

SuPeRBE Training Material

Macro Area of Expertise 6:

Risk Assessment At Small Urban Scale

Hazard: Drought (D)

Area of Expertise 6.1:

Urban Sector: Environment & biodiversity (D7)

**Risk Category: Damage Risk for Urban Green Spaces (D7.1)
& Damage Risk for Street Trees (D7.2)**

Level of competence: 3

DROUGHT

General Information

- “A period of abnormally dry weather long enough to cause a serious hydrological imbalance.” (source: <https://www.ipcc.ch/sr15/chapter/glossary/>)
- Natural phenomenon
- Intensified in recent decades by climate change and unsustainable land practices
- Human-induced climate change has contributed to increases in droughts due to increased atmospheric evaporative demand induced by increased temperature, decreased relative humidity, and increased net radiation
- More regions are affected by drought with increasing global warming



TYPES OF DROUGHT

- **Net water availability** - caused by precipitation deficits and changes in evapotranspiration
- **Agricultural drought** - caused by a lack of sufficient soil moisture and increased atmospheric evaporative demand
- **Ecological drought** - caused by a lack of sufficient soil moisture and increased atmospheric evaporative demand
- **Hydrological drought** - caused by a lack of runoff and surface water

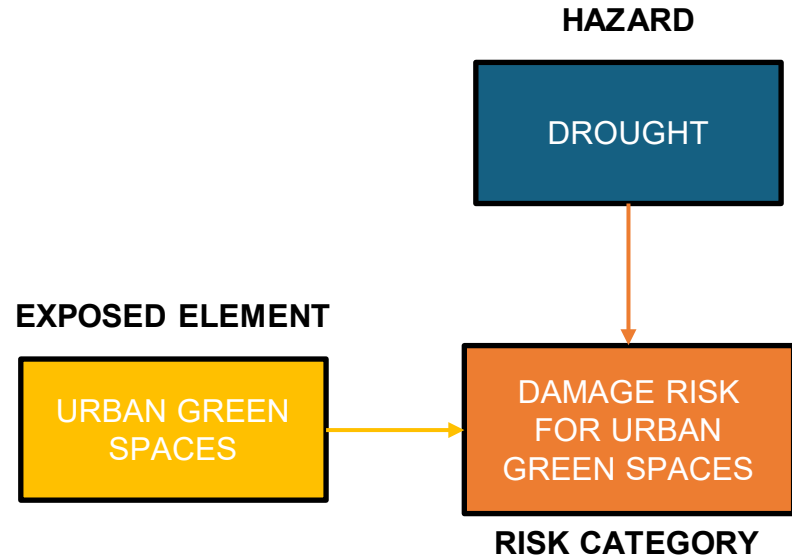


AFFECTED URBAN SYSTEMS

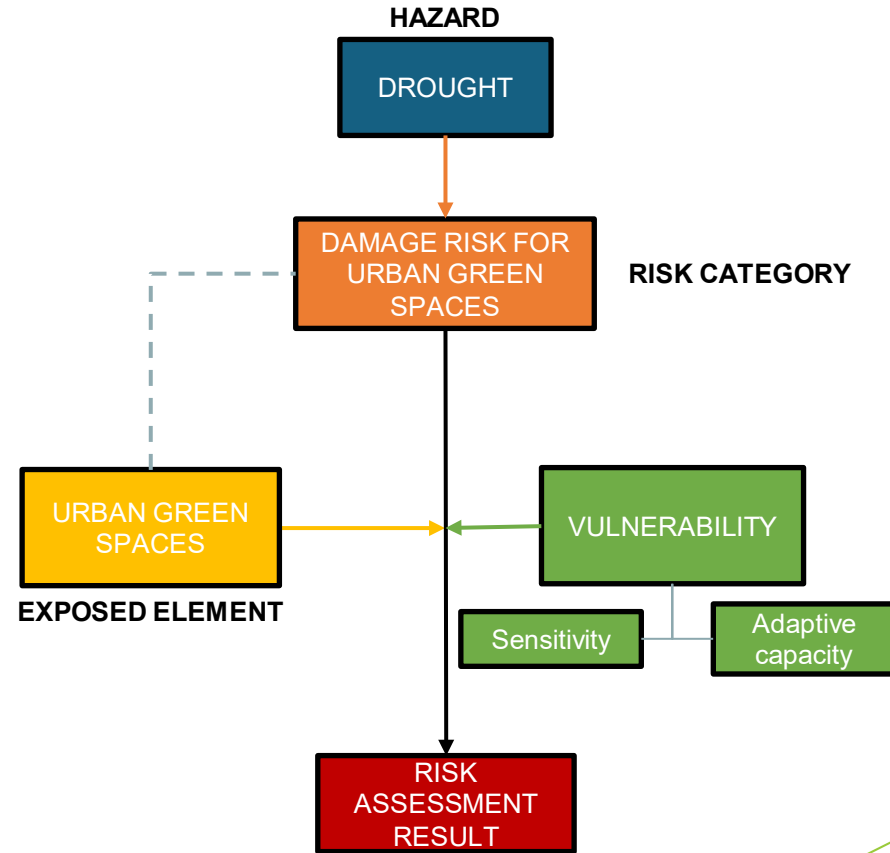
- Water supply system
 - Damage risk for water treatment plants
 - Damage risk for the water supply network
- **Environment & biodiversity**
 - **Damage risk for urban green spaces**
 - **Damage risk for street trees**
- Health
 - Health risk for the population
- Emergency services
 - Efficiency risk for the fire brigade
 - Efficiency risk for emergency medical services

