# Climate Impact Assessment Training Series

## Webinar 3: Selecting and monitoring climate adaptations for HEIs

Rob Wilby, Geography and Environment, Loughborough University
r.l.wilby@lboro.ac.uk

# Recap of Webinar 2

- Defined **risk** as the product of likelihood and consequence (various units)
- Showed how to visualize as a **risk matrix** for defined receptors (e.g., campus)
- Pointed to various sources of **adaptation checklists** and typologies
- Cautioned about **lock-in** and **mal-adaptation**; called for **low regret** action first



Loughborough University

# Likelihood and consequence (units)

| Likelihood | Climate Risk Matrix (Damages £) | | Consequence | | | | |
|---|---|---|---|---|---|---|---|
| | | | Nuisance costs £100s | Minor costs £1000s | Moderate costs £10,000s | Major costs £100,000s | Disaster costs £1,000,000s |
| | | | 1 | 2 | 3 | 4 | 5 |
| | Almost certain (most years) | 5 | | | | | |
| | Likely (1 in 2 years) | 4 | | | | | |
| | Possible (1 in 5 years) | 3 | | | | | |
| | Unlikely (1 in 10 year) | 2 | | | | | |
| | Rare (1 in 20 years) | 1 | | | | | |

# National Risk Register

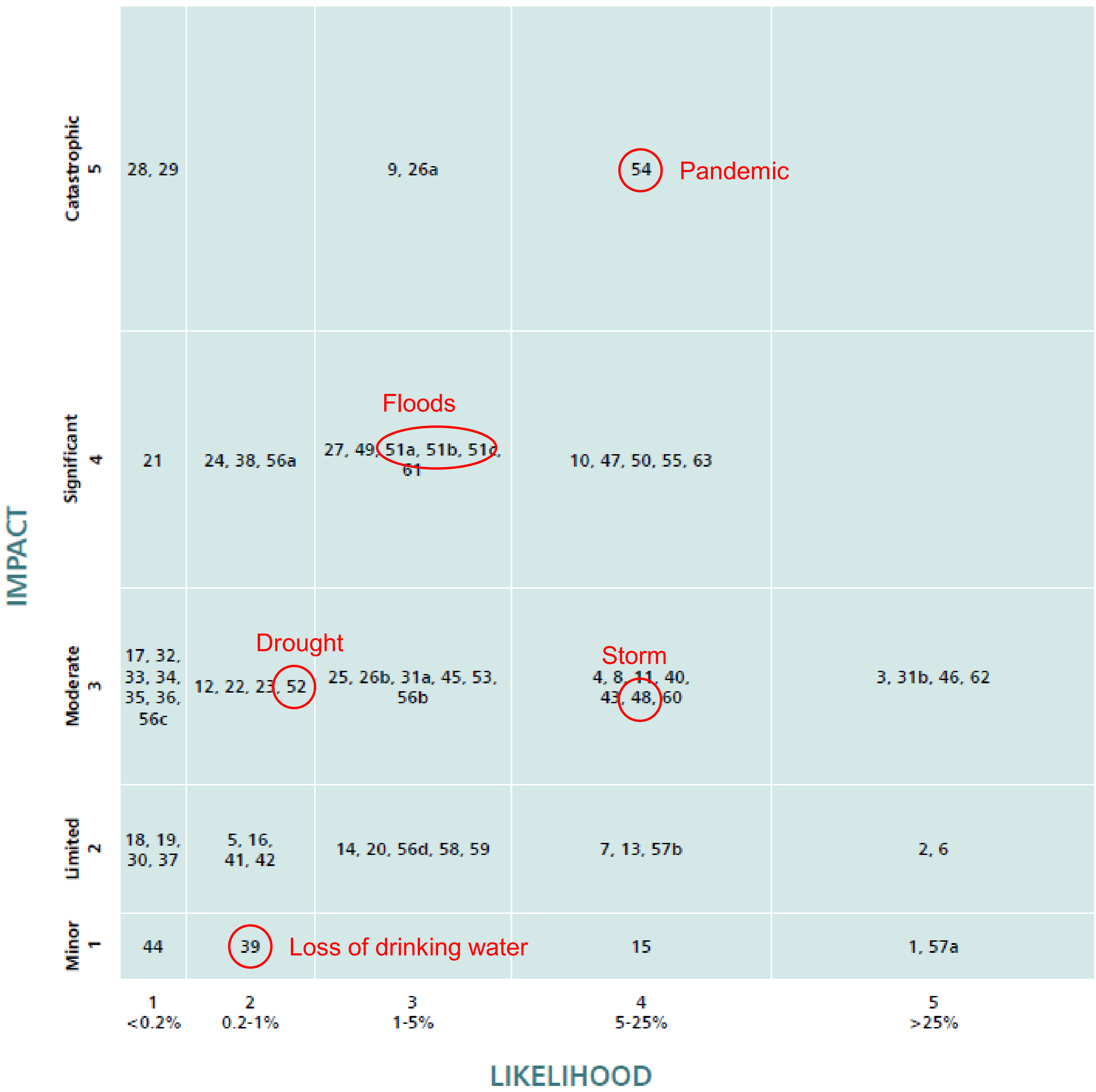
| Score | Percentage chance | PHIA yardstick designation |
|---|---|---|
| 5 | >25% | Almost certain (95-100%)<br>Highly likely (80-90%)<br>Likely or probable (55-75%)<br>Realistic probability (40-50%)<br>Unlikely (25-35%) |
| 4 | 5-25% | Highly unlikely (5-25%) |
| 3 | 1-5% | Remote chance (0-5%) |
| 2 | 0.2-1% | |
| 1 | <0.2% | |

Table 1: Summary detailing the alignment of the final 1-5 likelihood score for NSRA risks, its corresponding percentage chance and the label using the PHIA yardstick.

| | Impact 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Fatalities | 1-8 | 9-40 | 41-200 | 201-1,000 | >1,000 |
| Casualties | 1-18 | 17-80 | 81-400 | 400-2,000 | >2,000 |
| Economic cost | Millions of £ | Tens of millions £ | Hundreds of millions £ | Billions of £ | Tens of Billions £ |

Table 2: Example impact scale indicators for fatalities, casualties and economic cost.


Source: HMG (2023)




### Terrorism, cyber and state threats

1. International terrorist attack
2. Northern Ireland related terrorism
3. Terrorist attacks in venues and public spaces
4. Terrorist attacks on transport
5. Strategic hostage taking
6. Assassination of a high-profile public figure
7. Smaller-scale CBRN attacks
8. Medium-scale CBRN attacks
9. Larger-scale CBRN attacks
10. Conventional attacks on infrastructure
11. Cyber attacks on infrastructure

### Geographic and diplomatic

12. Disruption to global oil trade routes

### Accidents and systems failures

13. Major adult social care provider failure
14. Insolvency of supplier(s) of critical services to the public sector
15. Insolvency affecting fuel supply
16. Rail accident
17. Large passenger vessel accident
18. Major maritime pollution incident
19. Incident (grounding/sinking) of a vessel blocking a major port
20. Accident involving high-consequence dangerous goods
21. Aviation collision
22. Malicious drone incident
23. Disruption of space-based services

