooding area from XX% of the county (XX acres) to XX%. See the municipality appendices that include the ABFE flood zone for more detailed maps of both the ABFE and comparison to the effective FIRM.

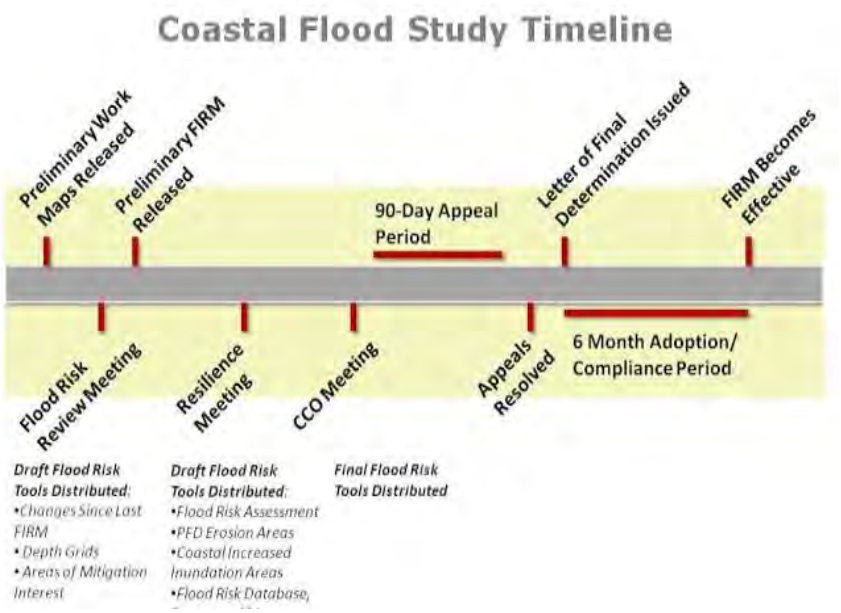
Figure X

Union County Effective FIRM Compared to Advisory Base Flood Elevations (ABFE) Map
(Source: FEMA Region II, Coastal Analysis and Mapping, FEMA Map Service Center – DFIRM, NJDEP)



The next phase in developing updated flood hazard for Union County will be the release of Preliminary Work Maps (PWMs). The PWMs created for certain New Jersey and New York communities are an interim product created by FEMA in the development of preliminary Flood Insurance Rate Maps (FIRMs). The PWMs reflect the results of the ongoing coastal flood hazard study for the New York/New Jersey coast that was mentioned at the beginning of this subsection. This information will replace the ABFE maps that were prepared for Union County to assist with rebuilding and recovery efforts in the aftermath of Sandy as the most recent data available from FEMA. FEMA is currently in the process of releasing PWMs showing coastal flood hazard data in certain communities in New Jersey and New York. The PWMs were scheduled for release to the public beginning in June 2013 and were to be delivered on a rolling community/county basis. Figure X shows the New Jersey Coastal Flood Study timeline from the point of releasing the PWMs.

Figure X
New Jersey Coastal Flood Study Timeline (From Release of PWMs)
(Source: FEMA Region II, Coastal Analysis and Mapping, Flood Risk Tools For New Jersey Communities)



As of May, 2014 FEMA has not provided an anticipated release date for the PWMs in Union County. The PWMs are intended to help communities and property owners understand current flood risk and likely flood insurance requirements in the future. The release of this information will also provide local officials an opportunity to review and comment on areas in their community where they believe risks are inappropriately mapped (understated or overstated).[23]

[23] FEMA Region II Coastal Analysis and Mapping

Sea Level Rise

In addition to the updated flood hazard data (ABFE maps) developed by FEMA there is also the concern of sea level rise and the impacts of future flood events to coastal communities over the next 20 to 50 years and beyond. NOAA, in partnership with FEMA the United States Army Corp of Engineers (USACE) and several other agencies has created a set of map services and related tools to help communities, residents, and other stakeholders consider risks from future sea level rise in planning for reconstruction following Hurricane Sandy. Even if current storm patterns remain the same in the future, sea level rise will increase the impact of coastal flooding during storms. The map services provided here integrate FEMA's most recent special flood hazard data with four scenarios of sea level rise. These scenarios include:

- lowest
- intermediate-low
- intermediate-high
- 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. They address different factors known to affect the risk of future sea level rise, including ocean warming and melting of mountain glaciers and ice sheets.[24]

The following maps, Figure X and Figure X, show the sea level rise scenarios for year 2050 and 2100.

These maps provide best available elevation information for post-Sandy planning and rebuilding, as well as to support federal agency planning, as needed and applicable. These maps are not intended to support regulatory flood hazard zone designation, insurance ratings, or other legal or regulatory constraints. Rather, these maps and services support scenario planning that may help decision makers prepare for and adapt to uncertainties surrounding the future risks posed by sea level rise. They help make transparent the level of risk accepted under different scientific assumptions underlying the expected rate of sea level rise in the 21st century.[25]

[24] NOAA – GeoPlatform. Sea Level Rise Planning Tool – New Jersey and New York
[25] NOAA – GeoPlatform. Sea Level Rise Planning Tool – New Jersey and New York

Figure X
Union County Sea Level Rise Scenario - 2050
(Source: Geo Platform, Sea Level Rise Planning Tool)

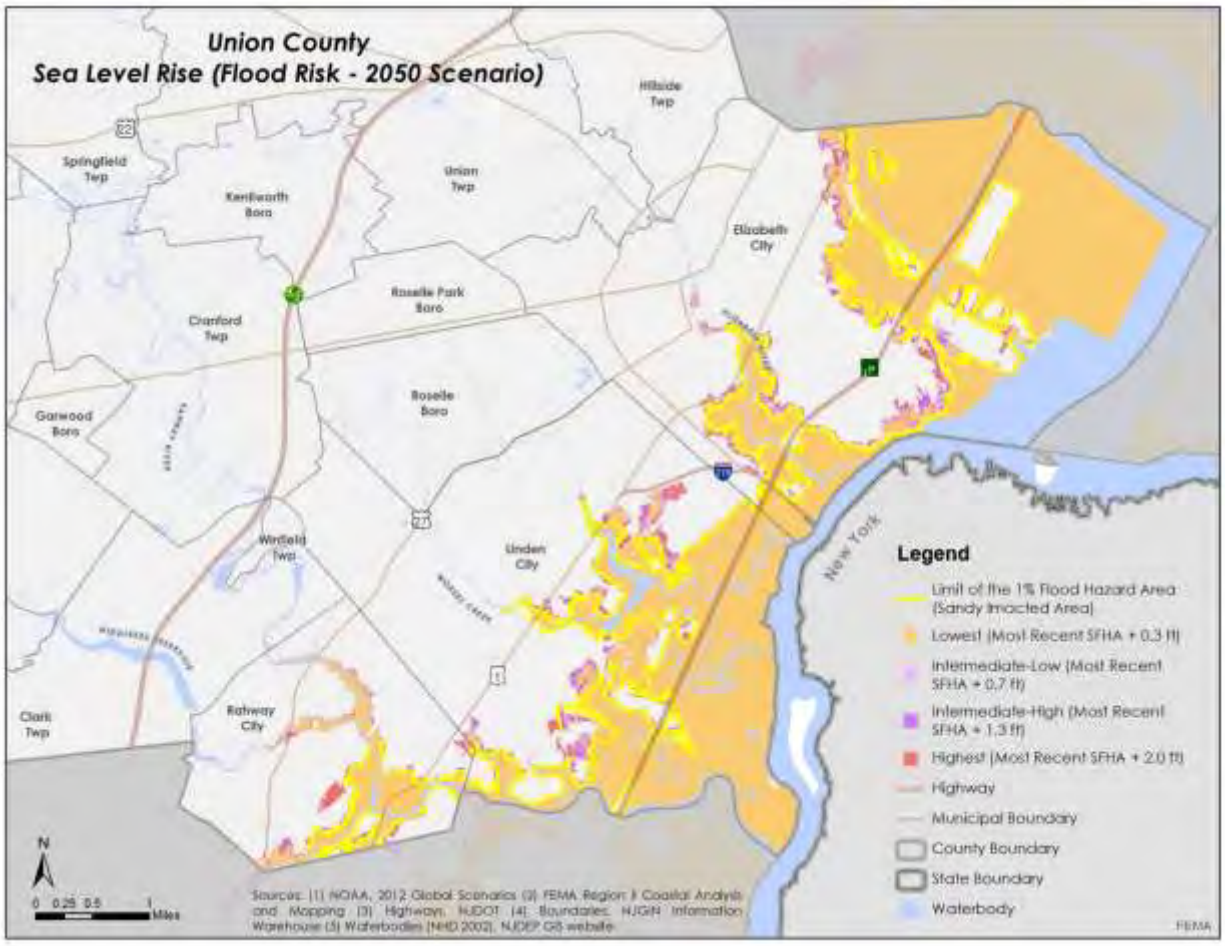
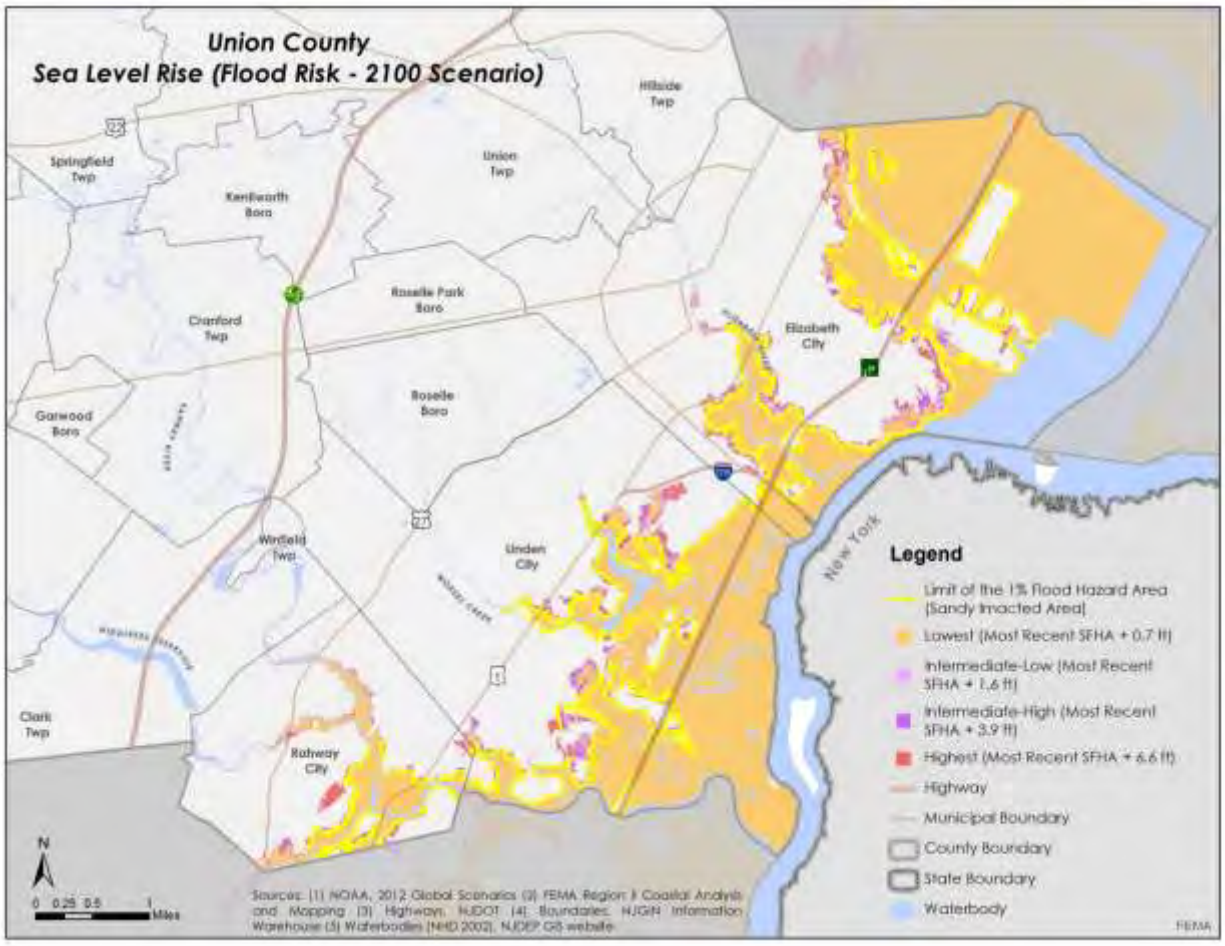


Figure X
Union County Sea Level Rise Scenario - 2010
(Source: Geo Platform, Sea Level Rise Planning Tool)



In addition to the tools developed by NOAA, a study completed in December, 2013 by the New Jersey Climate Adaption Alliance, a network of policymakers, public and private sector practitioners, academics, and nongovernmental and business leaders, indicated that the rates of sea level rise vary globally and sea levels along the New Jersey shore have risen faster than the global average due to land subsidence occurring at the same time water levels are rising. The report titled *Resilience – Preparing New Jersey for Climate Change* indicated a recent study led by Rutgers scientists has projected future rates of sea level rise (Miller et al., 2013). The projections are expressed as a best estimate and a range to account for uncertainties in future rates of global ocean warming and melting rates for the large ice sheets covering Greenland and Antarctica. According to these most recent projections, sea level is projected to rise by 7 to 16 inches by 2030, with a best estimate of 10 inches. In 2050, the range is 13 to 28 inches with a best estimate of 18 inches, and by 2100 the range is 30 to 71 inches with a best estimate of 42 inches. Even if the most conservative of these projections materialize, the implications for coastal flooding will be substantial.[26]

More detailed sea level rise maps for the City of Linden and City of Rahway can be found in Appendix A and X of the Plan update. The following subsections highlight several of the major flood areas throughout Union County. These include the Rahway River, Green Brook Sub Basin, and Passaic River.

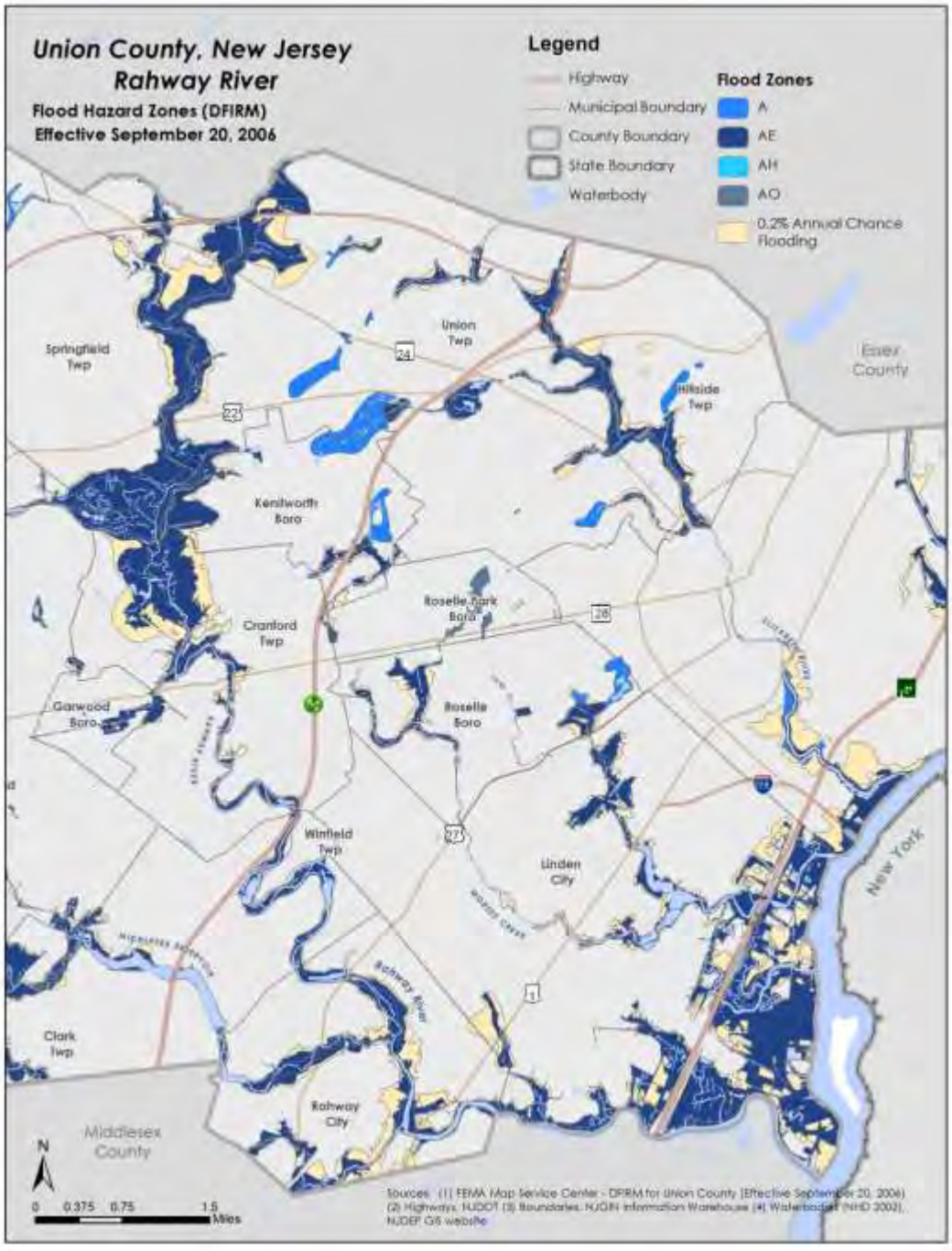
Rahway River Flooding

The Rahway River is 24 miles long and drains a land area of 41 square miles of Essex, Middlesex, and Union counties. There are 24 municipalities in the Rahway River watershed including Maplewood, Millburn, South Orange, and West Orange in Essex County; Carteret and Edison in Middlesex County; and Cranford, Mountainside, Springfield and Rahway in Union County. The Rahway River consists of four distinct branches. The West Branch begins in Verona and flows south through South Mountain Reservation and directly through downtown Millburn. The East Branch originates between West Orange and Montclair and travels South Orange and Maplewood. These two branches converge near Route 78 in Springfield and flow through the Clark and Union Townships and the City of Cranford. The confluence of the Robinson's and the South Branches of the river occurs in Rahway. The river continues through Linden and Carteret forming the boundary between Middlesex and Union counties and then drains into the Arthur Kill.

The Rahway River is the source of drinking water for the 26,500 people in the City of Rahway.[27] Figure X shows the FEMA flood zones for the Union County portion of the Rahway River.

[26] Resilience – Preparing for New Jersey Climate Change. A Gap Analysis From the New Jersey Climate Adaption Alliance. December, 2013.
[27] Rahway River Association

Figure X
Union County Portion of the Rahway River
(Sources: FEMA, NJDEP)



The most damaging floods of record within the Rahway River Basin resulted from the storms of July 1938, May 1968, August 1971, August 1973, July 1975, June 1992, October 1996, July 1997, Tropical Storm Floyd in September 1999, the April 2007 Nor'easter, and Hurricane Irene in August, 2011. After the April 2007 storm, the United States Army Corp of Engineers (USACE) -New York District indicated that 70 to 100 homes suffered major damage to first floor and foundations. Union and five other New Jersey counties were part of a Federal Disaster Declaration related to the April 2007 storm.[28] Some of the more recent major flooding events along the Rahway River are summarized below.

Tropical Storm Floyd

In September 1999, Tropical Storm Floyd (DR-1295) caused significant flooding in parts of Union County. FEMA Public Assistance (PA) Project Worksheets (PWs) indicate that infrastructure damages in Union County totaled just over $8.6 million. Of this amount, slightly more than $5 million in damages occurred in the City of Rahway. The downgraded hurricane resulted in over a foot of rain in the City of Rahway, flooding portions of St. Georges and Central Avenues along the Robinson's Branch of the Rahway River. Overbank flooding from Robinson's Branch resulted in water entering the Rahway Public Library, completely inundating the library basement with about 1.5' of water on the first floor.[29] This was the eighth time the library had experienced flooding in its 32-year history. The FEMA Public Assistance program determined the library was damaged beyond repair. FEMA awarded over $4.4 million in funds for construction of a new facility. An additional $558,000 was also provided by FEMA for content damages such as library books and computers. In 2005, the new Rahway Public Library was completed outside the floodplain behind City Hall.[30]

Table 4-X identifies the FEMA Public Assistance funds provided to applicants after Tropical Storm Floyd for municipalities located along the Rahway River (and its tributaries). The PWs indicate that the majority of the damages are from flooding along the Rahway River. However, some of the damages were attributable to flooding from other sources, as well as water intrusion into buildings resulting from high winds and rain. The table shows that the highest amount of FEMA PA funds was provided along the Rahway River, following Hurricane Floyd, to the City of Rahway. Almost all of the PA funds for this applicant were a result of the building damages (Category E) to the City Library described above.[31] See Section 7 of this Plan for a more detailed summary of the FEMA PWs for Union County.

[28] USACE - *Flood Damage Reduction and Ecosystem Restoration Study* – Fact Sheet
[29] FEMA - Public Assistance, DR-1295 – Project Worksheets
[30] City of Rahway - March 20, 2004 Press Release
[31] FEMA Region II, Public Assistance Program

Table 4-18
Project Worksheet Summary for Hurricane Floyd (DR-1295) Applicants in Union County along the Rahway River and its Tributaries, ordered by PW Total
(Source: FEMA Region II–Public Assistance Program)

Applicant Name	Cat. A	Cat. B	Cat. C	Cat. E	Cat. F	TOTAL
Rahway, City of	$43,577	$35,151	$1,665	$5,010,776	$0	$5,091,168
Springfield, Township of	$40,917	$45,573	$3,818	$527,363	$13,194	$630,865
Cranford, Township of	$111,441	$84,298	$151,800	$1,418	$0	$348,956
Union, Township of	$79,974	$44,176	$0	$10,161	$7,254	$141,565
Garwood	$15,196	$26,047	$0	$28,218	$2,000	$71,461
Clark, Township of	$29,726	$0	$0	$39,042	$0	$68,768
Linden, City of	$35,742	$18,583	$0	$0	$0	$54,325
Kenilworth	$26,379	$26,339	$0	$0	$0	$52,719
Union Township CAO, Inc.	$0	$0	$0	$15,903	$0	$15,903
Cranford First Aid Squad	$0	$1,808	$0	$5,009	$0	$6,817
Rahway Board of Education	$0	$1,198	$0	$0	$0	$1,198
Total	$382,952	$283,172	$157,283	$5,637,890	$22,448	$6,483,745

Note: For these applicants, no damages were reported for FEMA Categories D and G.

The FEMA Public Assistance categories are generally defined as follows

- **Category A: Emergency work, primarily debris clearance.**
- **Category B: Emergency protective measures.**
- **Category C: Permanent repair work, roads, and bridges.**
- **Category D: Permanent repair work, water control facilities.**
- **Category E: Permanent repair work, public buildings.**
- **Category F: Permanent repair work, utilities.**
- **Category G: Permanent repair work, parks, and recreation facilities.**

April 15-17, 2007 Nor'easter

The April 15 and 16, 2007 Nor'easter caused significant flooding in Cranford. The storm resulted in a total of 494 residential structures flooded; 66 homes were flooded above their first floor elevations and 427 homes had flooded basements. In addition, over $2.3 million in public infrastructure damage was recorded. This storm had a major impact on public infrastructure including approximately 4,000' of the dike system, the High Street Baldwin/Court footbridge, the Township Municipal Building, the Canoe Club and minor damage to the Hansel Dam at Sperry Park.[32]

[32] Cranford Township – Engineering Report on Tax Day Storm (April 15-17, 2007)

Figure 4-X
April 2007 Flooding in Cranford Township
(Source: Cranford Chronicle, April 16, 2007)

Hurricane Irene

On August 28, 2011 Hurricane Irene caused historic flooding along portions of the Rahway River, particularly the communities of Cranford, Springfield and Rahway. As part of the 2015 Plan update FEMA Public Assistance (PA) records were reviewed (as of June, 2014) for all applicants within Union County. Table 4-X identifies the FEMA PA funds provided to applicants after Irene for municipalities located along the Rahway River (and its tributaries). The table shows that as of June, 2014 Cranford Public Schools has received the highest amount of FEMA PA funds of any applicant located along the Rahway River. As a result of Irene, Cranford Public Schools has received a total of $1,536,824. The majority of these funds ($1,487,461) were associated with emergency protective measures. Compared to Tropical Storm Floyd, infrastructure damages from Irene along the Rahway River were less than half of the total damages from Floyd. However, development of PWs for these applicants is ongoing and the total estimated damages for this region may increase significantly once all damages are identified and PWs completed by FEMA.

Table 4-19
Project Worksheet Summary for Hurricane Irene (DR-4021) Applicants in Union County along the Rahway River and its Tributaries, ordered by PW Total
(Source: FEMA Region II–Public Assistance Program)

Applicant Name	Cat. A	Cat. B	Cat. C	Cat. D	Cat. E	Cat. F	TOTAL
Cranford Public Schools	$0	$1,487,461	$0	$0	$49,363	$0	$1,536,824
Cranford, Township of	$487,706	$134,446	$32,385	$34,146	$59,814	$0	$748,497
Clark, Township of	$116,931	$93,654	$0	$0	$1,847	$0	$212,432
Kenilworth, Borough of	$59,430	$60,613	$4,697	$0	$0	$0	$124,741
Cranford First Aid Squad	$0	$2,884	$0	$0	$35,023	$0	$37,907
Union Township DPW	$0	$0	$0	$0		$25,873	$25,873
Clark Public Schools	$3,742	$2,467	$0	$0	$5,017	$0	$11,225
Union Township Board of Ed.	$0	$0	$0	$0	$5,456	$0	$5,456
Grand Total	$667,810	$1,781,525	$37,082	$34,146	$156,520	$25,873	$2,702,956

Rahway River Basin Flood Risk Management – Feasibility Study

In 1999, the USACE-New York District published a *Flood Damage Reduction and Ecosystem Restoration Study* within the Rahway River Basin. The Rahway Basin is 89.1 square miles and encompasses Essex, Union, and Middlesex counties. The flooding within the Rahway River Basin has been caused principally by the rapid development of the area, which has resulted in a large increase of storm water runoff. Floods have caused damage to houses, businesses, municipal facilities, and public infrastructure. The study identified two potential flood damage reduction sites, one on the Rahway River main stem in Cranford and one on Robinson's Branch of the Rahway River in Rahway.[33] As of spring 2014, the status of the USACE study is provided below

- **Study has predominately focused on the Cranford area where the following has been completed**
- **Completed surveys, existing conditions, hydrology and hydraulics, environmental and cultural investigations**
- **Formulation of flood risk management alternatives for Cranford and upstream communities**
- **Completed economic analysis and development of BCRs**
- **Continue existing conditions analysis for the City of Rahway**

The USACE has identified the following as the next steps for the Feasibility Study

- **Preliminary Alternatives Analysis including cost estimates for Robinson's Brach Measures**

[33] USACE - Flood Damage Reduction and Ecosystem Restoration Study – Fact Sheet, April 2014

- **Economic Analysis which will produce a Benefit-Cost Ratio (BCR) for Robinson's Brach measures**
- **Basin Wide determination and optimization of Tentatively Selected Plan for Cranford measures & Robinson's Brach Measures (TSP)**
- **National Environmental Policy Act (NEPA) Scoping Meeting**
- **Conduct Environmental and Cultural Resources Field Investigations**
- **Develop Real Estate Plan**
- **Prepare a Feasibility Report and NEPA Documentation (Environmental Impact Statement)**
- **Public and Agency Reviews**

In Union County, efforts from local, state and federal agencies have helped to reduce flooding within municipalities impacted by the Rahway River. In Cranford Township and the City of Rahway floodplain management and infrastructure improvements have contributed to reducing flood related damages. In Cranford Township, improvements have included a new storm water drainage system, floodgates, and swale protection between Oak Lane and Herring Avenue. See municipality specific appendices for Cranford Township, the City of Rahway and Springfield Township for additional details about specific areas of flood concern, past flooding events along the Rahway River, and ongoing flood studies for this area of the County.

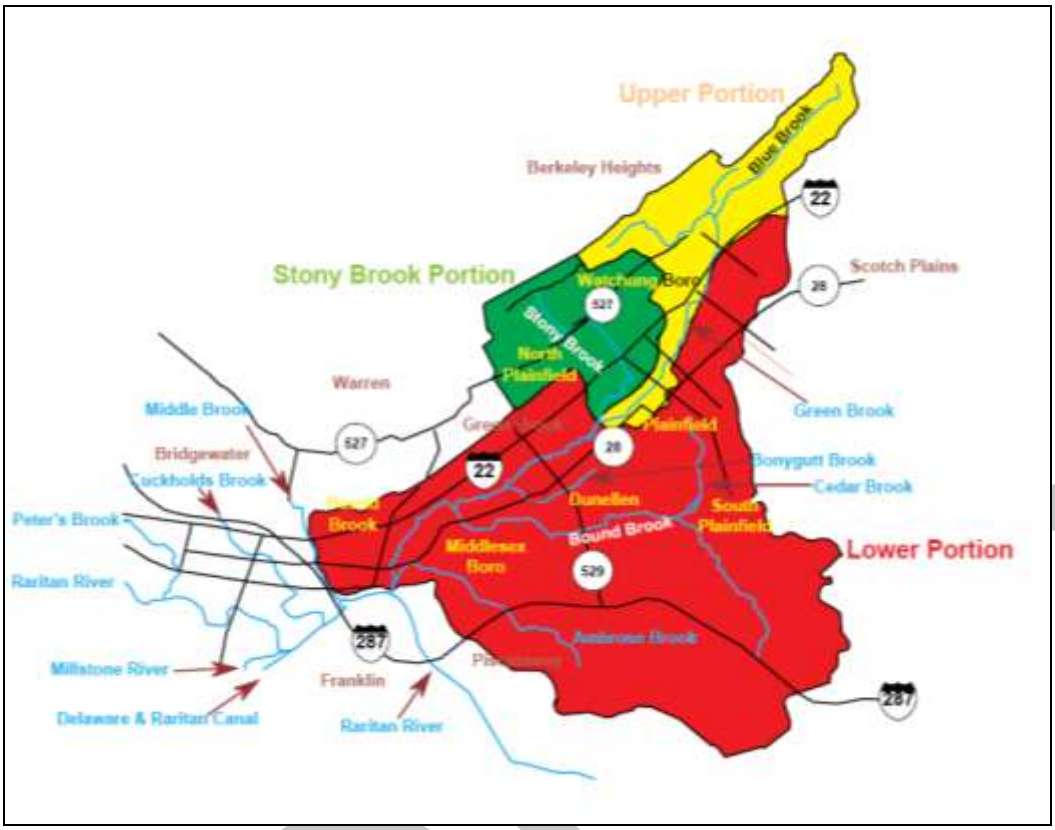
Green Brook Sub-Basin

In the southwestern portion of Union County, the Green Brook River creates a portion of the border between Union and Somerset Counties. This portion of the County is part of the Green Brook Sub Basin. The Basin covers an area 65 square miles and includes portions of three counties and 13 municipalities. In the past, the Green Brook Sub Basin has experienced severe, and sometimes devastating, flood damages.[34]

The U.S. Army Corp. of Engineers (USACE)–New York District has studied this area extensively in the past and has completed several flood control projects within the Basin, with additional projects currently in progress. Figure 4-X is a map that divides the Basin into three areas; Upper Portion, Stony Brook Portion, and the Lower Portion. The majority of the Upper Portion and the northeastern part of the Lower Portion are within Union County, and were impacted by major flood events in 1973, 1996, and 1999 (Tropical Storm Floyd). According to the USACE Tropical Storm Floyd caused two deaths and approximately $80 million in damages within the Green Brook Sub Basin, partially located in Union County.

[34] USACE - Raritan River Basin, Green Brook Sub Basin, NJ, Flood Damage Reduction Project – Fact Sheet

Figure 4-X
Green Brook Sub Basin: Upper Portion, Stony Brook Portion, and the Lower Portion
(Source: USACE–New York District)



In response to the 1971 and 1973 floods, the Green Brook Flood Control Commission was authorized by the State of New Jersey. The Commission is comprised of representatives from Middlesex, Somerset, and Union counties and is comprised of volunteer representatives appointed by the flood-affected municipalities and counties, as well as the State. The participating municipalities in Union County include the City of Plainfield and Scotch Plains Township.[35]

Most of the flooding problems within the City of Plainfield originate from the Green Brook River in Scotch Plains and in the area of Leland Avenue, and flow through streets across the basin before being diverted into Cedar Brook. The diversion leads to a condition where flood depths are deeper farther from the stream than they are in the immediate area. The result is a large floodplain throughout the northern portion of the city even though the majority of the Green Brook flows are contained within and adjacent to its banks.[36] The NFIP repetitive loss list for the City of Plainfield indicates that portions of Netherwood Avenue and Johnston Avenue have experienced moderate to severe flooding in the past.

[35] Green Brook Flood Control Commission website
[36] FEMA - Union County FEMA FIS, September 20, 2006

Passaic River Flooding

The banks of the Passaic River are relatively steep and cause the water-surface elevations to rise significantly during periods of intense rainfall. The Union County Flood Insurance Study (FIS) indicates major floods have occurred along the Passaic in 1903, 1905, 1907, 1936, 1971, and 1973. The flood of August 1973 was the worst flood event ever recorded at a gauging station in 45 years. The flood gage in Chatham Borough recorded a peak discharge of 3,380 CFS.[37] More recently the Passaic River experienced significant flooding in August 2011 after Hurricane Irene. Other recent minor flooding events occurred in March 2010 and March 2011.

In the Township of Berkley Heights, the Passaic River flows along the northern corporate limits in a relatively flat valley. During high flood stages, the Passaic River floods the adjacent plain, and flooding becomes especially widespread at junction points between four tributaries. Overbank flooding is also common among tributaries of the Passaic River during medium-to low-frequency flood flows because backwater flow from the Passaic tends to build up sediment in the downstream portions of the tributaries.[38].

Severity (Extent) of the Flood Hazard

Flood severity is measured in various ways, including frequency, depth, velocity, duration, and contamination, among others. In Union County, the metrics used to characterize the severity of the flood hazard depends on what part of the county is being considered, but generally the most important factor is how often floods occur.

Floods have been and continue to be the most frequent, destructive, and costly natural hazard facing Union County. Most recently, the county has been impacted by six significant flood events, in 1996, 1999, 2005, and 2007, 2011, and 2012. Hurricane Irene in August, 2011 was the most severe on record along the Rahway River Basin, where flood peaks were the highest ever recorded at five of the 20 long-term stream gages. The stream gages on the Elizabeth River and the two stream gages on the Rahway River at Springfield and Rahway recorded new peaks of record for 90, 74, and 90 years of record, respectively. [39]

Because of the nature of floods, discussions of extent (which FEMA considers analogous to *potential severity*) are necessarily location-specific. The jurisdictional appendices to this HMP include narrative and metrics related to flood extent on a local level. Very generally, flood extent in Union County ranges from a few inches of overland flow and ponding in some areas, to high-velocity flooding of multiple-foot depths in others. The latter type of flooding is found in close proximity to the two major flood sources in the County, the Rahway and Elizabeth Rivers. As noted, specifics about flood hazards are discussed in detail in the municipal appendices.

