



HR Wallingford
Working with water

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Supporting Climate Change Adaptation

Use of Onshore Pipeline Data

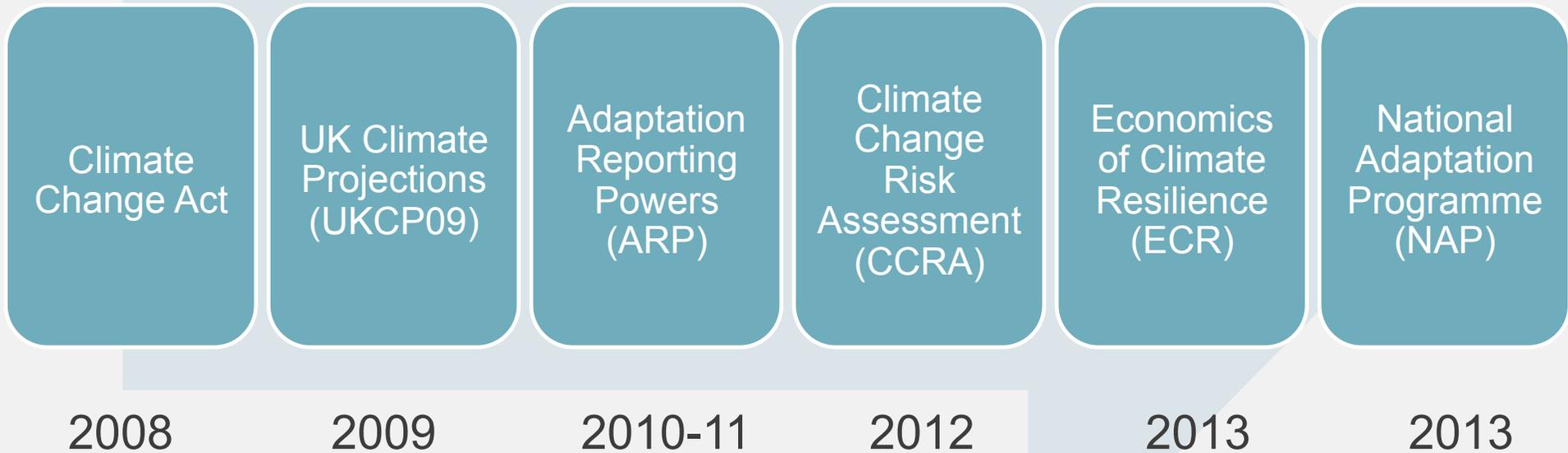
12 February 2014

Helen Udale-Clarke

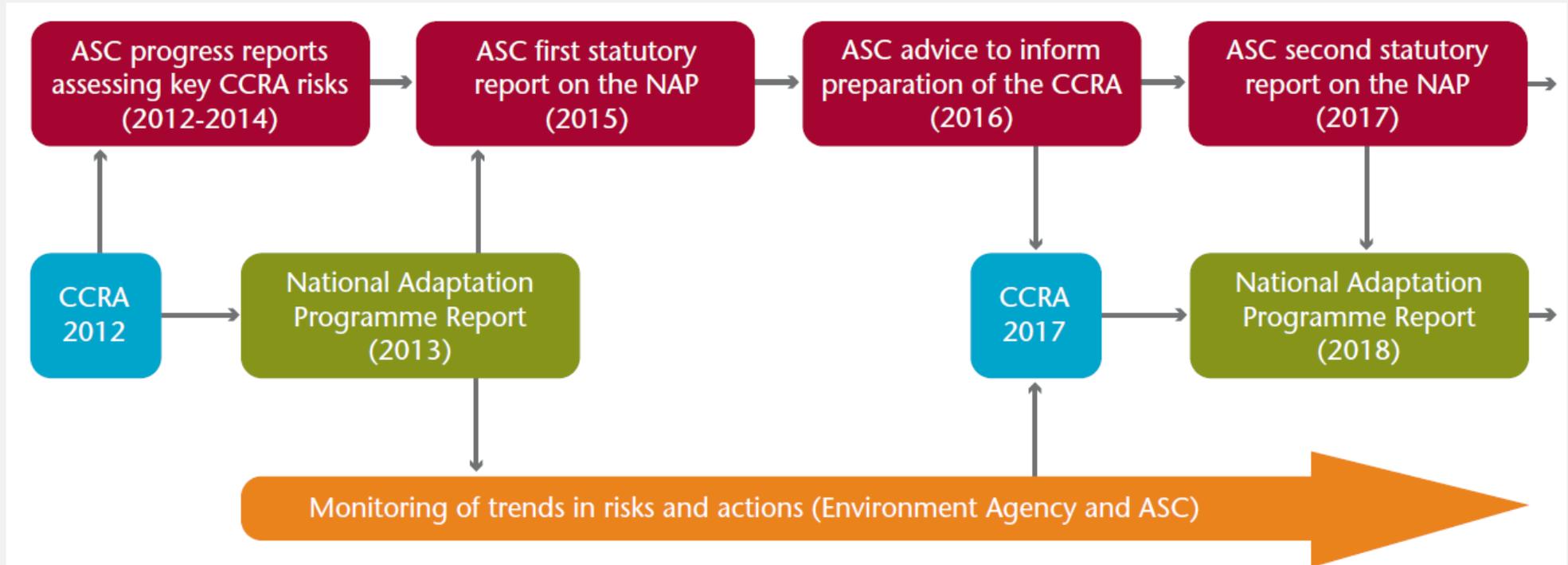
Independent international research and consultancy organisation in civil engineering and environmental hydraulics...



