Flood risk and water resources management with nature-based solutions on Florence city environment

Tommaso Pacetti[1], Matteo Pampaloni[1], Giulio Castelli[2], Enrica Caporali[1], Elena Bresci[2], Matteo Isola[1] and Marco Lompi[1]

[1] Department of Civil and Environmental Engineering
University of Florence, Firenze, Italy
(tommaso.pacetti@unifi.it)

[2] Department of Agriculture, Food, Environment and Forestry (DAGRI)
University of Florence, Firenze, Italy
(giulio.castelli@unifi.it)

HIGHLIGHTS

Online | 4–8 May 2020

- Integrated approach for planning NBS interventions in urban areas
- Evaluation of NBS multifunctionality through ES indicators
- Caractherization of NBS use for hydraulic risk mitigation and water resources management

Source: www.flickr.com/photos/la-citta-vita/4749837642

CREDITS

EGU General Assembly 2020
Online | 4–8 May 2020

The following slides have been produced thanks to the work of the entire team working on the Florence Project. The project was financed in 2019 by *Fondazione Cassa di Risparmio* under a dedicated programme to support academic research.

OUTLINE

Source: The SuDS Manual – Woods Ballard et al. (2015)

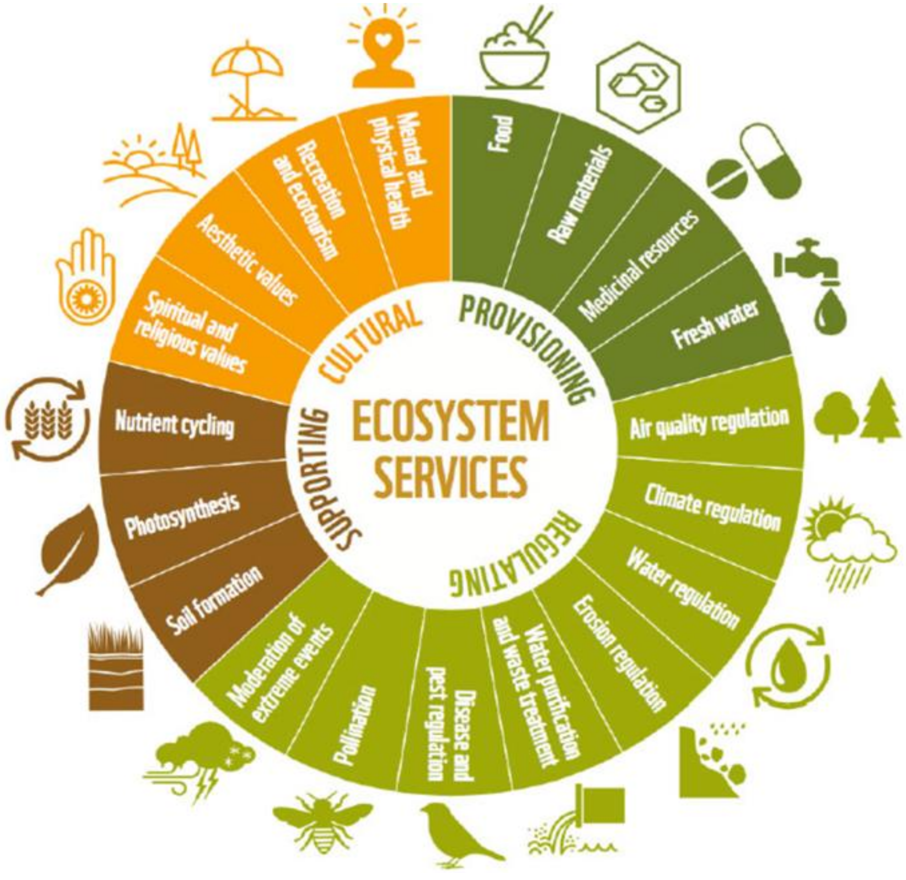
1. Mapping Ecosystem Services priority areas (main function and cobenefits) and constrains.
2. Multicriteria Analysis
3. Preliminary evaluation of suitable sites for NBS implementation.

ECOSYSTEM SEVICES MAPPING

- Evaluation of **Ecosystem Services** and definition of **indicators** to identify the most suitable areas for NBS's installation.

