5.4.10 Wildfire

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the wildfire hazard in Sussex County.

2016 HMP update Changes

- The hazard profile has been significantly enhanced to include a detailed hazard description, location, extent, previous occurrences, probability of future occurrence, and potential change in climate and its impacts on the wildfire hazard is discussed. The wildfire hazard is now located in Section 5 of the plan update.
- New and updated figures from federal and state agencies are incorporated. New Jersey Forest Fire Service (NJFFS) Wildfire Fuel Hazard data was used to identify wildfire fuel rankings in Sussex County. The 2010 NJFFS wildfire risk and fuel maps were also used to identify hazard areas in the County. The U.S. 2010 Census data was incorporated, where appropriate.
- Previous occurrences were updated with events that occurred between 2008 and 2015.
- A vulnerability assessment was conducted for the wildfire hazard; it now directly follows the hazard profile. To determine exposure, a spatial analysis was conducted using the NJFFS Fuel Hazard Area guidelines.

5.4.10.1 Profile

Hazard Description

A wildland fire can be defined as any non-structural fire that occurs in the wildland. Three distinct types of wildland fires have been defined and include: naturally occurring wildfire, human-caused wildfire, and prescribed fire. Many of these are highly destructive and can be difficult to control. They occur in forested, semi-forested, or less developed areas. Wildland fires can be caused by lightning, human carelessness, and arson. Most frequently, wildland fires in the State of New Jersey are caused by humans. Wildfires result in the uncontrolled destruction of forests, brush, field crops, grasslands, real estate, and personal property, and have secondary impacts on other hazards such as flooding, by removing vegetation and destroying watersheds.

Wildfires can increase the probability of other natural disasters, specifically floods and mudflows. Wildfires, particular large-scale fires, can dramatically alter the terrain and ground conditions, making land already devastated by fire susceptible to floods. Lands impacted by wildfire increase the risk of flooding and mudflow in those areas impacted by wildfire. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water; thus, creating conditions perfect for flash flooding and mudflows. Flood risk in these impacted areas remain significantly higher until vegetation is restored, which can take up to five years after a wildfire (FEMA 2013).

Flooding after a wildfire is often more severe, as debris and ash left from the fire can form mudflows. During and after a rain event, as water moves across charred and denuded ground, it can also pick up soil and sediment and carry it in a stream of floodwaters. These mudflows have the potential to cause significant damage to impacted areas. Areas directly affected by fires and those located below or downstream of burn areas are most at risk for flooding (FEMA 2013). For detailed information regarding flooding, see Section 5.4.4 (Flood).

The height of wildland fire season in New Jersey is typically in spring (March through May) and culminates in early May, corresponding with the driest live fuel moisture periods of the year. Although the spring months are the most severe, the summer and fall months may also experience extensive fires in the state. While the spring

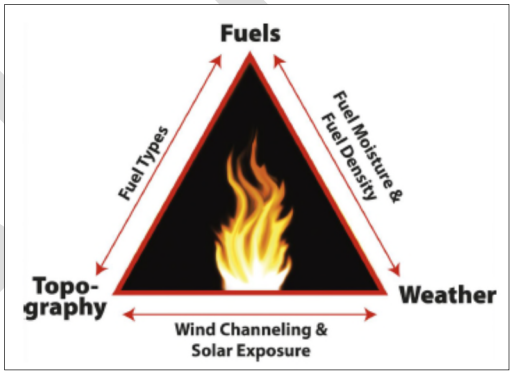
season is historically the period in which wildfire danger is the highest, wildland fires can occur every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires. Lightning generally is the cause of most fires in the peak season.

NJFFS, a division of NJDEP, is responsible for protecting the 3.15 million acres of public and private wildland in the state. NJFFS is under the direction of the state fire warden and is headquartered in Trenton. NJFFS has 85 full-time employees that provide an array of services including staffing the state's 21 fire towers, which are operational during the months of March, April, May, October, and November.

According to the NJFFS, each year in New Jersey, an average of 1,500 wildfires damage or destroy 7,000 acres of the state's forests. Wildfires not only damage woodlands, but threaten homeowners who live within or adjacent to forest environments. From January 1, 2015, to September 14, 2015, there were 814 wildfires in New Jersey that burned 2,563.5 acres. In contrast, during this same period in 2014, the State experienced 757 fires, which burned 6,433 acres (NJFFS 2015).

Fire Ecology and Wildfire Behavior

The "wildfire behavior triangle" illustrates how three primary factors influence wildfire behavior: fuel, topography, and weather. Each point of the triangle represents one of the three factors; the sides represent the interplay between the factors. For example, drier and warmer weather combined with dense fuel loads and steeper slopes will cause more hazardous fires than light fuels on flat ground.



A fire needs all of the following three elements in the right combination to start and grow: a heat source, fuel, and oxygen. The growth of the fire primarily depends on the characteristics of available fuel, weather conditions, and terrain. Climate change is also considered a potential source of influence. These four factors are described below:

- Fuel
  - Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs, and trunks take more time to warm and ignite.
  - Snags and hazard trees–especially those that are diseased, dying, or dead—are quickly engulfed and allow fires to spread quickly.
- Weather
  - Strong winds within the vicinity of the flames produce extreme fire conditions. Of particular concern are wind events that potentially persist for longer periods of time, or ones with significant wind speeds, which can sustain and quickly promote the spread of fire through movement of embers or exposure within tree crowns.
  - Spring and summer months, which can experience drought-like conditions extending beyond the normal season, also expand the average fire season. Likewise, the passage of a dry, cold front through the region can result in a sudden increase in wind speeds and a change in wind direction affecting fire spread.
  - Thunderstorm activity, which typically begins with wet storms, turns dry with little or no precipitation reaching the ground as the seasons progress.
- Terrain
  - Regional and local topography influence the amount and moisture of fuel.

