SAPIENZA
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FoCuS

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Department of Civil, Constructional and Environmental Engineering

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Department of Planning, Design, and Technology of Architecture

SOS CLIMATE WATERFRONT

Rome
29 march 2022

MAKE THE ANIENE VISIBLE and REDISCOVER RIVER LANDSCAPES

NEW PROJECTS FOR INDUSTRIAL SITES

Water- and heat-resilient built environment

WATERFRONT CLIMATE SOS

MARIE CURIE ACTIONS

European Commission

ALPHA CONSULT

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- Challenges related to flooding
- Strategies for resilience to flooding
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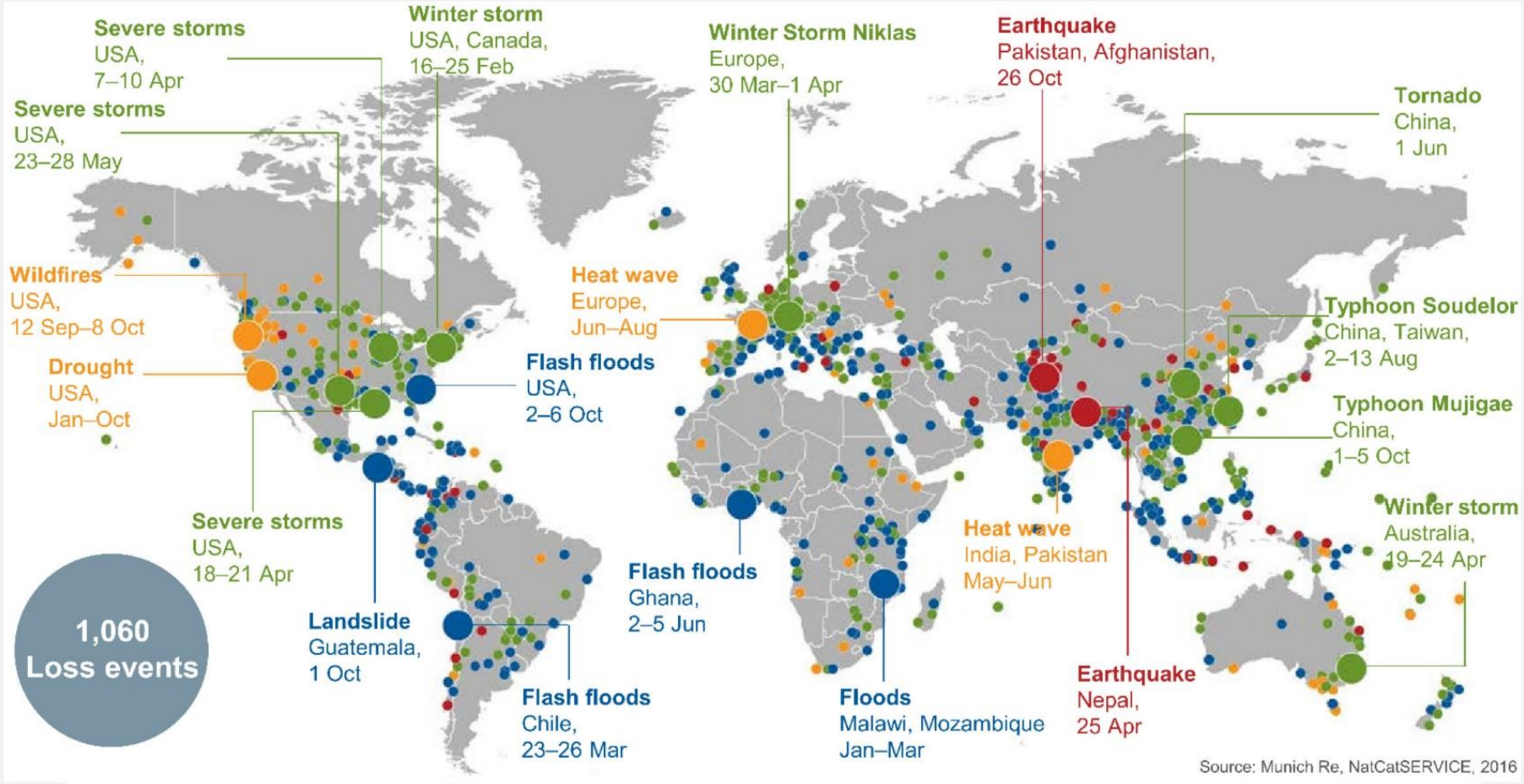
- Common strategies

Challenges



Future Land Consumption Challenges

Urbanization

1900 | 2 out of every 10 people lived in an urban area

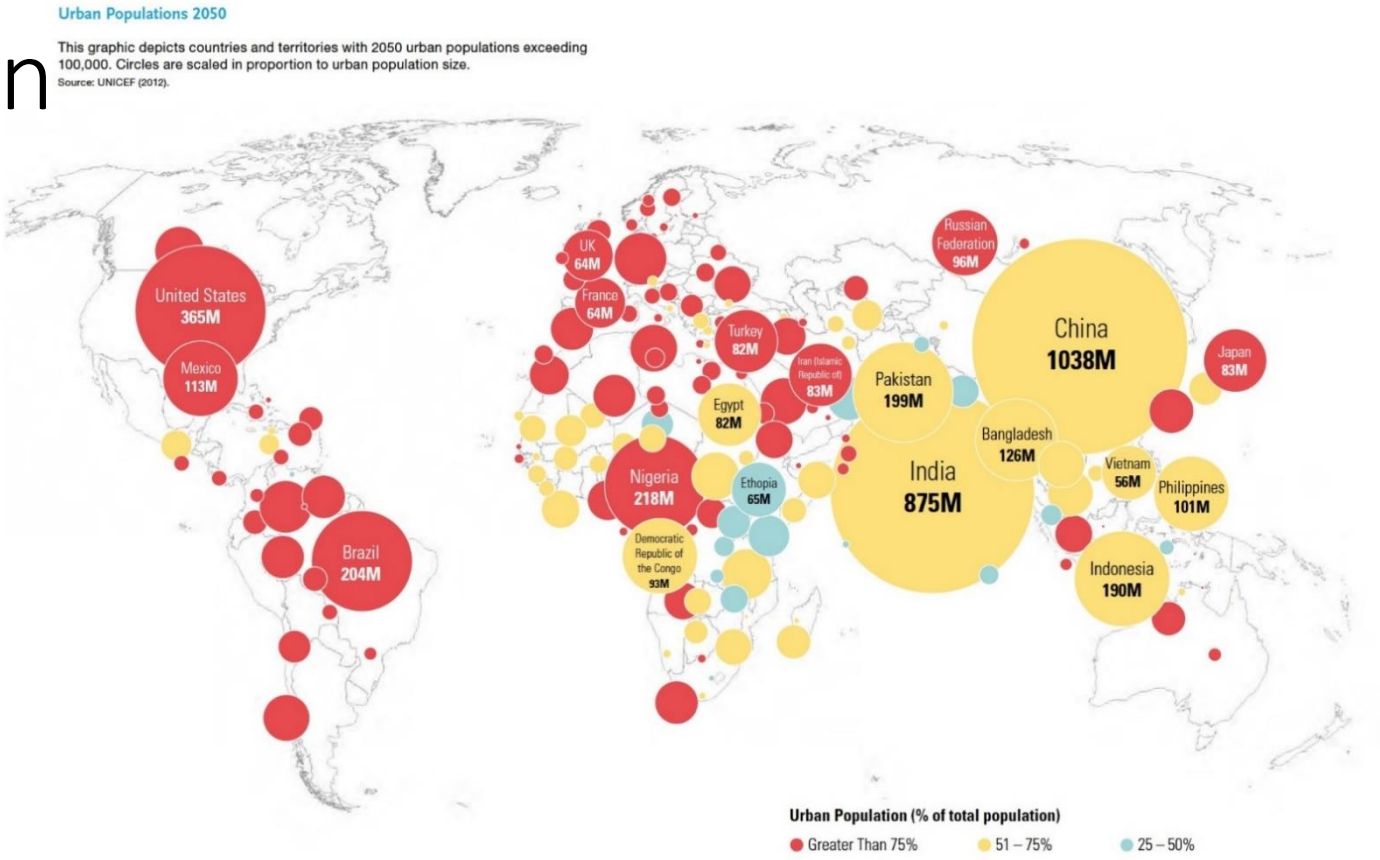
1990 | 4 out of every 10 people lived in an urban area