RISK ASSESSMENT FOR DAMAGE RISK FOR URBAN GREEN SPACES

- Hazard: Drought
- Exposed element: Urban green spaces

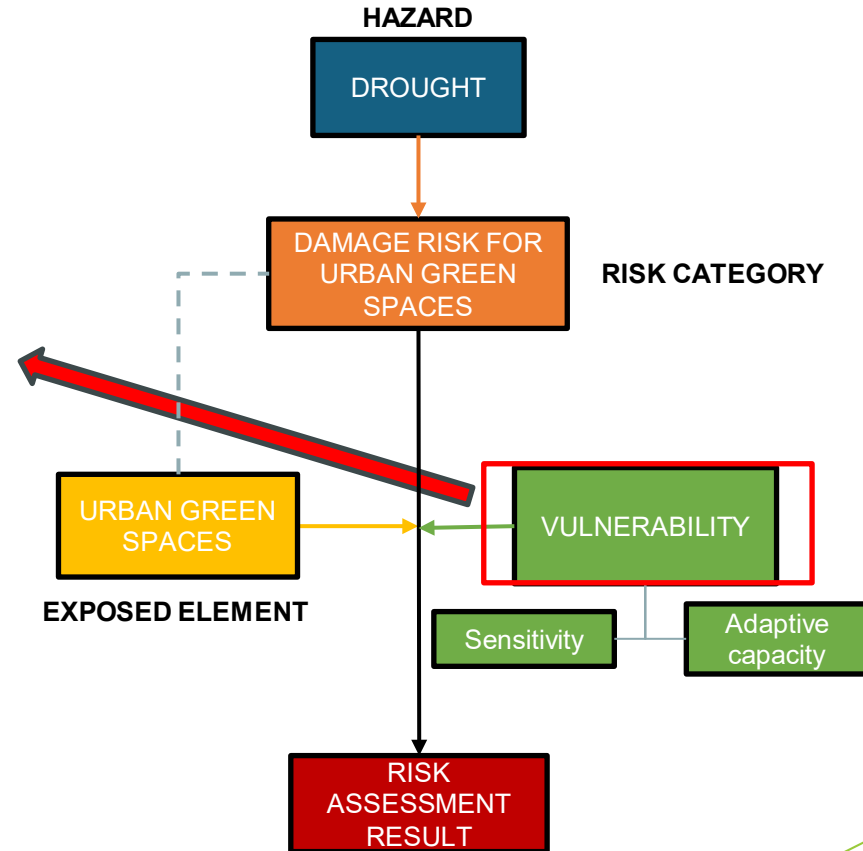


IMPACT CHAIN



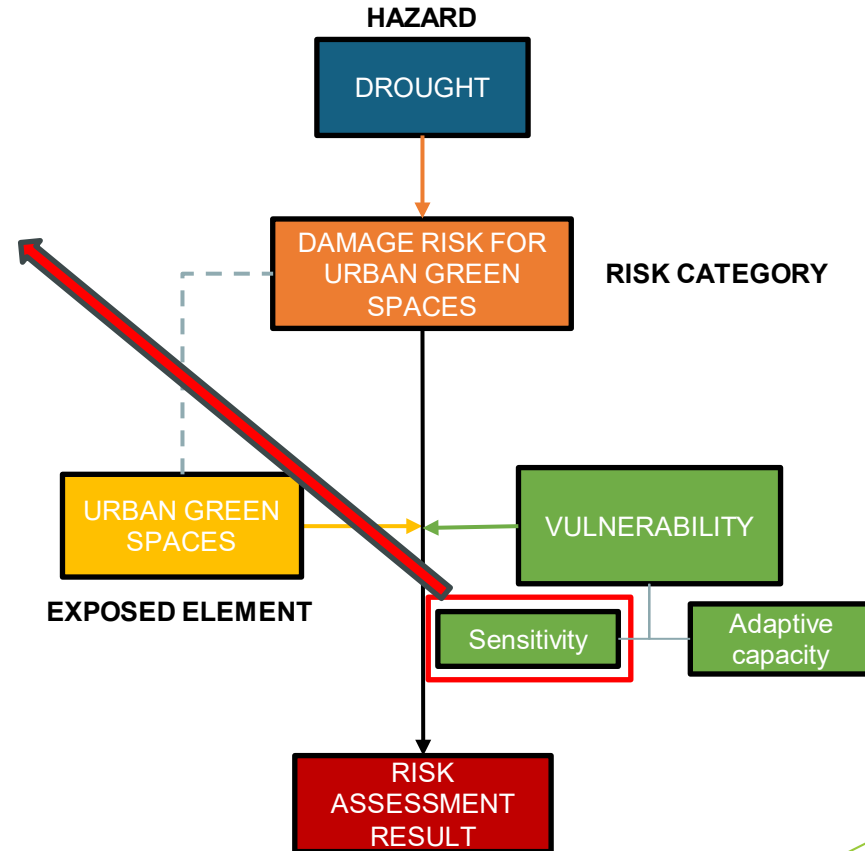
VULNERABILITY CRITERIA

- Soil stress
- Endangered species
- Habitats at risk
- Areas at risk
- Protected urban green spaces



VULNERABILITY ASSESSMENT

CRITERION	INDICATOR
Soil stress	Soil moisture stress
Endangered species	Number of endangered species
Habitats at risk	Percentage of vulnerable habitats
Areas at risk	Percentage of protected areas
Protected urban green spaces	Percentage of watered urban green spaces



Normalisation

Normalization is a crucial step in this process, as it transforms diverse indicator values into a common scale, typically ranging from 0 to 1. This ensures that each indicator contributes proportionately and comparably to the overall resilience score, regardless of its original unit or magnitude. By applying normalization, we enable meaningful synthesis of data, facilitate benchmarking across different contexts, and support more transparent and objective decision-making in resilience evaluations.

NORMALISATION INTERVAL

Normalisation values	Description
0.0-0.2	Optimal (no improvement necessary)
>0.2-0.4	Rather positive
>0.4-0.6	Neutral
>0.6-0.8	Rather negative
>0.8-1.0	Critical (could lead to severe consequences)

D7.1.1 SOIL MOISTURE STRESS

Description:

Number of days in a year on which soil moisture levels are not sufficient to meet the vegetation water demand (based on the requirements of plant species by land use type and the amount of water available in the soil)

Objective:

To quantify soil water deficit as an early indicator of drought, to assess ecosystem and vegetation vulnerability, and to integrate hydro-climatic and land-surface data.