Ecosystem Services: benefits people obtain from ecosystems (MAE,2005)

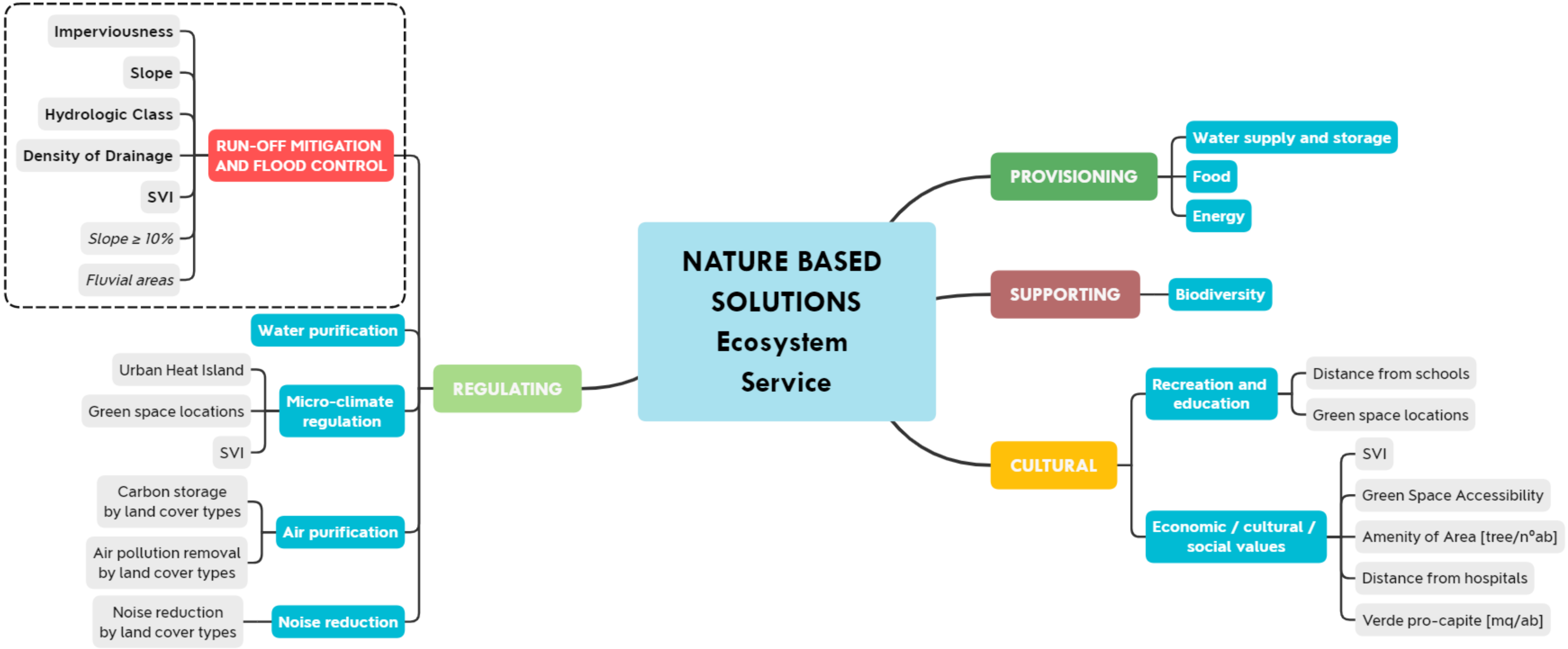
- **Provisioning services**
- **Regulating services**
- **Supporting services**
- **Cultural services**



Source: WWF Living Planet Report 2016

ECOSYSTEM SEVICES MAPPING

Based on a literature review of the main ES associated to NBS and the analysis of the context of the urban environmtne of the city of Florence, the following ES have been considered.



