FINAL REPORT FOR NJDCA REVIEW

8/27/2014

ESSEX COUNTY
NEW JERSEY

STRATEGIC RECOVERY PLANNING REPORT

Cover Photo by **Jerry McCrea/ The Star-Ledger – 11-1-12**

Public Outreach: Layton Consulting, LLC
Consensus Facilitation: Maverick & Boutique

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Purpose

The New Jersey Department of Community Affairs (NJDCA) has established a Post Sandy Planning Assistance Grant Program. The purpose of this program is to support long range planning for community redevelopment in the municipalities and counties sustaining damage from Superstorm Sandy. The Program provides grants to municipalities and counties to hire American Institute of Certified Planners/New Jersey Board of Professional Planners (AICP/PP) licensed planners to address conditions created or exacerbated by the storm, identify approaches to rebuilding that will be more resistant to damage from future storm events, and encourage sustainable economic growth.

The first step in the grant process is the preparation of a Strategic Recovery Planning Report (SRPR). A SRPR must be completed for municipalities and counties to be eligible for additional Post Sandy planning assistance. The purpose of the SRPR is to evaluate the impacts of the disaster on relevant community features. The evaluation can be broad or narrow but should focus on planning goals, strategies, and priorities leading to actions that are most urgently needed for public safety and economic recovery. The SRPR should serve as a guide for actions to be taken going forward not only to recover from the effects of Superstorm Sandy but also to reduce vulnerabilities to future disasters. The following document serves as the SRPR for Essex County, NJ.

This Strategic Recovery Planning Report was closely coordinated with the Essex County Hazard Mitigation Plan (HMP) Update, currently being undertaken by Tetra Tech, Inc., under the direction of the Essex County Sherriff's office and its Office of Emergency Management. The Mission Statement of the HMP Update is:

"**Mission Statement**
Through partnerships and strategic planning, identify and reduce the vulnerability to hazards in order to protect the health, safety, quality of life, environment, and economy of the communities within Essex County."

The HMP informational brochure posted on the Essex County Sherriff's Department website describes the County's focus as: "*The primary hazards of concern in Essex County include Flooding, Drought, and Severe Weather events such as Tornadoes, Hurricanes and Winter Storms*. *The plan will focus on existing and future buildings, infrastructure, and critical facilities that might be impacted. Critical facilities include police, fire, EMS, hospitals and shelters as well as infrastructure such as power-generation facilities, water utilities, roadways, railroads, and communication systems."*

Impact and Needs Assessment

The first step in developing a strategic action plan for Post Disaster Recovery is to assess the impact of Superstorm Sandy on the County of Essex and to identify specific needs for long term recovery that can be translated into specific types of projects (planning, infrastructure, mitigation & preparedness). The County Profile that follows takes the a form of a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis as it relates to long term recovery from the impact of Superstorm Sandy.

County Profile

Overview

Essex County is located in the northeast portion of New Jersey bordered by Passaic County to the north, Bergen and Hudson County to the east, Union County to the south and Morris County to the west (see Figure 2). Essex County is part of the New York metropolitan area and is the second densest county, behind Hudson County, in New Jersey. Essex County includes the City of Newark, the largest municipality within the state in population. The Borough of Caldwell is the smallest municipality in terms of land area, and Essex Fells has the lowest population in the County. Generally, the eastern portion of the county is more urban and less affluent as compared to the more suburban western portion of the county. Newark Liberty International Airport is located in the southeast portion of the county (Figure 4) and is one of the three New York metropolitan airports, LaGuardia and JFK International Airport, operated by the Port Authority of New York & New Jersey (the Port Authority). Additionally, the Port Authority operates the Port Newark-Elizabeth Marine Terminal in the county, the largest port facility on the East Coast and third largest nationally (Figure 4). The Port Newark-Elizabeth Marine Terminal is located on the Newark Bay and serves as the principal container ship facility for goods entering and leaving the New York-New Jersey metropolitan area.[1]

Most of Essex County is highly developed. According to the New Jersey Department of Environmental Protection's 2007 land use data, approximately 75% of the County is considered urban. The Essex County land uses are shown in Figure 3. While the County is highly urbanized, most of the area actually exists as residential land uses. According to the 2014 County's Tax Data, the county is approximately 40% residential. Approximately 10 % of the County is commercial. The land uses based on occupancy class data are shown in Figure 4.

The 2010 Census cited Essex County with a population of 783,969, which is approximately 9% of the statewide population. It is the third most populous county in the State of New Jersey. The largest municipal populations are in Newark, East Orange, Irvington and Bloomfield. Overall, the population density in the county is 6,211 persons per square mile, as compared to the statewide population density of 1,195 persons per square mile.[2] The 2010 population distribution is shown on Figure 1.

[1] Essex County Comprehensive Transportation Plan, 2013, Executive Summary, page 1.
[2] IBID, page 13.

Table 1. Essex County Population Statistics

Municipality	U.S. Census 2010 Total	Pop. 65+	% Pop. 65+	U.S. Census 2000* Total	Pop. 65+	Percent Pop. 65+	Low-Income Pop.*	% Low-Income Pop. of Total
Township of Belleville	35,926	4,263	11.9	35,928	4,806	13.4	2,939	8.2
Township of Bloomfield	47,315	5,665	12.0	47,683	6,827	14.3	2,772	5.9
Borough of Caldwell	7,822	1,257	16.1	7,584	1,350	17.8	347	4.8
Township of Cedar Grove	12,411	2,947	23.7	12,300	2,766	22.5	230	2
City of East Orange	64,270	7,572	11.8	69,824	7,845	11.2	13,159	19.2
Borough of Essex Fells	2,113	341	16.1	2,162	318	14.7	23	1.1
Township of Fairfield	7,466	1,528	20.5	7,063	1,065	15.1	195	2.8
Borough of Glen Ridge	7,527	718	9.5	7,271	757	10.4	219	3
Township of Irvington	53,926	4,829	9.0	60,695	4,576	7.5	10,420	17.4
Township of Livingston	29,366	4,942	16.8	27,391	4,221	15.4	480	1.8
Township of Maplewood	23,867	2,623	11.0	23,868	2,890	12.1	1,049	4.4
Township of Millburn	20,149	2,275	11.3	19,765	2,581	13.1	288	1.5
Township of Montclair	37,669	4,266	11.3	38,977	4,665	12.0	2,149	5.6
City of Newark	277,140	23,699	8.6	273,546	25,306	9.3	74,263	28.4
Borough of North Caldwell	6,183	870	14.1	7,375	801	10.9	75	1.2
Township of Nutley	28,370	4,115	14.5	27,362	4,402	16.1	1,312	4.8
City of Orange Township	30,134	3,364	11.2	32,868	3,562	10.8	6,078	18.8
Borough of Roseland	5,819	1,282	22.0	5,298	1,044	19.7	88	1.7
South Orange Village	16,198	1,705	10.5	16,964	2,024	11.9	791	5.3
Township of Verona	13,332	2,570	19.3	13,533	2,614	19.3	441	3.3
Township of West Caldwell	10,759	2,094	19.5	11,233	2,142	19.1	227	2.1
Township of West Orange	46,207	7,362	15.9	44,943	7,818	17.4	2,461	5.6
Essex County (TOTAL)	783,969	90,287	11.5	793,633	94,380	11.9	120,006	15.6

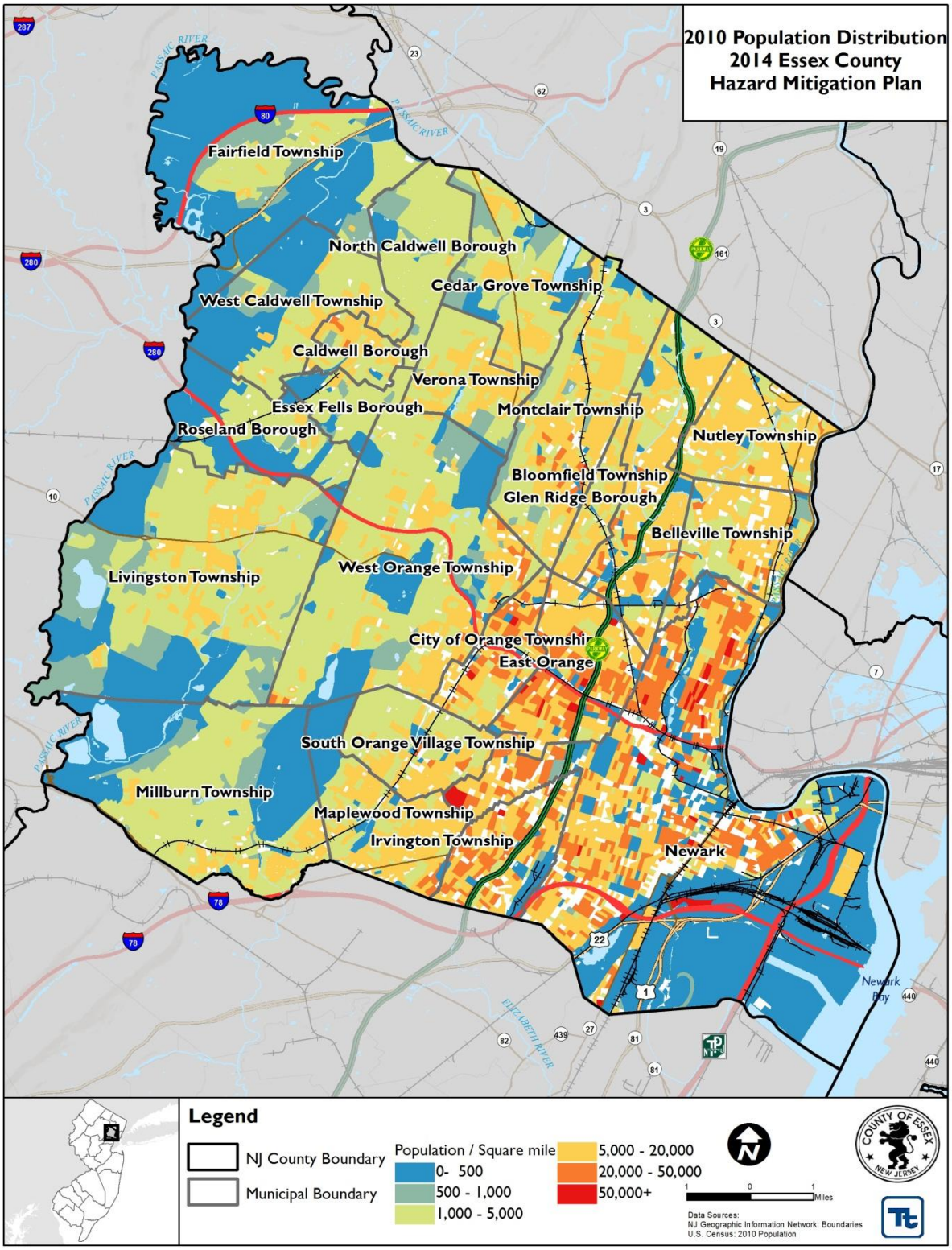
Source: *Census 2010 (U.S. Census Bureau); HAZUS-MH (for 2000 U.S. Census data)*
Note: *Pop. = population*
** Individuals below poverty level (Census poverty threshold for a 3-person family unit is approximately $15,000)*

Most of Essex County residents work in Essex County. In 2011 estimates from the US Census indicate that 52% of residents work in Essex County, 35% work in other New Jersey Counties, and 13% work outside New Jersey. Outside of Newark, employment in the county is clustered along Bloomfield Avenue, in established local commercial centers such as Glen Ridge, Montclair, Verona, and in the Fairfield/West Caldwell industrial area. There are other pockets of employment in West Orange, Roseland, Livingston, and along JFK Parkway in Millburn.[3]

Major state roadways include the Garden State Parkway which bisects the county and provides access to New Jersey shore destinations to the south and the New York Thruway to the north. I-280 provides access across the county. I-280, which is approximately 18 miles long, is a spur from I-80 in Parsippany-Troy Hills, Morris County to Newark, and I-95 (the New Jersey Turnpike) in Kearny. I-80 crosses the northwest corner of the County and I-78 crosses the southeast corner of the county. In addition to these major roadways, numerous state routes and county routes are present throughout the County (Figure 2).[4]

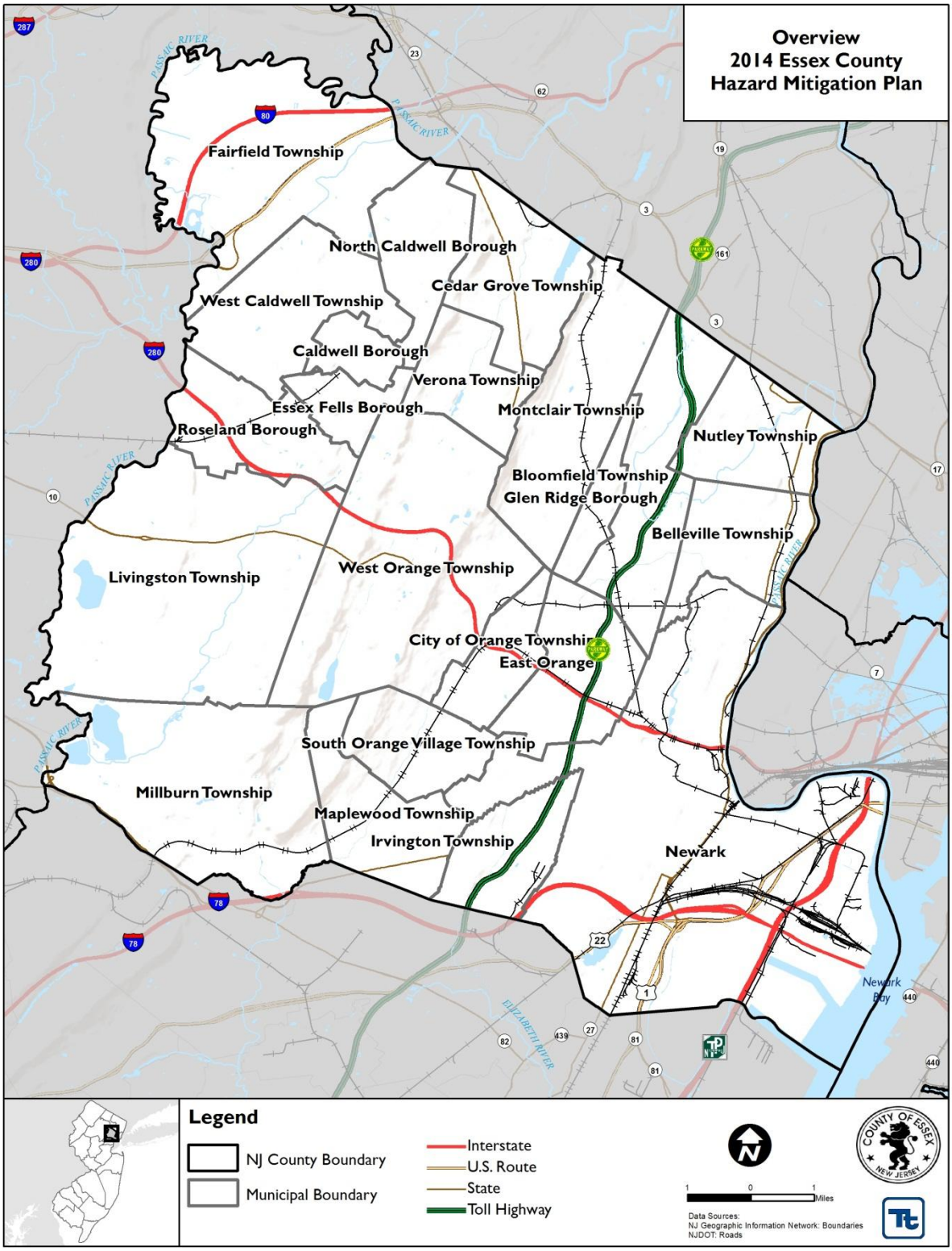
[3] IBID, page 10.
[4] Essex County Comprehensive Transportation Plan , 2013, page 15.

Figure 1. Distribution of General Population for Essex County, New Jersey



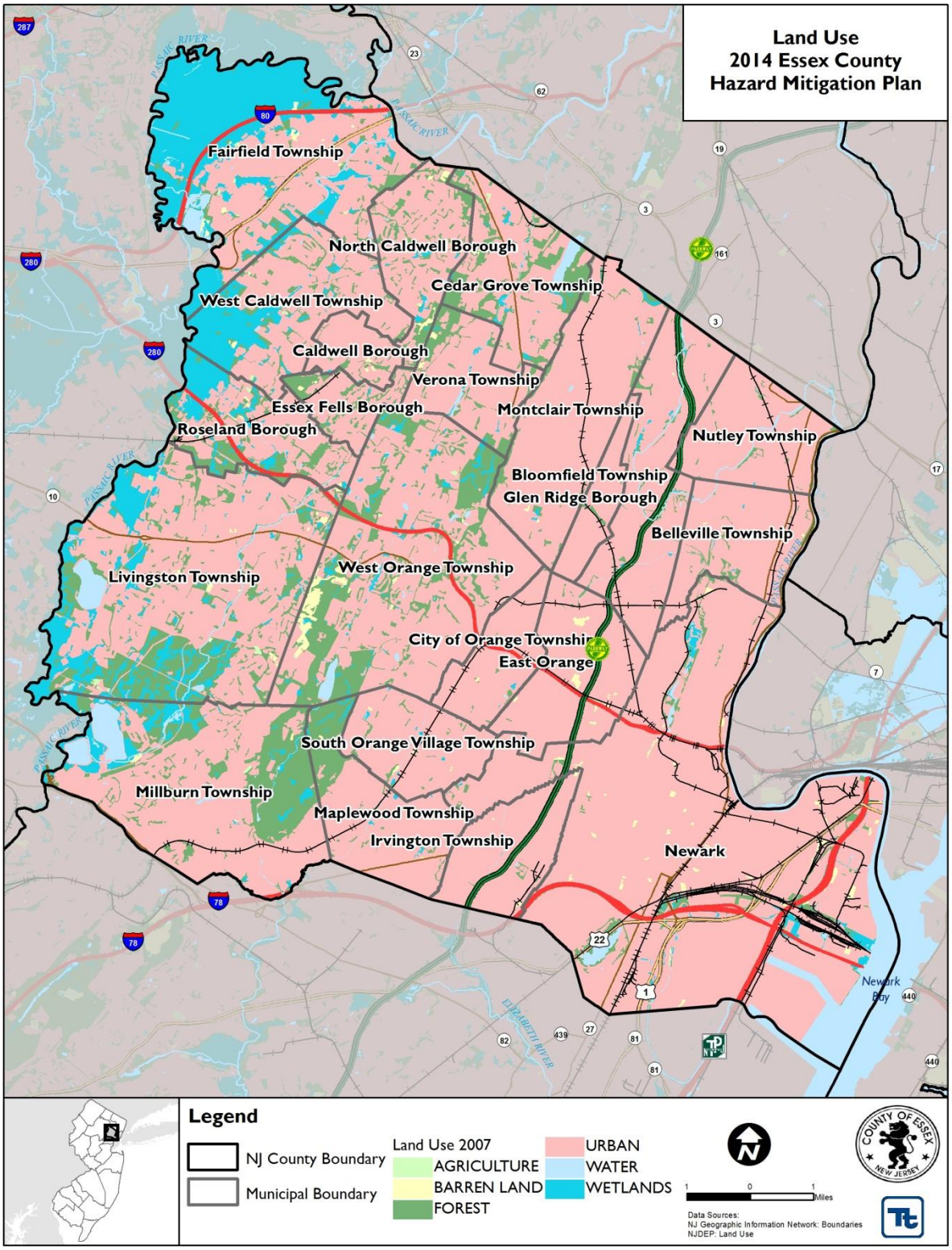
Source: U.S. Census 2010

Figure 2. Overview Essex County, New Jersey



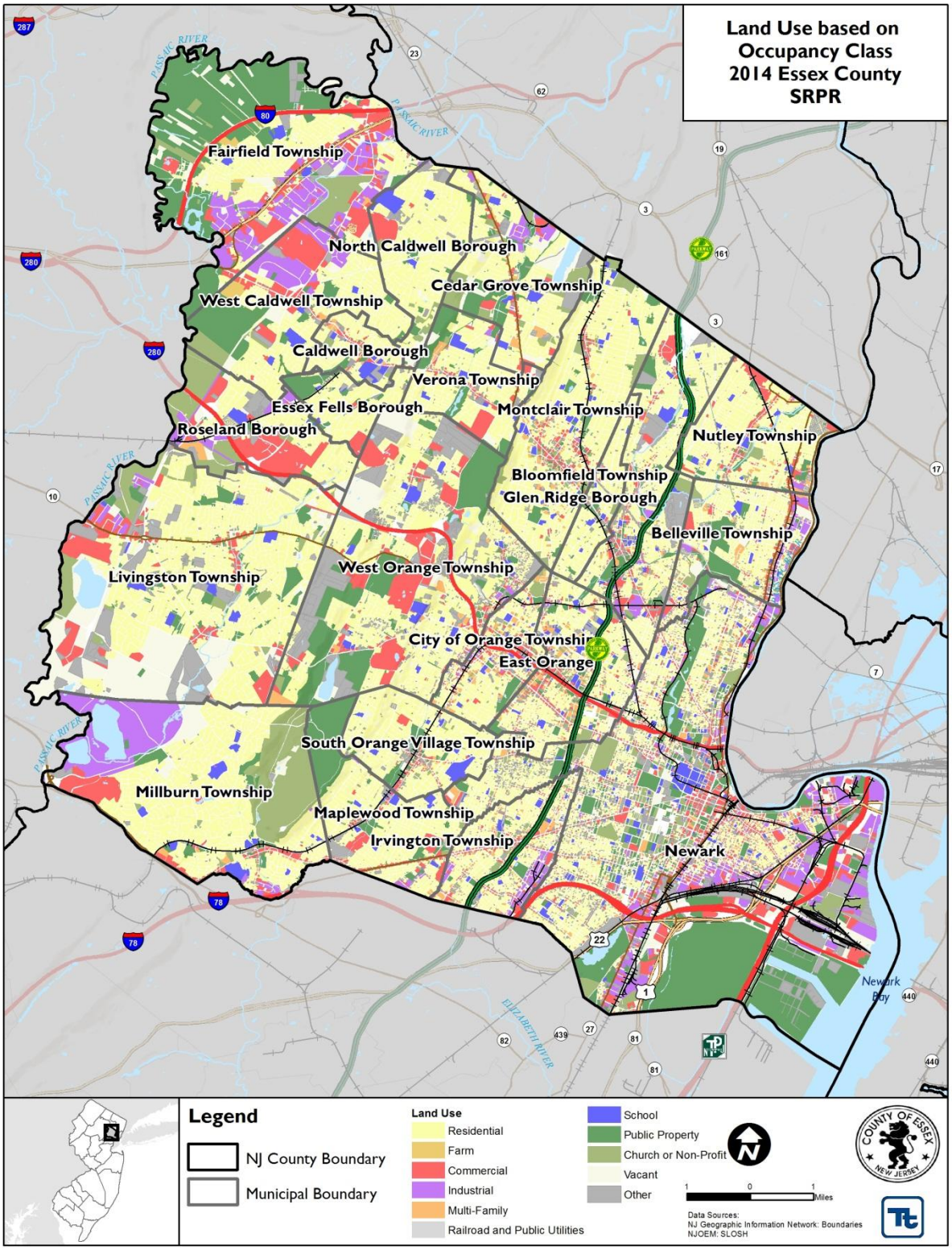
Source:NJGIN

Figure 3. NJDEP Land Use for Essex County, New Jersey



Source: NJDEP 2007

Figure 4. Land Use Based on Occupancy Class for Essex County, New Jersey



Source: EC planning 2014

Strengths

The County has a number of strengths that set it apart from other New Jersey counties:

- Home of New Jersey's largest city, Newark, which hosts one of the largest port facilities in the United States, as well as the only international airport (Newark Liberty) in New Jersey. Newark is home to Rutgers, NJIT, Essex County College, Seton Hall Law School and corporate headquarters to Prudential Insurance, PSE&G, as well as the County Seat. Newark is also a cultural and entertainment hub, home to Newark Symphony Hall, the NJPAC and the Prudential Center.
- Essex County is rich in educational resources, with many of its towns hosting colleges or universities such as:
    - Seton Hall University (Newark, South Orange)
    - Montclair State University (Montclair)
    - Bloomfield College (Bloomfield)
    - Caldwell College (Caldwell)
    - Gibbs College (Livingston)
- Essex County has approximately 26 miles of railroad track and 21 railroad stations, including Newark Penn Station which is also a hub for Amtrak service. There are five NJ TRANSIT commuter lines that travel through Essex County. These railroad lines primarily serve commuters to the City of Newark and New York City. Additionally, they also enable "reverse commuting" from these urban areas to outlying suburban locations.[5]

Weaknesses

While having the state's largest city as an employment and transportation hub is a strength for Essex County, there are weaknesses that Superstorm Sandy exposed which are also linked to Newark:

Figure 5. This photo from an article in the Star Ledger shows shipping containers in Port Newark that were blown over by winds from Superstorm Sandy. Photo Courtesy of the Port Authority of NY and NJ.

- Most of the County's road network leads to downtown Newark like the spokes of a wheel. However portions of the downtown and most of the City's industrial areas around the port and Newark Liberty International Airport are now in a flood hazard area (Figures 10 and 11).
- Along with the transportation and shipping infrastructure being vulnerable to storm events such as Sandy, the rail and power infrastructure is also vulnerable in its concentration in areas that are now considered flood hazard areas.

Opportunities

The experience gained by the County and its municipalities in dealing with the impacts from Sandy's surge and wind, as well as the flooding from rivers such as the Passaic in the northern Essex towns like Fairfield and Millburn and the Third River in Bloomfield and Montclair during Irene and Sandy are being

[5] IBID, page 17.

incorporated into the new Hazard Mitigation Plan now being compiled by the Essex County Sherriff's Department and its consultant, Tetra Tech, Inc. Some likely opportunities include:

- Improved stormwater management in flood prone areas through incorporation of flood storage techniques in managed wetlands within County parks and open space reservations
- Strategic replacement of street trees damaged by Sandy to avoid conflict with overhead wires
- Incorporation of new criteria for sites proposed for County facilities that avoids flood prone areas or requires suitable resilient design techniques.
- Incorporation of new criteria for prioritizing improvements to County and State roads, bridges, transit and freight facilities to emphasize evacuation routes and minimize exposure of rail rolling stock to flood damage.

Threats

In addition to the vulnerability to transportation and power infrastructure located in areas that Sandy exposed as subject to flooding, a number of other County or regional facilities are similarly threatened by future storm events.

As with the roadway network itself, the County's bridge infrastructure is aging. The median construction year for structures with a span of over 20 feet within the County is 1953, as such, the average bridge is approximately 60 years old. Based on recent structural inspection and assessment forms (SI&A) for 38% of the bridges and culverts, approximately 12.4% received a rating of poor or lower while the vast majority (87.6%) of these bridges received a rating of fair or higher. The most critical bridges are more than 100 years old and date back to the early 1900's or late 1890's.[6]

In addition to the threat of aging infrastructure, there are other County or regional facilities that were impacted by Sandy, including the County Correctional Facility in Newark and the Passaic Valley Sewerage Commisson's treatment plant, also in Newark.

Figure 6. The Essex County Correctional Facility (left) was flooded (right) during Sandy, causing a heighted state of emergency and a threat to the safety of inmates and staff.

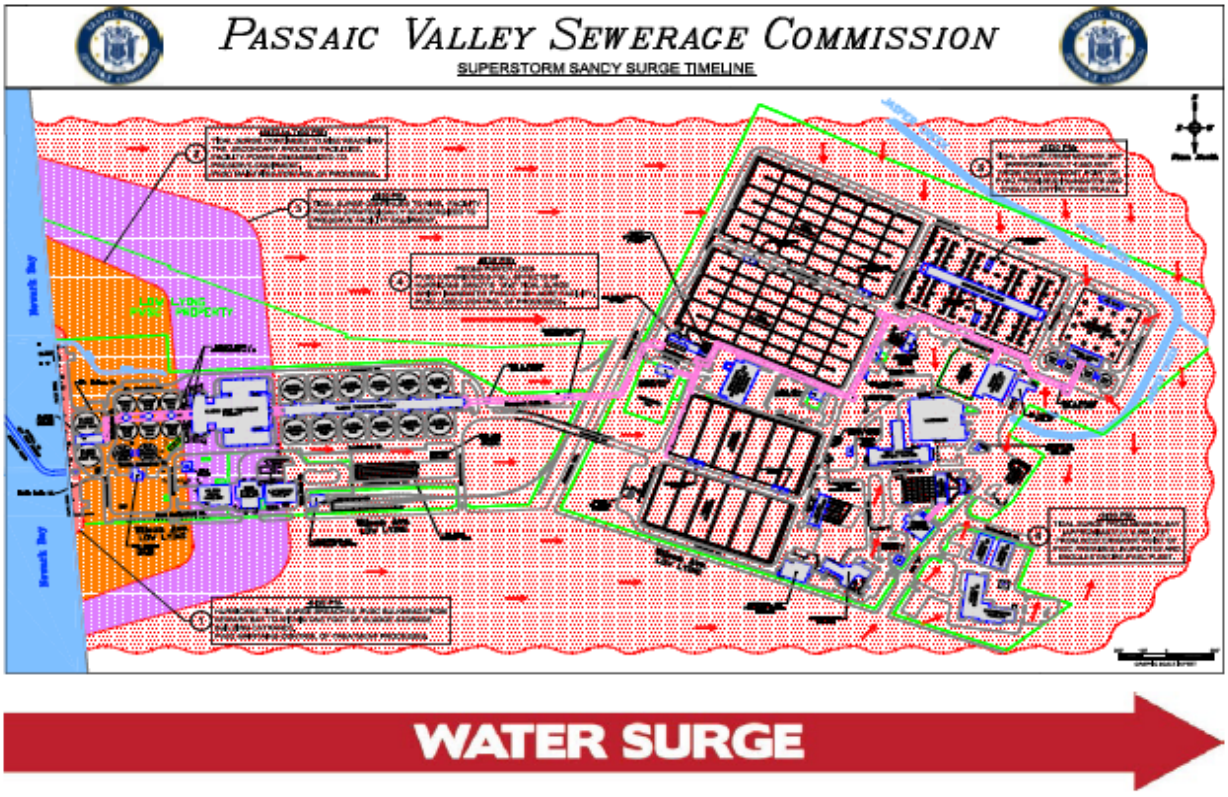
The Essex County Correctional Facility houses approximately 2,500 inmates and federal detainees. A Star Ledger article, posted on NJ.com on December 9, 2012, cited surveillance video from the facility that showed water as deep as six feet "lashing against the glass doors of the main entrance on Doremus Avenue." The article reported that the first floor of the facility had three inches of water and forced 800

[6] Essex County Comprehensive Transportation Plan, Dewberry, Maser Consulting, PA & Stump/HausmanPartnership, 2013, page 16.

inmates to be evacuated to the third floor, where men were held in the gymnasium and women in a visitors' hall. Even more alarming, is that the article reported that during the height of Sandy on October 29 the flood waters surrounded the building like a moat and "there was no way in or out", and that "corrections officers and other staff were stuck on site for two days straight". The article reported that County officials estimated the cost of repairing damages to the facility at 18.2 million dollars.[7]

The County Correctional Facility was not the only regional facility in the path of Sandy's surge from Newark Bay. According to Star Ledger articles published shortly after Sandy, the Passaic Valley Sewerage Commission's (PVSC) main treatment facility in Newark, which serves 1.4 million customers in Bergen, Passaic and three other counties, had been dumping roughly 240 million gallons of raw or partially treated sewage per day into Newark Bay and Upper New York Bay after Sandy struck.

Figure 7. Diagram from a PVSC publication illustrates the impact of Sandy's surge from Newark Bay into the wastewater treatment facility.



As water surged east from Newark Bay on to the Passaic Valley Sewerage Commission's property, the entire 140 acre complex quickly became inundated from the storm surge which reached heights of up to 12 feet.

[7] "Sandy Trapped Guards and Staff at Essex County Jail, Caused Millions in Damages", Eunice Lee, The Star-Ledger, posted on NJ.com on December 9, 2012.

The Star Ledger reported that from the time the facility was knocked out during the storm until Nov. 7, 2012, it discharged up to 500 million gallons a day of raw sewage, based on information the Ledger obtained from the federal Environmental Protection Agency. Partial treatment was restored Nov. 7, but secondary treatment is required to bring coliform counts down to acceptable levels. Even after November 7 the plant was still only able to conduct primary treatment of sewage. The storm knocked out power to the facility, flooded tunnels and damaged key equipment.

According to the PVSC publication "Recovering from Superstorm Sandy", secondary treatment was operational by November 26, 2012 and restored its permanent dewatering processes by December 18, 2012. It also indicates that in January (2013) it began "accepting all municipal, industrial, and water sludge and our LWA operation is back to accepting all streams of waste". The PVSC began "Flood Mitigation Planning" in June, 2013 and implemented a new temporary flood control barricade system (Muscle Wall) in July of 2013 to prepare for future extreme weather events. The initial mitigation planning strategy will include:

1) On-site Primary Power – To ensure PVSC has the ability to produce its own power to operate the plant without relying on outside sources.

2) Sustained Dewatering of PVSC – Emergency stand-by (generators) due to power loss.

3) Flood Wall – To protect PVSC from future tidal and storm surge.

4) Head Works Grit & Screening Electrical & Conveying System – To elevate out of the flood plain systems that deliver influent to PVSC.

5) Rehabilitation of PVSC's Existing Dewatering Centrifuges – Rebuilding of emergency back-up dewatering centrifuges presently mothballed at PVSC.

6) Regional Biosolids Facility – Upgrade to ensure the viability of accepting wastewater from our regional partners.

7) Upgrade Substations – Electrical power upgrades.

8) Plant wide Electrical Modification to Elevate Motor Control Centers – Elevation out of flood plain electrical components so as to not be susceptible to flood waters.

9) Plant-wide Pump Replacement (submersible type pumps) – Replacement of all sump pumps to submersible types.

10) Elevate Control Panels for Tunnel Sump Pumps - Elevation of control panels out of flood plain.

Figure 8. The temporary "muscle wall" erected to protect the PVSC treatment plan in July of 2013 would be replaced with a permanent flood wall as part of the PVSC's Flood Mitigation Plan. (Source: "Recovering from Superstorm Sandy," PVSC, January, 201

Figure 9. Passaic Valley Sewerage Commission Plant near Newark Bay was impacted by Sandy. This Star Ledger file photo shows raw sewerage bubbling up from ground.

Flood, Storm Surge, Sea Level Rise, Climate Change Overview

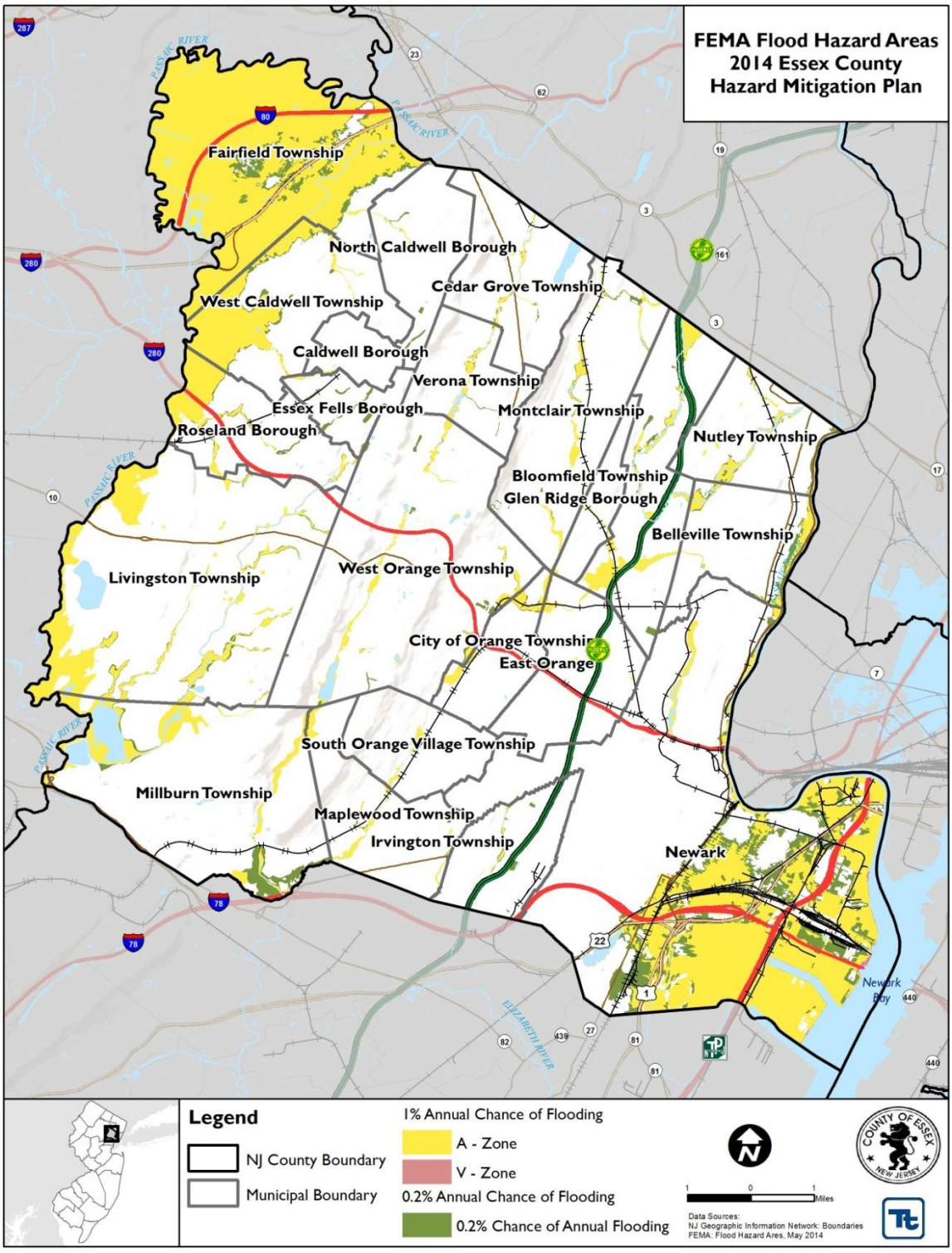
Flood

Flooding in Essex County is often the direct result of frequent weather events such as coastal storms, Nor'Easters, heavy rains, tropical storms, and hurricanes. Floods tend to occur in and around areas near existing bodies of water, such as rivers, streams, and the Atlantic Ocean. The most damaging floods (particularly riverine floods) in Essex County occur along the Passaic River in Fairfield Township.

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not a flood that will occur once every 100 years, rather it is a flood that has a 1% chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Due to this misleading term, FEMA has properly defined it as the 1% annual chance flood. This 1% annual chance flood is now the standard used by most federal and state agencies and by the NFIP (FEMA 2002).

Figure 10 illustrates the FEMA Flood Hazard Area in Essex County.

Figure 10. FEMA Flood Hazard Areas in Essex County



Source: FEMA 2014

Storm Surge

Typically, storm surge is estimated by subtracting the regular/astrological tide level from the observed storm tide. Typical storm surge heights range from several feet to more than 25 feet. The exact height of the storm surge and which coastal areas will be flooded depends on many factors: strength, intensity, and speed of the hurricane or storm; the direction it is moving relative to the shoreline; how rapidly the sea floor is sloping along the shore; the shape of the shoreline; and the astronomical tide. Storm surge is the most damaging when it occurs along a shallow sloped shoreline, during high tide, in a highly populated, and developed area with little or no natural buffers (for example, barrier islands, coral reefs, and coastal vegetation).

The most common reference to a return period for storm surges has been the elevation of the coastal flood having a 1% chance of being equaled or exceeded in any given year, also known as the 100-year flood. Detailed hydraulic analyses include establishing the relationship of tide levels with wave heights and wave run-up. The storm surge inundation limits for the 1% annual chance coastal flood event are a function of the combined influence of the water surface elevation rise and accompanying wave heights and wave run-up along the coastline.

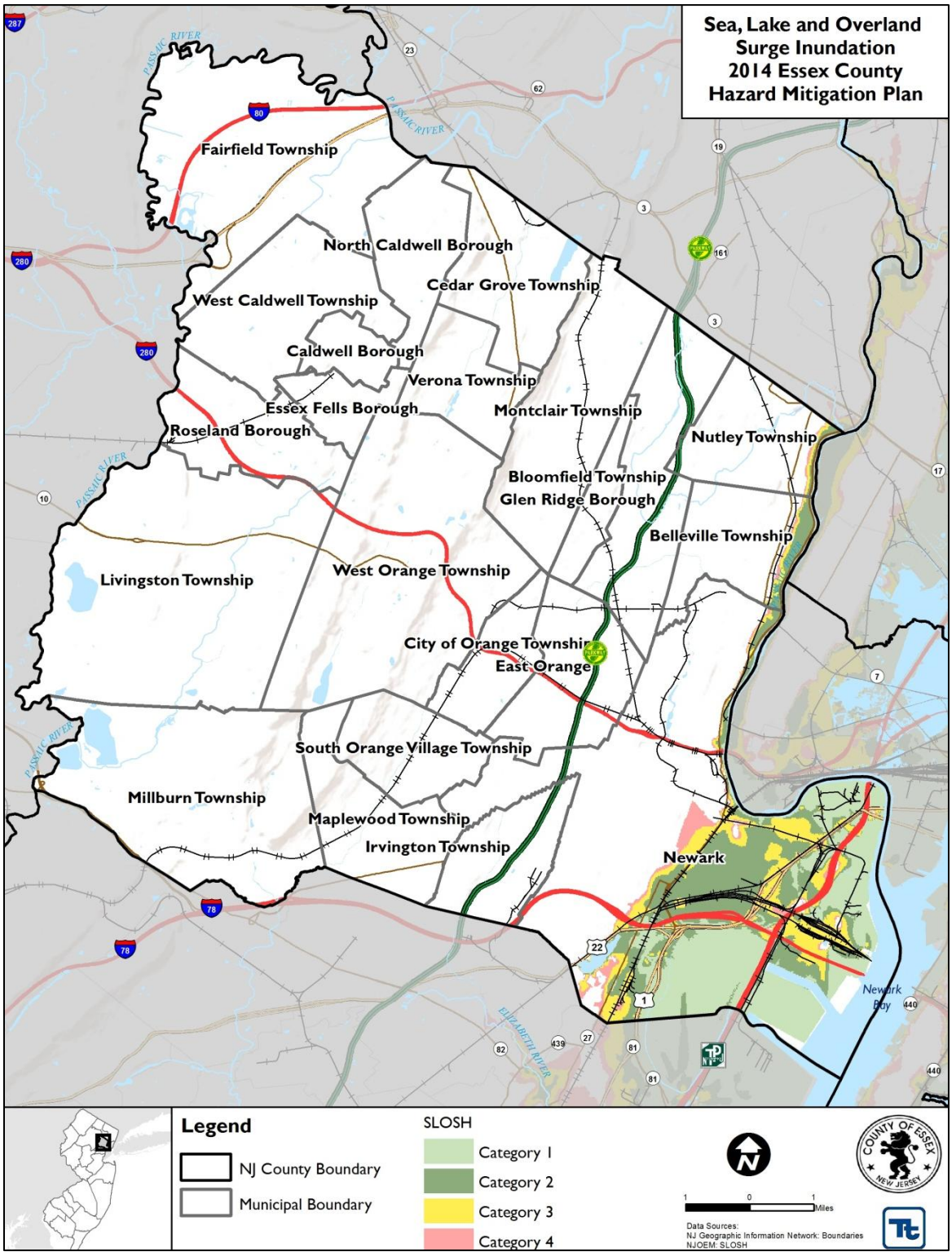
The risk of storm surge elevations higher than seven feet exists along certain coastal segments of Oregon, Washington, and Alaska; and in every coastal state from Texas to New Jersey. A storm surge associated with storms of longer recurrence intervals may result in more storm surge flooding, higher water levels, larger waves, and an increased likelihood of dune overwash, wave damage, and possible breaching of barrier islands.