[37] FEMA - Union County FEMA FIS, September 20, 2006
[38] FEMA - Union County FEMA FIS, September 20, 2006
[39] USGS. Hurricane Irene and the Associated Floods of August 27-30, 2011 in New Jersey, Scientific Investigations Report 2013-5234.

Impact on Life and Property (Vulnerabilities and Risk)

There are several ways to characterize flood impacts on life and property. These include geographic and spatial metrics, statistic data, and reports of injuries and deaths related to the hazard. Figures maintained by National Climatic Data Center indicate that Union County has experienced no deaths and no injuries from past flood events.[40] The subsections below focus on spatial measures of flood potential, and National Flood Insurance Program (NFIP) flood loss statistics.

The first table in this subsection (4-X), provides basic flood-related spatial data for all the jurisdictions in the County. The information includes the number of parcels in the community, the number of those parcels in the floodplain, and the number of parcels with at least 60% of their area in the Special Flood Hazard Area, i.e. areas with at least a one percent annual chance of flooding. These figures are not a direct proxy for risk because they do not indicate the locations or vulnerabilities of any structures or infrastructure that could be damaged by flooding. Nevertheless, the data do provide a general sense of potential exposure in the communities.

Table 4-20
Flood-related Spatial Information by Jurisdiction, Union County, New Jersey

Jurisdiction	Number of Parcels	Parcels in Floodplain	Parcels with more than 60% area in SFHA
Berkeley Heights	4,887	943	243
Clark	5,311	334	106
Cranford	8,305	1,731	496
Elizabeth	19,182	1,039	114
Fanwood	2,663	104	34
Garwood	1,524	262	90
Hillside	6,459	423	79
Kenilworth	3,052	545	258
Linden	12,113	997	325
Mountainside	2,700	230	20
New Providence	4,007	421	149
Plainfield	10,585	2,703	2089

[40] NOAA/NCDC database.

Jurisdiction	Number of Parcels	Parcels in Floodplain	Parcels with more than 60% area in SFHA
Rahway	8,161	1,592	600
Roselle	5,879	948	359
Roselle Park	3,680	386	179
Scotch Plains	8,069	1,460	434
Springfield	5,394	1,105	439
Summit	6,802	319	81
Union	17,831	1,773	603
Westfield	10,002	138	15
Winfield	696	1	243
Total	147,302	17,454	6,173

National Flood Insurance Program Insured Structures and Repetitive Loss Properties

Perhaps the best method of characterizing flood risk in a community is to evaluate flood insurance claims. FEMA's National Flood Insurance Program (NFIP) was established by Congress in 1968, for the purpose of enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal government will make flood insurance available within the community as a financial protection against flood losses. As of Spring, 2015, every incorporated jurisdiction in Union County (except Winfield) was a participating member of the NFIP. Because the NFIP has existed Flood insurance claims offer a rich source of quantitative information about past flood losses, and these data are displayed in the series of tables below. It should be recognized that this information should not be considered a perfectly reliable measure of flood risk, because it relies upon flood insurance data, in particular claims submitted to the NFIP. Not all owners of potentially flood prone property in a community purchase flood insurance, and in some cases they purchase insufficient insurance to cover their losses when a property does flood. Nevertheless, there in a large enough data set in Union County that the information provides a relatively good picture of the areas where flooding has occurred, and its magnitude.

Table X-X provides basic NFIP statistics for all jurisdictions in Union County, current as of February, 2014. The column entitled "Total $ in Force" indicates the sum of all coverage for structure and contents losses, i.e. the maximum current claims value. It does not represent actual claims, which are discussed later.

Table 4-21
National Flood Insurance Statistics as of February 2014, Union County, New Jersey
(Sources: FEMA – NFIP)

Jurisdiction	Joined NFIP	# of Policies	Total $ in Force
Berkeley Heights	3/1/78	222	$56,937,500
Clark	12/23/71	121	$30,777,900
Cranford	6/25/71	860	$221,891,700
Elizabeth	5/7/71	150	$55,829,100
Fanwood	10/28/77	38	$9,311,900
Garwood	2/1/77	79	$20,956,900
Hillside	9/14/79	97	$26,312,300
Kenilworth	3/2/83	176	$44,006,700
Linden	11/24/76	272	$74,814,200
Mountainside	2/16/77	40	$12,003,900
New Providence	11/23/73	151	$43,576,500
Plainfield	6/25/71	1,374	$302,471,800
Rahway	12/23/71	635	$153,748,700
Roselle	7/17/78	155	$56,302,800
Roselle Park	6/4/80	263	$15,173,600
Scotch Plains	9/30/77	336	$86,530,800
Springfield	10/1/71	339	$86,820,900
Summit	2/2/77	123	$35,118,200
Union	8/1/78	427	$112,056,100
Westfield	12/18/79	151	$44,726,100

Jurisdiction	Joined NFIP	# of Policies	Total $ in Force
Winfield	NA	NA	NA
Total	NA	6,009	$1,489,367,600

The next table provides additional County-wide flood insurance data related to claims, including the number of losses, total payments, average claim amount and the relative percentage of the average claim in a community versus the average claim County-wide. This metric illustrates the relative severity of floods. For example, Cranford appears to be much more at risk of severe flooding (the jurisdiction accounts for 23 percent of insurance losses in the County, and the average claim is 242% of the County average) than is Roselle Park, where there have been relatively few claims and their average value is only 35% of the County average. While these figures are not a definitive measure of risk, they do offer significant insight into relative risks in the County, particularly in cases where both the numbers of losses and the percent of County average differ significantly from the average jurisdiction.

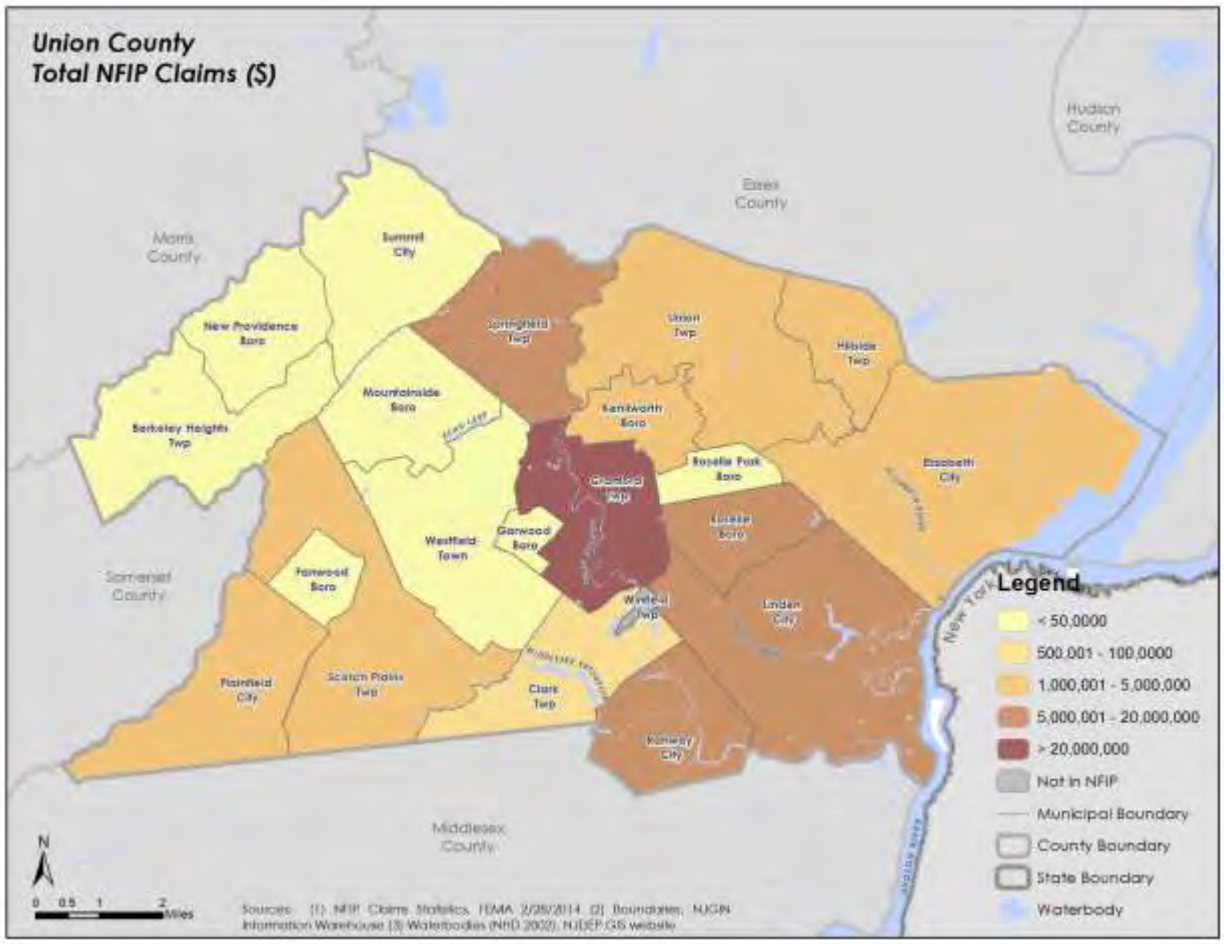
Table 4-22
NFIP Insurance Loss and Payment Statistics as of February 2014,
Union County, New Jersey
(Sources: FEMA – NFIP)

Jurisdiction	Number of Losses	Total Payments	Average Claim	% County Average
Berkeley Heights	85	$378,043	$4,448	40.50%
Clark	93	$904,321	$9,724	88.54%
Cranford	1,302	$40,366,800	$31,001	282.29%
Elizabeth	297	$4,743,448	$15,971	145.43%
Fanwood	9	$23,966	$2,663	24.25%
Garwood	37	$423,320	$11,441	104.18%
Hillside	207	$1,083,443	$5,234	47.66%
Kenilworth	151	$1,677,016	$11,106	101.13%
Linden	254	$5,411,793	$20,126	183.27%
Mountainside	22	$129,018	$5,865	53.40%
New Providence	84	$350,354	$4,171	37.98%

Jurisdiction	Number of Losses	Total Payments	Average Claim	% County Average
Plainfield	748	$3,719,615	$4,973	45.28%
Rahway	788	$17,729,300	$22,498	204.87%
Roselle	401	$7,289,309	$18,178	165.53%
Roselle Park	68	$258,051	$3,795	34.56%
Scotch Plains	212	$1,147,319	$5,412	49.28%
Springfield	322	$5,533,387	$17,184	156.48%
Summit	81	$422,006	$5,210	47.44%
Union	371	$4,990,549	$13,452	122.49%
Westfield	28	$201,222	$7,187	65.44%
Winfield	NA	NA	NA	NA
Total	5,560	$96,782,279	$21,981	NA

It is possible to complete a rudimentary flood risk assessment based on the figures in the table above. This is done by annualizing flood loss figures and projecting expected future losses (risk) over a specific planning horizon, using a present value coefficient that combines the required discount rate (7%) with the time period. The time period over which the claims occurred is 38 years, so the average annual figure for claims is $2,546,902 ($96,782,279/38). This annual figure can be projected over 50- and 100-year horizons using present value coefficients of 13.8 and 14.7, respectively. Thus, expected flood risks for a 50-year horizon are $35,147,247. For the 100-year horizon the figure is $37,439,459. Note that the jurisdictional appendices to this plan include more detailed loss projections (risk), and should be consulted for information about local flood hazards.

Figure X-X shows the Countywide distribution of NFIP insurance claims from 1977 to 2014. As expected, there are high concentrations of flood claims along the Rahway and Elizabeth Rivers, and to a lesser extent in the eastern reaches of the County.


Union County
Total NFIP Claims ($)
Hudson County
Essex County
Morris County
Somerset County
Middlesex County
Summit City
New Providence Boro
Berkeley Heights Twp
Springfield Twp
Union Twp
Hillside Twp
Mountainside Boro
Kenilworth Boro
Roselle Park Boro
Elizabeth City
Cranford Twp
Garwood Boro
Westfield Town
Fanwood Boro
Winfield Twp
Linden City
Plainfield City
Scotch Plains Twp
Clark Twp
Rahway City
New York
Legend
< 50,0000
500,001 - 100,0000
1,000,001 - 5,000,000
5,000,001 - 20,000,000
> 20,000,000
Not in NFIP
Municipal Boundary
County Boundary
State Boundary
Waterbody
N
0 0.5 1 2 Miles
Sources: (1) NFIP Claims Statistics, FEMA 2/28/2014 (2) Boundaries: NJGIN Information Warehouse (3) Waterbodies (NHD 2002), NJDEP GIS website

National Flood Insurance Program Repetitive Loss and Severe Repetitive Loss Properties

FEMA requires a discussion of NFIP Repetitive Loss and Severe Repetitive flood loss statistics in hazard mitigation plans. The NFIP defines *repetitive loss* properties as those with two or more claims of more than $1,000 each during any rolling ten-year period.

The flood risk assessment method is based on analysis of NFIP data on repetitive flood loss properties The NFIP defines repetitive loss (RL) properties as those that have received at least two NFIP insurance payments of more than $1,000 each in any rolling ten-year period. As of February 2014, Union County had 707 such properties based on a query of the FEMA BureauNet NFIP interface. The tables below include the number of repetitive loss properties, building and contents damages, the total number of claims, and the average claim amounts. Note that the table includes only those jurisdictions that have repetitive loss properties, so not all municipalities are listed. The City of Elizabeth is not included because the jurisdiction is not part of the Union County HMP.

Table 4-23 Summary of NFIP Repetitive Loss Statistics, Union County (Source: FEMA NFIP query, February, 2014)

Jurisdiction	RL Properties	RL Claims	Total Claims	Average Claim	% County Average
Berkeley Heights	5	13	$155,796	$11,984	42.22%
Clark	11	35	$508,770	$14,536	51.21%
Cranford	287	842	$30,352,487	$36,048	127.00%
Garwood	1	4	$218,543	$54,636	192.49%
Hillside	34	97	$706,990	$7,289	25.68%
Kenilworth	11	26	$142,808	$5,493	19.35%
Linden	28	82	$2,671,035	$32,574	114.76%
Mountainside	2	5	$41,477	$8,295	29.23%
New Providence	7	14	$189,737	$13,553	47.75%
Plainfield	79	198	$1,744,949	$8,813	31.05%
Rahway	123	362	$10,805,866	$29,850	105.17%
Roselle Park	2	5	$47,870	$9,574	33.73%
Roselle	41	159	$6,555,958	$41,232	145.27%
Scotch Plains	18	44	$458,268	$10,415	36.69%
Springfield	17	52	$957,811	$18,419	64.89%
Summit	2	12	$151,474	$12,623	44.47%
Union	38	109	$2,784,710	$25,548	90.01%
Westfield	1	2	$4,030	$2,015	7.10%
Total	707	2,061	$58,498,579	$28,383.59	---

Table 4-24 Repetitive Loss Properties by Occupancy Class, Union County
(Source: FEMA NFIP query, February, 2014)

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties
Single Family	596	42
Condo	3	0
2-4 Family	64	4
Other Residential	18	0
Non Residential	48	0
Union County	**729**	**46**

Flood Risk to Repetitive Loss Properties in Union County

Residential flood risk is calculated by a simple methodology that uses the FEMA default present-value coefficients from the benefit-cost analysis software modules. To perform this calculation, the flood insurance claims data were reviewed to determine an approximate period over which the claims occurred. This method should be used only for very general estimates of flood risk because the NFIP data represents only part of the flood losses in any jurisdiction. This is because there are always properties that are uninsured or under-insured.

As shown in Table X-X, there have been 2,061 flood insurance claims in the -year period, for an average number of claims per year of about two. Projected risks over 50- and 100-year timelines are shown in Table X-X below. It must be understood that individuals can obtain and cancel flood insurance policies, and the flood hazard depends on many variables, including the weather, so this projection is simply an estimate of potential damages. The jurisdictional appendices in this County HMP include more detailed discussions of repetitive loss properties.

Table 4-24
Projected 100-year Flood Risk in Union County
Based on Historic NFIP Claims for Repetitive Loss Properties
(Source: FEMA NFIP query February 2014)

Data	Value
Period in years	38
Number of claims	2,061
Average claims per year	54
Total value of claims	$58,498,579
Average value of claims per year	$1,539,436
Projected risk, 50-year horizon	$21,244,216
Projected risk, 100-year horizon	$22,629,712

Flood Risk to Severe Repetitive Loss Properties in Union County

The National Flood Insurance Program defines Severe Repetitive Loss as a residential property that is covered under an NFIP flood insurance policy and:

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

For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

Eight of Union's communities have Severe Repetitive Loss (SRL) properties as of February 2014. These communities and associated SRL statistics are shown in Table X-X below.

Table 4-25
Summary of NFIP Repetitive Loss Statistics, Union County
(Source: FEMA NFIP query, February, 2014)

Jurisdiction	SRL Properties	SRL Claims	Claims Value	Average Claim	% County Average
Berkeley Heights	1	4	$62,547	$15,637	43.46%
Clark	1	7	$52,831	$7,547	20.98%
Cranford	31	123	$5,662,172	$46,034	127.94%
Linden	1	4	$110,488	$27,622	76.77%
Plainfield	2	10	$168,404	$16,840	46.80%
Rahway	9	45	$964,581	$21,435	59.57%
Springfield	3	12	$496,139	$41,345	114.91%
Union	1	5	$38,774	$7,755	21.55%
Total	49	210	$7,555,936	$35,981	---

Occurrences of the Flood Hazard

To identify past occurrences of flooding in Union County queries were performed for both the NOAA NCDC database and SHELDUS database from the Hazards and Vulnerability Research Institute (HVRI). The NCDC database indicates that there have been 86 flood events in Union County in the period from 1984 to 2013. Of these 86 events, 13 flood events between 1950 and 2013 have resulted in property damage. The SHELDUS database included 10 flood events in Union County between 1950 and 2013 (six with property damage). Recent flood events causing property damage have occurred in 1996, 1999, 2005, 2007, 2011 and 2012. These events are listed in Table 4.X below. Note that additional flood events not listed in the NCDC database may have resulted in property and infrastructure damages.

Estimated property damages for these floods may not have been listed in the database because either the data was unavailable, or the damages were only minor and therefore not reported to the NCDC.

Table 4.26
Flood Events Resulting in Property Damage, Union County, 1950–2013
(Source: NOAA/NCDC, SHELDUS, USGS)

Location	Date	Hazard Type	Injuries	Deaths	Property Damage	Source
County-wide	03/06/1962	Flooding - High Winds	1	2	$3,846,153	SHELDUS
County-wide	08/21/1973	Flooding - Severe Storm	0	1	$416,667	SHELDUS
County-wide	11/6/1977	Flooding - Severe Storm	0	0	$2,380,952	SHELDUS
County-wide	03/29/1984	Flooding - High Winds	0	0	$500,000	SHELDUS
County-wide	10/30/1991	Flooding	0	0	$1,000,000	SHELDUS
County-wide	01/19/1996	Flooding - "Deluge of 96"	0	0	$6,000,000	SHELDUS
Springfield	10/19/1996	Flooding	0	0	$4,300,000	NCDC
County-wide	09/16/1999	Flooding	0	0	$4,200,000	NCDC
County-wide	04/02/2005	Flooding	0	0	$2,000,000	NCDC
Rahway	04/15/2007	Flooding from Nor'easter	0	0	$2,700,000	NCDC
County-wide	04/02/2010	Flooding - Severe Storm	0	0	Unknown	NCDC
County-wide	08/28/2011	Hurricane Irene	0	0	Unknown	NCDC
County-wide	10/29/2012	Hurricane Sandy	0	0	Unknown	NCDC
Total	----	----	1	2	$27,343,772	

In addition to the flood events listed in the NCDC and SHELDUS databases between 1950 and 2013, the Union County FIS indicates that a major flood event also occurred in 1971. The more recent floods that have occurred in Union County are summarized below. Incidents that have been declared a Major Disaster by the President are indicated by the disaster number (DR).

1/19/1996 (DR-1088) –Severe Storms and Flooding. The flash flooding of the afternoon and early evening of January 19, 1996 led to larger river flooding that extended through January 21 of the month. Strong southerly winds ushered very mild and moisture laden air into the region following a blizzard that hit New Jersey just days earlier. Street flooding became a major problem early on due to the rains and significant snowmelt. River and stream flooding occurred later in the afternoon of January 19 and continued well into the next day. In Union County, flood damages were estimated at $3 million.[41]

10/19/1996 (FEMA DR-1145) –Severe Storms and Flooding. A strong low pressure system slowly moved off the southern New Jersey coast on October 19. The storm produced heavy rains with rainfall totals of up to 8" in some parts of Union County. Heavy rainfall produced serious flooding of many rivers and small streams in Union County as well as serious widespread street and poor drainage flooding. The Rahway River in Springfield reached its' second highest level of record. In Cranford, downstream of Springfield, 100 homes were evacuated, and in Rahway, further downstream, 75 homes and one high rise apartment were evacuated due to rising flood waters. The Union County Office of Emergency

[41] NOAA/NCDC database

Management (OEM) estimated damages within the county at $4 million in damages to private homes and $300,000 to public infrastructure.[42]

9/16/1999 (DR-1295) –Hurricane Floyd. This fall hurricane put the entire Eastern Seaboard on flood watch, including every county in New Jersey. Although downgraded from a hurricane by the time it hit New Jersey, the storm lasted approximately 18 hours and resulted in rainfall totals of up to almost 12" in parts of Union County. The Rahway River at Springfield was above its flood stage of 5.5' on the September16 and September 17. The crest stage of 10.67' occurred around 10:00pm on September 16. The NCDC database indicates that in Union County initial damage estimates from the New Jersey OEM at $4.2 million.[43] A more detailed review of the FEMA Project Worksheets indicates that the Public Infrastructure damages alone totaled just over $8.6 million. The most significant damages occurred in the City of Rahway when overbank flooding from Robinson's Branch of the Rahway River resulted in floodwaters destroying the City's library.

04/02/2005–Severe Storms and Flooding. On April 2 and April 3 heavy rains from an intense low pressure system caused widespread flooding throughout northern New Jersey. The NJOEM estimated that the flooding forced 6,000 residents from their homes and caused a total of $60 million in damages. In Union County the damages were estimated at $12 million.[44]

4/15/2007 (DR-1694) –Severe Storms and Inland and Coastal Flooding. A seven-day Nor'easter deluged New Jersey with up to 9" of rain, causing millions of dollars of damage and killing three residents. Statewide damage was estimated at $180 million. In Union County maximum rainfall totals were 7.3" near Cranford Township in the central part of the county. The NCDC database estimated damages in Union County at $2.7 million. The most significant damages occurred in Cranford Township where the storm resulted in a total of 66 residential homes flooded above their first floor elevations, 427 homes with flooded basements, and over $2.3 million in public infrastructure damage.[45]

04/02/2010 –Severe Storms and Flooding. A slow moving storm moving north along the Atlantic coast produced heavy rains from March 12 - 15, 2010. Rainfall amounts were greatest in central and northeastern New Jersey. One of the highest rainfall totals was reported at USGS gage in Mountainside, New Jersey.

08/28/2011 (DR-4021) – Hurricane Irene. Hurricane Irene made landfall along the Outer Banks of North Carolina on August 27, 2011 as a Category 1 hurricane. The storm re-emerged over the Atlantic and made a second landfall as a tropical storm on August 28th in the Little Egg Inlet in southeastern New Jersey. Large portions of the county experienced flooding, with the most severe occurring in the municipalities of Cranford, Springfield, and Rahway. These areas were mainly impacted by flooding from the Rahway River. The United States Geological Survey (USGS) indicated the peak flood stage along the Rahway River at Rahway was 2.5 feet higher than the previous peak of record. The storm

[42] NOAA/NCDC database
[43] NOAA/NCDC database
[44] NOAA/NCDC database
[45] Cranford Township – Engineering Report on Tax Day Storm (April 15-17, 2007).

flooded thousands of residential homes in Cranford including the downtown area. The event was considered the worst flood event in Cranford's history with an estimated $75 million in property damages. See Appendix 3, Cranford Township Risk Assessment, for additional details about the impacts of Irene. In other areas of the county, police used boats to rescue nearly 90 people from their homes on flooded streets in Rahway and Springfield. In Rahway significant flooding occurred along West Grand Avenue and Rahway Avenue. An estimated 30,000 Union County residents were left without power.[46]

10/29/2012 (DR-4086) – See subsection below for a summary of Hurricane Sandy.

Figure X: Hurricane Irene, Flooding in Cranford Township
(Source: SternAssociates.com)

[46] Union County, NJ website. News and Events. Union Continues Response in Aftermath of Hurricane Irene.

Figure X: Hurricane Irene, Flooding in Downtown Cranford
(Source: SternAssociates.com)

Hurricane Sandy

In late October of 2012, Union County was impacted by Hurricane Sandy (DR-4086), a late season hurricane that originated as a tropical wave from the west coast of Africa. Sandy traveled across Cuba and other parts of the Caribbean, before moving northeastward, parallel to the coast of the southeastern United States. Sandy reached a secondary peak intensity of 85 knots while it turned northwestward toward the mid-Atlantic states. Sandy weakened somewhat and then made landfall as a post-tropical cyclone near Brigantine, New Jersey with 70-knot maximum sustained winds on October 29, 2012. Because of its tremendous size, however, Sandy drove a catastrophic storm surge into the New Jersey and New York coastlines.

With the highest storm surge levels on record, Sandy produced widespread damage to coastal and inland communities in New Jersey. In Union County the storm surge flooded the coastal areas of the County. See Section 5.3.17 for additional information about the storm surge flooding associated with Hurricane Sandy including a Union County inundation map. Although the flooding was substantial along the coastal portions of Union County, review of FEMA Public Assistance records indicates that infrastructure damages (including public facilities) related to flooding from Sandy was relatively minimal. In Union County the majority of the public infrastructure damages from Sandy were related to high winds.

Information provided by the NFIP can be used as an indication of the potential for flooding in Union

County, and the amount of damage it has caused in the past. It is recognized that relying on just NFIP data may not provide as comprehensive a picture as possible as not all people with flood damage belong to the NFIP or have submitted claims to the NFIP. But review of prior NFIP flood claims can help reveal areas of the county that are vulnerable to damages from flooding. In recent years, FEMA has focused considerable attention to insured, repetitive loss properties. By definition, these are properties that have had two or more flood insurance claim payments of at least $1,000 each over a ten-year period. In Union County, 434 residential and commercial properties have been identified as repetitive loss properties. Collectively, claim holders have received payments of just over $20.3 million (the figure includes claim payments for both building and contents damages).

Based on past and recent history, certain parts of Union County clearly have a high probability of flooding repeatedly in the future. Several areas adjacent to the Rahway River and portions of the Green Brook River area of the county have flooded several times in the past. With a total of 96 past flood events in Union County between 1950 and 2013, the County experiences a flood event on average roughly every 1.5 years. With one event roughly every 1.5 years, there is a 65% annual probability of a future flood events occurring in Union County. Severe flooding in Union County six out of the last 17 years suggests that the repeated flooding in specific areas is likely to occur again in the future.

Considering the impacts from flooding, the 2015 Union County HMPSC ranked floods as a high risk hazard (See Table X for a complete list of hazard rankings).

4.3.8 Hail

Description of the Hail Hazard

Hail is a form of precipitation comprised of spherical lumps of ice. Known as hailstones, these ice balls typically range from 5 mm–50 mm in diameter on average, with much larger hailstones forming in severe thunderstorms. The size of hailstones is a direct function of the severity and size of the storm. See Appendix A for a more detailed description and definition of the hail hazard.

Location of the Hail Hazard

Hailstorms occur more frequently during the late spring and early summer, when the jet stream migrates northward across the Great Plains. This period has extreme temperature changes from the ground surface upward into the jet stream, which produces the strong updraft winds needed for hail formation. The land area affected by individual hail events is not much smaller than that of a parent thunderstorm, an average of 15 miles in diameter around the center of a storm.

The potential for hail exists over the entire planning area, although the probability is relatively low compared to other parts of the U.S. There are at least a few occurrences of hail almost every year in the planning area, although for the most part they are minor.

Severity (or Extent) of the Hail Hazard

The severity of hailstorms is measured by duration, size of the hail itself, and geographic extent. All of these factors are directly related to the weather phenomena that create the hail that occurs as part of thunderstorms. The National Weather Service (NWS) and the Tornado and Storm Research Organization (TORRO) have developed tables measuring the intensity of hail. Table X below combines the two intensity scales.

Table 4-27
Hail Intensity Scales
(Source: NWS, TORRO – Tornado and Storm Research Organization)

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
HO	Hard Hail	Up to 0.33	Pea	No Damage
H1	Potentially Damaging	0.33 - 0.66	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60 -0.80	Dime or Grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80 – 1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2 – 1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6 – 2.0	Silver Dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0 – 2.4	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very Destructive	2.4 – 3.0	Tennis Ball	Severe roof damage, risk of serious injuries
H8	Very Destructive	3.0 – 3.5	Baseball to Orange	Severe damage to aircraft body
H9	Super Destructive	3.5 – 4.0	Grapefruit	Extensive structure damage. Risk of severe or even fatal injuries to persons caught in open
H10	Super Destructive	4+	Softball and up	Extensive structure damage. Risk of severe or event fatal injuries to persons caught in open

The planning area has a relatively low potential for significant hail events, based on previous records. Hailstorms affect areas within Union County equally and uniformly. Although the severity or extent of hailstorms is potentially as much as H-10 (super Destructive) in the table above, events in the middle of

the range are much more likely. Extreme hail events are usually localized, but the entire planning area can be considered about at equal risk. There is fairly high potential every year for smaller events lower on the scale above, with damage to exposed automobiles, trees and plants being the main kinds of effects.

Impact on Life and Property (Vulnerabilities and Risk)

There are no known instances of injuries or death from hail events in Union County. The SHELDUS database indicates property damage in Union County from hail events totaled $9,732 (none reported from NCDC). Presumably there are some damages, but most of these are likely addressed by citizens or insurance companies, and therefore there is no readily available open source record of damages.

All of Union County is subject to occasional hail. With rare exceptions there are no significant or long-term damages fairly often and has the potential to affect nearly anyone in the jurisdiction. The County-wide potential impact of the hail hazard is very small, however, as evidenced by historical records, which show little or no specific damage from hail. This is typical of such relatively minor hazards. In the case of hail, most losses are expected to be damage to vehicles. In such cases, automobile owners often make insurance claims, but such data sets are proprietary and not available for use in this plan. There are no significant vulnerabilities to structures from the hail hazard, and no expected recurrent losses, except occasional and relatively light damage to vehicles.

Occurrences of the Hail Hazard

The National Climatic Data Center reported 18 hail events in Union County from the period 1950 through 2013. Hailstone sizes from the 18 events ranged in diameter from 0.75 inches to 1.75 inches. The SHELDUS database was also queried for the same time period and identified six additional events, all prior to 1980. Table 4-X summarizes all Union County hail events between 1950 and 2013.

Table 4-28
Hail Events, Union County, 1950–2013
(Source: NOAA/NCDC)

Location	Date	Magnitude (inches)	Injuries	Deaths	Property Damage	Source
Union Co.	07/21/1962	N/A	0	0	$238	SHELDUS
Union Co.	07/23/1962	N/A	0	0	$2,381	SHELDUS
Union Co.	07/10/1967	N/A	0	0	$238	SHELDUS
Union Co.	11/04/1970	N/A	0	0	$625	SHELDUS
Union Co.	05/14/1975	N/A	0	0	$6,250	SHELDUS
Union Co.	06/05/1979	N/A	0	0	$0	SHELDUS
Union Co.	07/26/1987	1.00	0	0	$0	NCDC
Elizabeth	05/29/1995	0.75	0	0	$0	NCDC
Plainfield	07/11/1995	1.50	0	0	$0	NCDC
Garwood	08/05/1997	1.00	0	0	$0	NCDC
Union Co.	08/05/1997	0.75	0	0	$0	NCDC

Location	Date	Magnitude (inches)	Injuries	Deaths	Property Damage	Source
Mountainside	09/07/1998	1.25	0	0	$0	NCDC
Elizabeth	06/11/2001	0.75	0	0	$0	NCDC
Elizabeth	04/19/2002	0.88	0	0	$0	NCDC
Elizabeth	06/19/2002	1.75	0	0	$0	NCDC
Clark	06/19/2002	1.00	0	0	$0	NCDC
New Providence	03/21/2003	1.75	0	0	$0	NCDC
New Providence	07/22/2003	1.00	0	0	$0	NCDC
Plainfield	07/14/2004	1.00	0	0	$0	NCDC
Elizabeth	07/14/2004	0.75	0	0	$0	NCDC
Springfield	07/18/2006	1.75	0	0	$0	NCDC
Fanwood	07/21/2008	0.75	0	0	$0	NCDC
Fanwood	07/23/2008	0.88	0	0	$0	NCDC
Hillside	08/11/2008	0.75	0	0	$0	NCDC
Scotch Plains	06/26/2009	0.88	0	0	$0	NCDC
Plainfield	06/26/2009	0.88	0	0	$0	NCDC
Summit	07/26/2009	0.88	0	0	$0	NCDC
Springfield	07/26/2009	1.00	0	0	$0	NCDC
Fanwood	10/11/2010	0.88	0	0	$0	NCDC
Total	**----**	**----**	**0**	**0**	**$9,732**	

With a total of 24 previous hail events in Union County between 1950 and 2013, the County experiences a hail event on average about once every 2.5 years. With one event every 2.5 years, there is roughly a 38% annual probability of a future hail event occurring in Union County. Based on historical records from the NCDC database, the future probability of hail events in Union County is relatively high.

4.3.9 Hazardous Materials Release–Fixed Site

Description of the Hazardous Material Release–Fixed Site Hazard

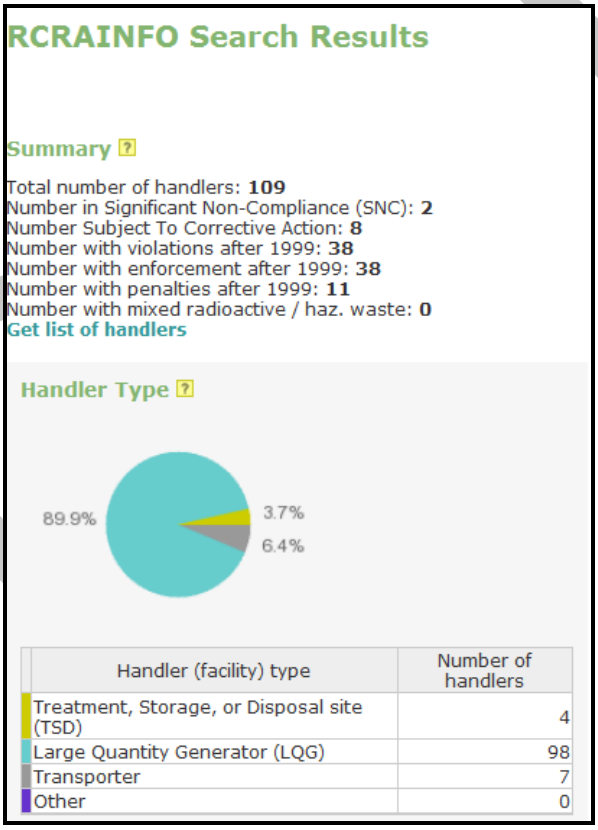
Hazardous materials come in the form of explosives, flammable and combustible substances, toxic releases, and waste material. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section focuses on those hazardous materials that occur at facilities, which are known as fixed site. The next section (5.3.10) addresses hazardous materials as they relate to transportation routes (off-site). See Appendix A for a more detailed description of the hazardous materials – fixed site hazard.