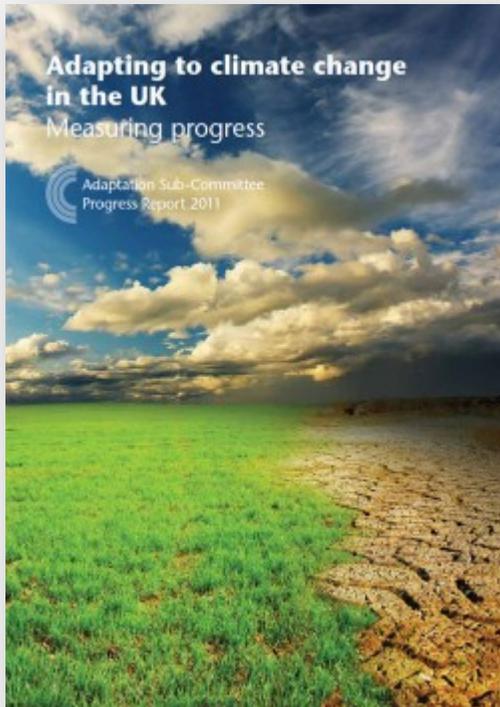
National Adaptation Programme



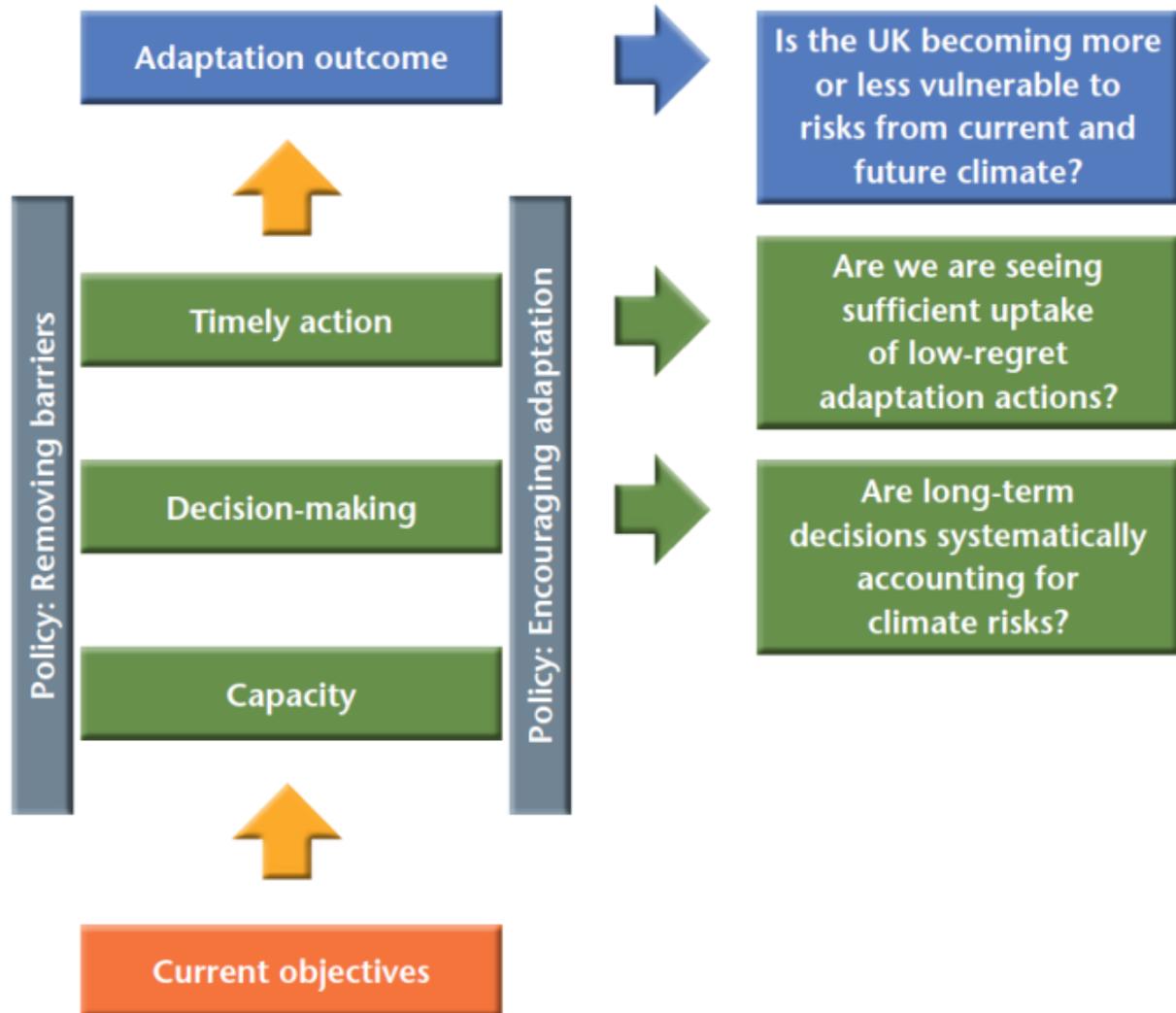
Adaptation Sub-Committee



ASC's adaptation ladder



Source: ASC, 2011



Assessing progress of adaptation to climate change in the UK

