

# CHAPTER 3: RISK ASSESSMENT

## RISK ASSESSMENT PROCESS

The process of risk assessment began with a half-day workshop on November 4, 2016 at the Eastern Shore Community College. Local, state, and federal government; cultural and environmental resource non-profits; and health care, transportation, utilities, law enforcement, business, and education interests were all represented. Together, they learned about historic hazards that have affected the Shore, the expected effect of sea-level rise on the frequency and intensity of tropical storms, and the role of hazard mitigation planning in protecting lives and property.

Participants were given worksheets with the hazards that were identified in the last two hazard mitigation plans, and asked to work in groups to prioritize those hazards, calling on their own knowledge, as well as new knowledge they had acquired from workshop presentations. They were instructed to add to the list if they judged there were items missing.

The starting set of hazards evaluated included:

- Coastal Flooding
- Coastal Erosion
- Drought
- Heat Wave
- Storm Water Flooding
- Ice and Snow
- Wildfire
- Biohazards
- High Wind
- Sewage Spills
- Hazmat Incidences
- Well Contamination

During the workshop, participants added invasive environmental diseases, fish kills, blast zone, thermonuclear disasters, and earthquakes.

Participants were asked to score hazards across several criteria using a set of guidelines provided, and shared below.

## PROBABILITY

Frequency of occurrence based on historical data plus projected future climate and meteorological conditions.

- 1 Unlikely (fewer than one event likely to occur within 100 years, past or future)
- 2 Likely (between one and ten events likely to occur in a 100-year period, past or future)
- 3 Highly Likely (11 or more events likely to occur in a 100-year period, past or future)

## AFFECTED STRUCTURES

Number of structures likely to be affected

- 1 Negligible (likely will affect zero or 1 building)
- 2 Few (likely will affect 2-10 buildings)
- 3 Large (likely will affect more than 10 buildings)

## PRIMARY IMPACTS

Based on the percentage of damage to typical structure or industry in the community

- 1 Negligible (less than 3 % damage)

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- 2 Limited (between 3% and 49% damage)
- 3 Critical (more than 49% damage)

### SECONDARY IMPACTS

Based on impacts to the community at large

- 1 Negligible (no loss of function, no displacement time, no evacuations)
- 2 Limited (some loss of function, displacement time or evacuations)
- 3 Critical (major loss of function, displacement time or evacuations)

### MITIGATION OPTIONS

Based on the number of cost-effective mitigation options

- 1 Few (0-1 cost effective mitigation options)
- 2 Several (2-3 cost effective mitigation options)
- 3 Many (more than 3 cost effective mitigation options)

The scores were compiled and averaged by A-NPDC staff and shared with all Steering Committee members and Planning Council members (all that attended the half-day workshop were members of one or the other). Hazards were divided into three priorities: high, medium, and low.

The resulting prioritization was presented at the first official meeting of the Steering Committee and Planning Council on December 3, 2014. At that meeting, the prioritization was slightly revised, combining some similar categories (such as hazmat, thermonuclear and blastzone). The high priority hazards – coastal flooding, wind, coastal erosion, and storm water flooding – did not change, and remained consistent with the previous two hazard mitigation plans (Table 3.1)