In addition to the coastal zone, the entire State is vulnerable to hurricanes and tropical storms, depending on the storm's track. The coastal areas are more susceptible to damage caused by the combination of both high winds and tidal surge. Inland areas, especially those in floodplains, are also at risk for flooding because of heavy rain and winds. The majority of damage following hurricanes and tropical storms often results from residual wind damage and inland flooding, as was demonstrated during recent tropical storms.

As noted, inundation from storm surge has devastating impacts on the State's coastal communities. The U.S. Army Corps of Engineers (USACE), in cooperation with FEMA, initially prepared Sea, Lake and Overland Surge from Hurricanes (SLOSH) inundation maps. SLOSH maps represent potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide. It does not include riverine flooding caused by hurricane surge or inland freshwater flooding. The mapping was developed for the coastal communities in New Jersey using the computer model to forecast surges that occur from wind and pressure forces of hurricanes coastline topography. In New Jersey, hurricane category is the predominant factor in worst-case hurricane surges. The resulting inundation areas are grouped into Category 1 and 2 (dangerous), Category 3 (devastating), and Category 4 (catastrophic) classifications. The hurricane category refers to the Saffir/Simpson Hurricane Intensity Scale, summarized below.

FEMA Region IV Risk Analysis Team developed storm surge inundation grids for the State in a spatial format from the maximum of maximums outputs from the SLOSH model. These represent the worst-case storm surge scenarios for each hurricane category (1 through 4).

Figure 11. Storm Surge Inundation Map



Source: NJOEM 2013

Sea Level Rise

During the 20th century, global sea level rose at an average rate of 0.6 inches per decade. Thermal expansion of a warming ocean and the melting of glaciers and ice sheets were the primary reasons for this rise in global sea level. Thermal expansion made the same amount of water take up more space, and the melting of glaciers and ice sheets added water to the ocean. The rate of global sea level rise has increased, with an average rate of 1.2 inches per decade since the early 1990s. Rates of sea level rise vary globally, and sea levels along the New Jersey coastline have risen faster than the global average. The rate of sea level rise is greater along the coastal plain of New Jersey due to the land subsiding at the same time that water levels are rising (Rutgers 2013).

NOAA tide gauge data shows that sea level at Atlantic City, Cape May, and Sandy Hook is rising at a rate of approximately 0.15 inches per year (inches/year) since recording began in the early to mid-1900s. Recent research completed by the NJDEP shows that pre-anthropogenic sea level rise in New Jersey was approximately 0.08 inches/year. This suggests that the anthropogenic contribution to the recent higher rate of rise is approximately 0.08 inches/year (NJDEP 2013).

There is currently no coordinated, interagency effort to identify agreed upon estimates for future sea level rise. The U.S. National Climate Assessment Development and Advisory Committee, a federal committee writing the next National Climate Assessment, outlines sea level rise scenarios in the National Oceanic and Atmospheric Administration's Office of Oceanic and Atmospheric Research, Climate Program Office, Technical Report OAR CPO-1 entitled 'Global Sea Level Rise Scenarios for the United States National Climate Assessment'. FEMA's best available special flood hazard area (SFHA), or the 1-percent annual chance flood, has been integrated with four scenarios of sea level rise (referred to as lowest, intermediate – low, intermediate - high and highest). Please note these scenarios do not predict future changes but describe estimated potential future conditions. This report notes that the greatest uncertainty surrounding estimates is the rate and magnitude of ice sheet loss, primarily from Greenland and West Antarctica. Global sea level rise scenarios for New Jersey and New York State are provided in Table 2. These four scenarios reflect different degrees of ocean warming and ice sheet loss.

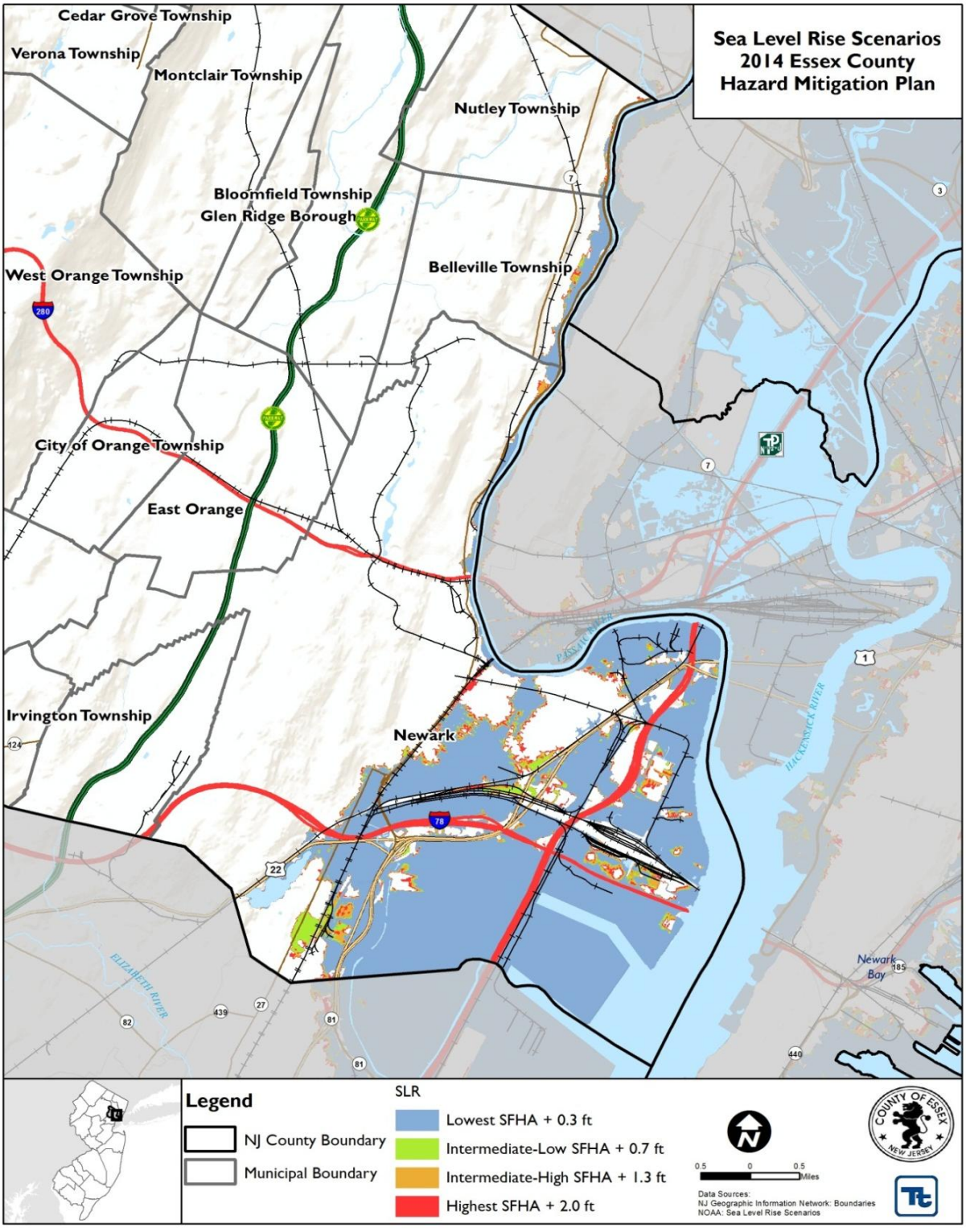
A map illustrating sea level rise scenarios in Essex County is provided in Figure 12.

Table 2. NOAA Sea Level Rise Scenarios for New Jersey

Scenario	2050 (feet of rise)	2100 (feet of rise)
Lowest	SFHA + 0.3 feet	SFHA + 0.7 feet
Intermediate - Low	SFHA + 0.7 feet	SFHA + 1.6 feet
Intermediate - High	SFHA + 1.3 feet	SFHA + 3.9 feet
Highest	SFHA + 2.0 feet	SFHA + 6.6 feet

Source: NOAA 2012
SFHA Special Flood Hazard Area

Figure 12. Sea Level Rise Scenarios Map



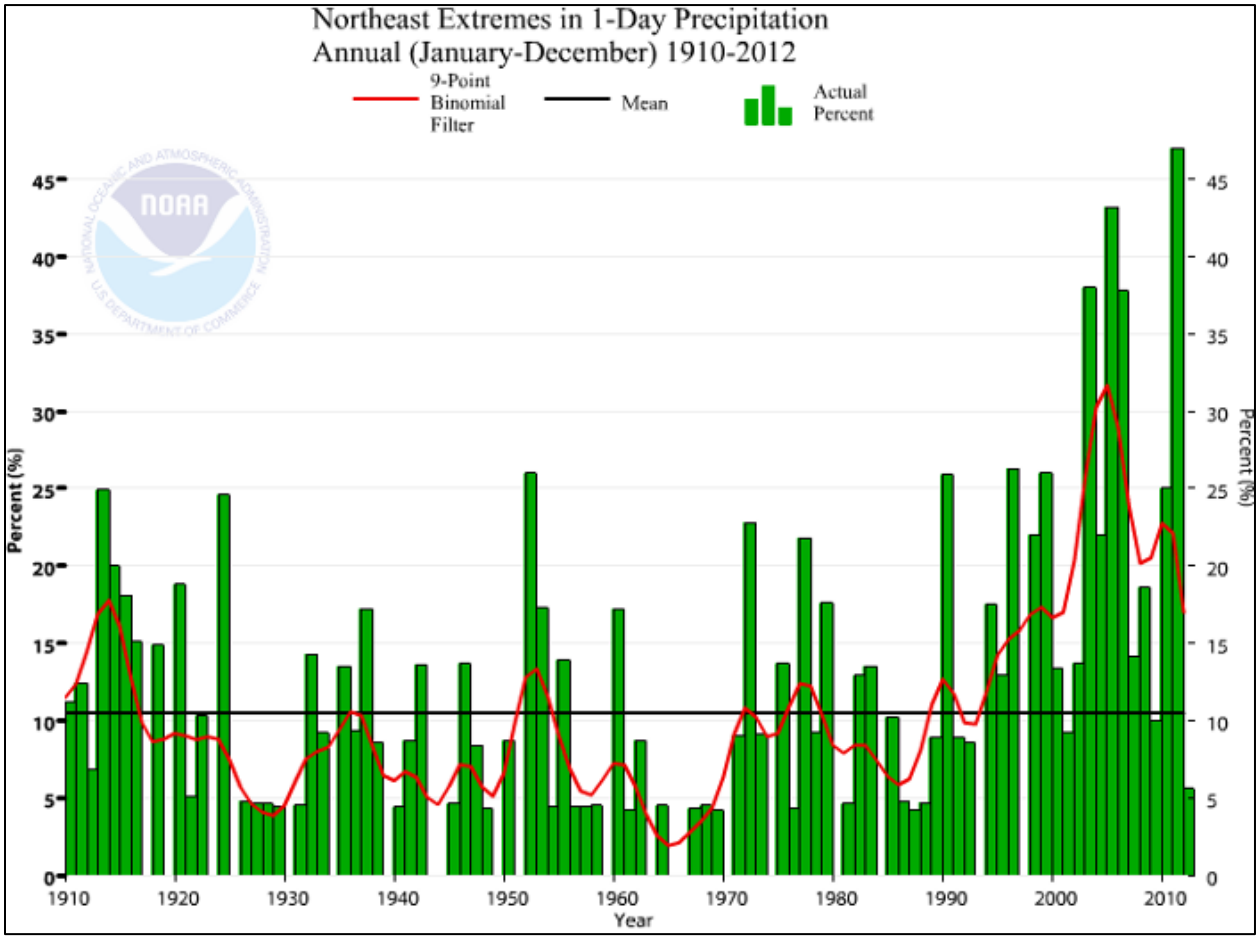
Source: NOAA 2013

Climate Change Impacts

In 2012, New Jersey's statewide average temperature was the highest in 118 years of records. The 56 degrees Fahrenheit (°F) average for 2012 is 2.8°F above the 1971 to 2010 mean. Nine of the 10 warmest calendar years on record have occurred since 1990, and the five warmest years have occurred since 1998. This is consistent with the long-term upward trend of 2.2°F per century. Abnormal warmth was common through much of 2012, with only one month (November) recording temperatures below the 1981 to 2010 average (Rutgers Climate Institute 2013).

Precipitation during 2012 was slightly below normal, averaging 43.21 inches statewide. It ranked as the eighth driest calendar year of the past 30 years. The central coastal area was wettest in 2012, with several stations in Ocean and Burlington Counties receiving more than 53 inches. Over the long term, there has been an upward trend in annual precipitation in New Jersey. Since 1895, annual precipitation has increased at a rate of 4.1 inches per century. Heavy precipitation events have increased in the past 20 years and it is expected that this trend may continue (Rutgers Climate Institute 2013). Figure 13 shows the frequency of heavy precipitation events in the northeastern U.S.

Figure 13. Frequency of Heavy Precipitation Events in the Northeastern U.S., 1910 to 2010



Source: Rutgers Climate Institute 2013

Some climatologists believe that climate change may play a role in the frequency and intensity of Nor'easters. Two ingredients are needed to produce strong Nor'easters and intense snowfall: (1) temperatures which are just below freezing, and (2) massive moisture coming from the Gulf of Mexico.

When temperatures are far below freezing, snow is less likely. As temperatures increase in the winter months they will be closer to freezing rather than frigidly cold. Climate change is expected to produce more moisture, thus increasing the likelihood that these two ingredients (temperatures just below freezing and intense moisture) will cause more intense snow events.

Impact Assessment

County Losses

Besides the impact of Sandy on the road, rail and air transportation network, power grid, freight movement at Port Authority facilities in Newark and County and regional facilities located in vulnerable areas, Essex County's municipalities, residents and businesses also suffered losses from wind and water damage.

The most significant riverine flooding area in Essex County is related to the large Flood Hazard (A Zone) shown in Figure 10 along the western Passaic River corridor in Fairfield, West Caldwell, Roseland, Livingston and Millburn. There is less direct exposure along the eastern Passaic River corridor except where the river becomes tidally influenced in parts of Nutley and Belleville along State Highway 21 and in portions of the downtown and Ironbound in Newark. However, towns such as Montclair, Bloomfield, and Nutley, located along Toney's Brook and the Third River, also experienced property losses due to flooding during both Irene and Sandy.

The Essex Board of Taxation identified substantial ratable loses because of Superstorm Sandy. Table 3 outlines the amount of loss in ratables for the ten most impacted municipalities in Essex County.

Table 3. Superstorm Sandy Ratable Loss Identified in Essex County

Municipality	Ratable Loss
Belleville	$259,600
Bloomfield	$77,200
Essex Fells	$394,800
Irvington	$104,000
Livingston	$141,800
Millburn	$172,900
Montclair	$2,005,900
Nutley	$228,600
South Orange	$174,500
West Orange	$549,300
Total	$4,108,600

Source: Essex County Board of Taxation, 2013

There were also other economic impacts associated with the storm including loss of wages and Rutgers University's School of Public Affairs and Administration in Newark, recently completed "The Impact of Superstorm Sandy On New Jersey Towns and Households" in October of 2013. This report provided an

in-depth analysis of the lost wages. The report indicated that there was an approximate $59 million loss in wages as a result of Superstorm Sandy in the County. The report also identified that there was an approximate average of six days of power loss in the county. The estimate was based on the average number of days the public schools were closed in the county. To illustrate the magnitude of the economic impact a summary of lost wages in Essex and New Jersey Counties is provided in Table 4.

Table 4. Lost Wages and Power Loss Estimates Resulting from Superstorm Sandy

	Lost Wages	Average FEMA IA Assistance	No Home Owners Insurance	Household Hardship Index	Index RANK
Newark, Essex	$59,077,746	$189	88%	100	1

	Days Without Power	Residential Claims Reported as Percent of Total Housing Unit	Residential Paid Loss $ per Housing Unit	Commercial Paid Loss per Non-Residential Parcels $	Commercial Claims Reported as % of Non-Residential Parcels	FEMA Municipal Assistance per Capita	People Served at Shelters per 1,000	Gas Calls per 10,000	Community Hardship Index
Atlantic	3	7%	$318	$59	0.62%	36	11	4	47
Bergen	6	8%	$379	$325	1.72%	10	1	36	52
Burlington	3	4%	$145	$39	0.35%	5	6	2	39
Camden	2	2%	$53	$29	0.20%	3	-	7	32
Cap May	4	7%	$242	$67	1.21%	42	3	2	47
Cumberland	2	2%	$53	$38	0.42%	14	-	6	33
Essex	6	6%	$298	$588	1.73%	11	1	6	47
Gloucester	2	3%	$102	$54	0.43%	7	0	0	33
Hudson	6	4%	$110	$553	3.06%	18	3	5	48
Hunterdon	6	14%	$799	$171	1.36%	19	2	27	58
Mercer	5	8%	$334	$137	1.12%	11	0	9	46
Middlesex	7	12%	$446	$270	1.89%	25	5	17	59
Monmouth	10	16%	$803	$200	1.96%	113	14	34	84
Morris	7	13%	$679	$162	1.60%	10	2	34	57
Ocean	8	17%	$718	$166	1.11%	68	9	21	73
Passaic	6	7%	$304	$200	1.64%	8	1	9	46
Salem	2	1%	$47	$5	0.10%	4	1	3	31
Somerset	9	15%	$807	$246	1.47%	12	3	19	62
Sussex	7	11%	$609	$77	0.81%	13	9	21	57
Union	9	13%	$626	$499	2.40%	17	1	8	59
Warren	2	10%	$449	$103	1.16%	8	1	11	44

Source: FEMA, 2013; NJDOE, 2013; DOBI, 2013; NJ DOBI, 2013; NJC, 2013.

Municipal Losses

Several individual municipalities in Essex County reported losses from Superstorm Sandy. An overview of those losses is provided below.

Table 5. Municipal Superstorm Sandy Damages Identified in Essex County

Municipality	Dates of Event	Event Type	FEMA Declaration	Essex County Design?	Did your community suffer losses/costs from this event? (Yes/No - If "yes" please complete an Event Loss Summary Sheet for this event.)
Belleville	October 26 to November 8, 2012	Superstorm Sandy	EM-3354	Yes	Damage to water mains and pressure regulators $54.863.09. Damage to roof at Town Hall $55,120.25. Damaged police records $75,685. Cat B $414,428.32. Cat A $555,476.63. Main St closed due to flooding, entire length. Strip mall flooded.
Verona	October 26 to November 8, 2012	Superstorm Sandy	EM-3354	Yes	Yes: $571,715.98
Millburn	October 26 to November 8, 2012	Superstorm Sandy	EM-3354	Yes	Yes

Source: ECOEM, 2014

Table 6. Maplewood Superstorm Sandy Damages Identified

Property Type	Damage Type	Number of Properties
Commercial		3
	Water in basement	2
	Water in basement - main break in street	1
Municipal Street		1
	River crested bridge deck	1
Residential		196
	Damage to car from tree	1
	Damage to garage from tree	2
	Damage to shed from tree	1
	Damaged electric meter	1
	Electrical arc when power restored	1
	Tree into house - exterior damage	35
	Water in basement	137
	Water leak into building	1
	Weatherhead pulled from house	15
	Wind damage to gutter	1
	Wind Damage to Roof	1
	Grand Total	200

Source: ECOEM, 2014

There were undoubtedly other damages in other communities as a result of Superstorm Sandy, however the information above was what was available at the time of the preparation of this report. The damage information should be used to gauge the type and amount of damage that was experienced across the County.

Flood Insurance Studies (FIS)

FEMA provides Flood insurance Studies(FIS's) for entire counties and individual jurisdictions. These studies aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. They are narrative reports of countywide flood hazards, including descriptions of the flood areas studied, the engineered methods used, principal flood problems, flood protection measures, and graphic profiles of the flood sources. The descriptions below are applicable to many areas that were affected by Superstorm Sandy and should be used as a framework for why, where, when and how there is flooding in the county.

A preliminary countywide FIS for Essex County has been completed and is dated May 30, 2014. The following discussion presents flood information as directly provided in the FEMA FIS document(s).

- *Township of Belleville* – The Township of Belleville is subject to flooding from the Passaic River, the Second River, and the Third River. All three flooding sources flow in well-defined channels with flooding occurring in adjacent low-lying areas. Flooding is generally the result of heavy rainfall produced by hurricanes moving up the Atlantic coastline, large frontal storms from the west and south, and local thunderstorms. Frequent flooding is also known to occur along the Third River between Fairway Avenue and Joralemon Street.

Historic floods occurred in 1902, 1903, 1936, and 1945. The 1903 flood had an estimated peak discharge of 39,800 cubic feet per second (cfs) and estimated 1% annual chance frequency at the confluence of the Passaic River and Newark Bay. The floods inundated large areas, causing damage to buildings and disruption of transportation and utility lines.