  - Barriers such as highways and lakes can affect the spread of fire.
  - Elevation and slope of landforms affect fire spread; flames move more easily uphill than downhill.
- Changes to Environment
  - Without an increase in summer precipitation (greater than any predicted by climate models), areas susceptible to future burning are very likely to increase.
  - Infestation from insects is also of concern as it may impact forest health. Potential insect populations may increase with warmer temperatures as a result of warmer temperatures. Infested, stressed trees increase the fuel load.
  - Tree species composition will change as species respond uniquely to a changing climate.
  - Wildfires cause both short-term and long-term losses. Short-term losses can include destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and the destruction of cultural and economic resources and community infrastructure.

Location

The NJFFS is broken up into three divisions (A, B, C). Each division is responsible for responding to wildfire events within their boundaries. Sussex County is located in Division A. All of Sussex County is susceptible to wildfire, and they can occur anywhere in the County. Additionally, a portion of Sussex County (i.e., involving eight municipalities) is located within the New Jersey Highlands Regions (New Jersey Highlands). The New Jersey Highlands is an area of 859,358 acres located in northwest New Jersey and includes 88 municipalities and parts of seven counties (Bergen, Hunterdon, Morris, Passaic, Somerset, Sussex, and Warren). The New Jersey Highlands Region serves as a significant green belt along the eastern coast. Forests comprise 47% of the Highland's landscape and is predominately hardwood forests, which provides a fuel hazard for wildfires.

NJFFS has developed Wildfire Fuel Hazard data for the state based upon NJDEP's 2002 Land Use/Land Cover (LU/LC) datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. NJFFS took the NJDEP Modified Anderson LU/LC Classification System 2002 and assigned Wildfire Fuel Hazard rankings to it. NJFFS used NJDEP's 2002 10-meter Digital Elevation Grids and calculated areas of 30% or greater slope throughout New Jersey. For areas of Wildfire Fuel Hazard with a ranking of 1 to 4 (i.e. "Low" to "Very High") that were coincident with areas of 30% or greater slope, the Wildfire Fuel Hazard Ranking was increased by one value (i.e. "Low" was increased to "Moderate", "Moderate" to "High", etc.). For areas of Wildfire Fuel Hazard with a ranking of 0, and 5 through 8, the Wildfire Fuel Hazard ranking remained the same. Once the LU/LC was coded according to the Wildfire Fuel Hazard, taking into account 30% or greater slopes, the data were divided by county. For Sussex County, this project was completed in May 2009.

Figure 5.4.10-1 and Figure 5.4.10-2 illustrate the wildfire fuel hazard and wildfire risk for Sussex County. For additional details regarding these figures, please refer to: http://www.state.nj.us/dep/parksandforests/fire/wildfire_hazard_mitigation.htm. According to these figures, a majority of Sussex County has a low fuel hazard and low risk. Every municipality in Sussex County has at least a small portion of the community located within the high to extreme risk area, with Walpack Township having largest percentage of land within the high to extreme risk area (29.9%). Table 5.4.10-1 indicates the land area in each of the wildfire fuel hazard ranking zones for Sussex County. Table 5.4.10-2 summarizes the approximate land area in the NJFFS risk areas in the County.

