

Delivering and evaluating multiple benefits in Blue-Green Cities

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24th November 2016
Blue-Green Infrastructure Conference, Belfast

bluegreencities.ac.uk

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 blue
green
CITIES

UK Flood Risk

Flooding is the UK's most serious natural hazard

Over 5 million properties (1 in 6) and large proportions of the UK's key infrastructure are at risk

Floods are expensive: the summer floods in 2007 cost the economy £3.2 billion (2014 floods >£1 bn)

May get worse with climate change (predicted wetter winters, more intense rainfall)

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UK flooding: Flood warnings remain as squally weather predicted

22nd November 2016 [Share](#)

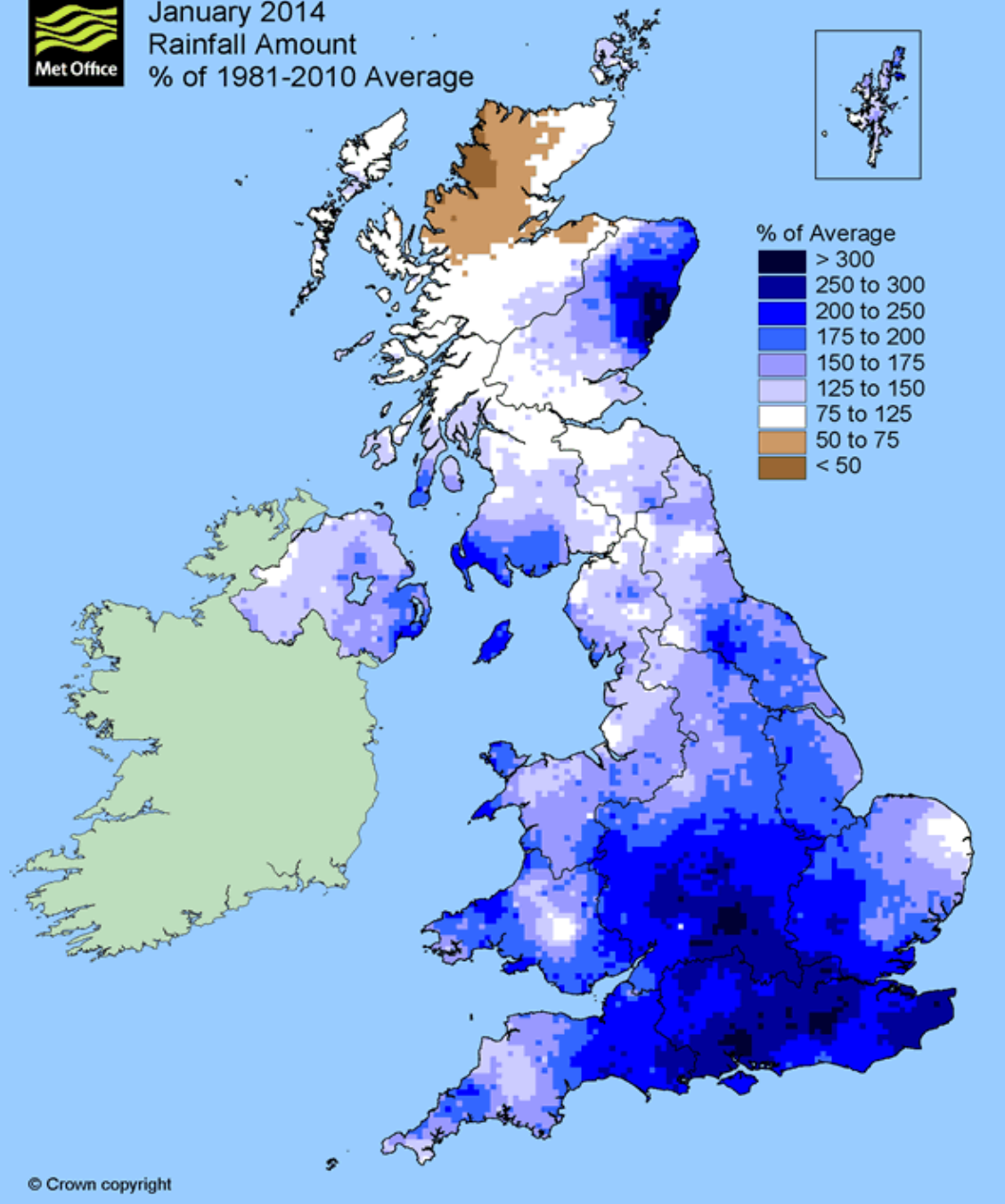
GETTY IMAGES

Wind and rain will continue to batter parts of England and Wales in the wake of Storm Angus, which has caused flash flooding and travel chaos.

The main rail line to the South West has been washed away in several places following torrential downpours.