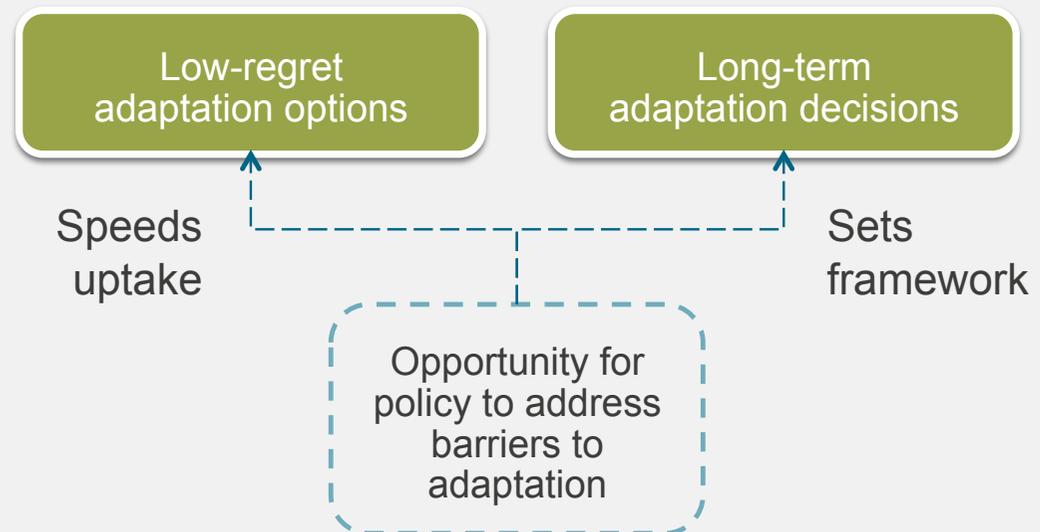
- 2011: Progress report
- 2012: Flooding and water scarcity
- 2013: Natural resources, agriculture and forestry
- 2014: Infrastructure, health and emergency planning, business supply chains
- 2015: Statutory evaluation of NAP



