SECTION 5

VULNERABILITY ASSESSMENT

44 CFR Requirement
44 CFR Part 201.6(c)(2)(ii): The risk assessment shall include a description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. The description shall include an overall summary of each hazard and its impact on the community. The plan should describe vulnerability in terms of: (A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; (B) An estimate of the potential losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate; (C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

5.1 OVERVIEW

This section builds upon the information provided in Section 4: *Hazard Identification and Analysis* by identifying and characterizing an inventory of assets in Myrtle Beach, and then by assessing the potential impact and amount of damages that can be expected to be caused by each identified hazard event. The primary objective of the vulnerability assessment is to quantify exposure and the potential loss estimates for each hazard. In doing so, Myrtle Beach may better understand its unique risks to identified hazards and be better prepared to evaluate and prioritize specific hazard mitigation actions.

This section begins with an explanation of the methodology applied to complete the vulnerability assessment, followed by a summary description of the asset inventory as compiled for Myrtle Beach. The remainder of this section focuses on the results of the assessment conducted and is organized by hazard as listed below:

- **Atmospheric**
  - 5.4 Drought
  - 5.5 Hailstorm
  - 5.6 Ice Storm
  - 5.7 Lightning
  - 5.8 Northeaster
  - 5.9 Wind Events/Thunderstorm
  - 5.10 Tornado
  - 5.11 Tropical Storm System/Hurricane
- **Geologic**
  - 5.12 Earthquake
  - 5.13 Tidal Wave/Tsunami

- **Hydrologic**
  - 5.14 Erosion
  - 5.15 Flood
  - 5.16 Storm Surge
  - 5.17 Sea Level Rise

- **Other**
  - 5.18 Acts of Terror
  - 5.19 Airplane Crash
  - 5.20 Hazardous Materials Incident
  - 5.21 Wildfire

5.2 METHODOLOGY

This vulnerability assessment was conducted using two distinct methodologies: (1) utilizing a geographic information system (GIS)-based analysis; and (2) applying a statistical risk assessment methodology. Each approach provides estimates for the potential impact of hazards by using a common, systematic framework for evaluation, including historical occurrence information provided in the *Hazard Identification and Analysis* section. The results of the vulnerability assessment for the aforementioned hazards are provided following the information on hazard identification and analysis.

A GIS-based analysis was conducted for the following hazards:

- Tropical Storm System/Hurricane
- Earthquake
- Flood
- Storm Surge
- Sea Level Rise
- Hazardous Materials Incidents
- Wildfire

A statistical risk assessment approach was used to analyze the remaining hazards:

- Drought
- Hailstorm
- Ice Storm
- Lightning
- Northeaster
- Wind Events/Thunderstorm
- Tornado
- Tidal Wave/Tsunami
- Erosion
- Acts of Terror
- Airplane Crash

A brief description of the two different approaches is provided on the following pages.

5.2.1 GIS-Based Analysis

For the GIS-based analysis, digital data was collected from local, regional, state and national sources. ESRI® ArcGIS™ 10.2 was used to assess hazard vulnerability utilizing this digital data, including local tax assessor records for individual parcels and buildings and georeferenced point locations for identified assets (critical facilities and infrastructure, special populations, etc.). Using these data layers, hazard vulnerability can be quantified by estimating the assessed building value for parcels and/or buildings determined to be located in identified hazard areas. FEMA's Hazus-MH software (further described below) was also used to model hurricane winds, coastal flood, storm surge and earthquake and estimate potential losses for these hazards. To estimate vulnerable populations in hazard areas, digital Census 2010 data by census block was obtained and census blocks intersecting with hazard areas were used to determine exposed population counts.

The objective of the GIS-based analysis was to determine the estimated vulnerability of people, buildings and critical facilities to the identified hazards for Myrtle Beach jurisdictions using best available geospatial data. Local databases were made available through Myrtle Beach including tax assessor records, parcel records, building footprints, and critical facilities data, as well as other regional, state, and federal government data sources were used in combination with digital hazard data as described in the *Hazard Identification and Analysis* section. The results of the analysis provided an estimate of the number of people, buildings, and critical facilities, as well as the value of buildings, determined to be potentially at risk to those hazards with delineable geographic hazard boundaries. A more specific description of the GIS-based analysis conducted for each particular hazard is provided in the individual hazard sections.

5.2.1 Risk Modeling Software Analysis

Hazus-MH

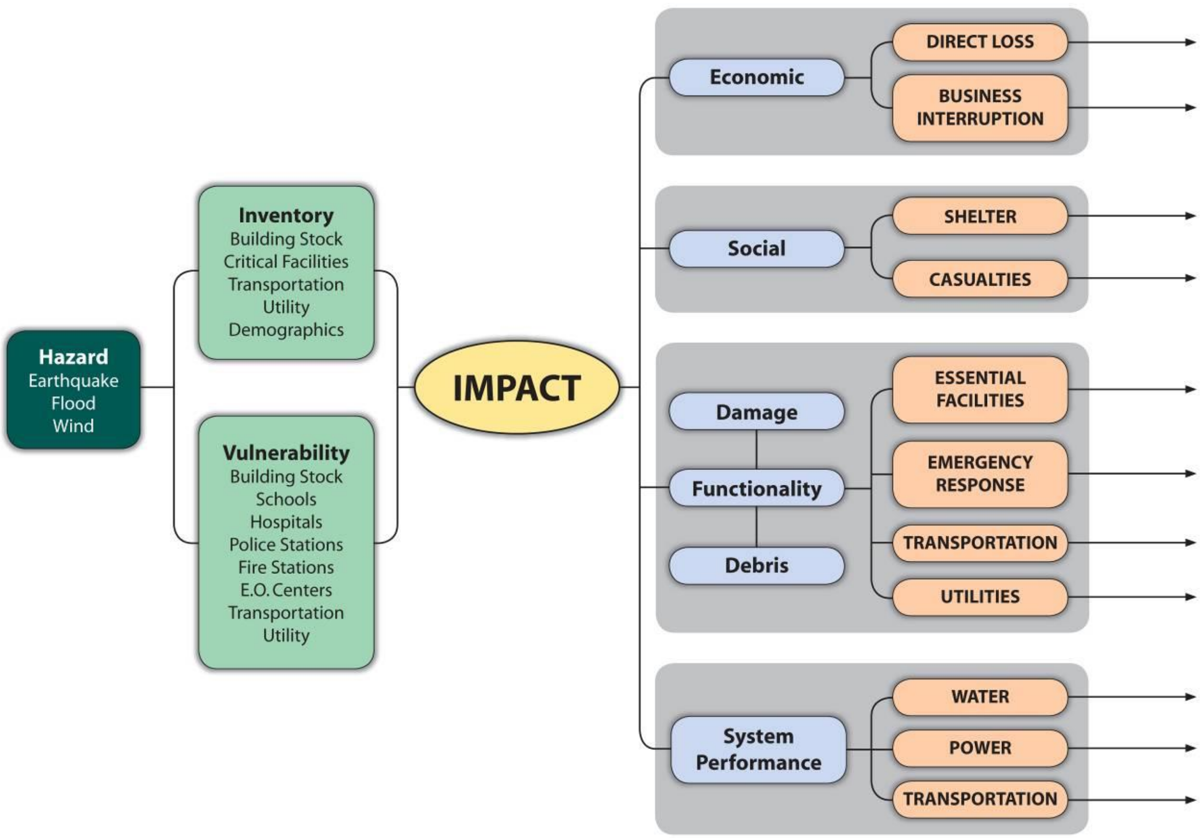
There are several models that exist to model hazards. Hazus-MH was used in this vulnerability assessment to address the aforementioned hazards

Hazus-MH is a standardized loss estimation software program developed by FEMA. It is built upon an integrated GIS platform to conduct analysis at a regional level (i.e., not on a structure-by-structure basis). The Hazus-MH risk assessment methodology is parametric, in that distinct hazard and inventory parameters (e.g., wind speed and building types) can be modeled using the software to determine the impact (i.e., damages and losses) on the built environment.

This risk assessment for Myrtle Beach applied Hazus-MH to produce hazard profiles and estimate losses for four hazards for the planning area. At the time this analysis was completed, Hazus-MH 2.2 (2015) was used to estimate potential losses from hurricane winds, coastal flood, storm surge and earthquake hazards using Hazus-MH methodology. In generating loss estimates through Hazus-MH, some data normalization was necessary to account for recognized differences between actual assessed building values as provided by Myrtle Beach and estimated replacement building value data as provided within Hazus-MH. In order to account for the difference between modeled and actual values, the ratio of estimated losses produced by Hazus-MH as compared to total Hazus-MH building inventory was used to estimate percent damage. The percent damage ratio was then applied to the local assessed values in order to estimate annualized potential losses and loss ratios in Myrtle Beach for this analysis.

Figure 5.1 illustrates the conceptual model of the HAZUS-MH methodology as applied to Myrtle Beach.

Figure 5.1: Conceptual Model of HAZUS-MH Methodology



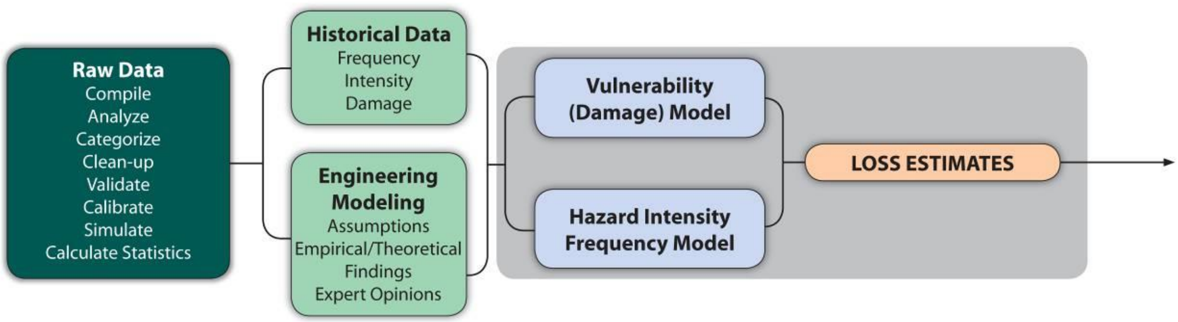
5.2.2 Statistical Risk Assessment Methodology

The statistical risk assessment methodology was applied to analyze hazards of concern that were outside the scope of HAZUS-MH and the GIS-based risk assessment. This includes hazards that do not have geographically-definable boundaries and are therefore excluded from spatial analysis through GIS. Examples include hailstorm, lightning, and tornado. This methodology uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information (presented in the *Hazard Identification and Analysis* section). Historical data for each hazard as described in the *Hazard Identification and Analysis* section was used and statistical evaluations were performed using manual calculations. The general steps used in the statistical risk assessment methodology are summarized below:

1. Compile data from local, state and national sources, as well as literature;
2. Clean up data, including removal of duplicate records and update losses to account for inflation;
3. Identify patterns in frequency, intensity, vulnerability and loss
4. Statistically and probabilistically extrapolate the patterns; and
5. Produce meaningful results, including the development of annualized loss estimates.

Figure 5.2 illustrates a conceptual model of the statistical risk assessment methodology as applied to Myrtle Beach.

Figure 5.2: Conceptual Model of the Statistical Risk Assessment Methodology



The vulnerability assessment findings are presented in terms of potential annualized losses, whenever possible. In general, presenting results in the annualized form is useful in three ways:

1. This approach accounts for the contribution of potential losses from all future disasters;
2. Annualized results for different hazards are readily comparable, thus easier to rank; and
3. The use of annualized losses is the most objective approach for evaluating mitigation alternatives.