Location of the Hazardous Material Release-Fixed Site Hazard

Although there is no single, comprehensive source of open-source information about hazardous materials in the state, there are sources that can be queried, and the results combined into a common summary. These sources include the US Environmental Protection Agency's Toxic Release Inventory database, and the Right-to-Know (RTK) network (which also acts as a switchboard for access to several other related databases.

In 2007 the BRS was replaced with the RCRAInfo. The new reporting system no longer reports biennially, but cumulative. Figure 4-X summarizes the query results for Union County. The results show roughly 90% of the hazardous waste material handlers are large quantity generators..

Figure 4-X
Union County Resource Conservation and Recovery Act (RCRAInfo)
Hazardous Waste Summary
(Source: The Right-to-know Network (RTKnet.org), RCRAInfo Query)



RCRAINFO Search Results

Summary

Total number of handlers: **109**
Number in Significant Non-Compliance (SNC): **2**
Number Subject To Corrective Action: **8**
Number with violations after 1999: **38**
Number with enforcement after 1999: **38**
Number with penalties after 1999: **11**
Number with mixed radioactive / haz. waste: **0**
Get list of handlers

Handler Type

Handler (facility) type	Number of handlers
Treatment, Storage, or Disposal site (TSD)	4
Large Quantity Generator (LQG)	98
Transporter	7
Other	0

Severity (or Extent) of the Hazardous Material Release–Fixed Site Hazard

The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment.

Threat to Human Safety and Welfare

- **Poisoning of water or food sources and/or supply**
- **Presence of toxic fumes or explosive conditions**
- **Damage to personal property**
- **Need for the evacuation of people**
- **Interference with public or commercial transportation**

Threat to the environment

Injury or loss of animals or plants or habitats that are of economic or ecological importance such as; commercial, recreation, or subsistence fisheries (marine plants, crustaceans, shellfish, aquaculture facilities) or livestock; seal haul outs; and marine bird rookeries

- **Impact to recreational areas such as public beaches**
- **Impact to ecological reserves, forests, parks, archaeological and cultural sites**

One method of classifying incident severity is by ranking from 1 to 4, with a "Level 1" incident considered minor; a "Level 2," moderate; a "Level 3," major; and a "Level 4" severe. Thresholds depend on the type of incident and hazards. Incidents categorized as minor or moderate are often associated with known hazardous materials and limited in the area impacted. Incidents categorized as major or severe are typically associated with a fire, explosion, or toxic cloud that impacts a large area, possibly disrupting essential services. Events of this magnitude present an immediate danger to the public, potentially causing deaths and injuries and may require the evacuation of large numbers of the population. Emergency response by local agencies will require assistance from outside resources to adequately respond to the incident.

In Union County the severity of hazardous material releases can be ranked by several methods. The EPA Toxic Release Inventory database within the Right-to-Know Network described above ranks the top cities for on-site releases, the top chemicals released, and the top companies for releases. The results from the TRI database show that the City of Linden released just over 93.2 million pounds between 1987 and 2011, followed by the City of Rahway with slightly more than 9.7 million pounds. The top chemical released during this same time period was hydrochloric acid.

Impact on Life and Property (Vulnerabilities and Risk)

Hazardous materials incidents (fixed sites) refer to uncontrollable releases of hazardous materials at a facility, which poses a risk to the health, safety, property, and the environment (MSP/EMD). The most

well-known example of a large-scale fixed-site hazardous materials incident is that which occurred at the Union Carbide plant in Bhopal, India in 1984. This incident caused 2,500 deaths and injuries to many others. Although incidents of this scale are fairly rare, smaller-scale incidents - those requiring a response and evacuation or other protective measures - are relatively common.

The Office of Hazardous Materials Safety (USDOT) tracks hazardous materials incidents by state. New Jersey has had 65 major incidents since 2001, with 10 injuries reported and damages totaling $5,739,540, an average of $819,934 per year. Based on the intensity of mixed land use in Union County (including heavy industrial and commercial uses), the likelihood that hazardous material incidents will continue to occur is high within the planning area, particularly in the eastern areas of Linden and Rahway, where there is a great deal of materials and infrastructure related to the chemical industry.

While there is potential for all residents of Union County to be adversely affected by hazardous materials releases, the majority of the risk is for those who are near potential release sites when events occur. The near- and long-term implications of exposure to hazardous materials depend on the type, concentration and amount of material to which someone is exposed. Other risk factors include the duration of the exposure and the time required to receive treatment.

There are significant and potential long-term damages associated with this hazard, although these must be characterized on a case-by-case basis, depending on a range of factors. This hazard was prioritized by the HMPSC as high, because the County has numerous sites where unintentional releases are at least possible. There are no significant vulnerabilities to structures from hazardous materials releases.

Occurrences of the Hazardous Material Release–Fixed Site Hazard

To identify past occurrences for fixed sites in Union County the Toxic Release Inventory Explorer database was queried from the EPA's website. Beginning in 1986, as part of the Emergency Planning and Community Right-to-know Act (EPCRA), certain industries as well as federal facilities have been required to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires the EPA and the States to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public as part of the Toxics Release Inventory.[47] In 1990 Congress passed the Pollution Prevention Act that required that additional data on waste management and source reduction activities be reported under the TRI program.

For Union County, the TRI database was queried for the years 2000 through 2012, the most recent year available. The results of the query are summarized below in Table 4-X. The total on site and off-site disposal or releases is reported in pounds, and includes facilities for all industries and chemicals in Union County. The table results show the number of facilities reported in the TRI database for Union County has declined from a high of 54 in 2001 to 33 in 2011. The quantity of the combined on and off-

[47] EPA – Toxic Release Inventory Program

site disposal and releases has also declined from a high of just over 3.9 million pounds in 2000 to slightly more than 2.7 million pounds in 2009. Although the total pounds released have varied by year, the overall trend has been downward over the past 12 years.

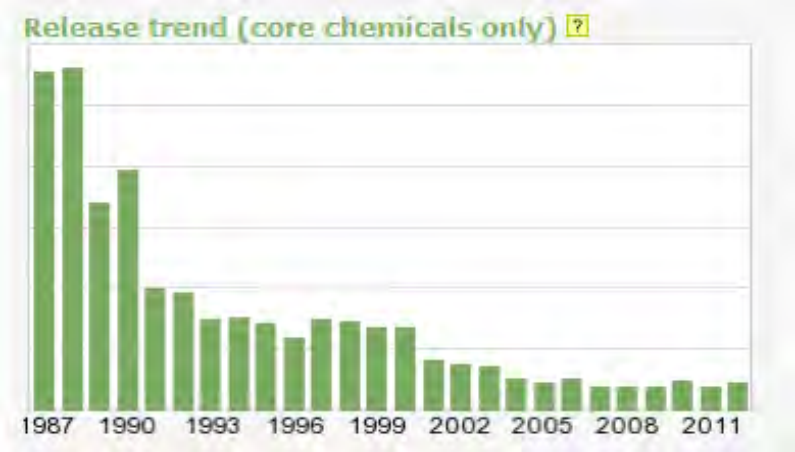
Table 4-29
Union County Toxic Release Inventory: 2000 – 2012
Summary of On-site and Off-site Reported Disposed of or Otherwise Released (in pounds)
(Source: US EPA – Toxic Release Inventory Database, March, 2014)

Year	# of Facilities Reported (TRI Explorer)	Total On-site Disposal or Other Releases (Pounds)	Total Off-site Disposal or Other Releases (Pounds)	Total On- and Off-site Disposal or Other Releases (Pounds)
2000	50	3,859,715	92,644	3,952,359
2001	54	3,158,757	466,375	3,625,132
2002	50	2,653,187	114,437	2,767,624
2003	48	2,646,641	214,150	2,860,791
2004	47	2,513,717	185,695	2,699,413
2005	45	2,610,409	128,100	2,738,508
2006	44	2,860,333	163,891	3,024,224
2007	41	3,298,301	98,671	3,396,972
2008	41	3,678,326	163,612	3,841,938
2009	38	2,521,135	214,361	2,735,496
2010	35	2,936,244	235,926	3,172,170
2011	33	3,151,853	166,351	3,318,204
2012	34	2,711,474	183,664	2,895,137
Total	**-----**	**38,600,092**	**2,427,877**	**41,027,968**

The details for each year can be found by querying the TRI Explorer database within the EPA's website. To query the database, navigate to the EPA -TRI home page located at http://www.epa.gov/tri and select "Get TRI Data" from the menu on the left side of the page. Then select the link "TRI Explorer", and "Facility" from the reports menu.

The reduction in releases for Union County can also be show graphically by displaying the TRI trend for a list of core chemicals during the period 1987 to 2012. For standard comparison purposes, the core chemical list excludes chemicals that have been added or removed within the reporting period. The core chemical restriction is applied to all RTK bar charts that display yearly trends. Figure 4-X illustrates that over the past 25 years the pounds released in Union County has dramatically been reduced from the peak in 1987 and 1988. The downward trend continued in the 1990's and 2000's, recently remaining fairly consistent for years 2005 - 2011.

Figure 4-X
Union County Toxic Release Inventory Trend (Core Chemicals): 1987 – 2011
(Source: Right-to-Know Network – Toxic Release Inventory)



4.3.10 Hazardous Materials Release - Transportation

Description of the Hazardous Material Release- Transportation Hazard

As described in Section 4.3.9, hazardous materials come in the form of explosives, flammable and combustible substances, toxic releases and waste material. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section deals those hazardous materials as they relate to transportation routes (off-site).

Hazardous materials release-transportation incidents refer to uncontrollable releases of hazardous materials during transport, which pose a risk to the health, safety, property, and the environment. Transportation related hazardous material incidents are most common along major U.S. highways (See Table X below), but can also occur through other modes of transportation including rail, water transport (shipping and ferries), air, and pipelines. Data collected by the U.S. Department of Transportation (DOT) shows that transportation related hazardous materials incidents are much more likely to occur on highways than through any other mode of transport. See Appendix A for a more detailed description of the hazardous materials – fixed site hazard.

Location of the Hazardous Material Release-Transportation Hazard

In Union County, hazardous materials are transported along state and county highways, railways, utility transmission pipelines and vessels traveling navigable waterways. In addition, chemicals can also be transported throughout Union County and the region by air transportation. As shown in the list of past

occurrences, the county is most vulnerable from accidents related to surface transportation mainly along Interstate 95 (NJ Turnpike).

Severity (Extent) of the Hazardous Material Release-Transportation Hazard

Similar to the fixed site hazardous material releases, the severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Releases are generally measured by volume and specific characteristics of the material in question.

Threat to Human Safety and Welfare

- **Poisoning of water or food sources and/or supply**
- **Presence of toxic fumes or explosive conditions**
- **Damage to personal property**
- **Need for the evacuation of people**
- **Interference with public or commercial transportation**

Threat to the Environment

Injury or loss of animals or plants or habitats that are of economic or ecological importance such as; commercial, recreation or subsistence fisheries (marine plants, crustaceans, shellfish, aquaculture facilities) or livestock; seal haul outs; and marine bird rookeries

- **Impact to recreational areas such as public beaches**
- **Impact to ecological reserves, forests, parks, archaeological and cultural sites**

One method of classifying incident severity is by ranking from 1 to 4, with a "Level 1" incident considered minor; a "Level 2", moderate; a "Level 3," major; and a "Level 4" severe. Thresholds depend on the sort of incident and hazards. Incidents categorized as minor or moderate are often associated with known hazardous materials and limited in the area impacted. Incidents categorized as major or severe are typically associated with a fire, explosion, or toxic cloud that impacts a large area, possibly disrupting essential services. Events of this magnitude present an immediate danger to the public, potentially causing deaths and injuries and may require the evacuation of large numbers of the population. Emergency response by local agencies will require assistance from outside resources to adequately respond to the incident.

Impact on Life and Property (Vulnerabilities and Risk)

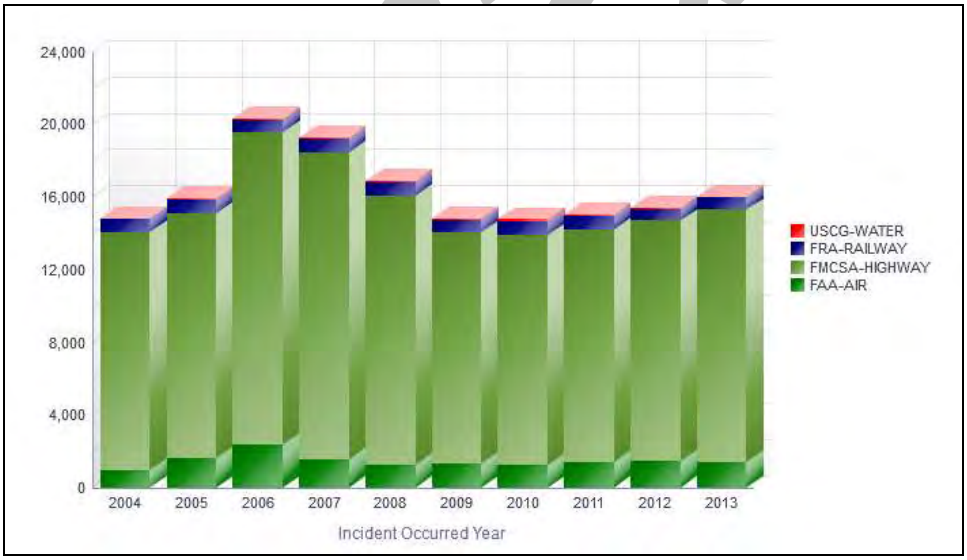
Table 4-X shows the reported hazardous materials incidents nationwide by category between 2004 and 2013. Within the graphic, the highway transportation related incidents are shaded light green. This data shows that the vast majority of hazardous materials incidents relate to highway born transport. The data also visually demonstrates that the number of hazardous materials incidents peaked during years 2006 and 2007, gradually increasing from 2009 to 2013. As northeastern New Jersey, and Union

County, continue to grow and maintain their importance as part of a transportation corridor, the likelihood for transportation-related hazardous materials releases will continue to grow.

While there is potential for all residents of Union County to be adversely affected by hazardous materials releases, the majority of the risk is for those who are near potential release sites when events occur. The near- and long-term implications of exposure to hazardous materials depend on the type, concentration and amount of material to which someone is exposed. Other risk factors include the duration of the exposure and the time required to receive treatment.

There are significant and potential long-term damages associated with this hazard, although these must be characterized on a case-by-case basis, depending on a range of factors. This hazard was prioritized by the HMPSC as high, because the County has numerous sites where unintentional releases are at least possible. There are no significant vulnerabilities to structures from hazardous materials releases.

Figure 4-X
Reported Hazardous Materials Incidents by Category 2004-2013
(Source: Office of Hazardous Materials Safety)



Occurrences of the Hazardous Material Release–Transportation Hazard

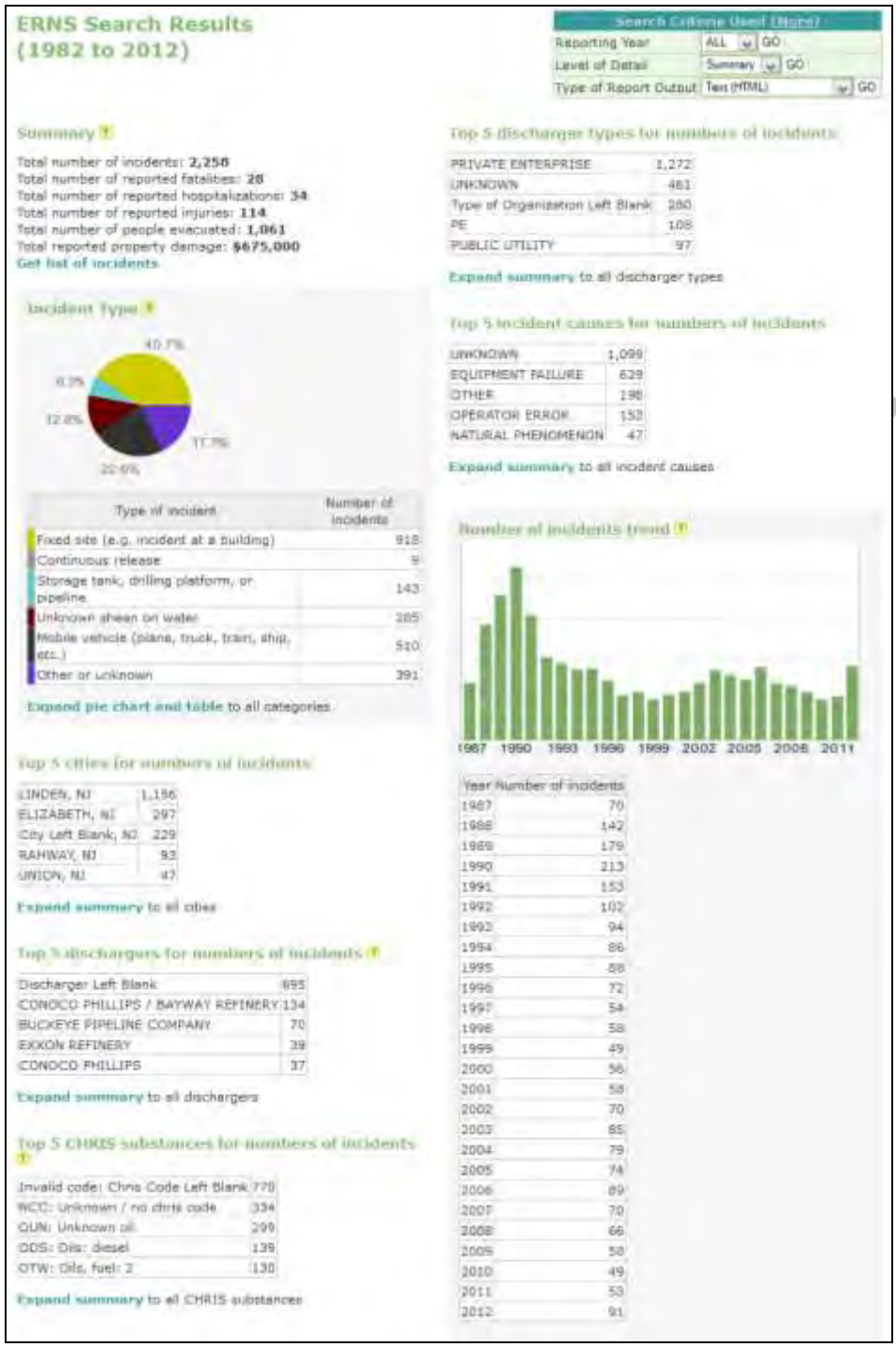
To identify past hazardous material transportation incidents for Union County, the EPA Emergency Response Notification System (ERNS) database was queried from the Right-to-Know website. The ERNS database is a database of incidents (spills and accidents) reported to the National Response Center. The National Response Center is operated by the U.S. Coast Guard, and has become the central point of

contact used for the reporting of many different kinds of incidents involving hazardous materials.[48] The database includes 12 incident types including vessels (ships), railroads, pipelines, and surface transportation.

As part of the Plan update the database was queried between 1982 and 2012 the range of years available in the database. The query results indicated there have been 2,258 hazardous material incidents, 114 injuries, and 28 fatalities over this 20 year period. The total reported property damage during this time period was $675,000. The results of the query are shown in Figure X.

[48] Right-to-know Network – Emergency Response Notification System database

Table 4-X
Union County Hazardous Material Transportation Incident Summary: 1982 - 2012
(Source: The Right-to-know Network (RTKnet.org)–Emergency Response Notification System)



ERNS Search Results (1982 to 2012)

Search Criteria Used (Help)

Reporting Year	ALL	GO
Level of Detail	Summary	GO
Type of Report Output	Text (HTML)	GO

Summary

Total number of incidents: **2,258**
Total number of reported fatalities: **28**
Total number of reported hospitalizations: **34**
Total number of reported injuries: **114**
Total number of people evacuated: **1,061**
Total reported property damage: **$675,000**
Get list of incidents

Top 5 discharger types for numbers of incidents

PRIVATE ENTERPRISE	1,272
UNKNOWN	461
Type of Organization Left Blank	280
PE	108
PUBLIC UTILITY	97

Expand summary to all discharger types

Incident Type

Type of incident	Number of incidents
Fixed site (e.g. incident at a building)	918
Continuous release	9
Storage tank, drilling platform, or pipeline	143
Unknown sheen on water	285
Mobile vehicle (plane, truck, train, ship, etc.)	510
Other or unknown	391

Expand pie chart and table to all categories

Top 5 incident causes for numbers of incidents

UNKNOWN	1,099
EQUIPMENT FAILURE	629
OTHER	198
OPERATOR ERROR	152
NATURAL PHENOMENON	47

Expand summary to all incident causes

Number of incidents trend

Year	Number of incidents
1987	70
1988	142
1989	179
1990	213
1991	153
1992	102
1993	94
1994	86
1995	88
1996	72
1997	54
1998	58
1999	49
2000	56
2001	58
2002	70
2003	85
2004	79
2005	74
2006	89
2007	70
2008	66
2009	58
2010	49
2011	53
2012	91

Top 5 cities for numbers of incidents

LINDEN, NJ	1,156
ELIZABETH, NJ	297
City Left Blank, NJ	229
RAHWAY, NJ	93
UNION, NJ	47

Expand summary to all cities

Top 5 dischargers for numbers of incidents

Discharger Left Blank	695
CONOCO PHILLIPS / BAYWAY REFINERY	134
BUCKEYE PIPELINE COMPANY	70
EXXON REFINERY	39
CONOCO PHILLIPS	37

Expand summary to all dischargers

Top 5 CHRIS substances for numbers of incidents

Invalid code: Chris Code Left Blank	770
NCC: Unknown / no chris code	334
QUN: Unknown oil	299
ODS: Oils: diesel	139
OTW: Oils, fuel: 2	130

Expand summary to all CHRIS substances

As shown in subsections 4-X and 4-X (fixed-site and transportation hazardous materials, respectively) the City of Linden consistently appears as one of the communities with the highest amounts of hazardous materials generated and handled. The jurisdiction is also the site of numerous transportation-related hazmat incidents. As part of the 2010 Plan, the original mitigation planning team also reviewed other records provided by the City of Linden and Union County as part of the planning process, including a database provided by the County (in spreadsheet format) that listed fixed-site hazmat incidents in the County in 2004 and 2005. Again in this case, the City of Linden had more incidents reported in the database than other jurisdictions. Presumably the numbers incidents correlate with the amount of hazardous materials in the county (and by extension with the amounts of materials being transported), there may be a need for additional and more rigorous study of the nature and location of incidents. The City of Linden and/or the County may wish to consider developing a more robust database to track additional details and metrics related to hazmat release incidents, with the purpose of (1) identifying any patterns that may exist [and that are not evident from reviewing existing information and (2) developing plans or specific mitigation actions to reduce risks in the future.

Of the 2,258 incidents identified in Table X above, 1,340 incidents were related to transportation during this time period. With a total of 1,340 past hazardous material (transportation) incidents in Union County between 1982 and 2012, the County experiences a hazardous material (transportation) event on average roughly 67 events per year. With 67 events per year, there is a 100% annual probability of a future transportation related hazardous material events occurring somewhere in Union County.

4.3.11 High Wind–Straight-Line Winds

(Includes Hurricane/Nor'easter/Tropical Storm/Thunderstorms)

Description of the Straight-Line Winds Hazard

For the purpose of this hazard mitigation plan, straight-line winds are defined as all winds that are not related to tornadoes. This includes winds from hurricanes, nor'easters, tropical storms, and thunderstorms. The first three hazards noted here can all be categorized as tropical cyclones, and are defined as originating over tropical/subtropical waters and having an organized, cyclonic surface wind circulation. As discussed elsewhere in this plan (in the present Section 5, and in Appendix A), hurricanes are defined as warm-core tropical cyclones with wind speeds of at exceeding 74 mph. Nor'easters are cyclonic storms that typically track up the east coast of the U.S., (often in winter) and often are first felt as a northeast wind. Tropical storms are warm-core tropical cyclones with sustained winds of at least 39 mph (but less than hurricane force winds). Thunderstorms are local storms produced by cumulonimbus clouds, and always accompanied by lightning and thunder. Notably, the first three of these hazards (in particular hurricanes and tropical storms) are measured and categorized primarily by their wind speed. This is also the case with thunderstorms, although as with the other hazards, their severity is also measured by rainfall. These four wind hazards are differentiated from tornadoes in that they are characterized by winds that tend to be in one general direction, rather than by highly localized, high-intensity cyclonic wind flows, as is the case with tornadoes (although in many cases the other

events spawn tornadoes). See Appendix A for a more detailed discussion of high wind–straight line winds.

Location of the Straight-Line Winds Hazard

The entire planning area is subject to the wind effects from hurricanes, nor'easters, tropical storms, other severe events. The hurricane and tropical storm risk in the United States extends along the entire east coast from Maine to Florida, the Gulf Coast (including Florida, Alabama, Louisiana, and Texas), and Hawaii. The northeast U.S., including New Jersey, is at a moderate risk based on historical storm tracks and the number of hurricanes that have made landfall along the Atlantic coastline. Figure 4-X shows how the frequency and strength of extreme windstorms vary across the United States. The map is based on a combination of all past occurrences and shows that New Jersey falls within the hurricane susceptible region (shown as cross-hatching). New Jersey is also within wind Zone II, where wind speeds can reach as high as 160 mph.[49]

Figure 4-X
Wind Zones in the United States
(Source: FEMA)

[49] FEMA, Wind Zone map

The high wind risk from nor'easters extends along the entire east coast. Nor'easters typically occur during the winter months and wind speeds can potentially reach hurricane force. The entire planning area is equally at risk from severe thunderstorms.

Severity (Extent) of the Straight-Line Winds Hazard

The severity of the wind hazard is measured primarily by velocity, although effects are clearly exacerbated by duration and the presence of windborne debris. As discussed in Section , New Jersey is not particularly prone to high wind hazards, but occasionally tropical storms or thunderstorms are severe enough to cause moderate damage in the area. The eastern portion of Union County is potentially more vulnerable from the high winds associated with hurricanes, nor'easters, and tropical storms, which often follow along the coast. The extent of a hurricane is categorized based on the Saffir-Simpson Hurricane Scale. The Saffir-Simpson Hurricane Wind Scale ranges between 1-to-5 based on a hurricane's sustained wind speed. See Appendix A, General Hazard Descriptions, for the Saffir-Simpson Scale and additional discussion about the extent of hurricanes.

Impact on Life and Property (Vulnerabilities and Risk)

The NCDC database indicates that Union County has experienced 459 thunderstorm and high wind events between 1950 and 2012. During this period there were 13 deaths, 36 injuries, and $3.9 billion in

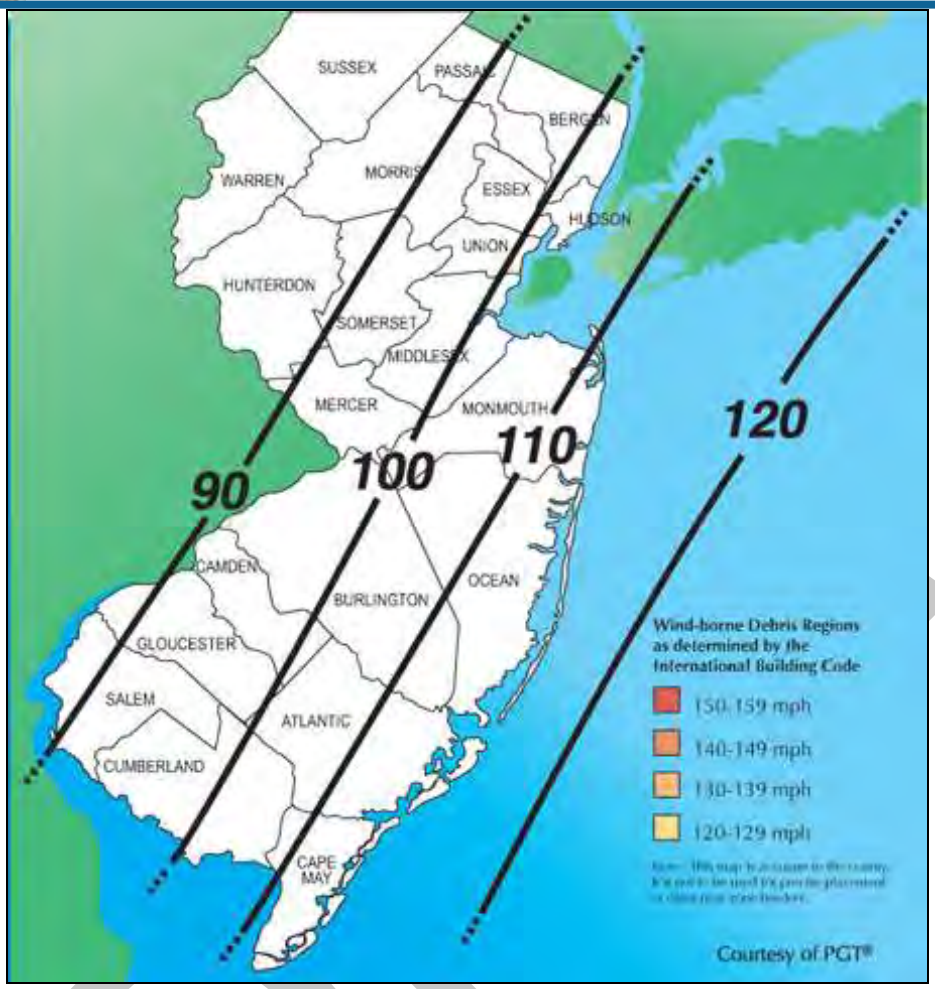
property damage. With recent changes to the structure of the NCDC database, reporting results for Union County now include other areas ("zones") in New Jersey. As a result, the majority of the reported data for Union appears to include other areas of New Jersey. The information in the NCDC database reflects a significant part of the costs of recovery from strong winds. However, there are also very significant costs associated with interrupted business, lost wages, lost tax base, etc. that are very difficult to quantify, but are nevertheless important metrics for determining the severity of the risk.

To protect life and property from wind events, all counties within the State of New Jersey, including Union County, are required to comply with the design wind loads developed by the International Building Code (IBC) and the International Residential Code (IRC). The building code administered within the incorporated areas of Union County require all new construction to be designed and constructed to 100 mph wind loads.[50] Figure 4-X identifies the minimum design wind speeds for New Jersey.

All residents of Union County are subject to the effects of high wind. As noted elsewhere, these effects include direct impacts on specific structures and (perhaps more significantly) power interruptions. This hazard was prioritized by the HMPSC as high, mostly because the hazard occurs regularly and affects nearly everyone in the County, particularly when there are significant hazard events like hurricanes or nor'easters, which have often resulted in long power outages related to trees falling on power lines. Potential impacts are widespread, though generally not life-threatening. Many structures in the County are vulnerable to high winds, but this is predominately related to trees and tree limbs falling on buildings, rather than direct wind damage to them. Because such losses are general borne by either property owners or insurance companies, it is generally not possible to obtain any information about wind damage to structures, except publicly owned-ones.

Figure 4-X
American Society of Civil Engineers (ASCE) New Jersey Wind Zone Map [
(Source: ASCE Minimum Design Loads for Buildings and other Structures)

[50] NJ Department of Community Affairs - Division of Codes and Standards: Bulletin No. 3-4 – Wind Speed Map



Occurrences of the Straight Line Winds Hazard

Between 1950 and 2013, there have been numerous hurricanes, nor'easters, tropical storms, and severe storms that have impacted all or part of Union County. The NCDC database identifies that Union County has been impacted by one tropical storm event and no hurricanes between 1950 and 2013. The event listed in the database was Tropical Storm Isabel, which impacted Union County on September 18 and 19, 2003. Tropical Storm Isabel is summarized as part of the high wind events listed below. In addition to the NCDC database, NOAA's Historic Hurricane Tracks database was also queried to identify past hurricane events with tracks within a 65 mile radius of Union County between 1950 and 2013. The query results identified 12 hurricanes or tropical storms that impacted Union County during this time period. Most of these events were downgraded to a tropical depression or less by the time they reached New Jersey.

Figure 4-X shows the 12 hurricanes and tropical storms that have impacted northern New Jersey and Union County from 1950 to 2013. The map was developed using NOAA's Historic Hurricane Tracks database with the track of each storm color coded with the hurricanes' intensity (Categories 1 – 5) and

tropical storm (green) as it traveled up the coastline.

Figure 4-X
Hurricanes and Tropical Storms Within a 65 Mile Radius of Union County, 1950 - 2013
(Source: NOAA Coastal Service Center – Historic Hurricane Tracks database)

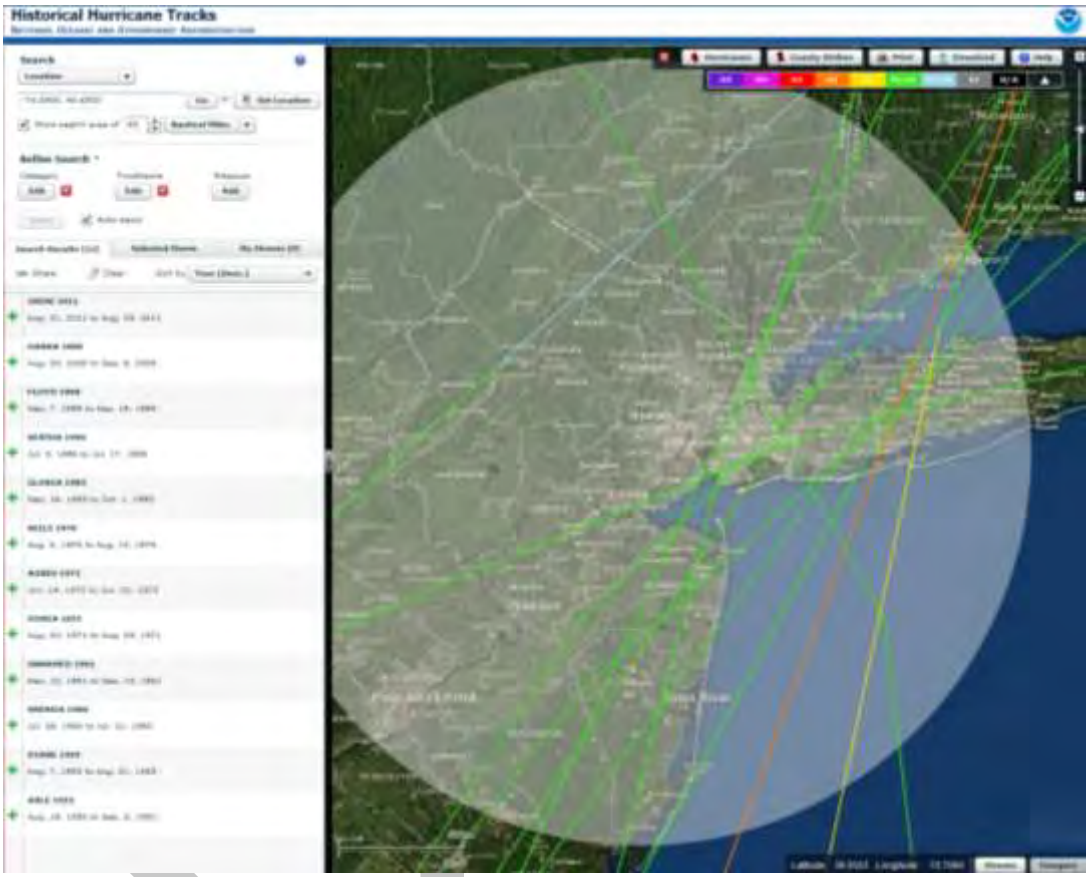


Table 4-X summarizes the 12 hurricanes and tropical storms that have impacted Union County over the last 63 years. Note that data from the Hurricane and Tropical Storm tracker did not include Hurricane Sandy in October, 2012. However, this event is discussed in detail later in this subsection.