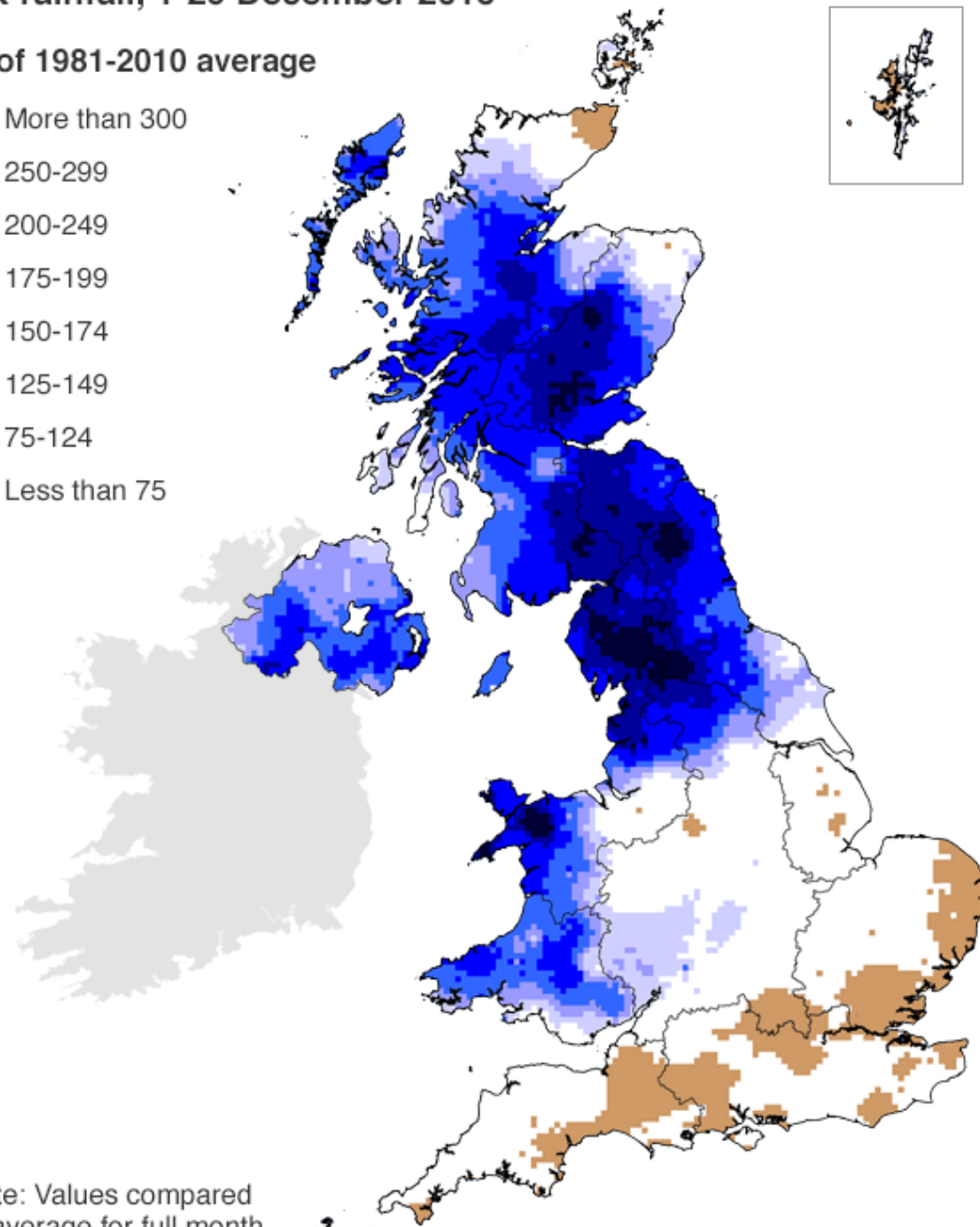
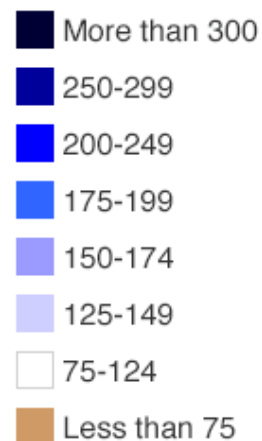
January 2014
Rainfall Amount
% of 1981-2010 Average