The estimated Annualized Loss (AL) addresses the key idea of risk: the probability of the loss occurring in the study area (largely a function of building construction type and quality). By annualizing estimated losses, the AL factors in historic patterns of frequent smaller events with infrequent but larger events to provide a balanced presentation of the risk.

Loss estimates provided in this vulnerability assessment are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics or economic parameters).

All conclusions are presented in "Conclusions on Hazard Vulnerability" (Section 5.22) at the end of this section. Findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment that follows.

5.3 STUDY AREA DEFINITION

5.3.1 Asset Inventory

An inventory of Myrtle Beach's geo-referenced assets[1] was compiled in order to identify and characterize those properties potentially at risk to the identified hazards. By understanding the type and number of assets that exist and where they are located in relation to known hazard areas, the relative risk and vulnerability for such assets can be assessed. Under this assessment, two categories of assets were created and then further assessed through GIS analysis. The two categories of assets consist of:

1. Improved Property: Includes all improved properties in Myrtle Beach according to local parcel data provided by Myrtle Beach.[2] The information has been expressed in terms of the number of parcels, number of buildings (based upon building footprint data), and total assessed value of improvements (buildings) that may be exposed to the identified hazards.

2. Critical Facilities: Includes airports, fire stations, hospitals, police stations, airports, schools, and other critical facilities located within Myrtle Beach.

The following tables provide a detailed listing of the geo-referenced assets that have been identified for inclusion in the vulnerability assessment for Myrtle Beach. While this listing is not all inclusive for assets located in the city, it is anticipated that it will be expanded during future plan updates as more geo-referenced data becomes available for use in GIS analysis.

5.3.2 Improved Property

Table 5.1 lists the number of parcels, the estimated number of buildings and the total assessed value of improvements for participating areas of Myrtle Beach (study area of vulnerability assessment).[3]

Table 5.1: Improved Property in Myrtle Beach

Jurisdiction	Number of Parcels		Estimated Number of Buildings	Total Assessed Value of Improvements	Total Market Value of Improvements
Myrtle Beach	32,630		16,537	$241,873,424	$4,472,038,300

Source: Myrtle Beach/Horry County GIS

[1] While potentially not all-inclusive for Myrtle Beach, "georeferenced" assets include those assets for which specific location data is readily available for connecting the asset to a specific geographic location for purposes of GIS analysis. Data for this analysis was obtained from the City of Myrtle Beach and Horry County.
[2] Improved properties in non-participating areas are not included in any way in this vulnerability assessment.
[3] Total assessed values for improvements is based on tax assessor records as joined to digital parcel data as of June 2015. This data does not include dollar figures for tax-exempt improvements such as publicly-owned buildings and facilities.

5.3.3 Critical Facilities

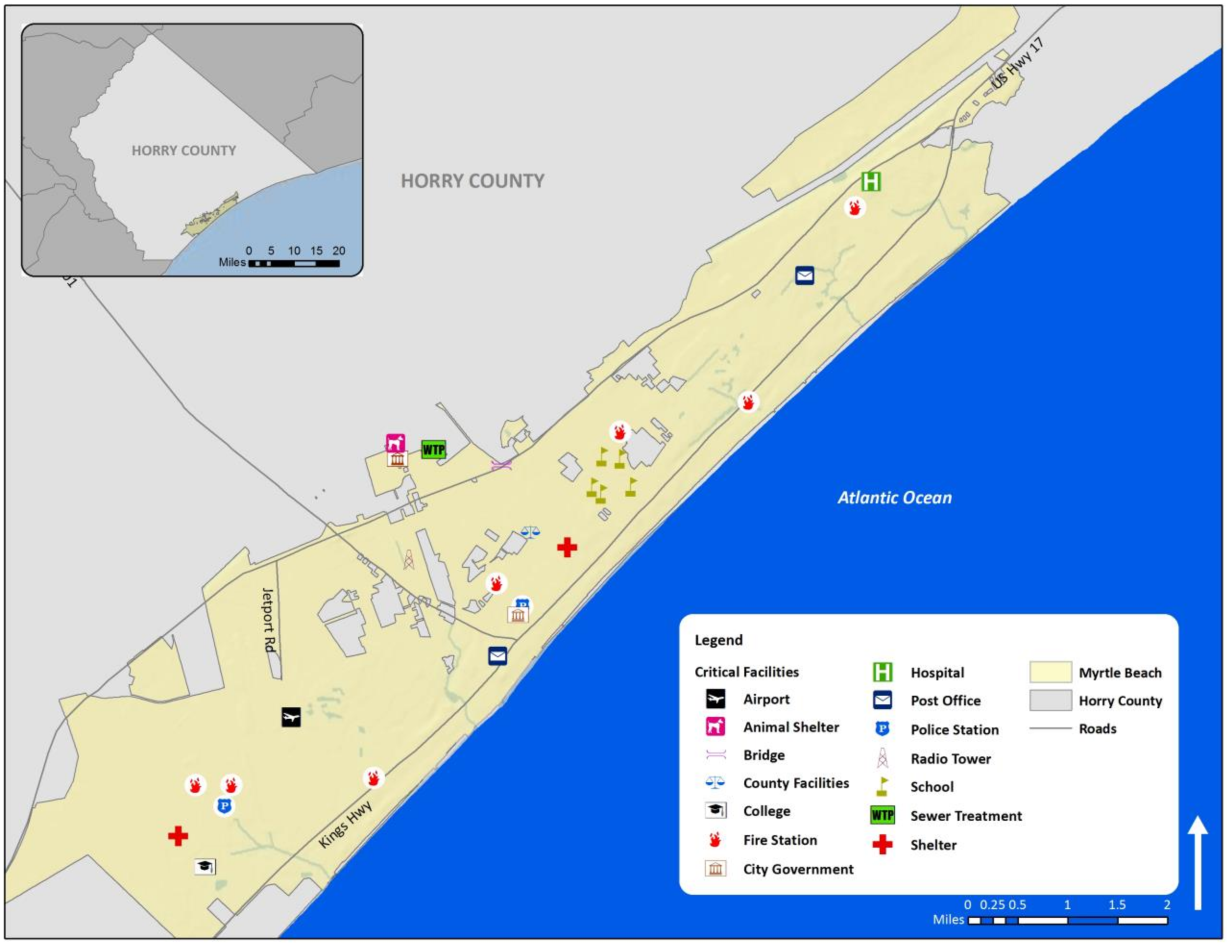
Table 5.2 lists the fire stations, police stations, hospitals, airports, and other essential facilities in Myrtle Beach. In addition, **Figure 5.3** shows the locations of essential facilities in Myrtle Beach. **Table 5.49**, near the end of this section, shows a complete list of critical facility names and hazard vulnerability.

Table 5.2: Critical Facilities in Myrtle Beach

Location	Number
Airports	1
Animal Shelters	1
Bridges	2
County Facilities	2
Colleges	1
Fire Stations	7
City Government	5
Hospitals	1
Post Offices	2
Police Stations	2
Radio Towers	1
Schools	5
Sewer Treatment Facilities	1
Shelters	2

Source: City of Myrtle Beach

Figure 5.3: Critical Facility Inventory for the City of Myrtle Beach



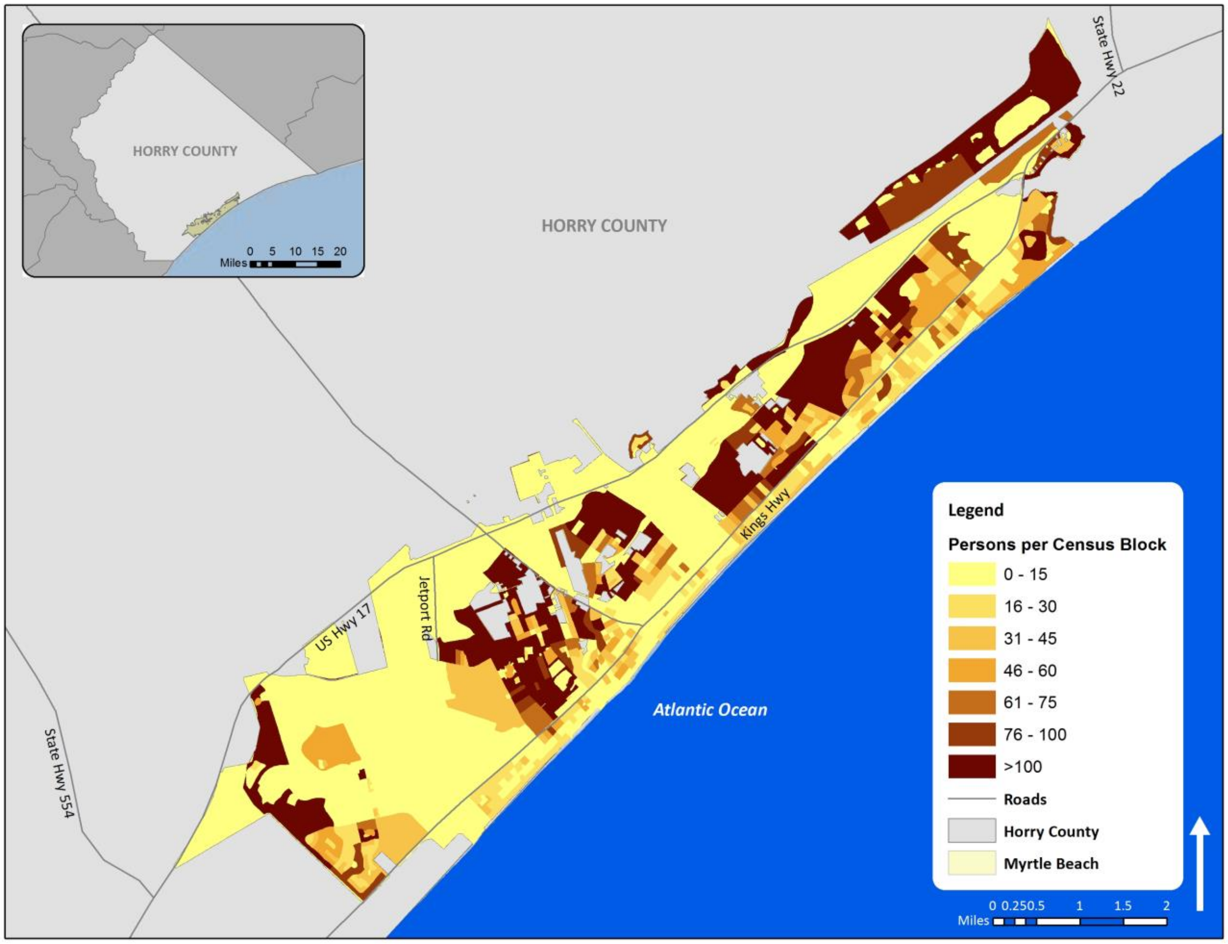
Source: City of Myrtle Beach

5.3.4 Social Vulnerability

In addition to identifying those assets potentially at risk to identified hazards, it is important to identify and assess those particular segments of the resident population in Myrtle Beach that are potentially at risk to these hazards. Further information on population can be found in Section 3, *Community Profile*.

Figure 5.4 illustrates the residential population density across the city as it was reported by the U.S. Census Bureau in 2010 at the census block level. The total population in Myrtle Beach according to Census data was 27,109 persons. As can be seen in the figure, most of the city's population is located along or near major transportation routes and waterways. More specific information on the estimated number of people living within identified hazard areas is provided for each hazard within this section.

