3. Risk Assessment

WHAT'S NEW IN CHAPTER 3?

- *Text revisions have been made based on hazards that have occurred in Bergen County since the Plan was last submitted in 2007.*
- *Historical population growth and building permit data has been added.*
- *Data regarding repetitive loss and severe repetitive loss properties in Bergen County has been added, as well as updated NFIP claims information.*
- *Critical facility data (text) has been updated to include new critical facilities and to remove those that have closed or moved. In addition, if any critical facility has been deemed more or less vulnerable to any natural hazard, it is reflected in the Plan.*
- *Tables and maps that contain critical facility data have also been updated as necessary.*
- *It should be noted that any charts or tables that were updated at their original source were included in the Plan; otherwise, such charts or tables remain unchanged.*
- *Information on recent disasters to impact Bergen County has been added.*

In assessing Bergen County's vulnerability to potential natural hazards, it was important to take into account the natural and built environments and review details of past hazard events.

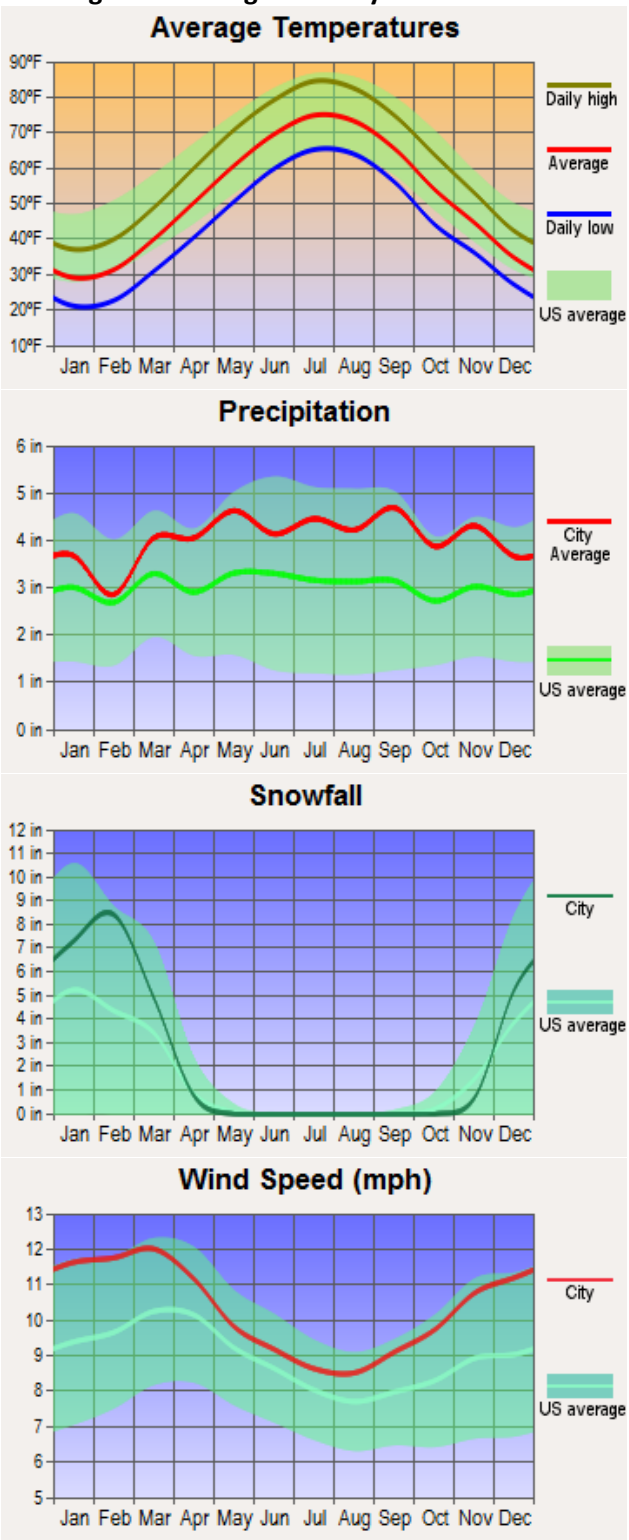
This chapter contains summary information regarding background characteristics of the land and environment for the County in general. It identifies natural hazards that have been experienced by most Bergen County municipalities. It also details hazards which have caused damage to individual municipalities in recent years and identifies critical facilities located in each municipality.

3.1 Climatological Characteristics of the County

Figure 3.1 gives a general overview of climatic conditions for Bergen County municipalities, on average, at different times of the year. In scoping out climatological data, it was found that most data sources maintain the information on a municipal level, not a county level. While NJMC Geographic Information Systems specialists determined that it might be possible to obtain raw data from the State of New Jersey Climatologist and create new county-wide graphics, it would be quite time consuming and probably not yield a significant amount of additional information. In comparing the data of numerous municipalities, it was determined that by selecting a centrally-located municipality in the County - Paramus - it provided climatological information closely representative of the overall County for purposes of a multi-jurisdictional plan such as this.

The following graphics include average climatology for temperature, precipitation, snowfall, and wind speed.[1]

Figure 3.1: Bergen County Weather Data



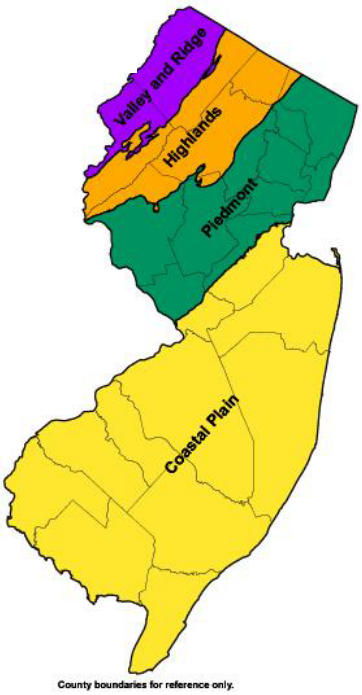
As noted, weather in Bergen County is seasonal with precipitation, snowfall, and wind speeds slightly exceeding, but within normal range, of the national average.

3.2 Physical Geography

Bergen County is situated within two of New Jersey's physiographic provinces, the Highlands and Piedmont Provinces, as illustrated in Figure 3.2.[2] Bergen contains the Palisades, one of the most dramatic geological features in the New York City region. The Palisades are a string of steep cliffs hovering over the western edge of the lower Hudson River. Rising vertically from the river edge, the cliffs range in height between 350 to 550 feet. Ramapo Mountain, at 1,171 feet, is the highest elevation on the southeast portion of the Highlands Province in Bergen County.

According to *The Geology of New Jersey*, a bulletin of the New Jersey Geologic Survey, the underlying rock base in the Highlands Province is primarily Middle Proterozoic age metamorphosed igneous and sedimentary rock. Where the Highlands meets the Piedmont Province, the crystalline rocks of the Highlands come into contact with much younger Triassic and Jurassic age sedimentary and Jurassic age igneous rocks of the Piedmont. The Highlands and Piedmont rocks are separated by a series of major faults, including the Ramapo Fault. Rocks range from the more resistant gneisses and granites of the hill areas to sandstone, siltstone, and shale deposited closer to the river and lake basins of the region.

The Palisades contain rifting associated with historic volcanic activity. Rock in this area is primarily basalt and diabase, indicative of this activity. Much of this underlying geologic data is illustrated in Figure 3.3, Bedrock Geology of Bergen County, on the following page.[3]



Source: New Jersey Geologic Survey

Figure 3.2: Physiographic Provinces of New Jersey

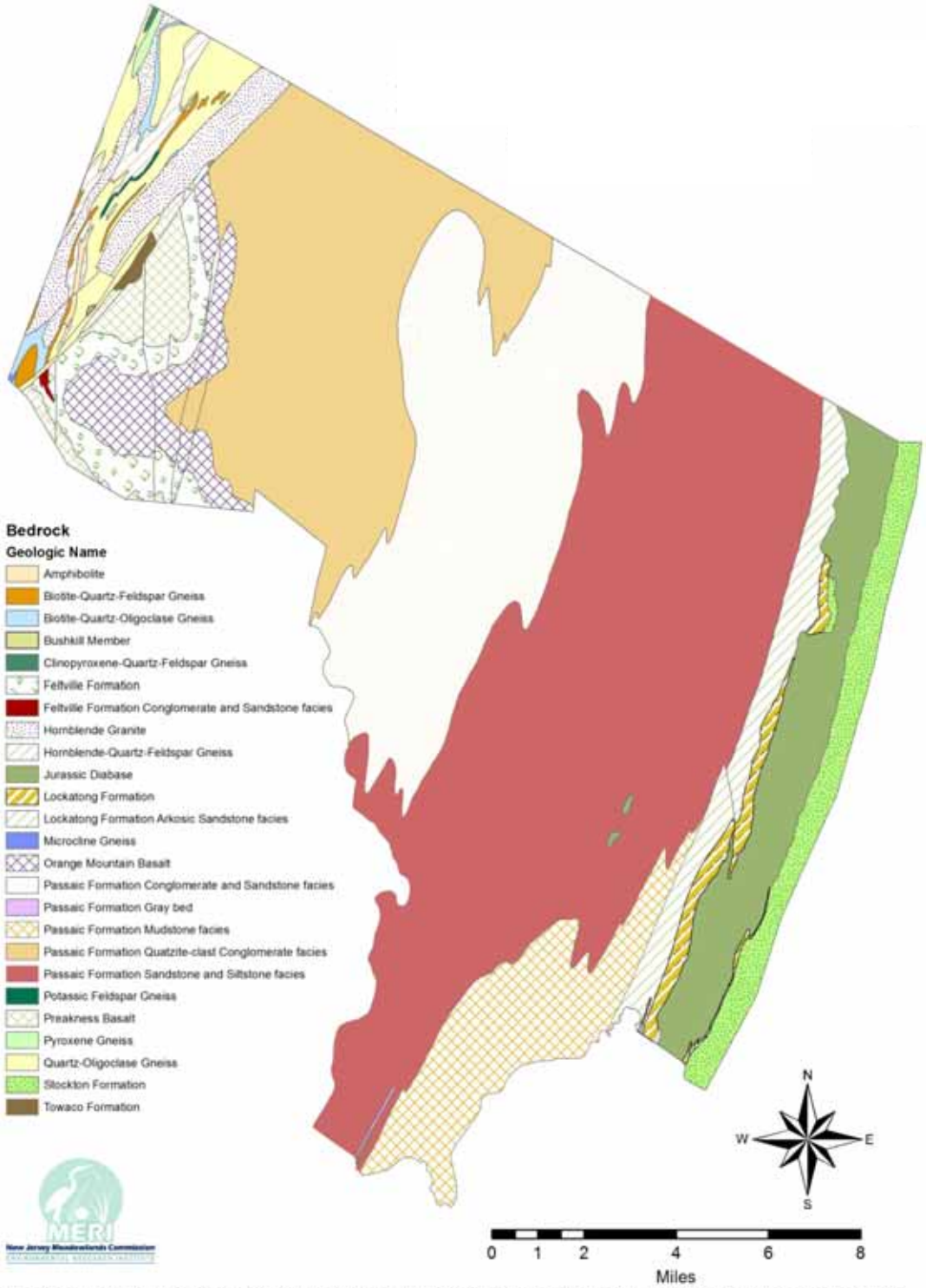


Figure 3.3: Bedrock Geology of Bergen County, NJ

3.3 Demographics/ Land Use/Transportation

Bergen County is a highly developed, primarily suburban area in New Jersey with several urban municipalities located throughout, including the county seat of Hackensack. While the County is the most densely populated in the state, the population is not evenly distributed by number or character. Northern Bergen County municipalities tend to be less densely populated than South Bergen municipalities. Northern towns also differ from the southern towns in that the northern demographic base tends to be of a higher household income and less diverse racial/ethnic background.

The developed nature of the County is reflected in the Land Use Land Cover of Bergen County map, Figure 3.4.[4] The map illustrates the County almost exclusively as urban land, with forest cover found mainly in the areas of the Palisades and Ramapo Mountains and wetlands principally in the Meadowlands District.

Land use in New Jersey is regulated at the municipal level in accordance with the State Constitution and the New Jersey Municipal Land Use Law. In the Meadowlands District in Bergen County, land use and zoning powers are within the purview of the New Jersey Meadowlands Commission's Master Plan and District Zoning Regulations.

There is a well-established transportation network throughout Bergen County. Major roadways consist of Interstate Routes 80, 95 (New Jersey Turnpike), and 287; U.S. Routes 1, 9W, and 202; many State highways including Routes 3, 4, 17, 120, and 208; and the Garden State and Palisades Parkways. These roadways are illustrated in Figure 3.5, Bergen County Major Roadways.[5]

For the purposes of this section only, Bergen County has been divided into six areas where the municipalities share common population and socio-economic characteristics, as well as topography. The Bergen County Department of Planning uses these designations due to the large number of municipalities. The geographic areas include the following:

Northwest Bergen: Allendale, Franklin Lakes, Glen Rock, Ho-Ho-Kus, Mahwah, Midland Park, Oakland, Ramsey, Ridgewood, Saddle River, Upper Saddle River, Waldwick and Wyckoff

Pascack Valley: Emerson, Hillsdale, Montvale, Park Ridge, River Vale, Washington, Westwood and Woodcliff Lake

Northern Valley: Alpine, Bergenfield, Closter, Cresskill, Demarest, Dumont, Englewood, Englewood Cliffs, Harrington Park, Haworth, Northvale, Norwood, Old Tappan, Rockleigh and Tenafly

Central Bergen: Bogota, Elmwood Park, Fair Lawn, Garfield, Hackensack, Lodi, Maywood, New Milford, Oradell, Paramus, River Edge, Rochelle Park, Saddle Brook and Teaneck

Southeast Bergen: Cliffside Park, Edgewater, Fairview, Fort Lee, Leonia, Palisades Park, Ridgefield and Ridgefield Park

Southwest Bergen: Carlstadt, East Rutherford, Hasbrouck Heights, Little Ferry, Lyndhurst, Moonachie, North Arlington, Rutherford, South Hackensack, Teterboro, Wallington and Wood-Ridge

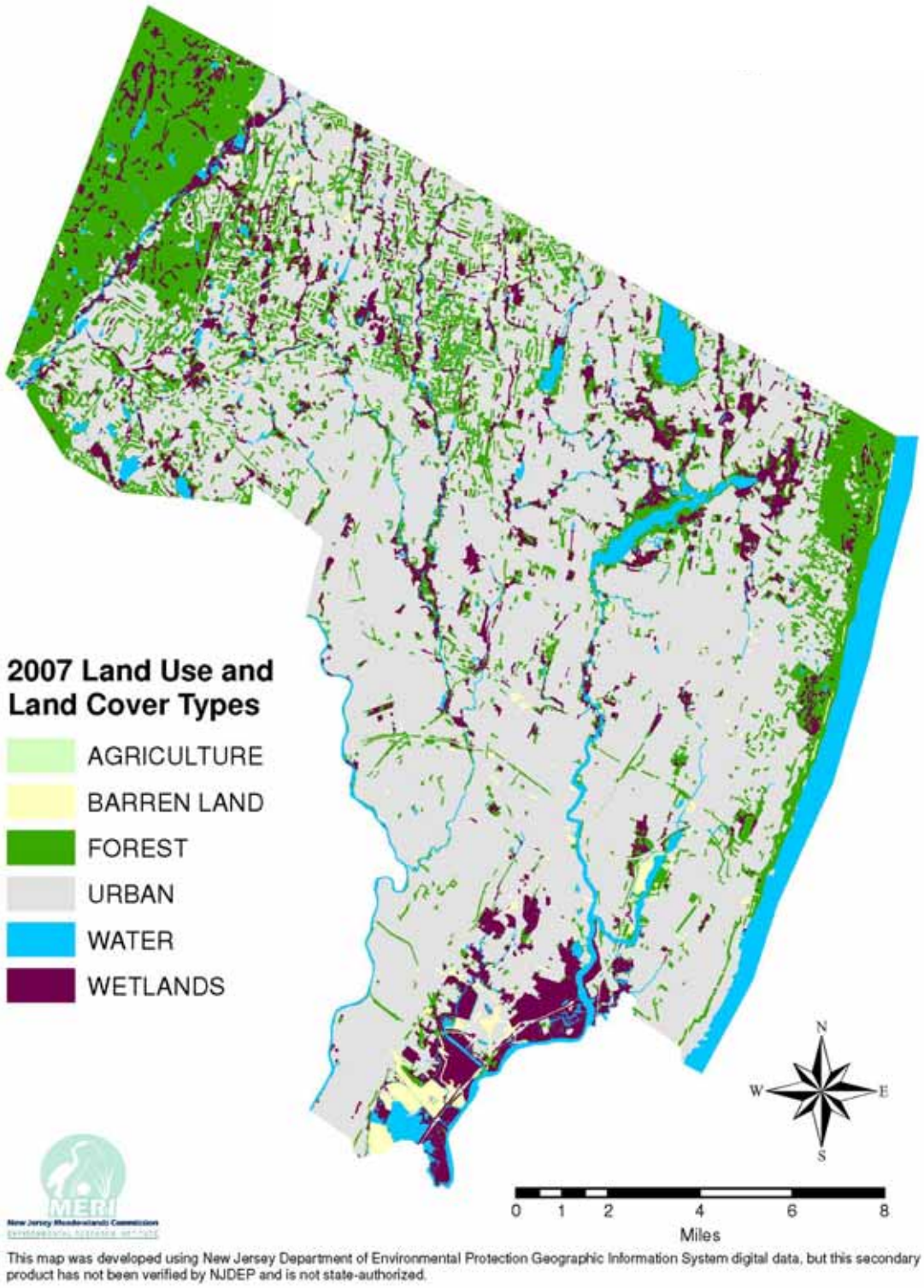
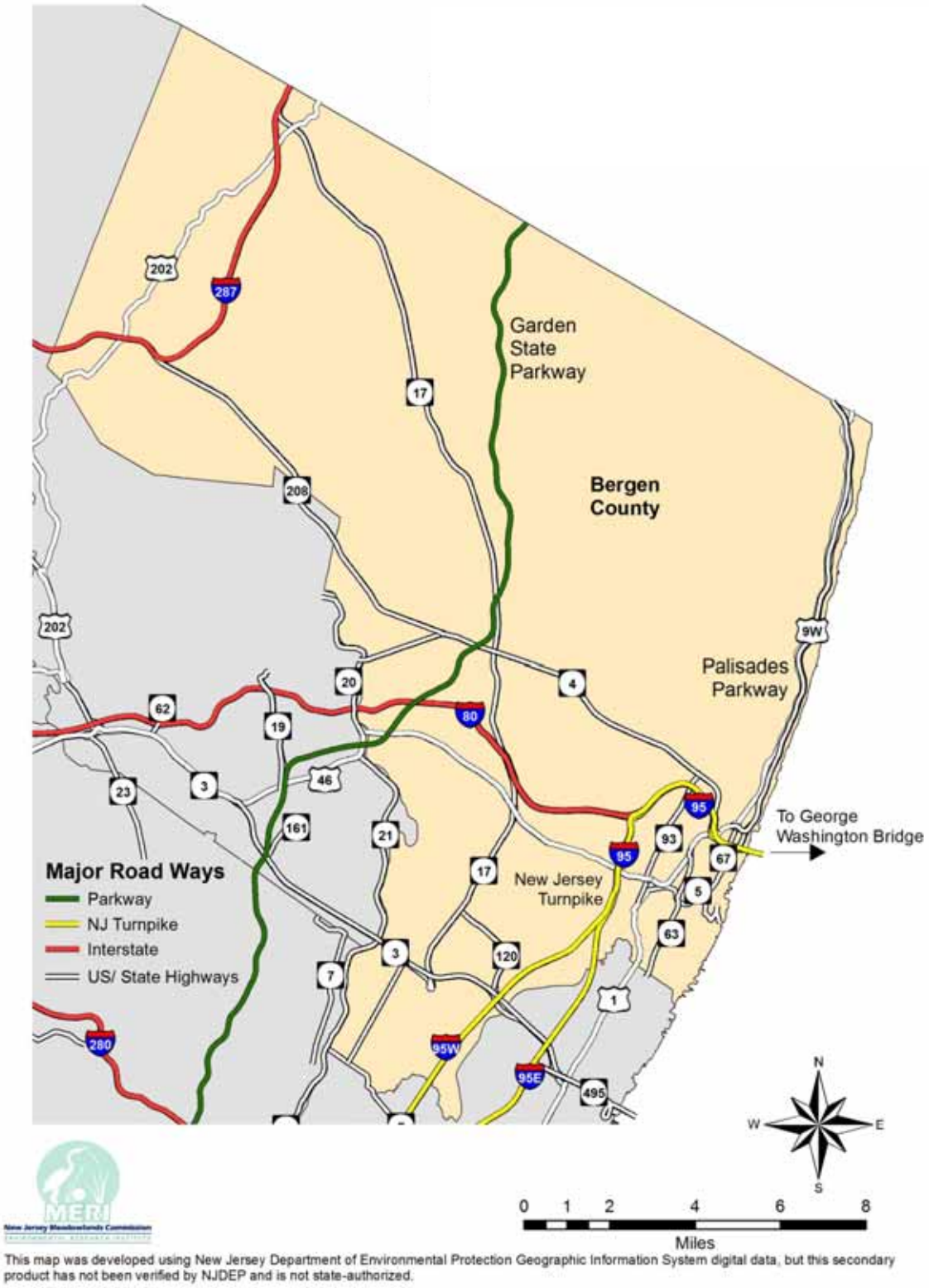


Figure 3.4: Land Use and Land Cover of Bergen County, NJ



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.

