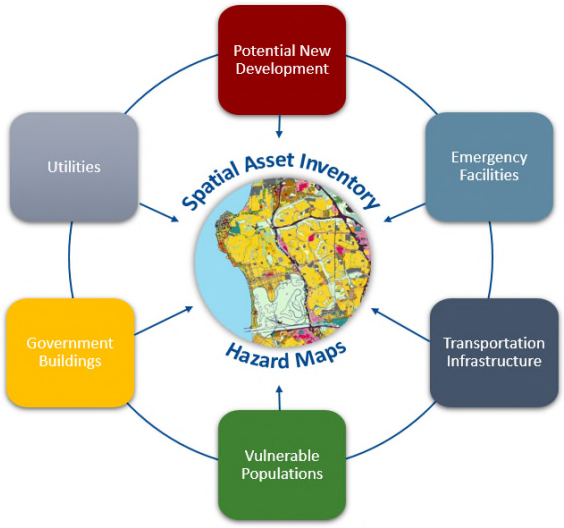
# 4.2 METHODOLOGY AND TOOLS

## 2020 HMP Changes

- The risk assessment was updated using best available information.
- The 2013-2017 American Community Survey 5-year estimates were utilized.
- Building footprints provided by Morris County Office of Information Technology (OIT) supplemented by Microsoft Bing footprints, updated parcels and RS Means 2019-dollar values were used to develop a structure-level building inventory and estimate replacement cost value for each building.
- The 2015 critical facility was reviewed and updated by using Morris County data and input from municipal partners.
- Lifelines were identified in the critical facility inventory to align with FEMA's lifeline definition.
- HAZUS-MH v4.2 was used to estimate potential impacts to the flood, wind and seismic hazards.
- Best available hazard data was used as described in this section.

## 4.2.1 Asset Inventories

Morris County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the HMP update, Morris County assessed vulnerability of the following types of assets: population, buildings and critical facilities/infrastructure and the environment. Some assets may be more vulnerable because of their physical characteristics or socioeconomic uses. To protect individual privacy and the security of critical facilities and community lifelines, information on properties assessed is presented in aggregate, without details about specific individual personal or public properties.




**The risk assessment included the collection and use of an expanded and enhanced asset inventory to estimate hazard exposure and vulnerability.**

### Population

Total population statistics from the 2013-2017 American Community Survey 5-year estimate were used to estimate the impacts to the County's population in place of the 2010 U.S. Census block estimates for the exposure analysis. Population counts at the Census tract level were averaged among the residential structures in the County to estimate the population at the structure level. This estimates a more precise distribution of population around the County than using the census block or census tract boundaries. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate.

FEMA's HAZUS-MH program was used to model estimate potential losses to flood, seismic and wind hazards; as discussed further later in this section. HAZUS-MH contains 2010 U.S. Census data and was used to estimate sheltering and injuries as part of the hazard analysis.

Research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard. This population is referred to as socially

vulnerable to hazard events. For the purposes of this planning process, vulnerable populations in Morris County include children, elderly, population below the poverty level, the physically or mentally disabled, non-English speakers and the medically or chemically dependent.

## Buildings

The general building stock was updated countywide with a custom-building inventory. To develop the building inventory, updated building footprints provided by Morris County and parcels from the 2018 MODIV tax assessor data obtained from the New Jersey Geographic Information Network Open Data portal were used. Where needed, the Microsoft Bing 2018 building footprints were used where data gaps existed. Attributes provided in the spatial files were used to further define each structure in terms of occupancy class, construction type, etc. The centroid of each building footprint was used to estimate the building location. Structural and content replacement cost values (RCV) were calculated for each building utilizing available assessor data and RSMeans 2019 values; a regional location factor for Morris County was applied (1.19 for residential structures; 1.15 for non-residential structures). Replacement cost value is the current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials. Total replacement cost value consists of both the structural cost to replace a building and the estimate value of contents of a building. The occupancy classes available in HAZUS-MH v4.2 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, governmental, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single-family dwellings.