- *Township of Bloomfield* – The Township of Bloomfield is subject to flooding from the Passaic River and the Second River. The flooding along the streams within the corporate limits to attributed mainly to backwater created by inadequate storm drains and culverts, clogged bridges, or shallow stream beds. Most of the lands adjacent to the rivers in the Township are affected by flooding, with the exception of the Third River section between John F. Kennedy Drive and Maple Street, where natural high riverbeds combined with natural high grounds confine floodwater to the channel. There are several other areas throughout the Township that experience flooding due to inadequate storm drainage systems. Historic floods in the Township occurred in May 1968, August and September 1971, and February 1973.

- *Township of Cedar Grove* - The Township of Cedar Grove is subject to flooding from the Peckman River and its tributaries. All flooding sources flow in well-defined channels with flooding occurring in adjacent low-lying areas. Flooding occurs along the Peckman River and its tributaries during times of excessive and prolonged rainfall, particularly in residential areas having steep slopes. This flooding is the result of high runoff combined with insufficient carrying capacity of bridge openings and culverts.

- *City of East Orange* - The flooding problem along the channel of the Second River Tributary in the City of East Orange has long been recognized and studied. The first comprehensive report on flooding problems of Second River Tributary in 1940 was stimulated by the 1938 flood. This report contained a master plan for the improvement of Second River Tributary, setting channel

slopes and improvements capable of carrying design flows with an expected frequency of 30 years.

Nishuane Brook has some reported flooding problems at the Dodd Street and Thomas Boulevard crossings. Flood damages during the August 1971 storm (Hurricane Doria) consisted of damage to approximately a dozen homes between Dodd Street and Lake Street along Second River Tributary. No specific damages were reported for East Orange for the flood of August 1973, even though the reported magnitude of this flood was on the same order as that of the 1971 flood in East Orange.

In addition to the problems outlined above, there is local flooding in East Orange caused by poor pipe drainage facilities along Summit Street and Melmore Gardens west of North Clinton Street, and at the street crossing at the railroad and Fourth Avenue.

- *Borough of Essex Fells* – Flooding within the Borough of Essex Fells usually occurs as a result of heavy rainfall from localized thunderstorms and hurricanes during the summer and fall months. Because of the low permeability of certain soils, the high degree of development, and the borough's inadequate storm sewers, some areas are subject to frequent flooding and ponding of surface water.

The basements of five houses along Devon Road and one house along Hawthorne Road in Essex Fells suffered considerable damage from flooding during Tropical Storm Doria in August 1971. The flood of August 2, 1973, had a 83-year recurrence interval measured at the nearest upstream gage (No. 01379500) to confluence with Passaic River, and had a less than 10-year recurrence interval measured at the nearest downstream gage (No. 01381900) at Pine Brook. The length of record of the upstream gage is from 1903 to 1911, and 1937 to the present, and the latter is from 1966 to the present. The flood of April 6-7, 1984, measured with the aforementioned gages, had a less than a 10-year recurrence interval upstream and a 44-year recurrence interval downstream. Floodwaters resulting from Hurricane Irene on August 29-30, 2011, measured at the same gages, had a recurrence interval of 16 years upstream and 22 years downstream.

- *Township of Fairfield* – The low-lying area of the wide floodplain of the Passaic River comprises much of the Township of Fairfield and forms a large natural storage area. Floodwaters from the Pompton River enter this storage area from the north near the Two Bridges area. During large floods, Beatties Dam, which is located above Little Falls, constricts the river section enough to cause floodwaters from the Pompton River to enter the Passaic River, flowing in both an upstream and downstream direction at the point where the two rivers join (Richard P. Browne Associates, 1975 and 1976). The storage area thus contains flows from the Passaic River and the Pompton River.

The flood peaks from the Pompton River are reduced and retarded somewhat due to the lake and reservoir storage on the northern upland tributaries and the valley storage between Pompton Lakes and Two Bridges. According to a USACE analysis, the Pompton River peak reaches the Passaic River approximately 12 to 18 hours before the Passaic River peaks. The southern upland tributaries of the Passaic River are as precipitous as the northern tributaries, but they join the Passaic River at widely separated points which results in desynchronization of their peaks. They are greatly affected by the large valley storage in the lower reaches and are, therefore, low flood producers into the Passaic River floodplains.

- *Borough of Glen Ridge* - Toneys Brook is contained in a deep gorge formed by the railroad embankment and Bloomfield Avenue. The gorge runs from a point upstream of Hillside Avenue

to a point behind the Parkway Apartments. Downstream of Hillside Avenue, a limited amount of homes and businesses have experienced minor flooding.

- *Township of Irvington* - The two major sources of flooding in the Township of Irvington are the Elizabeth River and inadequate internal drainage. During the August 2, 1973, (40-year recurrence interval, based upon frequency discharge curve for the Elizabeth River at Hillside) storm there was severe flooding throughout the township with many streets being impassable. During the August 17, 1974, (10-percent-annual-chance recurrence interval, based upon frequency discharge curve for the Elizabeth River at Hilliside) storm and during Hurricane Doria (2-percent-annual-chance recurrence interval, based upon frequency discharge curve for the Elizabeth River at Hilliside) in 1971, the township was declared a flood disaster area.

Additional flooding due to inadequate internal drainage has occurred in several areas of Irvington located in the vicinity of Durand Place and Wagner Place, Isabella Avenue and Delmar Place, Augusta Street and Ball Street, and Chestnut Avenue.

- *Township of Livingston* - The Livingston area is subject to frequent rainfalls of great intensity and varying origin. The rainfall may be from local thunderstorms, hurricanes, storms originating over the Atlantic Ocean, or storms coming from the mainland. High intensity, short duration storms tend to cause flooding of the smaller drainage basins of the Township. Lower intensity, longer duration storms are more troublesome to the waterways with larger tributary areas, such as Canoe Brook and the Passaic River.

The Township of Livingston is highly developed, with buildings and paved areas covering a significant portion of the land area and effectively reducing the amount of land available to absorb precipitation. Throughout most of the Township, the surface soil has a relatively low permeability, although there are a few local deposits of sand and gravel. In general, the slope of the terrain varies from 1 percent to 10 percent throughout most of the Township. The low permeability of the soil, the steep slope of the terrain, and the high degree of development in Livingston all contribute to relatively high amounts of runoff, especially from the high intensity storms experienced on the east coast of the United States. The runoff is carried in open waterways to the Passaic River. The present problems due to storm water runoff are principally related to high velocity flow, channel erosion (particularly in upstream areas), and subsequent depositions of rock and silt in the downstream portions of the brooks.

Local flooding in Livingston is generally due to inadequate storm sewers, high-water elevations in the streams to which the storm sewers discharge, or blockages, such as silting of the stream channel at the point of discharge from a storm sewer. In addition to causing silting and blockage of the stream channel, the erosion caused by the high velocities also undermines the embankments of the streams and affects the adjacent land area. This type of damage is caused not only by severe floods but also by the cumulative effects of lesser, but more frequent storms.

The downstream portions of Canoe Brook and Slough Brook, as well as the land area bordering the Passaic River, are greatly influenced by high-water levels in the Passaic River. A historic flood in Livingston in the Passaic River Basin occurred during October 1903; however, because of the low level of development at that time, damages were not too severe. The storm of October 1903 was centered over Paterson, where a total of 15.5 inches of rainfall was recorded.

A review of the great storms which have occurred in the northeastern states reveals that the Rahway River and its tributaries are located in the North Atlantic storm belt. Under extremely intensive and prolonged rains, the East Branch Rahway River; its tributary, Crooked Brook; and Lightning Brook, a

tributary of the Elizabeth River, overflow their banks in the Township of Maplewood. Also some bridges over East Branch Rahway River are topped by floodwaters, thus making roads impassable.

- *Township of Maplewood* - At the time the FIS for the Township of Maplewood was published, local flooding was due mainly to poor drainage. The storm sewer system was originally designed for 5- to 10-percent-annual-chance storms and the storm sewer could not accommodate rainfall resulting from the 1-percent-annual-chance storm.

The Township of Maplewood has sustained damages from floods that have occurred in the past, with the historic floods occurring during July 1901, February 1902, October 1903, August 1927, July 1938, August 1955, September 1971, and August 2, 1973. The damaging storms occurred in Maplewood during the floods of August 2, 1973, and July 1938. The historic flooding occurred during the storm of October 1903; however, because of the absence of development in the community, damages were not as great as those caused by the August 2, 1973 flood.

- *Township of Montclair* - Flooding along the streams within the Township of Montclair is mainly caused by backwater that is created by inadequate pipes, box culverts, and bridges clogged by deposits of silt and debris. Shallow, rocky streambeds and heavy brush cover on overbanks also limit effective flow areas.

The adjacent land area for the streams studied in detail in Montclair is affected by heavy rainfall, with the exception of a few areas where the channel is relatively wide and the banks are well stabilized. There are several other areas in the township, which, although not adjacent to a body of water, experience flooding due to an inadequate storm water drainage system.

Montclair has sustained damages from past floods. The significant floods occurred during May 1968, August and September 1971, and on February 2, 1973. Floodwaters caused disruption in traffic, inundation of streets, interruption of businesses, danger to life, and flooding of homes.

- *City of Newark* - The City of Newark is subject to tidal flooding from the Passaic River and Newark Bay. Most of the flood problems occur in the south and eastwardly (Ironbound Section) adjacent to U.S. Route 22 and Frelinghuysen Avenue. Flooding always occurs when an annual peak rainfall coincides with a high tide in Newark Bay. This area is susceptible to flooding because of its flat topography and low elevations.

A historic tide record was obtained in Newark during the October 1903 flood. The largest flood on record occurred August 28, 1971, with a peak discharge of approximately 6,500 cfs recorded at the USGS Second River at Belleville gage (no. 1392500). Due to drastic changes in urbanization over the gaging period a meaningful statistical return period could not be computed.

- *Borough of North Caldwell* – Due to the steep terrain through which it passes; the floodplain of Green Brook is confined and causes no major flood problems in the Borough.

- *Township of Nutley* - Flooding along the streams within the Township of Nutley is mainly attributable to backwater created by inadequate storm drains and culverts. Flooding that occurs from the culvert between Elm Street and Hillside Avenue on St. Pauls Branch is of particular concern to the township. The narrow, rocky channel and flat overbanks with heavy vegetation also contribute to the flooding problem. Even though some storms may last only a short period of time, heavy rainfall affects most of the adjacent land area along the streams within the community. Certain areas of River Road, which are parallel to the Passaic River, are subject to flooding during a rainstorm of high intensity.

There are several other areas within the Township of Nutley that, although not adjacent to a body of water, experience flooding because the storm water drainage system is inadequate. Problems also occur due to flooding conditions in the Third River and St. Pauls Branch, causing backwater in the storm drainage system. Another source of flooding is sanitary sewer backup due to excessive infiltration of the storm waters into the sanitary sewer system.

- *City of Orange Township* – The floodplains of Wigwam Brook, the East Branch Rahway River, and the East Fork of East Branch Rahway River in the City of Orange Township have been encroached upon to the point where most of them are developed. This encroachment has caused flood problems and damage from storms with recurrence intervals of less than one year.

The principal flood problems in the City of Orange Township are due to a combination of urbanization in the floodplain, manmade restrictions within the streams, and inadequate storm drainage. In a report prepared for the City of Orange Township and the Township of West Orange, it was determined that the approximate capacity of the East Fork of East Branch Rahway River between Forest Street and Central Avenue is only 90 cfs (Elson T. Killman Associates, Inc., 1977). The 1-percent-annual-chance flood at this location produces a flow of 560 cfs.

A significant flood along the East Fork of East Branch Rahway River occurred on August 28-29, 1971 (Tropical Storm Doria), and produced a discharge of 385 cfs at Mitchell Street (USACE, 1973). This discharge is equivalent to a flood with a recurrence interval of approximately 30 years. Flooding along Wigwam Brook is rather extensive throughout its length within the City of Orange Township corporate limits. Due to its highly developed floodplain, even minor flooding produces damage to residential and commercial structures.

- *Borough of Roseland* – Flooding within the Borough of Roseland occurs as a consequence of heavy rains usually resulting from localized thunderstorms and hurricanes during the summer and fall months. Due to the low permeability of certain soils, the high degree of development and less than adequate storm sewers in the borough, some areas are subject to frequent flooding and ponding of surface water. A damaging storm occurred on August 2, 1973, creating considerable overbank flooding along Passaic River, Foulerton's Brook, North Branch Foulerton's Brook, and Canoe Brook. This flood on Passaic River had an estimated return period of 83 years. Flooding associated with this storm caused traffic interruptions, property damage, siltation of streambeds, and erosion of embankments. Hurricane Irene on August 29-30, 2011, caused flooding on Passaic River and was estimated to have a 16-year return period.

Problem flooding locations in Roseland identified at various times include area along Foulerton's Brook at Locust, Second, Third, and Fourth Avenues, all of which have experienced flooding during severe rainstorms. There are other areas along North Branch Foulerton's Brook at Gates, Mitchell, and Godfrey Avenues, Plymouth Place, Freeman Street, and Condit Court where overbank erosion occurred during the August 1973 storm.

- *Township of South Orange Village* – Due to the topography of the East Branch Rahway River, and the Township of South Orange Village's proximity to the headwaters of the river, flood peaks occur rapidly. The flood cycle usually lasts a matter of hours, and, in most cases, lasts less than a day. Local drainage area flooding in Township of South Orange Village follows the same pattern. The major flood damage has occurred in the business community, where the flood waters have entered first-floor levels of retail and service type establishments and businesses; in addition, flood damage has occurred to the basements of residences. Because the village is highly congested even minor flooding causes damage to both public and private property and creates traffic hazards.

The Rahway River and its tributaries are located in the North Atlantic Storm Belt and flooding of the East Branch Rahway River in South Orange occurs frequently. Overflow of the East Branch Rahway River causes a flood problem in the Township of South Orange Village, between the northern and southern boundaries of the village, for residential, commercial, industrial, and public facilities. The principal cause of the flooding is the inability of the existing channel to accommodate the precipitation runoff. This is partly due to bridge constrictions and low channel capacities caused by encroaching development.

The Township of South Orange Village has sustained damages from floods; the historic floods occurred during July 1901, February 1902, October 1903, August 1927, July 1938, August 1955, May 1968, September 1971, and August 1973. The damaging storms on record occurred in South Orange during the floods of July 1938. The historic flooding occurred during the storm of October 1903; however, because of the absence of development in the community, damages were not as great as those that occurred during the August 1973 flood.

- *Township of Verona* – The Township is subject to flooding from the Peckman River and its tributaries. All flooding sources flow in well-defined channels, within adjacent low-lying areas. Flooding occurs during times of excessive and prolonged rainfall, particularly in residential areas having steep slopes. The flooding is a result of high runoff combined with insufficient carrying capacity of bridge openings and culverts.

- *Township of West Caldwell* - Flooding in West Caldwell is a result of heavy rainfall produced by hurricanes moving up the coast, large frontal storms from the west and south, and local thunderstorms. Historic floods affecting the Township of West Caldwell occurred in 1902, 1903, 1936, and 1945. The 1903 flood, with an estimated peak discharge of 39,800 cfs at the confluence of the Passaic River and Newark Bay, inundated large areas, causing damage to buildings and disruption of transportation and utility lines (New Jersey, 1974). A storm similar to the one which caused the flood of 1903 would result today in a significantly larger area of inundation and greater discharges, due to the increased percentage of impervious areas (New Jersey, 1973). Flooding has occurred in 1968 and 1971, resulting in estimated damages in excess of 1 million dollars in this locality.

The Passaic River flows along the western boundary of West Caldwell. The low areas in West Caldwell, adjacent to the Passaic River, are subject to flooding. Areas subject to inundation include residential, commercial, and park lands. The low flat areas adjacent to Pine, Green, and Kane Brooks in the lower reaches are also subject to flooding.

- *Township of West Orange* – The Township has been affected by flooding in most of the low-lying areas located along the numerous open stream courses within its boundaries. Several other areas are also affected by flooding due to poor drainage. In 2010, the Township of West Orange passed 2274-10 An Ordinance Amending and Supplementing Chapter 25 Section 28 of the General Ordinances of the Town of West Orange, Entitled “Steep Slope and Natural Features Ordinance” which amended the steep slope ordinance by placing additional restrictions of State open waters, wetlands, wetland transition areas, flood hazard areas, floodways and riparian zones. This amendment was warranted to prevent flooding, protect water quality, and preserve wildlife and aquatic habitat.

A major flood area exists along the East Fork of the East Branch Rahway River in West Orange, east of Valley Road between Freeman Street and Kingsley Street. The flooding problem there, which is due to inadequate channel capacity, has been studied by the USACE (USACE, 1973). The upper portions of this stream are steeply sloped but as of the publication of the [date] countywide FIS report, requests have been made to the USACE and NJDEP to assess whether there is flood storage potential at golf courses

and other open spaces as a part of the larger study underway to study flood mitigation alternatives in the Rahway River Basin.

North Branch Wigwam Brook has had serious flooding problems in the vicinity of Harrison and Mississippi Avenues, and along most downstream parts of the improved channel. This is due to excessive velocity and lack of channel capacity, notably at Ashwood Terrace, Whittelsey Avenue, Watson Avenue, and Washington Avenue. South Branch Wigwam Brook has had serious flooding reported in the vicinity of Watchung Avenue, Lakeside Avenue, Standish Avenue, and Ashland Avenue.

West Branch Rahway River has had flooding problems along its entire length from Northfield Avenue to Lake Vincent, although parts of this river flow through undeveloped or country club areas.

Along Peckman River, flooding has occurred between Nicholas Avenue and Kenz Terrace.

An area on the western boundary of the Township of West Orange known as the Merklin District is subject to frequent flooding due to inadequate pipe sewers and insufficient capacity of the existing storm water pumping station. The area flooded is centered between Hunterdon and Morris Roads and Westover and Tappan Terraces. The Mayfair District centered on Mayfair Drive in the north central part of the township is one such location plagued by flooding related to drainage issues. In this location flooding is caused by an inadequate storm water ejector system (Elson T. Killman Associates, Inc., 1972). The Township of West Orange has been moving forward with plans to undertake storm sewer improvements and in 2011 awarded construction contracts to begin the improvements to help alleviated flooding projects on several streets including Nestro Road, Midro Way, Mayfair Drive and Rosemont Terrace and Rosemont Drive. This project has been financed by a grant from the NJDEP and a loan from the New Jersey Environmental Infrastructure Trust.

For purposes of quantifying the extent of losses in the county, an analysis of the most current National Flood Insurance Policy (NFIP) property, claims and policy data was completed below.

NFIP

National Flood Insurance Policy data is a good way to help visualize where damaging flooding happens and how much damage the flooding events cause. FEMA Region 2 provided a list of residential and non-residential properties with NFIP policies, past claims and multiple claims (RLPs). According to the metadata provided: "The (*sic* National Flood Insurance Program) NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than $1,000 for each loss. The two losses must be within 10 years of each other & be as least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered."According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10-year period, and must be greater than 10 days apart.

Table 7 and 8 summarize the occupancy classes of the FEMA repetitive loss and severe repetitive loss properties in the County. The majority of the repetitive loss occupancy class is single family residences (71%). The majority of severe repetitive loss occupancy class is also single family residences (62%) (FEMA, 2014). This information is current as of March 31, 2014. Table 9 and Figure 14 summarize the NFIP policies, claims, and repetitive loss statistics for Essex County.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others.

