## Prerequisite Hazard Assessment

- Flooding
- Hurricane
- Tornado/high wind
- Earthquake
- Tsunami
- Wildfire
- Drought
- Landslide/unstable soils

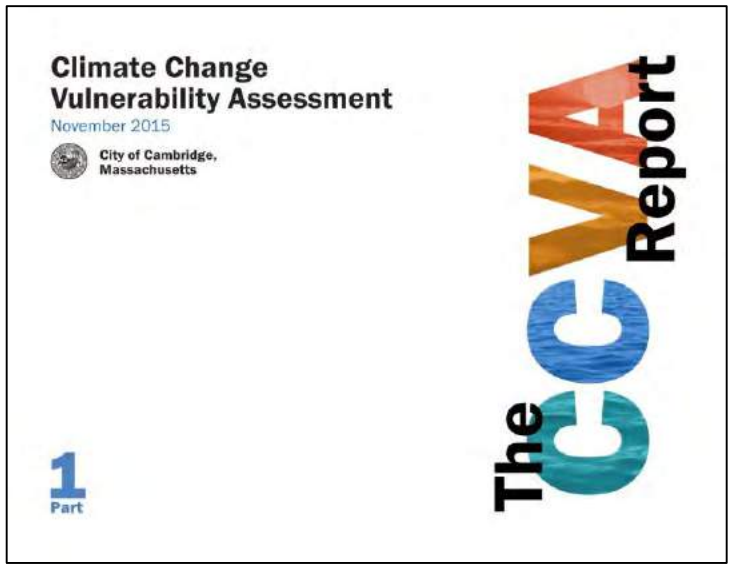
## Option 1: Climate Change

- Seas Level Rise and Storm Surge
- River Flooding Projects
- Winter Storms
- Temperature, Precipitation Changes and Storm Intensity

