

Scotland's Flood Resilience Conference 2024



Scotland's Flood Resilient Future



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#FRM2024

Scotland's Flood Resilience Conference 2024

Session 1: Policy

Chair: Ruth Wolstenholme, Sniffer



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Scotland's Flood Resilience Conference 2024

Session 1: Policy

Màiri McAllan, Cabinet Secretary for Transport,
Net Zero and Just Transition





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Scotland's Flood Resilience Conference 2024

Session 1: Policy

Rosemary Greenhill, Scottish Government



The background of the slide is a close-up photograph of water ripples, showing concentric circles and swirling patterns in shades of blue and white.

Water, Wastewater and Drainage Consultation: Water Industry Climate Change Adaptation

**Scotland's Flood Resilience Conference
8 February 2024**

**Rosemary Greenhill
Scottish Government**

Aim of the session

Objective

To hear your views on our policy proposals, particularly in relation to drainage.

Your views

Your views will inform the development of policy for the future of the Scottish water industry and how it can best respond to the impacts of the climate emergency.

How to provide feedback

- Through the consultation
- Verbally, or in writing, during this session
- Via email (waterpolicyconsultation@gov.scot)



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Our climate is becoming more unpredictable, and Scotland must adapt

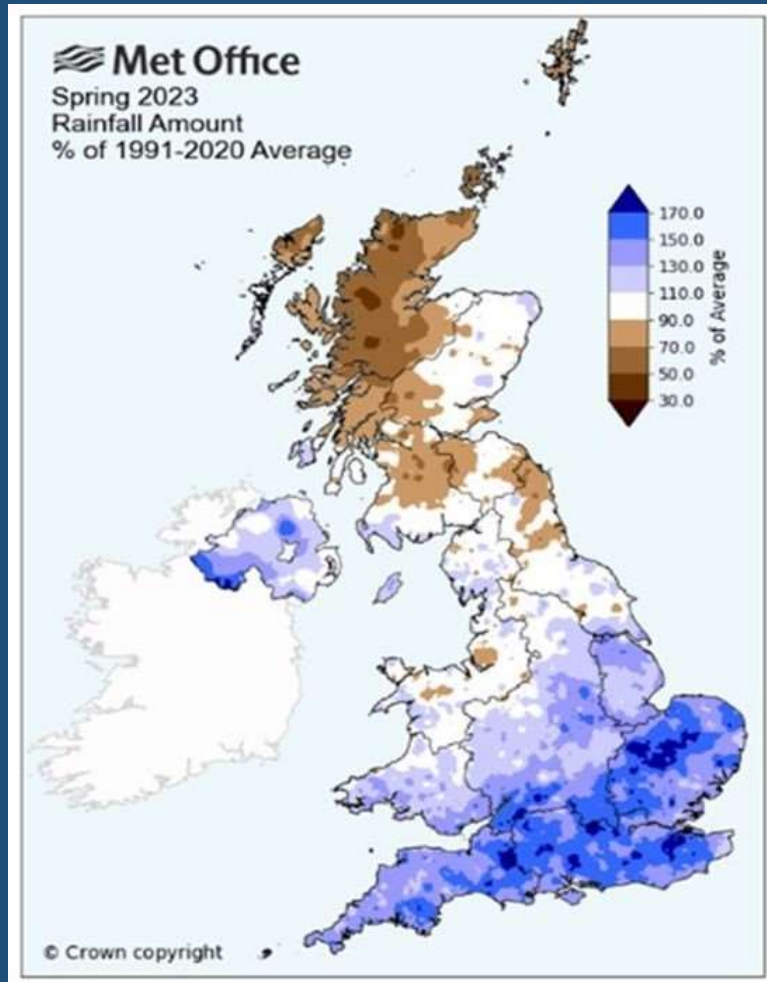


We're proposing the development of policy to respond to the climate emergency



This will help protect Scotland's environment and water resources for generations to come

Intense Storms



This diagram shows that in Spring 2023 rainfall was 30% of the average of 1991-2020.

More Flooding



Flooding from the
Craigie Burn in Perth



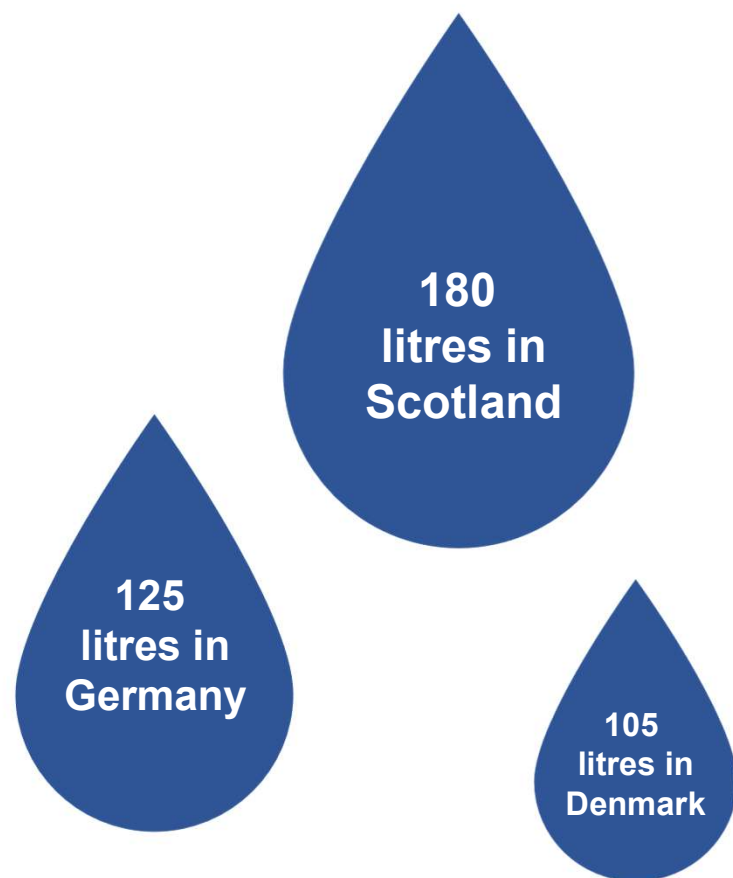
Flooding of a road in
Dunblane, 2023

Which requires...

- Creating a strategy for how we collect and carry away rainwater that falls on hard surfaces, including on private land.
- Measures to plan, fund and create green landscape and water design areas in urban spaces (Blue-Green Infrastructure). This could include trees, parks and ponds.

Water in Scotland

How much water does each person use per day?



Drainage & Surface Water Management

Climate Adaptation & Resilience Planning

Align policy, legislation & funding to drive positive action

Rainwater Drainage Network Planning

Plan and build new drainage networks to create climate resilient places

Strengthening Cross Organisational Partnerships

Cross policy working to generate multiple benefits for people and places

Rainwater Drainage Mapping

Understand where rainwater currently flows

Climate
Change

Partnership
Working

Modernisation



Green landscaping in Dundee
(Sustran Scotland, Dundee City Council and Scottish Water Project)



Surface water management in Sighthill,
North Glasgow (LDA Design in collaboration
with Morgan Sindall).



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Water, Wastewater and Drainage Policy Consultation

This consultation seeks your views on the Scottish Government's proposed principles and considerations in developing policy for the future of the water industry in Scotland in response to the climate emergency. Please use the link or QR code below to access the consultation:

<https://consult.gov.scot/energy-and-climate-change-directorate/water-wastewater-and-drainage-policy-consultation/>



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Scotland's Flood Resilience Conference 2024

Session 1: Policy

Catriona Laing, Scottish Government



Scottish National Adaptation Plan 2024-29

8 February 2024

Catriona Laing
Deputy Director
Domestic Climate Change Division



Scottish Government
Riaghaltas na h-Alba
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Setting the Scene

- The effects of climate change are already being felt by people, places and businesses in Scotland.
- As well as reducing emissions to net zero by 2045, we must also adapt to climate impacts that are already locked in.
- In our future climate, extreme events - such as storms, floods, droughts, and heatwaves - are likely to be more severe and to happen more often.
- This means we must adapt our places to withstand these changes.



© Forestry and Land Scotland 2022

▲ Storm Arwen devastation



© Lochalsh and South West Ross Community Fire Stations 2022

▲ Lochalsh wildfire

Scotland's national approach to adaptation

- The Climate Change (Scotland) Act 2009 requires a programme for climate change adaptation to be set out every 5 years. This must address risks identified in statutory UK Climate Change Risk Assessments (CCRA).
- Current adaptation plan is SCCAP 2. New adaptation plan will be referred to as SNAP 3 – Scottish National Adaptation Plan – in line with international naming conventions.

Climate Adaptation Architecture

Governance and Monitoring: annual progress report to Scottish Parliament. Monitoring framework being established. CCC already providing regular independent assessment reports.

Policy Delivery: current Adaptation Plan contains 170 policies and proposals. Draft Adaptation Plan 2024-29 out for consultation.

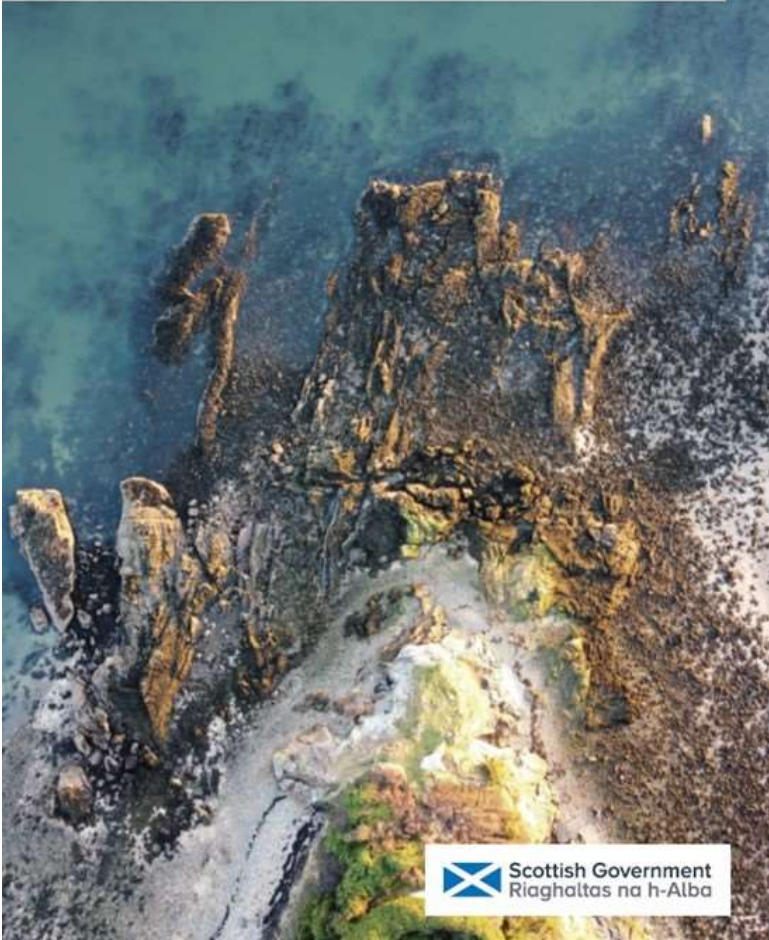
Policy Ownership: each of the 61 CCRA risks and opportunities have been assigned to a Scottish Government Directorate.

Evidence base: Climate Change Risk Assessment (CCRA) sets out 61 risks and opportunities. Updated every 5 years.

Legislation: Scottish Ministers must set out an Adaptation Programme responding to each Climate Change Risk Assessment

draft Scottish National Adaptation Plan: public consultation

Draft Scottish National Adaptation Plan (2024 – 2029)
Actions today, for a climate resilient future.



- Five outcomes; 22 objectives.



Nature connects:

Nature connects across our land, settlements, coasts and seas



Communities:

Communities are creating climate-resilient, healthy and equitable places.



Public services and infrastructure:

Public services are collaborating in effective, inclusive adaptation action.



Economy, business and industry

Economies and industries are adapting and realising opportunities in Scotland's Just Transition.



Scotland international role

Scotland's international role supports climate justice and enhanced global action on climate adaptation.

Climate impacts are local: place based approaches needed



Adaptation Plan: next steps

- **Policy in development:** Flood Resilience Strategy; Scottish Biodiversity Strategy to 2045; Water, wastewater and drainage policy proposals; Just Transition Plans; Climate Change Plan; future framework for agriculture; culture strategy, etc...
- **Being delivered:** Place Principle; National Planning Framework 4; Transport Scotland's adaptation strategy; Public Health Scotland's climate strategy; Community Climate Action Hubs; flood forecasting and warning; NHS climate strategy, etc...
- A stronger role for **place-based initiatives** driving effective, inclusive adaptation action across cities, regions and localities engaging a broader range of delivery partners.

**Draft SNAP3
public
consultation**
January –
April

**Respond
and revise**
May - July

Sept 2024
Final
programme
laid in
parliament



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Scotland's Flood Resilience Conference 2024

Session 1: Policy

David Faichney, Scottish Government



The National Flood Resilience Strategy

Scotland's Flood Resilience Conference
8 February 2024

David Faichney
Scottish Government

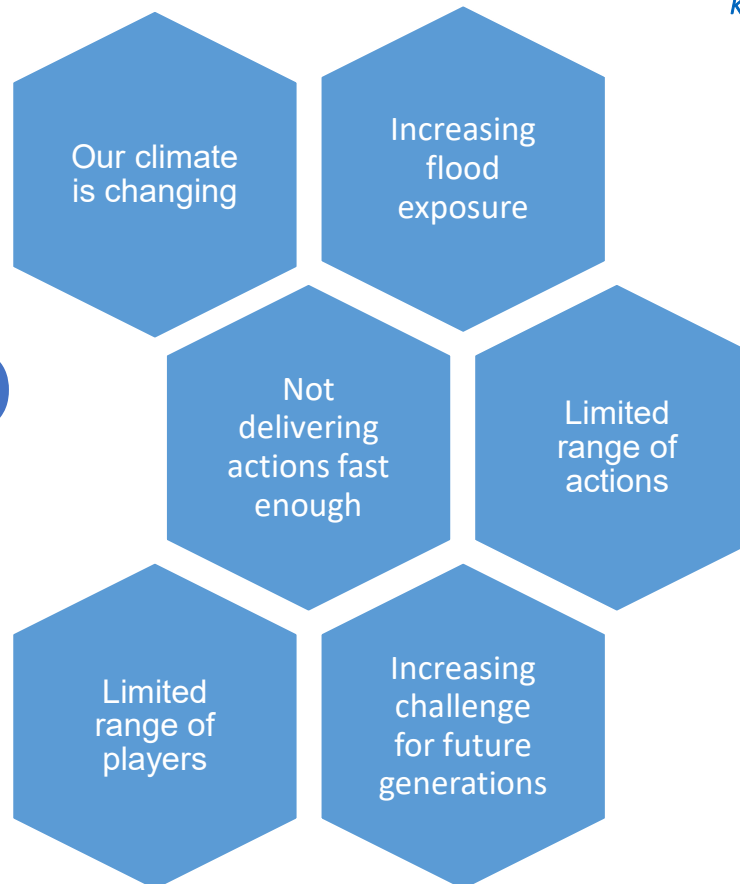
The National Flood Resilience Strategy

A key part of SNAP3 (*formerly known as SCCAP3*)

Why?

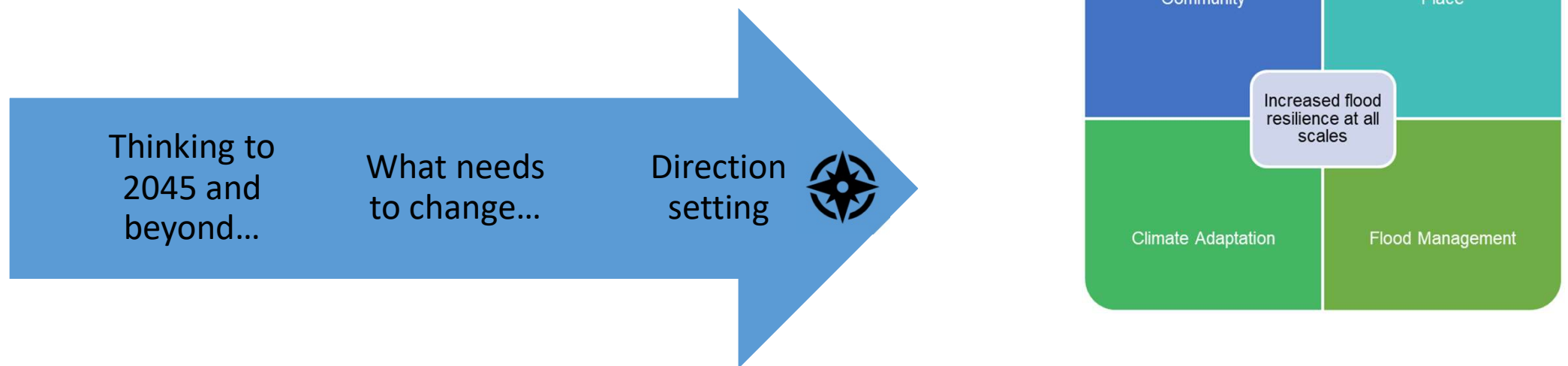
1

Flooding is our biggest domestic climate adaptation challenge



A Stronger & More Resilient Scotland - The Programme for Government 2022 - 23

Consult on a new flooding strategy for Scotland, including how we can build community flood resilience and engage a broader range of delivery partners to deliver more diverse flood management actions faster.



...and reflecting on recent floods



- Storms Babet and Gerrit high rainfall accumulations
- Significant impacts on floodplain receptors
- Even where a level of protection was in place
- Significant damage around coastline

...affirms the need for change and to think about our flood resilience in the widest possible context.



Cupar, Fife, flooded by Storm Gerrit. Credit: Bruce Russell

What is the purpose of the Flood Resilience Strategy?



To change our approach from “fixing flooding problems” to creating flood resilient places



Lay-out the principles we must follow to improve flood resilience in the period ahead



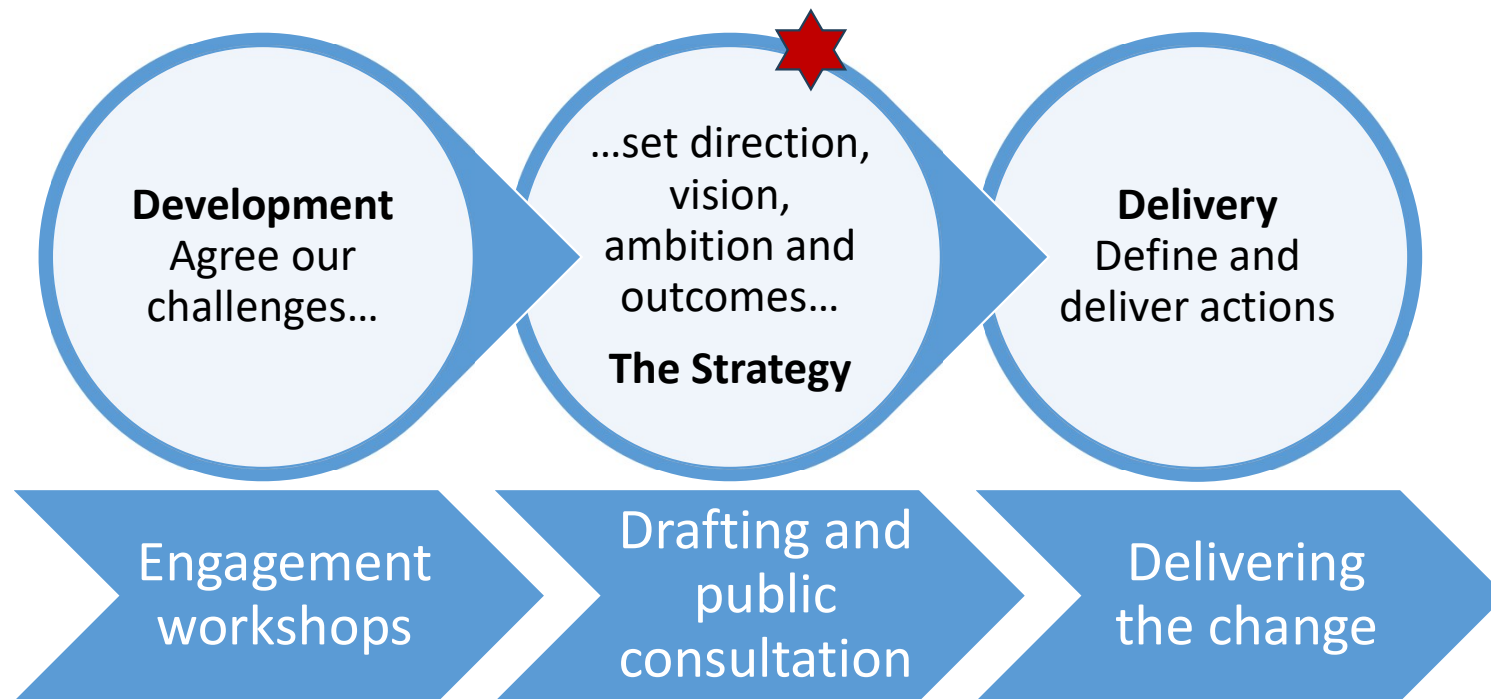
To set out the strategic level changes that we need to make

Make the best
use of all
available
resources

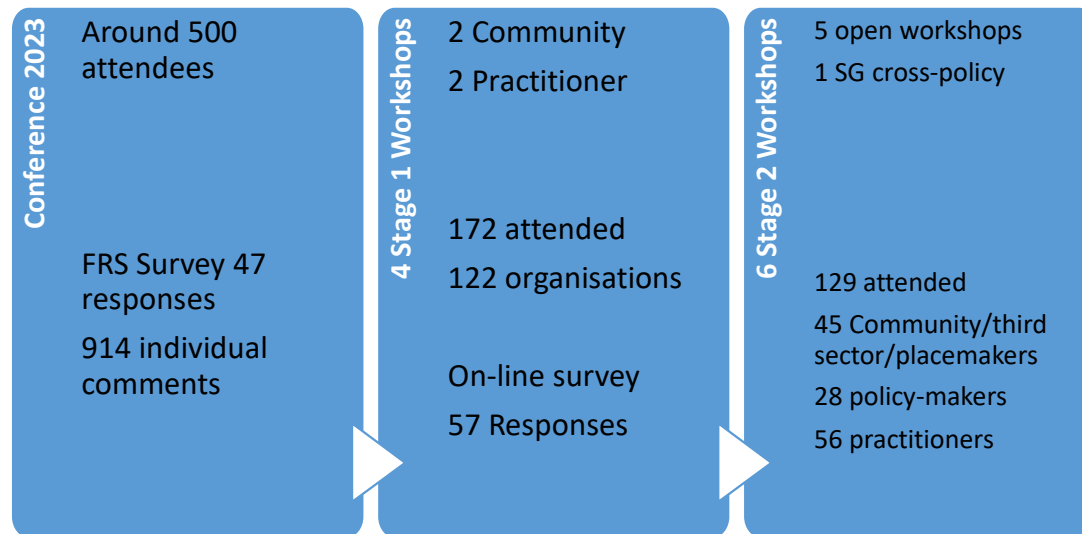
...reducing **flood exposure** by all available means

Flood Resilience Strategy process

Scotland's strategy – co-developed and co-delivered



Main steps in Strategy development



Including ongoing input from individuals and interested organisations – THANKS!



Workshop outputs

Themes

Hundreds of individual inputs falling into seven categories that we are taking forward under three headings in the consultation document.



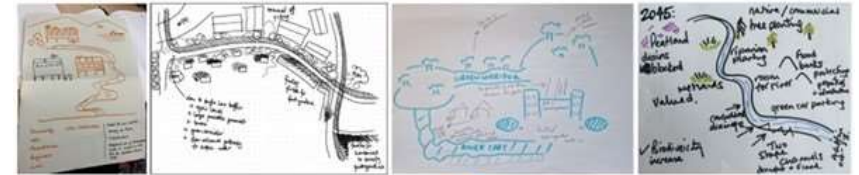
- Land ownership, management and use
- Inclusive community involvement
- Working together to make good decisions
- Roles, responsibilities and decision making
- Effective data and knowledge sharing
- Mindsets and individual behaviours
- Measuring success – some indicators



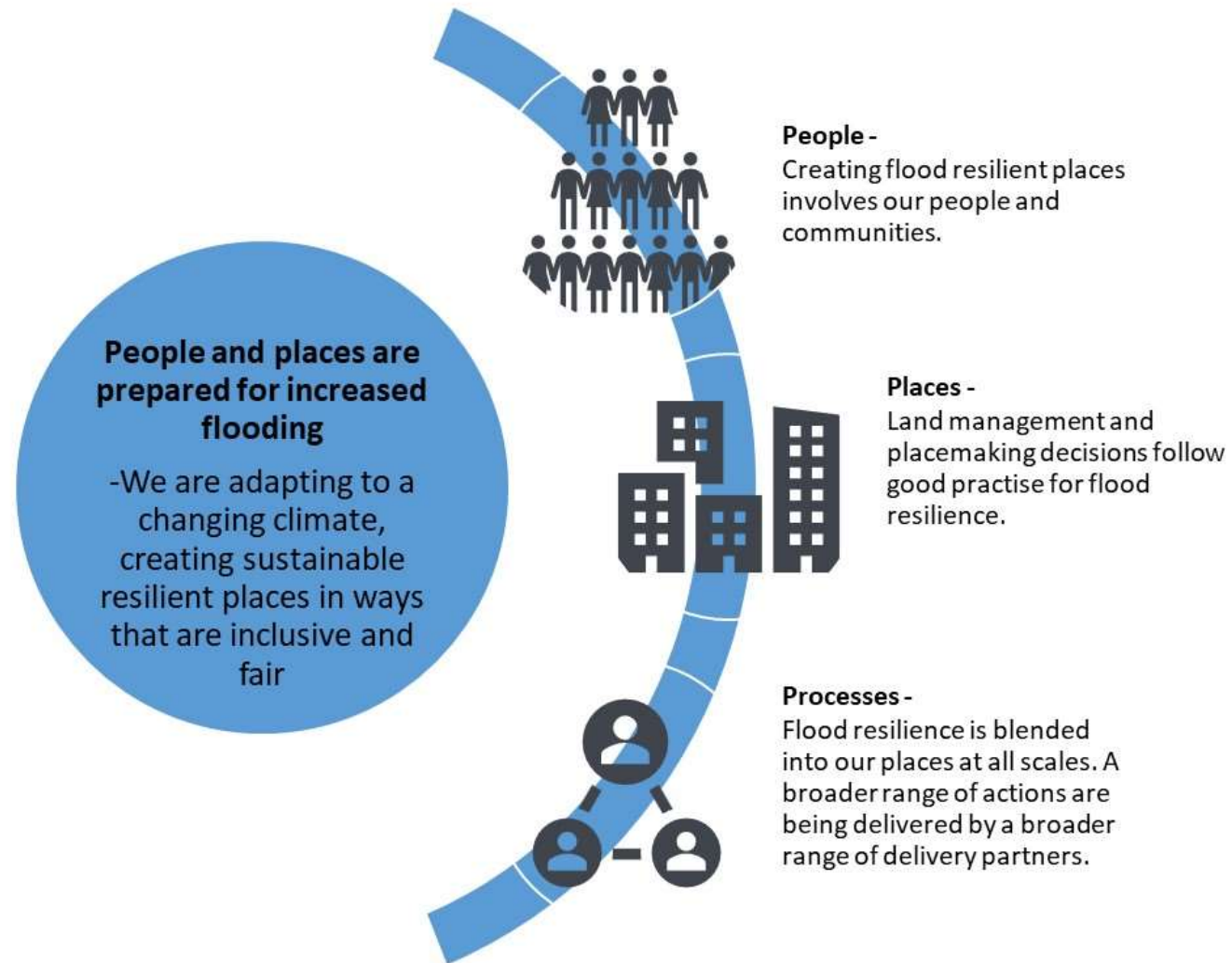
- People
- Places
- Processes

Key features of (good) flood resilient places in 2045

The focus is to identify what we want to move towards, and then – how to get there



Working vision and long-term outcomes



Involving people more



Developing community flood resilience as part of climate adaptation



Involving people in the design of their places



Helping them understand their flood exposure and how that may change through time



Helping them understand the options they may have



Short-term



Long-term



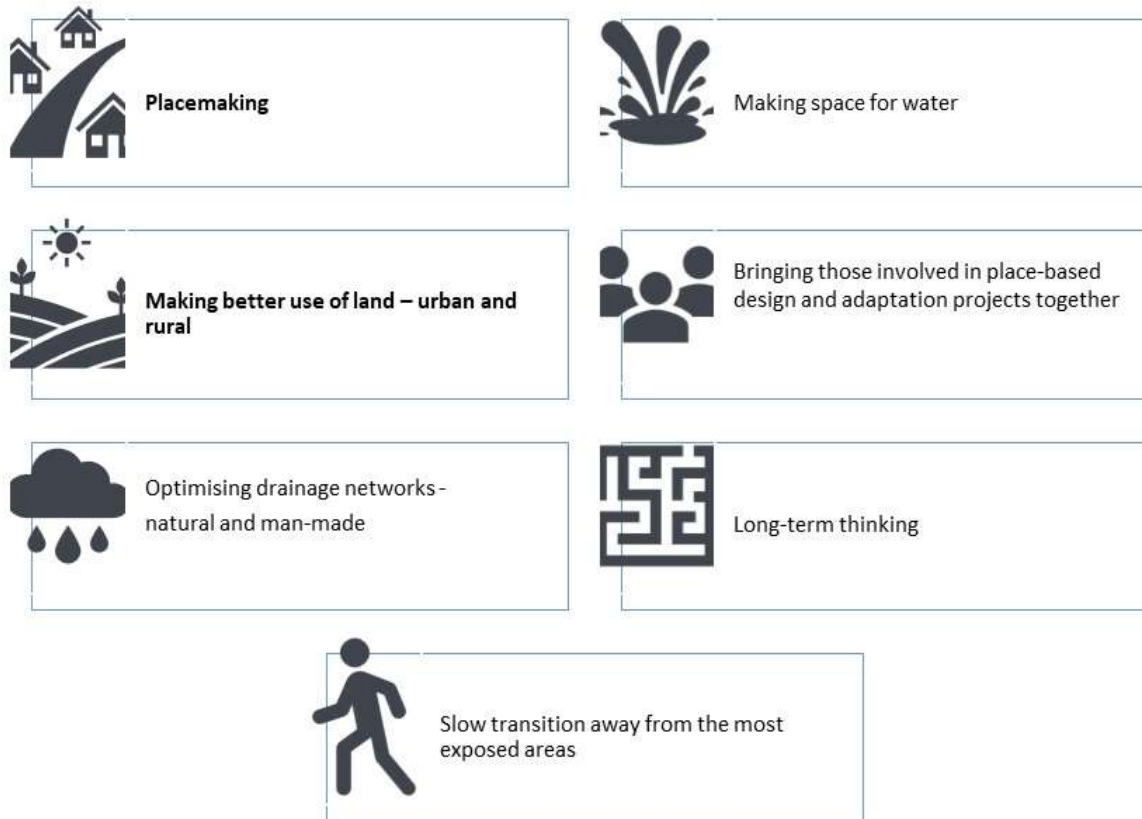
Small-scale



Large-scale

How can our people contribute to our flood resilience?

Making the most of our places



How can our places contribute to our flood resilience?

Improving processes to support the change



Increasing the range of actions



Increasing range of delivery partners



Using flood risk management plans to bring forward different actions



Accessing and deploying available resources



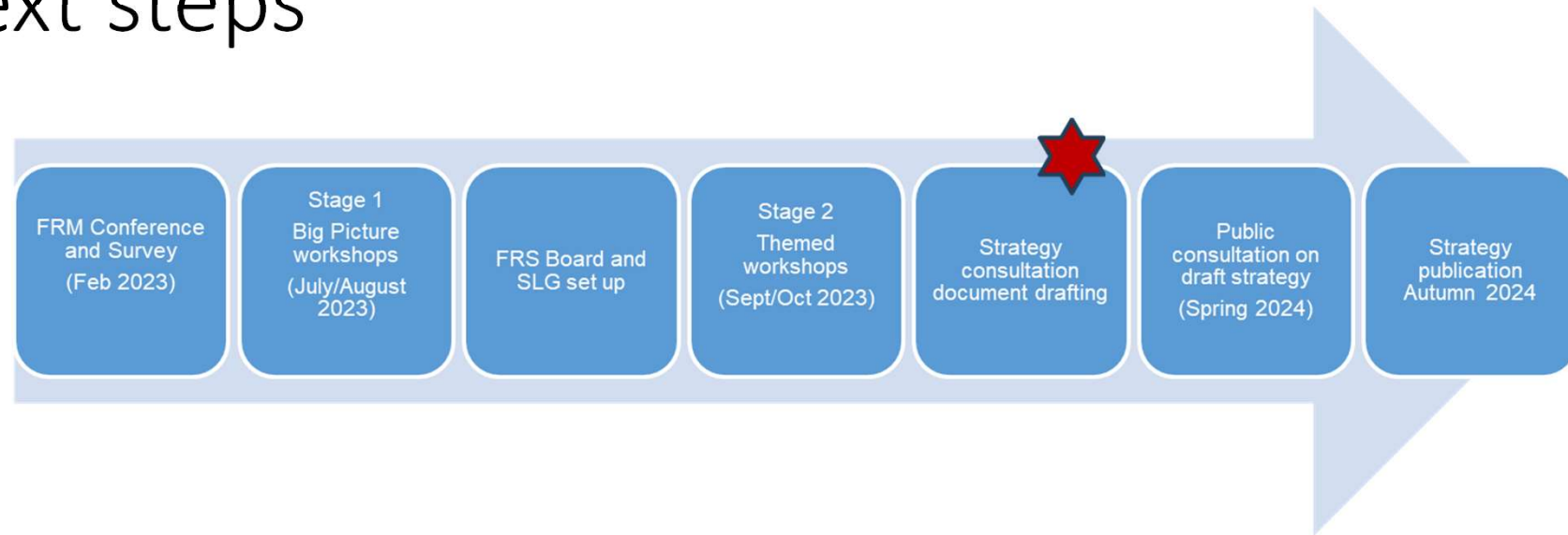
Supporting delivery partners



Improving governance, delivery and funding mechanisms

How can our processes contribute to our flood resilience?

Next steps



Key Message

Something we can ***all*** start doing now...



Communicate the shift in narrative from fixing flooding problems to designing places that are flood resilient.

Thank you!

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Audience Q&A

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Coming up next...

Session 2:

Placemaking for Resilience





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Scotland's Flood Resilience Conference 2024

Refreshments and Market Place





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Scotland's Flood Resilience Conference 2024

Session 2: Placemaking for Resilience

Chair: Deryck Irving, Hydro Nation



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Scotland's Flood Resilience Conference 2024

Session 2: Placemaking for Resilience

Ujwala Fernandes, AtkinsRéalis

Sian Lovell, AtkinsRéalis

Stephen Knox, City of Edinburgh Council



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CLIMATE READY EDINBURGH

EDINBURGH'S GREEN BLUE NETWORK AND
CLIMATE READY CRAIGLEITH



LANDSCAPE INSTITUTE
AWARDS 2023

30 YEARS OF CELEBRATING
PEOPLE, PLACE AND NATURE.

WINNER

 AtkinsRéalis

 **sustrans**

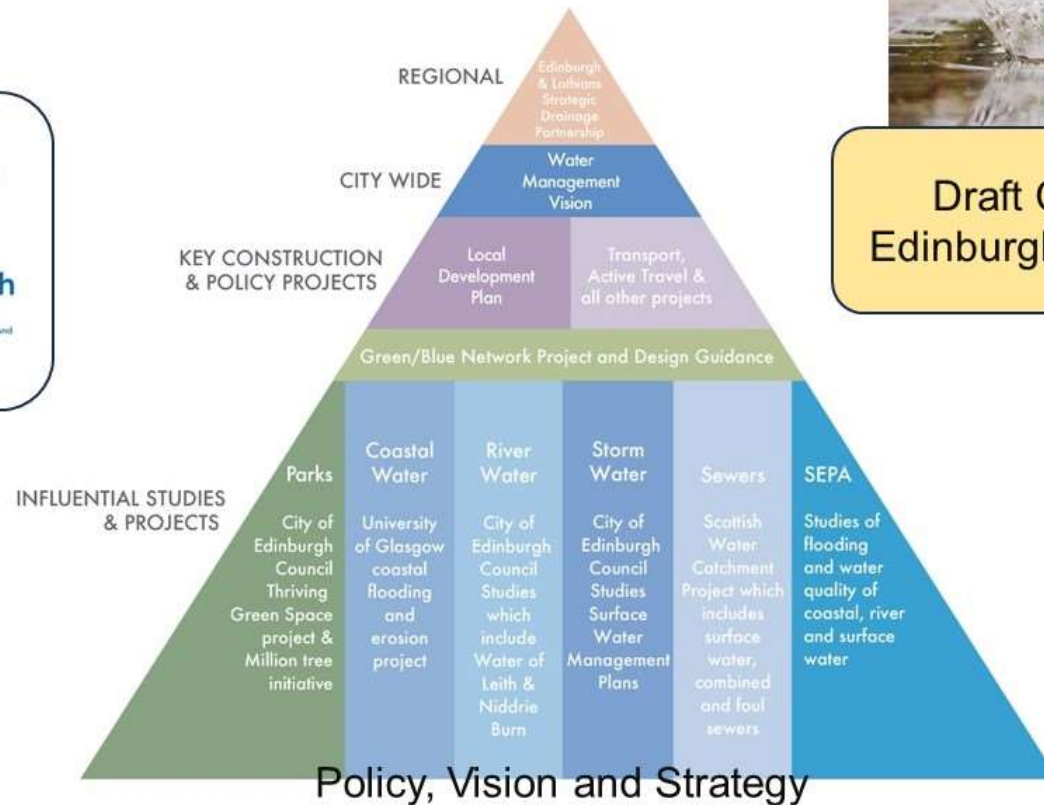
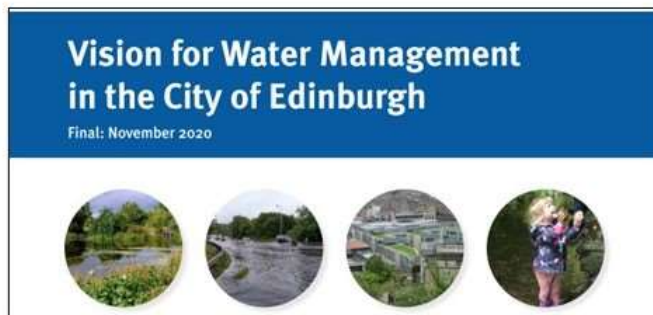
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THE CITY OF EDINBURGH COUNCIL

 **Scottish
Water**
Trusted to serve Scotland

 **SEPA**
Scottish Environment
Protection Agency

Planning for Climate Change

Edinburgh & Lothians Strategic Drainage Partnership



Draft Climate Ready Edinburgh Plan 2024-2030

CLIMATE READY EDINBURGH
Creating climate friendly places for people and nature

Edinburgh's Strategic Green Blue Network

Provides a 'joined up' approach to:

- sustainably managing water and flood risk
- making environmental changes
- supporting communities
- Improving wellbeing for people and nature
- future proofing of the city against the effects of climate change.



LANDSCAPE INSTITUTE
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30 YEARS OF CELEBRATING
PEOPLE, PLACE AND NATURE.

WINNER



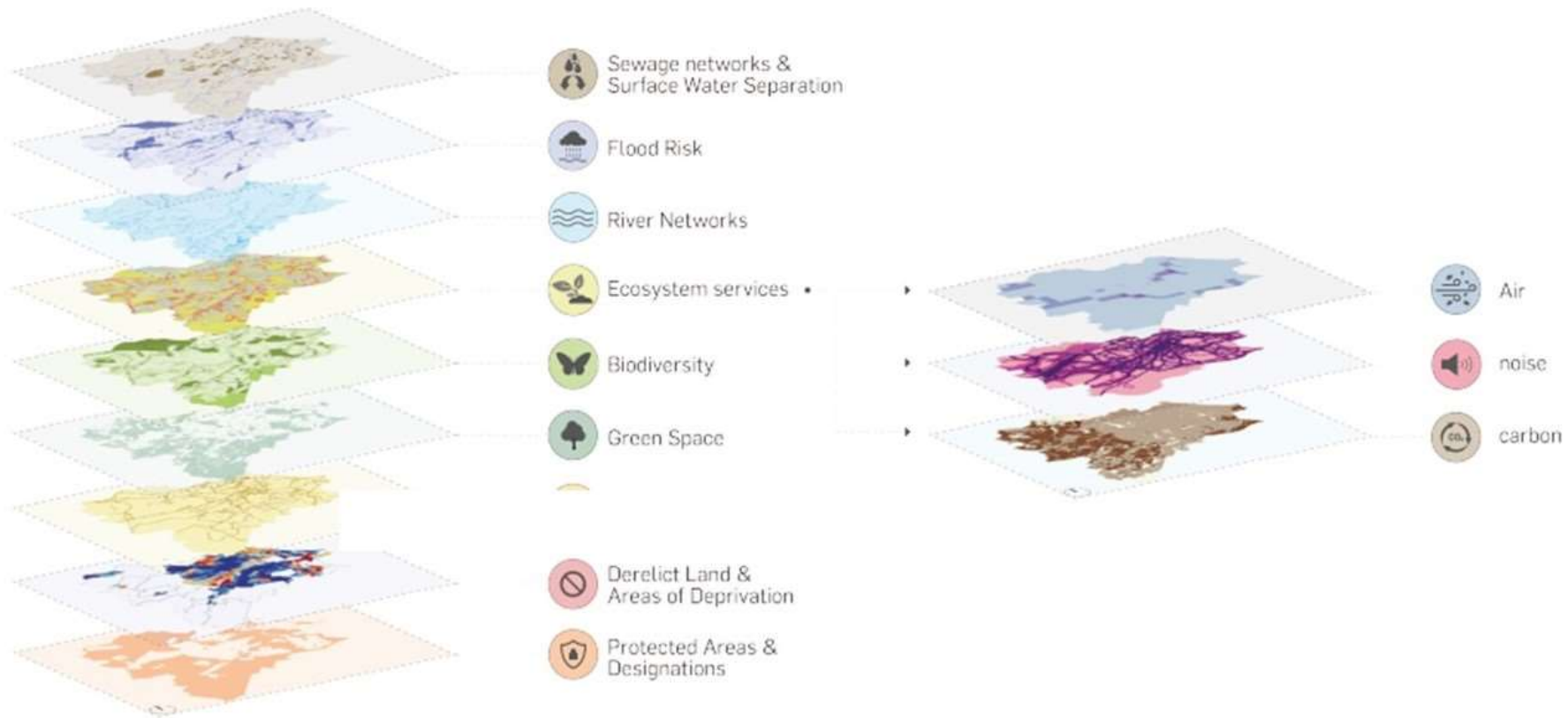
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Creating climate friendly places for people and nature

Edinburgh's Strategic Green Blue Network

Development

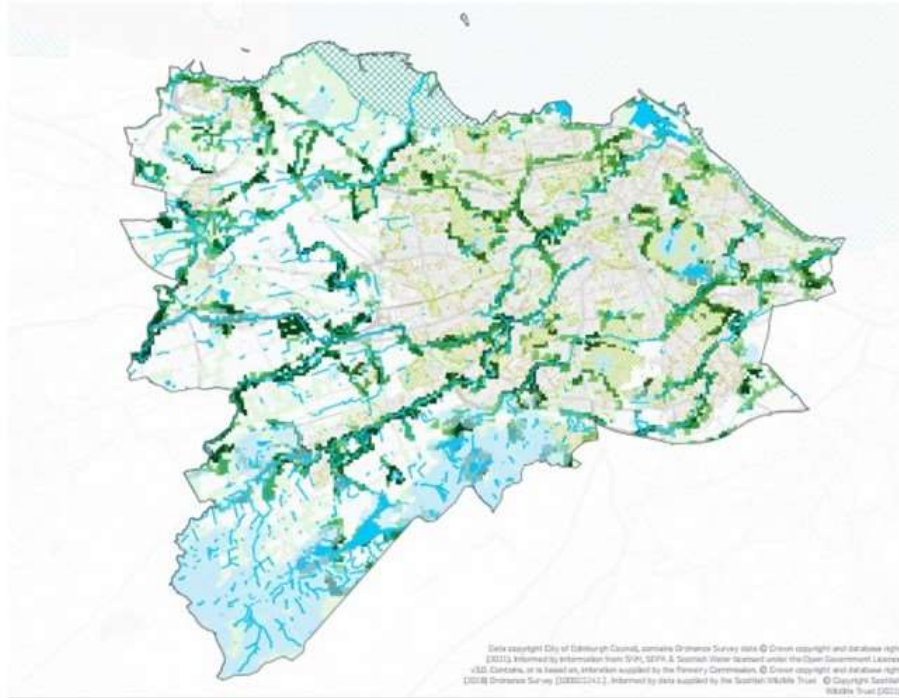
Innovative digital geospatial platform



CLIMATE READY EDINBURGH
Creating climate friendly places for people and nature

Edinburgh's Strategic Green Blue Network

Phases



Phase 1

- Informs and supports policies in City Plan 2030



Climate Ready Craigleith

- Pilot scheme

CLIMATE READY EDINBURGH

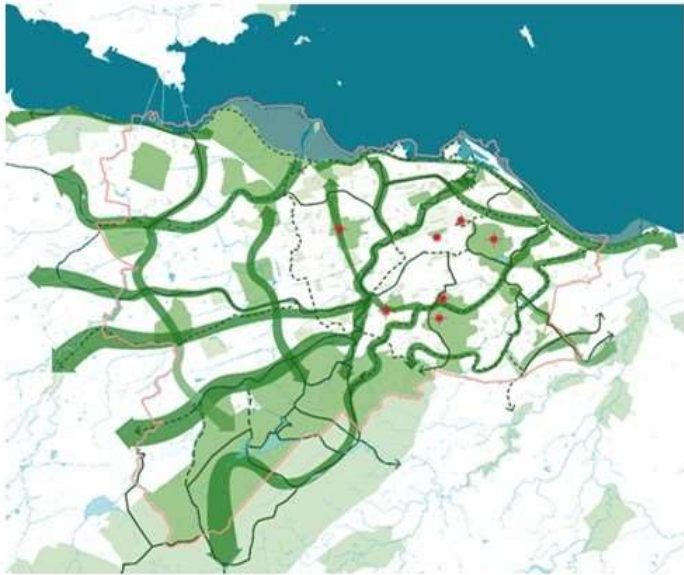
Creating climate friendly places for people and nature

Edinburgh's Strategic Green Blue Network

Phase 2

The Green Network

- Edinburgh's landscapes
- Green links
- Green blue opportunity areas



The Blue Network

- Strategic water networks
- Blue green opportunity areas.



The Biodiversity Network

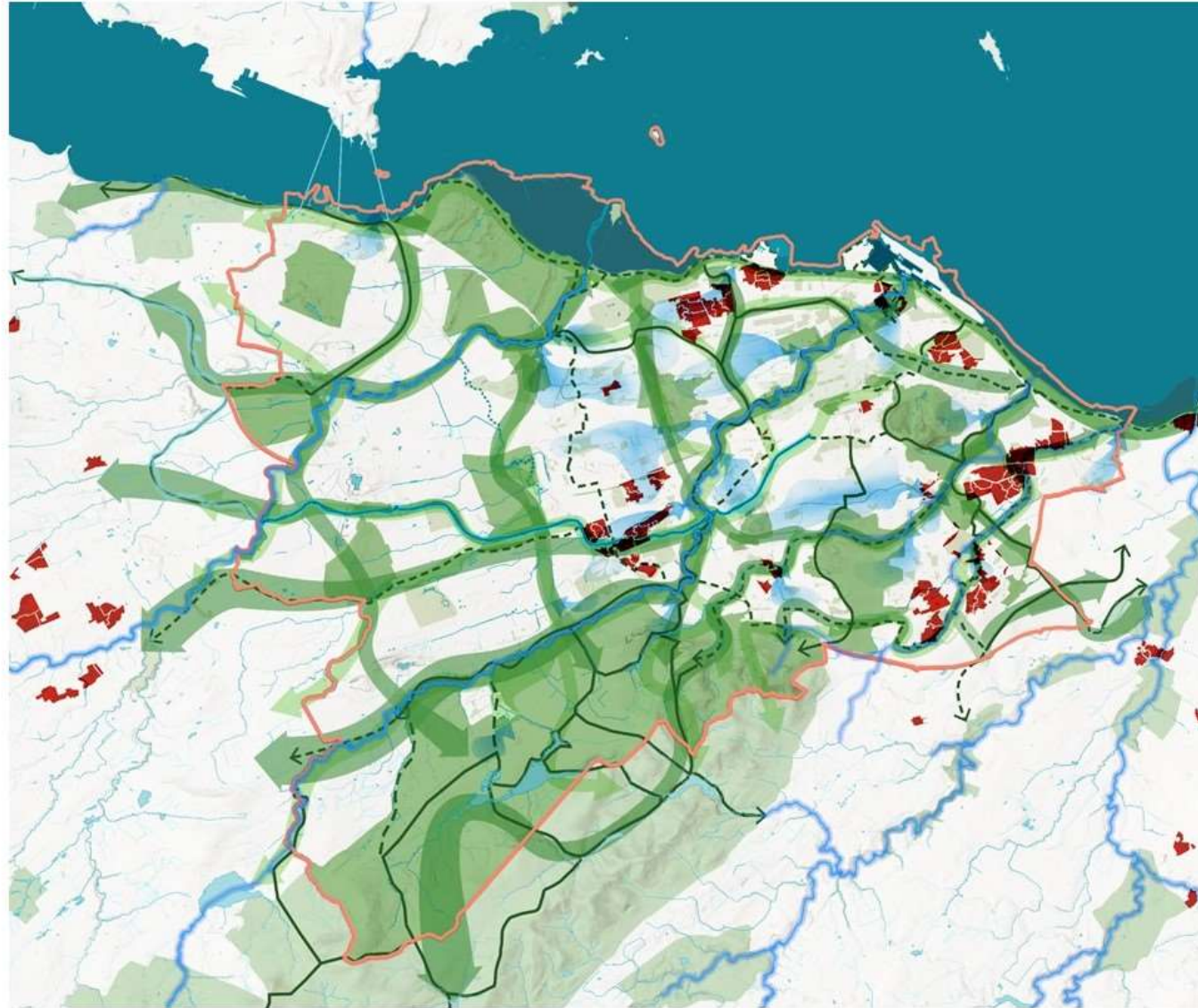
- Habitat connectivity
- Protected and priority habitats
- Green blue opportunity areas



Edinburgh's Strategic Green Blue Network

Value

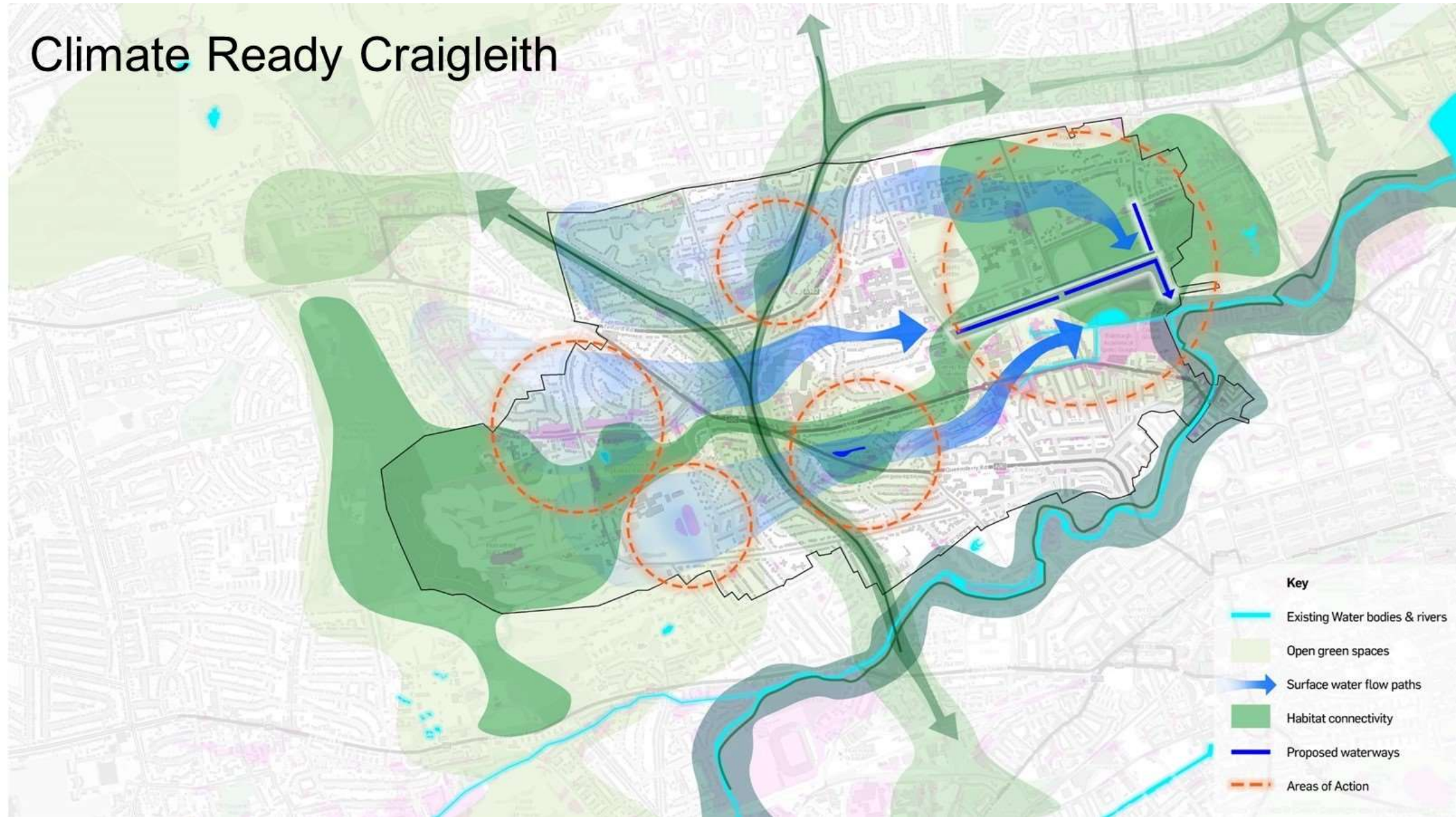
- Identifying green blue and blue green projects.
- Influencing policy
- Informing planning decisions
- Triggering actions to reduce flooding
- Supporting fair and equitable access to greenspace and nature
- Creating nature positive places
- Enabling a climate ready city

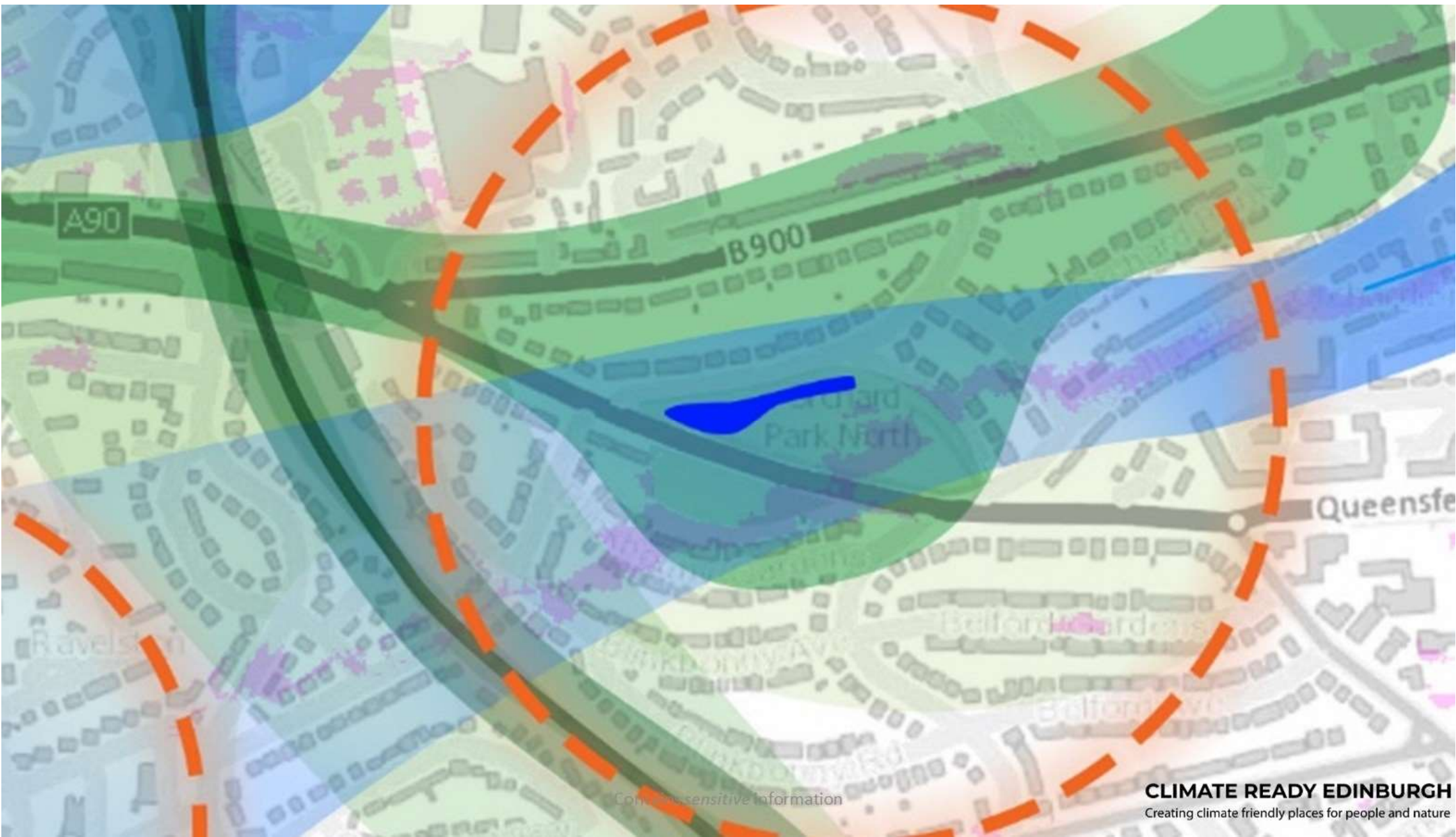


CLIMATE READY EDINBURGH

Creating climate friendly places for people and nature

Climate Ready Craigleith

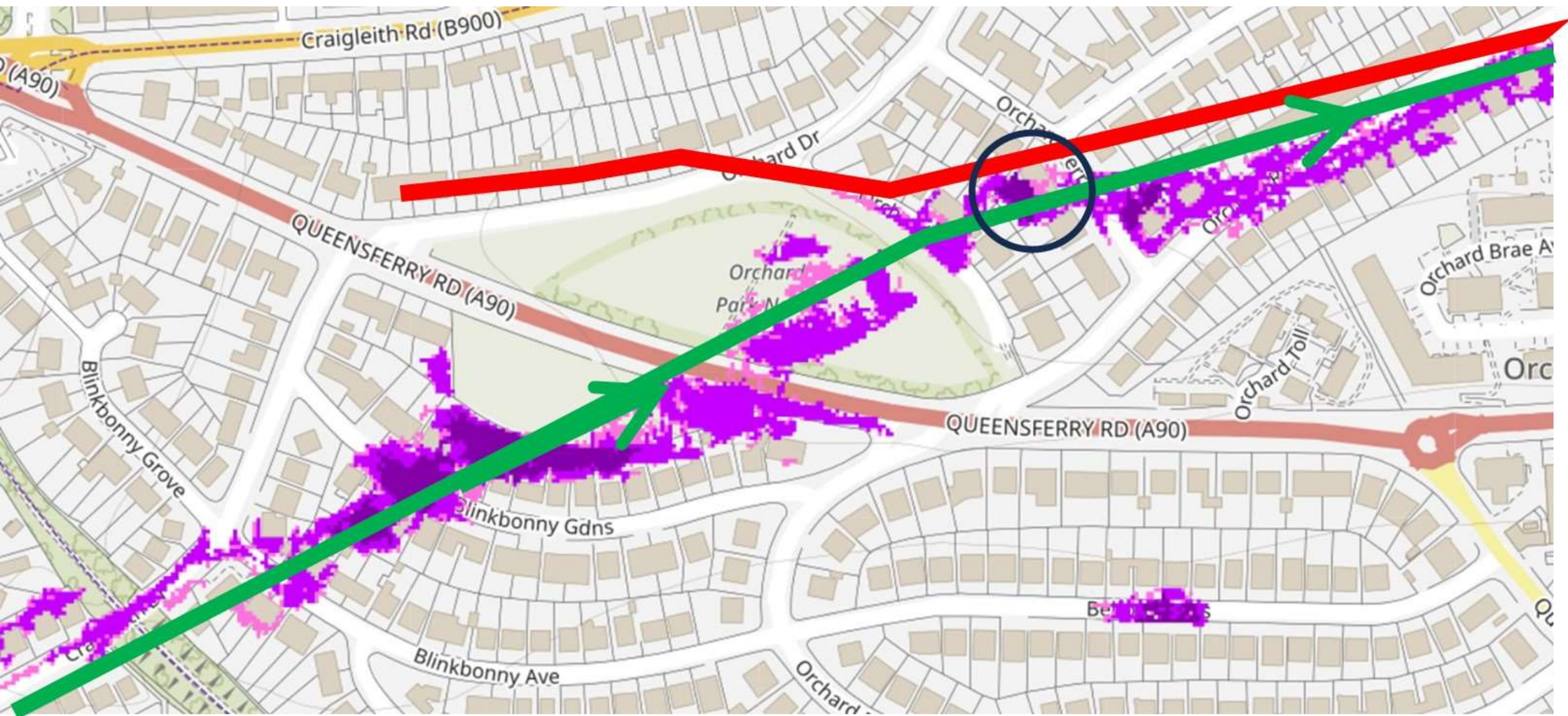




Complete sensitive information

CLIMATE READY EDINBURGH
Creating climate friendly places for people and nature



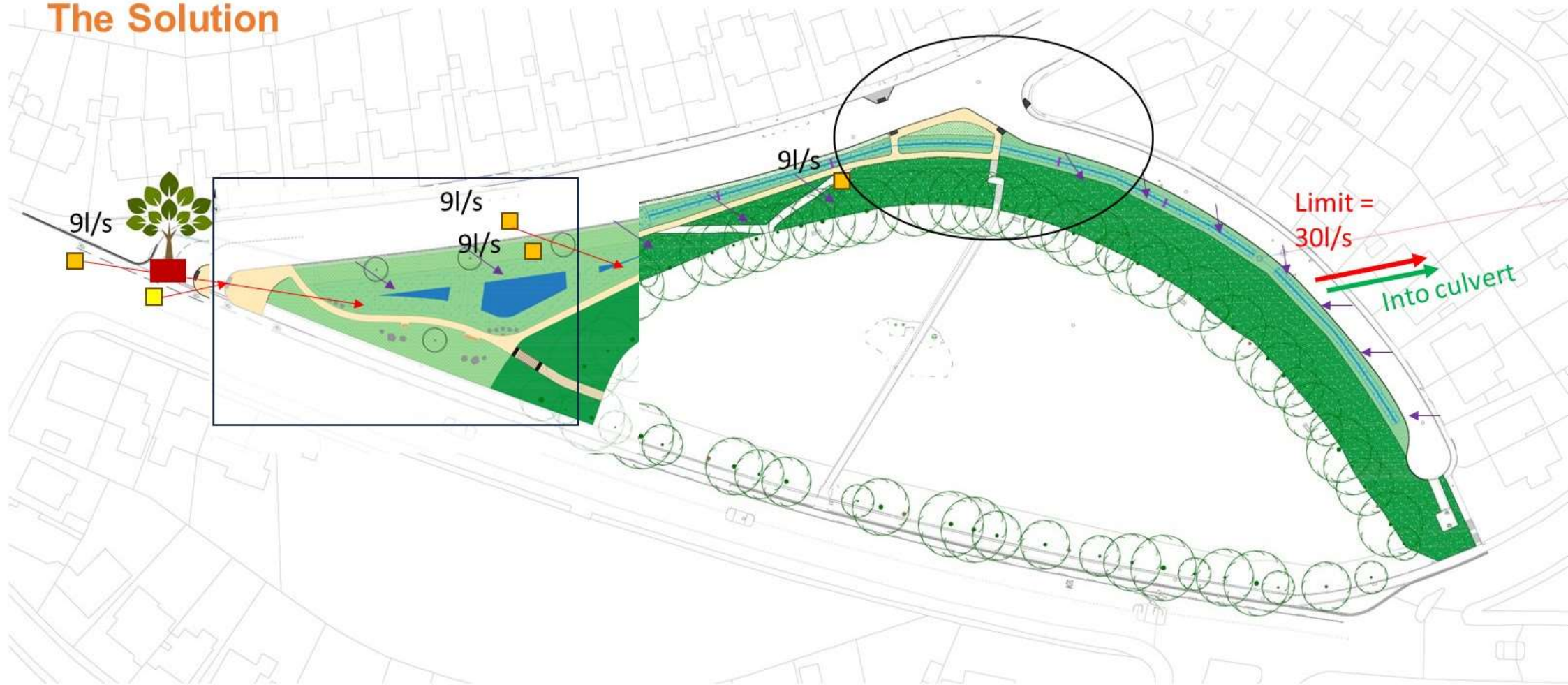


Contains *sensitive* information

CLIMATE READY EDINBURGH
Creating climate friendly places for people and nature

Climate Ready Craigleith

The Solution



CLIMATE READY EDINBURGH

Creating climate friendly places for people and nature

Climate Ready Craigleith

The Vision



CLIMATE READY EDINBURGH
Creating climate friendly places for people and nature



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Scotland's Flood Resilience Conference 2024