Table 7. Occupancy Class of Repetitive Loss Structures in Essex County

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties	Total (RL + SRL)
Single Family	226	65	291
Condo	7	1	8
2-4 Family	34	5	39
Other Residential	2	3	5
Non Residential	35	30	65
Essex County	**304**	**104**	**408**

Source: FEMA 2014

Note: RL = Repetitive Loss Property; SRL = Severe Repetitive Loss Property

Table 8. Occupancy Class of Repetitive Loss Structures in Essex County, by Jurisdiction

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family
Township of Belleville	6	0	10	1	13	2	0	1	0	1
Township of Bloomfield	5	2	0	0	11	0	0	1	0	0
Borough of Caldwell	0	0	0	0	0	0	0	0	0	0
Township of Cedar Grove	0	0	0	0	0	0	0	0	0	0
City of East Orange	0	0	0	0	0	0	0	0	0	0
Borough of Essex Fells	0	0	0	0	0	0	0	0	0	0
Township of Fairfield	2	3	10	0	139	2	1	24	0	64
Borough of Glen Ridge	0	0	0	0	0	0	0	0	0	0
Township of Irvington	3	0	0	0	3	0	0	0	0	0
Township of Livingston	0	0	0	0	4	0	0	0	0	0
Township of Maplewood	3	0	3	0	3	0	0	1	0	0
Township of Millburn	0	0	3	0	18	0	0	2	0	0
Township of Montclair	6	0	0	0	7	0	0	0	2	0
City of Newark	1	0	7	0	4	0	0	1	0	0
Borough of North Caldwell	0	0	0	0	1	0	0	0	0	0
Township of Nutley	1	2	1	0	10	1	0	0	1	0
City of Orange Township	6	0	0	1	4	0	0	0	0	0
Borough of Roseland	0	0	0	0	0	0	0	0	0	0
South Orange Village	0	0	0	0	0	0	0	0	0	0
Township of Verona	0	0	0	0	3	0	0	0	0	0
Township of West Caldwell	0	0	1	0	1	0	0	0	0	0
Township of West Orange	1	0	0	0	5	0	0	0	0	0
Essex County	**34**	**7**	**35**	**2**	**226**	**5**	**1**	**30**	**3**	**65**

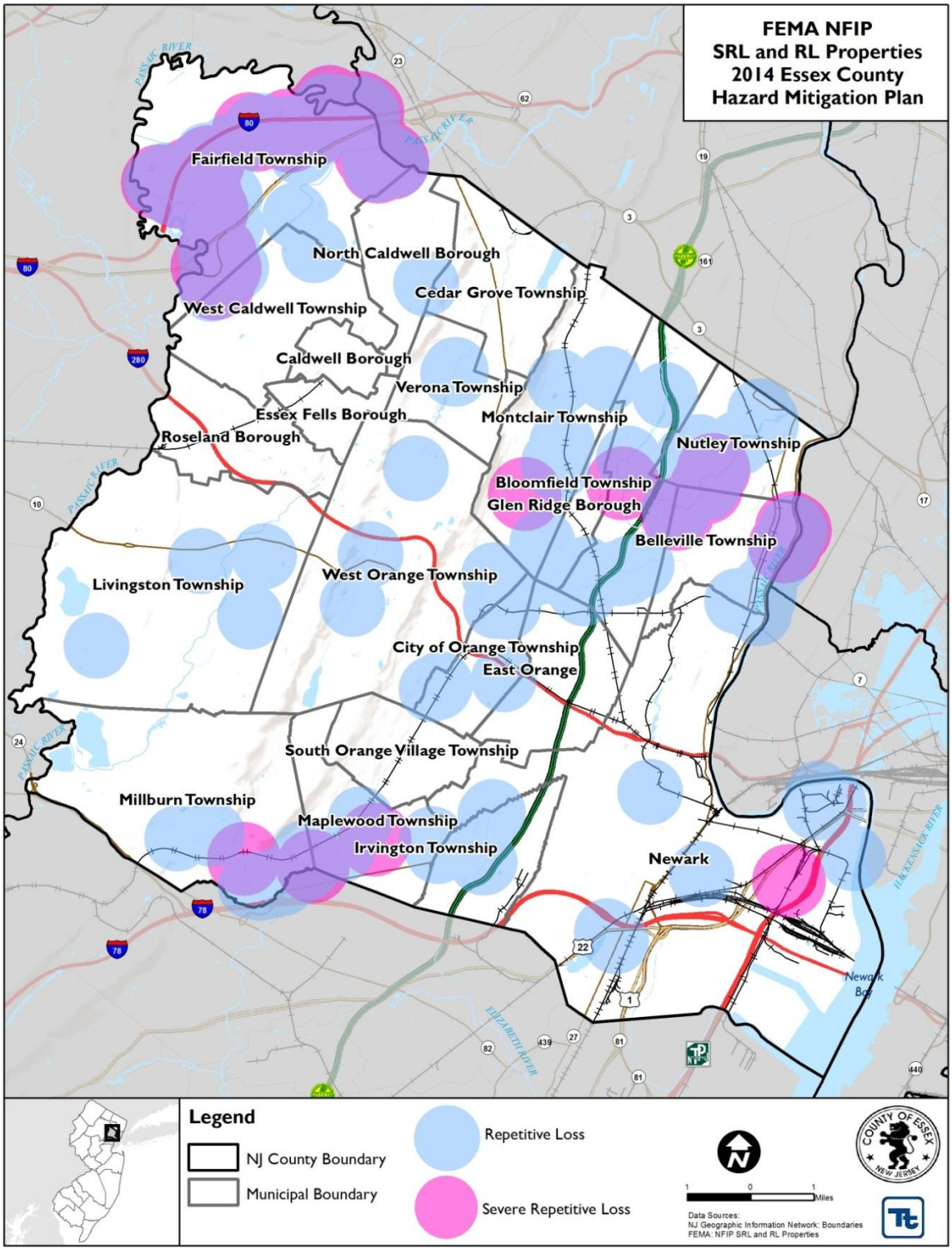
Source: FEMA, 2014
Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 2, and are current as of March 31, 2014.
Note (2): The statistics were summarized using the Community Name provided by FEMA Region 2.

Table 9. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)	# Policies in the 0.2% Flood Boundary (3)	# Policies Outside the Combined 1% and 0.2% Flood Hazard Areas (3)
Township of Belleville	138	159	$6,879,878	30	4	86	111	27
Township of Bloomfield	427	335	$2,731,547	18	1	317	317	110
Borough of Caldwell	1	1	$4,617	0	0	0	0	1
Township of Cedar Grove	43	5	$53,045	0	0	11	11	32
City of East Orange	79	39	$283,663	0	0	31	31	48
Borough of Essex Fells	11	10	$100,750	0	0	4	5	6
Township of Fairfield	1,148	1,670	$64,058,476	154	91	973	1,117	31
Borough of Glen Ridge	53	13	$38,521	0	0	18	18	35
Township of Irvington	66	86	$485,759	6	0	29	41	25
Township of Livingston	323	154	$1,162,839	4	0	97	114	209
Township of Maplewood	157	61	$1,159,326	9	1	32	34	123
Township of Millburn	292	222	$6,609,357	21	2	21	142	150
Township of Montclair	369	143	$1,142,339	13	2	209	227	142
City of Newark	264	182	$16,729,363	12	1	152	189	75
Borough of North Caldwell	31	13	$60,230	1	0	4	5	26
Township of Nutley	209	192	$1,646,681	14	2	134	143	66
City of Orange Township	269	117	$954,986	11	0	223	236	33
Borough of Roseland	40	16	$102,124	0	0	18	23	17
Township of South Orange	67	15	$106,783	0	0	0		67
Township of Verona	75	30	$195,146	3	0	34	38	37
Township of West Caldwell	83	32	$1,984,652	2	0	17	17	66
Township of West Orange	274	147	$853,080	6	0	136	151	123
Essex County	**4,419**	**3,642**	**$107,343,162**	**304**	**104**	**2,546**	**2,970**	**1,449**

Source: FEMA, 2014
Note (1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA and are current as of March 31, 2014 and are summarized by Community Name. Please note the total number of repetitive loss properties excludes the severe repetitive loss properties. The number of claims represents claims closed by 3/31/2014.
Note (2) Total building and content losses from the claims file provided by FEMA Region 2.
Note (3) The policies inside and outside of the flood zones is based on the latitude and longitude provided by FEMA Region 2 in the policy file.
Note (4) FEMA noted that where there is more than one entry for a property, there may be more than one policy in force or more than one GIS possibility.
Note (5) A zero percentage denotes less than 1/100th percentage and not zero damages or vulnerability as may be the case.

Figure 14. NFIP Repetitive Loss Areas – Essex County



Source: FEMA Region 2, 2014

It is noted that such an assessment of impacts will not account for home insurance claims filed as a result of wind damage to property as compared to water damage from flood inundation. Wind impacts from both Tropical Storm Irene and Superstorm Sandy were considerable, as most of Essex County's residential neighborhoods are in urbanized areas with large, mature street trees and mature vegetation in parks and on private property, which increased the property damage caused by felled trees and limbs. According to the 2013 amendment to the New Jersey Hazard Mitigation Plan, winds during Sandy gusted to 88 mph in Montclair and 78 mph in Newark and *"many buildings and homes were damaged, especially to siding and roof surfaces.*[8]

Vulnerability

As discussed above, the flood prone areas of Essex County along both the east and west branches of the Passaic River, as well as smaller stream corridors such as the Third River and Toney's Brook can be expected to continue to impact both residential and nonresidential uses that remain within the floodplain and flood hazard areas. Whereas in areas where Sandy's surge completely destroyed public and private property and severely damaged infrastructure and where recovery responses have included elevating bulkheads and streets, elevating or reconstructing homes, relocating, elevating or hardening community facilities, building dunes or levees, or the like, Much of the repetitive claims in Essex County were not caused by surge but by poor drainage and aged development in floodplains.

In order analyze Essex County's vulnerability to coastal storms like Superstorm Sandy, an exposure analysis was completed for flooding and storm surge.

Flooding

The impact of flooding on life, health, and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure is not limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (i.e., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). This statement is confirmed by the feedback gleaned by the use of the "Zing" methodology of Maverick & Boutique at the Stakeholder Workshop on July 15, 2014 at the Codey Arena (see Meeting Summary in Appendix). The degree of that impact will vary and is not strictly measurable. To estimate the population exposed to the 1- and 0.2-percent flood events, the floodplain boundaries were overlaid upon the 2010 Census population data in GIS (U.S. Census 2010). The 2010 Census blocks with their centroid in the flood boundaries were used to calculate the estimated population exposed to this hazard. Census blocks do not follow the boundaries of the floodplain and can grossly over or under estimate the population exposed when using the centroid or intersects of the Census block with the flood zones. The limitations of these analyses are recognized, and as such the results are only used to provide a general estimate.

The calculation of the 0.2-percent annual chance flood event results is cumulative in nature, as the population exposed to the 1-percent flood event will also be exposed to the 0.2-percent annual chance flood event. Using this approach, it was estimated that 30,213 people are exposed to the 1-percent annual chance event and 50,396 people are exposed to the 0.2-percent annual chance flood event.

[8] 2013 New Jersey Hazard Mitigation Plan Amendment, page E-2, State of New Jersey 2014 Hazard Mitigation Plan.

Table 10 lists the estimated population located within the 1- and 0.2-percent annual chance flood boundaries by municipality.

Table 10. Estimated Population Exposed to the Flood Hazard

Municipality	Total Population	SFHA Number	SFHA % of Total	0.2-Percent Chance Event Number	0.2-Percent Chance Event % of Total
Township of Belleville	35,926	1,371	3.8%	2,170	6.0%
Township of Bloomfield	47,315	2,948	6.2%	2,948	6.2%
Borough of Caldwell	7,822	0	0.0%	0	0.0%
Township of Cedar Grove	12,411	52	0.4%	52	0.4%
City of East Orange	64,270	277	0.4%	277	0.4%
Borough of Essex Fells	2,113	0	0.0%	0	0.0%
Township of Fairfield	7,466	3,711	49.7%	5,250	70.3%
Borough of Glen Ridge	7,527	15	0.2%	15	0.2%
Township of Irvington	53,926	519	1.0%	814	1.5%
Township of Livingston	29,366	1,080	3.7%	1,243	4.2%
Township of Maplewood	23,867	297	1.2%	297	1.2%
Township of Millburn	20,149	223	1.1%	1,483	7.4%
Township of Montclair	37,669	1,390	3.7%	1,647	4.4%
City of Newark	277,140	10,464	3.8%	25,357	9.1%
Borough of North Caldwell	6,183	5	0.1%	37	0.6%
Township of Nutley	28,370	1,480	5.2%	1,565	5.5%
City of Orange Township	30,134	2,318	7.7%	2,321	7.7%
Borough of Roseland	5,819	321	5.5%	407	7.0%
South Orange Village	16,198	394	2.4%	394	2.4%
Township of Verona	13,332	129	1.0%	314	2.4%
Township of West Caldwell	10,759	832	7.7%	832	7.7%
Township of West Orange	46,207	2,387	5.2%	2,973	6.4%
Essex County (TOTAL)	**783,969**	**30,213**	**3.9%**	**50,396**	**6.4%**

Sources: U.S. Census 2010; FEMA
Note: SFHA = Special Flood Hazard Area is the 1-percent chance event.

The table above shows that approximately 3.9 percent of the total population is exposed to the 1-percent annual chance flood event (both riverine and coastal) and that approximately 6.4 percent of the total population is exposed to the 0.2-percent annual chance flood event. For this project, the potential population impacted is used as a guide. Because the estimated population exposed to flooding does not include storm surge, this is a conservative estimate and may be higher if multiple impacts occur.
After considering the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure in the flood zone includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

The total land area located in the 1-percent and 0.2-percent annual chance flood zones was calculated for each jurisdiction, as presented in Table 11. To provide a general estimate of the structural/content replacement value exposure, the 1- and 0.2-percent DFIRM flood boundaries were overlaid upon the County's updated building stock inventory at the structure level. The buildings with their centroid in the flood boundary were totaled for each municipality. Table 12 summarizes these results. In summary, there 6,292 buildings located in the 1-percent annual chance flood boundary with an estimated $3.5 billion of building/contents exposed (based on improvement value). This represents approximately 4.2% of the County's total general building stock inventory (approximately $84 billion).

Table 11. Total Land Area Located in the 1-Percent Annual Chance Flood Zones (Acres)

Municipality	Total Area (acres)	1% Flood Event Hazard Area				0.2% Flood Event Hazard Area	
		A-Zone Area (acres)	% of Total	V-Zone Area (acres)	% of Total	Area (acres)	% of Total
Township of Belleville	2,156	195	9.0%	0	0.0%	297	13.76%
Township of Bloomfield	3433.63	394	11.5%	0	0.0%	406	11.81%
Borough of Caldwell	758	6	0.8%	0	0.0%	7	0.86%
Township of Cedar Grove	2,791	49	1.7%	0	0.0%	58	2.08%
City of East Orange	2514.07	42	1.7%	0	0.0%	42	1.68%
Borough of Essex Fells	906.13	9	1.0%	0	0.0%	64	7.10%
Township of Fairfield	6618.41	4,928	74.5%	0	0.0%	5,709	86.25%
Borough of Glen Ridge	818	15	1.8%	0	0.0%	16	1.92%
Township of Irvington	1865.65	23	1.2%	0	0.0%	56	3.00%
Township of Livingston	9,040	1,215	13.4%	0	0.0%	1,300	14.38%
Township of Maplewood	2,480	116	4.7%	0	0.0%	127	5.13%
Township of Millburn	6324.45	823	13.0%	0	0.0%	1,030	16.29%
Township of Montclair	3,995	151	3.8%	0	0.0%	185	4.64%
City of Newark	16,778	6,462	38.5%	6	0.0%	9,739	58.05%
Borough of North Caldwell	1967.6	23	1.2%	0	0.0%	45	2.28%
Township of Nutley	2,186	172	7.9%	0	0.0%	219	10.02%
City of Orange Township	1,418	115	8.1%	0	0.0%	126	8.91%
Borough of Roseland	2,361	459	19.5%	0	0.0%	500	21.20%
South Orange Village	1,822	43	2.4%	0	0.0%	43	2.36%
Township of Verona	1,796	65	3.6%	0	0.0%	79	4.39%
Township of West Caldwell	3,239	844	26.1%	0	0.0%	910	28.09%
Township of West Orange	7,756	286	3.7%	0	0.0%	349	4.50%
Essex County (Total)	**83,023**	**16,435**	**19.8%**	**6**	**0.0%**	**21,307**	**25.66%**

Source: FEMA 2009
Note: % = Percent
The area presented includes the area of inland waterways and excludes bays or oceans.

Table 12. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Improvement Value	Total (All Occupancies) A-Zone # Buildings	% Total	Improvement Value	% Total
Township of Belleville	9,154	$2,905,447,150	440	4.8%	$83,204,500	2.9%
Township of Bloomfield	11,383	$3,827,312,350	663	5.8%	$146,461,100	3.8%
Borough of Caldwell	2,116	$753,639,775	0	0.0%	$0	0.0%
Township of Cedar Grove	3,815	$1,657,089,082	28	0.7%	$7,468,600	0.5%
City of East Orange	9,310	$5,820,599,879	74	0.8%	$29,909,900	0.5%
Borough of Essex Fells	760	$567,106,700	0	0.0%	$0	0.0%
Township of Fairfield	3,169	$3,374,787,200	1,368	43.2%	$913,892,000	27.1%
Borough of Glen Ridge	2,214	$986,279,500	37	1.7%	$6,242,700	0.6%
Township of Irvington	9,312	$2,820,388,050	61	0.7%	$10,560,000	0.4%
Township of Livingston	9,510	$5,547,703,530	204	2.1%	$76,523,300	1.4%
Township of Maplewood	7,275	$2,733,369,500	84	1.2%	$22,112,500	0.8%
Township of Millburn	6,291	$8,045,533,450	28	0.4%	$31,354,200	0.4%
Township of Montclair	10,486	$5,890,125,479	354	3.4%	$92,296,100	1.6%
City of Newark	38,329	$18,709,618,398	1,798	4.7%	$1,753,302,799	9.4%
Borough of North Caldwell	1,951	$1,431,441,250	6	0.3%	$3,372,100	0.2%
Township of Nutley	8,884	$3,510,270,592	294	3.3%	$75,015,335	2.1%
City of Orange Township	4,354	$1,867,401,350	432	9.9%	$94,477,950	5.1%
Borough of Roseland	1,616	$1,435,628,250	46	2.8%	$47,680,600	3.3%
South Orange Village	4,508	$3,108,688,125	4	0.1%	$625,900	0.0%
Township of Verona	3,907	$1,598,018,325	75	1.9%	$12,165,750	0.8%
Township of West Caldwell	3,634	$2,040,951,278	36	1.0%	$49,759,100	2.4%
Township of West Orange	12,688	$5,503,784,816	260	2.0%	$83,031,900	1.5%
Essex County (Total)	**164,666**	**$84,135,184,028**	**6,292**	**3.8%**	**$3,539,456,334**	**4.2%**

Source: Essex County Planning Department, 2014; FEMA
Note: # = Number; % = Percent.
There are no buildings located in the V-zone in the City of Newark.

Table 13 below shows that there are 10,744 buildings located in the 0.2-percent annual chance flood boundary with an estimated $5 billion of building/contents exposed. This represents approximately 6.1% of the County's total general building stock inventory.

Table 13. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Improvement Value	Total (All Occupancies) 0.2-Percent # Buildings	% Total	Improvement Value	% Total
Township of Belleville	9,154	$2,905,447,150	648	7.1%	$118,348,300	4.1%
Township of Bloomfield	11,383	$3,827,312,350	664	5.8%	$150,208,400	3.9%
Borough of Caldwell	2,116	$753,639,775	0	0.0%	$0	0.0%
Township of Cedar Grove	3,815	$1,657,089,082	44	1.2%	$12,547,500	0.8%
City of East Orange	9,310	$5,820,599,879	74	0.8%	$29,909,900	0.5%
Borough of Essex Fells	760	$567,106,700	24	3.2%	$8,968,300	1.6%
Township of Fairfield	3,169	$3,374,787,200	2,262	71.4%	$1,348,087,100	39.9%
Borough of Glen Ridge	2,214	$986,279,500	39	1.8%	$6,698,200	0.7%
Township of Irvington	9,312	$2,820,388,050	207	2.2%	$29,819,500	1.1%
Township of Livingston	9,510	$5,547,703,530	259	2.7%	$89,072,500	1.6%
Township of Maplewood	7,275	$2,733,369,500	114	1.6%	$31,958,300	1.2%
Township of Millburn	6,291	$8,045,533,450	438	7.0%	$264,936,200	3.3%
Township of Montclair	10,486	$5,890,125,479	429	4.1%	$110,489,100	1.9%
City of Newark	38,329	$18,709,618,398	3,988	10.4%	$2,429,236,199	13.0%
Borough of North Caldwell	1,951	$1,431,441,250	27	1.4%	$8,079,900	0.6%
Township of Nutley	8,884	$3,510,270,592	348	3.9%	$102,032,035	2.9%
City of Orange Township	4,354	$1,867,401,350	481	11.0%	$102,907,850	5.5%
Borough of Roseland	1,616	$1,435,628,250	95	5.9%	$57,690,000	4.0%
South Orange Village	4,508	$3,108,688,125	4	0.1%	$625,900	0.0%
Township of Verona	3,907	$1,598,018,325	103	2.6%	$22,911,750	1.4%
Township of West Caldwell	3,634	$2,040,951,278	54	1.5%	$59,851,900	2.9%
Township of West Orange	12,688	$5,503,784,816	442	3.5%	$117,981,900	2.1%
Essex County (Total)	**164,666**	**$84,135,184,028**	**10,744**	**6.5%**	**$5,102,360,734**	**6.1%**

Source: Essex County Planning Department, 2014;
Note: # = Number; % = Percent.

The HAZUS-MH model estimated potential damages to the buildings in Essex County at the structure level using the custom County structure inventory developed for this plan. The potential damage estimated by HAZUS-MH to the general building stock inventory associated with the 1-percent annual chance flood is nearly $1 billion or 1.2-percent of the total building stock improvement value. The potential damage estimated by HAZUS-MH to the residential general building stock inventory associated with the 1-percent annual chance flood is $155 million or less than one-percent of the total building stock improvement value as noted in Table 14.

Table 14. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event

Municipality	Total Improvement Value	1% Annual Chance Event All Occupancies		Residential	
		Estimated Loss	% of Total	Estimated Loss	% of Total
Township of Belleville	$2,905,447,150	$14,727,102	0.51	$6,250,925	0.22
Township of Bloomfield	$3,827,312,350	$44,453,919	1.16	$22,759,741	0.59
Borough of Caldwell	$753,639,775	$0	0.00	$0	0
Township of Cedar Grove	$1,657,089,082	$934,218	0.06	$837,063	0.05
City of East Orange	$5,820,599,879	$3,781,469	0.06	$728,229	0.01
Borough of Essex Fells	$567,106,700	$0	0.00	$0	0
Township of Fairfield	$3,374,787,200	$196,854,299	5.83	$45,773,911	1.36
Borough of Glen Ridge	$986,279,500	$850,646	0.09	$513,952	0.05
Township of Irvington	$2,820,388,050	$4,665,426	0.17	$2,579,471	0.09
Township of Livingston	$5,547,703,530	$22,064,214	0.40	$6,313,529	0.11
Township of Maplewood	$2,733,369,500	$5,367,294	0.20	$808,868	0.03
Township of Millburn	$8,045,533,450	$45,443,264	0.56	$18,811,390	0.23
Township of Montclair	$5,890,125,479	$11,451,898	0.19	$7,761,541	0.13
City of Newark	$18,709,618,398	$549,978,470	2.94	$14,043,240	0.08
Borough of North Caldwell	$1,431,441,250	$256,105	0.02	$90,529	0.01
Township of Nutley	$3,510,270,592	$20,594,918	0.59	$10,279,065	0.29
City of Orange Township	$1,867,401,350	$22,359,052	1.20	$9,773,874	0.52
Borough of Roseland	$1,435,628,250	$21,002,571	1.46	$551,437	0.04
Township of South Orange Village	$3,108,688,125	$146,547	0.00	$0	0
Township of Verona	$1,598,018,325	$3,429,678	0.21	$2,977,509	0.19
Township of West Caldwell	$2,040,951,278	$4,135,824	0.20	$574,587	0.03
Township of West Orange	$5,503,784,816	$18,895,034	0.34	$4,248,434	0.08
Essex County (Total)	**$84,135,184,028**	**$991,391,949**	**1.18**	**$155,677,297**	**0.19**

Source: Hazus-MH v2.1; Essex County Planning Department, 2014; Essex County Real Property Tax Service, 2014
Note: % = Percent.
Dollar loss is based on the improvement value of the structure as provided by Essex County.