Figure 3.5: Bergen County, NJ Major Roadways

Population Growth

The Planning Team looked at population growth from 1960-2012, and building permits from 2002-2012. These data sources illustrate a number of trends as noted below.

Bergen County overall grew at a moderate 3.8% pace from 2000-2012, in which 64 of the 70 municipalities showed a positive growth rate. Southeast Bergen grew almost twice as fast as the rest of the County at 7.1%. This section of the County is experiencing rapid growth, particularly with multifamily residential developments along the Hudson River waterfront. Six of Southeast Bergen's eight municipalities have reached their highest population ever in 2012, Edgewater with a 35.9% growth rate from 2000-2012, and Palisades Park with a rate of 14.4% during that same time period. These figures are detailed in Table 3.1.[6]

Table 3.1: Population Growth from 1960 - 2012

POPULATION GROWTH								
NORTHWEST BERGEN	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2012**	**% Growth**
ALLENDALE	4,092	6,240	5,901	5,900	6,699	6,505	6,657	-0.7
FRANKLIN LAKES	3,316	7,550	8,769	9,873	10,422	10,590	10,660	2.3
GLEN ROCK	12,896	13,011	11,497	10,833	11,546	11,601	11,799	2.2
HO-HO-KUS	3,988	4,348	4,129	3,935	4,060	4,078	4,140	2.0
MAHWAH	7,376	10,800	12,127	17,905	24,062	25,890	26,168	8.0
MIDLAND PARK	7,543	8,159	7,381	7,047	6,947	7,128	7,227	3.9
OAKLAND	9,446	14,420	13,443	11,997	12,466	12,754	12,873	3.2
RAMSEY	9,527	12,571	12,899	13,228	14,351	14,473	14,727	2.6
RIDGEWOOD	25,391	27,547	25,208	24,152	24,936	24,958	25,205	1.1
SADDLE RIVER	1,776	2,437	2,763	2,950	3,201	3,152	3,178	-0.8
UPPER SADDLE RIVER	3,570	7,949	7,958	7,198	7,741	8,208	8,285	6.6
WALDWICK	10,495	12,313	10,802	9,757	9,622	9,625	9,857	2.4
WYCKOFF	11,205	16,039	15,500	15,372	16,508	16,696	16,867	2.2
TOTALS	**110,621**	**143,384**	**138,377**	**140,147**	**152,561**	**155,658**	**157,643**	**1.4**
PASCACK VALLEY	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2012**	**% Growth**
EMERSON	6,849	8,428	7,793	6,930	7,197	7,401	7,706	6.7
HILLSDALE	8,743	11,768	10,495	9,750	10,087	10,219	10,346	2.6
MONTVALE	3,699	7,327	7,318	6,946	7,034	7,844	7,959	11.7
PARK RIDGE	6,420	8,709	8,515	8,102	8,708	8,645	8,863	1.8
RIVER VALE	5,616	8,883	9,489	9,410	9,449	9,659	9,821	3.8
WASHINGTON	6,623	10,577	9,550	9,245	8,938	9,102	9,220	3.1
WESTWOOD	9,046	11,105	10,714	10,446	10,999	10,908	11,011	0.2
WOODCLIFF LAKE	2,742	5,506	5,644	5,303	5,745	5,730	5,827	1.5
TOTALS	**49,738**	**72,303**	**69,518**	**66,132**	**68,157**	**69,508**	**70,753**	**3.7**
NORTHERN VALLEY	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2012**	**% Growth**
ALPINE	921	1,344	1,549	1,716	2,183	1,849	1,933	-11.5
BERGENFIELD	27,203	29,000	25,568	24,458	26,247	26,764	27,017	2.9

POPULATION GROWTH								
CLOSTER	7,767	8,604	8,164	8,094	8,383	8,373	8,498	1.4
CRESSKILL	7,290	8,298	7,609	7,558	7,746	8,573	8,650	10.5
DEMAREST	4,231	5,133	4,963	4,800	4,845	4,881	4,967	2.5
DUMONT	18,882	20,155	18,334	17,187	17,503	17,479	17,645	0.9
ENGLEWOOD	26,057	24,985	23,701	24,850	26,203	27,147	27,605	5.1
ENGLEWOOD CLIFFS	2,913	5,938	5,698	5,634	5,322	5,281	5,337	0.3
HARRINGTON PARK	3,581	4,841	4,532	4,623	4,740	4,664	4,807	1.4
HAWORTH	3,215	3,760	3,509	3,384	3,390	3,382	3,403	0.4
NORTHVALE	2,892	5,177	5,046	4,563	4,460	4,460	4,848	8.1
NORWOOD	2,852	4,398	4,413	4,858	5,751	5,711	5,815	1.2
OLD TAPPAN	2,330	3,917	4,168	4,254	5,482	5,750	5,843	6.2
ROCKLEIGH	110	430	308	192	391	531	530	49.1
TENAFLY	14,264	14,827	13,552	13,326	13,806	14,488	14,635	5.7
TOTALS	**124,508**	**140,807**	**131,114**	**129,497**	**136,452**	**139,333**	**141,533**	**3.7**
CENTRAL BERGEN	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2012**	**% Growth**
BOGOTA	7,965	8,960	8,344	7,824	8,249	8,187	8,261	0.2
ELMWOOD PARK	19,344	20,511	18,377	17,623	18,925	19,403	19,890	4.9
FAIR LAWN	36,421	37,975	32,229	30,548	31,637	32,457	32,847	3.7
GARFIELD	29,253	30,797	26,803	26,727	29,786	30,487	30,872	3.6
HACKENSACK	30,521	36,008	36,039	37,049	42,677	43,010	43,845	2.7
LODI	23,502	25,163	23,956	22,355	23,971	24,136	24,360	1.6
MAYWOOD	8,667	11,460	11,087	9,895	9,523	9,555	9,588	0.6
NEW MILFORD	18,810	19,149	16,876	15,990	16,400	16,341	16,504	0.7
ORADELL	7,487	8,903	8,658	8,024	8,047	7,978	8,083	0.5
PARAMUS	23,238	28,381	26,474	25,004	25,737	26,342	26,532	3.0
RIVER EDGE	13,264	12,850	11,111	10,603	10,946	11,340	11,464	4.6
ROCHELLE PARK	6,119	6,380	5,603	5,587	5,528	5,530	5,575	0.9
SADDLE BROOK	13,834	15,975	14,084	13,296	13,155	13,659	14,021	6.2
TEANECK	42,085	42,355	39,007	37,825	39,260	39,776	40,093	2.1
TOTALS	**280,510**	**304,867**	**278,648**	**268,350**	**283,841**	**288,201**	**291,935**	**2.8**
SOUTHEAST BERGEN	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2012**	**% Growth**
CLIFFSIDE PARK	17,642	18,891	21,464	20,393	23,007	23,594	23,872	3.7
EDGEWATER	4,113	4,987	4,628	5,001	7,677	11,513	11,972	35.9
FAIRVIEW	9,399	10,698	10,519	10,733	13,255	13,835	14,217	6.8
FORT LEE	21,815	30,631	32,449	31,997	35,461	35,345	35,732	0.8
LEONIA	8,384	8,847	8,027	8,365	8,914	8,937	9,018	1.2
PALISADES PARK	11,943	13,351	13,732	14,536	17,073	19,622	19,936	14.4
RIDGEFIELD	10,788	11,308	10,294	9,996	10,830	11,032	11,255	3.8
RIDGEFIELD PARK	12,701	13,990	12,738	12,454	12,873	12,729	12,864	-0.1
TOTALS	**96,785**	**112,703**	**113,851**	**113,475**	**129,090**	**136,607**	**138,866**	**7.1**

POPULATION GROWTH								
SOUTHWEST BERGEN	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2012**	**% Growth**
CARLSTADT	6,042	6,724	6,166	5,510	5,917	6,127	6,319	6.4
EAST RUTHERFORD	7,769	8,536	7,849	7,902	8,716	8,913	8,978	3.0
HASBROUCK HEIGHTS	13,046	13,651	12,166	11,488	11,662	11,842	11,936	2.4
LITTLE FERRY	6,175	9,064	9,399	9,989	10,800	10,626	10,730	-0.7
LYNDHURST	21,867	22,729	20,326	18,262	19,383	20,554	21,223	8.7
MOONACHIE	3,052	2,951	2,706	2,817	2,754	2,708	2,734	-0.8
NORTH ARLINGTON	17,477	18,096	16,587	13,790	15,181	15,392	15,533	2.3
RUTHERFORD	20,473	20,802	19,068	17,790	18,110	18,061	18,219	0.6
SOUTH HACKENSACK	1,841	2,412	2,229	2,106	2,249	2,378	2,429	0.0
TETERBORO	22	19	19	22	18	67	70	74.3
WALLINGTON	9,261	10,284	10,741	10,828	11,583	11,335	11,592	0.1
WOOD-RIDGE	7,964	8,311	7,929	7,506	7,644	7,626	8,358	8.6
TOTALS	**114,989**	**123,579**	**115,185**	**108,010**	**114,017**	**115,629**	**118,121**	**3.5**

Building Permits

Building permit data from 2002-2012 was obtained from the New Jersey Department of Community Affairs. The highest numbers of approved permits was in Southeast Bergen, with 5,910 permits from 2002-2012. Southeast Bergen also has the highest permit numbers for 8 of the 11 years from 2002-2012. The municipalities with the most building permits County-wide during this period, also located in Southeast Bergen, were Edgewater, Cliffside Park, Palisades Park and Fort Lee, (see Table 3.2 and Figure 3.6.)

Because of the highly developed nature of Bergen County, much of the development that is occurring across the County is through redevelopment. Several towns are currently undergoing efforts to revitalize their downtown areas. Although the economy remains slow, Bergen County is a desirable place to live and work due to its location. Several major projects took place at the site of Giants Stadium in East Rutherford over the past few years. The MetLife 82,500 seat stadium and Giants training facility were constructed. The 4.8 million square foot American Dream entertainment and retail complex is currently under construction, and a new NJ Transit station and rail link that connects these facilities to the NJ Transit Pascack Valley Line is now operating for game days and events.

Table 3.2: Bergen County Building Permits, 2002-2012

ITALICS REPRESENTS HIGHEST REGIONALLY ANNUAL NUMBER

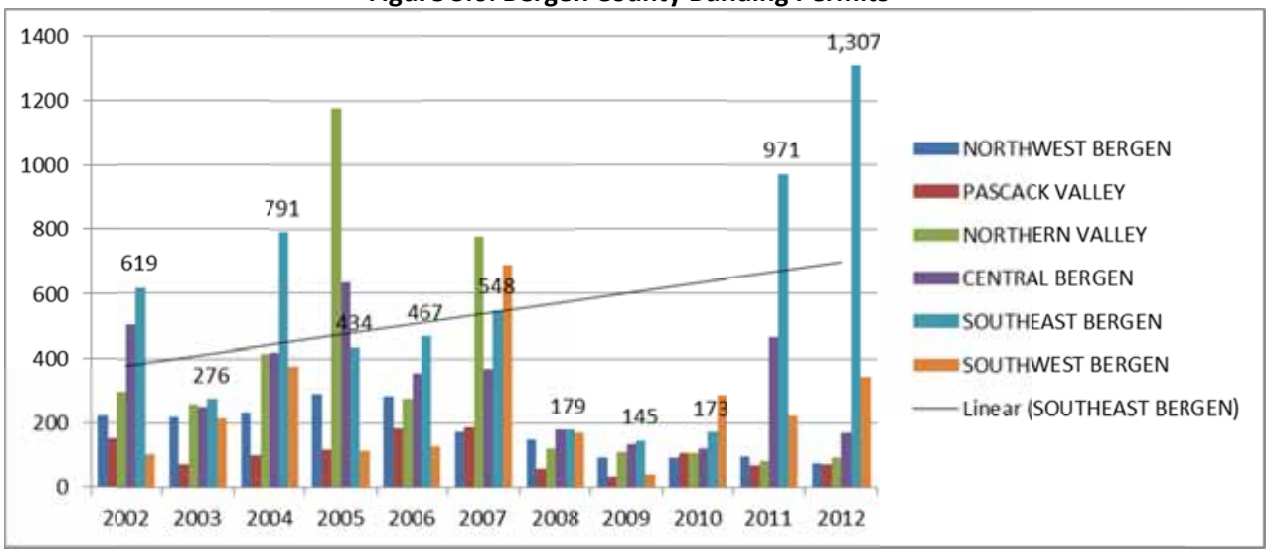
UNDERLINE REPRESENTS HIGHEST MUNICIPAL ANNUAL NUMBER

BUILDING PERMITS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		RANK
NORTHWEST BERGEN	221	219	234	290	283	174	149	91	92	96	73	**1,922**	
ALLENDALE	2	0	1	1	0	12	5	15	14	11	3	64	
FRANKLIN LAKES	38	30	44	37	140	26	12	10	12	15	7	371	
GLEN ROCK	12	3	2	3	5	6	7	4	2	21	6	71	
HO-HO-KUS	2	4	2	8	4	4	0	2	6	4	1	37	
MAHWAH	22	40	29	31	32	25	10	5	10	3	9	216	
MIDLAND PARK	13	6	7	2	8	3	1	0	1	3	0	44	
OAKLAND	5	29	9	2	8	2	5	1	2	6	4	73	
RAMSEY	9	20	11	121	12	7	51	14	5	2	3	255	
RIDGEWOOD	10	9	17	10	11	9	5	3	14	11	13	112	
SADDLE RIVER	5	14	17	21	16	16	8	7	2	5	8	119	
UPPER SADDLE RIVER	56	34	66	28	27	18	14	12	7	5	8	275	
WALDWICK	16	22	12	9	3	29	2	13	5	3	3	117	
WYCKOFF	31	8	17	17	17	17	29	5	12	7	8	168	
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
PASCACK VALLEY	151	71	99	117	183	186	54	30	104	65	69	**1,129**	
EMERSON	17	20	36	8	43	8	2	1	22	5	1	163	
HILLSDALE	6	10	6	13	6	12	3	5	17	0	4	82	
MONTVALE	15	6	4	18	49	112	20	2	39	33	16	314	
PARK RIDGE	19	11	22	13	59	13	5	3	5	1	16	167	
RIVER VALE	12	9	13	19	6	15	12	6	9	19	12	132	
WASHINGTON	66	3	1	4	2	12	1	4	5	2	2	102	
WESTWOOD	10	3	6	7	6	7	6	7	2	1	2	57	
WOODCLIFF LAKE	6	9	11	35	12	7	5	2	5	4	16	112	
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
NORTHERN VALLEY	296	259	414	*1,175*	275	*779*	121	108	104	82	90	**3,703**	
ALPINE	13	11	12	28	14	10	3	5	3	2	3	104	
BERGENFIELD	13	2	10	123	17	11	6	35	1	2	4	224	
CLOSTER	30	24	43	36	28	20	11	4	24	9	7	236	
CRESSKILL	16	25	101	90	13	11	4	5	6	7	12	290	
DEMAREST	8	10	33	39	31	13	7	7	9	7	6	170	
DUMONT	17	10	15	3	8	14	16	0	1	0	0	84	
ENGLEWOOD	8	72	13	685	10	388	11	3	6	2	3	1,201	**6**
ENGLEWOOD CLIFFS	36	32	51	35	23	27	20	7	11	6	12	260	

BUILDING PERMITS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		RANK
HARRINGTON PARK	29	4	45	7	9	5	3	2	3	1	3	111	
HAWORTH	3	2	5	13	9	6	2	0	1	0	4	45	
NORTHVALE	7	8	4	7	18	71	6	7	3	13	2	146	
NORWOOD	12	15	14	16	10	9	1	0	2	4	3	86	
OLD TAPPAN	50	18	29	45	32	11	8	7	11	6	7	224	
ROCKLEIGH	0	0	1	0	0	0	0	0	0	1	2	4	
TENAFLY	54	26	38	48	53	183	23	26	23	22	22	518	**8**
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
CENTRAL BERGEN	505	251	419	636	354	369	*179*	132	120	465	170	**3,600**	
BOGOTA	0	1	0	5	3	1	1	0	1	0	0	12	
ELMWOOD PARK	16	11	30	52	129	39	43	10	8	143	2	483	
FAIR LAWN	10	2	3	36	7	9	5	4	20	4	1	101	
GARFIELD	12	19	55	20	12	19	7	7	38	32	55	276	
HACKENSACK	31	11	92	104	64	59	49	65	4	227	3	709	**7**
LODI	34	47	55	58	26	11	4	2	4	6	1	248	
MAYWOOD	3	0	1	0	0	1	8	5	5	14	3	40	
NEW MILFORD	6	10	12	12	20	10	9	2	6	10	4	101	
ORADELL	0	1	5	3	5	2	4	4	2	2	9	37	
PARAMUS	96	28	36	47	42	25	22	14	15	18	17	360	
RIVER EDGE	2	2	4	9	3	11	1	0	1	1	2	36	
ROCHELLE PARK	3	83	35	4	10	1	2	0	2	0	57	197	
SADDLE BROOK	13	28	71	199	16	165	4	2	8	2	5	513	**9**
TEANECK	279	8	20	87	17	16	20	17	6	6	11	487	**10**
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
SOUTHEAST BERGEN	*619*	*276*	*791*	434	*467*	548	*179*	*145*	173	*971*	*1,307*	***5,910***	
CLIFFSIDE PARK	47	52	83	65	118	310	36	34	17	286	308	1,356	**2**
EDGEWATER	296	8	193	28	56	77	9	44	48	538	66	1,363	**1**
FAIRVIEW	22	42	30	56	32	29	14	25	8	62	9	329	
FORT LEE	117	39	43	37	54	35	40	17	48	25	820	1,275	**4**
LEONIA	11	2	2	0	3	2	33	1	0	1	1	56	
PALISADES PARK	117	106	331	233	187	78	36	18	47	59	101	1,313	**3**
RIDGEFIELD	9	25	28	14	13	12	10	6	5	0	2	124	
RIDGEFIELD PARK	0	2	81	1	4	5	1	0	0	0	0	94	
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
SOUTHWEST BERGEN	101	215	377	113	127	689	168	36	*287*	223	345	**2,681**	
CARLSTADT	15	8	6	22	21	14	4	0	0	3	0	93	

BUILDING PERMITS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		RANK
EAST RUTHERFORD	4	134	115	15	1	624	27	0	2	0	317	1,239	**5**
HASBROUCK HEIGHTS	24	11	15	17	15	12	21	1	6	3	7	132	
LITTLE FERRY	8	2	4	4	2	5	6	3	3	0	1	38	
LYNDHURST	8	24	189	2	7	3	0	0	0	201	5	439	
MOONACHIE	4	2	6	5	2	2	0	0	0	1	1	23	
NORTH ARLINGTON	13	10	13	5	0	2	69	6	0	0	0	118	
RUTHERFORD	12	9	7	19	18	5	6	13	2	5	3	99	
SOUTH HACKENSACK	1	3	7	0	2	1	26	0	1	4	1	46	
TETERBORO	0	0	0	0	0	0	0	0	0	0	0	0	
WALLINGTON	9	6	6	19	45	13	2	6	5	4	8	123	
WOOD-RIDGE	3	6	9	5	14	8	7	7	268	2	2	331	
GRAND TOTALS	1,893	1,291	2,334	*2,765*	1,689	2,745	850	542	879	1,902	2,054	**18,944**	
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
NORTHWEST BERGEN	221	219	234	290	283	174	149	91	92	96	73	1,922	
PASCACK VALLEY	151	71	99	117	183	186	54	30	104	65	69	1,129	
NORTHERN VALLEY	296	259	414	*1,175*	275	*779*	121	108	104	82	90	3,703	**2**
CENTRAL BERGEN	505	251	419	636	354	369	*179*	132	120	465	170	3,600	**3**
SOUTHEAST BERGEN	*619*	*276*	*791*	434	*467*	548	*179*	*145*	173	*971*	*1,307*	*5,910*	**1**
SOUTHWEST BERGEN	101	215	377	113	127	689	168	36	*287*	223	345	2,681	

Figure 3.6: Bergen County Building Permits



3.4 Hazard Identification

Table 3.3 is a list of potential natural hazards and the likelihood that an event may occur in Bergen County, taken from the State of New Jersey 2014 State Hazard Mitigation Plan, historical and recent hazard event data, and communication with local and regional experts.[7]

Table 3.3: Bergen County Hazards of Concern

Hazard Type	Identified Hazard of Concern?
Coastal Erosion (including enhanced discussion of beach protection) and Sea-Level Rise	No
Drought	Yes
Earthquake	Yes
Flood (riverine, coastal, storm surge, tsunami, and stormwater flooding caused by local drainage and high groundwater levels)	Yes
Geological Hazards (landslide and subsidence/ sinkholes)	Yes
Hurricane and Tropical Storms	Yes
Nor'easter	Yes
Severe Weather (high winds, tornadoes, thunderstorms, hail, and extreme temperature)	Yes
Winter Storms (snow, blizzards, and ice storms)	Yes
Wildfire	Yes

It should be noted that that the Planning Team only considered natural hazards for this Plan update.

In assessing risk associated with potential natural hazard occurrences, it is important to determine the probability and frequency of, and severity/vulnerability to the hazard. By doing so, the Plan is able to target and concentrate on hazards that are more likely to occur, cause the most harm, require the most attention, and/or are most easily or cost-effectively mitigated.