Session 2: Placemaking for Resilience

Lucie Stewart, SEPA

Sally Homoncik, AECOM



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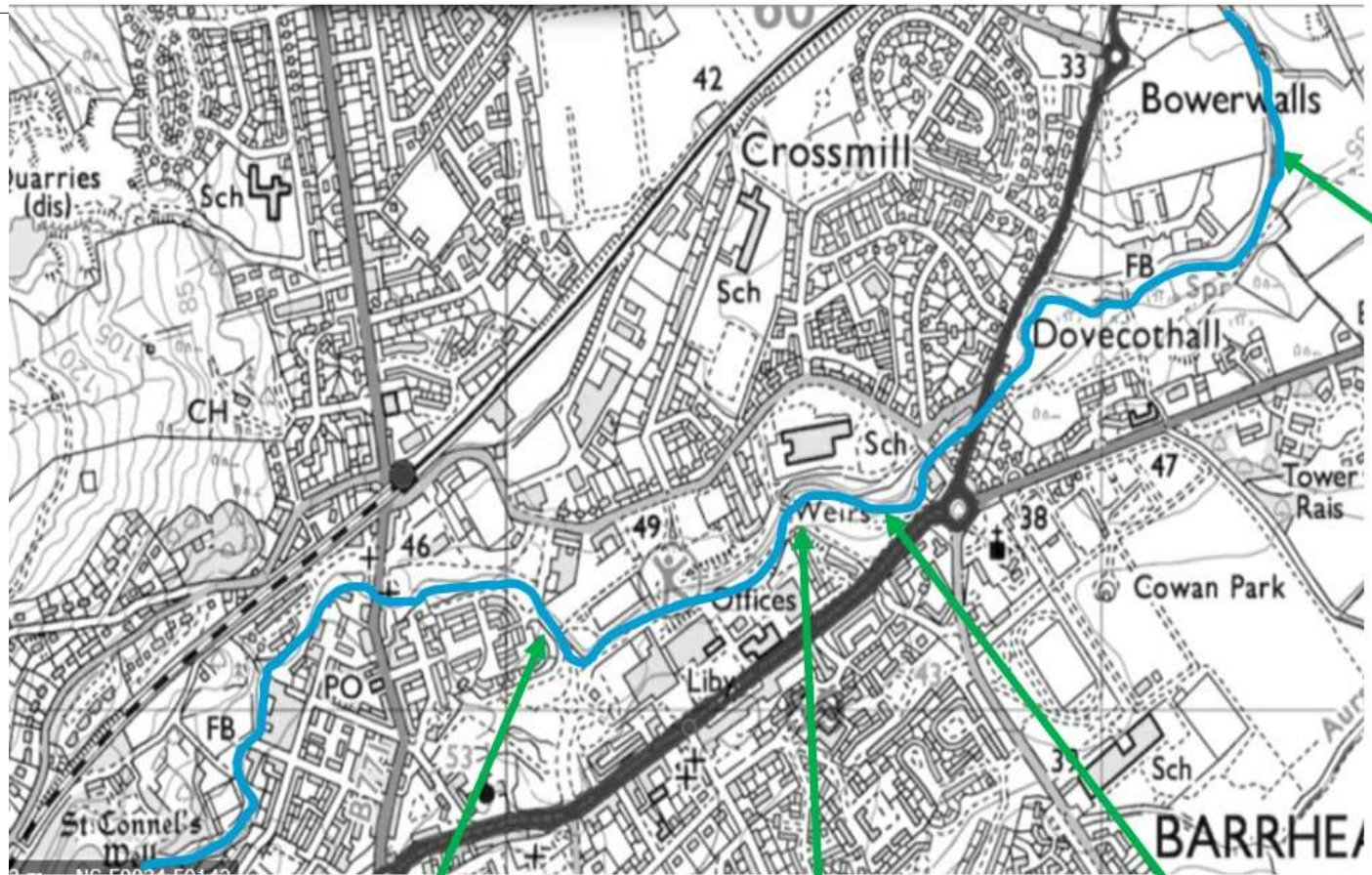
Levern Water River Restoration Project Barrhead

Placemaking for Resilience

Lucie Stewart, Water Environment Fund

Sally Homoncik, Aecom

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Cross Mill weir

Start of project

Calibar Park weir

End of restoration

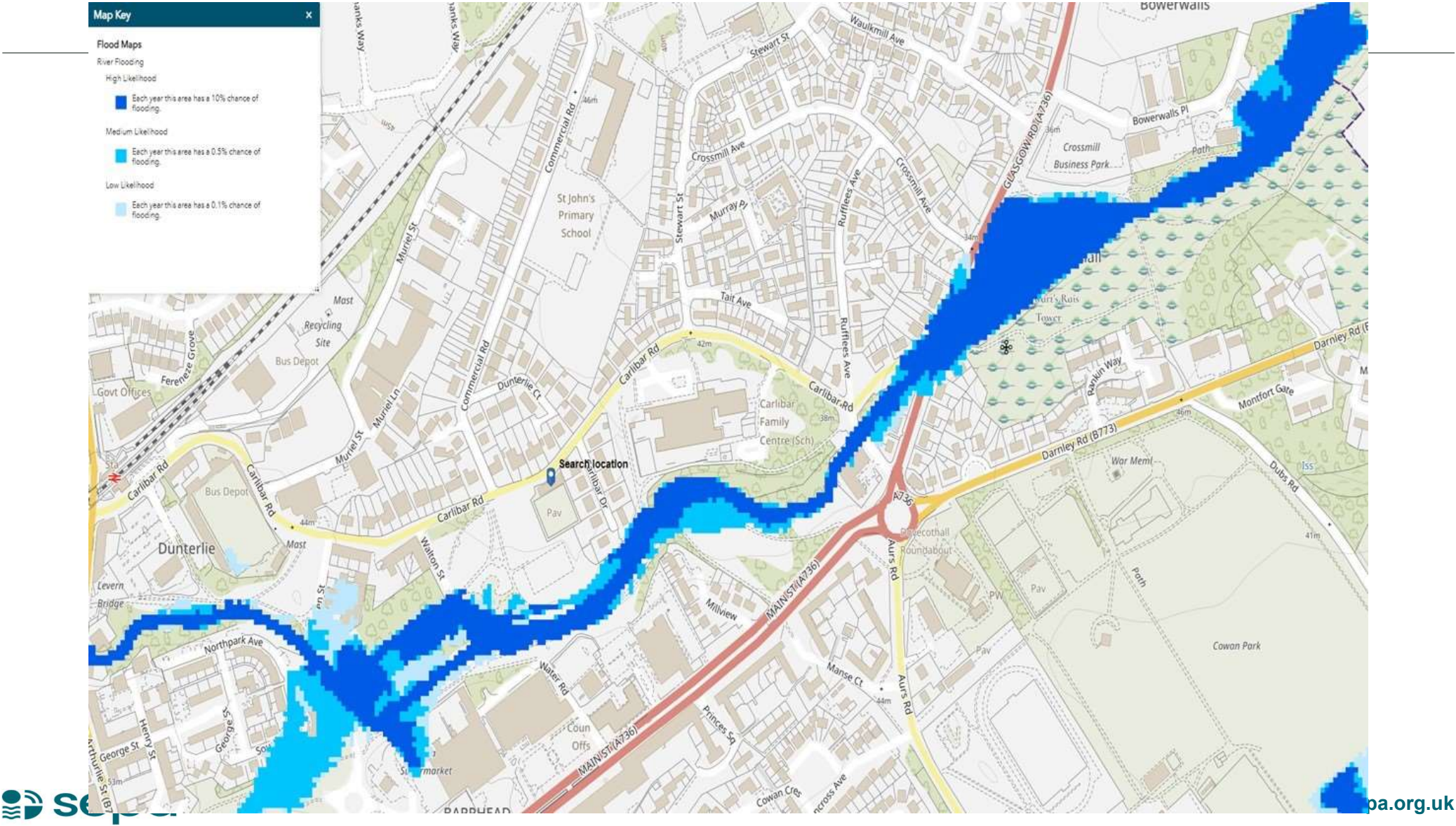
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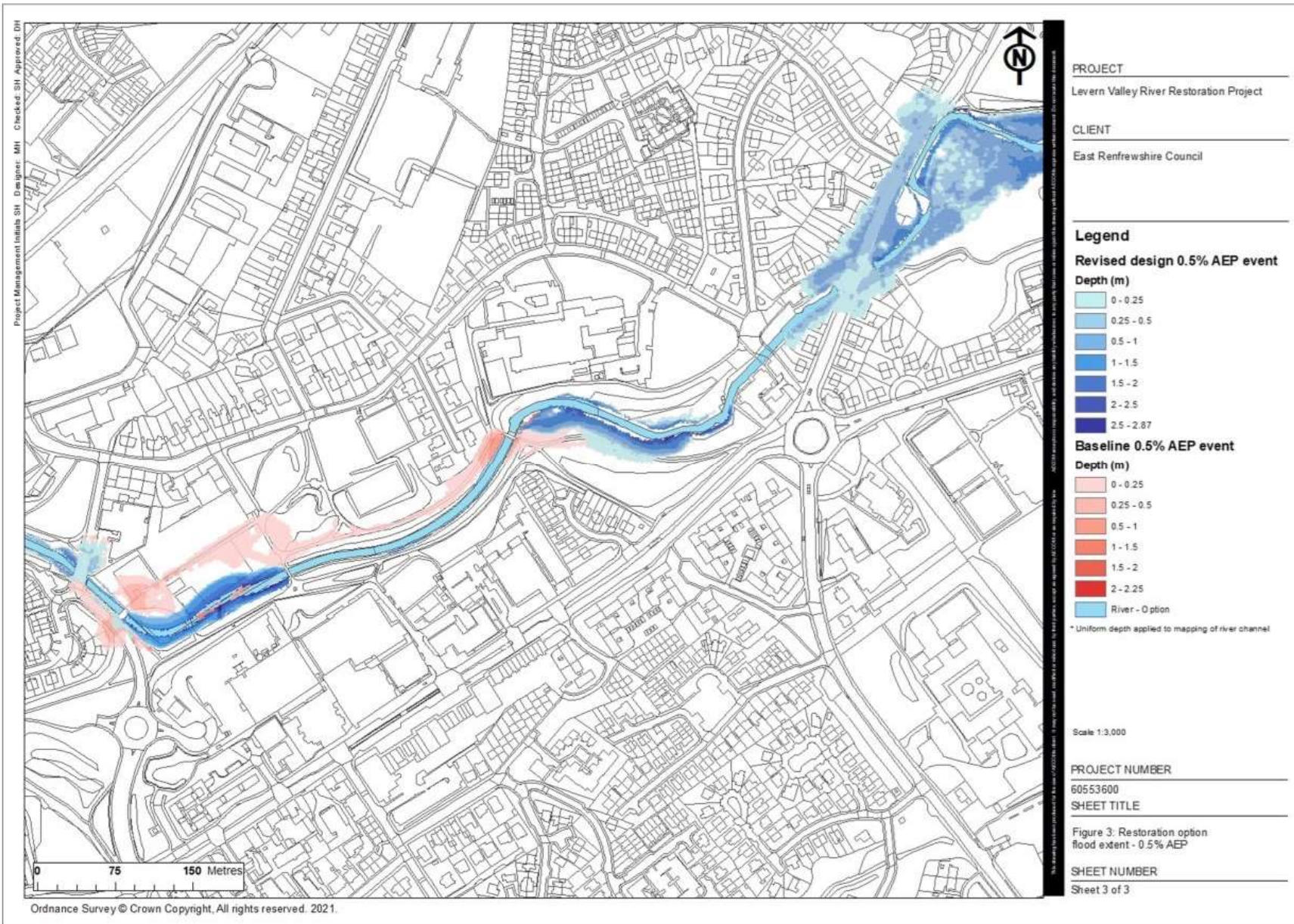


sepa.org.uk

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Flood Risk Change (0.5% AEP event)



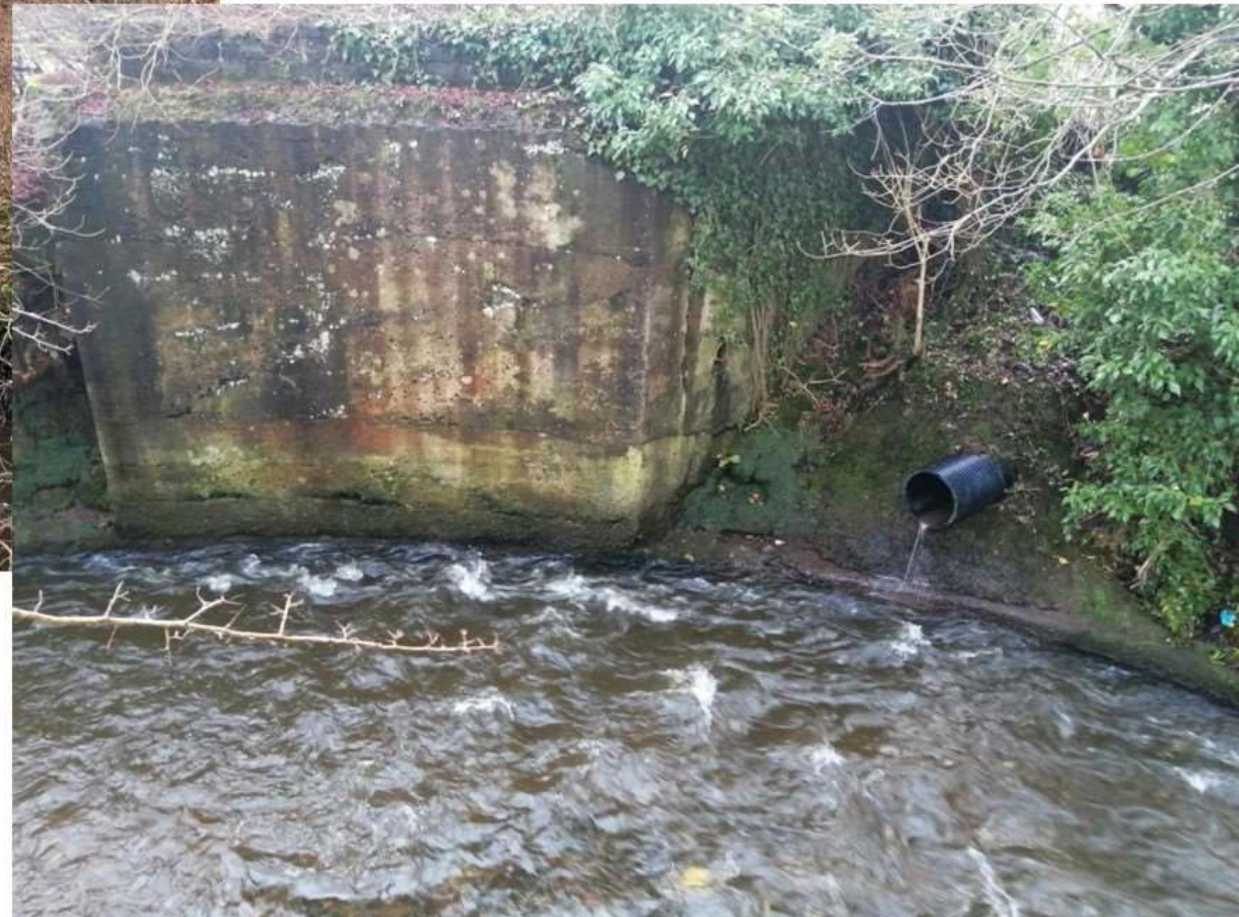
Flood Risk Impact of the Scheme

- Increased attenuation provision at Reach 2 compared to the baseline results
- Slight flood risk betterment both upstream and downstream (50%, 2% and 0.5% AEP events)
- Reach 2 - left bank flooding route from upstream Reach 2 to yellow bridge (weir location) is removed (minor flooding of park and footpaths mitigated)
- Reach 2 - floodplain is inundated much more frequently than baseline (at least 50% AEP compared to 2% in baseline)

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Site issues



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Challenges





Calibar Park weir

Two redundant weirs impassable to migratory fish also removed, with creation of riffles and pools and a backwater

Cross mill weir



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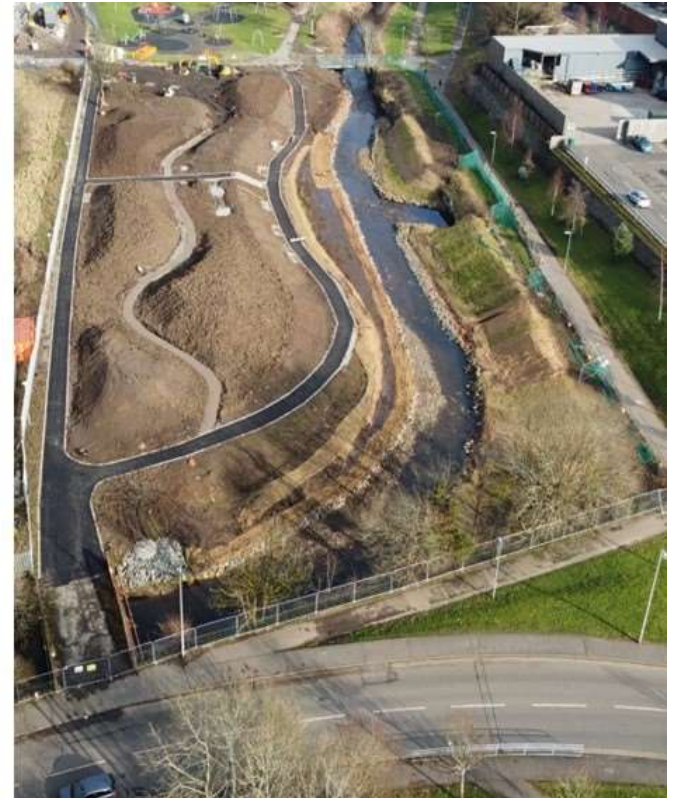


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One hectare of vacant and derelict land has been transformed, by moving contaminated soils, moving a sewer and creating a new river channel.

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Adaptation Outcomes

- Repurposing of vacant and derelict land
- Floodplain creation and reduced localised flooding
- New footpath network and greenspace
- Reuse of contaminated excavated material
- Raised awareness within community
- Tree planting
- Weir removal



The transformation



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Restored 1.5km of the Lavern Water
The Lavern Water has greater resilience to cope with heavy rainfall, preventing localised flooding

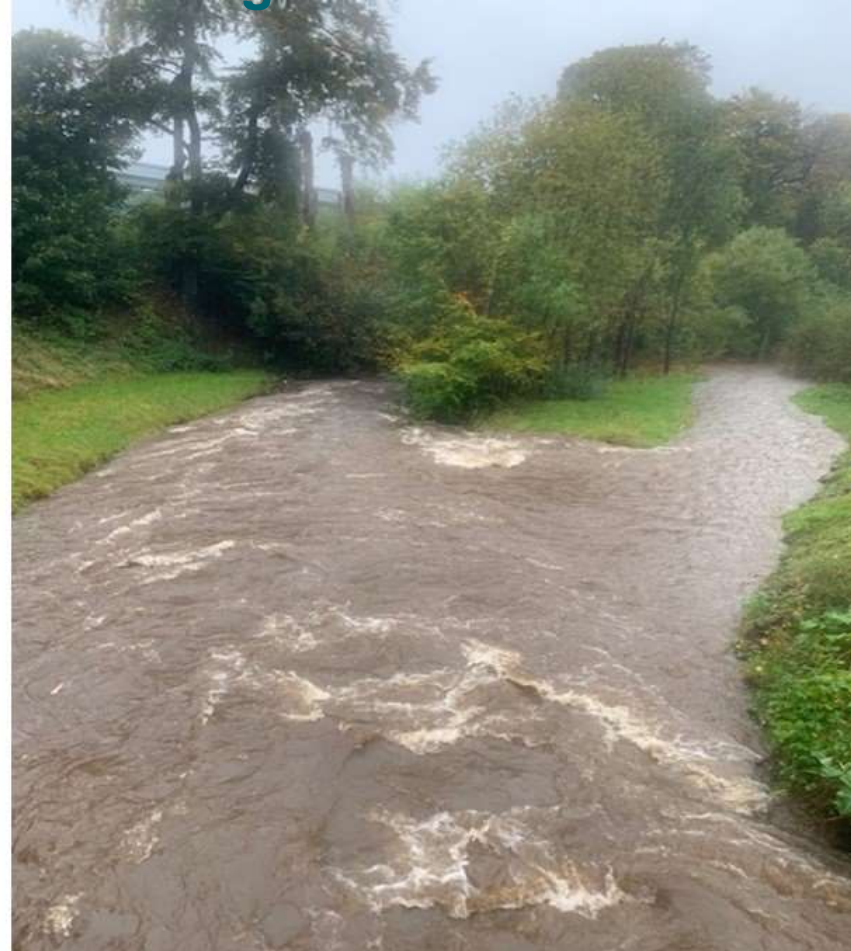


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Benefits of restoration to flooding



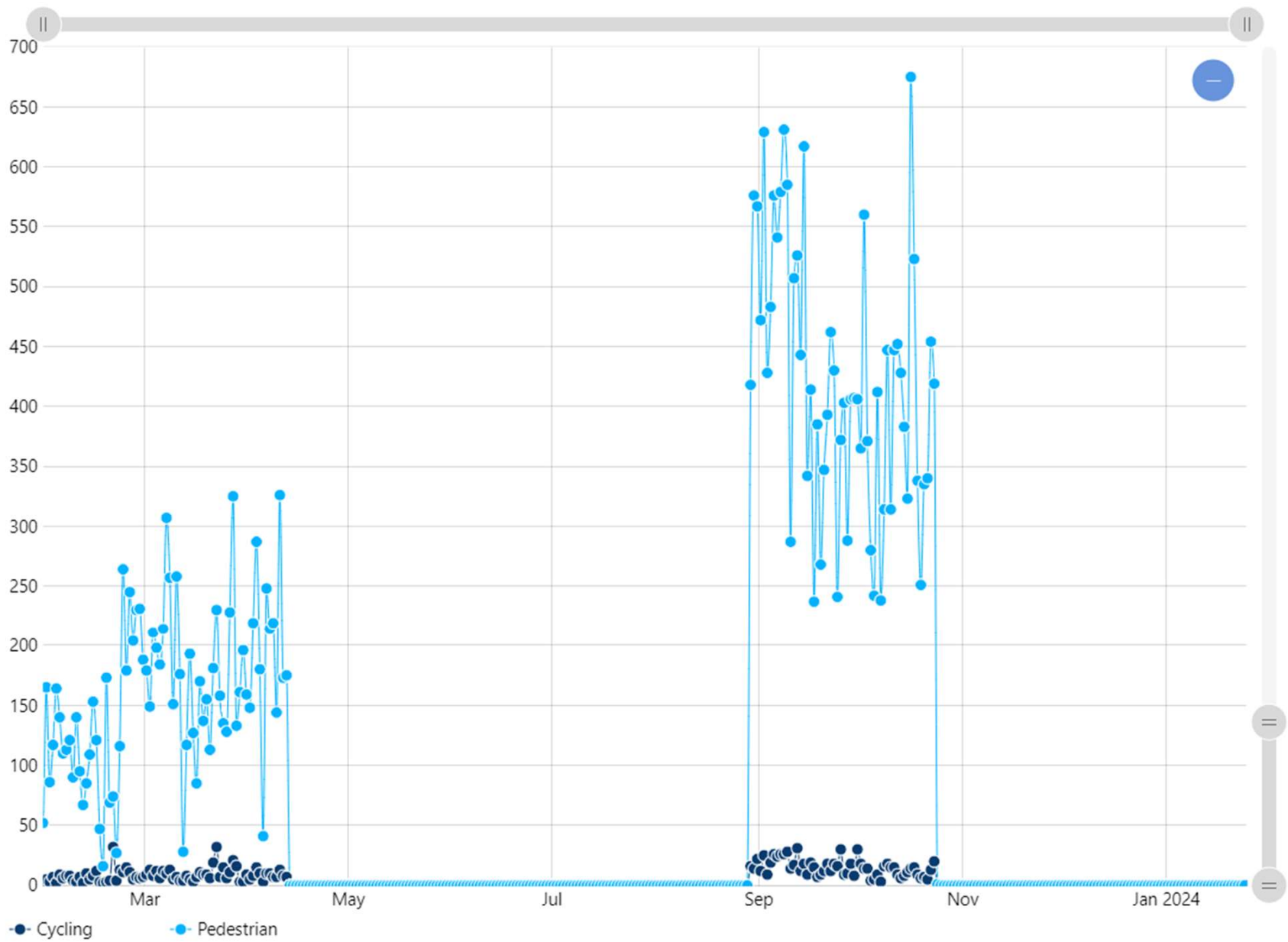
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Multiple benefits





Thank you

Contact details

Lucie Stewart
Restoration Specialist
Email: lucie.stewart@sepa.org.uk

sepa.org.uk





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Scotland's Flood Resilience Conference 2024

Session 2: Placemaking for Resilience

Geraldine Angus, Sweco

Gaye McKay, Glasgow City Council

Pauline Fletcher, Southside Housing Association



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Delivering Resilience in a new Urban Park

Gaye McKay
Pauline Fletcher
Geraldine Angus
8th February 2024

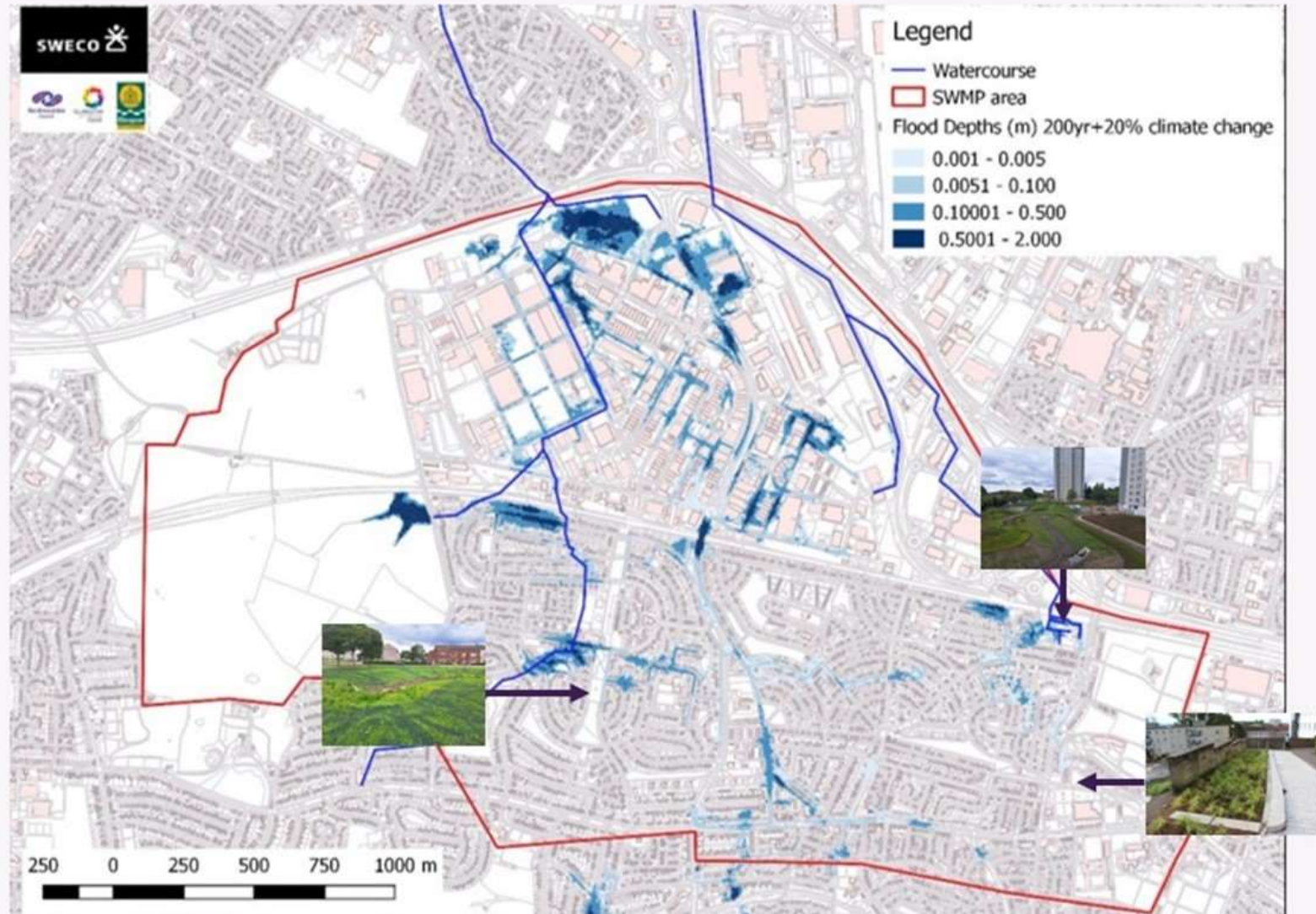


Project History

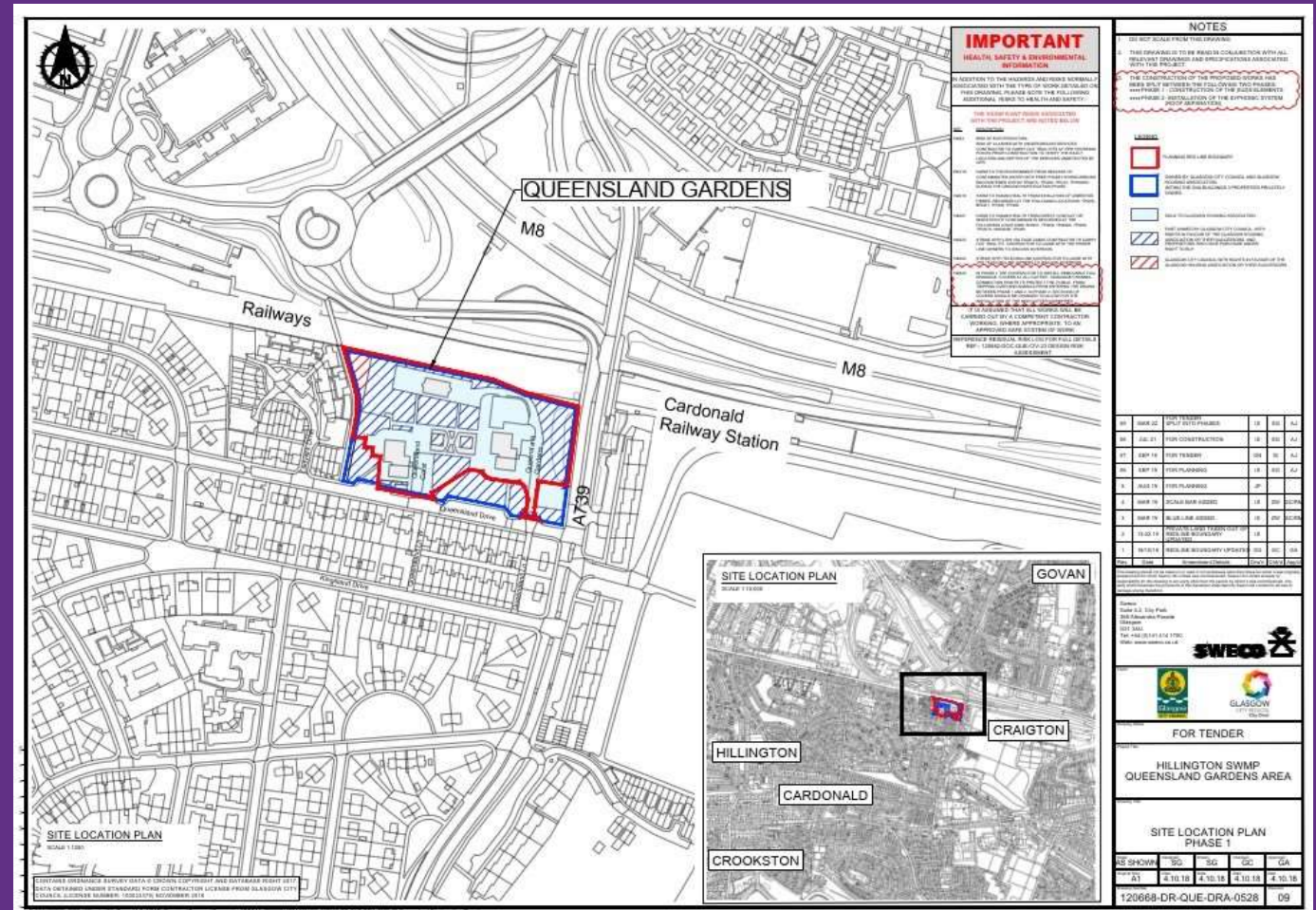
From SWMP to
integrated urban park



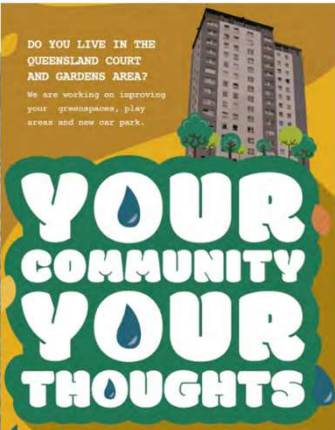
Setting – MGSDP – Hillington and Cardonald



Queensland Court and Gardens



Collaborative working and problem solving



Working with Southside Housing Association



Working with Renfrewshire Council



Working with Scottish Water



Working with NatureScot



Working with Network Rail – Basic Asset Protection Agreement



Working with Roads – Stopping Up Order



Working with legal - Land transfers and Collaboration Agreement



Working with Planners – Planning Permissions



Working with residents – Right to Buy Owners/ SHA tenants



Working with consultants – Detailed Design of SuDS = Sweco and Landscape Design = Raeburn Farquhar Bowen



Working with contractor – RJ McLeod

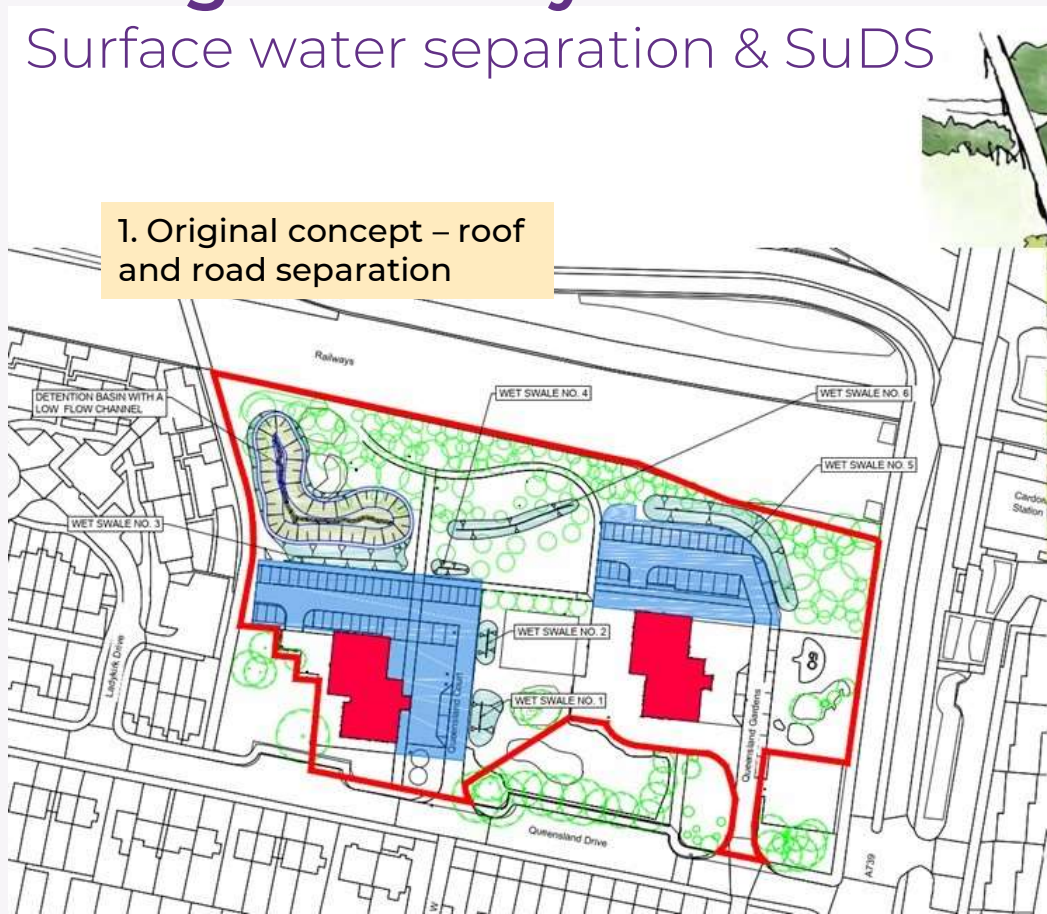


I'm Pauline Fletcher.

Design Journey

Surface water separation & SuDS

1. Original concept – roof and road separation



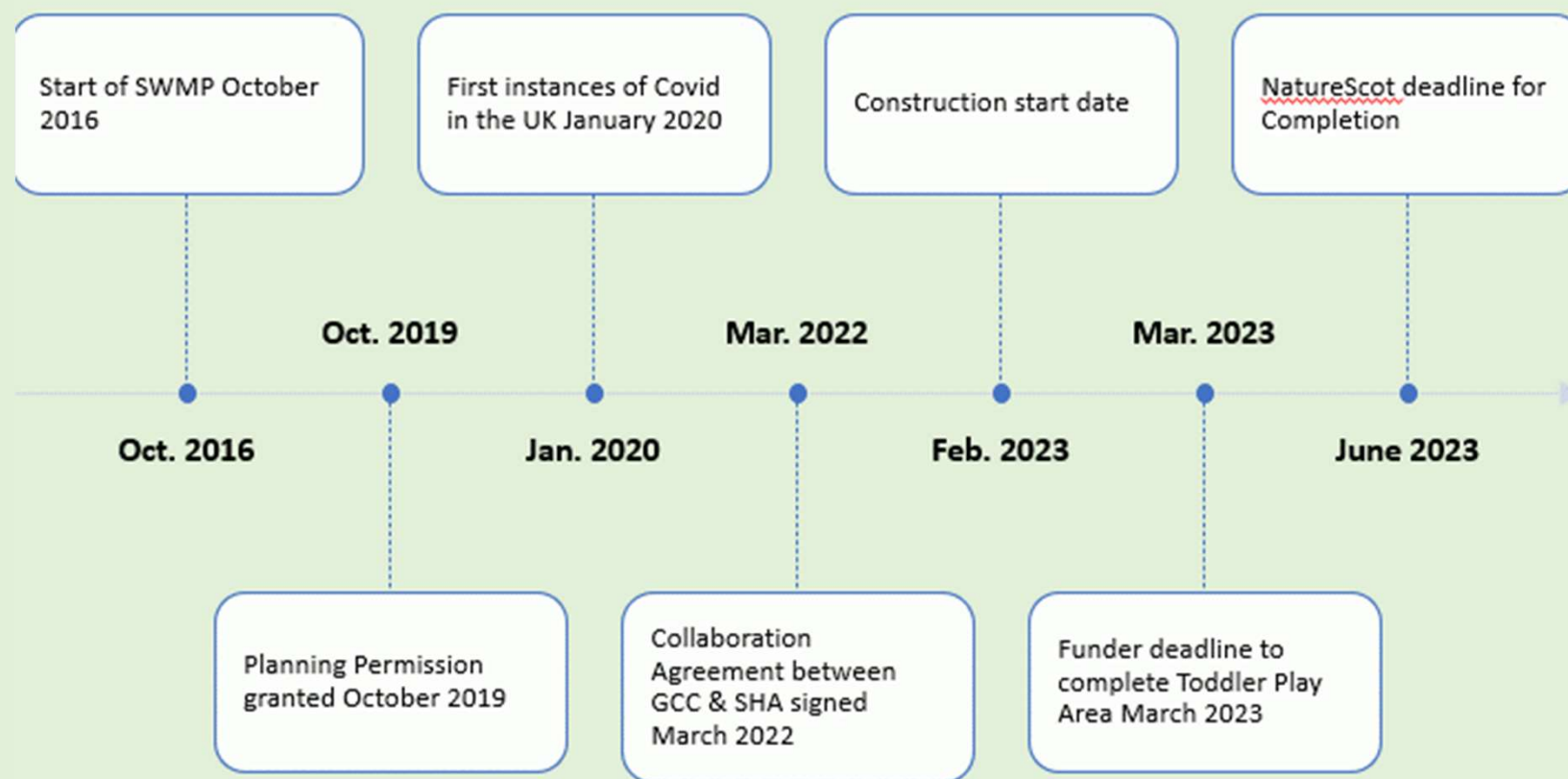
2. Additional Landscape Features



Final Design – post consultation



Timeline



Resilience Built In



Funding

Landscaping, &
placemaking



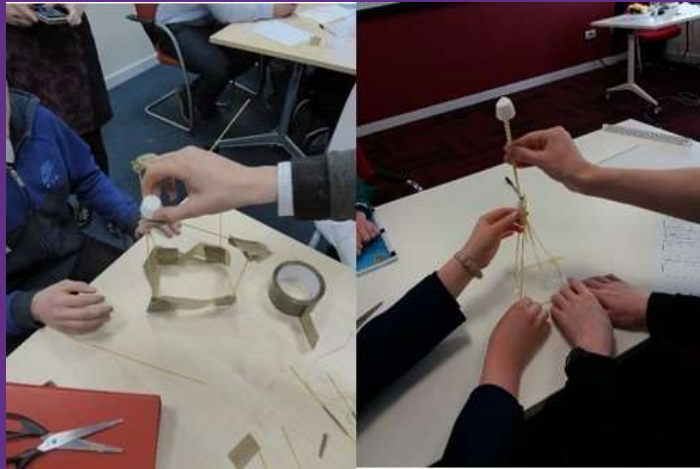
With thanks to:



Community Benefits



Job creation



School engagement



Time Capsule



Presentations

Placemaking & Resilience



Further information

<https://southside-ha.org/underused-greenspace-in-cardonald-transformed-into-vibrant-community-park/>

<https://youtu.be/GMvsxqeGLbE>

<https://www.sweco.co.uk/services/water-energy-industry/water-consultancy/water-management/resources/>



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Audience Q&A

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Coming up next...

Session 3:
Coastal change





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Scotland's Flood Resilience Conference 2024

Lunch and Market Place



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Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Chair: Will Burnish, Moray Council



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Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Alistair Rennie, NatureScot



Science update

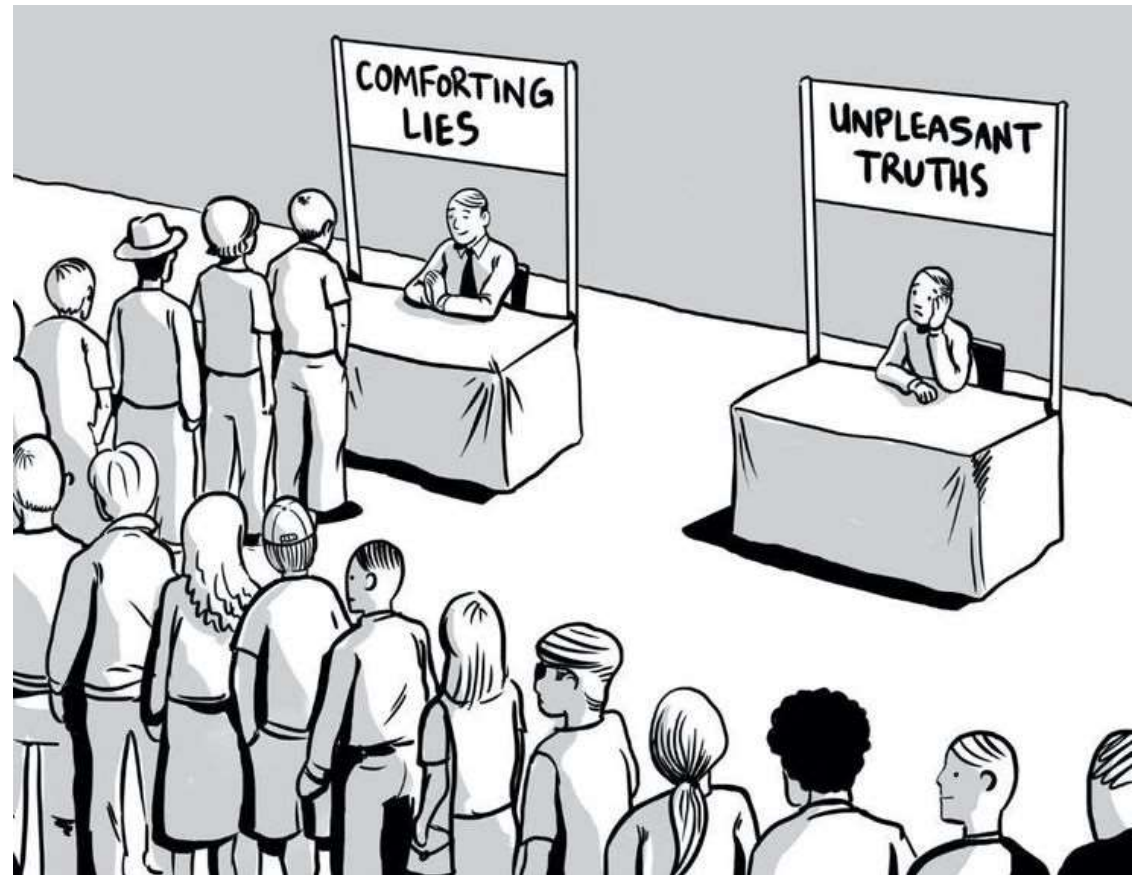
Coastal Change Adaptation @ FRM Conference 2024

Thursday 8th February 2024

Dr Alistair Rennie
DynamicCoast.com
DynamicCoast@nature.scot
@DynamicCoasts

Why is this important?

- People don't like change, uncertainty and bad news
- Our climate metrics are not improving & this matters to us all.
- We need to act now.

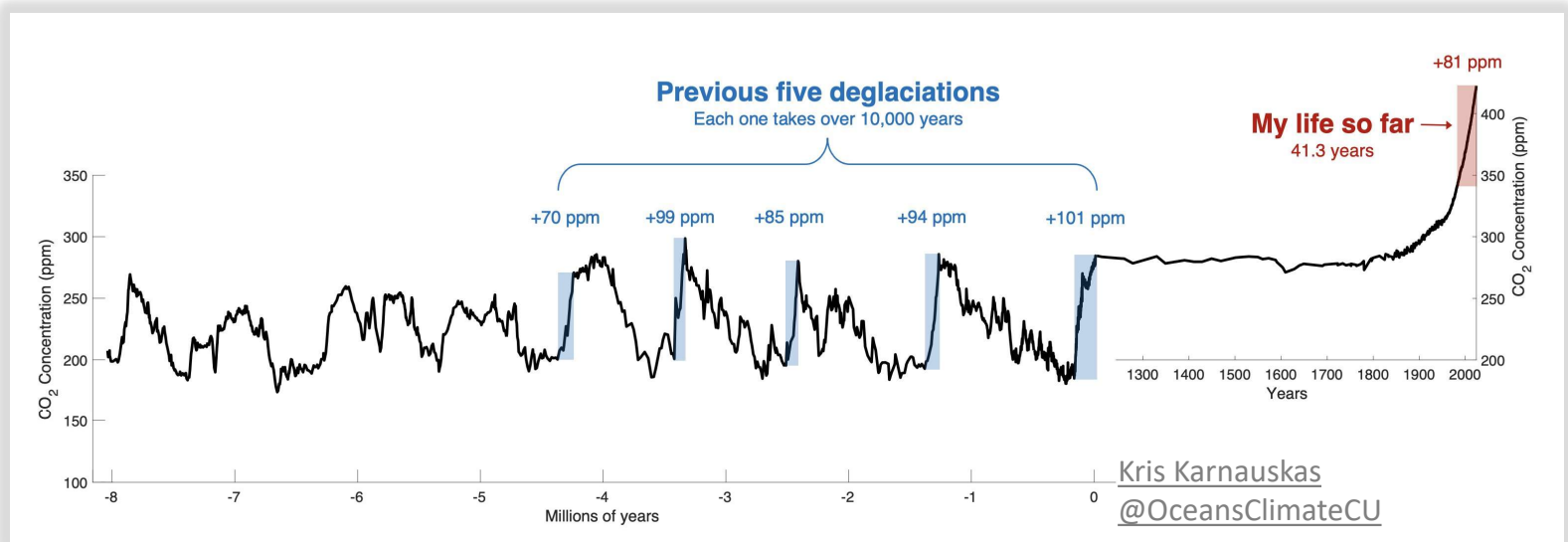
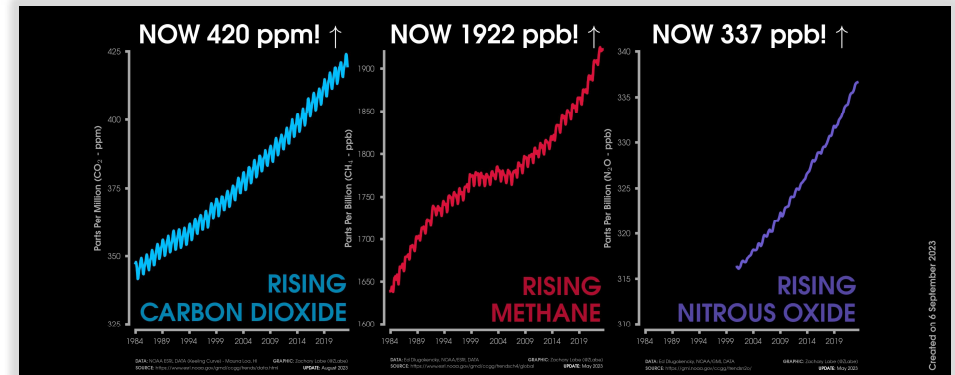
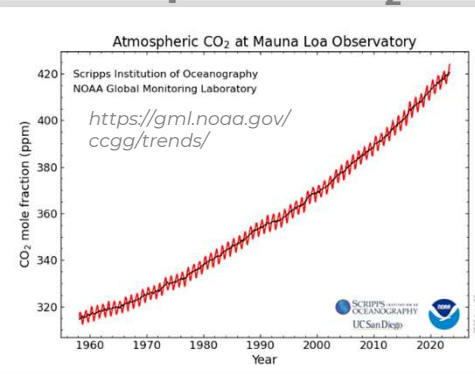


Climate observations

Anthropogenic
climate change
is:

↑ Global GHG,

Atmospheric CO₂

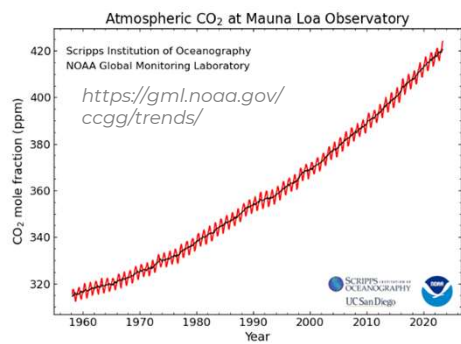


Climate observations

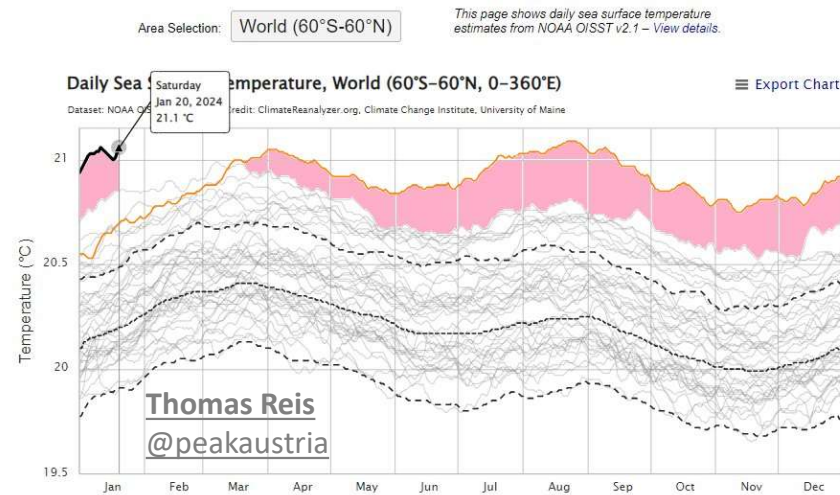
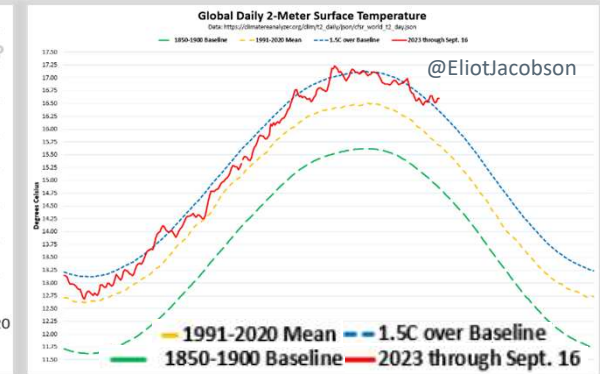
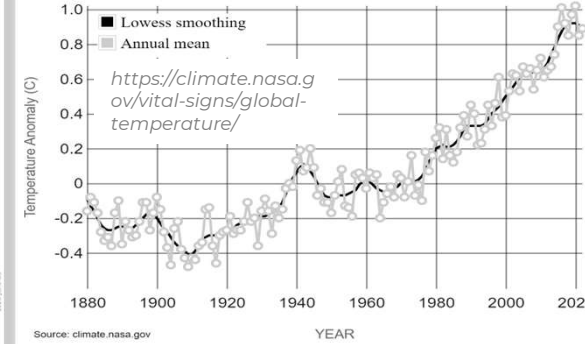
Anthropogenic climate change is:

↑ Global GHG,
↑ Global air and sea surface temperatures

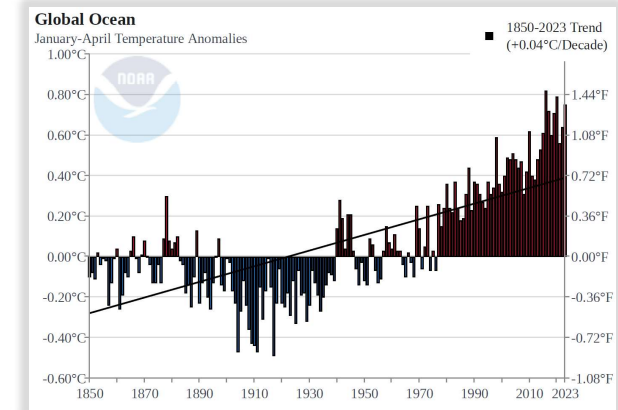
Atmospheric CO₂



Global atmospheric temperature



Global ocean temperature



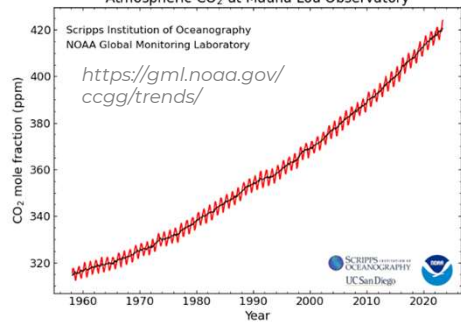
www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series/globe/ocean/yt/4/1850-2023

Climate observations

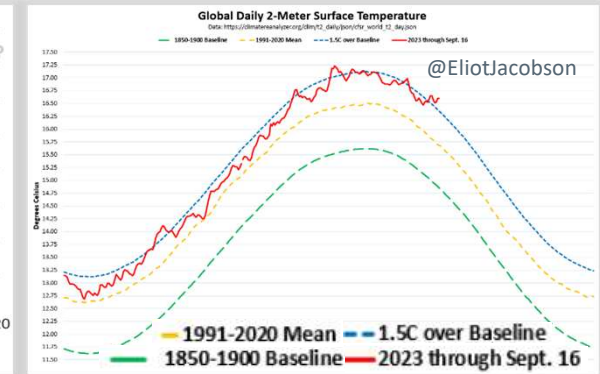
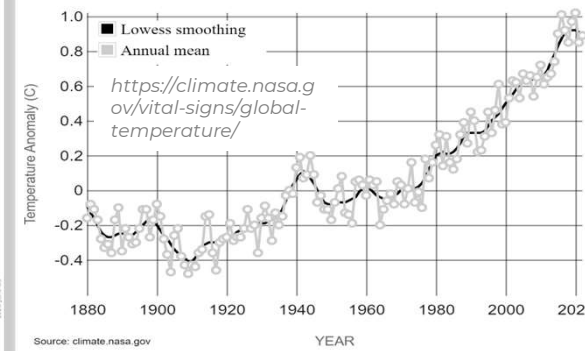
Anthropogenic climate change is:

- ↑ Global GHG,
- ↑ Global air and sea surface temperatures
- ↑ relative **sea level rise**:

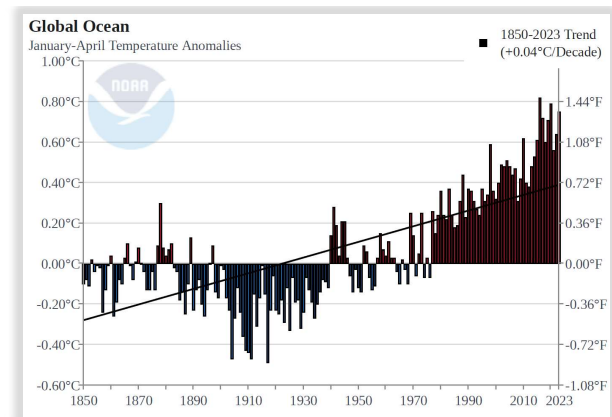
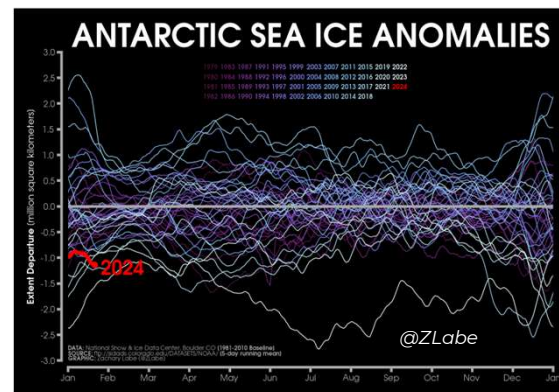
Atmospheric CO₂



Global atmospheric temperature



Global ocean temperature



www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series/globe/ocean/yt/4/1850-2023

Climate observations

Anthropogenic climate change is:

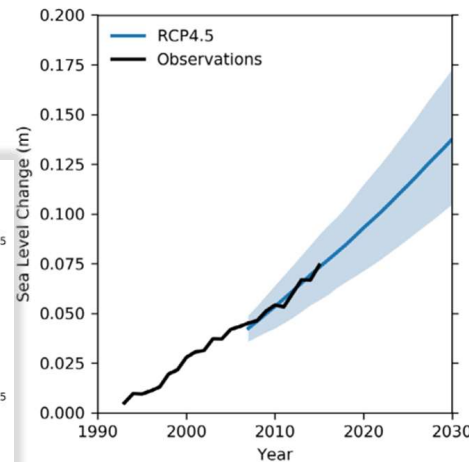
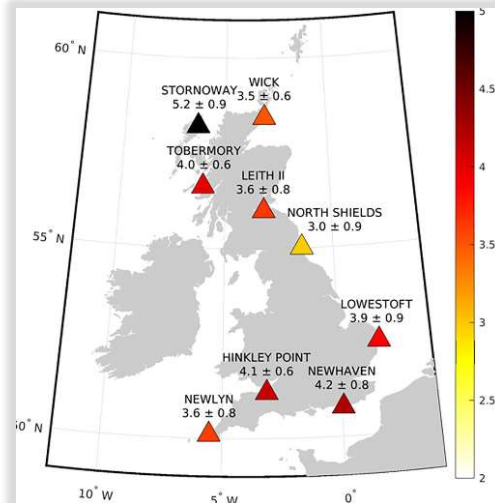
- ↑ Global GHG,
- ↑ Global air and sea surface temperatures
- ↑ Relative sea level rise:

Now faster than UKCP18 expectations.

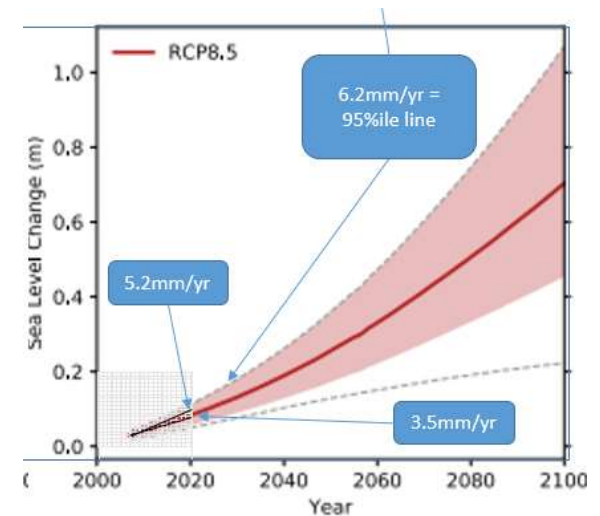
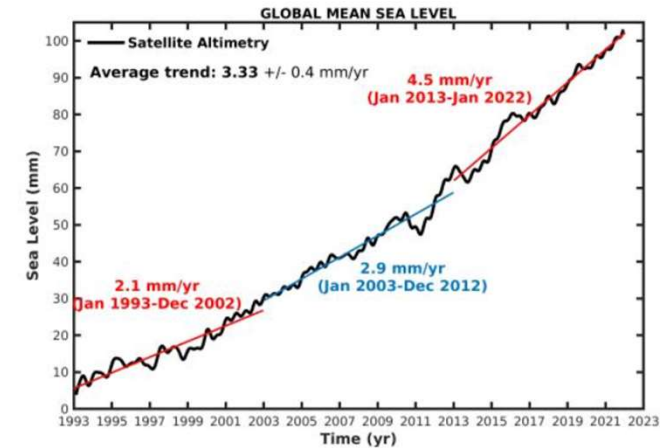
RCP8.5 95% isn't the worst case,
We may already be on track with it!
This is why CCA Guidance says use a range of #.

In 2018 UKCP18 demonstrated that Global MSLR was occurring at 3mm/yr in line with RCP4.5 central estimate.