Storm Surge

The impact of a hurricane on life, health, and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time was provided to residents. It is assumed that the entire County population is exposed to the hurricane hazard. Please refer to Section 4 (County Profile) for the total Essex County population vulnerable to this hazard.

To estimate the population in the hurricane inundation zones, the sum of the population in all Census Blocks with their centroid located in the SLOSH zone was calculated for each participating municipality. Table 15 summarizes the approximate population located in the hurricane inundation zones based on 2010 Census data. This exposure analysis is limited by the Census Block and SLOSH zone configurations. If a Block's centroid is not located within the underlying SLOSH zone it will not produce a result. For example, a portion of Newark is located within the Category 1 and Category 2 SLOSH inundation zones, however the Census Block centroid is not located within the SLOSH, even though a portion of the Block is located within the SLOSH zone. This circumstance does not produce an exposure result.

Table 15. Approximate Population in the Hurricane Inundation Zones

Municipality	Total Population (2010 Census)	Estimated Population in SLOSH Inundation Zones			
		Cat 1	Cat 2	Cat 3	Cat 4
Township of Belleville	35,926	0	1,488	2,369	2,523
Township of Bloomfield	47,315	0	0	0	0
Borough of Caldwell	7,822	0	0	0	0
Township of Cedar Grove	12,411	0	0	0	0
City of East Orange	64,270	0	0	0	0
Borough of Essex Fells	2,113	0	0	0	0
Township of Fairfield	7,466	0	0	0	0
Borough of Glen Ridge	7,527	0	0	0	0
Township of Irvington	53,926	0	0	0	0
Township of Livingston	29,366	0	0	0	0
Township of Maplewood	23,867	0	0	0	0
Township of Millburn	20,149	0	0	0	0
Township of Montclair	37,669	0	0	0	0
City of Newark	277,140	5,038	40,919	60,909	65,367
Borough of North Caldwell	6,183	0	0	0	0
Township of Nutley	28,370	0	191	398	987
City of Orange Township	30,134	0	0	0	0
Borough of Roseland	5,819	0	0	0	0
South Orange Village	16,198	0	0	0	0
Township of Verona	13,332	0	0	0	0
Township of West Caldwell	10,759	0	0	0	0
Township of West Orange	46,207	0	0	0	0
Essex County (Total)	**783,969**	**5,038**	**42,598**	**63,676**	**68,877**

Source: U.S. Census 2010 and NJOEM
Notes: Cat = Category Hurricane

To estimate potential building exposure to storm surge, the SLOSH inundation zones were overlaid with updated building inventory. The structures with their centroid in the inundation zones were used to calculate the estimated exposure. Tables 16 and 17 summarize the number of buildings and their estimated building replacement cost value exposed to hurricane storm surge by jurisdiction.

Table 16. Number of Buildings in the Hurricane Inundation Zones

Municipality	Total Number of Buildings	Number of Buildings in SLOSH Inundation Zones			
		Cat 1	Cat 2	Cat 3	Cat 4
Township of Belleville	9,154	0	371	583	624
Township of Bloomfield	11,383	0	0	0	0
Borough of Caldwell	2,116	0	0	0	0
Township of Cedar Grove	3,815	0	0	0	0
City of East Orange	9,310	0	0	0	0
Borough of Essex Fells	760	0	0	0	0
Township of Fairfield	3,169	0	0	0	0
Borough of Glen Ridge	2,214	0	0	0	0
Township of Irvington	9,312	0	0	0	0
Township of Livingston	9,510	0	0	0	0
Township of Maplewood	7,275	0	0	0	0
Township of Millburn	6,291	0	0	0	0
Township of Montclair	10,486	0	0	0	0
City of Newark	38,329	493	5,639	8,283	8,952
Borough of North Caldwell	1,951	0	0	0	0
Township of Nutley	8,884	0	174	442	621
City of Orange Township	4,354	0	0	0	0
Borough of Roseland	1,616	0	0	0	0
South Orange Village	4,508	0	0	0	0
Township of Verona	3,907	0	0	0	0
Township of West Caldwell	3,634	0	0	0	0
Township of West Orange	12,688	0	0	0	0
Essex County	**164,666**	**493**	**6,184**	**9,308**	**10,197**

Source: ECOEM, 2014

Table 17. Building Improvement Value in the Hurricane Inundation Zones

Municipality	Total Improvement Value	Estimated Improvement Value in SLOSH Inundation Zones			
		Cat 1	Cat 2	Cat 3	Cat 4
Township of Belleville	$2,905,447,150	$0	$90,475,600	$141,072,600	$145,864,900
Township of Bloomfield	$3,827,312,350	$0	$0	$0	$0
Borough of Caldwell	$753,639,775	$0	$0	$0	$0
Township of Cedar Grove	$1,657,089,082	$0	$0	$0	$0
City of East Orange	$5,820,599,879	$0	$0	$0	$0
Borough of Essex Fells	$567,106,700	$0	$0	$0	$0
Township of Fairfield	$3,374,787,200	$0	$0	$0	$0
Borough of Glen Ridge	$986,279,500	$0	$0	$0	$0
Township of Irvington	$2,820,388,050	$0	$0	$0	$0
Township of Livingston	$5,547,703,530	$0	$0	$0	$0
Township of Maplewood	$2,733,369,500	$0	$0	$0	$0
Township of Millburn	$8,045,533,450	$0	$0	$0	$0
Township of Montclair	$5,890,125,479	$0	$0	$0	$0
City of Newark	$18,709,618,398	$1,428,179,599	$2,737,880,899	$3,438,831,599	$3,689,954,299
Borough of North Caldwell	$1,431,441,250	$0	$0	$0	$0
Township of Nutley	$3,510,270,592	$0	$38,358,400	$89,749,333	$120,574,633
City of Orange Township	$1,867,401,350	$0	$0	$0	$0
Borough of Roseland	$1,435,628,250	$0	$0	$0	$0
South Orange Village	$3,108,688,125	$0	$0	$0	$0
Township of Verona	$1,598,018,325	$0	$0	$0	$0
Township of West Caldwell	$2,040,951,278	$0	$0	$0	$0
Township of West Orange	$5,503,784,816	$0	$0	$0	$0
Essex County	**$84,135,184,028**	**$1,428,179,599**	**$2,866,714,899**	**$3,669,653,532**	**$3,956,393,832**

Source: ECOEM; Essex County Planning Department, 2014

Vulnerability of Residential Land Uses

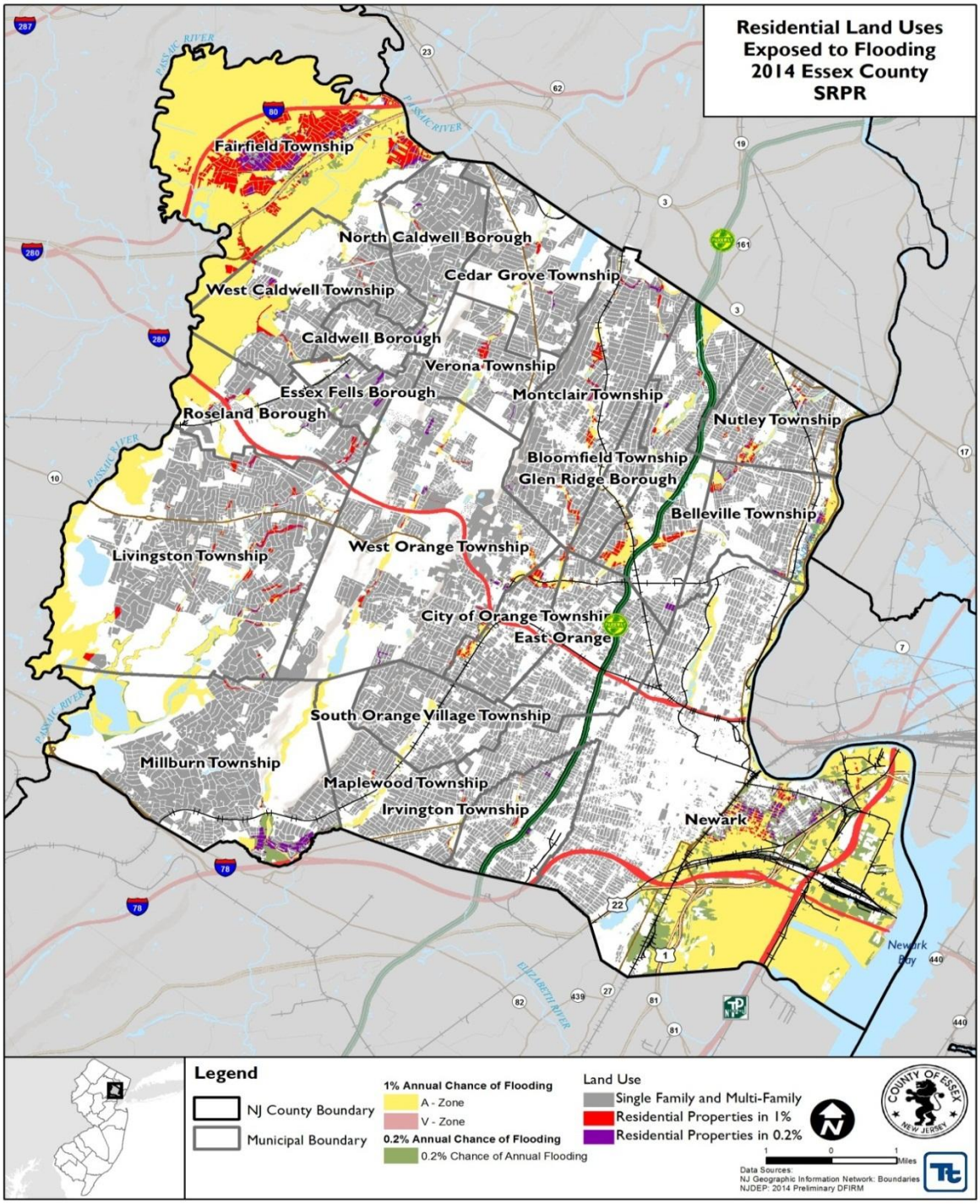
The areas of western Essex that were impacted by Irene and other heavy rainfall events, despite the respite from Sandy, remain vulnerable. In Fairfield Township, where the repetitive damages are by far the highest in Essex County, the memories of Irene and the storms that followed her a week later, are still fresh.

An exposure analysis was completed to assess the vulnerability of the residential land uses with in the County to flooding. To estimate the residential land uses exposed to the 1- and 0.2-percent flood events, the floodplain boundaries were overlaid upon the 2014 parcel data in GIS (2014 Essex County Planning). The parcels with their centroid in the flood boundaries were used to calculate the estimated the number and area residential properties exposed to this hazard and shown in Figure 17.

Figure 15. Esther Street in Newark's "island" neighborhood in the Ironbound. (Google Street view)

Figure 16. The "island" section of the Ironbound in Newark was hit hard by flood waters from the Passaic River and Newark Bay. At left is a Star Ledger photo on Waydell Street soon after Sandy showing the piles of debris on the street. At right is a Star Ledger photo of a gutted home on Esther Street in November of 2013.

Figure 17. Residential Properties Exposed to FEMA Flood Hazard Areas – Essex County



Source: NJDEP, 2014; Essex County Planning Department 2014

Table 18. Residential Land Use Exposure to Flooding

Municipality	Total Residential Land Use Area (acres)	Total Number of Residential Properties	1% Flood Event Hazard Area				0.2% Flood Event Hazard Area			
			Number of Residential Properties in A and V-Zone	% of Total	Residential Land Use Area in A and V-Zone (acres)	% of Total	Number of Residential Properties in 0.2%	% of Total	Residential Land Use Area in 0.2% (acres)	% of Total Residential Land Use Area
Township of Belleville	864	8,464	542	6.4%	23	2.7%	815	9.6%	43	4.98%
Township of Bloomfield	1,397	10,520	699	6.6%	65	4.6%	846	8.0%	79	5.63%
Borough of Caldwell	409	1,880	0	0.0%	0	0.0%	0	0.0%		0.00%
Township of Cedar Grove	1,111	3,610	59	1.6%	9	0.9%	86	2.4%	13	1.16%
City of East Orange	1,131	8,379	141	1.7%	7	0.7%	141	1.7%	7	0.66%
Borough of Essex Fells	539	739	10	1.4%	1	0.3%	74	10.0%	23	4.23%
Township of Fairfield	1,093	2,491	2,040	81.9%	806	73.8%	2,228	89.4%	958	87.61%
Borough of Glen Ridge	525	2,159	63	2.9%	4	0.8%	64	3.0%	5	0.88%
Township of Irvington	867	8,269	126	1.5%	8	0.9%	298	3.6%	20	2.29%
Township of Livingston	3,339	9,130	662	7.3%	106	3.2%	704	7.7%	128	3.83%
Township of Maplewood	1,139	6,876	140	2.0%	11	1.0%	185	2.7%	14	1.25%
Township of Millburn	2,506	6,023	94	1.6%	12	0.5%	489	8.1%	76	3.01%
Township of Montclair	2,428	9,786	537	5.5%	61	2.5%	659	6.7%	82	3.38%
City of Newark	2,459	29,806	1,309	4.4%	56	2.3%	2,701	9.1%	141	5.72%
Borough of North Caldwell	1,237	1,925	19	1.0%	9	0.7%	73	3.8%	17	1.36%
Township of Nutley	1,165	8,327	410	4.9%	33	2.8%	515	6.2%	42	3.64%
City of Orange Township	643	3,792	489	12.9%	41	6.4%	514	13.6%	45	7.05%
Borough of Roseland	611	1,520	99	6.5%	25	4.1%	174	11.4%	40	6.60%
South Orange Village	1,128	4,185	37	0.9%	1	0.1%	37	0.9%	1	0.10%
Township of Verona	877	3,684	129	3.5%	19	2.2%	193	5.2%	26	2.95%
Township of West Caldwell	1,137	3,449	171	5.0%	41	3.6%	226	6.6%	58	5.07%
Township of West Orange	2,782	12,094	426	3.5%	36	1.3%	636	5.3%	59	2.14%
Essex County (TOTAL)	**29,387**	**147,108**	**8,202**	**5.6%**	**1,376**	**4.7%**	**11,658**	**7.9%**	**1,876**	**6.39%**

Source: NJDEP, 2014; Essex County Planning Department 2014

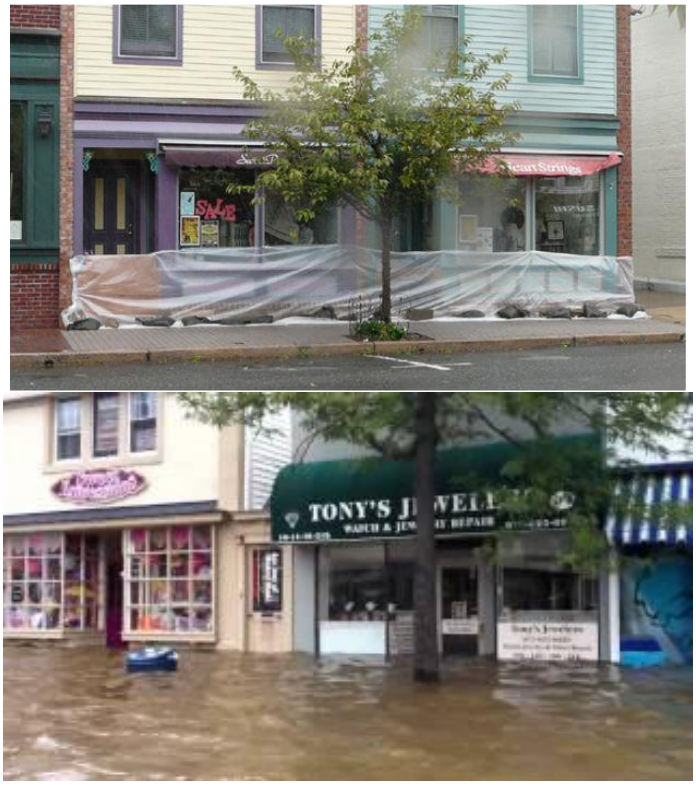
The analysis shows while most of the residential properties in the county are not vulnerable to flooding, the majority of the residential properties in Fairfield Township are vulnerable. In Fairfield Township approximately 74% of the total residential land use acreage and 82% of the residential properties are located in the 1% annual chance of flooding flood hazard area. Approximately 88% of the total residential land use area and 89% of the residential properties are located in the 0.2% annual chance of flooding flood hazard area.

Vulnerability of Non-residential Land Uses

As has been shown in the earlier discussions regarding the repetitive flooding of nonresidential properties located in flood prone areas in western Essex and in the A and V zone areas in the tidal waters of the Passaic River and Newark Bay in eastern Essex, the vulnerability of nonresidential land uses in Essex County is significant. Superstorm Sandy exposed the vulnerability of Port Newark Terminal and Newark Liberty Airport, as well as PSE&G power generating facilities, NJ Transit rail yards and PVSC wastewater treatment facilities located near the Passaic River and Newark Bay. However, the Port Authority quickly recovered from the storm, with the Star Ledger reporting that normal activities resumed by November 4, 2012, six days after Sandy swamped the container terminal in the Newark Bay, forcing ships that were tied up dockside or moored close to shore to go out to sea to avoid wave and surge damage. Based on the Ledger account, the Port Authority reported that their crews worked around the clock to clear hundreds of shipping containers "floated by floodwaters" and to "repair roadways, rail lines, electrical systems, and other port facilities damaged by the storm."[9]

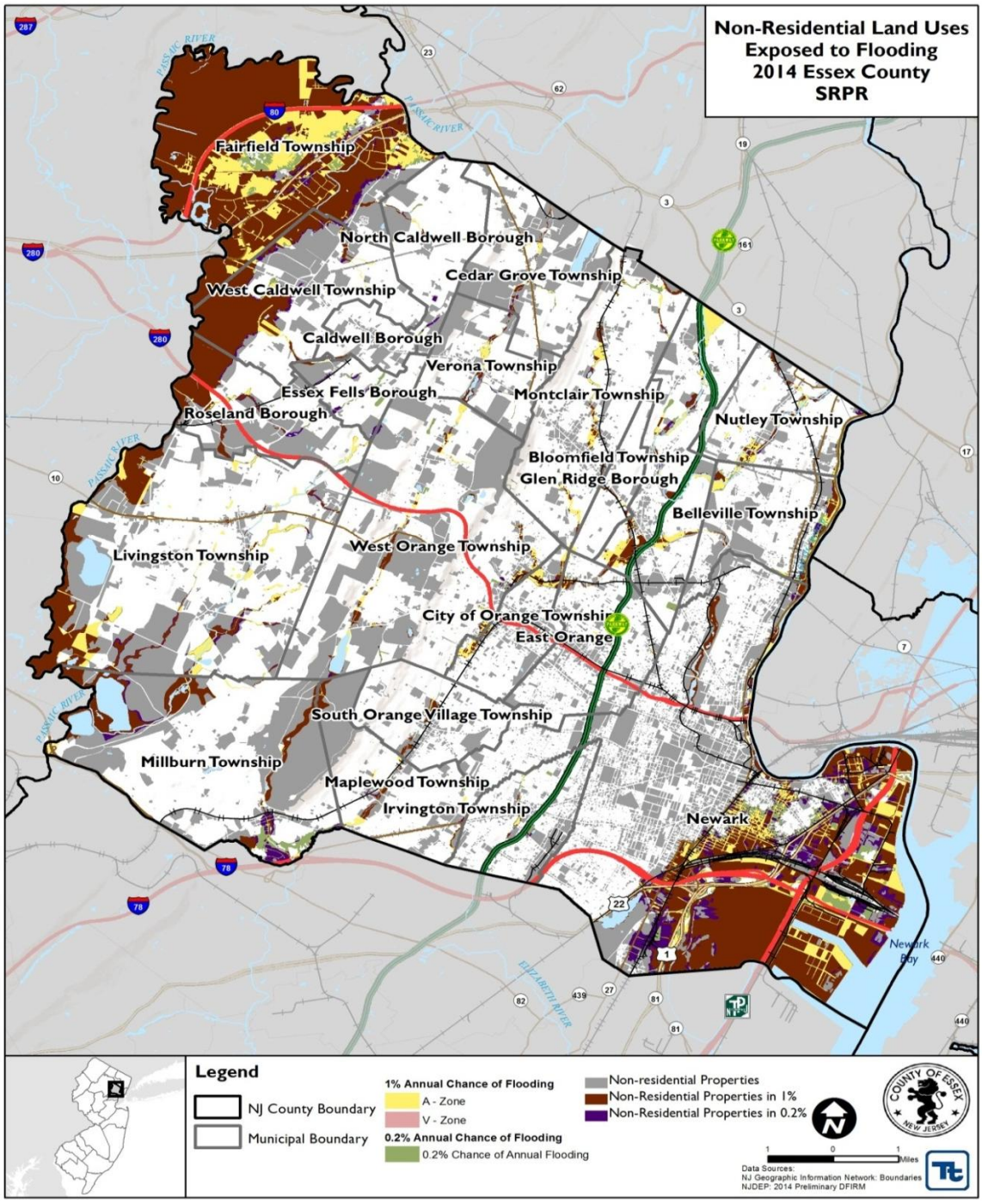
An exposure analysis was completed to assess the vulnerability of the non-residential land uses within the County to flooding. To estimate the non-residential land uses exposed to the 1- and 0.2-percent flood events, the floodplain boundaries were overlaid upon the 2014 parcel data in GIS (2014 Essex County Planning). The parcels with their centroid in the flood boundaries were used to calculate the estimated the number and area residential properties exposed to this hazard and shown in Figure 18.