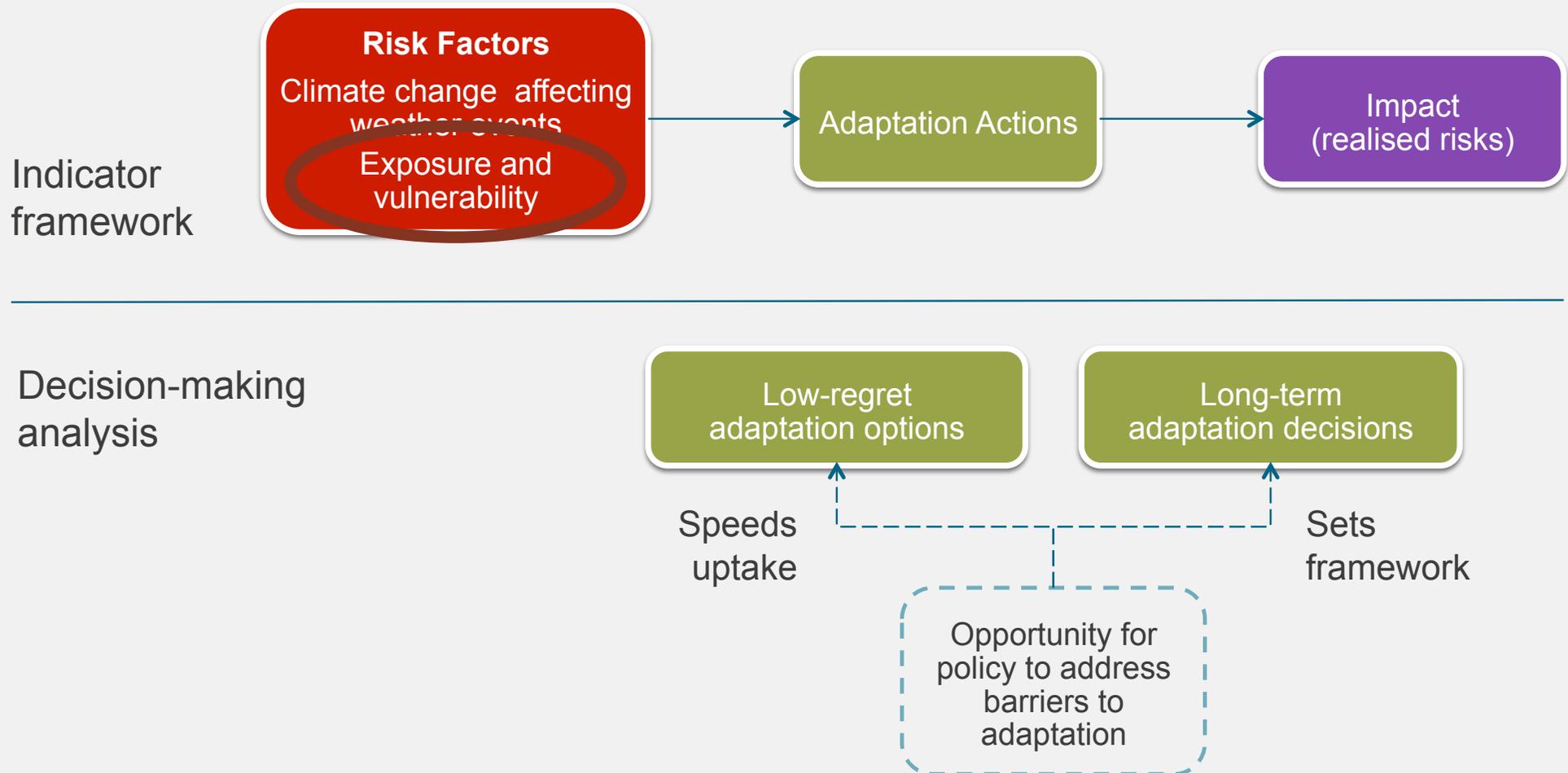
Indicator framework



Decision-making analysis



Identifying and analysing spatial indicators



Exposure = Asset is located at a **hazard**

Vulnerability = Function of

- (a) **criticality** of asset and
- (b) **risk management** being implemented

Criticality is based on size of asset not “critical infrastructure”.

Hazards considered



- River and coastal flooding
- Surface water flooding
- Groundwater flooding
- Coastal erosion
- Shrink-swell subsidence
- Natural Landslides
- River bridge scour
- Extreme heat
- Extreme wind
- Extreme waves

Sectors and assets with suitable data

Education

- Schools

Energy

- Electricity sub-stations
- Power stations
- Electricity pylons
- Onshore turbines
- Underground electricity transmission cable
- **Underground gas pipes**