Relative sea level rise
3.6-5.2mm/yr in Scotland



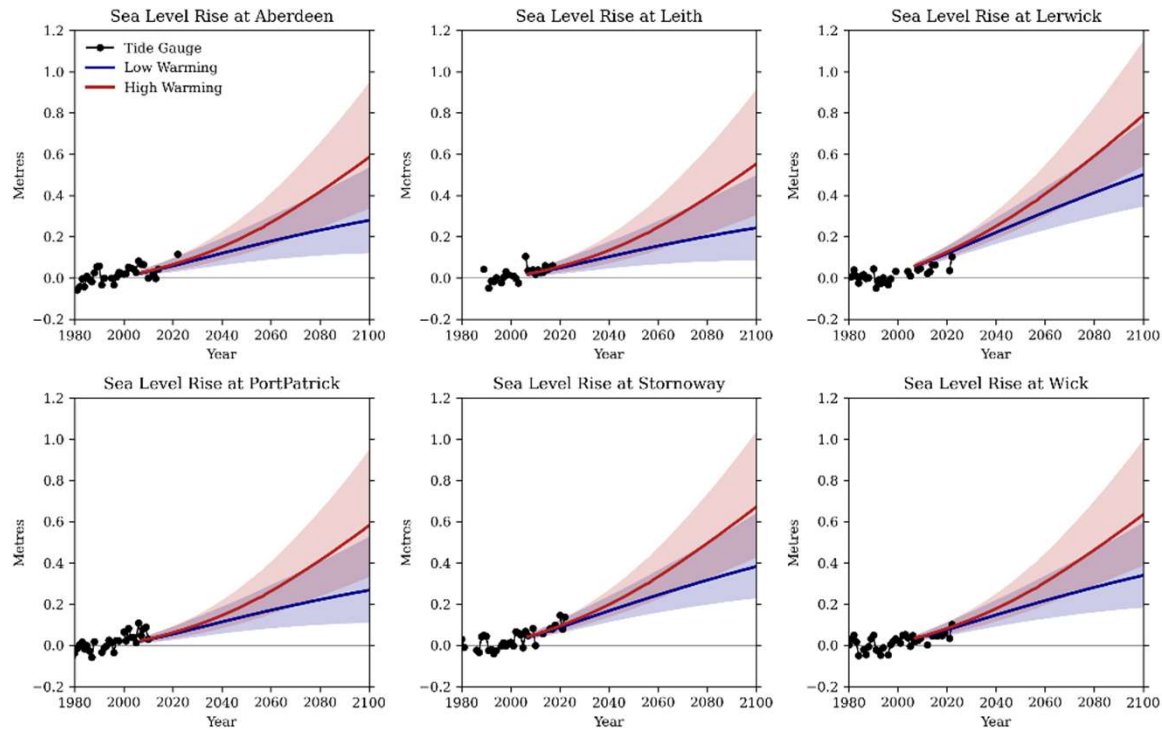
MetOffice (2022)
<https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.7787>



Implications

Sea level does not stop at 2100

(Matt Palmer, Mett Office)

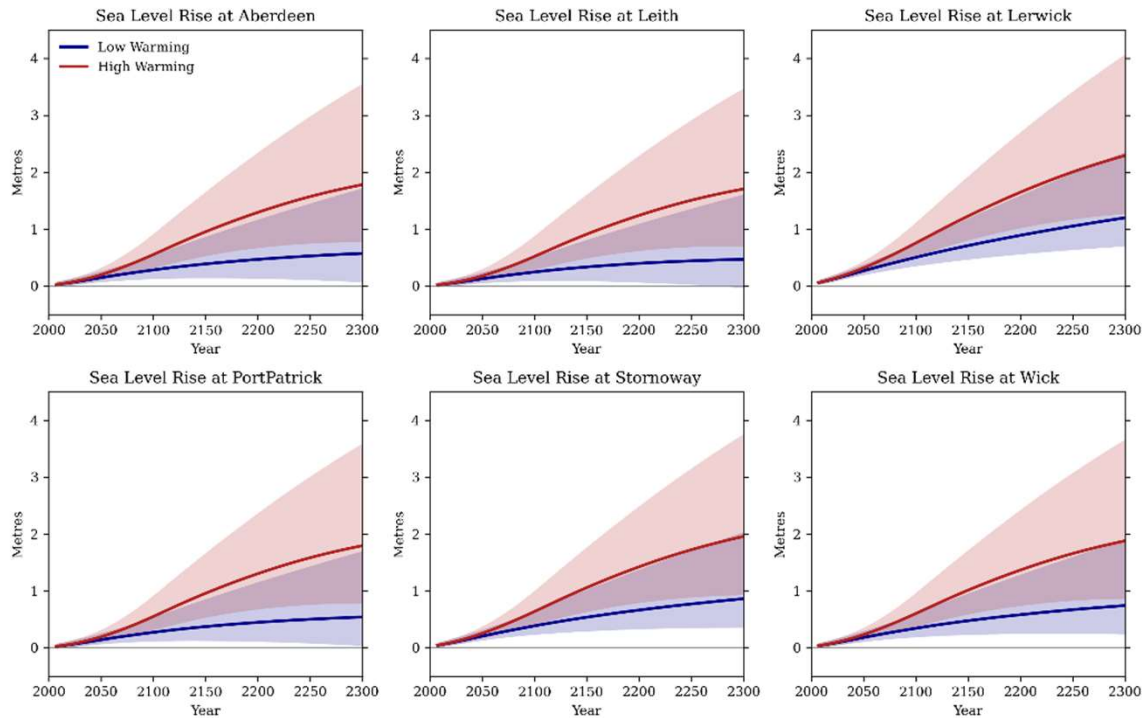


Data source: UKCP18

Implications

Sea level rise continues to 2300

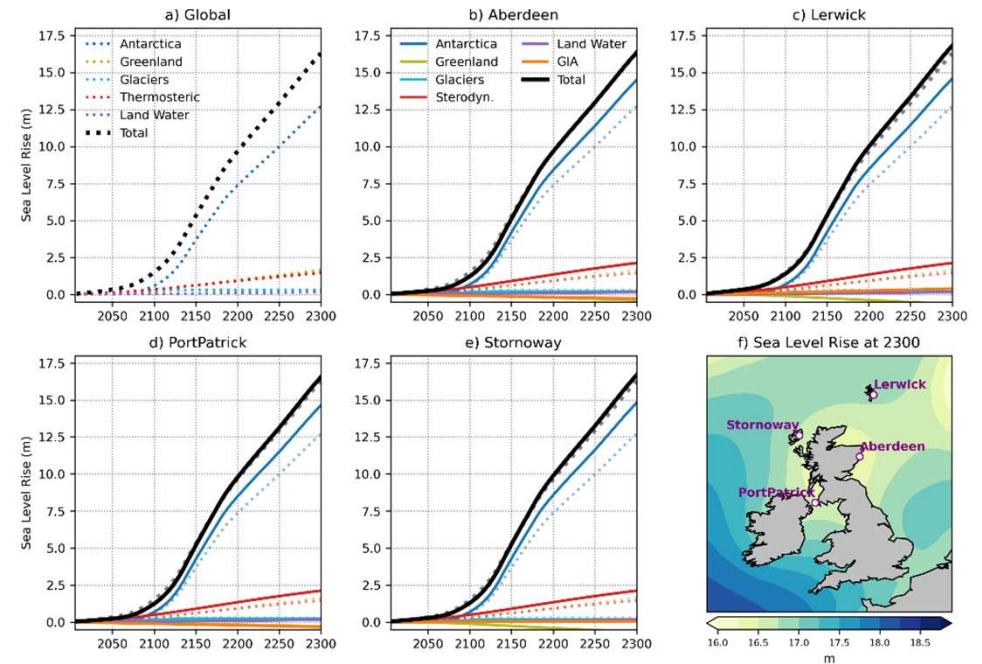
(Matt Palmer, Mett Office)



Data source: UKCP18

High-end scenarios are even more concerning

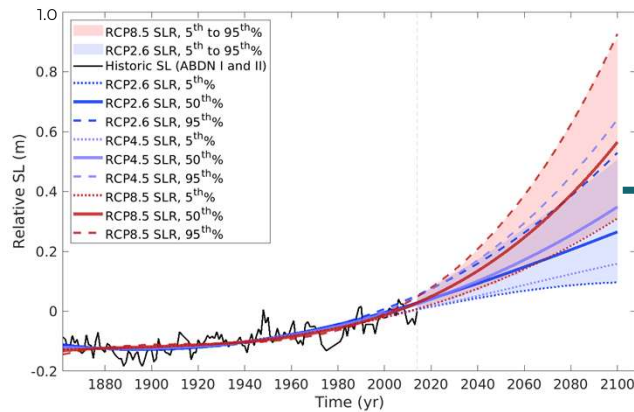
(Matt Palmer, Met Office)



Data sources: Palmer et al (in revision); IPCC AR6

Implications

Sea level (Aberdeen)



Flooding (surge heights) increasing, Aberdeen [\(Sniffer 2008\)](#)

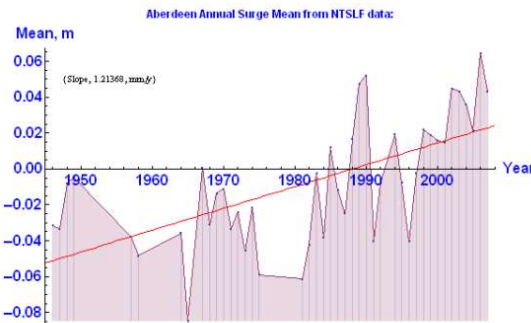


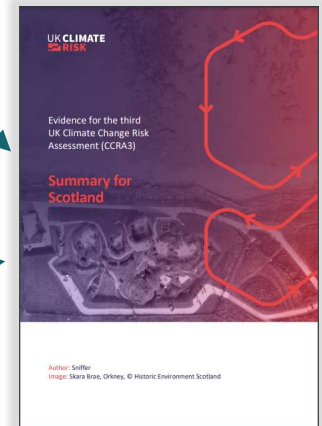
Figure 23 Mean surge level at Aberdeen

Phasing with
spring tides &
surges



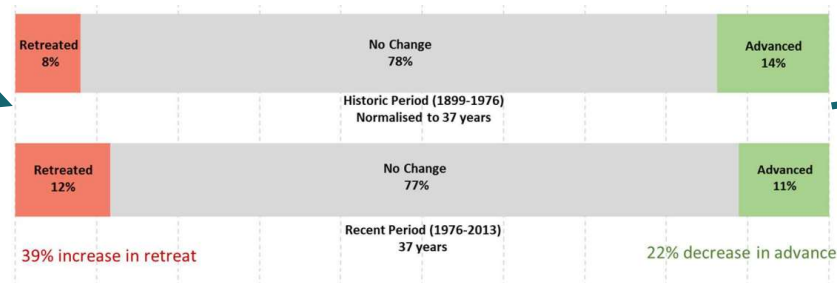
Coastal
erosion &
flooding, one
of Scotland's
most severe
climate risks.

(CCC 2021)



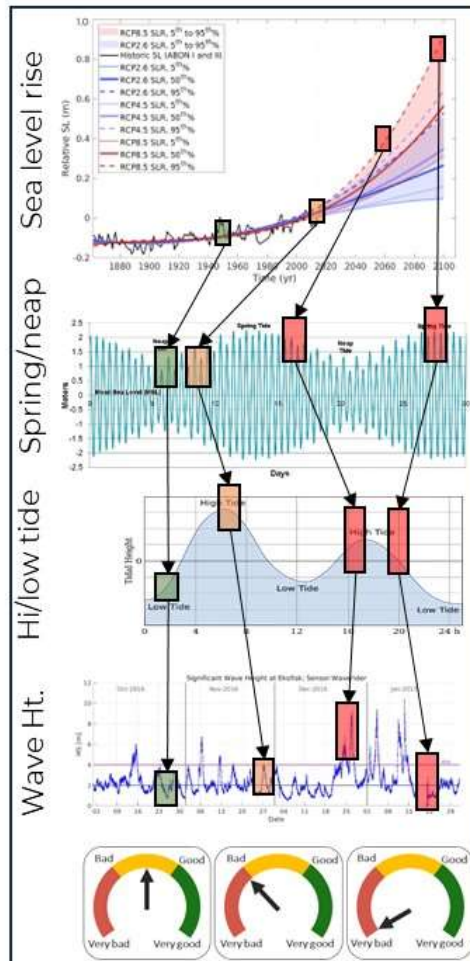
Phasing with
spring tides &
surges

Increasing extent of erosion in Scotland [\(Dynamic Coast 2017\)](#)

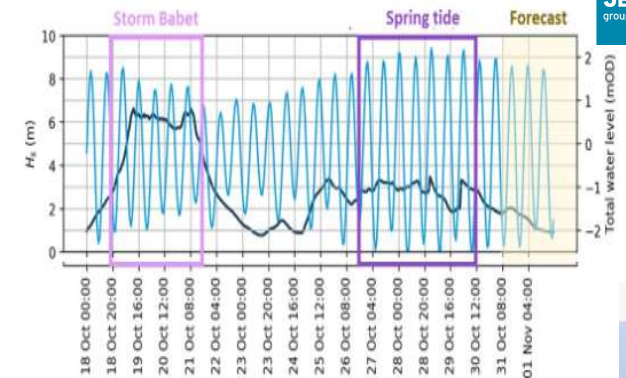


What does this look like?

- Our coast is a 4D complex space, where phasing and antecedent conditions are critical.
- RSLR underlies, tides, surges and waves.
- We are rolling the dice every day, without even knowing it.

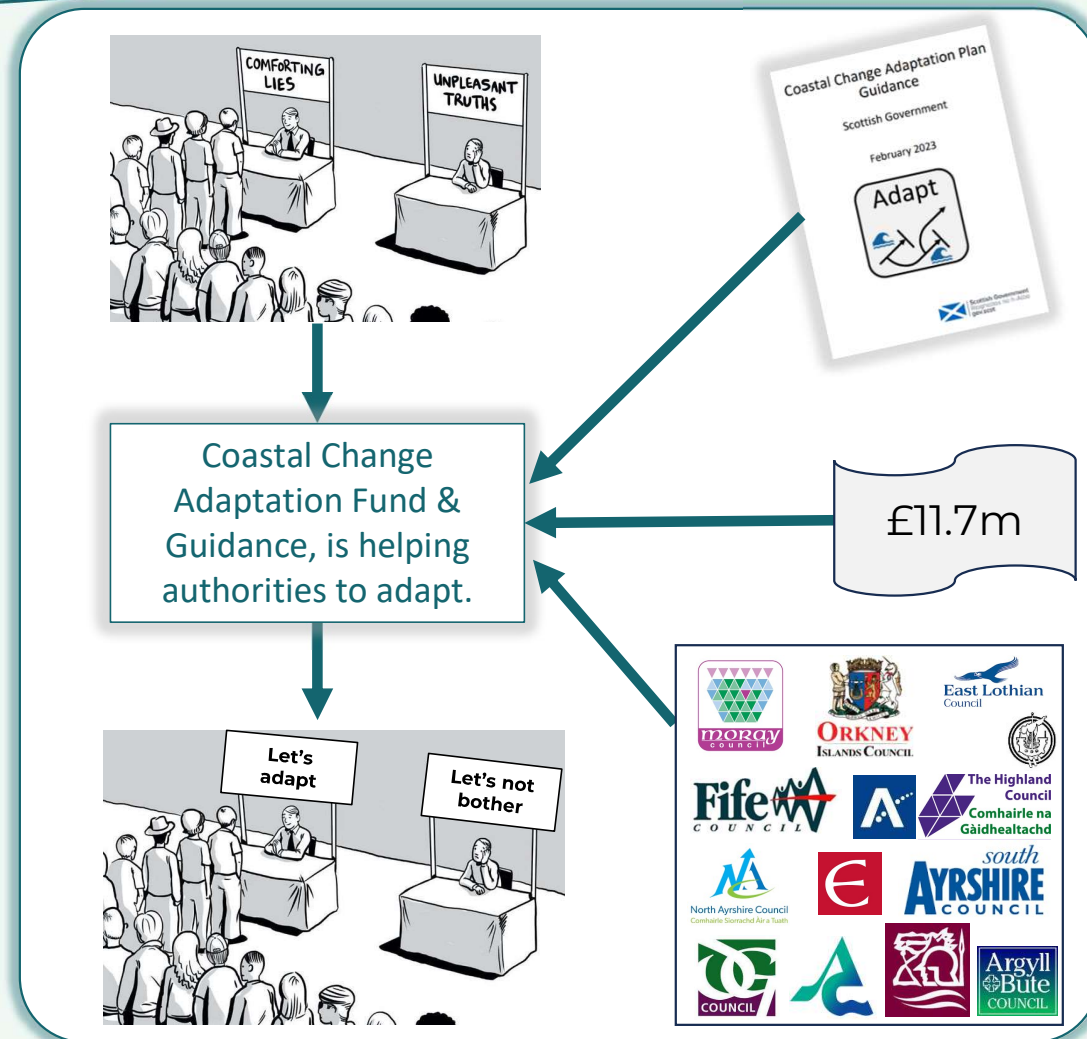


Storm Babet (+week after)
50+ impact locations



What we do now is important

- Which of these 'futures' do we want versus what we plan for? Incl. precautionary principle.
- As a community we need to inform public & decision makers to support sensible & sustainable options.
- CCAP (& FRS) are the mechanisms to do this. Let's explore and set the policies and trigger points, adapt as events unfold and keep on incorporating the latest science.
- I hope you will appreciate the practical adaptation steps our peers are starting to take. Some of us are turning this around.
- Visit **DynamicCoast.com** and click '**Adapt**' to see the progress!





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Tracy McKen, Scottish Government



Tracy McKen

Senior Policy Advisor

Water Environment and Resilience Team



Scottish Government
Riaghaltas na h-Alba
gov.scot

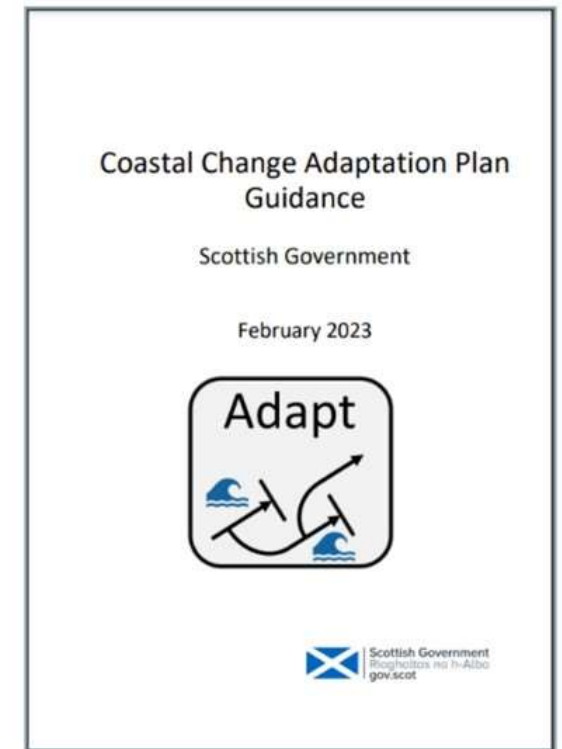
Coastal Adaptation and Wider Policies

- Scottish National Adaptation Plan (SNAP3)
- National Planning Framework 4
- Flood Resilience Strategy
- Placemaking – Place Principle



Coastal Change Adaptation Planning

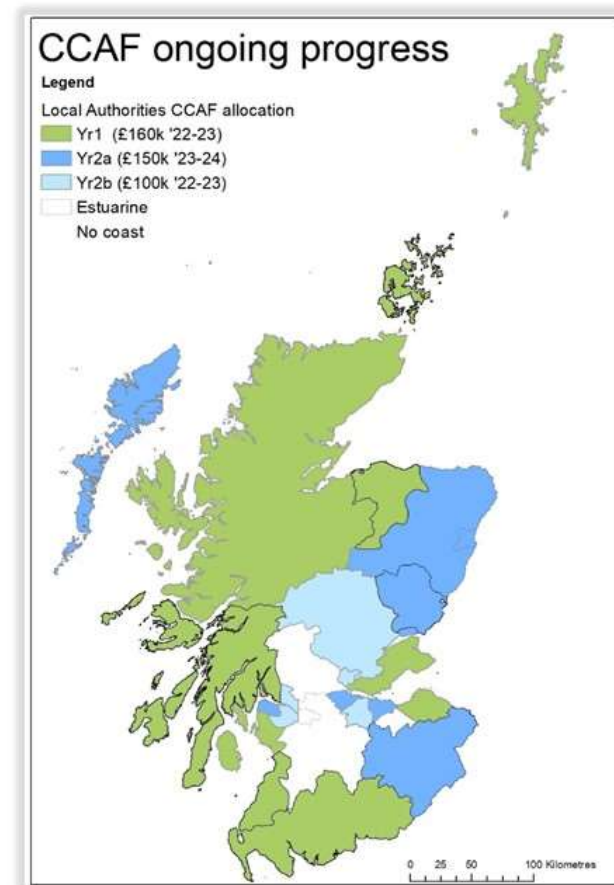
- Dynamic Coast (DC2) has identified the risks
- August 2021 – Funding for CCAP announced
- £11.7m over four financial years
- CCAP Guidance published Feb 2023



Coastal Change Adaptation Planning

Capital Funding Breakdown per year

- 2022-23 - £1.6 million – direct to 10 LAs
- 2023-24 - £2.6 million
 - £1.85 direct to 14 LAs
 - £0.55 distributed to LAs for case studies
- 2024-25 - £2.7 million
 - £1.65 direct to 19 LAs
 - £1.05 available for case studies
- 2025-26 - £5.0 million
 - Distribution still to be agreed



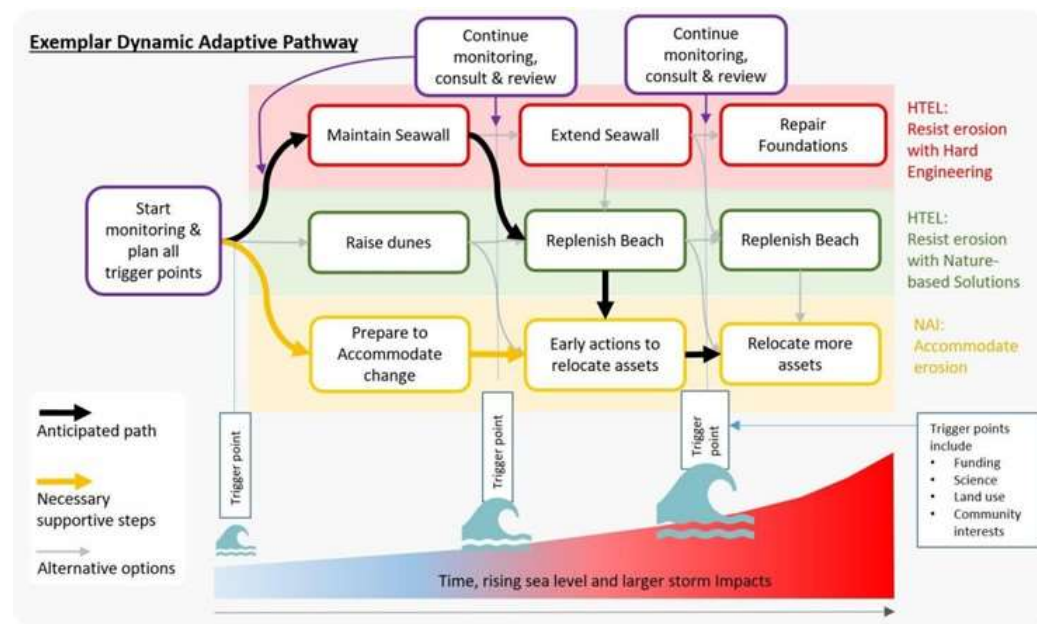
Crown copyright and database rights OS 2020 100017908



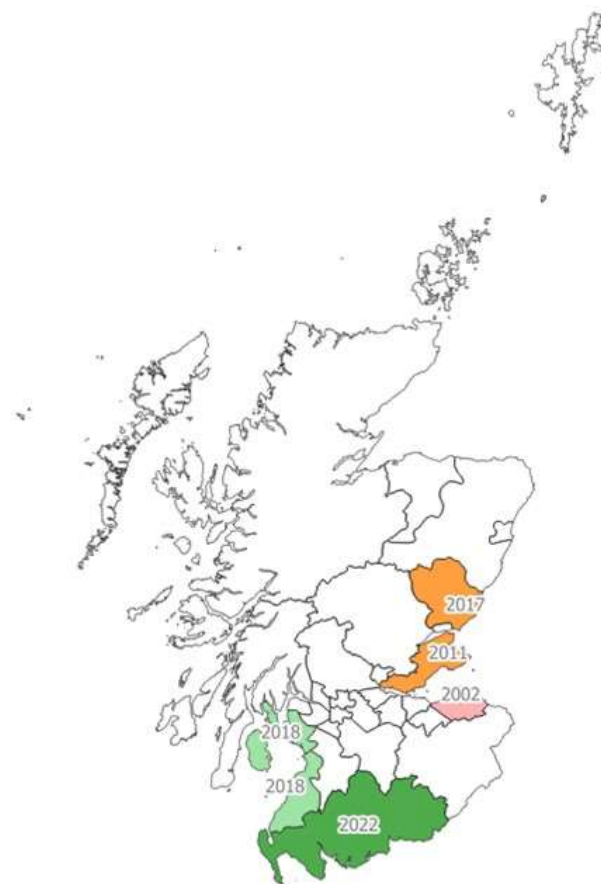
Scottish Government
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Coastal Change Adaptation Planning

- Have you used the guidance?
- Do you have any feedback?
- As part of SNAP3 further information on how to plan for sea level rise is planned – the guidance will be updated to incorporate this.
- What else would be useful?



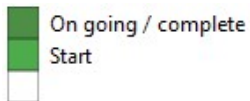
Who has a Plan?



LA	pre-existing SMP (date)
Dumfries and Galloway	2023
North Ayrshire	2018
South Ayrshire	2018
Angus	2017
Fife	2011
East Lothian	2003

What have we achieved in year 1 and 2 of funding?

Year 1



LA	CCAP in progress 2022-23
Moray	Yes

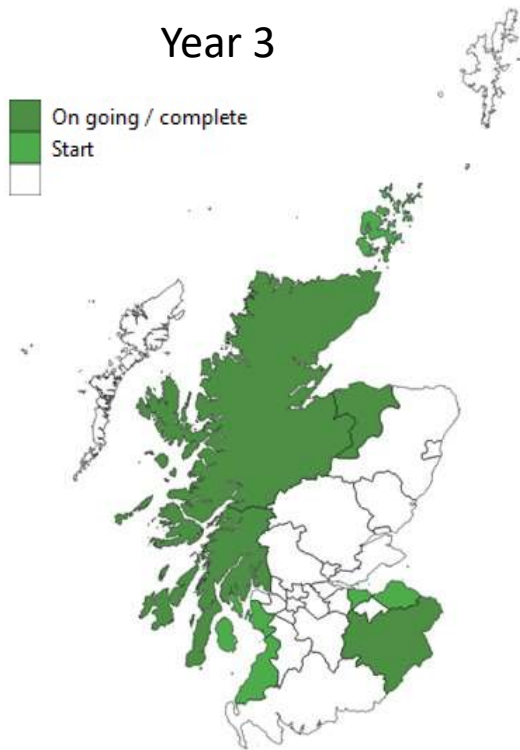
Year 2



LA	CCAP in progress or in place 2023-24
Highland	Yes
Argyll and Bute	Yes
Moray	Yes
Scottish Borders	Yes

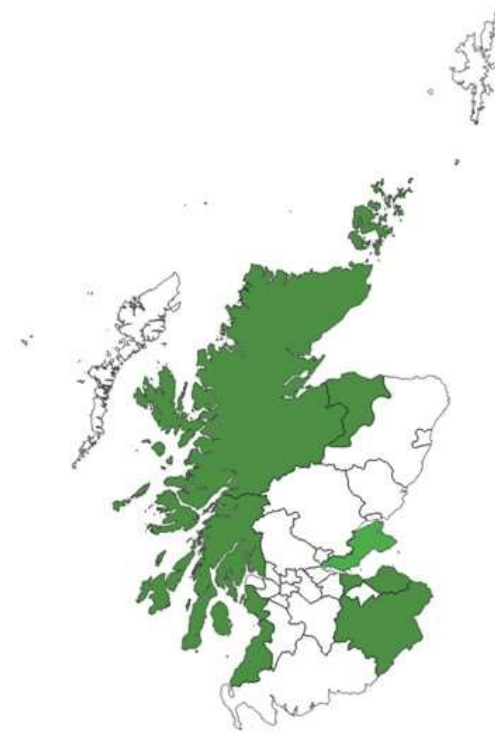
What we think is planned for year 3 and 4 of funding

Year 3



LA	CCAP in progress or in place 2024-25
Highland	Yes
Argyll and Bute	Yes
Orkney Islands	Yes
North Ayrshire	Yes
South Ayrshire	Yes
Moray	Yes
Edinburgh	Yes
East Lothian	Yes
Scottish Borders	Yes

Year 4

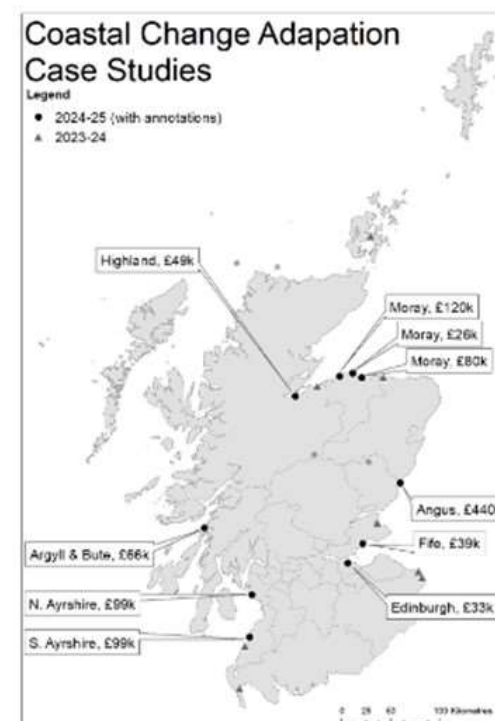


LA	CCAP in progress or in place 2025-26
Highland	Yes
Argyll and Bute	Yes
Orkney Islands	Yes
North Ayrshire	Yes
South Ayrshire	Yes
Moray	Yes
Fife	Yes
Edinburgh	Yes
East Lothian	Yes
Scottish Borders	Yes

Coastal Change Adaptation Case Studies

2024-25 case studies

Local Authority	Name	Funding, £k
Highland	End of life defences	£49
South Ayrshire	SAC SMP	£99
Angus	Montrose	£440
North Ayrshire	NAC SMP	£99
Moray	Kingston recharge	£80
Moray	Monitoring Moray Coast	£26
Moray	Near-Real Time Coastal Resilience Modelling	£120
Argyll and Bute	Luing (Cullipool)	£65
Fife	Fife Coastal Management	£39
Edinburgh	Infrastructure Owner Consultation	£33
	Total	1,050



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Coastal Change Case Studies

Case Study Reporting

- Examples are on the Dynamic Coast website: [Dynamic Coast - Coastal Change Adaptation](#)
- We have agreed to fund case studies so that ideas, knowledge and lessons can be shared across Scotland

Sandhead: Rewilding Project

April '23 to March '24 £36,000 Dumfries & Galloway Council



Sandhead, damage to natural vegetation caused by parked vehicles.
© Alex Whannel (2023).

Overview:
The project establishes an area for re-wilding. It will be fenced and signed to prevent vehicle parking, which compacts the sand and damages the fragile vegetation. This aims to help reduce coastal erosion and flooding, given the potential benefits that nature-based solutions may have in coastal erosion control, whilst supporting wildlife, and allowing visitors to enjoy the beach.

What we are hoping to learn:
We will use nature-based solutions to slow down the coastal erosion in this area.

It is expected that the re-establishment of the natural vegetation / dunes will act as a natural barrier to help retain the beach and make it more resilient.

This case study can be seen as a practical example of the use of nature-based solutions in the adaption for the future effects of climate change in Scotland's coastal environment.

"Where overuse has accelerated erosion, we hope that employing a nature-based solution will aid in the adaptation to the expected coastal changes which will occur as a result of climate change."

Brian Templeton, Team Leader –
Dumfries and Galloway Council's
Flood Risk Management Team

#adapt #community #ReWilding

The Scottish Government
Dumfries and Galloway Council
Dynamic Coast
#1, April 2023



Scottish Government
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Contact details – tracy.mcken@gov.scot



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Session 3: Coastal change

Rick Haynes, Fife Council

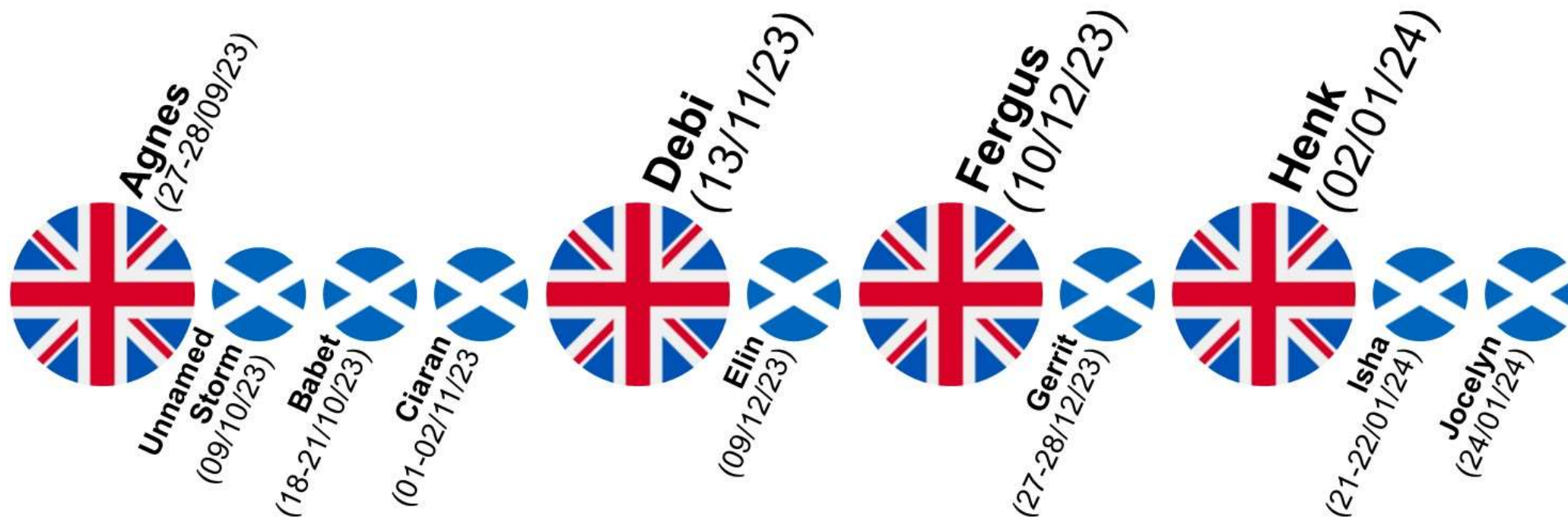


Fife Coastal Impacts

October / November 2023

Dr Rick Haynes
(Lead Consultant – Flooding, Shoreline & Harbours)

Storm Patterns 2023-24



Weather Pattern

Storm Babet

(18-21 October 2023)

- 150-200mm rainfall in eastern Scotland
- 2 MetOffice red warnings
- 58mph winds over much of Scotland
- 77mph at Inverbervie
- Gusts over 115mph on mountain tops
- MetOffice summary: [HERE](#)

Storm Ciarán

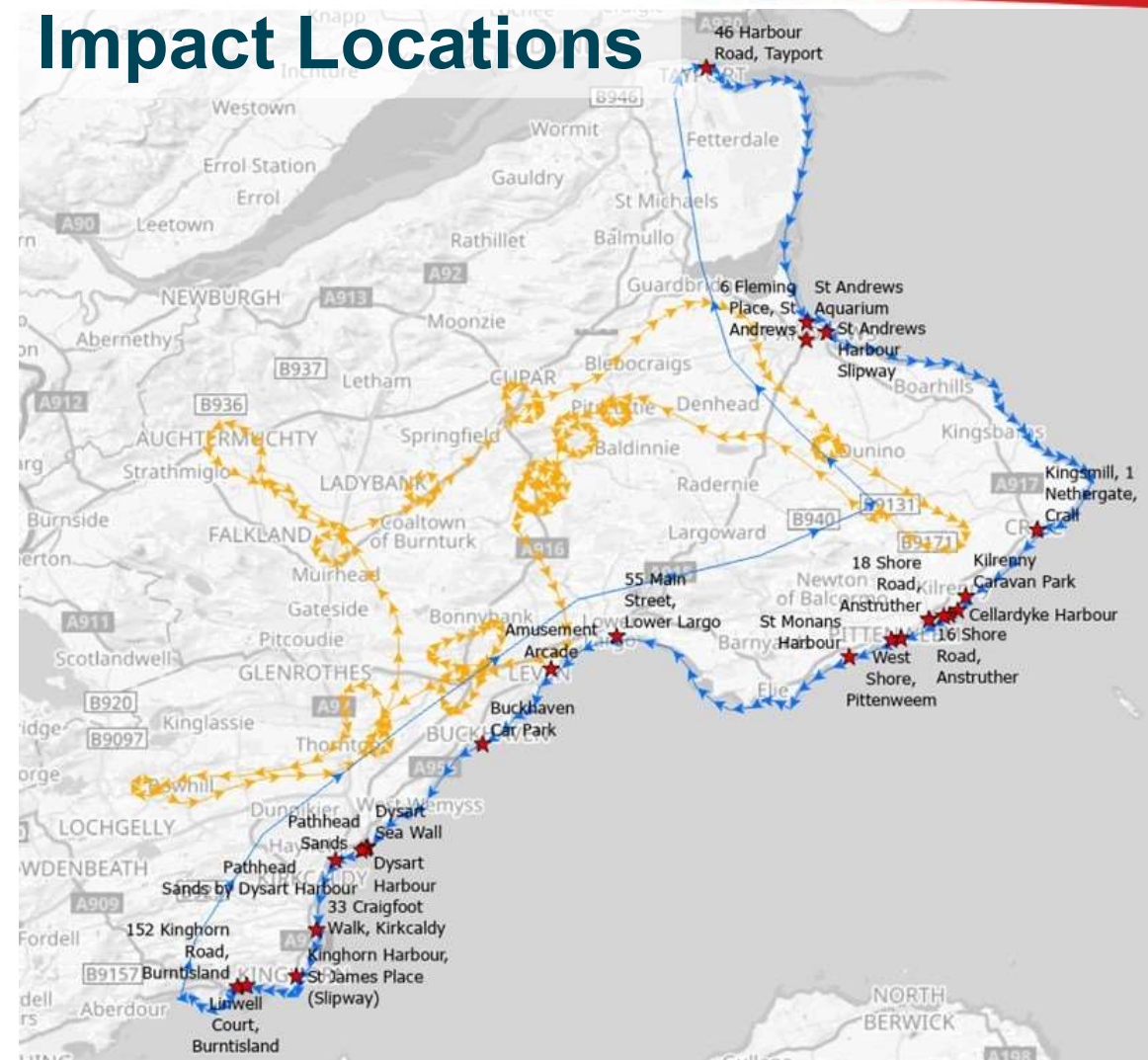
(01-02 November 2023)

- Comparable to 'Great Storm' of 1987
- Gusts of 69-81mph
- Typical for fairly major Atlantic Storm
- Exceptionally deep low pressure
- Additional rainfall to Storm Babet
- MetOffice summary: [HERE](#)

Weather Response

- Inspectors out post Storm Babet & Storm Ciarán
- [Civil Air Support](#) inland imagery flight (Ballingry to 'Muchty, Leven to Cupar to Strathkinness to Kingsmuir)
- [Civil Air Support](#) coastal imagery flight (Tayport to Burntisland):
 - Requested: Fri 03 Nov 2023
 - Flown: Sun 05 Nov 2023
 - Imagery delivered: Mon 06 Nov 2023
- Advice being provided to multiple locations from Mon 06 Nov 2023
- Stabilisation works commenced (Pittenweem) Fri 10 Nov 2023

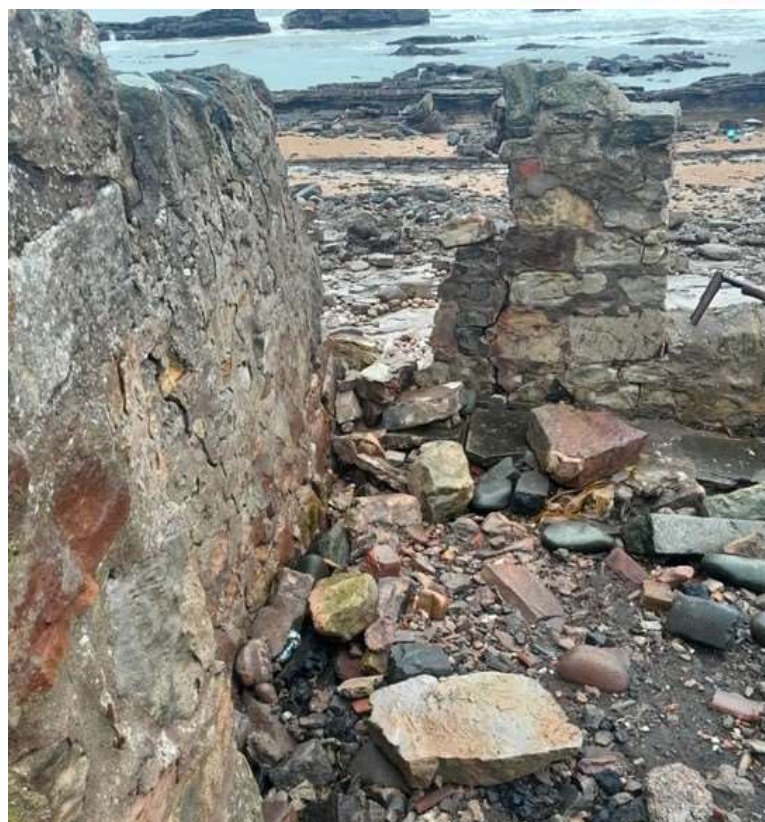
Impact Locations



27 discrete locations damaged

- 205km inland / 157km coastal flights
- Damage to:
 - Coastal Wall
 - Harbour Wall
 - Network Rail Underpass
 - Stone Revetement
 - Dunes & Parking area
 - Gabion Baskets
 - Coastal Paths
 - Destroyed Slipways

Kilrenny Caravan Park – Coastal gabions dislodged



Cellardyke – Coastal Staircase Damaged



**Leven – Car Park Retaining
Wall Failure**

Buckhaven – Car Park Gabions Damaged



Dysart – Coastal Defence Wall Damaged



**Seafield – Coastal
Path Damaged**



Kinghorn – Slipway Damaged



Anstruther – Shore Road Coastal Wall Collapse



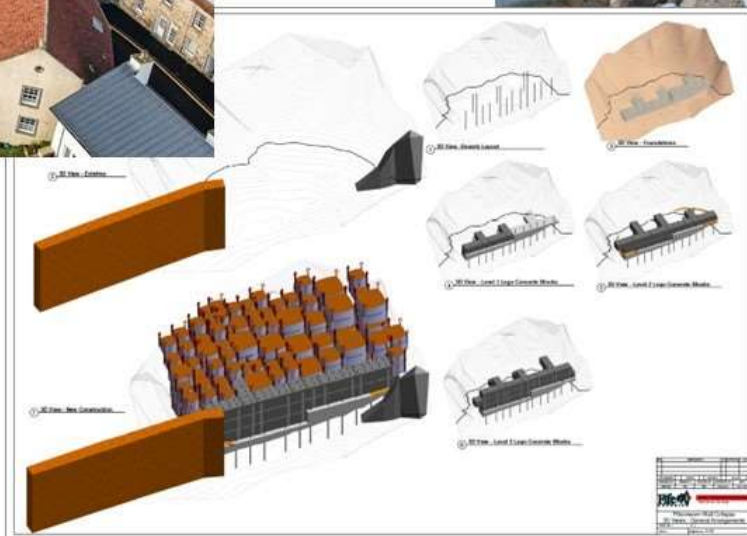
Shore Road, Anstruther - Stabilisation



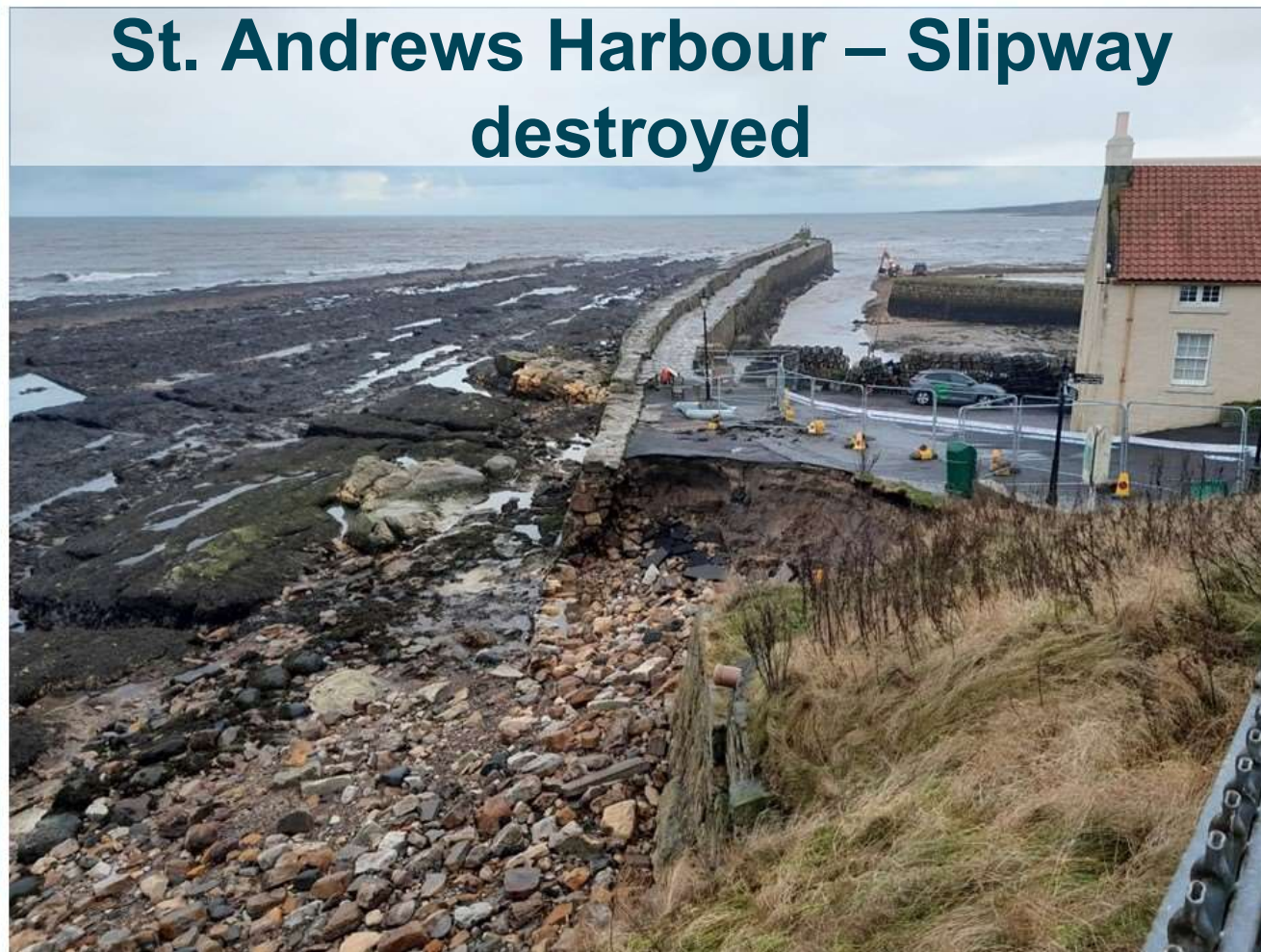
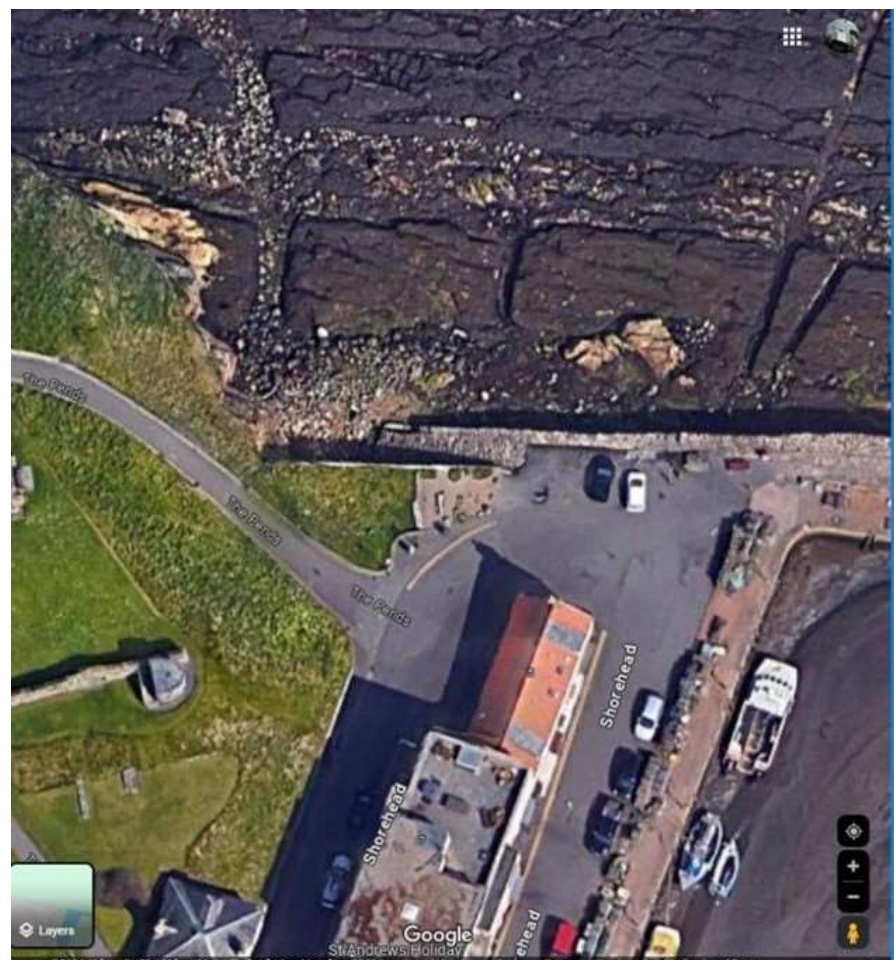
Pittenweem – Abbey Wall Road Coastal Wall Collapse



Pittenweem, Abbey Wall Road – Stabilisation



St. Andrews Harbour – Slipway destroyed



St. Andrews Harbour – Slipway stabilisation



Lessons Learned

- Emergency response vs Strategic response?
- Private ownership vs Public ownership
- Stabilisation vs Reinstatement?
- Managed Retreat vs Build Back vs Build Back Better?
- No Council Incident Management Team called; would it have helped?
- “Unplanned” / reactionary Fife Council spend: ≈ £152,000+
- Implications on Shoreline Management Plan / Coastal Change Adaptation Plan

Thank you, any questions?



Contact Details:

- Rick.Haynes@Fife.gov.uk
- FRM@Fife.gov.uk
- Harbours@Fife.gov.uk
- Coastal@Fife.gov.uk



#FRM2024

Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Will Burnish, Moray Council





Why CCAP is important for Moray



What stage are we at and what is next

Kingston Local Plan Triggers, Actions and Outcomes

low have the Triggers been defined?

If risk is present in a CMU, the lowest elevation of a property (minus 100mm frequency) or key road is used as a frequency of exceedance using the tide gauge sea period.

Is realised if the exceedance frequency increases within a year. There are two levels to the trigger that require different actions.

Expenditure
exceedance frequency of two or more in a ten year M.
exceedance frequency of two or more in a ten year M.
exceedance frequency of two or more in a ten year M.

Other factors
exceedance frequency of two or more in a ten year M.
exceedance frequency of two or more in a ten year M.

What are the possible Actions?

Actions, like Triggers, can also be applied to the entire Plan, or to specific. Actions bridge the gap between Triggers and Outcomes and define what processes need to be implemented before the most appropriate Outcome is realised.

Review risk assessment:

- Involve a review of available data and associated risk assessment; increased monitoring and planning for intervention because of the erosion and flooding triggers are included.

Community engagement:

- Practice: involve local groups, such as Councilors and community groups.
- Practice: involve third party stakeholders, such as MFL, local Gov, Nature Trust etc.
- Asset: includes private defences and harbours specific to defended or hybrid CMUs.

Real time data collection:

- Involve community engagement, surveys, photographs etc.

New risk assessment:

- Following a review of this risk assessment and/or community engagement, a new risk assessment may be required. This will follow appropriate guidance and include all necessary components to develop a preferred Adaptation Pathway and associated Action Plan.

What are the Phase 0 and Proactive Actions?

The delivery of the Plan during this phase has identified several Initial Proactive Actions that will be delivered on. These aim to support future phases of adaptation.

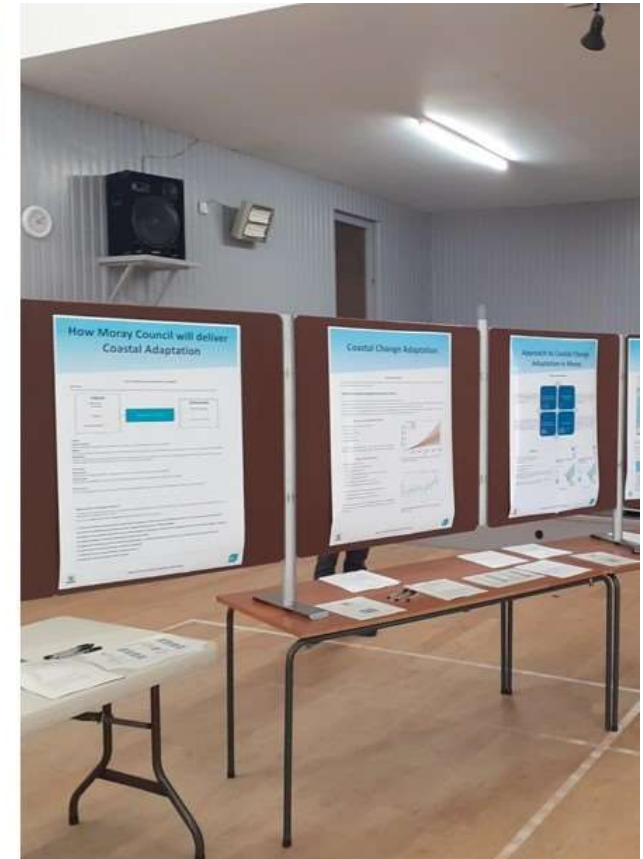
1. Investigate opportunities for single recycling.
2. Develop modelling framework to support future assessments.
3. Establish coordinated and consistent beach monitoring plan.
4. Adaptation and resilience workshop with local community and stakeholders.
5. Identify leadership and safeguarding space. Link with Regional Proactive Action 6 to deliver local opportunities.

What are the possible Outcomes?

Outcomes are the potential intervention measures that will be implemented after a trigger is realised and the associated actions have been undertaken. There are four possible outcome categories.

Category	Outcome	CMU
No intervention		All
Enhance natural features		All
Protect	Maintain defences	5
	Improve defences	5
	Remove defences	All
Create space	Set back defences	5
	Relocate assets	2, 3, 4, 5

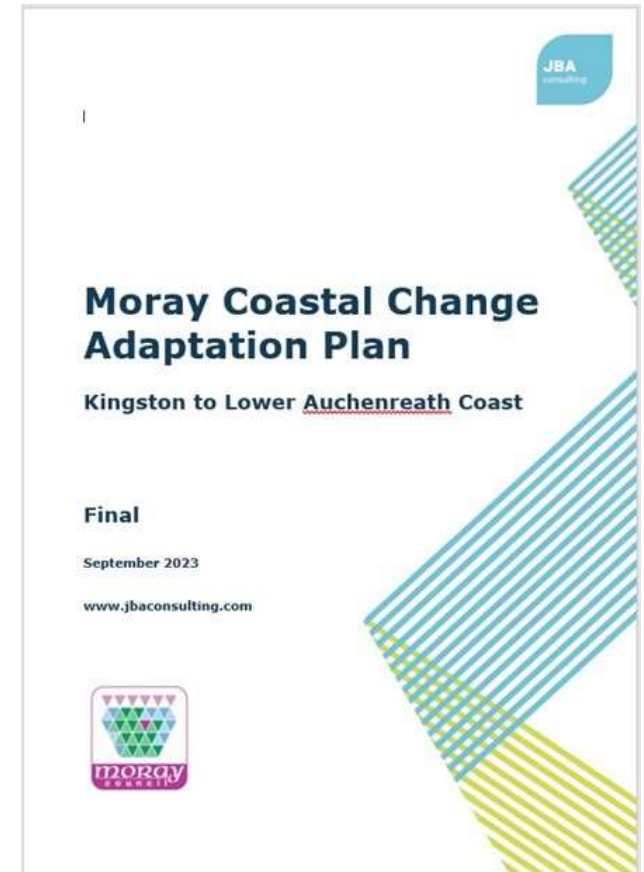
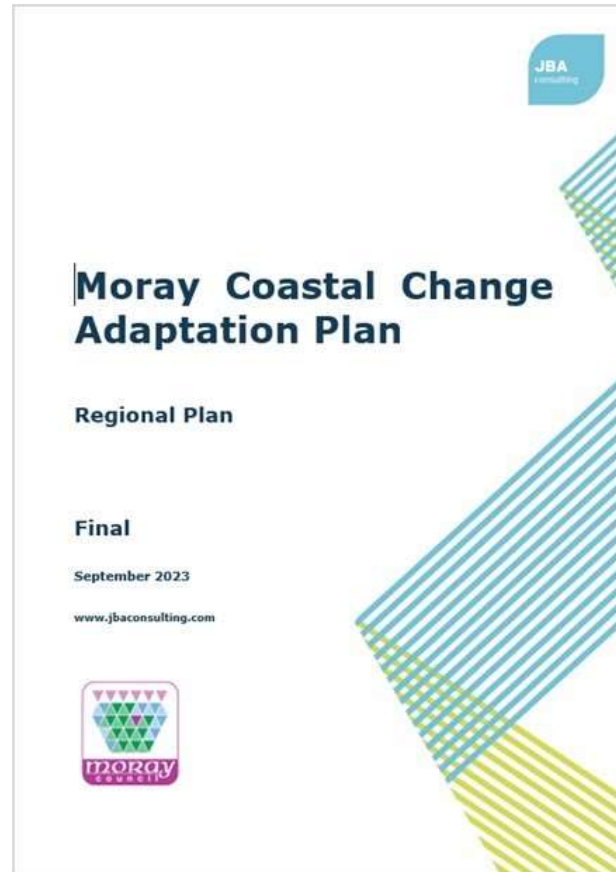
TRIGGERS
Erosion
--- Coastline
--- Erosion trigger level 1
--- Erosion trigger level 2



Moray Coastal Change Adaptation Workshops



Lessons Learned





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

James McLeod, Dumfries and Galloway Council



Scottish Flood Resilience Conference 2024

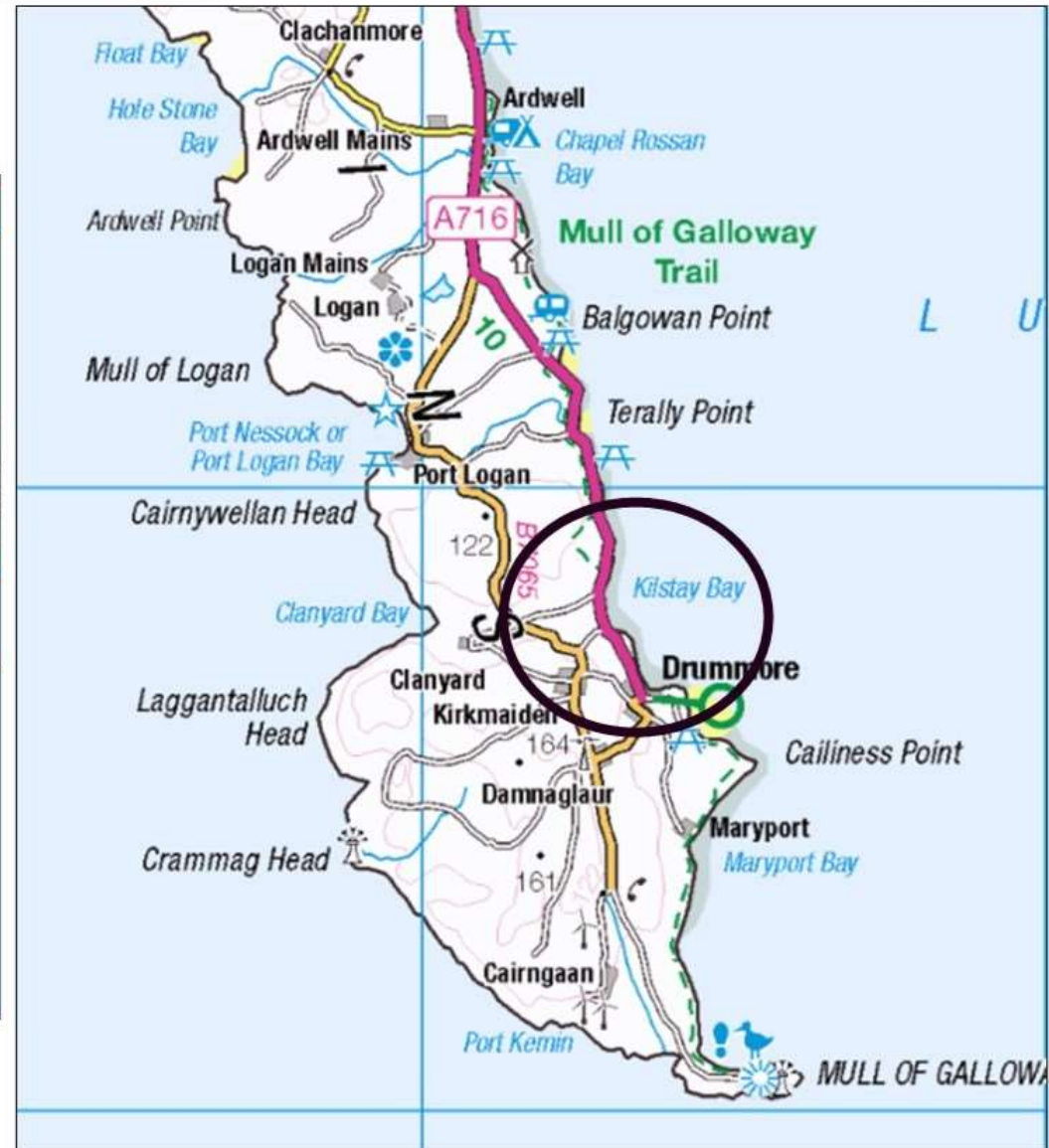


A716 – Adaptation Approach

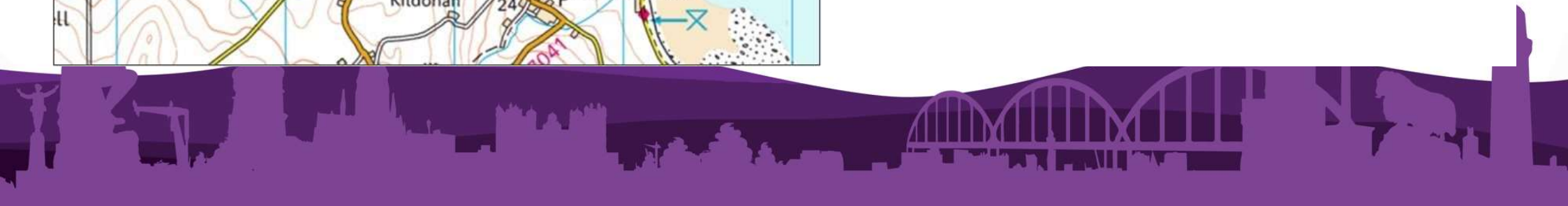
James McLeod, Infrastructure Manager



Location – Kilstay Bay



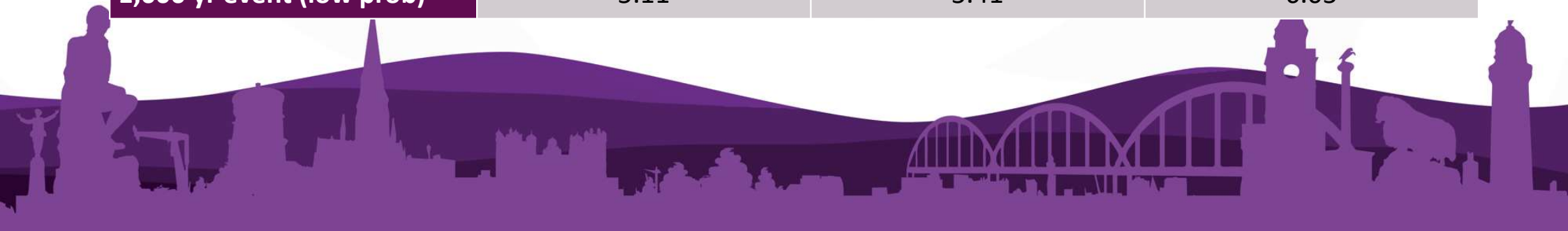
Location



Sea Level rises at Kilstay Bay

- Given rising sea level, the frequency of flooding and impact of wave thrown debris is expected to increase in the coming decades.