Figure 5.4: Population Density in Myrtle Beach



Source: U.S. Census Bureau, 2010

5.3.4 Development Trends and Changes in Vulnerability

Since the previous hazard mitigation plan was approved in 2010, Myrtle Beach has experienced some growth and development. **Table 5.3** shows the number of building units constructed since 2010 according to the U.S. Census American Community Survey.

Table 5.3: Building Counts for Myrtle Beach

Jurisdiction	Total Housing Units (2013)	Units Built 2010 or later	% Building Stock Built Post-2010
Myrtle Beach	22,579	158	0.7

Source: United States Census Bureau

Table 5.4 shows population growth estimates for the city from 2010 to 2013 based on the U.S. Census Annual Estimates of Resident Population.

Table 5.4: Population Growth for Myrtle Beach

Jurisdiction	Population Estimates (as of July 1)				% Change 2010-2013
	2010	2011	2012	2013	
Myrtle Beach	26,696	27,079	27,433	27,884	4.3%

Note: July 1 population estimates were used in this table to allow comparison of annual population counts (April 1 Census estimates were used for all other population counts throughout the plan which is why the counts may differ).
Source: United States Census Bureau

Based on the data above, there has been a low rate of residential housing development in the county since 2010. However, it should be noted that the city is essentially built out in many areas. Additionally, there has been some significant population growth in the city since 2010. Since the population has increased, there is now a greater number of people exposed to the identified hazards. Therefore, development and population growth have impacted the city's vulnerability since the previous local hazard mitigation plan was approved and there has been some increase in the overall vulnerability.

It is also important to note that as development increases in the future, greater populations and more structures and infrastructure will be exposed to potential hazards if development occurs in the floodplains, storm surge zones, sea level rise inundation areas, primary and secondary hazardous materials buffers, or high wildfire risk areas.

Atmospheric Hazards

5.4 DROUGHT

PRI Value: 2.1
Annualized Loss Estimate: *Negligible*

According to the qualitative assessment performed using the PRI tool, the drought hazard scored a PRI value of 2.1 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.5** summarizes the risk levels assigned to each PRI category.

Table 5.5: Qualitative Assessment for Drought and Heat Wave

Probability	Likely
Impact	Minor
Spatial Extent	Small
Warning Time	Less than 6 hours
Duration	Less than 6 hours

Because it cannot be predicted where drought may occur, all existing and future buildings, facilities and populations in Myrtle Beach are considered to be equally exposed to this hazard and could potentially be impacted. These results are shown Tables 5.1-5.3. It is important to note that only reported drought events have been factored into this vulnerability assessment.[4]

Table 5.6 shows total exposure and potential annualized property losses and percent loss ratios resulting from the drought hazard for Myrtle Beach.

Table 5.6: Total Exposure and Potential Annualized Losses from Drought

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$0

5.4.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are equally exposed to the drought hazard, and any anticipated future damages or losses are expected to be minimal.

5.5 HAILSTORM

PRI Value: 2.6
Annualized Loss Estimate: *$610*

According to the qualitative assessment performed using the PRI tool, the hail hazard scored a PRI value of 2.6 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.7** summarizes the risk levels assigned to each PRI category.

Table 5.7: Qualitative Assessment for Hail

Probability	Highly Likely
Impact	Minor
Spatial Extent	Moderate
Warning Time	Less than 6 hours
Duration	Less than 6 hours

Because it cannot be predicted where hail may fall, all existing and future buildings, facilities and populations in Myrtle Beach are considered to be equally exposed to this hazard and could potentially be impacted (Tables 5.1-5.3). It is important to note that only reported hail events have been factored into this vulnerability assessment.[5]

To estimate losses due to lightning, NCDC historical hailstorm loss data was used to develop a hailstorm stochastic model. In this model:

[4] It is possible that additional drought events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.
[5] It is possible that additional hail events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

- Losses were scaled for inflation;
- Expected annualized losses were calculated through a non-linear regression of historical data.

Table 5.8 shows total exposure and potential annualized property losses and percent loss ratios resulting from the hailstorm hazard for Myrtle Beach.

Table 5.8: Total Exposure and Potential Annualized Losses from Hailstorm

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$610

5.5.1 Asset Vulnerability

While all of the inventoried assets in Myrtle Beach are equally exposed to the hail hazard, any anticipated future damages or losses are expected to be minimal. Specific critical facilities can be found in **Table 5.49** near the end of this section.

5.6 ICE STORM

PRI Value: 2.7
Annualized Loss Estimate: *Negligible*

According to the qualitative assessment performed using the PRI tool, the ice storm hazard scored a PRI value of 2.7 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.9** summarizes the risk levels assigned to each PRI category.

Table 5.9: Qualitative Assessment for Ice Storm

Probability	Possible
Impact	Critical
Spatial Extent	Large
Warning Time	More than 24 hours
Duration	Less than one week

Because it cannot be predicted where an ice storm or winter storm (as defined in the *Hazard Identification and Analysis* section) may occur, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. These results are shown in Tables 5.1-5.3. It is important to note that only reported ice/winter storm occurrences have been factored into this vulnerability assessment.[6]

[6] It is possible that additional winter storm and freeze events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

Although NCDC does not report any historical damage, local records show at least $256,000 in past damages to property due to ice/winter storms.

Table 5.10 shows total exposure and potential annualized property losses and percent loss ratios resulting from the ice storm hazard for Myrtle Beach.

Table 5.10: Total Exposure and Potential Annualized Losses from Ice Storm

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$12,190

5.6.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are exposed to the winter weather hazard (**Table 5.49**). Specific vulnerabilities for these assets will be greatly dependent on their individual design and the mitigation measures in place, where appropriate. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates.

5.7 LIGHTNING

PRI Value: 2.4

Annualized Loss Estimate: $45,325

According to the qualitative assessment performed using the PRI tool, the lightning hazard scored a PRI value of 2.2 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.11** summarizes the risk levels assigned to each PRI category.

Table 5.11: Qualitative Assessment for Lightning

Probability	Highly Likely
Impact	Minor
Spatial Extent	Negligible
Warning Time	Less than 6 hours
Duration	Less than 6 hours

Because it cannot be predicted where lightning may strike, all existing and future buildings, facilities and populations in Myrtle Beach are considered to be exposed to this hazard and could potentially be impacted. These results are shown in Tables 5.1-5.3. It is important to note that only reported lightning strikes have been factored into this vulnerability assessment.[7]

[7] It is possible that additional lightning strikes may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

To estimate losses due to lightning, NCDC historical lightning loss data was used to develop a lightning stochastic model. In this model:

- Losses were scaled for inflation;
- Expected annualized losses were calculated through a non-linear regression of historical data.

Table 5.12 shows total exposure and potential annualized property losses and percent loss ratios resulting from the lightning hazard for Myrtle Beach.

Table 5.12: Total Exposure and Potential Annualized Losses from Lightning

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$45,325

5.7.1 Asset Vulnerability

While all of the inventoried assets in Myrtle Beach are equally exposed to the lightning hazard, any anticipated future damages or losses are expected to be minimal. Inventoried critical facilities in Myrtle Beach can be found in **Table 5.49** near in the end of this section.

5.8 NORTHEASTER

PRI Value: 2.7
Annualized Loss Estimate: Negligible

According to the qualitative assessment performed using the PRI tool, the northeaster hazard scored a PRI value of 2.7 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.13** summarizes the risk levels assigned to each PRI category.

Table 5.13: Qualitative Assessment for a Northeaster

Probability	Possible
Impact	Critical
Spatial Extent	Large
Warning Time	More than 24 hours
Duration	Less than one week

Because it cannot be predicted what areas a northeaster may affect, all existing and future buildings, facilities and populations in Myrtle Beach are considered to be exposed to this hazard and could potentially be impacted. These results are shown in Tables 5.1-5.3.

Given the lack of historical loss data on significant northeaster damage occurrences in Myrtle Beach, it is assumed that while one major event could potentially result in significant losses due to lightning, annualizing structural losses over a long period of time would most likely yield a very low annualized loss estimate for the city.

Although NCDC does not report any historical damage, local records show around $14.8 million in damages to property across Horry County from the 1987 Northeaster.

Table 5.14 shows total exposure and potential annualized property losses and percent loss ratios resulting from the northeaster hazard for Myrtle Beach.

Table 5.14: Total Exposure and Potential Annualized Losses from Northeaster

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$0

5.8.1 Asset Vulnerability

While all of the inventoried assets in Myrtle Beach are equally exposed to the Northeaster hazard, any anticipated future damages or losses are expected to be minimal. Inventoried critical facilities for Myrtle Beach can be found in **Table 5.49** near the end of this section.

5.9 WIND EVENTS (THUNDERSTORM)

PRI Value: 3.1
Annualized Loss Estimate: $93,425

According to the qualitative assessment performed using the PRI tool, the wind event hazard scored a PRI value of 3.1 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.15** summarizes the risk levels assigned to each PRI category.

Table 5.15: Qualitative Assessment for Wind Events

Probability	Highly Likely
Impact	Limited
Spatial Extent	Large
Warning Time	Less than 6 hours
Duration	Less than 6 hours

Historical evidence shows that the city is vulnerable to thunderstorm and severe wind hazards. This is an atmospheric hazard, so all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. These results are shown in Tables 5.1-5.3. It is important to note that only reported thunderstorm wind events have been factored into this vulnerability assessment.[8]

[8] It is possible that additional thunderstorm events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

To estimate losses due to severe thunderstorm wind, NCDC data for occurrences in Myrtle Beach was used to develop a severe thunderstorm stochastic model. In this model:

- Losses were scaled for inflation;
- Expected annualized losses were calculated through a non-linear regression of historical data

Table 5.16 shows total exposure and potential annualized property losses and percent loss ratios resulting from the severe thunderstorm wind hazard for Myrtle Beach.

Table 5.16: Total Exposure and Potential Annualized Losses from Severe Thunderstorm Wind

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$93,425

5.9.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are exposed to the severe thunderstorm wind hazard. Specific vulnerabilities for these assets will be greatly dependent on their individual design and the mitigation measures in place, where appropriate. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates. A complete list of critical facilities at risk can be found in **Table 5.49** near the end of this section.

5.10 TORNADO

PRI Value: 2.3
Annualized Loss Estimate: $593,972

According to the qualitative assessment performed using the PRI tool, the tornado hazard scored a PRI value of 2.4 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.17** summarizes the risk levels assigned to each PRI category.

Table 5.17: Qualitative Assessment for Tornado

Probability	Possible
Impact	Critical
Spatial Extent	Small
Warning Time	Less than 6 hours
Duration	Less than 6 hours

Historical evidence shows that the city is vulnerable to tornadic activity. This hazard can result from severe thunderstorm activity or may occur during a major tropical storm or hurricane. Because it cannot be predicted where a tornado may touch down, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. These results are shown in Tables 5.1-5.3. It is important to note that only reported tornadoes have been factored into this vulnerability assessment[9].

To estimate losses due to tornadoes, NCDC historical tornado loss data for occurrences in Myrtle Beach was used to develop a tornado stochastic model. In this model:

- Losses were scaled for inflation;
- Expected annualized losses were calculated through a non-linear regression of historical data

Table 5.18 shows total exposure and potential annualized property losses and percent loss ratios resulting from the tornado hazard for Myrtle Beach.

