5.1 METHODOLOGY AND TOOLS

A risk assessment is the process of measuring the potential loss of life, personal injury, and economic and property damage resulting from identified hazards. Identifying potential hazards and vulnerable assets allows planning personnel to address and reduce hazard impacts and emergency management personnel to establish early response priorities. Results of the risk assessment are used in subsequent mitigation planning processes, including determining and prioritizing mitigation actions that reduce each jurisdiction's risk to a specified hazard. Past, present, and future conditions must be evaluated to most accurately assess risk for the county and each jurisdiction. The process focuses on the following elements:

- **Hazard identification –** Use all available information to determine what types of hazards may affect a jurisdiction.
- **Profile each hazard –** Understand each hazard in terms of:
  - Extent – Severity of each hazard
  - Location – Geographic area most affected by the hazard
  - Previous occurrences and losses
- **Assess Vulnerability**
  - Exposure identification – Estimate the total number of assets in the jurisdiction that are likely to experience a hazard event if it occurs by overlaying hazard maps with the asset inventories.
  - Vulnerability identification and loss estimation – Assess the impact of hazard events on the people, property, economy, and lands of the region, including estimates of the cost of potential damage or cost that can be avoided by mitigation.
  - Future changes that may impact vulnerability – Analyze how demographic changes, projected development, and climate change impacts can alter current exposure and vulnerability.

The following summarizes the asset inventories, methodology, and tools used to support the risk assessment process.

5.1.1 Asset Inventories

Wyoming County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the Hazard Mitigation Plan (HMP) update, Wyoming County assessed exposure and vulnerability of the following types of assets: population, buildings and critical facilities/infrastructure, new development, 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, 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 2014–2018 American Community Survey (ACS) 5-year estimate were used to estimate the exposure and potential impacts to the county's population. To determine population statistics for villages, towns, and cities, the population of villages was subtracted from the total town population. The Hazus default data was used to determine number of buildings per block. Population counts at the jurisdictional

level were then averaged among the residential blocks in the county to estimate the population by block. Hazus default data only provides building counts on the block level, so it is not as precise as a building-level analysis. Nevertheless, the results are used to provide a general estimate for planning purposes.

As discussed in Section 4 (County Profile), research has shown that some populations are at greater risk from hazard events because of decreased resources or physical abilities. Vulnerable populations in Wyoming County included in the risk assessment are children, elderly, population below the poverty level, non-English speaking individuals, and persons institutionalized with a disability.

Buildings

Hazus 4.2 default data was used as the building stock inventory. Hazus default data provides building information, such as occupancy class, on the block level based on 2010 U.S. Census block data and 2018 RSMeans cost data. Block data does not follow hazard boundaries, possibly leading to gross overestimates or underestimates of exposed building stock value. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate.

Critical Facilities and Lifelines

*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).*

The critical facility inventory in Hazus, which includes essential facilities, utilities, high potential loss, transportation features, and user-defined facilities as outlined in Section 4 (County Profile), was updated by the Wyoming County Planning Partnership, where information as available. The update involved a review for accuracy and identification as to whether the critical facility is considered a lifeline in accordance with the Federal Emergency Management Agency's (FEMA) definition; refer to Appendix E (Risk Assessment Supplementary Data). To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

Environment and Land-Use Area

National land-use land cover data created by the U.S. Geological Survey (USGS) in 2016 was used to assess land-use characteristics of the county. This dataset was converted from a raster to a vector polygon, which informed spatial areas of residential, non-residential, and natural land-use areas. Residential land-use types incorporated all classes listed as developed land-use, except for those identified as vacant (i.e., Developed – Low Intensity, Developed – Medium Intensity, Developed – High Intensity). Non-residential land-use types included all other classes. Within non-residential land-use types, natural land areas were extracted into a new category, which includes barren land, forest, water, and wetlands. The natural land areas were referenced to calculate the total acres of natural land area exposed to hazard areas of concern.

Furthermore, occupancy classes of parcels in the county were used to calculate the number of acres of assessed developed residential and non-residential land exposed to the hazard areas of concern. Parcels were assigned general occupancies based on the occupancy class of buildings that intersect the parcel area. Non-residential parcels include developed land used for commercial, industrial, government, education, religion, and education. Residential parcels include developed land used for single and multi-family housing.

New Development

In addition to assessing the vulnerability of the built environment, Wyoming County examined recent development over the last 5 years and anticipated new development in the next 5 years. Each jurisdiction was asked to provide a list by parcel ID or address of major development that has taken place within these timeframes.

New development was separated by anticipated in the next five years and recently developed over the last five years. An exposure analysis was conducted in Geographic Information System (GIS) to determine hazard exposure to these development sites. Projects that are built on multiple parcels were assessed as one unit, so if one parcel identified within the project boundary intersected a spatial hazard layer, the entire project was considered 'exposed' to the hazard area of concern.

Identifying these changes and integrating new development 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 4 (County Profile), and hazard exposure analysis results are presented in Section 9 (Jurisdictional Annexes) as a table in each annex.