Table 4-X
Hurricanes and Tropical Storms Impacting Union County, 1950 - 2013
(Source: National Hurricane Center – Hurricane and Tropical Storm Tracker)

Event Date	Hurricane/TS	Storm Name	Category (at Landfall)	Maximum Winds at Closest Recorded Point Near Union Co. (knots)
August 18, 1952	Tropical Storm	Able	N/A	30
August 7, 1955	Tropical Storm	Diane	N/A	40
July 28, 1960	Tropical Storm	Brenda	N/A	45
September 12, 1961	Tropical Storm	Unnamed	N/A	35
August 20, 1971	Tropical Storm	Doria	N/A	45
June 14, 1972	Tropical Storm	Agnes	N/A	55
August 6, 1976	Hurricane	Belle	1	60
September 16, 1985	Hurricane	Gloria	2	85
July 5, 1996	Tropical Storm	Bertha	N/A	60
September 7, 1999	Tropical Storm	Floyd	N/A	50
August 28, 2008	Tropical Storm	Hanna	N/A	45
August 21, 2011	Tropical Storm	Irene	N/A	55

Thunderstorms

As mentioned in the Impact on Life and Property section, the NDCC indicates there have been 459 thunderstorm events in the region. Of this total, seven events in Union County have exceeded 69 mph since 1950. These seven events are summarized in Table 4-X below. The table also includes three recent high wind events identified from the SHELDUS database. The wind speeds were unknown for these events.

Table 4-X
Significant High Wind Events (Excluding Tornado Winds) Union County, 1950–2013
(Source: NOAA/NCDC, SHELDUS)

Location	Date	Hazard Type	Magnitude	Injuries	Deaths	Property Damage	Source

Location	Date	Hazard Type	Magnitude	Injuries	Deaths	Property Damage	Source
County-wide	11/20/1989	Severe Thunderstorm Wind	61	0	0	$0	NCDC
County-wide	7/18/1997	Severe Thunderstorm Wind	63	0	0	$0	NCDC
Linden, City of	9/7/1998	Severe Thunderstorm Wind	63	0	0	$3,000,000	NCDC
Berkeley Heights, Township of	5/18/2000	Severe Thunderstorm Wind	75	0	0	$0	NCDC
Kenilworth, Borough of	4/19/2002	Severe Thunderstorm Wind	70	0	0	$0	NCDC
Springfield, Township of	7/22/2003	Severe Thunderstorm Wind	60	0	0	$0	NCDC
County-wide	3/8/2008	High Wind	60	0	0	$0	NCDC
County-wide	3/13/2010	High Wind	unknown	0	0	$50,000	SHELDUS
County-wide	2/19/2011	High Wind	unknown	0	0	$25,000	SHELDUS
County-wide	8/8/2011	Severe Thunderstorm Wind	unknown	0	0	$40,000	SHELDUS
County-wide	10/29/2012	High Wind	unknown	0	0	$180,000	SHELDUS
Total	----	----	----	**0**	**0**	**$3,295,000**	

The NWS, NOAA, and the NCDC do not specifically track nor'easter events. However, the events listed for Union County within the Ocean and Lake Surf category of the NCDC database along with other open data sources indicates there have been numerous nor'easters in the past that have impacted the planning area with high winds. Some of the larger nor'easter events occurred in years 1993, 1996, 2006, 2007 and 2009. As mentioned above, there have been 459 thunderstorm and high wind events between 1950 and 2013 that have impacted northern New Jersey and Union County.

Several of the hurricane, tropical storm, and nor'easter events are highlighted below.

September 27, 1985–Hurricane Gloria. After brushing the outer banks of North Carolina the storm moved northward just off the Atlantic coast until making landfall as a Category 2 Hurricane near western Long Island, New York. Along the coastline of northern New Jersey sustained winds were approximately 80 mph with gusts over 100 mph. Hurricane Gloria caused one of the largest single power outages at the time, including about 230,000 customers in New Jersey.

October 28, 1991 (Perfect Storm). The 1991 Halloween Nor'Easter, also known as the Perfect Storm, caused strong waves of up to 30 feet (nine meters) in height. High tides along the shore were only

surpassed by the 1944 hurricane, while significant bay flooding occurred. Strong waves and persistent intense winds cause extreme beach erosion. In all, damage estimates totaled $90 million (equivalent to $142 million in 2008 dollars). The event resulted in no deaths within the State of New Jersey.

March 16, 1993 (Storm of the Century). One of the most intense nor'easters to ever effect the United States. The "Storm of the Century" label was given to the event due to the record low pressure, wind speeds, temperature, and snowfall. Fallen trees from high winds left 3 million customers without electrical power.[51] Wind gusts of over 70 mph were reported at New York City's LaGuardia airport.

October 18, 1996 (Nor'easter). A 5-day nor'easter that lasted from October 18– 23. Record rainfall, flooding, and high winds effected parts of New Jersey from Morris County to Camden County to Hunterdon County.

September 18, 2003–Tropical Storm Isabel. Isabel made landfall as a hurricane near Drum Inlet, North Carolina on the September 18 and weakened as it tracked farther inland. Winds gusted were recorded up to 62 mph in New Jersey. In Union County, high winds downed numerous trees and electrical power lines, which resulted in the closure of major streets and schools. It was one of the worst power outages on record for area utilities. Jersey Central Power and Light reported that 220,000 of its customers lost power while Connectiv Energy reported about 162,000 of its customers lost power.

February 12, 2006 (Nor'easter). A Nor'easter that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion.

November 12-13, 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 from November 12th through the 14th. Initial damage estimates were placed at $180 million. By several measures this was one of the worst Nor'Easters to affect New Jersey since 1991.

August 31, 2011 (DR-4021) – Hurricane Irene. Hurricane Irene made landfall along the Outer Banks of North Carolina on August 27, 2011 as a Category 1 hurricane. The storm re-emerged over the Atlantic and made a second landfall as a tropical storm on August 28th in the Little Egg Inlet in southeastern New Jersey. Union County experienced tropical storm force winds as a result of Irene. High winds caused widespread power outages that lasted for up to two weeks in areas that were subsequently impacted by the remnant moisture from Tropical Storm Lee several weeks later in September.[52] An estimated 30,000 Union County residents were left without power.[53]

November 7, 2012 (Nor'easter). A strong Nor'Easter caused high winds along the coast, heavy snow in east central New Jersey and ten foot waves along the ocean front and minor tidal flooding along the ocean front. The event caused setbacks with restoration efforts near and along coastal areas caused by

[51] NOAA/NCDC database
[52] NOAA/NCDC Tropical Storms – Union County, New Jersey, Event description.
[53] Union County, NJ website, News and Events, Union Continues Response in Aftermath of Hurricane Irene.

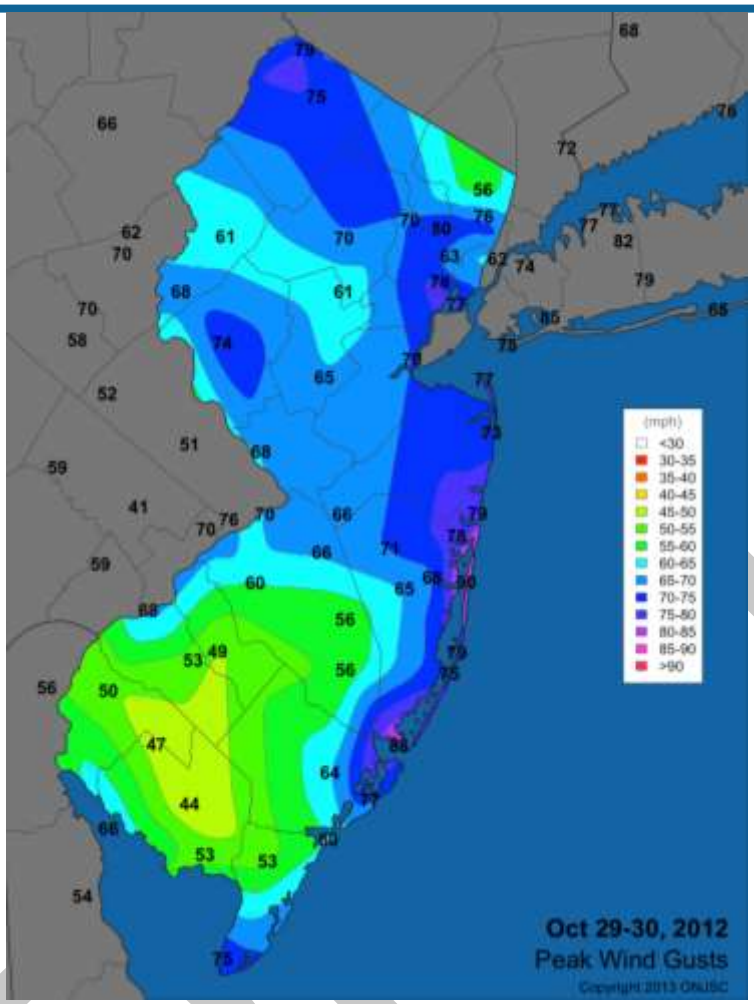
Hurricane Sandy, particularly in Monmouth and Ocean Counties. It also forced some coastal area evacuations again.

October 29, 2012 (DR-4086) - Hurricane Sandy. Sandy made landfall as a post-tropical cyclone near Brigantine, New Jersey with 80 mph maximum sustained winds on October 29, 2012 (see additional description below).

Figure X shows the Sandy peak wind gusts for New Jersey from October 29-30, 2012. The map shows that the peak wind gusts in northeast Union County reached 75-80 mph. The winds decreased to 70-75 mph in central Union County and 65-70 in the western half of the county. The map was produced by the Office of the New Jersey State Climatologist (ONJSC) using reports gathered from a variety of sources including the National Weather Service (NWS) and the New Jersey Weather and Climate Network stations.

The Department of Energy estimates that as many as 2.6 million customers in New Jersey were without power for as long as two weeks in some jurisdictions. According to a report produced by Rutgers University about the impacts of Hurricane Sandy, the power was out the longest in Monmouth and Union Counties, losing power for an average period of ten and nine days respectively. In Union County damages to public infrastructure totaled roughly $14.7 million based on review of FEMA Public Assistance (PA) Project Worksheet (PW) records. Review of the PWs for Union County indicates the majority of the damages and cleanup costs (debris removal from public roadways) resulted from high winds associated with the event.

Table 4-X
Sandy Peak Wind Gusts, October 29-30 2012
(Source: Office of the New Jersey State Climatologist (ONJSC))



Review of FEMA Public Assistance (PA) Project Worksheets (PWs) indicates that the majority of infrastructure damages in Union County were a result of high winds. Table X below summarizes the FEMA PWs by Category for Union County. The table shows that infrastructure damages (including debris removal and emergency protective measures) in Union County totaled slightly more than $14.7 million as of June, 2014. Of this total, category A (Debris Removal) had the highest of all categories with debris removal costs totaling just over $9 million.

Table 4-X
Project Worksheet Summary for Hurricane Sandy (DR-) By Category
(Source: FEMA Region II–Public Assistance Program)

FEMA Category	Total Damages
A	$9,040,923
B	$4,943,492
C	$191,142

FEMA Category	Total Damages
E	$415,742
F	$77,270
G	$117,707
Grand Total	**$14,786,275**

The planning area has been impacted by 12 hurricanes or tropical storms over the last 63 years. On average, Union County experiences the wind affects of a hurricane about every five years. With one event roughly every five years, there is a 19% annual probability of a future flood events occurring in Union County. Recent hurricanes such as Sandy and Irene over past few years suggest that future hurricanes or tropical storms are likely to affect Union County again in the future. However, as mentioned, almost all had been downgraded to tropical storm or tropical depression status by the time they reached New Jersey. In the future, Union County can be considered at moderate to high risk from experiencing the high wind effects from hurricanes and tropical storms. The risk is also considered moderate from nor'easters. New Jersey experiences one or two storms every year that could potentially be classified as nor'easters, but not all of these are severe enough to cause significant damages or result in disaster declarations. Union County has been impacted by high winds from four nor'easters over the past 15 years. The planning area is affected by a strong nor'easter on average about every four years. Considering the impacts from straight line winds, the 2015 Union County HMPSC ranked High Winds – Straight Line Winds as a high risk hazard (See Table X for a complete list of hazard rankings).

Risk Calculations

This subsection describes the risk assessment for the high wind–straight-line wind hazard (non-tornado). As discussed previously, this hazard category includes high winds related to hurricanes, tropical storms, nor'easters, and thunderstorms. The risk calculations are completed using both the data and methodology of FEMA HAZUS-MH 2.1 (SP2, Fall 2014). The model has been substantially improved in last several years, and gives estimates for both the hazard profiles and for the risk calculations on a census-tract basis.

The first step in the risk assessment process is to determine wind profiles for the Union County. Using the probabilistic models within HAZUS-MH, the table below shows the wind hazard profiles for Union County at various frequencies:

Union County Wind Hazard Profiles
Maximum Sustained Wind Speeds (1 min, over open surface)
(Source: FEMA HAZUS-MH 2.1 for Union County, NJ (Fall 2014)

Return Interval [years]	Maximum Wind Speed [mph]	Probability of occurrence
10	21	0.1
20	48	0.05

Return Interval [years]	Maximum Wind Speed [mph]	Probability of occurrence
50	67	0.02
100	88	0.01
200	89	0.005
500	101	0.002
1000	113	0.001

The wind risk assessment for the county was then conducted using the same HAZUS-MH 2.1 Hurricane Wind Module. All figures are based on 50-year and 100-year time horizon and a 7% discount rate (used to determine net present value of the risk, as required by the OMB).

A query from HAZUS model in the fall of 2014 was used as the basis for total structure and content values for each land use category for Union County:

Union County: Square Footage and Value for Predominant Asset Classes (Source: HAZUS-MH 2.1, Fall 2014)

Land Use Category	Total Square Footage	Structure Value (HAZUS)	Contents Value (HAZUS)
Residential	252,757,313	$33,128,555,000	$16,569,892,000
Commercial	73,158,517	$9,285,270,000	$9,780,452,000
Industrial	27,137,582	$2,871,349,000	$4,075,882,000
Agriculture	1,130,511	$97,738,000	$97,738,000
Education	4,819,935	$760,297,000	$760,297,000
Government	1,271,134	$167,709,000	$185,235,000
Religious	5,228,263	$725,907,000	$823,415,000
Total	365,503,255	$47,036,825,000	$32,292,911,000

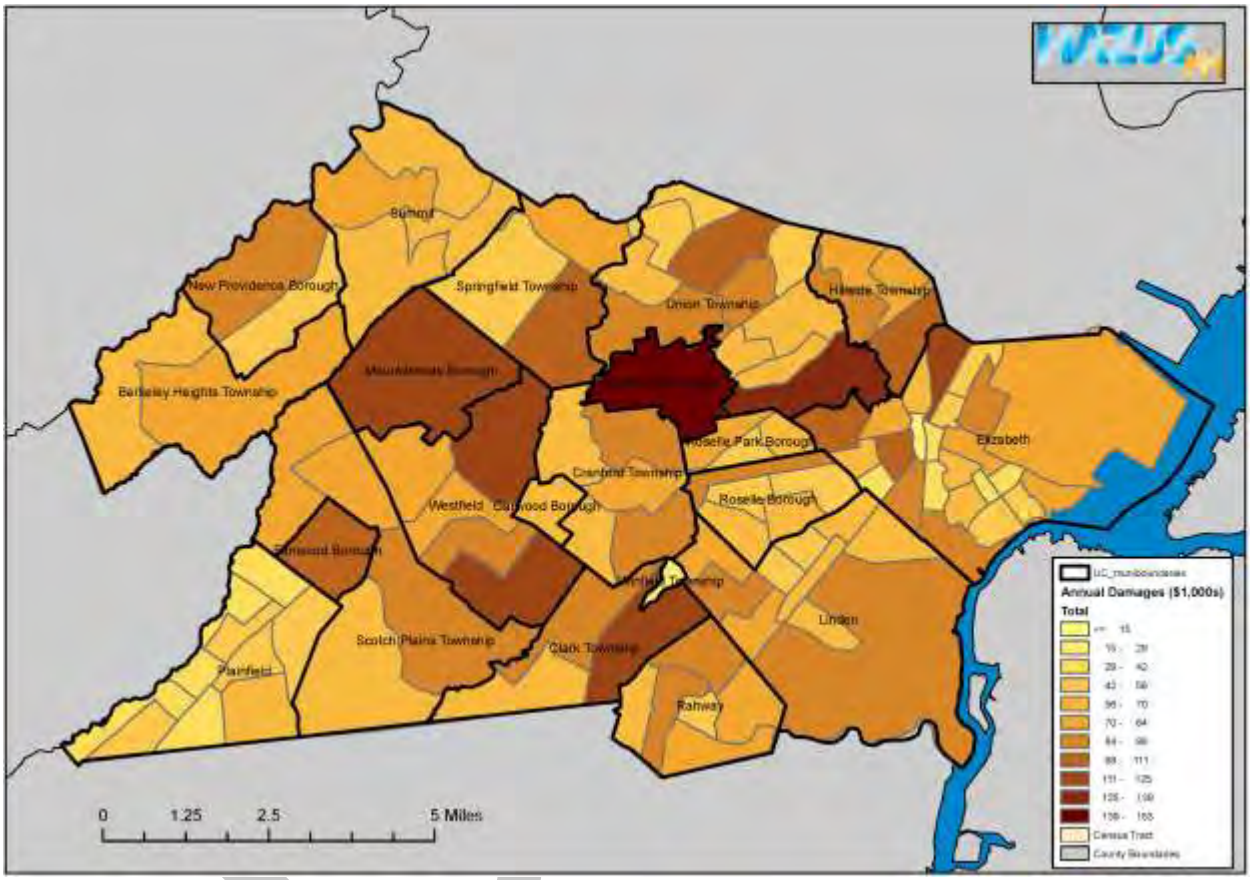
HAZUS-MH performed hurricane wind risk calculations over the suite of probabilistic storms with the above return periods and produces annualized results in various direct and indirect loss categories, over the range of seven principal occupancy classes. Based on the Federal OMB-prescribed discount rate of 7%, annualized losses were subsequently converted into 50-year and 100-year horizon projections, utilizing conversion factors of 13.80 and 14.27, respectively.

In similar fashion, risk calculations were performed for all individual jurisdictions within the Union County. A breakdown of annualized losses for the seven principal land uses in all 21 Union County municipalities is presented in the table below. For the projected losses over the 50-year and 100-year horizon, annualized damages still need to be multiplied by the factors of 13.80 and 14.27, respectively.

The total annualized damages, broken down by the census tract are depicted in HAZUS-MH output. Census tract 34039033600 (encompassing the entire Borough of Kenilworth) has the highest annual

losses in the amount of $152,748.

Estimated Hurricane Wind Risk to Union County
Total Annualized Losses per Census Tract
(Source: HAZUS-MH 2.1 Hurricane Wind Module, Fall 2014



Estimated Hurricane Wind Risk to Union County Assets
Based on Annualized losses per Basic Occupancy Class, over the 50-year and 100-year Horizons
(Source: HAZUS-MH 2.1 Hurricane Wind Module, Fall 2014

Occupancy Class	Residential	Commercial	Industrial	Agricultural	Religious	Government	Education	TOTAL
Total SF	252,757,313	73,158,517	27,137,582	1,130,511	4,819,935	1,271,134	5,228,263	365,503,255
Annualized Building Damages	$4,557,335	$527,193	$198,546	$7,008	$36,633	$7,990	$32,936	$5,367,640
Annualized Contents Damages	$866,399	$244,028	$147,196	$3,572	$13,683	$3,808	$15,554	$1,294,240
Annualized Inventory Loss	$0	$6,866	$22,023	$423	$0	$0	$0	$29,313
Annualized Relocation Cost	$303,048	$83,765	$12,089	$1,024	$4,959	$1,774	$5,959	$412,617
Annualized Business Income Lost	$625	$46,917	$2,552	$61	$2,358	$93	$1,482	$54,089
Annualized Rental Loss	$175,233	$44,935	$2,242	$41	$433	$513	$325	$223,721
Annualized Lost Wages	$1,472	$50,292	$4,108	$24	$5,545	$5,908	$3,489	$70,837
Total Annualized Damages	$5,904,112	$1,003,995	$388,756	$12,153	$63,611	$20,086	$59,744	$7,452,457
50-year Risk	$81,482,647	$13,856,136	$5,365,223	$167,717	$877,897	$277,214	$824,531	$102,851,365
100-year Risk	$84,245,772	$14,326,006	$5,547,161	$173,404	$907,667	$286,614	$852,492	$106,339,115

Estimated Hurricane Wind Risk to Union County Jurisdictions
Annualized losses per Basic Occupancy Class

(Source: HAZUS-MH 2.1 Hurricane Wind Module, Fall 2014

Municipality Name	Residential	Commercial	Industrial	Agricultural	Religious	Government	Education	Annualized Loss
Berkeley Heights Township	$129,973	$10,311	$2,713	$269	$709	$384	$518	$144,876
Clark Township	$214,391	$33,252	$9,649	$738	$2,387	$704	$2,233	$263,355
Cranford Township	$324,985	$39,433	$18,245	$607	$2,820	$966	$9,176	$396,232
Elizabeth	$1,186,709	$273,086	$91,138	$509	$16,472	$6,148	$11,090	$1,585,151
Fanwood Borough	$93,033	$4,988	$1,254	$270	$521	$50	$142	$100,257
Garwood Borough	$46,576	$9,274	$7,222	$127	$468	$324	$288	$64,279
Hillside Township	$251,080	$48,530	$30,990	$216	$2,018	$775	$3,827	$337,437
Kenilworth Borough	$94,358	$29,853	$26,133	$502	$1,292	$28	$582	$152,748
Linden City	$491,076	$149,474	$49,281	$394	$4,474	$1,797	$2,862	$699,357
Mountainside Borough	$87,514	$14,505	$8,855	$227	$506	$199	$262	$112,067
New Providence Borough	$114,198	$12,169	$7,624	$414	$1,181	$308	$820	$136,714
Plainfield City	$368,711	$41,053	$13,817	$389	$6,374	$1,722	$8,780	$440,847
Rahway City	$335,151	$59,463	$25,212	$395	$4,535	$2,249	$3,276	$430,282

Roselle Borough	$254,345	$23,015	$23,573	$126	$1,797	$320	$1,205	$304,382
Roselle Park Borough	$164,532	$18,504	$4,937	$1,638	$661	$310	$1,016	$191,599
Scotch Plains Township	$263,222	$18,978	$2,765	$2,944	$2,700	$195	$1,441	$292,244
Springfield Township	$186,085	$35,677	$8,992	$297	$2,106	$440	$2,061	$235,657
Summit City	$228,881	$31,054	$6,242	$472	$3,140	$304	$2,326	$272,419
Union Township	$645,680	$106,780	$47,308	$924	$5,994	$842	$5,016	$812,545
Westfield Township	$409,660	$44,437	$2,784	$693	$3,349	$1,949	$2,425	$465,298
Winfield Township	$13,955	$160	$20	$0	$108	$70	$399	$14,712
	$5,904,112	$1,003,995	$388,756	$12,153	$63,611	$20,087	$59,744	$7,452,457

Power losses induced by straight-line winds

In addition to inducing structural damage to the buildings, straight line winds also cause considerable losses by knocking out electrical power grids. A preliminary analysis of wind-induced power losses was conducted, using historical power loss records and FEMA BCA V. 4.8 software.

Most of the Union County communities are supplied by PSE&G electric utility, while the others (Berkeley Heights, New Providence and Summit) are serviced by Jersey Central Power & Light. Two communities (Mountainside and Springfield) are equally serviced by both utilities.

Based on the availability of records and geographic distribution, power losses were projected on a basis of records provided by PSE&G, assuming that other utility's data are in correlation. Full or partial records were made available on a jurisdictional level for several recent historic events: March 201 Nor'easter, September 2011 Hurricane Irene, October 2011 storm and October 2012 Hurricane Sandy.

Hazards were estimated by assigning return interval to the historic events:

Event	Nor'easter 2010	Hurricane Irene 2011	Storm 2011	Hurricane Sandy 2012
Estimated Average Outage [days]	1	1	1	2
Estimated Maximum Outage [days]	6	7	8	15
Estimated Return Interval [yrs]	5	10	5	25

Estimates of affected population, where needed, were done using population proportion approach. Table below depicts estimates of power loss using data for four major recent events *(numbers in italics are estimated).*

	Population	Nor'easter 2010	Irene 2011	Storm 2011	Sandy 2012
Berkeley Heights Township	13,183	847	2,633	1,129	5,348
Clark Township	14,756	785	2,219	1,046	5,180
Cranford Township	22,625	1,765	8,060	2,353	8,581
Elizabeth	124,969	7,269	17,774	9,692	50,757
Fanwood Borough	7,318	418	1,062	557	2,879
Garwood Borough	4,226	364	1,471	486	1,962
Hillside Township	21,404	1,074	1,523	1,432	8,601
Kenilworth Borough	7,914	692	2,794	922	3,728
Linden City	40,499	2,073	1,304	2,764	18,239
Mountainside Borough	6,685	512	2,126	683	2,701
New Providence Borough	12,171	782	2,431	1,042	4,938
Plainfield City	49,808	3,627	15,483	4,836	18,711
Rahway City	27,346	2,333	9,846	3,111	12,151
Roselle Borough	21,085	1,471	4,973	1,962	8,897

Roselle Park Borough	13,297	1,286	7,633	1,715	4,495
Scotch Plains Township	23,510	1,460	3,906	1,946	9,856
Springfield Township	15,817	1,016	3,159	1,354	6,417
Summit City	21,457	1,378	4,286	1,837	8,705
Union Township	56,642	2,789	3,582	3,718	22,709
Westfield Township	30,316	2,443	10,967	3,257	12,066
Winfield Township	1,471	152	715	203	717
Total Union County	467,186	30,000	93,312	40,000	189,529
All customers affected		34,534	107,947	46,045	217,637
PSE&G customers affected		30,000	93,312	40,000	189,529

Further analysis entailed FEMA BCA v. 4.8, DFA (Damage-Frequency Assessment) Module for electric utility, with the economic losses of $131/capita/day referenced from FEMA BCAR Standard Economics Values Methodology (V. 5, August 2011).

Final risk estimates per jurisdictions are depicted in a table below. The table presents annual risk estimates, with power loss projections over 50-year and 100-year horizons.

	Population	Annual Risk	50-year horizon	100-year horizon
Berkeley Heights Township	13,183	$121,133	$1,671,726	$1,728,477
Clark Township	14,756	$124,859	$1,723,147	$1,781,644
Cranford Township	22,625	$254,718	$3,515,298	$3,634,635
Elizabeth	124,969	$965,402	$13,323,268	$13,775,563
Fanwood Borough	7,318	$56,533	$780,198	$806,684
Garwood Borough	4,226	$46,779	$645,585	$667,501
Hillside Township	21,404	$165,348	$2,281,926	$2,359,392
Kenilworth Borough	7,914	$95,379	$1,316,301	$1,360,987
Linden City	40,499	$339,544	$4,685,961	$4,845,038
Mountainside Borough	6,685	$68,932	$951,313	$983,608
New Providence Borough	12,171	$111,835	$1,543,406	$1,595,802
Plainfield City	49,808	$513,600	$7,088,063	$7,328,687
Rahway City	27,346	$329,574	$4,548,367	$4,702,774
Roselle Borough	21,085	$193,742	$2,673,784	$2,764,553
Roselle Park Borough	13,297	$159,174	$2,196,720	$2,271,294
Scotch Plains Township	23,510	$216,024	$2,981,292	$3,082,501
Springfield Township	15,817	$145,337	$2,005,759	$2,073,850
Summit City	21,457	$197,161	$2,720,969	$2,813,340
Union Township	56,642	$437,567	$6,038,751	$6,243,753
Westfield Township	30,316	$341,306	$4,710,278	$4,870,181

Winfield Township	1,471	$20,193	$278,678	$288,139
Total Union County	467,186	$4,904,140	$67,680,790	$69,978,403

4.3.12 High Wind–Tornado

Description of the Tornado Hazard

A tornado is a rapidly rotating vortex or funnel of air extending ground ward from a cumulonimbus cloud. Most of the time, vortices remain suspended in the atmosphere. When the lower tip of a vortex touches earth, the tornado becomes a force of destruction. Approximately 1,000 tornadoes are spawned by severe thunderstorms each year. See Appendix A for a more detailed description of the tornado hazard.

Location of the Tornado Hazard

From 1991 - 2010, Texas experienced the highest average annual number of tornadoes with 155, followed by Nebraska (96), Florida (66), and Oklahoma (62).[54] During this time period New Jersey averaged two tornado events per year. NOAA has recorded 1 - 5 tornadoes per 1,000 square miles across the northern half of New Jersey, including Union County. All regions of Union County have been subject to tornados. A map of previous occurrences is available as Figure 4-X.

Severity (or Extent) of Tornado Hazard

Tornado damage severity is measured by the Fujita Tornado Scale (F-Scale), named after Dr. T. Theodore Fujita who first introduced the scale in 1971. The Fujita Scale assigns numerical values based on wind speed and categorizes tornadoes from 0 to 5. The scale is based on damage caused by a tornado related to the fastest quarter-mile wind speed at the height of a damaged structure. The letter "F" precedes the numerical value. Tornadoes are related to larger vortex formations, and therefore often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. See Appendix A for a description of the Fujita Tornado Measurement Scale.

New Jersey currently ranks thirty-seventh for frequency of tornadoes when compared to other states. Tornadoes have an impact on Union County equally and uniformly. The severity of the tornadoes identified in the NCDC database for Union County ranged from F0 to an F1.

Impact on Life and Property (Vulnerability and Risks)

The NCDC database reports there have been no deaths and three injuries from tornadoes in Union County. Tornadoes have caused an estimated $9.57 million in property damage. The most property damage occurred from an F1 tornado on July 26, 1994, two miles north of Kenilworth Borough. The tornado was 100 yards wide and was on the ground for approximately two miles. The tornado caused

[54] NOAA/NCDC US Tornado Climatology, Historical Records and Trends

an estimated $5 million in damages and injured three people.[55] The NCDC database provides no additional details about the event.

People living in manufactured or mobile homes are most exposed to damage from tornadoes. Even if anchored, mobile homes do not withstand high wind speeds as well as permanent, site-built structures. Older residential structures are also more vulnerable to damages from a tornado.

All residents of Union County are subject to the effects of tornadoes, although they are relatively uncommon in this part of the country. As noted elsewhere, potential effects include direct impacts on specific structures and (perhaps more significantly) power interruptions. There is always the risk of injury and deaths in tornadoes as well. This hazard was prioritized by the HMPSC as medium, mostly because the hazard occurs very infrequently and impacts tend to be highly localized. Property losses from tornadoes are generally general borne by either property owners or insurance companies, so it is usually not possible to obtain any information about wind damage to structures, except publicly owned-ones.

Occurrences of the Tornado Hazard

The NCDC and SHELDUS report a total of 13 tornadoes in Union County between 1950 and 2013. The databases indicate there were seven F0 and six F1 tornados. These events are listed below in Table X.

Table 4.X
Tornado Events, Union County, 1950–2013
(Source: NOAA/NCDC, SHELDUS)

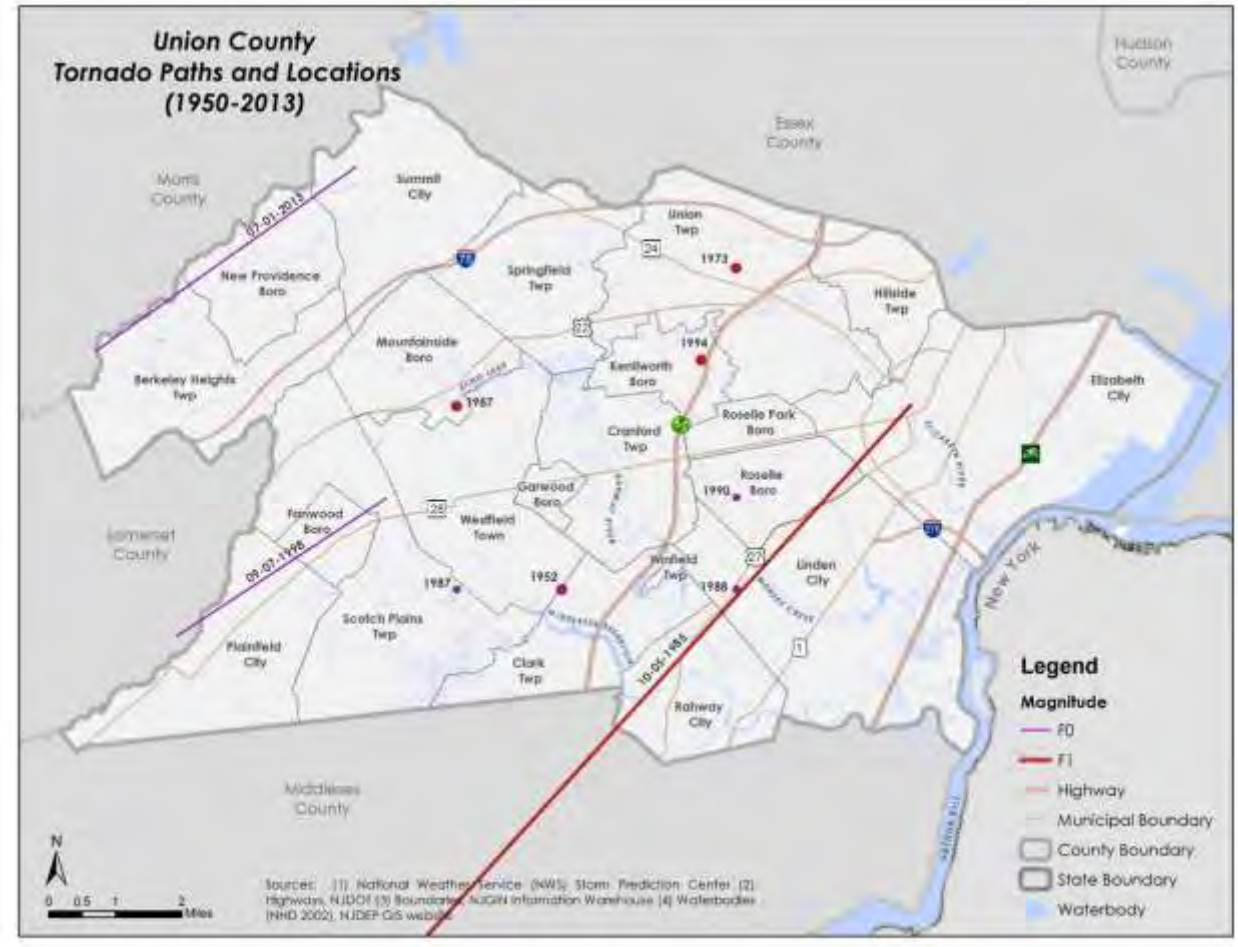
Location	Date	Injuries	Deaths	Magnitude	Property Damage	Source
County-wide	04/05/1952	0	0	F1	$2,500	NCDC
County-wide	07/21/1962	0	0	F1	$238	SHELDUS
County-wide	06/29/1973	0	0	F1	$2,500	NCDC
County-wide	10/05/1985	0	0	F0	$0	NCDC
County-wide	07/14/1987	0	0	F1	$0	NCDC
County-wide	07/26/1987	0	0	F0	$0	NCDC
County-wide	05/23/1988	0	0	F0	$0	NCDC
County-wide	11/16/1989	0	0	F0	$0	NCDC
County-wide	10/18/1990	0	3	F0	$2,500,000	NCDC
County-wide	07/15/1992	0	0	F0	$0	NCDC
County-wide	07/26/1994	0	0	F1	5,000,000	NCDC
Plainfield, City of	09/07/1998	0	0	F0	$1,500,000	NCDC
Clark Township and City of Rahway	09/07/1998	0	0	F1	$550,000	NCDC
Berkeley Heights, Township of	07/01/2013	0	0	EF0	$20,000	NCDC

[55] NOAA/NCDC database

Location	Date	Injuries	Deaths	Magnitude	Property Damage	Source
Total		**0**	**3**		**$9,575,238**	

Figure X identifies tornado locations in Union County between 1950 and 2013. The tornado data is from the National Weather Service's Storm Prediction Center, and appears to only include some of the past events. Highlighted on the map are the three tornado paths for events that occurred in 1985, 1998, and 2013.