Table 5.4.10-1. Area in the Wildfire Fuel Hazard Ranking Zones in Sussex County

Hazard Area	Area (Square Miles)
Extreme	31.8
Very High	11.8

Hazard Area	Area (Square Miles)
High	25.4
Moderate	98.0
Low	247.5

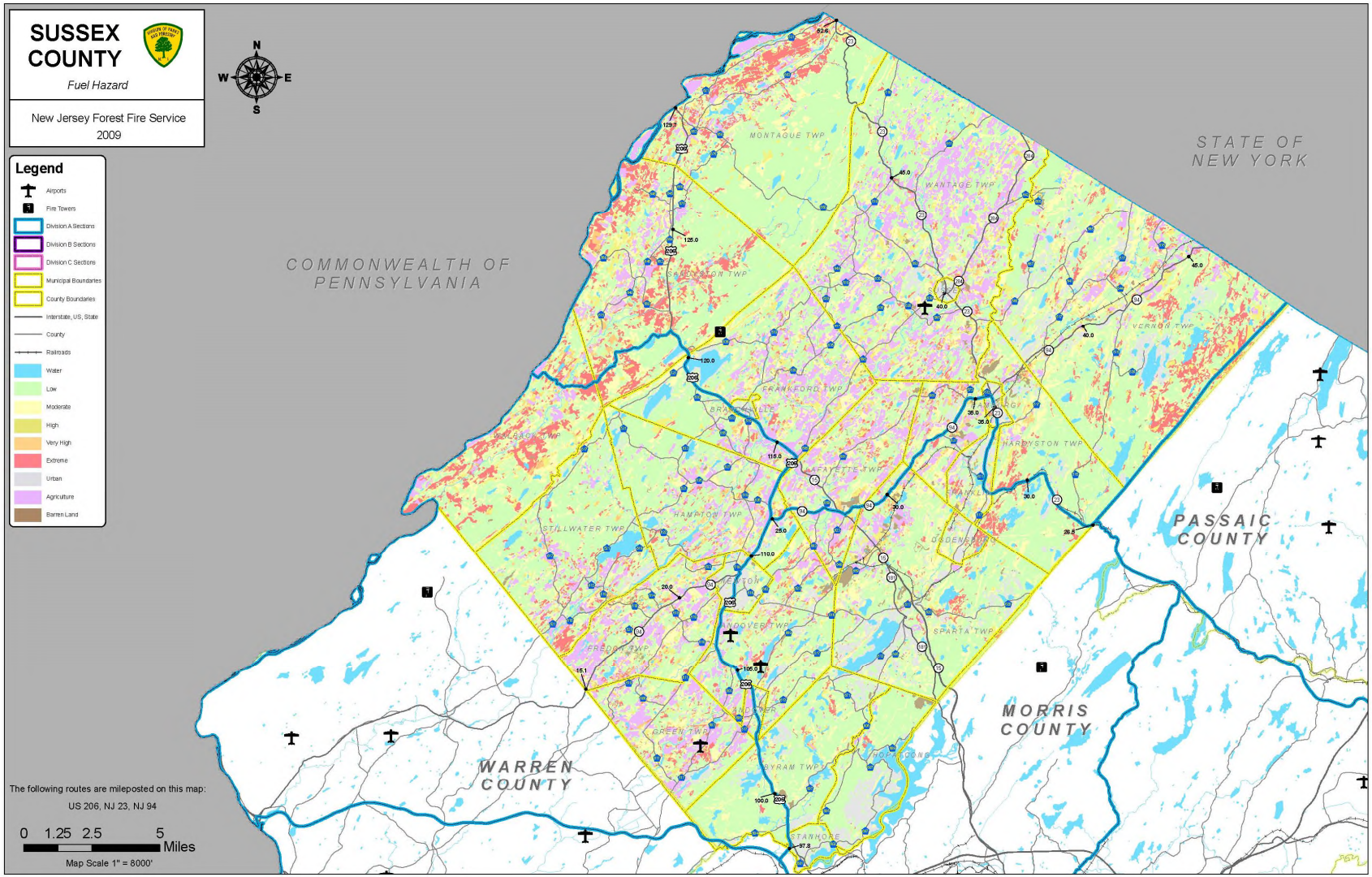
Source: NJFFS 2015

Table 5.4.10-2. Approximate Area in Wildfire Fuel Hazard Ranking Zones in Sussex County

Municipality	Total Area (Square Miles)	New Jersey Forest Fire Service Risk Areas			
		Low to Moderate	% in Hazard Area	High to Extreme	% in Hazard Area
Borough of Andover	1.4	0.7	46.6%	0.1	8.7%
Township of Andover	21.0	13.5	64.2%	2.3	10.8%
Borough of Branchville	0.6	0.2	37.7%	0.03	5.3%
Township of Byram	22.4	17.6	78.8%	0.8	3.5%
Township of Frankford	35.3	21.1	59.8%	3.9	11.0%
Borough of Franklin	4.4	2.0	46.5%	0.6	14.2%
Township of Fredon	18.0	10.1	55.9%	2.6	14.5%
Township of Green	16.1	9.0	56.0%	2.0	12.7%
Borough of Hamburg	1.2	0.3	28.5%	0.1	10.3%
Township of Hampton	25.4	16.8	66.2%	2.4	9.6%
Township of Hardyston	32.5	23.3	71.8%	3.8	11.8%
Borough of Hopatcong	12.3	7.2	58.4%	0.2	1.5%
Township of Lafayette	17.9	9.5	52.9%	2.5	13.8%
Township of Montague	46.4	34.6	74.6%	6.7	14.5%
Town of Newton	3.4	1.5	44.8%	0.1	3.6%
Borough of Ogdensburg	2.2	1.0	47.1%	0.4	20.4%
Township of Sandyston	42.2	27.9	66.0%	9.9	23.6%
Township of Sparta	38.9	25.7	66.0%	2.9	7.6%
Borough of Stanhope	2.2	1.0	46.7%	0.02	1.0%
Township of Stillwater	28.2	19.9	70.6%	3.0	10.7%
Borough of Sussex	0.6	0.1	23.2%	0.01	1.4%
Township of Vernon	69.9	46.4	66.3%	10.7	15.2%
Township of Walpack	24.8	15.2	61.5%	7.4	29.9%
Township of Wantage	67.4	40.8	60.5%	6.2	9.2%
Sussex County Total	**534.7**	**345.5**	**64.6%**	**68.9**	**12.9%**