5.1.2 Methodology

To address the requirements of the DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Wyoming 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 5.1-1 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 are located in the hazard area and may incur future impacts.
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 5.1-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities	New Development
Earthquake	E, H	E, H	E, H	E
Epidemic	Q	Q	Q	Q
Fire	Q	Q	Q	Q
Flood	E, H	E, H	E, H	E
Hazmat	E	E	E	E
Severe Storm	H	H	H	Q
Severe Winter Storm	Q	Q	Q	Q
Transit Accident	Q	Q	Q	Q
Utility Failure	Q	Q	Q	Q
Water Supply Contamination	Q	Q	Q	Q

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

Hazards U.S. – Multi-Hazard (Hazus)

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 with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. Hazus is 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 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 uses default Hazus 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' 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 is available at http://www.fema.gov/hazus.

In general, modeled losses were estimated in the program using depth grids for the flood analysis and probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for hurricane wind and seismic hazards. The probabilistic model generates estimated damages and losses for specified return periods (e.g., 100- and 500-year). Table 5.1-2 displays the various levels of analyses that can be conducted using the Hazus software.

Table 5.1-2. Summary of Hazus Analysis Levels

Hazus Analysis Levels	
Level 1	*Hazus provided hazard and inventory data with minimal outside data collection or mapping.*
Level 2	*Analysis involves augmenting the Hazus 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 typically done in conjunction with the use of local data.*

Earthquake

A probabilistic assessment was conducted for Wyoming County for the 500-year mean return period (MRP) through a Level 2 analysis in Hazus 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 Earthquake User Manual, "*Although the software offers users the opportunity to prepare comprehensive loss estimates, it should be recognized that uncertainties are inherent in any estimation methodology, even with state-of-the-art techniques. Any region or city studied will have an enormous variety of buildings and facilities of different sizes, shapes, and structural systems that have been constructed over a range of years under diverse seismic design codes. There are a variety of components that contribute to transportation and utility system damage estimations. These components can have differing seismic resistance.*" (FEMA 2020). 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. Class D and E NEHRP soils are the two classes most susceptible to amplified ground motion during an earthquake. Additionally, national landslide data from USGS was referenced to assess inventory exposed to high landslide susceptible areas. Landslide susceptibility can impact the residual events caused by earthquakes.

An exposure analysis was conducted for the county's assets (population, building stock, critical facilities, and new development) using NEHRP soil data provided by New York State and the national landslide susceptibility data where landslide susceptibility was listed as high susceptibility. The exposure analysis focused on soil types that would experience amplified ground motion during an earthquake (i.e., Class D and E). According to the NEHRP data, assets with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to these soil types.

Data from New York State was used in Hazus v4.2 to replace default NEHRP soils. Groundwater was set at a depth of five (5) feet (default setting). The default assumption is a magnitude 7.0 earthquake for all return periods. Although damages are estimated at the Census tract level, results were presented at the municipal level. Since there are multiple Census tracts that contain more than one jurisdiction, an area analysis was used to extract the percent of each tract that falls within individual jurisdictions. The percentage was multiplied against the results calculated for each tract and summed for each jurisdiction.

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, boils, etc.

Epidemic

All of Wyoming County is considered exposed to disease outbreak events. A qualitative assessment was conducted for the epidemic hazard. Research from the Centers for Disease Control and Prevention was utilized to qualitatively assess the most recent COVID-19 outbreak.

Fire

A qualitative assessment was conducted for the structural fire hazard. All structures in the county are considered exposed to this hazard. The National Fire Danger Rating System (NFDRS) established a Fire Danger Rating in New York, and this rating was used to assess fire danger risk within Wyoming County.

Flood

The 1- and 0.2-percent chance flood events were examined to evaluate Wyoming 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 following data was used to evaluate exposure and determine potential future losses for this plan update:

- Q3 data from FEMA for Wyoming County dated from the 1970s/1980s (details provided below)
- The 1-percent annual chance flood depth grid generated using the Q3 FEMA data and 1-meter Digital Elevation Model (DEM) from the New York Office of Information Technology Services (NYOIT)

FEMA Digital Flood Insurance Rate Maps (DFIRMs) are not available for Wyoming County. Wyoming County digitized their effective Flood Insurance Rate Maps (FIRMS) to spatially delineate the 1-percent and 0.2-percent annual chance flood boundaries.

To estimate exposure to the 1 percent and 0.2 percent annual chance flood events, the Q3 flood boundaries were overlaid on the centroids of updated assets (population, building stock, critical facilities, and new development). Centroids that intersected the flood boundaries were totaled to estimate the building replacement cost value and population exposed to the flood inundation areas.

To estimate potential losses, a Level 1/2 Hazus v4.2 riverine flood analysis was performed for the 1 percent annual chance flood event. The default building inventory and the default combined with user-defined critical facility inventory were incorporated into Hazus. Hazus calculated the estimated potential losses across dasymetric blocks to the population (sheltering needs) using the 2010 U.S. Census population data. It also calculated potential damages to the general building stock and critical facility inventories based on the depth grid generated and the default Hazus damage functions in the flood model.