Figure 4-X
Union County Tornadoes, 1950-2013
(Source: NOAA/NCDC)



Based on previous occurrences, the probability of future tornado events in Union County is one event every five years. The overall impact to the planning area from tornadoes is moderate considering the frequency and magnitude of the past occurrences. Note that Section 6 of this hazard mitigation Plan includes a more detailed discussion about tornado risk in Union County.

With a total of 13 past tornado events in Union County between 1950 and 2013, the County experiences a tornado event on average roughly every five years. With one event roughly every five

years, there is a 20% annual empirical probability of a future tornado events occurring in Union County.

To quantify tornado risks further, the methodology used in this assessment applied Tornado Module FEMA BCAR 4.8 software and related references (FEMA BCAR Tornado Methodology, May 2009). A statistical count for Union County was developed for all six levels of the Enhanced Fujita (EF) scale, formulated through its annual probability of occurring. For each of the EF levels, an analysis was performed for the for the probability of human injury and death, and degree of damage inflicted upon a typical residential structure in Union County:

Class	Tornado Count [1950-2008]	Annual Probability of Occurrence	Level of Damage Caused to Single Family Residential Structure	Degree of Damage	Probability of Average Injury	Probability of Death
EF0	6.78	0.00007%	None or very minor damage	1%	0%	0%
EF1	17.19	0.00137%	Minor damage	5%	5%	0%
EF2	5.00	0.00178%	Moderate damage	20%	10%	0%
EF3	1.21	0.00190%	Severe damage/partial collapse	55%	10%	5%
EF4	0.54	0.00288%	Total collapse	90%	20%	10%
EF5	0	0.00000%	Complete destruction	95%	30%	50%

In quantifying tornado risks, the values for average human injury and death were assumed at the default level of $748,509 and $6,412,265, respectively. These values were adopted from FEMA guidance documentation and are derived from FAA and insurance studies. The value for the average residential structure is at $250/sqft, at the average size of 2,000 sqft.

Tornado risk was calculated by applying composite annualized number of injuries and deaths to the population of the county (467,186). Similarly, the annualized direct structural losses (where the representative structure is a 2,000 sqft single-family residence) were applied to the total number of structures in the County (158,486).

The analysis showed that the annual count for average injury at the county level is at 4.734, and for the death 1.79. In monetary terms, the risk for damages, injuries, and death is displayed in annualized values, as well as projections for the 50-year, and 100-year horizon:

Tornado Risk	Direct Losses	Average Injury	Death
Annualized	$3,221,470	$3,543,334	$11,480,063
50-year horizon	$44,456,291	$48,898,002	$158,424,863
100-year horizon	$45,970,382	$50,563,369	$163,820,493

4.3.13 Ice Storm

Description of the Ice Storm Hazard

Although snow is the weather phenomenon most commonly associated with winter, ice storms can cause significant disruption to business and create treacherous driving conditions (See Section 5.3.16, Severe Storm–Winter Weather, for a detailed discussion of winter weather). The freezing rain that coats all objects in a sheath of ice can cause power outages, structural damage, damaging tree falls. Ice storms occur when rain droplets fall through freezing air and but do not freeze until they touch objects such as trees, roads, or structures. A clear icy sheath, known as a glaze, forms around branches, structures, and wires and has been known to bring down high-tension utility, radio, and television transmission towers. See Appendix A for a more detailed description of the ice storm hazard.

Location of the Ice Storm Hazard

All regions of Union County have been subject to ice storms. Besides temperature, their occurrence depends on the regional distribution of the pressure systems, as well as local weather conditions. The distribution of ice storms often coincides with general distribution of snow. In Union County, as a coastal storm moves northeastward offshore, a cold rain may be falling in the far eastern part of the county, changing to freezing rain in the central region, and snow over the extreme western Watchung Mountains. A locality's distance to the passing storm center is often the crucial factor in determining the temperature and type of precipitation during a winter storm.

The potential for ice storms is uniform for the entire planning area. All people and assets are considered to have the same degree of exposure.

Severity (Extent) of the Ice Storm Hazard

The severity of the ice storm hazard is dependent on a variety of factors including the surface temperature, duration of the event, and thickness of the ice.

Impact on Life and Property (Vulnerabilities and Risk)

The NCDC database indicates there have been no deaths, injuries, or property damage from previous ice storms in Union County. However, ice storms most likely have caused both infrastructure and property damage such as downed electrical power lines and trees falling on houses. In addition, ice storms potentially put lives at risk from automobile accidents on ice covered roadways. With no indication of past damages from ice storms, or events that included a wintry mix, this hazard was not selected as part of the more detailed risk assessment.

Occurrences of the Ice Storm Hazard

The NCDC database indicates there have been five ice storms that have impacted Union County between 1950 and 2013. In addition to the four ice storms, the database indicates there has been one

wintry mix event that includes a combination of snow, sleet, and freezing rain.

Four of the five events occurred between February and March of 1994. The database provides no indication as to why there are no events prior to 1994, although presumably occurrences roughly follow the same pattern and frequency as shown in the NCDC list. A typical event occurred on February 23, 1994 when one low pressure system moved past western New York State, another formed over northern Virginia. The combination of the two lows and a cold high pressure system over Canada produced a major winter storm. The region received between 3" and 5" of snow before a dangerous coating of ice was deposited as the snow changed to sleet and freezing rain. Major transportation problems developed as roadways became extremely hazardous.[56].

The most recent event occurred on February 1, 2011 when a complex low pressures system tracked northeast bringing a mixture of snow, sleet and freezing rain to the region. A second round of heavier freezing rain and sleet occurred on the evening of the 1st, causing numerous accidents and road closures.[57]

Union County experiences an event that includes freezing rain or ice as part of a winter storm about once every three years, based on the five ices storms and one wintry mix event between 1994 and 2013. With one event roughly every three years, there is a 31% annual probability of a future ice storm events occurring in Union County. Based on previous data, the probability of ice storms occurring in the future is relatively high. However the overall impact to life and property throughout the planning area will most likely be low to moderate. Considering the low impacts from ice storms, the 2015 Union County HMPSC ranked ice storms as a low risk hazard (See Table X for a complete list of hazard rankings). As a low priority hazard, the HMPSC determined that ice storms would not be included as part of the more detailed risk assessment.

4.3.14 Landslide (non-seismic)

Description of the Landslide Hazard

A landslide is a natural geologic process involving the movement of earth materials down a slope, including rock, earth, debris, or a combination of these, under the influence of gravity. However, there are a variety of triggers for landslides such as: a heavy rainfall event, earthquakes, or human activity. The rate of landslide movement ranges from rapid to very slow. A landslide can involve large or small volumes of material. Material can move in nearly intact blocks or be greatly deformed and rearranged. The slope may be nearly vertical or fairly gentle.[58] See Appendix A for a more detailed description and definition of the Landslide hazard.

[56] NOAA/NCDC database Ice Storms in Union County
[57] NOAA/NCDC database, Ice Storms in Union County, event on 02/01/2011
[58] Delano and Wilshusen, 2001

Location of the Landslide Hazard

Landslides are usually associated with mountainous areas but can also occur in areas of generally low relief. In low-relief areas, landslides occur due to steepening of slopes: as cut and fill failures (roadway and building excavations), river bluff failures, collapse of mine waste piles, and a wide variety of slope failures associated with quarries and open-pit mines.[59]

The New Jersey Geological Survey (NJGS) has developed several landslide susceptibility maps for Union County and the State of New Jersey. In Union County, the area most susceptible to landslides is concentrated near the northwestern portion of the County. As shown in Figure 4-X, the majority of this portion of the county is shaded red indicating that the landslide susceptibility is considered high in this area with moderate incidence. The landslide susceptibility is considered low in the remainder of the planning area.

Figure 4-X
New Jersey Landslide Susceptibility/Incidence Map
(Source: New Jersey Geological Survey)

[59] USGS, Landslide Types and Process, 2004

In 2002, as part of the Earthquake Loss Estimation Study for Union County, the NJGS produced a landslide susceptibility map using six landslide classes from the HAZUS model (HAZUS User Manual Table 9.2 - National Institute of Building Sciences). The six landslide classes are broken down into two general categories; Landslide Class A (strongly connected rock) and Landslide Class B (weakly connected rock). Figure 4-X identifies the landslide susceptibility areas in Union County based on the color coded landslide classes. The map shows the most susceptible landslide areas appear to be concentrated along the Watchung Mountains in Springfield and Scotch Plains Townships and Mountainside Borough. The majority of the landslide susceptibility areas in the county are within the Landslide Class B III, shaded green on the map. These areas are considered to have weakly connected rock and soil, with a slope angle of 10-15 degrees.

Figure 4-X
Union County Landslide Susceptibility Map
(Source: Earthquake Loss Estimation Study for Union County, New Jersey: Geologic Component
(New Jersey Geologic Survey, 2002)

Severity of the Landslide Hazard

Landslides are considered highly site specific events and are concentrated in areas of steep slopes. The severity of the landslide hazard depends on a combination of slope angle and the geologic material underlying the slope.

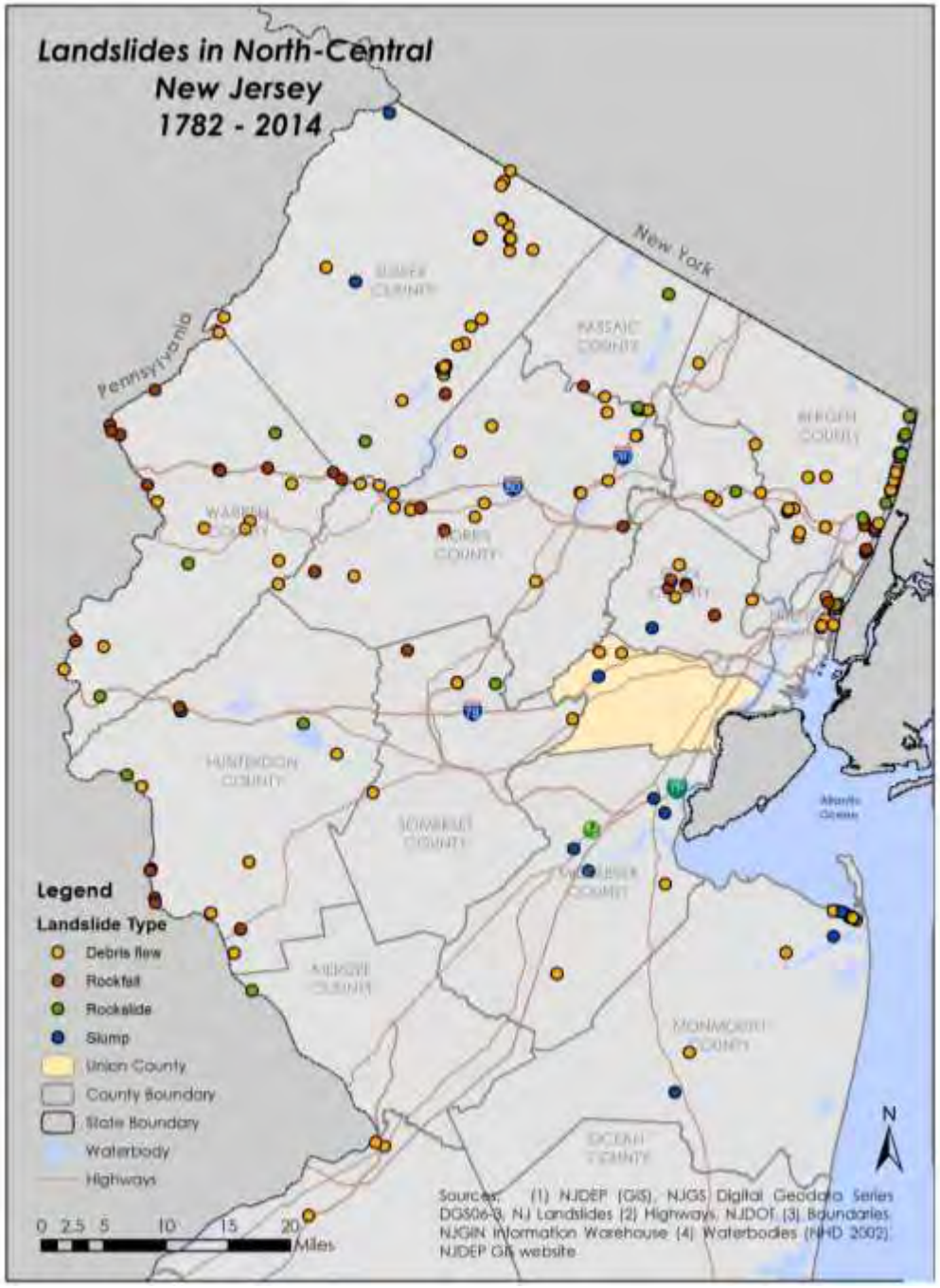
Impact on Life and Property (Vulnerabilities and Risk)

According to the NJGS (as shown in the graphic above), the western portion of Union County is moderately to highly susceptible to landslides. Although moderately susceptible to landslides, there are no known instances of injuries or death from past events in the county. The western part of the county is of relatively low population density (between 500 and 1,000 people per square mile). Given these factors, it is reasonable to presume that impacts on life and property will continue to be minimal, although future development must avoid areas where the hazard is present.

Occurrences of the Landslide Hazard

The NJGS indicates there have been 237 landslides statewide in New Jersey between 1782 and June, 2014. With the exception of several landslides in the southern half of New Jersey, nearly all of these events occurred in the northern and central part of the State. Figure 4-X, identifies the landslides that have occurred in northern and central part of New Jersey. In Union County, there have been three landslides (two debris flows and one slump) during this time period. All three of these events occurred in the western part of the county in the Watchung Mountains.

Figure 4-X
Landslides in North-Central New Jersey
(Sources: NJDEP, New Jersey Geological and Water Survey, June 2014)



Note: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Table X summarizes the three landslide events in Union County between 1782 and June, 2014.

Table 4-X
Landslide Events in Union County, 1782 - 2014
(Sources: NJDEP, New Jersey Geological and Water Survey, May 2014)

Municipality	Event Date	Landslide Type	Cause	Injuries	Deaths	Material Quantity/Length	Description
Summit, City of	8/28/2011	Debris Flow	Heavy Rain	0	0	400 Yards	NJ Transit railroad tracks south of Edgewood Road covered by a debris flow during Tropical Storm Irene. Temporary closure of tracks.
Summit, City of	08/17/1991	Debris Flow	Heavy Rain	0	0	Not Available	A debris flow triggered by heavy rain covered the railroad track. NJ Transit railroad operations were temporarily shut down between Murray Hill and Summit.
Berkeley Heights, Township of	1983 (1)	Slump	Heavy Rain	0	0	200 Linear Feet	Fill material failure knocked down trees after heavy rain during construction of I-78.

Note: (1) Actual month and day unknown (1983 event).

Landslide probabilities are largely a function of surface geology, but are also influenced by both weather and human activities, as noted above. With a total of three past landslide events in Union County between 1782 and 2013, the County experiences a landslide event on average roughly every 77 years. With one event every 77 years, there is a 1.2% annual probability of a future landslide event

occurring in Union County. The probability of future landslides having a significant impact on property and life in the planning area is relatively low. Considering the low impacts from landslide, the 2015 Union County HMPSC ranked landslide as a low risk hazard (See Table X for a complete list of hazard rankings). As a low priority hazard, the HMPSC determined that landslide would not be included as part of the more detailed risk assessment.

4.3.15 Severe Storm – Lightning

Description of the Lightning Hazard

Lightning events are generated by atmospheric imbalance and turbulence due to a combination of conditions. Lightning, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees F. See Appendix A for a more detailed description of the lightning hazard.

Location of the Lightning Hazard

Lightning occurs over the entire planning area, particularly during the spring and summer months.

Severity of Lightning Hazard

Severe lightning events can occur anywhere in the planning area. Even during common events, the lightning current can branch off to strike a person from a tree, fence, pole, or other tall object. In addition, electrical current may be conducted through the ground to a person after lightning strikes a nearby tree, antenna, or other tall object. The current also may travel through power lines, telephone lines, or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture. Lightning may use similar processes to damage property or cause fires.

Impact on Life and Property (Vulnerabilities and Risk)

About 100 deaths and 500 injuries are reported annually across the U.S. from this hazard. According to the NCDC, in Union County there were no deaths, one injury, and $2 million in property damages related to lightning from 1950 to 2007. All of the property damage was from a single lightning event on June 3, 1995 in the City of Rahway. The low injury and death rate from previous lightning events points to a relatively low vulnerability for lightning hazards in the planning area. The HMPSC rated this hazard *low* priority.

Although local information about lightning damages, injuries and deaths is not readily available, it is possible to derive such risks using national-level data from open sources. A 2013 publication by the National Fire Protection Association entitled *Lightning Fires and Lightning Strikes* provides excellent statistics. According to the report, annual national damages related to lightning total $112,750,000. The

large majority of damages is from lightning-induced structure fires, both residential and non-residential. The report noted above provides much more information regarding types of fires and locations, but this is not germane to the Union County HMP. Table X-X shows the estimated lightning risk from physical damages in Union County jurisdictions. The monetary risk figures in the following two tables are calculated using the FEMA value of life figures from the BCAR guidance (inflated to present value) and present value coefficients representing the planning horizons at a 7% discount rate.

Table X-X
Estimated Lightning Risk (physical damages) to Union County Jurisdictions

Jurisdiction	Population	% of U.S.	Annual Risk	50-year Risk	100-Year Risk
Berkeley Heights	13,183	0.00417%	$4,702	$64,881	$67,091
Clark	14,756	0.00467%	$5,263	$72,623	$75,096
Cranford	22,625	0.00716%	$8,069	$111,351	$115,143
Fanwood	7,318	0.00231%	$2,610	$36,016	$37,243
Garwood	4,226	0.00134%	$1,507	$20,799	$21,507
Hillside	21,404	0.00677%	$7,633	$105,341	$108,929
Kenilworth	7,914	0.00250%	$2,822	$38,949	$40,276
Linden	40,499	0.01281%	$14,443	$199,319	$206,107
Mountainside	6,685	0.00211%	$2,384	$32,901	$34,021
New Providence	12,171	0.00385%	$4,341	$59,900	$61,941
Plainfield	49,808	0.01575%	$17,763	$245,134	$253,482
Rahway	27,346	0.00865%	$9,753	$134,585	$139,169
Roselle	21,085	0.00667%	$7,520	$103,771	$107,306
Roselle Park	13,297	0.00421%	$4,742	$65,442	$67,671
Scotch Plains	23,510	0.00744%	$8,385	$115,706	$119,647
Springfield	15,817	0.00500%	$5,641	$77,845	$80,496
Summit	21,457	0.00679%	$7,652	$105,602	$109,199
Union	56,642	0.01792%	$20,201	$278,768	$288,262
Westfield	30,316	0.00959%	$10,812	$149,202	$154,284
Winfield	1,471	0.00047%	$525	$7,240	$7,486

The second general category of lightning risk is deaths. The report noted above provides an excellent array of statistics on national and regional levels, and should be referred to for more detail. The annual number of lightning deaths in the State of New Jersey is 0.76 (see Table 5, page 22; 13 deaths over the period 2003 to 2012). Table X-X shows estimated deaths in Union County jurisdictions, derived from national level data.

Table X-X
Estimated Lightning Risk (physical damages) to Union County Jurisdictions

Jurisdiction	Population	% of U.S.	Annual Risk	50-year Risk	100-Year Risk
Berkeley Heights	13,183	0.16764%	8,170	$112,743	$116,583
Clark	14,756	0.25704%	12,527	$172,867	$178,754
Cranford	22,625	0.08314%	4,052	$55,913	$57,818
Fanwood	7,318	0.04801%	2,340	$32,289	$33,389
Garwood	4,226	0.24317%	11,851	$163,538	$169,107
Hillside	21,404	0.08991%	4,382	$60,467	$62,526
Kenilworth	7,914	0.46011%	22,423	$309,433	$319,972
Linden	40,499	0.07595%	3,701	$51,077	$52,816
Mountainside	6,685	0.13828%	6,739	$92,993	$96,160
New Providence	12,171	0.56587%	27,577	$380,559	$393,520
Plainfield	49,808	0.31068%	15,140	$208,938	$216,054
Rahway	27,346	0.23955%	11,674	$161,100	$166,587
Roselle	21,085	0.15107%	7,362	$101,596	$105,056
Roselle Park	13,297	0.26710%	13,017	$179,629	$185,746
Scotch Plains	23,510	0.17970%	8,757	$120,850	$124,966
Springfield	15,817	0.24377%	11,880	$163,943	$169,526
Summit	21,457	0.64351%	31,360	$432,774	$447,514
Union	56,642	0.34442%	16,785	$231,630	$239,519
Westfield	30,316	0.01671%	814	$11,239	$11,622
Winfield	1,471	0.14977%	7,299	$100,725	$104,155

All residents of Union County are potentially subject to damages from lightning. However, as discussed above, while lightning is very common, significant damages resulting from it are not. Structures in the County are generally not vulnerable to lightning, and when damages do occur they are usually the responsibility of property owners or their insurance companies. As such, there is little or no information about damages. The HMPSC rated this hazard low priority.

Occurrences of the Lightning Hazard

There were 13 instances of lightning reported in the NCDC database for Union County from 1950 to 2013. All 13 events occurred between 1994 and 2009. The database provides no indication as to why there are no events prior to 1994, although presumably occurrences roughly follow the same pattern and frequency as shown in the NCDC list. Clearly, there are many such events every year, but they are presumably not significant enough to reach the threshold for reporting to NOAA/NCDC for inclusion in the database.

Table 4-X
Lightning Events, Union County, 1994–2013
(Source: NOAA/NCDC)

Location	Date	Injuries	Deaths	Property Damage	Source
Elizabeth	06/29/1994	0	0	$0	NCDC
Union Co.	07/26/1994	0	0	$0	NCDC
Linden	08/13/1994	0	0	$0	NCDC
Rahway	06/03/1995	0	0	$2,000,000	NCDC
Plainfield	08/05/1995	0	0	$0	NCDC
North Plainfield	07/14/1996	0	0	$0	NCDC
Scotch Plains	06/20/1998	0	0	$1,000	NCDC
Plainfield	11/20/2000	0	0	$2,500	NCDC
Linden	05/29/2001	1	0	$2,000	NCDC
Elizabeth	06/11/2001	0	0	$0	NCDC
Springfield	07/23/2008	0	0	$0	NCDC
Kenilworth	06/26/2009	0	0	$0	NCDC
Elizabeth	07/29/2009	0	0	$0	NCDC
Total	**----**	**1**	**0**	**$2,005,500**	**----**

As mentioned above, the most significant lightning event occurred in the City of Rahway on September 3, 1995. A lightning strike at a lumber yard started a fire and causing extensive damage estimated at $2 million in property damage. Based on the occurrences between 1994 and 2009, the probability of future lightning events in Union County is approximately one or two significant events per year.

With a total of 13 past landslide events in Union County between 1994 and 2013, the County experiences a lightning event on average roughly every five years. With one significant event roughly every 1.5 years, there is a 68% annual probability of a future lightning event occurring in Union County. Events in Union County will most likely continue to occur in the future but impacts on property and life in the planning area will most likely be relatively low. Considering the low impacts from lightning, the 2015 Union County HMPSC ranked lightning as a low priority hazard (See Table X for a complete list of hazard rankings).

4.3.16 Severe Storm – Winter Weather

Description of the Winter Weather Hazard

Winter storms bring various forms of precipitation that occur only at cold temperatures, such as snow, sleet, or a rainstorm where ground temperatures are cold enough to allow icy conditions. These cold weather storms can also take the form of freezing rain or a wintry mix. See Section 4.3.13, Ice Storm, for a detailed discussion of the ice storm hazard.

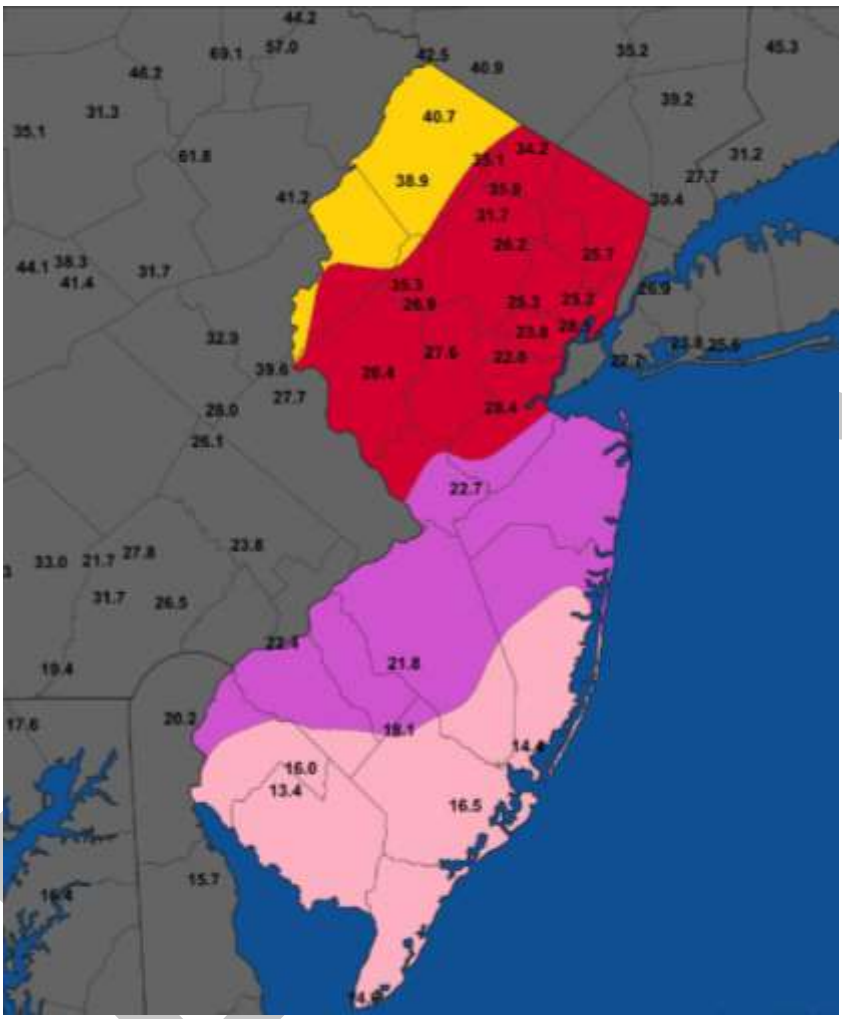
Heavy snowfall and extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold. Winter storms can result in flooding, storm surge, closed highways, blocked roads, downed power lines, and hypothermia. See Appendix A for a more detailed description of the severe storm – winter weather hazard.

Figure 4-X
Heavy Snow from the 1993 Storm of the Century
(Source: Popular Mechanics-Science)

Location of the Winter Storm Hazard

The potential for winter storms is uniform for the entire planning area. All people and assets are considered to have the same degree of exposure. Seasonal snowfall in New Jersey varies from an average of about 13" in Cumberland County to as much as 40" in parts of Sussex County. There is, however, significant variation from year to year. February is the month when maximum accumulations on the ground are usually reached. Figure 4-X shows that in Union County the average seasonal snowfall between 1981 and 2010 has ranged from approximately 23” – 26”.

Figure 4-X
Average Seasonal Snowfall in New Jersey, 1981-2010
(Source: office of the New Jersey State Climatologist)



Severity (Extent) of Winter Storm Hazard

The severity of winter storms can range significantly from a dusting of snow to a blizzard. From review of the State of New Jersey 2015 Hazard Mitigation Plan Update (Draft), 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 (e.g., weekday versus weekend), and time of season.[60] The extent of the winter storm hazard is based off of a classification system developed by

[60] State of New Jersey 2014 Hazard Mitigation Plan (Draft), Section 5.11 Severe Winter Weather

NOAA's National Climatic Data Center (NCDC) for winter storms impacting the eastern two-thirds of the United States. The ranking system, referred to as the Regional Snowfall Index (RSI) includes five categories that range from Notable to Extreme. The RSI is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population. Table 4-X identifies the five ranking categories and RSI Values.

Table X
Regional Snowfall Index (RSI)
(Source: NOAA, NCDC 2011)

Category	Description	RSI Value
1	Notable	1-3
2	Significant	3-6
3	Major	6-10
4	Crippling	10-18
5	Extreme	18+

The most severe type of winter storm is the blizzard. This is perhaps the most severe type of winter storm, characterized by low temperatures, strong winds, and heavy blowing snow. In Union County there have been four snowstorms categorized as blizzards over the past 20 years. The NCDC database query results include winter storm events between 1994 and 2013. In mid-March 1993, the eastern U.S. experienced one of the most intense winter storms on record. The event, known as the "Storm of the Century," caused blizzard conditions throughout most of New Jersey dumping as much 3' of snow in some parts of the state.

Impact on Life and Property (Vulnerabilities and Risk)

The NCDC reports there have been no injuries, deaths, or property damage due to winter weather events in Union County. Presumably there are damages from winter weather events, but most likely were never reported to the NCDC.

All residents of Union County are subject to the effects of winter weather. As noted elsewhere, these effects include direct impacts on specific structures, injuries or deaths from hypothermia, traffic accidents and (perhaps most significantly) power interruptions resulting from ice-laden trees falling on power lines. This hazard was prioritized by the HMPSC as high, mostly because the hazard occurs regularly and affects nearly everyone in the County. Potential impacts are widespread, though generally not life-threatening. Structures are generally not vulnerable to the effects of winter weather, except in the rare cases where roofs collapse under extreme snow loads. Although there is some potential for this in Union County, the risk is small. Because such losses are general borne by either property owners or insurance companies, it is generally not possible to obtain any information about winter weather-related damage to structures, expect publicly owned-ones. The HMPSC rated this hazard a high priority.

The two most significant risks from winter weather in Union County are traffic accidents and power losses. This subsection discusses damages from traffic accidents, and uses national statistics found in the National Health Statistics Report entitled Deaths Attributed to Heat, Cold and other Weather Events in the United States, 2006 to 2010. The publication is produced by the U.S. Department of Health and Human Services Centers for Disease Control and Prevention. This report includes national statistics on deaths and injuries from traffic accidents that attributable to sleet, slush and snow.

Table X-X
Check figures annualized

Hazard	Injuries	Deaths
Snow/sleet	58,011	769
Icy pavement	45,133	580
Snow/slush	43,503	511

In the date range indicated in the title, there were 6,652 deaths nationwide related to exposure to cold, including other contributing factors. This translates to an annual national figure of 1,330. Jurisdiction-level risks from hypothermia are then derived as a proportion to the national statistics, based on population. In Table X-X below, the annual risk figure is estimated using the FEMA value of life (see documentation supporting the Benefit-Cost Analysis Re-Engineering, entitled Standard Economic Values), inflated to 2015 value using the Consumer Price Index. The 50-year and 100-year risk calculations in the table are completed using a standard present value coefficient that incorporates the required 7% discount rate.

Occurrences of the Winter Weather Hazard

Winter storms occur frequently enough in Union County to be a threat to people and property. Generally, the winter storm season in Union County runs from December to March. The NCDC reports that in Union County there have been 36 snow and wintry mix events between 1950 and 2013. Although the query results begin in 1950 the first reported event is in 1994. It is unclear why the database does not include any events prior to 1994.

Table 4-X summarizes some of the major winter storm events that have impacted Union County in the past. The blizzards in December, 2010 and October 2011 both received Major Disaster Declarations in Union County.

Table 4-X
Summary of Notable Winter Storm Events impacting Union County
(Sources: NOAA, National Weather Service)

Date(s)	Storm Type	Description
February 7, 1978	Blizzard	This blizzard caused an estimated $24 million in damage statewide, primarily to dunes, beaches, and public facilities along the beachfront.
March 13, 1993 (DR-3106)	Blizzard	Event known as the "Storm of the Century" affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States. The "Storm of the Century" label was given to the event due to the record low pressure, wind speeds, temperature, and snowfall. All 21 counties in New Jersey were included in the Presidentially Declared Disaster. In Union County snowfall totals ranged from 11"-13".
January 7, 1996 (DR-1088)	Blizzard	A State of Emergency was declared for the blizzard that hit the state. Road conditions were dangerous due to the high winds and drifts. Both government and contract snow plowing operations were running at a maximum. Local roads were impassable. This blizzard also brought on coastal flooding with the high tides of Sunday evening and Monday morning, and there were reports of damage to dunes and beaches from the heavy wave activity. More than 400 National Guard personnel were activated for transport assistance, primarily for medic missions. In Union County snowfall totals ranged from 20"-30".
February 16, 2003	Snow Storm	The combination of the very cold temperatures and the approach of a strong storm system caused widespread snow to break out, starting before sunrise on Sunday, February 16. Snow continued during the day Sunday, heavy at times, and continued into Sunday night. Precipitation continued on Monday, before finally coming to an end on Tuesday. Total snowfall in Union County ranged from 18.5" to 23.5". New Jersey requested and was granted a Snow Emergency Declaration for all 21 counties. The President's Day snowstorm tied or set records in all 21 New Jersey counties including Union. Statewide, the event resulted in damages estimated at approximately $30.2 million.