2010 | 5 out of every 10 people lived in an urban area

2030 | 6 out of every 10 people will live in an urban area

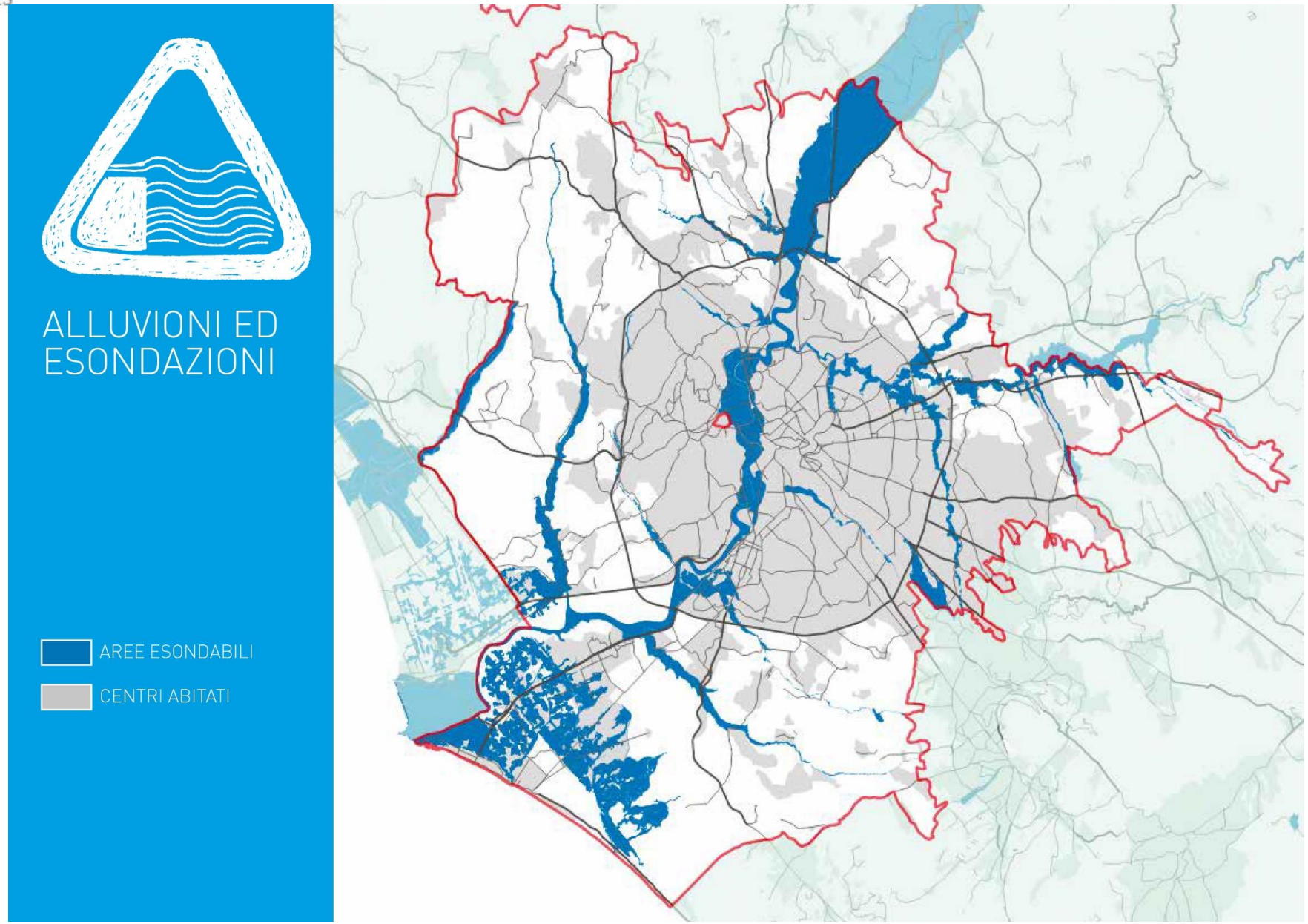
2050 | 7 out of every 10 people will live in an urban area