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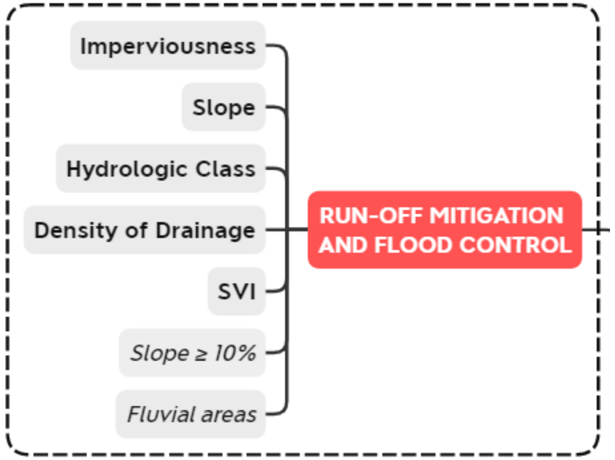
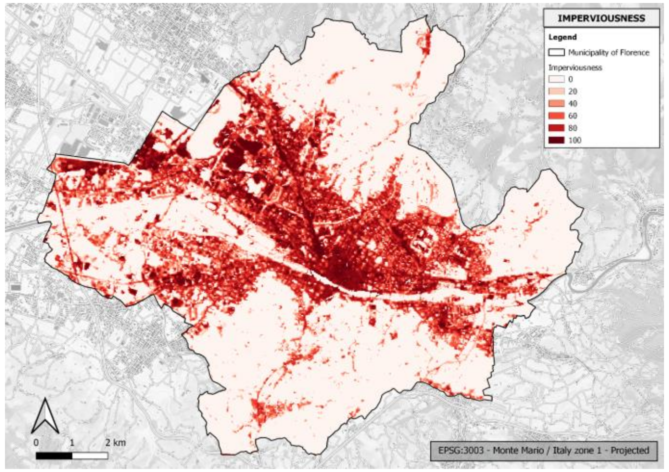
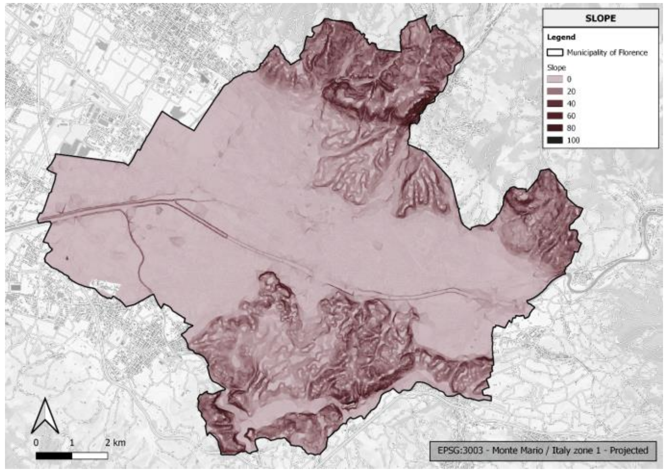
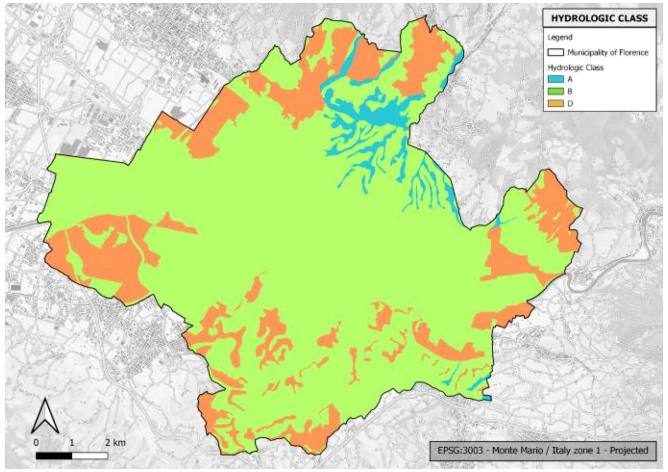
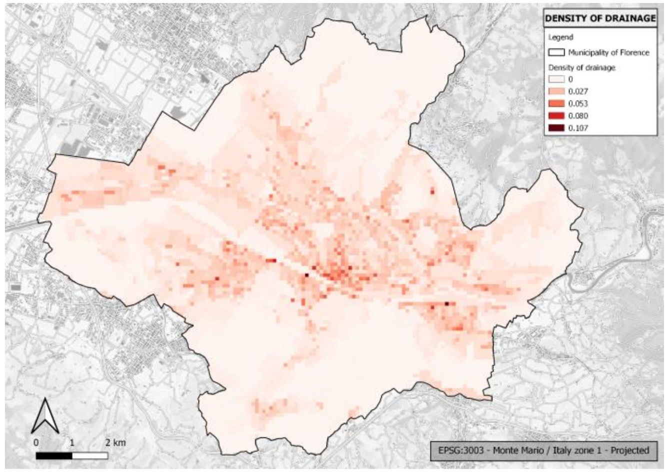
A multicriteria analysis on the indicators that charactherize runoff mitigation and flood control (emerged as the main issue to be solved) is carried out to select the most critical areas.