January 2014 Rainfall Anomaly

UK rainfall, 1-29 December 2015

% of 1981-2010 average

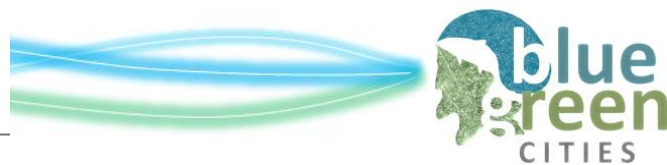


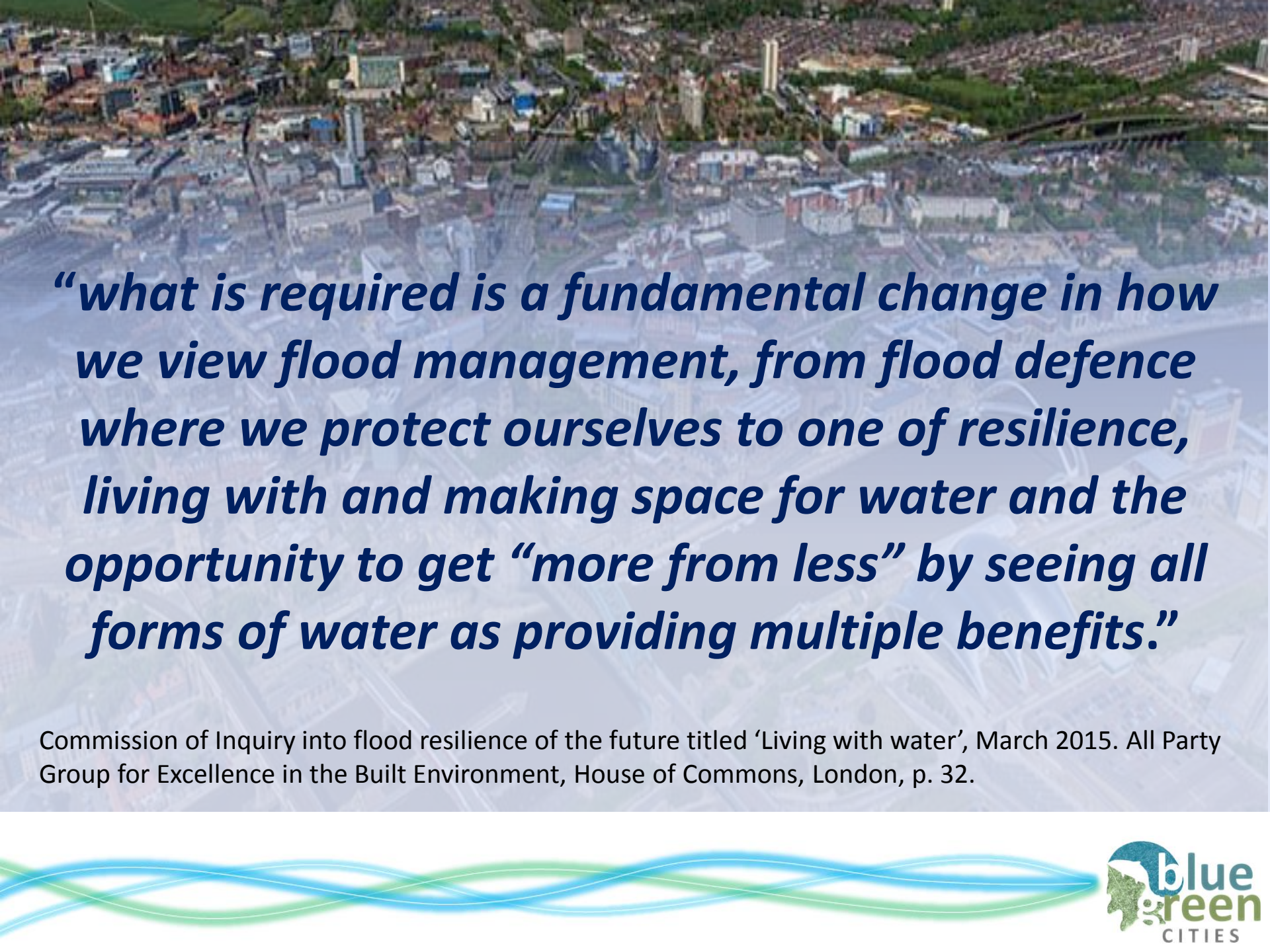
December 2015 Rainfall
Anomaly

Note: Values compared
to average for full month

Source: Met Office

BBC





“what is required is a fundamental change in how we view flood management, from flood defence where we protect ourselves to one of resilience, living with and making space for water and the opportunity to get “more from less” by seeing all forms of water as providing multiple benefits.”

Commission of Inquiry into flood resilience of the future titled ‘Living with water’, March 2015. All Party Group for Excellence in the Built Environment, House of Commons, London, p. 32.

A Grey Future: bigger pipes, more pipes, huge pipes



London without the Thames Barrier during the December 2013 tidal surge (Environment Agency simulation)

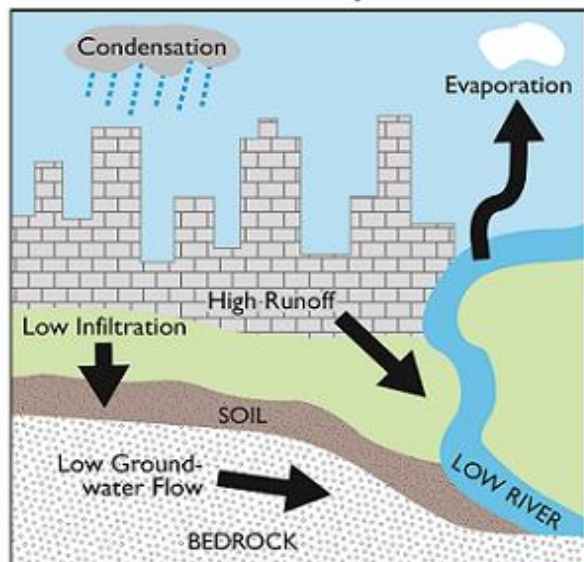


Source:

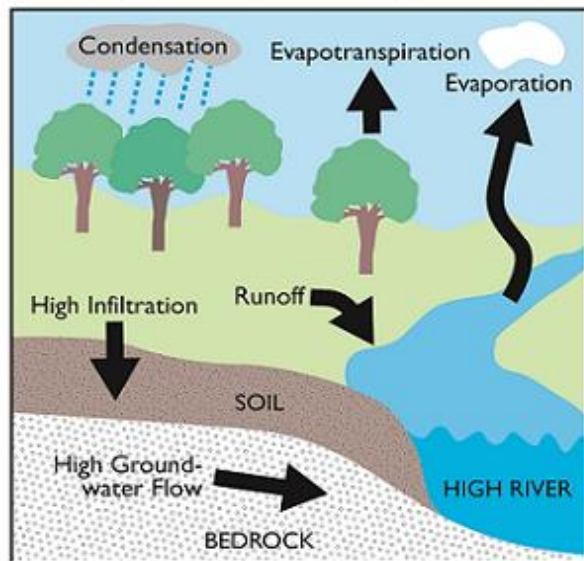
<http://www.bbc.co.uk/news/magazine-26133660>

Water Cycle

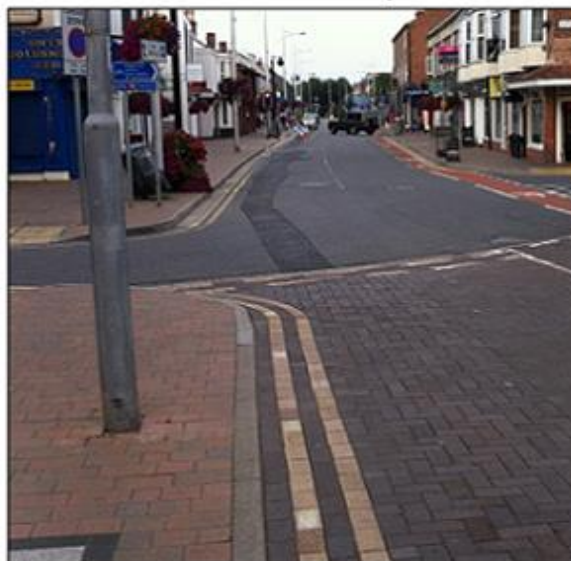
Urban



Natural



Streetscape



Blue-Green Cities

- Working with nature to manage water and deliver a range of other benefits to society, the economy and the environment
- Multifunctional landscape
- Blue-Green space connectivity