What Event	Current still water levels (mOD)	2050 still water levels (mOD) (UKCP18 RCP8.5 95%) +0.3m	2100 still water levels (mOD) (UKCP18 RCP8.5 95%) +0.94m
MHWS	2.77	3.07	3.71
HAT	3.32	3.62	4.26
1 yr event (annual)	4.07	4.37	5.01
10 yr event (high prob)	4.44	4.74	5.38
1,000 yr event (low prob)	5.11	5.41	6.05



Proper engineering works

- Significant investment over the years >£1M



Current Storm impacts



A716 Road Closure gates

Sunday 09:31

FLOOD WARNING issued for West Luce Bay South. Go to sepa.org.uk/floodupdates or call [0345 9881188](tel:03459881188) using quick dial [24331](tel:24331)



Main Route (A716) and Diversion Route (B7065)



Diversion Route (B7065) Improvements

- Funded from £160K allocation

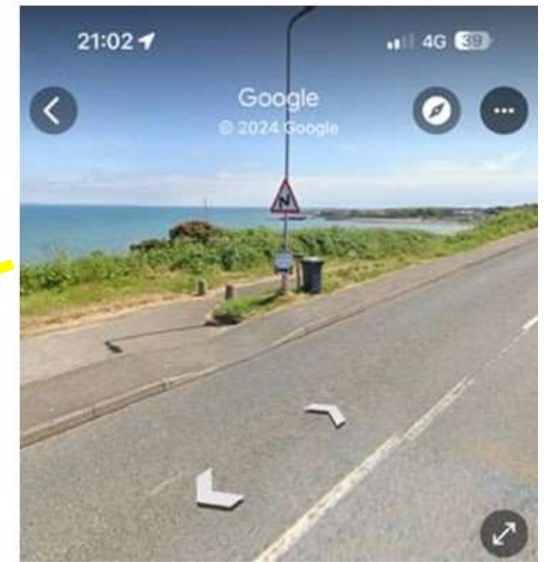
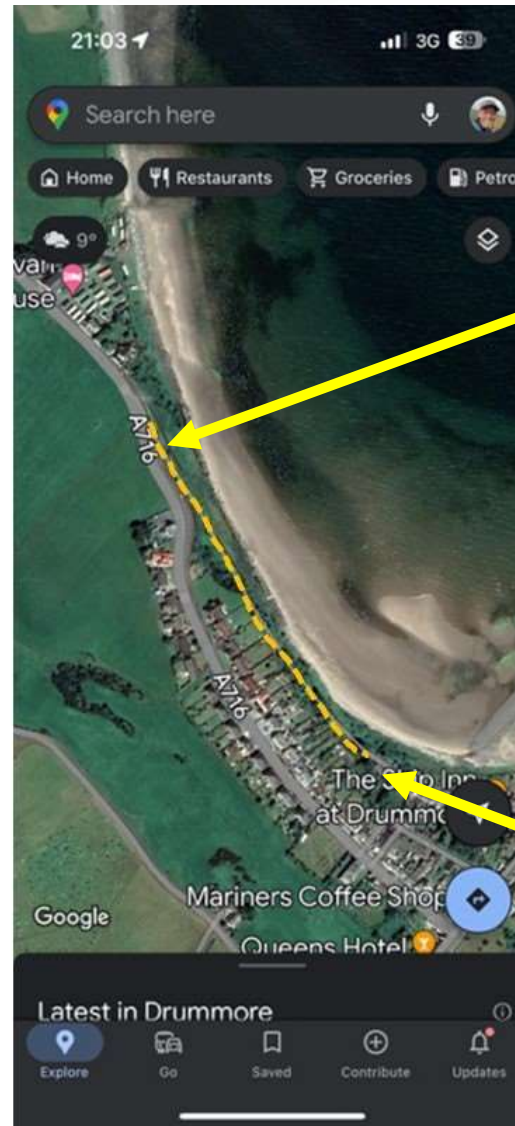


A716 CLOSED AHEAD
AT KILSTAY BAY
FOR A716 NORTH
FOLLOW DIVERSION



Previous abandonment

In the 1980s

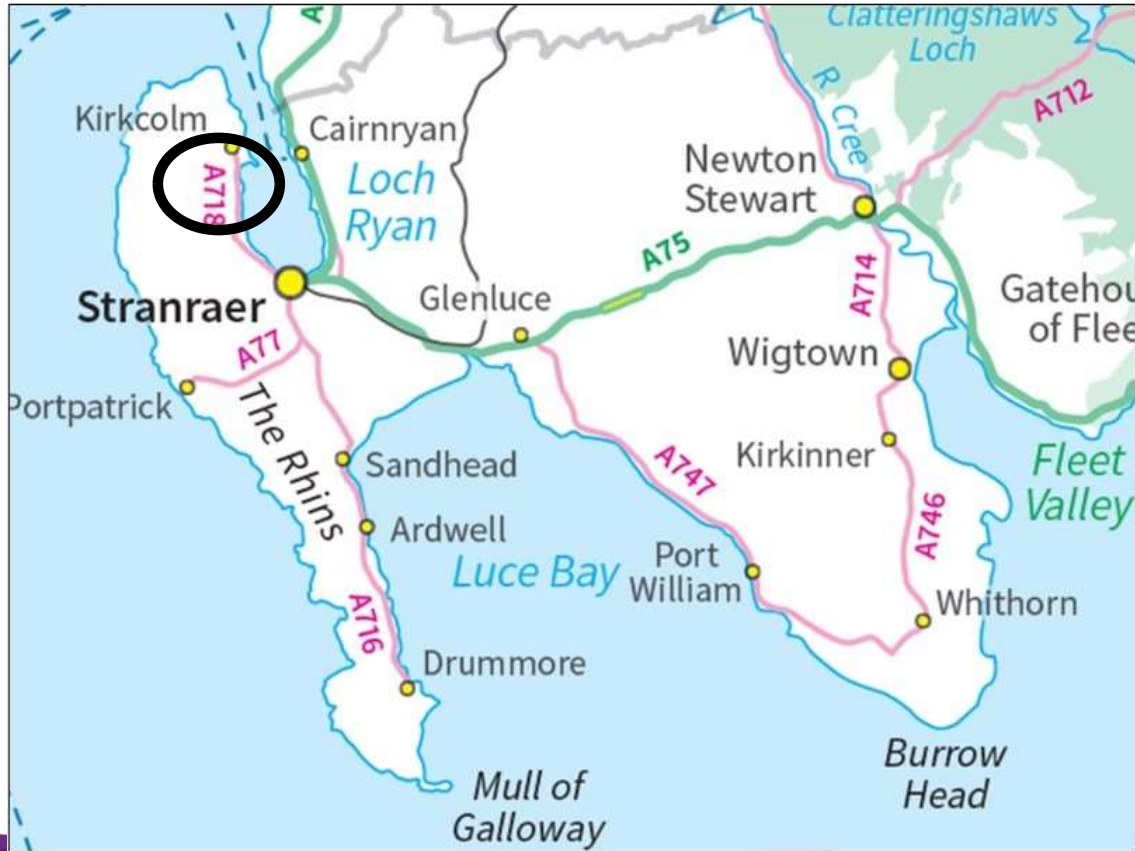


Discussion points

- A716 has not been abandoned and properties still access this road.
- And access for six properties withing closure section continues to be developed
- Still the main road from the South Rhins, but liable to more frequent closure due to storm events.
- But some investment into alternative route is being made.
- Study is funded to consider medium to long term options for South Rhins access.
- And this is the next one we will consider...



Location – A718 Soleburn



Location – A718 Soleburn

- Road level +3m AOD
- These are scallop shells on the shore side of the road 🙄



Thanks for listening. Any questions?

James McLeod

james.mcleod@dumgal.gov.uk



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Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Chair: Will Burnish, Moray Council





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Steve McFarland, SEPA

Doug Pender, JBA Consulting



SEPA Coastal Flood Hazard Map Update

Doug Pender, Bryony McLeod,
Nicci Buckley, Steve Hallsworth
and Steve McFarland

SEPA Coastal Flood Hazard Maps

Background and Need to Update

Inform flood risk management and spatial planning

Still water level projection maps (2013)

Nationally a reasonable picture of overall flood hazard from the sea (but!)

At the scale of individual communities, some significant discrepancies between maps and reality

Use in first cycle flood risk management plans (December 2015) exposed community level issues



SEPA Coastal Flood Hazard Maps

Approach to Updating



CREW sponsored research project to propose methodology for Scotland

Step 1. National Offshore Joint Probability Multivariate dataset

Step 2. Prioritize updates regionally based on need and practicality

Step 3. For each phase undertake a coastal characterization, gather data, develop models appropriate to coastal area, produce inundation maps

Step 4. Process outputs and Publish Maps
OGL

SEPA Coastal Flood Hazard Maps

Sequencing

Phase 1a and 1b. Northeast Scotland, Orkney and na h-Eileanan Siar – published Nov 2023.

Phase 2. Southeast Scotland – underway, Doug's update to follow

Phase 3. Southwest Scotland – scoping currently planned for late 2024 / early 2025

Phase 4. Northwest Scotland and Shetland - ??

Each phase represents a complex multiyear project



SEPA Coastal Flood Hazard Maps

Comparison of old and new

Should be a better representation of flood extents particularly in the detailed areas as modelling now includes mechanisms for waves

Example on right from Stonehaven more closely resembles the flood extents provided by the community in the aftermath of 2012 floods

Further information on SEPA website as to how the new maps were developed. May produce additional information for Partners as to how the maps can be best interpreted



SEPA Coastal Flood Hazard Maps

Evolution of the maps



Each phase of the updates is progressed on the best information available to be used at the time eg Coastal Flood Boundary datasets / climate change projections for future flood maps

Maximize the return by looking for additional benefits – eg use for flood warning scheme recalibration

Open data preferred to avoid complex and protracted licensing / restricted onward use

SEPA Coastal Flood Hazard Maps

The need for better data and understanding

The information used in the models impacts the quality of the maps; some examples

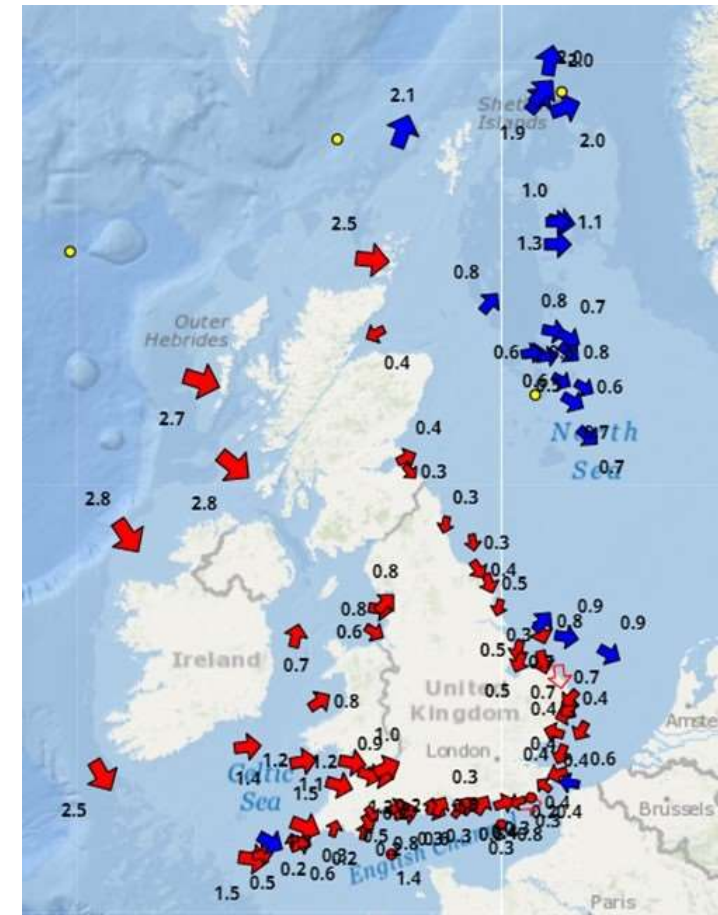
Sparse coverage of wave data in the nearshore area to calibrate and validate wave models

Uncertainty in the coastal flood boundary data sets is high in some areas of Scotland

Wave overtopping rates very sensitive to coastal and intertidal features – no systematic collection of nearshore bathymetry, intertidal areas and beaches

Improved techniques needed for wave overtopping inundation mapping and erosion enhanced future flood risk

CEFAS Wavenet



OFFICIAL

SEPA Coastal Flood Hazard Maps

Approach to Phase 2: Southeast Scotland – Over to Doug



Primary Objectives

- 1. Identify and classify flood defence features**
- 2. Improve understanding of extreme sea levels in Firths of Forth and Tay**
- 3. Update flood hazard maps for entire area**
 - Extreme sea levels
 - Wave setup
 - Wave runup
 - Wave overtopping

1. Defence classification

- **Built** and **natural** “defences”
- **Risk** based classification
 - **Hazard:** Potential inundation if defence is removed
 - **Receptor:** Potential consequence of that inundation

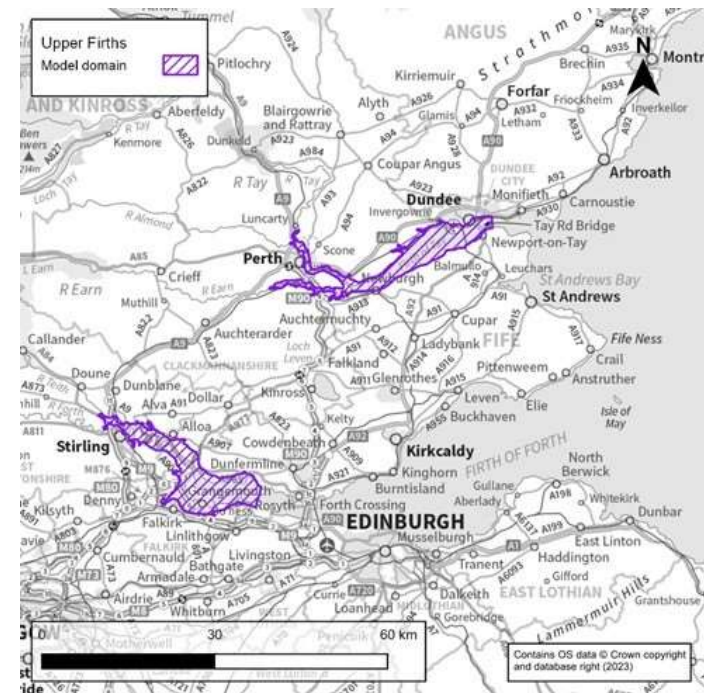
Classification	Combined rating	Description applied in classification
A	$9 \leq A$	Removal would lead to many receptors at risk with large scale inundation of properties and infrastructure. Emergency service response likely
B	$5 \leq B < 9$	Removal would lead to risk of some properties or infrastructure, or more significant risk at lighter use sites e.g. car parks, golf courses.
C	$3 \leq C < 5$	Removal would lead to minimal damage of some properties or infrastructure in a localised area, or more significant risk to undeveloped sites.
D	$D < 3$	Removal would lead to minimal damage of undeveloped sites.
E	N/A	Impacts of removal are unknown or unquantifiable, e.g. areas of saltmarsh.

St Andrews Example



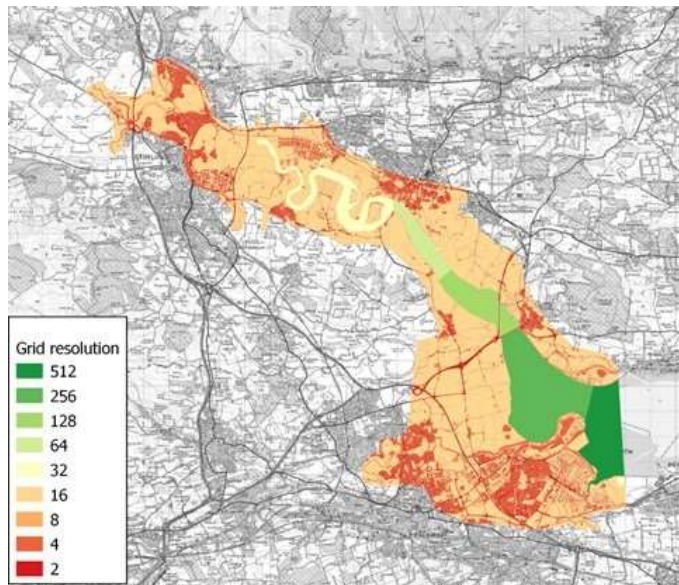
2. Extreme Sea Levels in Firths

- **Aim:** Understand the uncertainty and sensitivity of existing CFB levels in the Firths
- **Sensitivity testing:**
 - Boundary conditions
 - Wind forcing
- Used for **detailed modelling** with overtopping inflows added
- Fluvial/tidal **joint probability** flood extents

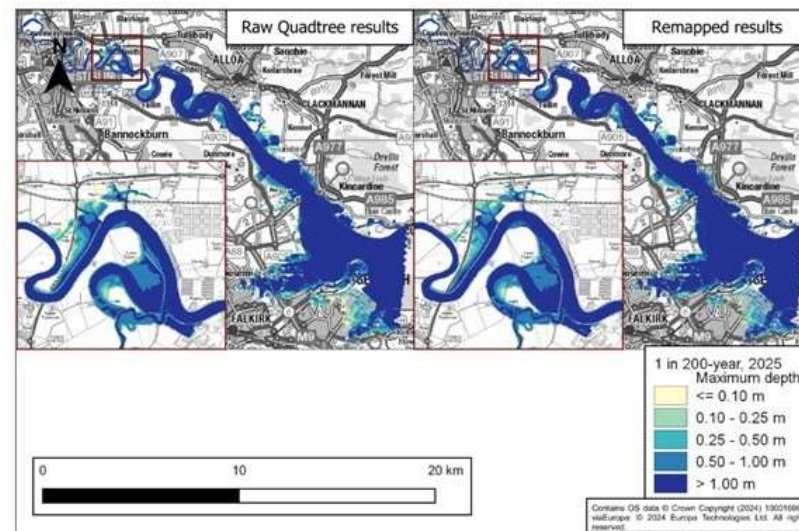


2. Extreme Sea Levels in Firths

Forth Model Grid Resolution



Forth Model Inundation



3. Mapping updates

Simplified Mapping

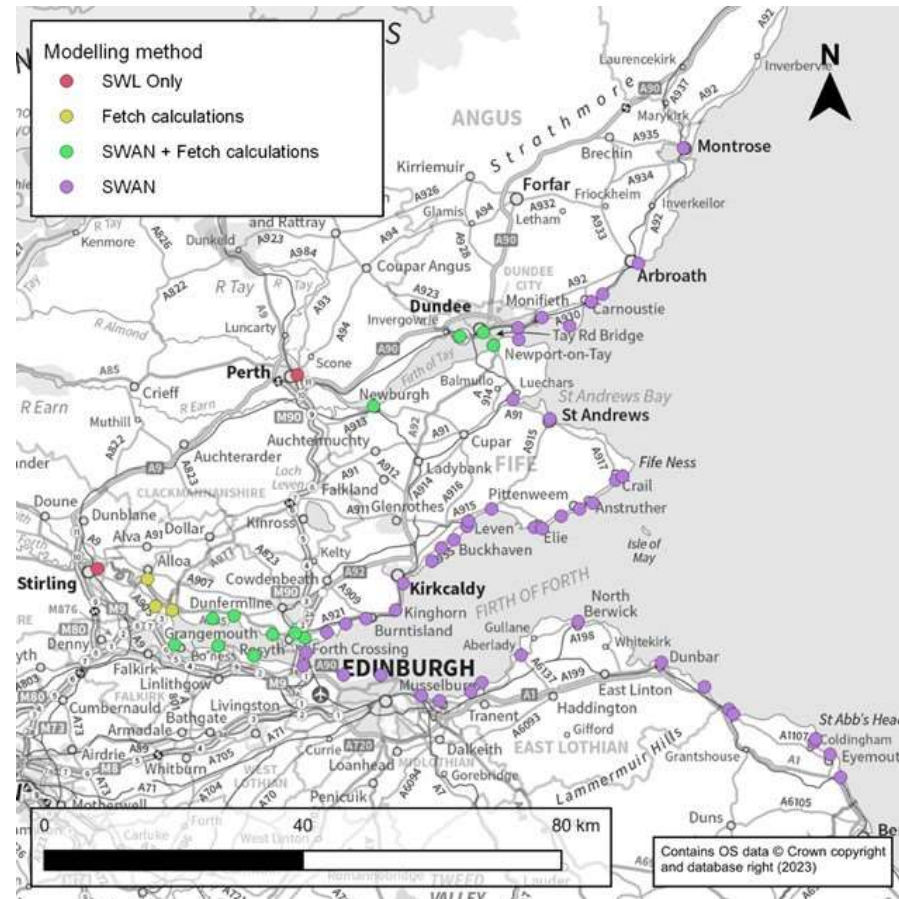
- Projection of (total) extreme sea level estimates
- Developed from CFB data (no wave exposure)
- Inclusion of wave setup and runup (wave exposed coasts)

Detailed Mapping

- Developed by high resolution TUFLOW modelling
- Inclusion of wave transformation and overtopping

3. Mapping updates

- **Upper Firth**
 - SWL only
- **Inner Firth**
 - Fetch limited waves
- **Outer Firth**
 - Mixture of fetch and open sea
- **Open Coast**
 - Exposed to waves generated in the North Sea

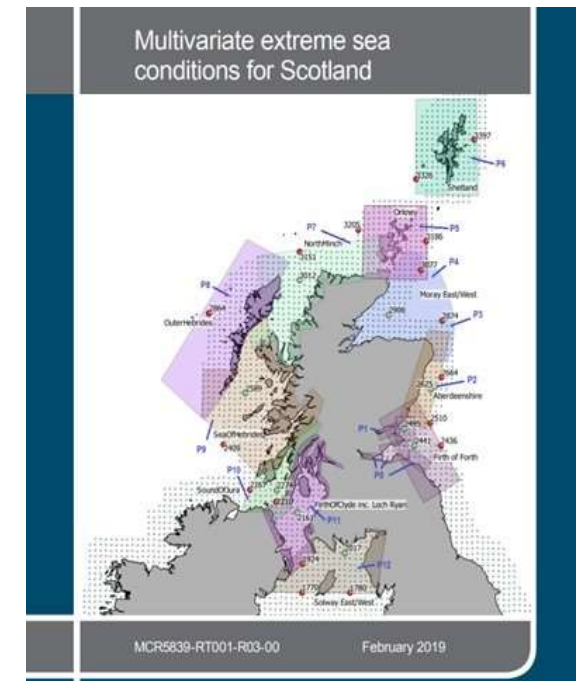


3. Detailed Mapping

Offshore Datasets

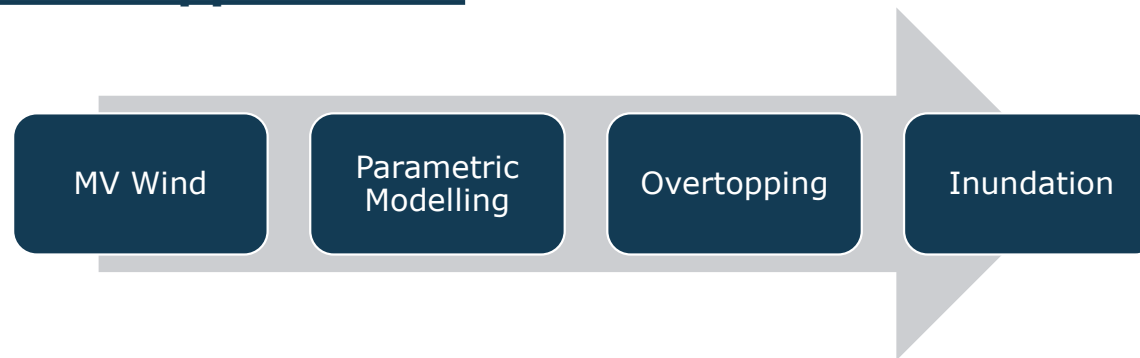
- MV data for 17 offshore locations
- Each dataset equivalent to 10,000 years and wave and sea level data
- Variables include:
 - Significant wave height (H_s)
 - Wave steepness (based on T_{m-10})
 - Wave direction (θ)
 - Directional spreading parameter
 - Wind speed (U)
 - Wind direction (θ_u)
 - Water level.

Point	Multivariate Area
P0	Firth of Forth
P1	Tay Firth
P2	Aberdeenshire
P3a	Moray East
P3b	Moray East
P4a	Moray West
P4b	Moray West
P5*	Orkney East
	Orkney West
P6*	Shetland East
	Shetland West
P7	North Minch
P8	Outer Hebrides
P9	Sea of Hebrides
P10a	Sound of Jura (Islay)
P10b	Sound of Jura (Jura)
P11a	Firth of Clyde North
P11b	Firth of Clyde South
P12*	Solway Firth East/West

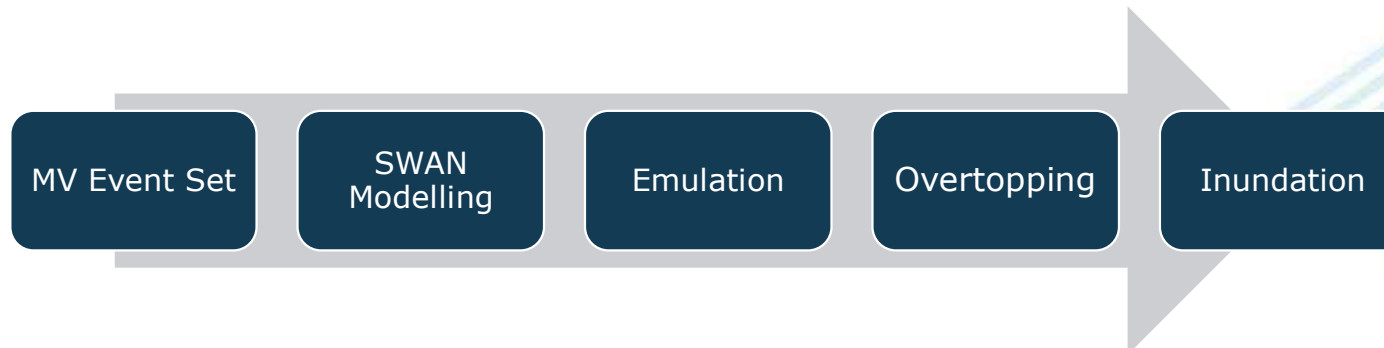


3. Detailed Mapping

Low Waves – Upper Firths



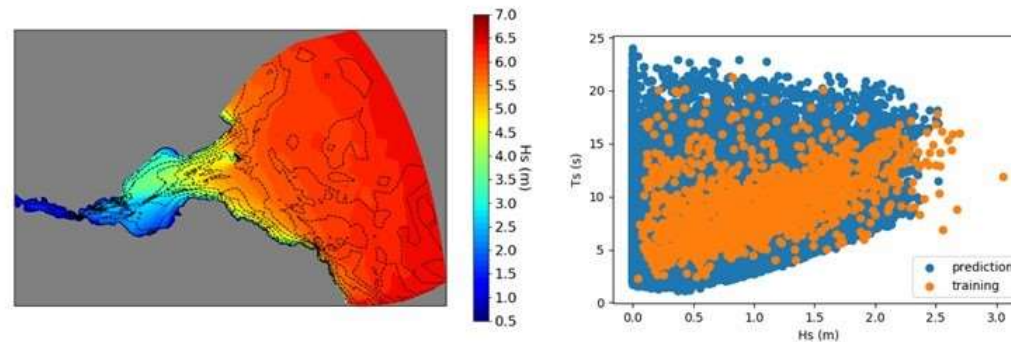
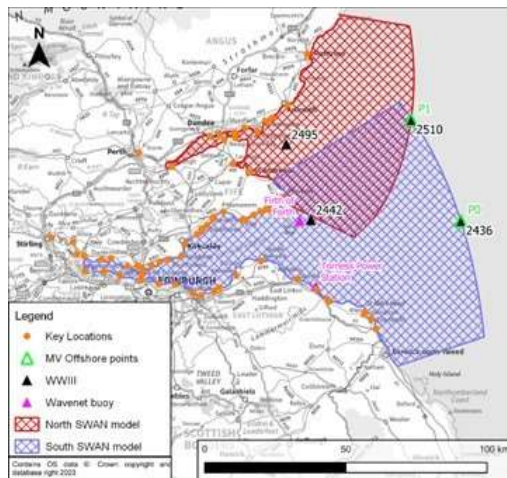
Higher Waves – Outer Firth and Open Coasts



3. Detailed Mapping

SWAN Modelling

- 2x 2D SWAN models
- MDA event set modelling in SWAN
- Results extracted at locations of interest
- Machine Learning emulators to transform



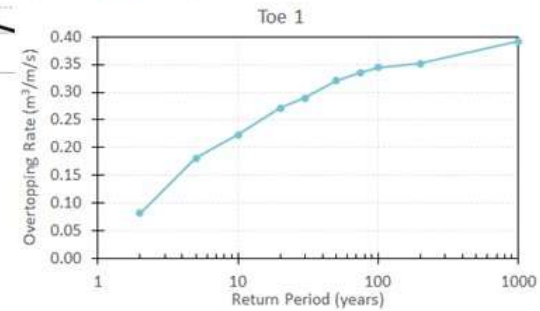
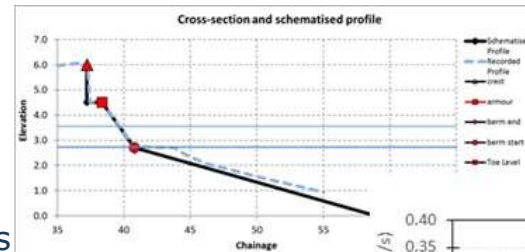
Parametric Modelling

- Estimates from empirical equations (e.g. JONSWAP)
- Fetch defined for each location
- Forced by MV wind

3. Detailed Mapping

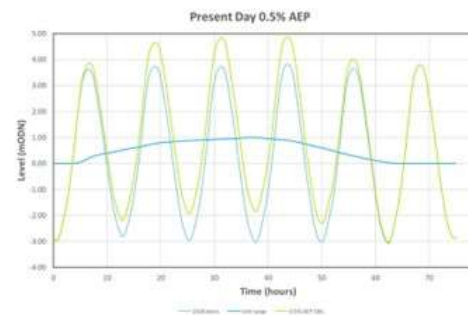
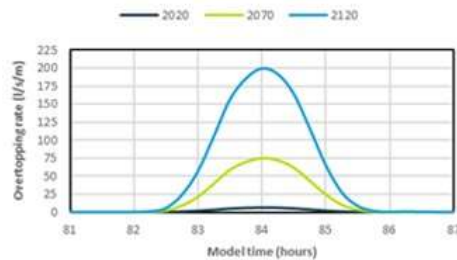
Wave overtopping

- EurOtop Neural Network and Manual
 - Estimate rate for each MV event
 - Using nearshore wave estimates
- Estimate RP overtopping volumes



Inundation boundaries

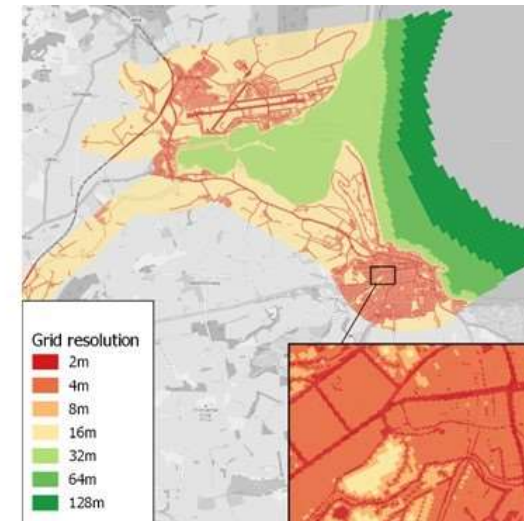
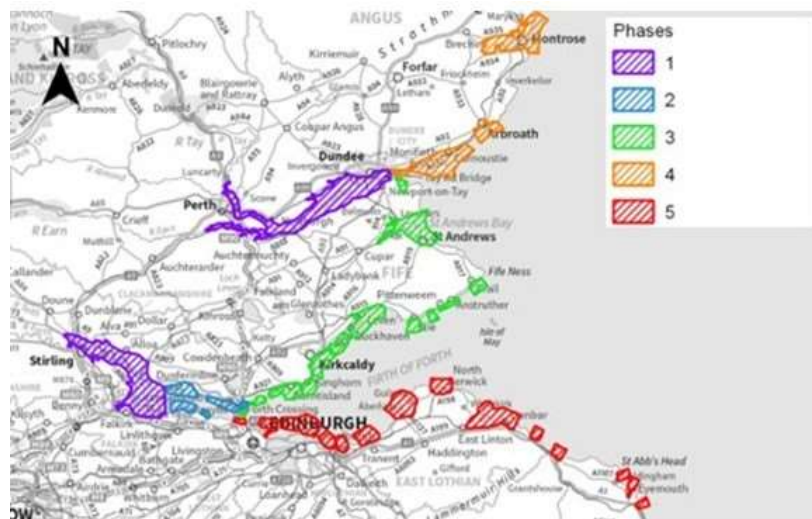
- Extreme sea level from CFB
- Corresponding RP overtopping hydrographs



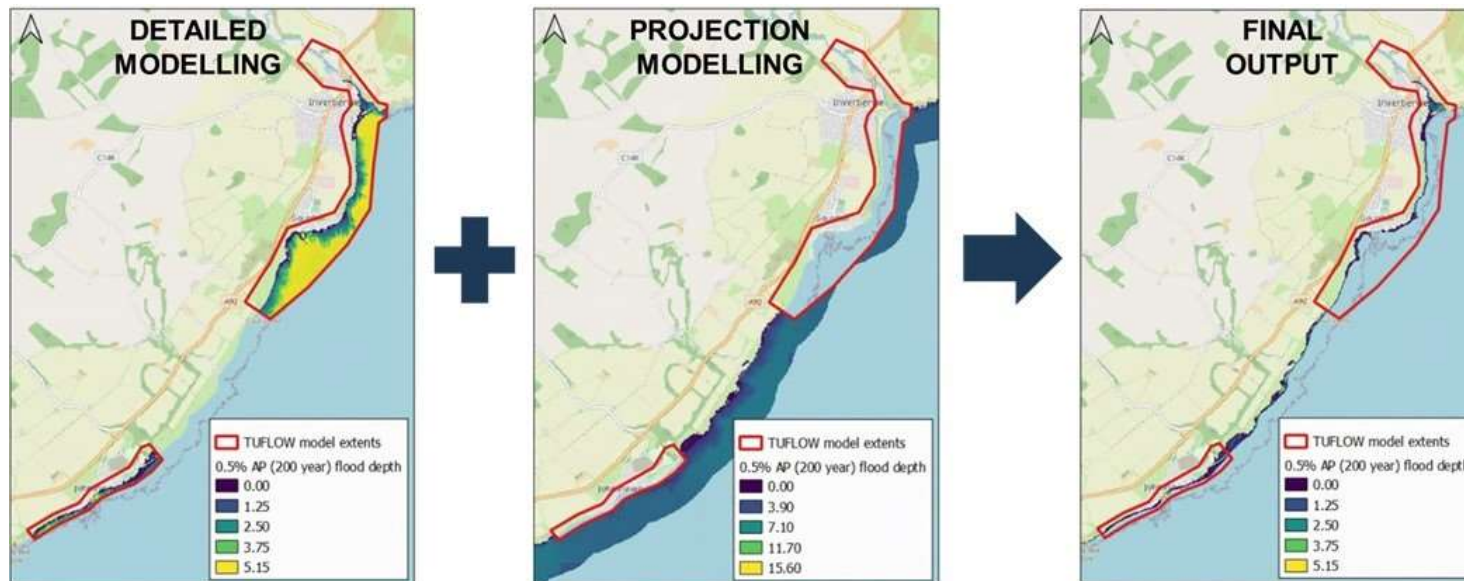
3. Detailed Mapping

TUFLOW Inundation Modelling

- TUFLOW HPC quadtree
- Variable grid resolution
 - 2m minimum
- Propagation of flood volumes from overtopping and SWL



3. Map Generation



3. Map Products

- **Return Periods**
 - 1 in 2, 5, 10, 30, 50, 100, 200 and 1,000-year

- **Climate Change Scenarios**
 - UKCP18 RCP8.5
 - 2050 (95th %ile)
 - 2100 (50th & 95th %ile)
 - Notional increases of +1.0m, +2.0m, +3.5m, +5.0m (Storyboards) to support Adaptation Planning
 - 1 in 30 and 1 in 200-year only

- **Scenarios**
 - Defended
 - Undefined – Defined by Defence Classification

Thank you

Contact details

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Lead Specialist Coastal Flooding
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Contact details

DOUG PENDER
Technical Director, JBA Consulting
Email: doug.pender@jbaconsulting.com



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Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Jonathan Campbell, Arup

Karen Dalgish, South Tyneside Council





Flood and coastal resilience innovation programme

Part of the £200m
Flood and coastal innovation programmes

Stronger Shores

Making British coastlines and communities stronger in the face of flooding, coastal erosion and climate change.

Scottish Flood Resilience Conference 2024

South Tyneside and Stronger Shores

ARUP

Council facing growing challenge of managing effects of climate change in the context of funding constraints and sustainable development goals.



Little Haven
seawall
realignment and
beach widening



A183 Coast
Road
Realignment –
completed
Autumn 2023

A Motion for the Ocean



South Tyneside declared an urgent need for ocean recovery. Leadership of Stronger Shores driven by this commitment and builds on track record of partnership.

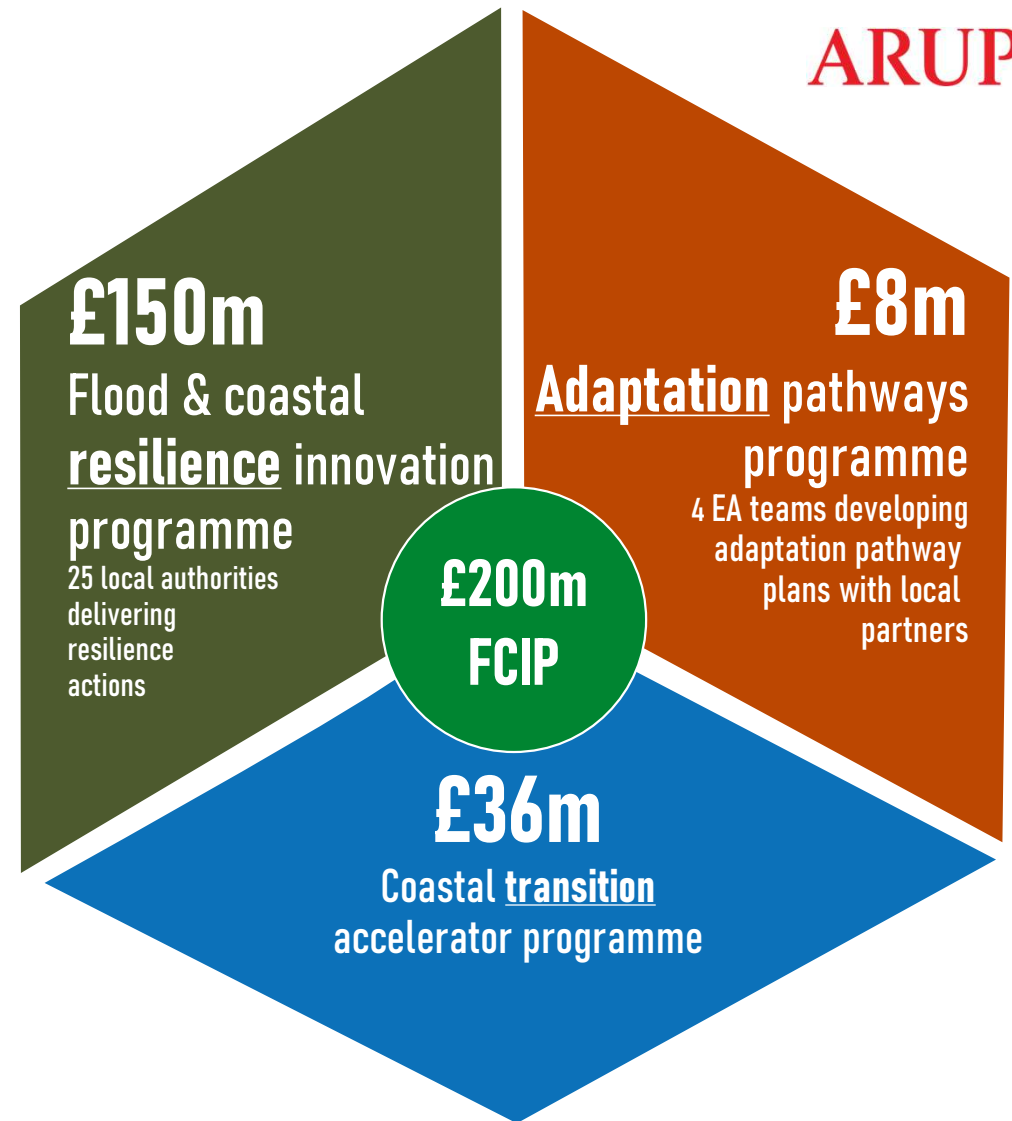
Flood and coastal innovation programme (FCRIP)

Innovative practical action

- £200m | 2021-27
- 25 local authorities
- 4 EA areas
- 2+ coastal authorities

We will drive innovation in flood and coastal resilience and adaptation to a changing climate. We're investing £200 million to test and develop new ways to create a nation resilient to flooding and coastal change.

ARUP



Stronger Shores aims to...

- improve understanding of costs and benefits of sub-tidal **kelp, seagrass and native oyster habitats**.
- identify **innovative methods for modelling, monitoring, restoring** these habitats.
- address existing evidence gaps - provide a **blueprint for risk management authorities** to follow when considering nature-based solutions.
- maximise opportunities for **partnership and community involvement**.



Delivery Partners



Collaborative Partners



Berwickshire & Northumberland
Marine Nature Partnership

Local Authority Partners



Northumberland
County Council



HARTLEPOOL
BOROUGH COUNCIL



North Tyneside Council



South Tyneside Council

Wider Context



- Stronger Shores legacy aims - catalyst for further action and partnership.
- Ambitious - knowledge gaps and challenges will only be partially addressed.
- Recognised that there is a significant amount of wider effort across the UK & Ire.
- Rapidly evolving space - challenging to join the dots and collate information.
- Proactive engagement key to ensure integrated and complementary projects.

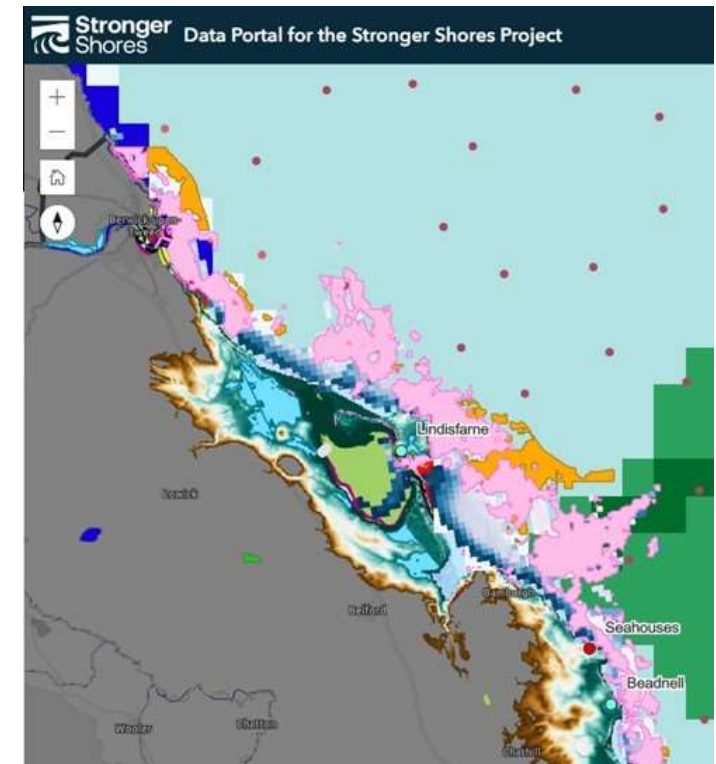
References (top to bottom): Eger, A. M. et al. (2022) Kelp Restoration Guidebook: Lessons Learned from Kelp Projects Around the World, The Nature Conservancy; Gamble, C. et al (2021) Seagrass Restoration Handbook, ZSL; Burrows M.T. et al (2021) Assessment of Carbon Storage and Sequestration Potential Within the English North Sea (Including within Marine Protected Areas), SAMS.

Toolkit for Risk Management Authorities

Findings of the project must be presented in a FCERM context based on needs of RMAs.

Key themes identified to date include:

- Improved natural asset mapping
- Modelling guidance
- Natural Capital Accounting Data
- Optimal restoration methodologies and delivery costs
- Funding and governance advice



Take-away Messages

ARUP

- Seeking to address the knowledge gaps.
- Partnership and engagement is key.
- South Tyneside want to support sharing of learning across wider actors.



- We want to hear from Risk Management Authorities regarding essential aspects of the 'Toolkit'.
- If interested in hearing more, please get in touch!





strongershores@southtyneside.gov.uk

StrongerShores.com

@StrongerShores



A wide-angle photograph of a rocky coastline. The ocean is a deep blue, with white foam from waves crashing against dark, jagged rocks in the foreground. The sky is a lighter blue with soft, white clouds. The text "We're living in a climate emergency." is superimposed in the center of the image.

We're living in a climate emergency.



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Scotland's Flood Resilience Conference 2024

Session 3: Coastal change

Toby Wilson, RSPB



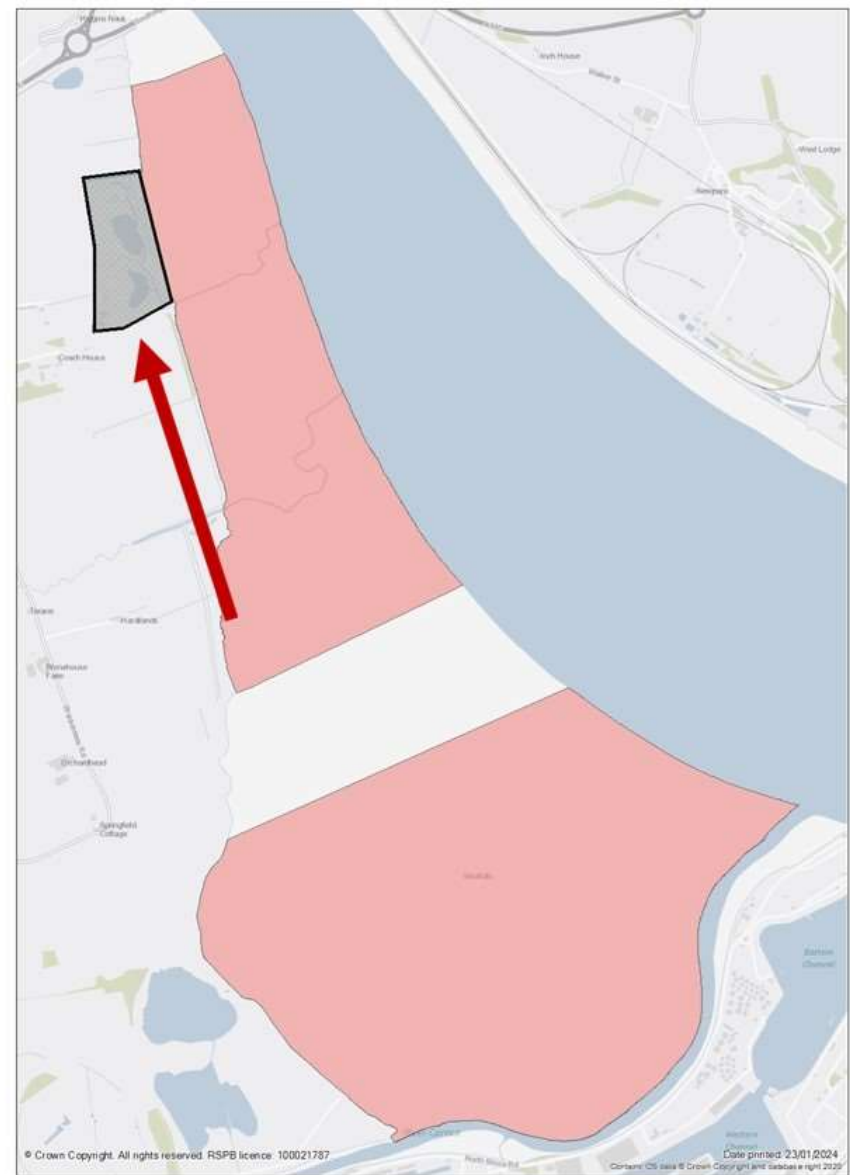


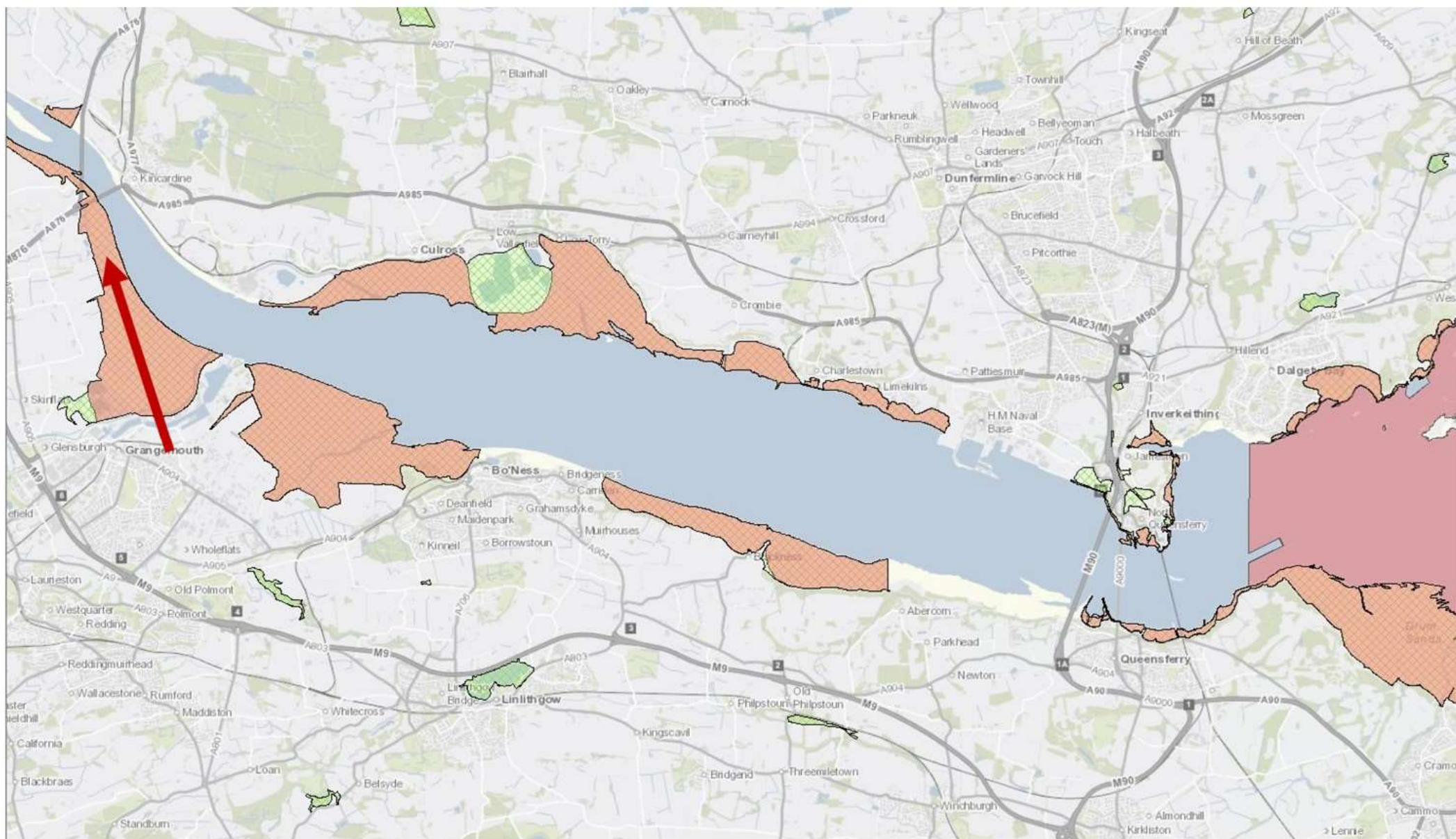
Managed realignment at Skinflats

Lessons learned from a
long journey to delivery

Toby Wilson

Senior Conservation Officer





Skinflats SSSI

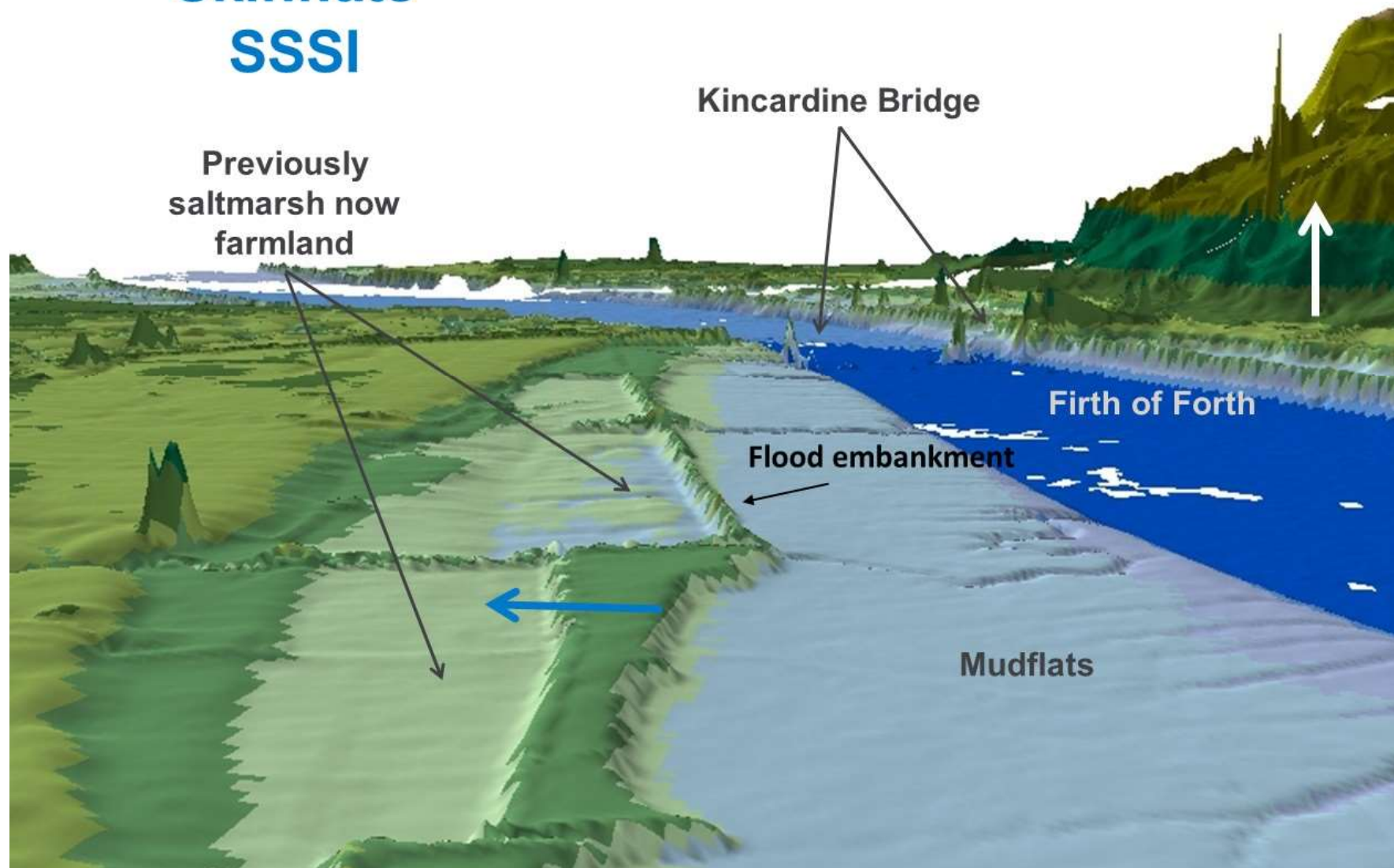
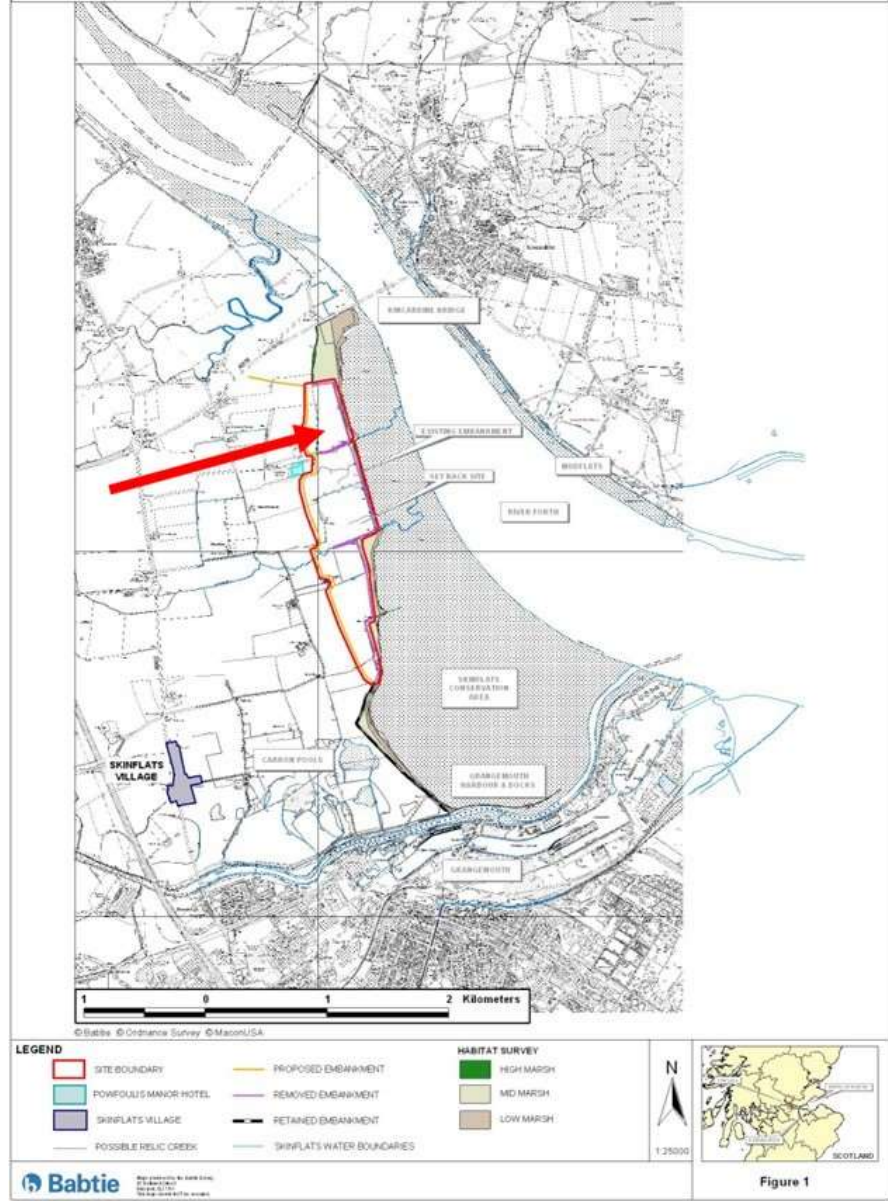


Figure 1 : Skinflats Site Map



Project led by SNH in 2003 looked to deliver managed realignment across the wider Skinflats area

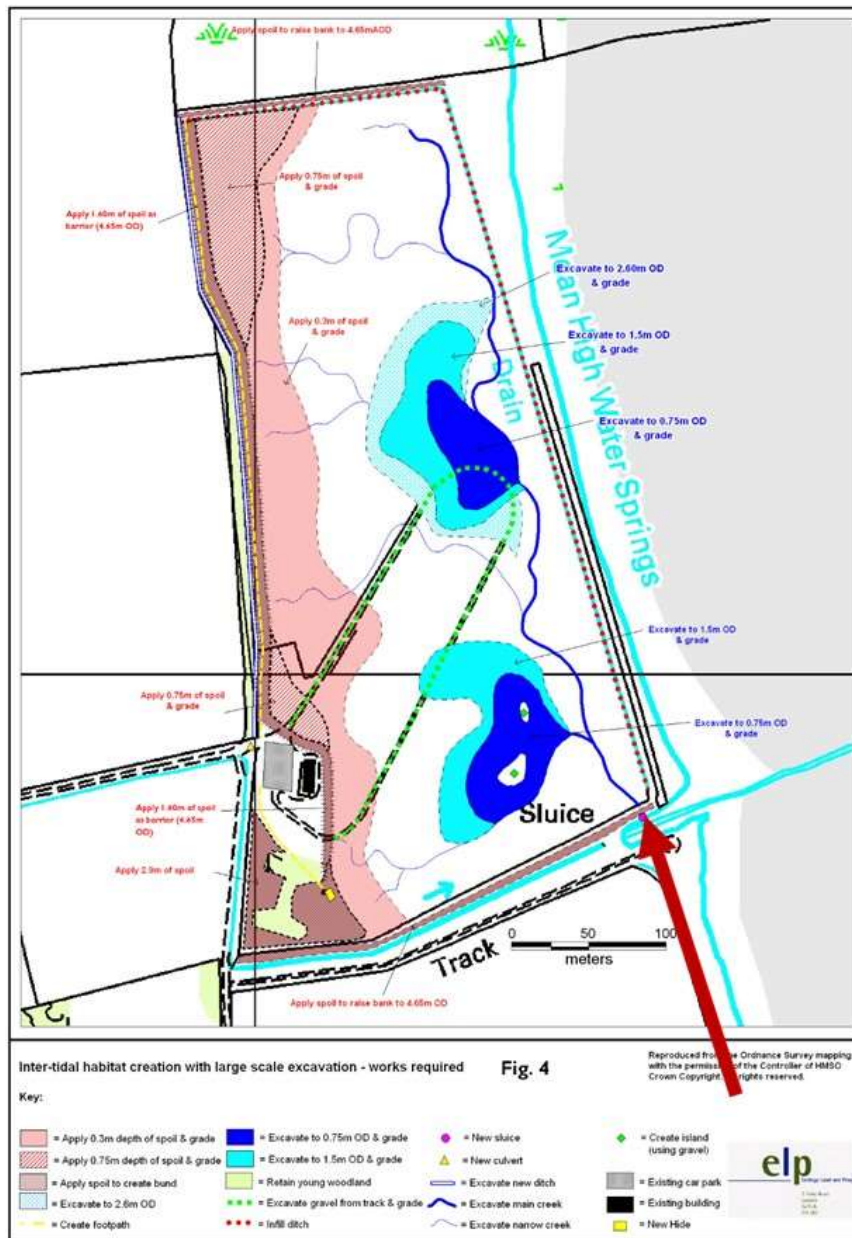


The objectives of the project were to:

- Create 9ha of new intertidal habitat.
- Improve the site from wintering waders and wildfowl e.g Redshank, Curlew, Oystercatcher.
- Act as a demonstration site for coastal adaptation.

Regulated tidal exchange (pipe through sea wall with a sluice)

- Limited loss of SSSI saltmarsh (SNH advice).
- More 'controlled' project, noting community concerns.
- Potential to speed up saltmarsh colonisation.













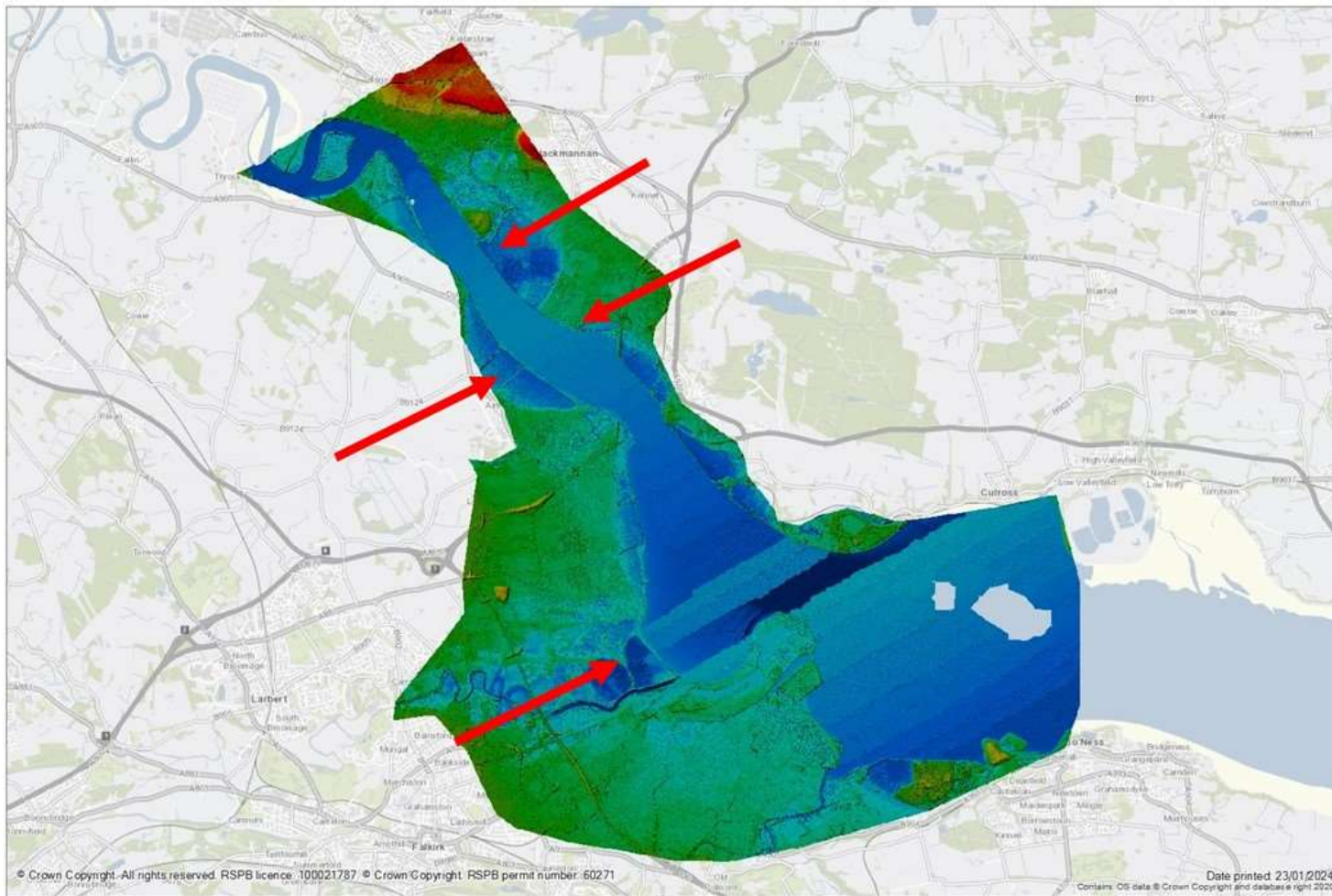






Lessons learned:

- Get the community involved from an early stage.
- Learn from examples out there.
- Saltmarsh colonises quickly.
- Do not put hard engineering in a dynamic environment.