## Critical Facilities and Lifelines

The 2015 HMP critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities was updated by Morris County and municipal partners. The update involved a review for accuracy, additions or deletions of new/moved critical assets, identification of backup power for each asset (if known) and whether the critical facility is considered a lifeline in accordance with FEMA's definition; refer to Appendix E (Risk Assessment Supplement). To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

*A **lifeline** provides indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security (FEMA).*

## Environment

The New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), and the Bureau of Geographic Information Systems (BGIS) updated their 2012 Land-Use/Land Cover data in 2015 to delineate the land-use and land cover areas in the County. Version 3.3 of the NJDEP's Landscape Project released in May 2017 was used to delineate the areas of critical habitats for endangered species in the State. The Landscape Project combines documented wildlife locations with NJDEP aerial photo-based 2012 Land Use/Land Cover (LULC) to delineate imperiled and special concern species habitat within New Jersey. Many species occurrence locations cannot be published because they may represent nest sites, roost sites, dens and other sites used by species that are vulnerable to human disturbance and, in some cases, susceptible to illegal collection. At the same time, wildlife moves, as individual animals use various habitat features within the landscape to fulfill their foraging, sheltering and breeding needs. Therefore, protecting individual occurrences or the area used by one individual is generally not sufficient to protect the local population. Landscape Project maps address these issues by displaying habitat patches that animals use and that are required to support local populations, rather than pinpointing exact locations of the most sensitive wildlife sites or simply protecting points where species happened to be observed at one point in time.

### New Development

In addition to assessing the vulnerability of the built environment, Morris County examined recent and anticipated new development. Each jurisdiction was asked to provide a list by parcel ID or address of major development that has taken place over the last 5 years and anticipated major development over the next 5 years. An exposure analysis was conducted in GIS to determine hazard exposure. Identifying these changes and integrating into the risk assessment provides communities information to consider when developing the mitigation strategy to reduce these vulnerabilities in the future (one tool in the Mitigation Toolbox discussed in Section 6 – Mitigation Strategy). The identified new development is listed in Section 9 (Jurisdictional Annexes) as a table in each annex.

## 4.2.2 Methodology

To address the requirements of the DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Morris County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Three different levels of analysis were used depending upon the data available for each hazard as described below. Table 4.2-1 summarizes the type of analysis conducted by hazard of concern.

1) **Historic Occurrences and Qualitative Analysis** – This analysis includes an examination of historic impacts to understand potential impacts of future events of similar size. In addition, potential impacts and losses are discussed qualitatively using best available data and professional judgement.

2) **Exposure Assessment** – This analysis involves overlaying available spatial hazard layers, or hazards with defined extent and locations, with assets in GIS to determine which assets are located in the impact area of the hazard. The analysis highlights which assets may be affected by the hazard. If the center of each asset is located in the hazard area, it is deemed exposed and potentially vulnerable to the hazard.

3) **Loss estimation** — The FEMA Hazus modeling software was used to estimate potential losses for the following hazards: Flood, Earthquake, Hurricane. In addition, an examination of historic impacts and an exposure assessment was conducted for these spatially-delineated hazards.

**Table 4.2-1. Summary of Risk Assessment Analyses**

| Hazard | Data Analyzed | | | | |
|---|---|---|---|---|---|
| | Population | General Building Stock | Critical Facilities | Environment | New Development |
| Dam and Levee Failure | Q | Q | Q | Q | Q |
| Disease Outbreak | Q | Q | Q | Q | Q |
| Drought | Q | Q | Q | Q | Q |
| Earthquake | E, H | E, H | E, H | Q | E |
| Extreme Temperatures | Q | Q | Q | Q | Q |
| Flood | E, H | E, H | E, H | E | E |
| Geological Hazards | E | E | E | Q | E |
| Harmful Algal Bloom | Q | Q | Q | Q | Q |
| Hazardous Substances | Q | Q | Q | Q | Q |
| Infestation | Q | Q | Q | Q | Q |
| Severe Weather | Q | Q | Q | Q | Q |

| Hazard | Data Analyzed | | | | |
|---|---|---|---|---|---|
| | Population | General Building Stock | Critical Facilities | Environment | New Development |
| Severe Winter Weather | Q | E, Q | Q | Q | Q |
| Wildfire | E | E | E | Q | E |

*E – Exposure analysis; H – Hazus analysis; Q – Qualitative analysis*

## Hazards U.S. – Multi-Hazard (HAZUS-MH)


In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. or HAZUS. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard methodology, HAZUS-MH with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations, which have been developed by hazard and information technology experts, to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, HAZUS-MH uses default HAZUS-MH provided data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. HAZUS-MH's open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage. More information on HAZUS-MH is available at http://www.fema.gov/hazus.

In general, probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for the flood, wind and seismic hazards. The probabilistic model generates estimated damages and losses for specified return periods (e.g., 100- and 500-year). For annualized losses, HAZUS-MH calculates the maximum potential annual dollar loss resulting from various return periods averaged on a "per year" basis. It is the summation of all HAZUS-supplied return periods (e.g., 10, 50, 100, 200, 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard each year is calculated. Table 4.2-2 displays the various levels of analyses that can be conducted using the HAZUS-MH software.