The *probability* of future events is the chance or likelihood that a hazard will occur in any given year. For instance, a flood event that has at least a 1 in 100 (or 1%) chance of occurring in any given year is known as a 100-year flood event, and the area that could potentially be flooded by such an event is known as the 100-year floodplain. The expected average *frequency* of such a flood would be once every 100 years.

The *severity* or *vulnerability* with regard to a specific hazard is the estimate of potential damage or impact that a particular hazard event may have on a designated community.

Table 3.4 shows New Jersey emergency and disaster declarations from 1955-2012. Bergen County has experienced 15 disaster declarations since 1996.

Table 3.4: FEMA Major Disaster Declarations-New Jersey, 1955-2012

FEMA Disaster No.	Disaster Date	Type of Disaster	BC
DR41	August 1955	Hurricane, floods	
DR124	March 1962	Severe storms, high tides, flooding	
DR205	August 1965	Water shortage	
DR245	June 1968	Heavy rains, flooding	
DR310	September 1971	Heavy rains, flooding	
DR402	August 1973	Severe storms, flooding	

EM3005	November 1974	Severe storms, high winds, high tides	
DR477	July 1975	Heavy rains, high winds, hail, tornadoes	
DR519	August 1976	Severe storms, high winds, flooding	
DR528	February 1977	Ice conditions	
EM3083	October 1980	Water shortage	
DR701	April 1984	Coastal storms, flooding	
DR749	October 1985	Hurricane Gloria	
DR936	March 1992	Coastal storm	
DR973	December 1992	Coastal storm	
EM3106	March 1993	Severe blizzard	
DR1088	January 1996	Snow, blizzard	Y
DR1145	November 1996	Flooding	Y
DR1189	September 1997	Severe storms, flooding	
DR1206	March 1998	Coastal storm	
DR1295	September 1999	Hurricane Floyd	
EM3147	September 1999	Hurricane Floyd	Y
EM3148	September 1999	Hurricane Floyd	Y
DR1337	August 2000	Flooding	
EM3156	November 2000	Virus threat	Y
EM3169	September 2001	Terrorist attack emergency declaration	
FM2411	June 2002	Double trouble fire	
EM3181	March 2003	Snowstorm	Y
EM3188	September 2003	Power outage	Y
DR1530	July 2004	Severe storm, flooding	
DR1563	October 2004	Tropical Depression Ivan	
DR1588	April 19, 2005	Severe storms and flooding	Y
EM3257	September 2005	Hurricane Katrina evacuation	Y
DR1653	July 7, 2006	Severe Storms And Flooding	
DR1694	April 26, 2007	Severe Storms/Coastal And Inland Flooding	Y
DR1867	December 22, 2009	Tropical Storm Ida and Nor'easter	
DR1873	February 5, 2010	Severe Winter Storm And Snowstorm	
DR1889	March 23, 2010	Severe Winter Storm And Snowstorm	
DR1897	April 2, 2010	Severe Storms And Flooding	Y
DR1954	February 4, 2011	Severe Winter Storm and Snowstorm	Y
DR4021	August 31, 2011	Hurricane Irene	Y
DR4033	September 15, 2011	Severe Storms and Flooding	
DR4039	October 14, 2011	Remnants of Tropical Storm Lee	
DR4048	November 30, 2011	Severe Storm	Y
DR4070	July 19, 2012	Severe Storms and Straight-Line Winds	
DR4086	October 30, 2012	Hurricane Sandy	Y

3.5 Hazards Eliminated

Based on the combination of geographic location, climate, and geology, the Plan will not address avalanches, coastal erosion, tsunamis, volcanoes, subsidence, hailstorms, or expansive soils. The likelihood of such events being a critical threat to Bergen County or any of the constituent municipalities reflected in the Plan is negligible.

Avalanche
An avalanche is the flow of snow down a slope. Avalanches typically do not occur on slopes flatter than 25 degrees or steeper than 60 degrees. Snow does not accumulate well on steep slopes and does not flow well on flat slopes. Bergen County does not have mountainsides that are vulnerable to avalanches, nor do snowfall accumulations reach amounts large enough for avalanches to be considered a hazard. There have been no incidences of avalanches in the past.

Coastal Erosion
Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, or wave currents. Note that Bergen County, per FEMA's Flood Insurance Rate Maps, does not have any Zone V or Zone E hazard areas. As such, the area is not designated as having "coastal flood zones with wave action" and coastal erosion, though not impossible, is unlikely in the area. Wave oscillations are attenuated by the funneling of ocean water through several restrictions and bays, including Upper New York Bay, Kill Van Kull, and Newark Bay. Only six counties in the State of New Jersey have designated Zone V or Zone E hazard areas (Ocean, Cape May, Atlantic, Monmouth, Middlesex and Hudson).

Tsunami
A tsunami is a series of large waves created by an underwater disturbance such as an earthquake, landslide, volcanic eruption, or meteorite. Tsunamis generally affect the coastlines and thus were eliminated as a hazard in Bergen County.

Volcano
A volcano is a mountain that opens downward to a reservoir of molten rock below the surface of the earth. The danger zone around a volcano typically covers a 20-mile radius. Active volcanoes in the United States are found mainly in Hawaii, Alaska, and the Pacific Northwest. Volcanoes were eliminated as a possible hazard in Bergen County.

Subsidence
Subsidence is the motion of a surface (usually, the Earth's surface) as it shifts downward relative to a datum such as sea-level. Subsidence frequently occurs in karst terrains, where dissolution of limestone by fluid flow in the subsurface causes the creation of voids (i.e. caves). If the roof of these voids becomes too weak, it can collapse and the overlying rock and earth will fall into the space, causing subsidence at the surface. This type of subsidence can result in sinkholes, which can be hundreds of meters deep.

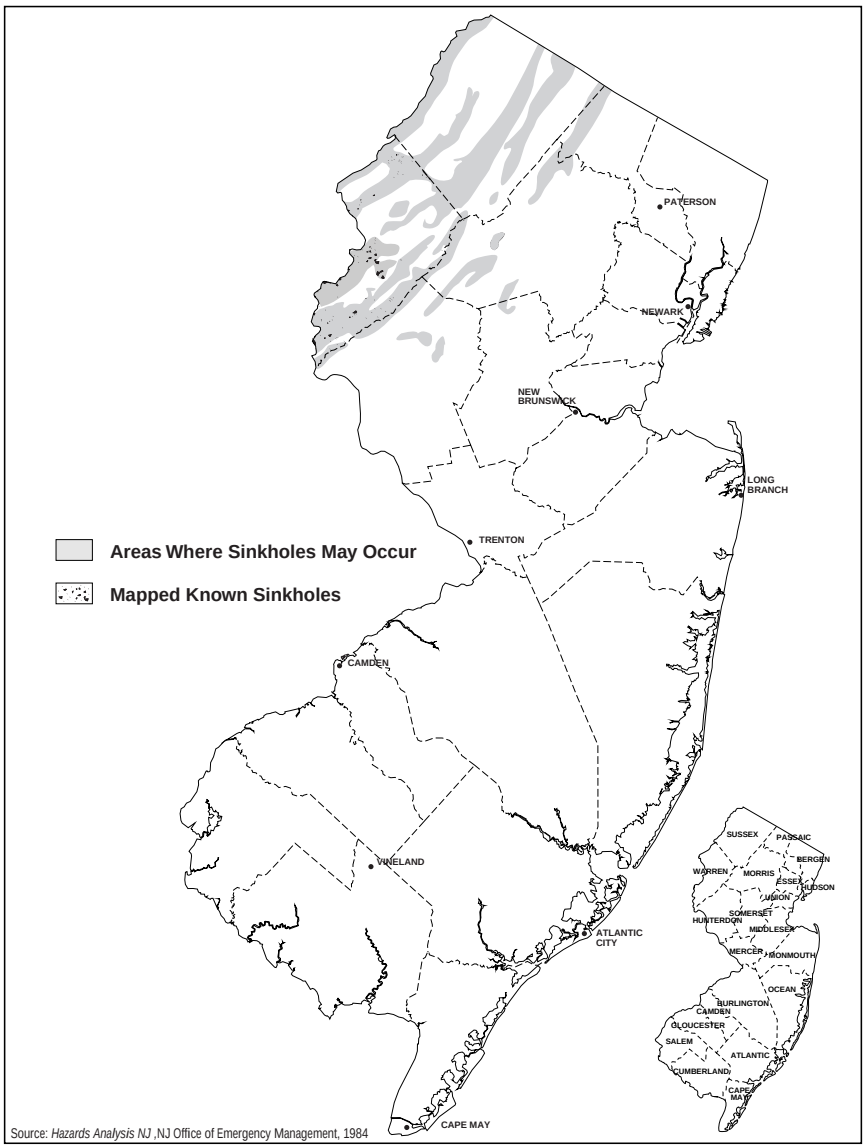


Figure 3.7: Areas Prone to Natural Sinkhole Development

The New Jersey Geological Survey has identified municipalities in New Jersey that have significant limestone deposits which may contribute to subsidence hazards. None are located in Bergen County. As Figure 3.7 indicates, Bergen County has no significant limestone deposits, and thus no areas that are prone to natural sinkholes. The probability of subsidence occurring is low and further assessment of this hazard is not needed.[8]

Hailstorm

Hail is a form of precipitation which consists of balls or irregular lumps of ice (hailstones). Hailstones on Earth consist mainly of water ice and measure between 5 and 50 millimeters in diameter, with the larger stones coming from severe thunderstorms. Hail forms in strong thunderstorm clouds, particularly those with intense updrafts, high liquid water content, great vertical extent, large water droplets, and where a good portion of the cloud layer is below freezing. In the summer months in New Jersey, thunderstorms are very common. However, the possibility of hail is relatively low because the cloud layers are usually not below freezing and the precipitation usually falls as rain. A total of 21 hailstorms have been recorded in Bergen County dating back to May of 1986, as detailed in Table 3.5.[9]

The last recorded hailstorm was in July 2012 with the largest hail measuring 1" in diameter. Of the 40 recorded hailstorms, none have caused significant property damage, injury or death. The largest diameter hailstone recorded was 1.75" in diameter, which would not result in significant damage.

While hailstorms may occur in Bergen County, the probability of hailstorms posing a significant hazard is very low. In general, hailstones do not reach a large enough size to cause a considerable damage or injury. Hailstorms thus were eliminated as a potential hazard in Bergen County.

Table 3.5: Bergen County Historical Hail Events

	Location or County	Date	Time	Type	Magnitude
1	BERGEN	5/31/1986	14:30	Hail	0.75 in.
2	BERGEN	9/22/1987	14:54	Hail	1.00 in.
3	Paramus	5/6/1997	12:30 PM	Hail	0.88 in.
4	Hackensack	5/8/1999	4:45 PM	Hail	0.75 in.
5	Lyndhurst	4/9/2001	7:01 PM	Hail	0.88 in.
6	Lodi	5/29/2001	2:05 PM	Hail	0.75 in.
7	Lyndhurst	8/14/2001	6:50 PM	Tstm/Wind/hail	0 kts.
8	Maywood	8/28/2001	5:00 PM	Tstm/Wind/hail	0 kts.
9	Saddle Brook	4/19/2002	4:40 PM	Hail	1.00 in.
10	Garfield	5/31/2002	6:10 PM	Hail	1.00 in.
11	Ramsey	5/31/2002	6:48 PM	Hail	0.75 in.
12	Garfield	6/19/2002	3:31 PM	Hail	1.00 in.
13	Teterboro	6/26/2002	4:20 PM	Hail	1.00 in.
14	Oakland	5/12/2004	2:21 PM	Hail	0.88 in.
15	Lyndhurst	5/12/2004	3:05 PM	Hail	0.75 in.
16	Ramsey	6/1/2004	4:00 PM	Hail	1.00 in.
17	Allendale	6/1/2004	4:03 PM	Hail	1.75 in.
18	Saddle River	6/1/2004	4:15 PM	Hail	1.75 in.
19	Central Portion	6/1/2004	5:25 PM	Hail	0.75 in.
20	Ft Lee	8/11/2004	1:35 PM	Hail	1.00 in.
21	Rutherford	6/22/2005	2:30 PM	Hail	0.75 in.
22	Saddle Brook	6/16/2007	14:38	Hail	0.88 in.

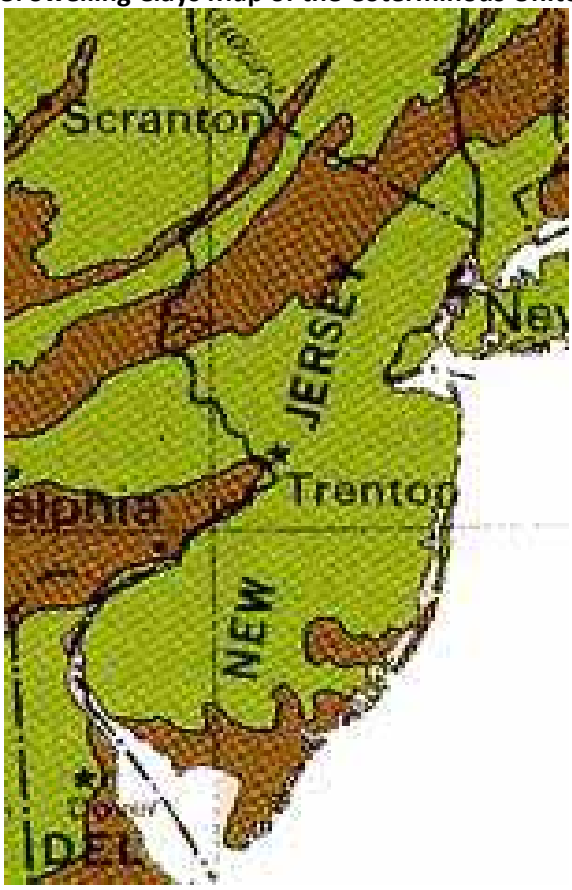
23	Waldwick	6/16/2008	17:25	Hail	0.75 in.
24	Ft Lee	8/11/2008	9:30	Hail	0.75 in.
25	Wortendyke	8/15/2008	15:51	Hail	0.88 in.
26	Oakland	3/29/2009	18:45	Hail	0.75 in.
27	Ridgewood	4/21/2009	21:51	Hail	0.75 in.
28	Westwood	6/15/2009	14:29	Hail	0.75 in.
29	Westwood	6/15/2009	14:29	Hail	0.75 in.
30	Hillsdale Manor	7/7/2009	22:14	Hail	0.75 in.
31	Oakland	7/17/2009	20:53	Hail	1.00 in.
32	Hillsdale Manor	7/24/2009	21:15	Hail	0.75 in.
33	Woodcliff Lake	12/9/2009	16:50	Hail	0.75 in.
34	North Arlington	10/11/2010	19:24	Hail	1.00 in.
35	Harrington Park	6/9/2011	17:00	Hail	1.25 in.
36	Norwood	6/9/2011	17:07	Hail	1.75 in.
37	Oradell	8/19/2011	18:00	Hail	1.75 in.
38	Englewood Cliffs	9/29/2011	11:55	Hail	0.88 in.
39	Bergenfield	9/29/2011	12:00	Hail	0.75 in.
40	Oakland	7/1/2012	15:37	Hail	1.00 in.
41	Fort Lee	8/28/2013	11:48	Hail	0.88 in.

Expansive Soils

According to the USGS, expansive soils are those that shrink or swell as the moisture content decreases or increases.[10] Expansive clay particles are invisible to the naked eye and swell by absorbing large amounts of water relative to their volume. When these particles dry out, they can shrink considerably. When winter rains fall on the dry, cracked ground, the clays swell; the cracks close; and the ground can heave up as much as several inches. Expansive soils pose a threat when built upon. A house built on expansive soil will likely move if the foundation has not been designed to take the soil type into account. Movement occurs because the soils expand so forcefully, the foundation actually shifts. Different parts of the house can move at different rates and distances, thus cracking the foundation. During extreme drought conditions, even homes that are not normally affected by expansive soil problems may experience slight cracking.

According to Figure 3.8, most of the soil in New Jersey has less than a 50% chance of consisting of clay with a slight to moderate swelling potential.[11]. There have been no recordable incidents in the past where expansive soils have caused significant damage in Bergen County. As such, expansive soils will not be addressed in the Plan.

Figure 3.8: Swelling Clays Map of the Coterminous United States



MAP LEGEND

- Unit contains abundant clay having high swelling potential
- Part of unit (generally less than 50%) consists of clay having high swelling potential
- Unit contains abundant clay having slight to moderate swelling potential
- Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
- Unit contains little or no swelling clay
- Data insufficient to indicate clay content of unit and/or swelling potential of clay (Shown in westernmost states only)

3.6 Profiling Hazards and Assessing Vulnerability

Coastal Flooding

Coastal flooding is typically a result of storm surges, wind-driven waves, and/ or heavy rainfall. These conditions are produced by hurricanes during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push sea water up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forest lands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts.

According to the September 30, 2005 FEMA Flood Insurance Study (FIS) for Bergen County, New Jersey, which supersedes the December 8, 1998 FIS, principal flooding in southern Bergen County results from tidal stages of the Newark Bay, which affect the Hackensack River, and in turn, Bellman's Creek and Wolf Creek. The tidal influence is negated on Wolf Creek by a tidal barrier located approximately 1,000 feet upstream of the confluence of Wolf Creek and Bellman's Creek.[12]

Specifically, the FIS notes that the Hackensack Meadowlands District is impacted yearly by nor'easter storm events. Additionally, nor'easters and hurricanes have produced the largest stream elevations, and not rainfall events. The maximum historical tide was produced by a hurricane on September 3, 1821. The surge was approximately 10 to 11 feet above normal tide. In 2012, Superstorm Sandy wreaked havoc on Bergen County with surges that registered approximately 4-5 feet above average high tide (NAVD88). Figure 3.9 shows water elevation levels and storm surge depths as recorded by the Meadowlands Environmental Research Institute sensor at the Barge Club Marina monitoring station in the Hackensack River in Carlstadt, New Jersey.

The FIS differentiates between coastal flooding and riverine flooding (see below). Coastal flooding, due to hurricanes and nor'easters, is isolated according to the report and related Flood Insurance Rate Maps (FIRMs) to the following locations:

Hackensack River

- Village of Ridgefield Park (Portions of Major Flooding Due to Coastal Surges)
- Borough of Bogota (All Due to Coastal Surges)
- Borough of North Arlington (Portions)
- Township of Lyndhurst (Portions)
- Borough of Little Ferry (All)
- Borough of Teterboro (All)
- Borough of Rutherford (Portions)
- Borough of East Rutherford (Portions)
- Borough of Moonachie (All)
- Borough of Carlstadt (All)
- City of Hackensack (Portions)
- Township of Teaneck (Portions)
- Township of South Hackensack (All)
- Borough of Hasbrouck Heights (All)

Hudson River

- Borough of Edgewater (All)
- Borough of Fort Lee (All)
- Borough of Englewood Cliffs (All)
- Borough of Tenafly (Portions)
- Borough of Alpine (All)

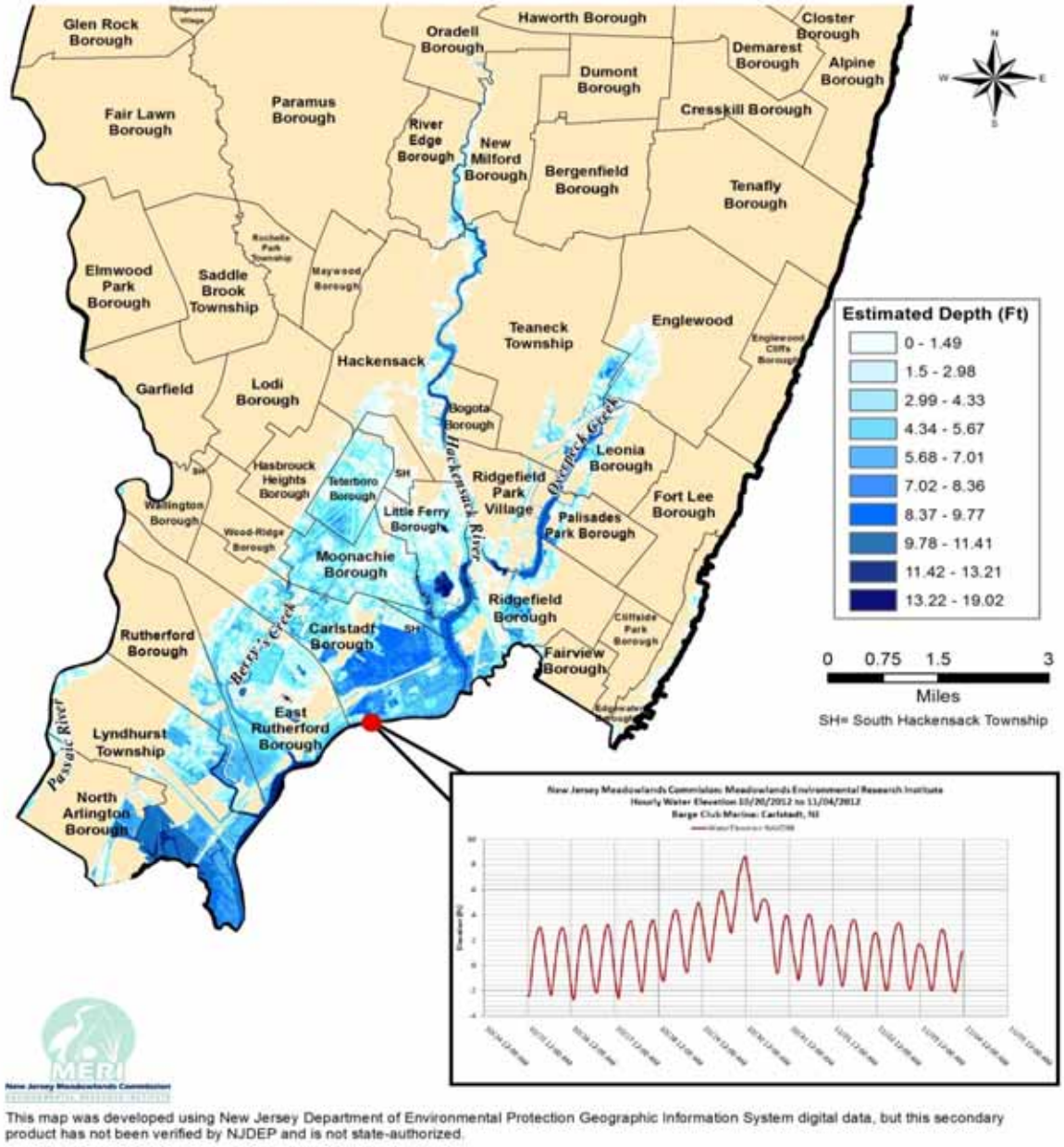


Figure 3.9: MERI Water Elevation Levels & USGS/FEMA Estimates Sandy Storm Surge Depth Superstorm Sandy 2012

As shown above, the extent of coastal flooding (with the exception of the Borough of Edgewater) from a surge in the Hudson River is extremely limited due to the steep topography along the New Jersey banks.