Less theoretical modelling, time to deliver!



Thank you



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Audience Q&A

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#FRM2023

Coming up next...

Session 4:

Challenges of funding and multiple drivers





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Refreshments and Market Place





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 4: Challenges of funding and multiple drivers

Chair: Kit England, Paul Watkiss Associates



Join at
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#Floodresilience2024





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 4: Challenges of funding and multiple drivers

Angus Pettit, JBA Consulting



Challenges of Funding Flood Resilience

Angus Pettit

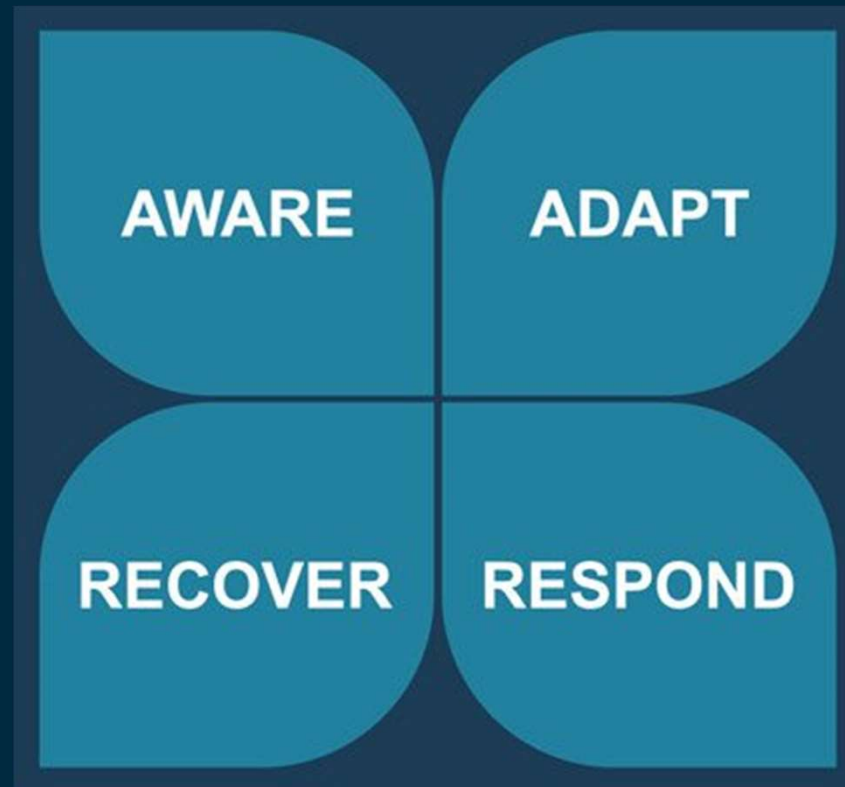
Introduction

Winter floods highlight the need for resilience

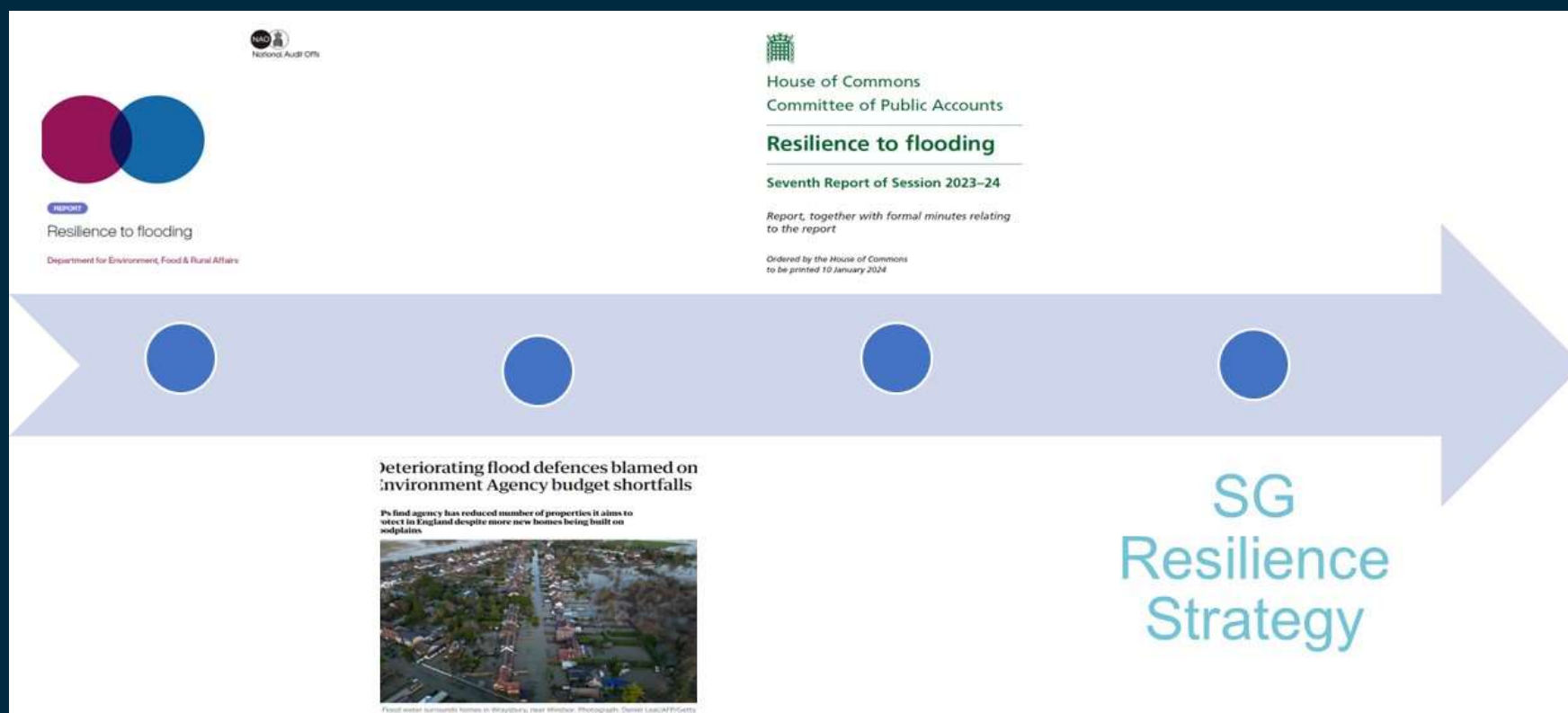
Increased pressure on existing assets

A need to think holistically about flood risk

Need to act now to enable resilient actions to be funded



Where are we now?



Funding?

Historic funding for flood mitigation

Direct funding to local
authorities

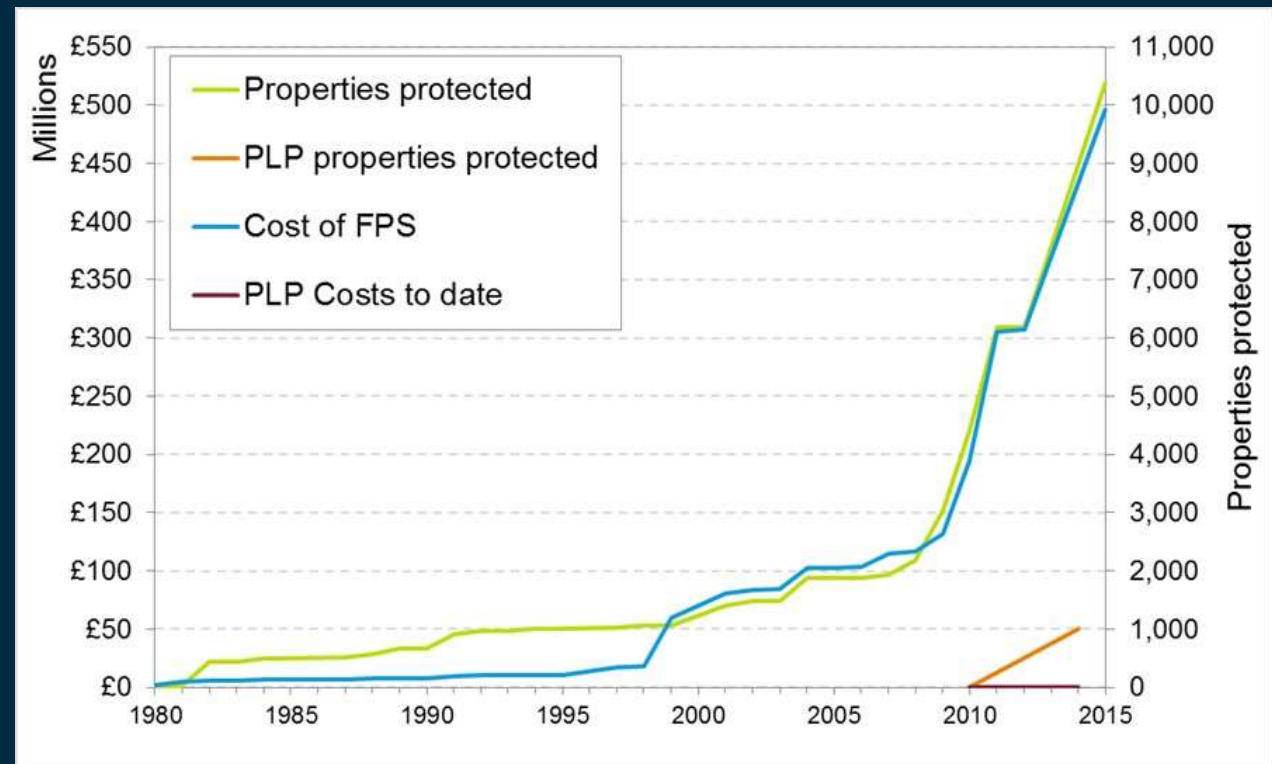
General Capital Grant

SEPA flood forecasting

Scottish Flood Forum to build
flood resilience

Periodic post-flood grants to
individuals

Bellwin scheme (recovery)

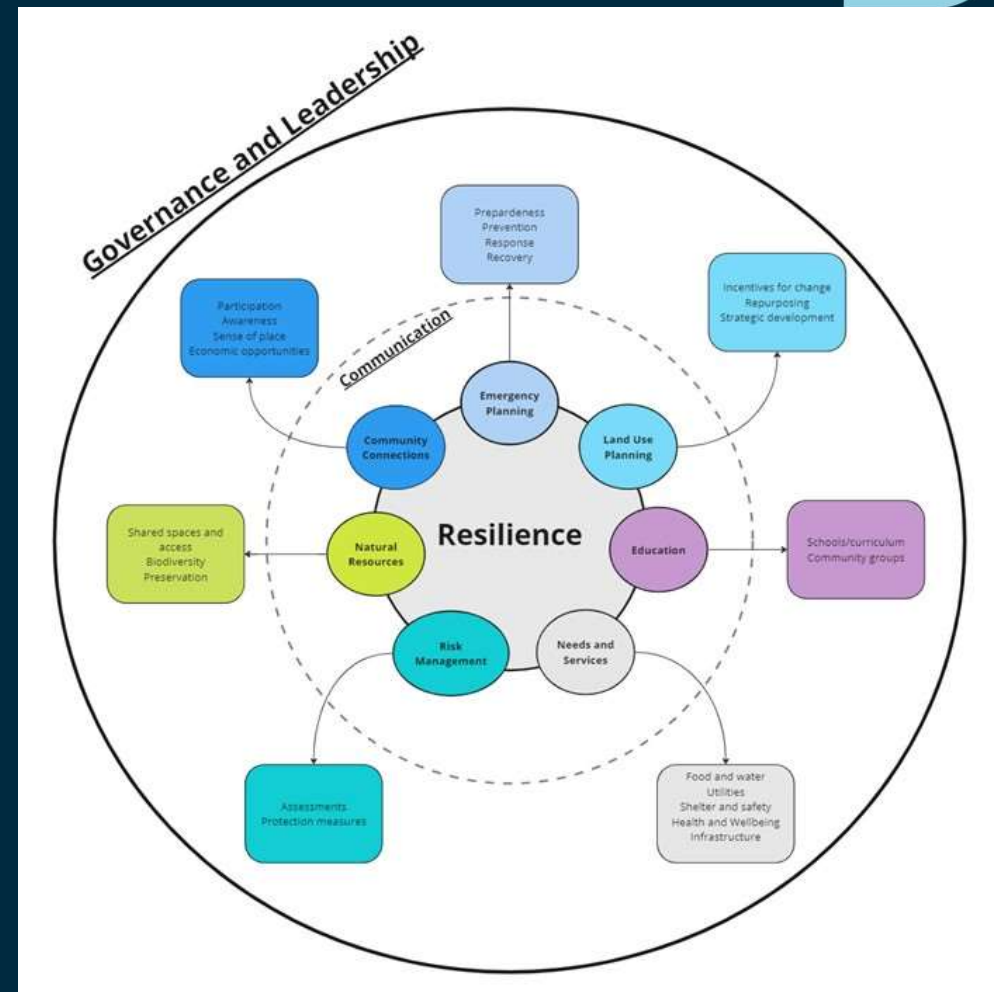


What does resilience look like?

Resilience: Build capacity of the whole-System to cope with hazards, reduce vulnerability and enable quicker recovery.

It is a layered approach:

- **Level 1 – Principles** – the direction of travel. These must be applied and not conflict with each other.
- **Level 2 – Components** – the building blocks of the System that is exposed to hazards/change which define how resilient that system is.
- **Level 3 – Indicators** – the make-up of the components. The details that are underpinning the Resilience. Where actions are set and change measured.



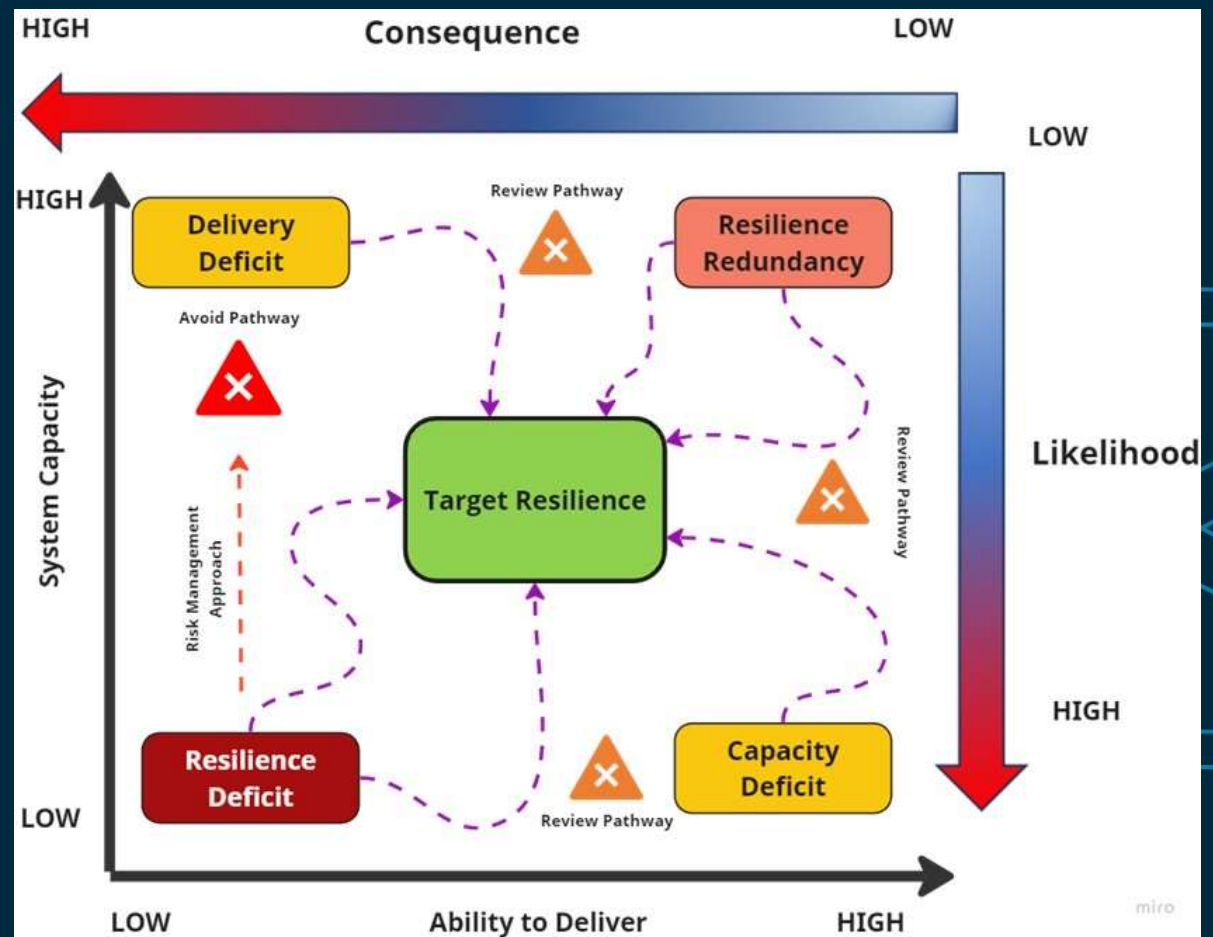
What are the key questions?

- What is the system that is looking to increase resilience?
- What are all the Components that contribute to resilience of the system?
 - Who is responsible for these?
- What state are they all in?
- How do you derive a strategy to increase resilience?
 - What is the governance structure?
 - How do you set actions?
 - How do you fund actions?
 - How do you monitor the System?
 - How do you measure progress?

Risks of traditional flood funding?

A *Risk Management* approach can lead to **Deficit** – High consequence when defences overtopped. Inevitable.

Adaptation Pathways need to be used to move towards the **Target Resilience**.



Food for thought

Example: A small community is at risk of flooding

From a “traditional” approach the preferred management option is to **Sustain the Standard of Service** for 50 years. This means performance decreases through the life to effectively match that offered currently.

Taking this as the only action; will this community be more or less resilient in 50-years?

The challenge is to deliver the same level of Resilience with a lower level of Risk Management.

Resilient actions and funding DPO



Slide 229

DPO

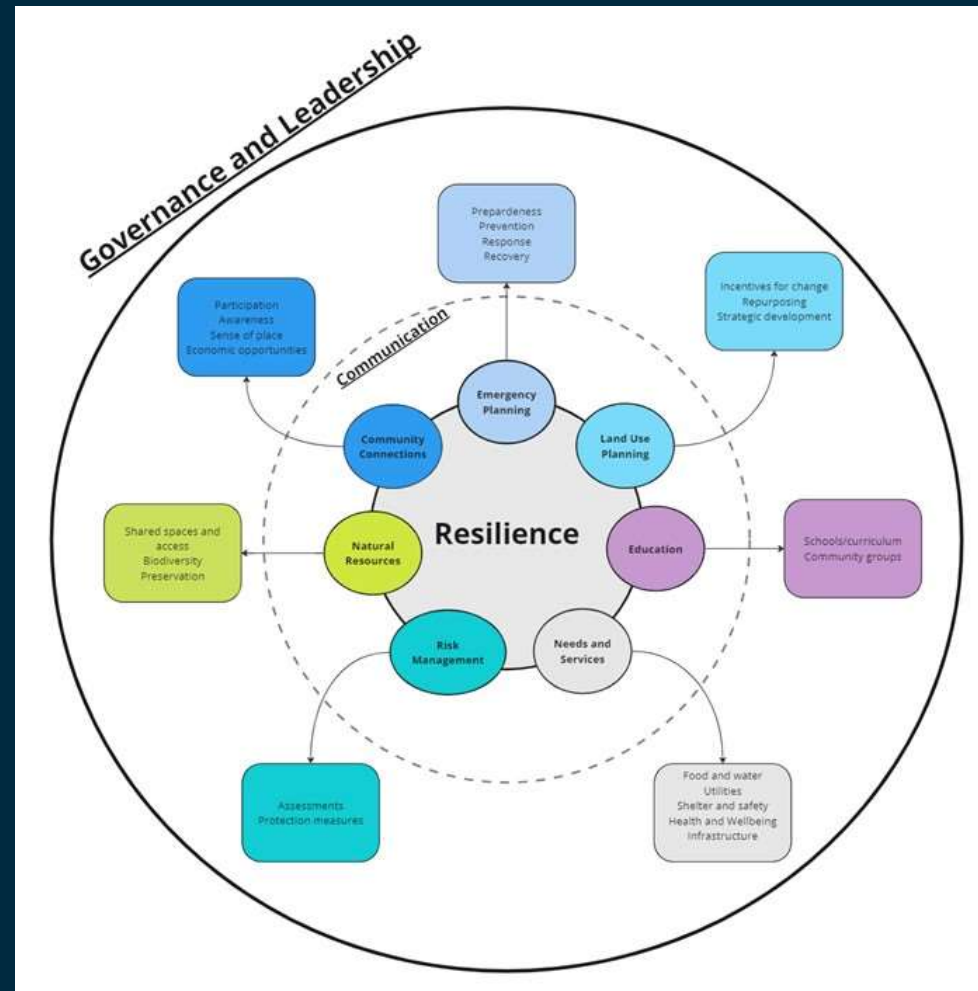
Is it useful to map this more directly back to the figure on slide 5. "Resilient Components". If we set an agree set of components then all you have to do is fund actions that can be tied back directly. Then you are "doing resilience".

Doug Pender, 2024-01-30T10:37:54.995

What does resilience look like?

Does the current funding model align with resilience actions?

Resilience needs an alternative funding model.

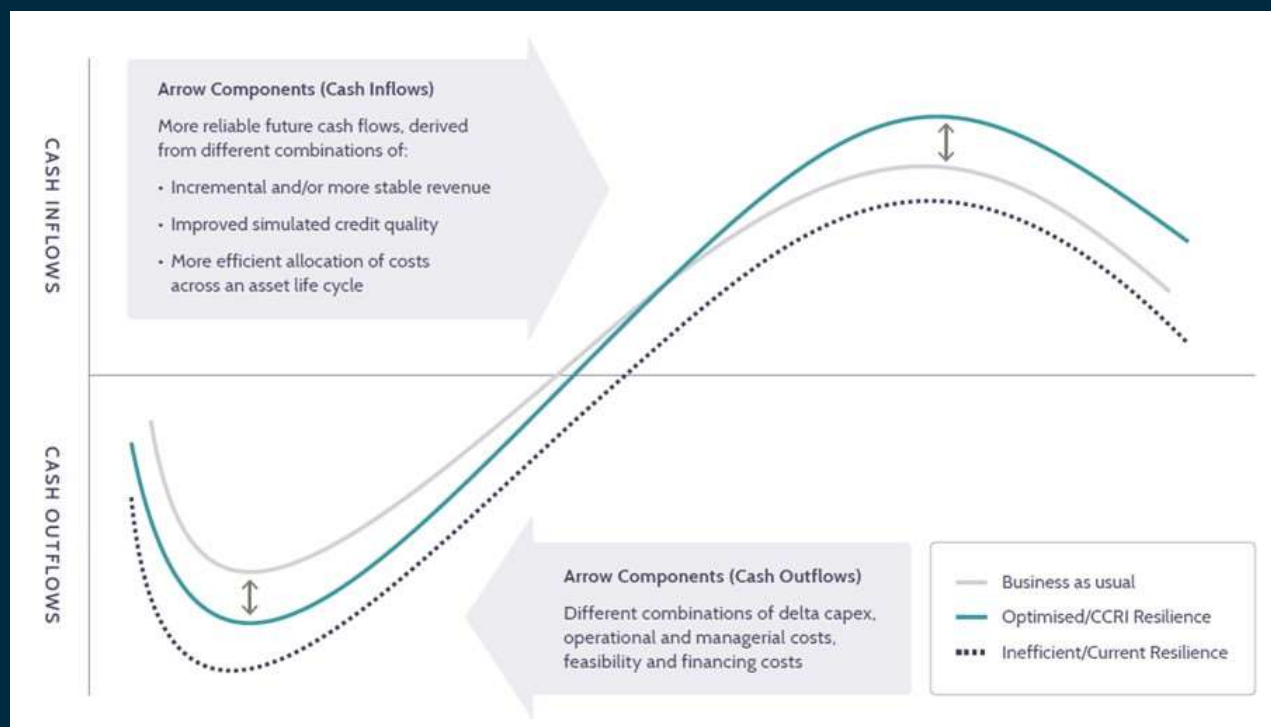


Economic basis for long term decision making?

Many resilience (and adaptation) actions have greater economic benefits to society than their costs.

Making decisions today that enable long term resilience interventions will often have long and short-term economic benefits greater than their costs.

Investing early will save future cash flows and result in wider benefits



What does funding resilience look like?



A consistent framework for resilience that can be translated to any organisation / sector / system

A proportional approach to investment, governance and scrutiny

An approach that can fund:

- Immediate actions
- Enabling actions
- Future actions



DP0 How do we start this? We need a consistent framework that can be translated to any system and any organisation to demonstrate consistency. This applies to all sectors. Public, private and third so it doesn't conflict.

Doug Pender, 2024-01-30T10:45:32.268

DP0 0 We need to be careful that we can demonstrate that we are however funding actions that will have impact. Esp around future uncertainty. This is not just climate.

Doug Pender, 2024-01-30T10:46:43.067

DP0 1 Sliding scale of investment, governance and scrutiny.

Immediate actions - £££

Enabling actions - ££

Future actions - £

Red tape on immediate actions has to be removed.

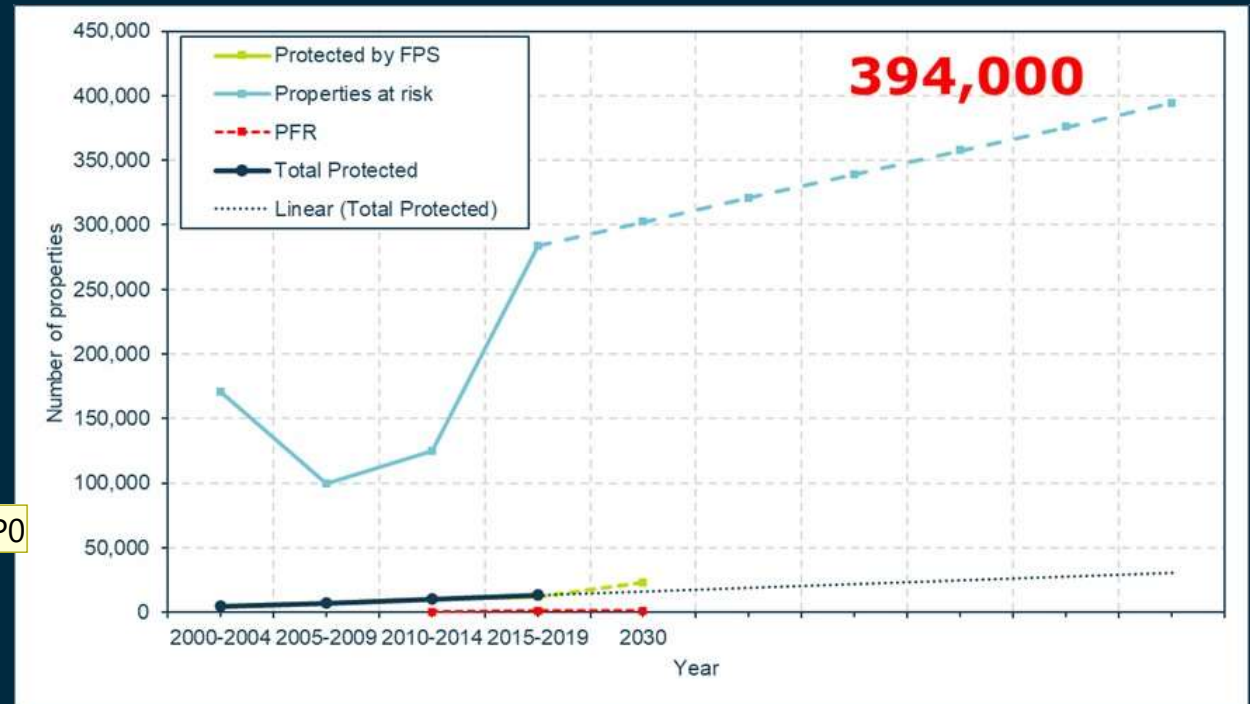
Doug Pender, 2024-01-30T10:48:03.235

Challenges of current appraisal model

What needs to change?

- Define a metric(s) of resilience to track how funding is delivering against targets
- Calculate a budget that is sufficient to keep-up with climate risks

DP0



Slide 233

DPO

And other changes. Demographics etc. It's not just climate that will drive.

Doug Pender, 2024-01-30T10:48:44.168

An example from Wales

Key findings

Long-term Investment Requirements for Flood Defences in Wales

Scenario	Total Benefits	Total Cost	Annual Cost	Properties remaining at high risk	Reduction of properties at high risk	Benefit for every £1 spent
A	£26.6bn	£5bn	£50m	42,464	63,811	£2.8
B	£26.3bn	£2.20bn	£22m	52,884	53,390	£11.9
C	£26.2bn	£2.38bn	£23.8m	49,146	57,129	£5.3
D	£25.9bn	£1.97bn	£19.7m	60,553	45,721	£13.1

Findings:

- Benefits outweigh the costs
- If funding stays the same, residual damages increase
- At a community level, many are uneconomical
- Residual damages remain, so other resilience actions are needed

What long term challenges remain?

Managed retreat in some area?

Do we need to move from long term protection to medium-term protection whilst seeking long term managed retreat?

DP0



Slide 235

DPO

We need to accept more risk.

To do this we need to understand our assets better. Can we still take a conservative and precautionary approach to every aspect of the resilience "system".

Doug Pender, 2024-01-30T10:49:56.278

DPO 0

Worth highlight here how the "world" has changed in your time as a professional? We could all be living on Mars by 2200

Doug Pender, 2024-01-30T11:01:30.265

DPO 1

Maybe here introduce the excellent, good and bad decisions? Are we confident that we can make excellent decisions for 2100?

Maybe shifting the narrative to avoiding bad will enable more flexibility and dynamic funding?

Doug Pender, 2024-01-30T11:02:57.593

Why not just implement this now?



Cost of protecting via flood defences: ~£76k

Assuming an average house value of £185k

Total cost of buying all 284k properties at risk = £53b

Can we implement other innovative funding approaches?



Are there other options for funding managed retreat?



Compensation

Replacement /
deposit for
new
properties

High costs
and no
government
policy

Rollback

Demolish at-
risk properties
and provision
and funds to
relocate

High costs
and no
government
policy

Levy scheme

Levy raising
funds
allocated to
pay out funds
once
properties
become
uninhabitable

Adaptation fund

Residents are
given support
from a local
authority fund

Accumulator fund

Homeowners
pay into a
fund which
accumulates
over time to
balance the
drop in value
at risk
increases

What about private sector funding?



Partnership Funding
approach similar to England?

Can corporate disclosure
initiatives help to identify and
fund resilience?

Market based initiatives?

- Example of FIRNS
- Green finance initiatives

THE PHYSICAL CLIMATE RISK ASSESSMENT METHODOLOGY (PCRAM)
Guidelines for Integrating Physical
Climate Risks in Infrastructure
Investment Appraisal

What next?

Lots of funding opportunities

Trials and investigations

Legal consideration

Include resilience as a core objective for funding (but must be defined)

Develop methods to quantify social and environmental outcomes to enable funding for resilient actions that support these measures

Adapt appraisal process to focus on resilience

Calculate a budget that is sufficient to keep-up with climate risks

Conclusions



We need resilience indicators to measure success

We need a budget and target for resilience

We need a funding mechanism that must:

- Support resilience components working together
- Delivers excellent short-term decisions
- Enables good medium-term decisions
- Avoids bad long-term decisions

Regulatory Framework





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Scotland's Flood Resilience Conference 2024

Session 4: Challenges of funding and multiple drivers

Conor Price, CPE Consulting

Duncan Morrison, Scottish Borders Council



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Scotland's Flood Resilience Conference 2024

Session 4: Challenges of funding and multiple drivers

Laurence Cload, Mott MacDonald

Alan Fraser, The Highland Council





SNIFFER Carbon Reduction on River Ness

8th February 2024

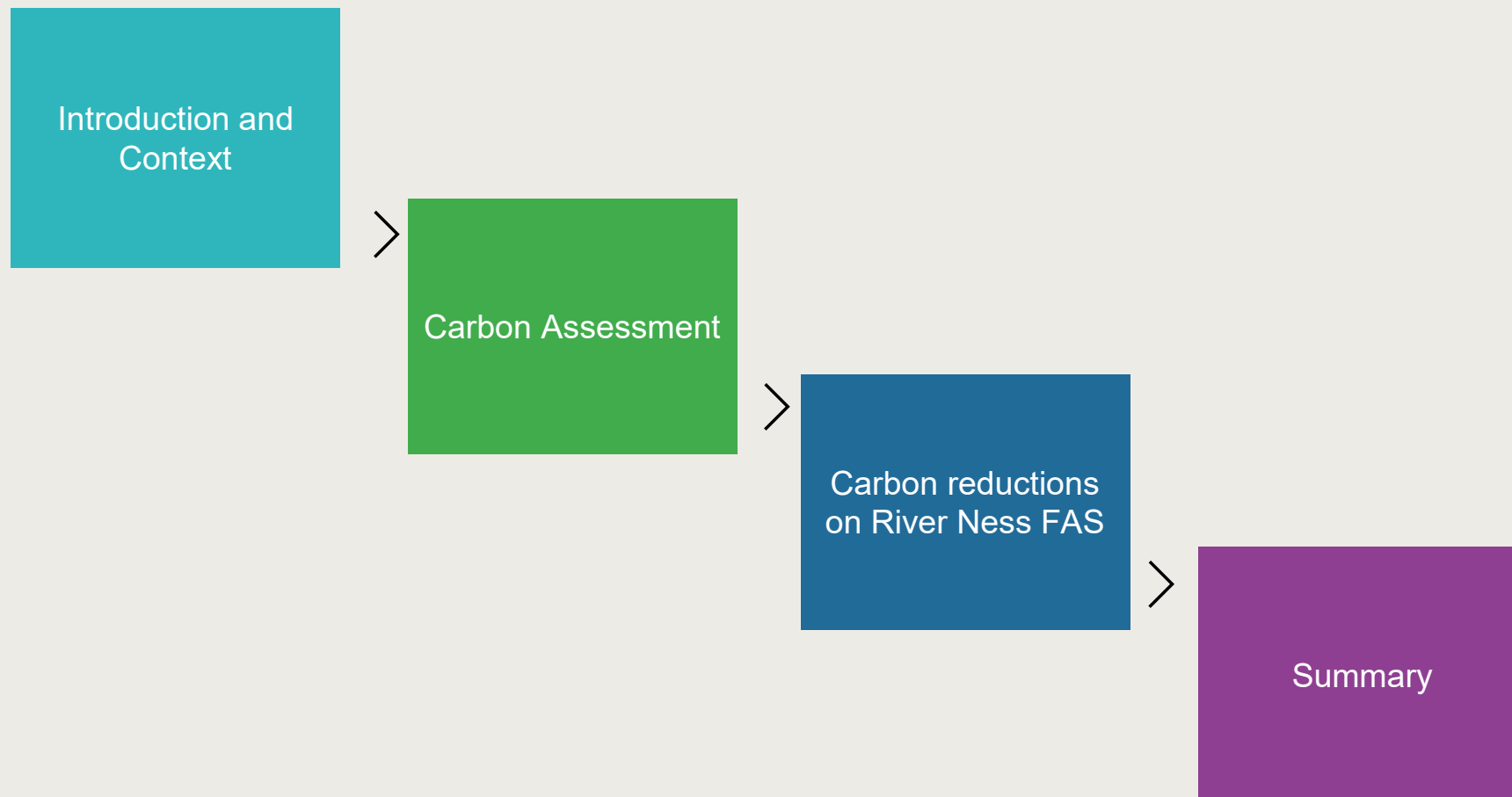
Alan Fraser
MEng CEng MICE
The Highland Council



Laurence Cload
MEng CEng MICE
Mott MacDonald



Contents



1. Introduction & Context

Introduction

- Changes in science
- Changes in national legislation
- Changes in Council strategy

Average reduction of

2,000
TCO₂e
per year



Photo by The Highland Council

River Ness Flood Alleviation Scheme

Combined tidal and fluvial flooding –1%AEP+CC

4km defences

795 Res. and 188 NR

£60m + benefits

£22m cost

Annual average flow - $300\text{m}^3/\text{s}$
(35 competition pools a minute)

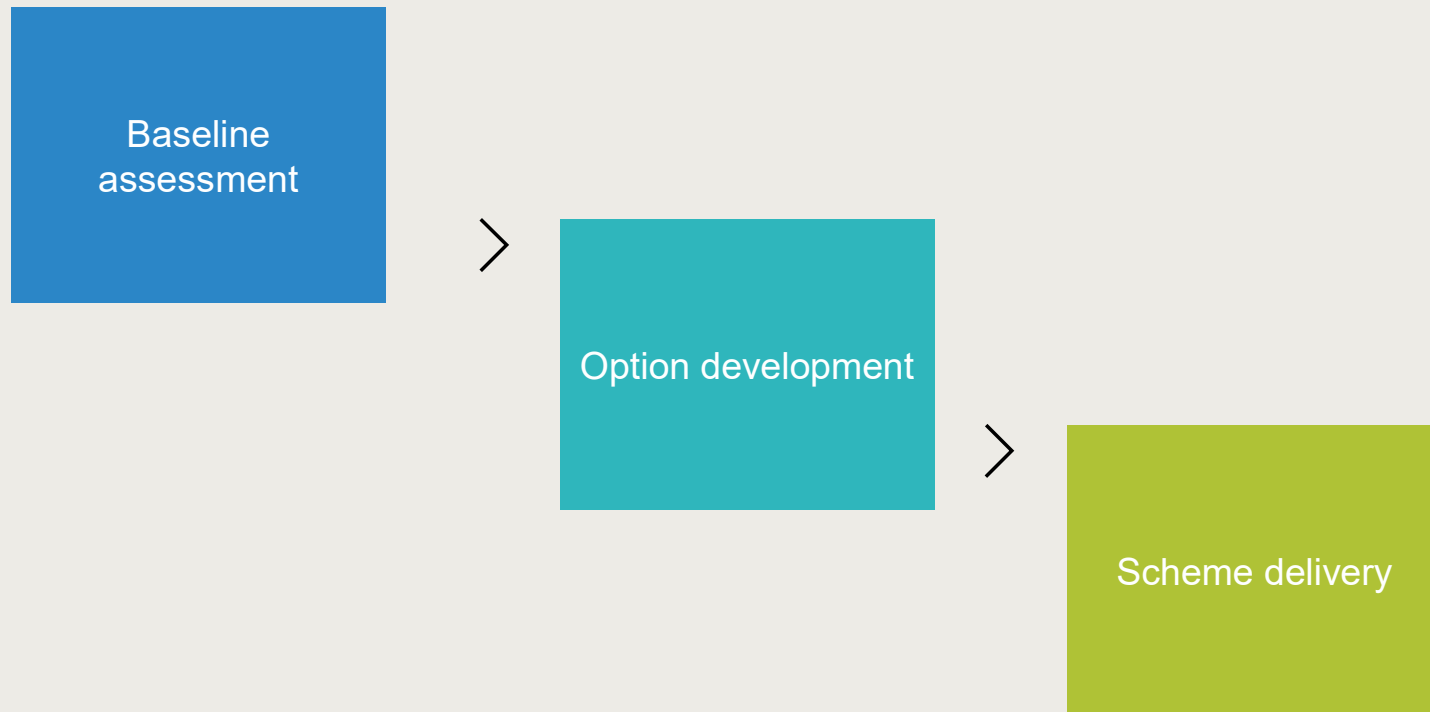
Design flow $954\text{m}^3/\text{s}$ for 30 hours

Completed in 2015



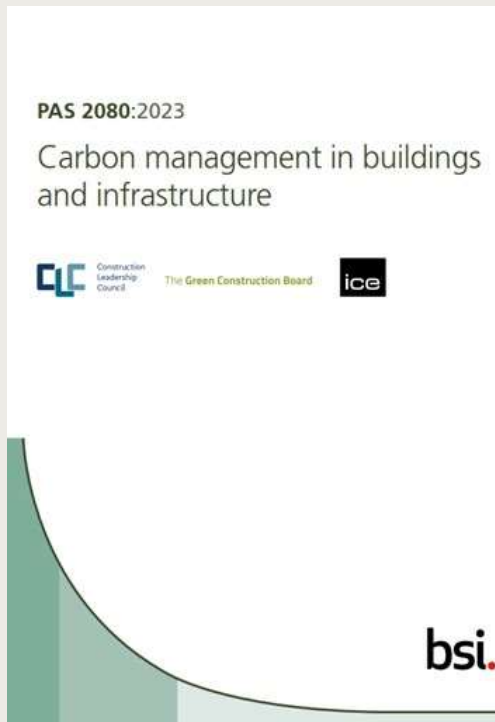
2. Carbon Assessment

Carbon Assessment Process



PAS 2080:2023

Overview



A common process to realise low carbon outcomes towards the 2050 net zero target

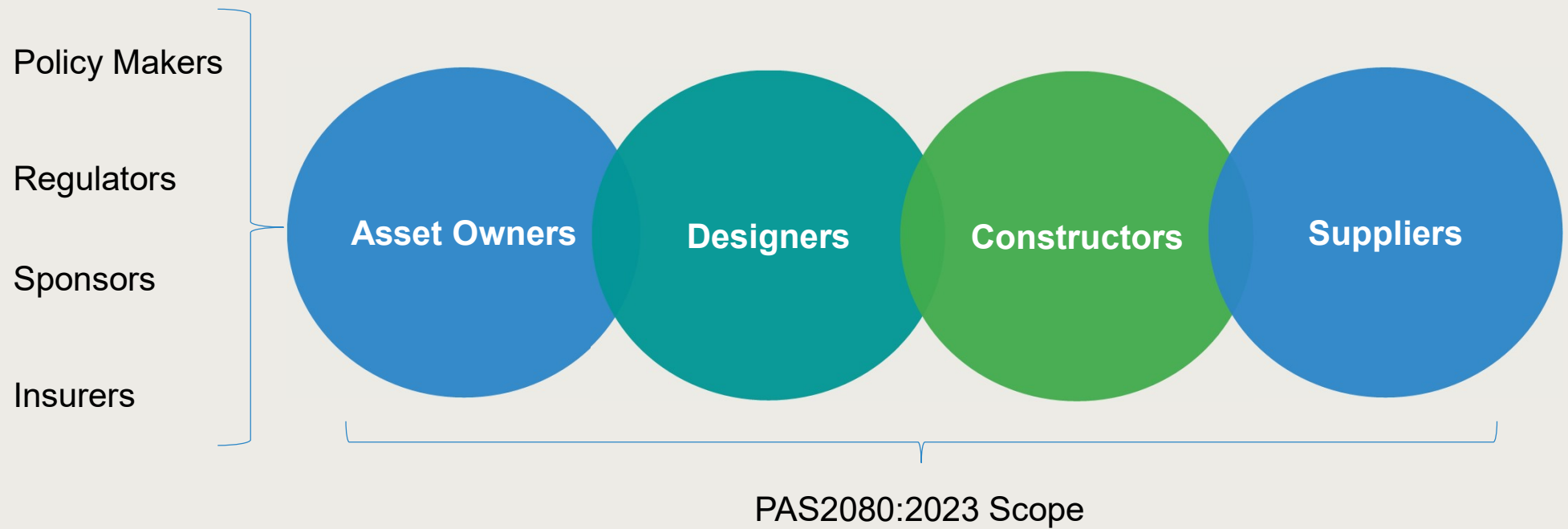
Guidance on how to manage whole life carbon in projects and programmes

Includes requirements for all carbon value chain members

Provides consistent terminology

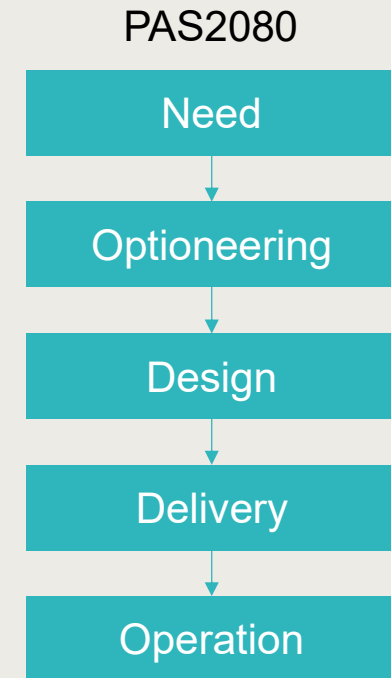
PAS 2080:2023

Carbon Value Chain Members



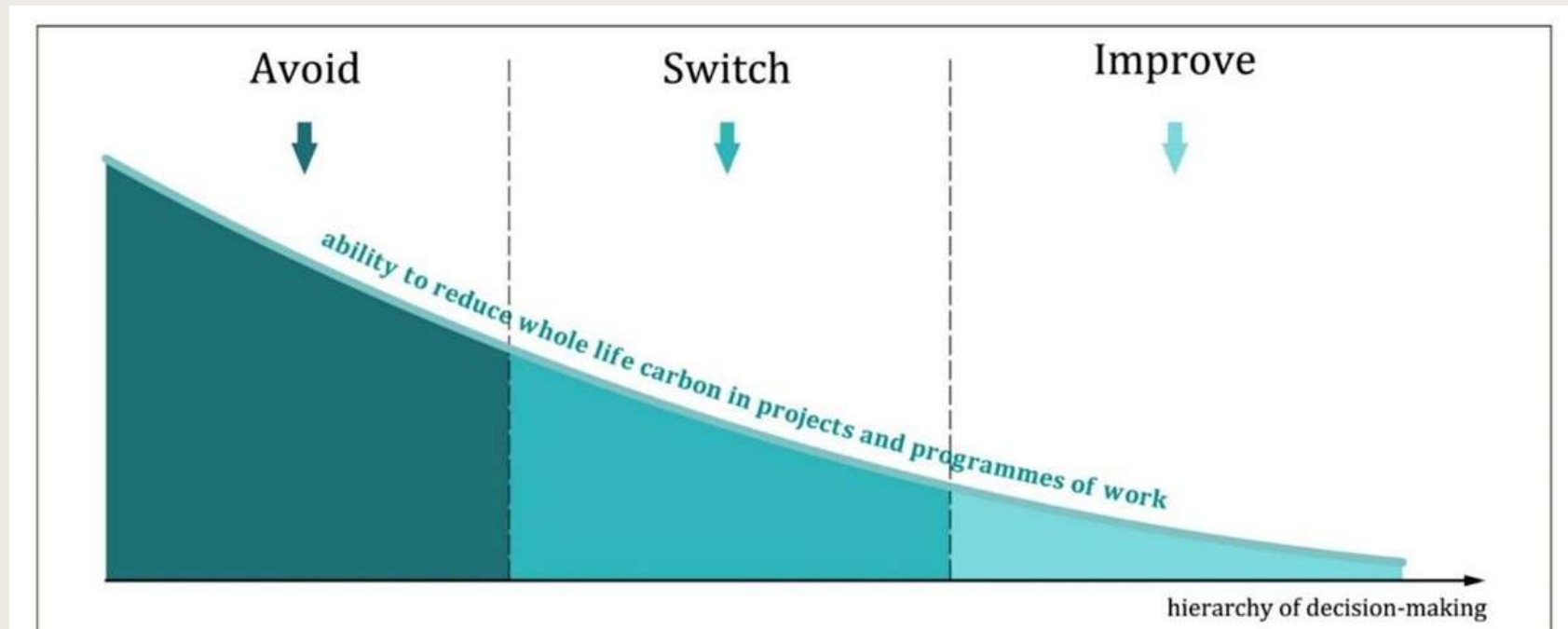
Stages for carbon assessment

- Flood defences are used to adapt to climate change, but every flood protection project has an individual solution
- Each stage we can influence the carbon outcome through the decisions that are made
- Strategy / Need – Avoid, Resilience, NBS, Type of scheme
- Optioneering – Option section, type of defence, extent
- Design – Material selection, precast, construction approach
- Delivery – Difficulty, approach, vehicles
- Operation – Number of pumps, gates



Avoid...Switch...Improve

The ability to influence whole life carbon decreases across the asset lifecycle and at each stage



PAS2080:2023

3. Carbon Reductions on River Ness Flood Alleviation Scheme

Flood Defences – Opportunities to ‘Avoid’

Remove need or reduce extent of flood defences:

General Solution:

Examples:

NFM / NBS	Remove risks	Adapt
<i>Upstream catchment changes to reduce runoff</i>	<i>Remove receptors from floodplain</i>	<i>Provide resilience to receptors and the community</i>
<ul style="list-style-type: none"> • Peatland restoration • Afforestation • Leaky barriers 	<ul style="list-style-type: none"> • Property relocation • Raised infrastructure • Build outside risk areas 	<ul style="list-style-type: none"> • Floodable property • Disaster planning

River Ness FAS Outcomes

- Tidal scheme, so little NFM / NBS
- Existing city - a lot of receptors
- Scheme was halved due to properties upstream preferring to have the flood risk [Resilience]

Flood Defences – Opportunities to ‘Switch’ / ‘Improve’

Option selection to consider carbon

Type of scheme	Consider location	Walls vs Embankments	Remove operational requirements
Diversion Flood Storage Flood Walls Property level protection Cost + carbon benefit of different approaches	Reduce length Merge with environment Landscaping Road repairs	Embankments have a lower carbon impact More space needed for embankments	Operations require energy and effort for assessing carbon Minimise use of pumps, gates and demountable defences

River Ness FAS Outcomes

- Tight for space
- Optioneering showed walls were most economical
- Embankments were used where possible – about 10% of the length
- Designed out 4 flood gates

Direct defences as walls selected as preferred option

Emissions Quantification - Overview

Per m of flood wall

1

Seepage Control

Piles weldable structural steel

1822 kgCO₂e

2

Wall

average UK concrete mix

552 kgCO₂e

3

Facing

Natural stonework

64 kgCO₂e

4

Railings

Handrail – Stainless

62 kgCO₂e

5

Coping Stone

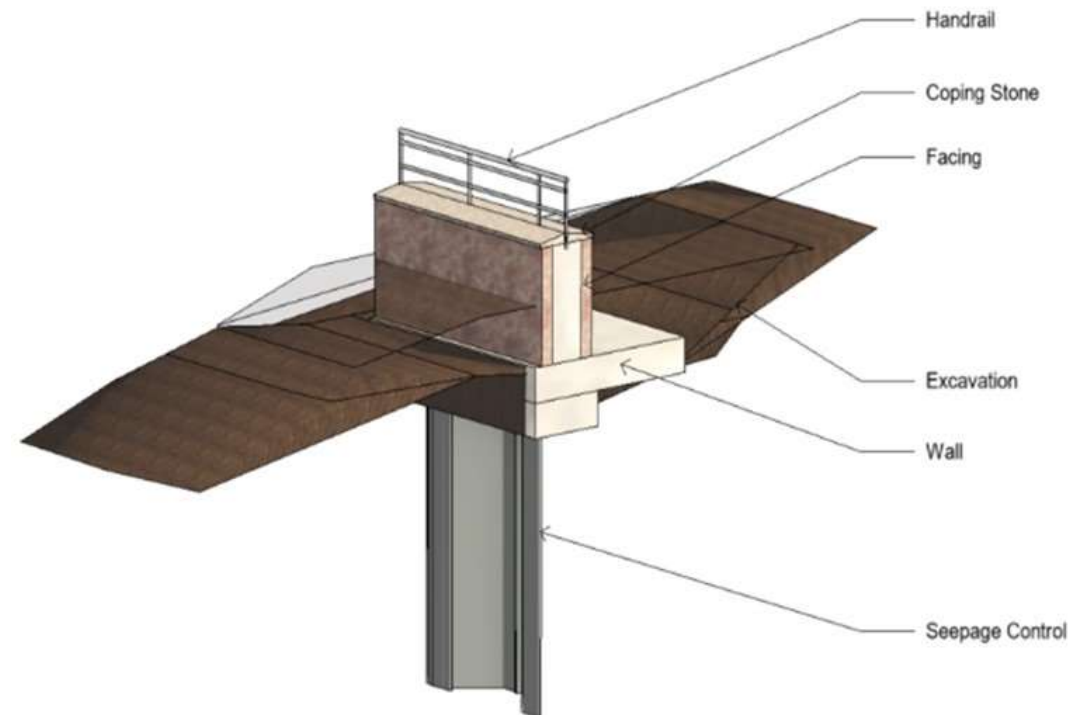
Natural Stone on lime mortar
26 kgCO₂e

6

Excavation

Maximum depth 1 m
4 kgCO₂e

Component	kgCO ₂ e / m
Seepage control (1)	1822
Wall (2-6)	708



Emissions Quantification - Seepage

Per m of flood wall

1

Steel /
Recycle

Piles weldable
structural steel

1822 kgCO₂e

1b

Plastic /
Recycle

93% PVC

376 kgCO₂e

1d

Pumps

Per use / per pump

251kgCO₂e

100 TCO₂e over life
depending on use

1a

Embankment
with Clay
Matting

From the
middle of River

1459 kgCO₂e

1c

Concrete
Secant wall

C20/25

diameter 0.6m

677kgCO₂e

Component	kgCO ₂ e / m	Reduced
Seepage control (1)	1822	376
Wall (2-6)	708	708



Emissions Quantification - Wall

Per m of flood wall

2

Concrete

Average UK
RC concrete
mix C32/40
552 kgCO₂e

2a

Precast

Reduce size
414 kgCO₂e

2b

Steel Piles

Piles weldable
structural steel
504.42kgCO₂e

2c

Blockwork/
membrane
349 kgCO₂e

2d

Concrete Mix

Change concrete
mix
349 kgCO₂e

Component	kgCO ₂ e / m	Reduced
Seepage control (1)	1822	376
Wall (2-6)	708	505



Emissions Quantification - Railings

Per m of flood wall, 1m high

3

Railings
Handrail –
Stainless
62 kgCO₂e

3b

Railings
Handrail –
Galvanised Steel
28 kgCO₂eq

3d

Railings
Stainless wire
with mild steel
posts
13 kgCO₂eq

3a

Railings
Handrail –
Mild Steel
16 kgCO₂e
recoating not
included

3c

No Railings
Increase RC
wall
55kgCO₂eq

3e

Railings
Timber
2 kgCO₂eq
10yrs replacement
cycle

Component	kgCO ₂ e / m	Reduced
Seepage control (1)	1822	376
Wall (2-6)	708	456

3f

Railings
Glass panel with
stainless steel support
30 kgCO₂eq



Emissions Quantification - Facing

Per m of flood wall

4

Facing
Natural
stonework
64 kgCO₂e

4b

Facing
Fake stone
stonework
64 kgCO₂e

4d

RC Concrete
Pattern concrete
14 kgCO₂e

4a

Blockwork
with render
Block work
26 kgCO₂eq

4c

Excavation
Haling stone
Maximum
depth 1 m
3.6kgCO₂eq

Component	kgCO ₂ e / m	Reduced
Seepage control (1)	1822	376
Wall (2-6)	708	378



Emissions Quantification - Totals



Component	kgCO2e / m	Reduced
Seepage control (1)	1822	376
Wall (2-6)	708	378

		Baseline		With reductions	
	Quantity (m)	kgCO2e/m	Total TCO2e	kgCO2e/m	Total TCO2e
Seepage control	3,176	1,822	5,787	376	1,194
Concrete Wall	3,928	708	2,781	378	1,485
Steel Pile Wall	278	2,541	706	378	105
Pumps (No of)	3	n/a	300	n/a	300
Embankments	220	500	110	500	110
Concrete piles	246	75	18	75	18
		Totals	9,701		3,212

67% reduction in carbon!