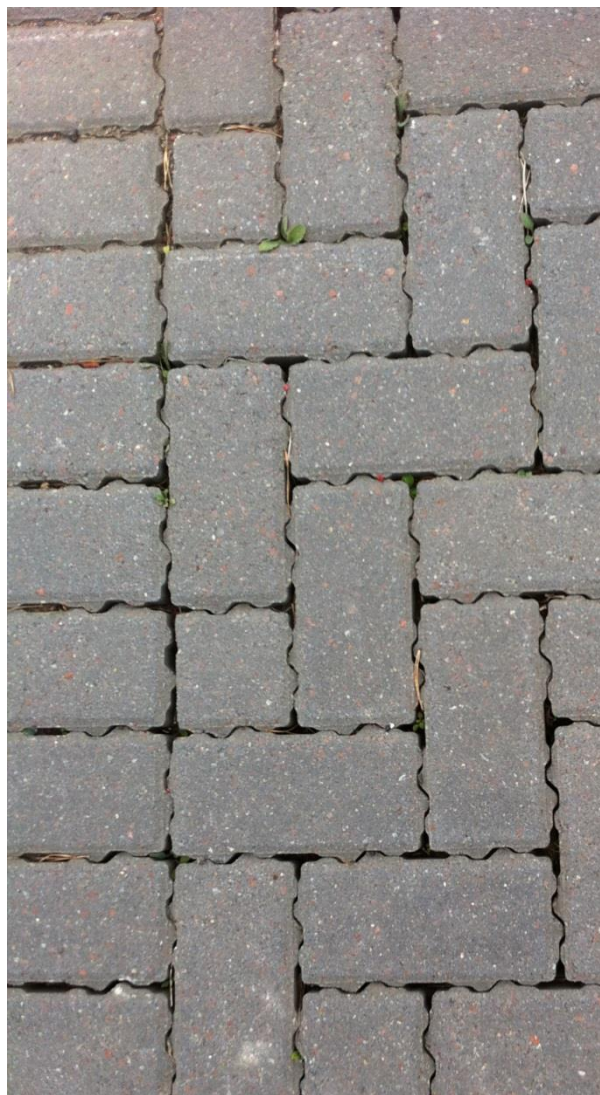
BLUE-

GREEN

Blue-Green infrastructure



(less blue-green) Blue-Green infrastructure



Blue-Green Cities Research Aim

Develop and rigorously evaluate strategies for managing flood risk that deliver multiple benefits as part of urban planning and renewal

Blue-Green Cities Research Approach

Model Existing
Flood Risk
Management

Model
Citizens'
Behaviours

Evaluate
Multiple Flood
Risk Benefits

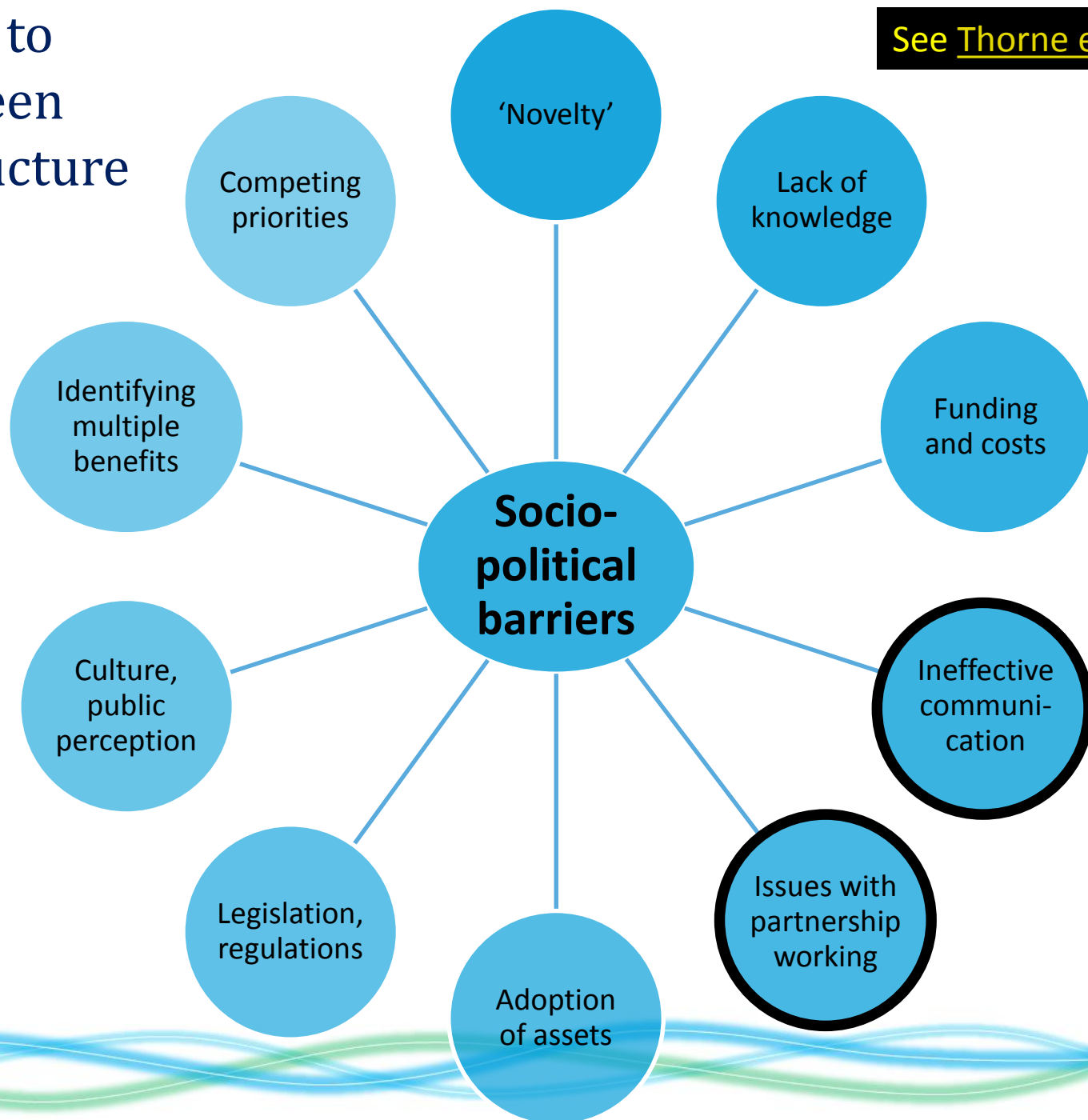
Stakeholder and
Community
Communications