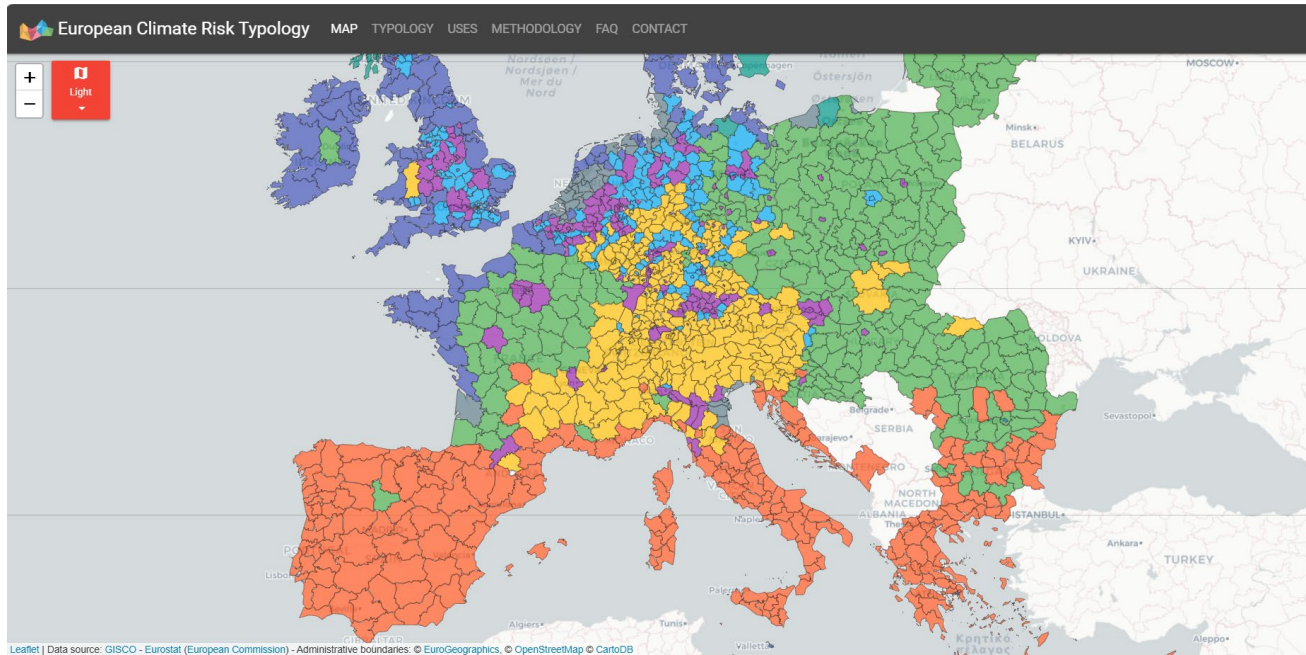
Relevance:

Declining soil moisture is often the first indicator of drought conditions. Soil moisture stress reduces vegetation cover and evapotranspiration, and persistent dryness affects ecosystem stability.

D7.1.1 SOIL MOISTURE STRESS

CALCULATION: STEP-BY-STEP EXAMPLE

- Find the data for your area at: <https://european-crt.org/map.html> or the national database



D7.1.1 SOIL MOISTURE STRESS

BENCHMARKING

Critical value (1) = National average +20%

Optimal value (0) = National average -20%

Range of values: higher is better (HIB)

D7.1.1 SOIL MOISTURE STRESS NORMALISATION

Indicator

Soil moisture stress: 120
National average: 110

Critical value (1) = 132
Optimal value (0) = 88

Normalised value: **0.73**

Vulnerability Level: **RATHER NEGATIVE**

D7.1.2 NUMBER OF ENDANGERED SPECIES

Description:

The number of species classified as endangered living in the area.

Objective:

To quantify biodiversity vulnerability at the local scale, to assess how drought contributes to species endangerment, to support environmental risk management by identifying ecological hotspots that need protection, and to integrate ecological indicators into drought risk assessment frameworks, linking environmental degradation to long-term sustainability.

Relevance:

Drought reduces surface water availability, making endangered species and species with specialised habitats needs particularly vulnerable. A high (or rising) number of endangered species indicates reduced ecosystem resilience.

D7.1.2 NUMBER OF ENDANGERED SPECIES

CALCULATION: STEP BY STEP

Step 1: Find the number of endangered species living in the area in the local or national database

D7.1.2 NUMBER OF ENDANGERED SPECIES

BENCHMARKING

Critical value (1) = 5 or more endangered species

Optimal value (0) = 1 endangered species

Range of values: lower is better (LIB)

D7.1.2 NUMBER OF ENDANGERED SPECIES

NORMALISATION

Indicator

Number of endangered species: 3

Normalised Value: 0,5

Vulnerability Level: **NEUTRAL**

D7.1.3 PERCENTAGE OF VULNERABLE HABITAT

Description:

Percentage of area covered by habitats that are at risk of drought. An expert estimates the risk of habitats.

Objective:

To quantify the spatial extent of habitats sensitive to drought stress, and to assess ecosystem exposure and vulnerability to reduced water availability.