Figure 3.10 shows the locations of coastal and riverine floodplains in Bergen County, as well as the boundary between the coastal and fluvial flood zones[13]. Data for this figure was compiled from two sources. The Digital Flood Insurance Rate Maps (DFIRMs) were obtained from FEMA. Municipal boundaries and the hydrography stream network were obtained from NJDEP. **Appendix B** contains individual maps of each Bergen County municipality, showing critical facility location and the 100-year floodplain.

The magnitude of the coastal flooding and riverine flooding in Bergen County municipalities are further highlighted in Table 3.6 below.

For coastal flooding, the flood hazard area boundaries represent the extent of inundation caused by a coastal surge with a 1% and 0.2% annual probability of occurrence (also known as the 100-year and 500-year events, respectively) and critical facilities provided by the municipalities have been added to the maps. The elevations used to develop these extents are based on the findings of the above FIS. In the past, FEMA's Flood Insurance Rate Maps (FIRMs) were updated every 10-15 years in the New York metropolitan area. The new digital format (DFIRM) allows for more accurate floodplain determinations, and the capability to update the maps more frequently. FEMA states in the FIS that the flooding in the study area is predominantly tidal and that elevations resulting from a given tide are not sensitive to fluvial flows with the exception of Teterboro airport, an area flooded by Moonachie Creek.[14]

Since the creation of New Jersey's Coastal Management (CZM) Program in 1980, the NJDEP has regulated development and other related activities in coastal areas in order to reduce the probability of impact from coastal erosion and flooding, as well as to protect the sensitive coastal environment from human disturbance. These areas include:

- Lands regulated under the Coastal Area Facility Review Act (CAFRA);
- State tidal waters from mean high water (MHW) to the 3-mile limit;
- New Jersey Meadowlands District;
- Tidal wetlands; and
- Properties located between the MHW line landward to the first public roadway, if between 100 and 500 feet of the MHW line.

As noted earlier in the Plan, parts of ten Bergen County municipalities are located within the New Jersey Meadowlands District - Carlstadt, East Rutherford, Little Ferry, Lyndhurst, Moonachie, North Arlington, Ridgefield, Rutherford, South Hackensack, and Teterboro. The majority of these municipalities have properties located along the Hackensack River or tidal tributaries of the river. They also contain numerous tidal wetlands. These municipalities have been some of the most severely impacted by coastal flooding in the County in the past and remain susceptible.

Riverine/Stormwater Flooding

Periodic flooding of lands adjacent to non-tidal rivers and streams is a natural and inevitable occurrence. When stream flow exceeds the capacity of the normal water course, some of the above-normal stream flow spills over onto adjacent lands within the floodplain. Unlike coastal flooding (above), riverine flooding is a function of precipitation levels and water runoff volumes within the watershed of the

stream or river. The recurrence interval of a flood is defined as the average time interval, in years, expected to take place between the occurrence of a flood of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

As with coastal flooding, floodplains are divided into areas that experience different levels of flooding depending on their elevation. A 100-year riverine flood will inundate the 100-year zone of that floodplain, and a 500-year flood will inundate the 500-year flood zone. The 500-year floodplain is higher in elevation. Several methods were used by FEMA to develop the inundation extents. For smaller watersheds, with drainage areas less than 1 square mile, the Rational Method was used. The Rational Method is a very simplified peak flow analysis. For larger watersheds, the hydrology was based on Special Report No. 38, a method developed by NJDEP and the USGS. Input parameters include drainage area, main channel slope, surface storage area, and impervious cover. Lastly, when a sufficient amount of data was available, flood-flow frequency data was established using actual discharges from local gauging stations.

Flooding is one of the most common and frequently identified hazards in Bergen County. It is also one that Bergen municipalities seek the most assistance for, along with other water-related hazards. While New Jersey land use regulations are in place to control future development in the floodplain, older structures still exist and need to be maintained.

Critical Facility Vulnerability to Flooding and Storm Surge

Many critical facilities throughout Bergen County are vulnerable to flooding. Tables 3.6 and 3.7 list those facilities that are vulnerable to flooding or storm surge and/or have experienced damage from flood or storm surge in the past.

Table 3.6: Bergen County Critical Facilities Vulnerable to Flooding

Facility Name
Allendale
Allendale DPW
Allendale Fire Department
Allendale Police Department
Allendale Volunteer Ambulance Corps
Allendale Water
Brookside School
Hillsdale School
Northern Highlands Regional High School
Bergenfield
Bergenfield Municipal
Bogota
DPW Garage
Carlstadt
Carlstadt Public Works
Carlstadt Pump Station (Barell Ave)
Carlstadt Pump Station (Industrial Rd)
NJ Meadowlands Commission Marina
PSE&G Substation
Pumping Station 1 (Jony Drive)
Williams Transcontinental LPG Pipeline
Closter
Closter Borough Hall
Closter DPW Headquarters
Closter EMS Headquarters
Closter Fire Headquarters
Closter Public Library
Spectrum for Living
Tenakill School
Cresskill
Ambulance Station
Cresskill High School
Electric Substation
Public Fire Station
Public Works Building
Demarest
Anderson Avenue
County Road
Demarest D.P.W
Hardenburgh Ave
Hardenburgh Ave. Bridge
Hardenburgh Ave.-Dam
Knickerbocker Road
Piermont Road
Dumont
94/95 Schraalenburgh Way Senior Housing
Dumont Borough Hall
Dumont D.P.W Building
Dumont Fire Co. #2
Dumont Police Department
Dumont Volunteer Ambulance Corp.
Pump Station (White Beeches Dr)
Verizon Central Office
East Rutherford
Alfred S. Faust Intermediate School
East Rutherford Department of Public Works
East Rutherford Fire Dept.-Carlton Hill Firehouse
East Rutherford Sewage Authority Lift Station
East Rutherford Sewage Authority Pump Station
Federal Reserve Bank
Henry P. Becton Regional High School
McKenzie School
PSE&G Switching Station
Williams Gas Pipeline Valve Station
Edgewater
Comfort Inn Motel
DPW Annex
Duane Reed Pharmacy
Edgewater Boro Hall and Police Dept.
Edgewater D.P.W
Edgewater Fire Department
Edgewater Library
Edgewater Multi-Plex
Edgewater Municipal
Edgewater Pathmark/Pharmacy
Edgewater Senior Center
Edgewater Volunteer 1st Aide Squad
Edgewater Water Pollution Control Facility
EVG School
George Washington School
Grand Cove Marina
Hess Oil
Holy Rosary Church
Mitsuwa
Palisade Learning Center
Prime Time Learning Center
Sewer Plant #3
Sunrise Assisted Living
Waterford Towers

Elmwood Park
Elmwood Park Water Distribution Center
Prime Energy Co-Generation
Sewer Pumping Station (Parkview Ave)
Sewer Pumping Station (Martha Ave)
Sewer Pumping Station (River Dr)
Englewood
Route 4
Route 95
Shop Rite Pharmacy
Englewood Cliffs
Pump Station (Chestnut St)
Pump Station (Hollywood
Pump Station (Jane Dr)
Pump Station (Lyncrest Rd)
Pump Station (Roberts Rd)
Unilever Best Foods
Fair Lawn
Fair Lawn DPW Complex
Fair Lawn Memorial Pool
Fair Lawn Parks Bldg
Fair Lawn Sewer Facility (Canger Pl.)
Fair Lawn Sewer Facility (River Rd.)
Fair Lawn Sewer Facility (Saddle River Rd.)
Fair Lawn Water Facility #15
Fair Lawn Water Facility #16
Fair Lawn Water Facility #17
Fair Lawn Water Facility #19
Fair Lawn Water Facility (Wagaraw Rd.)
Memorial Junior High School
Parks & Recreation Garage
Well House
Fairview
Department of Public Works
Fort Lee
Pump Station (Valley St)
Recreation Center
Franklin Lakes
Franklin Lakes Borough Hall
Garfield
Garfield Fire Co #4
Public Service Electric Sub-Station
Hackensack
Bergen County Academies
Bergen County Administrative Building
Bergen County Central Municipal Court
Bergen County Conklin Youth Center
Bergen County Dept. of Public Works

Bergen County Housing, Health & Human Services
Bergen County Jail & BCI Building
Bergen County Justice
Bergen County Maintenance Garage & Fueling Storage
Bergen County Police-Patrol Unit
Bergen County Probation
New Bergen County Agency Building
Ever Ready Oil
Hackensack Dept. of Public Works
PSE&G
Public Service Sub Station
Regent Care
Senior Center & Addiction Rec. Program
Harrington Park
D.P.W Building
Harrington Park Municipal Building
Hasbrouck Heights
Franklin Sewage Pumping Station
Hasbrouck Heights D.P.W
PSE&G Power Substation
Haworth
Haworth Ambulance Corps
Haworth DPW Bldg. #1
Haworth DPW Bldg. #2
Haworth Municipal Complex
United Water Treatment Facility and Reservoir
Hillsdale
Hillsdale Dept. Public Works
PSE&G Electric Substation
Hillsdale Public Library
Ho-Ho-Kus
Bogert Rd. Sewer Station
Bogert Rd. Well #2
Brewster Dams
Community Church and Shelter
Emergency Landing Facility
Flood Monitoring Station
Ho-Ho-Kus Ambulance
Ho-Ho-Kus Borough Hall and Shelter
Ho-Ho-Kus Fire Dept.
Ho-Ho-Kus Inn
Ho-Ho-Kus Police Dept.
Hollywood Ave Well #1
Maple Ave Bridge
Mill Road Bridge
Northwest Bergen Pump Station
Phone Trunk Station
Railroad viaduct

Verizon Switching Center
Leonia
Leonia High School
Little Ferry
Bergen County Utilities Authority
Depyster Creek Pump
Early Learners Child Center
Eckel Rd. Pump Station
Little Ferry D.P.W
Little Ferry Hook & Ladder Fire Dept.
Little Ferry Hose Co. Fire
Little Ferry Library
Little Ferry Municipal
Little Ferry Nursery School
Little Ferry Public Safety Building
Losen Slote Drain Station
Maiden Lane Drain Station
Main & Franklin St. Pump Station
Main St. Pump Station
Memorial School
Public Service Electric
Scientific Design
Scientific Design
St. Margaret's of Cartona Church
Union Ave Pump Station
Washington School
Williams St. Drainage
Willow Lake Pump Station
Lodi
D.P.W Yard
Lodi Borough Hall
Lodi Fire Headquarters
LVAC-Lodi EMS
Washington School
Lyndhurst
Bergen Community College at the Meadowlands
Lyndhurst Pump Station #1
Lyndhurst Pump Station #2
Lyndhurst Pump Station #3
Lyndhurst Pump Station #4
Mahwah
Dept. of Public Works/ DPW Garage
Fire Co #3
Public Works Garage
Maywood
Maywood Health Care Center
Maywood DPW
Municipal Pump Station

PSEG Substation
Midland Park
D.P.W Garage
DEP Dam
DEP Dam (Godwin Ave)
Kentshire Apartments
Midland Park Fire Dept.
Verizon/ T-Mobile Cell
Verizon/ T-Mobile Cell
Towers
Montvale
DPW Garage
Moonachie
Civic Center
Concord St. Pump Station
Crest Foam
Department of Public Works
Lincoln Place Pump Station
Moonachie Ave Pump
Moonachie Fire Department
Moonachie First Aid Squad
Moonachie Road Pump Station
Municipal Building
Robert L. Craig School
New Milford
New Bridge Road
New Milford D.P.W
New Milford High School
PSE&G sub-station & electric switching station
River Rd.
United Water Resource Landscaping Yard
North Arlington
Daniel Morris Firehouse Co.
North Arlington D.P.W
North Arlington EMS
North Arlington Little League Field
North Arlington/Lyndhurst Joint Waste Water
PSE&G Power Sub-Station (North Arlington)
Williams Transco Natural Gas Pipeline
Northvale
BCUA Sanitary Sewer Pump Station
Northvale Sanitary Pump Station
Norwood
Buckingham at Norwood-Care and Rehab Center
Norwood Ambulance
Norwood Borough Hall
Norwood D.P.W
Norwood Police Station

Norwood Police Station-EOC
Norwood Public School
Old Tappan
Borough of Old Tappan (Sewer Pump Station #1)
Lake Tappan
Lake Tappan Dam
Old Tappan Borough Hall
Old Tappan Exxon
Tennessee Gas Pipeline
Pipeline
Oradell
NJT Bus
Oradell Public Works
PSE&G Gas Distribution
Palisades Park
Department of Public Works
Time Warner Cable Co.
Paramus
Bergen County Regional Medical Center
Arcola Power Sub Station
Department of Public Works
Orchard Hills Power Sub Station
Paramus Borough Hall
Paramus Park Power Sub Station
Radio Antenna/ Repeater Site (US Cable)
Sewer Pump Station (Dunkerhook Road)
Sewer Pump Station (Grove Street)
Sewer Pump Station (Southcrest Drive)
Spring Valley Road Power Sub Station
Woodland Ave Power Sub Station
Park Ridge
Borough Hall
Park Ridge DPW / Water / Electric
Park Ridge Fire Department
Park Ridge Police Headquarters/ Triboro Radio EOC
Tri-Boro Ambulance
Ramsey
Crystal Spring Lake Dam
Ridgefield
English Neighborhood Reform Church
CSX Freight Railroad
PSE&G Generating Station
PSE&G Sub Station
Ridgefield Ambulance Corp. Building
Ridgefield Community
Ridgefield Department of Public Works
Ridgefield Fire House #3
Wolf Creek Culverts and Bridges

Ridgefield Park
Callahan Chemical Co., Inc.
Department of Public Works
Dowling Fuel Co.
NYS&W Fuel Depot
Ridgefield Park High School
Ridgewood
Carr Water Well System Building
Ridgewood Fire Dept. Headquarters
Ridgewood Parks Building
Ridgewood Village Hall/Police Station
Ridgewood Water Building
Sewer Pump Station (Bellair Rd)
Sewer Pump Station (Franklin Tpk)
Sewer Pump Station (Lake Ave)
Water Well Pump (Grove St)
Water Well Pump (Lakeview Dr)
Water Well Pump (Linwood & Northern Pkwy)
Water Well Pump (Ridgewood Ave)
Water Well Pump (Ridgewood Ave)
Water Well Pump (Saddle River Rd)
St.)
River Edge
PSE&G
River Edge D.P.W
River Edge Fire Dept. Co. #2
Von Steuben House
River Vale
Ambulance Corps
Lake Tappan
Police Headquarters
Public Works Garage
South Fire Station
Rochelle Park
AT&T / Verizon Telecommunications Center
Bristol Manor Nursing Home
Fire/EMS/D.P.W
Ramada Inn
Offices/Police/EOC
Rockleigh
Bergen County Health Care Center
Rutherford
Borough of Rutherford Public Works
Saddle Brook
Brookwood Convalescent Home
Engine Co #1 Fire Station
Kessler Institute
Saddle Brook High School

Saddle Brook Police Headquarters
St. Philips School
Saddle River
Department of Public Works
South Hackensack
Fire Headquarters
Garfield Park Sewage Pumping Station
Grove Street Sewage Station
Huyler St Pump Station
J. Josephson Company
Leuning Street
Memorial Elementary
Phillips Avenue
Public Service Electric Sub Station
Restaurant Depot
Saddle River Ave. Sewage Station
Town Hall Complex
U.S. Post Office
Vreeland Avenue
Wesley Street
Teaneck
D.P.W Yard
Tenafly
Cell Tower (Monopole)
County Manor Nursing
Tenafly D.P.W
Teterboro
Bergen County Animal Shelter
Bergen County Technical H.
Bergen County Youth Complex (JDC)
Municipal Building
Public Works Facility
Sewer & Storm Water Pumping Station
Teterboro Airport
Waldwick
Forum School
Franklin Turnpike
Northwest Bergen Utilities Authority
Village School
White Pond Dam
Wallington
Farmland Dairies
Westwood
Berkeley School
Brookside School
Ketler School
Westwood DPW
Westwood Regional Middle School

Westwood Substation
Woodcliff Lake
Dam
Wood-Ridge
Anderson Ave. Pump Station
Department of Public Works

Table 3.7: Bergen County Critical Facilities Vulnerable to Storm Surge

Facility Name
Carlstadt
Carlstadt Pump Station (Barell Ave)
Carlstadt Pump Station (Industrial Rd)
NJ Meadowlands Commission Marina
Pumping Station 1 (Jony Drive)
Williams Transcontinental LPG Pipeline
East Rutherford
Alfred S. Faust Intermediate School
East Rutherford Department of Public Works
East Rutherford Fire Dept.-Carlton Hill Firehouse
East Rutherford Sewage Authority Lift Station
East Rutherford Sewage Authority Pump Station
Federal Reserve Bank
Henry P. Becton Regional High School
Williams Gas Pipeline Valve Station
Edgewater
Edgewater Water Pollution Control Facility
Fair Lawn
Fair Lawn Public Library
Fair Lawn Senior Center
Fair Lawn Water Facility #19
Fort Lee
Fort Lee Parking Authority
Garfield
Public Service Electric Sub-Station
Hasbrouck Heights
Hasbrouck Heights D.P.W
Little Ferry
Bergen County Utilities Authority
Depyster Creek Pump
Early Learners Child Center
Eckel Rd. Pump Station
Little Ferry D.P.W
Little Ferry Hook & Ladder Fire Dept.
Little Ferry Hose Co. Fire
Little Ferry Library
Little Ferry Municipal
Little Ferry Nursery School
Little Ferry Public Safety Building
Losen Slote Drain Station
Maiden Lane Drain Station
Main & Franklin St. Pump Station
Main St. Pump Station
Memorial School
Public Service Electric
Scientific Design
Scientific Design
St. Margaret's of Cartona Church
Union Ave Pump Station
Washington School
Williams St. Drainage
Willow Lake Pump Station
Lyndhurst
Lyndhurst Pump Station #1
Lyndhurst Pump Station #2
Lyndhurst Pump Station #3
Lyndhurst Pump Station #4
Midland Park
Midland Park Fire Dept.
Moonachie
Civic Center
Concord St. Pump Station
Crest Foam
Department of Public Works
Lincoln Place Pump Station
Moonachie Ave Pump
Moonachie Fire Department
Moonachie First Aid Squad
Moonachie Road Pump Station
Municipal Building
Robert L. Craig School
New Milford
New Bridge Road
New Milford High School
North Arlington
Daniel Morris Firehouse Co.
North Arlington D.P.W
North Arlington/Lyndhurst Joint Waste Water
PSE&G Power Sub-Station (North Arlington)
Oradell
New Jersey Transit Bus
River Edge
PSE&G
River Edge Fire Dept. Co. #2
Von Steuben House
Rutherford
Borough of Rutherford Public Works
Saddle Brook
Engine Co #1 Fire Station
South Hackensack

Grove Street Sewage Station
Huyler St Pump Station
J. Josephson Company
Public Service Electric Sub Station
Saddle River Ave. Sewage Station
Teaneck
D.P.W Yard
Pump Station
Wood-Ridge
Anderson Ave. Pump Station
Department of Public Works