Table 5.18: Total Exposure and Potential Annualized Losses from Tornado

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$593,972

5.10.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are exposed to the tornado hazard (**Table 5.40**). Specific vulnerabilities for these assets will be greatly dependent on their individual design and the mitigation measures in place, where appropriate. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates.

5.11 TROPICAL STORM SYSTEM/HURRICANE

PRI Value: 2.9

Annualized Loss Estimate: $8,488,637

According to the qualitative assessment performed using the PRI tool, the tropical storm system and hurricane hazard scored a PRI value of 2.9 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.19** summarizes the risk levels assigned to each PRI category.

[9] It is possible that additional tornado events may have occurred since 1950 that were not reported to NCDC and are not accounted for in this analysis.

Table 5.19: Qualitative Assessment for Tropical Storm System and Hurricane

Probability	Likely
Impact	Critical
Spatial Extent	Large
Warning Time	More than 24 hours
Duration	Less than 24 hours

Because hurricanes and tropical storms often impact large areas and cross jurisdictional boundaries, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. These results are shown in Tables 5.1-5.3. Hurricanes and tropical storms can cause damage through numerous additional hazards such as flooding, coastal erosion, high winds and precipitation, thus it is difficult to estimate total potential losses from these cumulative effects. However, the current HAZUS-MH hurricane model only analyzes hurricane winds and is not capable of modeling and estimating cumulative losses from all hazards associated with hurricanes; therefore only hurricane winds are analyzed in this section. Vulnerability to storm surge resulting from hurricanes is addressed individually in a separate section.

Hurricanes and tropical storms can cause damage through numerous additional hazards such as flooding, erosion, tornadoes, high winds, and precipitation, thus it is difficult to estimate total potential losses from these cumulative effects. The current Hazus-MH hurricane model only analyzes hurricane winds and is not capable of modeling and estimating cumulative losses from all hazards associated with hurricanes; therefore only hurricane winds are analyzed in this section. It can be assumed that all existing and future buildings and populations are at risk to the hurricane and tropical storm hazard. Hazus-MH 2.1 was used to determine annualized losses for the county as shown below in **Table 5.20.** In the comparative annualized loss analysis at the end of this section, only losses to buildings are reported in order to best match annualized losses reported for other hazards. Hazus-MH reports losses at the U.S. Census tract level, so determining participating jurisdiction losses was not possible.

Table 5.20: Annualized Loss Estimations for Hurricane Wind Hazard

Location	Building Loss	Contents Loss	Inventory Loss	Total Annualized Loss
Horry County	$70,287,000	$24,784,000	$170,000	$95,241,000

Source: Hazus-MH 2.2

A probabilistic scenario was created using HAZUS-MH to assess the vulnerability of Myrtle Beach to hurricane winds. Default HAZUS-MH wind speed data and damage functions, and methodology were used to determine the potential estimated losses for 50-, 100-, 200-, 500-, and 1000-year frequency events. Since this information on loss estimation was only available at the county level, Myrtle Beach loss was calculated by utilizing the county-level estimate and attributing a proportion of that estimate based on the ratio of building counts in Myrtle Beach to building counts in Horry County, as per American Community Survey 2013 data. It should be noted that since Myrtle Beach is a developed community located directly on the coast, it is likely that this calculation likely underestimates losses from hurricanes. **Table 5.21** shows estimated potential losses to improved properties in incorporated Myrtle Beach for 50-, 100-, 200-, 500- and 1000-year hurricane wind event scenarios.

Table 5.21: Potential Losses to Improved Property from Tropical Storm Systems and Hurricanes by Return Period

Return Period	Estimated Potential Losses
10-year	$2,167,322
20-year	$17,140,118
50-year	$77,265,507
100-year	$184,964,450
200-year	$391,358,717
500-year	$839,953,421
1000-year	$1,200,273,448

Source: HAZUS-MH, 2.2

Table 5.22 shows total exposure and potential annualized property losses and percent loss ratios resulting from the tropical storm system and hurricane hazard for Myrtle Beach. As explained above, overall annualized loss was calculated by utilizing the county-level estimate and attributing a proportion of that estimate based on the ratio of building counts in Myrtle Beach to building counts in Horry County.

Table 5.22: Total Exposure and Potential Annualized Losses from Tropical Storm Systems and Hurricanes

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$8,488,637

5.11.1 Asset Vulnerability

All of the assets inventoried in Myrtle Beach are exposed to hurricane and coastal storm wind (**Table 5.49**). Specific vulnerabilities for these assets will be greatly dependent on their individual design and the mitigation measures in place, where appropriate. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates.

Geologic Hazards

5.12 EARTHQUAKE

PRI Value: 2.0
Annualized Loss Estimate: $24,563

According to the qualitative assessment performed using the PRI tool, the earthquake hazard scored a PRI value of 2.0 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.23** summarizes the risk levels assigned to each PRI category.

Table 5.23: Qualitative Assessment for Earthquake

Probability	Unlikely
Impact	Minor
Spatial Extent	Moderate
Warning Time	Less than 6 hours
Duration	Less than 6 hours

An earthquake has the potential to impact all existing and future buildings, facilities and populations. These results are shown in Tables 5.1-5.3.

For the earthquake hazard vulnerability assessment, a probabilistic scenario was created to estimate the annualized loss for the county. The results of the analysis reported at the U.S. Census tract level do not make it feasible to estimate losses at the jurisdiction level. Since the scenario is annualized, no building counts are provided. Losses reported included losses due to building damage (structural and non-structural), contents, and inventory. However, like the analysis for hurricanes, the comparative annualized loss figures at the end of this section only utilize building losses in order to provide consistency with other hazards. **Table 5.24** summarizes the findings.

Table 5.24: Annualized Loss Estimations for Earthquake Hazard

Location	Structural Loss	Non-Structural Loss	Contents Loss	Inventory Loss	Total Annualized Loss
Horry County	$203,000	$686,000	$232,000	4,000	$1,125,000

Source: Hazus-MH 2.2

Table 5.25 shows total exposure and potential annualized property losses and percent loss ratios resulting from the earthquake hazard for Myrtle Beach. Since the best available information on loss estimation was only available at the county level, annualized loss was calculated by utilizing the county-level estimate and attributing a proportion of that estimate based on the ratio of building counts in Myrtle Beach to building counts in Horry County based on American Community Survey 2013 data.

Table 5.25: Total Exposure and Potential Annualized Losses from Earthquake

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$24,563

5.12.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are exposed to the earthquake hazard (**Table 5.49**). Specific vulnerabilities for these assets will be greatly dependent on their individual design and the mitigation measures in place, where appropriate. Such site-specific vulnerability determinations are outside the scope of this assessment but will be considered during future plan updates.

5.13 TIDAL WAVE/TSUNAMI

PRI Value: 1.7

Annualized Loss Estimate: Negligible

According to the qualitative assessment performed using the PRI tool, the tsunami hazard scored a PRI value of 1.7 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.26** summarizes the risk levels assigned to each PRI category.

Table 5.26: Qualitative Assessment for Tidal Wave and Tsunami

Probability	Unlikely
Impact	Limited
Spatial Extent	Small
Warning Time	Less 6 hours
Duration	More than 24 hours

Table 5.27 shows total exposure and potential annualized property losses and percent loss ratios resulting from the tidal wave/tsunami hazard for Myrtle Beach.

Table 5.27: Total Exposure and Potential Annualized Losses from Tidal Wave/Tsunami

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$0

5.13.1 Asset Vulnerability

It is assumed that the City's vulnerability to this hazard would be very similar to results calculated for storm surge.

Hydrologic Hazards

5.14 EROSION

PRI Value: 2.4

Annualized Loss Estimate: Negligible

According to the qualitative assessment performed using the PRI tool, the erosion hazard scored a PRI value of 2.4 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.28** summarizes the risk levels assigned to each PRI category.

Table 5.28: Qualitative Assessment for Erosion

Probability	Highly Likely
Impact	Minor
Spatial Extent	Small
Warning Time	More than 24 hours
Duration	More than 1 week

Table 5.29 shows total exposure and potential annualized property losses and percent loss ratios resulting from the erosion hazard for Myrtle Beach. A distance of 100 yards from the shoreline was utilized to give a rough estimate of the number of people, properties, and facilities at risk to erosion. This distance was chosen because it generally encompasses structures that are along the coastline. It should be noted that the population estimate is likely low because it is calculated using Census data which reflects permanent residents, many of whom do not live along the coastline.

Table 5.29: Total Exposure and Potential Annualized Losses from Erosion

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	304	$73,147,430	$0

5.13.1 Asset Vulnerability

According to the SC Department of Health and Environmental Control, all of Myrtle Beach is classified as a standard erosion zone which means it is a segment of shoreline not directly influenced by an inlet or associated shoals. Because the annual rate of erosion for all survey monuments is also relatively similar across the city at -0.59, all assets are considered to be at some risk to erosion. However, it should be noted that assets located closer to the ocean and directly along the shoreline are at highest risk to erosion. No critical facilities are located directly adjacent to the shoreline.

5.15 FLOOD

PRI Value: 3.3

Annualized Loss Estimate: $257,381

According to the qualitative assessment performed using the PRI tool, the flood hazard scored a PRI value of 3.4 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.30** summarizes the risk levels assigned to each PRI category.

Table 5.30: Qualitative Assessment for Flood

Probability	Highly Likely
Impact	Critical
Spatial Extent	Moderate
Warning Time	6 to 12 hours
Duration	Less than one week

In order to assess flood risk, a GIS-based analysis was used to estimate exposure to flood events using Digital Flood Insurance Rate Map (DFIRM) data in combination with local tax assessor records (2015). The determination of assessed value at-risk (exposure) was calculated using GIS analysis by summing the total assessed building values for only those improved properties that were confirmed to be located within an identified Zone A/AE (1-percent-annual-chance floodplain), Zone VE (1-percent-annual-chance coastal flood zone with associated wave action), Zone X500 (0.2-percent-annual-chance floodplain) and the floodway if/where applicable. **Table 5.31** lists the number of properties determined to be located within each of the special flood hazard areas along with the improved values for structures located on those properties.

Table 5.31: Total Exposure of Improved Properties to Flood[10]

JURISDICTION	Estimated Number of Buildings At Risk	Estimated Assessed Value of Improved Buildings At Risk
AT-RISK (1-PERCENT-ANNUAL-CHANCE FLOOD)		
Myrtle Beach	1.193	$61,763,774
AT-RISK (COASTAL VE ZONE)		
Myrtle Beach	472	$93,670,746
AT-RISK (0.2-PERCENT-ANNUAL-CHANCE FLOOD)		
Myrtle Beach	1,280	$35,451,340

Hazus-MH was used to estimate potential losses in Myrtle Beach resulting from potential coastal flood events. A Digital Elevation Model (DEM) was obtained from the U.S. Geological Survey (USGS) for the study area coordinates for input and flood depth was estimated at the pixel level for affected areas, along with the proportion of the area affected within the census block. Transects and stillwater elevations were input from data provided in the 2003 FEMA Flood Insurance Study for this area. Hazus-

[10] Since many structures and parcels are located within more than one flood zone, this exposure analysis likely overestimates the total number and dollar value that are located within all areas of flood risk because some structures/parcels are counted within multiple zones.

MH was utilized to estimate floodplain boundaries, potential exposure for each event frequency, and loss estimates based on probabilistic scenarios for 10-, 50-, 100-, 200- and 500-year flood events using a Level 1 analysis and through data normalization using 2007 tax assessed property values. **Table 5.32** shows estimated potential losses for 10-, 50-, 100-, 200-, and 500-year flood event scenarios that resulted from this analysis.