Date(s)	Storm Type	Description
December 26, 2010 (DR-1954)	Blizzard	A rapidly intensifying low pressure system tracked from off the Southeast US coast on Christmas Day and then past the Mid Atlantic Coast on Sunday December 26th. Bands of heavy snow plus embedded thunderstorms and very strong winds affecting the region Sunday afternoon through Sunday night. The powerful blizzard brought a widespread area of 20 to 30 inches of snow across Northeast New Jersey. The heavy snow was accompanied by area wide winds of 25 to 40 mph and gusts in excess of 60 mph Sunday afternoon into Sunday night, resulting in near whiteout conditions with blowing and drifting snow and making all forms of travel extremely difficult to nearly impossible. Major Disaster Declaration Declared on February 4, 2011. Snowfall totals in Union County were highest in Elizabeth with 31.8 inches followed by 29 inches in Roselle and 27 inches in Union and Clark Townships. Additional details about the event can be found from the National Weather Service – New York Office http://www.erh.noaa.gov/okx/SOO/case_studies/12262010.html
October 29, 2011 (DR-4048)	Snow Storm	A historic and unprecedented early-season winter storm impacted the area on Saturday, October 29, with more than one foot of heavy wet snow falling on interior portions of northeast New Jersey. This is the first time a winter storm of this magnitude has ever occurred in October. The heaviest snow fell across interior northeast New Jersey, with up to 18 inches of snowfall across higher elevations. Thousands of people across northeast New Jersey lost power during this event as heavy snow accumulated on trees that still had partial to full foliage during mid-autumn. This caused extensive felling of trees and limbs across the region and damage to power lines. In Union County a significant number of trees came down due to the heavy wet snow.

With a total of 36 past winter storm events in Union County between 1950 and 2013, the County experiences a winter storm event on average roughly every two years. With one event roughly every two years, there is a 57% annual probability of a future winter storm events occurring in Union County. Based on past history, the probability of winter weather events occurring in the future is relatively high, based on previous data.

4.3.17 Storm Surge (Includes Hurricanes, Nor'easters, Tropical Storms)

Description of the Storm Surge Hazard

Storm surges are caused by hurricanes, nor'easters, and tropical storms that impact coastal areas. Surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15' or more. In addition, wind driven waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides.[61] In addition to flooding coastal areas, storm surge can also reach further inland impacting lakes and rivers.

Storm surges are particularly damaging when they occur at the time of a high tide, combining the effects of the surge and the tide. This increases the difficulty of predicting the magnitude of a storm surge since it requires weather forecasts to be accurate to within a few hours. See Appendix A for a more detailed description of the storm surge hazard.

Location of the Storm Surge Hazard

Storm surge vulnerability is closely related to elevation relative to sea level and proximity to the coast, the lower the elevation, and closer to the potential sources of flooding; the more likely it is that an area will be negatively impacted by surge. Surge can come directly from the Atlantic Ocean and various bays in the state, and also can occur as a result of backwater effects on rivers. The storm surge hazard associated with hurricanes and other severe storms has historically been responsible for coastal flooding and erosion along the New Jersey coastline. In Union County the area along the Arthur Kill in the far eastern part of the county has the greatest vulnerability to storm surge, simply because of its location.

In 2007, FEMA's Risk Analysis Team with Region IV (Atlanta, Georgia) developed the Coastal Flood Loss Atlas (CFLA) to better assess and properly mitigate the risks and vulnerabilities associated with storm surge. The CFLA unites the National Hurricane Center's (NHC) Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model with FEMA's loss estimation model, HAZUS (Hazards US), creating an easily and readily accessible atlas of possible coastal flood conditions and losses to support pre- and post-hurricane landfall strategies.

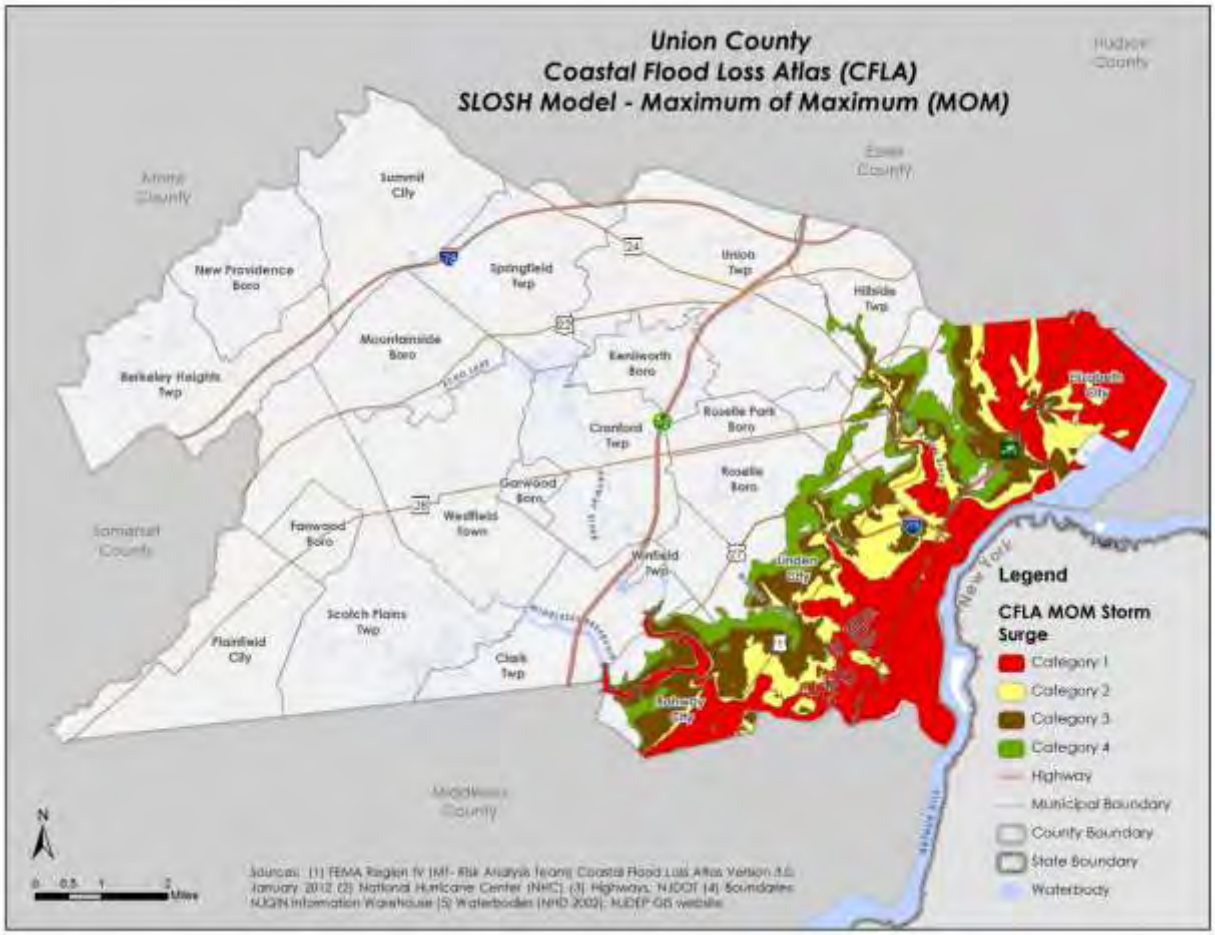
The Risk Analysis Team developed storm surge inundation (i.e. water depth over land) grids in GIS format from SLOSH Maximum of Maximums (MOMs) outputs per hurricane category. These outputs are considered the worst case storm surge scenarios for each Saffir-Simpson hurricane category (1 through 5) under perfect storm conditions. Local emergency management officials use MOMs to delineate storm surge evacuation zones, and the CFLA complements FEMA HES to achieve the goal of comprehensive risk and vulnerability assessments for all hurricane storm surge scenarios and

[61] NOAA – storm surge description

evacuation zones. The CFLA establishes a baseline level of coastal flood risks and vulnerabilities that can be further assessed for better, more comprehensive understanding of coastal hazards and disasters.

Figure 4.X below shows the maximum storm surge extent for hurricane categories 1 through 4 in Union County. Note that the Category 5 extent is not included on the map. The CFLA summary indicated that Category 5 MOM SLOSH models have not been produced for FEMA Region II by NOAA's National Hurricane Center. Thus, there are no Category 5 loss estimates for these areas in the CFLA.

Figure 4-X
Union County SLOSH Maximum of Maximum (MOM)Storm Surge Limit, Hurricane Categories 1-4
(Source: FEMA Region IV, Coastal Flood Loss Atlas (CFLA), SLOSH)



Severity (Extent) of the Storm Surge Hazard

Storm surges inundate coastal floodplains by tidal elevation rise in inland bays and ports, and backwater flooding through coastal river mouths. Severe winds associated with low-pressure systems cause increase in tide levels and water surface elevations. Storm systems also generate large waves that run up and flood coastal areas. The combined effects create storm surges that affect the beach, marsh, and low-lying floodplains. Shallow offshore depths can cause storm driven waves and tides to pile up against the shoreline and inside bays. Table 4-X highlights the factors that can influence the severity of coastal storms.

Table 4-X
Factors that Influence the Severity of Storm Surge

Factor	Effect
Wind Velocity	The higher the wind velocity the greater the damage.
Storm Surge Height	The higher the storm surge the greater the damage.
Coastal Shape	Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.
Storm Center Velocity	Then slower the storm moves, the greater damage. The worst possible situation is a storm that stalls along a coast, through several high tides.
Nature of Coast	Damage is most severe on low-lying island barrier shorelines because they are easily over washed by wave action.
Previous Storm Damage	A coast weakened by even a minor previous storm will be subject to greater damage in a subsequent storm.
Human Activity	With increased development, property damage increases and more floating debris becomes available to knock down other structures.

Impact on Life and Property (Vulnerabilities and Risk)

In Union County, there have been no deaths or injuries due to storm surge. No property damage has been reported related to storm surge from open sources. Rahway City was able to provide a limited amount of surge damage data that resulted from Hurricane Floyd. The storm surge resulting from Floyd caused the Rahway River to rise to a level that significantly damaged the City library. Eight homes were also damaged to the point that they qualified for acquisition through FEMA funded programs.

Occurrences of the Storm Surge Hazard

The structure of the NCDC database combines coastal flooding and storm surge events into a category titled "Ocean and Lake Surf." The database indicates there have no storm surge events and three coastal flooding events that have impacted Union County between 1950 and 2013. In addition to the events listed in the NDCD, Hurricane Sandy also resulted in extensive storm surge flooding. The four events are summarized below in Table 4-X.

Table 4-X
Storm Surge Events, Union County, 1950–2013
(Source: NOAA/NCDC)

Date	Hazard Type	Description	Injuries	Deaths	Property Damage	Source
03/03/1994	Nor'easter	A powerful nor'easter moving northward along the Atlantic coastline. Strong northeasterly winds of between 35 mph and 40 mph prevailed for several hours with gust of around 60 mph. The winds also attributed directly to widespread, but relatively minor coastal flooding along with moderate beach erosion.	0	0	0	NCDC
12/06/1996	Nor'easter	Storm produced heavy rain with peak wind gusts of 40-50 mph. Minor coastal flooding.	0	0	Unknown	NCDC
03/13/2010 (DR 1897)	Nor'easter	An intensifying low pressure tracking slowly northeast from the Mid-Atlantic States created a prolonged period of strong easterly winds across the region March 12th through the 14th. The most intense winds and resultant tidal rises occurred on March 13th with widespread moderate flooding occurring. Tidal departures of 3 to 5 feet were recorded, with many places seeing water levels reaching their highest levels in almost 20 years.	0	0	Unknown	NCDC

Date	Hazard Type	Description	Injuries	Deaths	Property Damage	Source
10/29/2012 (DR 4086)	Hurricane Sandy	Widespread moderate to major coastal flooding occurred along Newark Bay and the Arthur Kill as peak storm tides in New York Harbor surpassed all previously documented high water marks (See additional details following table).	Unknown	2 in Union County	▪ 863 structures with minor damage. ▪ 110 with major damage	FEMA Modeling Task Force (MOTF). Centers for Disease Control, New York Times

The most recent storm surge event in Union County occurred as a result of Hurricane Sandy on October 29, 2012. The storm produced three to six feet of inundation above ground level along the Arthur Kill and in the Elizabeth Port Authority Marine Terminal along Newark Bay in eastern Union County. The inundation generally extended about 2 miles inland past the New Jersey Turnpike, while a few feet of inundation occurred 5 miles inland on the Rahway River. This inundation caused areas of moderate to major damage to industrial complexes, such as the Bayway refinery. In addition, the Elizabeth Port System was disrupted for a week to repair road and rail ways, hundreds of displaced shipping containers, damaged electrical systems and other port cargo from the inundation. Also, over 10,000 cars were destroyed in the Elizabeth and Newark Port System from the salt water inundation. The marina in the port area of Elizabeth, N.J. was also destroyed as a result of the storm surge.[62]

The surrounding neighborhoods in this area also experienced significant damage. Flooding from the surge impacted 20-30 homes in the Trembly Point neighborhood within the City of Linden. The effects of the storm continued through October 31 and resulted in 60 reported casualties in New York State (48 in New York City alone), and 34 casualties in New Jersey. With the highest storm surge levels on record, Sandy produced widespread damage to coastal and inland communities in both States and estimated damages of $42 billion in New York and $30 billion in New Jersey.[63]

After Sandy, the FEMA Modeling Task Force (MOTF), a group of modeling and risk analyst experts from FEMA Regions VIII (Denver) and IV (Atlanta) that was activated by FEMA in support of disaster response operations. The group consists of individuals with experience in multi-hazard loss modeling and impact assessments, including earthquakes, hurricanes, riverine and coastal floods (surges, tsunamis), winter storms and others. The MOTF plays an important role in coordinating hazard and modeling information from a variety of sources to develop consensus for best estimates of impacts before, during, and after events. The MOTF integrates observed information throughout disasters to verify, and enhance impact assessments. The MOTF developed Sandy storm surge inundation areas for both New York and New Jersey. The surge inundation boundary was created from field-verified High Water Marks (HWMs) and Storm Surge Sensor data from the USGS (through February 14, 2013). The MOTF used HWMs and Surge

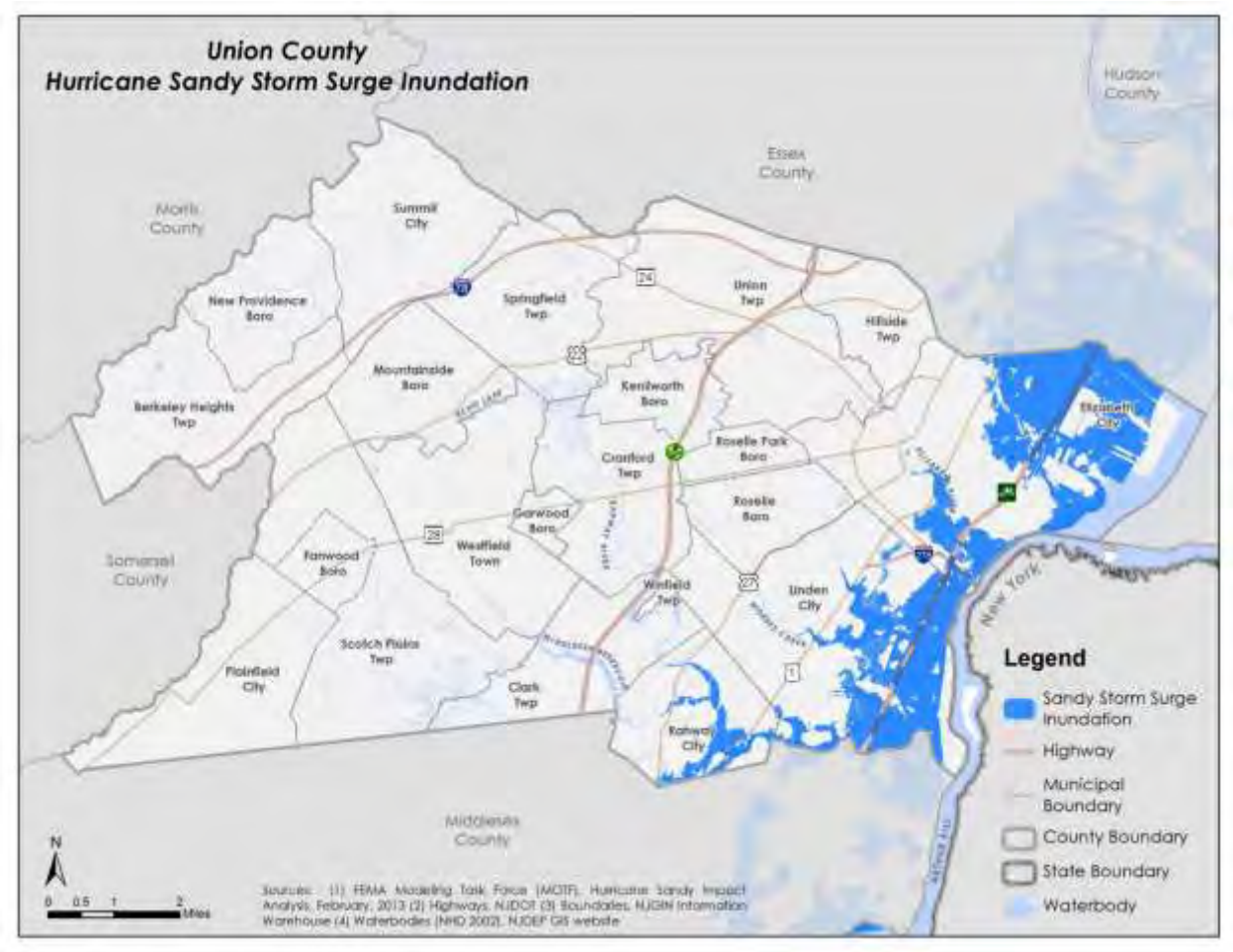
[62] NOAA. National Climatic Data Center (NCDC). Coastal Flooding hazard – Union County, NJ. October 29, 2012 event description.
[63] FEMA. New York/New Jersey Coastal Advisory Flood Hazard Information Development. Final Report. August 30, 2013. Risk Assessment Mapping And Planning (RAMPP)

Sensor data to interpolate a water surface elevation, then subtracted from the best available Digital Elevation Model (DEM), to create a depth grid and surge boundary by state.[64]

Figure X identifies the Sandy storm surge inundation area for Union County. The map shows a significant portion of eastern Union County was inundated by Sandy.

[64] FEMA Modeling Task Force (MOTF) Hurricane Sandy Impact Analysis

Figure 4-X
Hurricane Sandy Storm Surge Inundation Map – Union County
(Source: FEMA Modeling Task Force (MOTF) Hurricane Sandy Impact Analysis)



As part of the analysis completed by MOTF, the team calculated the population and households exposed to the surge from Sandy. The impacts to Union County are summarized below in Table 4-X.

Table 4-X
Sandy Impacts
(Source: FEMA Modeling Task Force (MOTF) Hurricane Sandy Impact Analysis)

	Population/Households
Population (2010)	536,499
Households (2010)	188,118
Population exposed to Storm Surge	17,441
Households Exposed to Surge	6,049

With a total of four past storm surge events in Union County between 1950 and 2013, the County experiences a storm surge event on average roughly every 16 years. With one event roughly every 16 years, there is a 6.3% annual probability of a future storm surge event occurring in Union County. From the historical data provided in the NCDC database and other sources, the probability of future storm surge events occurring along far eastern part of Union County is considered high. Considering the impacts from storm surge flooding, the 2015 Union County HMPSC ranked storm surge as a high priority hazard (See Table X for a complete list of hazard rankings).

4.3.18 Wildfire

Description of the Wildfire Hazard

Wildfires are uncontrolled fires often occurring in wild land areas, which can consume houses or agricultural resources if not contained. Wildfires/urban interface is defined as the area where structures and other human development blend with undeveloped wild land. See Appendix A for a more detailed description and description of the wildfire hazard.

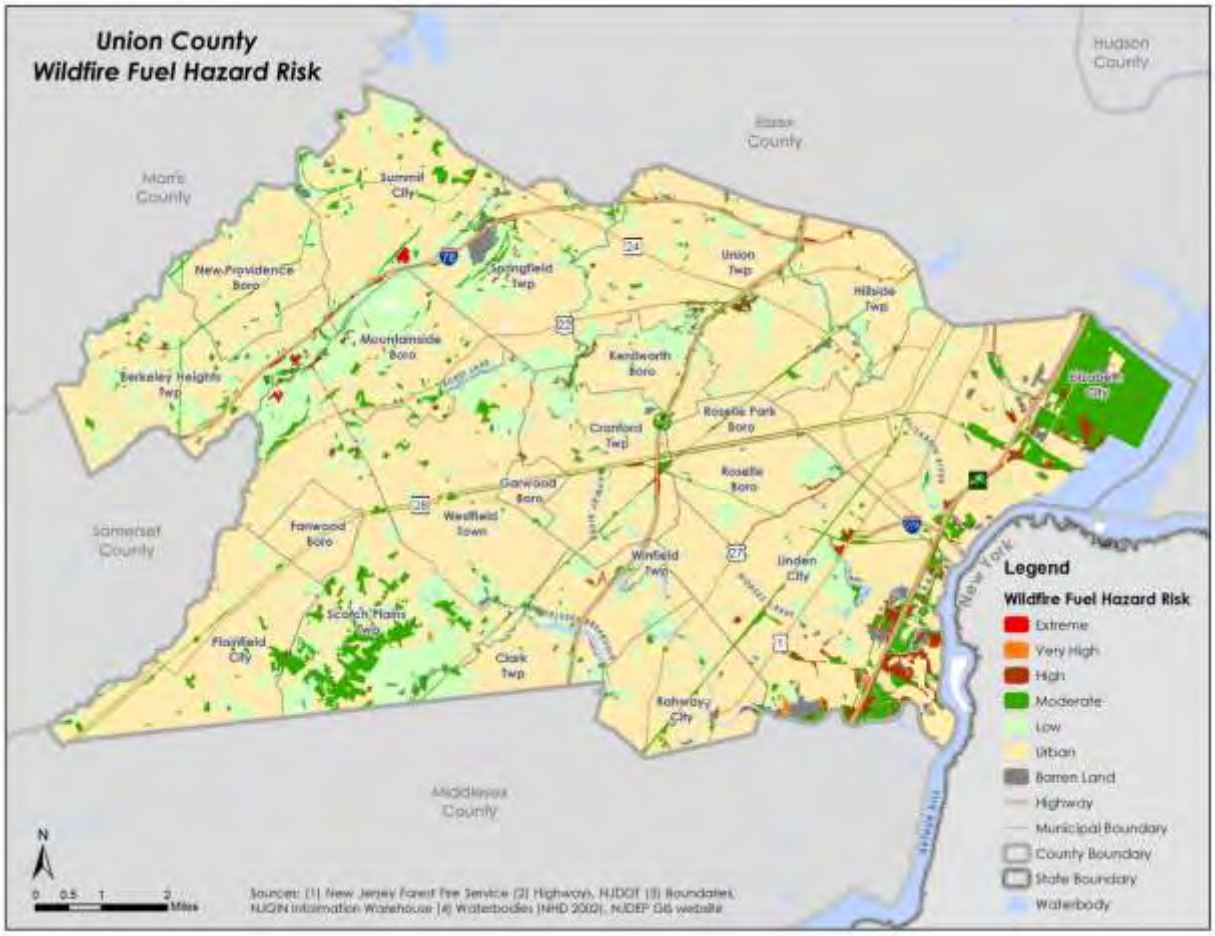
Location of the Wildfire Hazard

The potential for wildfires exists over the entire planning area, although the probability is relatively low because of the predominately urban nature of the planning area, as well as the fire detection and suppression capabilities that exist in the county. Figure X below identifies the wildfire fuel hazard risk for Union County. Fuel hazard refers to the risks associated with the amount of biomass that will burn under a given set of conditions. Moisture content and fuel size are the primary determinants of availability. Arrangement and compactness of fuel may also determine availability.[65] The map was developed based on GIS data obtained from the New Jersey Forest Fire Service (NJFFS) a division of the New Jersey Department of Environmental Protection (NJDEP) website. The NJFFS developed the Wildfire Fuel Hazard data based upon NJDEP's 2002 Land Use/Land Cover (LU/LC) datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets (considering both land use and slope to determine rankings).

The wildfire fuel hazard data was released for the State of New Jersey in May, 2009. The map (and following table) shows that the majority of the county is located in the urban category (shaded tan) with minimal fuel hazard risk from wildfires. The high risk areas of Union County are colored brown (high risk) and orange (very high risk). There are some small high and very high risk areas predominately in southeastern Linden and eastern Elizabeth.

[65] National Park Service. Fire and Fuel Management: Definitions, ambiguous terminology and references.

Figure 4-X
Union County Wildfire Fuel Hazard Risk
(Source: NJDEP (GIS), New Jersey Forest Fire Service)



Note: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Table X below identifies the number of acres and square miles per wildfire fuel hazard risk category in Union County. The "Low" fuel hazard risk category has the highest number of square miles, with a total of 17.85 square miles within the County. The table also shows that the majority of the County is urban (as reflected on the map above), indicating a very low risk from the wildfire hazard.

Table X
Union County Wildfire Fuel Hazard Risk, Number of Acres and Square Miles
(Source: NJDEP (GIS), New Jersey Forest Fire Service)

Fire Description	Total Acres	Square Miles
Extreme	68	0.10
Very High	86	0.13
High	863	1.34
Moderate	4,930	7.70
Low	11,426	17.85
Urban	47,442	74.12
Total acres	**64,816**	**101.19**

The NJFFS has also produced wildfire risk maps in 2010 for New Jersey. Figure X below identifies the wildfire risk for Union County. The map shows the wildfire risk increases towards the western half of the County. The greatest risk is located in the western area of the County, particularly Scotch Plains Township and Berkeley Heights Township.

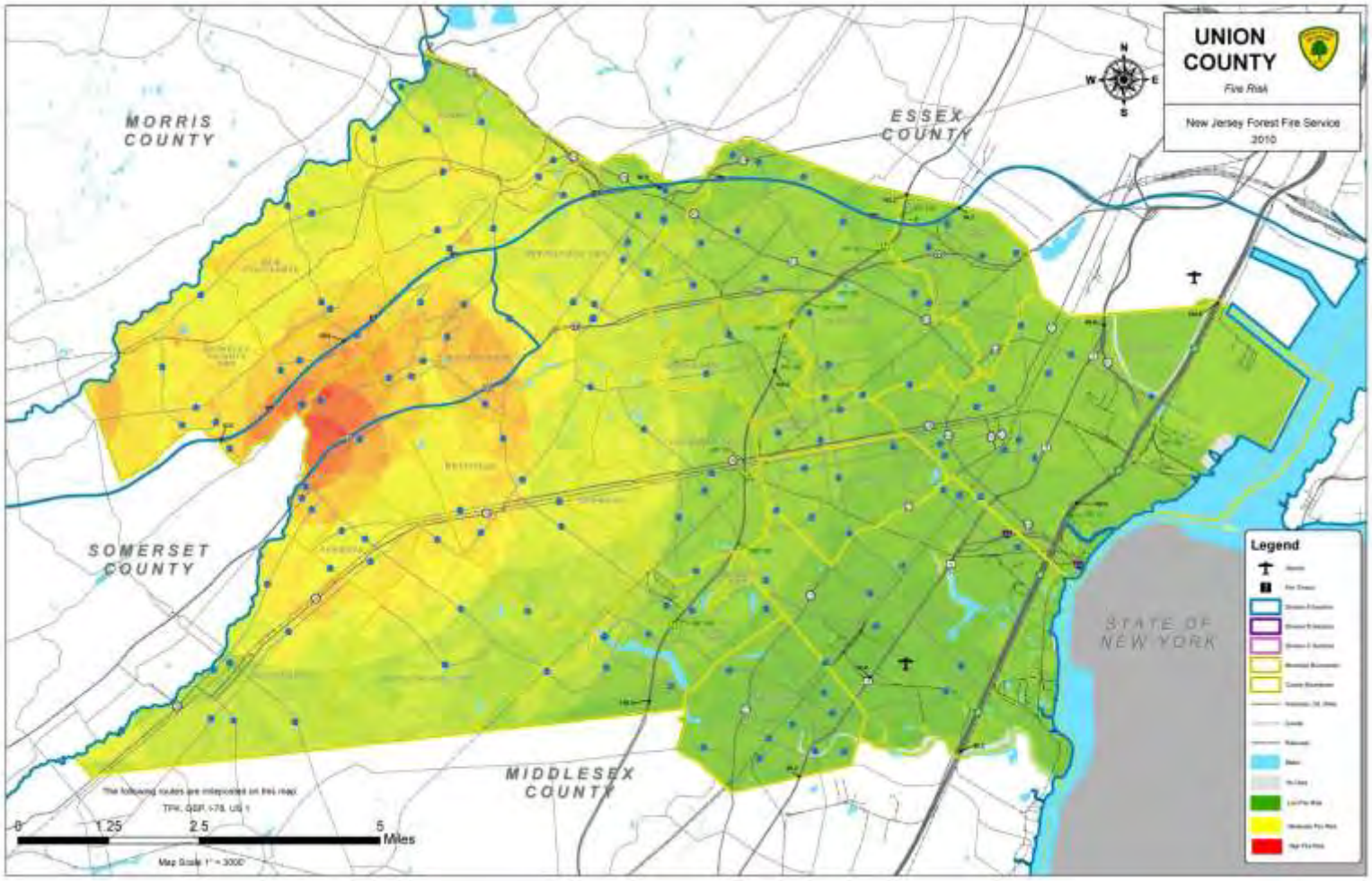
Severity (Extent) of the Wildfire Hazard

The frequency and severity of wildfires is dependent on weather and on human activity. In the planning area, severity has historically been very low, and duration a matter of hours to a day. The risk is increased and compounded by increasing development within the zone commonly referred to as the "wildland-urban interface (WUI)." Within this zone of natural landscape, buildings become additional fuel for fires when fires do occur. Most wildland fires are man-caused and occur in the interface of developed lands and forest and range lands. In particular, the dry conditions, high temperatures, and low humidity that characterize drought periods set the stage for wildfires.

The Colorado State Forest Service has developed a fire intensity scale (FIS) that quantifies potential fire intensity based on high to extreme weather conditions, fuels, and topography. *The FIS was developed to measure wildfire intensity by magnitude. The FIS consists of six classes and ranges in magnitude from one to six and similar to the Richter scale of earthquake magnitude, each* unit increase in FIS is a meaningful ten-fold increase in fireline intensity. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 6, represents extreme wildfire intensities.[66] A detailed description of the FIS classes is provided in the following table.

[66] Colorado State Forest Service. Colorado Wildfire Risk Assessment Project. Final Report. February 21, 2013.

Figure 4-X
Union County Wildfire Risk
(Source: New Jersey Forest Fire Service, 2010)



Impact on Life and Property (Vulnerabilities and Risk)

There are no records of deaths or injuries and no recorded loss of property from wildfires in the planning area. Although there have been no reported injuries or property damage from wildfires the areas of highest risk to life and property in Union County can be identified by examining the Wildland Urban Interface (WUI). The United States Forest Service (USFS) defines WUI as the area where houses meet or intermingle with undeveloped wildland vegetation. This makes the WUI a focal area for human-environment conflicts such as wildland fires, habitat fragmentation, invasive species, and biodiversity decline. The WUI is where wildfire poses the biggest risk to human lives and structures. Using GIS, the USFS integrated U.S. Census and USGS National Land Cover Data, to map the risk areas related to the WUI. Figure X identifies the WUI areas for Union County. The maps shows the highest risk areas are the high density interface/intermix (shaded red and orange) and the medium density interface/intermix (shaded dark and light brown). In Union County, the higher risk areas are mainly located in parts of Berkeley Heights Township, New Providence Borough, Summit City, Springfield Township, Mountainside Borough, Fanwood Borough, and Plainfield Township.

As noted, only a few areas in the County are vulnerable to wildfires, and even these are at very low risk because of the nature of the landscape, weather, and the effectiveness of detection and suppression capabilities. This hazard was prioritized by the HMPSC as low, because there is negligible history of occurrences and losses, and very little exposure. Potential impacts are very limited and generally not life-threatening. Some structures in the County are vulnerable to fires, but there is no practical way to determine relative risk because this depends on factors such as fuel availability, structure type and proximity to fire-prone areas.

Occurrences of the Wildfire Hazard

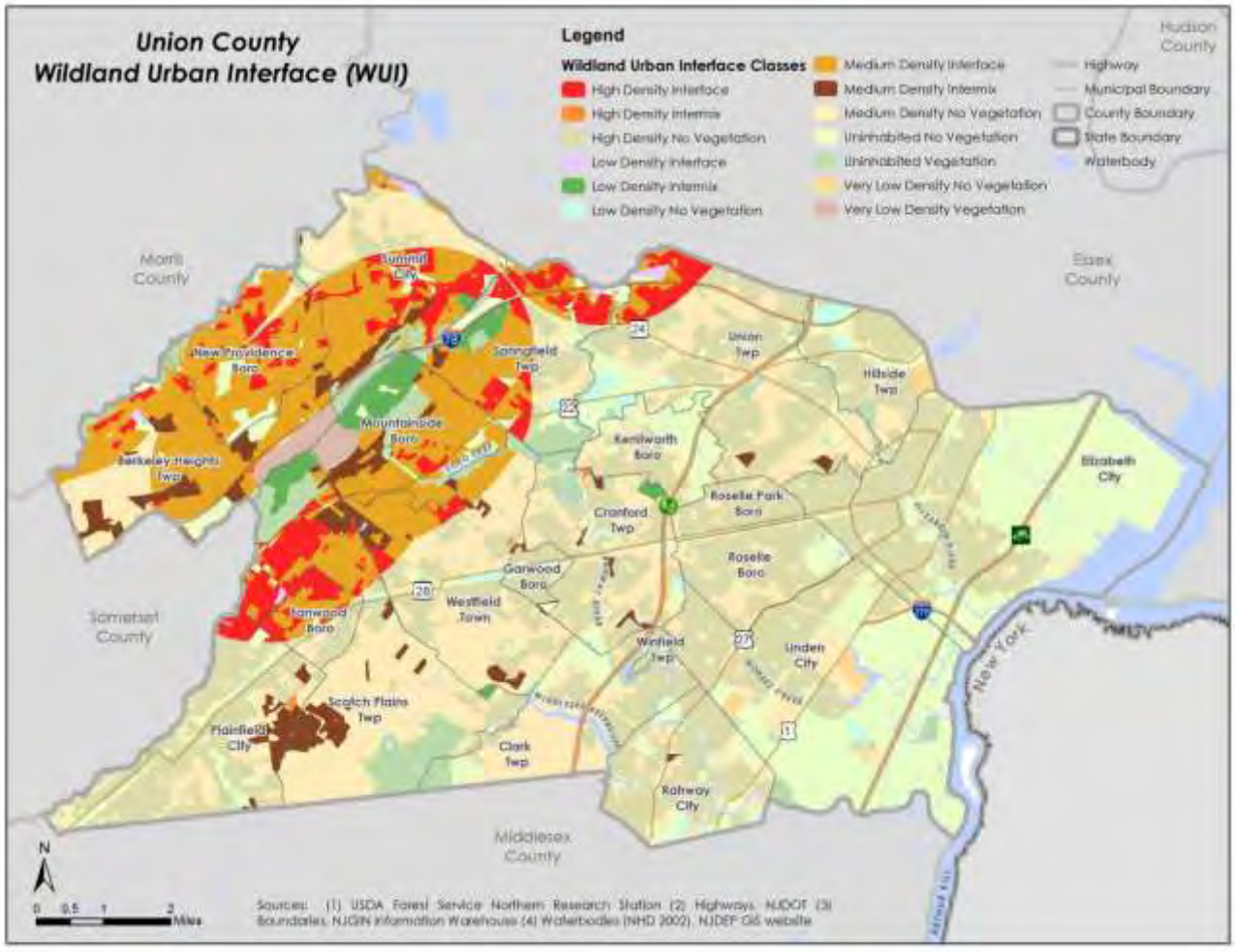
The NJFFS indicates there are approximately 1,500 wildfires that destroy 7,000 acres of forest land in New Jersey each year. A variety of sources were reviewed to identify past wildfire events in New Jersey including the NJFFS, the NCDC, the SHELDUS database, and other open sources of data. The NCDC and SHELDUS database indicate there have been no significant wildfires in Union County between 1950 and 2013. Review of additional data sources identified one wildfire even in Cranford Township on March 14, 2012. A brush fire covering about one acre of wooded area adjacent to Nomahegan Park in Cranford spread through the dry brush about 300 yards into the woods on the Cranford side of Kenilworth Boulevard.[67] There have most likely been other small similar wildfire events, but due to the size did not meet the threshold to be reported as part of the data collected by the NDCD.