### Table 4.2-2. Summary of HAZUS-MH Analysis Levels

| HAZUS-MH Analysis Levels | |
|---|---|
| Level 1 | HAZUS-MH provided hazard and inventory data with minimal outside data collection or mapping. |

| HAZUS-MH Analysis Levels | |
|---|---|
| Level 2 | Analysis involves augmenting the HAZUS-MH provided hazard and inventory data with more recent or detailed data for the study region, referred to as "local data" |
| Level 3 | Analysis involves adjusting the built-in loss estimation models used for the hazard loss analyses. This Level is typical done in conjunction with the use of local data. |

## Dam Failure

A qualitative analysis was conducted for the dam failure hazard. For security reasons, these asset locations and downstream inundation due to a failure are not displayed on maps or discussed in this plan.

## Disease Outbreak

A qualitative analysis was conducted for the disease outbreak hazard.

## Drought

To assess the vulnerability of Morris County to drought and its associated impacts, a qualitative assessment was conducted. The United States Department of Agriculture (USDA) Census of Agriculture 2017 was used to estimate economic impacts. Information regarding the number of farms, land area in farms, total market value of products sold, etc. was extracted from the report and summarized in the vulnerability assessment. Additional resources from the Center for Disease Control and the U.S. Environmental Protection Agency were used to assess the potential impacts to the population from a drought event.

## Earthquake

A probabilistic assessment was conducted for Morris County for the 100-, 500- and 2,500-year MRPs through a Level 2 analysis in HAZUS-MH v4.2 to analyze the earthquake hazard and provide a range of loss estimates. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract.

> As noted in the HAZUS-MH Earthquake User Manual, "*Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS Earthquake Model, possibly at best by a factor of two or more*" (FEMA 2015f). However, HAZUS' potential loss estimates are acceptable for the purposes of this HMP.

Ground shaking is the primary cause of earthquake damage to man-made structures and soft soils amplify ground shaking. One contributor to the site amplification is the velocity at which the rock or soil transmits shear waves (S-waves). The National Earthquake Hazard Reductions Program (NEHRP) has developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses.

An exposure analysis was also conducted for the County's assets (population, building stock, critical facilities, and new development) using the NEHRP soil data and liquefaction susceptibility data. NEHRP Soil Classes

Type D and Type E and liquefaction susceptibility Class 4 were used to determine what assets are more vulnerable to seismic activity. Assets with their centroid in the hazard areas were totaled to estimate the numbers and values located on these soil types.

Data from the New Jersey Geologic and Water Survey was used in HAZUS-MH v4.2 to replace default NEHRP and liquefaction susceptibility conditions. Groundwater was set at depth of five (5) feet (default setting). The default assumption is a magnitude 7.0 earthquake for all return periods. Damage and loss due to liquefaction, landslide, or surface fault rupture were not included in this analysis. Although damages are estimated at the census tract level, results were presented at the municipal level.

Damage estimates are calculated for losses to buildings (structural and non-structural) and contents; structural losses include load carrying components of the structure, and non-structural losses include those to architectural, mechanical, and electrical components of the structure, such as nonbearing walls, veneer and finishes, HVAC systems, boilers, etc. For census tracts encompassing multiple municipalities, the default general building stock inventory was used to calculate the percent of the total census tract replacement cost value in each municipality. This percentage was applied to the census tract losses to estimate the municipal-level losses. For example, two municipalities are located within one census tract. The total replacement cost value of Municipality A is 90% of the total census tract replacement cost value, while Municipality B is 10% of the total value. Therefore, 90% of the losses for the census tract will be applied to Municipality A, and 10% will be applied to Municipality B.

## Extreme Temperatures

A qualitative assessment was conducted for the extreme temperatures hazard. Information from the Center for Disease Control, Morris County, and municipal partners were used to assess the potential impacts to the County's assets.

## Flood

The 1- and 0.2-percent chance flood events were examined to evaluate Morris County's risk and vulnerability to the riverine flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

The preliminary Morris County FEMA Digital Flood Insurance Rate Map (DFIRM) dated August 2017 was used to evaluate exposure and determine potential future losses. Depth grids were generated using the preliminary DFIRM and 10-foot resolution Digital Elevation Model (DEM) provided by NJ DEP and integrated into the HAZUS-MH v4.2 riverine flood model used to estimate potential losses for the 1-percent annual chance flood event.

