Ruleset Library

WHO	This guidance is for the practitioner in Step 2.
WHAT	To assess different levels of vulnerability and risk, rulesets, or criteria, are developed. Each component of the assessment framework (adaptive capacity, Magnitude of Impact, etc.) considers a different aspect of how community assets might be affected by hazards. This guidance provides various examples by hazard that can be used as a starting place to develop assessment criteria.
SUPPORTING RESOURCES	The Resource 2.2b | Exercise: Ruleset Development worksheet will be used to develop rulesets for the project. This guidance will be used during this exercise. Use the list of spatial assessments from Resource 2.1a | Determine Assessment Type
INSTRUCTIONS	1. For assessment types determined to be spatial, review the hazards and their associated criteria below. 2. Use the criteria below to guide the development of rulesets for the project in the exercise: Resource 2.2b | Exercise: Ruleset Development a. The practitioner may need to investigate what information is available in the spatial data before the ruleset development for the project can be completed.

Vulnerability and Risk Assessments

Floodplain Inundation

In coastal areas, floodplains mapped by FEMA represent a combination of rainfall-induced flooding and flooding caused by storm surges during severe storm events. Rainfall-induced flooding occurs during an extended and/or extreme rainfall event which typically causes rivers, lakes, or ponds to overflow their banks or overwhelm the urban drainage system. The analysis uses the most recent floodway, wave action, 1% annual chance (100-year), and 2% annual chance (500-year) floodplains designated by FEMA to support the National Flood Insurance Program.

Two methods for assessing floodplain inundation follow: FFE vs. BFE and Without FFE.

FFE vs. BFE Rulesets

First Floor Elevation (FFE) values may be available for the structures in the study area. If this is the case, this ruleset can be used for the Floodplain Inundation analysis.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in inundation extent and high criticality	**H**	Structure built outside floodplain or first floor elevation above base flood elevation (BFE)
M	Structure in inundation extent	**M**	First floor elevation between BFE and 1ft below BFE
L	No structure in inundation extent (land only)	**L**	First floor elevation of structure more than 1 ft below BFE

Risk:

Probability		Magnitude of Impact	
H	In 100-year inundation extent	**H**	Structure exposed to potential flood depth 1.5 ft or greater in wave action zones OR 3 ft or greater in stillwater zones
M	In 500-year inundation extent	**M**	Potential flood depth between -2ft to 1.5 ft in wave action zones OR 1 ft to 3 ft in stillwater zones
L	---	**L**	Potential flood depth less than -2 ft in wave action zones OR less than 1 ft in stillwater zones

Without FFE Rulesets

In most cases, the structure data for the community will not have FFE values. If that is the case, a ruleset identical or similar to this one can be used. Note that the difference here is that there are no rulesets for Magnitude of Impact. To account for this in the spatial analysis, high, medium, and low are all considered equal in Magnitude of Impact.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in inundation extent and high criticality	**H**	Building in floodplain, built [YEAR] or after, BFE +1ft regulations apply. OR no building in floodplain.
M	Structure in inundation extent	**M**	Building in floodplain, built between [YEAR] and [YEAR] (post-FIRM), some regulations apply.

L	No structure in inundation extent (land only)	L	Building in floodplain, built before any BFE requirements were established (pre-FIRM).

Risk:

Probability		Magnitude of Impact	
H	In 100-year inundation extent	H	N/A
M	In 500-year inundation extent	M	N/A
L	---	L	N/A

Tidal Flooding

Tidal flooding in the flooding of the low-lying land along the coastline from a high tide that is not associated with a tropical storm. Tidal flooding is sometimes also called “high tide flooding” or “nuisance flooding” as it is most severe at high times and happens even when weather conditions are clear.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in inundation extent and high criticality	H	Structure built out of floodplain or structure in floodplain built after BFE requirements were raised to 1ft, [YEAR]
M	Structure in inundation extent	M	Structure in floodplain built after BFE requirements were put in place, [YEAR]
L	No structure in inundation extent (land only)	L	Structure in floodplain built before BFE requirements were put in place, [YEAR]