## Option 2: Emergency Planning

- Evaluate readiness
- Continual Assessment

## Hazard Mitigation Plans for Boston and Cambridge


# **Hurricane** Hazard Assessment

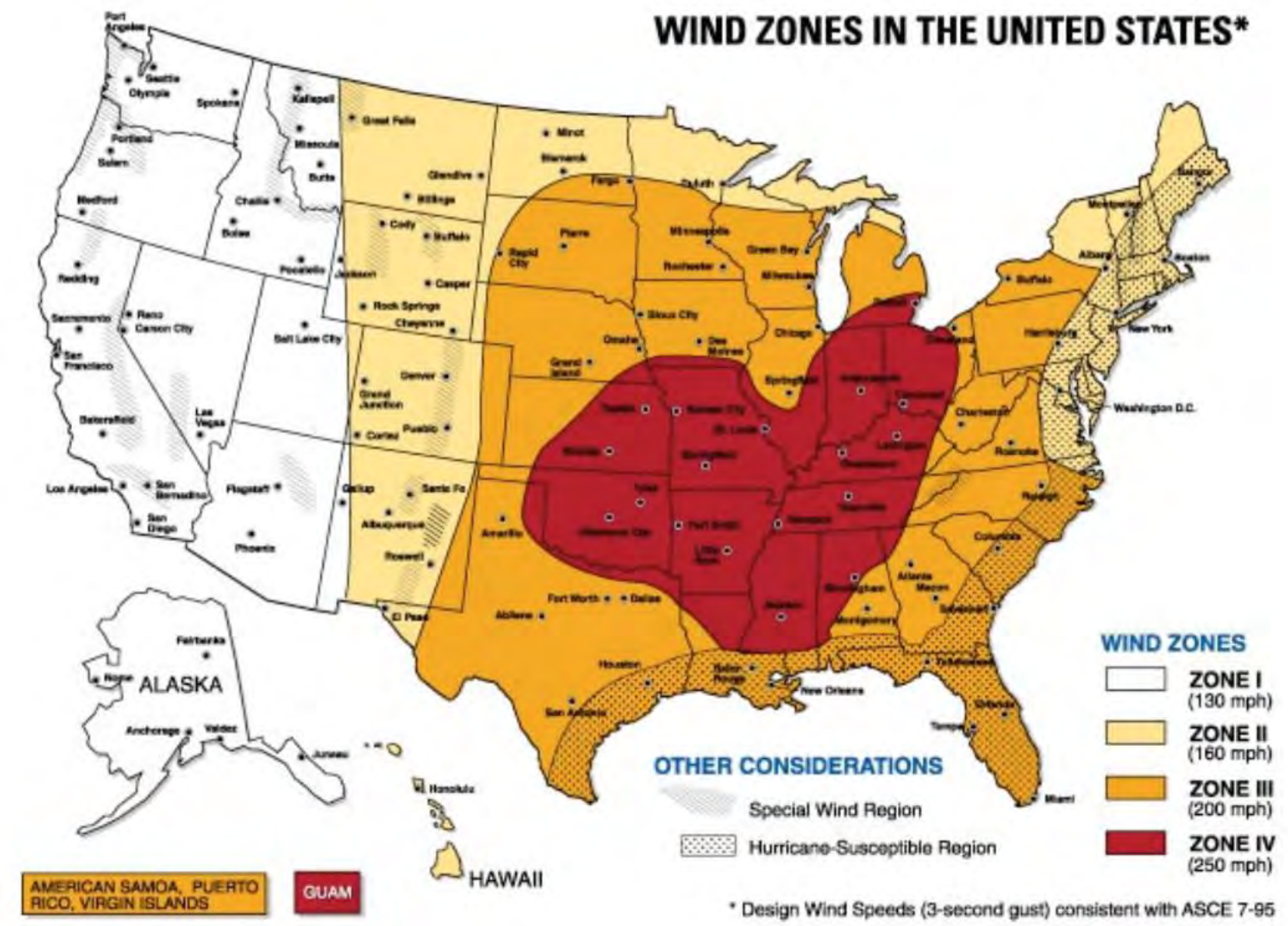



**Figure I.2** **Wind zones in the United States**

# **Tornado/High Wind** Hazard Assessment

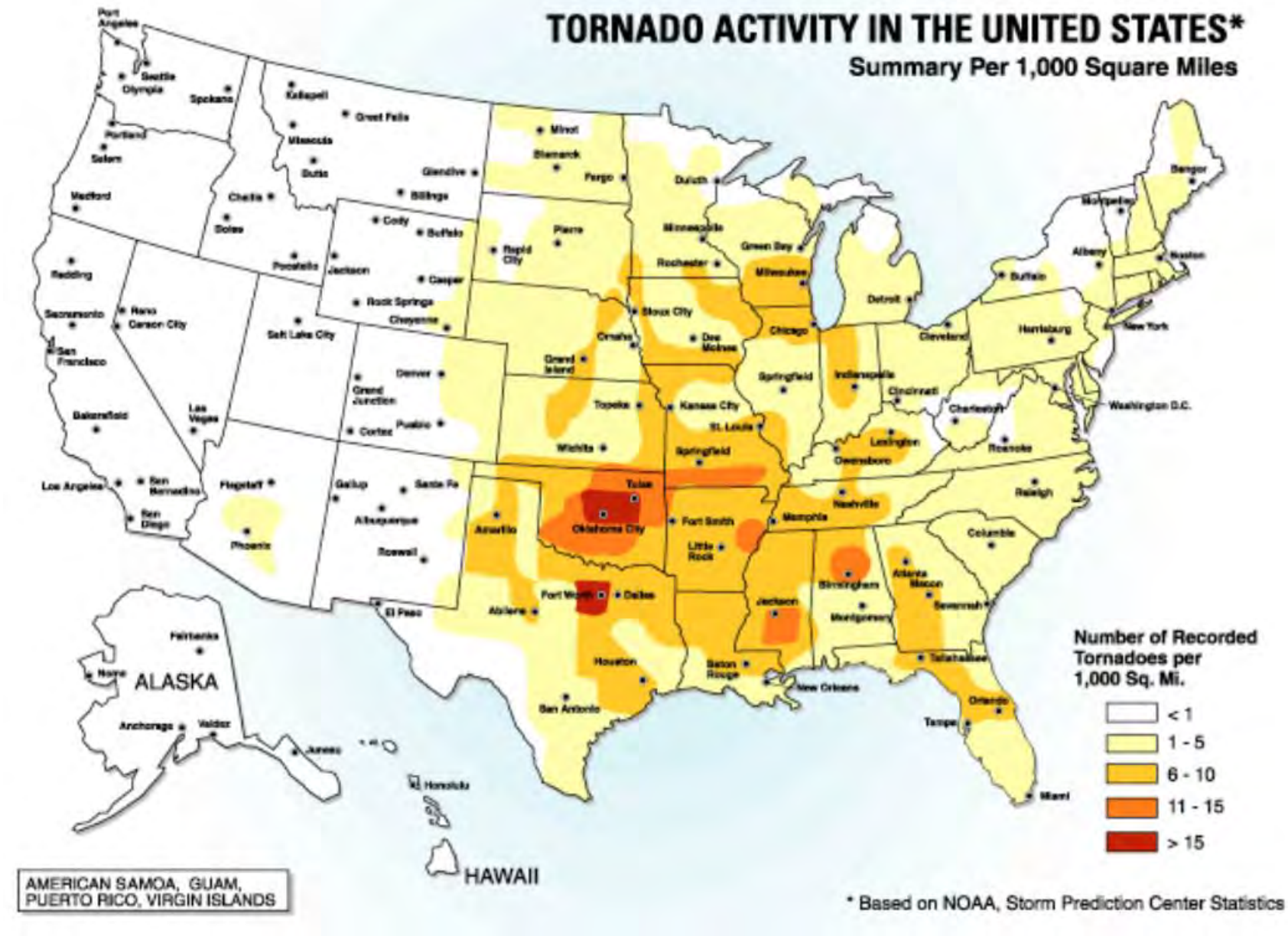



**Figure I.1** **The number of tornadoes recorded per 1,000 square miles**

# **Tornado/High Wind** Hazard Assessment

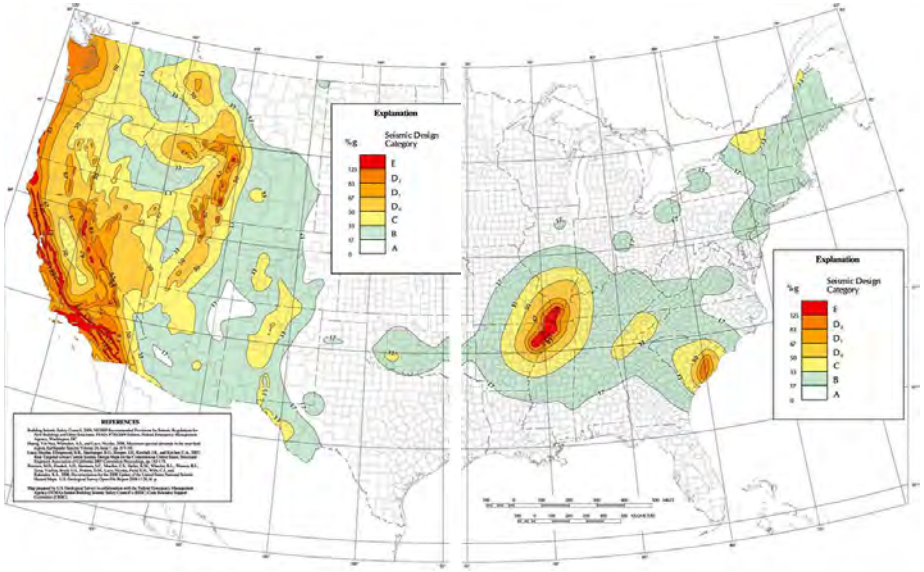
| NUMBER OF TORNADOES PER 1,000 SQUARE MILES (See FIGURE 1.1) | WIND ZONE (See Figure 1.2) I | II | III | IV |
|---|---|---|---|---|
| <1 | LOW RISK | LOW RISK ★ | LOW RISK ★ | MODERATE RISK |
| 1 - 5 | LOW RISK | MODERATE RISK ★ | HIGH RISK | HIGH RISK |
| 6 - 10 | LOW RISK | MODERATE RISK ★ | HIGH RISK | HIGH RISK |
| 11 - 15 | HIGH RISK | HIGH RISK | HIGH RISK | HIGH RISK |
| >15 | HIGH RISK | HIGH RISK | HIGH RISK | HIGH RISK |

Low Risk: Need for high-wind shelter is a matter of homeowner preference.