Figure 18. This photo in a Star Ledger article from August 29, 2011, shows the preparations for Tropical Storm Irene that come from experience with frequent flood events, while the photo below it, obtained online, shows the extent of the flooding in the same area during Irene. The flooding from Irene was called by the Mayor, "the worst in the Township's history."



[9] "Port Resumes Operations In Sandy's Wake", Steve Strunsky, Star Ledger/NJ.com, November 4, 2012.

Figure 19. Non-Residential Properties Exposed to FEMA Flood Hazard Areas – Essex County



Source: NJDEP, 2014; Essex County Planning Department 2014

Table 19. Non-Residential Land Use Exposure to Flooding

Municipality	Total Non-Residential Land Use Area (acres)	Total Number of Non- Resid. Properties	1% Flood Event Hazard Area: Number of Non – Resid. Properties in A and V-Zone	% of Total	Non –Resid. Land Use Area in A and V-Zone (acres)	% of Total	0.2% Flood Event Hazard Area: Number of Non-Resid. Properties in 0.2%	% of Total	Non-Resid. Land Use Area in 0.2% (acres)	% of Total Non-Residential Land Use Area
Township of Belleville	740	1,146	116	10.1%	74	10.0%	160	14.0%	95	12.82%
Township of Bloomfield	779	1,091	179	16.4%	154	19.8%	194	17.8%	167	21.43%
Borough of Caldwell	184	286	1	0.3%	6	3.5%	2	0.7%	7	3.58%
Township of Cedar Grove	1,188	350	45	12.9%	35	2.9%	49	14.0%	39	3.24%
City of East Orange	632	1,616	62	3.8%	26	4.1%	62	3.8%	26	4.14%
Borough of Essex Fells	232	65	7	10.8%	8	3.3%	22	33.8%	29	12.48%
Township of Fairfield	4,580	1,194	1,050	87.9%	4,129	90.2%	1,110	93.0%	4,258	92.97%
Borough of Glen Ridge	86	87	13	14.9%	7	7.8%	13	14.9%	7	8.65%
Township of Irvington	490	1,433	48	3.3%	9	1.8%	71	5.0%	17	3.46%
Township of Livingston	3,487	777	185	23.8%	848	24.3%	190	24.5%	896	25.69%
Township of Maplewood	845	508	60	11.8%	77	9.2%	81	15.9%	82	9.70%
Township of Millburn	3,034	465	78	16.8%	782	25.8%	176	37.8%	882	29.08%
Township of Montclair	824	1,069	133	12.4%	61	7.4%	140	13.1%	66	7.98%
City of Newark	8,337	13,003	1,879	14.5%	3,720	44.6%	2,648	20.4%	4,544	54.51%
Borough of North Caldwell	437	92	7	7.6%	13	2.9%	12	13.0%	23	5.35%
Township of Nutley	476	762	117	15.4%	75	15.7%	127	16.7%	88	18.43%
City of Orange Township	451	1,048	160	15.3%	45	10.0%	175	16.7%	50	11.03%
Borough of Roseland	1,189	186	64	34.4%	400	33.6%	73	39.2%	427	35.87%
South Orange Village	341	415	20	4.8%	38	11.2%	20	4.8%	38	11.21%
Township of Verona	635	335	21	6.3%	43	6.7%	30	9.0%	48	7.61%
Township of West Caldwell	1,764	296	104	35.1%	888	50.3%	119	40.2%	947	53.71%
Township of West Orange	2,862	1,160	253	21.8%	149	5.2%	303	26.1%	176	6.15%
Essex County (TOTAL)	**33,593**	**27,384**	**4,602**	**16.8%**	**11,586**	**34.5%**	**5,777**	**21.1%**	**12,912**	**38.44%**

Source: NJDEP, 2014; Essex County Planning Department 2014

The analysis shows approximately 38% of the total acreage of non-residential properties in the County are vulnerable to flooding. In Fairfield Township approximately 90% of the total residential land use acreage and 88% of the residential properties are located in the 1% annual chance of flooding flood hazard area. Approximately 92% of the total non-residential land use area and 93% of the non-residential properties are located in the 0.2% annual chance of flooding flood hazard area.

Strategic Recovery Action Plan

Background Documents

At the time of preparation of this SRPR, the County had not updated its Master Plan/Growth Management Plan in many years, but had adopted a Complete Streets Policy in 2012 and focused its attention on a Comprehensive Transportation Plan, which was completed in 2013. In 2014 the County obtained a Local Capacity Grant from Together North Jersey to compile a Complete Streets Plan to implement the Policy by integrating Complete Streets recommendations of the Comprehensive Transportation Plan into its land use regulations and design standards. As a result, we have relied on the Comprehensive Transportation Plan for the most current data, demographics, etc.

The most relevant work being done concurrently with the preparation of this SRPR is the new Hazard Mitigation Plan being prepared by Tetra Tech, Inc. under the direction of the Office of Emergency Management within the Essex County Sherriff's Department. To date, Tetra Tech has been conducting a series of outreach meetings with Essex County municipalities and evaluating hazard impacts. They have also been gathering general planning documents from municipalities and evaluating them for relevancy to the Hazard Mitigation Plan.

The table in the following pages summarizes the background documents that have be reviewed in conjunction with the County's ongoing Hazard Mitigation Plan Update and relied upon as a foundation for informing this SRPR. These documents provide useful insight into strategies for resiliency, especially the 2003 Parks and Open Space Plan and the 2007 Environmental Resources Inventory (ERI). The Parks and Open Space Master Plan speaks to the need for parks and open space in the more dense urban communities in eastern Essex County, while the ERI speaks to the need to plan for the potential impacts of climate change and heat islands, with the associated threat of sea level rise. These goals, when considered together, suggest that parks and open space can play a dual role of providing recreation and enjoyment in good weather, while absorbing rainfall and storing water during serious storm events. Large reservations such as South Mountain Reservation, Eagle Rock Reservation, Great Piece Meadows and West Essex Park contain wetlands, meadows and other lands which may be adaptable for flood storage without using hard engineering methods such as dams or basins.

Table 20. Background Planning and Land Use Regulatory Documents Review

Name of Plan/Document	Relevant Goals
Park, Recreation, and Open Space Master Plan, April 2003	Needs analysis for open space in Essex County: Land needs for public recreation Land needs for resource protection Need for rehab and care of existing county parks Need for new recreation facilities and programs Need for responsiveness for public concerns Need for partnerships and funding Land needs for public recreation Brownfield redevelopment Need for rehab and care of existing county parks Need for new recreation facilities and programs Need for responsiveness to public concerns
Environmental Resource Inventory 2007	Environmental Resource inventories are used to support policy and decision making by providing a detailed description of historic resources, climatology, geology, soils, water resources, wetlands, air quality, land use, and wildlife in Essex County. The document is intended to help develop initiatives to preserve open space, reclaim brownfield sites and evaluate future development projects. It will also provide information for new educational programs at our state-of-the art Essex County Environmental Center.
Environmental Resource Inventory 2007	Climatology- As global climate change becomes increasingly publicized in the media, the general public is becoming interested in climate influence on ecological systems, as well as its influence on quality of life and the economy. This section discusses climatologic characteristics of Essex County and of the northeastern region, and evaluates how these characteristics influence the county's ecology, energy use and quality of life. Heat Islands-Mean air temperatures within the Newark are on average 2.7 degrees F higher than in surrounding suburban areas. From a quality of life standpoint, heat islands contribute to higher costs and energy use through increased reliance on air conditioning; and contribute to increased heat related discomfort, illness such as asthma and mortality.
	Potable Water Supply- The great amount of industrial and residential development in the Essex County/Newark Basin area coupled with certain regional geological characteristics creates a high potential for ground water contamination under certain conditions. Due to the great degree of interconnectedness to other deposits and sometimes to the surface, shallow unconfined

Name of Plan/Document	Relevant Goals
	aquifers in heavily fractured rocks such as shale are particularly susceptible to contamination within Essex. Fractures among rocks create an avenue for the migration of various chemical contaminants.
	Known Contaminated Sites - Essex County contains over 1,100 Known Contaminated Sites. The KCS are dispersed throughout all municipalities in Essex; however, the greatest concentrations of KCS are in the eastern half of the county, particularly in Newark City /Eastern Newark, as well as Irvington, the Oranges and Maplewood. Clusters of sites are also found along the border of Bloomfield and Nutley and central Montclair and in the vicinity of lower Fairfield.
	Steep Slopes - Essex County contains a number of steep slope areas, particularly along the Watchung Ridges in central Essex. "Steep" slopes are those slopes typically at a 15% gradient or greater. Slopes included in the mapping are between 15% and 60% gradients. Essex County steep slope areas exist primarily along the second Watchung Mountain Ridge in Cedar Grove, Verona, and south through portions of the Second and along the First Watchung Mountain Ridge in West Orange and through Maplewood. NJDEP mapping identifies steep slopes extending along the eastern edge of the First Watchung Mountain from South Mountain in Montclair southwest through West Orange and South Orange. Many additional small areas of steep slopes are mapped in central Essex County. In east Essex County, pockets of steep slope areas are mapped around portions of Weequahic Lake in Newark and near Yantacaw Park in Nutley.
Environmental Resource Inventory 2007	The Passaic River and the Newark Bay- In terms of natural and cultural development, the Passaic River (Appendix D, Photograph J) is perhaps the most influential feature of Essex County and like the county, has a complex natural and cultural history. From its indigenous settlements to its relationship to the industrial age, it has played a crucial role in the development of the region. The natural communities and populations of wildlife its upstream portions support are significant, particularly when considered in the context of the surrounding suburban sprawl. Yet much of the river has been subject to physical and chemical degradation for over a century with substantial impact to ecological diversity, water quality and quality of life for its human inhabitants. The heavy development of the Passaic Valley region particularly within river floodplain has contributed to the flooding problems for which the Passaic River is infamously known.

Name of Plan/Document	Relevant Goals
Environmental Resource Inventory 2007	Floodplains in Essex County- The most extensive areas of 100 Year FEMA mapped floodplains in Essex County extend along the Passaic River through much of the Passaic Meadows Complex in Fairfield, West Caldwell and Roseland. In southwestern Essex County, extensive 1/2- to 1-mile-wide floodplains exist in the vicinity of Slough and Canoe Brooks in Millburn Township and near Willow Brook in Livingston. In eastern Essex County, much of Lower Newark City is within the Floodplain of Newark Bay. Other larger floodplains are identified along the West Branch of the Rahway River, and along Second River, Wigwam Brook, and Third River in northeastern Essex County (see Appendix C, FEMA Floodplain Figure).
	Since 1900, major floods in the Passaic River Basin have taken 26 lives and cost more than $4.5 billion in total losses. Flooding has had major impacts to business and transportation infrastructure in Essex. Increased residential and industrial development in the Basin has compounded the problem as the natural vegetation communities, which moderate flood flow through absorption of precipitation and provide groundwater recharge, are transformed to impervious surfaces that increase stormwater runoff. Major flood events, prompting Federal Disaster Declarations, occurred in 1968, 1971, 1972, 1975, 1984, 1992, 1999, and 2005.
	Air Quality- In 2004, eight VOCs were found in mean concentrations above the accepted Health Benchmark established by NJDEP. These compounds include the following in micrograms per cubic meter ug/m3. The Essex County Health Department (2006) identified trichloroethylene as of particular concern within Essex County because of the multiple local emission sources.
Comprehensive Energy Master Plan 2011	1. Increase energy efficiency and conservation, reduce energy consumption and reduce peak 2. Decrease energy costs to the County 3. Identify renewable energy opportunities on County properties that would generate 22.5% of the county's electricity by 2021. 4. Recommend actions that would reduce greenhouse gas emissions 10% by 2018. 5. Increase the use of sustainable practices within County operations and growth.

Name of Plan/Document	Relevant Goals
2012 Newark Master Plan	Goal 1: Economy = Economic Development Provide current and future residents with a range of job and business opportunities that contribute to Newark's economic growth, support work-life satisfaction, and promote long-term household prosperity Goal 2: Equity = Safe and Healthy Neighborhoods Leverage growth to create visible and self-sustaining improvements in Newark's neighborhoods, support tight-knit community life, and promote human health, development, and well-being Goal 3: Environment = A City of Choice Become a "city of choice" where a diverse range of people will want to live, work, learn, and play by improving environmental quality and connecting Newark and the region to broad commercial, educational, cultural, and social possibilities
2009 Township of Belleville Master Plan	13. To enable environmental quality to be addressed in all pending developments by applying strict performance standards to all pending developments according to the site plan ordinance. 17. To encourage storm water management controls for all new developments.
2008 Essex County All-Hazard Mitigation Plan	Mitigation Goals Goal 1. Develop hazard mitigation policies and programs designed to reduce the impact of natural and man-made hazards on people and property. Goal 2. Identify and implement hazard mitigation projects to reduce the impact of hazard events and disasters. Goal 3. Conduct studies and implement planning processes to increase the understanding of local hazard vulnerability and to protect the natural environment. Goal 4. Improve education and outreach efforts regarding preparedness and mitigation actions that can be implemented by citizens, businesses and county and municipal government officials. Goal 5. Improve evacuation procedures for natural and man-made hazards.

Land Subdivision and Site Plan Resolutions

The Land Subdivision and Site Plan Resolutions for Essex County were reviewed as part of the Essex County Comprehensive Transportation Plan with recommendations to include Transect-based standards and sustainable best practices for stormwater management. Further review is expected based on the Complete Streets Implementation Plan that is being undertaken with the Local Capacity Grant from Together North Jersey in 2014. The current Site Plan and Subdivision Resolutions contain only traditional stormwater management standards and do not include any goals, objectives, or policies related to future storm mitigation or post storm recovery.

Identification of Projects

Projects identified in the Draft Essex County HMP Update (2014) are provided in Table 21, below. These projects form the basis for mitigation input to this Strategic Recovery Action Plan.

Table 21. Draft Essex County Mitigation Actions – Essex County Hazard Mitigation Plan

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
Essex-1	Obtain backup power to ensure continuity of operations. Sites currently identified: Essex County K9/Bomb building/DPW building generator	Existing	All	Essex County Sheriff's Office	High	High $150,000	HMGP	Short	High
Essex-2	Obtain backup power to ensure continuity of operations. Sites currently identified: Essex County Patrol Division Headquarters generator (Newark)	Existing	All	Essex County Sheriff's Office	High	High $150,000	HMGP	Short	High
Essex-3	Obtain backup power to ensure continuity of operations. Sites currently identified: Essex County OEM Storage/Crime Scene Facility (Orange) generator	Existing	All	Essex County Sheriff's Office	High	High $300,000	HMGP	Short	High
Essex-4	Essex County Traffic Control Transfer Switch generator	Existing	All	Essex County Sheriff's Office	High	High $100,000	HMGP	Short	High
Essex-5	Obtain backup power to ensure continuity of operations. Sites currently identified: Essex County DPW/Fleet Headquarters generator	Existing	All	Essex County Sheriff's Office	High	High $350,000	HMGP	Short	High

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
Essex-6	Obtain backup power to ensure continuity of operations: Provide Energy Allocation-generators at DPW/Roads and Bridges Headquarters (Cedar Grove)	Existing	All	Essex County Sheriff's Office	High	High $284,160	HMGP	Short	High
Essex-7	Catholic Charities of the Archdiocese of Newark: Generator for shelter	Existing	All	Newark City, Essex County Sheriff's Office	High	High $113,017	HMGP	Short	High
Essex-8	Newark AIDS Consortium, INC. Broadway House: Newark AIDS Consortium INC. Broadway House for Continuing Care generator	Existing	All	Newark City, Essex County Sheriff's Office	High	High $250,000	HMGP	Short	High
Essex-9	Seton Hall University: Seton Hall University generator project	Existing	All	Seton Hall University, Essex County Sheriff's Office	High	High $865,000	HMGP	Short	High
Essex-10 (OLD)	Repair bridge into Senior Recreational Center (Belleville Old Mill St.) (Old initiative)	Existing	All	County Engineering Office	High	High	HMGP	Short	Low
Essex-11 (OLD)	Bridge projects - Five vulnerable bridges have been identified. It is the intent and purpose of this project to rehabilitate bridges requiring structural work. All bridges are county owned. Center Street Bridge in Nutley;	Existing	Flood	County Engineering Office	High	High $7 million	Federal, State Grant opportunities	Long Term DOF	Medium

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
	Hoover Ave Bridge in Bloomfield; Cherry Hill Bridge in Millburn; Dougall Street Bridge in West Caldwell; Lyons Ave Bridge in Irvington (Old initiative)								
Essex-12 (OLD)	Utilize the recommendations of the Strategic Recovery Planning Report to further identify roadway flooding upon county roadways and to develop future mitigation actions to address those issues (Old initiative)	Existing	Flood	County Engineering Office	High	High	Federal, State grant opportunities HMGP, PDM	Long Term DOF	Medium
Essex-13 (OLD)	Enlarge Drainage system on JFK Parkway in Millburn. JFK is a county owned roadway as well as an evacuation route. (Old initiative)	Existing	Flood	County Engineers Office	High	High	Federal, State Grant Opportunities	Long Term DOF	Medium
Essex-14 (OLD)	Enlarge Drainage system on Bloomfield Ave in Verona. Bloomfield Ave is a county owned roadway as well as an evacuation route. (Old initiative)	Existing	Flood	County Engineers Office	High	High	Federal, State Grant Opportunities	Long Term DOF	Medium
Essex-15 (OLD)	Stream culvert work in residential areas storm water run-off– Eagle Rock Reservation area including Afterglow Ave. and Ravine Rd and flooding of Cole Rd. (Old initiative)	N/A	Flood	County Engineers Office	High	High	Federal, State Grant Opportunities HMGP, PDM	Long Term DOF	Medium

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
Essex-16 (OLD)	Conduct a study to evaluate the drainage system to reduce the impacts of flooding on Passaic Avenue and Bloomfield Avenue in Verona as both are evacuation routes (Old initiative)	N/A	Flood	County Engineers Office	High	High	Federal, State Grant Opportunities HMGP, PDM	Long Term DOF	Medium
Essex-17	Purchase three 525 gallon potable water trailers	N/A	Wildfire Drought Severe Weather	Essex County Sheriff's OEM	High	High	Federal, State grants	Short Term DOF	Medium
Essex-18	Provide redundant methods for Voice/Data transmissions 4G wireless broadband at DPW Headquarters.	N/A	All	Sheriff's Communicati on Bureau	High	High	Federal, State grants	Short Term DOF	Medium
Essex-19	Purchase 4 digital sign boards with variable message capability	N/A	All	Essex County Sheriff's OEM and County Engineering	High	High	Federal, State Grant Opportunities HMGP	Short Term DOF	Medium
Essex-20	Purchase portable flood wall which will be deployed prior to a flooding event to protect critical county facilities	Existing	Flood	County Engineering, County OEM	High	High	Federal, State Grant Opportunities HMGP, PDM	Short Term DOF	High
Essex-21	Install quick-connects for emergency generators at nine County fueling stations	Existing	All	County Engineering	High	Medium	Federal, State Grant Opportunities , HMGP, PDM	Short Term DOF	High
Essex-22	Install a County-Wide emergency alert system	Both	All	Essex Sheriff's Office of Emergency	High	High $300,000	Federal, State Grant Opportunities , HMGP, PDM	Short Term DOF	Medium

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
				Management			Homeland Security Grants		
Essex-23	Conduct a functional exercise related to school safety	NA	All	Essex Sheriff's Office	High	Medium	Homeland Security Grants	Short Term DOF	Medium
Essex-24	Administratively and financially support installing flood control measures in flood zone areas to protect critical facilities (i.e., levees, trenches, sump pump systems) or obtain equipment to address short-term needs (i.e., pumps) These facilities include the following at this time: County Detention Facility in Newark Passaic Valley Sewerage Commission	Existing	Flood, Coastal Storm, Severe Weather	Essex Sheriff's Office of Emergency Management ; PVSC	Medium	Medium	Federal, State Grant Opportunities HMGP, PDM	Short Term DOF	High
Essex-25	Pursue Sandy Recovery Planning Assistance Grant from NJ Department of Community Affairs	NA	All	Division of Planning	High	Low	NJ DCA	DOF	High
Essex-26	Develop a five year plan for capital projects directly linked to recovery, mitigation or preparedness	Both	All	Division of Planning	High	Low	NJ DCA; County	Short DOF	High
Essex-27	Update the County Master Plan with a Community Resiliency Element that reviews the Land Use Plan Element and	Both	All	Division of Planning	High	Low	NJ DCA; County	Short DOF	High

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
	development standards against the vulnerability issues outlined in this SRPR and adopt as a Master Plan Element.								
Essex-28	Review zoning and land use regulations against the vulnerability issues outlined in this SRPR and develop amendments to anticipate necessary changes to height, bulk and setback requirements needed to improve resiliency based on recommendations in the Community Resiliency Element	Both	All	Division of Planning	High	Low	NJ DCA; County	Short DOF	High
Essex-29	Develop specific strategic plans for neighborhoods most severely impacted by Sandy, including the "Island" neighborhood in the Ironbound and impacted neighborhoods in Fairfield Township	Both	All	Division of Planning	High	Low	NJ DCA; County	Short DOF	High
Essex-30	Review existing permitting procedures to determine improvements for fast-tracking/streamlining for expediting projects directly related to recovery or mitigation and that are consistent with adopted Design Standards	Both	All	Division of Planning	High	Low	NJ DCA; County	Short DOF	High
Essex-31	Develop design standards to address the visual impact of	Both	All	Division of Planning	High	Low	NJ DCA; County	Short DOF	High

Initiative	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Mitigated	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
	mitigation measures such as elevating bulkheads, elevating buildings on foundations or pilings, etc. Such design standards might include requirements for skirting exposed pilings, parking under the lowest habitable floor, using exterior decking to stagger stairways to elevated first floor levels, etc.								