# Baseline risks (campus level)

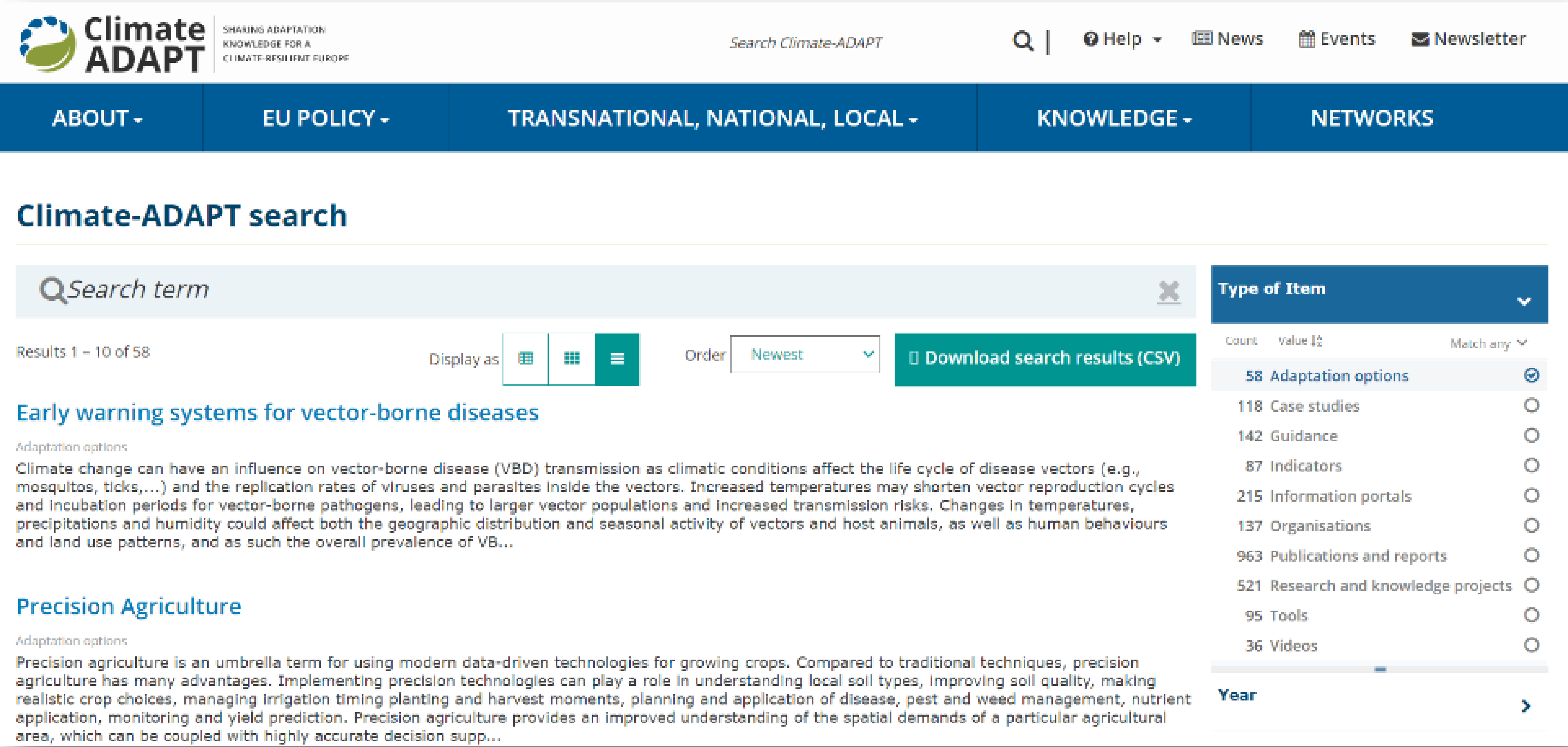
| Climate Risk Matrix (Baseline 2020s) | | Consequence | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Nuisance costs £100s | Minor costs £1000s | Moderate costs £10,000s | Major costs £100,000s | Disaster costs £1,000,000s | Tens £Millions | Hundreds £Millions |
| **Likelihood** | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Almost certain (most years) | 5 | | | | | | | |
| Likely (1 in 2 years) | 4 | | | Heatwave | | | | |
| Possible (1 in 5 years) | 3 | | Drought | | Flood | | | Storm |
| Unlikely (1 in 10 year) | 2 | | | Snow | | | | |
| Rare (1 in 20 years) | 1 | | | | Wind | Surge | | |
| Very rare (1 in 50+ years) | ½ | | | | | Loss of drinking water | | |

# Adaptation checklist (GEF projects)

| Adaptation actions | | Description |
|---|---|---|
| Human and social capital | Capacity building | Developing human resources, institutions, and communities, equipping them with the capability to adapt to climate change |
| | Practice and behaviour | Revisions or expansion of practices and on the ground behaviour that are directly related to building resilience |
| Institutions and governance | Management and planning | Incorporating understanding of climate science, impacts, vulnerability and risk into government and institutional planning and management |
| | Policy | The creation of new policies or revisions of policies or regulations to allow flexibility to adapt to changing climate |
| Communication tools | Information | Systems for communicating climate information to help build resilience towards climate impacts (other than communication for early warning systems) |
| | Monitoring systems | Implementation of new or enhanced tools and technologies for communicating weather and climate risks, and for monitoring changes in the climate system |
| Infrastructure | 'Grey' infrastructure | Any new or improved hard physical infrastructure aimed at providing direct or indirect protection from climate hazards |
| | 'Green' infrastructure | Any new or improved soft, natural infrastructure aimed at providing direct or indirect protection from climate hazards |
| Financing | | New financing or insurance strategies to prepare for future climate disturbances |
| Technology | | Develop or expand climate-resilient technologies |

Based on:
Biagini et al. (2014)

# Options and case studies




Source: [Climate ADAPT]

# Discussion of tasks set in Webinar 2


**A guide to evaluating and managing climate risks to universities**

In the third part of their series, Rob Wilby and Shona Smith explain how universities can determine their climate risk exposure, then identify actions to reduce associated threats to people, property and operations

**Robert Wilby, Shona Smith**
Loughborough University, University of Leeds

1) Read THE Campus article on *[A guide to evaluating and managing climate risks to universities]*

2) Map your climate hazards (baseline and 2050s) onto a blank risk matrix (slide 19):

| Climate Risk Matrix (Damages £) | | | Consequence | | | | |
|---|---|---|---|---|---|---|---|
| | | | Nuisance costs £100s | Minor costs £1000s | Moderate costs £10,000s | Major costs £100,000s | Disaster costs £1,000,000s |
| | | | 1 | 2 | 3 | 4 | 5 |
| Likelihood | Almost certain (most years) | 5 | | | | | |
| Likelihood | Likely (1 in 2 years) | 4 | | | | | |
| Likelihood | Possible (1 in 5 years) | 3 | | | | | |
| Likelihood | Unlikely (1 in 10 year) | 2 | | | | | |
| Likelihood | Rare (1 in 20 years) | 1 | | | | | |

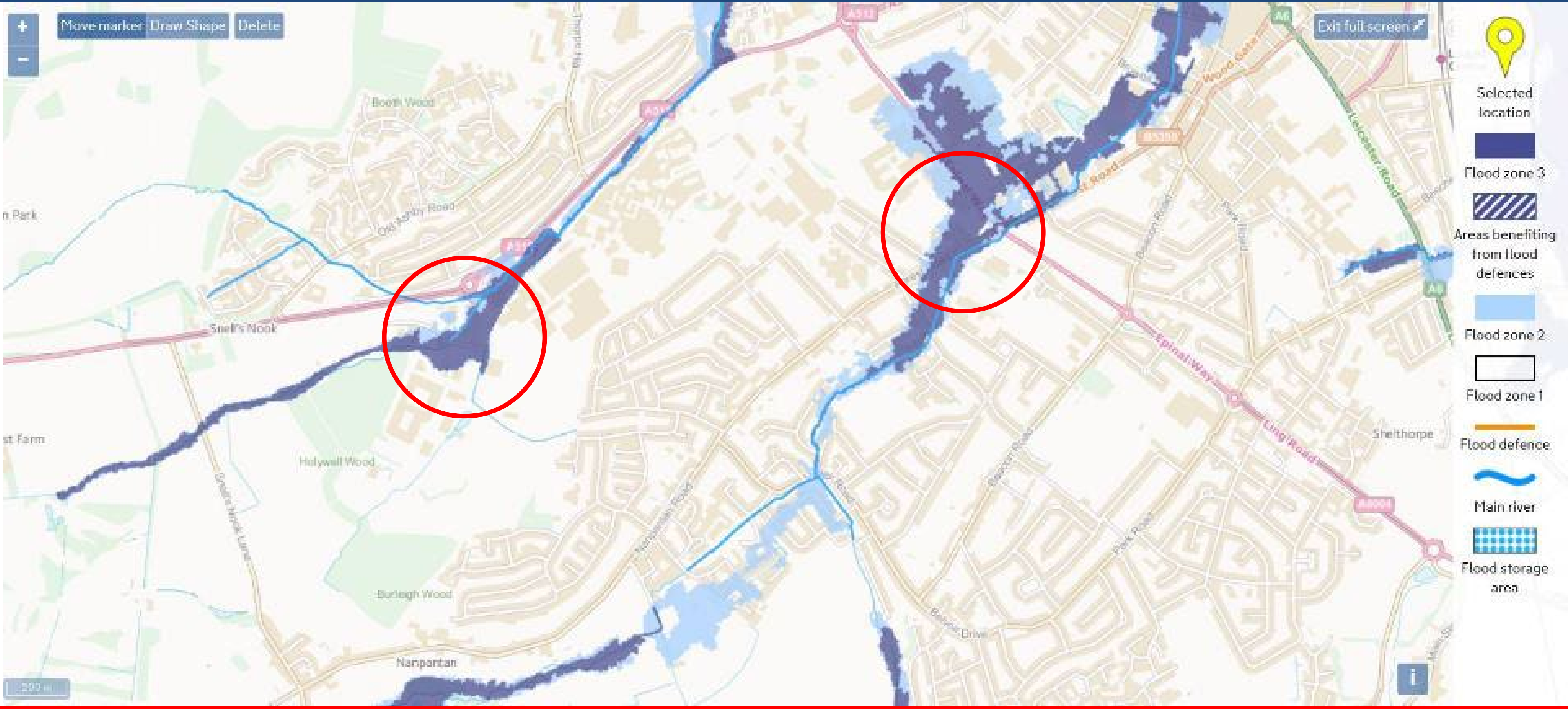
3) Suggest **3 adaptation options** for the most significant climate risk at your HEI