Defined by UN HABITAT as a city with a population of more than 10 million

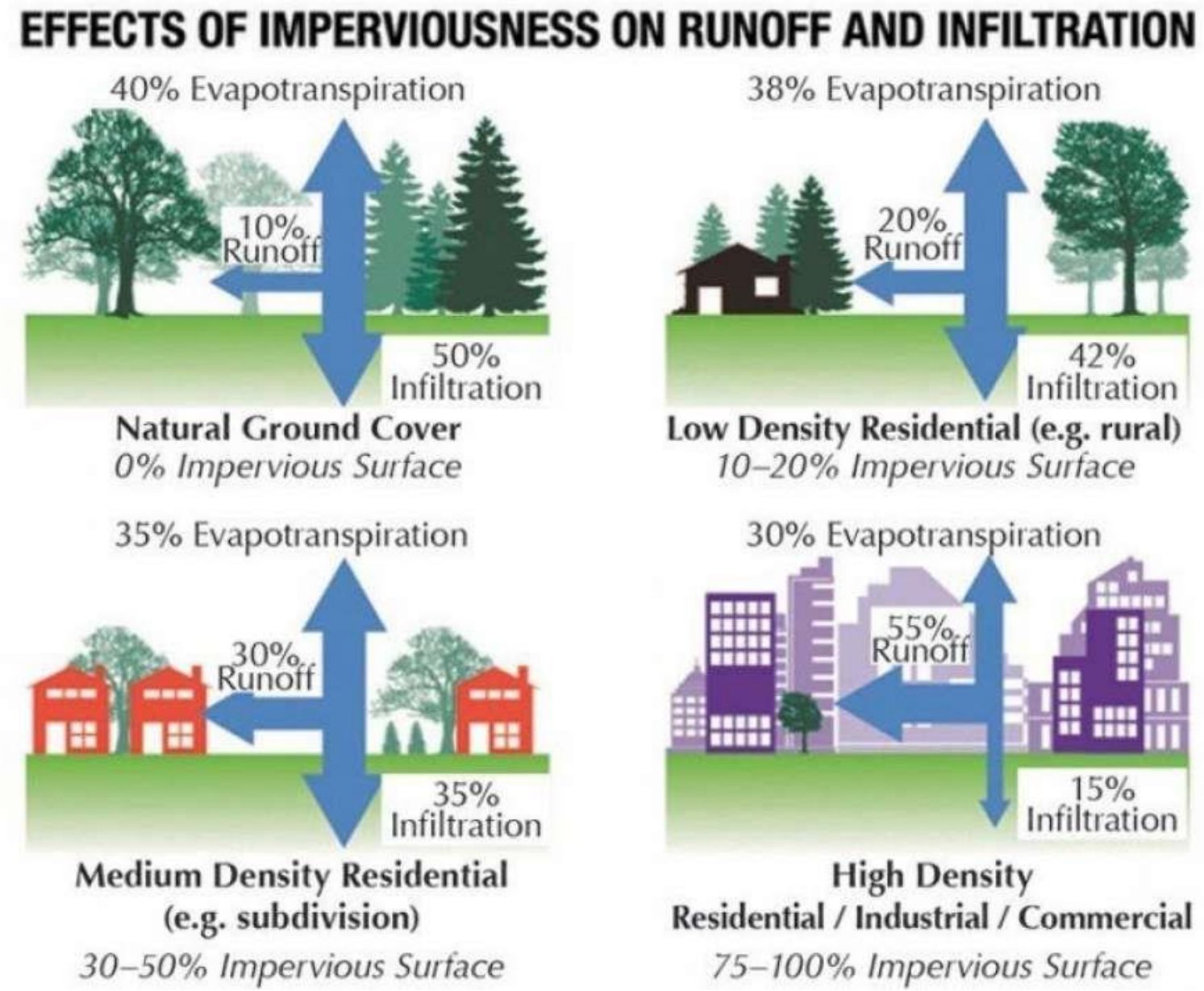


Future Land Consumption Challenges

Challenges related to flooding

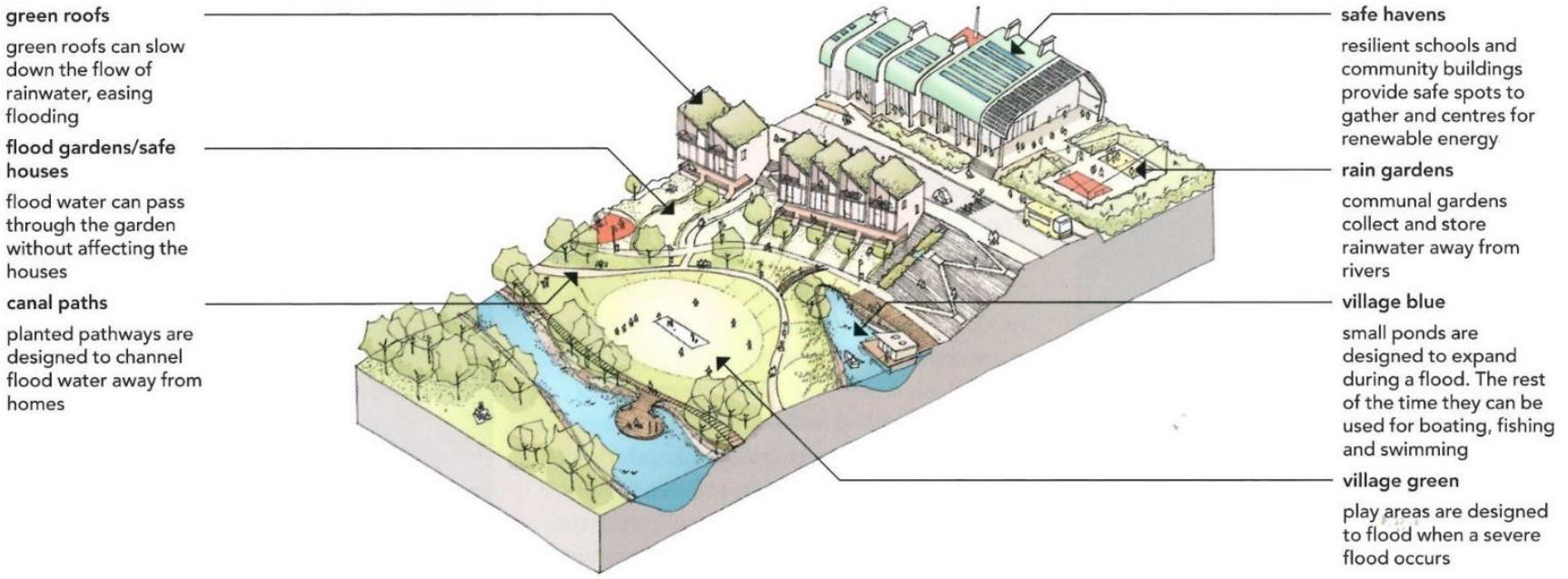


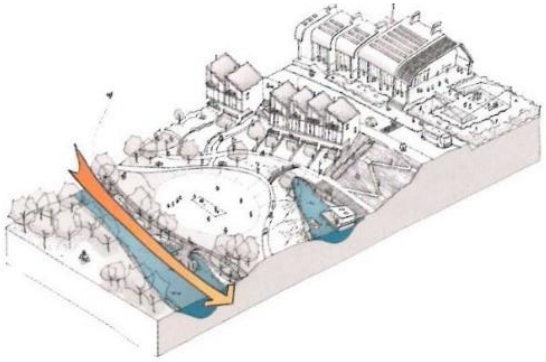
Challenges related to flooding



Strategies for resilience to flooding

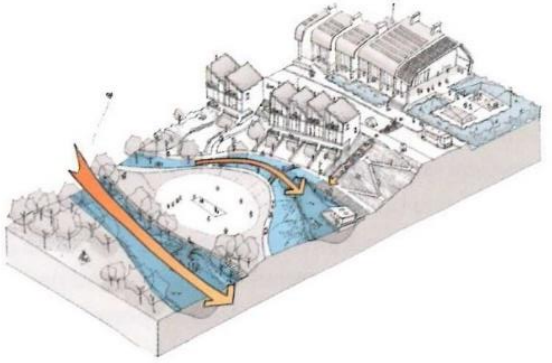
Strategies for resilience to flooding





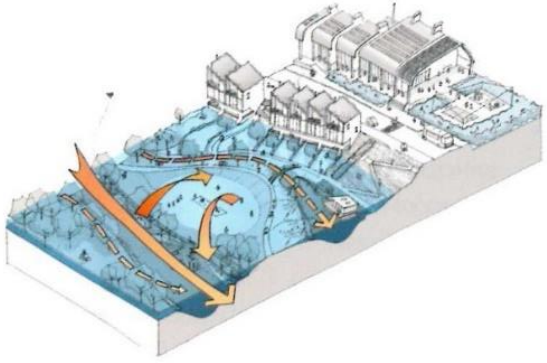
Everyday

For the majority of the time the river contains the flow of water.



During a storm (5% probability)

Rainwater is held in dedicated rain gardens and on the roofs of buildings; the river expands into channels, away from homes, in a predetermined way.



During a very big storm (1% probability)

Rainwater is held in dedicated rain gardens and on the roofs of buildings; flood water is directed into multi-use recreation areas and gardens designed to cope with flood water.

Strategies for resilience to flooding

Table 1 Flood and runoff volume control characteristics of drainage system components.