Health

- Care homes
- Emergency Services
- GP surgeries
- Hospitals

ICT

- Data centres
- Mobile telecommunications masts

Transport

- Railway line
- Railway stations
- Road
- Rail/Road bridges

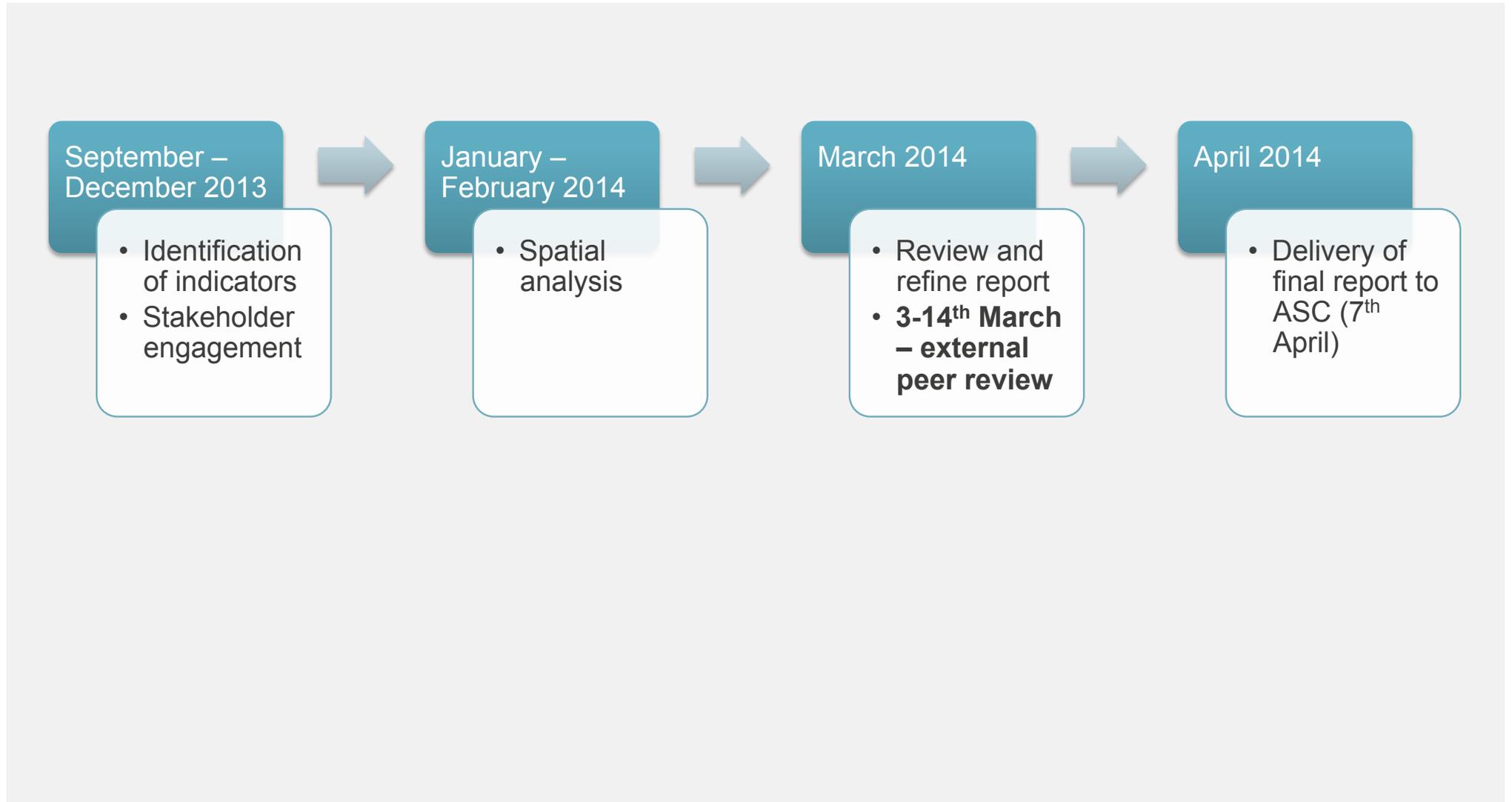
Water

- Clean water treatment sites
- Wastewater treatment sites

Data provided by the Health and Safety Laboratory with the permission of:

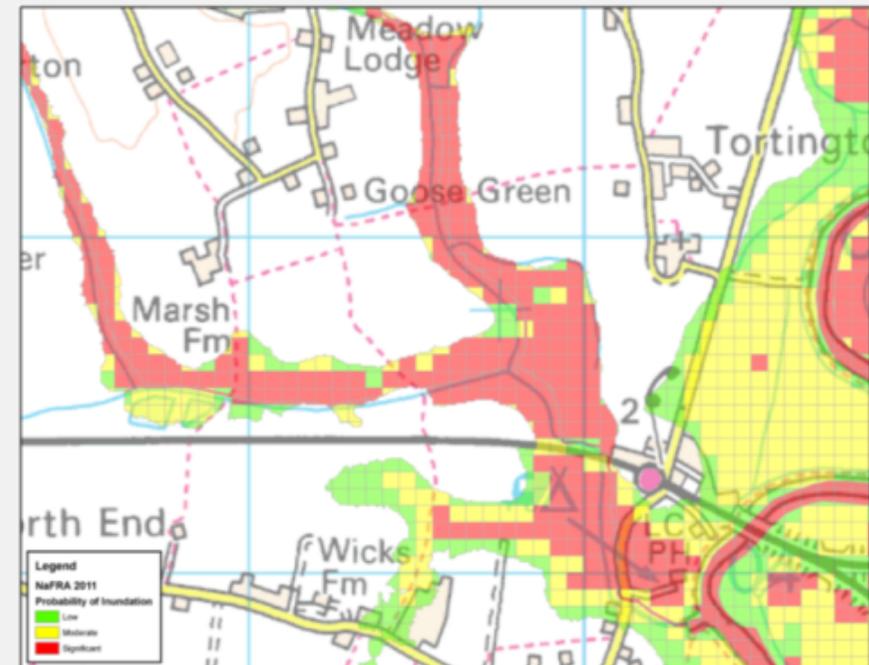
- Neil Jackson, National Grid Distribution
- Grant Rogers, Wales and West Utilities
- Barry Mackay, Scotia Gas Networks/Southern Gas Networks
- Barry Dalus, Northern Gas Networks

ENGLAND ONLY



Technical method developed by HR Wallingford

- England-wide interpretation of spatial datasets using GIS spatial analysis techniques
- Integrated all datasets with a 100m vector grid and used an SQL database to perform queries