To estimate exposure to the 1-percent- and 0.2-percent annual chance flood events, the DFIRM flood boundaries, updated assets (population, building stock, critical facilities, and new development) with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to a flooding event. A Level 2 HAZUS-MH v4.2 riverine flood analysis was performed. Both the critical facility and building inventories were formatted to be compatible with HAZUS-MH v4.2 and its Comprehensive Data Management System (CDMS). Once updated with the inventories, the HAZUS-MH v4.2 riverine flood model was run to estimate potential losses in Morris County for the 1-percent annual chance flood event. A user-defined analysis was performed for the building stock; buildings located within the floodplain were imported as user-defined facilities to estimate potential losses to the building stock at the structural level. HAZUS-MH v4.2 calculated the estimated potential losses to the population (default 2010 U.S. Census data) and potential damages to the general building stock and critical facility inventories based on the depth grid generated and the default HAZUS-MH v4.2 damage functions in the flood model.

The NFIP policies, claims, and repetitive and severe repetitive loss properties were examined.

All municipal participants were asked to identify areas that flood outside the FEMA delineated floodplain to map 'urban flooding.' When provided, this information was included in GIS, summarized in Section 4.3.6 and used to inform the mitigation strategy.

Areas of forests, wetlands, and critical habitat landscapes located within the 1- and 0.2-percent annual chance flood event boundaries were also calculated to estimate impacts on the environment. The boundaries of these areas were intersected with the floodplains in ArcGIS to calculate the areas exposed to the 1- and 0.2-percent annual chance flood events.

#### 4.2.2.1 Geological Hazards

The New Jersey Geologic and Water Survey (NJGWS) delineated a landslide susceptibility layer that differentiates areas based on the ground surface and slope. This layer was updated in July 2016 and utilized for this analysis. The categories are defined as follows:

- Class A
  - AI – Strongly cemented rock; slope angle of 15-20 degrees
  - AII – Strongly cemented rock; slope angle of 20-20 degrees
  - AIV – Strongly cemented rock; slope angle of 30-40 degrees
  - AVI – Strongly cemented rock; slope angle of greater than 40 degrees
- Class B
  - BIII – Weakly cemented rock and sandy soil; slope angle of 10-15 degrees
  - BIV – Weakly cemented rock and sandy soil; slope angle of 15-20 degrees
  - BV – Weakly cemented rock and sandy soil; slope angle 20-30 degrees
- Class C
  - CVI – Shales and clayey soil; slope angle of 10-15 degrees
  - CVII – Shales and clayey soil; slope angle of 15-20 degrees
  - CIX – Shales and clayey soil; slope angle of 20-40 degrees if dry or 10-15 degrees if groundwater at surface
  - CX – Shales and clayey soil, groundwater at surface; slope angle greater than 15 degrees

To determine what assets are exposed to landslide, the County's assets were overlaid with the hazard area. Assets with their centroid located in the hazard area were totaled to estimate the number (or count) and replacement cost values exposed to a hazard event.

#### Harmful Algal Blooms Hazards

A qualitative assessment was conducted for the harmful algal blooms hazard.

#### Hazardous Substances Hazards

A qualitative assessment was conducted for the hazardous substances hazard.

#### Infestation Hazards

A qualitative assessment was conducted for the infestation hazard.

## Severe Weather

All of Morris County is exposed to severe weather events. Additionally, a HAZUS-MH v4.2 probabilistic analysis was performed to analyze the wind hazard losses for Morris County. The probabilistic HAZUS-MH hurricane hazard activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with Morris County. HAZUS-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Default demographic and updated building and critical facility inventories in HAZUS-MH v4.2 were used for the analysis. A qualitative assessment was conducted for the remainder of the severe weather hazards. Information from Morris County and municipal partners were used to assess the potential impacts to the County's assets.

## Severe Winter Storm

All of Morris County is exposed to severe winter storm events. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A percentage of the custom-building stock structural replacement cost value was utilized to estimate damages that could result from winter storm conditions. Given professional knowledge and the currently available information, the potential losses for this hazard are considered to be overestimated; hence, providing a conservative estimate for losses associated with winter storm events.

## Wildfire

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. For the wildfire hazard, the NJFFS Wildfire Fuel Hazard "extreme', 'very high' and 'high' areas are identified as the wildfire hazard area. The defined hazard area was overlaid upon the asset data (population, building stock, critical facilities and potential new development) to estimate the exposure to each hazard.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, the County's assets were overlaid with the hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to a wildfire event.