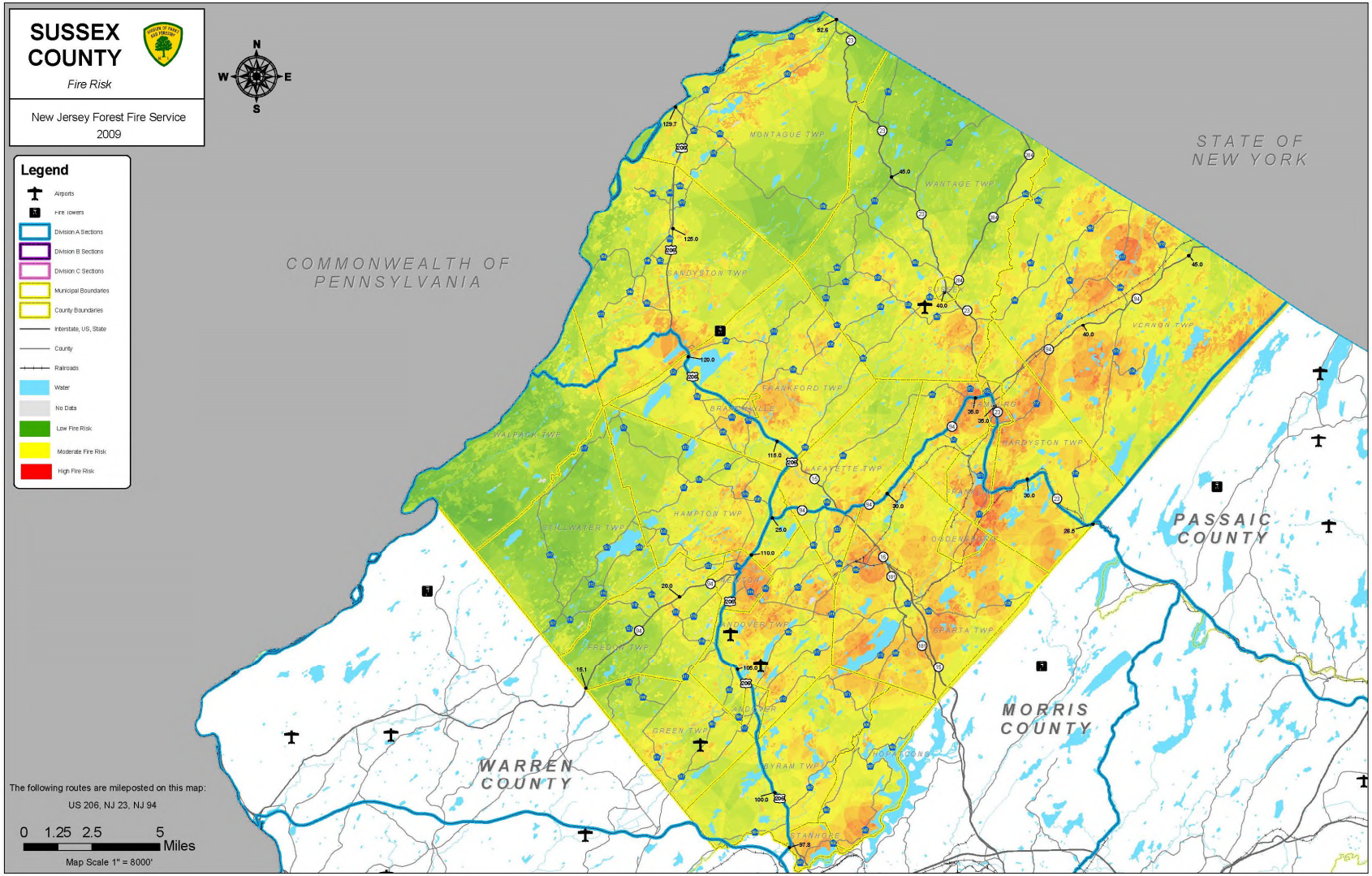
Source: NJFFS 2015

Figure 5.4.10-1. Wildfire Fuel Hazard for Sussex County



Source: New Jersey Forest Fire Service 2010

Figure 5.4.10-2. Wildfire Risk for Sussex County



Source: New Jersey Forest Fire Service 2010

Extent

The extent (that is, magnitude or severity) of wildfires depends on weather and human activity. NJFFS uses two indices to measure and monitor dryness of forest fuels and the possibility of fire ignitions becoming wildfires. These indices include the National Fire Danger Rating System's (NFDRS) Buildup Index (BUI), and the Keetch-Byram Drought Index (KBDI). Both are used for fire preparedness planning, which includes the following: campfire and burning restrictions, fire patrol assignments, fire lookout tower staffing, and readiness status for both observation and firefighting aircraft (NJFFS 2015).

The **Buildup Index (BUI)** is a number that reflects the combined cumulative effects of daily drying and precipitation in fuels with a 10-day time lag constant. The BUI can represent three to four inches of compacted litter or can represent up to six inches or more of loose litter (North Carolina Forest Service 2009).

The **Keetch-Byram Drought Index (KBDI)** is a drought index designed for fire potential assessment as defined by the U.S. Forest Service (USFS). It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The KBDI attempts to measure the amount of precipitation necessary to return the soil to full field capacity. It is a closed system ranging from 0 to 800 units and represents a moisture regime from 0 to 8 inches of water through the soil layer. Zero is the point of no moisture deficiency and 800 is the maximum drought that is possible. At any point along the scale, the index number indicates the amount of net rainfall that is required to reduce the index to 0, or saturation (USFS-Wildland Fire Assessment System [WFAS] 2015; Florida Forest Service N.D.).

Additionally, the NFDRS is used to provide a measure of the relative seriousness of burning conditions and threat of fire throughout the United States. It allows fire managers to estimate the day's fire danger for a given area. The NFDRS uses a five color-coded system to help the public understand fire potential; this color scale has been adapted slightly for NJFFS purposes. The NFDRS (with the NJFFS color scheme) is as follows:

Table 5.4.10-3. Fire Danger Rating and Color Code

Fire Danger Rating and Color Code	Description
Low (L) (Green)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate (M) (Blue)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open-cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H) (Yellow)	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH) (Orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E) (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and tree tops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under

Fire Danger Rating and Color Code	Description
	these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

Source: NJFFS 2015, WFAS 2015

Previous Occurrences and Losses

Many sources were used to identify wildfire previous occurrences and losses in Sussex County. With so many sources reviewed loss and impact information may vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP update.

Between 1954 and 2015, New Jersey was included in two FEMA fire management assistance (FMA) declarations. These two events occurred prior to 2008 and were discussed in the 2011 HMP; however, neither impacted Sussex County. There have been no additional declarations since the 2011 HMP. For the 2016 HMP update, wildfire events from 2008 to 2015 are summarized in Appendix X. For events prior to 2008, please refer to the 2011 Sussex County HMP.

Probability of Future Occurrences

Estimating the approximate number of wildfires to occur in Sussex County is difficult to predict in a probabilistic manner. This is because a number of variable factors impact the potential for a fire to occur and because some conditions (for example, ongoing land use development patterns, location, fuel sources, and construction sites) exert increasing pressure on the WUI zone. Based on available data, urban fires and wildfires will continue to present a risk to Sussex County. Given the numerous factors that can impact urban fire and wildfire potential, the likelihood of a fire event starting and sustaining itself should be gauged by professional fire managers on a daily basis. Although a definite prediction of future wildfire events cannot be noted, an analysis of the frequency of past occurrences can give professionals a rough guide as to how many potential events may occur each year if current trends continue.