Moderate Risk: Shelter should be considered for protection from high winds.
High Risk: Shelter is preferred method of protection from high winds.
★ Shelter is preferred method of protection from high winds if house is in hurricane-susceptible region.

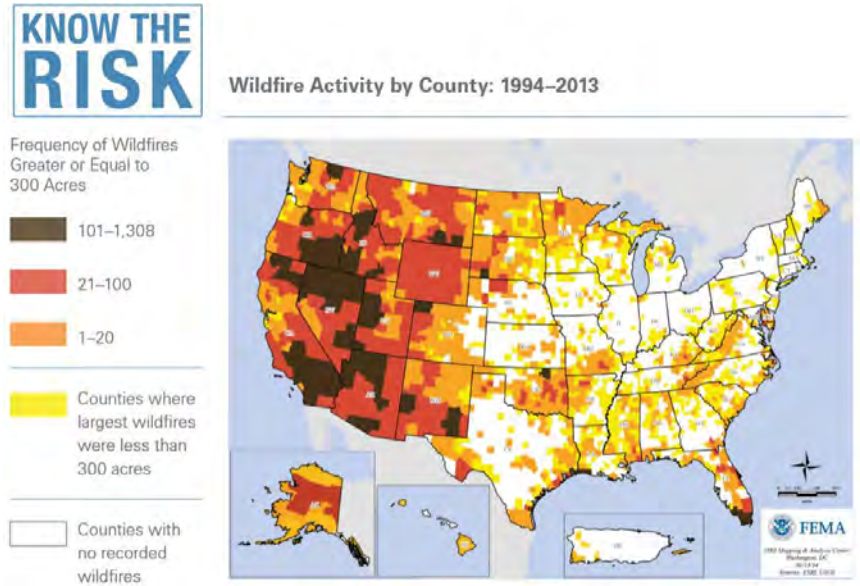
# IPpc98 • Assessment and Planning for Resilience

| IPpc98 | | | | | | | | | | | | | | IPpc99 | | | IPpc100 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prerequisite | | | | | | | | Option 1: Step 1 | | | | | | | | | | | |
| Flooding | Hurricanes | Tornado/ Wind | Earthquake | Tsunami | Wildfire | Drought | Landslide | Sea Level Rise | River Flooding | Winter Storms | Temp, Rain, Storm | Option 1: Step 2 | Option 2 | Hazard 1 | Hazard 2 | Hazard 3 | Thermal Resilience | Back up Power | Potable Water |
| | Moderate | Moderate | | | | | | | | | | | | | | | | | |
| | Moderate | Moderate | | | | | | | | | | | | | | | | | |
| | Moderate | Moderate | | | | | | | | | | | | | | | | | |