# 2050s risks (campus level)

| Likelihood | Climate Risk Matrix (2050s) | | Consequence: Nuisance costs £100s | Minor costs £1000s | Moderate costs £10,000s | Major costs £100,000s | Disaster costs £1,000,000s |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| | Almost certain (most years) | 5 | | | | | |
| | Likely (1 in 2 years) | 4 | | | Heatwave | | |
| | Possible (1 in 5 years) | 3 | | Drought | | Flood | |
| | Unlikely (1 in 10 year) | 2 | | | Snow | | |
| | Rare (1 in 20 years) | 1 | | | | Wind | |

# Flood risk (present climate)

Flood Zone 3a (land with a 1 in 100 or greater annual probability of river flooding):
+20% to +25% floods for ‘less vulnerable’ uses (e.g., offices, leisure facilities)
+25% to +40% floods for ‘more vulnerable’ (e.g., student halls, educational facilities)




Flood Zone 3b (functional floodplain with annual probability of less than 1 in 20):
only ‘water compatible’ developments permitted
+20% for ‘water compatible’ uses (e.g., amenity, biodiversity, outdoor sports)

# Climate risk analysis (for 2050s Lufbra)

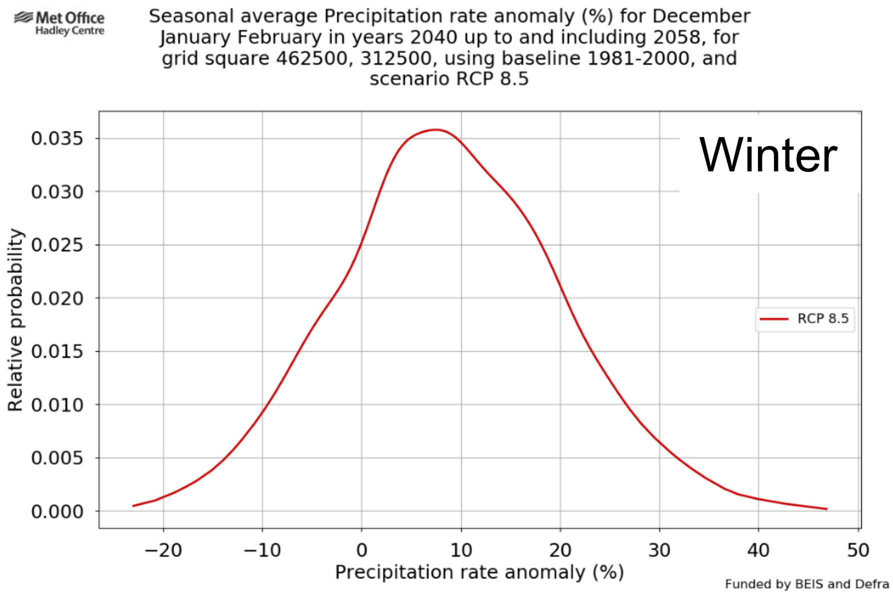
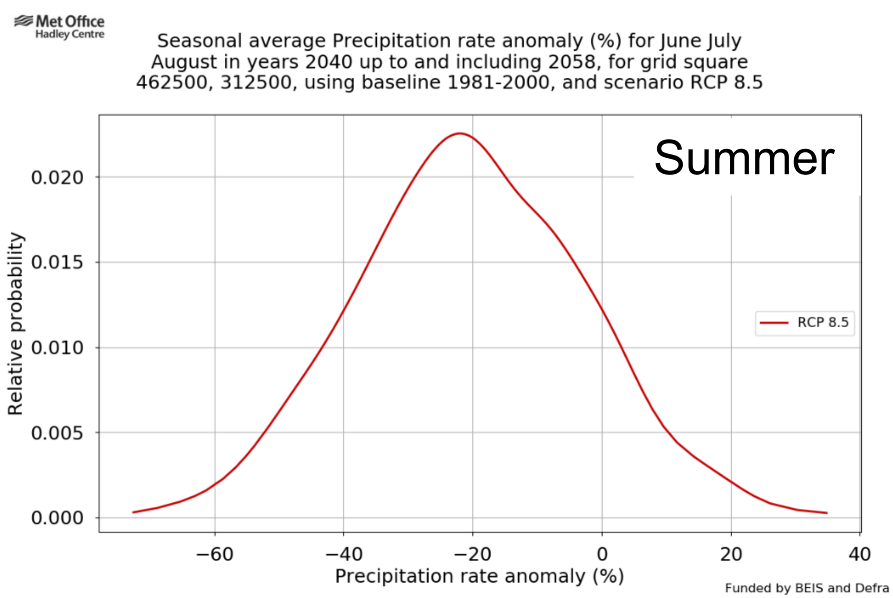
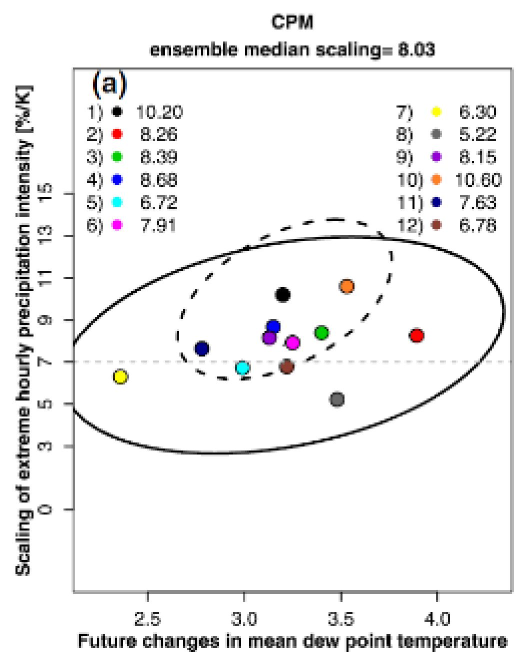



**Table 1: peak river flow allowances by river basin district (based on a 1961 to 1990 baseline)**

| River basin district | Allowance category | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|---|
| Severn | H++ | 25% | 45% | 90% |
| | Upper end | 25% | 40% | 70% |
| | Higher central | 15% | 25% | 35% |
| | Central | 10% | 20% | 25% |