Risk:

Probability		Magnitude of Impact	
H	---	H	Structure exposed to significant inundation (1.1ft+)
M	In inundation extent	M	Structure exposed to some inundation (0.5ft+)
L	---	L	Structure minimally exposed or no structure exposed (land only)

Sea Level Rise

Sea level rise is the relative rise of the local mean sea level over time, is a persistent inundation hazard, and can also increase the frequency and severity of tidal flooding. To assess the effects of relative sea level rise, sea level changes of different thresholds are mapped on top of current tidal datums to map the extent of persistent inundation.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in inundation extent and high criticality	H	Structure built out of floodplain or structure in floodplain built after BFE requirements were raised to 1-2ft, [YEAR]
M	Structure in inundation extent	M	Structure in floodplain built after BFE requirements were put in place, [YEAR]
L	No structure in inundation extent (land only)	L	Structure in floodplain built before BFE requirements were put in place, [YEAR]

Risk:

Probability		Magnitude of Impact	
H	Within 1ft sea level rise inundation extent	H	Structure exposed and above median value
M	Within 2ft sea level rise inundation extent	M	Structure exposed and below median value
L	Within 3ft sea level rise inundation extent	L	No structure exposed (land only)

Storm Surge

Storm surge is flooding caused by an abnormal rise in tide from a severe storm (e.g., hurricane) over and above the usual, astronomical tide. The wind and air pressure from a storm pushes the water toward the shore, which causes an increase in water level above the natural tide. The height of the storm surge depends on the intensity of the storm, how fast the storm is moving, the size of the storm, the direction it's coming from, and the shape of the shoreline. A storm surge can occur during any tidal water level (e.g., at low tide, high tide, etc.). The assessment uses the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) Maximum of the Maximum Envelopes of Water (MOM) layer developed by the NOAA National Weather Service's Hurricane Center.

Exposure as Magnitude of Impact Rulesets

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in inundation extent and high criticality	H	Structure built out of floodplain or structure in floodplain built after BFE requirements were raised to 1-2ft, [YEAR]
M	Structure in inundation extent	M	Structure in floodplain built after BFE requirements were put in place, [YEAR]
L	No structure in inundation extent (land only)	L	Structure in floodplain built before BFE requirements were put in place, [YEAR]

Risk:

Probability		Magnitude of Impact	
H	Cat. 1 hurricane extents	H	Structure exposed
M	Cat. 2-3 hurricane extents	M	---
L	Cat. 4-5 hurricane extents	L	No structure exposed (land only)

Depth as Magnitude of Impact Rulesets

Storm surge can be evaluated in two separate groups based on hurricane categories. For this method, all assessment factors are the same *except* probability, which changes depending on the hurricane categories (indicated below using "//" in the factor descriptions). The storm categories grouped for two separate assessments would be: Storm Surge, categories 1-2; Storm Surge, categories 3-5.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in inundation extent and high criticality	H	Building in floodplain, built [YEAR] or after. BFE+1ft regulations apply. Or, no building in floodplain.
M	Structure in inundation extent	M	Building in floodplain, built between [YEAR] and [YEAR] (post-FIRM), some regulations apply.
L	No structure in inundation extent (land only)	L	Building in floodplain, built before any BFE requirements were established [pre-FIRM].

Risk:

Probability		Magnitude of Impact	
H	Cat. 1 hurricane extents // Cat. 3 inundation extent	H	Structure exposed to potential flood depth 3ft or greater
M	Cat. 2 hurricane extents // Cat. 4 inundation extent	M	Structure exposed to potential flood depth between 1 and 3ft
L	-- // Cat. 5 inundation extent	L	Structure exposed to potential flood depth less than 1ft

Wildfire

Wildfire is a natural disturbance that provides benefits to ecosystems and natural systems, but it can become a threat when it negatively impacts communities and the community assets we value. Drought conditions can lead to a greater chance of wildfire. Note that compared to flooding, wildfire events are usually smaller and more contained and do not have the same kind of probabilistic return periods.