Eastern Shore of Virginia Hazard Mitigation Plan

*Table 1 Eastern Shore of Virginia Hazard Prioritization*

Hazard Type	2016 Plan Ranking	2011 Plan Ranking	2006 Plan Ranking	Probability	Impacts			Mitigation Options	Total Score
					Affected Structures	Primary Impact	Secondary Impact		
High Wind	High	High	High	2.96	2.92	2.58	2.67	1.79	12.92
Coastal Erosion	High	High	High	2.96	2.83	2.46	2.58	1.83	12.67
Coastal Flooding	High	High	High	2.96	2.96	2.46	2.63	1.67	12.67
Storm Water Flooding	High	High	High	2.92	2.63	2.38	2.38	2.17	12.46
Well Contamination	Medium	Unranked	Unranked	2.00	2.17	1.96	1.75	2.04	9.92
Ice-Snow	Medium	Medium	Medium	2.46	2.13	1.50	2.13	1.67	9.88
Biological Hazards**	Medium	Unranked	Unranked	2.35	1.63	1.71	1.83	1.88	9.39
Drought	Medium	Medium	Medium	2.13	1.63	2.13	1.88	1.46	9.21
Sewage Spills	Medium	Medium	Unranked	2.00	1.79	1.58	1.79	1.83	9.00
Wildfire	Low	Medium	Low	1.75	1.96	1.71	1.67	1.71	8.79
Hazardous Materials Incidents*	Low	Low	Low	2.04	1.42	1.38	1.71	1.92	8.46
Heat Wave	Low	Low	Medium	2.42	1.38	1.46	1.50	1.38	8.13
Fish Kills	Low	Unranked	Low	2.04	1.38	1.58	1.67	1.29	7.96
Invasive Environmental Disease***	Low	Unranked	Unranked	2.00	1.00	1.00	1.00	2.00	7.00
Earthquake	Low	Unranked	Unranked	1.00	1.50	1.50	1.50	1.00	6.50

\*Haz-Mat Incidents include oil spills, blast zone, thermo-nuclear

\*\*Bio Hazards include invasive human diseases and pandemic pathogens

\*\*\*Invasive Environmental Disease includes invasive land and water species and diseases



With the hazards identified, the groups began the risk analysis for the four priority hazards: coastal flooding, wind, coastal erosion, and storm water flooding. The first step was to thoroughly document their histories, to understand the causes, and look at the human systems that have been put in place to attempt to mitigate their effects. This work can be found in [Chapter 4: Wind](#); [Chapter 5: Coastal Erosion](#); [Chapter 6: Coastal Flooding](#); and [Chapter 7: Storm Water Flooding](#).

The extent and vulnerability of each of the high priority hazards, as well as those hazards that did not rank as high, are documented in each of locality chapters, beginning with [Chapter 8: Eastern Shore Region](#). Structures insured by the National Flood Insurance Program (NFIP) that have been repetitively damaged by floods are addressed in the appropriate local chapters.

## DEFINITIONS OF EASTERN SHORE HAZARDS

### HIGH PRIORITY HAZARDS

The four high priority hazards scored virtually evenly in the prioritization. All other hazards placed well behind these four. Hazards ranked as medium or low priority are not considered in substantial detail across the region since mitigation options either do not exist or the mitigation options are not as cost effective as the high priority mitigation options. On the Eastern Shore, mitigating damages from ice/snow events, sewage spills, drought, wildfire, hazmat incidents, heat waves, or biohazards are not as cost effective as mitigating damages from coastal flooding, storm water flooding, coastal erosion, and high wind events, which cause extensive disruption and damage.

However, individual towns may have prioritized some of the other hazards and provided more detail on extent and vulnerability due to local conditions or experience.

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#### HIGH WIND

High wind events are highly likely, affecting large numbers of buildings. These events can result from the same tropical and nor'easter systems as coastal flooding. Primary impacts are seen in the form of direct property damage (building, contents, and inventory) and secondary impacts from business interruption losses (income, relocation, rental, wages). Damage to buildings in such storms is widespread and can be critical, with some suffering more than 49 percent damage from these events.

Damage from thunderstorm wind tends to be more localized, as are those from tornadoes, but tornadoes can be far more destructive, with some buildings suffering more than 49 percent damage. Thunderstorm winds and tornados are not typically destructive across the entire region, although tornadoes can draw emergency services from across the region.

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#### COASTAL EROSION

Coastal erosion is considered to be highly likely, affecting large numbers of buildings. Damages can be critical with buildings suffering more than 49 percent damage from these events. Primary impacts to buildings and property are commonly connected to other secondary impacts such as shoaling of navigable waterways and degradation of water quality. These events are not typically disruptive to the entire region.