For the purpose of this HMP update, the most up-to-date data was collected to calculate the probability of future occurrence. Information from the 2011 HMP and the NOAA-NCDC storm events database were used to identify the number of wildfires that occurred between 1950 and 2015. Using these sources ensures the most accurate probability estimates possible. The table below shows these statistics, as well as the annual average number of events and the estimated percent chance of a wildfire occurring in a given year (NOAA-NCDC 2016; Sussex County HMP 2011). Based on these statistics, there is an estimated 16.67% chance of a wildfire occurring in any given year in Sussex County.

Table 5.4.10-4. Probability of Future Occurrence of Wildfire Events

Hazard Type	Number of Occurrences Between 1950 and 2015	Rate of Occurrence	Recurrence Interval (in years)	Probability of event Occurring in Any Given Year	% Chance of Occurring in Any Given Year
Wildfire	11	0.17	6.00	0.17	16.67

Source: NOAA-NCDC 2016; Sussex County HMP 2011

In Section 5.3, the identified hazards of concern for Sussex County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for wildfire in the County is considered 'frequent' (likely to occur within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

A gradual change in temperatures will alter the growing environment of many tree species throughout the United States and New Jersey, reducing the growth of some trees and increasing the growth of others. Tree growth and regeneration may be affected more by extreme weather events and climatic conditions than by gradual changes in temperature or precipitation. Warmer temperatures may lead to longer dry seasons and multi-year droughts, creating triggers for wildfires, insects, and invasive species. Increased temperature and change in precipitation will also affect fuel moisture during wildfire season and the length of time during while wildfires can burn during a given year (U.S. Department of Agriculture [USDA] 2012). Climate change may also increase the frequency of lightning flashes. A warmer atmosphere holds more moisture which is one of the key items for triggering a lightning strike. Lightning strikes cause approximately half the wildfires in the United States. If the frequency of lightning strikes increases, the potential for wildfires from these strikes also increases (Lee 2014). Wildfire incidents are predicted to increase throughout the United States due to climate change, causing at least a doubling of areas burned within the next century (USDA 2012).

By the 2020s, the average annual temperature in New Jersey is projected to increase by 1.5°F to 3°F above the statewide baseline (1971 to 2000), which was 52.7°F. By 2050, the temperature is projected to increase 3°F to 5°F (Sustainable Jersey Climate Change Adaptation Task Force 2013). As for precipitation, Northern New Jersey's 1971-2000 precipitation average was over five inches (12%) greater than the average from 1895-1970 (Office of New Jersey State Climatologist). Average annual precipitation is projected to increase in the region up to 10% by the 2020s and up to 15% by the 2050s. Most of the additional precipitation is expected to come during the winter months (New York City Panel on Climate Change [NPCC] 2013).

As stated above, according to the temperature projections for Northern New Jersey, including Sussex County, this area can expect warmer and drier conditions which may increase the frequency and intensity of wildfires. Higher temperatures are expected to increase the amount of moisture that evaporates from land and water. These changes have the potential to lead to more frequent and severe droughts, which, in turn, increases the likelihood of wildfires (U.S. EPA 2014; Northern Arizona University 2012).

5.4.10.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the wildfire hazard, the portions of Sussex County in the NJFFS Wildfire Fuel Hazard 'high', 'very high' and 'extreme' areas are identified as the wildfire hazard area. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), located in the hazard area are exposed and potentially vulnerable to wildfire. The following text evaluates and estimates the potential impact of the wildfire hazard on the County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2011 Sussex County HMP
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

Wildfire hazards can impact significant areas of land, as evidenced by wildfires throughout the State of New Jersey and United States over the past several years. Fire in urban areas has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas. Wildfire, however can spread quickly, become a huge fire complex consisting of thousands of acres, and present greater challenges for allocating resources, defending isolated structures, and coordinating multi-jurisdictional response. If a wildfire occurs at a WUI, it can also cause an urban fire and in this case has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas.

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Given the immediate response times to reported wildfires, the likelihood of injuries and casualties is minimal. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding caused by the impacts of silt in local watersheds.

Data and Methodology

The NJFFS uses Wildfire Fuel Hazard data to assign wildfire fuel hazard rankings across the State. This data, developed in 2009, is based upon NJDEP's 2002 Land Use/Land Cover datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. Figure 5.4.10-1 presented earlier in this section illustrates the defined wildfire fuel hazard rankings for Sussex County. For the wildfire hazard, the NJFFS Wildfire Fuel Hazard "extreme', 'very high' and 'high' areas are identified as the wildfire hazard area. The statistics in the 'moderate' to 'low' areas are also reported below.

To determine vulnerability, a spatial analysis was conducted using the NJFFS Fuel Hazard Area guidelines. When the analysis determined the hazard area would impact an area in a jurisdiction, or the location of critical facilities, these locations were deemed vulnerable to the hazard. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

Impact on Life, Health and Safety

As demonstrated by historic wildfire events in New Jersey and other parts of the country, potential losses include impacts to human health and life of residents and responders, structures, infrastructure and natural resources. In addition, wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment.

Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

As a way to estimate the County's population vulnerable to the wildfire hazard, the population located within the NJFFS hazard areas were overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center within the high/very high/extreme hazard area were used to calculate the estimated population exposed to the wildfire hazard. Population located in the moderate and low zones are reported as well. Table 5.4.10 -5 summarizes the estimated population exposed by municipality.