Options for
Hard/Soft
Measures

Demonstration
Case Study

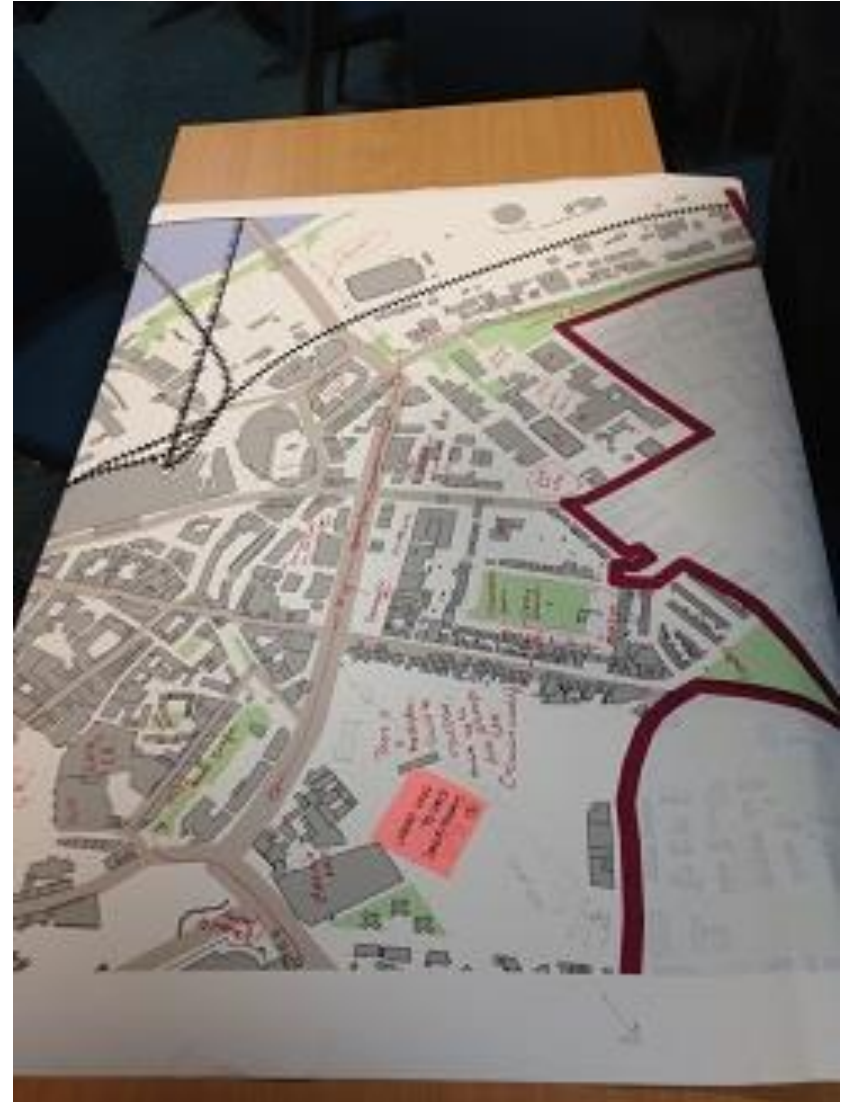
Barriers to Blue-Green infrastructure

See [Thorne et al., 2015](#)



The Newcastle Learning and Action Alliance

Hypothetically 'Blue-Greening' the urban core



Newcastle helps lead the way in blue-green cities move to combat flood risk

15:30, 19 FEB 2016 | BY [TONY HENDERSON](#)

More water storage and greening spaces in Newcastle are the basis for the city conference pledge at the Life Science Centre



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Blue-Green Cities conference line up, left to right, Fula Ogunyoye, Haskoning DHV; David Wilkes, Arup; Marie Fallon, Environment Agency; Clare Rogers, Newcastle University; Richard Warneford, Northumbrian Water; Coun Ged Bell, Newcastle City Council

Blue and green could rival black and white as key colours in the Newcastle of the future.