Table 5.32: Potential Losses to Improved Property from Flood by Return Period

Return Period	Estimated Potential Losses
10-year	$17,077,760
50-year	$55,221,771
100-year	$100,924,637
200-year	$114,974,503
500-year	$205,146,073

Source: Hazus-MH

Table 5.33 shows total exposure and potential annualized property losses and percent loss ratios resulting from the flood hazard analysis for Myrtle Beach.

Table 5.33: Total Exposure and Potential Annualized Losses from Flood

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	10,317	$190,885,860	$257,381

Source: Hazus-MH and Horry County Tax Assessor Data

5.15.1 Asset Vulnerability

There are no inventoried assets for Myrtle Beach determined to be vulnerable to the effects of flood. That is to say, none are located specifically in the identified floodplain. However, it is possible that some assets may be vulnerable to flooding from stormwater or from higher magnitude events.

5.16 STORM SURGE

PRI Value: 2.9

Annualized Loss Estimate: $145,591,250

According to the qualitative assessment performed using the PRI tool, the storm surge hazard scored a PRI value of 2.7 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.34** summarizes the risk levels assigned to each PRI category.

Table 5.34: Qualitative Assessment for Storm Surge

Probability	Likely
Impact	Critical
Spatial Extent	Moderate
Warning Time	More than 24 hours
Duration	Less than 24 hours

As discussed in the *Hazard Identification and Analysis* section, storm surge is a flood hazard which is related to hurricanes, but differs from coastal flood events. Only storm surge related to hurricanes is analyzed in this section.

The surge hazard was modeled using SLOSH (Sea, Lake, and Overland Surges from Hurricane). SLOSH was developed by the National Hurricane Center, FEMA, and the Army Corp of Engineers. The SLOSH Maximum of the MEOWs (MOM) data was used to determine SLOSH vulnerability.[11] MOM is a composite of the Maximum Envelope of Water (MEOW), which is generated by running several hypothetical hurricanes and collecting their associated surge heights. The MOM uses the maximum recorded surge height from the MEOW scenarios for each grid block. The data used for Myrtle Beach was updated as of 2010 and was taken from the SC northern conglomerate SLOSH basin. For the vulnerability assessment, critical facilities were overlaid on the surge areas to determine the height of surge (above mean sea level) for each facility.

Table 5.35 lists the number of properties determined to be located within each of the defined storm surge inundation zones in the City along with the improved values for structures located on those properties. It should be noted that this estimation does not take into account whether structures have been elevated or otherwise protected against storm surge impacts. It simply identifies properties and are located within the inundation zones and which could potentially be impacted.

Table 5.35: Total Exposure of Improved Properties to Storm Surge

Storm Surge Inundation Zone	Number of Properties	Total Assessed Value of Improvements (Buildings)	Total Market Value of Improvements (Buildings)
Category 1	145	$19,052,342	$337,376,600
Category 2	1,160	$101,3485,06	$1,774,346,400
Category 3	5,204	$145,591,250	$2,603,937,800
Category 4	12,639	$212,404,416	$3,881,692,200
Category 5	15,392	$231,744,950	$4,266,314,800

Table 5.36 shows total exposure and potential annualized property losses and percent loss ratios resulting from the Category 3 storm surge hazard analysis for Myrtle Beach.

[11] The SLOSH training manual indicates that SLOSH is accurate within +/- 20 percent.

Table 5.36: Total Exposure and Potential Annualized Losses from Category 3 Storm Surge

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	15,629	$145,591,250	$0

5.16.1 Asset Vulnerability

There are a total of 38 inventoried assets in Myrtle Beach determined to be vulnerable to the effects of storm surge. A Category Three storm threatens Myrtle Beach Fire Station 2. A Category Four storm threatens 28 of the 41 critical facilities identified in this analysis. Finally, a Category Five storm threatens every critical facility identified in this analysis with the exception of Fire Station 5, Grand Strand Medical Center, and Myrtle Beach Intermediate School. All of the assets determined to be at risk to storm surge are listed in **Table 5.49** toward the end of this section.

5.17 SEA LEVEL RISE

PRI Value: 2.4
Annualized Loss Estimate: *Undetermined*

According to the qualitative assessment performed using the PRI tool, the sea level rise hazard scored a PRI value of 2.1 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.37** summarizes the risk levels assigned to each PRI category.

Table 5.37: Qualitative Assessment for Sea Level Rise

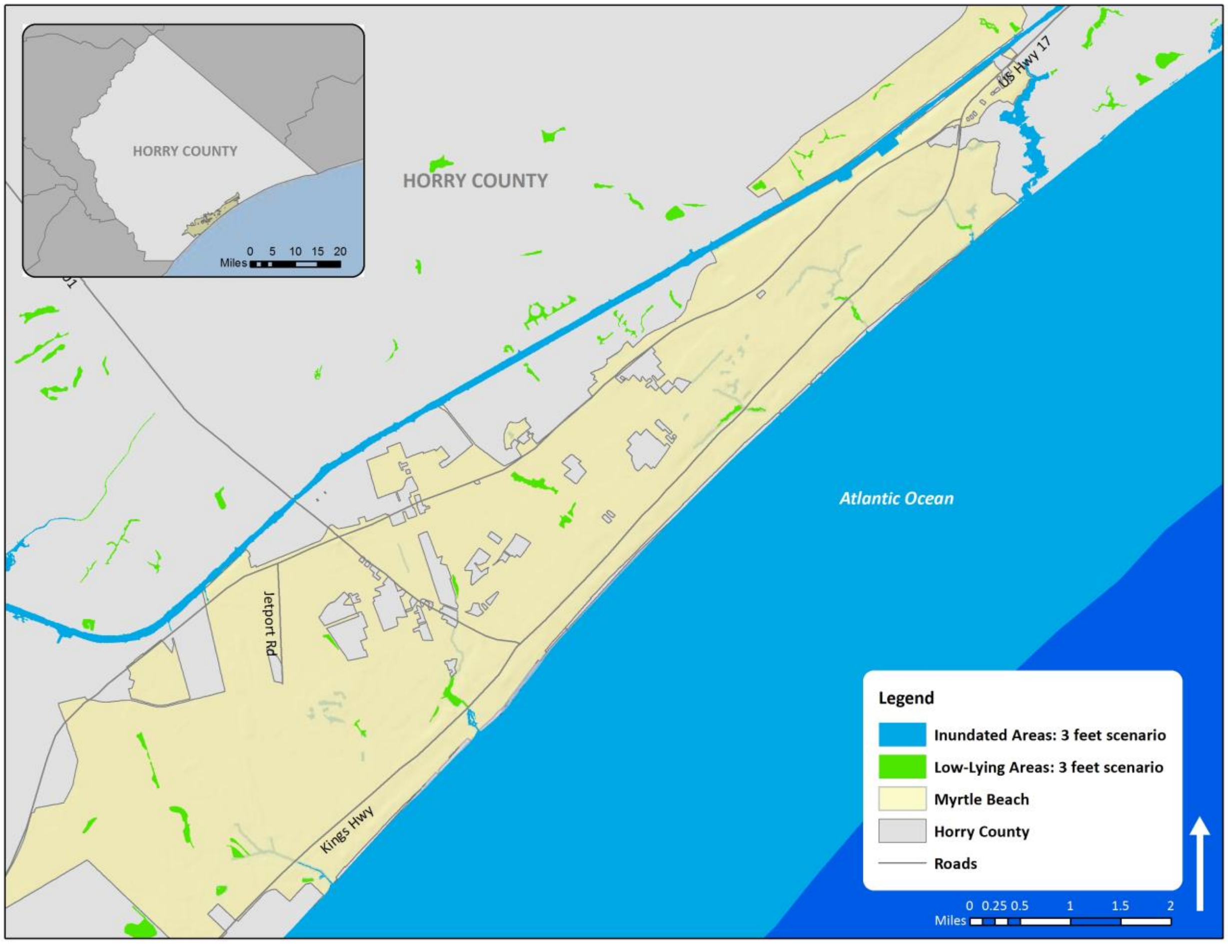
Probability	Likely
Impact	Minor
Spatial Extent	Small
Warning Time	More than 24 hours
Duration	More than one week

Sea Level Rise can cause loss of property, habitat, and valuable tourism dollars. However, measuring its affects can be difficult. For this analysis, data provided by the South Carolina Emergency Management Division was used. This data, highlighted in Section 4: *Hazard Identification and Analysis*, shows sea level rise scenarios at 0.6meter, 1.0 meter, 3.0 meters, and 6 meters.

In order to determine vulnerability, parcel information was overlaid on the sea level affected areas for each "zone" (3 feet and 6 feet of sea level rise) using geographic information system (GIS). Structures located within an affected area are considered to be vulnerable. **Figure 5.5** shows the affected areas in Myrtle Beach for the 3 feet scenario and **Figure 5.6** shows the 6 feet scenario. **Table 5.38** shows the complete results of the analysis, including number of structures in a sea level rise zone and the improved value of the vulnerable structures.

Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. A more detailed analysis of these areas is required to determine the susceptibility to flooding.[12]

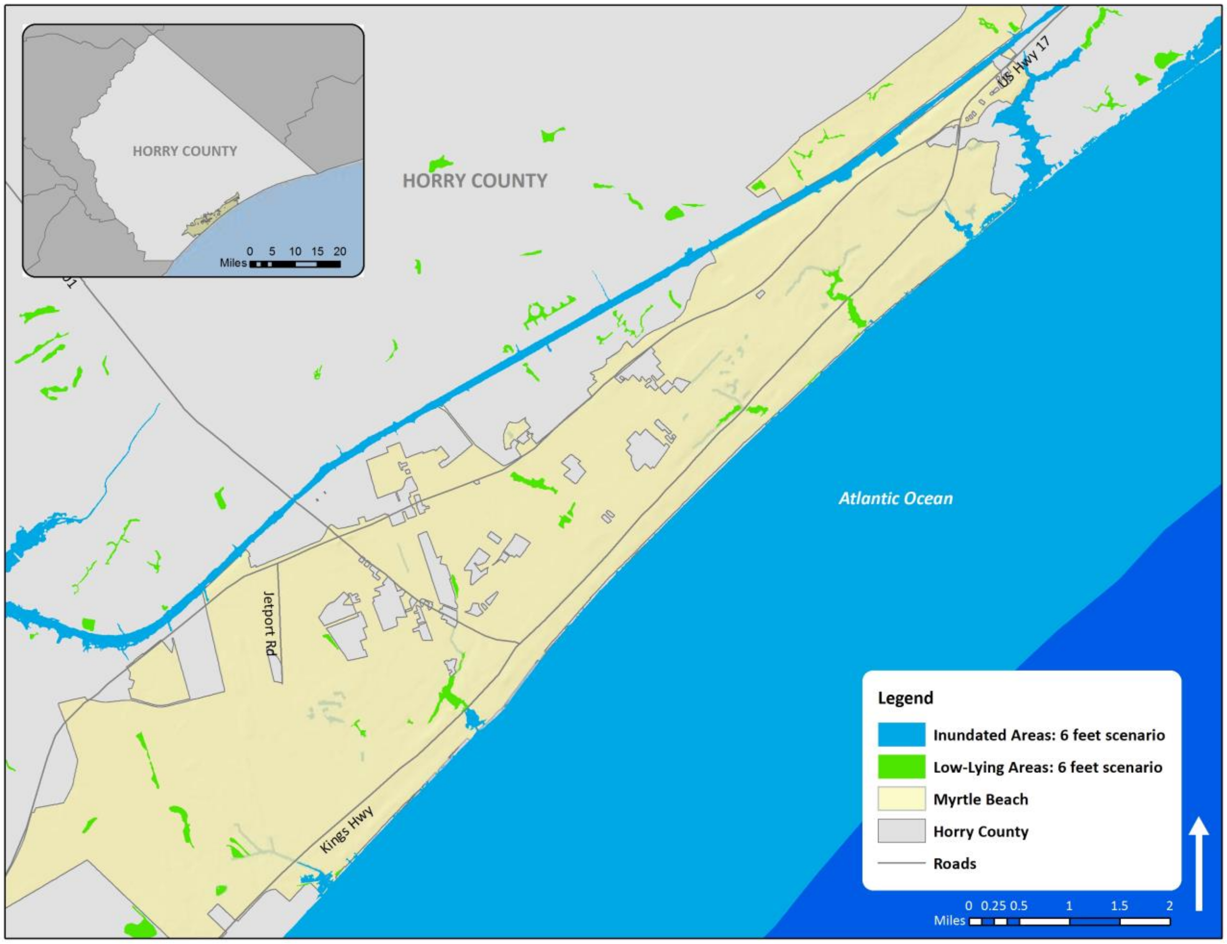
Figure 5.5: Areas Affected by 3 feet of Sea Level Rise