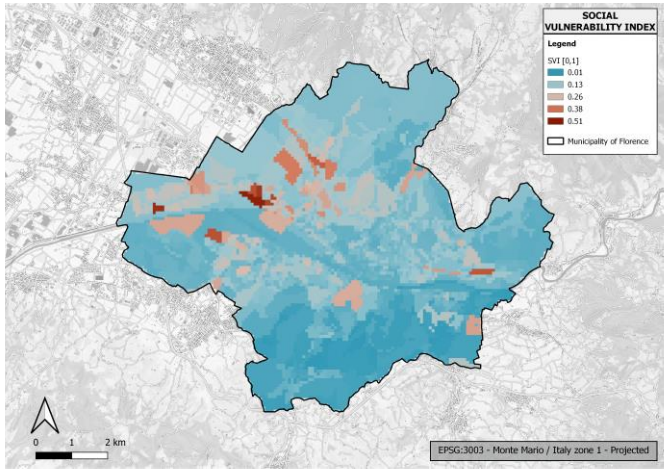












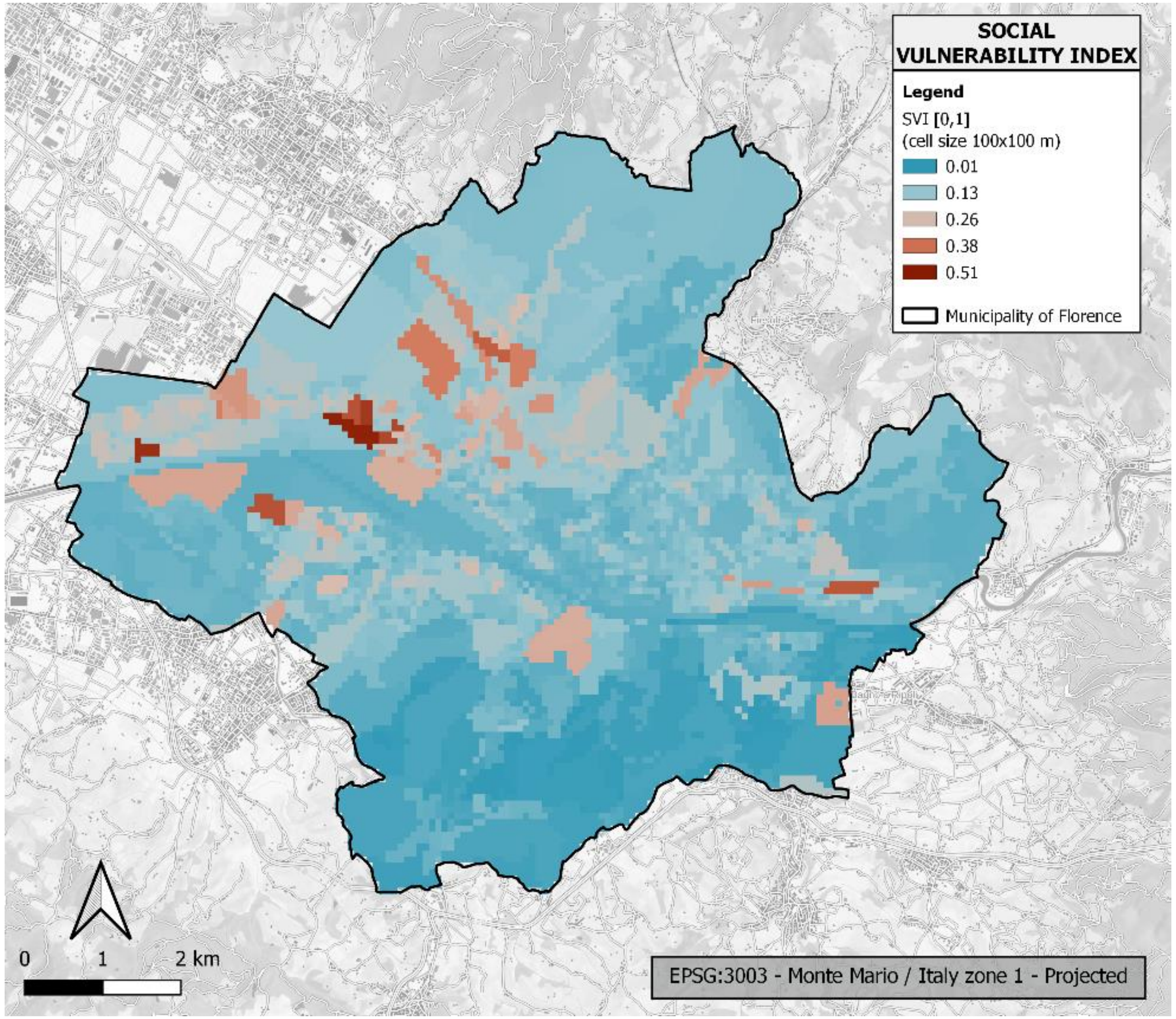
MULTICRITERIA ANALYSIS

Assessment of the Social Vulnerability Index of Municipality of Florence

Although different groups of society are exposed to a natural risk in a similar way, the risk has different consequences since diverse are the skills and the abilities to react to a danger.

An index that evaluate the **social vulnerability to floods for the Municipality of Florence,** is proposed on the basis of the major factors that influence social vulnerability.

The most suitable proxy variables are selected from data of Italian National Institute of Statistics (Census 2011), statistical yearbooks of the Municipality of Florence and other pertinent data.