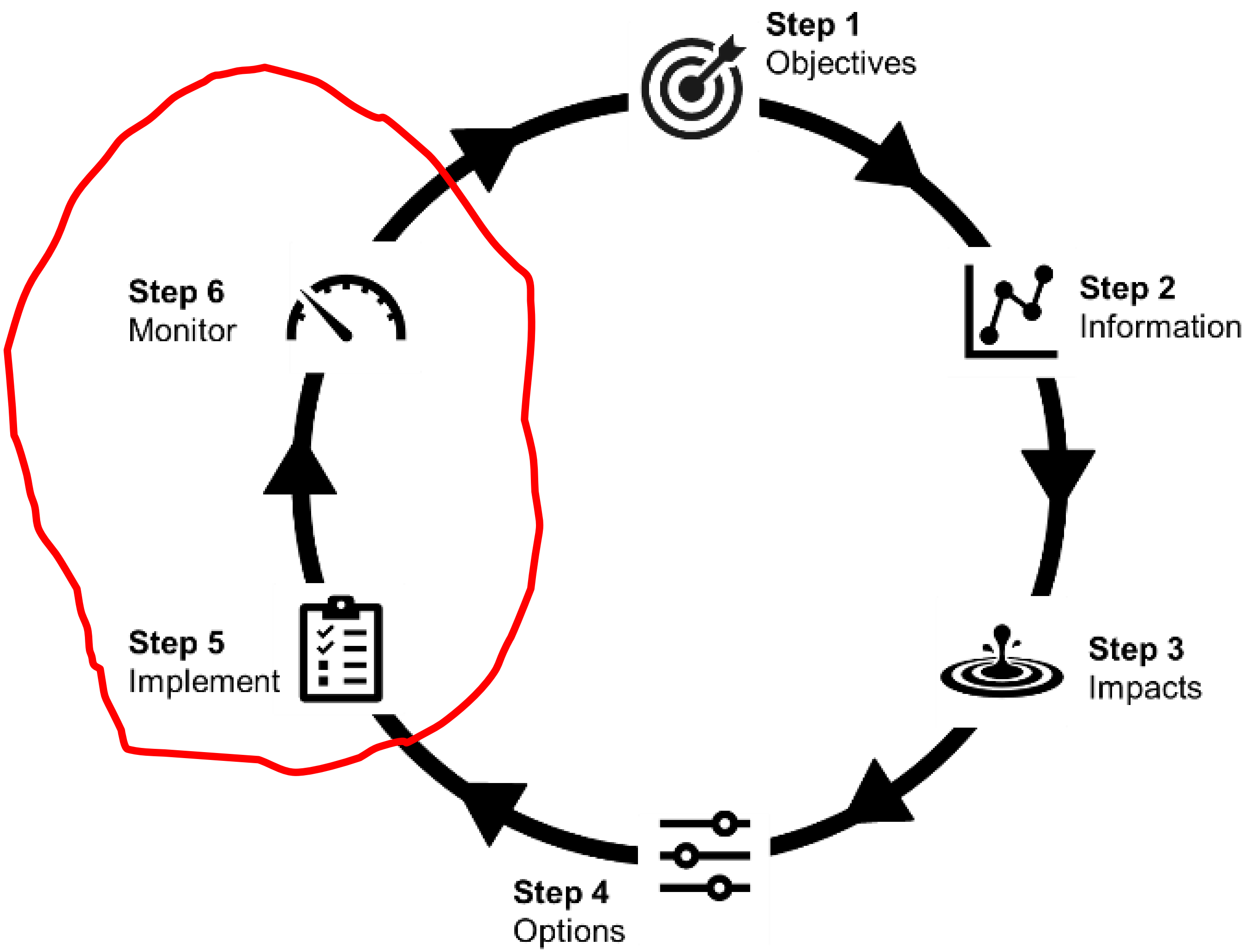

Extreme hourly rainfall in summer is expected to increase by ~8% in the UK for every degree of warming.

Source: Fosser et al. (2020)

# A portfolio of adaptation options (Loughborough campus)


- Maintain and clear local **drainage** networks;
- Avoid further **development** in parts of campus that are already flood prone;
- Use ([Previsico]) **flood warnings** to prepare (e.g., evacuate people, move vehicles, set-up temporary barriers);
- Incorporate **allowances** for climate change in new infrastructure designs;
- Install flood **embankments** and bunds;
- Retrofit **resilience measures** (e.g., raise floor levels, replace floor materials, improve drainage);
- Re-establish /protect **green spaces**;
- Replace impermeable surfaces with green roofs and **permeable** parking.

# Focus of Webinar 2




Source: [UUCN (2023)]

# Part I: Implementing adaptation actions (Step 5)

# What criteria could be used to evaluate these adaptation options?


- Maintain and clear local **drainage** networks;
- Avoid further **development** in parts of campus that are already flood prone;
- Use (Previsico) **flood warnings** to prepare (e.g., evacuate people, move vehicles, set-up temporary barriers);
- Incorporate **allowances** for climate change in new infrastructure designs;
- Install flood **embankments** and bunds;
- Retrofit **resilience measures** (e.g., raise floor levels, replace floor materials, improve drainage);
- Re-establish /protect **green spaces**;
- Replace impermeable surfaces with green roofs and **permeable** parking.

# Weight these options appraisal criteria

1 (low importance) to 10 (high importance)

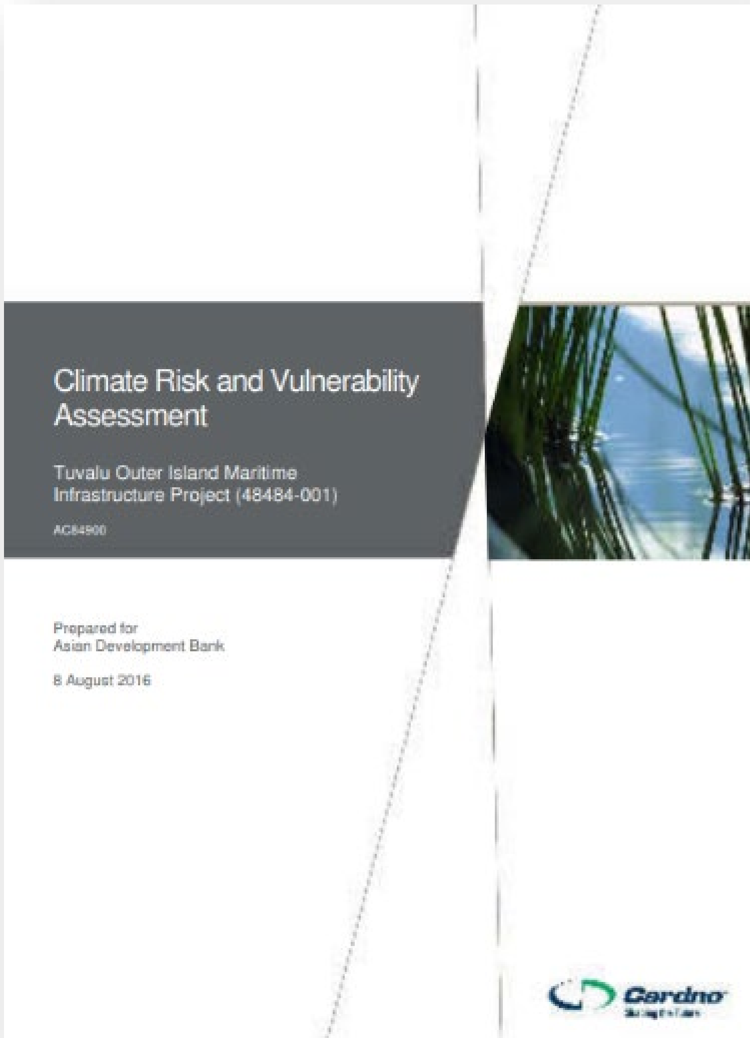
| Criteria | Description |
|---|---|
| Effectiveness | Degree to which the option is effective in minimising the extent of potential climate change impacts |
| Cost effectiveness | Ratio of effectiveness score (above) to the cost estimate |
| Functionality, Accessibility & Safety | Degree to which the option affects the safe operation of the facility or site |
| Adaptability | Ease with which the option may be upgraded in response to realised climate change impacts |
| Complementarity (co-benefits) | Degree to which the option addresses more than one risk |
| Longevity | Degree to which the option has a long, low maintenance life span |
| Ease of Implementation | Extent to which implementation may be hindered by legal, planning, policy or logistical considerations |
| Environment & Social | Extent to which the option has negative environmental or social impacts during construction and/or operation of the risk treatment |

Adapted from the Tuvalu Outer Island Maritime Infrastructure Project (48484-001)

# Which options would you prioritise and why?

| Category | Sub-category | Options |
|---|---|---|
| Human and social capital | Capacity building | • Flood awareness raising, curriculum refresh with hydrological and hydraulic modelling |
| | Practice and behaviour | • Maintenance of drainage systems |
| Institutions and governance | Management and planning | • Prepare an organisational flood resilience plan |
| | Policy | • Avoid development in flood prone areas<br>• Climate change allowances for infrastructure |
| Information and communication tools or technology | Information | • Flood susceptibility maps, catalogue of flood impacts and flood risk indicators |
| | Warning or observing systems | • Flash flood warning system |
| Infrastructure | "Grey" infrastructure | • Flood embankments and bunds<br>• Retrofit resilience measures |
| | "Green" infrastructure | • Re-establish and protect green spaces<br>• Green roofs and permeable car parks |
| Financing | | • Insurance, compensation for relocation, inventory of damages, review insurance |
| Technology | | • Early warning systems, remote sensing water depths, water harvesting systems |