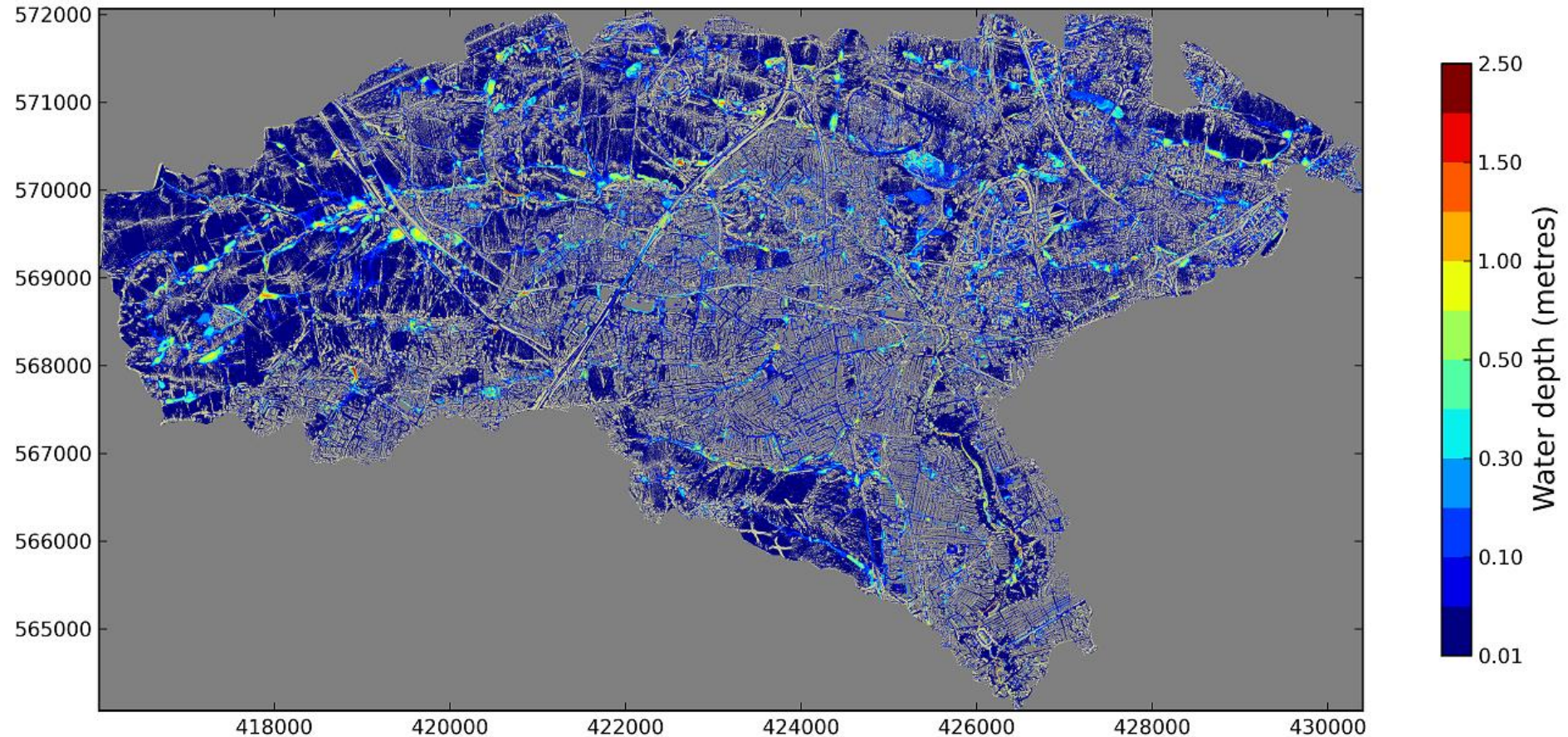
Source:

<http://www.chroniclive.co.uk/news/north-east-news/newcastle-helps-lead-way-blue-10914312>



Development of a flood inundation model: CityCAT

Time: 51 mins



Water depth map of **Ouseburn catchment**

(120 km², 2 m cell size, 30 million cells, 60 min storm event, 100-yr return period)

Glenis and Kilsby, *unpublished data* (Newcastle University)

Flooding and sediment

Southwell (East Midlands)
2013 – after the floods



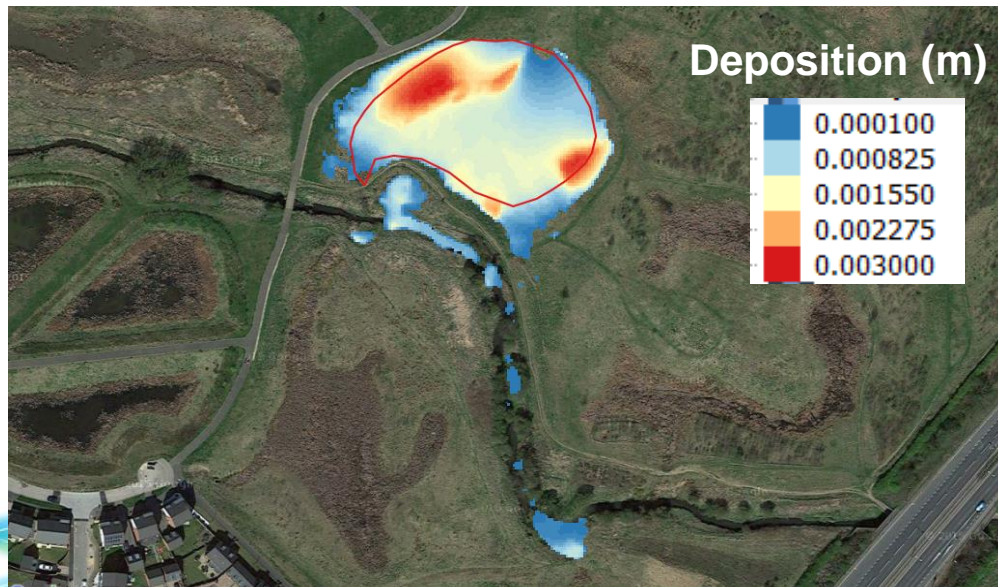
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Source: Daily Mail

Water and sediment transport modelling



River flood routing simulations 100 yr event, 1 hr duration, with sustainable drainage pond



Sediment deposition in sustainable drainage pond (100 yr event, 1 hr)

See [Ahilan et al., 2016](#)

Sediment dynamics within a sustainable drainage treatment train



Water quality improvement, detention (and treatment) of heavy metal pollutants

See [Allen et al., 2015](#)

Natural flood risk management and river restoration



See [Janes et al., 2016](#)

Community behaviours and preferences

- Local People are the local experts - with useful knowledge
- People value Blue-Green assets - if they understand them
- People will help maintain the Blue-Green assets they value
- People need to feel *ownership* to make BG solutions work
- People must be engaged prior to and throughout implementation

See [Everett et al., 2015](#)