Infrastructure	Rainfall Interception	Runoff Volume Reduction	Runoff Volume Control	Large Floods Reduction	Peak Runoff Reduction
Rainwater Harvesting	Y	Y	N	SD	Y
Green Roofs	Y	N	N	N	Y
Infiltration Features	Y	Y	N	SD	Y
Permeable Pavements	Y	Y	Y	Y	Y
Subsurface Storage	N	N	Y	Y	Y
Filter Drains	Y	Y	Y	SD	Y
Swales	Y	Y	N	SD	Y
Subsurface Conveyance	N	N	Y	N	N
Filter Strips	Y	N	N	N	SD
Treatment Systems	N	N	N	N	N
Bio-retention systems	Y	Y	N	SD	Y
Detention Basins	Y	N	Y	Y	Y
Retention Ponds	Y	N	Y	Y	Y
Wetlands	Y	N	Y	SD	Y

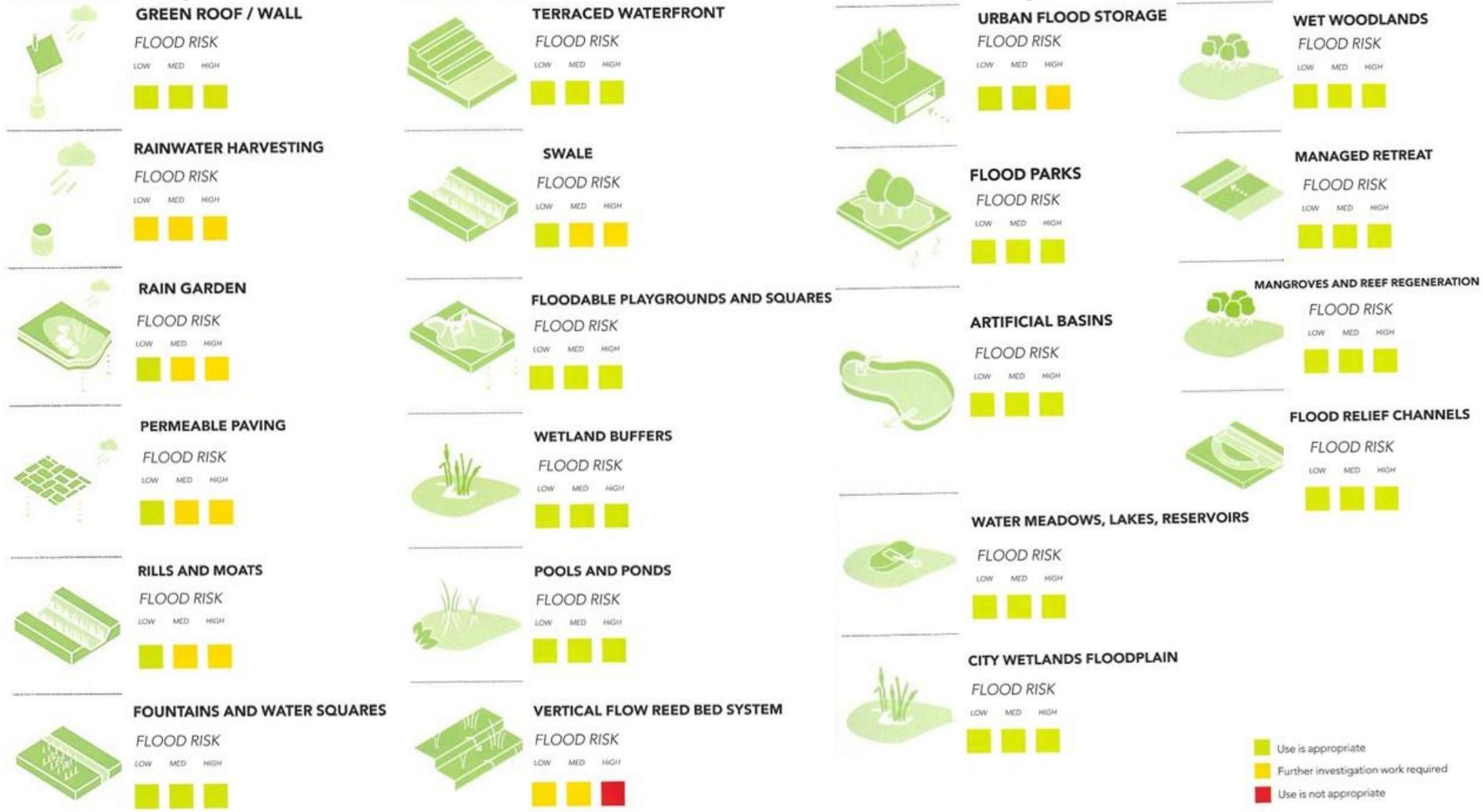
Y - Yes (where design allows); N - No; SD - Scale Dependent.

Table 3 Water-quality control and improvement properties of drainage system components.

Infrastructure	Large sediment Reduction	Fine Sediment Reduction	Hydro-Carbon Reduction	Metals Capture	Nutrient Control
Rainwater Harvesting	N	N	N	N	N
Green Roofs	N	N	Y	N	N
Infiltration Features	Y	N	Y	Y	Y
Permeable Pavements	Y	Y	Y	Y	Y/N
Subsurface Storage	N	N	N	N	N
Filter Drains	N	Y	N	Y	Y
Swales	Y	Y	Y	Y	Y
Subsurface Conveyance	N	N	N	N	N
Filter Strips	Y	N	Y	Y	Y/N
Treatment Systems	Y	Y	Y	Y	Y
Bio-retention systems	N	Y	Y	Y	Y
Detention Basins	Y	Y	Y	Y	Y/N
Retention Ponds	N	Y	Y/N	Y	Y/N
Wetlands	N	Y	Y/N	Y	Y