## Considerations for Mitigation and Next Steps

The following items are to be discussed for considerations for the next plan update to enhance the vulnerability assessment:

- All Hazards
  - Utilize updated and current demographic data. If 2020 U.S. Census demographic data is available, use this data to generate more accurate hazard exposure to the Morris County residents.
- Dam Failure
  - Updated dam failure inundation areas to estimate assets exposed to this hazard.
- Flood
  - General building stock inventory can be updated to include attributes regarding first floor elevation and foundation type (basement, slab on grade, etc.) to enhance loss estimates.

  - Utilize the effective DFIRM, when the preliminary DFIRMs are completed and adopted, if there are any changes to the flood hazard delineation.
  - Conduct a HAZUS-MH loss analysis for more frequent flood events (e.g., 10 and 50-year flood events).
- Earthquake
  - Identify unreinforced masonry in critical facilities and privately-owned buildings (i.e., residences) by accessing local knowledge, tax assessor information, and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes and plans to provide emergency response/recovery efforts at these properties can be developed.
- Extreme Temperature
  - Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of most at risk areas.
- Geological Hazards
  - A pilot study conducted in Schenectady County, NY (Landslide Susceptibility – A Pilot Study of Schenectady County, NY) provided a detailed methodology for delineating high-risk landslide areas. This study looked at a variety of environmental characteristics including slope and soil conditions to determine areas at risk to landslide. To coincide with the methodology of that study, the generated slopes were categorized into five classes: 0%-2%; 3%-7%; 8%-15%; 16%-25%; Greater than 25%. Should the County determine the need for a more detailed assessment of risk, the slopes greater than 25% should be used to delineate the hazard area for the vulnerability assessment. Additional environmental and soil characteristics used in the Schenectady County plan can be collected and used to follow the methodology used to further delineate the County's most at risk areas.

- Severe Weather
  - General building stock inventory can be updated to include attributes regarding protections against strong winds, such as hurricane straps, to enhance loss estimates.
- Severe Winter Storm
  - If available for the region, obtain average snowfall distributions to determine if various areas in the County have historically received higher snowfalls and may continue to be more susceptible to higher snowfalls and snow loads on the building stock and critical facilities and infrastructure.
- Wildfire
  - General building stock inventory can be updated to include attributes such as roofing material or fire detection equipment.

### 4.2.3 Data Source Summary

Table 4.2-3 summarizes the data sources used for the risk assessment for this plan.

**Table 4.2-3. Risk Assessment Data Documentation**

| Data | Source | Date | Format |
|---|---|---|---|
| Population data | U.S. Census Bureau; American Community Survey 5-year Summary | 2010; 2017 | Digital (GIS) format |
| Building footprints | Morris County OIT; Microsoft Bing | 2019; 2018 | Digital (GIS) format |
| MODIV Tax Assessor data | NJ Office of Information Technology | 2018 | Digital (GIS/Tabular) format |

| Data | Source | Date | Format |
|---|---|---|---|
| Critical facilities | Morris County | 2019 | Digital (GIS) format |
| Morris County preliminary DFIRM maps | FEMA | 2017 | Digital (GIS) format |
| NEHRP Soil | NJDEP/NJGWS | 2015 | Digital (GIS) format |
| Liquefaction Susceptibility | NJDEP/NJGWS | 2015 | Digital (GIS) format |
| Landslide Susceptibility | NJDEP/NJGWS | 2015 | Digital (GIS) format |
| Carbonate Hazard Area | NJDEP | 2006 | Digital (GIS) format |
| Wildfire Fuel Hazard | NJFFS | 2009 | Digital (GIS) format |
| Future projected flood inundation extents | North Jersey Transportation Planning Authority (NJTPA) | 2019 | Digital (GIS) format |
| Census of Agriculture | USDA | 2017 | Digital (PDF Report) format |
| 10-foot Resolution Digital Elevation Model | NJ DEP | 2016 | Digital (GIS) Format |

*DFIRM* *Digital Flood Insurance Rate Map*
*FEMA* *Federal Emergency Management Agency*
*GIS* *Geographic Information System*
*NJDEP* *New Jersey Department of Environmental Protection*
*NJFFS* *New Jersey Forest Fire Service*
*NJGWS* *New Jersey Geological and Water Survey*
*USDA* *United States Department of Agriculture*

## Limitations

For this risk assessment, the loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct such a study
- Incomplete or dated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed by the participating municipalities
- The amount of advance notice residents have to prepare for a specific hazard event

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Morris County will collect additional data to update and refine existing inventories, to assist in estimating potential losses.

Potential economic loss is based on the present value of the general building stock utilizing best available data. The County acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events causing great economic loss. However, monetized damage estimates to critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.