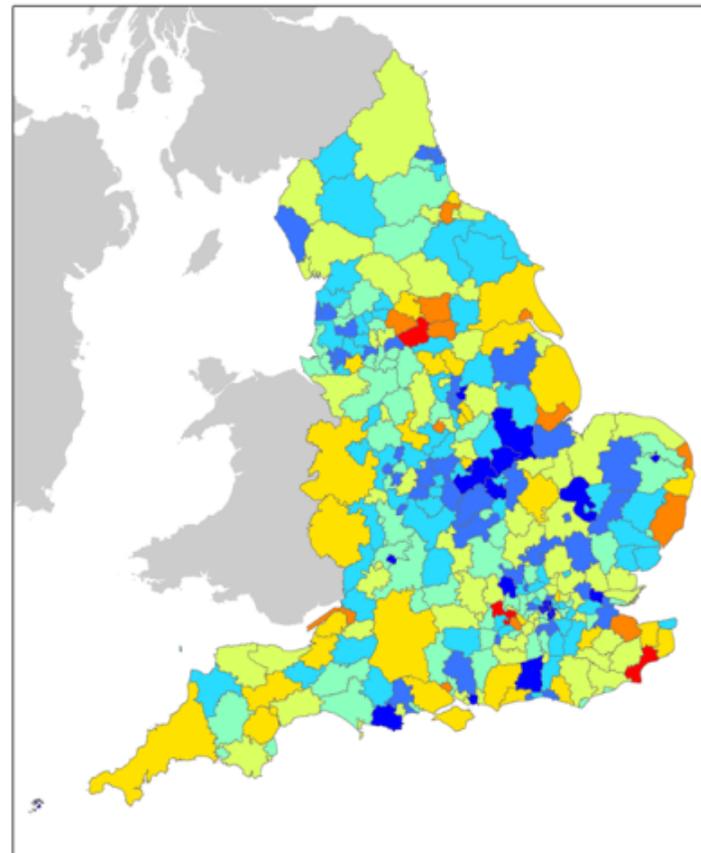


Floods indicators: example results

Main messages (information from 2001-2011)

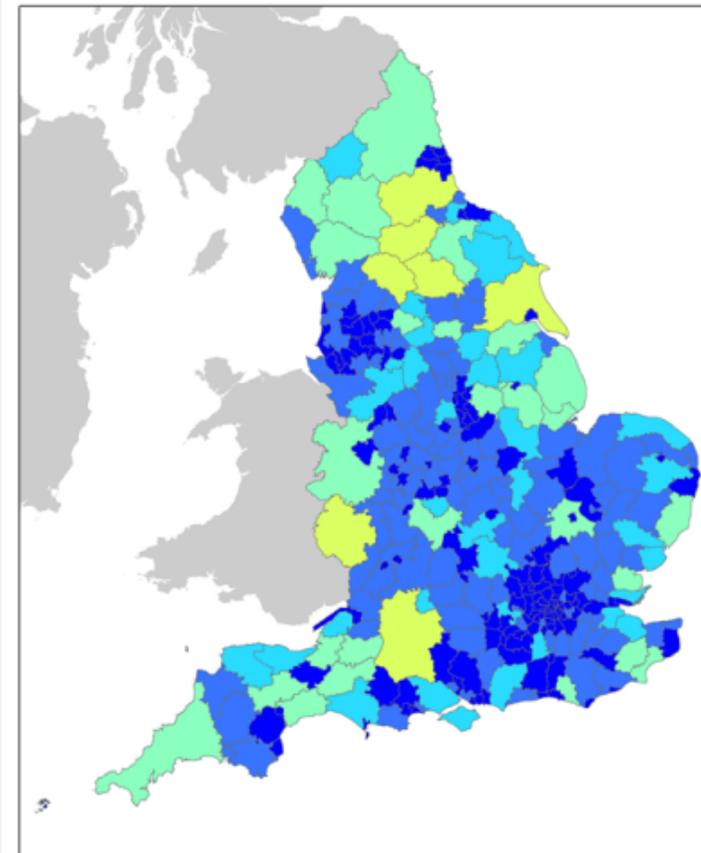
- Development in the floodplain grew at a faster rate than elsewhere in England
- 1 in 5 properties built in the floodplain are in areas of significant flood risk
- The number of properties on erodible coastlines increased by about 11%.
- The area of impermeable surfaces within urban areas has increased
- <3% electricity facilities, 7% water facilities and 10% sewerage facilities are located in areas of significant flood risk*.

Floods indicators: example results Electricity and sewerage facilities at significant flood risk



Number of Electricity facilities in areas at greater likelihood than 1 in 75 year risk. 2011