Source: Draft Essex County HMP Update 2014

In addition to county-wide initiative, overall, a comprehensive range of specific mitigation initiatives were considered by each participating municipality to pursue in the future to reduce the effects of hazards. These initiatives are dependent upon available funding (grants and local match availability) and may be modified or omitted at any time based on the occurrence of new hazard events and changes in municipal priorities. Both the four FEMA mitigation action categories and the six CRS mitigation action categories are listed in the table below to further demonstrate the wide-range of activities and mitigation measures selected. Table 22 lists the common mitigation actions identified across a majority of the communities.

Table 22. Draft Essex County Mitigation Actions – Essex County Hazard Mitigation Plan

Municipality	Acquisitions & Elevations	Drainage / Stormwater	Education & Awareness	Generators	Natural Systems Protection	Structure & Infrastructure	Local Plans & Regulations
Belleville, Township of	X	X	X	X	X	X	X
Bloomfield, Township of	X	X	X	X	X	X	X
Caldwell, Borough of		X	X	X	X		X
Cedar Grove, Township of			X	X			
East Orange, City of		X	X	X	X		X
Essex Fells, Borough of	X		X	X	X		
Fairfield, Township of	X		X	X		X	X
Glen Ridge, Borough of	X		X	X		X	X
Irvington, Township of	X	X		X	X	X	
Livingston, Township of	X	X	X	X	X	X	X
Maplewood, Township of	X	X		X	X	X	X
Millburn, Township of	X	X	X	X	X	X	X
Montclair, Township of	X	X	X	X	X	X	X
Newark, City of	X	X	X	X	X	X	X
North Caldwell, Borough of	X	X		X		X	X
Nutley, Township of	X	X	X	X	X	X	X
Orange Township, City of				X		X	X
Roseland, Borough of	X	X		X	X	X	X
South Orange Village, Township of	X	X	X	X	X	X	X
Verona, Township of	X	X		X		X	X
West Caldwell, Township of			X	X	X	X	
West Orange, Township of	X	X	X	X	X	X	X

Source: Draft Essex County HMP Update 2014

Figure 20. A Bloomfield home in Essex County slated to be rehabilitated with federal Sandy money. /TANYA BREEN/STAFF PHOTOGRAPHER – Asbury Park Press, March 30, 2014

While the County has been successful in receiving for a significant amount of relief funding for rehabilitating damaged properties (Figure 19), the County public outreach has identified a number of additional projects as part of the current update to the Essex County Hazard Mitigation Plan and through stakeholder engagement. These projects are summarized below.

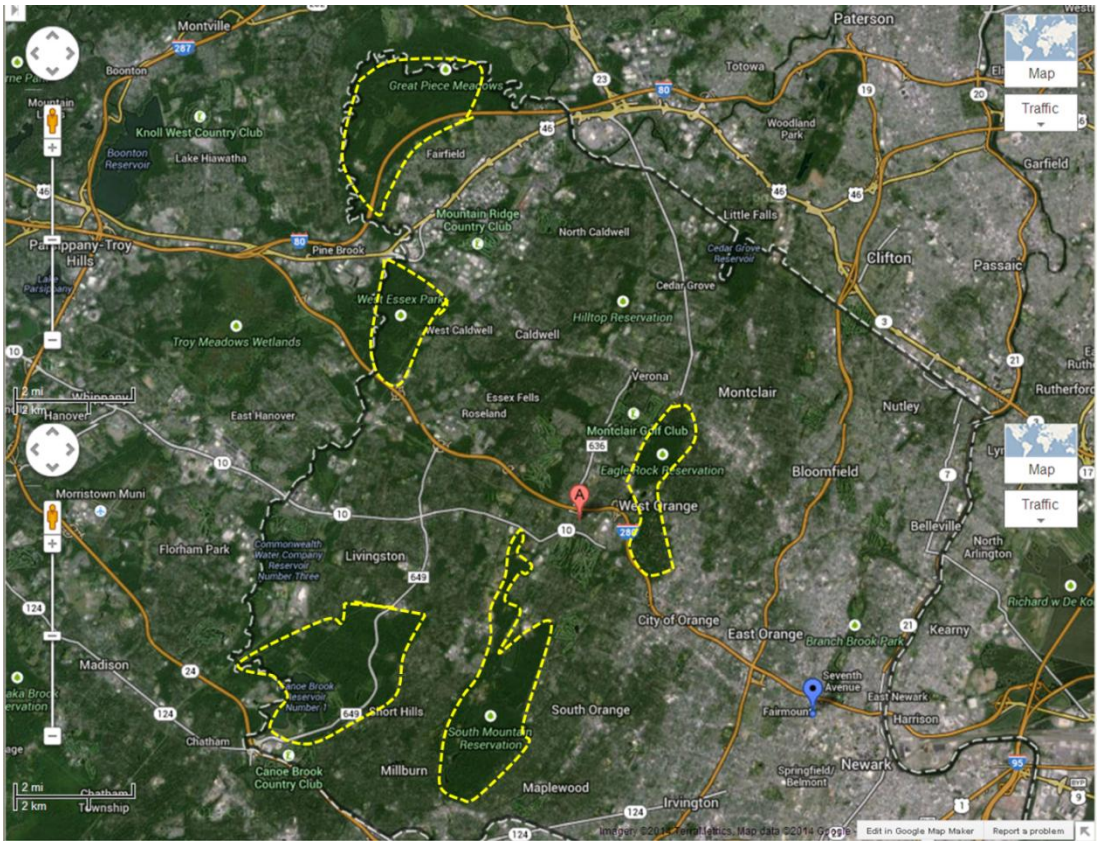
Stakeholder Recommendations

The County and the SRPR consultant team conducted extensive outreach efforts to stakeholders such as the County's municipalities, other County departments, the Port Authority of New York and New Jersey, NJTPA, Essex County College, Newark Public Library, PSE&G, Passaic Valley Sewerage Commission, NJ Transit, etc. The consultant team coordinated and facilitated a stakeholder workshop on July 15, 2014 at the Richard Codey Arena. The workshop was facilitated by Abby Straus and John Findlay of Maverick & Boutique using a cutting edge methodology called "Zing" that employs the use of wireless keyboards used by participants to input their responses and simultaneously see those of other participants. The meeting summary provided by Maverick & Boutique is found in the Appendix of this SRPR and the actions/projects identified by the participants are summarized below.

- Use "green" infrastructure to reduce stormwater flooding.
- Use managed wetlands on County park and open space lands to reduce downstream flooding.
- Acquire private properties subject to repetitive flood damage for expansion of parks and open space areas and prohibit new development in flood prone areas.
- Use development review process to require overhead utilities be put underground to minimize vulnerability during wind and ice storms.

- Develop alternative fuel sources and emergency fuel storage capacity; a clearer protocol for shared resources; improved redundancy in power and mobility.
- Develop long term strategy for reducing vulnerability of major public facilities such as the County Jail, Passaic Valley Sewerage Commission treatment plant and NJ Transit rolling stock in areas subject to surge inundation – factoring long term effects of sea level rise.
- Improve emergency command and control communications using innovative technologies such as large coverage WiFi.
- Incorporate solar and wind energy powered "smart" technology into the design and construction or reconstruction of County roads and traffic control signalization and electronic message signage for resiliency during major power outages.

Figure 21. Large public parks and open-space reservations are located near areas of flood vulnerability and offer opportunities for flood mitigation. This Google image has been marked with dashed yellow lines to show the major open-space reservations in Essex County.



Based on the Needs Assessment and Vulnerability Analysis, this SRPR is recommending a more extensive series of projects, which are organized into two categories: Hazard Mitigation and Preparedness.

Hazard Mitigation

1. Hazard mitigation projects generally involve backup emergency power (generators) for critical facilities such as hospitals, public safety infrastructure, water & sewer systems, communications and shelters. Other hazard mitigation projects focus on the strategies of "Rebuild By Design" (An Initiative of the President's Hurricane Sandy Rebuilding Task Force in collaboration with NYU's Institute for Public Knowledge, Municipal Art Society, Regional Plan Association and the Van Alen Institute – www.rebuildbydesign.org)), which include: "Resist, Delay, Store & Discharge". Projects that relocate, elevate, or harden vulnerable facilities or infrastructure "resist" the impact of flooding and surge. The preceding table of projects from the ongoing Hazard Mitigation Plan process focuses on backup power generators, for example. Projects that absorb flood waters or the energy of waves during a severe storm "delay" and reduce impacts.

2. Projects that capture rain before it becomes "runoff" and stores it in raingardens, bioswales, cisterns, green roofs, managed wetlands, etc., reduce the volume of water that causes flooding (Figure 21). These projects will require engineering feasibility studies and cost estimates that exceed the scope of this SRPR, but which could be incorporated into the "Post Disaster Recovery Capital Improvement Plan" proposed for Phase 2 Sandy funding under "Preparedness" below.

3. While mitigation projects that "delay" and "store" excess rainfall intercepts rainwater before it enters the system, "discharge" strategies address removing excess water from the system through the installation of additional pumps, employing alternative drainage routes, etc. As an example, the Passaic Valley Sewerage Commission has employed a combination of "resist" and "discharge" strategies in its mitigation plan.[10]

Preparedness (see Table 23)

4. Post Disaster Recovery Capital Improvement Plan
   a. Develop a five year plan for capital projects directly linked to recovery, mitigation or preparedness.
   b. Pursue Sandy Recovery Planning Assistance Grant from the NJDCA.

5. Community Resiliency Element – Master Plan
   a. Update the County Master Plan with a Community Resiliency Element that reviews the Land Use Plan Element and development standards against the vulnerability issues outlined in this SRPR and adopt as a Master Plan Element.
   b. Pursue Sandy Recovery Planning Assistance Grant from the NJDCA.

6. Update Land Development Regulations
   a. Review zoning and land use regulations against the vulnerability issues outlined in this SRPR and develop amendments to anticipate necessary changes to height, bulk and setback requirements needed to improve resiliency based on recommendations in the Community Resiliency Element.
   b. Pursue Sandy Recovery Planning Assistance Grant from the NJDCA.

7. Neighborhood Plans
   a. Develop specific strategic plans for neighborhoods most severely impacted by Sandy, including the "Island" neighborhood in the Ironbound and impacted neighborhoods in Fairfield Township.

[10] http://www.nj.gov/pvsc/home/forms/pdf/Superstorm_Sandy_Update_2014a.pdf

b. Pursue Sandy Recovery Planning Assistance Grant from the NJDCA.

8. Permit Process- Quality Improvement
   a. Review existing permitting procedures to determine improvements for fast-tracking/streamlining for expediting projects directly related to recovery or mitigation and that are consistent with adopted Design Standards (Project 9).
   b. Pursue Sandy Recovery Planning Assistance Grant from the NJDCA.

9. Design Standards (integrating elevated structures into community design character)
   a. Develop design standards to address the visual impact of mitigation measures such as elevating bulkheads where they exist along either branch of the Passaic, elevating buildings on foundations or pilings, etc. Such design standards might include requirements for skirting exposed pilings, parking under the lowest habitable floor, using exterior decking to stagger stairways to elevated first floor levels, etc. (see example of home designs in flood zones below).
   b. Pursue Sandy Recovery Planning Assistance Grant from the NJDCA.

Figure 22. These images portray examples of architectural-design treatments to visually integrate elevated buildings to the ground plane.

10. Hardening of Infrastructure – The County's roads and facilities such as the Correctional Facility and the PVSA treatment plan were impacted by either flooding or loss of power or both. Operating equipment at pump stations needs to be either raised above flood levels or hardened for protection against future events.

11. Hydrologic studies of the County's large wilderness reservations (Figure 21) to determine feasibility for flood mitigation using sustainable design methods (managed wetlands, bio-retention, temporary flood storage in expanded floodplains, etc.

12. The long term impacts of future sea level rise should be projected and studied for Newark Bay and the tidal portions of the Passaic River.

Table 23. ESSEX COUNTY POST DISASTER RECOVERY PROJECT MATRIX – Preparedness (post-disaster planning) Projects

Recovery Project		Responsible Entity	Duration	Recovery Value		
			TYPE	Community Need	Feasible	Sustainable
4.	Post Disaster Recovery Capital Improvement Plan	County, NJDCA Grant	Short Term Preparedness	High	High	Mod
5.	Community Resiliency Element – Master Plan	County, NJDCA Grant	Short Term Preparedness	High	High	High
6.	Update Land Development Regulations	County, NJDCA Grant	Short Term Preparedness	High	High	High
7.	Neighborhood Plans	County, NJDCA Grant	Short Term Preparedness	High	High	High
8.	Permit Process – Streamlining	County, NJDCA Grant	Short Term Preparedness	Mod	High	Mod
9.	Design Standards	County, NJDCA Grant	Short Term Preparedness	Mod	High	High
10.	Harden infrastructure	County, FEMA	Short Term Preparedness	High	High	High
11.	Hydrologic Feasibility Studies of County wilderness reservations	County	Short Term Preparedness	High	High	High
12.	Impact Study of Future Sea Level Rise on Newark Bay	NOAA/Rutgers	Long Term Preparedness	Mod	High	High

APPENDIX

Strategic Recovery Planning Report

Meeting Notes

Public Meeting 7-15-14

1. Thinking about POWER/ENERGY, COMMUNICATIONS, TRANSPORT, ROAD TRAVEL, TOWN PLANS (flooding, etc.) what worked well during Irene, Sandy and other major events that we want to KEEP? Respond like this: POWER: KEEP the……because

- TRANSPORTATION: KEEP the bicycle and pedestrian conductivity which was extremely valuable during post sandy lack of fuel and improve these facilities in the future in case auto and public transit systems are disrupted.
- COMMUNICATIONS: Irene was flood, less wind; Sandy wind, less flood, but communication was effective among government entities. COORD: Government entities worked well and shared facilities.
- COMMUNICATIONS: Keep the old form of communication. Transition into new technology proved ineffective as the community is made up of Brazilian, Portuguese, Spanish and older families which rely on word of mouth rather than from new technology
- Communication and Coordination between Local and County OEM, current mutual aid agreements served us well.
- Assistance from State, National Guard and other federal agencies.
- COMMUNICATIONS: Air broadcast (radio and TV) provided most reliable emergency information. Back-up power was OK. Number of roof leaks, storm systems held ok. Radio communication was good. No major damage to the structures.

Themes: coordination and communication, inter-governmental relations,

2. Thinking about POWER/ENERGY, COMMUNICATIONS, TRANSPORT, ROAD TRAVEL, TOWN PLANS (flooding, etc.) what worked well during Irene, Sandy and other major events that we want to ABANDON? Respond like this: POWER: ABANDON the……because

- Town Plans: Move away from grey infrastructure and more towards green/open space to mitigate flooding
- Abandon new building in known flood areas.
- Abandon use of above ground electrical power where practical.
- POWER/ENERGY: Aerial/Overhead communications and power lines were knocked out of service. Encourage U/G installation of data and electrical lines.
- Lack of fuel. Phone land lines were down, no way to get basic construction supplies.

- Notification systems broke down. R911. Street flooding caused the area to be locked down. Needed additional generator. Lack of fuel for emergency vehicles.
- VULNERABILITY: Too many facilities and infrastructure in vulnerable areas. Power facilities vulnerable, which led to power outages and fuel shortages - NO REDUNDANCY
- Lack of clearly marked countywide evacuation routes
- TOWN PLANS: Abandon future development in flood plain areas. Discontinue investment in flood plain areas. TRANSPORTATION: Resiliency planning for public transportation infrastructure such as the PATH from Essex County to NYC. Also, NJTRANSIT train stations and tracks

Themes: Lack of fuel, landlines/phone, cellular, moving supplies around was difficult, road closures, development on flood plain areas

3. Thinking about POWER/ENERGY, COMMUNICATIONS, TRANSPORT, ROAD TRAVEL, TOWN PLANS (flooding, etc.) what could work better than it did during Irene, Sandy and other major events that we want to INVENT/REINVENT? Respond like this: POWER: REINVENT the.....to achieve...

- Traffic signals should be interconnected to a shared emergency power source to maintain public safety and efficiency.
- Wind damage mitigation such as overhead utilities. Prepare better for last resort communications such as preplanned public information distribution points, increase shelter supplies and staffing. Ensure all public buildings have back up power and ensure a few community fuel stations have back up power.
- Design and build underground power and phone lines. Use of electric cars/trucks.
- Create fuel storage.
- Flood proof firehouse and other infrastructure facilities.
- Purchase additional portable generators for traffic control.
- Large coverage WIFI network available to general public for free during emergency
- As roads are being reconstructed, install solar panel based roads that can not only serve a sower sources but also change traffic patterns very quickly
- Quick connect generator available for gas stations along evacuation routes
- POWER; elevate, relocate or build backup generation capacity; WIND: develop mitigation strategies for minimizing property damage and overhead utility damage; ECONOMIC: Design for wave & surge - levee, bulkhead, etc.

Themes: Power grid and underground utilities, transportation solutions

4. Thinking about the planning report presented here tonight, what other factors, if any, do you feel should be considered or further developed? What is the most important thing to do moving forward?

- Timely distribution of funds, so that basic projects can be implemented expeditiously.
- Provide funding for raising properties.
- Flood control for the Passaic river

- Purchase homes in the flood prone areas
- Raise structure above the base flood elevation.
- Targeted assistance towards vulnerable populations, especially those in public housing
- Flood/Wind mitigation planning for the power grid.
- Increased involvement from local government officials in the planning and preparations so that the better understand their local capabilities.

6. Project: Thinking about the topic categories, describe a project that will help mitigate or enable Essex County to recover from events such as Irene/Sandy and sea level rise. Respond like this: Category + (3-5 word Snazzy Name for the project) and 25 word description.

1. **Power Beneath-** u/g power, data line conversion
2. **Complete streets and green roads** - concentrated effort to utilize solar panel based road infrastructure that serves as both a power source, traffic control tool, and pedestrian + bike transportation lanes that facilitate people gaining access to necessary resources
3. **Cycling connections** - safe access to employment, housing, and food by bicycle
4. **Design and construct large size facilities** capable to house large number of people. Facilities should have sored food and clothing.
5. **Community Rating System - CRS** - Assistance should be given to towns to apply for CRS (FEMA) to help their community with the cost of flood insurance.
6. **Regional city/county Wi-fi** - to be made available during emergencies that can serve as initial emergency information dissemination tool while laptops/cell phones are still largely functional
7. **I have Gas-** Natural gas generators/ hybrid as alternative to traditional gasoline
8. Local Community Response System: **Emergency alerts through block captain or word of mouth** applications
9. **Let's Talk!** Streamline the sharing of facilities between towns and with County - Do it like the Fire Departments!

Thinking about the report and /or the long terms effects of climate change/future weather events, how could you contribute to the MITIGATION, PREVENTION or RESPONSE. Respond like this: RESPONSE: (name of your organization) + (what you could do) + (type of event)

Emergency Management, Fire Department - Operate the EOC, response to emergencies. Responsible for Damage Assessments and long term recovery and FEMA reimbursements.

Essex County DPW- Traffic Signal electrical redundancy/ flood ponding pumping/ evacuation route signage/ ITS deployment/ planning standards for new development and arboratorial services.

Ironbound Community Corporation: Currently working on - Mitigation: Promoting green infrastructure, assisting Blue Acres Program, new sustainability plans for East Ferry; Prevention - Disaster Preparedness training across local community; Response - Work with local OEM; Community Response System; Post-disaster recovery studies/research on resiliency planning and climate change that may be of use to county

MASER - Technical Assistance - Work with NJAPA and NJASLA to mobilize volunteer professional services

North Jersey Transportation Planning Authority: MITIGATION, PREVENTION: Resiliency planning funding available based on county and/or Newark interest, assistance with state transportation agencies on transportation infrastructure operations and future construction projects that may be vulnerable to a storm

North Jersey Transportation Planning Authority: MITIGATION; PREVENTION: Currently doing studies/research on resiliency planning and climate change that may be of use to county

TESC is considering effort to provide a seminar for newly elected mayors to acclimate them to current/future issues and local government administration. Could offer climate change and extreme weather education as part of this

TETRA TECH: Provide information and support to county and municipalities in ongoing CRS to reduce flood vulnerability and impacts as well as flood insurance premiums.

West Orange OEM Improve communication ability and training level of local assets to respond to natural events such as storms and weather.

Suggestion: City of Phoenix has own natural gas infrastructure and is a vendor - maybe municipalities with capacity for this could assist other municipalities in fueling their vehicles/generators/etc. during emergency rather than relying on incoming fuel and commercial providers

Other ideas: Food waste recycling. Improving the public transportation system to reduce use of cars.

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