Based on the analysis, an estimated 11,033 people, or 7.4% of the County's population, is located in the high, very high and extreme wildfire hazard area. Overall, the Township of Montague, Township of Sandyston, and Township of Hardyston have the greatest number of individuals located in the extreme/very high/high hazard areas.

Table 5.4.10-5. Estimated Population Located in the NJFFS Fuel Hazard Areas

Municipality	US. Census 2010 Population	Estimated Population Exposed			
		Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Borough of Andover	606	0	0.0%	175	28.9%
Township of Andover	6,319	232	3.7%	3,523	55.8%
Borough of Branchville	841	0	0.0%	381	45.3%
Township of Byram	8,350	156	1.9%	4,816	57.7%
Township of Frankford	5,565	931	16.7%	3,446	61.9%
Borough of Franklin	5,045	515	10.2%	1,329	26.3%
Township of Fredon	3,437	612	17.8%	1,772	51.6%
Township of Green	3,601	395	11.0%	1,918	53.3%
Borough of Hamburg	3,277	305	9.3%	870	26.5%
Township of Hampton	5,196	147	2.8%	3,917	75.4%
Township of Hardyston	8,213	1,766	21.5%	4,138	50.4%
Borough of Hopatcong	15,147	0	0.0%	4,359	28.8%
Township of Lafayette	2,538	237	9.3%	1,588	62.6%
Township of Montague	3,847	892	23.2%	1,928	50.1%
Town of Newton	7,997	0	0.0%	2,446	30.6%
Borough of Ogdensburg	2,410	90	3.7%	912	37.8%
Township of Sandyston	1,998	436	21.8%	1,176	58.9%
Township of Sparta	19,722	872	4.4%	11,913	60.4%
Borough of Stanhope	3,610	8	<1%	400	11.1%
Township of Stillwater	4,099	545	13.3%	2,238	54.6%

Table 5.4.10-5. Estimated Population Located in the NJFFS Fuel Hazard Areas

Municipality	US. Census 2010 Population	Estimated Population Exposed			
		Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Borough of Sussex	2,130	0	0.0%	384	18.0%
Township of Vernon	23,943	1,924	8.0%	12,298	51.4%
Township of Walpack	16	0	0.0%	15	93.8%
Township of Wantage	11,358	970	8.5%	6,623	58.3%
Sussex County Total	**149,265**	**11,033**	**7.4%**	**72,565**	**48.6%**

Source: 2010 US Census, NJFFS 2015

Impact on General Building Stock

The most vulnerable structures to wildfire events are those located within the NJFFS identified extreme, very high or high fuel hazard areas. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. To estimate the buildings exposed to the wildfire hazard, the hazard areas were overlaid upon the custom building inventory in the County. The improvement value of the structures with their center in the hazard area were totaled. Table 5.4.10-6 summarizes the estimated building stock inventory exposed by municipality. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

Table 5.4.10-6. Buildings Located in Wildfire Fuel Hazard Zones

Municipality	Total Number of Structures	Total Improved Value (Structure and Estimated Contents)	Number of Structures Exposed				Building Improved Value Exposed			
			Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed	Extreme, Very High and High	% of Total Exposed	Moderate and Low	% of Total Exposed
Borough of Andover	257	$182,562,894	2	<1%	55	21.4%	$1,345,767	<1%	$36,527,564	20.0%
Township of Andover	2,248	$1,259,872,091	93	4.1%	756	33.6%	$85,352,230	6.8%	$567,081,072	45.0%
Borough of Branchville	353	$174,318,470	2	<1%	53	15.0%	$1,035,772	<1%	$24,268,367	13.9%
Township of Byram	3,401	$1,543,404,464	16	<1%	869	25.6%	$10,536,361	<1%	$440,177,839	28.5%
Township of Frankford	2,716	$1,653,244,645	105	3.9%	1,227	45.2%	$106,366,352	6.4%	$786,832,232	47.6%
Borough of Franklin	1,630	$881,717,214	30	1.8%	143	8.8%	$19,252,499	2.2%	$91,265,580	10.4%
Township of Fredon	1,236	$842,171,127	105	8.5%	736	59.5%	$81,432,841	9.7%	$502,012,283	59.6%
Township of Green	1,280	$962,383,257	93	7.3%	634	49.5%	$85,197,298	8.9%	$557,603,621	57.9%
Borough of Hamburg	1,464	$747,007,403	42	2.9%	42	2.9%	$32,280,095	4.3%	$29,312,170	3.9%
Township of Hampton	2,143	$1,398,457,332	53	2.5%	894	41.7%	$49,421,978	3.5%	$584,096,287	41.8%
Township of Hardyston	3,731	$1,652,499,901	257	6.9%	814	21.8%	$137,125,045	8.3%	$465,356,617	28.2%
Borough of Hopatcong	6,378	$2,224,090,408	14	<1%	293	4.6%	$10,988,987	<1%	$162,395,688	7.3%
Township of Lafayette	1,020	$802,389,890	68	6.7%	564	55.3%	$66,236,221	8.3%	$431,297,639	53.8%
Township of Montague	1,972	$858,431,631	227	11.5%	613	31.1%	$116,618,913	13.6%	$294,556,886	34.3%
Town of Newton	2,320	$1,504,040,803	4	<1%	110	4.7%	$2,455,940	<1%	$72,641,940	4.8%
Borough of Ogdensburg	915	$390,034,452	17	1.9%	60	6.6%	$8,743,647	2.2%	$32,528,377	8.3%
Township of Sandyston	1,136	$588,862,570	113	9.9%	558	49.1%	$62,747,631	10.7%	$306,462,047	52.0%
Township of Sparta	7,447	$4,731,600,744	156	2.1%	2,116	28.4%	$109,041,519	2.3%	$1,513,321,708	32.0%
Borough of Stanhope	1,468	$859,784,777	1	<1%	97	6.6%	$655,396	<1%	$63,487,442	7.4%
Township of Stillwater	1,871	$931,811,957	71	3.8%	829	44.3%	$48,558,461	5.2%	$467,162,675	50.1%
Borough of Sussex	579	$424,677,833	2	<1%	21	3.6%	$1,034,252	<1%	$16,210,669	3.8%
Township of Vernon	11,280	$4,759,388,701	209	1.9%	2,829	25.1%	$143,230,061	3.0%	$1,602,814,658	33.7%
Township of Walpack	25	$16,093,258	7	28.0%	15	60.0%	$4,130,648	25.7%	$9,712,129	60.3%
Township of Wantage	4,156	$2,250,158,879	252	6.1%	2,215	53.3%	$143,771,815	6.4%	$1,192,258,390	53.0%
Sussex County Total	**61,026**	**$31,639,004,702**	**1,939**	**3.2%**	**16,543**	**27.1%**	**$1,327,559,728**	**4.2%**	**$10,249,383,882**	**32.4%**