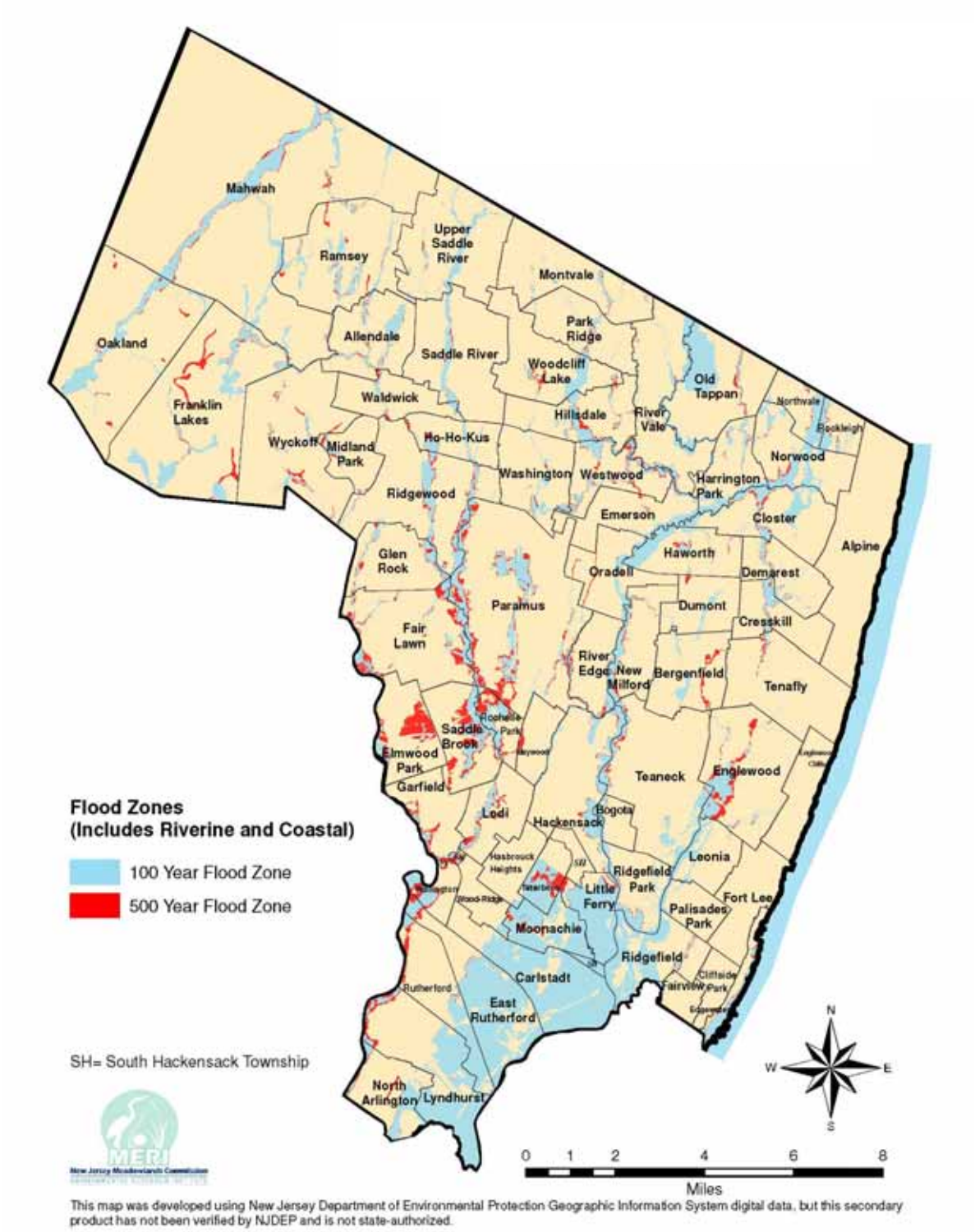


Figure 3.10: FEMA 2006 FIRM 100 & 500 Year Flood Zones
Bergen County, NJ

Table 3.8: Percentage of Bergen County Municipalities Subject to 100- and 500-Year Flood

Municipality	Riverine		Coastal	
	100 Year	500 Year	100 Year	500 Year
ALLENDALE BORO	11	13	1	1
ALPINE BORO	0	0	1	1
BERGENFIELD BORO	5	8	0	0
BOGOTA BORO	0	0	13	13
CARLSTADT BORO	0	0	77	77
CLIFFSIDE PARK BORO	0	0	0	0
CLOSTER BORO	20	22	0	0
CRESSKILL BORO	10	11	0	0
DEMAREST BORO	7	8	0	0
DUMONT BORO	5	5	0	0
EAST RUTHERFORD BORO	3	4	64	64
EDGEWATER BORO	0	0	49	53
ELMWOOD PARK BORO	9	25	0	0
EMERSON BORO	10	11	0	0
ENGLEWOOD CITY	10	16	0	0
ENGLEWOOD CLIFFS BORO	0	0	1	1
FAIR LAWN BORO	11	18	0	0
FAIRVIEW BORO	0	1	4	5
FORT LEE BORO	0	0	1	1
FRANKLIN LAKES BORO	10	13	0	1
GARFIELD CITY	9	14	0	0
GLEN ROCK BORO	8	11	0	0
HACKENSACK CITY	6	6	12	13
HARRINGTON PARK BORO	22	23	0	0
HASBROUCK HEIGHTS BORO	0	0	3	3
HAWORTH BORO	21	23	0	0
HILLSDALE BORO	13	16	0	0
HOHOKUS BORO	11	13	0	0
LEONIA BORO	16	16	0	0
LITTLE FERRY BORO	0	0	80	84
LODI BORO	9	14	0	0
LYNDHURST TWP	4	6	46	46
MAHWAH TWP	6	7	0	0
MAYWOOD BORO	3	5	0	0
MIDLAND PARK BORO	4	7	0	0
MONTVALE BORO	4	4	0	0
MOONACHIE BORO	0	0	77	81

Municipality	Riverine		Coastal	
	100 Year	500 Year	100 Year	500 Year
NEW MILFORD BORO	14	17	0	0
NORTH ARLINGTON BORO	5	8	16	16
NORTHVALE BORO	25	27	0	0
NORWOOD BORO	21	22	0	0
OAKLAND BORO	6	7	3	3
OLD TAPPAN BORO	26	27	0	0
ORADELL BORO	9	11	0	0
PALISADES PARK BORO	7	7	0	0
PARAMUS BORO	12	18	0	0
PARK RIDGE BORO	5	6	0	0
RAMSEY BORO	10	12	0	0
RIDGEFIELD BORO	8	9	40	40
RIDGEFIELD PARK VILLAGE	10	10	14	15
RIDGEWOOD VILLAGE	12	15	0	0
RIVER EDGE BORO	11	13	0	0
RIVER VALE TWP	14	15	0	0
ROCHELLE PARK TWP	31	49	0	0
ROCKLEIGH BORO	24	26	0	0
RUTHERFORD BORO	5	8	25	26
SADDLE BROOK TWP	16	29	0	0
SADDLE RIVER BORO	7	7	0	0
SOUTH HACKENSACK TWP	4	7	21	21
TEANECK TWP	7	8	2	3
TENAFLY BORO	1	2	0	0
TETERBORO BORO	0	0	48	62
UPPER SADDLE RIVER BORO	8	8	0	0
WALDWICK BORO	5	6	0	0
WALLINGTON BORO	29	39	0	0
WASHINGTON TWP	7	8	0	0
WESTWOOD BORO	19	24	0	0
WOOD-RIDGE BORO	0	0	5	5
WOODCLIFF LAKE BORO	10	11	0	0
WYCKOFF TWP	3	5	0	0

* Percentage Values based on 2010 Municipal Boundaries and 2006 FEMA Firms

Drought

Bergen County is in New Jersey's Northeast Drought Region, as designated by NJDEP. Droughts of varying intensity occur several times a decade in New Jersey, as noted in Table 3.7.[15] Table 3.8 details the drought classifications.[16] Fortunately, in addition to being the hottest and most drying, the high summer months of July and August are normally the wettest months of the year as a result of the greater availability of atmospheric moisture and the higher frequency of thunderstorms.

Reservoir levels decrease and aquifer draw-downs intensify during drought conditions. According to the NJDEP's drought resource website, river and reservoir levels are equally important as water supply sources to Bergen County.[17] All municipalities in Bergen County are equally likely to be impacted by drought conditions.

The New Jersey Drought Emergency Plan, prepared by the New Jersey Departments of Law and Public Safety and Environmental Protection, fully identifies authority, organization, concept of operations, and responsibilities for any drought emergency and is used as needed in response to potential drought situations. Drought status information is maintained at http://njdrought.org. Drought emergencies are implemented when drought begins to affect residents and businesses.

When emergencies are declared, all residents, including those with private wells, are urged to adhere to mandatory restrictions such as limiting or eliminating lawn watering, driveway washing, and car washing. Often, non-essential business use may be restricted. When waterways approach historic low flows, groundwater supplies may also be affected.

Table 3.9: New Jersey Drought Periods - Northern Climate Division

Periods of 2 or More Months of Severe or Extreme Drought

-- Northern Climate Division --		
Drought Periods	**Duration**	**Lowest PDSI**
8/1932 - 9/1932	2 months	-3.40 in 9/1932
11/1949 - 1/1950	3 months	-3.67 in 12/1949
9/1957 - 11/1957	3 months	-3.12 in 11/1957
8/1964 - 8/1966	25 months	-5.51 in 8/1966
12/1980 - 1/1981	2 months	-3.77 in 1/1981
3/1985 - 4/1985	2 months	-3.82 in 4/1985
8/1995 - 9/1995	2 months	-3.43 in 8/1995
7/1999 - 8/1999	2 months	-4.15 in 7/1999
12/2001 - 5/2002	6 months	-4.57 in 2/2002
7/2002 - 9/2002	3 months	-3.28 in 8/2002

Note: Based on the monthly Palmer Drought Severity Index as computed by the National Climatic Data Center. Period of record: January 1895 through April 2014

Table 3.10: Palmer Classifications

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

Extreme Heat

According to FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a dome of high atmospheric pressure traps hazy, damp air near the ground. Extremely dry and hot conditions can provoke dust storms and low visibility. Droughts occur when a long period passes without substantial rainfall. A heat wave combined with a drought is a very dangerous situation. All municipalities in Bergen County are equally likely to be impacted by extreme heat.

The elderly, the very young, and those who are disabled are at risk from extreme heat. Studies indicate that extreme heat that continues for periods longer than 2 days causes a significant rise in heat-related illnesses. Spending several hours each day in air conditioning, however, can reduce the risk of heat-related illness. People living in urban areas may be at greater risk from the effects of a prolonged heat wave than people living in rural regions. Stagnant atmospheric conditions can trap pollutants in urban areas, and asphalt and concrete stay warm longer. This phenomenon is known as the urban heat island effect.

The risks associated with a heat wave can include:

- Heat cramps: Muscular pains and spasms resulting from heavy exertion. Heat cramps are often the first signal that the body is suffering from extreme heat.
- Heat exhaustion: A form of mild shock that typically occurs when people exercise heavily or work in a hot, humid place where body fluids are lost through heavy sweating.
- Heat/Sun stroke: A life-threatening condition in which the victim's temperature control system that produces sweating to cool the body stops working. The body temperature can rise to the extent that brain damage and death may result if the body is not cooled quickly.

New Jersey experiences temperatures in the summer that range from 85 to 100 degrees, with occasional temperatures that may reach above 100 degrees Fahrenheit. The probability of Bergen County experiencing extreme heat is very high (see Figure 3.11.) It is almost certain that there will be a

period of extreme heat in Bergen County every summer. Steps to be taken to stay safe during extreme heat include:

- Stay indoors as much as possible and limit exposure to the sun.
- Stay on the lowest floor out of the sunshine if air conditioning is not available.
- Consider spending the warmest part of the day in public buildings such as libraries, schools, movie theaters, shopping malls, and other community facilities. Circulating air can cool the body by increasing the perspiration rate of evaporation.
- Eat well-balanced, light, and regular meals. Avoid using salt tablets unless directed to do so by a physician.
- Drink plenty of water. Persons who have epilepsy or heart, kidney, or liver disease; are on fluid-restricted diets; or have a problem with fluid retention should consult a doctor before increasing liquid intake.
- Limit intake of alcoholic beverages.
- Dress in loose-fitting, lightweight, and light-colored clothes that cover as much skin as possible.
- Protect face and head by wearing a wide-brimmed hat.
- Check on family, friends, and neighbors who do not have air conditioning and who spend much of their time alone.
- Never leave children or pets alone in closed vehicles.
- Avoid strenuous work during the warmest part of the day. Use a buddy system when working in extreme heat, and take frequent breaks.

According to the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC), extreme heat has claimed lives in New Jersey. While extreme heat is unavoidable, it is important that residents follow the proper precautions and safety practices when the weather gets extremely hot.

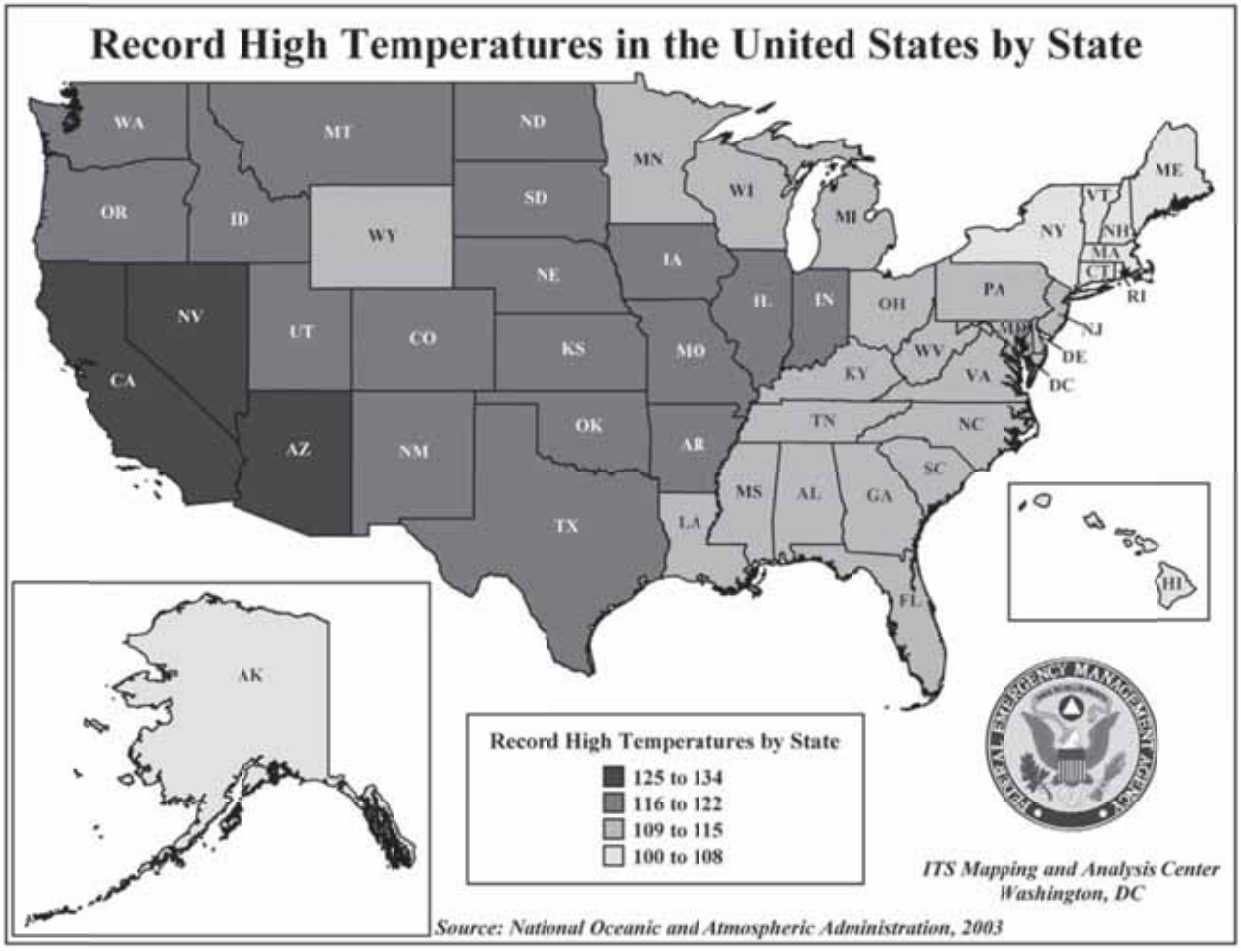
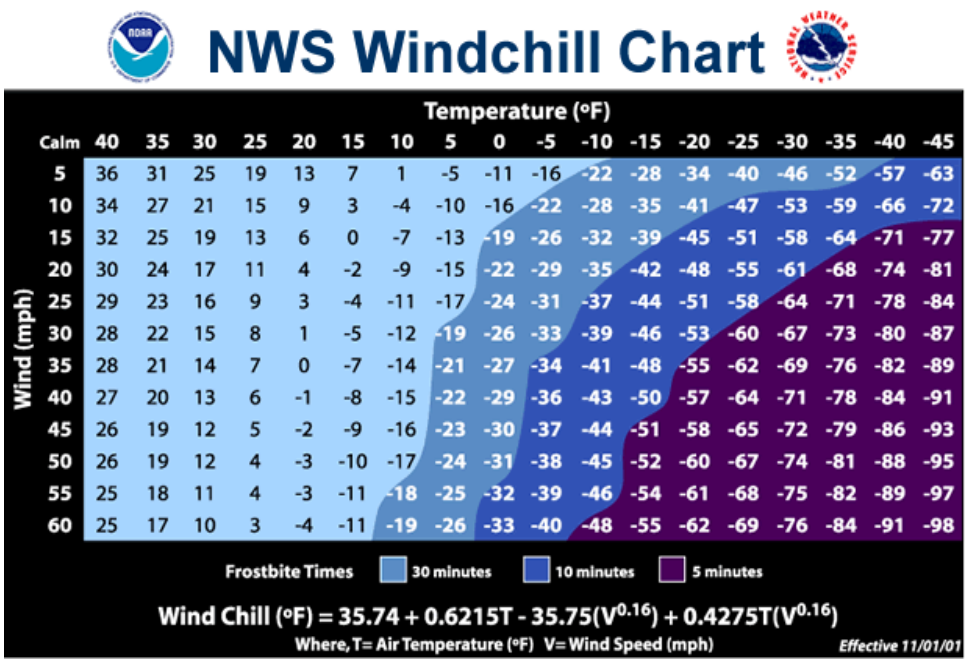


Figure 3.11: Record High Temperatures in the United States by State[18]

Winter Storm/Extreme Cold

Winters in New Jersey can be extremely hazardous. Temperatures often reach well below freezing point and wind chills can make it feel as though it is below zero degrees Fahrenheit. All municipalities in Bergen County are equally likely to be impacted by extreme cold and winter storms. Wind chill is an index of air temperature indicating how quickly heat is lost from skin when exposed to cold, windy conditions. Figure 3.12 shows what the temperature actually feels like with the wind chill factor.[19]

Wind chills can lead to serious conditions of frost bite and even hypothermia. Hypothermia, or abnormally low body temperature, results when the body starts losing heat faster than it can be produced. Hypothermia can affect the brain, making it difficult for the victim to think clearly, move well, or even realize that they are in danger. When the body temperature is below 95 degrees Fahrenheit, the situation is an emergency.



NWS Windchill Chart

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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

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

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

Effective 11/01/01

Figure 3.12: National Weather Service Wind Chill Chart

Those most at risk include the elderly, babies sleeping in cold bedrooms, children left unattended, and anyone who remains outdoors for long periods. Symptoms of hypothermia include uncontrolled shivering, memory loss, disorientation, and drowsiness. Warning signs in infants include cold, bright red skin and very low energy. Frostbite is damage to body tissue caused by extreme cold. Symptoms of frostbite include numbness and a pale color in extremities such as fingers, toes, and earlobes. Skin may feel unusually firm or waxy. If you must go outdoors during extremely cold temperatures, it is important to dress appropriately:

- Wear several layers of loose-fitting, lightweight, warm clothing rather than one layer of heavy clothing. The outer garments should be tightly woven and water repellent.
- Wear mittens, which are warmer than gloves.
- Wear a hat.
- Cover your mouth with a scarf to protect your lungs.

Extremely cold temperatures and wind chills are not the only hazards that affect New Jersey in the winter. New Jersey is also highly susceptible to snow storms, blizzards and nor'easters. A blizzard includes winds of 35 mph or more and blowing snow that reduces visibility to less than ¼ mile for three hours or longer. Heavy snow can immobilize a region and strand commuters, close airports, stop the flow of supplies and disrupt emergency and medical services. Accumulations of snow can cause the collapse of roofs, trees, and power lines. Homes and farms may be isolated for days, and unprotected crops may be lost. A Nor'easter is defined as a macro-scale storm whose winds come from the northeast, especially in the coastal areas of the northeastern United States and Atlantic Canada (http://www.wikipedia.com). More specifically, it describes a low pressure area whose center of rotation is just off the coast and whose leading winds in the left forward quadrant rotate onto land from the northeast. The precipitation pattern is similar to other extratropical storms. A Nor'easter can cause coastal flooding, coastal erosion and gale force winds. The northeastern United States, from New Jersey to the New England coast, Quebec and Atlantic Canada see nor'easters each year, most often in the

winter and early spring, but also sometimes during the autumn. These storms can leave inches of rain or several feet of snow on the region, and can last for several days. There have been several severe storms to hit Bergen County in recent years. Two of the most severe were the North American Blizzard of 1996 (January) and the North American Blizzard of 2006 (February).

The Blizzard of 1996 was a state declared emergency which dropped at least 24" of snow onto the entire state of New Jersey. Roads were shut down during the three day storm and power outages were reported statewide. Businesses were closed either due to road conditions or because of the loss of power. Table 3.9 shows a summary of snowfall for the northeast and comparisons to other storms.

Snowfall totals for the Blizzard of 1996 are based on data received through Tuesday morning. Record snowfall amounts are for storms spanning no more than two days. Another state declared emergency, the Blizzard of 2006 saw record snowfall for New York City at 26.9" recorded at Central Park. In New Jersey, the storm was powerful enough to stop NJ Transit bus service from 7:00 a.m. to 4:00 p.m. 21.0" of snow fell in Newark, New Jersey and 16,000 people were left without power. Businesses were closed for most of the day throughout northern New Jersey.

