APPENDIX B: HAZUS® RISK ANALYSIS

HAZUS® RISK ANALYSIS

Hazus® version 5.1 is a nationally standardized risk modeling methodology that identifies areas with high risk for natural hazards and estimates physical, economic, and social impacts of earthquakes, hurricanes, floods, and tsunamis.

Managed by FEMA's Natural Hazard Risk Assessment Program, Hazus® partners with other federal agencies, research institutions, and regional planning authorities to ensure the latest scientific and technological approaches are applied to determine potential losses from disasters and to identify the most effective mitigation actions for minimizing those losses.

Hazus® can quantify and map risk information such as:

- **Physical Damage** to residential and commercial buildings, schools, critical facilities, and infrastructure.
- **Economic Loss** to include job loss, business interruptions, and repair and reconstruction costs.
- **Social Impacts** to include estimates of displaced households, shelter requirements, and populations exposed to floods, earthquakes, hurricanes, and tsunamis.
- **Cost Effectiveness** of common mitigation strategies, such as elevating structures in a floodplain or retrofitting unreinforced masonry buildings.

Each Hazus® model uses inventory information (buildings, infrastructure, and population), hazard extent and intensity data, and damage functions to estimate the impacts of disasters. Estimated impacts vary by model, but include building damages, economic losses, displaced households, casualties, debris, and the loss of function for essential facilities. Two specific model for the Eastern Shore of Virginia were evaluated to update the current hazard mitigation plan.

> The Hazus® Flood Model calculates physical damage and economic loss due to coastal flooding. Losses are calculated using functions that relate the depth and type of flooding to the degree of damage for various categories of buildings.
>
> The Hazus® Hurricane Model estimates physical and economic damage to buildings due to wind and windborne debris. Wind hazard data are generated at the census track level. The model considers gusts, terrain roughness, and tree coverage data for incoming hurricanes, historic storms, or probabilistic hazards.

Because the Eastern Shore is roughly 70 miles long, storm events affect areas of the Shore differently, depending upon their direction of approach, approach speed, circumference, and other factors. The Steering Committee and Accomack-Northampton PDC staff chose to reflect the results of the 100-year scenarios, or 1-percent-annual-chance storm event, to present in the Hazard Mitigation Plan. The software offers other scenarios and their associated wind speed as well as flood impacts, as the Hazus® model offers a wide variety of variables.

HAZUS® METHODOLODY

The Hazus® Methodologies generated an estimate of the consequences to a community from a natural hazard scenario or from a probabilistic hazard. The resulting "loss estimate" will generally describe the scale and extent of damage disruption that may result from a potential event. The following information can be obtained.

- *Quantitative Estimates of Losses* in terms of direct costs for repair and replacement of damaged buildings and system components, direct costs associated with loss of function, (e.g., loss of business revenue and relocation costs), casualties, household displacements, quantity of debris, and regional economic impacts.
- *Functionality Losses* in terms of loss-of-function and restoration times for critical facilities such as hospitals, components of transportation and utility systems, and simplified analyses of loss-of-system-function for electrical distribution and potable water systems.
- *Extent of Induced Hazards* in terms of exposed population and building value due to potential flooding or fire following an earthquake.

To generate this information, the Hazus® Methodology contains baseline inventory data to include:

- Classification systems used in assembling inventory and compiling information on the building stock, the components of transportation and utility systems, and demographic and economic data.
- Standard calculations for estimating type and extent of damage and for summarizing losses.
- National and regional databases containing information for use as baseline (built-in) data useable in the calculation of losses, if there is an absence of user-supplied data.

HAZUS® SOFTWARE

The Hazus® software uses GIS technologies for performing analyses with inventory data and displaying losses and consequences on applicable tables and maps. The Flood Model allows practitioners to estimate the economic and social losses from flood events; however, this model requires data to be applied to each report and can vary based on adopted methodology.

DATA ELEVATION MODEL SELECTION

The data needed to obtain the Digital Elevation Model Selection (DEMs) is available for download and is part of developing the Coastal Flood Model.

Figure 1: Hazus® Software: Data Elevation Model Extent

SHORELINE IDENTIFICATION

The user of Hazus® also needs to identify the shorelines that will impact the community prior to creating the Coastal Flood Model.