Source: Sussex County; NJ Department of the Treasury, 2015; NJFFS 2015

Impact on Critical Facilities

It is recognized that a number of critical facilities are located in the wildfire hazard area, and are also vulnerable to the threat of wildfire. Many of these facilities are the locations for vulnerable populations (i.e., schools, senior facilities) and responding agencies to wildfire events (i.e., fire, police). Table 5.4.10-6 and 5.4.10-7 summarize the critical facilities located within the wildfire fuel hazard ranking zones by jurisdiction.

Table 5.4.10-7. Facilities in Extreme, Very High, or High Wildfire Fuel Hazard Ranking Zones in Sussex County

Municipality	Facility Types			
	Dam	Government Building	Public Health	Potable Pump
Borough of Andover	1	0	0	0
Township of Andover	1	0	0	0
Borough of Branchville	0	0	0	0
Township of Byram	2	0	0	0
Township of Frankford	0	0	0	0
Borough of Franklin	0	0	0	0
Township of Fredon	2	0	0	0
Township of Green	0	0	0	0
Borough of Hamburg	0	0	0	0
Township of Hampton	1	0	0	0
Township of Hardyston	0	1	0	1
Borough of Hopatcong	0	0	0	0
Township of Lafayette	0	0	0	0
Township of Montague	0	0	0	0
Town of Newton	0	0	0	0
Borough of Ogdensburg	1	0	0	0
Township of Sandyston	2	0	0	0
Township of Sparta	3	0	1	0
Borough of Stanhope	0	0	0	0
Township of Stillwater	0	0	0	0
Borough of Sussex	0	0	0	0
Township of Vernon	3	0	0	0
Township of Walpack	0	0	0	0
Township of Wantage	0	0	0	0
Sussex County Total	**16**	**1**	**1**	**1**

Source: NJFFS 2015; Sussex County, NJDEP

Table 5.4.10-8. Facilities in Moderate and Low Wildfire Fuel Hazard Ranking Zones in Sussex County

Municipality	Facility Types														
	Communication	Dam	DPW	Emergency Operation Center	Fire Station	Government Building	Municipal Hall	Police Station	Potable Pump	School	Senior	Shelter	Substation	Wastewater Pump	Well
Borough of Andover	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Township of Andover	2	12	1	0	1	0	0	0	1	0	0	0	0	1	0
Borough of Branchville	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Byram	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Frankford	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Borough of Franklin	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0
Township of Fredon	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Green	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Hamburg	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Township of Hampton	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0
Township of Hardyston	0	8	0	1	0	0	0	0	0	0	0	0	0	0	0
Borough of Hopatcong	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0
Township of Lafayette	0	2	1	1	0	0	0	1	0	0	0	0	1	0	0
Township of Montague	0	6	1	0	0	0	0	0	0	0	0	0	0	1	0
Town of Newton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Ogdensburg	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Sandyston	0	12	1	0	0	0	0	0	0	0	0	0	0	0	0
Township of Sparta	0	15	0	0	0	0	0	0	0	0	0	0	0	1	0
Borough of Stanhope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Stillwater	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0
Borough of Sussex	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Township of Vernon	0	30	1	0	0	0	0	0	0	0	0	0	0	0	0
Township of Walpack	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Township of Wantage	0	5	1	1	0	1	0	0	0	0	0	0	0	0	0
Sussex County Total	**4**	**122**	**8**	**3**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**6**	**1**

Source: NJFFS 2015; Sussex County; NJDEP
Note: DPW – Department of Public Works
EMS – Emergency Medical Services

Impact on Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from working to fight these fires.

Future Growth and Development

Areas targeted for potential future growth and development in the next five years have been identified across Sussex County at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. It is anticipated that any new development and new residents in the extreme, very high or high fuel hazard areas will be exposed to the wildfire hazard (refer to Figure 5.4.10-3 below).

Effect of Climate Change on Vulnerability

According to the U.S. Fire Service (USFS), climate change will likely alter the atmospheric patterns that affect fire weather. Changes in fire patterns will, in turn, impact carbon cycling, forest structure, and species composition. Climate change associated with elevated greenhouse gas concentrations may create an atmospheric and fuel environment that is more conductive to large, severe fires (USFS, 2011). Under a changing climate, wildfires are expected to increase by 50% across the U.S. (USFS, 2013).

Fire interacts with climate and vegetation (fuel) in predictable ways. Understanding the climate/fire/vegetation interactions is essential for addressing issues associated with climate change that include:

- Effects on regional circulation and other atmospheric patterns that affect fire weather
- Effects of changing fire regimes on the carbon cycle, forest structure, and species composition, and
- Complications from land use change, invasive species and an increasing wildland-urban interface (USFS, 2011).