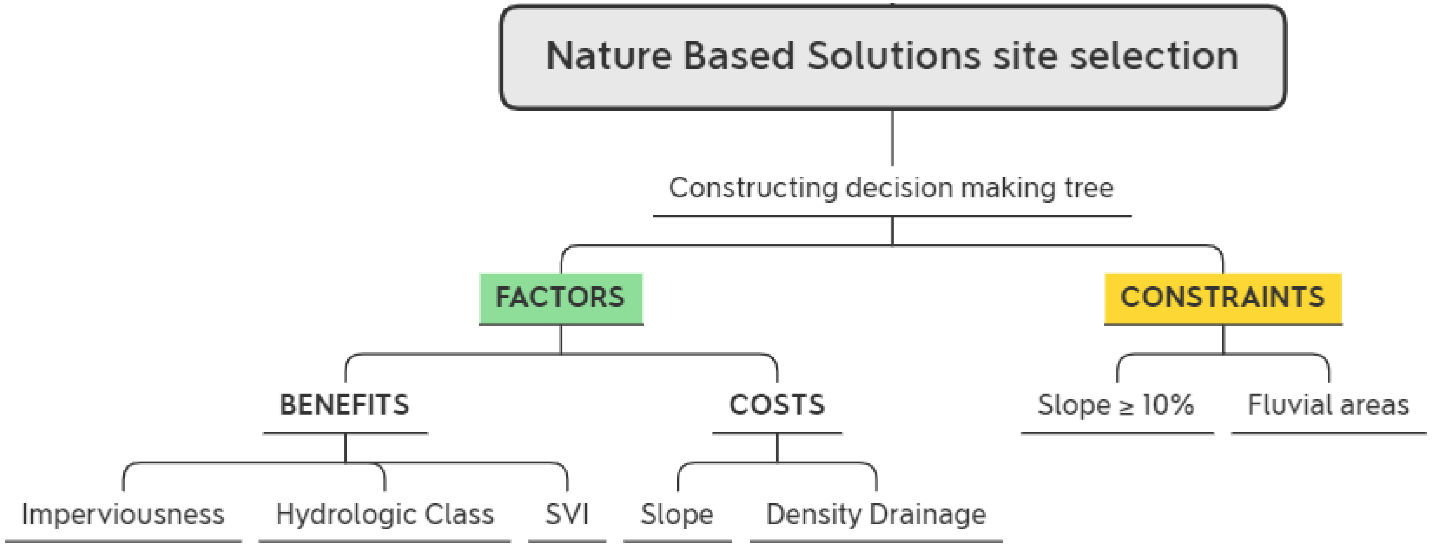
SELECTED REFERENCES

CUTTER S. L., (1996). Vulnerability to environmental hazards. Progress in Human Geography, 20 (4), 529:539.

WU S-Y., *et. al*. (2002). Vulnerability of coastal communities to sea-level rise: a case study of Cape May County, New Jersey, USA. Climate Research, 22, 255:270.

OULAHEN G, *et. al*. (2015). Unequal Vulnerability to Flood Hazards: “Ground Truthing” a Social Vulnerability Index of Five Municipalities in Metro Vancouver, Canada, Annals of the Association of American Geographers, 105:3, 473-495.

Tree decision making



CONSTRAINTS

Criterion that determines which areas should be considered as absolutely NOT suitable.

FACTORS

Criterion that contributes to a certain degree to the output (suitability)

- **Benefit criteria**: contributes positively to the output: the more you have, the better is
- **Cost criteria**: contributes negatively to the output: the less you have, the better it is

MULTICRITERIA ANALYSIS

Development of different test scenarios for the identification of a pilot area:

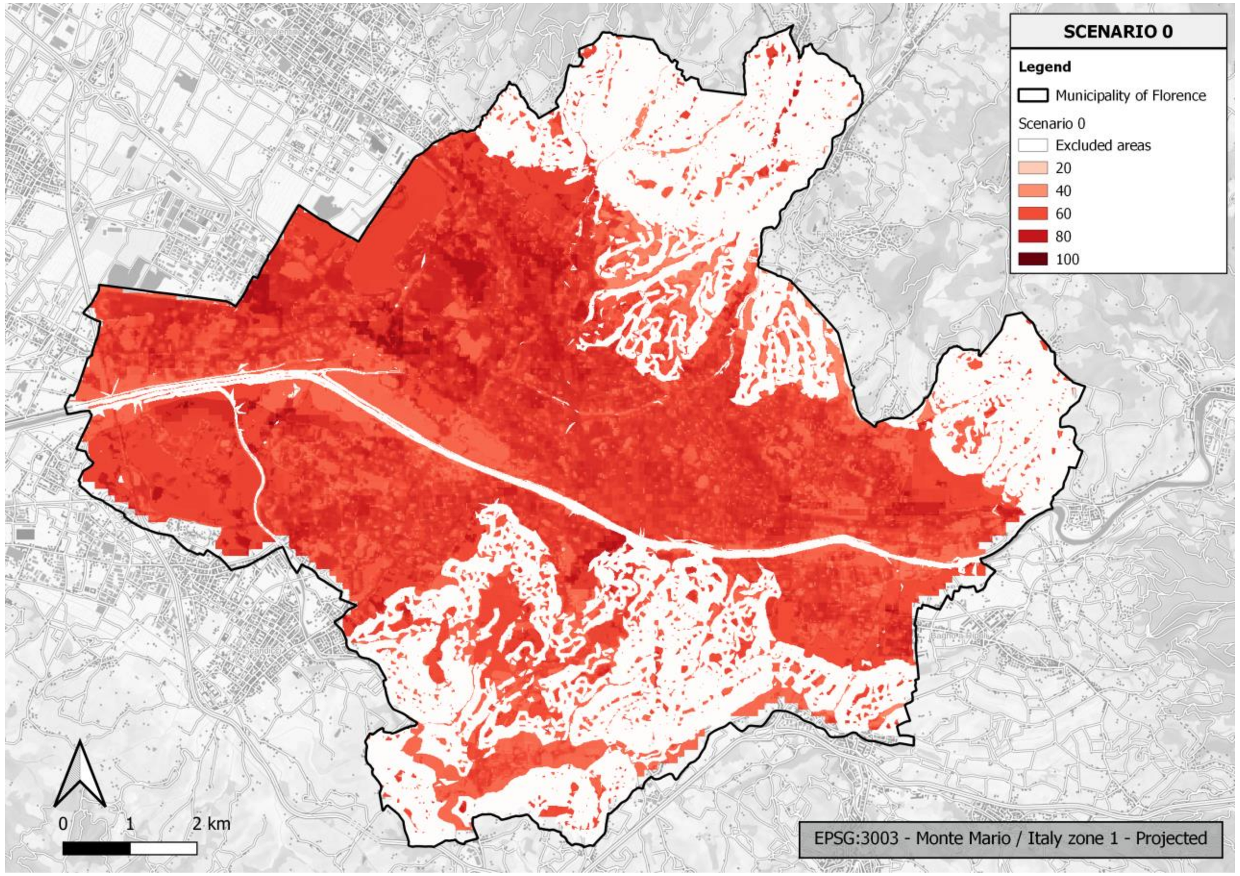
<u>SCENARIO 0</u>

<u>AHP Matrix – CR = 0 < 1</u>

	IMP	S	HC	DD	SOVI
IMP	1	1	1	1	1
S	1	1	1	1	1
HC	1	1	1	1	1
DD	1	1	1	1	1
SOVI	1	1	1	1	1

<u>Weight</u>

- Imperviousness – 0.200
- Slope – 0.200
- Hydrologic Soil Class – 0.200
- Density Drainage – 0.200
- Social Vulnerability Index – 0.200



MULTICRITERIA ANALYSIS

Development of different test scenarios for the identification of a pilot area:

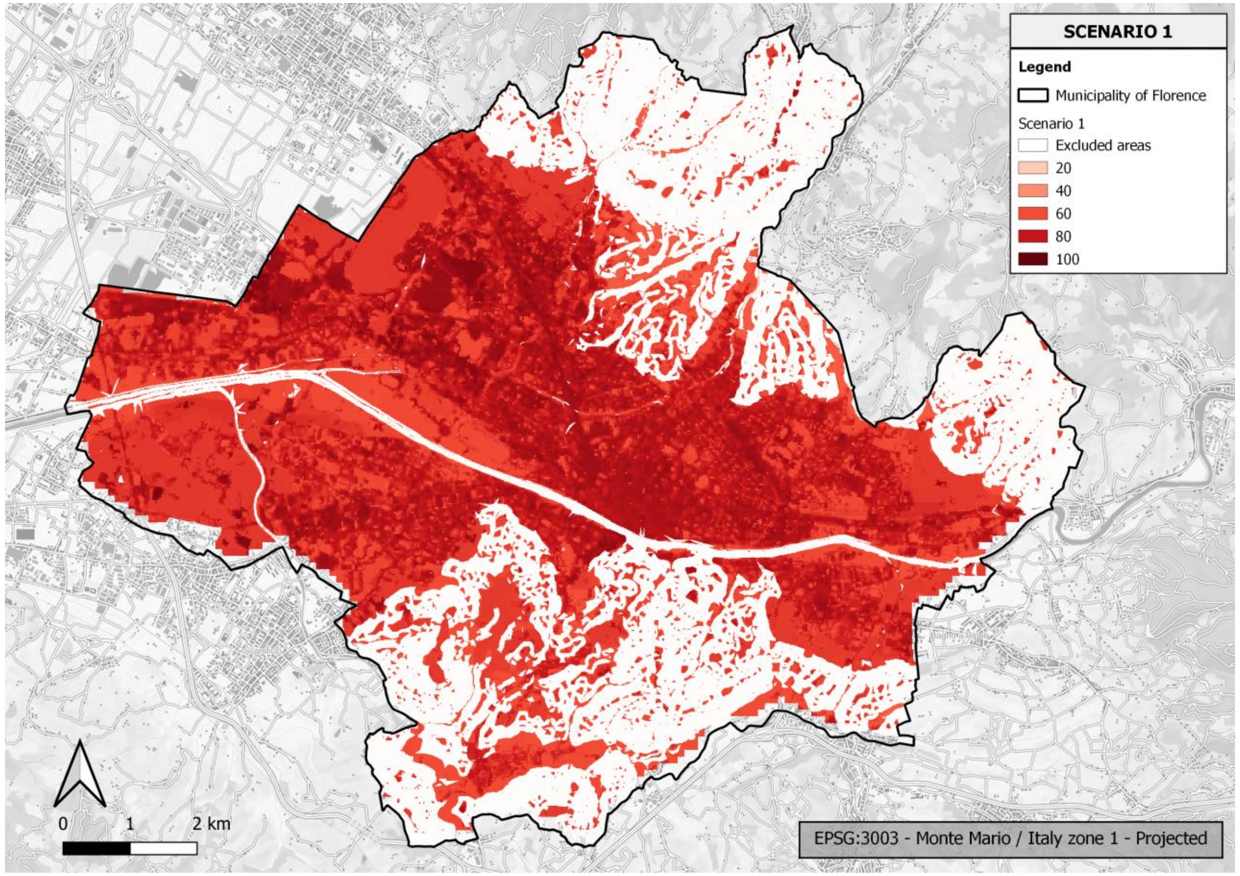
SCENARIO 1

AHP Matrix – CR = 0.069 < 1

	IMP	S	HC	DD	SOVI
IMP	1	1/3	3	5	3
S	3	1	5	3	5
HC	1/3	1/5	1	1	3
DD	1/5	1/3	1	1	1
SOVI	1/3	1/5	1/3	1	1

Weight

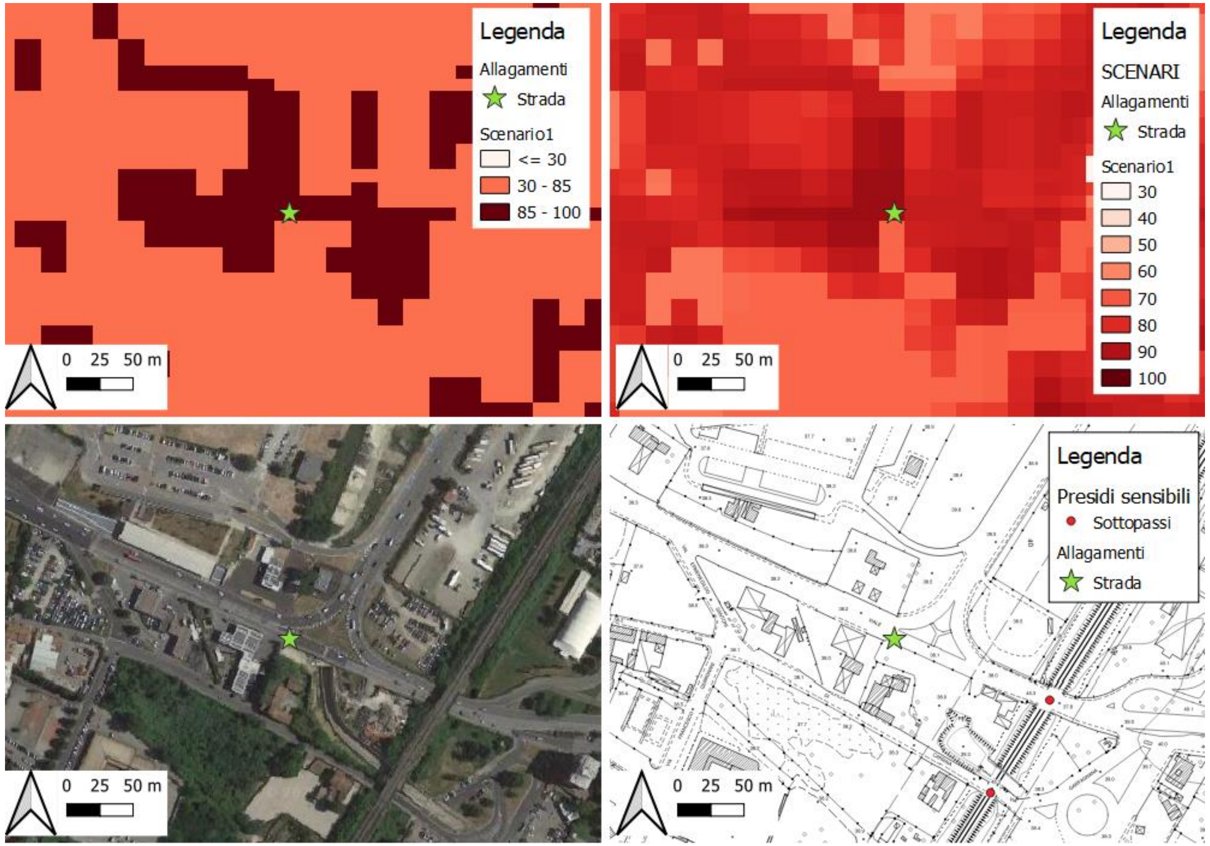
- Imperviousness – 0.267
- Slope – 0.460
- Hydrologic Soil Class – 0.112
- Density Drainage – 0.090
- Social Vulnerability Index – 0.071