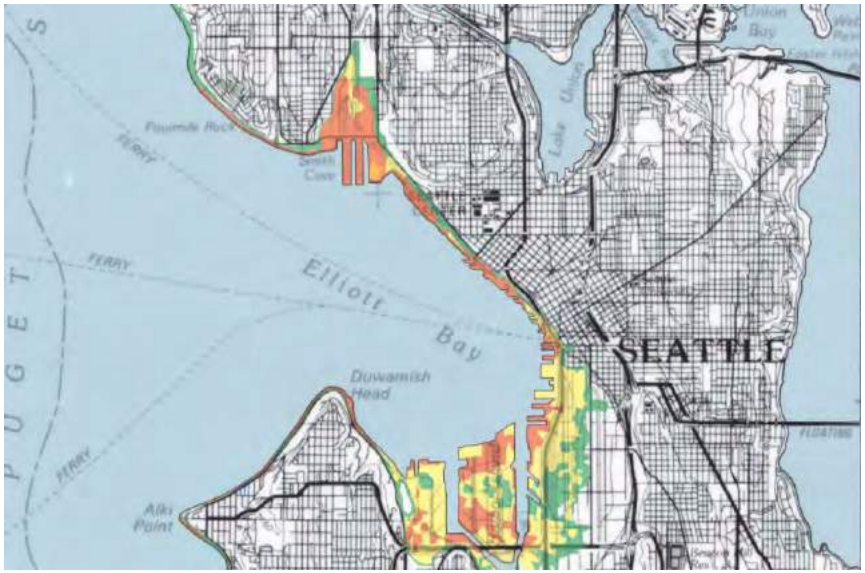
## **Earthquake** Hazard Assessment



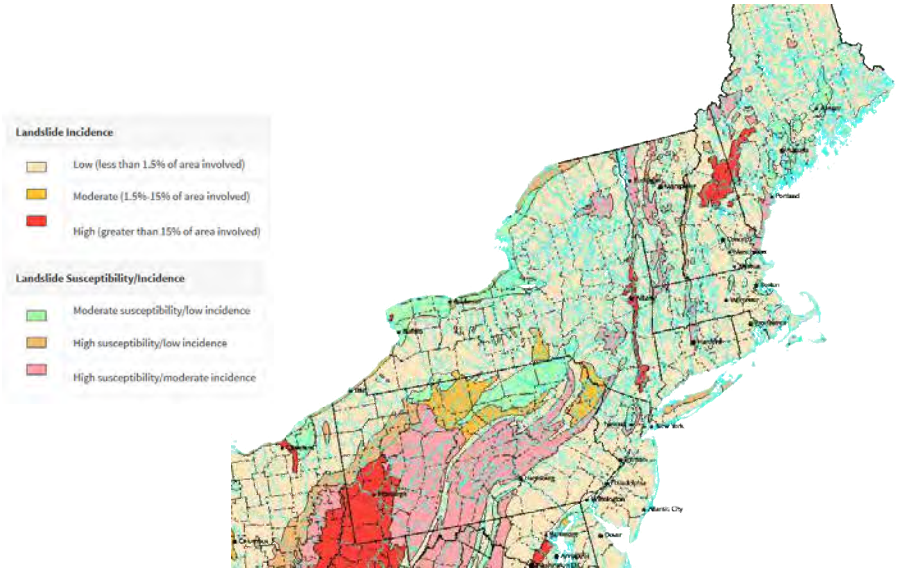

## **Wildfire** Hazard Assessment




## **Tsunami** Hazard Assessment

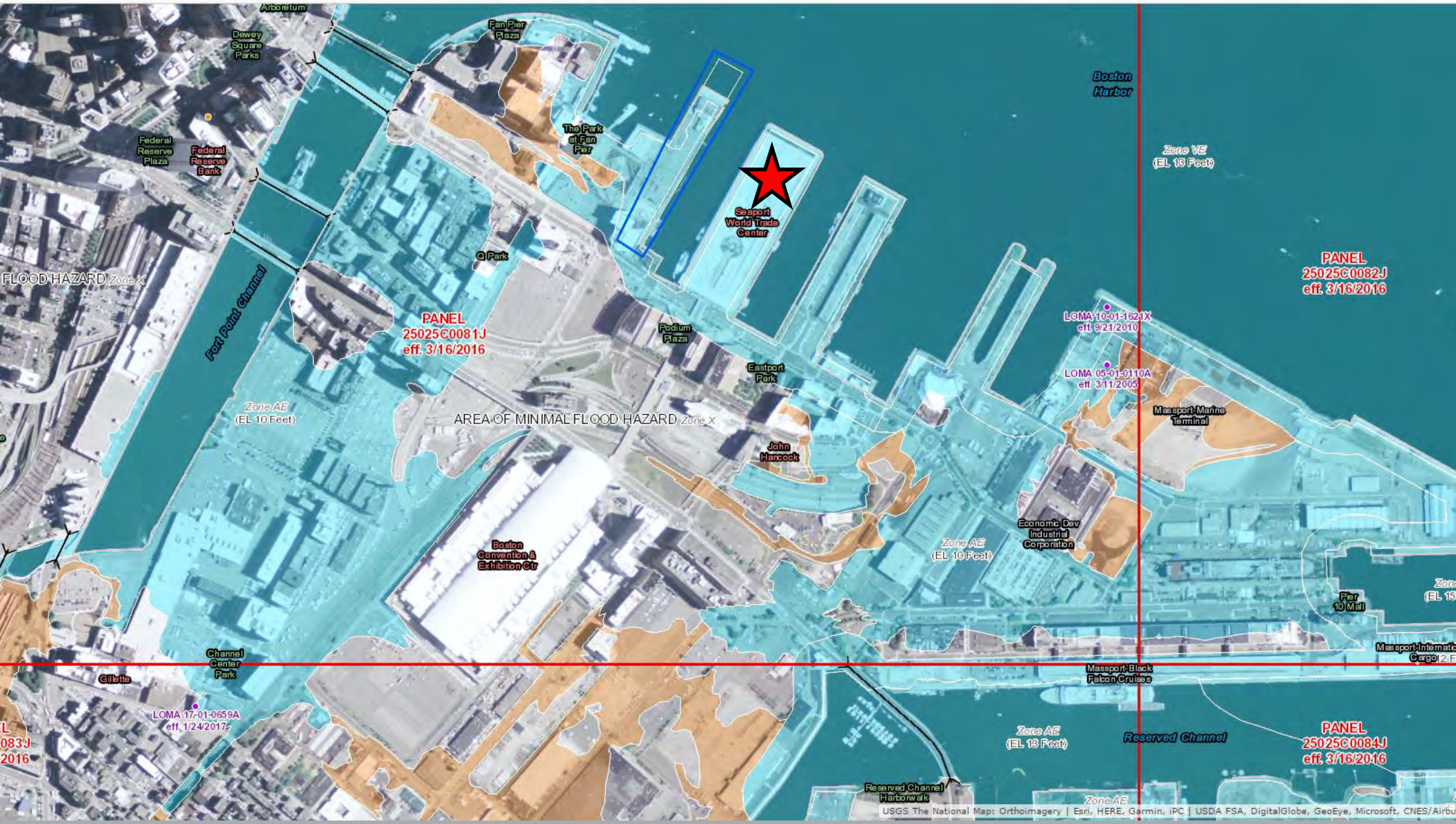



## **Landslide** Hazard Assessment

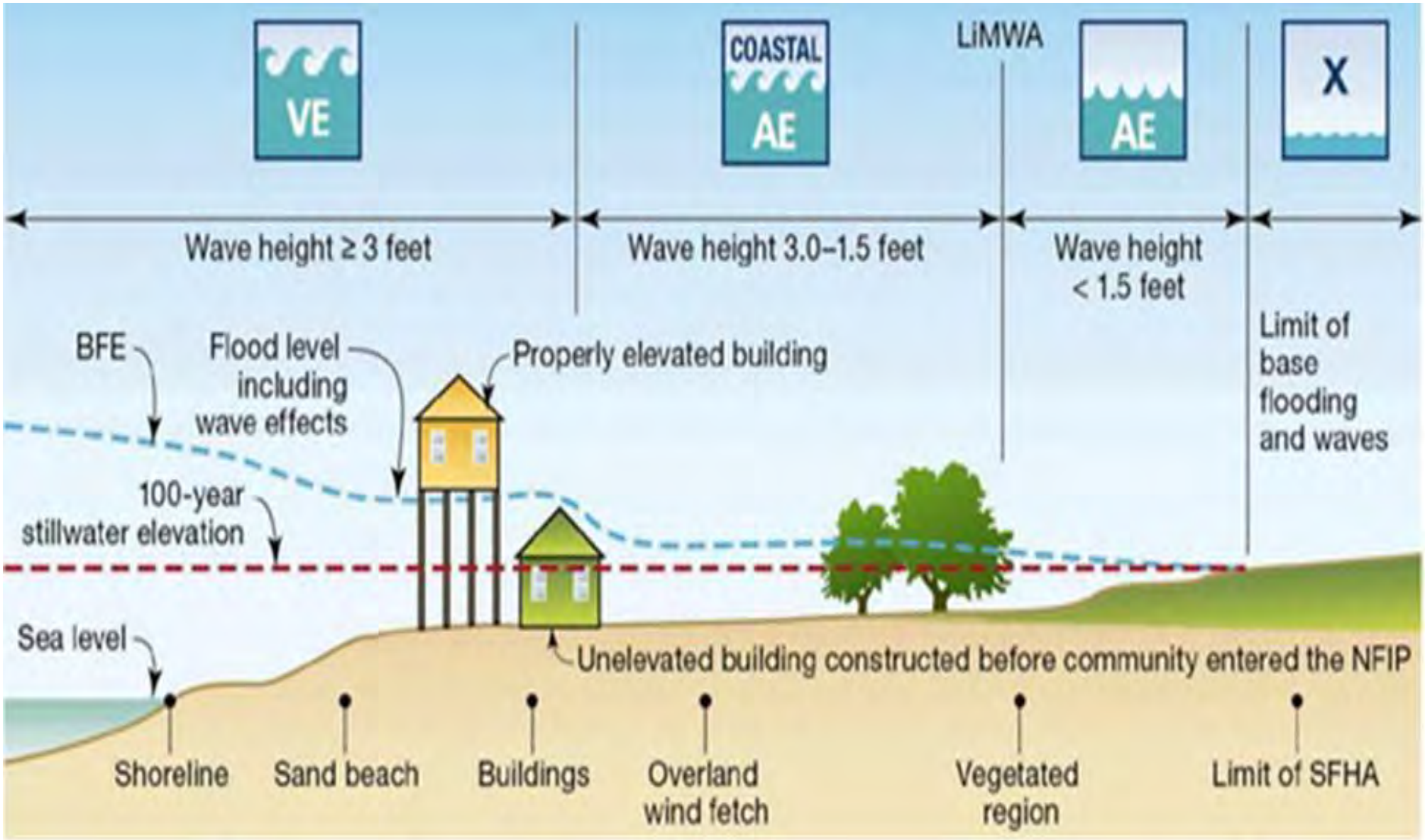


# **Flooding** Hazard Assessment

## FEMA Flood Insurance Rate Map (FIRM)



## Flood Zone Classification



# IPpc98 • Assessment and Planning for Resilience

| IPpc98 | | | | | | | | | | | | | | IPpc99 | | | IPpc100 