Source: NOAA Office of Coastal Management

[12] NOAA Office of Coastal Management, Sea Level Rise Viewer

Figure 5.6: Areas Affected by 6 feet of Sea Level Rise



Source: NOAA Office of Coastal Management

Table 5.38: Total Exposure and Potential Annualized Losses from Sea Level Rise Hazard

Sea Level Rise Scenario	Estimated Population at Risk	Number of Structures	Total Assessed Value of Improvements (Buildings)
Inundated Areas: 3 feet	581	46	$2,918,484
Low-Lying Areas: 3 feet	1,753	18	$4,251,206
Inundated Areas: 6 feet	740	113	$15,081,716
Low-Lying Areas: 6 feet	3,039	73	$11,037,776

5.20.1 Asset Vulnerability

No critical facilities were found to be vulnerable to Sea Level Rise in either the 3 feet or the 6 feet scenario.

Other Hazards

5.18 ACTS OF TERROR

PRI Value: 1.9
Annualized Loss Estimate: *Negligible*

According to the qualitative assessment performed using the PRI tool, the terror hazard scored a PRI value of 1.9 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.39** summarizes the risk levels assigned to each PRI category.

Table 5.39: Qualitative Assessment for Acts of Terror

Probability	Unlikely
Impact	Critical
Spatial Extent	Negligible
Warning Time	Less than 6 hours
Duration	Less than 6 hours

It cannot be predicted where an act of terror may occur, so all existing and future buildings, facilities and populations in Myrtle Beach are considered to be equally exposed to this hazard and could potentially be impacted. This cumulative vulnerability is shown in Tables 5.1-5.3.

Given the lack of historical loss data on terror events in the Myrtle Beach, while it is assumed that one major event could potentially result in significant losses, annualizing structural losses over a long period of time would most likely yield a very low annualized loss estimate for the city.

Table 5.40 shows total exposure and potential annualized property losses and percent loss ratios resulting from the acts of terror hazard for Myrtle Beach.

Table 5.40: Total Exposure and Potential Annualized Losses from Acts of Terror

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$0

5.17.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are exposed to a terrorist attack (**Table 5.49**).

5.19 AIRPLANE CRASH

PRI Value: 2.1
Annualized Loss Estimate: *Negligible*

According to the qualitative assessment performed using the PRI tool, the airplane crash hazard scored a PRI value of 2.1 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.41** summarizes the risk levels assigned to each PRI category.

Table 5.41: Qualitative Assessment for Airplane Crash

Probability	Unlikely
Impact	Critical
Spatial Extent	Small
Warning Time	Less than 6 hours
Duration	Less than 6 hours

An airplane crash could occur anywhere in the city, so all existing and future buildings, facilities and populations in Myrtle Beach are considered to be equally exposed to this hazard. These results are shown Tables 5.1-5.3.

Table 5.42 shows total exposure and potential annualized property losses and percent loss ratios resulting from the airplane crash hazard for Myrtle Beach.

Table 5.42: Total Exposure and Potential Annualized Losses from Lightning

Location	Estimated Population At Risk	Total Assessed Value of Improvements (Buildings)	Annualized Expected Property Losses
Myrtle Beach	27,109	$4,472,038,300	$0

5.18.1 Asset Vulnerability

All of the inventoried assets in Myrtle Beach are potentially at-risk to an airplane crash. These assets are listed in **Table 5.49** near the end of this section.

5.20 HAZARDOUS MATERIALS INCIDENTS

PRI Value: 2.5
Annualized Loss Estimate: *$3,923*

According to the qualitative assessment performed using the PRI tool, the hazardous materials incident hazard scored a PRI value of 2.5 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.43** summarizes the risk levels assigned to each PRI category.

Table 5.43: Qualitative Assessment for Hazardous Materials Incidents

Probability	Likely
Impact	Limited
Spatial Extent	Small
Warning Time	Less than 6 hours
Duration	Less than 24 hours

Hazardous material or toxic releases can have a significant negative impact. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage. In a hazardous materials incident, solid, liquid and/or gaseous contaminants may be released from fixed or mobile containers. Weather conditions will directly affect how the hazard develops. Non-compliance with fire and building codes, as well as failure to maintain existing fire and containment features can substantially increase the damage from a hazardous materials release. The duration of a hazardous materials incident can range from hours to days. Warning time is minimal to none.

The Toxic Release Inventory (TRI) is a publicly available database from the federal Environmental Protection Agency (EPA) that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to EPA and to their state or tribal entity. A facility must report if it meets the following three criteria:

- The facility falls within one of the following industrial categories: manufacturing; metal mining; coal mining; electric generating facilities that combust coal and/or oil; chemical wholesale distributors; petroleum terminals and bulk storage facilities; RCRA Subtitle C treatment, storage, and disposal (TSD) facilities; and solvent recovery services;
- Has 10 or more full-time employee equivalents; and
- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, bioaccumulative and toxic (PBT) chemicals are subject to different thresholds of 10 pounds, 100 pounds or 0.1 grams depending on the chemical.

Figure 5.7 shows the locations of TRI listed toxic sites in Myrtle Beach with buffers. Two sizes of buffers—0.5 mile and 1.0 mile—are assumed in respect to the different levels of effect: immediate (primary) and secondary. Primary and secondary impact sites were selected based on guidance from the PHMSA Emergency Response Guidebook. For mobile analysis, the major roads (Interstate highway and U.S. highway) and railroads are the transportation corridors where hazardous materials are primarily transported that could adversely impact people and buildings. The buffers along the transportation corridors are drawn with the same size as fixed site analysis and are shown in **Figure 5.8**. **Table 5.44** shows estimated toxic release exposure of people and buildings for fixed sites and **Table 5.45** shows the results for mobile site toxic release.

Figure 5.7: TRI Sites with Buffers in Myrtle Beach

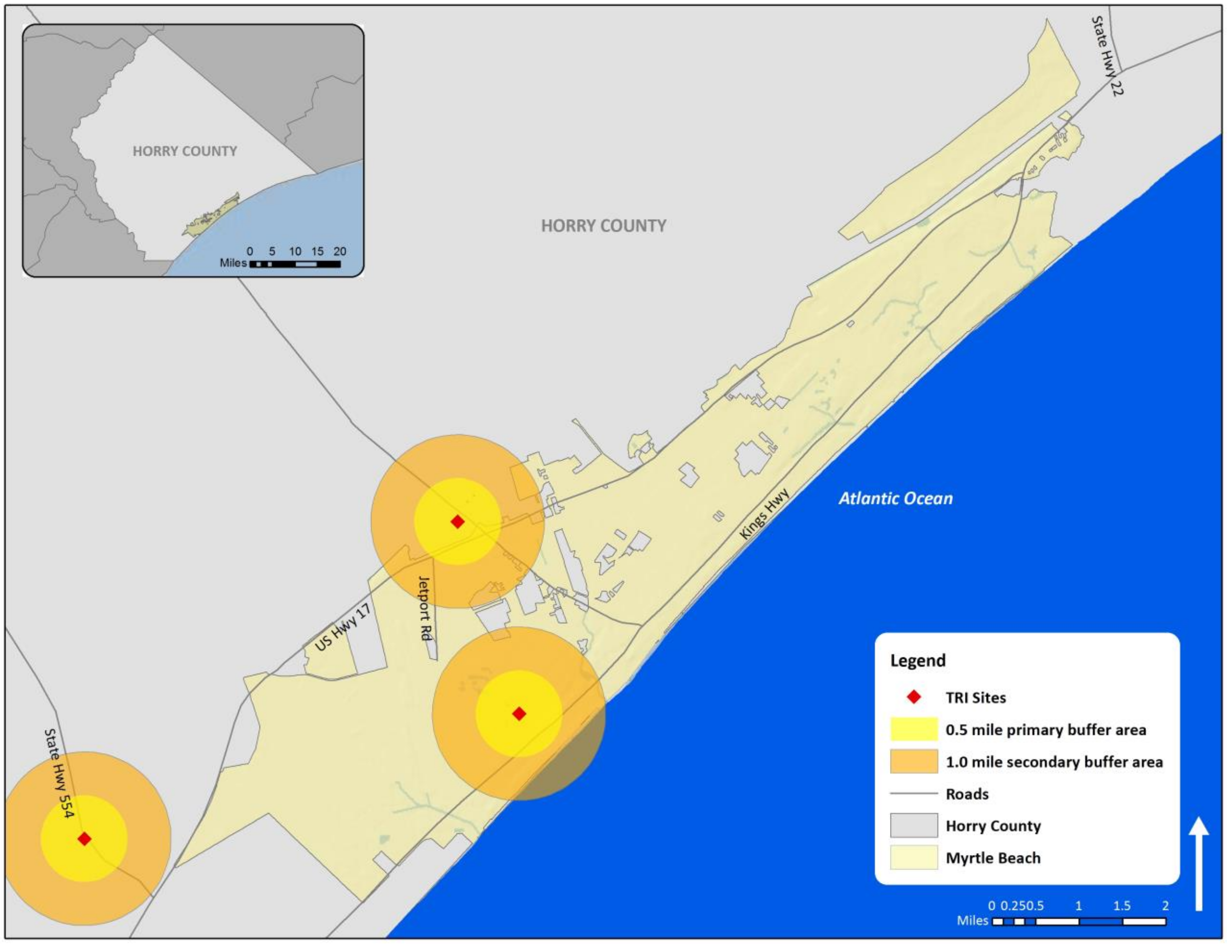


Table 5.44: Exposure of Persons and Improved Property to Hazardous Materials (Fixed Sites)

	Estimated Population At Risk	Estimated Number of Buildings	Total Assessed Value of Improvements (Buildings)	Total Market Value of Improvements (Buildings)
Within 0.5 mile	2,602	810	$10,968,268	$197,349,100
Within 1.0 mile	6,429	3925	$44,615,886	$802,194,600