According to the New Jersey Forest Fire Service there have been no wildfire events over 100 acres in Union County between 1924 and 2011. Based on review of historical wildfire records, Union County ranks near the bottom of average annual fire incidents and number of acres burned in New Jersey.

[67] Cranford Patch. Large Brush Fire Spreads Through Cranford Woods. March 15, 2012.

With a total of one significant past wildfire events in Union County between 1950 and 2013, the County experiences a wildfire event on average roughly once every 63 years. With one event roughly every 63 years, there is a 1.5% annual probability of a future wildfire event occurring in Union County. The past wildfire data indicates that the probability of future wildfires occurring in the county is fairly low, and will most likely have a limited impact on property and life in the planning area. Considering the extensive development (urban areas) and limited forested areas, the 2015 Union County HMPSC ranked wildfire as a low risk hazard (See Table X for a complete list of hazard rankings). As a low risk hazard, the HMPSC determined that wildfire would not be included as part of the more detailed risk assessment.

Figure 4-X



Note: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Section 5: Capabilities and Action Plan

As mentioned elsewhere, during the 2015 Plan Update portions of the original HMP were preserved, including some of the terms and language. This Section includes some elements from the original 2010 version of the Plan.

5.1 Mitigation Goals, Objectives, and Actions

This section contains goals, objectives, and action items for the Union County New Jersey Multi-Jurisdictional Hazard Mitigation Plan. For the purposes of this Plan, the following definitions are proposed:

- **Goals** are general guidelines that explain what the county and participating municipalities want to achieve. Goals are expressed as broad policy statements representing desired long-term results.
- **Objectives** (or strategies) describe strategies to attain an identified goal. Objectives are more specific statements than goals; objectives are also usually measurable and can have a defined completion date.
- **Mitigation Actions** are the specific steps (projects, policies, and programs) that advance a given objective. They are highly focused, specific, and measurable.

The hazard identification and risk assessment in Sections 5 consisted of identifying the hazards that affect Union County and the potential for damage to community assets that are vulnerable to the hazards. As required by the planning process, the original working group developed four mitigation goals in 2010. The four goals (and supporting objectives) from the 2010 Plan were discussed and reviewed at the second HMPSC meeting held on July 26, 2014. The goals from the 2010 version were circulated to the HMPSC for comment. After careful analysis, the Steering Committee determined that the original goals (and objectives) from the 2010 Plan were appropriate to include in the 2015 update.

5.1.1 Goals

The broad goals of the 2015 Union County Hazard Mitigation Plan update are as follows:

- **Goal 1:** Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact
- **Goal 2:** Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards
- **Goal 3:** Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities
- **Goal 4:** Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

5.1.2 Objectives

Objectives are well-defined intermediate points in the process of achieving goals. The objectives are linked to the goals by including the goal number prior to describing the objective. For example Objective 1.A is associated with Goal 1. Specific objectives and actions to support these goals are described in Table 5-1. Additionally, actions related to enhanced data collection (flood and critical facilities excepted) are described in Table 5-2. Municipality-specific actions are described in each municipality appendix (Appendices 1 – 20). Union County mitigation planning objectives include:

- **Objective 1.A:** Increase awareness of risks and understanding of the advantages of mitigation by the general public and local government officials
- **Objective 1.B:** Increase local government official awareness regarding funding opportunities for mitigation.
- **Objective 1.C:** Increase local government official awareness regarding opportunities for participation in and contributing to future Plan updates.
- **Objective 2.A:** Improve availability of the county and participating municipalities to collect data related to all relevant hazards for use in future planning efforts.
- **Objective 2.B:** Provide government officials and local practitioners with educational opportunities and information regarding best practices for hazard mitigation planning, project identification, and implementation
- **Objective 2.C:** Acquire and maintain detailed data regarding critical facilities such that these sites can be prioritized and risk-assessed for possible mitigation actions
- **Objective 3.A:** Continue support of hazard mitigation planning, project identification, and implementation at the municipal and county level.
- **Objective 3.B:** Support increased NFIP/CRS participation
- **Objective 3.C:** Support increased integration of municipal/county hazard mitigation planning and floodplain management with effective municipal/ county zoning regulation, subdivision regulation, and comprehensive planning.
- **Objective 3.D:** Elicit and support efforts to address shortcomings in existing laws, programs, and administrative rules related to hazard mitigation.
- **Objective 3.E:** Provide for user-friendly hazard-data accessibility for mitigation and other planning efforts and for private citizens
- **Objective 3.F:** Provide direct support, where possible, to municipal mitigation programs.
- **Objective 3.G:** Provide opportunities for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the plan update process
- **Objective 4.A:** Facilitate development and timely submittal of project applications meeting state and federal guidelines for funding (1) for RL and SRL properties and (2) for hardening / retrofitting infrastructure and critical facilities with highest vulnerability ratings.
- **Objective 4.B:** Maintain and enhance local planning and regulatory standards related to future development and investments.

5.2 Identification and Analysis of Mitigation Actions

5.2.1 Potential Mitigation Actions

Union County has identified several hazard mitigation actions that would benefit the county. These were identified in the HMPSC meetings, which included input from representatives of governmental organizations, local businesses, and private citizens. This was based in part on consideration of the range of potential mitigation actions for hazards faced by Union County and its constituent municipalities which are described below.

5.2.2 Public Awareness

Insurance industry and emergency management research has demonstrated that awareness of hazards is not enough. People must know how to prepare for, respond to, and take preventive measures against threats from natural hazards. This research has also shown that a properly run local information program is more effective than national advertising or public campaigns.

Although concerted local, county, and statewide efforts to inform the public exist, lives and property continue to be threatened when segments of the population remain uninformed or chose to ignore the information available. Public education serves to assist the communities with problems experienced from flood, high wind–straight-line winds, earthquake/geological, dam failure, hazardous material releases–fixed sites, severe storm–winter weather, and high wind–tornados as well as other lower priority hazards. Educating the public of these life and property saving techniques must remain a high priority item at the local, state, and federal level and is consistent with Goal 1.

Projects identified by the HMPSC are as follows:

- Develop *All Hazards* public education and outreach program for hazard mitigation and preparedness
- Initiate a public awareness program on local TV for hazard safety
- Conduct evacuation exercises with and for local Office of Emergency Management (OEM) personnel and private citizens
- Conduct yearly workshops related to FEMA hazard mitigation grant programs, including Flood Mitigation Assistance (FMA) grant program, Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) grant program, Severe Repetitive Loss (SRL) grant program, and Repetitive Flood Claims (RFC) grants program, with a focus on those aspects available to private firms and property owners (coordinated with Action 1.B.1, below)
- Educate the public through New Jersey Office of Emergency Management (NJOEM) and New Jersey Forest Fire Service outreach programs and hazard mitigation workshops

5.2.3 Prioritized Mitigation Action Items

For the original (2010) version of the HMP, the County used a process known by the abbreviation STAPLEE to assign priorities to the range of mitigation activities that were included in the Plan. See Appendix G, *STAPLEE Analysis of Mitigation Actions* in the 2010 HMP for additional details about how the County carried out this process.

The 2015 HMPSC reviewed the STAPLEE process used for the 2010 Plan and determined that the process is needlessly complicated, and would not be used for the 2014 update. As discussed below, the Committee prioritized the actions using a simple high/medium/low scale based on the following criteria, on a scale of 1-3. Each action in the table below was assigned a score of 1, 2, or 3 during a meeting of the HMPSC, based on the 4 categories listed below. The scores were then averaged and the result was the basis of the prioritization.

1. Effectiveness in reducing damages
2. Feasibility
3. Availability of funding
4. Support by community leadership

To update the original mitigation actions, the action tables from the 2010 HMP were distributed to the HMPSC, and members were requested to update and provide comments. The updates and comments were then integrated into the Action Tables. Each action item identifies a point of contact, the cost effectiveness of the project, a schedule for completion, and suggested funding sources. As part of the 2015 Plan update, the mitigation actions items from the original Plan were updated to reflect Union County's current priorities for specific activities to achieve the goals discussed in Section 5.1.1.

5.2.4 Countywide Mitigation Actions

As part of the original Plan, the 2010 HMPSC developed the following program of county-wide mitigation actions in response to the risk assessments included in the original Plan. As part of the 2015 Plan update, the HMPSC reviewed and updated the mitigation actions table (Table 5- 1). The HMPSC discussed each action item with the lead office, and the tables were modified to include the status for each item. The status identifies work that has been completed to satisfy the action, or progress made as of December, 2014. The actions are divided into two tables. The actions from the original Plan are included in Table 5-1. Completed actions are noted in the status column (and shaded light gray). In addition, actions that are no longer valid are identified with ~~strikethrough~~ text to indicate these are no longer actions considered by the HMPSC. New actions identified as part of the 2015 Plan update are included in Table 5-2. All mitigation action items pertain to both current and future development as well as infrastructure, as applicable, within Union County. Note that action items identified for each jurisdiction can be found in the individual municipalities appendices (Appendices 1 – 20)

Table 5-1
Mitigation Goals, Objectives, and General Actions from the 2010 Plan

GOAL 1: Improve EDUCATION AND OUTREACH efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
1.A.1: Develop *All Hazards* public education and outreach program for hazard mitigation and preparedness.	High	Union County and municipal OEMs	One year	Union County and municipal OEM personnel	Better informed populace creates a greater willingness and expectation to participate in mitigation actions.	**2015 Status:** Ongoing effort
~~1.A.2: Initiate a public awareness program on local TV channel for hazard safety.~~	~~Medium~~	~~Union County and municipal OEMs~~	~~Six months to one year~~	~~Union County and municipal OEM personnel, local public TV~~	~~A better informed and involved population reduces risk and loss.~~	**2015 Status:** Union County does not have a local county TV station. HMPSC determined it was not worth the staff resources to establish.
1.A.3: Conduct evacuation exercises with and for local Office of Emergency Management (OEM) personnel and private citizens.	Medium	UC OEM	One year	Union County and municipal OEM personnel, local business and 250 citizen groups	Public participation leads to more active emergency and preparedness response.	**2015 Status:** Conducted an overturned tanker exercise

GOAL 1: Improve EDUCATION AND OUTREACH efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
~~1.A.4: Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC, with a focus on those aspects available to private firms and property owners (coordinated with Action 1.B.1, below).~~	~~High~~	~~UCOEM, NJOEM~~	~~Ongoing~~	~~Existing state assets and federal grants~~	~~Makes local officials and the public aware of federal grants thereby increasing participation.~~	**2015 Status:** Removed, as it is repeated under Action 1.B.1 below.
~~1.A.5: Educate the public through NJOEM and New Jersey Forest Fire Service outreach programs and hazard mitigation workshops.~~	~~High~~	~~NJOEM, New Jersey Forest Fire Service~~	~~Ongoing~~	~~Existing state resources~~	~~Encourages the development of Pre-Disaster Mitigation plans and participation in mitigation grant programs.~~	**2015 Status:** HMPSC determined the wildfire risk was not sufficient enough to justify the staff commitment.

GOAL 1: Improve EDUCATION AND OUTREACH efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
1.B.1: Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC (coordinated with Action 1.A.4, above).	High	UCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Makes local officials aware of federal grants thereby increases participation.	**2015 Status:** Union County OEM has not conducted yearly workshops but has lead workshops after Irene and Sandy disaster declarations. OEM will continue to work with coordinators in the County to stay informed about mitigation funding opportunities.
1.C.1: Reach out to municipal Floodplain Administrators, depts. of planning, public works, engineering, etc. regarding the importance of hazard mitigation planning and provision of municipal plans and data for planning purposes	High	UCOEM and municipal coordinators	Ongoing	Existing county and municipal resources	Makes local officials aware of benefits of plan participation.	**2015 Status:** Through this emphasis, the County improved its mitigation plan participation to 100%. Continued outreach to these agencies over the next five years.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.1: Develop and maintain relationships with organizations that can provide technical information and/or assistance in the areas of hazard identification and risk assessment , e.g., incorporate information re: implementation of Risk MAP initiative as source of improved information re: flood risk in participating municipalities.	Medium	UCOEM, Rutgers University, New Jersey Geological Survey (NJGS), National Oceanic and Atmospheric Administration (NOAA) and United States Army Corp of Engineers (USACE)	Ongoing	Existing county staff, FEMA, NJOEM, Rutgers University, NJGS, other federal agencies including NOAA and USACE	Provides the basis for making decisions about where to focus mitigation activities, including further study, and eventually mitigation projects.	**2015 Status:** HMPSC working to identify staff and resources and to complete this action.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.2: Undertake site-specific studies to better characterize flood risks to areas with extensive flood loss histories (see also municipal actions in jurisdictional appendices).	High	UCOEM	Starting within six months, then ongoing	Union County OEM staff, municipal staff	This is an essential step in developing flood mitigation actions.	**2015 Status:** Partially complete with the publication of FEMAs New Jersey Coastal Flood Study. ABFE maps for the coastal areas of Union County released by FEMA in February of 2013.
2.A.3: Coordinate with state efforts to undertake detailed vulnerability assessments and develop mitigation options for critical facilities in A and AE zones.	Medium - High	Union County and municipal OEMs	To be determined based on funding	Existing staff	Step in process of securing grant funds to mitigate risks to these sites.	**2015 Status:** See jurisdictional appendices for identification of critical facilities in the floodplain

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.4: Use best possible flood data, including DFIRM and Map Mod data, if available, in next plan update. Track implementation of Risk MAP initiative to ensure Union County and municipalities gain full advantage of opportunities under this program.	High	Union County and municipal OEMs	3-years	Existing staff	This is essential data for establishing flood risk.	**2015 Status:** HMPSC used the best available flood hazard data which at the time of the Plan update was the ABFE data released by FEMA/Risk MAP in February, 2013.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.5: Continuously update and verify status of repetitive loss and severe repetitive loss lists from the NFIP.	High	Union County and municipal OEMs	Ongoing	Existing staff	Essential to continuing the county's efforts to reduce flood losses. Enables the county to appropriately prioritize its actions to mitigate repetitive loss and severe repetitive loss properties, in accordance with FEMA requirements (and contributes to qualifying the county and local jurisdictions for the 90:10 federal-local match under the SRL program).	**2015 Status:** The County requests this data as mitigation program efforts, funding, and storm events warrant.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
~~2.A.6: Inventory critical facilities to identify those in geographic areas that may be prone to high ground motion during earthquakes (due to proximity to faults or to soil characteristics), and those with structures that may be at risk during an earthquake.~~		~~UCOEM, with support from NJGS~~	~~1 year~~	~~FEMA grants, existing staff and resources~~	~~Allows risk-based decisions regarding protection of critical facilities.~~	**2015 Status:** Critical facilities inventoried and included in each jurisdictional appendix.
~~2.A.7: Coordinate with state efforts to prioritize critical facilities and conduct more detailed earthquake risk assessments, taking into account the relative importance of the facility and the level of seismic hazard.~~		~~UCOEM, FEMA, NJGS~~	~~1 year~~	~~FEMA grants, existing staff and resources~~	~~Serves as first step in a long-term plan to reduce risks to the most critical county facilities.~~	**2015 Status:** HMPSC agreed to delete this action to focus on higher risk hazards.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards

Action	Priority	Responsible Entity	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
~~2.A.8: Work with NJGS to determine soil and shake characteristics at specific sites that the county has identified as priority critical facilities with potential vulnerabilities to earthquake forces, and then work with engineers to develop appropriate projects.~~		~~UCOEM with NJGS~~	~~1 year~~	~~Potential collaboration with ongoing NJGS Hazards US-based earthquake studies~~	~~This is an essential step in developing appropriate mitigation actions for priority facilities.~~	**2015 Status:** HMPSC agreed to delete this action to focus on higher risk hazards.
~~2.A.9: Coordinate with NJGS and other county, state and federal agencies to better identify specific sites in the county that may be exposed to the effects of geo-hazards such as landslides, sinkholes, and subsidence.~~		~~UCOEM, New Jersey Department of Environmental Protection (NJDEP), NJGS~~	~~2 years~~	~~Existing resources and staff~~	~~Although risk does not appear to be particularly high from these hazards, there remains a need to better understand the hazards on a site-specific basis. Studies will be used as the basis for developing additional actions and strategies to mitigate risk, particularly when critical facilities are at risk.~~	**2015 Status:** HMPSC agreed to delete this action to focus on higher risk hazards.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.10: Using a prioritized list of state, county, and local facilities, coordinate with state effort to survey wind vulnerabilities, based on criteria such as age of the facility, value of operations, proximity to the coast, etc.	Low	UCOEM, NJOEM, with cooperation of other agencies that own and/or operate the facilities; New Jersey State Climatologist	1-year	Existing resources and staff	Although wind is not as significant a risk to the county as some other hazards, there are likely some critical facilities that are quite vulnerable to wind hazards, and where these vulnerabilities may be relatively inexpensive to mitigate.	**2015 Status:** This has not been completed due to lack of resources and other critical priorities.
2.A.11: Conduct wind risk assessments on a limited number of high-priority facilities that appear to be vulnerable to high winds. Assessments will use standard FEMA guidelines, procedures, and software, including the wind hazard database.	Low	UCOEM, municipal OEMs	1-year	Existing resources and staff	Quantifies risk to most important facilities.	**2015 Status:** Action has not been started. Remains to be completed. Though the County has moderate risk due to wind damage, the higher risk is related to tree fallings.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.12: Coordinate with state efforts to inventory or survey prioritized areas to determine if there is a need for additional study or data collection related to wildfire and/or urban-interface fires. Focus of inventory/study will be on identifying areas where there exist vulnerable populations or built environment and/or areas where fuel loads and other conditions suggest potential for wildfire risk.	--	UCOEM, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing resources and staff	Establishes basis for additional studies and eventually mitigation actions, if they are indicated.	**2015 Status:** Complete. The US Forest Service has produced Wildland Urban Interface (WUI) maps to identify populations at risk.
2.A.13: Coordinate with state efforts to maintain current information about fuel loads and conditions that may affect potential for fires.	--	UCOEM, New Jersey Forest Fire Service	Ongoing	Existing resources and staff	Provides a basis for risk assessment.	**2015 Status:** Complete. In 2010 the NJDEP produced Wildfire fuel hazard maps for the state of New Jersey.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.14: For areas with significant risk from wildfires or urban interface fires, perform detailed studies to objectively determine (a) the potential for wildfires, including likely magnitude, and (b) vulnerabilities of surrounding populations, built environment, and functions.	--	UCOEM, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing resources and staff	Provides a basis for risk assessment.	**2015 Status:** Complete. In 2010 the NJDEP produced Wildfire fuel hazard maps for the state of New Jersey. In addition, the The US Forest Service has produced Wildland Urban Interface (WUI) maps to identify populations at risk.
2.A.15: Coordinate with state efforts to conduct wildfire risk assessments for areas and assets that are determined to have the most hazard (fuel load, etc.) potential, and the most vulnerable structures, populations, or operations.	Low	UCOEM, New Jersey Forest Fire Service, outside engineering consultants	Ongoing	Potential FEMA grants to conduct studies as indicated.	Quantifies which facilities are at most risk, and forms basis for determining where mitigation actions should be contemplated.	**2015 Status:** Remains to be completed.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.16: Maintain effective coordination and information sharing related to hazardous material sites with NJOEM and the Right to Know (RTK) Network.	Medium	UCOEM, RTK Network, NJOEM.	Ongoing	Existing resources and staff	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.	**2015 Status:** Ongoing coordination between Union County OEM and the NJDEP.
2.A.17: Complete data collection for Geographic Information System (GIS) analysis and mapping of potential areas of impact related to hazardous material sites.	High	UCOEM	Ongoing	Existing resources and staff	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.	**2015 Status:** Ongoing coordination between Union County OEM and the NJDEP.
2.A.18: Integrate data about hazardous materials with most current available information about other risk factors, e.g. population, climate, other site-specific characteristics.	High	UCOEM, RTK Network, NJDEP, USEPA	Ongoing	Existing resources and staff	Potentially allows integration of hazardous materials information with data related to natural hazards.	**2015 Status:** Ongoing development of GIS interface that can be used by staff in the field.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.19: Complete a detailed analysis of past losses related to winter storms to determine if additional study is indicated.	--	Union County and local agencies with critical facilities	2-years	Existing resources and staff	Provides a basis for determining if any additional study is warranted; data can be used as part of next plan update.	**2015 Status:** Complete. This action completed as part of the 2015 Plan update.
~~2.A.20: Undertake a survey of critical facilities to identify and prioritize those that may have structural characteristics that make them vulnerable to excessive snow and ice loads.~~	--	~~Union County and local agencies with critical facilities~~	~~2 Years~~	~~Existing resources and staff~~	~~Provides a basis for prioritizing actions, including mitigation.~~	**2015 Status:** HMPSC agreed to delete this action to focus on higher risk hazards.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
~~2.A.21: Complete a detailed analysis of past losses related to nor'easters and other coastal storms to determine if additional study is indicated. Work with state and federal agencies to develop a detailed characterization of erosion history and risks in particular.~~	--	~~Union County and local agencies with critical facilities; New Jersey State Climatologist~~	~~3 years~~	~~Existing resources and staff~~	~~Provides a basis for determining if any additional study is warranted; data can be used as part of next Plan update.~~	**2015 Status:** HMPSC agreed to delete. This study would most likely be similar to the FEMA New Jersey Coastal Flood Study that has already been completed. ABFE maps for the coastal areas of Union County released by FEMA in February of 2013. The HMPSC decided to delete this action based on the study completed already, combined with the low risk from the erosion hazard.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.22: Work with appropriate agencies to identify specific areas that are vulnerable to storm effects, then inventory assets and populations in these areas as the basis for a risk calculation.	Medium	UCOEM, municipal OEMs, NOAA, USACE, local officials, NJDEP	3-years	Existing resources and staff	Provides a basis for determining if any further risk assessment action is warranted.	**2015 Status:** This effort is ongoing. NJDEP has initiated developing building footprint data within flood zones to further identify properties at risk.
2.A.23: Work with NJDEP to more fully understand the dam hazard rankings and methodology behind them, particular regarding high-hazard sites.	--	UCOEM, NJDEP	3-years	NJDEP, USGS, NRCS	Provides a basis for further development and prioritization any future actions or strategies.	**2015 Status:** Complete. This action completed as part of the 2015 Plan update and risk assessment.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.24: Undertake more detailed engineering study of Clark Reservoir Dam, which may pose a risk downstream.	Low	UCOEM with NJDEP, NJOEM	Ongoing	NJDEP, USGS, NRCS	Provides a basis for additional work on risk assessment, or on specific mitigation actions, including modifications to structures, evacuation plans, or public information.	**2015 Status:** This action remains to be completed. This remains a low priority for the County given its high cost/low benefit ratio. The Dam spills into a downstream park, so it is likely that the inundation area is not intensively development.
~~2.A.25: Conduct detailed risk assessments for dams that appear to have vulnerabilities, and where there is potential for significant damage or loss of life.~~	--	~~UCOEM, NJDEP, engineering consultants~~	~~Ongoing~~	~~NJDEP, USACE, USGS, NRCS~~	~~Quantifies potential losses from dam failures where vulnerabilities have been identified.~~	**2015 Status:** HMPSC determined that the Clark Reservoir Dam is the only dam potentially at risk. HMPSC agreed to delete this action considering all dams in the county follow the NJDEPs dam safety regulations.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.26: Work with state and federal agencies to compile additional information about potential impacts of storm surge in coastal areas, in order to develop a more comprehensive understanding of the risks prior to undertaking additional studies or actions.	--	UC OEM, with cooperation from NJDEP and potentially USACE	Ongoing	NJDEP, USACE, USGS, NRCS	Storm surge may present some risk to particularly vulnerable assets and populations, but it is necessary to develop and analyze specific kinds of data (such as ground and asset elevations, numbers of population at risk, etc.) in order to make a reliable determination.	**2015 Status:** Action completed with the publication of FEMAs New Jersey Coastal Flood Study. ABFE maps for the coastal areas of Union County released by FEMA in February of 2013.
2.A.27: In areas that are determined to have significant risk (based on preliminary study), initiate an effort to obtain additional information about (1) surge hazards, including modeling, to the extent that more information is needed and (2) the assets, populations, and functions in identified surge zones.	Medium	UCOEM with cooperation from NJDEP and potentially USACE. Some potential for FEMA to contribute	2-years	Possibility of cooperation from state and federal agencies	This information provides the basis for detailed risk assessment, and will allow the county to determine if mitigation actions are warranted.	**2015 Status:** The USACE has initiated a study in the lower Rahway that may include this type of modeling and detailed risk assessment.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
2.A.28: Conduct a detailed, quantitative risk assessment for storm surge.	Medium	UCOEM with assistance from NJDEP and USACE	2-3-years	Possibility of cooperation from state and federal agencies. If sufficient risk is identified in preliminary studies, potential for applying for federal grant funds for additional detailed study.	Basis for determining if mitigation is indicated.	**2015 Status:** Complete. This action completed as part of the 2015 Plan update and risk assessment.
2.A.29: Consolidate and incorporate relevant local data related to hazards, extent, probability, exposure, risk, history, etc.	High	Union County and municipal OEMs	Ongoing	Existing resources	Basis for hazard identification, risk assessment, and mitigation strategies	**2015 Status:** Complete. This action completed as part of the 2015 Plan update and risk assessment.
2.A.30: Conduct detailed study to identify and map erosion hazard zones.	Low	Union County and municipal OEMs	4-years	FEMA, NJDEP	Mapping and defining erosion hazard zones will be useful to future development decisions.	**2015 Status:** This has yet to be completed due to lack of resources.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards

Action	Priority	Responsible Entity	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
2.B.1: Participate in training and workshops.	High	Union County and municipal OEMs, NJOEM, New Jersey Forest Fire Service	Ongoing	Existing state resources	Workshops and training are an important venue to promote and increase participation in hazard mitigation programs and reaches a wide variety of people and interests.	**2015 Status:** Training and workshops are ongoing.
2.C.1: Develop a database inventory of critical facilities countywide (county-, local-, and privately-owned), including fire and police stations, medical facilities, major public buildings important for emergency response and recovery, and critical lifeline transportation and utility nodes such as bridges, water treatment plants, wastewater treatment plants, high voltage electric substations, and hazardous materials facilities.	High	UCOEM	Ongoing	Existing staff, possibly consultants depending on funding availability	Developing basic information such as this will allow the state to meet federal requirements for prioritizing mitigation grant funds that will be directed to reducing losses to critical facilities.	**2015 Status:** Union County OEM has developed an initial database. There is an ongoing effort to improve the data.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Action	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**	**Status of Action**
~~2.C.2: Prioritize critical facilities and complete Phase 1 site surveys to identify vulnerabilities.~~	--	~~Union County and municipal OEMs~~	~~Commencing immediately, then ongoing~~	~~Existing staff~~	~~This is an essential first step in understanding risks and developing mitigation actions.~~	**2015 Status:** HMPSC agreed to combine this action item with 2.C.1. Site surveys of critical facilities will be completed If required as part of prioritizing.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.A.1: Continue working with the State, as well as local jurisdictions, to encourage local cooperation in making Repetitive Loss (RL) (and SRL) property mitigation a high priority, and to offer municipalities technical support in carrying out the requirements of FEMA mitigation programs as well as current information related to RL and SRL properties.	High	UCOEM	Ongoing	Existing staff	This represents a basic requirement to initiate and sustain program momentum for RL and SRL mitigation.	**2015 Status:** Ongoing effort as funding becomes available. Union County OEM supports the municipalities and provides assistance with developing Letters of Interest (LOI) and other funding opportunities.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.A.2: Provide grants information, planning tools, training, and technical assistance to increase the number of public and private sector hazard mitigation projects.	High	UCOEM, NJOEM, FEMA Region II	Ongoing	Existing Resources, Mitigation Grant	Expanding the number of hazard mitigation projects will improve the county's resistance to hazards and reduce the impact of hazard events on its municipalities.	**2015 Status:** Ongoing effort as funding becomes available. Union County OEM supports the municipalities and provides assistance with developing Letters of Interest (LOI) and other funding opportunities.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.A.3: Conduct direct outreach and education to municipal OEMs and other potential participants in Plan maintenance and future Plan updates	High	UCOEM	Ongoing	Existing resources	Increases efficacy and participation in hazard mitigation planning	**2015 Status:** Union County OEM has worked with municipalities to increase participation in the planning process. Number of participating municipalities has increased from 13 in 2010 to 20 in 2015 (Elizabeth City prepared their own plan).

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
~~3.A.4: Work with NJOEM and FEMA to incorporate "recommended revisions" per NJOEM and FEMA Region II review of this Plan into future Plan updates.~~	~~High~~	~~GCOEM~~	~~Ongoing~~	~~Existing resources~~	~~Builds on successful completion of initial Plan and incorporates NJOEM and FEMA input.~~	**2015 Status:** Complete. This was completed as part of the 2010 Plan update and will be done in 2015 as well.
3.B.1: Conduct community outreach, workshops, and training to increase NFIP participation (coordinate with outreach actions listed under Objectives 1.A and 1.B).	High	Union County Economic Development Corporation / UCOEM	Ongoing	Existing resources	This action encourages participation in the program, so that flood losses will be insured and covered, and it allows eligibility in the FMA program.	**2015 Status:** Outreach to municipalities to increase NFIP participation is ongoing.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.B.2: Encourage municipalities to participate in the CRS program, including potentially setting up CRS site visits and/or workshops for interested jurisdictions.	High	UCOEM, NJOEM	2-years	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved.	**2015 Status:** Ongoing. Union County OEM continues to encourage municipalities to join the CRS program. In 2014 Roselle Park Borough became the 4th municipality in the Union County to join the CRS program.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.B.3: Encourage municipalities to include identification and prioritization of actions related to future participation in and compliance with the NFIP	High	Union County and municipal OEMs	Ongoing	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved	**2015 Status:** Ongoing. This is a requirement of the Plan and Union County OEM assists municipalities as necessary with identifying and prioritizing actions related to compliance with the NFIP.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.C.1: Encourage enforcement of floodplain management as it relates to new and existing construction by integrating hazard mitigation practices with zoning, subdivision ordinances, comprehensive planning, and other land use tools at the municipal level.	High	Union County Economic Development Department/ UCOEM	Ongoing	Existing resources and Federal grant funds (FEMA Community Assistance Program-State Support Services Element)	Guides communities in a more effective control and use of floodplains.	**2015 Status:** The County works with towns on every application that requires approval to ensure that approvals are compliant with existing local and state regulations.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.C.2: Coordinate with state efforts to encourage the New Jersey League of Municipalities to become more involved in mitigation activities, and in particular to support the activities described in Action 3.C.1 and 3.D.1.	Low	New Jersey League of Municipalities	Ongoing	Existing staff	Advances all goals in the Plan by increasing preparedness and knowledge of citizens, and law and policymakers.	**2015 Status:** The County supports efforts from other agencies and organizations to encourage more effective mitigation and land use planning, but continues to focus its resources on assisting the towns directly.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
~~3.D.1: Encourage enforcement of floodplain management as it relates to new and existing construction by integrating hazard mitigation practices with zoning, subdivision ordinances, comprehensive planning, other land use tools, and environmental and other regulatory mechanisms via state requirements, reviews, and regulations. Coordinate with the State Planning Commission to integrate the State Development and Redevelopment Plan and the State Hazard Mitigation Plan Update.~~	~~–~~	~~UCOEM, NJDCA, NJDEP, State Planning Commission, municipal building inspectors, municipal floodplain managers, local planning/zoning boards~~	~~Ongoing~~	~~Existing resources~~	~~Guides communities in a more effective control and use of floodplains.~~	**2015 Status:** HMPSC agreed to combine this action item with 3.C.1. considering the action covers much of the same task.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.E.1: Develop a simple GIS platform, or build upon an existing platform, to maintain and analyze critical facilities inventories and information about hazards.	High	UCOEM in cooperation with state or county agencies	1-year	Existing resources and staff	Provides a basis for understanding risks and maintaining most current information; provides a good means of maintaining data needed for period updates to the Hazard Mitigation Plan; and (potentially) helps to identify promising sites, mitigation actions, and grant proposals.	**2015 Status:** This is ongoing and part of an existing database already developed by Union County OEM. Will continue to enhance database and develop other GIS platforms.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.F.1: Explore potential for possible regionalization or consolidation of hazard mitigation planning, administration, and/or implementation at the county level.	Medium	UCOEM	3-years	UASI North Region	This could help support, coordinate, and consolidate hazard mitigation capabilities.	**2015 Status:** Support from Union County OEM is ongoing and will continue in the future. OEM will continue to lead HMP process for current and future Plan updates.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
3.G.1: Provide regular summaries to neighboring communities re: plan monitoring and update procedures (as outlined in Section 10) and post updates on Union County's website for public access to the plan update process.	Medium	UCOEM	On-going	Existing resources and staff	This will help Union County meet plan update requirements as well as provide a mechanism for identifying possible cooperative efforts for neighboring communities.	**2015 Status:** The 2010 plan was updated as needed in response to severe storm events, information about these activities was posted and distributed through the website and other means to stakeholders. The plan maintenance procedures have been reviewed as part of this update.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
~~4.A.1: Coordinate with state efforts to develop and implement a detailed severe repetitive loss mitigation strategy that will qualify the county and municipalities for 90:10 cost share under the FEMA SRL program.~~	~~High~~	~~UCOEM, NJOEM~~	~~Immediate and ongoing~~	~~Existing local, state, and federal funding programs~~	~~Protects people, property, and response assets while removing high cost structures from the NFIP.~~	**2015 Status:** Action deleted. The Biggert Waters Flood Insurance Reform Act of 2012 eliminated the SRL program.
4.A.2: Continue working with local and regional jurisdictions to encourage and support their efforts to mitigate RL (and SRL) properties, either individually through the use of cluster solutions and/or basin projects, as appropriate, and offer technical support in carrying out the requirements of FEMA mitigation programs. (see action plan within individual municipality appendices for further detail).	High	UCOEM, NJOEM	Ongoing	Federal grants, Green Acres, other open space funds	Initiates a long-term process to protect property from effects of repetitive flooding.	**2015 Status:** Effort is ongoing. Union County OEM provides support and technical assistance with mitigating RL and SRL properties to jurisdictions as needed.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
4.A.3: Implement mitigation projects and programs intended to reduce risk to critical facilities (see action plan within individual municipality appendices for further detail).	Varied	Varied	Ongoing	Federal grants, other state and local sources	Reduces exposure and risk to critical facilities.	**2015 Status:** See action plan within individual municipality appendices for projects related to mitigating critical facilities.
~~4.A.4: Implement other mitigation projects and programs as appropriate at the municipal level~~	~~Varied~~	~~Varied~~	~~Ongoing~~	~~Federal grants, other state and local sources~~	~~Varied~~	**2015 Status:** HMPSC agreed to delete this action since it doesn't apply to Union County. See action plan within individual municipality appendices for other mitigation projects at the jurisdictional level.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
~~4.B.1: Integrate hazard mitigation Plan and priorities into floodplain management, zoning, subdivision regulation, and other local regulations as appropriate.~~	~~High~~	~~UCOEM, municipal OEMs and local permitting and planning offices~~	~~Ongoing~~	~~Existing County and Local Resources~~	~~Implements all goals by mitigating risk to new construction on a jurisdiction-wide basis~~	**2015 Status:** HMPSC agreed to delete this action since it doesn't apply to Union County. See action plan within individual municipality appendices for actions related to these activities at the jurisdictional level.
~~4.B.2: Ensure full and effective enforcement of building codes, floodplain management, zoning, and other risk-reducing regulations.~~	~~High~~	~~UCOEM, municipal OEMs and local permitting and planning offices~~	~~Ongoing~~	~~Existing County and Local Resources~~	~~Advances all goals in the plan by ensuring effectiveness of existing local tools~~	**2015 Status:** HMPSC agreed to delete this action since it doesn't apply to Union County. See action plan within individual municipality appendices for actions related to these activities at the jurisdictional level.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Action	Priority	Responsible Entity (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority	Status of Action
4.B.3: Integrate hazard mitigation priorities into transportation planning and other capital planning	Medium	UCOEM, County Engineering, County Economic Development Department	Ongoing	Existing County Resources	Advances all goals in the plan by ensuring consistency of major investments with mitigation priorities	**2015 Status:** The County has worked to integrate mitigation needs with capital priorities and will continue to prioritize mitigation actions within the transportation and other County planning efforts.