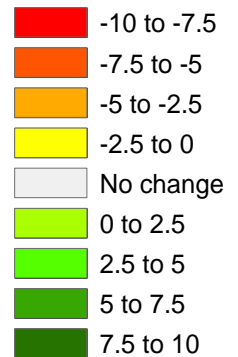
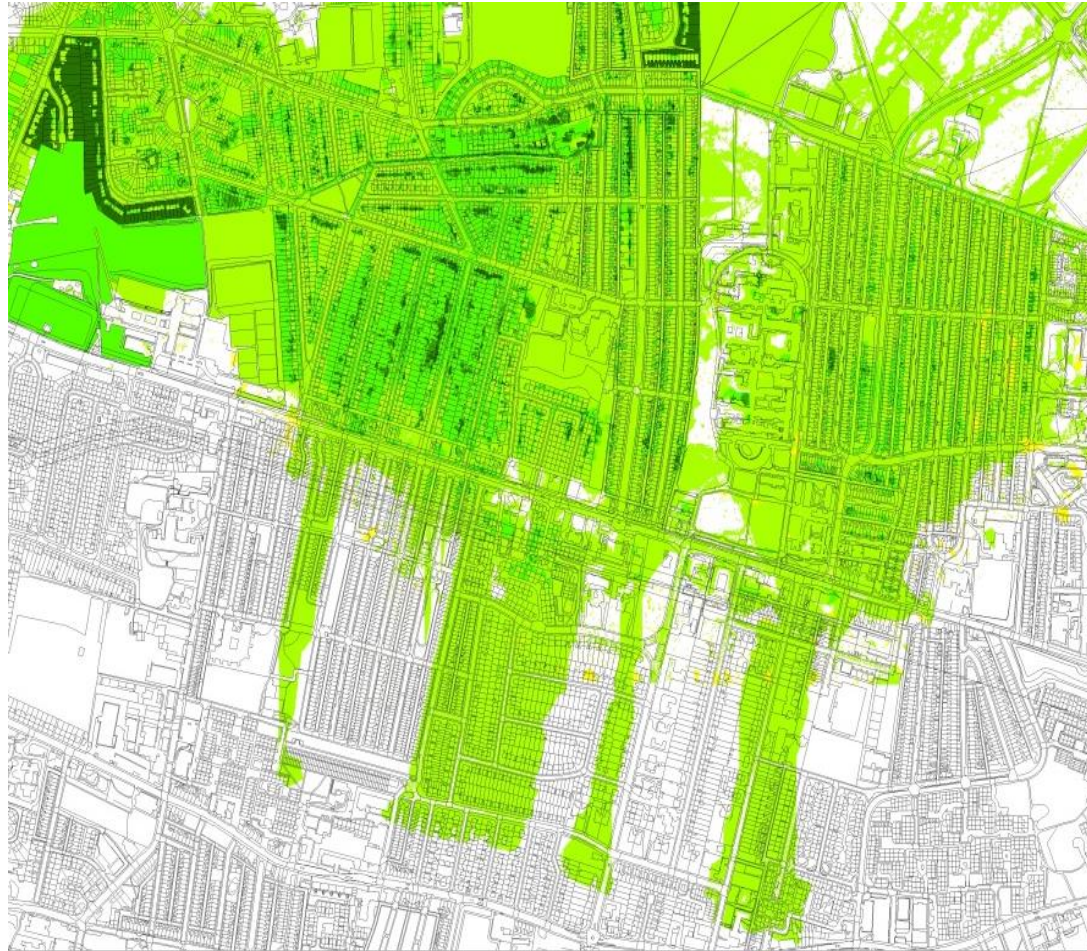


Evaluating the multiple benefits of Blue-Green infrastructure

ArcGIS toolkit for multiple benefit evaluation

- Air pollution
- Access to greenspace
- Carbon sequestration
- Noise
- Habitat connectivity
- Flood