While the NJOEM does not recommend driving during a snowstorm or blizzard, they offer the following precautions if a resident finds it absolutely necessary to take a motor vehicle out on the road in inclement cold weather conditions:

- Always buckle your seat belt.
- Brake properly to avoid skidding. If driving on snow or ice, start slowly and brake gently. Begin braking early when you come to an intersection.
- If you start to slide, ease off the gas pedal or brakes. Steer into the direction of the skid until you regain traction, and then straighten your vehicle. If you have antilock brakes, apply steady pressure.
- In fog, drive with headlights set on dim or use fog lights.
- In rain, fog, snow or sleet, stay within the limits of your vision. If it is too difficult to see, pull off the road and stop.
- Drive slowly and increase your following distance. Your speed should adjust for conditions and match the flow of traffic.
- Watch for slick spots. Be physically and mentally prepared to react.

Given the history of extreme temperatures and snowstorms in New Jersey and Bergen County in particular, it is almost certain that at least one case of extreme cold and/or snowfall will be seen during winter months. It is important to make sure residents know what precautions to take when these conditions occur. Though it is not possible to keep everyone indoors during cold temperatures and to keep all drivers off the roads during snow storms, it is important for Bergen County Police and OEM to be able to do their best to prevent unnecessary injuries or deaths.

Table 3.11: Snowfall Amounts for the Northeast
Data compiled by the Northeast Regional Climate Center at Cornell University. [20]

City	Blizzard of '96 Total (inches)	Record Snowfall Amount	Date of Record Amount	"Storm of the Century" (March 1993)
Philadelphia, PA	30.7	21.3	Feb. 11-12, 1983	12.0
Newark, NJ	27.8	22.6	Feb. 3-4, 1961	12.7
Washington Dulles AP	24.6	22.8	Feb. 10-11, 1983	14.1
Providence, RI	24.0	28.6	Feb. 7-8, 1978	10.2
Elkins, WV	23.4	20.7	Nov. 24-25, 1950	18.8
Baltimore, MD	22.1	22.8	Feb. 11, 1983	11.9
Wilkes-Barre/Scranton, PA	21.0	21.4	Mar. 13-14, 1993	21.4
Charleston, WV	20.5	18.9	Mar. 13-14, 1993	18.9
New York, NY	20.2	26.4	Dec. 26-27, 1947	10.6
Boston, MA	18.2	27.1	Feb. 6-7, 1978	12.8
Hartford, CT	18.2	21.0	Feb. 11-12, 1983	14.8
Washington National AP	17.1	18.7	Feb. 18-19, 1979	6.6
Bridgeport, CT	15.0	17.0	Dec. 19-20, 1948	10.8
Portland, ME	10.2	27.1	Jan. 17-18, 1979	18.6
Pittsburgh, PA	9.6	24.6	Mar. 12-13, 1993	24.6
Williamsport PA	8.6	24.1	Jan. 12-13, 1964	15.9

Earthquake

Damaging earthquakes are rare, but not unheard of in New Jersey. Earthquakes with an estimated magnitude of 5.2 on the Richter scale occurred in the New York City area in 1737 and 1834. In historic times, earthquakes of magnitudes between 6 and 7 have occurred in the Boston, Massachusetts and Charleston, South Carolina areas, and in the St. Lawrence Valley of Quebec. New Jersey is in a similar tectonic setting as these places and earthquakes of this magnitude are possible. The risk of a damaging quake, in combination with the density and value of the buildings, place New Jersey tenth among all states for potential economic loss from earthquakes.

New Jersey Geological Survey[21]

FEMA defines an earthquake as a sudden slipping or movement of a portion of the earth's crust, accompanied and followed by a series of vibrations. It is important to understand all of the terms associated with earthquakes, which include the following:

Epicenter: The place on the Earth's surface directly above the point on the fault where the earthquake rupture begins. Once fault slippage begins, it expands along the fault during the earthquake and can extend hundreds of miles before stopping.

Fault: The fracture across which displacement occurs during an earthquake. The slippage may range from less than an inch to more than 10 yards in a severe earthquake.

Magnitude: The amount of energy released during an earthquake, which is computed from the amplitude of the seismic waves. A magnitude of 7.0 on the Richter scale indicates an extremely strong earthquake. Each whole number on the scale represents an increase of about 30 times more energy released than the previous whole number represents. Therefore, an earthquake measuring 6.0 is about 30 times more powerful than one measuring 5.0. The relationship between magnitude and intensity is detailed in Table 3.10.

Seismic Waves: Vibrations that travel outward from the earthquake fault at speeds of several miles per second. Although fault slippage directly under a structure can cause considerable damage, the vibrations of seismic waves cause most of the destruction during earthquakes.

Aftershock: An earthquake of similar or lesser intensity that follows the main earthquake.

Table 3.12: Approximate Relationship between Magnitude and Intensity[22]

Magnitude	Felt Area	Distance Felt	Modified Mercalli Scale
	(Square miles)	(approx. miles)	(close to epicenter)
3.0-3.9	750	15	I-III
4.0-4.9	3,000	30	IV-V
5.0-5.9	15,000	70	VI-VII
6.0-6.9	50,000	125	VII-VIII
7.0-7.9	200,000	250	IX-X

Magnitude	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded on seismograph.
2.5 to 5.4	Often felt, but only causes minor damage.
5.5 to 6.0	Slight damage to buildings and other structures.
6.1 to 6.9	May cause serious damage in very populated areas.
7.0 to 7.9	Major earthquake. Serious damage.
8.0 or greater	Massive earthquake. Can totally destroy communities near epicenter.

The longest and most active geologic fault in New Jersey is the Border Fault. The fault, which divides the Highlands and Piedmont Physiographic Provinces, geologically unique regions, extends south from Stony Point, New York to Reading, Pennsylvania. In the north, it passes into New Jersey about half a mile west of State Route 202 in Bergen County, and passes out of northwestern New Jersey north of Stockton in Hunterdon County. The Ramapo section of this fault, known as the Ramapo Fault, extends south from the New Jersey-New York border along two thirds of the New Jersey portion of the Border Fault, and has been the most active section of the Border Fault. Over 25 percent of the earthquakes experienced in New Jersey over the past 200 years had their epicenters within 30 miles of the fault.

Figure 3.13 represents historical earthquake epicenters spatially across Bergen County. Most have been less than 2.5 in magnitude which is usually undetected. A few have been around a magnitude 3.0 which may cause minimal damage, if any. Although predicting the time, place, and magnitude of earthquakes is not possible, it is possible to predict their potential to do damage. Structural damage caused by an earthquake depends on how much the ground shakes. The amount of ground shaking, in turn, 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. The New Jersey Geological Survey maps seismic soil properties, including shaking behavior, liquefaction susceptibility, and tendency to landslide.

The USGS maps the peak ground acceleration (PGA) values with a 10% chance of being exceeded over 50 years. Figure 3.14 shows the geographic area affected (all colored areas on the map), the probability of an earthquake of each given level of severity (10% chance in 50 years, or once in 500 years), and the severity (the PGA is indicated by color). The lowest risk of earthquake is shown in gray and the greatest risk in brown. PGA is a measure of the strength of ground movements. PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity. If the PGA value is less than 2 (i.e., a gray color), seismic risk is relatively low and earthquakes are not required to be identified as a hazard. In the case of Bergen County, there is a PGA value of 5-6, which means the seismic risk is moderate to high. Figure 3.14 shows peak ground acceleration (PGA) with a 10% chance of being exceeded over 50 years as highest in northeastern New Jersey (5-6%g) and decreasing to the south (2%g). According to FEMA's How-To Guidance entitled, *Understanding Your Risks*, earthquakes should be profiled as a hazard if the PGA is greater than 3%g.[23]

In addition to the map data, Bergen County has the ability to evaluate the potential vulnerability in terms of estimated loss from earthquakes and other natural hazards. The Hazards U.S. Multi-Hazard (HAZUS-MH) is a nationally applicable standardized methodology and software program that estimates potential losses from earthquakes, hurricanes, and floods. HAZUS-MH, developed by FEMA, uses GIS to map and display hazard data as well as the results of damage and economic loss estimates for buildings and infrastructure. HAZUS-MH can also estimate the impacts of earthquakes, hurricane winds, and floods on populations.[24]

HAZUS-MH studies indicate a low frequency, but high potential dollar losses for earthquakes in northern New Jersey. The New York Consortium for Earthquake Mitigation (NYCEM) HAZUS Multi-Hazards Study of the greater New York City metro area (including parts of northern New Jersey) indicated a low hazard frequency, but high severity because of dense population, vulnerable infrastructure, and substantial economic value. According to *Earthquake Risks and Mitigation in the New York/New Jersey/Connecticut Region*, prepared by the NYCEM, the replacement value of the buildings in Bergen County is $56 billion.[25] The New Jersey Geological Survey (NJGS) has conducted a HAZUS earthquake loss estimation study for Bergen County. This report, entitled, *Earthquake Loss Estimation Study for Bergen County, New Jersey*, used HAZUS to estimate quantitative earthquake losses for Bergen County. The report considered various earthquake "worst case" scenarios using default HAZUS rock/soil data, as well as updated data compiled by the NJGS. For example, for a 5.0 magnitude earthquake occurring in Bergen County, it is estimated that 12,800 buildings would be damaged, with $1.08 billion in property damages and $80 million in business interruption losses. The report lists several caveats that accompany the use of the HAZUS model, but concludes that the results for the 5.0 magnitude earthquake are reasonably representative of the actual damage an earthquake in New Jersey could cause, although the damage

would not be limited to Bergen County. The complete report is available for download from the NJDEP website[26].

The most recent earthquake recorded in Bergen County was a magnitude 2.0 recorded in November 2012. The largest earthquake reported in New Jersey was a magnitude 5.3 recorded November 30, 1783. This earthquake was felt from New Hampshire to Pennsylvania.[27]

Figure 3.13: Earthquakes with Epicenters in Bergen County, NJ

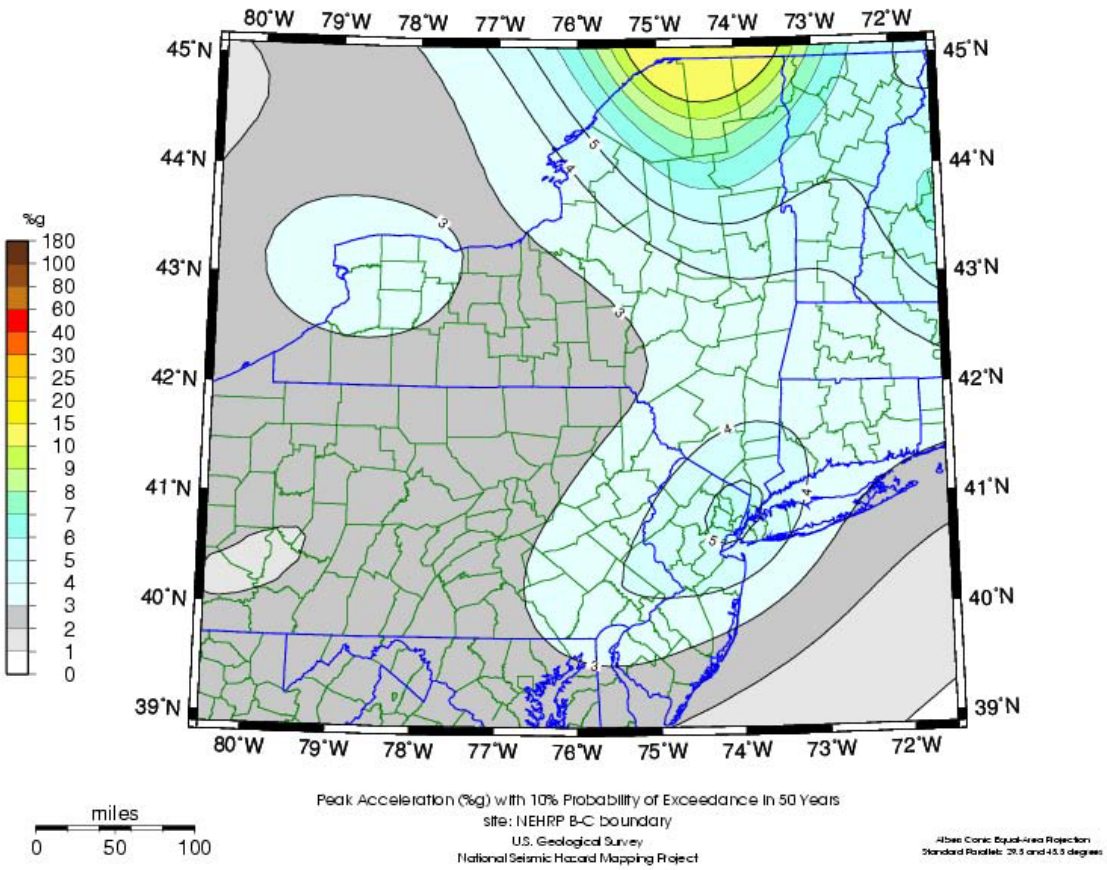


Figure 3.14: Peak Ground Acceleration with a 10% Probability of Exceedance in 50 Years

Landslides/ Mudslides

A landslide is a geological phenomenon which includes a wide range of ground movement, such as rock falls, deep failure of slopes and shallow debris flows. Although gravity's action on an over-steepened slope is the primary reason for a landslide, there are other contributing factors affecting the original slope stability such as a heavy rainfall event, earthquake, 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 practically intact or be greatly deformed and rearranged. The slope may be nearly vertical or fairly gentle.

The USGS defines landslide as the movement of rock, debris or earth down a slope. The term landslide encompasses events such as rock falls, topples, slides, spreads and flows, such as debris flows commonly referred to as mudflows and mudslides. Landslides can be initiated by rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by man-made construction activities, or any combination of the above. Failure of a slope occurs when the force that is pulling the slope downward (gravity) exceeds the strength of the earth materials that compose the slope. Materials can move slowly, (millimeters per year) or can move quickly and disastrously, as is the case with debris-flows. Debris-flows can travel down a hillside of speeds up to 200 miles per hour (more commonly, 30 - 50 miles per hour), depending on the slope angle, water content, and type of earth and debris in the

flow. These flows are initiated by heavy, usually sustained, periods of rainfall, but sometimes can happen as a result of short bursts of concentrated rainfall in susceptible areas. Burned areas charred by wildfires are particularly susceptible to debris flows, given certain soil characteristics and slope conditions.

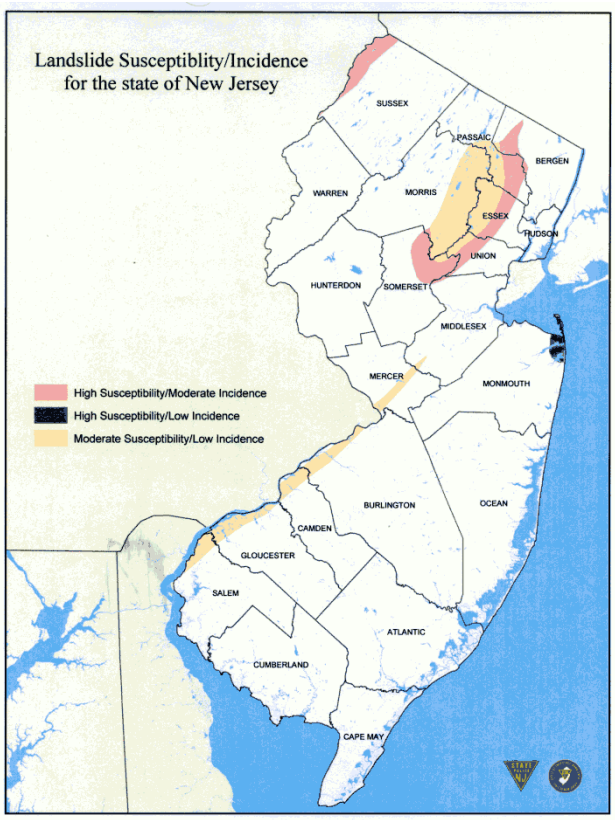


Figure 3.15: Landslide Susceptibility/Incidence for the State of New Jersey

Figure 3.15 was compiled based on attributes associated with 133 historic and recent landslide locations mapped by the New Jersey Geological Survey.[xxviii] The landslides have occurred in the northern and central part of the state and include slumps, debris flows, rockfalls and rockslides. Although New Jersey landslides are not as common as in other areas of the United States, they are a geologic hazard in areas with steep to moderate slopes or geologic units prone to failure. They cause damage to utilities, property, and transportation routes.

Damage from New Jersey landslides is likely in the hundreds of thousands of dollars. New Jersey landslides have caused fatalities and injuries, although none were recorded in Bergen County. The northwest portion of the County is the only area with steep hills that lead up to the Ramapo Mountains. Figure 3.15 depicts a small area in the northwest portion of Bergen County as having a high susceptibility to landslides, but a moderate incidence. The sharp cliffs of the New Jersey Palisades lift much of the County up from the eastern boundary with the Hudson River. Figure 3.16 shows sites of past occurrences of landslides particularly in the Palisades Cliffs area of the County, primarily due to weathering and heavy rain. Table 3.X below lists the Bergen County critical facilities that are vulnerable to landslides.

Table 3.13: Bergen County Critical Facilities Vulnerable to Landslides

Facility Name
Carlstadt
Carlstadt Pump Station (Barell Ave)
Edgewater
Colony Community Center
Edgewater Senior Center
Englewood Cliffs
St. Peter's College
Fort Lee
Bluff Rd. Pump Station
Fort Lee Historical Park
Lewis F. Cole Middle School
Pump Station (Main St)
Pump Station (Palisades
Garfield
Kidz University
New Concepts For Living
Hackensack
Bergen County Police-Patrol Unit
Hillsdale
Woodcliff Lake Dam
Little Ferry
Bergen County Utilities Authority
Depyster Creek Pump
Main St. Pump Station
Willow Lake Pump Station
Lodi
D.P.W Yard
Midland Park
D.P.W Garage
DEP Dam
DEP Dam (Godwin Ave)
Kentshire Apartments
North Arlington
Daniel Morris Firehouse Co.
North Arlington D.P.W
North Arlington EMS
North Arlington/Lyndhurst Joint Waste Water
PSE&G Power Sub-Station (North Arlington)
Old Tappan
Lake Tappan
Lake Tappan Dam
Tennessee Gas Pipeline
Pipeline
Ramsey
Crystal Spring Lake Dam
Ridgefield
Wolf Creek Culverts and Bridges
River Vale
Town Hall
Washington Township
Immaculate Heart Academy (High School)
Jesse F. George School
Washington School (Elementary)
Washington Volunteer Fire Department
Woodcliff Lake
Dam

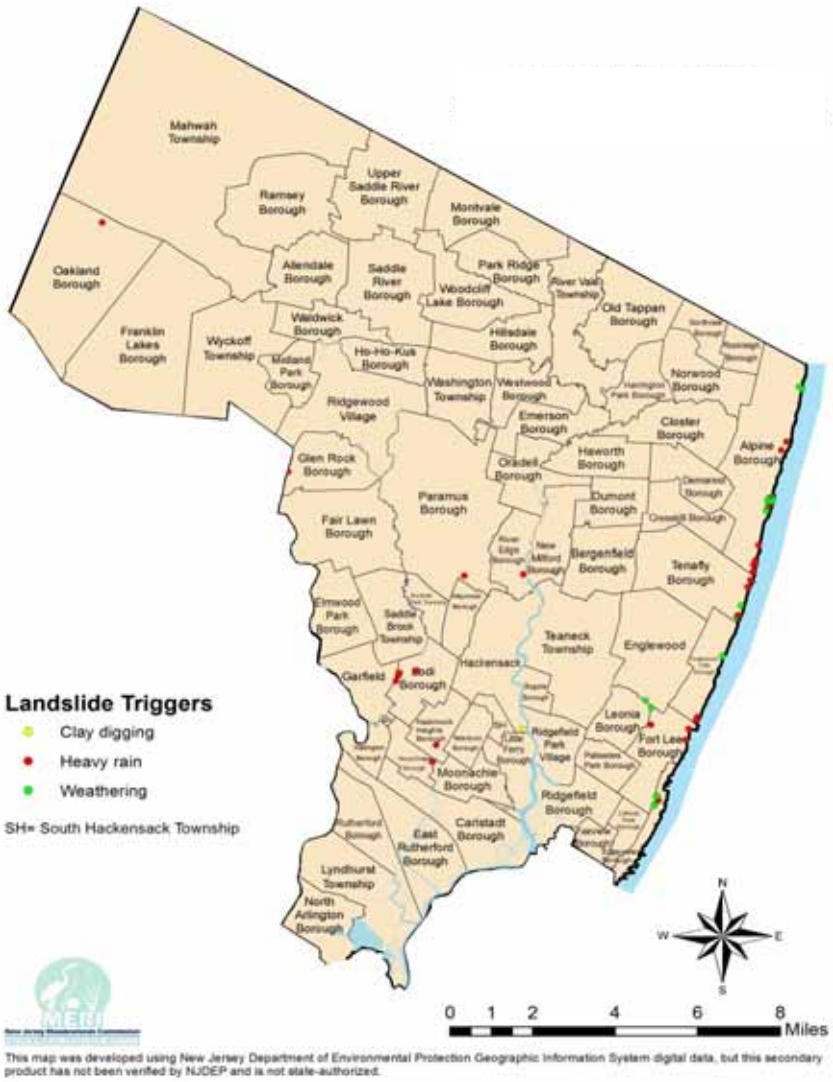


Figure 3.16: Landslides within Bergen County, NJ

High Winds/ Tornadoes

The American Meteorological Society defines a tornado as a violently rotating column of air, in contact with the ground, either pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud.[29].