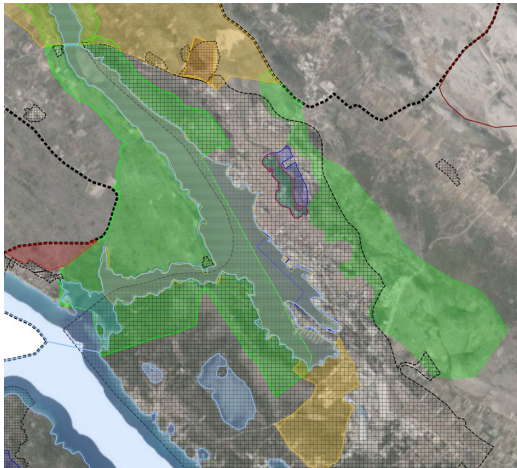
Relevance:

Drought reduces soil moisture, groundwater levels and surface water flow, leading to habitat degradation or loss. A high percentage of vulnerable habitats indicates that local biodiversity and ecosystem services are at risk.

D7.1.3 PERCENTAGE OF VULNERABLE HABITAT

CALCULATION: STEP BY STEP

Step 1: Use the local spatial plan in GIS to identify protected areas, natural habitats, etc.



Step 2: Based on your expert knowledge, estimate which of these habitats are at risk

Step 3: Calculate the area of habitats at risk

Step 4: Divide the area of habitats at risk by the total area of neighbourhood to get a percentage of habitats that are at risk

$$\frac{\text{Habitat at risk (km}^2\text{)}}{\text{Total neighbourhood area (km}^2\text{)}} \times 100$$

D7.1.3 PERCENTAGE OF VULNERABLE HABITAT

BENCHMARKING

Critical value (1) = 40% or more

Optimal value (0) = 0%

Range of values: lower is better (LIB)

D7.1.3 PERCENTAGE OF VULNERABLE HABITAT

NORMALISATION

Indicator

Percentage of vulnerable habitats: 15%

Normalized Value: 0,38

Vulnerability Level: **RATHER POSITIVE**

D7.1.4 Percentage of protected areas

Description:

Percentage of area that is under Natura 2000 protection or similar.

Objective:

To quantify the extent of land under environmental protection and evaluate its role in reducing vulnerability, and to provide an indicator of ecological resilience and adaptive capacity within urban areas.

Relevance:

Protected areas often include water-rich or climate-buffering ecosystems that help retain water and maintain microclimates. They harbour biodiversity, ecological stability, and adaptive capacity. In the urban context, the presence of protected areas supports urban cooling, water retention and air quality regulation.

D7.1.4 Percentage of protected areas

CALCULATION: STEP BY STEP

Step 1: Find the area of the Natura 2000 (or similar) protected area in the assessed neighbourhood

Step 2: Divide the Natura 2000 (or similar) area by the the total area of the neighbourhood to get the percentage

$$\frac{\text{Natura 2000 area [km2]}}{\text{Total area [km2]}} \times 100$$

D7.1.4 Percentage of protected areas

BENCHMARKING

Critical value (1) = 0%

Optimal value (0) = 40% or more

Range of values: higher is better (HIB)

D7.1.4 Percentage of protected areas

NORMALISATION

Indicator

Percentage of protected areas: 12%

Normalized Value: 0,7

Vulnerability Level: **Rather negative**

D7.1.5 PERCENTAGE OF WATERED URBAN GREEN SPACES

Description:

Percentage of urban green spaces that are regularly watered during the drought periods.

Objective:

To assess the sustainability and resilience of urban green infrastructure under drought conditions, to evaluate how much of a city's green infrastructure depends on active watering and to what extent it is vulnerable to water scarcity.

Relevance:

Watered green spaces help maintain vegetation vitality, evapotranspiration cooling, and biodiversity habitats. Maintaining green areas mitigates the Urban Heat Island (UHI), and improves air quality.

D7.1.5 PERCENTAGE OF WATERED URBAN GREEN SPACES

CALCULATION: STEP BY STEP

Step 1: Identify the area of all urban green spaces in neighbourhood

Step 2: Identify the area of urban green spaces that are frequently watered

Step 3: Divide the area of watered urban green spaces by the total area of urban green spaces to get the percentage

$$\frac{\text{Watered urban green spaces}}{\text{All urban green spaces}} \times 100$$

D7.1.5 PERCENTAGE OF WATERED URBAN GREEN SPACES

BENCHMARKING

Critical value (1) = 0%

Optimal value (0) = 100%

Range of values: higher is better (HIB)