# Weights are context specific (here Tuvalu)




| Criteria | Weight (0 to 1) |
|---|---|
| □ Residual risk/ effectiveness | 1 |
| □ Functionality and safety | 0.8 |
| □ Adaptability | 0.8 |
| □ Complementarity | 0.4 |
| □ Longevity | 0.4 |
| □ Ease of implementation | 0.4 |
| □ Environmental/ social impacts | 0.2 |

Source: ADB (2016)

# Cost-effectiveness analysis

| Criteria | Weight | Option B: Extend the access jetty further landward, above the future sea level. | | Option C: Locate these assets above the future sea level and/or storm surge level. | | Option D: Raise the crest level of the breakwaters. | | Option F: Adopt larger armour units. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Assigned Score | Weighted Score | Assigned Score | Weighted Score | Assigned Score | Weighted Score | Assigned Score | Weighted Score |
| Residual Risk / Effectiveness | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| Functionality, Accessibility & Safety | 0.8 | 3 | 2.4 | 3 | 2.4 | 4 | 3.2 | 4 | 3.2 |
| Adaptability | 0.8 | 4 | 3.2 | 1 | 0.8 | 3 | 2.4 | 1 | 0.8 |
| Complementarity | 0.4 | 2 | 0.8 | 2 | 0.8 | 4 | 1.6 | 2 | 0.8 |
| Longevity | 0.4 | 3 | 1.2 | 4 | 1.6 | 4 | 1.6 | 4 | 1.6 |
| Ease of Implementation | 0.4 | 3 | 1.2 | 2 | 0.8 | 2 | 0.8 | 2 | 0.8 |
| Environment & Social | 0.2 | 3 | 0.6 | 1 | 0.2 | 3 | 0.6 | 3 | 0.6 |
| **Effectiveness Score** | | | **12.4** | | **9.6** | | **13.2** | | **9.8** |
| Cost | | | $94,300 | | $29,390 | | $109,622 | | $109,622 |
| **Cost-Effectiveness Ratio** | | | **0.13** | | **0.33** | | **0.12** | | **0.09** |

Source: ADB (2016)

# Cautionary remark (NBS)

Climate ADAPT | SHARING ADAPTATION KNOWLEDGE FOR A CLIMATE-RESILIENT EUROPE

Search Climate-ADAPT | English | Help | News | Events | Newsletter

ABOUT | EU POLICY | TRANSNATIONAL, NATIONAL, LOCAL | KNOWLEDGE | NETWORKS

Home › Database › Adaptation options › **Urban green infrastructure planning and nature-based solutions**

**Adaptation option**

## Urban green infrastructure planning and nature-based solutions

Urban Green Infrastructure planning (UGI) is a strategic approach to develop interconnected and multifunctional networks of blue and green spaces that potentially provide a wide range of environmental, social and economic benefits and simultaneously enhance the climate resilience of cities. The European Commission emphasizes strategic green space planning at different spatial scales (from neighbourhood to city-wide) and encourages cities to promote delivery of ecosystem services and protection of biodiversity. Urban green infrastructure includes different types of blue-green spaces such as forests, wetlands, agricultural land, public parks, private gardens, single green elements (street trees, green roofs, etc.) or ponds and streams. These play a crucial role in enhancing climate adaptation and mitigation capacities, and reducing negative impacts of climate change hazards such as heatwaves, flooding and drought in cities.

The EU biodiversity Strategy for 2030 states concrete actions for the promotion of nature-based solutions that should be systematically integrated into urban planning. The European Union defines nature-based solutions (NbS or NBS) as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience". IUCN calls for adopting a holistic ecosystem-based approach when implementing NbS and states: "solutions based on nature use the power of functioning ecosystems as infrastructure to provide natural services to benefit

**Date of creation:**
2023

**Keywords:**
Ecosystems, Green space, Land-use planning, multifunctionality, sustainable cities

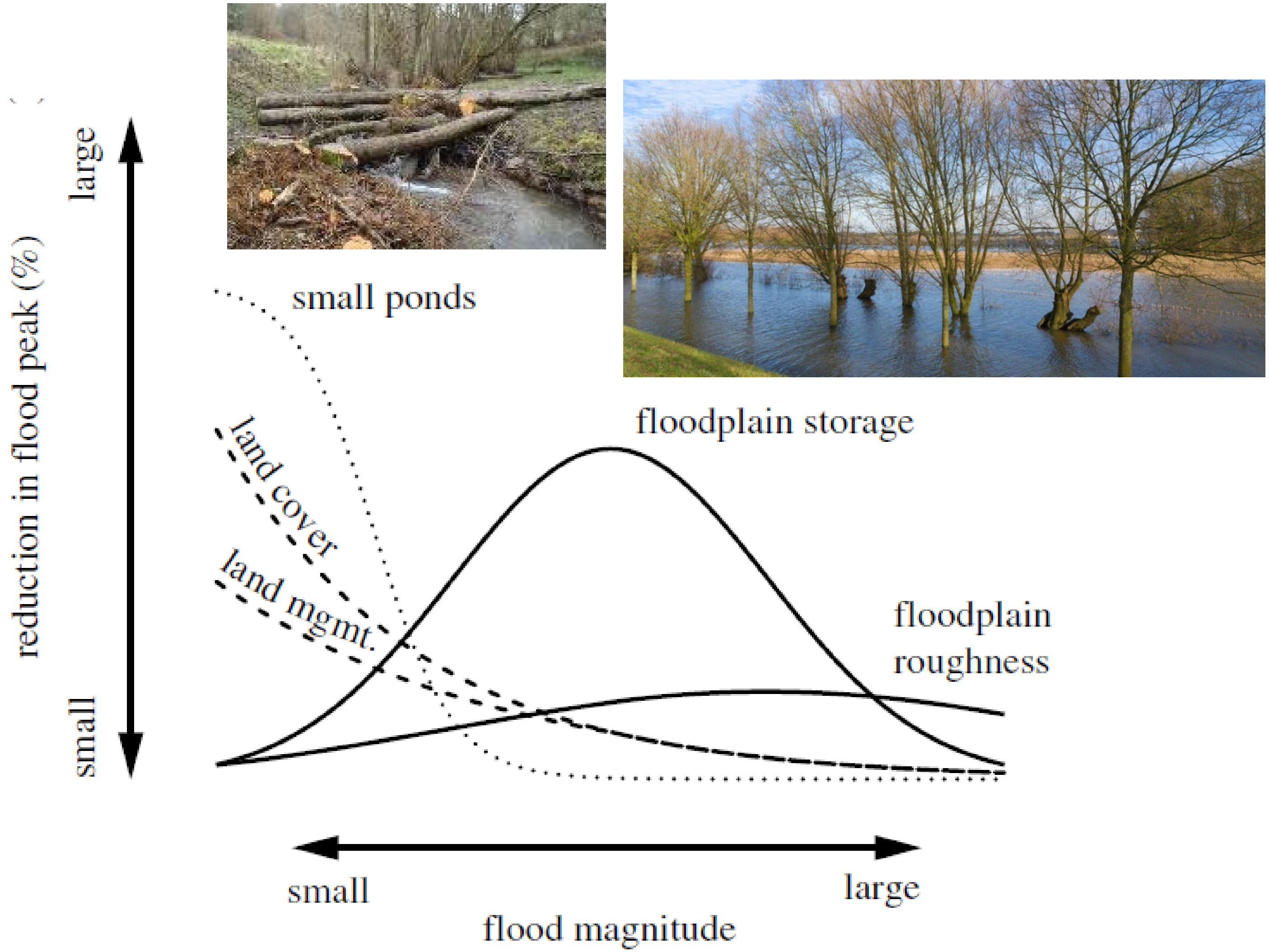
**Adaptation elements:**
Nature-based solutions