Results validation by developing an archive analysis of the pluvial flood events occurring in Florence.

SCENARIO 1 – Area pilota 1

Svincolo Peretola (Viale Guidoni in entrata alla città)



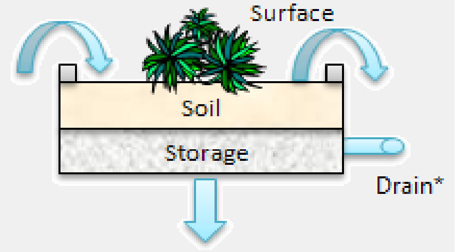
Source: https://www.quinewsfirenze.it/una-barriera-di-acqua-tra-firenze-e-prato.htm

Source: http://www.firenzetoday.it/cronaca/pioggia-temporali-tramvia-10-agosto-2017.html

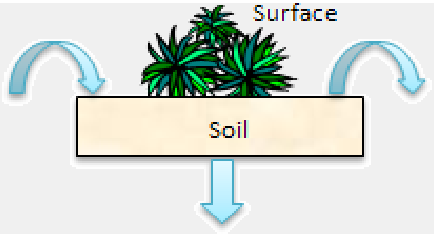
NEXT STEPS

Hydraulic modelling of the selected pilot area, simulating the effects of introducing a Sustainable Urban Drainage System (SUDS).

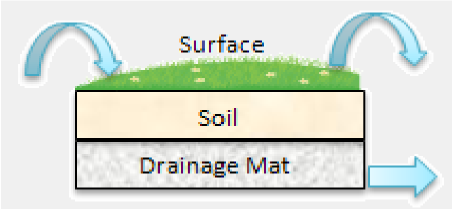
BIO-RETENTION CELL



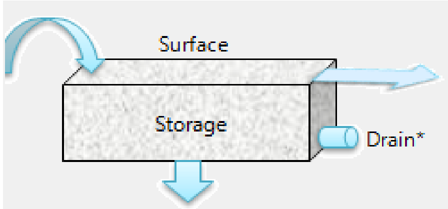
RAIN GARDENS



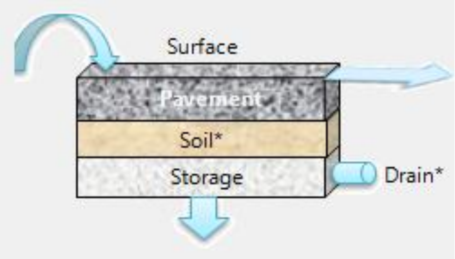
GREEN ROOF



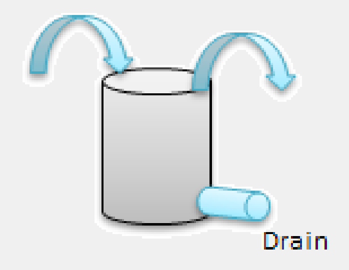
INFILTRATION TENCH



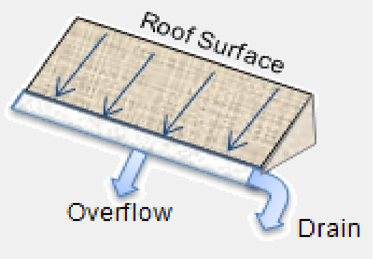
PERMEABLE PAVEMENT



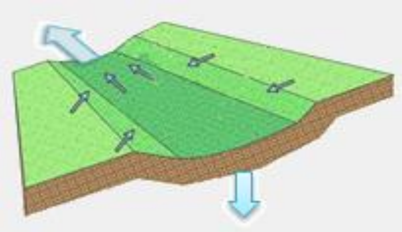
RAIN BARREL



ROOFTOP DISCONNECTION



VEGETATIVE SWALE



Source: Storm Water Management Model Reference Manual, Volume III – Water Quality