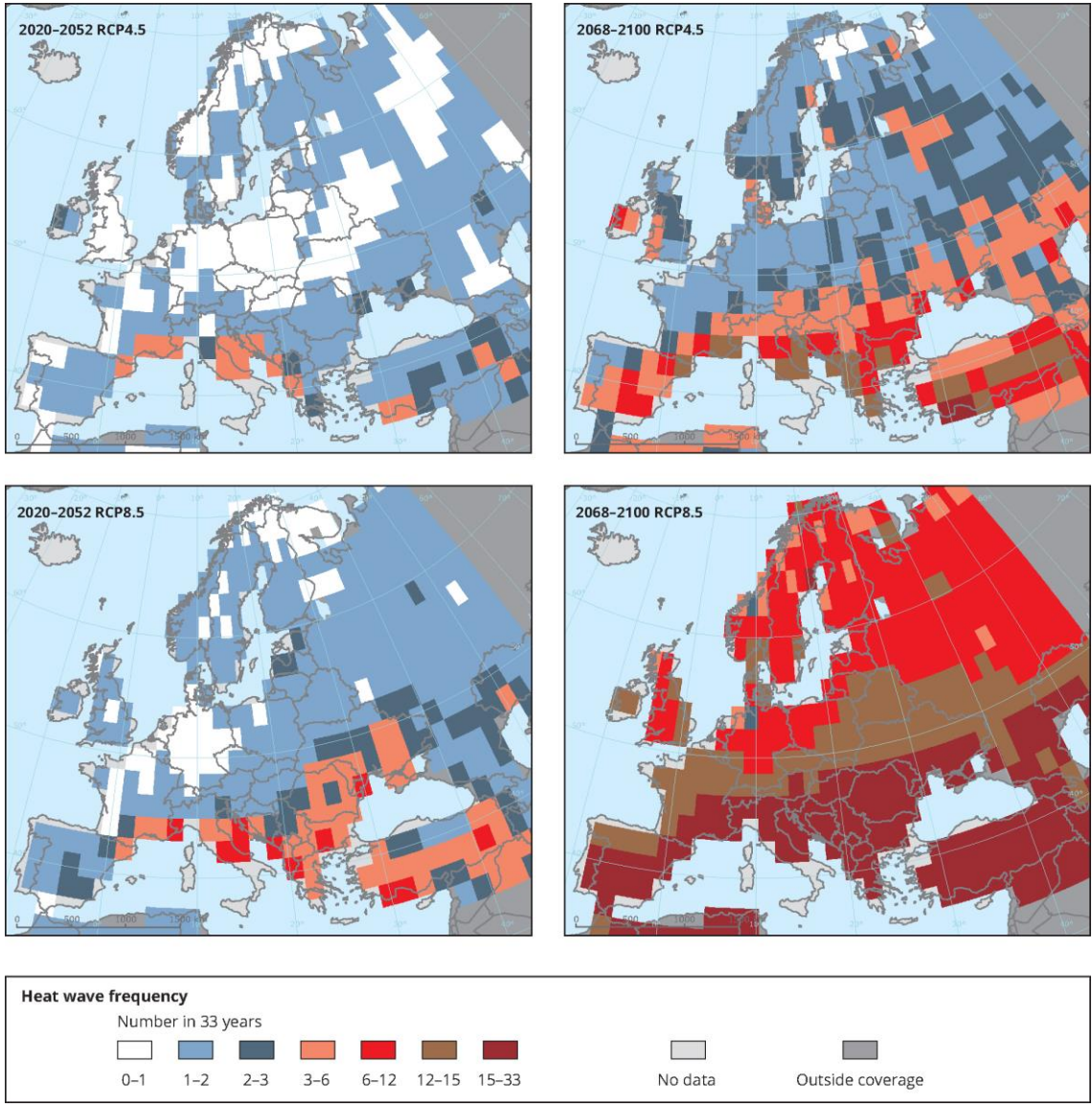
Y = Yes (where design allows); N = No; Y/N = performance dependent on soil characteristics.

Strategies for resilience to flooding



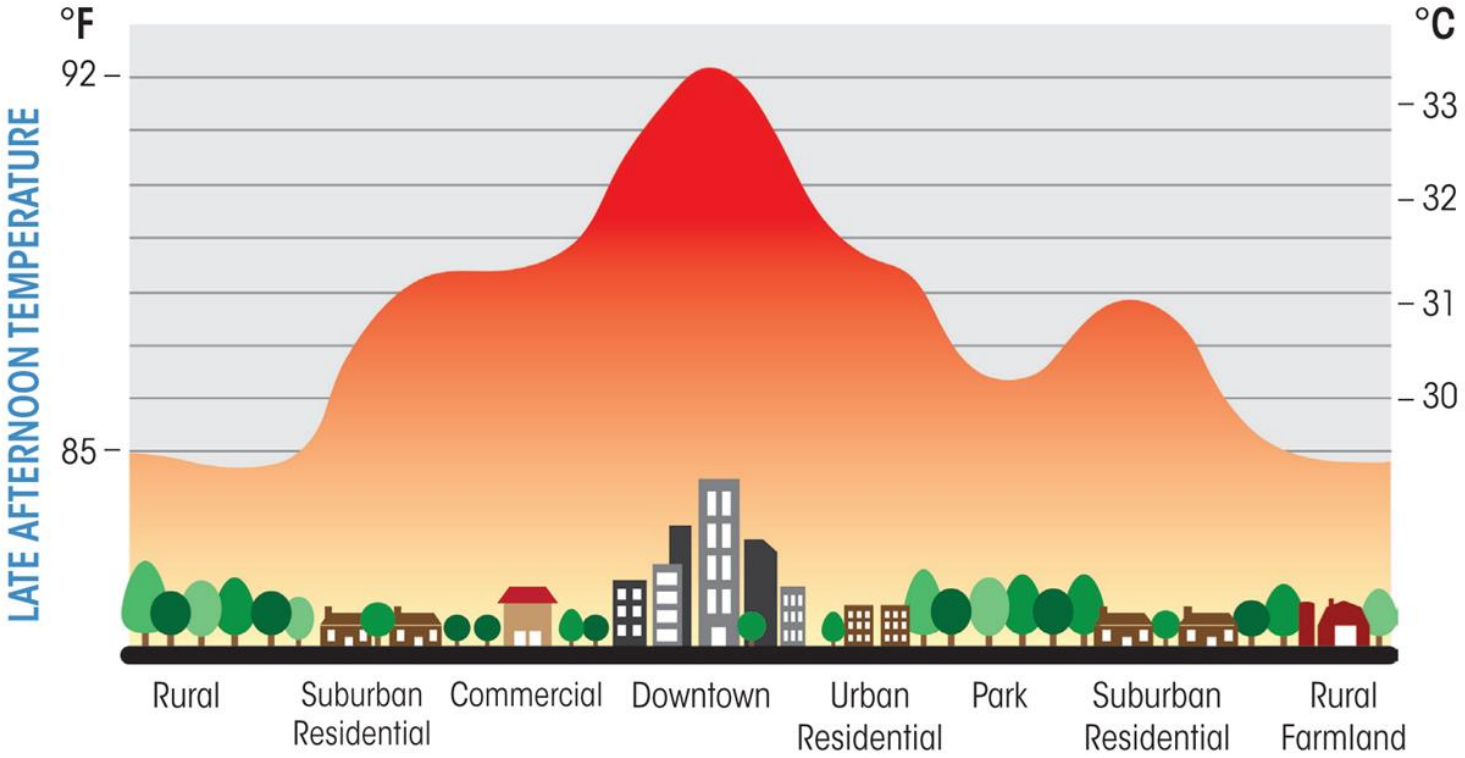
Challenges related to heat

- Heatwaves
- 70,000 excess deaths (Europe, 2003)
- Increasingly exacerbated and frequent