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prerequisite | | | | | | | | Option 1: Step 1 | | | | | | | | | | | |
| Flooding | Hurricanes | Tornado/ Wind | Earthquake | Tsunami | Wildfire | Drought | Landslide | Sea Level Rise | River Flooding | Winter Storms | Temp, Rain, Storm | Option 1: Step 2 | Option 2: Red Cross | Hazard 1 | Hazard 2 | Hazard 3 | Thermal Resilience | Back up Power | Potable Water |
| Zone VE (El. 19 ft) | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | | | | | | | | | | | | |
| Zone X | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | | | | | | | | | | | | |
| Zone VE (El. 13 ft) | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | | | | | | | | | | | | |

## Prerequisite Hazard Assessment

- Flooding
- Hurricane
- Tornado/high wind
- Earthquake
- Tsunami
- Wildfire
- Drought
- Landslide/unstable soils

## Option 1: Climate Change

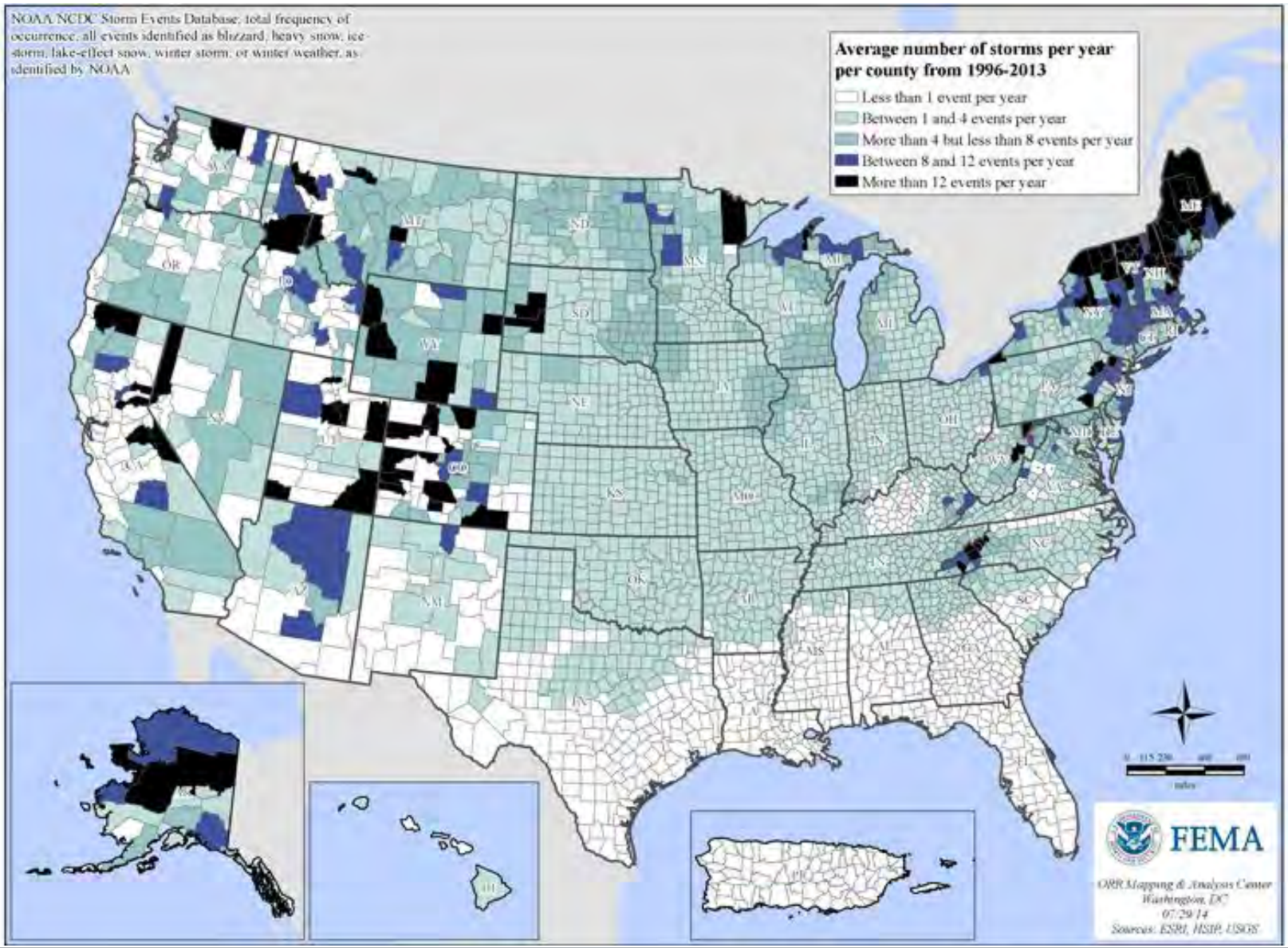
- Seas Level Rise and Storm Surge
- River Flooding Projects
- Winter Storms
- Temperature, Precipitation Changes and Storm Intensity