Hazardous Material

Overall, potential losses from HazMat incidents are difficult to quantify due to the many variables and human elements. Data regarding this hazard were obtained from Wyoming County and the Planning Partnership as well as appropriate state and federal resources.

The exposure analysis was conducted for the county's assets (population, building stock, critical facilities, and new development) using a radius around potential HazMat incident sites as follows: exposure within a half-mile of highways, exposure within a half-mile of railways, exposure within a half-mile of pipelines, and exposure within a half-mile of HazMat facilities, which included U.S. Environmental Protection Agency (USEPA) Superfund (sites with hazardous material contamination) and Toxics Release Inventory sites (facilities with toxic chemicals).

Severe Storm

A Hazus probabilistic analysis was performed to analyze the wind hazard for Wyoming County. The probabilistic hurricane model 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 Wyoming County. Hazus v4.2 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. The 100-year and the 500-year MRP events were examined for the wind/severe storm hazard. The analysis used default demographic data provided in the Hazus model with default Hazus general building and critical facility inventories.

Severe Winter Storm

All of Wyoming County is exposed and vulnerable to the winter storm hazard. 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 (i.e., 1 percent, 5 percent, and 10 percent of total replacement cost value). Given professional knowledge and 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.

Transportation Accident

A qualitative assessment was conducted for the transportation accident hazard. This hazard was split into four different types: vehicular accidents, aviation accidents, hazardous materials in transit, and railway accidents. The risk and extent of these four types of transit hazards was qualitatively assessed to determine impact on the county.

Utility Failure

To assess the county's vulnerability to the utility failure hazard and its associated impacts, a qualitative assessment was conducted. Information from the EPA, FEMA, and other federal and state resources were referenced to assess the potential impacts to the county's assets from utility failure.

Water Supply Contamination

All of Wyoming County is considered exposed to water supply contamination. A qualitative analysis was completed to assess the potential risk of groundwater contamination. Resources from Wyoming County Health Department, New York State Department of Environmental Conservation, New York State Department of Health, and EPA were used to assess the potential impacts to the county's assets.

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
  - Implement a user-defined general building stock dataset that uses assessor data and building footprints for up-to-date information on the county's current structures.
  - Utilize updated and current demographic data. If 2020 U.S. Census demographic data is available at the U.S. Census block level during the next plan update, use the Census block estimates and residential structures for a more precise distribution of population, or the current American Community Survey 5-Year Estimate populations counts at the Census tract level.
- Flood
  - The 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.
  - Conduct a Hazus loss analysis for more frequent flood events (e.g., 10 and 50-year flood events).
  - As more current FEMA floodplain data become available (i.e., DFIRMs), update the exposure analysis, and generate a more detailed flood depth grid that can be integrated into the current Hazus version.
  - Conduct a repetitive loss area analysis.
- 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.
- Severe Storm
  - The general building stock inventory can be updated to include attributes regarding protection against strong winds, such as hurricane straps, to enhance loss estimates.
  - Collect data on historic costs incurred to reconstruct buildings, cultural resources and/or infrastructure due to coastal erosion impacts.
  - Integrate evacuation route data that is currently being developed.

5.1.3 Data Source Summary

Table 5.1-3 summarizes the data sources used for the risk assessment for this plan.

Table 5.1-3. Risk Assessment Data Documentation

Data	Source	Date	Format
Population Data	U.S. Census Bureau; American Community Survey 5-Year Estimates	2010; 2018	Digital (GIS) format
Building Data	Hazus v4.2 Default Data	2010	Digital (GIS) format
Critical Facilities	Wyoming County Steering Committee and Planning Committee, Hazus v4.2 Default Data	2019/2020	Digital (GIS) format
New Development Data	Wyoming County Planning Department	2020	Digital (GIS) Format
Q3 Flood Mapping	Wyoming County GIS[1]	1970/1980	Digital (GIS) format
NEHRP Soil	NYS	n.d.	Digital (GIS) format
1-meter Resolution Digital Elevation Model	New York Office of Information Technology Services (NYOIT)	2017	Digital (GIS) Format
NY County Boundaries (Basemap)	ESRI	2002	Digital (GIS) Format
NY Waterways (Basemap)	NYS Office of State Comptroller (NYS OCS)	2008	Digital (GIS) Format
NY Railroads (Basemap)	NYS Department of Transportation (NYS DOT)	2013	Digital (GIS) Format
NY Road Centerlines (Basemap)	NYS GIS	2020	Digital (GIS) Format
Superfund Sites	EPA	2018	Digital (GIS) Format
TRI Sites	EPA	2018	Digital (GIS) Format

Limitations

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:

1) Approximations and simplifications necessary to conduct such a study
2) Incomplete or dated inventory, demographic, or economic parameter data
3) The unique nature, geographic extent, and severity of each hazard
4) Mitigation measures already employed by the participating municipalities
5) The amount of advance notice residents have to prepare for a specific hazard event
6) Uncertainty of climate change projections

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, Wyoming County will collect additional data to collect additional data, 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.

[1] Q3 Flood Mapping data was received from Wyoming County GIS, which was created by FEMA in 1970/1980.