Tornadoes vary in intensity regardless of shape, size, and location, though strong tornadoes are typically larger than weak tornadoes. Tornado intensities are rated by the damage on a scale known as the Fujita Scale, found in Table 3.11.[30]

Tornado season in New Jersey is generally March through August, although tornadoes can occur at any time during the year, according to the *State of New Jersey 2014 State Hazard Mitigation Plan*.[31] Since 1956, there have been eight recorded instances of tornadoes touching down in Bergen County. Two of

the most destructive tornadoes occurred on July 10, 1989 in Fair Lawn causing approximately five million dollars in damage. The tornadoes were rated F0 on the Fujita Scale.

Most recently on May 17, 2007, winds of 60-80 mph caused a microburst, a powerful downdraft that hits the ground and spreads out according to the National Weather Service, causing destructive storm damage. Bergen County is in a low risk zone for tornadoes and high winds, but is vulnerable to tornado damage due to the dense development in the County. All municipalities in Bergen County are equally likely to be impacted by a tornado.

Figure 3.17 illustrates the number of tornadoes per 1,000 square miles of the northern New Jersey area to be 1-5.[32] Figure 3.18[33] and Figure 3.19[34] indicate that in Zone II, in which Bergen County is located, community shelters are the preferred method of protection from high winds events, as homes could also be susceptible to a hurricane. Based on historic facts, the probability of a tornado in Bergen County is low.

Table 3.14: The Fujita Scale

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

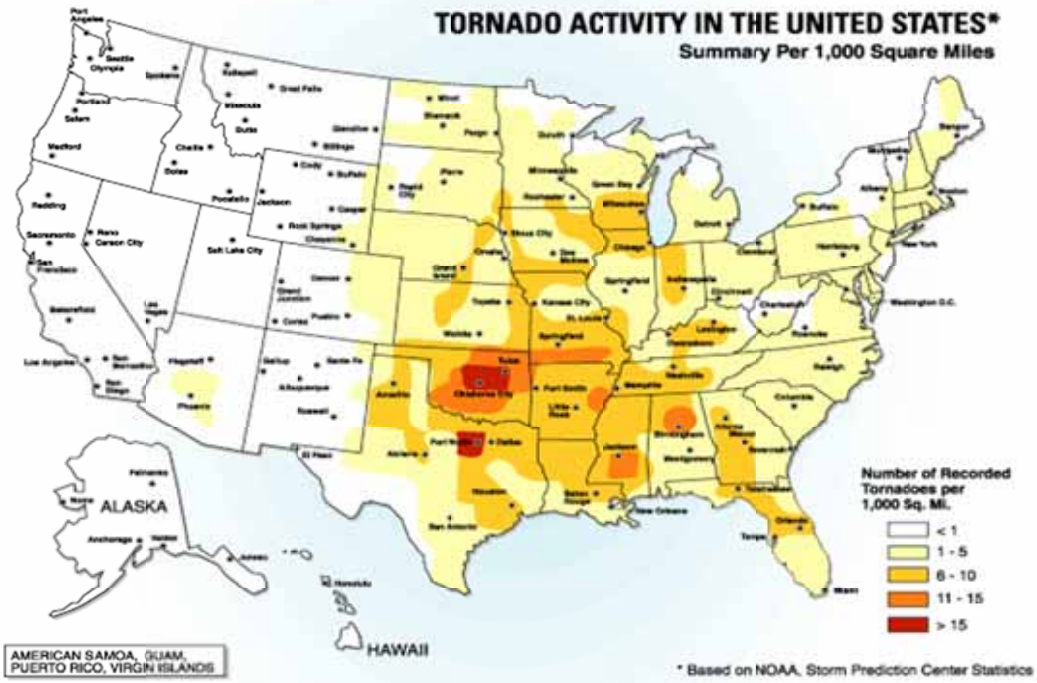
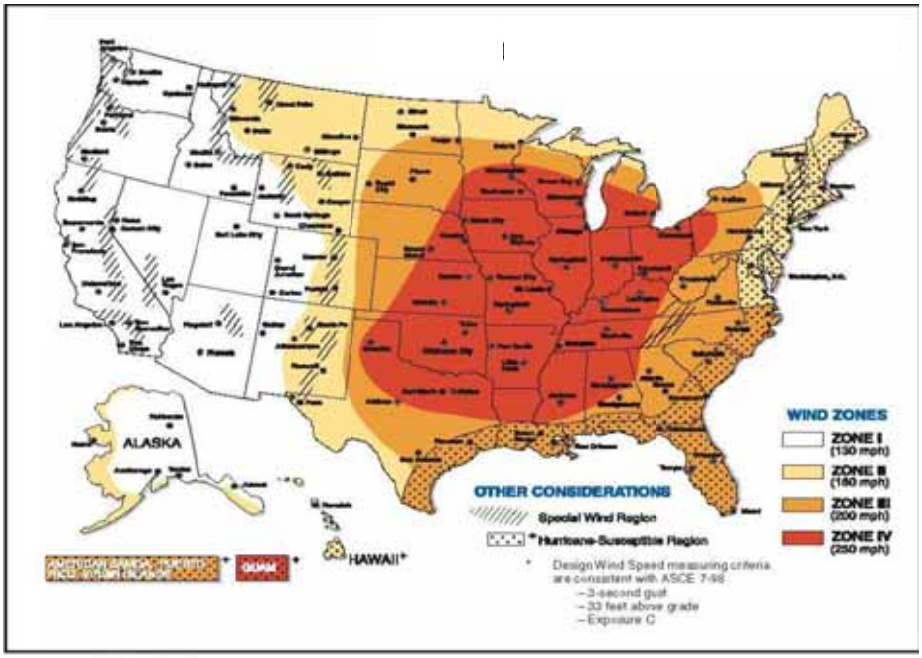


Figure 3.17: Tornado Activity in the United States



Source: ASCE 7-98

Figure 3.18: Design Wind Speed Map for Community Shelters

NUMBER OF TORNADOES PER 1,000 SQUARE MILES (See Figure I.1)	WIND ZONE (See Figure I.2) I	II	III	IV
<1	LOW RISK	LOW RISK ★	LOW RISK ★	MODERATE RISK
1 - 5	LOW RISK	MODERATE RISK ★	HIGH RISK	HIGH RISK
6 - 10	LOW RISK	MODERATE RISK ★	HIGH RISK	HIGH RISK
11 - 15	HIGH RISK	HIGH RISK	HIGH RISK	HIGH RISK
>15	HIGH RISK	HIGH RISK	HIGH RISK	HIGH RISK

LOW RISK	MODERATE RISK	HIGH RISK
Need for high-wind shelter is a matter of homeowner preference	Shelter should be considered for protection from high winds	Shelter is preferred method of protection from high winds

★ Shelter is preferred method of protection from high winds if house is in hurricane-susceptible region

Figure 3.19: Tornado Risk by Wind Zone

Wildfire

Bergen County has a relatively low probability of being affected by wildfires, as indicated by Figure 3.20. The Ramapo Mountain State Forest in Mahwah and Palisades Interstate Park in Fort Lee, Englewood Cliffs, Tenafly and Alpine are considered to be moderate wildfire hazards and the Meadowlands marsh grasses and old landfills are deemed to be a high hazard area. The remainder of the County is developed, lowering the risk of wildfires. A great deal of landfill closure work has been taking place in the New Jersey Meadowlands, further reducing the potential for future wildfires in Bergen County.

Wildfires generally start and grow depending on a combination of 3 factors: fuel, topography, and weather. Dry plant debris like leaves and branches, steep slopes which allow flames to climb uphill, and any of a variety of weather conditions that may start or spread a fire including strong winds, thunderstorms, or dry, drought like conditions.

Although wildfires can occur at any time during the year, most destructive fires in New Jersey occur during the spring. The weather conditions provide optimal conditions for the rapid spread of wildfires. **Table 3.XX** lists Bergen County critical facilities that are vulnerable to wildfire.

Table 3.15: Bergen County Critical Facilities Vulnerable to Wildfires

Facility Name
Carlstadt
Carlstadt Presbyterian
Pumping Station 1 (Jony Drive)
Demarest
Academy of Holy Angels School (Shelter)
Anderson Avenue
County Road
County Road School
Demarest Cooperative
Demarest D.P.W
Demarest Fire Department
Demarest Middle School/Shelter
Hardenburgh Ave
Hardenburgh Ave. Bridge
Luther Lee Emerson School
Northern Valley Catholic Academy
Northern Valley Regional High School (Shelter)
Piermont Road
East Rutherford
Alfred S. Faust Intermediate School
Boiling Springs Gardens
East Rutherford Building Department
East Rutherford Fire Department-Station #13
East Rutherford Fire Dept.-Carlton Hill Firehouse
East Rutherford Municipal Building
East Rutherford Police Headquarters
McKenzie School
NJSEA Fire Station
St. Joseph's Church School
Edgewater
Colony Community Center
Comfort Inn Motel
DPW Annex
Edgewater Boro Hall and Police Dept.
Edgewater Community
Edgewater D.P.W
Edgewater Library
Edgewater Multi-Plex
Edgewater Municipal
Edgewater
Edgewater Post Office
Edgewater Senior Center
Edgewater Senior Center
Edgewater Volunteer 1st Aide Squad
Edgewater Water Pollution Control Facility
EVG School
Holy Rosary Church
Lord's Grace Church
Mitsuwa
Montessori School
Palisade Learning Center
Prime Time Learning Center
Sewer Plant #3
Sunrise Assisted Living
Transco Gas Pipeline
Waterford Towers
Elmwood Park
Elmwood Park Water Distribution Center
Emerson
Armenian Home
Assumption Academy
Emeritus at Emerson
Emerson Dept. of Public Works
Villano Elementary School
Englewood Cliffs
Borough Hall Court and Police Facility
Citibank (Citigroup) NA
Communication Tower
Department of Public Works
Englewood Cliffs Fire Dept.
PSEG Substation
Pump Station (Chestnut St)
Pump Station (Hollywood
Pump Station (Jane Dr)
Pump Station (Lyncrest Rd)
Pump Station (Roberts Rd)
St. Peter's College
Unilever Best Foods
Unilever Best Foods NA
Volunteer Ambulance Corps
Fairview
Department of Public Works
Fairview Police Department/ Municipal Co.
Walker St. Firehouse
Fort Lee
PSEG Substation
Public School #4
Franklin Lakes
Becton Dickinson and Co.
Franklin Lakes Volunteer Ambulance Bldg.

Garfield
Bergen Arts/ Science Charter School
Garfield Group Home
Happy Times Daycare
Kidz University
New Concepts For Living
Susana's Day Care
Glen Rock
Municipal Complex
Ridgewood Pollution Plant
Hackensack
Bergen County Probation
Haworth
Haworth Ambulance Corps
Haworth DPW Bldg. #1
Haworth DPW Bldg. #2
Haworth Municipal Complex
United Water Treatment Facility and Reservoir
Hillsdale
Woodcliff Lake Dam
Ho-Ho-Kus
Hermitage
Little Ferry
Depyster Creek Pump
Early Learners Child Center
Little Ferry Hook & Ladder Fire Dept.
Little Ferry Nursery School
Losen Slote Drain Station
Memorial School
Scientific Design
Scientific Design
Washington School
Lodi
D.P.W Yard
Mahwah
Dept. of Public Works/ DPW Garage
Fire Co #3
Fire Company #1
International Crossroads
Joyce Kilmer School
Lenape Meadows School
Mahwah High School
Ramapo Ridge Middle
Midland Park
Godwin School
Highland School
New Milford
New Milford Vol. Ambulance Corp.

River Rd.
United Water Resource Landscaping Yard
North Arlington
Corsi House
Daniel Morris Firehouse Co.
Jefferson School
Jefferson School
North Arlington Health and Senior Centers
North Arlington High School
North Arlington Middle
PSE&G Power Sub-Station (North Arlington)
Queen of Peace Church
Queen of Peace Grammar School
Queen of Peace High School
Washington School
Northvale
BCUA Sanitary Sewer Pump Station
Northvale Sanitary Pump Station
Norwood
Norwood Fire House
Old Tappan
Bi-State Plaza Shopping
Korean Presbyterian Church of the Palisades
Old Tappan Commons Senior Housing
Old Tappan DPW
Old Tappan Exxon
Old Tappan Fire
Old Tappan First Aid Corps
Old Tappan Police Headquarters
Old Tappan Public Library
Prince of Peace Church
Rockland Electric (Con Ed) Substation
Saint Pius X Roman Catholic Church
Sunrise Assisted Living
Tom's Automotive Specialists (Citco)
Trinity Reformed Church
Paramus
Arcola Power Sub Station
Orchard Hills Power Sub Station
Paramus Park Power Sub Station
Spring Valley Road Power Sub Station
Woodland Ave Power Sub Station
Ramsey
NJ Transit Train Station
Ramsey Municipal Bldg.
Ramsey Public Library
Ridgefield
New Jersey Turnpike

NJ State Highway 46
Ridgefield Park
Active Chemical Co. Number Four
EMS, Rescue, Fire Chief's, Backup EOC
Friendship Hook & Ladder Co. Number One
Hazelton Truck Co. #2
Hose Co. Number One
NYS&W Fuel Depot
Overpeck Engine Co. Number Two
Westview Hose Co. Number Three
Saddle River
Calicooneck Road
South Hackensack
Fire Headquarters
Leuning Street
Phillips Avenue
Public Service Electric Sub Station
Restaurant Depot
Town Hall Complex
Town Hall Complex
Town Hall Complex
Town Hall Complex
Wesley Street
Teaneck
D.P.W Yard
Fire Dept. Headquarters
Municipal Building
Upper Saddle River
Police Headquarters
Waldwick

Franklin Turnpike
Waldwick Train Station
Wallington
Emergency/ Ambulance
Farmland Dairies
Washington Township
Twp. of Washington Police Dept.
Twp. of Washington Police Dept. Communications
Washington Volunteer Fire Department
Westwood
Hackensack UMC at Pascack Valley
Kurt Versen Company
Lanman & Kemp-Barclay &
Wood-Ridge
Assumption Church
Borough Hall
Catherine E. Doyle School
Department of Public Works
Wood-Ridge High School
Woodridge Intermediate School
Wyckoff
Christian Health Care Center
Coolidge School
Eisenhower School
Wyckoff Public Library

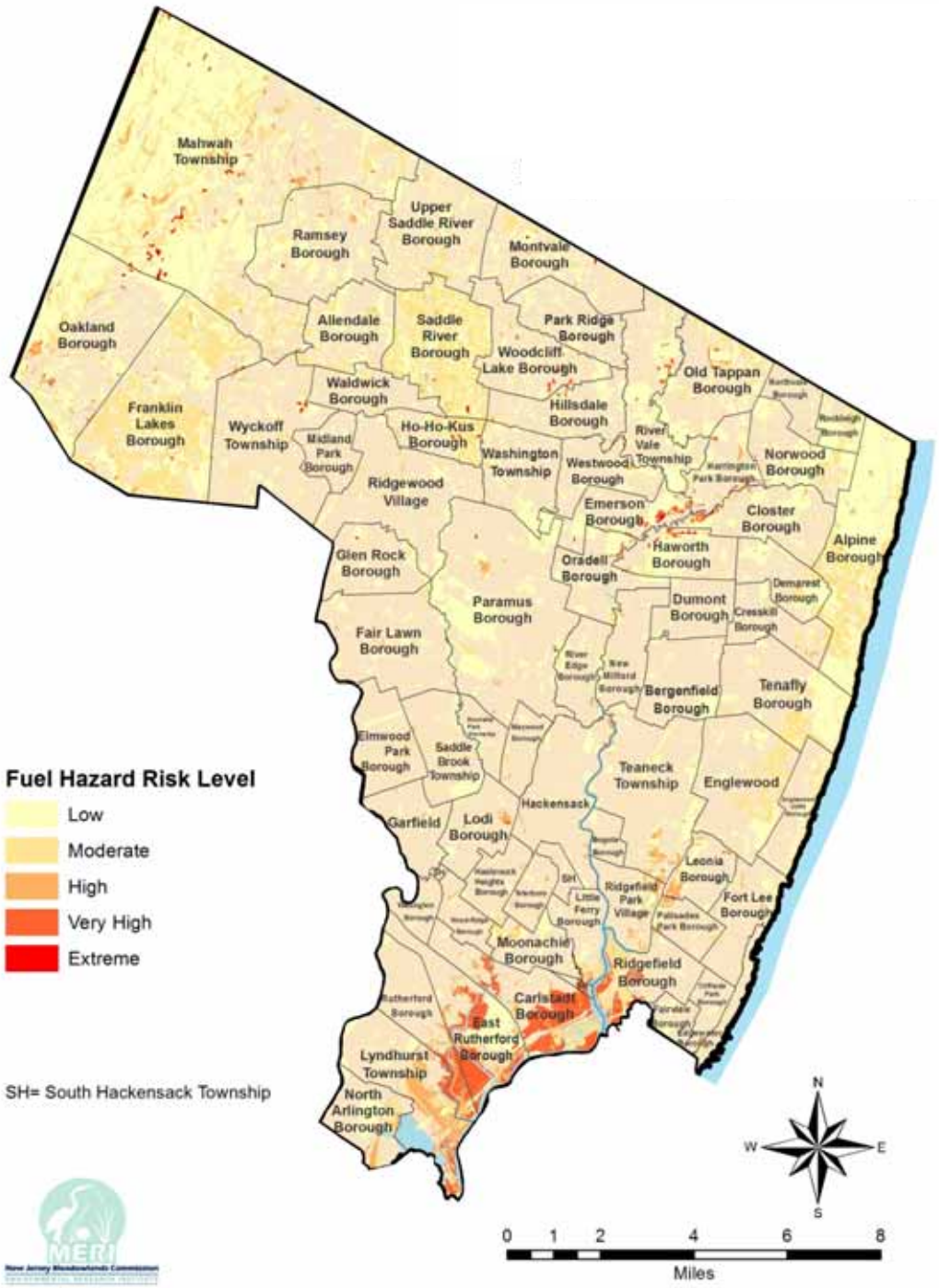


Figure 3.20: Wildfire Fuel Hazard Risk Levels Based on 2002 LU/LC
Bergen County, NJ

Hurricane/ Tropical Storm

Hurricane season normally extends from June 1 through November 30 in New Jersey. The peak potential for hurricane and tropical storm activity runs from mid-August through the end of October.[35]

The combination of warm ocean water, humid air and consistent winds contributes to the formation of tropical cyclones – low-pressure systems of circulating winds, clouds and thunderstorms – over the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. As they gain strength, these cyclones are classified as tropical depressions, tropical storms, or hurricanes. A tropical depression has maximum sustained wind speeds of 38 miles per hour (mph) or less. A tropical storm has maximum sustained wind speeds of 39 to 73 mph. The Saffir-Simpson Hurricane Scale rates hurricane strengths, from Category 1 to Category 5 (see Table 3.12 below.)

Table 3.16: Saffir-Simpson Hurricane Scale (Source: NOAA 2013)

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph	Very dangerous winds will produce some damage: Homes with well-constructed frames could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph	Extremely dangerous winds will cause extensive damage: Homes with well-constructed frames could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (Major)	111-129 mph	Devastating damage will occur: Homes with well-built frames may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (Major)	130-156 mph	Catastrophic damage will occur: Homes with well-built frames can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (Major)	>157 mph	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Figure 3.21: Empirical Probability of a Named Storm

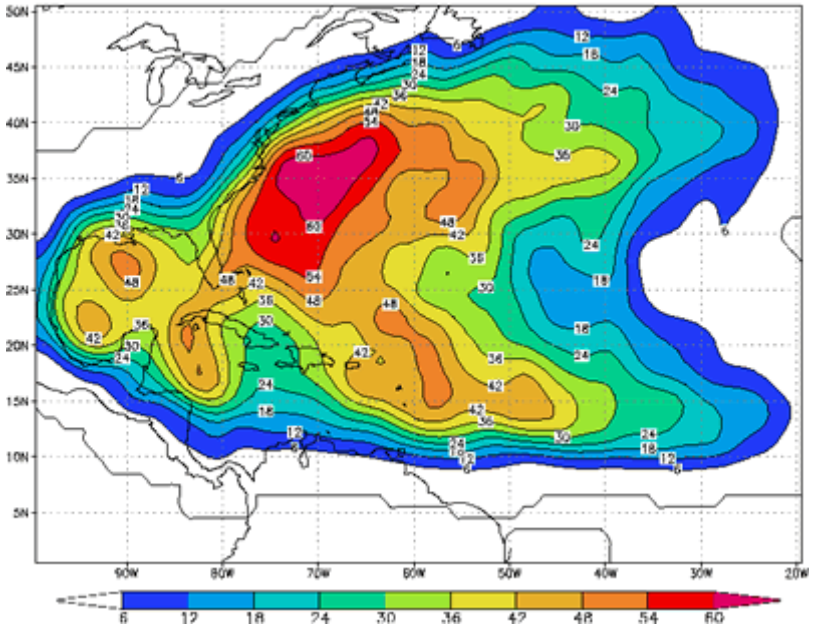


Figure 3.21 indicates the probability of a tropical storm or hurricane affecting a particular area sometime during the June to November hurricane season.[36] The years 1944 to 1999 are utilized in the analysis along with counted hits when a storm or hurricane was within about 100 miles (165 km). For example, people living in New Orleans, Louisiana have about a 40% chance (the green-orange color) per year of experiencing a strike by a tropical storm or hurricane. For the United States, the locations that have the highest chances of a tropical storm or hurricane occurrence are Miami, Florida with a 48% chance and Cape Hatteras, North Carolina with a 48% chance. Just outside of the United States, San Juan, Puerto Rico has a 42% chance of a tropical storm or hurricane occurring.[37]

The probability of Bergen County being struck by a tropical storm or hurricane is difficult to predict. Because much of Bergen County is developed, the vulnerability is extremely high if an event were to occur. Tropical storms and hurricanes do not need to have a direct path over Bergen County to affect the residents. Table 3.13 shows the potential magnitude of impact that may occur if a tropical storm or hurricane were to hit the area.[38] Table 3.13 is taken from the New Jersey Hurricane Evacuation Study (HES) and Figure 3.22 (in four panels, also below) contains a County map showing the limits of potential tidal flooding from Categories 1 through 4 hurricanes as calculated by the National Weather Service-National Hurricane Center's SLOSH Model. Each map shows the limits of potential flooding from Category 1-4 hurricanes and the numbers of housing units in the Category 1-4 inundation areas. This information is provided in order to facilitate the drawing or re-drawing of evacuation zones by county and municipal emergency management officials.