Morgan and Fenner,
in review



Achieving Urban Flood Resilience in an Uncertain Future



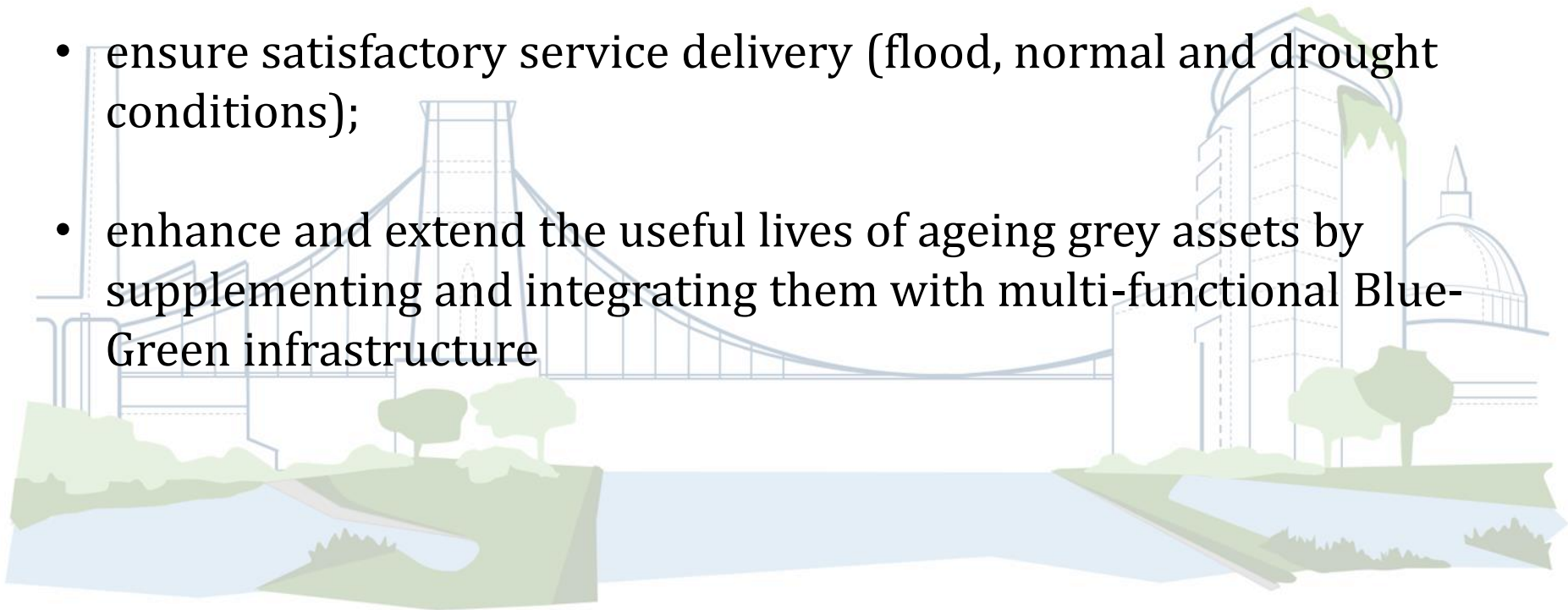
Aim

To conduct research necessary to make *urban flood resilience* achievable nationally, by making transformative change possible through adoption of the whole systems approach to urban flood and water management

Achieving urban flood resilience in an uncertain future

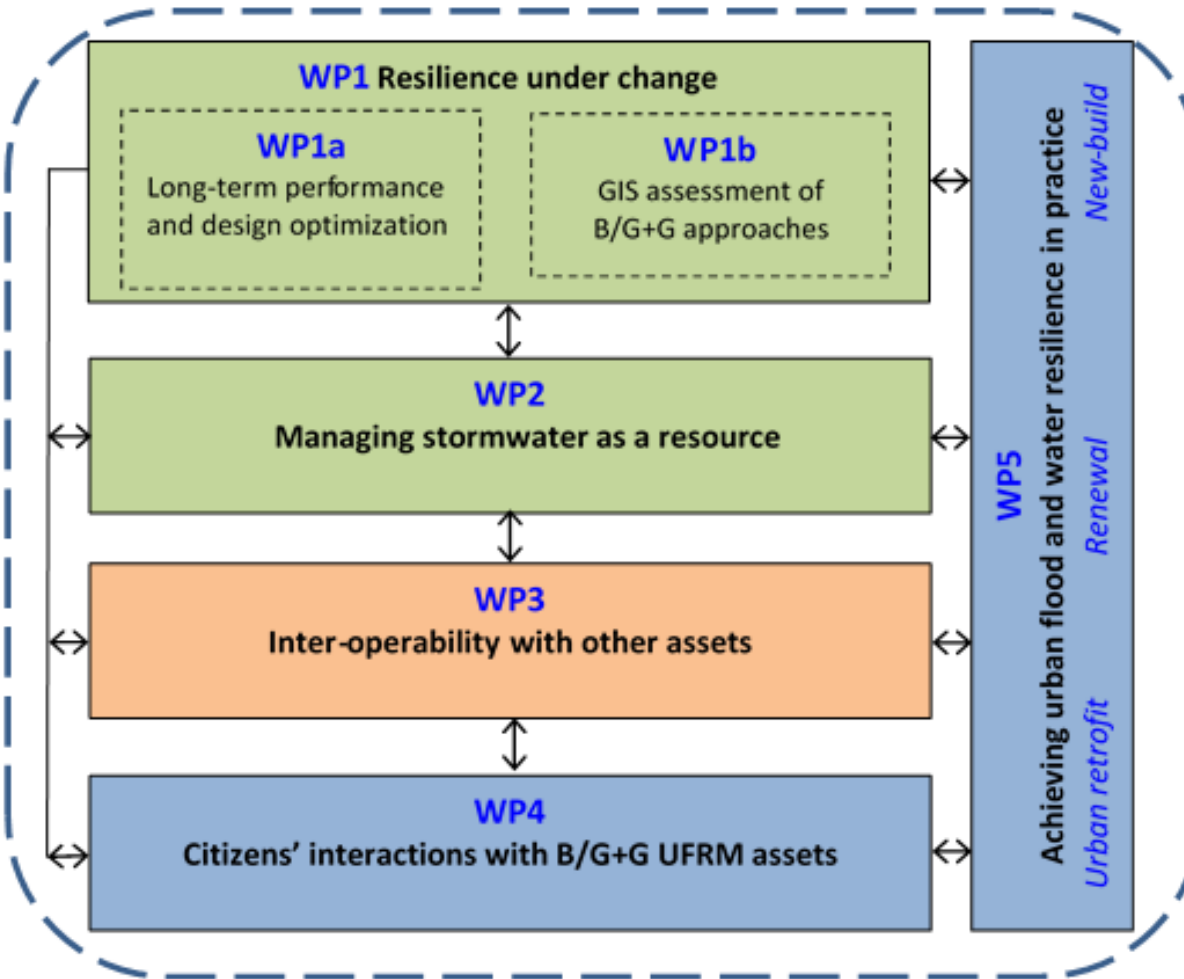
Investigate how planning and organisation of existing and new urban water systems (including flood risk management, waste/stormwater management and water security) can be transformed to:

- ensure satisfactory service delivery (flood, normal and drought conditions);
- enhance and extend the useful lives of ageing grey assets by supplementing and integrating them with multi-functional Blue-Green infrastructure



Key Themes

Holistic UFRM
Integrated treatment trains
Inter-operability and connectivity
Co-optimisation and multi-functional design
Sustainable service delivery
Adaptive capacity
Partnership working



Key Pressures

Climate change impacts
Demographic changes
New build development
Retrofit solutions
Urban renewal and gentrification
Community behaviour

■ Engineering design of integrated treatment trains ■ Inter-operable UFRM ■ Sustainable service delivery, planning

The Blue-Green Cities Research Consortium has been supported by:

- Engineering and Physical Sciences Research Council
- Northern Ireland Rivers Agency
- Environment Agency
- Northumbrian Water
- Newcastle City Council