D7.1.5 PERCENTAGE OF WATERED URBAN GREEN SPACES

NORMALISATION

Indicator

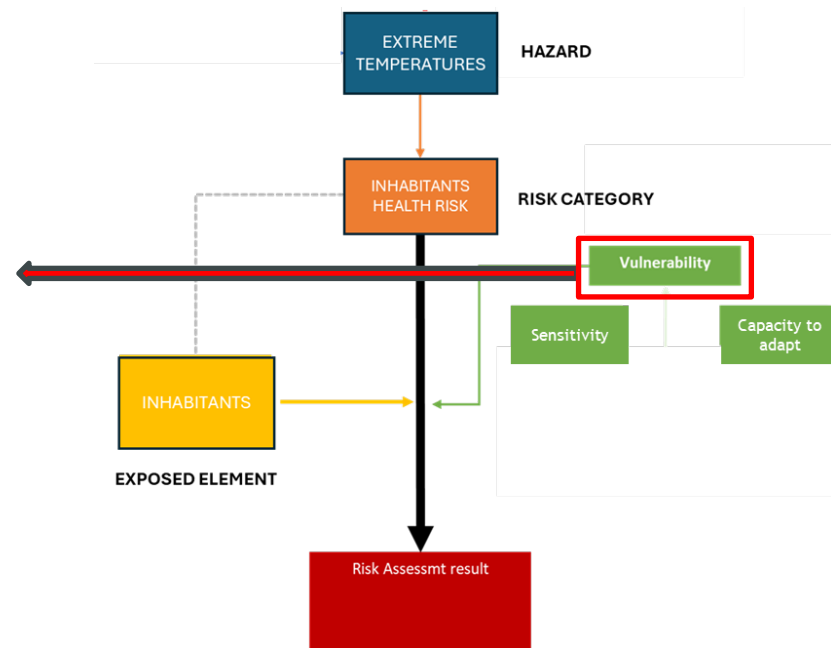
Percentage of watered urban green spaces: 40%

Normalised Value: 0,6

Vulnerability Level: **Rather negative**

OVERALL VULNERABILITY

Criterion	Normalised value
Soil moisture stress	0,73
Number of endangered species	0,5
Percentage of vulnerable habitats	0,38
Percentage of protected areas	0,7
Percentage of watered urban green spaces	0,6



OVERALL VULNERABILITY

Criterion	Normalised value	Weight
Soil moisture stress	0,73	0,25
Number of endangered species	0,5	0,2
Percentage of vulnerable habitats	0,38	0,15
Percentage of protected areas	0,7	0,15
Percentage of watered urban green spaces	0,6	0,25

TOTAL = 1 (100%)

OVERALL VULNERABILITY (VULNERABILITY VALUE - VV)

Normalised score

Weight

$$VV = \sum_{i=1}^n (I_i \times W_i)$$

Criterion	Normalised value	Weight
Soil moisture stress	0,73	0,25
Number of endangered species	0,5	0,2
Percentage of vulnerable habitats	0,38	0,15
Percentage of protected areas	0,7	0,15
Percentage of watered urban green spaces	0,6	0,25

$$VV = 0.73 \times 0.25 + 0.5 \times 0.2 + 0.38 \times 0.15 + 0.7 \times 0.15 + 0.6 \times 0.25 = 0.5945$$

Vulnerability Value (VV) = 0,5945

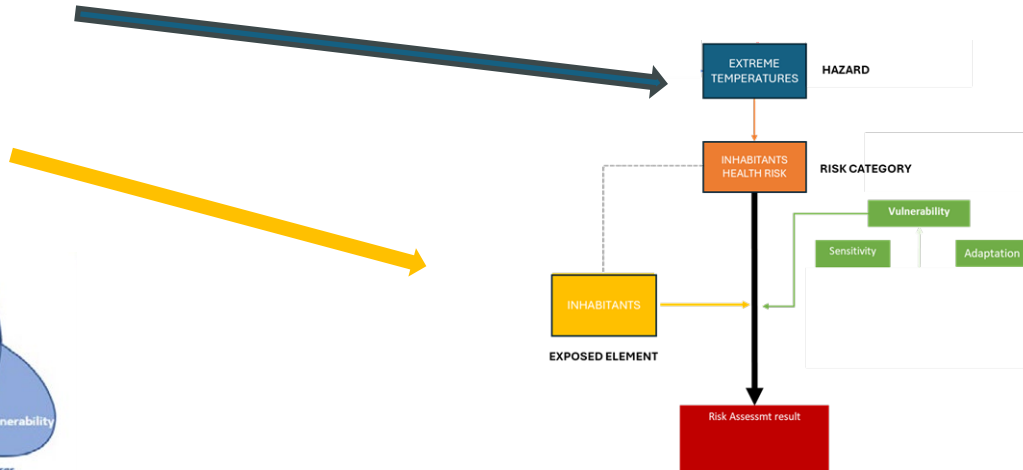
Vulnerability Level = **RATHER
NEGATIVE**