Carbon Benefit

Property damage protection only

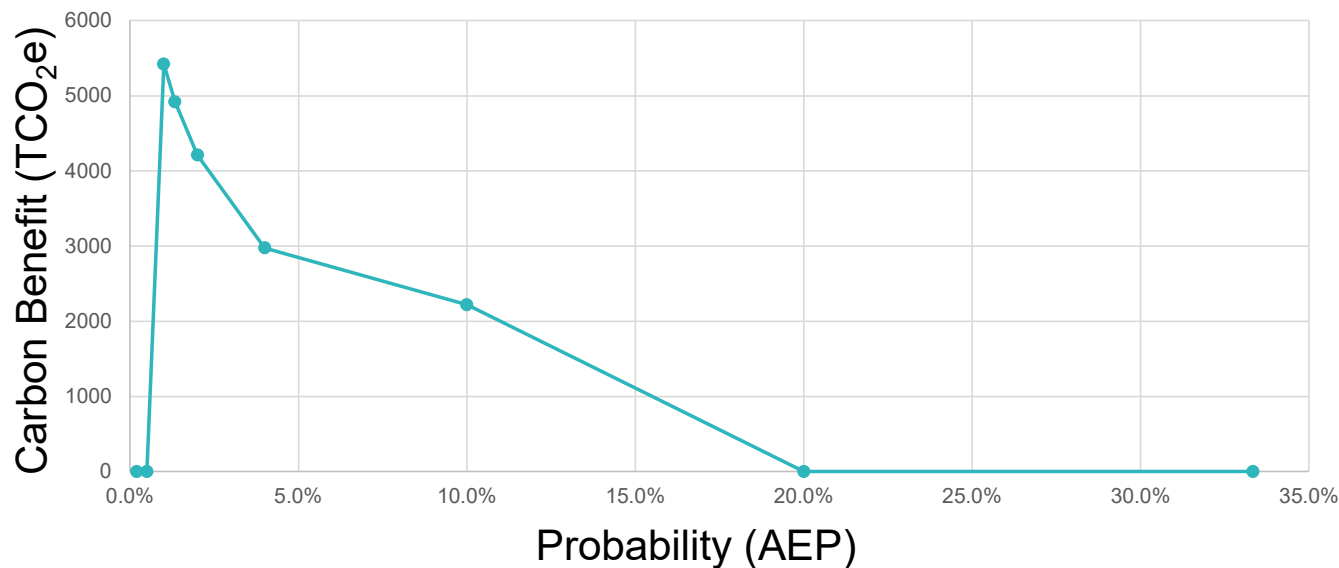
Engineering Sustainability

ice Publishing

Net-zero carbon dioxide emissions in flood defence schemes

Laurence Cloud MEng, CEng MICE
Associate Flood Risk Engineer, Mott MacDonald, Inverness, UK
(mail@lozweb.free-online.co.uk)

3 to 6 TCO₂e saved per property per flood by avoiding property repairs (Carbon benefit)



River Ness Probability Carbon Benefit Curve

600 TCO₂e Average Annual Carbon Benefit

60,000 TCO₂e benefit over 100 years
vs 9,700 TCO₂e construction
vs 3,200 TCO₂e reduced carbon

Overall

River Ness FAS Case Study

- Following PAS 2080:2023: Very little change of River Ness Flood Alleviation Scheme – Walls would still be the preferred option
- Options to reduce carbon in the wall design to be balanced against structural requirements, environmental and ground conditions, landscape and architecture
- Carbon benefit of 60,000 TCO₂e, compared to a scheme carbon construction cost of 9,700 TCO₂e
- 67% potential to reduce carbon cost for walls or 3,200 TCO₂e
- A carbon benefit of 4,400 TCO₂e has already been achieved with the scheme defending against 2 flood events above 10%AEP
- Adaption does save carbon, though mitigation of Climate Change would be preferred

4. Summary





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Scotland's Flood Resilience Conference 2024

Session 4: Challenges of funding and multiple drivers

Dylan Huws, AECOM Ltd

Gerard McColgan, Dawson WAM



Scottish Government
Riaghaltas na h-Alba
gov.scot



Campbeltown Flood Protection Scheme and Surface Water Management Plan

Dylan Huws – AECOM
Gerrard McColgan – Dawson WAM



Dylan Huws
Technical Director - AECOM



Gerard McColgan
Commercial Director - Dawson WAM

Summary of Presentation

- ABC approach to commissioning the delivery of the scheme development
- History of flooding in Campbeltown
- Scheme development
- Delivery of the Flood Protection Scheme
 - Fluvial Elements
 - Pluvial Elements
- Project Update

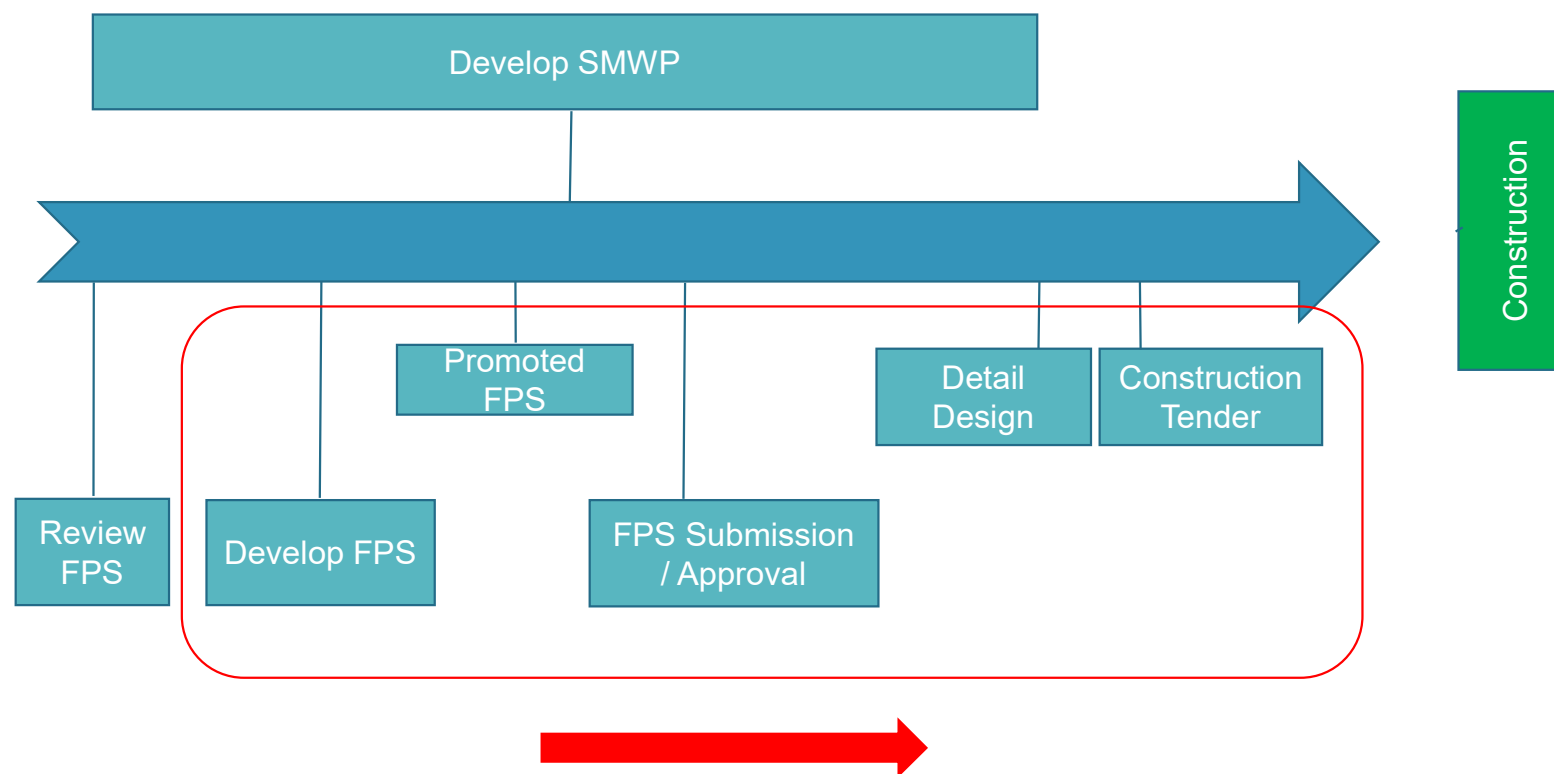


Campbeltown (PVA 01/40)

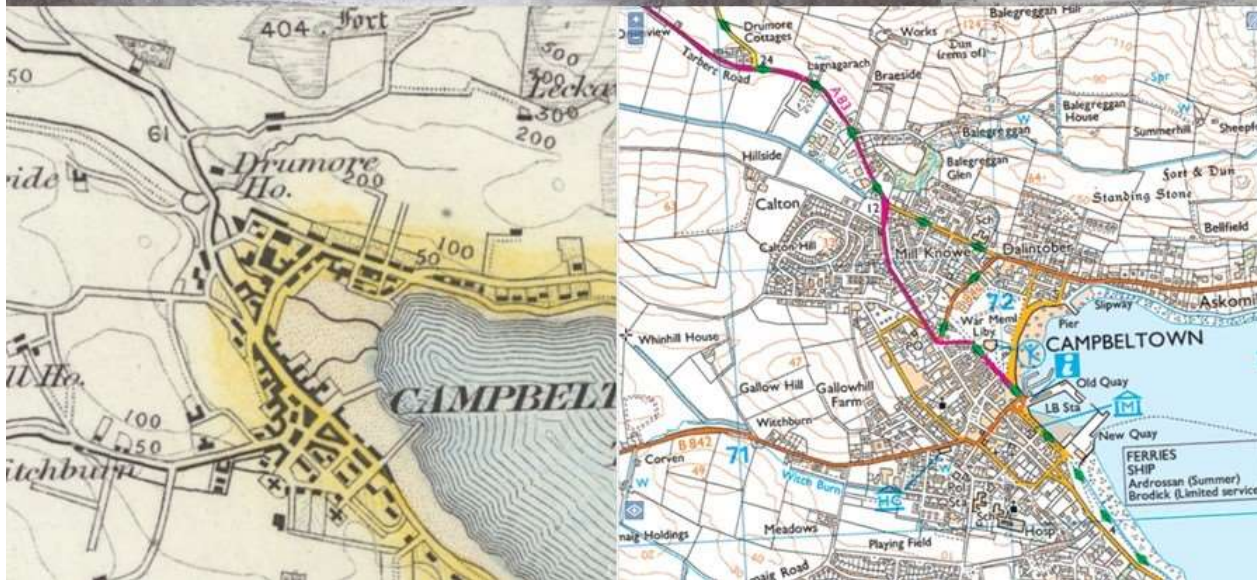
- A Flood Protection Scheme is to be developed for Campbeltown to reduce flood risk from small watercourses.
 - Argyll & Bute Council to produce Surface Water Management Plan to reduce surface water flood risk in Campbeltown.
- 
- A map of Campbeltown and the surrounding region in Argyll & Bute, Scotland. The map shows the town of Campbeltown, the Campbeltown Airport, and various watercourses including the Machrihanish Burn, the Gairn Burn, and the Gairn Burn. Flood risk zones are indicated by different colors: yellow for low risk, orange for medium risk, and red for high risk. The map also shows the A83 road and the A85 road. The map is titled 'Campbeltown' and 'Argyll & Bute Council'.
- ABC Commissioned a framework to deliver the actions
- This provided a flexibility in approach ensuring that findings of previous stage considered going forward



Delivery of the LFRMP Actions

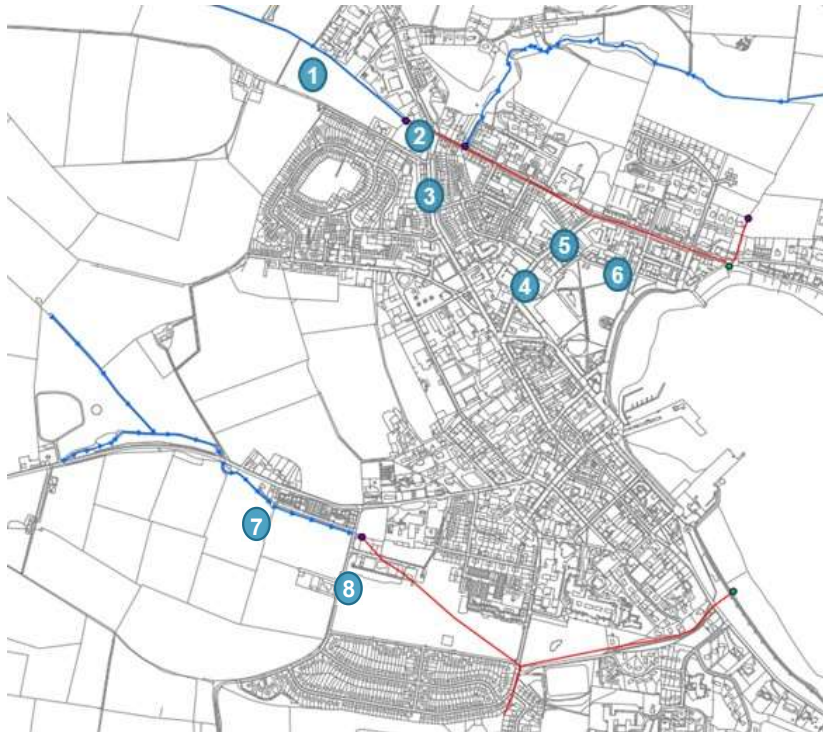


Historical flooding

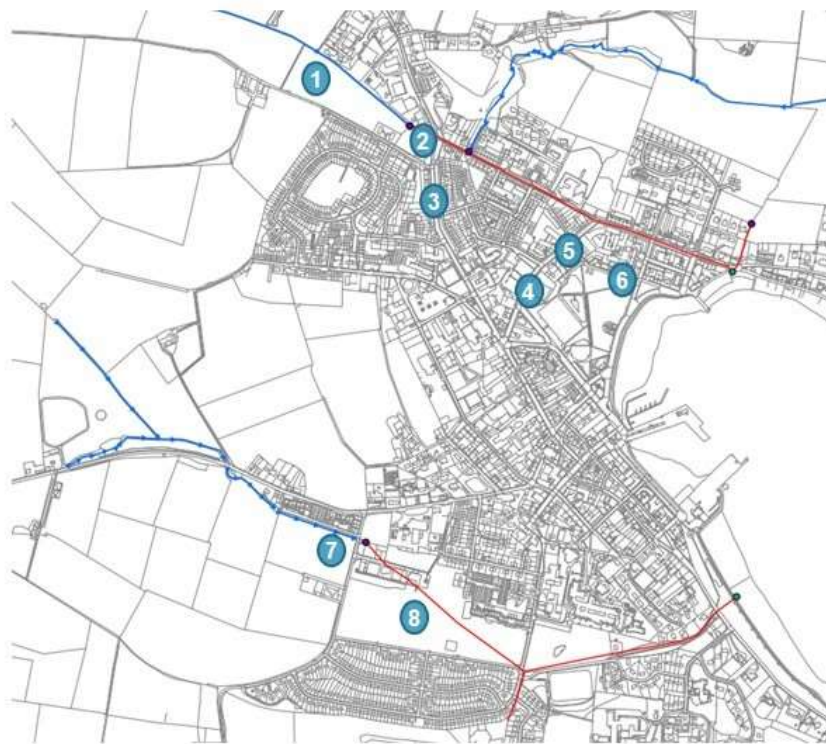


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More recent flooding in Campbeltown



More recent flooding in Campbeltown

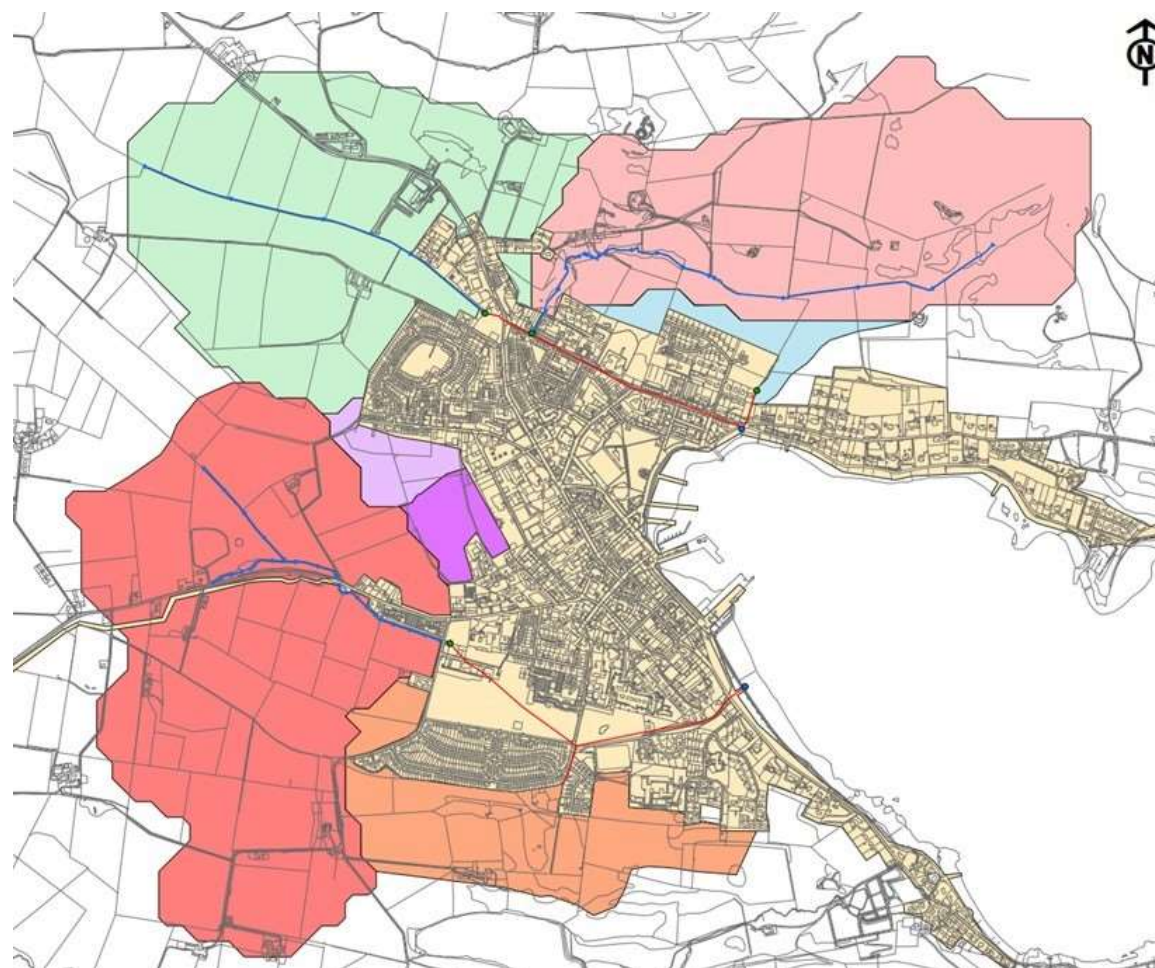


With events as recent as 2013, 2014,
2016



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Drainage catchments assessed



Legend

- Culvert Inlets
- Culvert Outlets
- Watercourses/Rivers
- Major Culverts
- SW Sewer Catchment
- Dalintober Drainage Catchment
- Balegreggan Burn Catchment
- Millknowe Burn Catchment
- Witch Burn Upper Catchment
- Witch Burn Lower Catchment
- Roding North Catchment
- Roding South Catchment



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Detailed hydraulic modelling



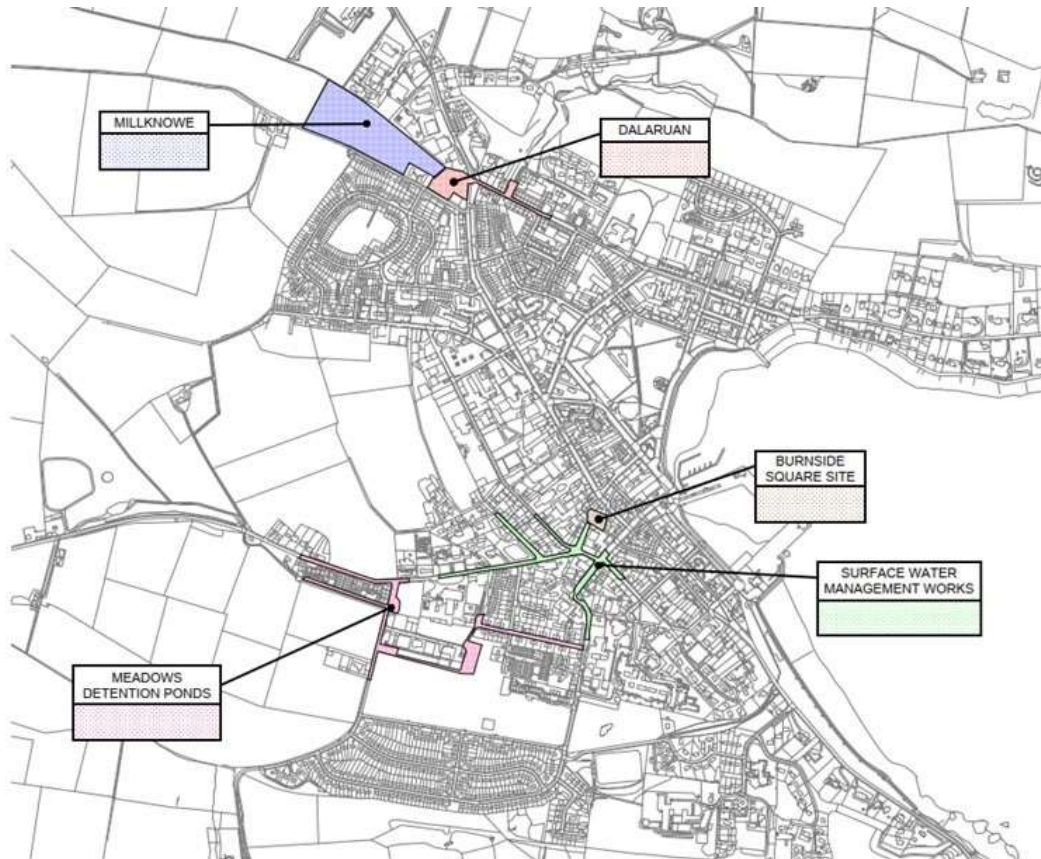
Sewer – flooding due to the exceedance of the sewer systems is expected during extreme events along Longrow and Bolgam Street. These flows are shown to continue towards Lochend Street and Kinloch Park as levels fall in this direction.

Scale of Flood Risk 1 in 200 year event

- 277 residential & 130 non-residential properties at risk of flooding
- Potential damage during a 1 in 200 year event: £16M
- Estimated damage over next 100 years: £38M



The Flood Protection Scheme Measures



Fluvial — the most dominant flood source in Campbeltown is the **Millknowe Burn** overtopping at Hillside.

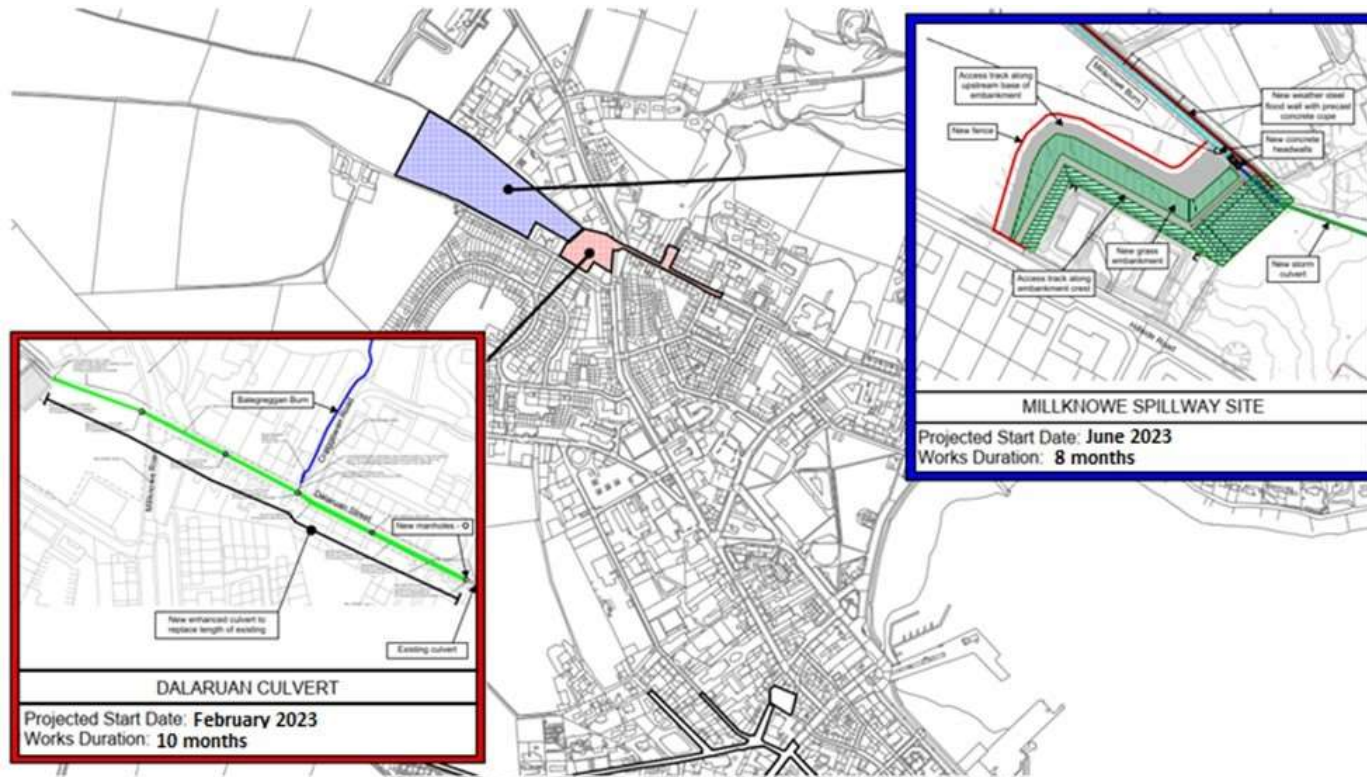
Flood water flows along Millknowe Road then Lady Mary Row before ponding around John and Saddell Street.

Flows from the **Balgreggan Burn** cause overtopping during extreme events at the Dalaruan Intake and results in overland flows into the town.

Pluvial – Surface water runoff during extreme events exceed the capacity of the drainage and sewer network. This leads to overland flows and the ponding of water in the low points of the town



Flood Protection Measures - Fluvial

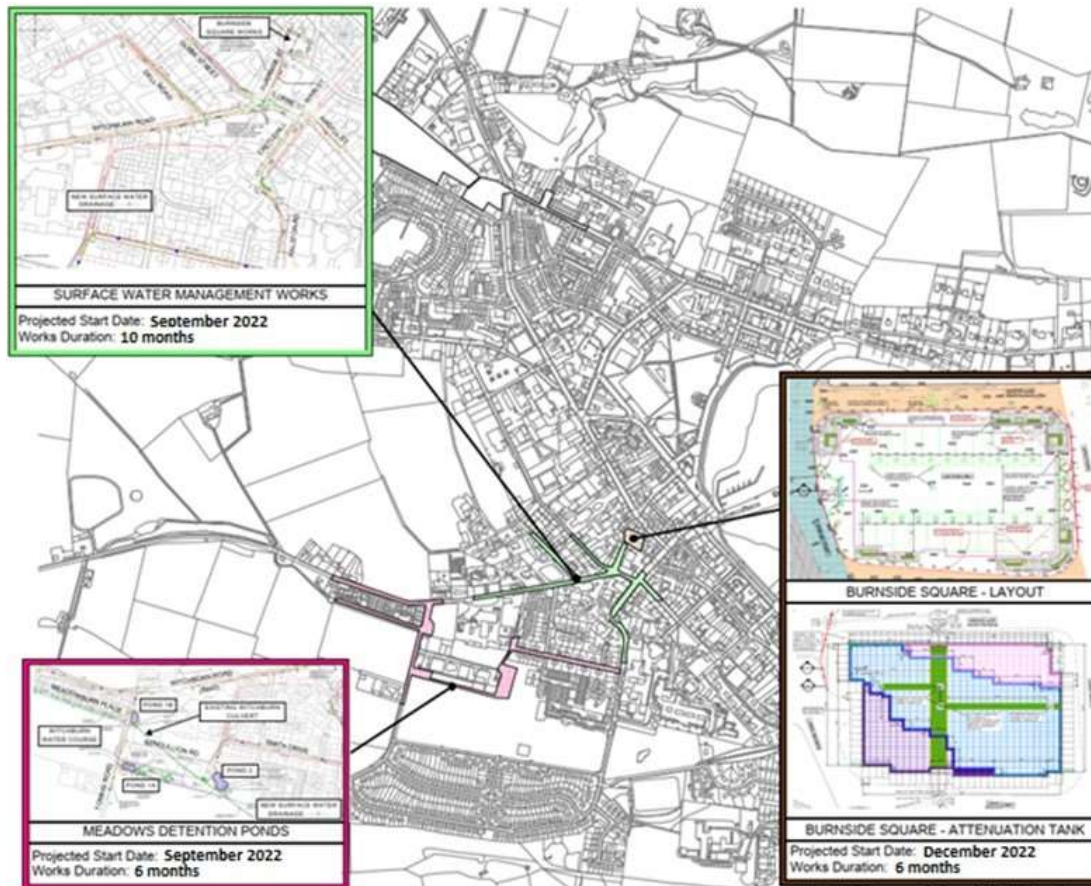


Fluvial — The Millknowe flood storage area consists of a combination of a raised embankment at the eastern end of the storage area near the Hillside Flats and the playing fields together with a flood wall along the edge of the Industrial Estate.

The Dalaruan culvert has upsized to provide additional conveyance and storage capacity



Flood Protection Measures - Pluvial



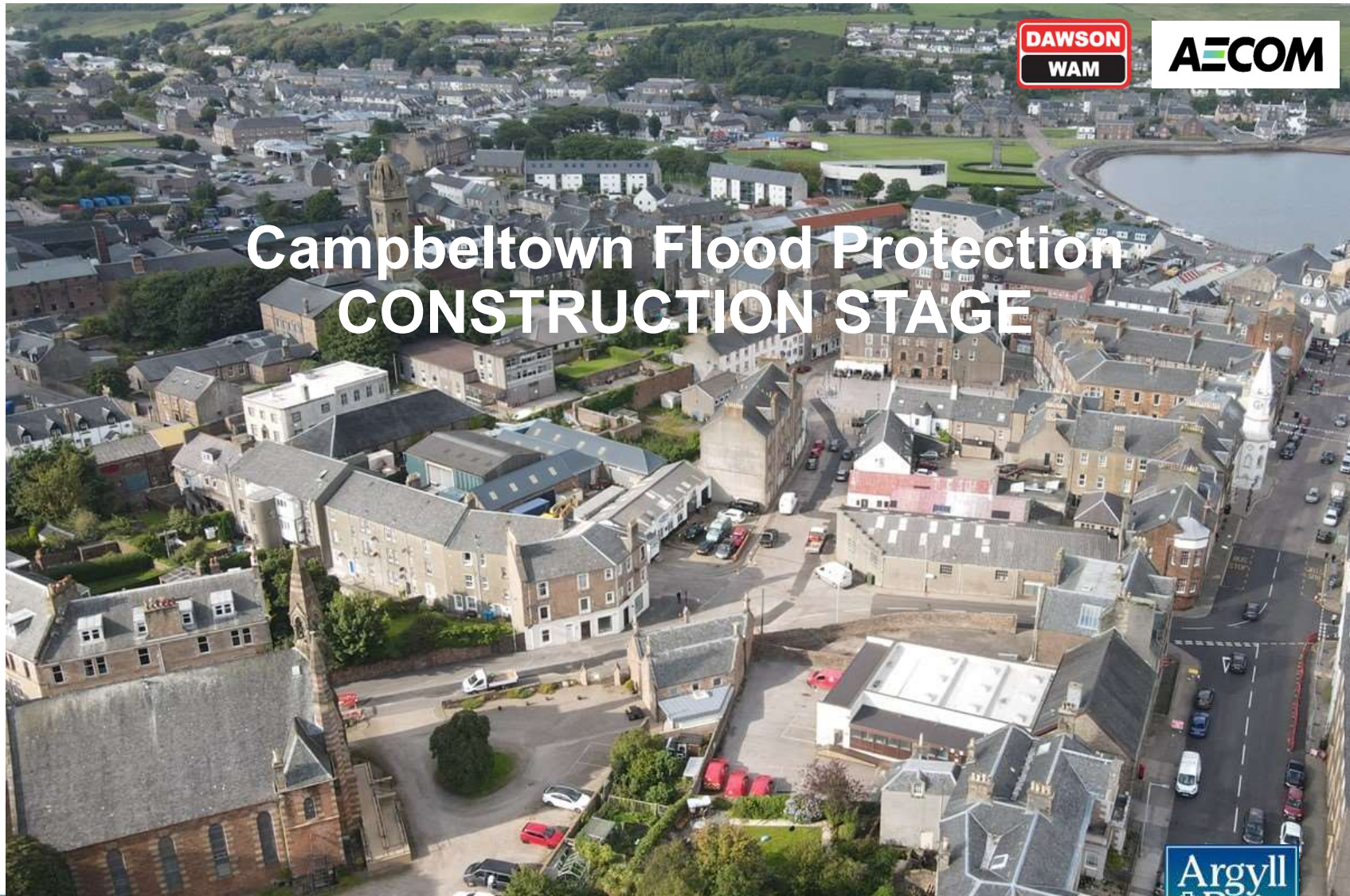
Pluvial — extensive areas of Campbeltown are served by a traditional combined system where the surface water runoff and foul sewers are collected in a combined sewer system.

Surface water separation allows the direct road runoff to be conveyed through a dedicated system to a below ground attenuation tank.

Flood flows are attenuated with discharge rates regulated to greenfield runoff rates.

Attenuation tank under Burnside Square together with detention basins in the meadows and surrounding area





Campbeltown Flood Protection CONSTRUCTION STAGE



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Contract Award



- **DAWSON WAM Contract Award June 2022**
- **18 Month Contract**
- **NEC3 Option A Contract**
- **Scheme Value £15m**
- **AECOM Design & PM**
- **Mobilised September 2023**
- **Stakeholder Business and public engagement**
- **Pop up Event**
- **Public Liaison officer**
- **Engaging Local supply chain**

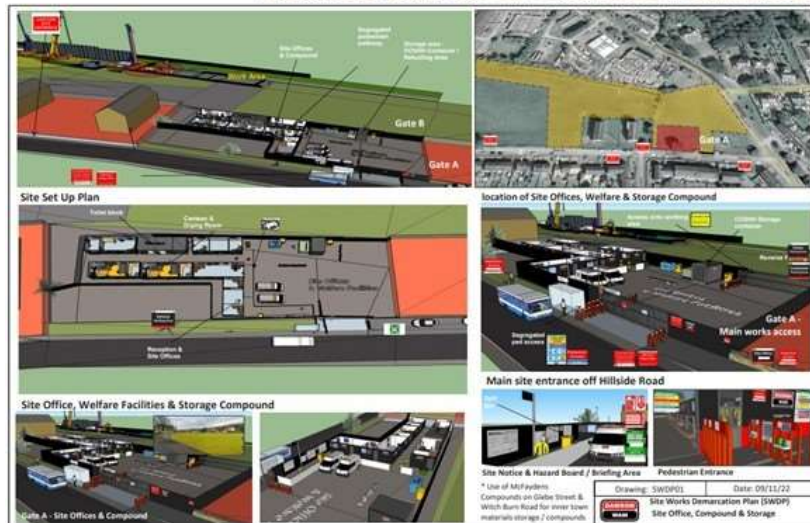


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Project Risks



- Utilities/Service Clashes
- Ground Conditions
- Lands Access – 3D Models
- Traffic Management/Road Closures
- Supply Chain – Rural Area
- Structural Surveys
- Flood event during construction
- Environmental Consultation (SEPA)
- Collaborative Approach



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Meadows Surface Water Management



- SCOPE:
- Surface water management involved over 1.2 Km of new pipework ranging from 150mm to 375mm mainly on public roads.
- Construction of 3 No drainage basins around the meadows and Tomaig Road Area
- Full width reinstatement of all carriageways
- Reinstatement & Planting



Meadows Detention Ponds



- Service clash prevention



Burnside SuDS



- **SCOPE:**
- Surface water management involved over 1 Km of new pipework ranging from 150mm to 450mm mainly on public roads.
- Construction of 550m³ Geocellular tank within Burnside Square
- Reinstatement of Burnside Square to facilitate multi-purpose functional event space
- Extensive disruption to business owners
- Risks working close proximity to buildings
- Extensive Service Congestion



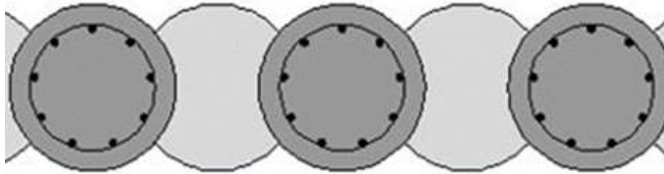
Burnside SuDS – Temporary Works



- Temporary Works Key
- Pedestrian access to businesses to be maintained
- Additional SI
- Granular Material – Could not batter excavation safely
- Work Collaboratively with AECOM/Client
- Time Constraint – Summer 2023
- In-house SECANT Piled Cofferdam solution
- Extensive consultation with local businesses



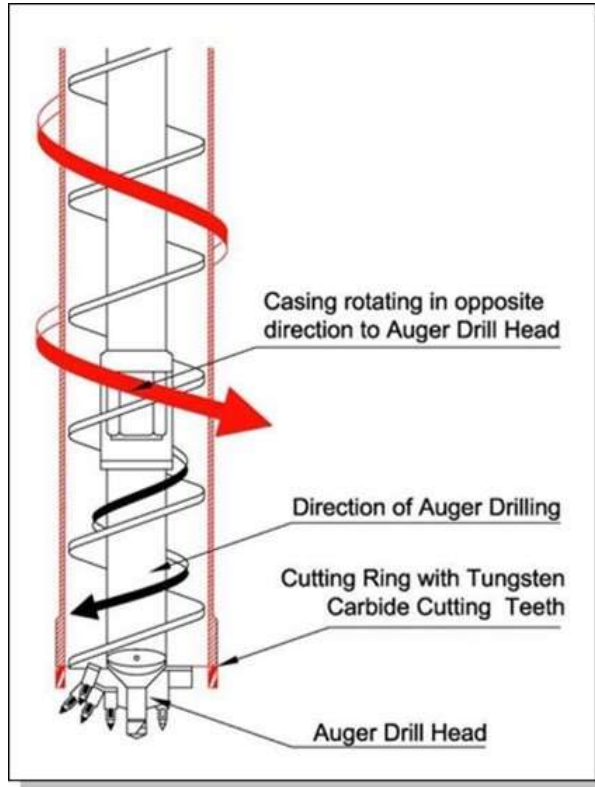
Burnside SuDS – SECANT Piling



- **SECANT** pile wall is formed by constructing alternating primary (female) and secondary (male) concrete piles where the secondary piles partially cut into each side primary in order to form a continuous impervious structure.
- Advantage over sheet piled wall in close proximity to buildings or where dense ground conditions
- Polystyrene formers in trench supported with concrete for accurate installation
- Polystyrene is removed prior to drilling and recycled
- 450mm dia



Burnside SuDS – SECANT Piling



Burnside SuDS – Geocellular Tank

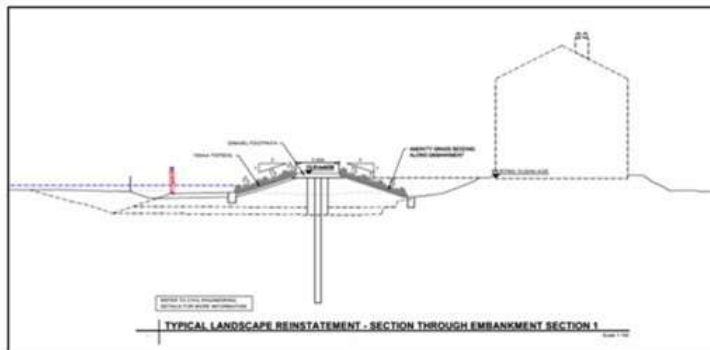


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Burnside SuDS – Reinstatement



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Millknowe Burn – Sheet pile Installation



- 450m AZ Sheet Piles
- 125m encased in 2.6m (Avg) height earth embankment
- 325m to enclose the dam structure
- Sheet piles into cohesive soils
- DAWSON WAM in house piling rig with 36vv hammer
- Pre-Auger & Hydropress to de-risk pile installation close to buildings
- Vibration monitoring
- Temporary platforms



Millknowe Burn – Construction



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Millknowe Burn – Construction



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Dalaruan Culvert Upgrade



- Online replacement of 285m of existing culvert on Dalaruan Street from Millknowe storage area
- Through early investigation works – changed from concrete box culvert to twin pipe pipes due to services and phasing works
- Upgrade generated increased capacity to store and convey flows more efficiently during flood events
- Prevent spills at Balgreggan Burn



Community Engagement



- Early community engagement proved crucial in project success
- Monthly Newsletters
- Good lines of communication and Complaints dealt with efficiently
- Engagement with Schools, local charities donations and engagement with youth development groups
- Employment of Campbeltown natives & local contractor
- Good communication between Client & AECOM



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ANY QUESTIONS?



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Audience Q&A

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Thank you for attending Day 1 of the conference





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Scotland's Flood Resilience Conference 2024 Day 2 – People

Session 5: Learning from recent events

Chair: Susan Veitch, The Highland Council



Join at
slido.com
#Floodresilience2024





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

Greg Wolverson, Met Office



Flood Forecasting in Scotland

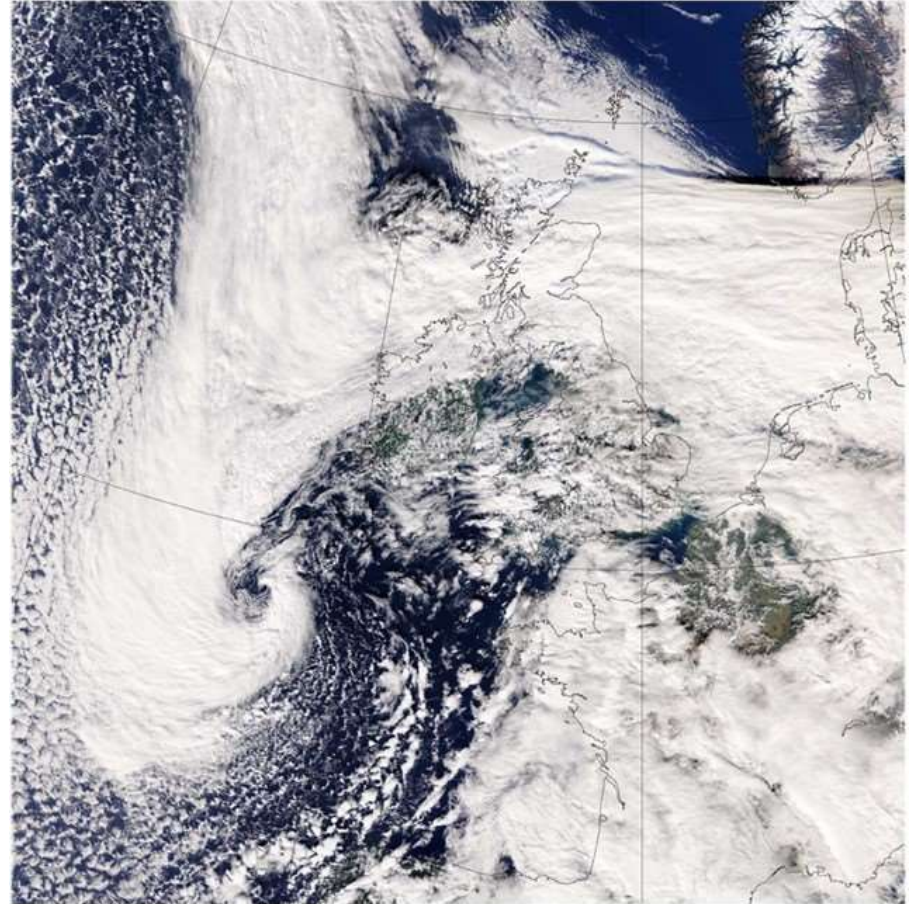
Gregory Wolverson

Civil Contingencies Advisor Team

UK Met Office

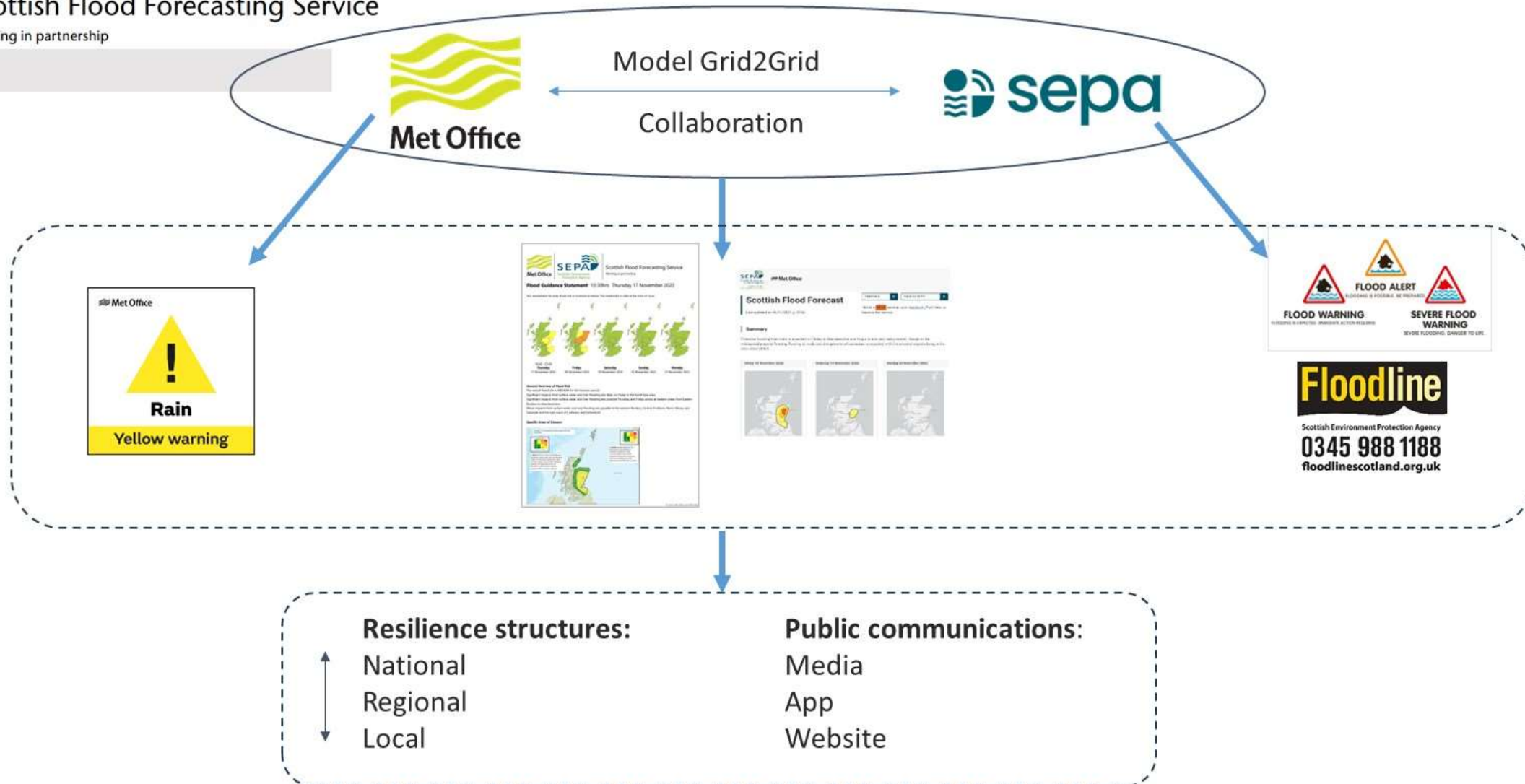
Content

- Partnerships, structures and output
- Storm Babet: Meteorological background and context
- Links to climate change



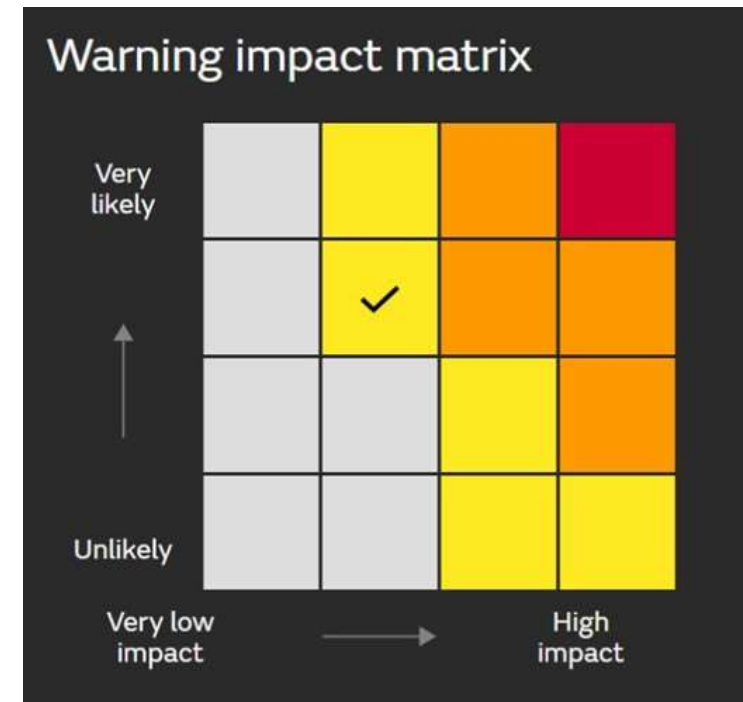
Scottish Flood Forecasting Service

Working in partnership



National Severe Weather Warning Service

- Impact based warnings service
- Forecast provides an **Expected Level of Impact** and a **Likelihood of this Impact** occurring
- Thresholds are no longer used to trigger warnings, but form part of the decision process
- Numerous and varied 'customers' – both the public and emergency responders



Typical scenarios



←
Dynamic

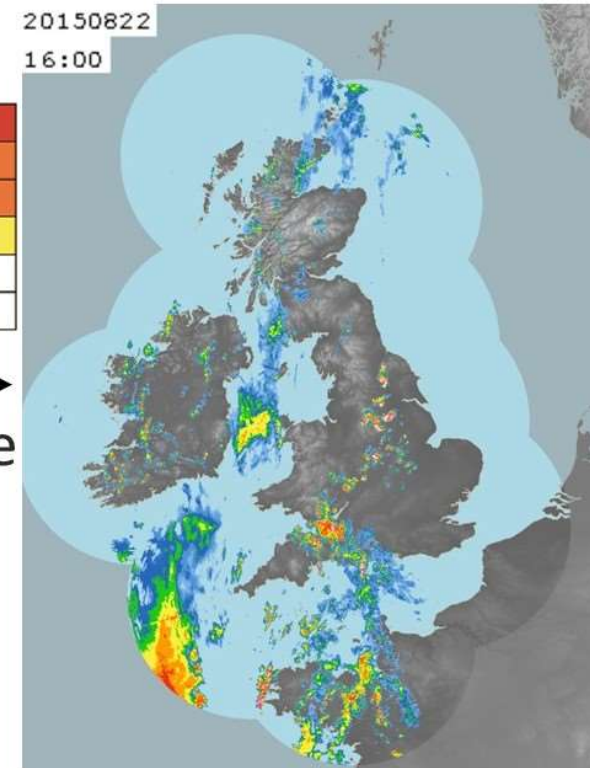
Likelihood	High			✓		
	Medium					
	Low					
	Very low					
		Very low	Low	Medium	High	
Impact						

Widespread low
impacts

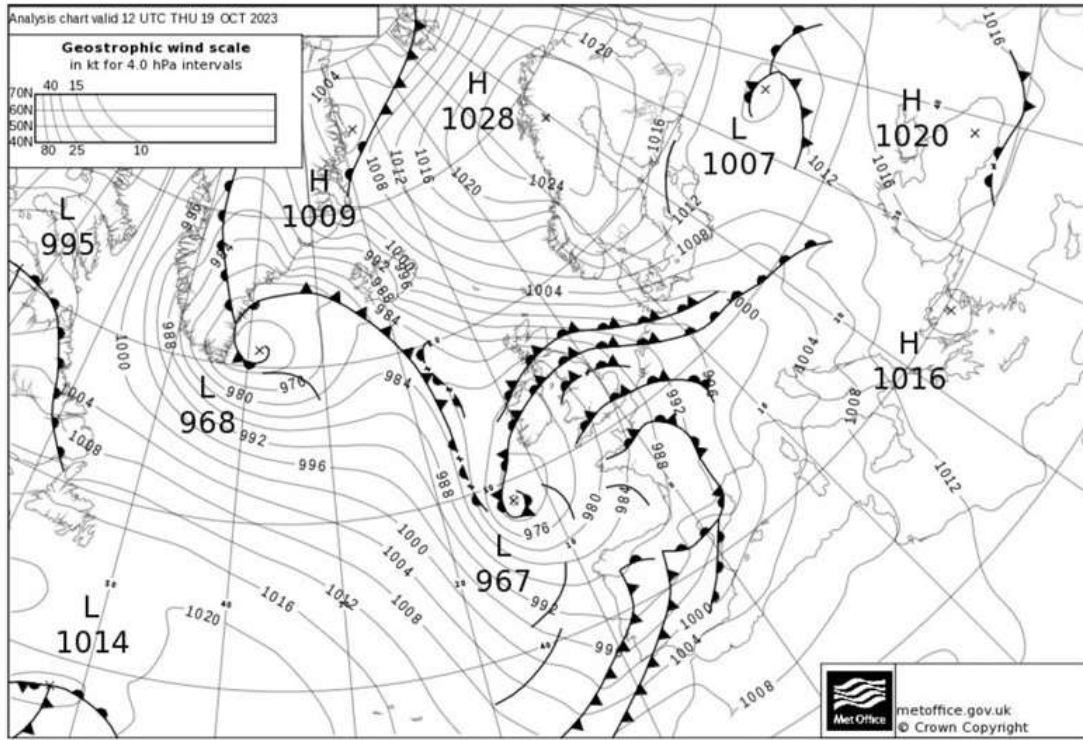
Isolated medium
impacts

Likelihood	High				
	Medium				
	Low				
	Very low			✓	
		Very low	Low	Medium	High
Impact					

→
Convective

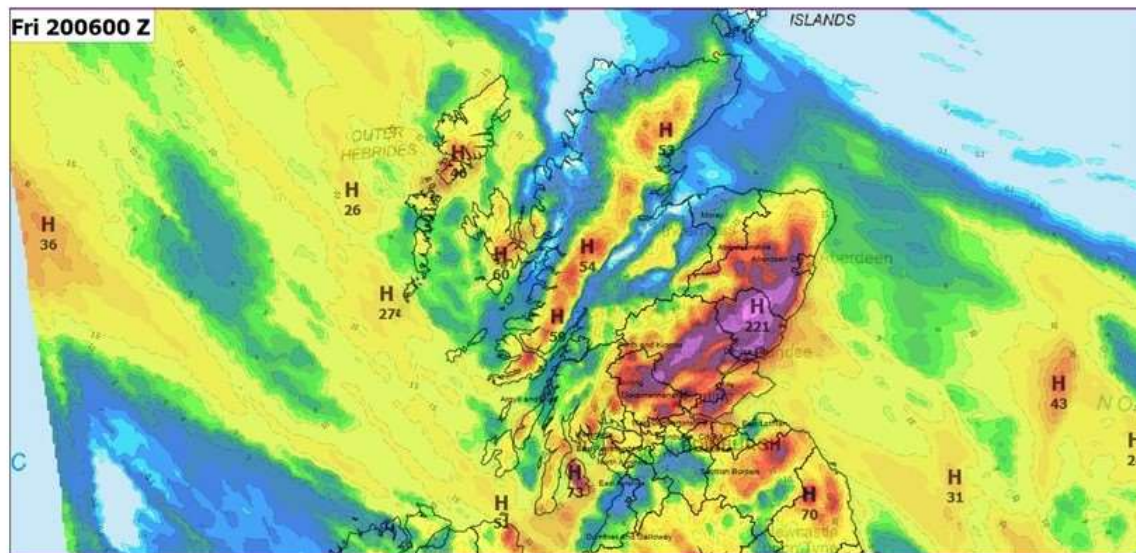


Storm Babet – Synoptic Overview

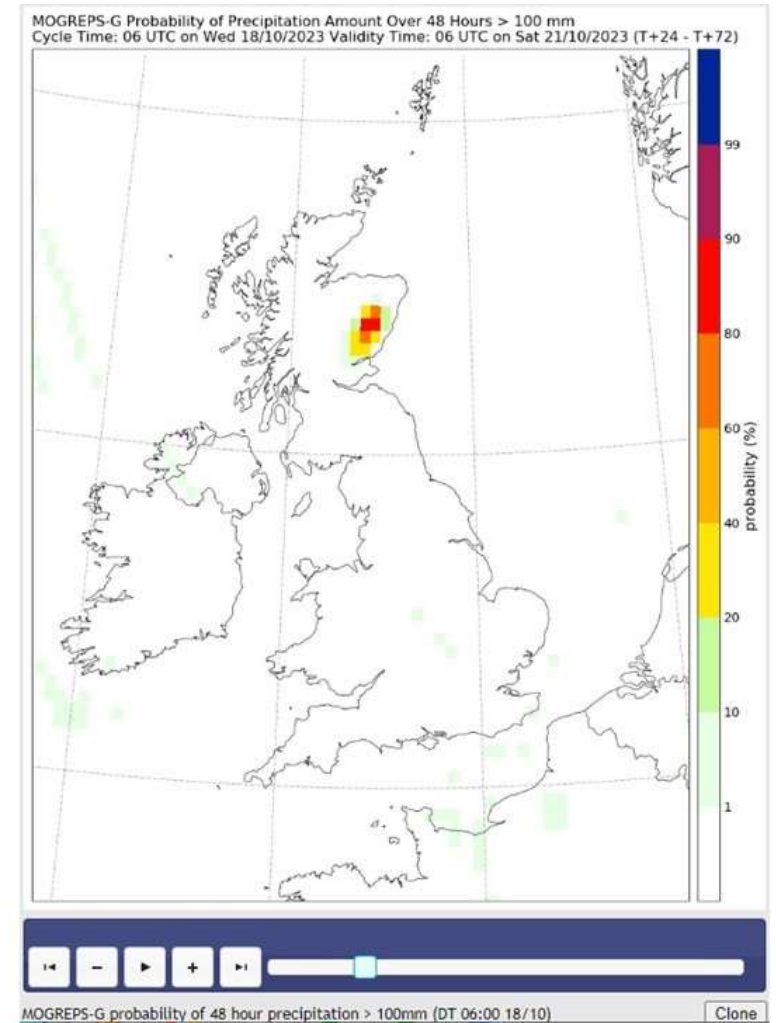


Storm Babet – modelling

Strong and mostly consistent rain signal



Deterministic 24hr rainfall totals from 03Z 17th October run
(Amber issued)



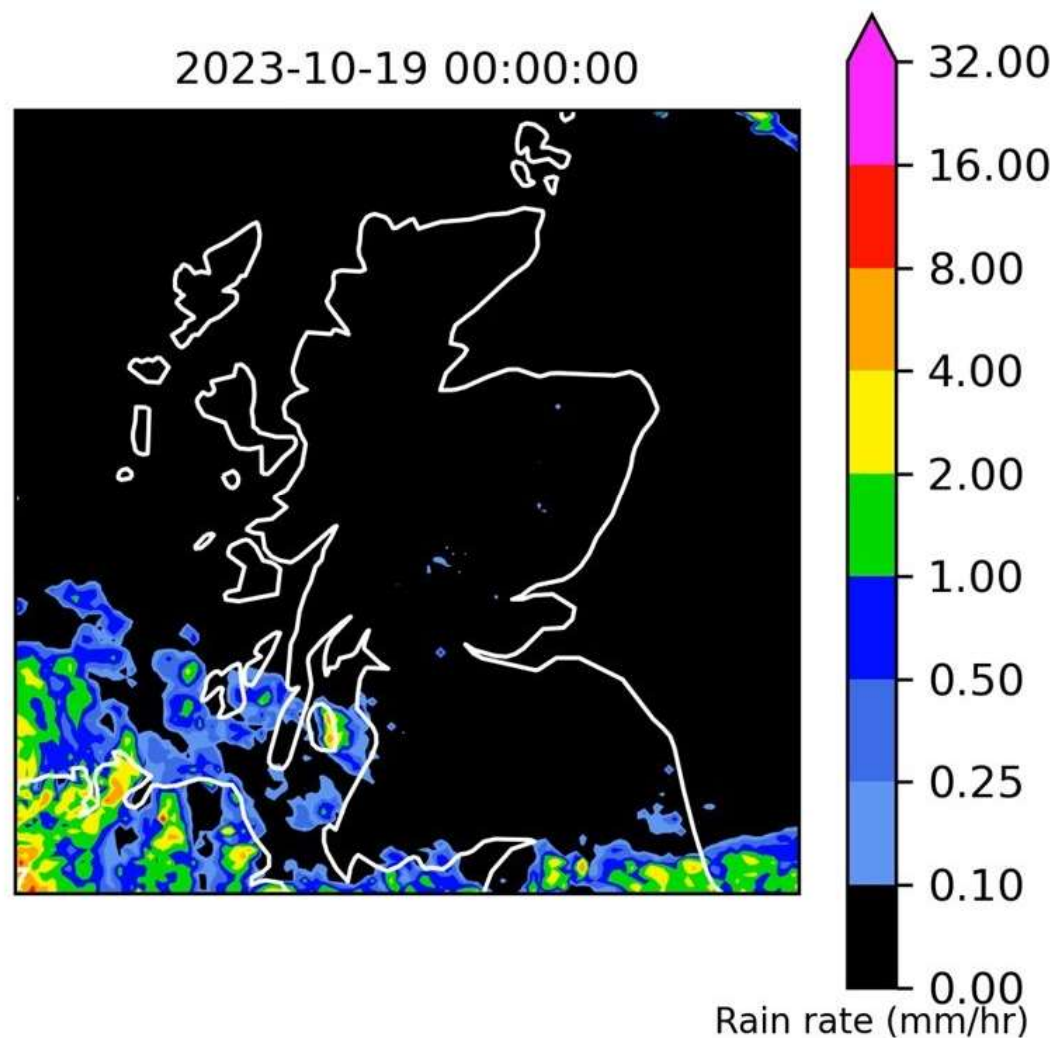
Ensemble probability of exceeding 100mm
(Red issued)

Storm Babet – Radar sequence

Near-stationary frontal system brought persistent pulses of rain to eastern Scotland.

Rainfall rates were enhanced by mountains as mild air was forced to rise and condense.

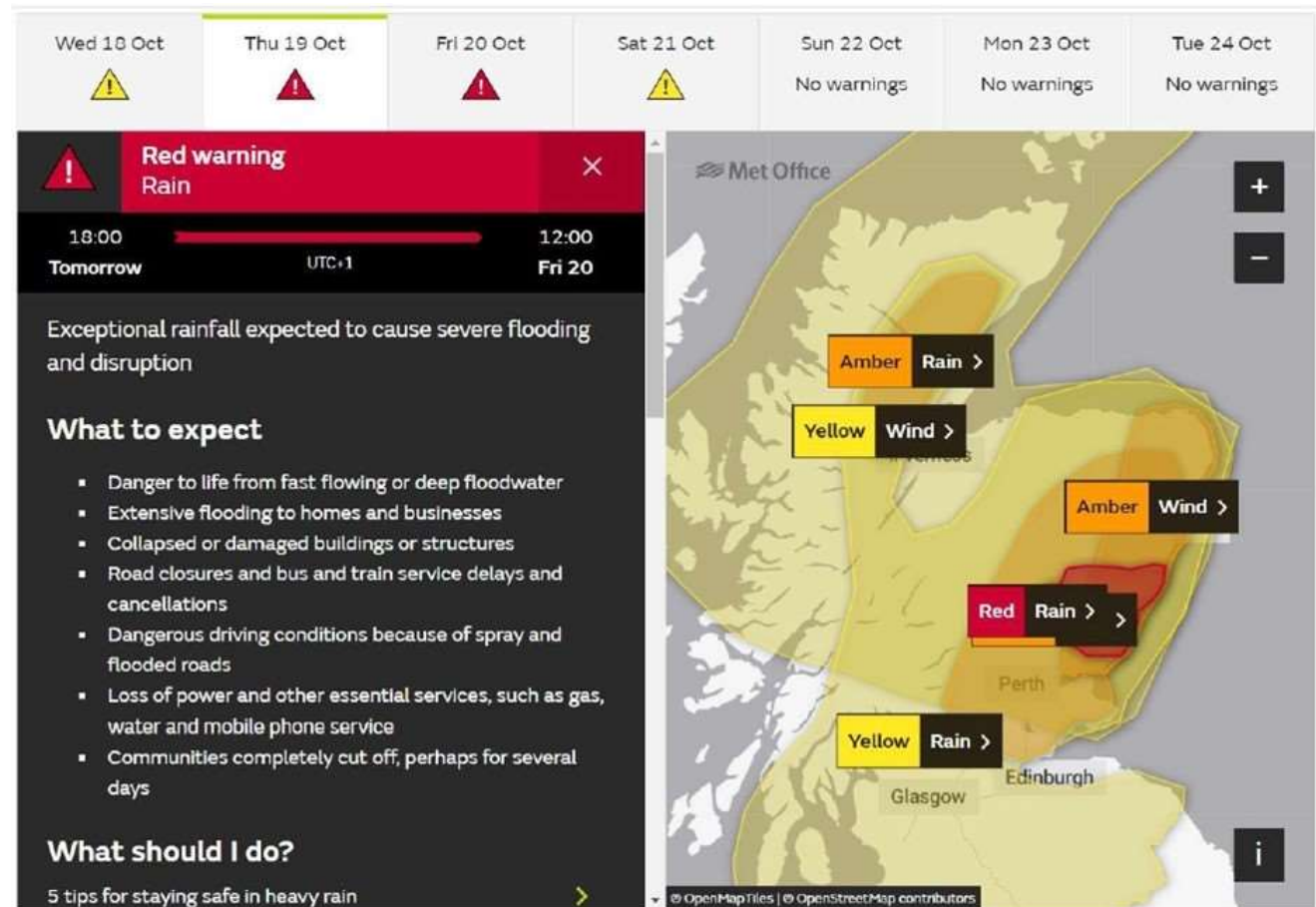
Due to the time of year, minimal precipitation was locked in as snow.



Storm Babet – Warnings

The storm was well signalled in advance allowing a structured warning escalation

Warning complexities are common in multi-parameter, large-scale events



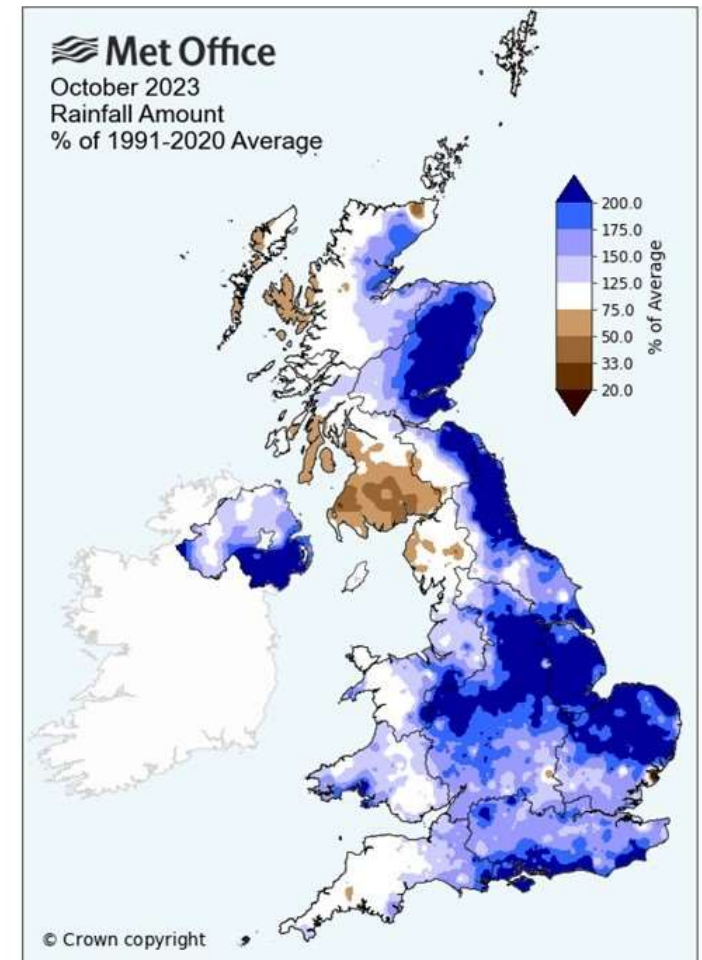
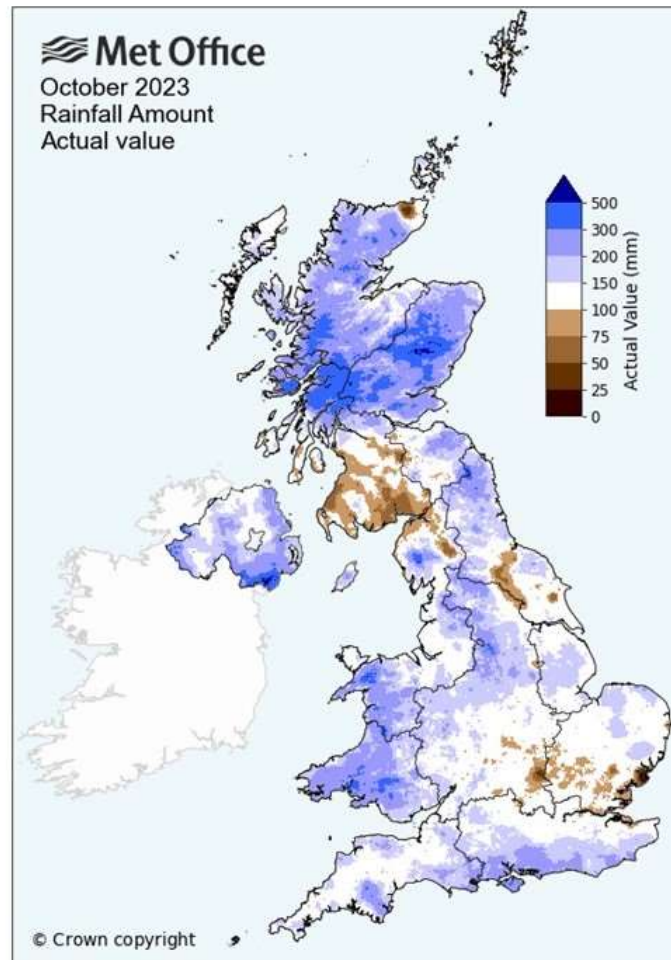
Storm Babet – Context

October was wet for much of Scotland and the UK.

The anomalies for eastern Scotland were exceptional.

Angus recorded its wettest day on record in a series from 1891, with 98.5mm

(Fettercairn, Aberdeenshire recorded 129.5mm)

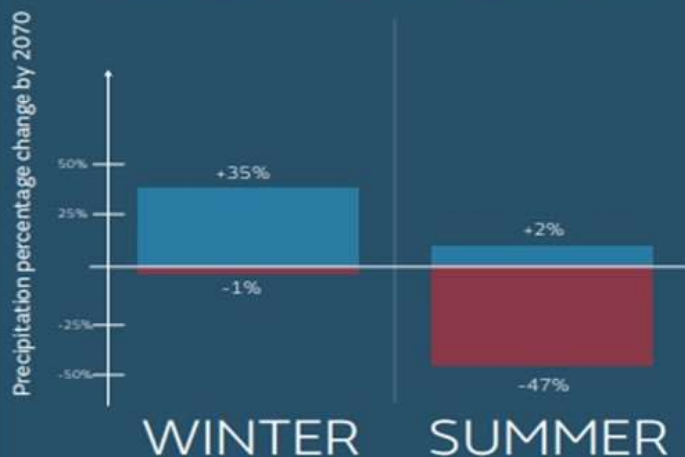


FUTURE PRECIPITATION CHANGE

PROBABILISTIC PROJECTIONS

WETTER WINTERS, DRIER SUMMERS*

UKCP Probabilistic (25km) projections show that by 2070, under a high emission scenario, average winter precipitation is projected to increase, whilst average summer rainfall is projected to decrease.



UKCP LOCAL (2.2KM)

FUTURE INCREASES IN EXTREME HOURLY RAINFALL INTENSITY

By 2070, extreme hourly rainfall intensity associated with an event that typically occurs once every two years increases by 25%.



CHANGES IN THE TYPE OF RAINFALL

By 2070, Local (2.2km) projects more of the rain in winter will come from frontal rain events of higher intensity and in summer from short lived high intensity showers.