## Option 2: Emergency Planning

- Evaluate readiness
- Continual Assessment

# **Winter Storm** Climate Change Hazard Assessment

## FEMA Winter Storms Event Average By County: 1996-2013



## Prerequisite Hazard Assessment

- Flooding
- Hurricane
- Tornado/high wind
- Earthquake
- Tsunami
- Wildfire
- Drought
- Landslide/unstable soils

## Option 1: Climate Change

- Seas Level Rise and Storm Surge
- River Flooding Projects
- Winter Storms
- Temperature, Precipitation Changes and Storm Intensity

## Option 2: Emergency Planning

- Evaluate readiness
- Continual Assessment

# IPpc98 • Assessment and Planning for Resilience



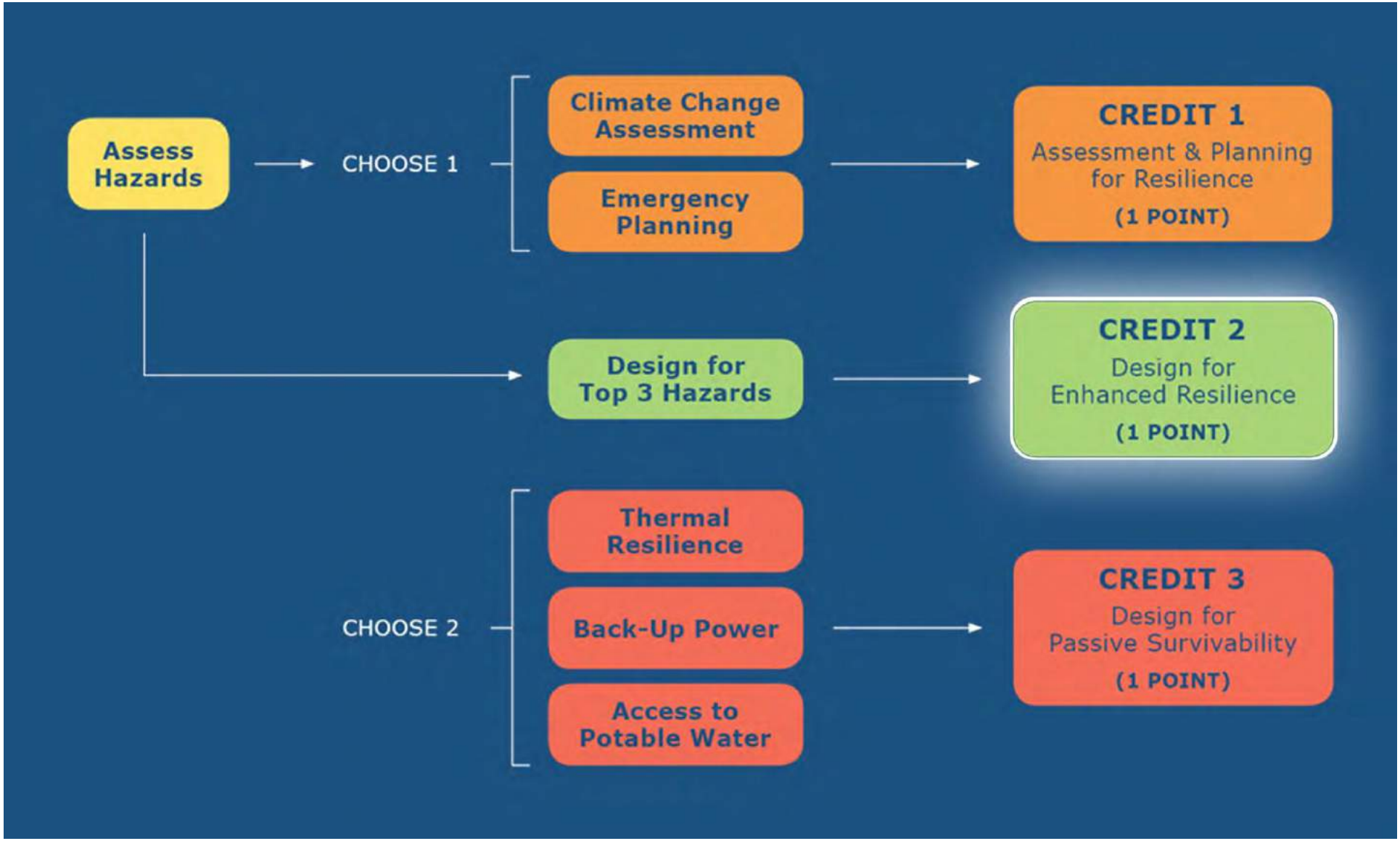




| IPpc98 | | | | | | | | | | | | | | | IPpc99 | | | IPpc100 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prerequisite | | | | | | | | Option 1: Step 1 | | | | | | | | | | | | |
| Flooding | Hurricanes | Tornado/ Wind | Earthquake | Tsunami | Wildfire | Drought | Landslide | Sea Level Rise | River Flooding | Winter Storms | Temp, Rain, Storm | Option 1: Step 2 | Option 2: Red Cross | | Hazard 1 | Hazard 2 | Hazard 3 | Thermal Resilience | Back up Power | Potable Water |
| Zone VE (El. 19 ft) | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | >7 ft rise | Not Applicable | 8-12 per Year; | +5.1F 7.2% 10% | Yes | No | | | | | | | |
| Zone X | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | > 3ft rise | Not Applicable | 8-12 per Year | +5.1F 7.2% 10% | Yes | No | | | | | | | |
| Zone VE (El. 13 ft) | Moderate | Moderate | Catagory B | Not Applicable | White/yellow | <25% | Low | <3ft rise | Not Applicable | 8-12 per Year | +4.8F 7.2% 10% | Yes | No | | | | | | | |