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#### COASTAL FLOODING

## Risk Assessment

These events are highly likely, affecting large numbers of buildings, infrastructure, and people. Primary impacts are seen in the form of direct property damage (building, contents, and inventory) and secondary impacts from business interruption losses (income, relocation, rental, wages). Damage to buildings can be critical, with some suffering more than 49 percent damage from these events.

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### STORM WATER FLOODING

These events are highly likely, affecting large numbers of buildings, infrastructure, and people. Damages can be critical with buildings suffering more than 49 percent damage from these events. These events can be disruptive to the region, causing some displacement and evacuations.

## MEDIUM PRIORITY HAZARDS

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### WELL CONTAMINATION

This hazard was not ranked in either of the last two plans, but rose to the top of the medium priority list for this plan. It was seen as a medium likelihood of occurrence, affecting a moderate number of structures, but with few feasible mitigation opportunities.

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### ICE/SNOW

The probability of ice and snow events is deemed moderately likely for the current plan. These hazards affect small numbers of structures, and are considered to cause limited damage to the structures on the Eastern Shore. However, they can affect large numbers of people, and tie up large amounts of local resources for towns located along major travel routes, particularly U.S. Route 13. Ice and snow can be disruptive to the region, causing loss of function to the area's commercial businesses, schools, shellfish harvesting industry, and aquaculture industry.

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## BIOHAZARDS

Biohazards are considered low likelihood events, with little impact on buildings, but high impact on the population. Pandemic pathogens, and tick and mosquito-borne illnesses fall into biohazards. This category also includes secondary impacts to primary events, such as illnesses that develop in confined spaces, such as shelters, or from injury or food spoilage following extended power outages.

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## DROUGHT

Droughts are seen as moderately likely, a decrease in emphasis from the 2011 plan. Droughts cause critical damages to the water supply for farmers and residents, so while primary (building) impacts are low, secondary impacts from crop loss can be quite high. These events are typically disruptive to the region causing some loss of individual water supply wells and regional income loss.

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## SEWAGE SPILLS

This hazard is considered moderately likely, with low primary and secondary impacts. This marks a decrease from the 2011 plan, which viewed sewage spills as highly likely, with a small number of structures affected by an event. These events cause limited damages to structures and cause limited disruption to the region. The committee considers there to be limited cost effective options for mitigating these events.

## LOW PRIORITY HAZARDS

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### WILDFIRES

The Eastern Shore is not an area where wildfires are of a scale that damage the entire region. These events are considered highly likely but affect small numbers of structures, and generally cause negligible damage to the larger wood product industry.

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### HAZMAT INCIDENTS

These events are reprioritized to unlikely for the current plan. Formerly the category was defined as incidents such as those that might occur with the transport of hazardous materials, are at an industrial location with hazardous materials, which cause negligible damage to the structures on the Eastern Shore, but could have implications for nearby residents, and are moderately disruptive to the region. With the new plan, hazmat incidents are re-defined to also include larger-scale incidents such as oil spills, blast zones, and thermo-nuclear incidents.

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### HEAT WAVES

These events are very likely but generally do not affect the built environment, although they can be harmful to people and animals. Heat waves cause negligible damages to structures and industries in the community. These incidents are not typically disruptive to the region.

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### FISH KILLS

Fish kills are considered highly likely, but with low impact on structures and human lives, although they do cause short-term disruption to the fishing industry, and can have secondary impacts on income.

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### INVASIVE ENVIRONMENTAL DISEASE

Invasive environmental disease was seen as moderately likely, and includes invasive land and water species and diseases. Local examples include plants like purple loosestrife, phragmites, nutria (a large marsh-dwelling rodent), and diseases that caused the devastating die-off of oyster beds.

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### EARTHQUAKE

These are considered by the Steering Committee to be very low likelihood events that would have medium impacts on structures, income, and industry.