**Key Type Measures:**
D1: Nature based Solutions and Ecosystem based approaches: Green options

**IPCC adaptation options categories:**
Structural and physical: Ecosystem-based adaptation options

Source: Climate ADAPT


Cornish Seal Sanctuary, Gweek, Cornwall March 2023



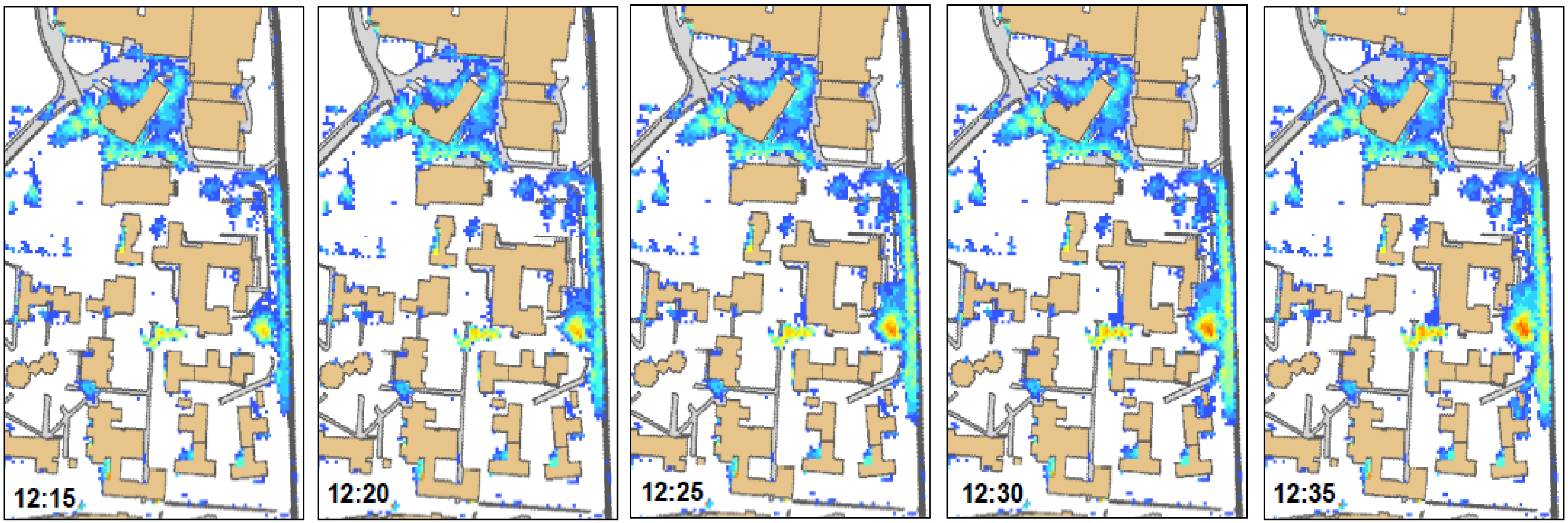

Effect of different types of NFM intervention on flood peak reduction.
Source: Dadson et al. (2017)

# Pause for reflection

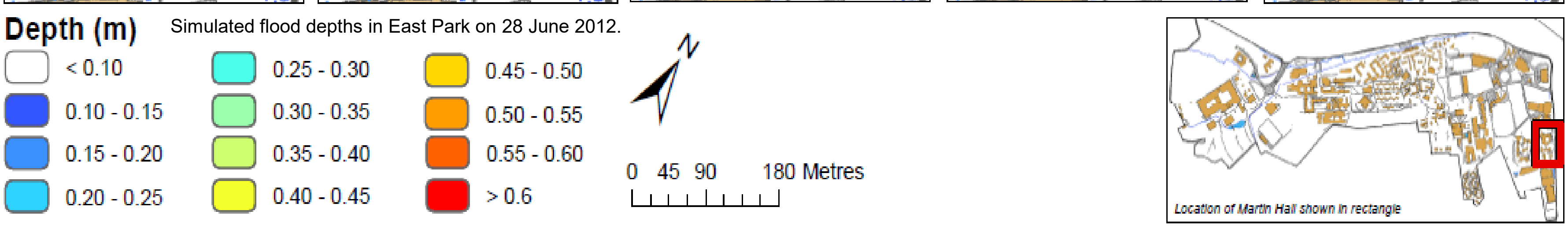
What are the key criteria for evaluating adaptation actions at my HEI?

What adaptation actions could be prioritised at my HEI?

What adaptation actions require a more strategic approach?




Simulated flood depths in East Park on 28 June 2012.

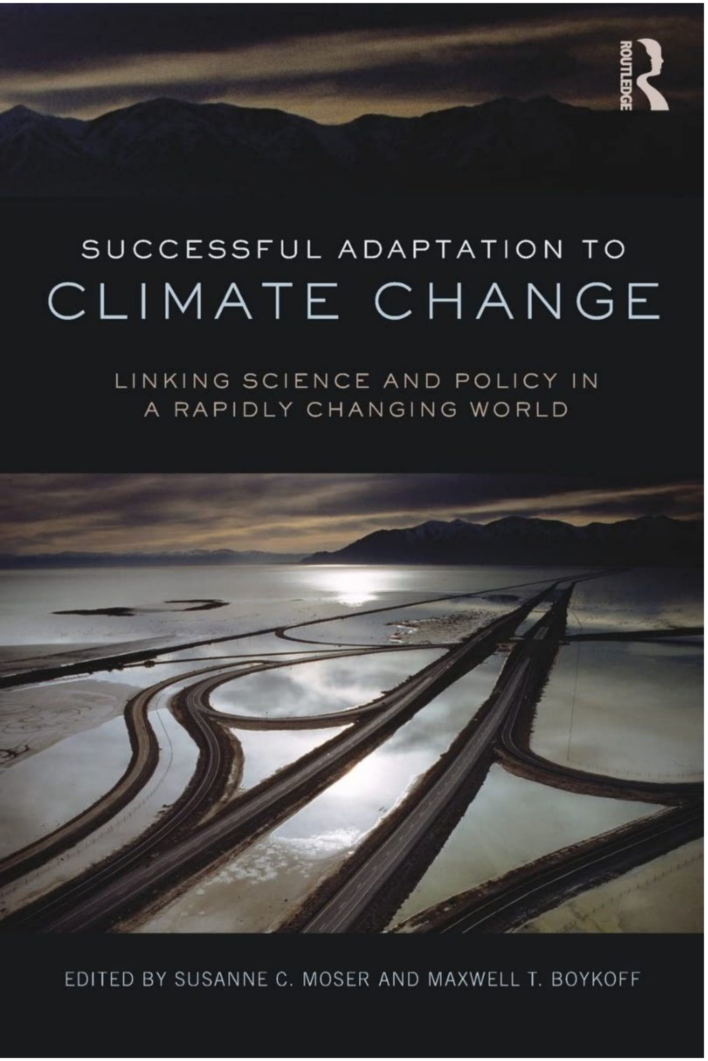



Source: Green, D. 2018. Understanding urban rainfall-runoff responses using physical and numerical modelling approaches. [Unpublished PhD Thesis], Loughborough University.

# Part II: Monitoring progress (Step 6)


Source: Sanders (2023)

# Measuring adaptation benefits is not easy




Published 2013

**Practical challenges in measuring progress:**

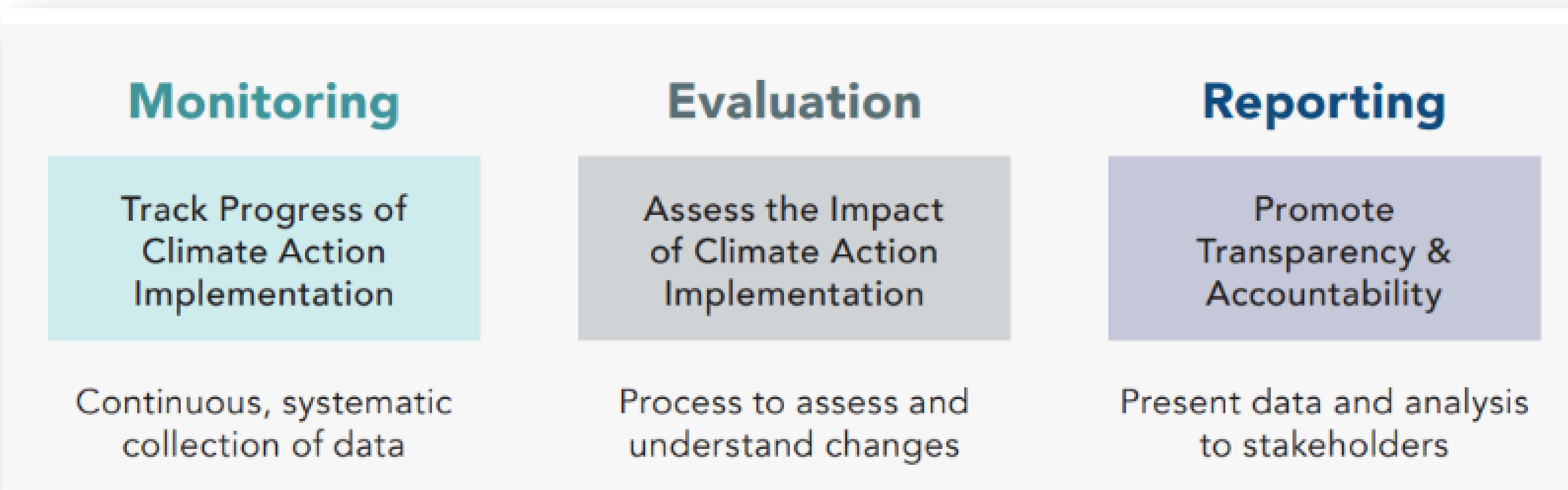
- Establishing a baseline
- No single metric
- Long-term horizons
- Uncertainty and complexity
- Context specific
- Identifying beneficiaries
- Attributing cause(s) of benefits