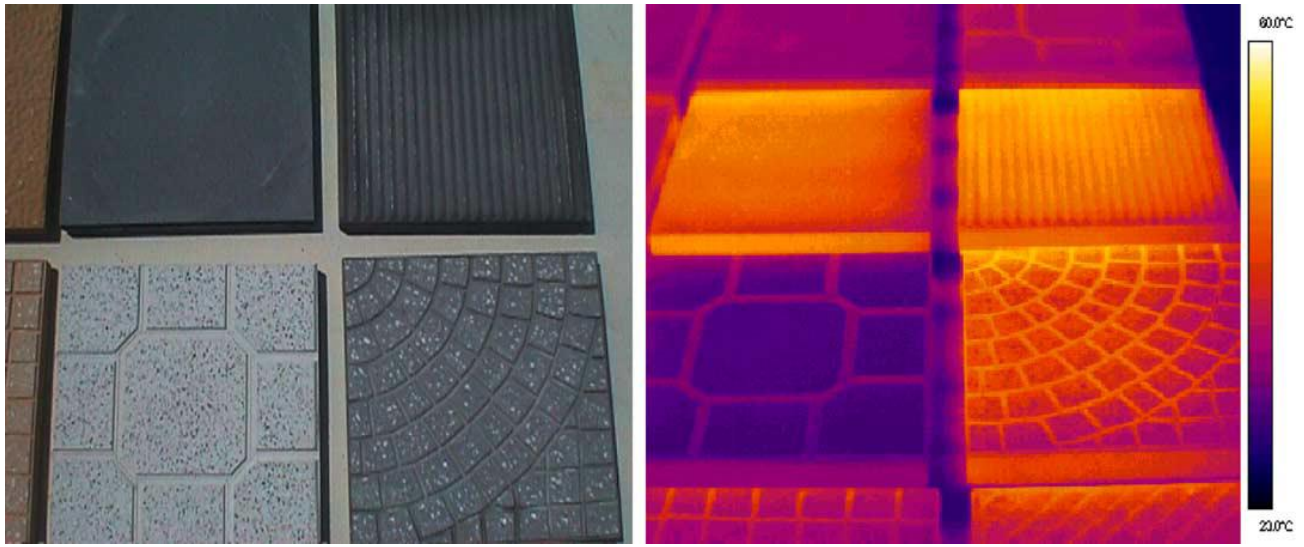
Challenges related to heat

- Urban Heat Island
- Up to +10°C
- Exacerbate heatwaves



Strategies for resilience to heat

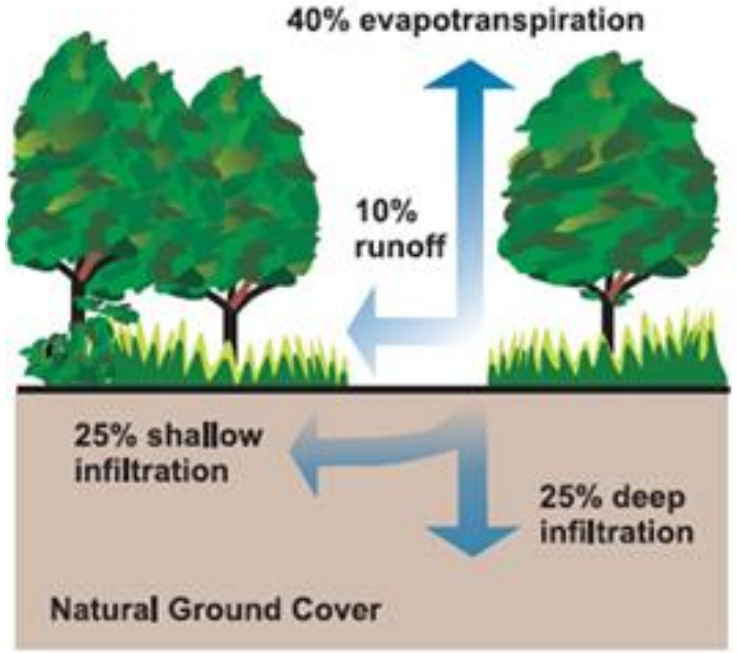
- Cool materials
- Reflect back the incoming solar radiation
- Cool surface and air temperature

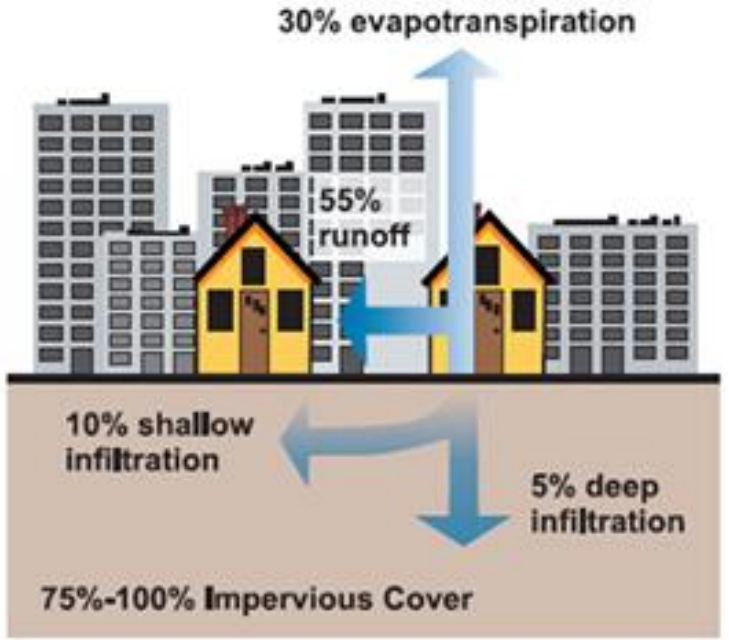


Doulos, L., Santamouris, M., & Livada, I. (2004). Passive cooling of outdoor urban spaces. The role of materials. Solar energy, 77(2), 231-249.