New actions identified as part of the 2015 Plan update are included below in Table 5-2.

Table 5-2
New (2015) Union County Hazard Mitigation Goals, Objectives, and General Actions

GOAL 1: Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact						
Objective	**Action**	**Priority**	**Responsible Entity**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 1.A: Increase awareness of risks and understanding of the advantages of mitigation by the general public and local government officials (see also Action Plan within the municipal appendices).	1.A.2: Identify ways to improve County's capacity for mass evacuations	Medium	Union County OEM	Within 3 years	Union County OEM	Improved ability to evacuation populations quickly can save lives.
Objective 2.A: Improve availability of the county and participating municipalities to	1.A.1: Training for using GIS interface on tablets in the field	High	Union County OEM	Next 2-4 years	Union County OEM	Allows "real-time" access to GIS data while working in the field.

collect data related to all relevant hazards for use in future planning efforts.	1.A.2: Inspect all levees on county property as part of dam inspections	Medium	Union County Engineering	Within 5 years	Union County OEM	Provides additional inspections to ensure continued dam safety.
GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities						
Objective 3.A: Continue support of hazard mitigation planning, project identification, and implementation at the municipal and county level.	Work with towns to ensure extended care facilities have back-up power or quick connects	Medium	Union County OEM/Engineering	Within 1 year	Union County OEM	Facilities that require special evacuation needs are a high priority to allow them to shelter in place.
	Improve options for power redundancy within County	Medium	Union County OEM/Engineering	5-10 years	Union County OEM	Much of the public and private expense from Sandy within the County was a result of power loss. Improving power duplicity would improve emergency response and free resources to address mitigation needs.
	Purchase portable generators for use	High	Union County OEM	2 years	Union County OEM	Previous storms have demonstrated that having additional mobile generators on hand will help

	Generator for Public Works building	High	Department of Public Works	1 year	Union County OEM	Its purpose is to maintain and repair the counties infrastructure in regards to roads and traffic signals, debris removal, storm sewers, dams and flood control. Additionally, it is a primary fuel source for all of the counties road crews and some surrounding municipalities.
	Find location for a County-wide distribution center. Perhaps in the Quarry.	Medium	Union County OEM	2 years	Union County OEM	The County needs a central location for emergency operations and distribution to communities. The OEM's location is insufficient for this purpose.

5.2.5 Municipal Mitigation Actions

In addition to the county-wide mitigation actions, jurisdictional specific mitigation actions were also developed as part of the 2010 Plan. Initial priorities for the 2010 Plan were set in a similar manner as the county actions. Working with the local jurisdictional point of contacts the mitigation action items with highest priority were generally considered to be the most cost effective and most compatible with the communities' social and cultural values. Similar to the county actions, the 2010 mitigation actions for each participating municipality were also analyzed using the STAPLEE criteria and results reviewed and approved by each of the municipal coordinators.

As part of the 2015 Plan update the jurisdictional mitigation actions were relocated from the Mitigation Action Plan section to individual jurisdictional appendices. See Appendices 1-20, Section 4, for the status of the jurisdictional specific mitigation actions identified in 2010 as well as new actions identified as part of the 2015 Plan update. As mentioned in Section 3, seven additional jurisdictions participated in the Plan update in 2015. These jurisdictions included

- Clark, Township of
- Fanwood, Borough of
- Kenilworth, Borough of
- Mountainside, Borough of
- Roselle, Borough of
- Scotch Plains, Township of
- Winfield, Township of

For the jurisdictions listed above all mitigation action items identified are new for the 2015 Plan update. For all jurisdictional actions, individual communities will implement identified projects with their own resources as feasible using capital improvement funds. The individual municipalities will generally follow the priorities set in this Plan update, although variations in funding may alter the specific order. However, it is anticipated that the majority of the actions in the Plan update will be implemented as funds become available through various federal mitigation grant programs.

5.3 Capabilities

Although not required by Disaster Mitigation Act of 2000 or the Interim Final Rule, a capability assessment adds context to a mitigation plan by providing an inventory of a municipality's programs and policies, and an analysis of its capacity to carry them out. These are essential for developing mitigation strategies and actions.

The 2010 Plan included a capability assessment which reviewed Union County's resources in order to identify, review, and analyze what the county is doing to reduce losses, and to identify the framework that is in place for the implementation of new mitigation activities. The HMPSC reviewed the capability assessment from the 2010 Plan and agreed that there have been minimal changes in the county capabilities and therefore was not completed again as part of the 2015 Plan update. The assessment

from 2010 is useful in gauging whether the current local organizational structures and inter-jurisdictional or county coordination mechanisms for hazard mitigation could be improved, and how.

The focus of the 2015 Plan update was updating capability assessments for each of the participating municipalities. This local capability is extremely important, because the municipal officials know their own landscape best. Additionally, many of the most critical and effective hazard mitigation strategies and programs, including enforcement of floodplain management, building codes, and land-use planning, require a strong local role to achieve effective implementation.

New Jersey follows a strong *home rule* legal philosophy. That philosophy dictates that all land in the state not directly belonging to a government entity is incorporated into a municipality. State statutes require each municipality to assign an individual to be responsible for its local emergency management duties. The municipal emergency management coordinator is responsible for coordinating municipal emergency response and recovery operations with county, state, and federal officials.

5.3.1 Methodology

The 2010 capability assessment resulted from research, interviews, and surveys. Relevant documents were reviewed related to hazard mitigation, including especially the New Jersey State Hazard Mitigation Plan Update (2008), as well as state and federal sources related to funding, planning, and regulatory capability.

For the county capability assessment, a series of in-depth one-on-one interviews provided key insights and information. In Union County, these interviews were conducted during the period of September, 2008 through February 2009 with the following individuals:

- Salena Carroll, Deputy Emergency Management Coordinator, County Office of Emergency Management
- Thomas Mineo, County Engineer, County Division of Engineering
- Matt Mathan, Lead, County Information Technologies GIS Section
- Thomas Connell, Community Development Chief, Division of Planning and Community Development
- Thomas Macdermot, Chief, Bureau of Construction Management

5.3.2 Capability Assessment for Union County

In accordance with New Jersey's home rule structure, authority over the three key tools for proactive hazard mitigation–land use planning, floodplain management, and building code enforcement–reside at the municipal level. For more on this, see Section 8.5. Counties play a coordinating role in these matters.

Relevant Ordinances and Policies

This section, as illustrated in Table 5-3 provides a list of Union County ordinances and policies that have the potential to affect and/or promote mitigation within the county. Understanding which ordinances

and policies affect mitigation in the county is a helpful component to mitigation activities. Many of the ordinances and policies that most directly affect development in relation to hazards reside at the municipal level. These include zoning, floodplain management, and building code enforcement.

Table 5-3

Union County Ordinances and Policies Relevant To Hazard Mitigation

Ordinance/Policy	Description	Enforcement
Municipal Land Use Law	Encourages appropriate development in municipalities that promotes public health, safety, morals, and general welfare.	Municipal planning and zoning offices.
Cross-Acceptance Report	Encourages consistency between municipal, county, regional, and state plans for development and redevelopment.	Union County Division of Planning and Community Development
Union County Traffic and Transportation Plan	Encourages sound planning for growth and economic development.	Union County Division of Planning and Community Development
Union County Farmland Preservation, Open Space, Parks and Recreation Trust Fund Plan	Trust fund referendum to set aside $.01 per $100 of assessed valuation to preserve agricultural lands or open space.	Union County Division of Planning and Community Development
Emergency Operations Plan	The county is required by state Statute to update its Emergency Operations Plan every four years. The current Plan used is dated [Insert Date].	Union County Office of Emergency Management
The *Union County Alliance*	A bi-partisan consortium of government, business and civic leaders whose principal missions are to position the County as a better place to live and work, and to advance the County's interests on key development issues.	Union County Division of Planning and Community Development

Fiscal Capacity

This section, as illustrated in Table 8.4.2-1, provides a list of local funding sources within Union County and determines if that funding source can be used to affect or promote mitigation within the county. Understanding where potential funding sources are available to the county is a helpful component to mitigation activities.

Table 5-4

Union County Funding/Financing Sources Relevant To Hazard Mitigation

Financial Resources	Accessible or Eligible to Use
General Fund	Yes
Development Fees	No
Community Development Block Grant (CDBG)	Yes
Capital Improvements Project Funding	Yes
Authority to Levy taxes for Specific Purposes	Yes
Fees for Water, Sewer, Gas or Electric Service	Yes
Green Acres Fund	Yes
Impact Fees for Homebuyers or Developers for New Developments/Homes	No
County Match Fund	Yes
Transportation Grant Funds	Yes

Generally, the following conditions must be met in order for a project to be considered for county funding: [depending on the funding source a project may have to be approved by a standing committee (as with Community Development Funding or Open Space Trust Fund Dollars) or may only need the recommendation of the approval of the County Manager and approval by the County Board of Chosen Freeholders.. Additionally, counties may participate in projects that affect county infrastructure, including roads and drainage infrastructure.

Technical, Administrative, and Regulatory Capacity

This section provides a review of the administrative and technical resources within the county's departments to determine if all of the necessary resources are available to Union County to engage in

mitigation planning processes. Table 8.4.3-1 indicates potential resource needs, and indicates whether the county currently has staff with that expertise or available outside contractors.

Table 5-5

Union County Administrative and Technical Capacity

(Source: http://www.ucnj.org/econdev/ucecon.html#f)

Staff/Personnel Resources	On Staff	Department/Agency
Planner(s) or engineer with knowledge of land development and Land management practices	Yes	Bureau of Land and Facilities Planning.
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Yes	Division of Engineering
Planners or Engineer(s) with an understanding of natural and/or human-caused hazards	No	
Floodplain Manager	No	
Surveyors	Yes	Division of Engineering
Staff with education or expertise to assess the community's vulnerability to hazards	Yes	Bureau of Land and Facilities Planning. and Division of Engineering
Personnel skilled in GIS and/or HAZUS	Yes	Bureau of Land and Facilities Planning. and Division of Engineering
Scientists familiar with the hazards of the community	No	
Emergency Manager	Yes	OC EOM

Additionally, although most land-use related regulatory powers in New Jersey reside at the municipal level, counties have the ability to influence and guide development in important ways. These are discussed below.

Intra- and Inter-Jurisdictional Coordination

In 2010, the County Office of Emergency Management reported having a good relationship with its municipal counterparts as well as other county departments. In the past, the majority of this interaction has been in response to events and not necessarily specific to hazard mitigation projects, however it is assumed with the development of this hazard mitigation plan there will be better communication or coordination on project implementation. The relationship with NJOEM is well established and close coordination has happened during previous interactions. The county has had only one event requiring significant FEMA interaction and it was reported that things went smooth and all parties involved were satisfied with the outcome.

Regionalization

Municipalities in New Jersey are currently being encouraged to consolidate (*regionalize*) services and functions. These may include police, fire, EMS, limited emergency operations functions, and other items.

Municipalities in New Jersey are currently being encouraged to consolidate ("regionalize") services and functions. These may include police, fire, EMS, limited emergency operations functions, and other items. In Union County, the county freeholders have taken the lead to build a consensus among its residents on shared services.

The county has been awarded a $104,500 grant in 2010 from the state Department of Community Affairs that enabled it to create the Shared Services committee, both with the intention of creating initiatives on shared and regionalized services. Union County was only one of two counties in the entire state to receive the award. Union County Board of Chosen Freeholders held a Shared Services meeting with more than 20 representatives from 11 municipalities in early September. The committee explored more than 60 areas to share services, and agreed to pursue mutual opportunities in several areas, including Information Technologies, Emergency Communications/911 dispatching, and Animal Control.

Two areas showing regionalization are communications and in the detection, deterring, response to and recovery from threats and incidents of terrorism. The New Jersey Urban Security Initiative (UASI) provides resources to state, county, and municipal governments to develop plans for terrorism events on a regional level. While this initiative focuses primary on operations and is still relatively a new concept, the coordination and cooperation being established will strengthen the process of regionalizing other services in the county.

In terms of regionalizing hazard mitigation efforts the county currently feels this would not work and the municipal OEMs should continue to remain responsible for their mitigation programs. Reasons for this revolve mainly around limited staffing at the county level that would not allow the close coordination needed to effectively manage a program of this type.

Land Use Planning and Regulation

The Union County Division of Planning and Community Development has the authority to approve or reject all land development projects and site plans at the municipal level under the New Jersey Municipal Land Use Law. This gives the county some control and provides a mechanism for coordinated development. The Division of Planning and Community Development also manages drainage issues/projects along county roads and holds meetings in which the municipalities are encouraged to participate and bring forth current issues.

The Division of Planning and Community Development carries out a wide range of planning functions and programs relating to land use, environmental and infrastructure issues in Union County. The Division is responsible for preparing and updating the land use and demographic elements of the County Comprehensive Plan. This division prepares and updates the Open Space and Recreation, Aquifer Protection, Water Supply, Wastewater Management, Storm Drainage, energy, and general environmental resources management elements of the County Plan. Division staff also conducts environmental and functional planning reviews required by other divisions under various regulations.

The Division of Planning and Community Development is responsible for reviewing development proposals (i.e. Subdivision and Site Plan Applications) to determine whether county roads/property and or drainage facilities would be adversely affected. The objective with this is to reduce hazards to the general public caused by unsafe traffic conditions and or flooding. The county also encourages municipalities to coordinate large development projects with them to address any transportation, wastewater, and storm drainage issues that may arise.

Floodplain Management

Floodplain management in Union County is a function strictly handled at the municipal level of government. The county is not responsible for adopting or enforcing a minimum floodplain ordinance. At the municipal level, all 21 municipalities have adopted some type of ordinance that restricts or controls development or construction in flood prone areas. For more information on floodplain management and NFIP participation at the municipal level, see Appendices 1-20.

The county is required to follow all applicable national and state restrictions pertaining to floodplains and wetlands when acquiring land for parks and recreation through programs such as Green Acres or Farmland Preservation. Such lands are then owned by the county.

Building Code Enforcement

Building code enforcement in Union County takes place at the municipal level of government. All municipalities are required by New Jersey law to enforce the New Jersey Uniform Construction Code. Building codes are either enforced by local inspectors or third party contractors. Union County manages the county Construction Board of Appeals, which provides a mechanism to solve disputes over construction practices at the municipal level.

Economic Development Planning

The Union County Department of Economic Development is responsible for promoting and developing the economic growth of the county. The Director of Economic Development is fully responsible for the implementation and coordination of all economic development plans and programs including matters affecting workforce investment, community development, quality of housing and preservation of historic sites and programs. The Department works to strengthen Union County's economy and positioning the county to compete in a global marketplace by stimulating and creating new jobs, retaining existing businesses, and facilitating economic growth and development in partnership with the Union County Alliance, the Union County Economic Development Corporation and all other public/private partnerships.

1. Capital Improvements Planning

The County Treasurer, by law, is the custodian of all county funds and is responsible for meeting the county's long and short term capital fund requirements. Drainage projects and improvements to roads, bridges, and county facilities receive annual appropriations in the budget which are important projects in terms of hazard mitigation.

2. Land Conservation

Union County is highly developed and very little land is available for agriculture, mining, logging or other extractive industries. Indeed, the County has no mining or logging industries at all, and had only marginal representation in these areas in recent history. Agriculture was once a major industry, but the rapid pace of development that marked the twentieth century saw the conversion of farmlands into industrial and residential properties.

The County's park system and municipal parks provide for over 6,000 acres of open space and recreational facilities for the County population. That acreage amounts to almost 10 percent of the County's total land area.

Union County maintains an active land conservation program through two specific programs, the Farmland Preservation Program and the Open Space Preservation Program. Funding for the Open Space Preservation Program comes partially through the State's Green Acres program and also from a county open space tax. As such, the county is bound to all Green Acres regulations during the appraisal process of acquiring land which includes surveying, soil studies, etc. Once acquired, the land is typically designated as park or recreation land and is then maintained by the county.

While hazard mitigation may not formally be expressed as such in this process, much of the acquired land has been adjacent to bodies of water, wetlands, or part of existing county parklands and therefore reducing exposure.

5.3.3 Capability Assessment for Municipalities within Union County

As part of the municipal capability assessment completed in 2010, a web-based survey tool was designed and administered. The questions were vetted by the Union County Office of Emergency Management (UCOEM) from June 2008 until December 2008. The survey was targeted to the primary municipal contacts for this planning process. For the most part, these are municipal Office of Emergency Management (OEM) coordinators. Other municipal staff with relevant expertise–including those in the departments of planning, public works, and buildings–were also encouraged to take the survey.

The survey generally covered the following topics:

- Staff, personnel, and technical capability
- Knowledge of Federal Emergency Management Agency (FEMA) mitigation programs
- Current/ongoing mitigation efforts
- Intra- and inter-governmental coordination
- Land use and regulation
- Floodplain management
- Building code inspection
- Capital improvement
- Land conservation programs

As part of the 2015 Plan update, a capability assessment was completed for each participating municipality. The results of the assessment can be found in the individual municipality appendices (Appendices 1-25).

5.4 Floodplain Management

Improved floodplain management, including land use planning, zoning, and enforcement at the local level can reduce flood related damages for both existing buildings and new development and are consistent with Goal 3. The use of the National Flood Insurance Program (NFIP), the predominant flood insurer in the U.S., is critical to the reduction of future flood damage costs to the taxpayer. Following catastrophic floods in the early 1960s, the NFIP was established by the U.S. Congress in 1968, Property owners and businesses could purchase coverage for flood damage. The program is currently administered by FEMA. One stipulation of the program is that communities make a commitment to regulate the location and design of future floodplain construction to increase safety from flood hazards. The federal government established a series of building and development standards for floodplain construction to serve as minimum requirements for participation in the program.

The effective FIRMs for Union County have been revised a number of times to reflect more detailed information and changes to the floodplain, and is now used as the minimum flood hazard area within which development must conform to floodplain management regulations. Prior to releasing the Advisory Base Flood Elevations (ABFE) in February, 2013, 13.39% of Union County was located in the

100-year floodplain (areas with a 1% annual chance flooding). The proposed ABFE would increase the percent of county floodplain to 17.64%. All developments, regardless of the location, require a permit to include buildings, fill, and any other type of development. Under New Jersey's *home rule* system, different offices in the various municipalities have authority over the necessary permits.

The NFIP requires that when the cost of reconstruction, rehabilitation, addition, or other improvements to a building equals or exceeds 50% of the fair market value, then the building must meet the same construction requirements as a new building. Substantially damaged buildings must be brought up to new construction standards. A residence or building damaged so that the cost of repairs equals or exceeds 50% of the structure's fair market value must also be elevated above the Base Flood Elevation (BFE) in flood zones where BFEs are available.

See Table 5-1 for the dates on which the communities of Union County joined the NFIP. Each community in Union County is a participating community in the NFIP and is required to have both a well-trained municipal floodplain manager and construction code official to enforce municipal ordinances. To ensure adequate enforcement of both codes, each community in Union County should encourage additional training opportunities for all code enforcement personnel, to include its municipal floodplain manager. These ordinances are intended to addresses methods and practices to minimize flood damage to new and substantial home improvement projects, as well as addressing zoning and sub-division ordinances and state regulations as enforced through the NJDEP.

5.4.1 Continued Compliance with the NFIP

Table 5-6
National Flood Insurance Program

Name of Community	Date Joined NFIP
Berkeley Heights Township	March 1, 1978
Clark Township	December 23, 1971
Cranford Township	June 25, 1971
Elizabeth City	May 7, 1971
Fanwood Borough	October 28, 1977
Garwood Borough	February 1, 1977
Hillside Township	September 24, 1979
Kenilworth Borough	March 2, 1983
Linden City	November 24, 1976
Mountainside Borough	February 16, 1977
New Providence Borough	November 23, 1973
Plainfield City	June 25, 1971
Rahway City	December 17, 1971
Roselle Borough	June 4, 1980
Roselle Park Borough	July 17, 1978
Scotch Plains Township	September 30, 1977

Name of Community	Date Joined NFIP
Springfield Township	October 1, 1977
Summit City	February 2, 1972
Union Township	August 1, 1978
Westfield Township	December 18, 1979
Winfield Township	March 1, 1978

Jurisdictional participation in the National Flood Insurance Program (NFIP) is important to Union County and its 536,499 residents. The County is firmly committed to assisting communities with continued compliance with the NFIP. Prior and future actions related to NFIP compliance can be found within the individual jurisdictional appendices.

5.4.2 Building Codes

The New Jersey Unified Construction Code is the mandated construction code for all New Jersey municipalities. The State of New Jersey Department of Community Affairs issues licenses to all construction code and Sub-code officials that enforce the State's Uniform Construction Code. However, the state's Department of Environmental Protection is the lead state agency for the administration of the state's Floodplain Management Program. Each community that participates in the NFIP must adopt and enforce municipal floodplain management regulations that meet or exceed the minimum requirements of the NFIP as directed by the state's Floodplain Management Program. This requirement is in addition to the enforcement of the State Uniform Construction Code.

Floodplain management, land use planning, and building codes serve to assist the communities with problems experienced from floods, hurricanes, tornadoes, and thunderstorms/lightning/high winds as well as other lower priority hazards.

5.4.3 Community Rating System

The Community Rating System (CRS) was established through the NFIP. It is a program that municipalities can elect to join and provides incentives for activities that go beyond the minimum standards of the NFIP. Once a community has joined, participants receive a discount on their flood insurance premiums. In Union County, there are currently four participating CRS communities: **City of Linden, City of Rahway, Roselle Borough, and Roselle Park Borough.**

Roselle Park Borough is the most recent jurisdiction in Union County to join the CRS program, accepted into the program in fall, 2014. The county will continue to encourage other jurisdictions to join the CRS program. As a result of being part of the CRS, these communities actively pursue public outreach programs. One of the requirements of CRS is an annual outreach project, such as a Repetitive Loss Outreach Program. This program would focus on repetitive loss areas within the county and consists of three main components. The first is to advise the homeowners that they live in a repetitive loss area and could be subject to flooding. The second is to give the homeowner appropriate property protection

measure guidelines. The third is to make the homeowner aware of the basic facts about Flood Insurance.

Section 6: Approval and Adoption

6.1 Authority

Authority for the preparation of both the original 2010 Union County Hazard Mitigation Plan (HMP) and update is derived from the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, P.L. 93-288, as amended by the Disaster Mitigation Act of 2000, P.L. 106-390. The Disaster Mitigation Act of 2000 (The Act) required State and local governments to develop and formally adopt natural Hazard Mitigation Plans by November 2003 in order to be eligible to apply for Federal assistance under the HMGP. The Act was further amended to extend the planning requirement deadline to November 2004.

When the DMA 2000 was signed into law on October 30, 2000, the Robert T. Stafford Disaster Relief and Emergency Assistance Act was amended by adding a new section, 322 – Mitigation Planning. Section 322 places new emphasis on local mitigation planning. It requires local governments to develop and submit mitigation plans as a condition of receiving Hazard Mitigation Grant Program (HMGP) project grants. An Interim Final Rule (IFR) for implementing Section 322 was published in the Federal Register, 44 CFR Parts 201 and 206, on February 26, 2002. The requirements for local plans, or Local Mitigation Plan Criteria, are found in part 201.6.

In addition to the Plan requirement, the Act also requires communities to utilize a specific planning process developed for an all hazards approach to mitigation planning. This four step planning process is crucial to ensure that the effective planning by a community meets all the Plan content criteria required by the Act. The Act requires adoption by the local governing body and specifies a stringent review process, by which States and FEMA Regional Offices will review, evaluate and approve hazard mitigation plans.

The Plan was also prepared pursuant to the Flood Mitigation Assistance Program (44 CFR 78.6), the Hazard Mitigation and Pre-Disaster Mitigation Programs (44 CFR Parts 201 and 206), and the process outlined in materials prepared by the Federal Emergency Management Agency for the Community Rating System of the National Flood Insurance Program.

In the State of New Jersey, counties are empowered to manage their own affairs via a governing body known as the Board of Chosen Freeholders. The following is an excerpt from the relevant portion of the New Jersey Statutes Annotated (NJSA 40:20 et seq.)[68]:

The property, finances, and affairs of every county shall be managed, controlled and governed by a board elected therein, to be known as "the board of chosen freeholders of the county of [Union] and the executive and legislative powers of the county shall be vested in that board of chosen freeholders, except where by law any specific powers or duties are imposed or vested in a Constitutional officer.

The board of chosen freeholders of any county which has created the office of county administrator, pursuant to the provisions of NJS 40A:9-42, may, by resolution, delegate to that office such executive and administrative powers, duties, functions, and responsibilities as the board may deem appropriate.

[68] New Jersey Office of the Attorney General.

6.2 Approval and Adoption Procedure

As part of the approval process for the original 2010 HMP, the Federal Emergency Management Agency (FEMA) Region II determined that the Plan was "approvable pending adoption (APA)" On October 22, 2010. Shortly after receiving APA status, on November 9, 2010, the Union County Hazard Mitigation Working Group met and recommended that Union County and the participating municipalities should adopt the Plan. The original Plan was then submitted to the Union County Board of Chosen Freeholders as well as the appropriate entity for each participating municipality for review and adoption. The resulting Adoption Resolutions (December 8, 2010 for Union County) were then submitted to FEMA Region II for approval. FEMA subsequently issued formal approval letters to NJOEM for Union County and each participating municipality that adopted the Plan. NJOEM in turn issued approval letters to the approved jurisdictions.

Table 6-1
Municipal Jurisdiction Approval and Adoption Dates

Municipality	Approval Date	Adoption Date
Berkeley Heights, Township of		
Clark, Township of		
Cranford, Township of		
Fanwood, Borough of		
Garwood, Borough of		
Hillside, Township of		
Kenilworth, Borough of		
Linden, City of		
Mountainside, Borough of		
New Providence, Borough of		
Plainfield, City of		
Rahway, City of		
Roselle Park, Borough of		
Roselle, Borough of		
Scotch Plains, Township of		
Springfield, Township of		
Summit, City of		
Union, Township of		
Westfield, Town of		
Winfield, Township of		

Throughout the 2015 HMP Update process, the HMPSC and Stakeholders Group had opportunities to provide comments and feedback. See Section 4: Planning Process, for a list of HMPSC and Stakeholder participants. On [insert date] Union County submitted the initial draft of the 2015 Plan Update to NJOEM for review and comments. After addressing NJOEM comments in the document, the HMP

update was resubmitted for final consideration and approval by NJOEM and FEMA Region II. FEMA provided a Letter of Approvability (Approval Pending Adoption) on [insert date], and the Plan update was forwarded to the Union County Board of Chosen Freeholders for adoption, which occurred on [insert date].The adoption resolution is provided as Appendix E of the 2014 HMP update. Following adoption, the plan update was resubmitted to FEMA for final approval, which occurred on [insert date]. The FEMA approval letter is included as Appendix D.

6.3 Multi-Jurisdiction Adoption Resolutions

Union County and the 20 participating municipalities formally adopted the updated version of the HMP. The County adopted the Updated HMP on [insert date], and the municipalities adopted the Plan between [insert date] and [insert date]. Section 5 of each of the municipal appendices contains signed Adoption Resolutions for the participating municipalities.

Section 7: Plan Monitoring and Maintenance

7.1 Method for Monitoring the Plan

The 2015 Plan update will be monitored by the Union County Office of Emergency Management (UCOEM) for several related purposes:

- Maintain the currency of hazard and risk information.
- Ensure that mitigation projects and actions reflect the priorities of Union County and stakeholders.
- To comply with Federal Emergency Management Agency (FEMA) and New Jersey State requirements for plan maintenance and maintain Union County's eligibility for federal disaster assistance and mitigation grants.

The Union County Emergency Management Coordinator will continuously monitor the plan with respect to the purposes noted above, according to the schedule described in Section 7.2, and with respect to the update triggers noted in Section 7.4 below. The Union County Hazard Mitigation Plan Steering Committee will be maintained with membership continuing to correspond to the Local OEM Coordinators. Local OEM Coordinators will be encouraged and supported by the UCOEM in their efforts to continue to seek expanded membership in local hazard mitigation planning and implementation consistent with Action Item 1.C.1. Specifically, monitoring activities by UCOEM with the support of the HMPSC will consist of:

- Soliciting and reviewing reports from participating municipalities regarding status of implementation of action items from the Plan and compiling the information in a spreadsheet or database format for comparisons with future status reports. Status reports will be collected yearly (consistent with Section 7.2) and will be collected at regularly scheduled quarterly Local OEM Coordinator meetings with UCOEM or via e-mail and will indicate if projects have been:
    - Scoped and/or documented for FEMA grant applications;
    - Submitted for FEMA funding programs;
    - Approved (or denied approval) for FEMA funding;
    - Documented for funding by other means (e.g., municipal capital improvement plans);
    - Funded (or not approved for funding) by other means;
    - Under construction;
    - Completed; and
    - (for completed projects only) Subject to hazard conditions such that avoided losses can be documented.
- Tracking progress of sources of improved or revised data for use in subsequent Plan updates on an annual (at a minimum) basis.
- Preparing a report of the status of implementation of action items from the Plan and the availability of improved or revised data. The report will include recommendations to the Hazard Mitigation Plan Steering Committee regarding the need and/or advantages of undertaking updates to all or part of the Plan prior to the five-year required update (see Section 8.4).

7.2 Schedule for Monitoring the Plan

Informal Plan monitoring activities will be ongoing. In addition to the FEMA mandated five year update cycle, the Union County Emergency Management Coordinator or their designee (Coordinator) will perform monitoring activities for the 2015 Plan as described in Section 7.1 once a year, after every declared disaster, or more often as circumstances require.

In addition to the scheduled reports, the Coordinator will convene meetings after damage-causing natural hazard events, particularly if there is a declared disaster that includes Union County, to review the effects of such events. Based on those effects, adjustments to the mitigation priorities identified in Section 5 may be made or additional event-specific actions identified.

7.3 Method and Schedule for Evaluating and Updating the Plan

Comprehensive evaluation of and updates to the 2015 Plan update will be undertaken on a five-year cycle (at a minimum). This Plan update was adopted on [insert date], and thus must undergo a formal FEMA-compliant update process by [insert date]. Approximately one year prior to the five year anniversary of Plan adoption or sooner if circumstances require, the Coordinator will initiate a comprehensive evaluation of the Plan with particular attention to FEMA guidance.

The criteria to be used in this evaluation include (but are not limited to) the following:

- Assessing whether or not goals and objectives in the Plan address current and expected conditions;
- Determining if there are any changes in risk factors and/or data that would be relevant to hazards in Union County;
- Determining if capabilities have changed relative to the County and municipalities' ability to plan and implement hazard mitigation projects;
- Determining if significant changes have occurred in the availability of funding at federal and state levels to support hazard mitigation planning and implementation; and
- Results in implementing the Plan per monitoring reports (per Sections 8.2 and 8.3).

The Coordinator will prepare a report (1) describing the update requirements; (2) summarizing the staff evaluation of the Plan, highlighting areas that require updating and explaining the reasons why the updates are needed, and; (3) providing detailed recommendations about how the 2015 Plan should be updated, noting any technical work that may be required. The report will sequentially be provided to the Union County Hazard Mitigation Planning Steering Committee (HMPSC) and Union County Board of Chosen Freeholders for consideration. The report will also be posted on the Union County OEM website for public review and comment.

The HMPSC and the Board of Chosen Freeholders will review the report and recommendations and advise the Coordinator how to proceed on the individual recommendations for the updates. The Union County Emergency Management Coordinator will initiate activities to carry out the recommendations, and will prepare draft updates to the 2015 Plan on a schedule determined in cooperation with the HMPSC and the Board of Chosen Freeholders.

When the draft updates are completed, the HMPSC will be convened to conduct the comprehensive evaluation and revision. The HMPSC and Coordinator will produce a final draft of the updated Plan for consideration by the Board. The Board will review the updated Plan, indicate any desired changes, approve and adopt the Plan in sufficient time to meet FEMA requirements.

7.4 Circumstances that will Initiate Plan Review and Updates

This section identifies the circumstances or conditions under which UC OEM will initiate Plan reviews and updates.

- On the recommendation of the Coordinator or on its own initiative, the Union County Board of Chosen Freeholders may initiate a Plan review at any time.
- At approximately the 1-year anniversary of adopting the Plan update, and every year thereafter.
- After natural hazard events that appear to significantly change the apparent risk to Union County assets (particularly a declared event that includes Union County), operations and/or constituents.

7.5 Other Local Planning Mechanisms

It should be noted that Union County has limited land use planning and zoning authority, so the County has few opportunities to incorporate this Plan into other local mechanisms, such as zoning and subdivision ordinances, or comprehensive land use plans. This Plan will be incorporated, to the extent possible, into the Union County Farmland Preservation, Open Space, Parks and Recreation Trust Fund Plan and the Union County Capital Improvement Program. In addition, Union County OEM will work with individual municipalities to incorporate the recommendations of the Plan into local comprehensive planning and capital improvement programs.

Participating municipalities in this Plan update will work to incorporate the goals of this Plan into the next update of relevant plans and regulations, including comprehensive plans, zoning codes, and capital improvement plans. It should be noted that counties and municipalities are not empowered to make alterations or improvements to the state's building code, the Uniform Construction Code. Details about each municipality's progress on plan integration are included in their municipal appendix.

7.6 Continued Public Involvement

Union County recognizes the importance of a comprehensive and inclusive mitigation planning process. The County and its participating municipalities are committed to engaging stakeholders and the public in mitigation planning. Therefore, the plan will be posted on the Union County Office of Emergency Management website and copies of the Plan will be made available for review during normal business hours at the Union County Office of Emergency Management. The Union County Public Information Officer (PIO) will be responsible for receiving, tracking, and filing public comments on the plan. The PIO will work with the Union County HMP Coordinator shall be responsible to assure that public comment and input on the Plan, and hazard mitigation in general, are recorded and addressed, as appropriate.