Number of Facilities	
0	11 - 25
1 - 2	26 - 50
3 - 5	51 - 100
6 - 10	> 100

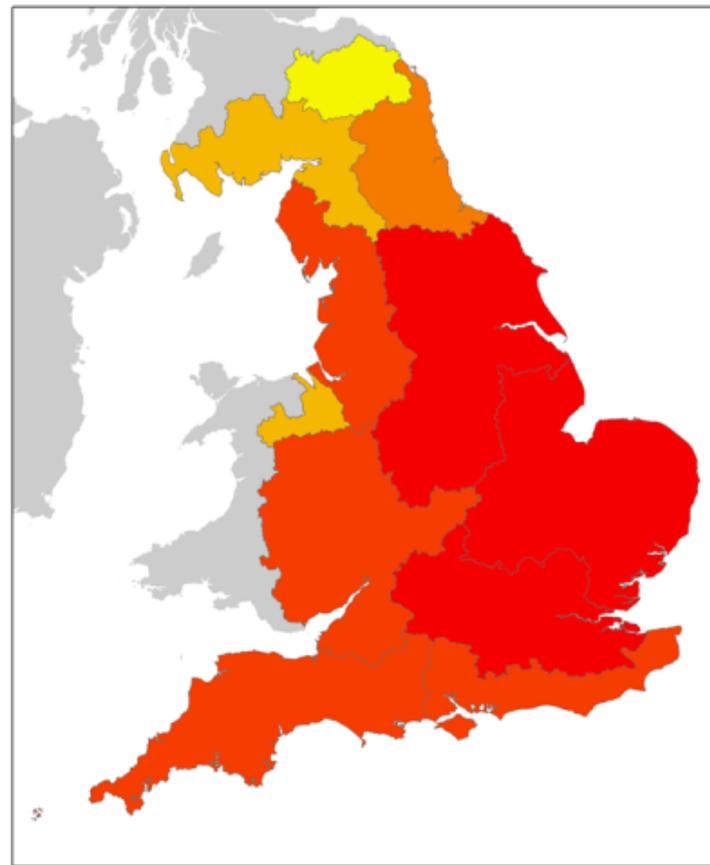


Number of Sewerage facilities in areas at greater likelihood than 1 in 75 year risk. 2011

Number of Facilities	
0	11 - 25
1 - 2	26 - 50
3 - 5	51 - 100
6 - 10	> 100

Water scarcity indicators: example results

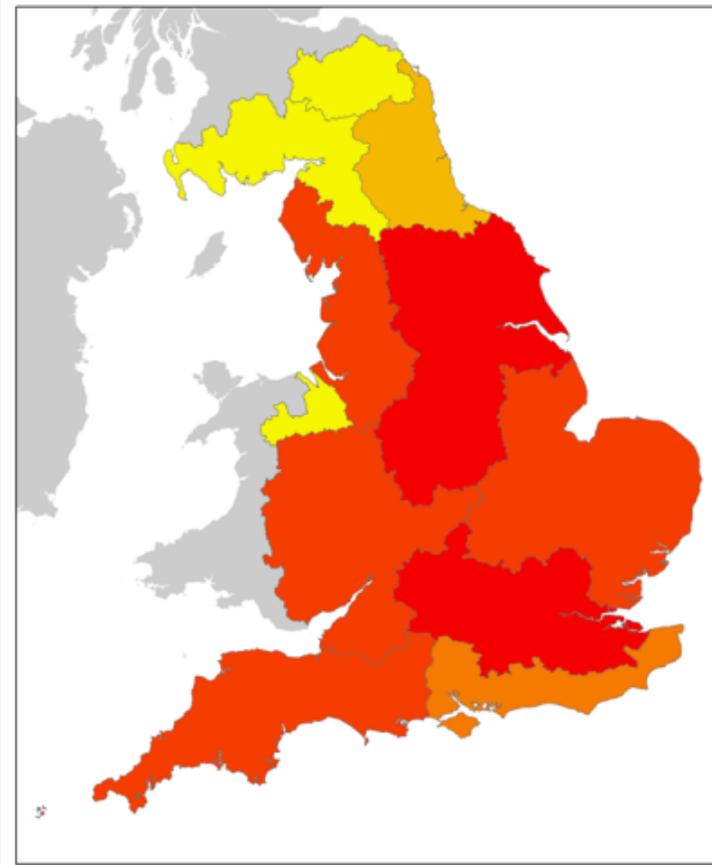
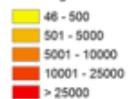
Development within areas of water scarcity



Annual Change in Number of Residential Properties Within Areas of Water Scarcity

2001 - 2008

Annual change 2001 to 2008



Annual Change in Number of Residential Properties Within Areas of Water Scarcity

2008 - 2011

Annual change 2008 to 2011



Any questions?

Additional slides

Scour risk assessment

- Pipelines: transport infrastructures with many stream crossings (buried or aerial)
- Streams: subject to lateral and vertical movements



Probabilistic based approach

Work developed under our internal research and consultancy projects and under FUTURENET, an ARCC project to address vulnerabilities in transport infrastructure



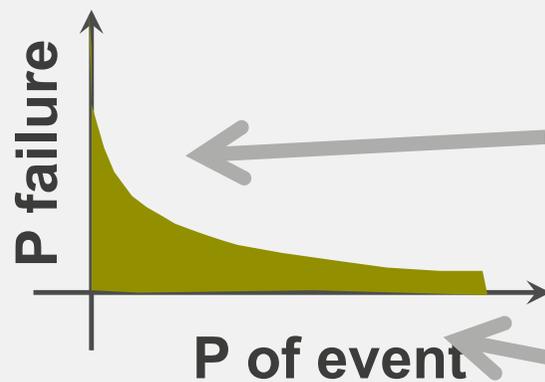
Probabilistic based approach

$$\text{Risk} = \text{Probability} \times \text{Consequences}$$

Mobility of the
river

Susceptibility of
the structure

Disruption & delay time,
replacement, repair,
environmental costs,...



