5.1 METHODOLOGY AND TOOLS

This section describes the methodology and tools used to support the risk assessment process.

Methodology

The risk assessment process used for this Plan is consistent with the process and steps presented in FEMA 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA, 2001). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in the community. A risk assessment provides a foundation for the community's decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs (Section 6 and Section 9 of this plan).

Step 1: The first step of the risk assessment process is to identify the hazards of concern. FEMA's current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and many other assets. Often, natural hazards can be predicted, where they tend to occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Step 2: The next step of the risk assessment is to prepare a profile for each hazard of concern. These profiles assist communities in evaluating and comparing the hazards that can impact their area. Each type of hazard has unique characteristics that vary from event to event. That is, the impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, the probability of occurrence of a hazard in a given location impacts the priority assigned to that hazard. Finally, each hazard will impact different communities in different ways, based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: To understand risk, a community must evaluate what assets it possesses and which assets are exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical facilities at risk, located in Section 4, prepares the community to develop risk scenarios and estimate potential damages and losses for each hazard.

Tools

To address the requirements of DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Tioga County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Our standardized tools used to support the risk assessment are described below.

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 that 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. The guidance Using HAZUS-MH for Risk Assessment: How-to Guide (FEMA 433) was used to support the application of HAZUS-MH for this risk assessment and plan. More information on HAZUS-MH is available at http://www.fema.gov/plan/prevent/hazus/index.shtm.

In general, probabilistic analyses were performed to develop estimates of long-term average losses (annualized losses) for the earthquake and wind hazards, as well as an expected/estimated distribution of losses (mean return period losses) for the earthquake, flood and wind hazards. The probabilistic hazard generates estimates of damage and loss for specified return periods (e.g., 100- and 500-year). For annualized losses, HAZUS-MH 2.0 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.

Custom methodologies in HAZUS-MH 2.0 were used to assess potential exposure and losses associated with hazards of concern for Tioga County:

- Inventory: The default demographic data in HAZUS-MH 2.0, based on the 2000 U.S. Census, was used for analysis. However, the 2010 U.S. Census data was used to estimate hazard exposure at the municipal level.

  The valuation of general building stock and the loss estimates determined in the Planning Area were based on the default general building stock database provided in HAZUS-MH 2.0. The general building stock valuations are Replacement Cost Value from RSMeans as of 2006. The occupancy classes available in HAZUS-MH 2.0 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single family dwellings.

  The critical facility inventory (essential facilities, utilities, transportation features and user-defined facilities) was updated for the earthquake, flood and wind hazard models. This comprehensive inventory was developed by gathering input from numerous sources including Tioga County GIS, participating municipalities and input from the Planning and Steering Committees.

  The 'user-defined facilities' category includes all assets that the County deemed critical to include in the inventory and that do not fit within a pre-defined HAZUS-MH facility category. These facilities include shelters, senior care facilities and municipal-owned buildings.

- Earthquake: A Level 2 HAZUS-MH 2.0 analysis using a probabilistic scenario was performed to analyze the earthquake hazard losses for Tioga County (annualized losses and 100-, 500- and 2,500-year mean return period [MRP] losses). A Level 1 analysis is a basic estimate of earthquake losses based on national databases and using the default data in the model. Default demographic and general building stock data in HAZUS-MH 2.0 were used for the earthquake analysis. However, as described above, updated critical facility inventories were used. Additionally, a local soil map provided by NYSOEM was entered into HAZUS-MH 2.0 to replace default soil conditions. HAZUS-MH 2.0 uses the seismic soil type classes recommended by the National Earthquake Hazard Reduction Program (NEHRP). The NEHRP soils 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 (NYSEMO, 2004; NYCEM, 2003). When a Level 1 HAZUS-MH 2.0 earthquake analysis is conducted, the NEHRP soil classification type "D" is used as the soil type across the entire study region. For this HMP, a local soil map with the County's NEHRP soil types (A through E) provided by NYSOEM was entered into HAZUS-MH 2.0 and used for all analyses.

- Flood: The HAZUS-MH 2.0 riverine model; the Tioga County FEMA Digital Flood Insurance Rate Maps (DFIRMs); and USGS one-third ArcSecond Digital Elevation Models (DEM) (10 meter resolution) were used to estimate exposure and potential losses associated with the flood hazard (see Figure 5.1-1). At the time the flood analysis was conducted for this Plan, the Tioga County DFIRMs were still considered preliminary. The final effective DFIRM date is April 17, 2012 (FEMA, 2012).

  HAZUS-MH 2.0 was used to run the hydrology and hydraulics for the selected river reaches, using the DFIRMs as a guide. HAZUS-MH 2.0 generated the flood-depth grid and flood boundary for the specified return periods (100- and 500-year MRPs) and calculated the estimated damages to the general building stock and critical facilities based on this depth grid. Default damage functions and first-floor elevations were used. The Flood Annualized Loss Analysis option in HAZUS-MH 2.0 is deactivated pending forthcoming methodology adjustments. Therefore, annualized flood losses were not calculated for Tioga County.

  Hurricane/Wind: A modified Level 1 HAZUS-MH probabilistic analysis was performed to analyze the wind hazard losses for Tioga County. The probabilistic 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 the Planning Area. Annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Default demographic and general building stock data in HAZUS-MH 2.0 were used for the analysis. However, as described above, updated critical facility inventories were used.

- Other Hazards: HAZUS-MH support was used to evaluate other hazards (severe winter storm, extreme temperature), as feasible. For many of the hazards evaluated in this risk assessment, historic data are not adequate to model future losses at this time. However, HAZUS-MH can map hazard areas and calculate exposures if geographic information on the locations of the hazards and inventory data are available. For some of the other hazards of concern, areas and inventory susceptible to specific hazards were mapped and exposure was evaluated to help guide mitigation efforts discussed in Section 6 and Section 9. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment.

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 affects 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 and 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, Tioga County will collect additional data to assist in developing refined estimates of vulnerabilities to natural and non-natural hazards.