Source: Horry County GIS

Figure 5.8: Mobile Sites with Buffers in Myrtle Beach

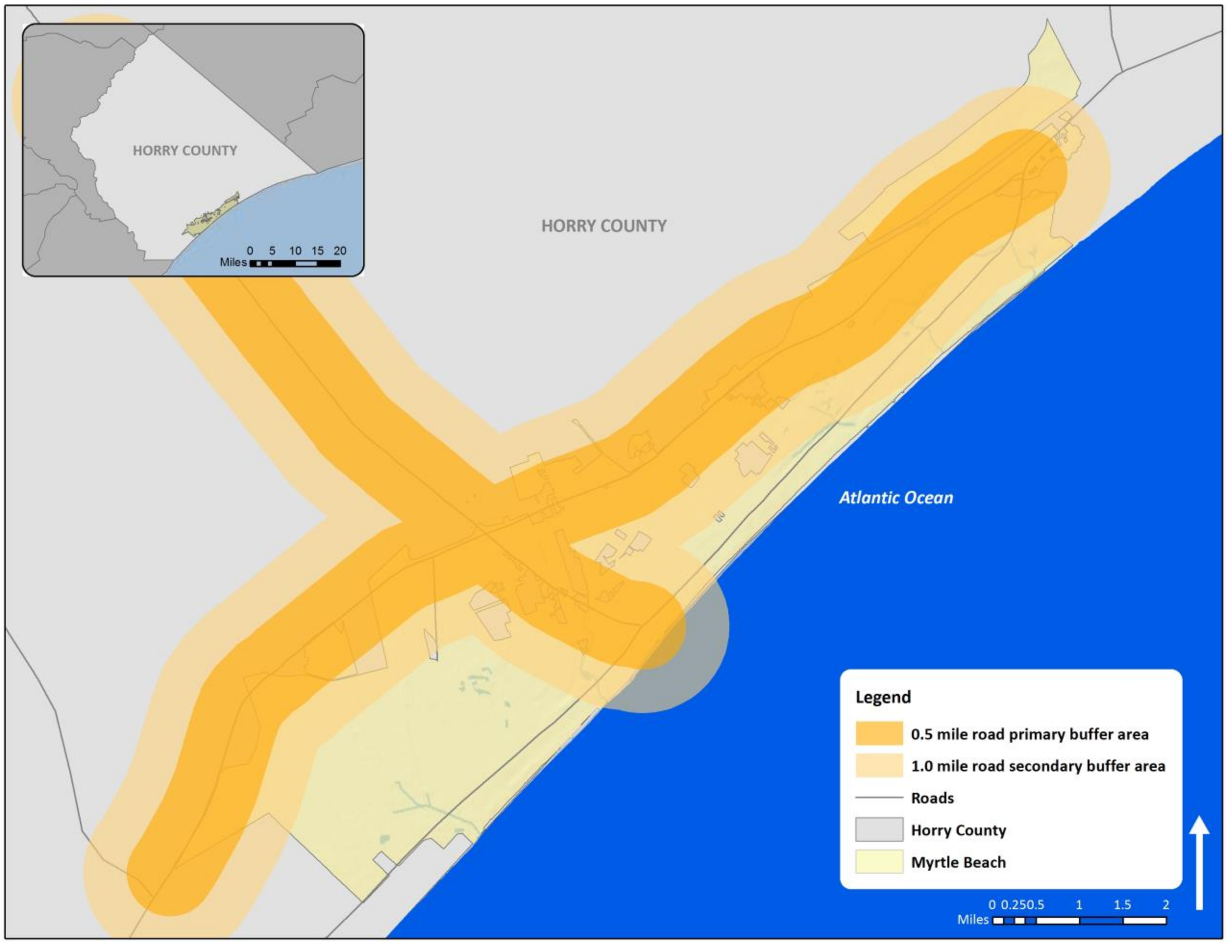


Table 5.45: Exposure of Persons and Improved Property to Hazardous Materials (Mobile Sites)

	Estimated Population At Risk	Estimated Number of Buildings	Total Assessed Value of Improvements (Buildings)	Total Market Value of Improvements (Buildings)
Within 0.5 mile				
Highway	16,746	4,932	$67,921,060	$1,290,016,100
Within 1.0 mile				
Highway	24,760	11,935	$133,124,470	$2,546,312,400

Most hazardous materials incidents that occur in Myrtle Beach are contained and suppressed before destroying any property or threatening lives. Given the lack of historical loss data on significant hazardous materials incidents resulting in structural losses in Myrtle Beach, it is assumed that while one major event could result in significant losses, annualizing structural losses over a long period of time would most likely yield a negligible annualized loss estimate for Myrtle Beach.

5.19.1 Asset Vulnerability

There are a total of 4 inventoried assets in Myrtle Beach determined to be vulnerable to a fixed-site hazardous materials incident. This includes Myrtle Beach International Airport, Fire Station 3, Rescue 81, and Fire Station S36. Many assets are vulnerable to a mobile hazardous materials incident, including 29 critical facilities in the roads buffer areas and 16 facilities in the rails buffer areas. All of the assets determined to be at risk to hazardous materials incidents are listed in **Table 5.49** toward the end of this section.

5.21 WILDFIRE

PRI Value: 2.7
Annualized Loss Estimate: *Negligible*

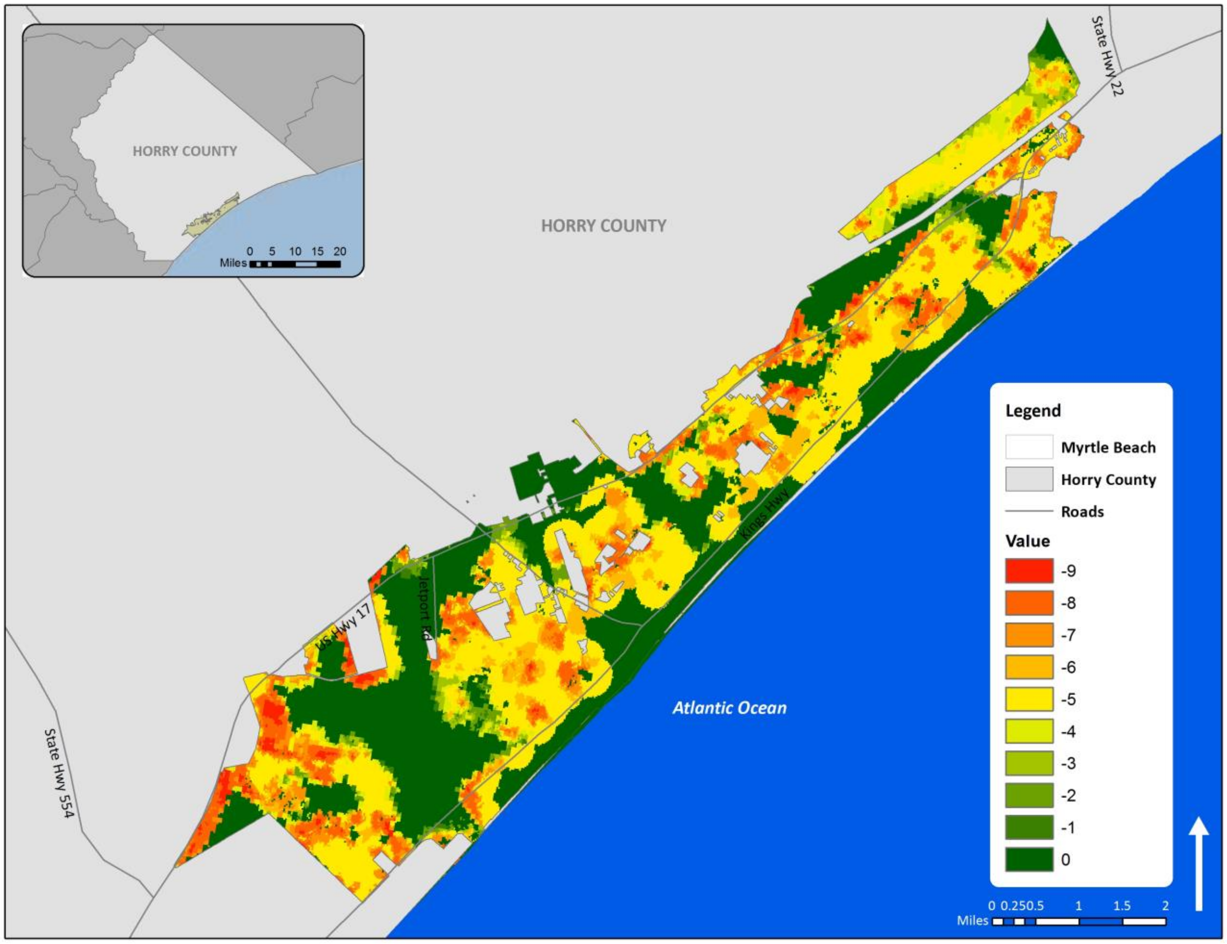
According to the qualitative assessment performed using the PRI tool, the wildfire hazard scored a PRI value of 2.8 (from a scale of 0 to 4, with 4 being the highest risk level). **Table 5.46** summarizes the risk levels assigned to each PRI category.

Table 5.46: Qualitative Assessment for Wildfire

Probability	Highly Likely
Impact	Minor
Spatial Extent	Moderate
Warning Time	Less than 6 hours
Duration	Less than one week