Strategies for resilience to heat

- SUDs: greenery, trees





Common strategies

- Cool permeable paving
- SUDs: greenery, trees
- Water











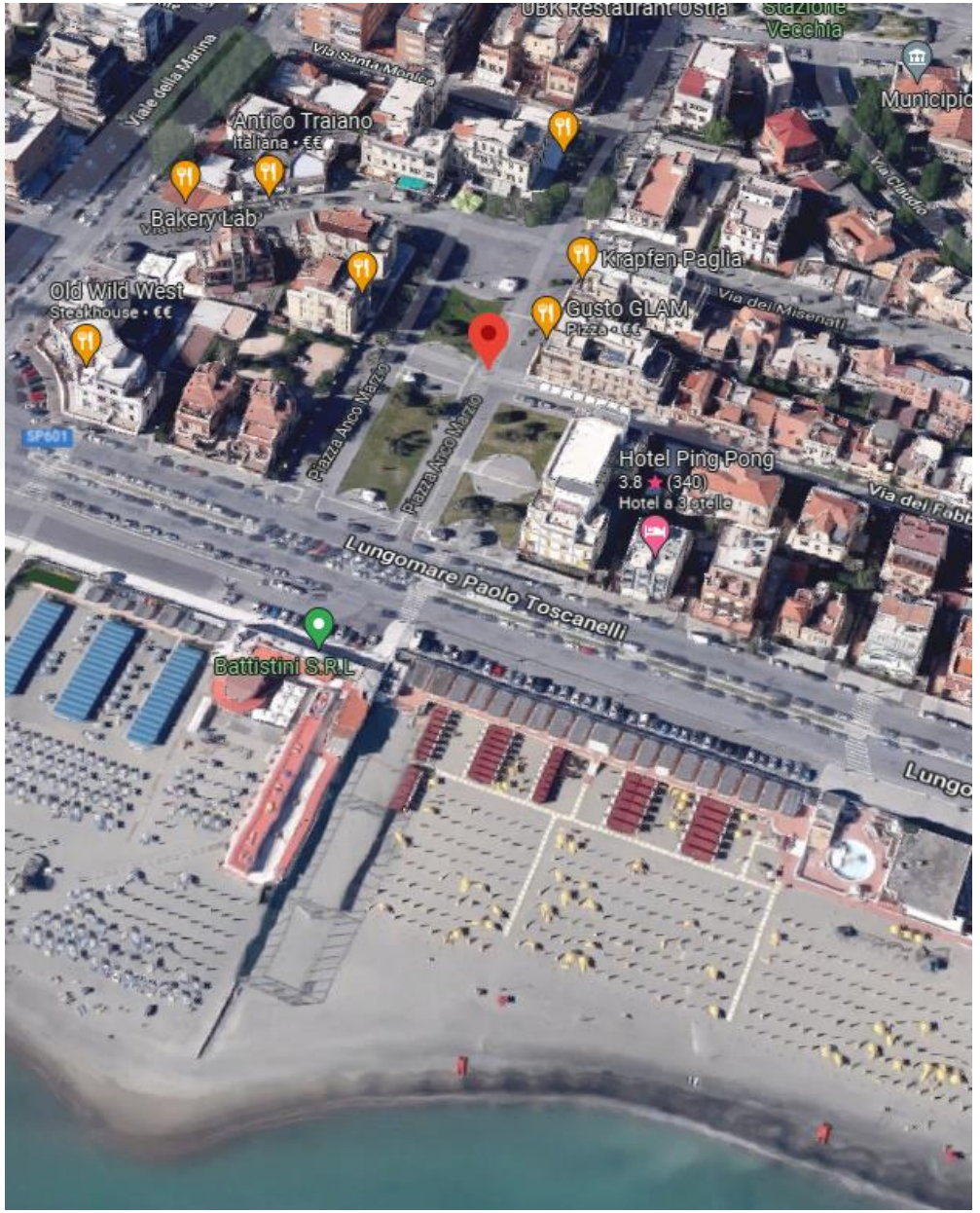
Research

- Ostia
- Public square
- Mitigate flooding (runoff) and heat

Ref case: as is

Dev case: further impermeabilization

Strat case: strategies applied

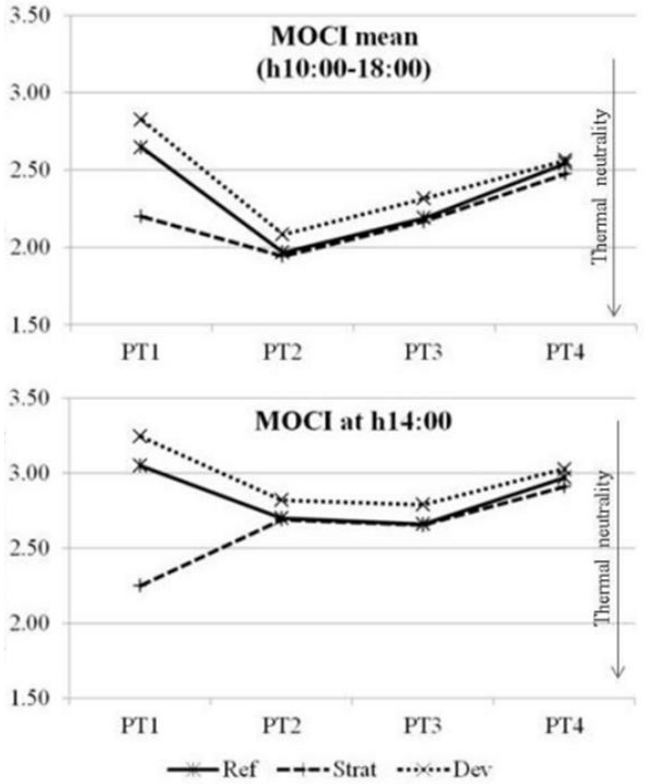


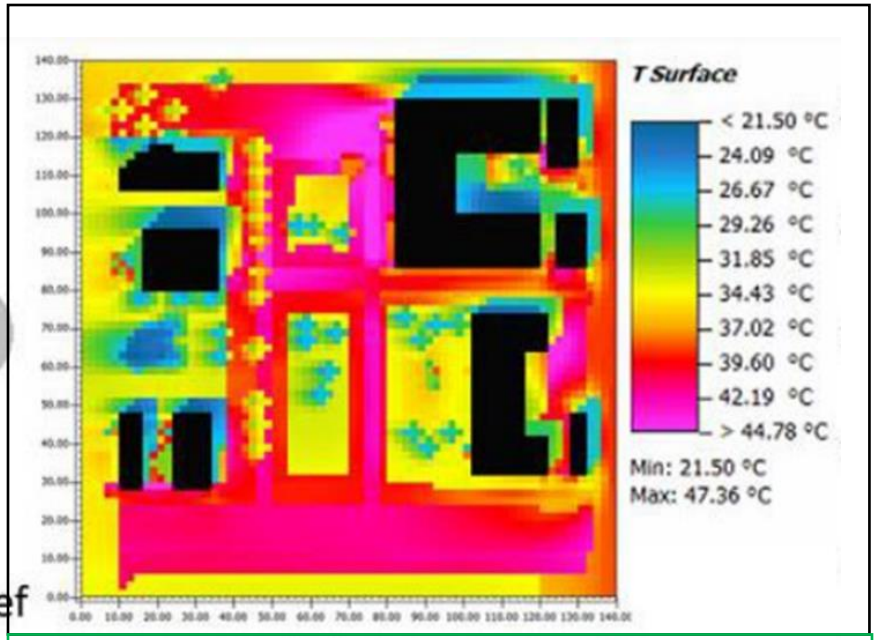
Research

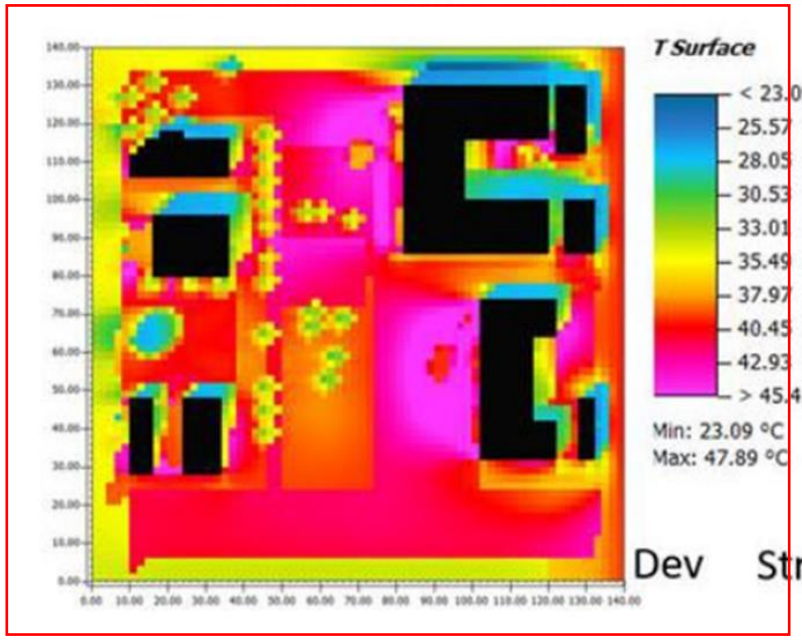
Ref case: as is

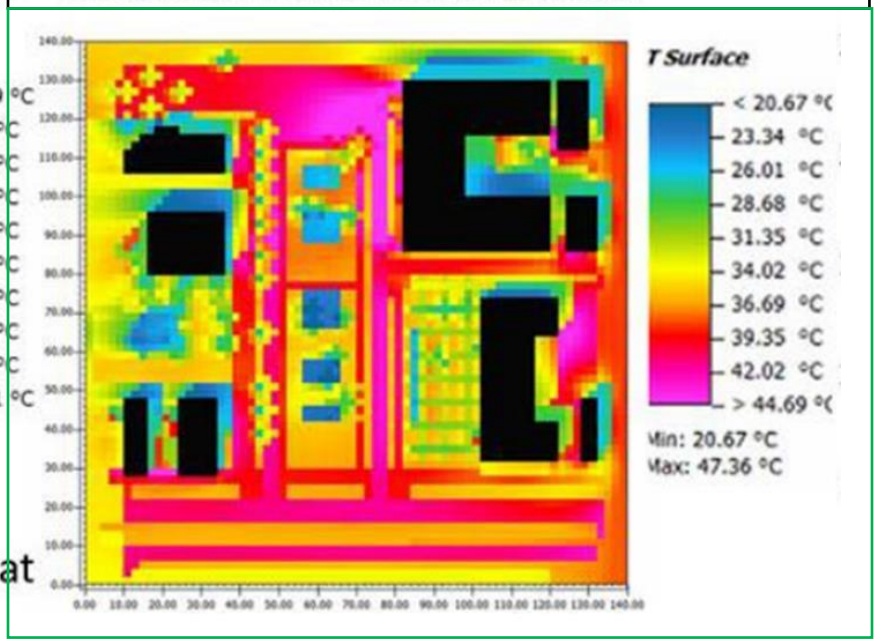
Dev case: further impermeabilization

Strat case: strategies applied







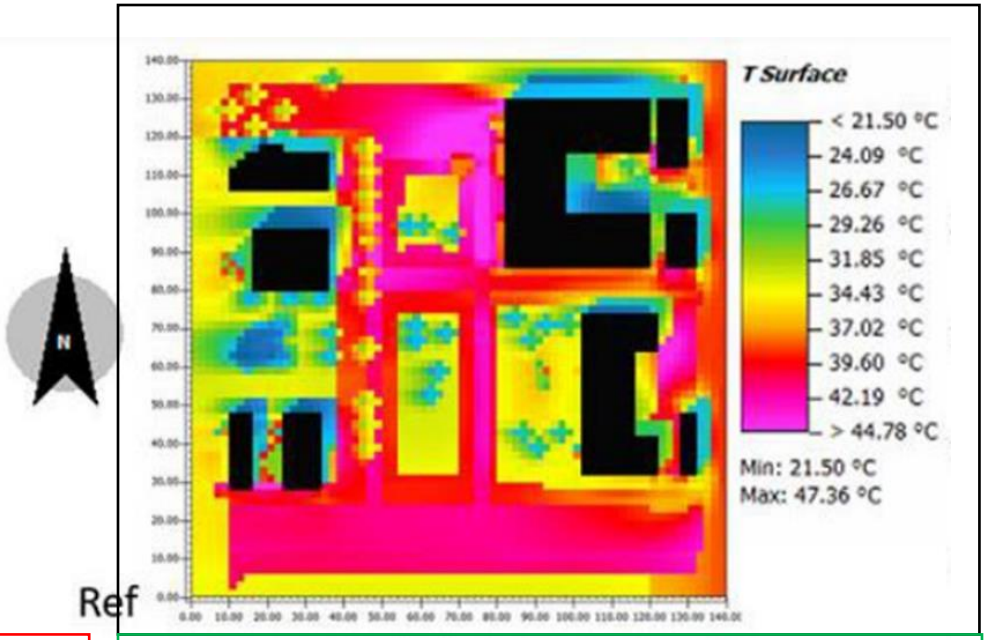


Research