# LEED Pilot Credits on Resilient Design

RESILIENT DESIGN
INSTITUTE




A schematic showing the basic structure of the three pilot credits. Graphic: Jessie Woodcock, ZGF

## Intent

Design and construct buildings that can resist, with minimal damage, reasonably expected natural disasters and weather events (i.e. flooding, hurricanes, tornadoes/high winds, earthquakes, tsunamis, drought, and wildfires.

## Implement Mitigation Strategies for Top 3 Hazards

- Flooding (including Hurricanes)
- Tornado/High Wind (including Hurricanes)
- Earthquake
- Tsunami
- Wildfire
- Drought
- Landslides and unstable soils

# IPpc99 • Design for Enhanced Resilience







| IPpc98 | | | | | | | | | | | | | | IPpc99 | | | IPpc100 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prerequisite | | | | | | | | Option 1: Step 1 | | | | | | | | | | | |
| Flooding | Hurricanes | Tornado/ Wind | Earthquake | Tsunami | Wildfire | Drought | Landslide | Sea Level Rise | River Flooding | Winter Storms | Temp, Rain, Storm | Option 1: Step 2 | Option 2: Red Cross | Hazard 1 | Hazard 2 | Hazard 3 | Thermal Resilience | Back up Power | Potable Water |
| Zone VE (El. 19 ft) | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | >7 ft rise | Not Applicable | 8-12 per Year; | +5.1F 7.2% 10% | Yes | No | Flooding w/ Waves | Hurricanes | Tornado / High Wind | | | |
| Zone X | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | > 3ft rise | Not Applicable | 8-12 per Year | +5.1F 7.2% 10% | Yes | No | Hurricanes | Flooding (localized) | Tornado / High Wind | | | |
| Zone VE (El. 13 ft) | Moderate | Moderate | Category B | Not Applicable | White/yellow | <25% | Low | <3ft rise | Not Applicable | 8-12 per Year | +4.8F 7.2% 10% | Yes | No | Flooding w/ Waves | Hurricanes | Tornado / High Wind | | | |

| Projects | Top 3 Hazards identified in IPpc98 – Assessment and Planning for Resilience |
|---|---|
|  University Hall, *Boston* | Flooding w/ Waves |
| | Hurricanes |
| | Tornado / High Wind |
|  MIT.nano, *Cambridge* | Hurricances |
| | Flooding (localized) |
| | Tornado / High Wind |
|  IYRS, *Newport* | Flooding w/ Waves |
| | Hurricanes |
| | Tornado / High Wind |

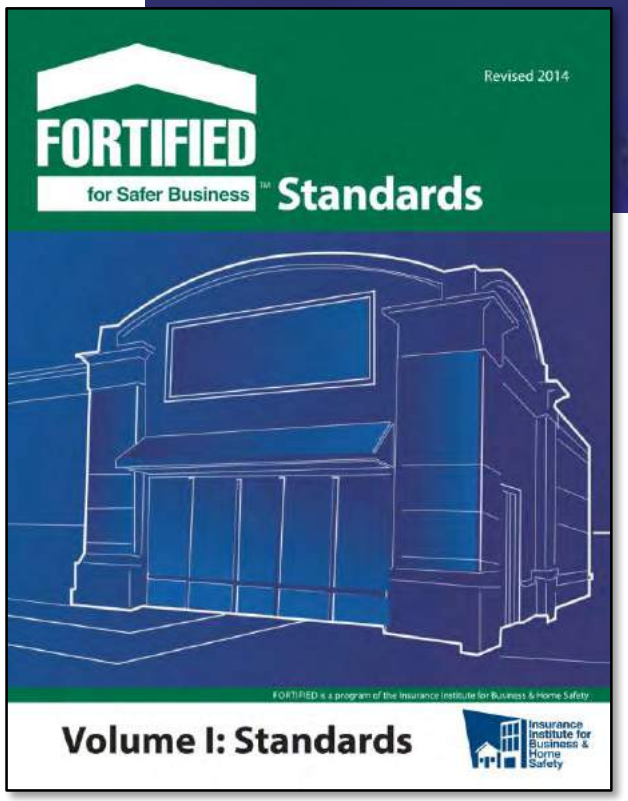
## Flooding (Including Hurricanes)

Option 1: Flooding-Specific Design Measures

- American Society of Civil Engineers ASCE 24-14 Flood Resistant Design and Construction.
  - Includes Flood Design Class-Specific Requirements (Classes 1-4)

Option 2: FORTIFIED Standards

- FORTIFIED for Safer Business DESIGN CRITERIA 3.4 Flood Specific Design Requirements (all non-residential projects)

# University Hall, University of Massachusetts Boston

*Columbia Point, Boston, MA*