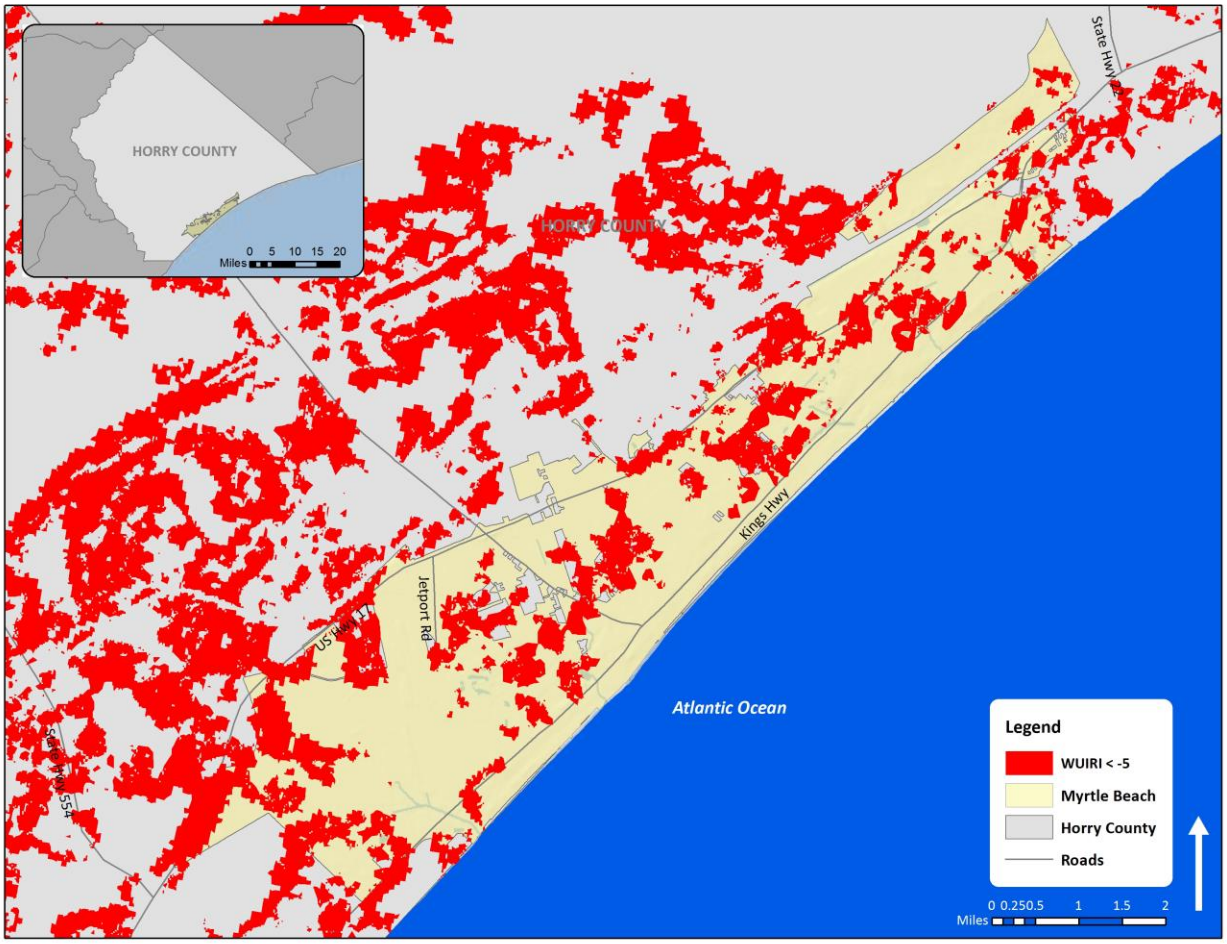
To estimate exposure to wildfire, the approximate number of parcels and their associated improved value was determined using GIS analysis. For the critical facility analysis, areas of risk were intersected with critical facility locations. **Figure 5.9** shows the Wildland Urban Interface Risk Index (WUIRI) data, which is a data layer that shows a rating of the potential impact of a wildfire on people and their homes. The key input, Wildland Urban Interface (WUI), reflects housing density (houses per acre) consistent with Federal Register National standards. The location of people living in the WUI and rural areas is key information for defining potential wildfire impacts to people and homes. Initially provided as raster data, it was converted to a polygon to allow for analysis. The Wildland Urban Interface Risk Index data ranges from 0 to -9 with lower values being most severe (this is only a measure of relative risk). **Figure 5.10** shows the areas of analysis where any grid cell is less than -5. Areas with a value below -5 were chosen to be displayed as areas of risk because this showed the upper echelon of the scale and the areas at highest risk.

Figure 5.9: Wildland Urban Interface Risk Index in Myrtle Beach



Source: Southern Wildfire Risk Assessment

Figure 5.10: Wildland Urban Interface Risk Index Values Less than -5



Source: Southern Wildfire Risk Assessment

To estimate exposure to wildfire, a determination of value for at-risk properties was calculated through GIS analysis by summing the total assessed building values for those improved properties confirmed to be located within areas of high or moderate wildfire risk areas. This information can be found in **Table 5.47**.

Table 5.47: Qualitative Assessment for Wildfire

Location	Estimated Population At Risk	Estimated Number of Buildings	Total Assessed Value of Improvements (Buildings)	Total Market Value of Improvements (Buildings)
Myrtle Beach	22,967	5,049	$61,486,770	$1,180,593,600

5.21.1 Asset Vulnerability

There are five assets vulnerable to wildfire based on the Southern Wildfire Risk Assessment data including a bridge, two fire stations, a post office, and a radio tower.

5.22 CONCLUSIONS ON HAZARD VULNERABILITY

The results of this vulnerability assessment are useful in at least three ways:

- Improving our understanding of the risk associated with the natural hazards in Myrtle Beach through better understanding of the complexities and dynamics of risk, how levels of risk can be measured and compared, and the myriad of factors that influence risk. An understanding of these relationships is critical in making balanced and informed decisions on managing the risk.

- Providing a baseline for policy development and comparison of mitigation alternatives. The data used for this analysis presents a current picture of risk in Myrtle Beach. Updating this risk "snapshot" with future data will enable comparison of the changes in risk with time. Baselines of this type can support the objective analysis of policy and program options for risk reduction in the region.

- Comparing the risk among the natural hazards addressed. The ability to quantify the risk to all these hazards relative to one another helps in a balanced, multi-hazard approach to risk management at each level of governing authority. This ranking provides a systematic framework to compare and prioritize the very disparate natural hazards that are present in Myrtle Beach. This final step in the risk assessment provides the necessary information for local officials to craft a mitigation strategy to focus resources on only those hazards that pose the most threat to the city.

Exposure to hazards can be an indicator of vulnerability. Economic exposure can be identified through locally assessed values for improvements (buildings), and social exposure can be identified by estimating the population exposed to each hazard. This information is especially important for decision-makers to use in planning for evacuation or other public safety related needs. **Table 5.48** provides a summary of the estimated population counts and improved property values at-risk (exposed) to each hazard.

Table 5.49 provides a summary of results for the vulnerability assessment conducted for each of Myrtle Beach's assets (from the inventory listed earlier in this section). The table lists those assets that are determined to be exposed to each of the identified hazards (marked with an "**X**"). It should be noted that in addition to the facilities listed below, the city also has 142 sewer pumping stations and 11 elevated water storage tanks that it maintains both inside and outside of the city limits. These facilities were not mapped and analyzed, but are considered critical.

Table 5.48: Summary of Total Exposure and Potential Annualized Losses to Identified Hazards in Myrtle Beach

Hazard	**Estimated Population At Risk**	**Total Assessed Value of Improvements At-Risk (Buildings)**	**Annualized Expected Property Losses**
Atmospheric			
Drought	27,109	$4,472,038,300	$0
Hailstorm	27,109	$4,472,038,300	$610

Hazard	**Estimated Population At Risk**	**Total Assessed Value of Improvements At-Risk (Buildings)**	**Annualized Expected Property Losses**
Ice Storm	27,109	$4,472,038,300	$12,190
Lightning	27,109	$4,472,038,300	$45,325
Northeaster	27,109	$4,472,038,300	$0
Wind Events	27,109	$4,472,038,300	$93,425
Tornado	27,109	$4,472,038,300	$593,972
Tropical Storm System/Hurricane	22,759	$4,472,038,300	$8,488,637
Geologic			
Earthquake	27,109	$4,472,038,300	$24,563
Tidal Wave/Tsunami	27,109	$4,472,038,300	$0
Hydrologic			
Erosion	304	$73,147,430	$0
Flood	10,317	$190,885,860	$257,381
Storm Surge	15,392	$145,591,250	$0
Sea Level Rise	6,113	$33,289,182	Undetermined
Other			
Acts of Terror	27,109	$4,472,038,300	$0
Airplane Crash	27,109	$4,472,038,300	$0
Hazardous Materials Incident	24,760	$133,124,470	$3,923
Wildfire	22,967	$61,486,770	$0

Table 5.49: Critical Facilities/Assets in Myrtle Beach

		ATMOSPHERIC								GEOLOGIC		HYDRO					OTHER						
FACILITY NAME	FACILITY TYPE	Drought	Hailstorm	Ice Storm	Lightning	Northeaster	Wind Events/ Thunderstorm	Tornado	Tropical Storm/Hurricane	Earthquake	Tidal Wave/Tsunami	1.0 percent annual chance flood	0.2 percent annual chance flood	Storm Surge Cat 3	Storm Surge Cat 5	Sea Level Rise	Acts of Terror	Airplane Crash	HAZMAT Fixed (0.5 mile)	HAZMAT Fixed (1.0 mile)	HAZMAT Roads (0.5 mile)	HAZMAT Roads (1.0 mile)	Wildfire
Myrtle Beach International Airport	Airport	X	X	X	X	X	X	X	X	X					X		X	X		X			
Grand Strand Humane Society	Animal Shelter	X	X	X	X	X	X	X	X	X					X		X	X				X	
N Hwy 17 Byp-2	Bridge	X	X	X	X	X	X	X	X	X					X		X	X			X	X	X
N Hwy 17 Byp-2	Bridge	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
HGTC MB 1000 Speir	College	X	X	X	X	X	X	X	X	X					X		X	X					
21st Avenue Complex	County	X	X	X	X	X	X	X	X	X					X		X	X				X	
Horry County Magistrate-Myrtle Beach	County	X	X	X	X	X	X	X	X	X					X		X	X				X	
Myrtle Beach Fire Station 1	Fire Station	X	X	X	X	X	X	X	X	X					X		X	X				X	X
Myrtle Beach Fire Station 2	Fire Station	X	X	X	X	X	X	X	X	X				X	X		X	X					
Myrtle Beach Fire Station 3	Fire Station	X	X	X	X	X	X	X	X	X					X		X	X	X	X			
Myrtle Beach Fire Station 4/EOC/Police Station	EOC/Fire/ Police Station	X	X	X	X	X	X	X	X	X					X		X	X					
Myrtle Beach Fire Station 5	Fire Station	X	X	X	X	X	X	X	X	X							X	X			X	X	
Myrtle Beach Fire Station 6	Fire Station	X	X	X	X	X	X	X	X	X					X		X	X			X	X	X
Myrtle Beach International Airport Fire Station	Fire Station	X	X	X	X	X	X	X	X	X					X		X	X					
City Hall	Government	X	X	X	X	X	X	X	X	X					X		X	X			X	X	

FACILITY NAME	FACILITY TYPE	ATMOSPHERIC								GEOLOGIC		HYDRO					OTHER						
		Drought	Hailstorm	Ice Storm	Lightning	Northeaster	Wind Events/ Thunderstorm	Tornado	Tropical Storm/Hurricane	Earthquake	Tidal Wave/Tsunami	1.0 percent annual chance flood	0.2 percent annual chance flood	Storm Surge Cat 3	Storm Surge Cat 5	Sea Level Rise	Acts of Terror	Airplane Crash	HAZMAT Fixed (0.5 mile)	HAZMAT Fixed (1.0 mile)	HAZMAT Roads (0.5 mile)	HAZMAT Roads (1.0 mile)	Wildfire
City Services Building	Government	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
Purchasing Department	Government	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
Solid Waste Station	Government	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
Public Works	Government	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
Grand Strand Medical Center	Hospital	X	X	X	X	X	X	X	X	X							X	X			X	X	
MBPD- Law Enforcement Center	Police Station	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
MBPD- Training Center	Police Station	X	X	X	X	X	X	X	X	X					X		X	X					
Myrtle Beach Post Office (67th Ave N)	Postal	X	X	X	X	X	X	X	X	X					X		X	X			X	X	X
Myrtle Beach Post Office (N Kings Hwy)	Postal	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
MB Radio Tower	Radio Tower	X	X	X	X	X	X	X	X	X					X		X	X			X	X	X
Myrtle Beach Elementary	School	X	X	X	X	X	X	X	X	X					X		X	X				X	
Myrtle Beach High	School	X	X	X	X	X	X	X	X	X					X		X	X				X	
Myrtle Beach Intermediate	School	X	X	X	X	X	X	X	X	X							X	X				X	
Myrtle Beach Middle	School	X	X	X	X	X	X	X	X	X					X		X	X				X	
Myrtle Beach Primary	School	X	X	X	X	X	X	X	X	X					X		X	X				X	
Grand Strand Water and Sewer Authority Plant	Sewer Treatment	X	X	X	X	X	X	X	X	X					X		X	X			X	X	
Convention Center	Shelter	X	X	X	X	X	X	X	X	X					X		X	X					
Crabtree Gymnasium	Shelter	X	X	X	X	X	X	X	X	X					X		X	X					