Ref case: as is

Dev case: further impermeabilization

Strat case: strategies applied

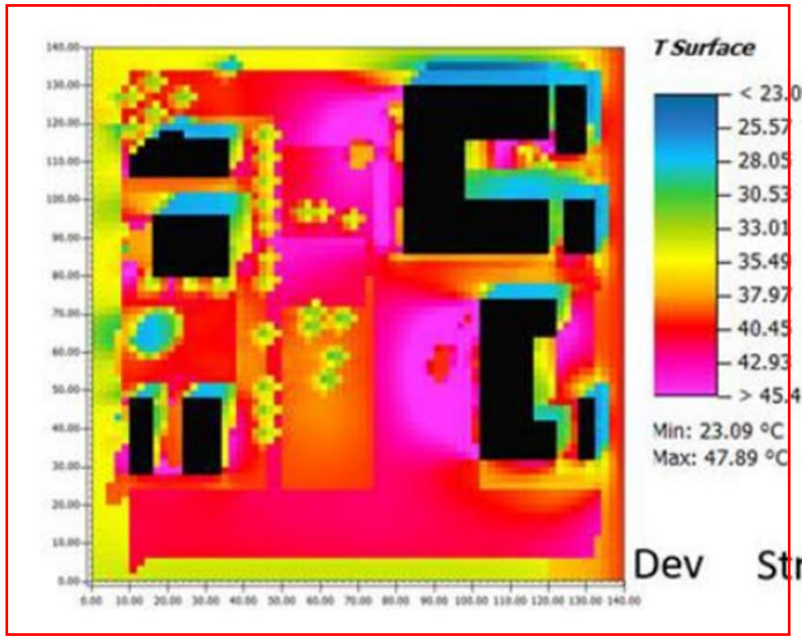


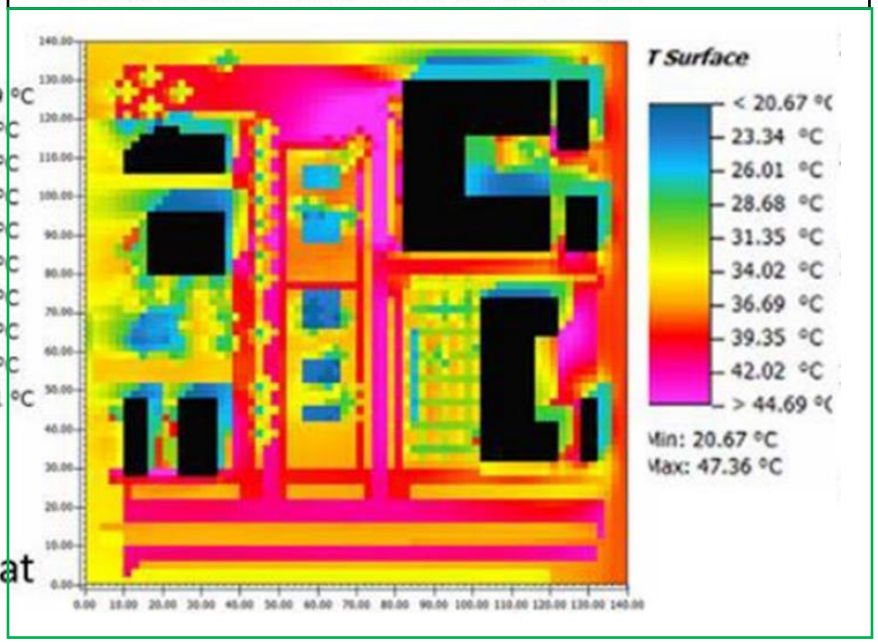
From excess runoff

REF runoff: 67.1 mm

Dev runoff: 90.84 mm

Strat runoff: 42.2 mm





Common strategies

- It is possible to mitigate more than one challenge at a time, by means of a joint consideration of them
- The result is a more resilient built environment in marine or fluvial contexts

Thank you for your attention!

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Design for complexity: multi-scale and multi-objective adaptive strategies and methods for uncertain climatic conditions
IS (10)