2) We obtain a probability of pipeline exposure (or failure)

1) Given an event with a probability

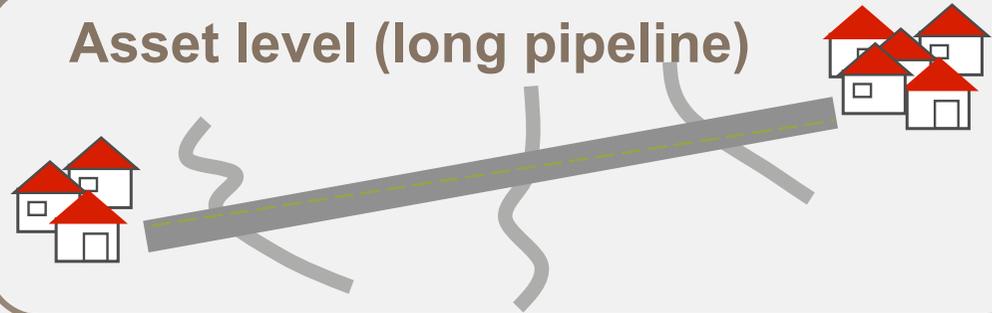
River crossing level



Identify possible failure mechanisms
(to design remediation works)

Estimate overall risk of pipeline
Identify problematic crossings

Asset level (long pipeline)



■ Tiered approach

Screening Phase



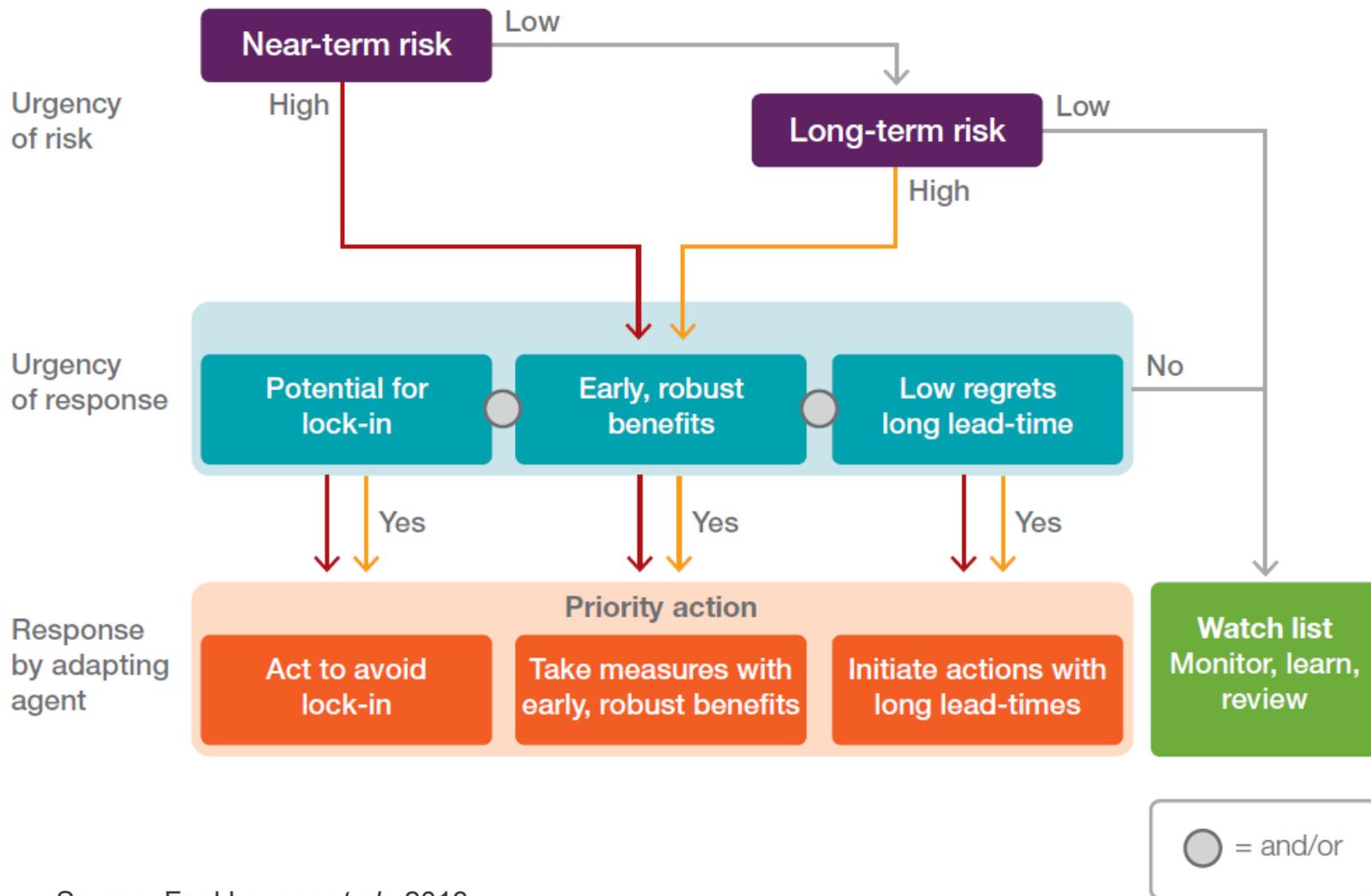
Full Quantitative Risk Assessment



Detailed Studies and Design of
Countermeasures



Prioritising adaptation action



Source: Fankhauser *et al.*, 2013