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

Bruce Campbell, SEPA



Forecasting and Warning for Storm Babet: a Team Effort

Bruce Campbell- Flood Forecaster

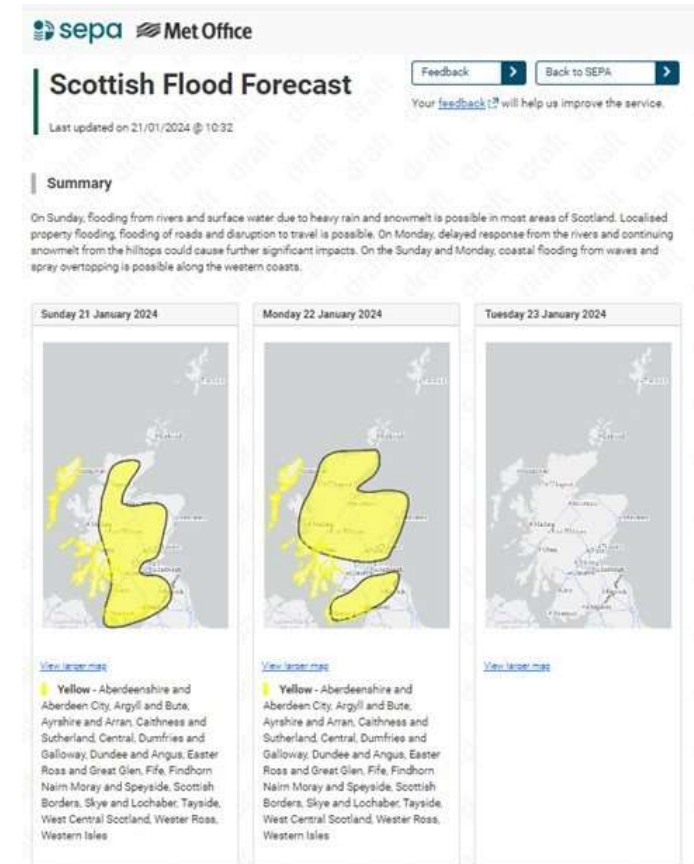
9th February 2024- Sniffer Flood Resilience Conference



Scottish Flood Forecasting Service

Partnership with the Met Office

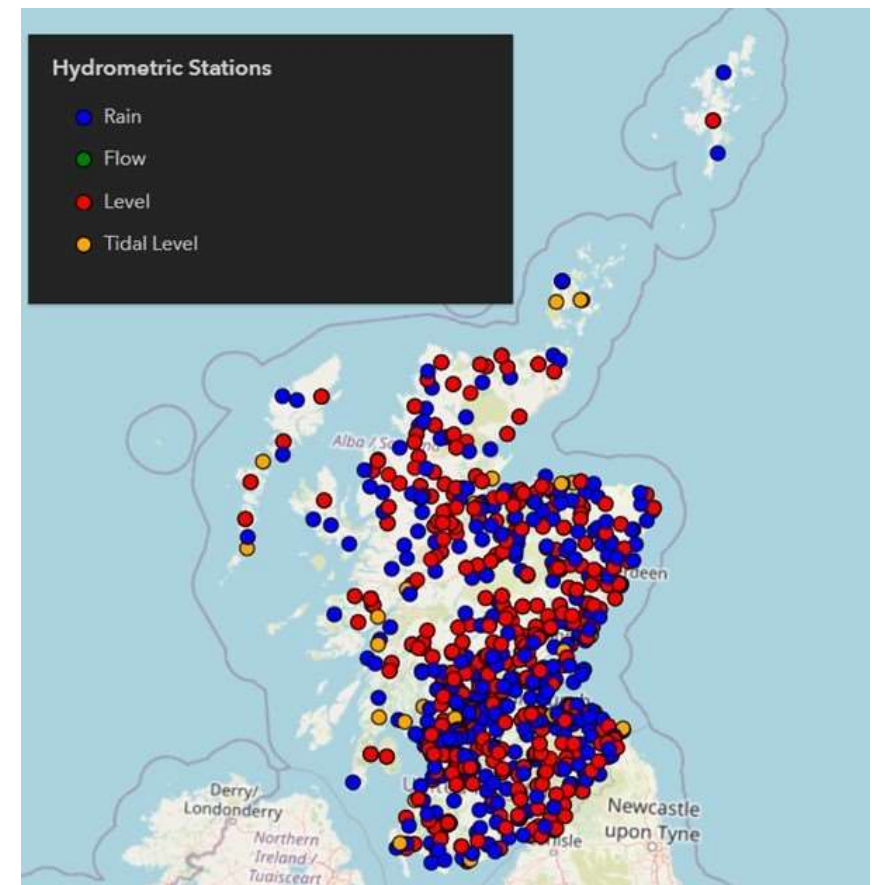
- Aim to provide Category 1 and 2 responders (CCA) with better information in relation to flood risk
- Integration of meteorological and hydrological forecasts to inform tactical planning around flooding.
- Core product of the partnership is the Daily Flood Guidance Statement (FGS) with a 5 day outlook.
- In 2023, launched a public equivalent called the Scottish Flood Forecast (SFF) with a 3 day outlook.
- SFFS compliments existing services like NSWWS (MO) and Flood Warning Service (SEPA), 24/7 365 days of the year.



How we forecast for the next 5 days

Key inputs

- MO Guidance products issued with 5-day outlooks for rainfall and general coastal conditions.
- Data feeds received for FEWS Scotland enabling 5-day predictions for river flows (G2G) and coastal conditions at specific locations.
- At least 1 discussion every day between SEPA and the Met Office to discuss flood risk. Share the output of our models.
- Data from our Hydrometric network inc. river, rainfall and tide gauges to inform current conditions and model forecasts.
- Input from other duty officers on reports of flooding or on the ground conditions.



Storm Babet

Focus on South Esk

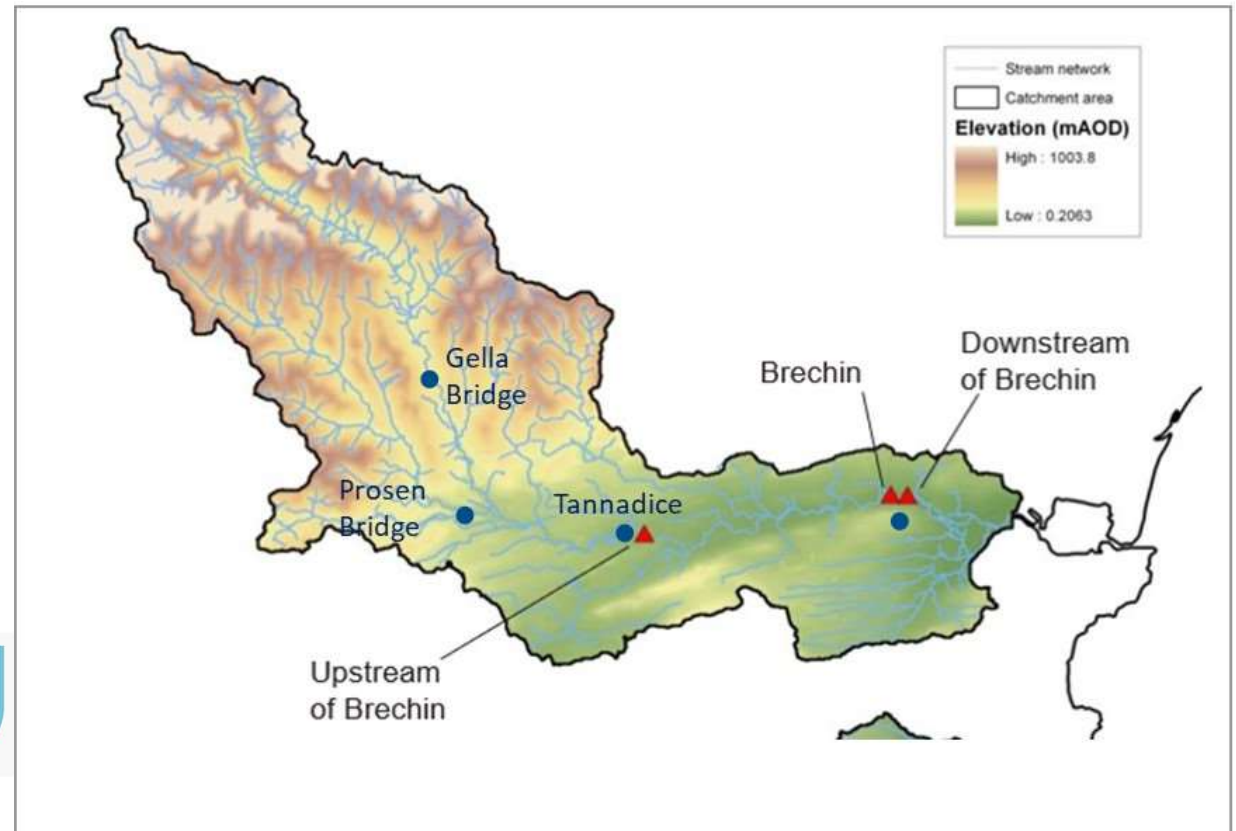
Catchment Overview

Key characteristics South Esk

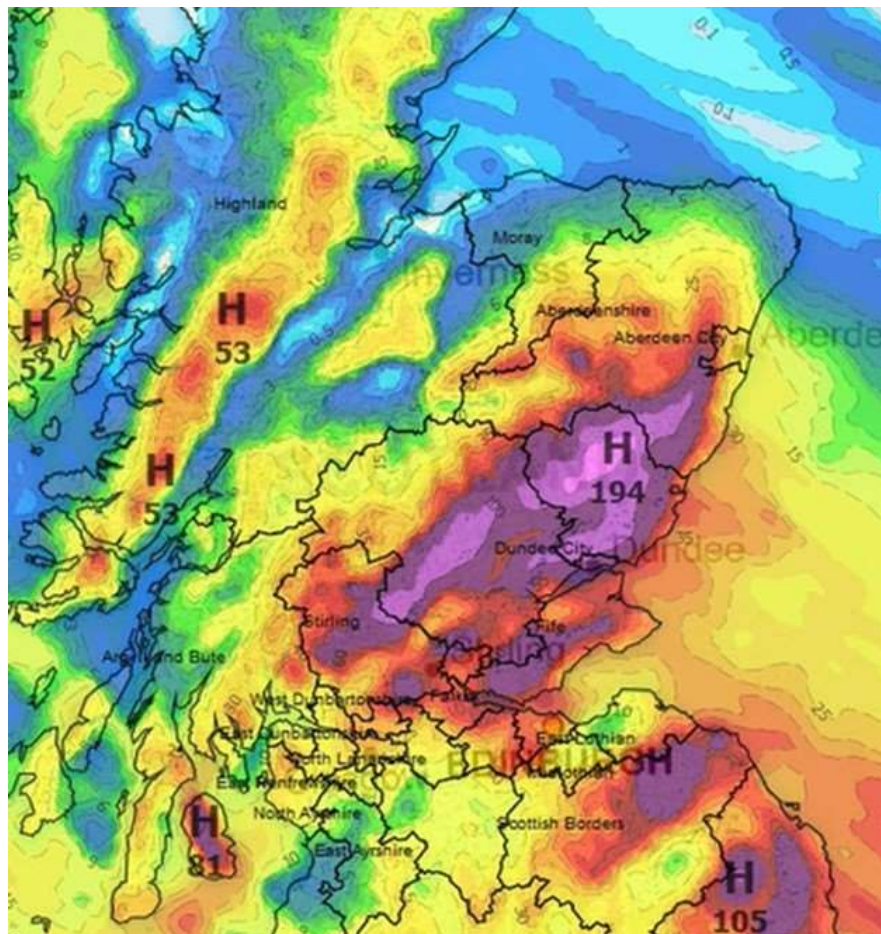
- Southern Grampian Mountains
- Steep upper catchment, peaks of 1000m
- Lower catchment flat arable land
- 2 main tributaries, respond differently
- Limited storage
- Brechin located at the lower end before enters Montrose Basin



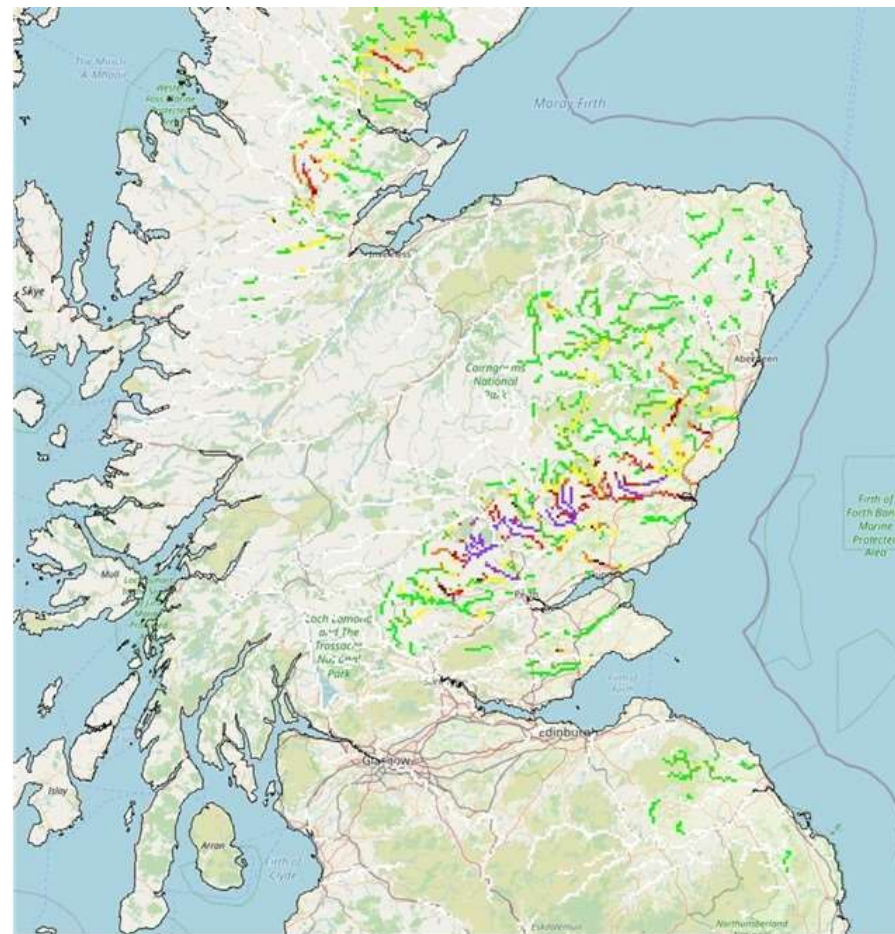
© JBA



Tues 17th Oct AM Assessment



Met Office 24hr Accumulation
18th/19th

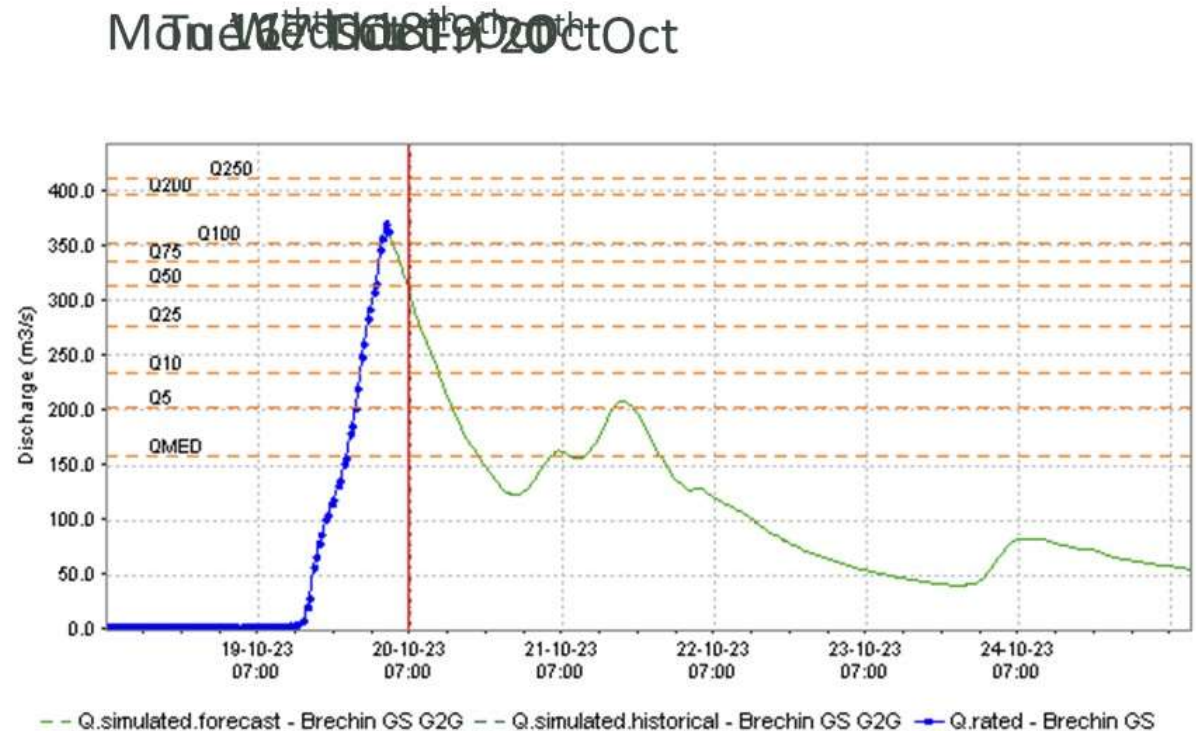


Grid2Grid Spatial
19th

Key points

Weather and forecast response

- Rainfall amounts forecast are unusual for the east
- G2G is showing a significant response in the areas of concern
- Forecast is consistent, slight variations
- No existing snowpack or snow forecast
- Ground conditions are already wet so little storage available.
- By 18th October we have high confidence there will be severe flooding in parts of Angus.

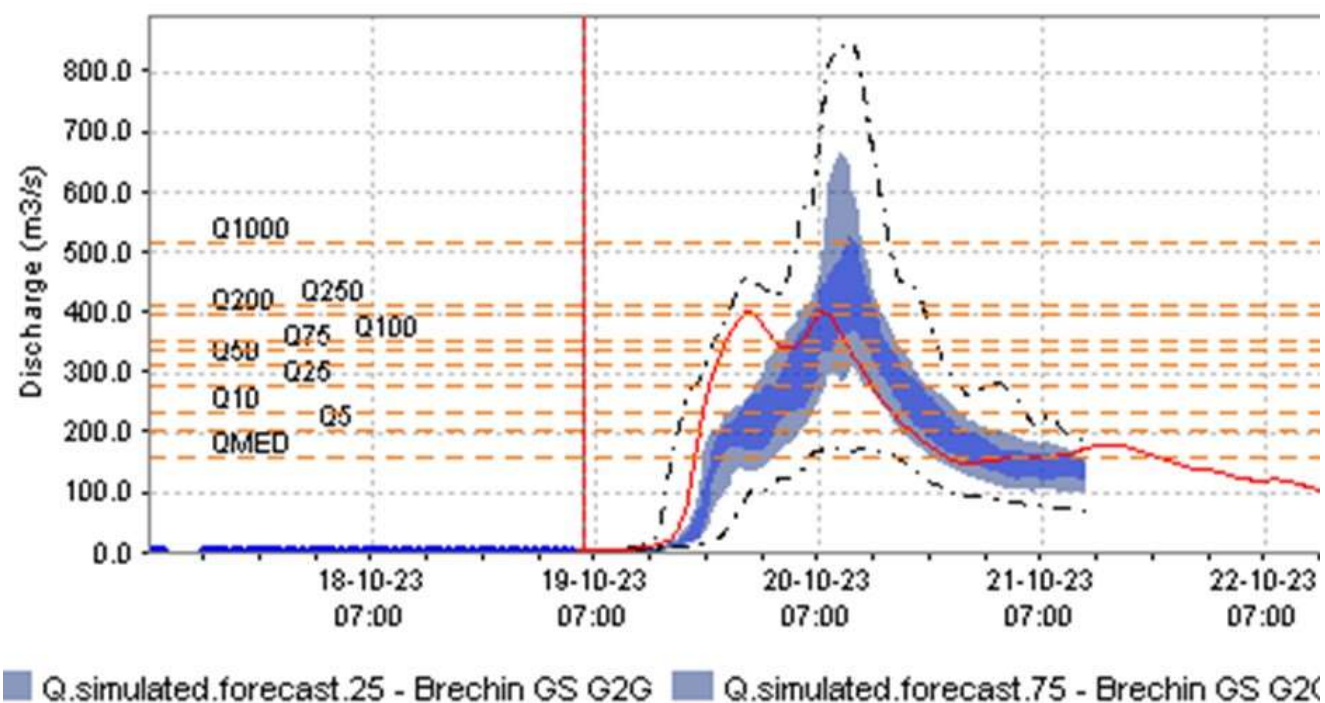


Brechin, significant issues at approx. 340m³/s

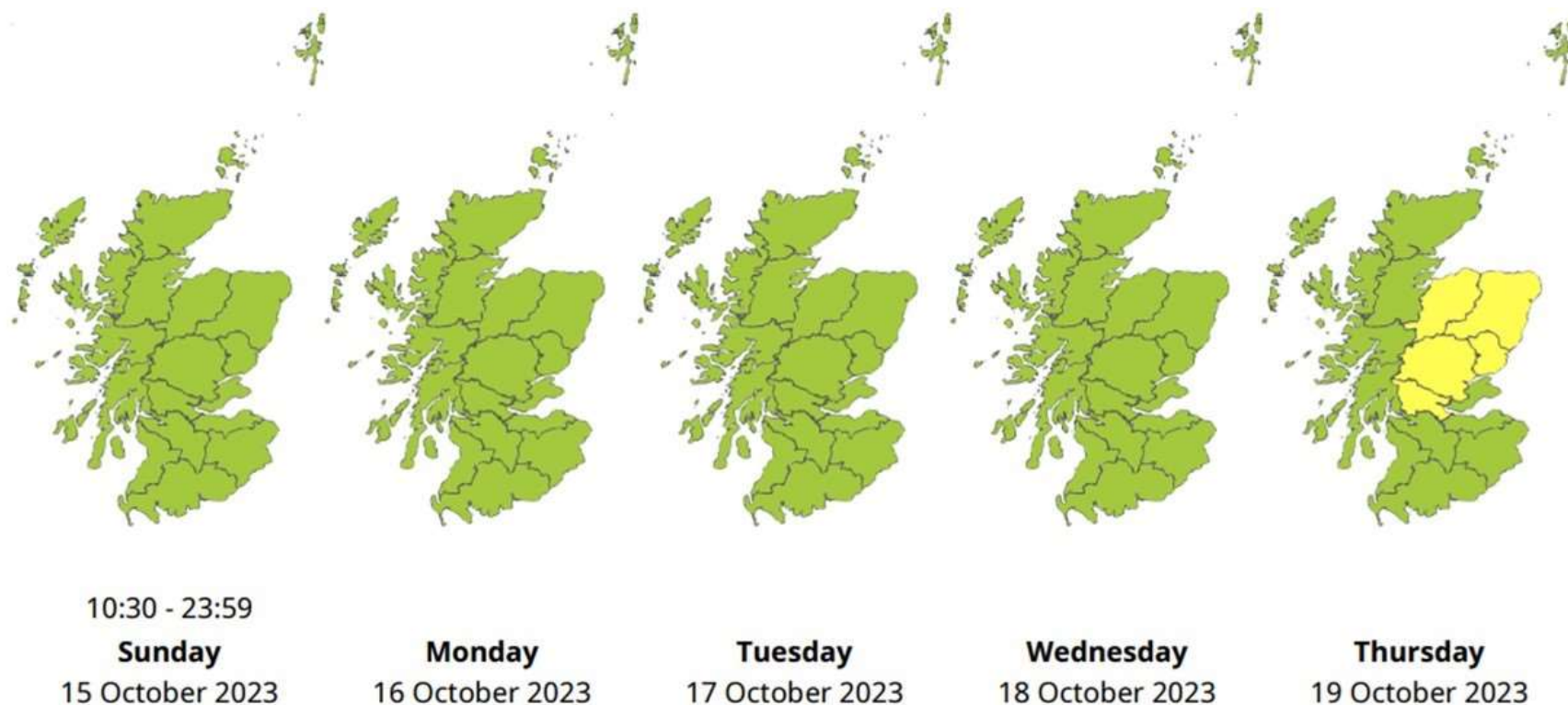
Not so black and white

Sources of uncertainty

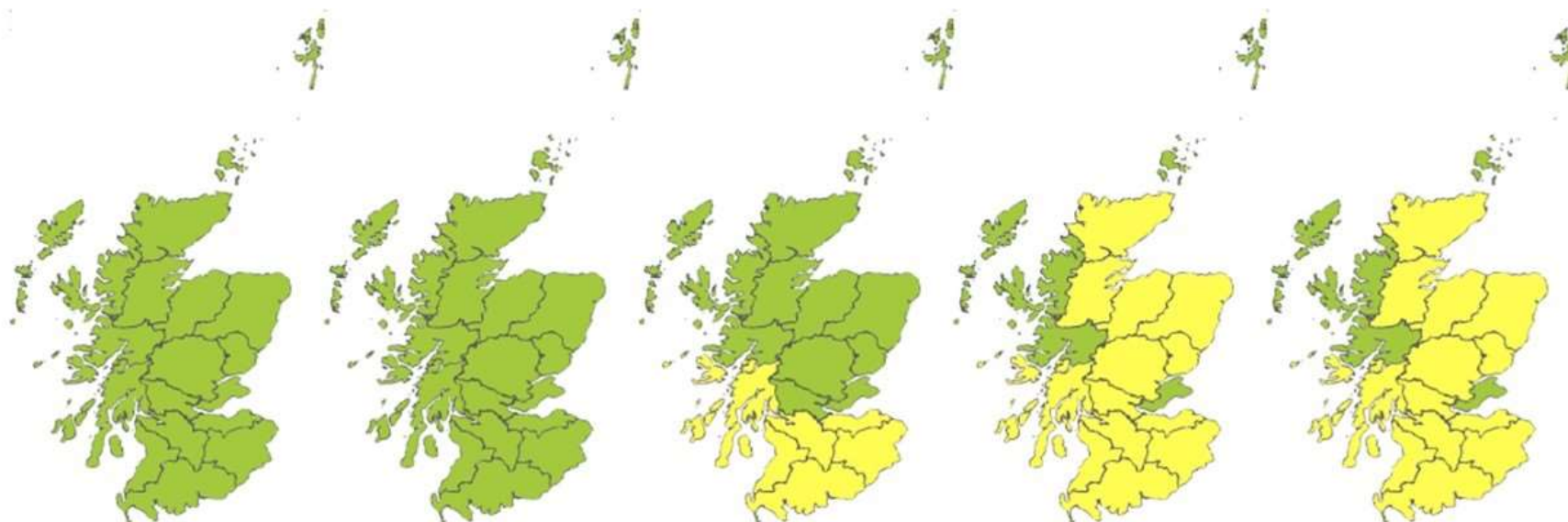
- The weather could still change a bit (MOGREPS)
- The model and underlying assumptions
- Our own rating to convert levels to flow
- Reliability of flood defences and embankments



Flood Guidance Statement Sequence (Sunday 15th Oct)



Flood Guidance Statement Sequence (Monday 16th Oct)



10:30 - 23:59
Monday
16 October 2023

Tuesday
17 October 2023

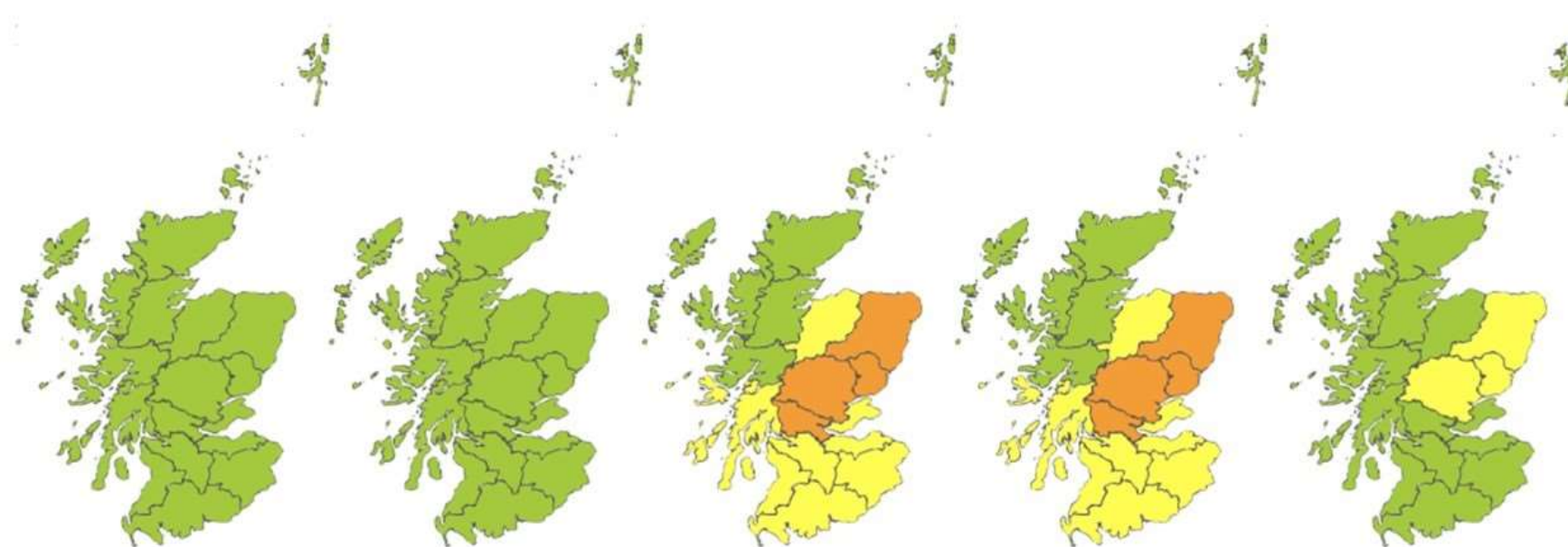
Wednesday
18 October 2023

Thursday
19 October 2023

Friday
20 October 2023



Flood Guidance Statement Sequence (Tuesday 17th Oct)



10:30 - 23:59

Tuesday

17 October 2023

Wednesday

18 October 2023

Thursday

19 October 2023

Friday

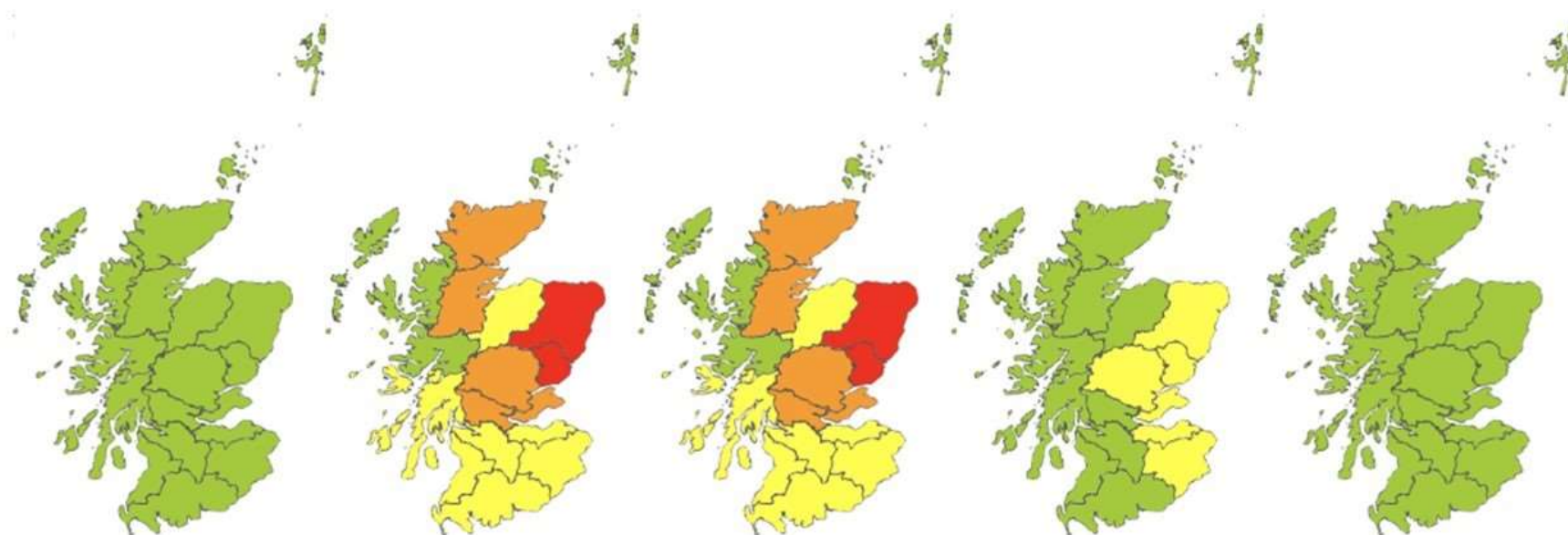
20 October 2023

Saturday

21 October 2023

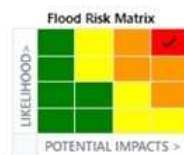


Flood Guidance Statement Sequence (Wednesday 18th Oct)

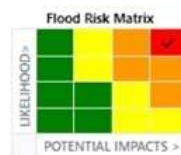


10:30 - 23:59
Wednesday
18 October 2023

Thursday
19 October 2023



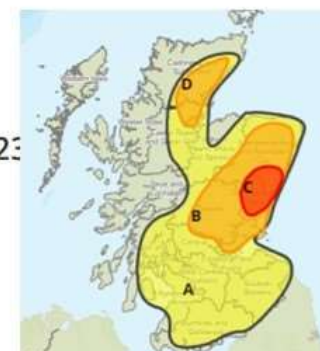
Friday
20 October 2023



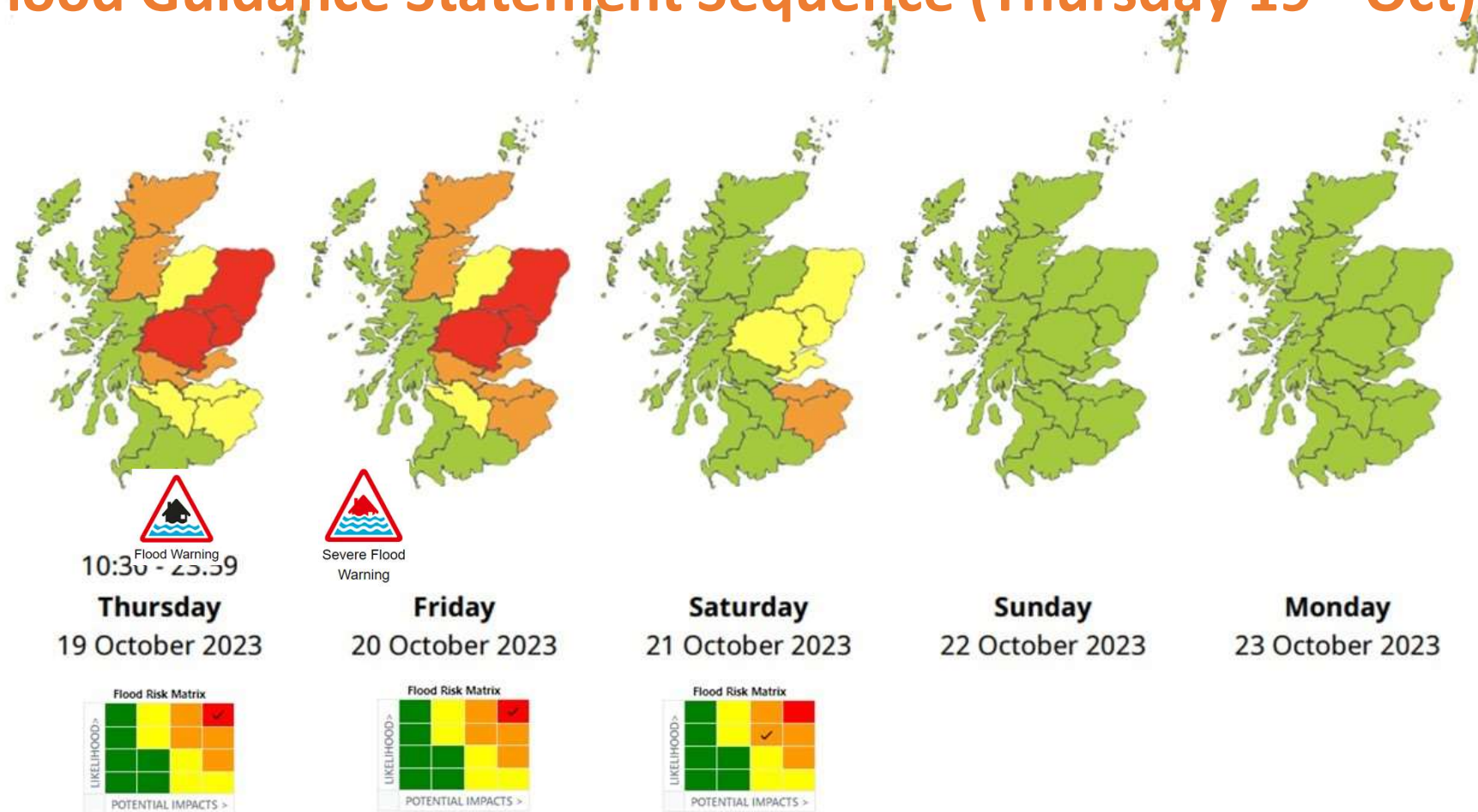
Saturday
21 October 2023



Sunday
22 October 2023



Flood Guidance Statement Sequence (Thursday 19th Oct)



Forecasting and Warning Storm Babet

Some Headlines from a Hydrological Perspective

Rainfall

- Waterside Perth 176mm (24hrs)- validates forecast rain
- Invermark 158mm (24hrs)

Rivers- Highest on record

- Brechin (South Esk) (44yr record)
- Balmossie Mill (Dighty Water- Dundee) (54yr record)

Gauges washed out/instrumentation damaged

Brechin, Tannadice, Balmossie (back up and running in 5-6 days)



Tannadice- S Esk

The SEPA Team

- Flood Forecasters
- Flood Warning Duty Officers
- Duty Flood Advisors
- Flood Duty Managers
- System Support staff
- Hydrometry teams
- Communications

Team Scotland

- MO
- Transport Scotland
- Emergency responders
- Strategic Coordination Groups
- Local Authorities,
- Local Resilience Partnerships
- Scottish Government (ScoRR)
- Media
- Volunteers

SEPA and MO have a key role to play but without actions and planning by others, the outcomes would be a lot worse

Thank you

Contact details

Bruce Campbell
Hydrometry National Team Manager
Email: bruce.campbell@sepa.org.uk

sepa.org.uk



Thanks to:
Mike Cranston, Amy Tavendale, Tom Crow,
Alistair Cargill



#FRM2024

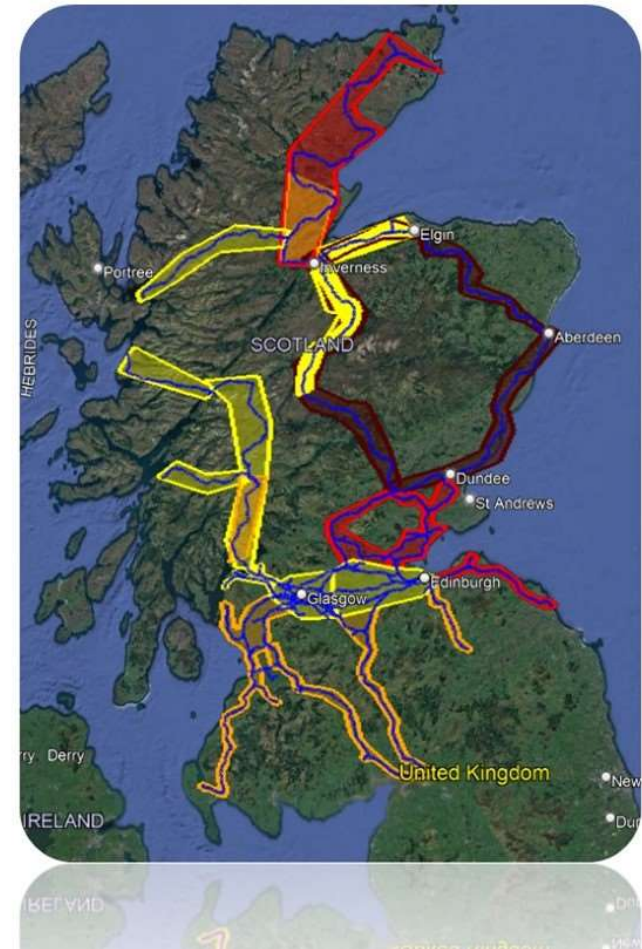
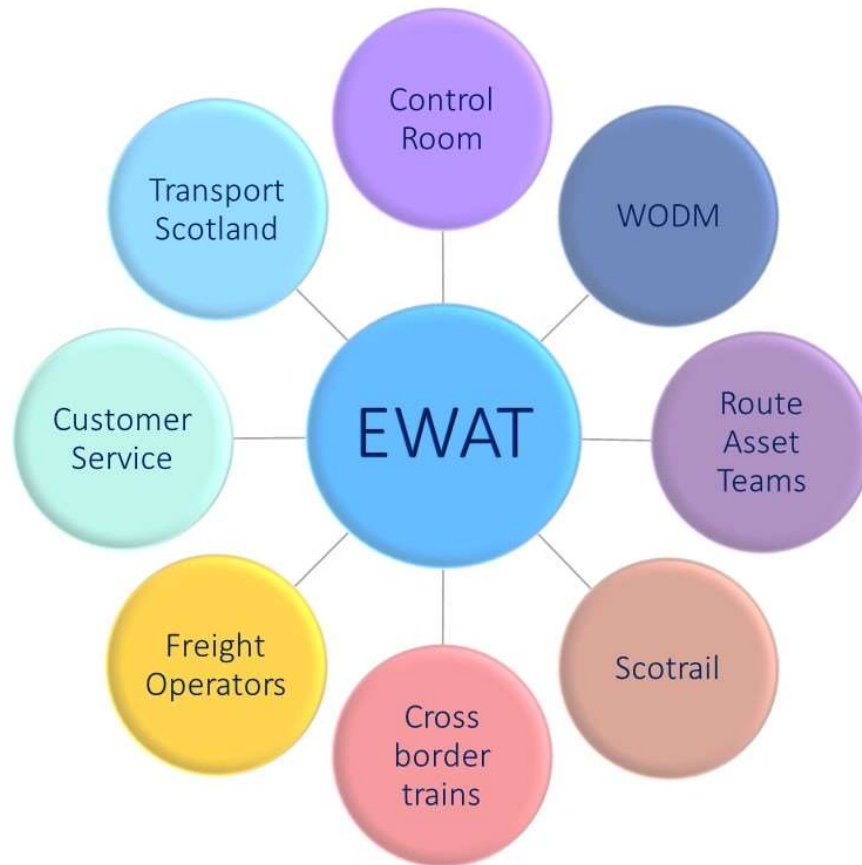
Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

Rachel Long, Network Rail



Operational Planning





Impact - Kyle Line

Impact – Aberdeen to Inverness



- Surface runoff from side long ground discharging directly onto track
- transporting silt and debris from adjacent fields contaminating track and blocking drainage system.
- Site flooded resulting in line closure

Field drains blocked water running across fields

Field ditch with water flowing towards railway

Additional source of water flowing across field towards railway

Water flowing down road re-entering field and then railway

Water from restricted culvert flowing along field

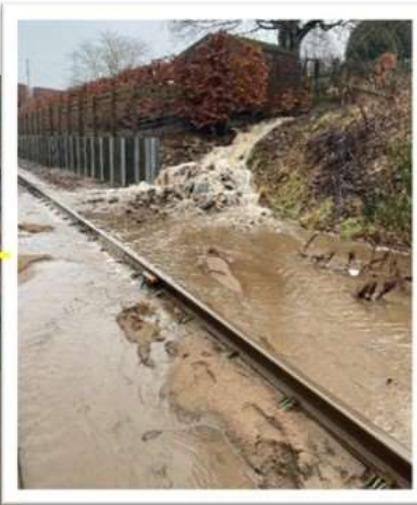
Restricted culvert

Well overflowing into ditch

Water flowing down road in 2 locations eroding road edge

Restricted culvert

Water boiling up at this location



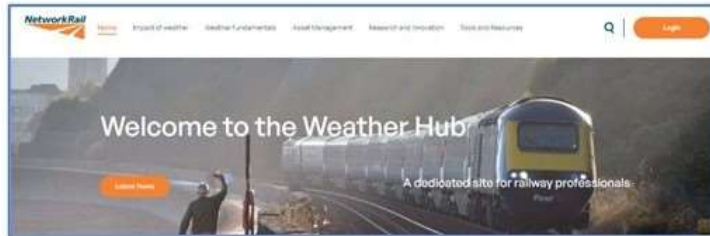


Weather Operations Delivery Managers (WODMs)

- WODM produces a forecast hazard table/Map
- 24/7 Monitoring of weather tools and data
- Live weather analysis during weather events
- Risk based approach
- Review extreme weather events
- Proactive approach for targeted speed restrictions in convective rainfall events
- Additional forecast advice e.g. OHL Frost for LNER/Lumo/TPE trains and tunnel icing forecast (winter)
- Bespoke Project forecasts



Understanding the Weather



The Weather Hub is a central body of information and best practice relating to the impact of weather on the rail network and its effective management.

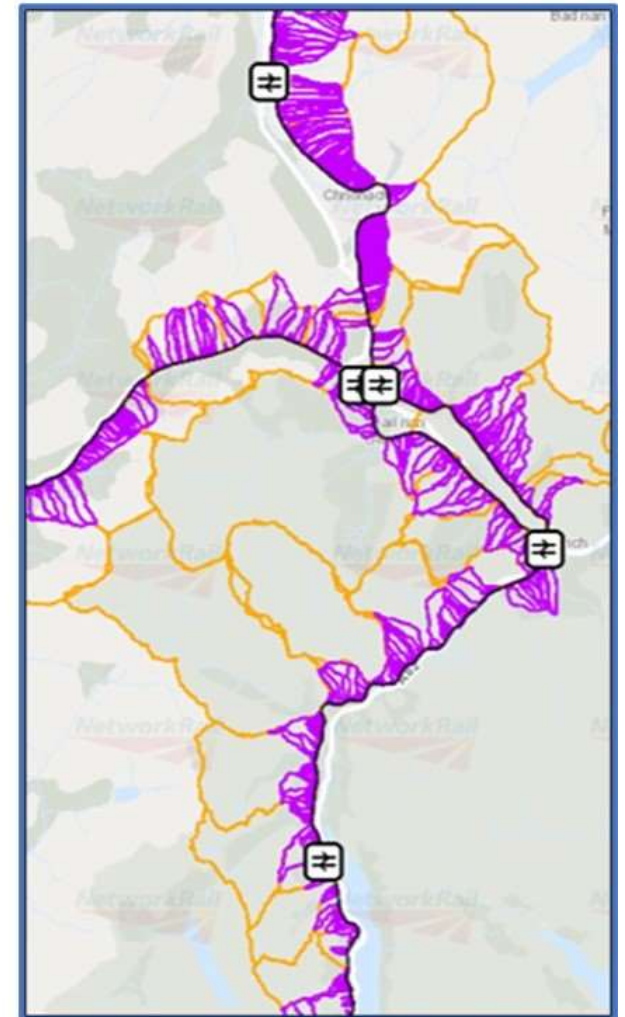


Technology



Designing for climate change

- Infrastructure no longer resilient to climate
- Drainage as a system
- Sustainable construction
- Understanding catchment
- Flood Risk Assessment
- Failsafe design
- Options - Do nothing vs Do Minimum vs “Gold plated”
- Communicate residual risks



Working collaboratively and developing networks



SOCIETY OF CHIEF OFFICERS OF
TRANSPORTATION IN SCOTLAND





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

Tom Dougall, Transport Scotland

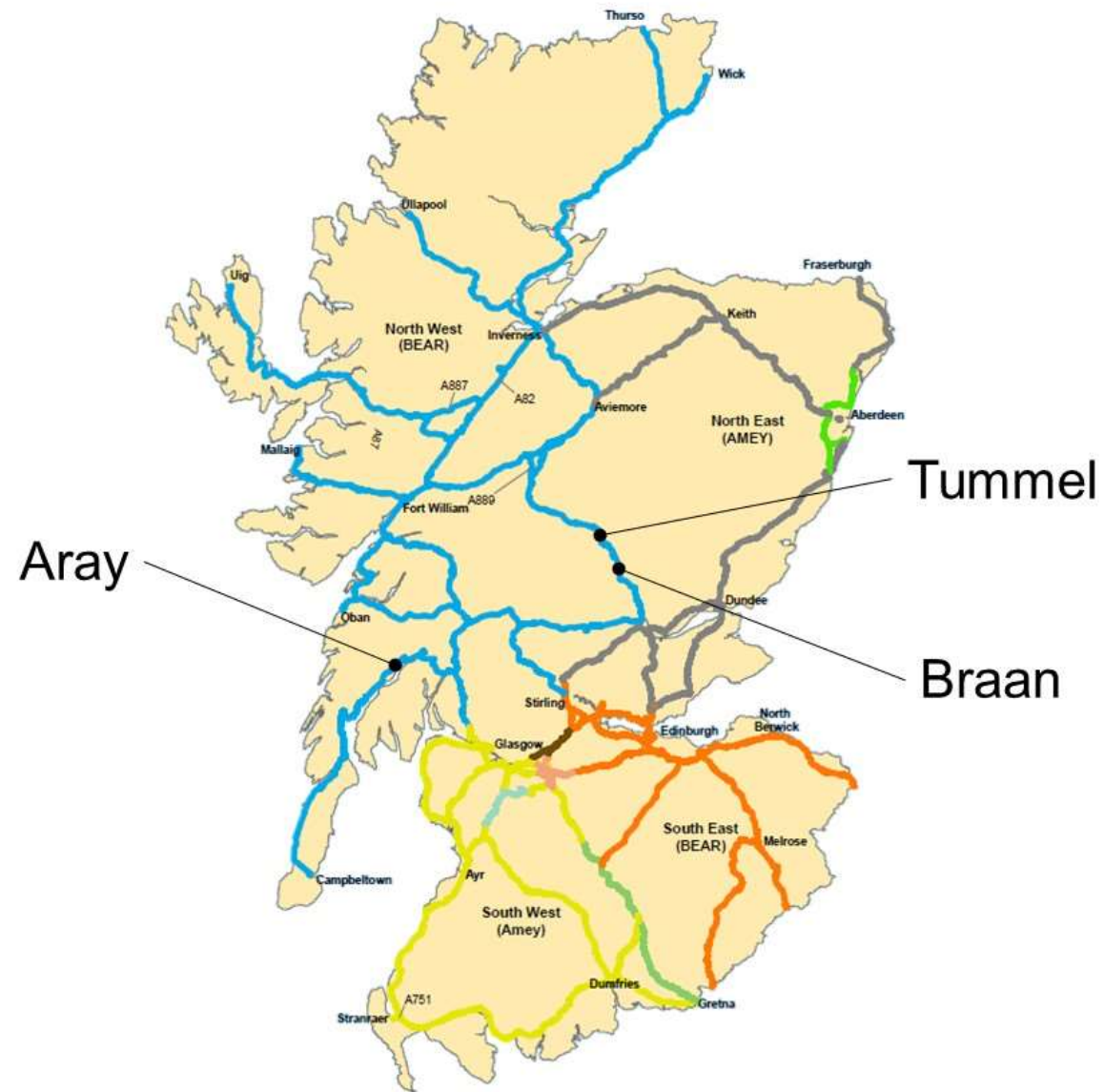


Storm Challenges and Impact

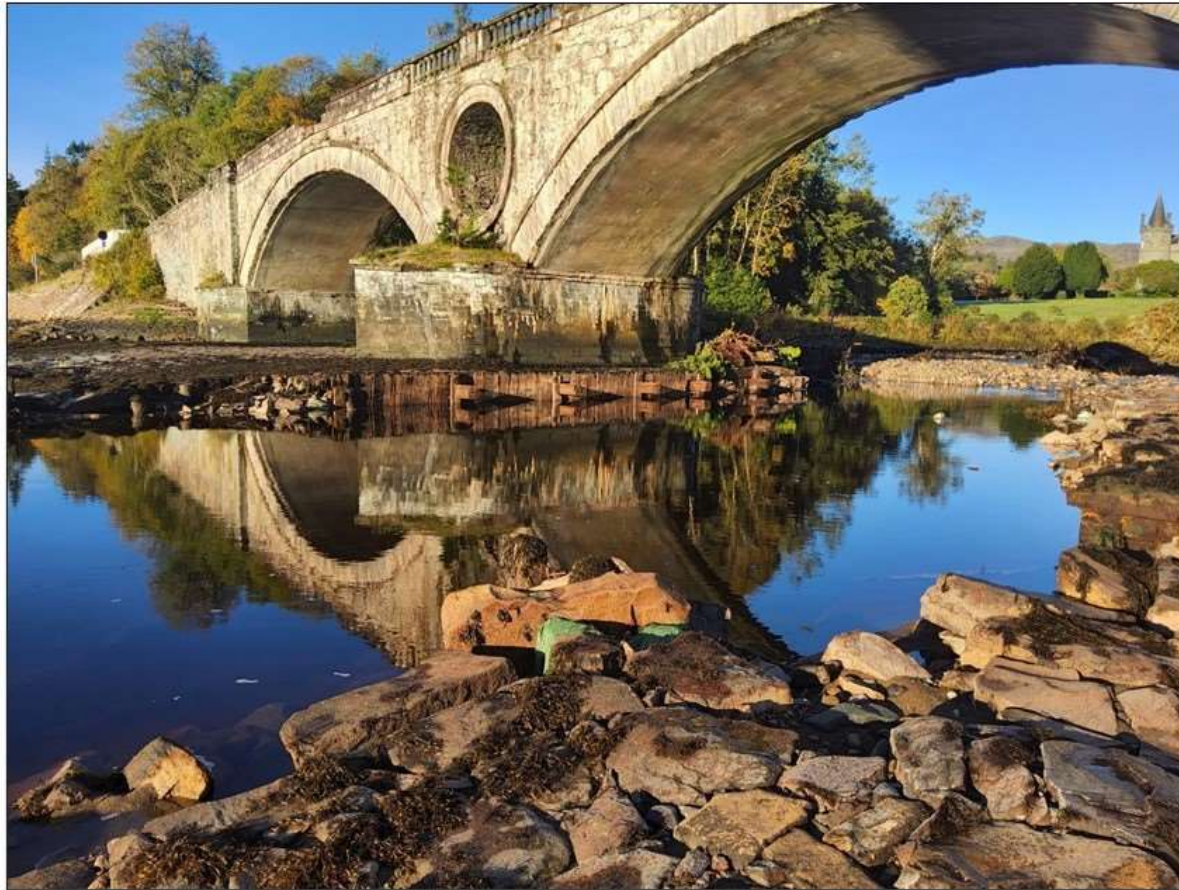
Tom Dougall
Transport Scotland
NW Unit Bridge Manager