It is projected that higher summer temperatures will likely increase the high fire risk by 10 to 30-percent. Fire occurrence and/or area burned could increase across the U.S. due to the increase of lightning activity, the frequency of surface pressure and associated circulation patterns conductive to surface drying, and fire-weather conditions, in general, which is conductive to severe wildfires. Warmer temperatures will also increase the effects of drought and increase the number of days each year with flammable fuels and extending fire seasons and areas burned (USFS, 2011).

Future changes in fire frequency and severity are difficult to predict. Global and regional climate changes associated with elevated greenhouse gas concentrations could alter large weather patterns, thereby affecting fire-weather conducive to extreme fire behavior (USFS, 2011).

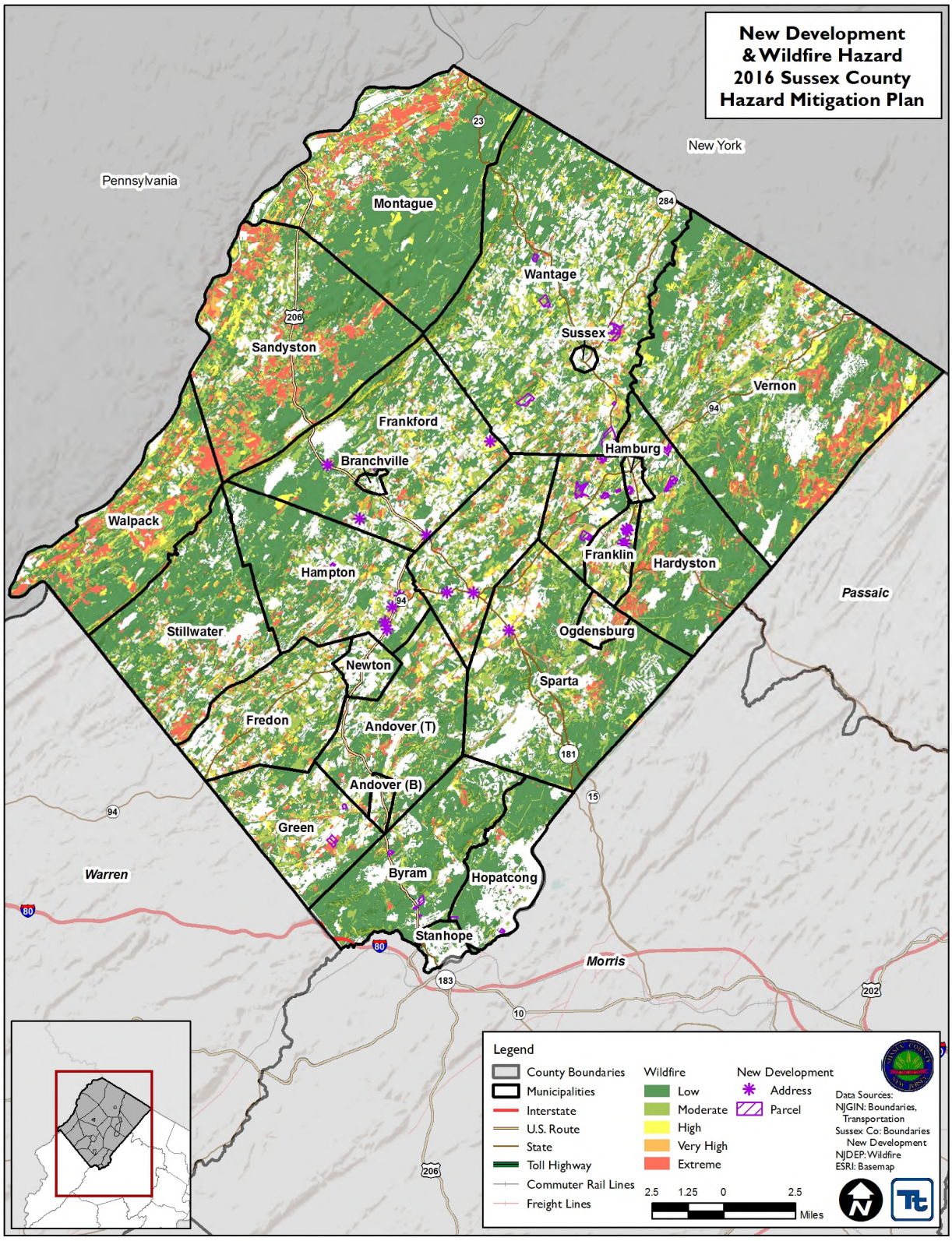
Change of Vulnerability

A wildfire exposure analysis was conducted as part of the 2011 HMP risk assessment. For the 2011 HMP, spatial data from the LANDFIRE project was used to conduct the exposure analysis. The spatial data is generated at 30-meter resolution, so a County-wide analysis was conducted. For the 2016 Update, Wildfire Fuel Hazard data from NJDEP was utilized to conduct the exposure analysis at the municipal level. The 2016 Update also used 2010 Census data, 2015 MODIV tax data, and an updated critical facility inventory. Overall, the updated vulnerability assessment provides a more current exposure analysis for the County.

Additional Data and Next Steps

As the custom building inventory is updated additional building attributes regarding the construction of structures, such as roofing material, fire detection equipment, structure age, etc. may be incorporated as available. As stated earlier, buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. The proximity of these building types to the fuel hazard areas should be identified for further evaluation. Development and availability of such data would permit a more detailed estimate of potential vulnerabilities, including loss of life and potential structural damages.

Figure 5.4.10-3. Potential New Development and Wildfire Hazard



Source: NJDEP, Sussex County