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 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, Burlington 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, 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. 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 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 version 2.1 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.

HAZUS-MH version 2.1 (HAZUS-MH) was used to estimate losses associated with the hazards of concern for Burlington County. The following describes the methodology used to estimate exposure and potential losses to Burlington County at the municipal level.

- Inventory: The 2010 U.S. Census data at the Census-block level was used to estimate hazard exposure at the municipal level. In terms of building data, the total improved values from the parcel dataset provided by Burlington County Department of Information Technology, the parcel data from New Jersey's Geographic Information Network (for the City of Beverly only), and the HAZUS-MH default general building stock replacement cost values were used to evaluate exposure. The default demographic and building stock data in HAZUS-MH was used to estimate potential losses.

  The critical facility inventory (essential facilities, utilities, transportation features and user-defined facilities) was updated beginning with all GIS data provided by Burlington County Geographic Information Systems. The critical facility inventory was formatted to be compatible with HAZUS-MH and its Comprehensive Data Management System (CDMS).

- Flood: For this plan update, a sub-meter accuracy Digital Elevation Model (DEM) was used. The 1-percent annual chance flood event was examined to evaluate Burlington County's risk and vulnerability to the flood hazard. The Preliminary Digital Flood Insurance Rate Map (DFIRM) with the addition of the Advisory Base Flood Elevation V-zone were used to estimate exposure and estimate potential losses using HAZUS-MH. HAZUS-MH flood modeling was used to generate approximate 1-percent annual chance flood boundaries within the areas covered by the two military installations where data is not available in the preliminary DFIRM. The HAZUS-MH flood model was used to estimate Burlington County's estimated potential losses at the Census-block level using the default building inventory.

- Severe Storm (Wind and Storm Surge): A HAZUS-MH probabilistic analysis was performed to analyze the wind hazard losses for Burlington 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 identify those with tracks associated with the County. Annualized losses and the 100- and 500-year MRPs were examined for the wind hazard. Default demographic and building data in HAZUS-MH and updated critical facility data were used for the analysis.

  The Sea – Lake Overland Surge from Hurricanes (SLOSH) model, which represents potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide was used to estimate exposure. Please note these inundation zones do not include riverine flooding caused by hurricane surge or inland freshwater flooding. The model, developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes, considers only storm surge height and does not consider the effects of waves.

- Earthquake: A probabilistic assessment was conducted for Burlington County for the 100-, 500- and 2,500-year MRPs using HAZUS-MH to analyze the earthquake hazard and provide a range of loss estimates for Burlington County. 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. According to the New York City Area Consortium for Earthquake Loss Mitigation (NYCEM), probabilistic estimates are best for urban planning, land use, zoning and seismic building code regulations (NYCEM, 2003). The default assumption is a magnitude 7 earthquake for all return periods.

  In addition to the probabilistic scenarios mentioned, an annualized loss run was conducted in HAZUS 2.1 to estimate the annualized general building stock dollar losses for the County. The annualized loss methodology combines the estimated losses associated with ground shaking for eight return periods: 100, 250, 500, 750, 1000, 1500, 2000, 2500-year, which are based on values from the USGS seismic probabilistic curves. Annualized losses are useful for mitigation planning because they provide a baseline upon which to 1) compare the risk of one hazard across multiple jurisdictions and 2) compare the degree of risk of all hazards for each participating jurisdiction.

- Landslide: To estimate Burlington County's vulnerability to ground failure due to landslides, the Geology - Landslide Incidence and Susceptibility GIS layer from National Atlas was used to coarsely define the general landslide susceptible area. The Geology - Landslide Incidence and Susceptibility GIS layer was overlaid upon the Burlington County municipalities, 2010 Census population data, custom building inventory and Burlington County's critical facility inventory to estimate exposure. The limitations of this analysis are recognized and are only used to provide a general estimate.

- Wildfire: The NJ Forest Fire Service Wildfire Fuel Hazard data assigns wildfire fuel hazard rankings across Burlington County. 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. The asset data (population, building stock and critical facilities) presented in the County Profile was used to support an evaluation of assets exposed and the potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data was overlaid upon the NJ Forest Fire Service Fuel hazard area. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

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- Coastal Erosion and Sea Level Rise: The CAFRA boundary, which legislates land use within the coastal area, was used to determine exposure to the coastal erosion hazard. Land within this boundary is under the jurisdiction of the Coastal Area Facilities Review Act (CAFRA), N.J.S.A. 13:19-1 et seq (as amended to July 19, 1993). This area includes the Advisory V-zone and any area indicated by the Advisory data with wave action.

  Projected sea-level rise data (in one-foot increments) available from Jacques Cousteau National Estuarine Research Reserve (http://slrviewer.rutgers.edu/about.html) was considered and used for this analysis. Please note these levels do not include additional storm surge due to a hurricane or Nor'easter. The current Advisory maps and preliminary DFIRMs also do not include the effects of sea-level rise. Miller et al. projects an approximate 2-foot in sea-level rise by 2050 for the State of New Jersey in *A geological perspective on sea-level rise and impacts along the U.S. mid-Atlantic coast* (July 2013, Submitted to Earth's Future). For the purposes of this planning effort, the year 2050 and associated projected 2-foot rise was used as a reasonable and responsible planning horizon.

- Other Hazards (Drought and Severe Winter Storm): HAZUS does not estimate potential losses from the drought or severe winter storm hazards. Where appropriate, an exposure analysis using HAZUS-MH default building inventory or 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 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 Burlington County 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, Burlington County will collect additional data to assist in developing refined estimates of vulnerabilities to natural hazards.

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