Hurricanes have also been evaluated by category. A Category 1 event in NJ would predominantly impact the Hackensack Meadowlands District and the Hackensack River communities in general, up to the Oradell Reservoir in Oradell, NJ. However, while the Hudson River area communities in NJ are marginally impacted, even up to a Category 4, both the Passaic River communities and communities around Overpeck Creek, a tributary of the Hackensack River, are affected.

Per the USGS (Fact Sheet 2005-3121, October 2005), there is a high probability of 20-40 hurricanes reaching the NJ area in the next 100 years.[39] Additionally, per the Colorado State University Department of Atmospheric Science (April 9, 2008 report), there is a 31% chance (annually) of a Category 3, 4 or 5 event impacting the East Coast and a 44% chance (annually) of a Category 1 or 2 event. Global temperature increase does not seem to be modifying these probabilities.[40]

Table 3.17: Bergen County Vulnerable Housing Data

BERGEN COUNTY VULNERABLE HOUSING UNIT DATA

		PERMANENTLY OCCUPIED HOUSING UNITS[1]				MOBILE HOMES[2]		
		CAT 1	CAT 2	CAT 3	CAT 4	OCCUPIED	TOTAL	TOTAL HU
1	Fairview Boro	4	3	40	72	0	0	5,070
2	Cliffside Park Boro	0	0	0	0	0	0	10,340
3	Edgewater Boro	1,737	100	182	97	8	8	5,702
4	Fort Lee Boro	0	0	0	0	7	7	16,028
5	Englewood Cliffs Boro	0	0	0	0	0	0	1,889
6	Ridgefield Boro	29	19	21	119	6	6	4,124
7	Palisades Park Boro	23	24	82	218	0	0	6,609
8	Leonia Boro	70	58	99	147	0	0	3,345
9	Englewood City	356	252	164	782	42	42	9,607
10	North Arlington Boro	24	82	107	146	0	0	6,519
11	Lyndhurst Twp	89	1,037	481	592	0	0	8,113
12	Rutherford Boro	168	91	144	677	0	0	7,228
13	East Rutherford Boro	28	26	45	632	0	0	3,753
14	Carlstadt Boro	170	6	66	113	147	158	2,687
15	Moonachie Boro	844	28	0	0	229	245	895
16	Little Ferry Boro	3,343	196	66	301	0	0	4,216
17	Wood-Ridge Boro	44	32	2	0	0	0	3,071
18	Wallington Boro	425	599	624	633	0	0	4,907
19	Ridgefield Park Village	566	178	61	296	6	6	6,134
20	Teterboro Boro	2	4	1	0	0	0	9
21	Hasbrouck Heights Boro	0	141	34	46	6	6	4,789
22	South Hackensack Twp-SE	0	0	0	0	0	0	0
23	South Hackensack Twp-N	40	461	187	327	0	0	1,054
24	South Hackensack Twp-W	6	0	1	2	0	0	27
25	Bogota Boro	25	22	16	114	0	0	2,915
26	Garfield City	16	63	114	416	7	7	11,715
27	Lodi Boro	117	5	17	69	230	305	9,977
28	Hackensack City	403	1,112	457	4,299	8	8	18,925
29	Teaneck Twp	234	119	62	482	13	13	13,430
30	Elmwood Park Boro	0	0	0	0	16	16	7,338
31	Saddle Brook Twp	0	0	0	0	0	0	5,161
32	Rochelle Park Twp	0	0	0	0	0	0	2,118
33	Maywood Boro	0	0	0	0	8	8	3,813
34	Alpine Boro	0	0	0	0	0	0	737
35	Rockleigh Boro	0	0	0	0	0	0	80
36	Norwood Boro	0	0	0	0	0	0	1,885
37	Northvale Boro	0	0	0	0	6	6	1,515
38	Demarest Boro	0	0	0	0	0	0	1,634
39	Tenafly Boro	0	0	0	0	17	17	4,887
40	Cresskill Boro	0	0	0	0	8	8	2,695
41	Closter Boro	0	0	0	0	10	10	2,872
42	Harrington Park Boro	0	0	0	0	0	0	1,577
43	Old Tappan Boro	0	0	0	0	0	0	1,902
44	Dumont Boro	0	0	0	5	0	0	6,335
45	Bergenfield Boro	0	0	0	0	0	0	9,292
46	Haworth Boro	0	0	0	0	0	0	1,144
47	River Vale Twp	0	0	0	0	0	0	3,311
48	New Milford Boro	311	66	57	320	10	10	6,443
49	Emerson Boro	0	0	0	0	0	0	2,416
50	Westwood Boro	0	0	0	0	0	0	4,612
51	Oradell Boro	0	0	0	12	0	0	2,812
52	River Edge Boro	91	16	2	41	0	0	4,191
53	Park Ridge Boro	0	0	0	0	0	0	3,268
54	Montvale Boro	0	0	0	0	0	0	2,589
55	Hillsdale Boro	0	0	0	0	6	6	3,504
56	Woodcliff Lake Boro	0	0	0	0	0	0	1,904
57	Washington Twp	0	0	0	0	0	0	3,304
58	Paramus Boro	0	0	0	10	7	7	8,337
59	Saddle River Boro	0	0	0	0	4	4	1,196
60	Upper Saddle River Boro	0	0	0	0	6	6	2,524
61	Ho-Ho-Kus B0ro	0	0	0	0	0	0	1,466
62	Ridgewood Village	0	0	0	0	11	11	8,848
63	Fair Lawn Boro	0	0	0	0	0	0	12,131
64	Waldwick Boro	0	0	0	0	5	5	3,496
65	Glen Rock Boro	0	0	0	0	0	0	4,026
66	Allendale Boro	0	0	0	0	0	0	2,143
67	Midland Park Boro	0	0	0	0	0	0	2,645
68	Ramsey Boro	0	0	0	0	9	9	6,407
69	Wyckoff Twp	0	0	0	0	0	0	5,638
70	Mahwah Twp	0	0	0	0	131	131	9,651
71	Franklin Lakes Boro	0	0	0	0	6	6	3,419
72	Oakland Boro	0	0	0	0	0	0	4,323
	TOTALS	9,164	4,740	3,123	10,968	969	1,071	340,666

[1] Category 2 through 4 units are in addition to preceding category(ies).
[2] Mobile homes can be seasonal housing units and vice versa.

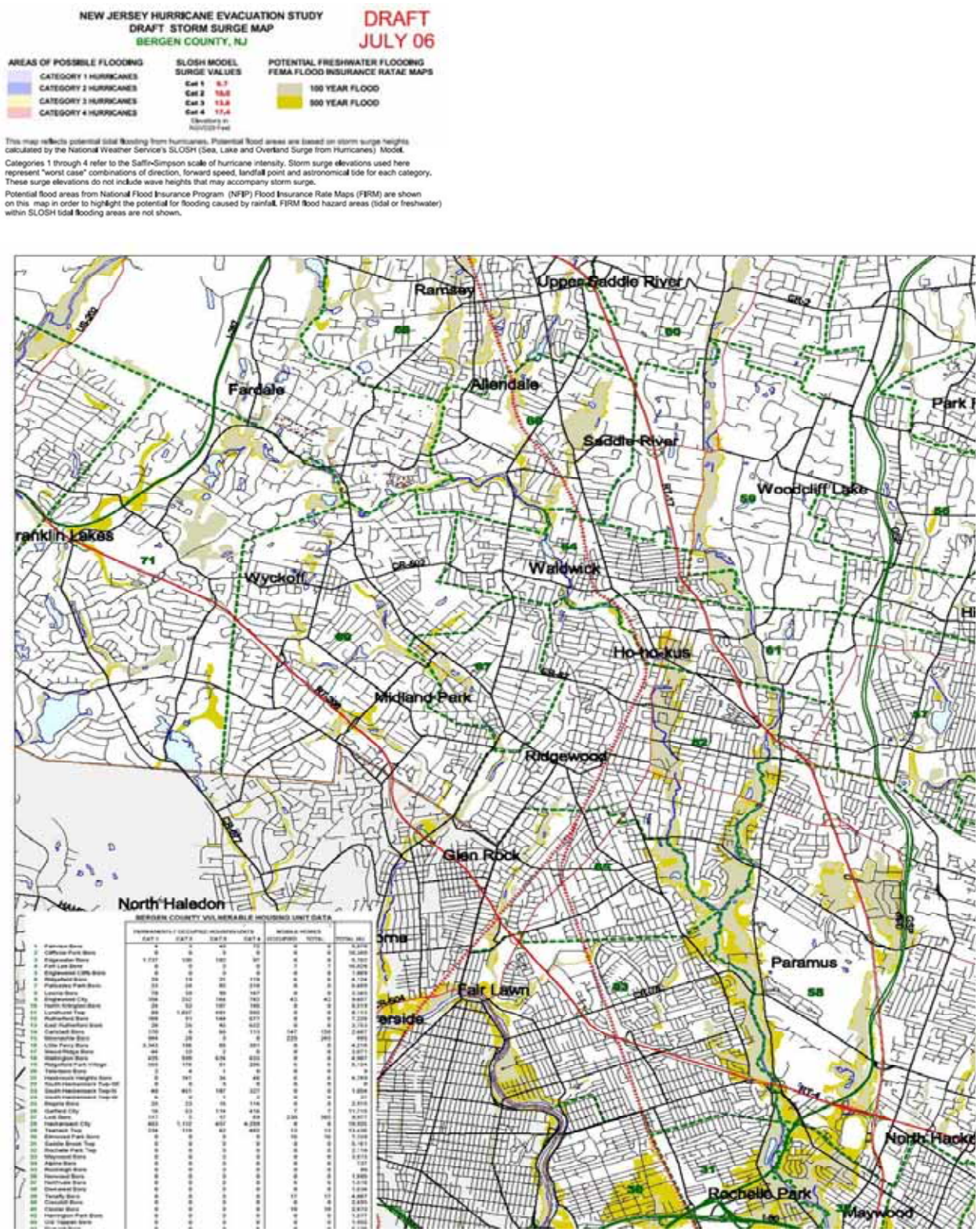


Figure 3.22 (Panel #1): New Jersey Hurricane Evacuation Study Draft Storm Surge Map - Bergen County

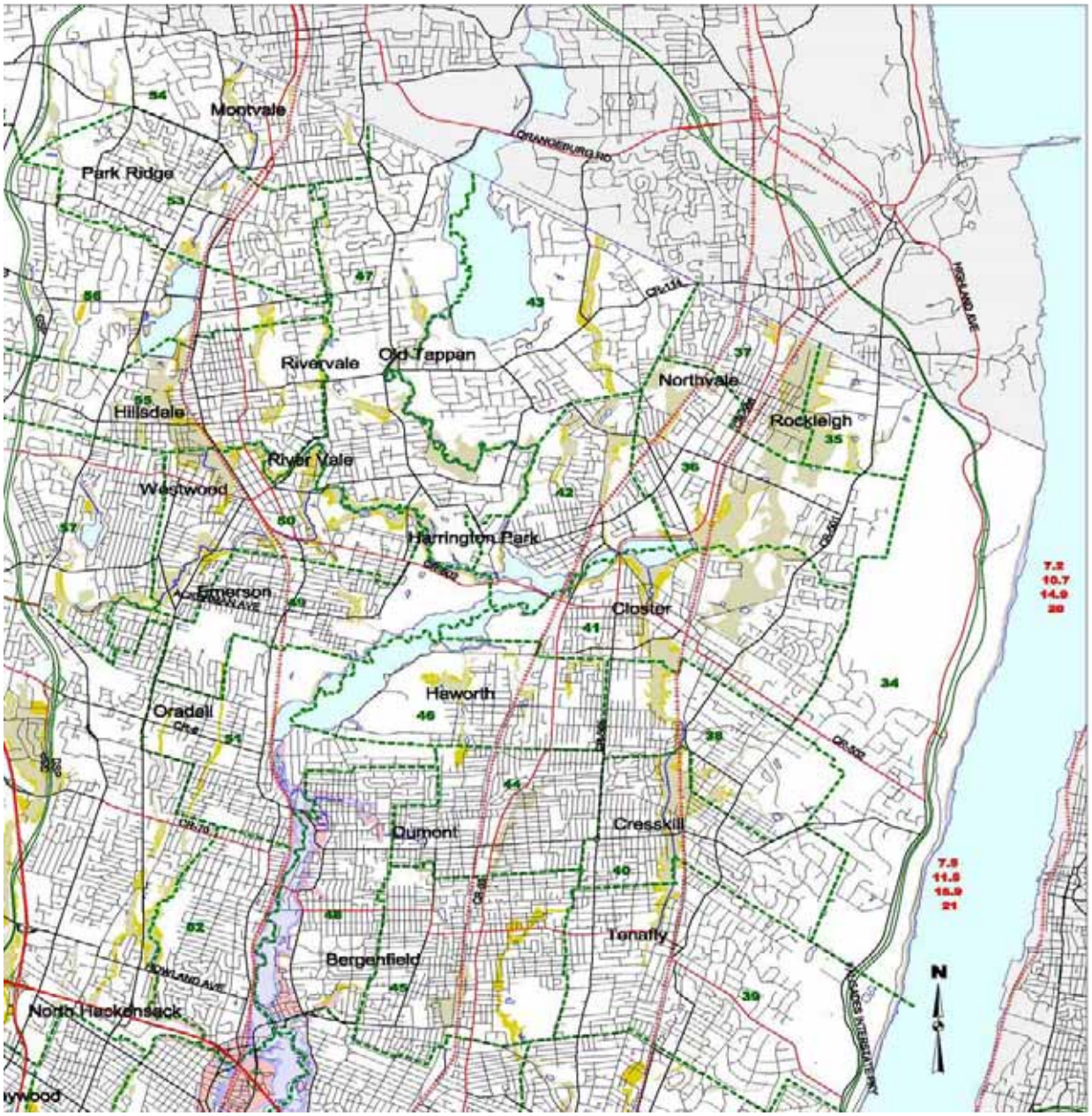


Figure 3.22 (Panel #2): New Jersey Hurricane Evacuation Study Draft Storm Surge Map - Bergen County

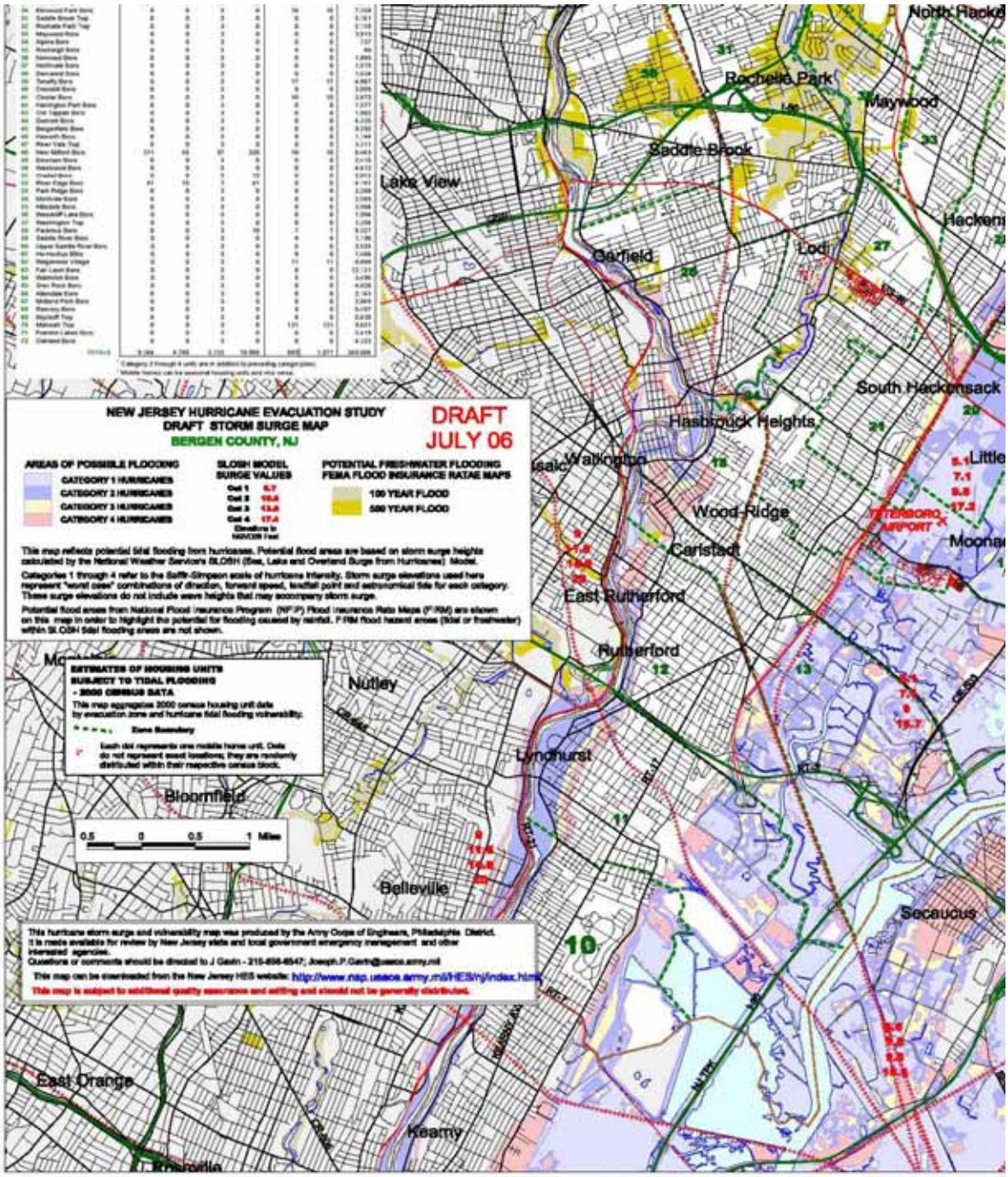


Figure 3.22 (Panel #3): New Jersey Hurricane Evacuation Study Draft Storm Surge Map - Bergen County

Figure 3.22 (Panel #4): New Jersey Hurricane Evacuation Study Draft Storm Surge Map - Bergen County

3.7 Assessing Vulnerability: Identifying Critical Facilities

This Plan contains extensive information regarding the critical facilities identified by the 70 Bergen County municipalities. A detailed discussion of all critical facilities in each municipality, and to the degree to which each is vulnerable to the natural hazards identified in this plan, is included in this Plan.

Identified critical facilities may include structures such as:

- municipal buildings;
- police and fire stations;
- rescue squads;
- emergency operation centers ;
- shelters;
- schools;
- hospitals;
- transportation systems;
- utilities (power plants, substations, power lines, gas lines);
- oil facilities;
- hazardous material facilities;
- dams;
- communication networks;
- public works;
- detention centers;
- water supplies;
- wastewater facilities;
- roads and bridges;
- airports;
- rail terminals; and
- nursing/care centers.

Critical facility information was provided by individual municipal OEM Coordinators, as well as the Bergen County Office of Emergency Management and the Bergen County Prosecutor's Office. Certain hazards that affect Bergen County are universal, meaning that there is no separation of shared risk; each Bergen County municipality is equally as vulnerable to the occurrence of certain hazards. These universal hazards include high winds, drought, earthquake, and winter storm. Other hazards are geographic in nature, meaning that certain locations are more at risk to certain hazards. These hazards include flooding, storm surge, landslide and wildfire. The critical facilities that are vulnerable to these "geographic" hazards are detailed in the discussion of each hazard found in this section.

Maps identifying the critical facilities for each Bergen County municipality, as well as a description of all critical facilities and their vulnerability by municipality are included in **Appendix B** and **Appendix C,** respectively. **Appendix D** contains summary maps of the county that depict the critical facilities in the municipalities and their vulnerability to the various natural hazards described in this plan.

This Plan does not identify all existing structures within each municipality which may be vulnerable to the identified natural hazards. Additionally, it does not identify future buildings, infrastructure, or critical facilities that may be constructed which may be vulnerable to the identified natural hazards. The

collection of such data does not qualify for mitigation funding and would need to be considered by the County as part of a future preparedness strategy.

3.8 Identifying Impacts

The Plan does not include specific data regarding natural hazard impacts to all buildings in each jurisdiction. The collection of this data is described in further detail and included as a Bergen County action item in the mitigation strategy section of the Plan.

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