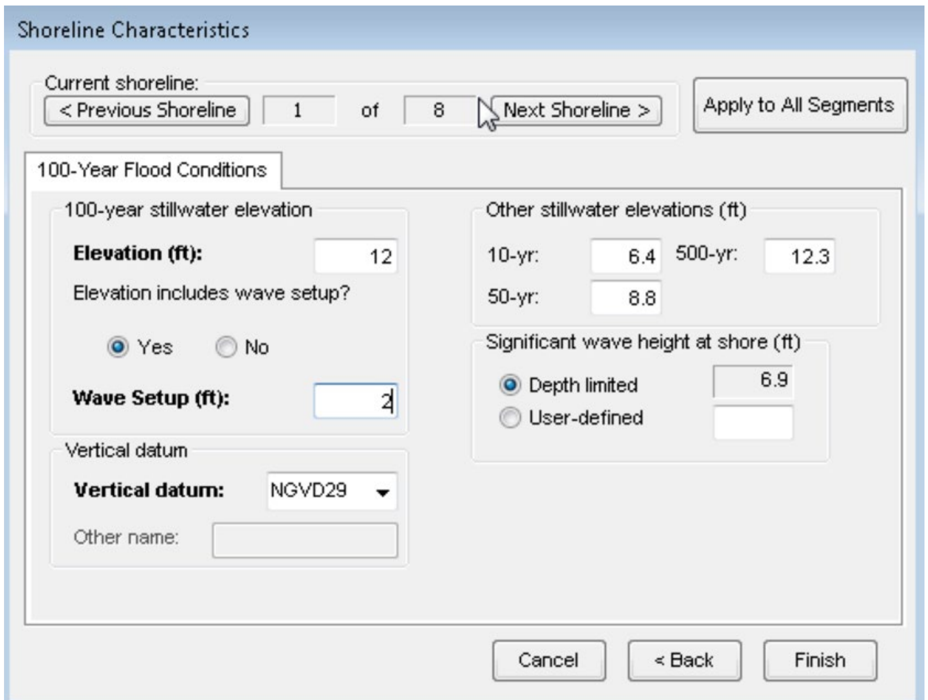
- Hazus® has a built-in default national shoreline that is delineated by county. In Study Regions that are sub-county or a combination of multiple sub-counties all of the associated shorelines of the counties will be brought in. This is by design to account for coastal flooding at specific locations that does not necessarily originate from the closest shorelines to those locations.
- Once the shorelines have been selected, the next step in the process is to characterize the chosen shorelines.

Figure 2: Hazus® Software: New Scenario Selection

SHORELINE CHARACTERIZATION

Shoreline Characterization – Stillwater Flood Conditions represent the water surface absent wave height and wave runup. Data that is developed and provided by FEMA under the Flood Insurance Study (FIS) was used in both Accomack and Northampton Counties as well as the incorporated areas. This data is authorized by the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The elevation at Stillwater for a 1-percent event are listed in the document and used in each Hazus® Coastal Flood Model. A wave setup was set at a default of two feet per recommendation of Hazus® Help Desk for this region.

Figure 3: Hazus® Software: Shoreline Characteristics



DATA AND MODELING ISSUES

Although the Hazus® 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 build over a range of years under varying design codes. A variety of components contribute to transportation and utility system estimations in certain hazard models.

There are also insufficient comprehensive data from past events or laboratory experiments to determine precise estimates of damage based on different measures of hazard severity, such as known flood depths or wind speeds. To deal with this complexity and lack of data, buildings and components of systems are grouped into categories based on key characteristics. The relationships between measures of hazard severity and average degree of damage with associated losses for each building category are based on current data and available theories.

The results of a natural hazard loss analysis should not be looked upon as a prediction. Instead, they are only an estimate, as uncertainty inherent to the model will be influenced by quality of inventory data and the hazard parameters.

Current models often extended beyond the boundaries of the towns impact quality of the data. In most cases, larger models, such as a census tract or county model, were defined correctly and aligned geographically with the size of the community, and the number of housing units compared favorably to Census numbers. Other model data was determined to be unreliable without additional information from FEMA and the NFIP.

The most significant challenge while running the Hazus® models was the lack of historical approaches and data from previous years. Not having access to certain historical models did not allow for the Steering Committee to evaluate and provide discrepancies.

FEMA HAZUS® Program: https://www.fema.gov/flood-maps/products-tools/hazus