Rulesets described here utilize the Southern Group of State Foresters (SGSF) WUI Risk Index to evaluate risk and the SILVIS Lab WUI areas to identify the exposure extent. For areas outside of the Southeastern U.S. (not using the SGSF dataset), the rulesets will need to be revised.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Structure in exposure extent and high criticality	H	Property within 5-min emergency response AND near fire hydrant
M	Structure in exposure extent	M	Property within 5-min emergency response OR near fire hydrant
L	No structure in exposure extent (land only)	L	Property outside 5-min emergency response

Risk:

Probability		Magnitude of Impact	
H	N/A	H	Highest WUI Risk Index
M	N/A	M	Medium WUI Risk Index
L	N/A	L	Low WUI Risk Index

Landslides

Vulnerability:

Sensitivity			
H	Structure in debris flow pathway and high criticality	H	Structure built out of potential debris flow ara
M	Structure in debris flow pathway extent	M	Structure in potential debris flow area and built after [YEAR]
L	No structure in debris flow pathway extent (land only)	L	Structure in potential debris flow area and built before [YEAR]

Risk:

Probability		Magnitude of Impact	
H	Property with high average risk index	H	Structure exposed and above median value
M	Property with moderate average risk index	M	Structure exposed and below median value
L	Property with low average risk index	L	No structure exposed (land only)

Vulnerability Only Assessments

Extreme Heat

Extreme heat events are periods of excessively hot and/or humid weather that can last for multiple days. Extreme heat is a pressing public health risk. For the purpose of this assessment, households with members over 65 years of age and younger than 18 years are recognized as populations that are biologically more sensitive to heat events (i.e. 'sensitive individuals'). Relative heat vulnerability in a neighborhood (i.e., block group or census tract) is calculated as a combination of 1) Exposure and Sensitivity, which considers how sensitive individuals may be potentially impacted by high percentages of impervious surface/developed land cover contributing to the urban heat island effect (or exposure), and 2) adaptive capacity, which considers the cooling effect of dense tree canopy and the median income as an indicator of ability to afford household cooling and medical services (if necessary).

Note that this assessment is a vulnerability only analysis at the "neighborhood" scale.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Highest number of sensitive individuals AND high percentage of developed land cover	H	High amount of tree canopy coverage AND high median household income
M	Lower number of sensitive individuals OR lower percentage of developed land cover	M	Lower amount of tree canopy coverage OR lower median household income
L	Lower number of sensitive individuals AND lower percentage of developed land cover	L	Lower amount of tree canopy coverage AND lower median household income

High Winds

This assessment shows properties that may be more vulnerable to high winds based on use type and relevant regulations at the time the primary structure was built. As the climate warms, hurricanes may occur more frequently, which increases the likelihood of a strong hurricane (Cat. 3-5) with high sustained winds.

Note that this assessment is a vulnerability only analysis.

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Property is considered high criticality	H	Building built [YEAR] or after, or no primary structure present
M	---	M	Building built between [YEAR] and [YEAR]
L	Property is not considered high criticality	L	Building built before regulations existed

Earthquake

An earthquake is a sudden, rapid shaking of the earth due to seismic activity. The National Earthquake Hazard Reduction Plan (NEHRP) site class map (part of the FEMA HAZUS 4.1 data suite) was used to assess earthquake hazard. The NEHRP site class map is based on the 1997 NEHRP provisions. Site classes provide a simplified measure of the potential for strong shaking in a particular area based on soil conditions (softer soils amplify ground motion).

Vulnerability:

Sensitivity		Adaptive Capacity	
H	Property in higher susceptibility (Class E) area and high criticality	**H**	Structure built in [YEAR] or after, latest regulations apply.
M	Property in lower susceptibility (Class D) and high criticality; OR property in higher susceptibility (Class E) area	**M**	Structure built between [YEAR] and [YEAR], some regulations apply.
L	Property in lower susceptibility (Class D) area	**L**	Building built before [YEAR] or unknown building year.