EXPOSURE OF INHABITANTS

AFTER ASSESSING VULNERABILITY, IT IS NECESSARY TO QUANTIFY TWO ADDITIONAL FACTORS TO DETERMINE THE LEVEL OF RISK:

-HAZARD

-EXPOSURE



HAZARD LIKELIHOOD

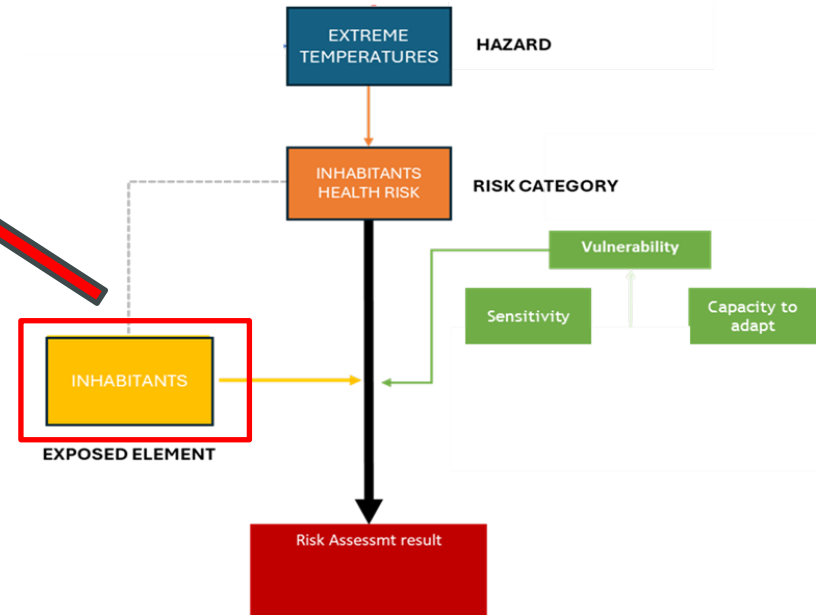
Hazardous event		Slow-onset process		Hazard Value (HV)
Frequent	Likely to occur often in a lifetime (every 10years)	Very likely	Very likely to occur in the next ten years	1-0.9
Probable	Likely to occur several times in a lifetime (every 25 years)	Likely	Likely to occur in the next 10 years	0.89-0.66
Occasional	Likely to occur sometime in a lifetime (every 50 years)	As likely as not	As likely as not to occur in the next 10 years	0.65-0.33
Remote	Unlikely but still possible to occur in a lifetime (100 years)	Unlikely	Unlikely to occur in the next 10 years	0.32-0.0

Hazard Value (HV) = 0.6 (Occasional)

THIS INFORMATION IS PROVIDED BY SECAPs

EXPOSED AREA

CODE	CRITERION	INDICATOR
D7.1-E1	Exposed area	Area of urban green spaces



EXPOSURE OF URBAN GREEN SPACES

Extend of the exposure	Exposure Value (EV)
Minor	0.01 – 0.10
Low	0.11 – 0.20
Moderate	0.21 – 0.30
Critical	0.31 – 0.50
Major	0.51-1.00

Area of urban green space = 7

Critical value (1) = 10 km and more

Optimal value (0) = Less than 0,5 km

Normalised value (Exposure Value - EV) = **0,684**

Exposure Level: **MAJOR**

RISK ASSESSMENT

Risk Category: Environment and biodiversity (D7)
Exposure: Damage risk for urban green spaces (D7.1)

- Hazard Value = 0,6
- Exposure Value = 0,684
- Vulnerability Value = 0,5945

- W_{HV} weight of HV  0,5
- W_{EV} weight of EV  0,25
- W_V weight of VV  0,25

$$HV^{W_{HV}} \times EV^{W_{EV}} \times VV^{W_V}$$



RISK LEVEL = 0.62
RATHER NEGATIVE