**Operational challenges:**

- Multiple reporting requirements and frameworks
- Financing and sustaining MER (long enough for behaviour change)
- Coordinating data collection across agencies
- Accounting for maladaptation

# Monitoring, evaluation and reporting (MER)

*Developing and implementing a climate action plan is not a 'one-off' exercise. It requires continuous monitoring, evaluation and reporting (MER) of progress and periodic updates. MER will allow for actions to be tracked, assessed and reported in an organised manner to promote KLCH's accountability in the implementation of its climate actions.*
Source: KLCAP2050

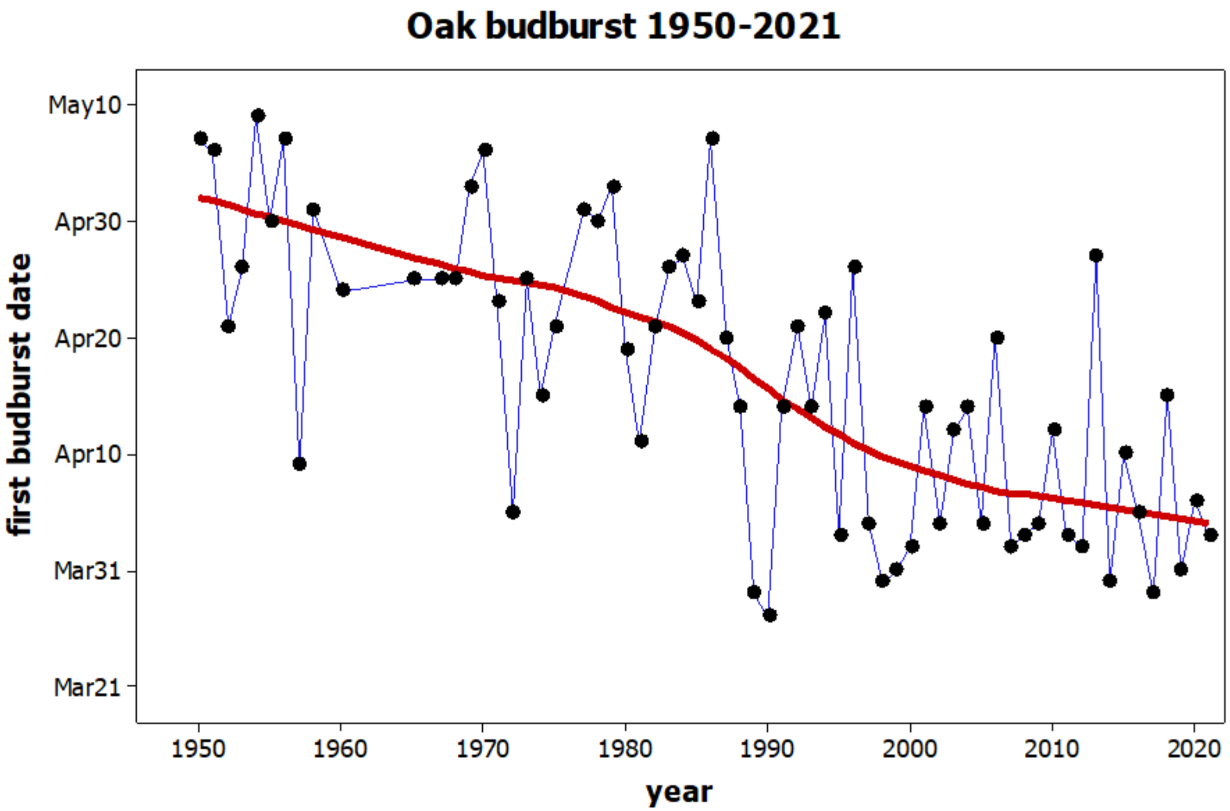



## Prime monitoring indicators (Kuala Lumpa)

- Volume of water retention capacity created ($m^3$) (public and private space)
- Area of vegetated green cover created ($m^2$) (public and private space)
- Number of Low Impact Development (LID) measures installed
- Temperature difference (°C) between LID and Non-LID areas
- % of target neighbourhoods committed to landscaping
- Temperature difference (°C) between paved and de-paved spaces
- Temperature difference (°C) between vegetated and non-vegetated areas
- % of population within walking distance of a green spaces

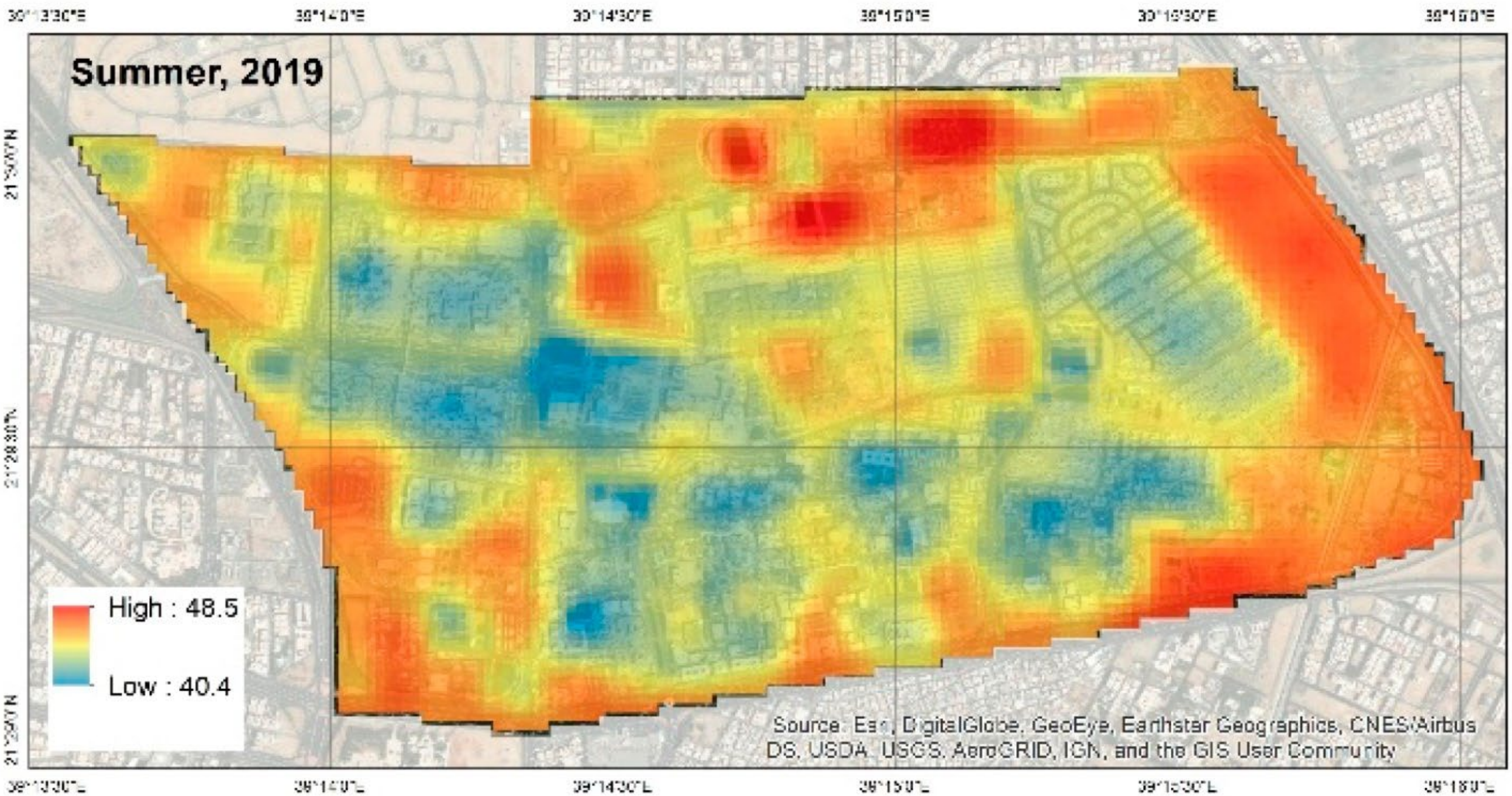
Source: KLCAP2050

# Monitoring as an opportunity to engage



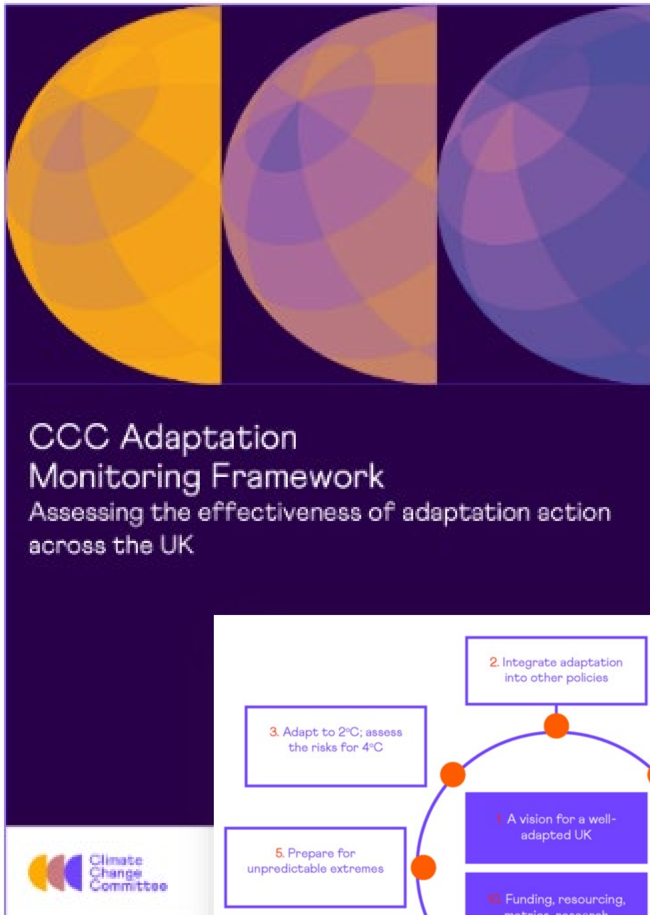

Recording oak leaf budburst (when the scales burst to reveal the colour of the new green leaves) as an **indicator of climate change**. Source: [Judith Garforth]

# Monitoring as an opportunity to engage (2)




Landsat 8 estimated land surface temperature (°C) over King Abdulaziz University, Jeddah, Saudi Arabia campus during summer. Source: Addas et al. (2020)

# Pause for reflection





Source: [Climate Change Committee]

Who is responsible for monitoring, evaluation and reporting (MER) adaptation benefits at my HEI?

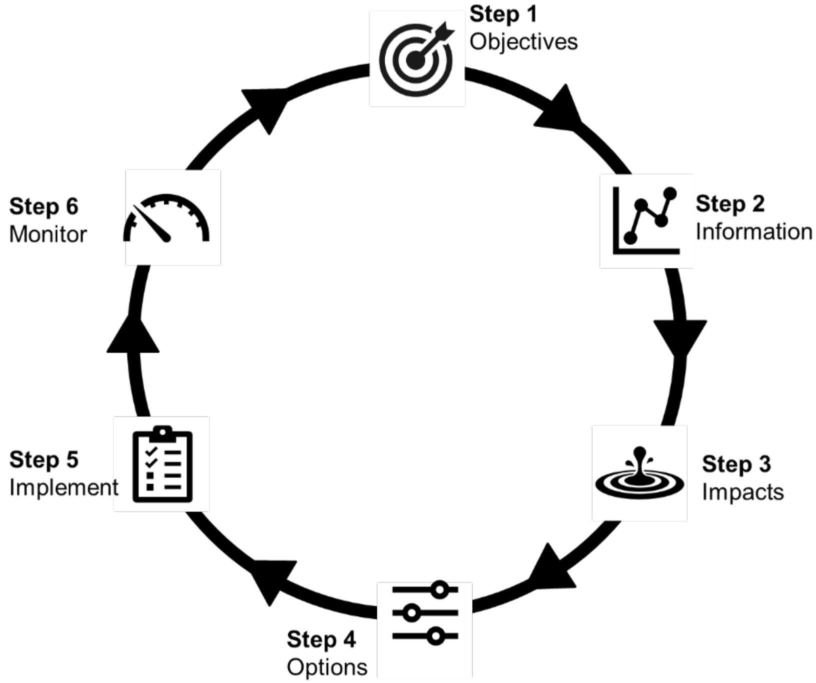
What are the target audiences and holders of responsibility for these adaptation reports?

What are the most helpful/ impactful indicators of adaptation benefits?

Who might be involved in monitoring?

How open/ publicly available should adaptation data and indicators be?

What should be the reporting frequency for adaptation benefits?

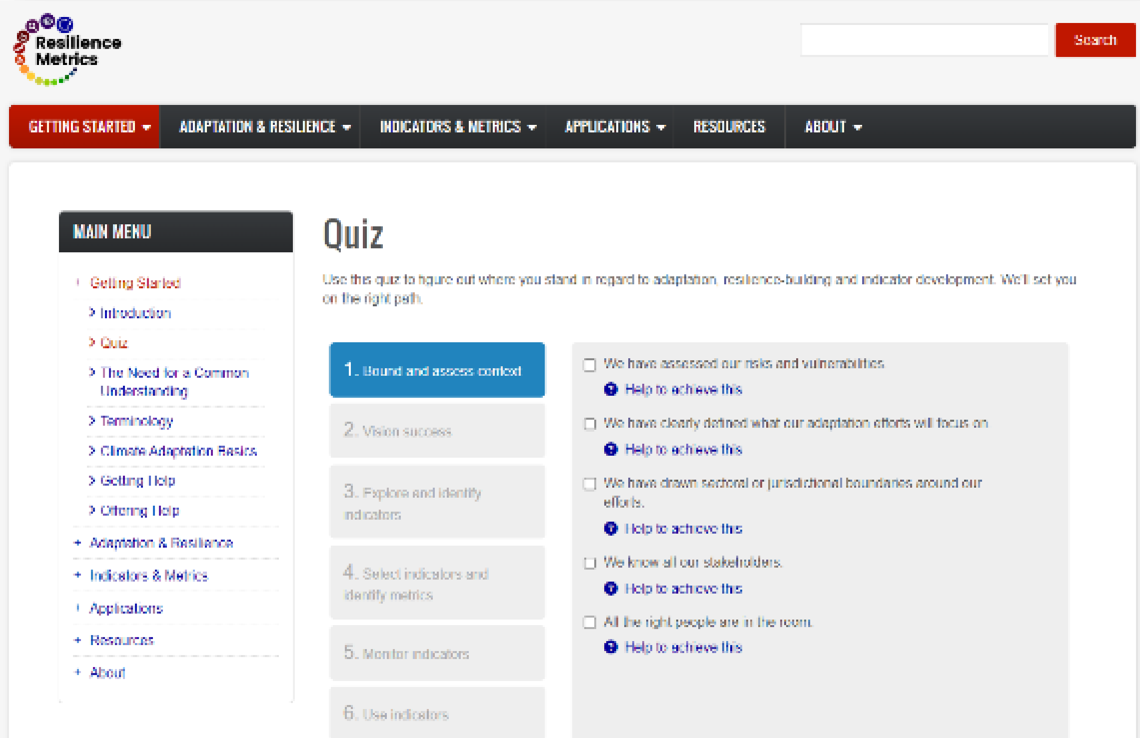



# Final remarks

- **Frameworks** guide the RNZ process and help to organise climate risk and adaptation workflows
- **Technical awareness** could improve ToRs and deliverables supplied by consultants/ partners
- **Sharing insights** and good practices on RNZ benefits the HEI sector as a whole – join the COP ☺

# Further resources


Source: THE Campus




Source: Resilience Metrics

# Next steps?


*Webinar 3: Selecting and monitoring climate adaptations for HEIs*
EAUC, in partnership with the UK University Climate Network, AUDE and BUFDG, 26 September 2023

Loughborough University