Scour Management

- Assessments
- Management Strategy
- Programme of Works
- Scour Inspections



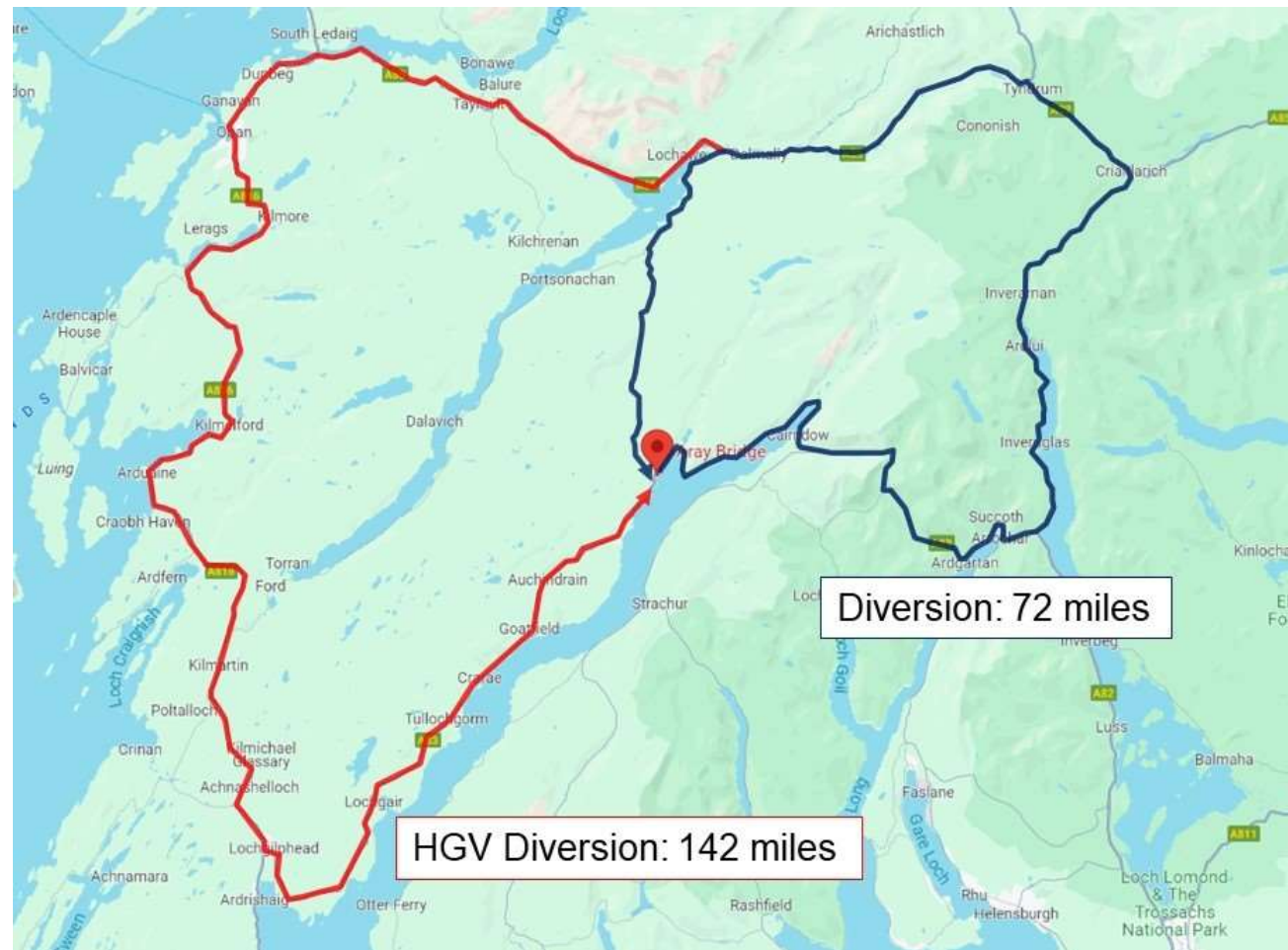




Aray





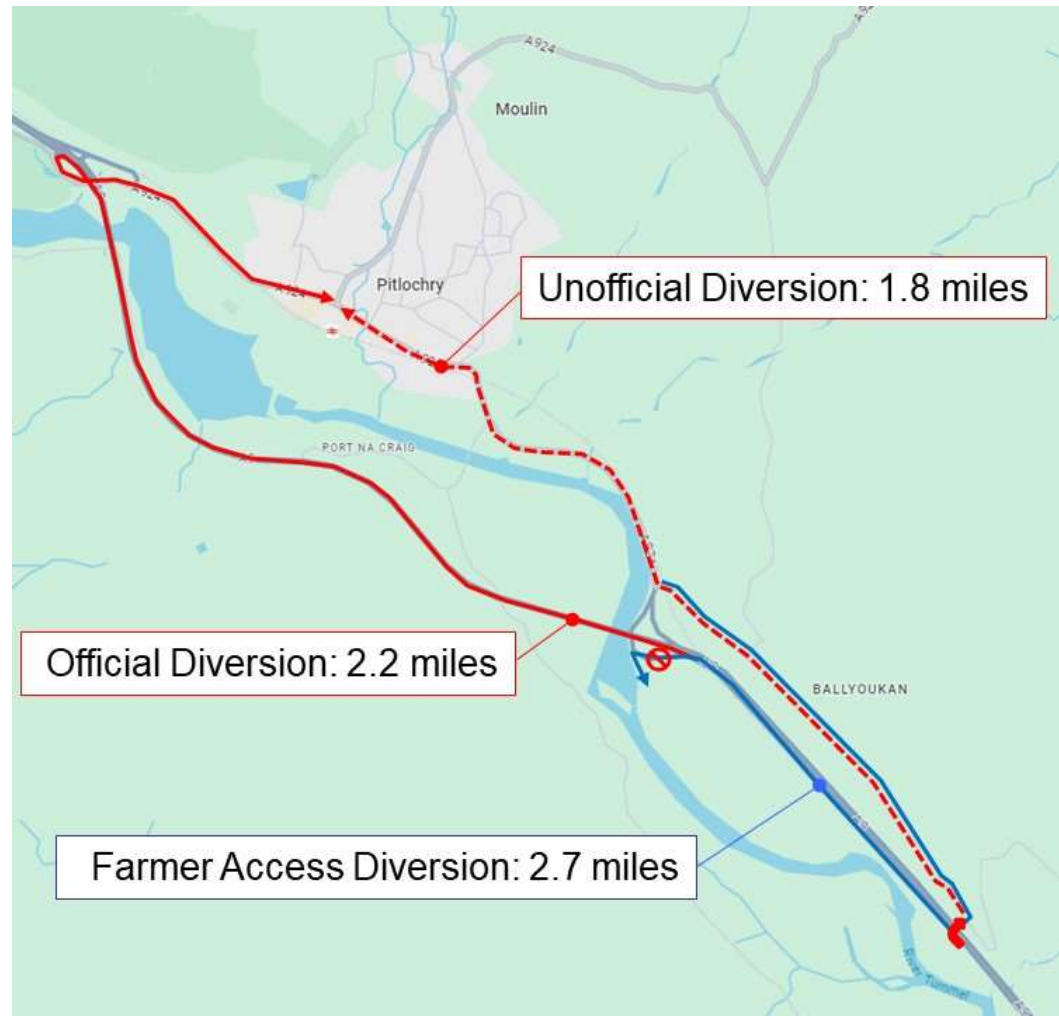




Tummel











Braan







Impact

- Length of Diversions
- Connectivity
- User Behaviour



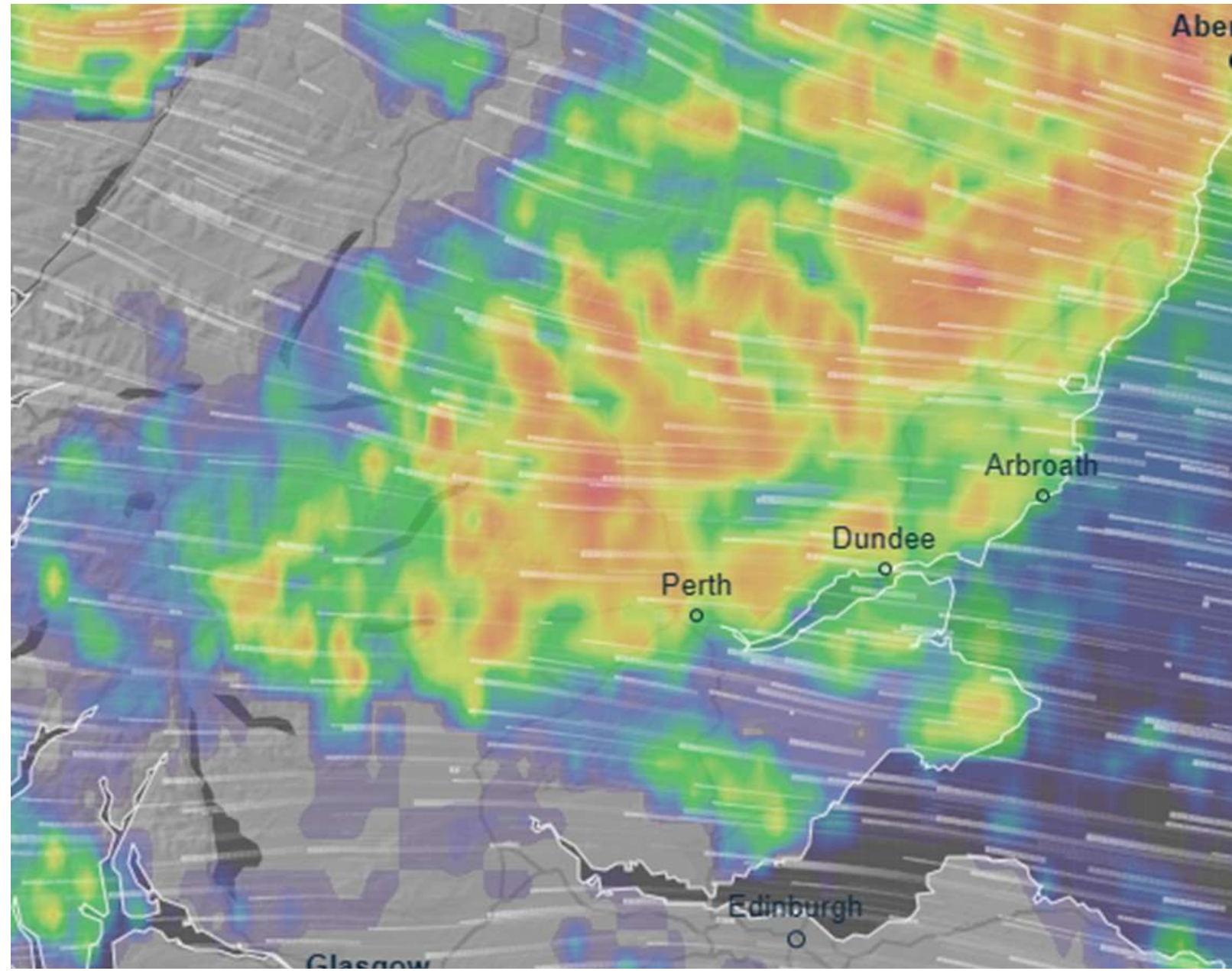
#FRM2024

Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

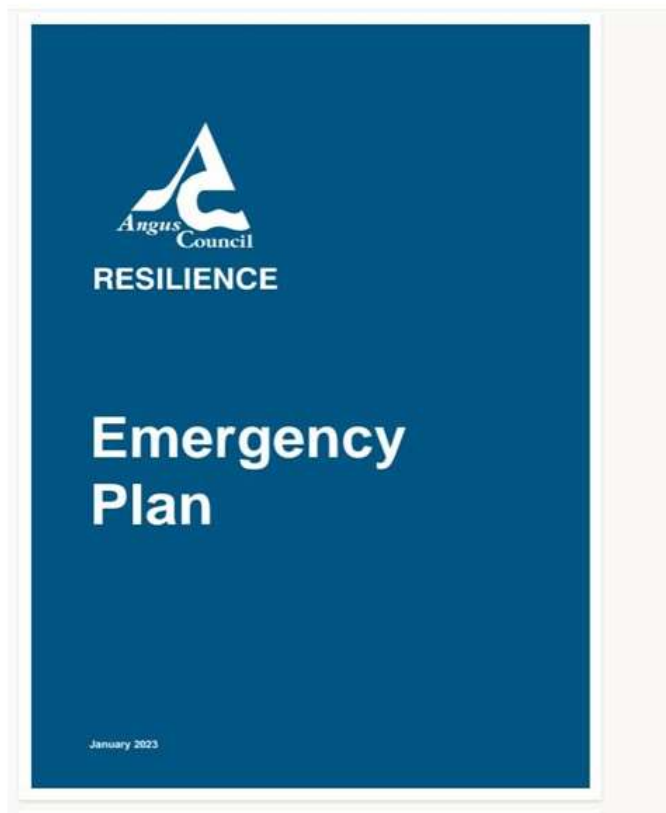
Jacqui Semple, Angus Council



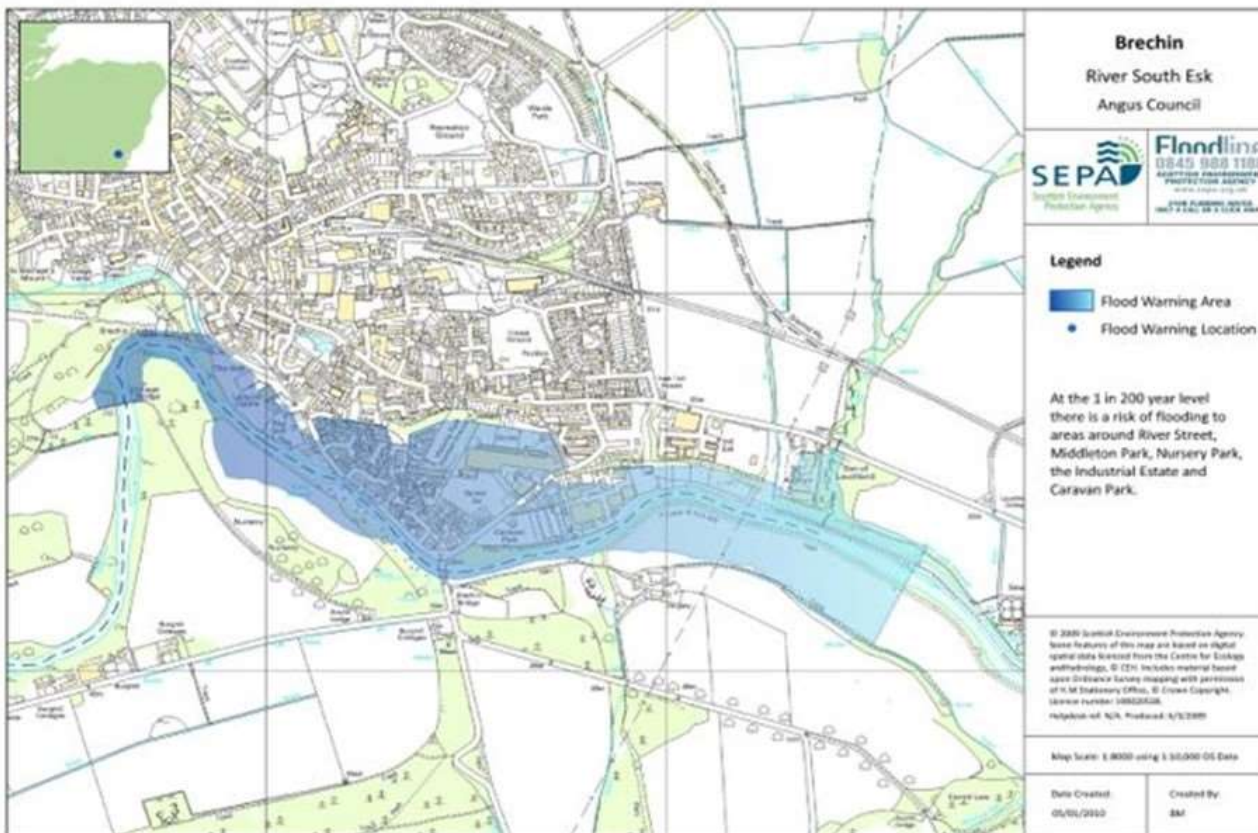




Preparation – Plans



**EMERGENCY RESPONSE –
GENERIC MULTI-AGENCY CO-ORDINATION PLAN**





Finavon and Tannadice

South Esk

Angus Council



Legend

Flood Warning Area

Flood Warning Location

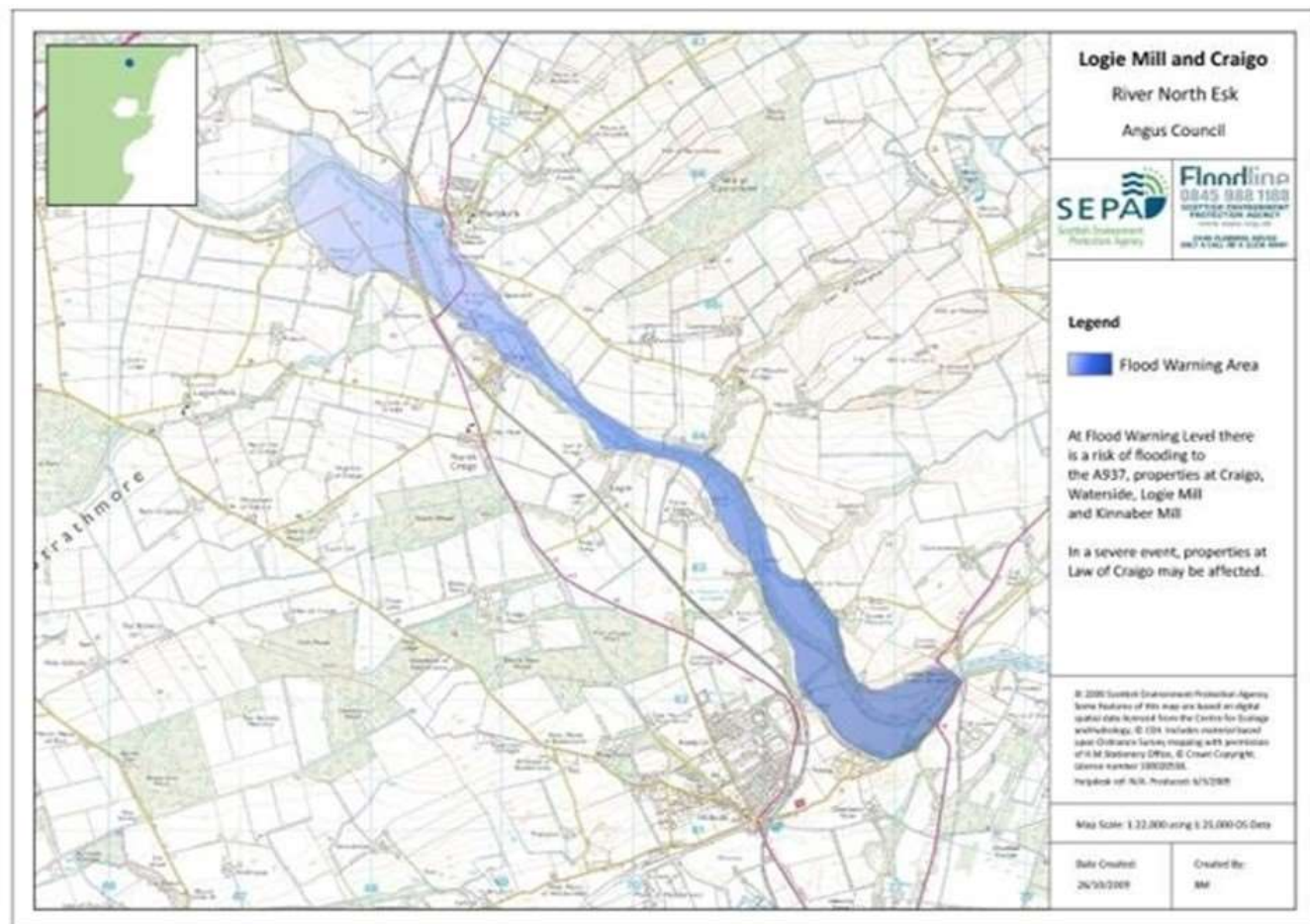
At the 1 in 200 year level there is a risk of flooding to agricultural land and property, the B957, the A90 and access roads upstream of Brechin.

© 2009 Scottish Environment Protection Agency. Some features of this map are based on digital spatial data licensed from the Centre for Ecology and Hydrology. © 2009. Includes material based upon Ordnance Survey mapping with permission of HM Stationery Office. © Crown Copyright. Licence number 100020046. Reproduced with permission of the Crown Copyright Licensing Agency.

Map Scale: 1:45,000 using 1:50,000 OS Data

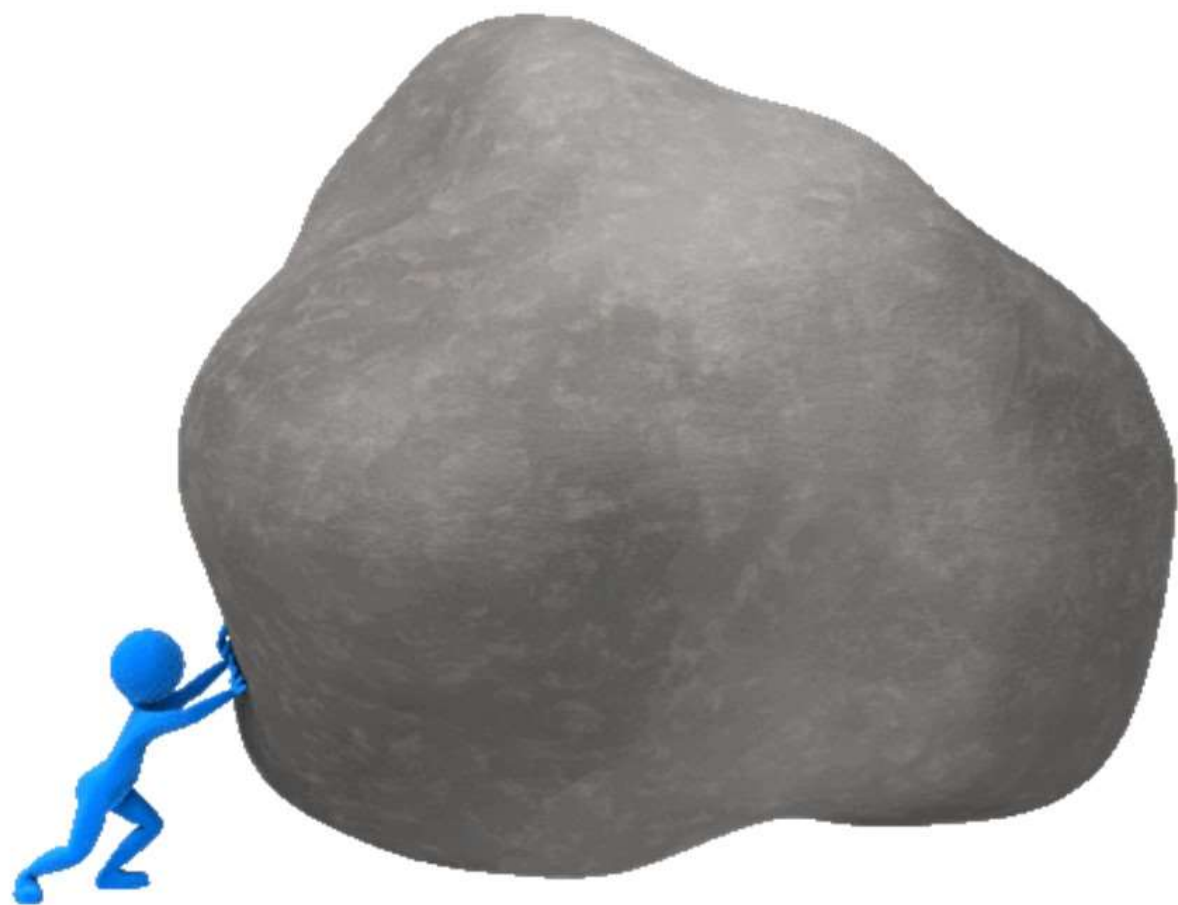
Date Created:
20/04/2009

Created By:
BM



Co-ordination, Command and Communication





PRIORITIES AND ACTIONS

- Collective situational awareness – intelligence, warnings, informing, forecasted impacts and next steps with criticality.
- Agreed objectives of all agencies – safety of responders and volunteers.
- Risk to life – red means danger – doesn't it?
- Roles and responsibilities – well rehearsed and understood.
- Communication - internal and external
- Evacuation and rescue
- Community and flood resilience groups
- Care for people & recovery
- Roads/bridges/structures

PRIORITIES & ACTIONS (Con)

- Community engagement and spirit
- Community/flood resilience exemplar
- Business and hotel support
- Staff – above and beyond
- Volunteers/third sector
- Mutual aid
- Media – onside (or not) and messaging
- Exceptional response

KEY CHALLENGES

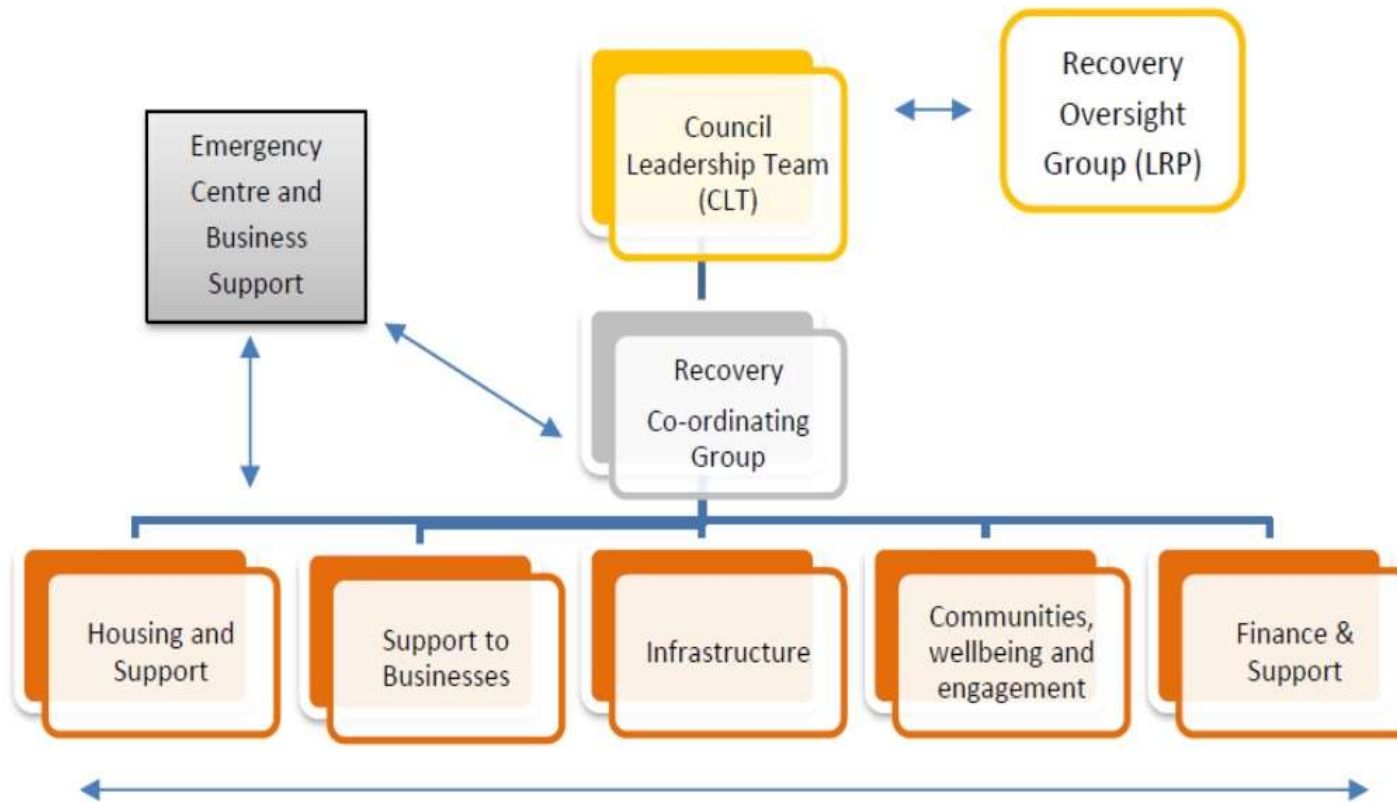
- Travel – anywhere
- 4 x 4 deployed
- Opening of three rest centres – staff and resources
- Media
- Escalation of criticality - continuing weather challenges
- Working in the virtual world
- Data sharing
- Knowledge and training of staff
- Public expectation
- Ignoring of danger to life and evacuation messages
- Timescales for completion of tasks



RECOVERY – it's complex

- Recovery plans
- Started at the same time as response
- Workstreams
- Interdependencies
- Roles and responsibilities
- Peer support and review
- Using information/guidance and outcomes from previous incidents to inform our approach
- Short medium and longer term
- Scottish Government and Ministers

RECOVERY STRUCTURE



LEARNING

- Debriefs – hot, response and ongoing recovery
- Training – all staff, with a wider reach
- Media approach worked well – we want to enhance this in our plans
- Timing is everything
- Data sharing
- Building and sharing the picture
- Virtual world vs being in the same location/co-ordination centre
- Enhancing our pre-planned work
- Looking after our staff and volunteers
- This will happen again – is it the norm?





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

Gareth Boyd, Watertight International





Scotland's Flood Resilient Future
Session 5 – Learning from Recent Events
(The Power of Build Back Better and Preparedness)

9 February 2024



Introduction to Watertight

- We are award winning, leading providers of property flood resilience (PFR) in the UK to the EA, LLFAs (local authorities), Department for Education and Build Back Better (Flood Re) delivery partner for a leading British Insurer
- EA and DfE – planned works
- BBB – reactive works
- Watertight design, source, install and maintain bespoke and innovative property flood resilience solutions
- Watertight deliver PFR taking into account the person, the property and the flood with a solution designed and delivered within the scope of the industry code of practice.
- We do not manufacture products but provide a range of project management services, advice and solutions
- Developed the Resilico flood compliance platform



Lessons Learned and Observations from Recent Events – context of Build Back Better

- BBB launched by Flood Re in April 2022. Watertight assisted Flood Re with PFR demo at Parliament



- Watertight are the delivery partner for leading British Insurer
- Pre Surge (recent events) – 20 BBB claims
- Surge (recent events) – 110 BBB claims
- Total BBB claims 130 (approx. 15 in Scotland) to base lessons learned and observations
- Our surge plan did not expect the geographic spread of claims



Heat Map BBB 2023



Build Back Better

FLOODRE



Speak to your insurer to see if they offer Build Back Better



After Build Back Better families can be back in their homes in a matter of days rather than months



Offers up to £10,000 extra to enable property flood resilience measures to be installed following a flood insurance claim



Build Back Better gives homeowners peace of mind that next time it floods they're homes and lives are protected



Reduces future flood insurance claims by keeping more water out and protecting homes against the water that does get in



Flood Re



floodre.com



[floodre](https://twitter.com/floodre)



Lessons Learned and Observations from Recent Events – Key Themes

- The Power of Build Back Better
- Protection v Adaptation (national policy at individual property level)
- Battle (negotiation) within PFR
 - Resistance
 - Recoverability
 - Preparedness
- Communication - Timing is everything
- Consider the Power of Build Better Before



The Power of Build Back Better

- BBB empowers – feeling that individuals can make a difference to their own circumstances and those of their community, to manage their risk, take responsibility and have some control

- Flood hierarchy



- Positive reception from homeowners – examples
- Need for more education and awareness about BBB prior to flood - Preparedness





Protection v Adaptation (national policy at individual property level)

- Government alone cannot protect everyone or everything from increasing flood risk
- National strategy for flood and coastal risk management presents an explicit shift in approach from flood **protection** (traditional flood defences) to flood **resilience adaptation** (a systematic approach to reduce and live with increasing risk)
- Education and Awareness - BBB allowed us to and facilitated this discussion with homeowners but at their own property level.

National	protection	adaptation
Individual	resistance	recoverability



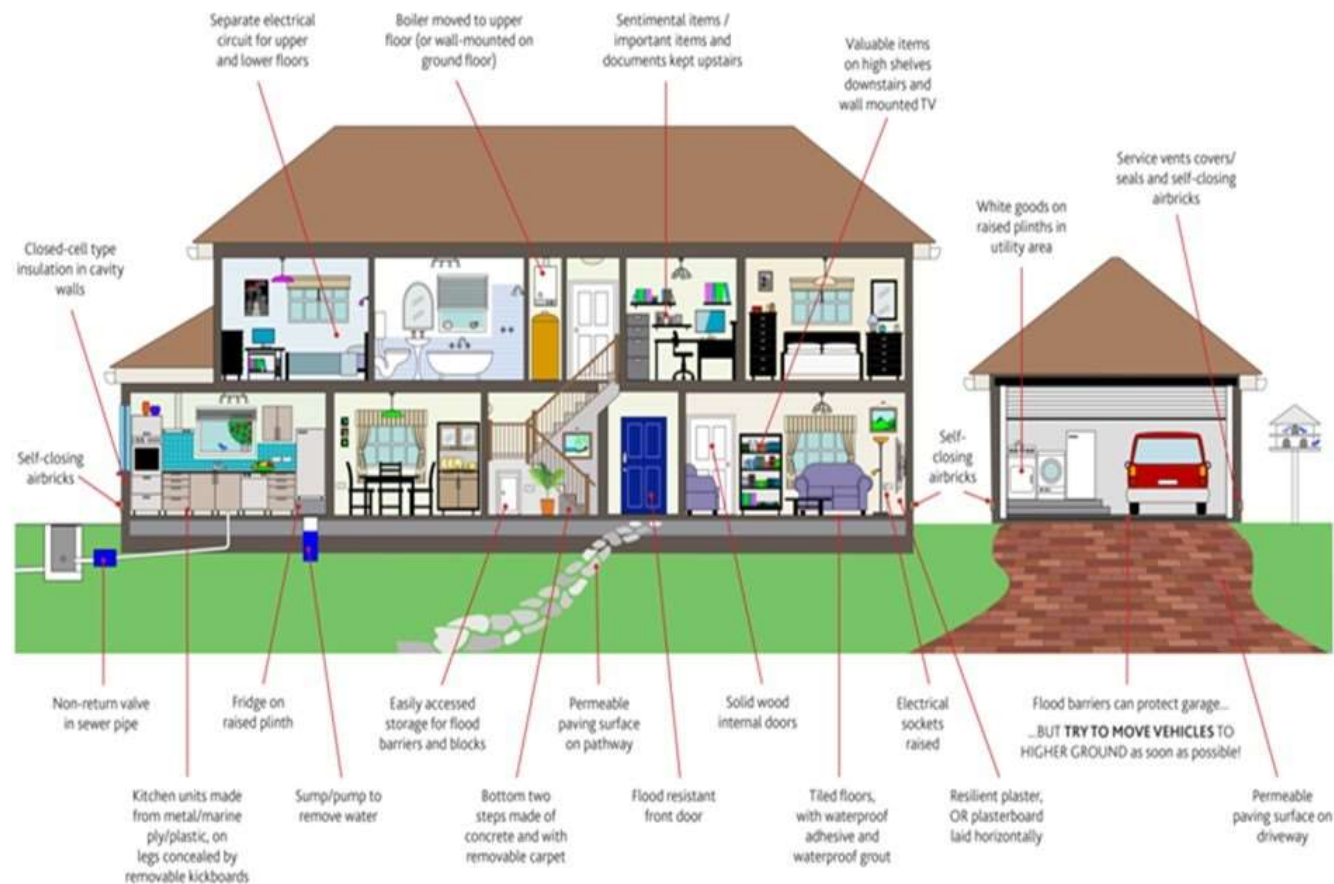
Battle (negotiation) within PFR

- PFR includes any resilience measures built into individual properties designed to allow people to live with the risk of flooding.
- BBB grant of £10,000 (inc VAT) – net £8,333 – options
 - Resistance (protection)
 - Recoverability (adaptation)
 - Preparedness
- BBB a contribution to resilience, it may not meet the full cost
- BBB / PFR – no one size fits all solution – a jigsaw



Options for PFR and BBB

Combined resistance and resilience measures Keeping water out for as long as possible buys valuable time to raise / move your belongings





Battle (negotiation) within PFR

- **Resistance** measures (eg barriers and doors) to keep water out of a property
- Most commonly wanted by homeowners at beginning of BBB journey and in conversations.
- seen as protection





Battle (negotiation) within PFR

- **Recoverability** adapting the property with measures, products and construction methods that reduce the damage caused if water does enter a building to aid faster recovery
- Adaptation – possibly an upgrade (flood door for normal door). “Knitting” in the BBB grant to insured repairs to get most value for money
- recoverability is a harder conversation because it is about the next time, not the current, saving insurers money!



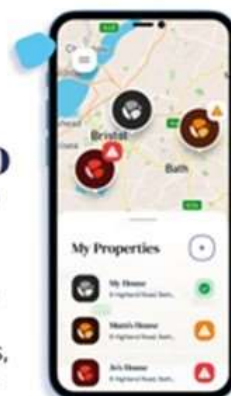


Battle (negotiation) within PFR

- **Preparedness**, knowing what to do and when to do it – access to flood alerts, having a flood plan and maintaining your PFR
- Regardless of spend on resistance or recoverability, preparedness is always required, but often overlooked, both at individual level and national level
- All BBB recipients are being onboarded to Resilico



The Resilico smart phone app enables you to access flood alerts, create a bespoke flood plan and to maintain your PFR measures.



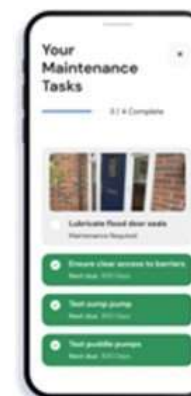
Receive flood warnings



Receive flood warnings



Create a personalised flood plan



Maintain your PFR Measures



Key Lesson / observation – the importance of Preparedness

BBB / PFR options / variables per property (examples)

Property	A	B	C	D
resistance	✓	✓		
recoverability	✓		✓	
preparedness	✓	✓	✓	✓

National	Individual
protection	resistance
adaptation	recoverability
Preparedness	

Case Study – Brechin (River Street)



Case Study – Brechin (River Street)



Case Study – Brechin (River Street)



Case Study – Brechin (River Street)



Case Study – Brechin (River Street)



Case Study – Brechin (River Street)





Communication – Timing is everything

- SLA - contact made within 24 hours of BBB appointment
- Phonecall to explain BBB and discuss survey
- emotional v practical v financial – all people are different
- Empathy required, must be homeowner led
- Information overload – too many options
- Journey back home:
 - Alternative accommodation – a priority
 - Drying out
 - Insured repairs report
 - BBB survey and options
- When is the best time to survey for BBB, discuss options
- Resistance is always preferred the closer to the event, recoverability is a harder conversation because it is about the next time, not the current, saving insurers money!
- Preparedness not a priority early in the conversation
- This is the national policy protection v adaptation conversation at an individual property level
- BBB is a contribution, not always the full solution – must be understood that further interventions (resistance or recoverability may be required)



Consider the Power of Build Better Before

- Consider Build Back Before
- It would be planned, not reactive
- Education and awareness
- First priority would be Preparedness – how do you remain prepared for something that may or may not ever happen
- A roadmap to resilience
- Now being talked about by Flood Re
- Greater empowerment for homeowners taking responsibility
- Requirement for subsidies and funding
- To be continued.....
- Thank-you
- Gareth Boyd 07764 224594
- gareth@watertightinternational.com



#FRM2024

Scotland's Flood Resilience Conference 2024

Session 5: Learning from recent events

Carol Raeburn, Scottish Flood Forum





WHEN THE PHONES START RINGING.....

The SFF response to Storm Babet and other weather events.

Carol Raeburn

Your Emergency Plan – Our Business as Usual

Support individuals and communities at risk of flooding.

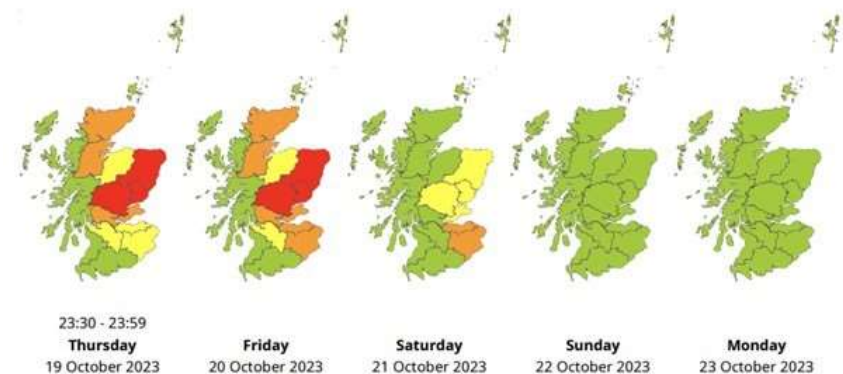
Multiple incidents across Scotland.

Simultaneous weather events.

Wide areas of impact.

Flood Guidance Statement 23:30hrs Thursday 19 October 2023

Our assessment for daily flood risk in Scotland is below. This statement is valid at the time of issue.



General Overview of Flood Risk

Evening Update - No changes

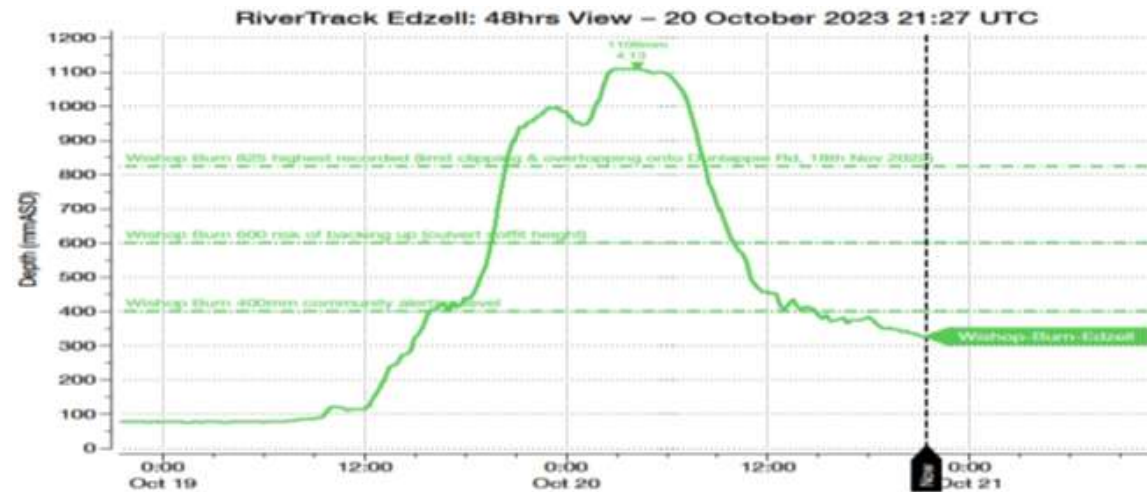
The flood risk is HIGH for Thursday to Friday. Severe impacts from rivers and surface water are expected in the north-east on Thursday and Friday. Elsewhere, in the south and west significant impacts from rivers and surface water could occur. There is a chance of significant impacts in the north west Highlands too. Also on Thursday and Friday, minor impacts from coastal flooding are possible particularly along the east coast. Please see below for further details and Area of Concern maps. More rain is expected through into Saturday and this has the potential to also cause significant river and surface water impacts especially in south eastern areas.

Lessons Learned – Shaping the Response to the People

- Social :** make-up of communities, education, media.
- Technological :** access to mobile phones, computers, data.
- Economic :** cost of living crisis, unemployment, business support, budget.
- Environmental :** climate, recent weather events, frequency of flooding, forecast information.
- Political :** election year, multiple channels for complaint.
- Legal :** home owners responsibilities, insurance, GDPR, FOIs, H&S of staff and volunteers.
- Ethical:** duty of care to clients, staff and ourselves.



Community Groups – Worth their Weight in Gold



- Please keep up the fantastic work. You really all do help keep my mind at rest knowing you're doing everything possible.
- Anonymous

Life goes on.....

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Audience Q&A

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Coming up next...

Session 6:

Enabling resilience in communities





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Scotland's Flood Resilience Conference 2024

Refreshments and Market Place





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Scotland's Flood Resilience Conference 2024

Session 6: Enabling resilience in communities

Chair: Jonny Casey, Sniffer



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Scotland's Flood Resilience Conference 2024

Session 6: Enabling resilience in communities

Dr Rhian Thomas, University of Glasgow



Climate Extremes and Public Health Impacts

Dr Rhian Thomas

School of Geographical & Earth Sciences

University of Glasgow

WORLD
CHANGING
GLASGOW

Scotland's Flood Resilience Conference 2024

Dynamic Earth, Edinburgh



08-09 February 2024



Scottish Government
Riaghaltas na h-Alba
gov.scot

 sniffer
knowledge brokers
for a resilient Scotland

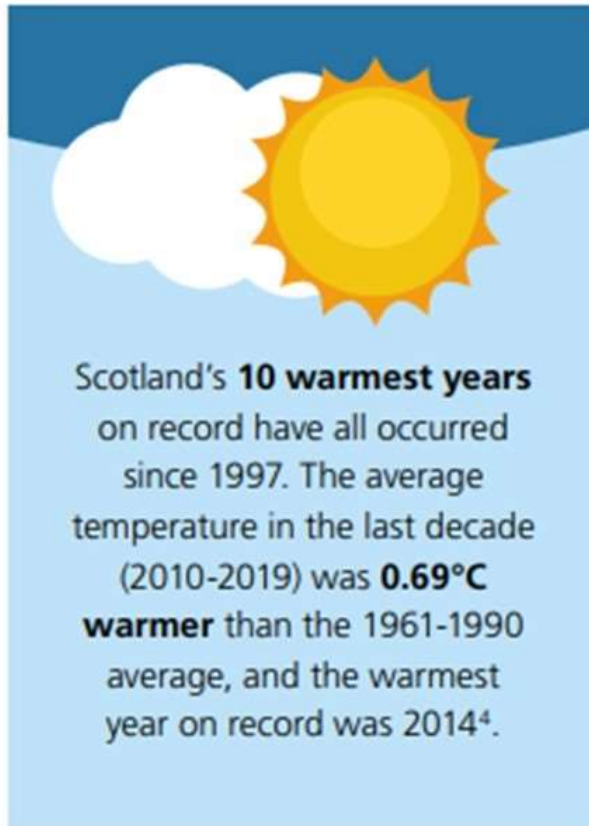
THE SUNDAY TIMES
GOOD
UNIVERSITY
GUIDE
2024
SCOTTISH
UNIVERSITY
OF THE YEAR

Why should we think about the relationship between climate change and public health in Scotland?

- What are the links between climate change and public health?
- Who is most vulnerable?
- Why should we care about this in Scotland?
- What can Scotland do?



Scotland's Changing Climate



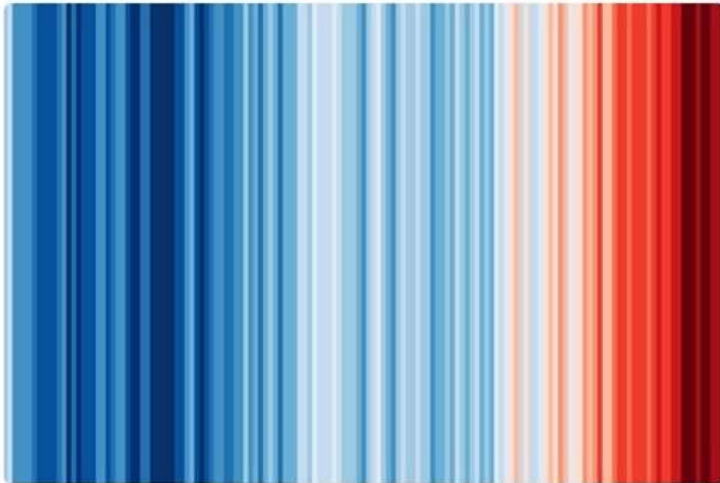
Impacts

WMO confirms that 2023 smashes global temperature record

NEWS

12 January 2024

The World Meteorological Organization (WMO) has officially confirmed that 2023 is the warmest year on record, by a huge margin.



Ed Hawkins Warming Stripes

Ed Hawkins



Increase in water scarcity events



SEPA's National Flood Risk Assessment (2018)

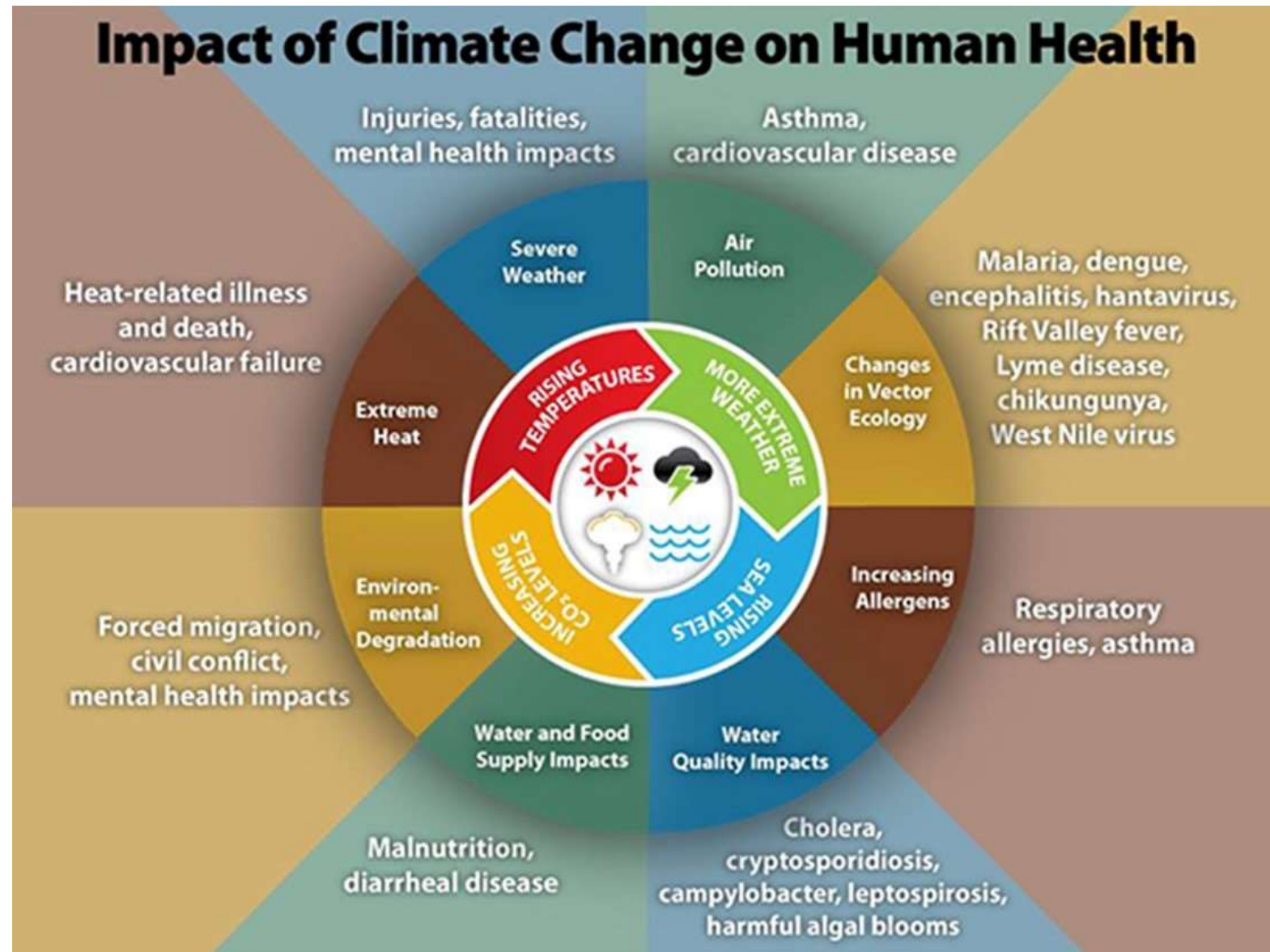
1 in 11 homes; 1 in 7 businesses/services

Scotland's climate is changing faster than expected

(Rivington & Jabloun 2022 Climate Trends and Future Projections in Scotland)

There is clear evidence linking climate change to detrimental health impacts
(World Health Organisation, 2021)

Climate change has already negatively impacted mental health globally and is expected to worsen with future climate change
(6th Assessment Report IPCC)

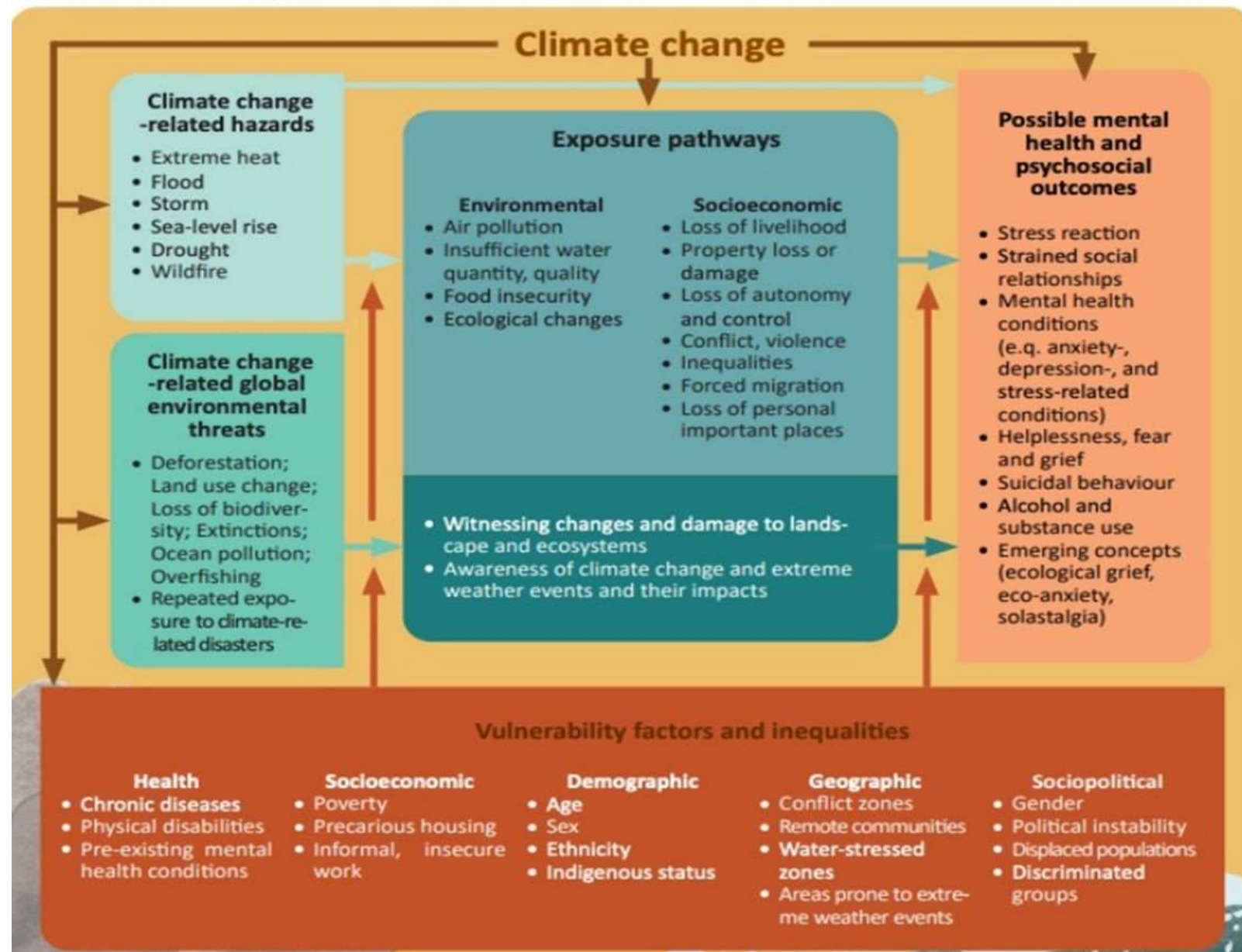


Centers for Disease Control and Prevention

Climate change is increasingly having stronger and longer-lasting impacts on people, which can directly and indirectly affect their **mental health and psychosocial well-being** (WHO, 2022)

Impacts can be:

- **Direct**
- **Indirect**
- **Psychosocial**



Climate change affects everyone – but not equally

Certain groups are disproportionately at risk from climate change-related hazards:

- Children
- Elderly
- Women
- Indigenous and minority groups
- Pre-existing mental health conditions
- Socio-economically deprived

(WHO, 2022)

Vulnerability factors and inequalities

Health	Socioeconomic	Demographic	Geographic	Sociopolitical
<ul style="list-style-type: none">• Chronic diseases• Physical disabilities• Pre-existing mental health conditions	<ul style="list-style-type: none">• Poverty• Precarious housing• Informal, insecure work	<ul style="list-style-type: none">• Age• Sex• Ethnicity• Indigenous status	<ul style="list-style-type: none">• Conflict zones• Remote communities• Water-stressed zones• Areas prone to extreme weather events	<ul style="list-style-type: none">• Gender• Political instability• Displaced populations• Discriminated groups

Mental Health and Climate Change in the UK

- The greatest health impacts of flooding in the UK are on mental health: people who experience flooding are at higher risk (~ X 6) of depression, anxiety and post-traumatic stress disorder compared to those unaffected by flooding (HECC overview 2023)
- The greater the depth and duration of the floodwater, the greater the risk of poor mental health outcomes



Protecting and improving the nation's health

The English National Study for Flooding and Health: First year report

Briefing for policy makers and practitioners



Health Effects of Climate Change (HECC) in the UK

State of the evidence 2023



Mental Health and Climate Change in Scotland

- Children, older people, those living alone or with pre-existing chronic & mental illness and disability, and stressful life circumstances, place-based occupations, low incomes, rural & remote areas were found to be more vulnerable (e.g. Werritty, 2007; Brisley et al., 2012 Philip et al., 2020)

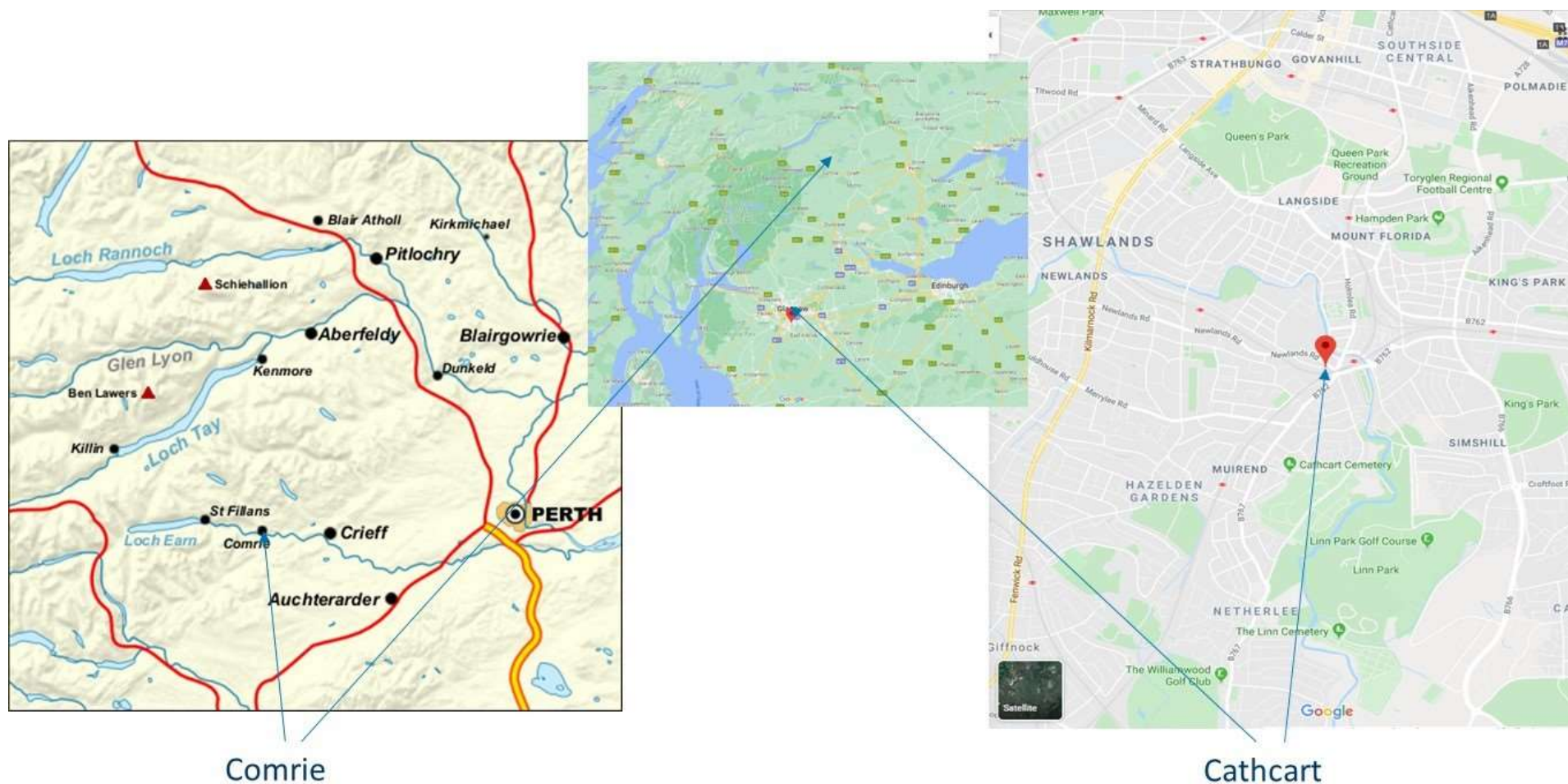
Particular vulnerabilities for Scotland:

- Scotland's population is ageing
- Scotland has areas of greater deprivation than rest of UK
- Health is poorest in the most deprived areas of Scotland
- 98% of land mass is rural (SPICe)

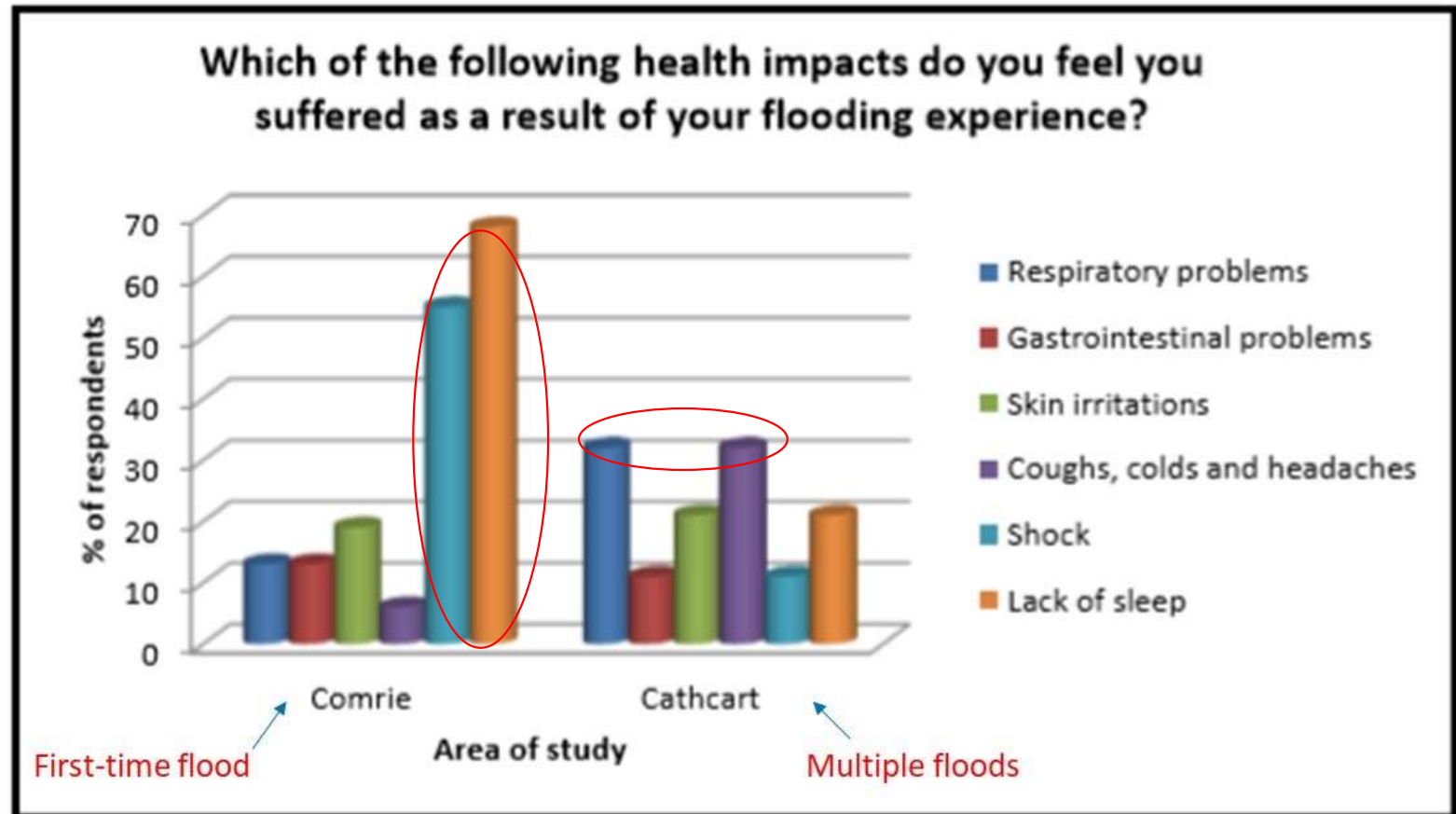
Secondary stressors for mental health:

- Lack of flood warning – or not enough time to respond
- Flood water depth and duration
- Extent of flood damage
- Structural damage and costs of rebuilding/repair
- Upheaval and financial implications of cleaning up
- Distress and financial implications of displacement/evacuation from home (temporary or permanent)
- Loss of and damage to possessions and burden on household costs
- Insurance-related issues e.g. dealing with insurance claims
- Disrupted access to employment, education, and wider facilities
- Disrupted access to health and social care services
- Damage to agriculture or livestock, leading to loss of food supplies

The social impacts of climate change: Investigating the association between flooding and public health in Scotland
(Watt, K 2015)



What are the impacts of flooding on public health?



(Watt, K 2015)

Highlights importance of understanding direct & indirect health impacts, particularly as number of areas experiencing flooding projected to rise

Mental Health and Flood Experience:

80% of all respondents cited experiencing "stress."

Prescription rates for anti-depressants in the months after the flooding events surged dramatically (Comrie Medical Centre, Watt, K 2015)

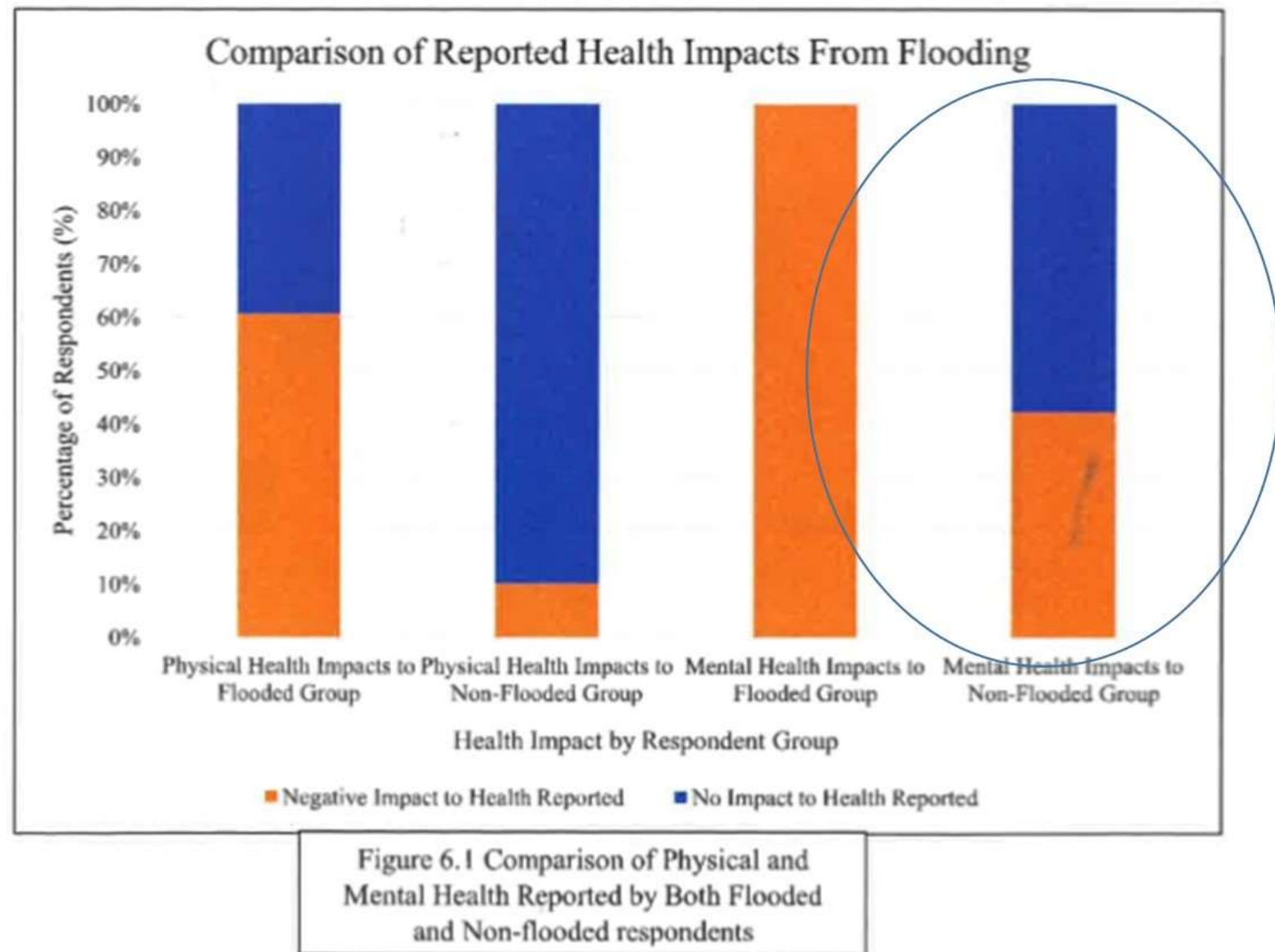
Mental Health and Dependents:

"I wasn't flooded personally but I now worry every time we have heavy rain. My 73 year old mum lives right on the Earn and was in hospital last winter. I am very anxious for her safety living right on the river"

(Comrie resident) (Watt, K 2015)

Potential for long-term PTSD to continue unnoticed, leading to physical health issues, exacerbating mental health
(Tapsell & Tunstell 2008)

(Paul, E. 2018 Flood Hazard in Hawick: An investigation into the relationships between risk perception, vulnerability, and the health impacts of flooding)



Mental health impacts clearly felt by non-flooded residents also

Importance of understanding indirect effects on mental health (e.g. Ingle & Jafry, 2019)

Do NOT have to be flooded directly to increase stress/anxiety

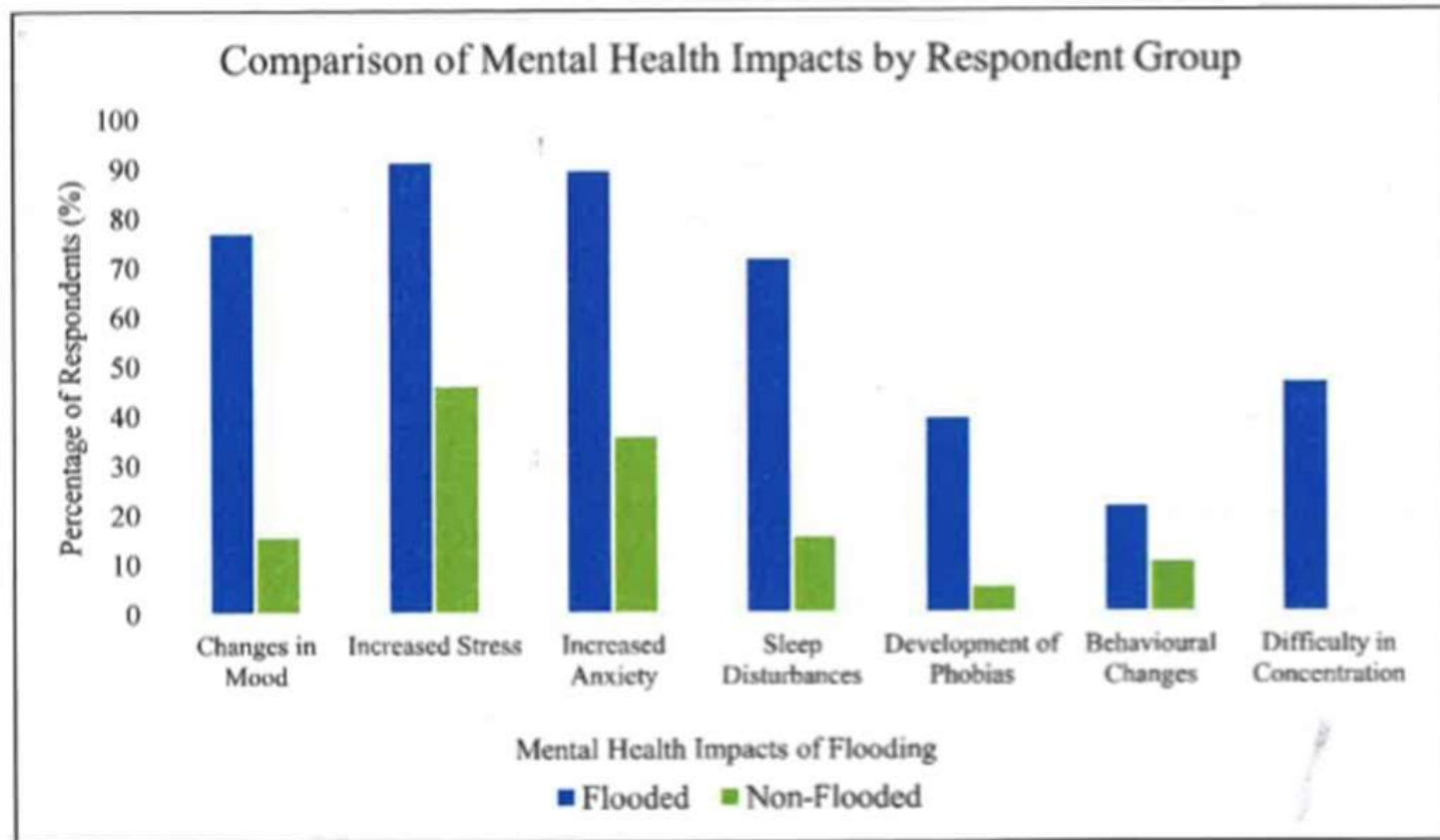
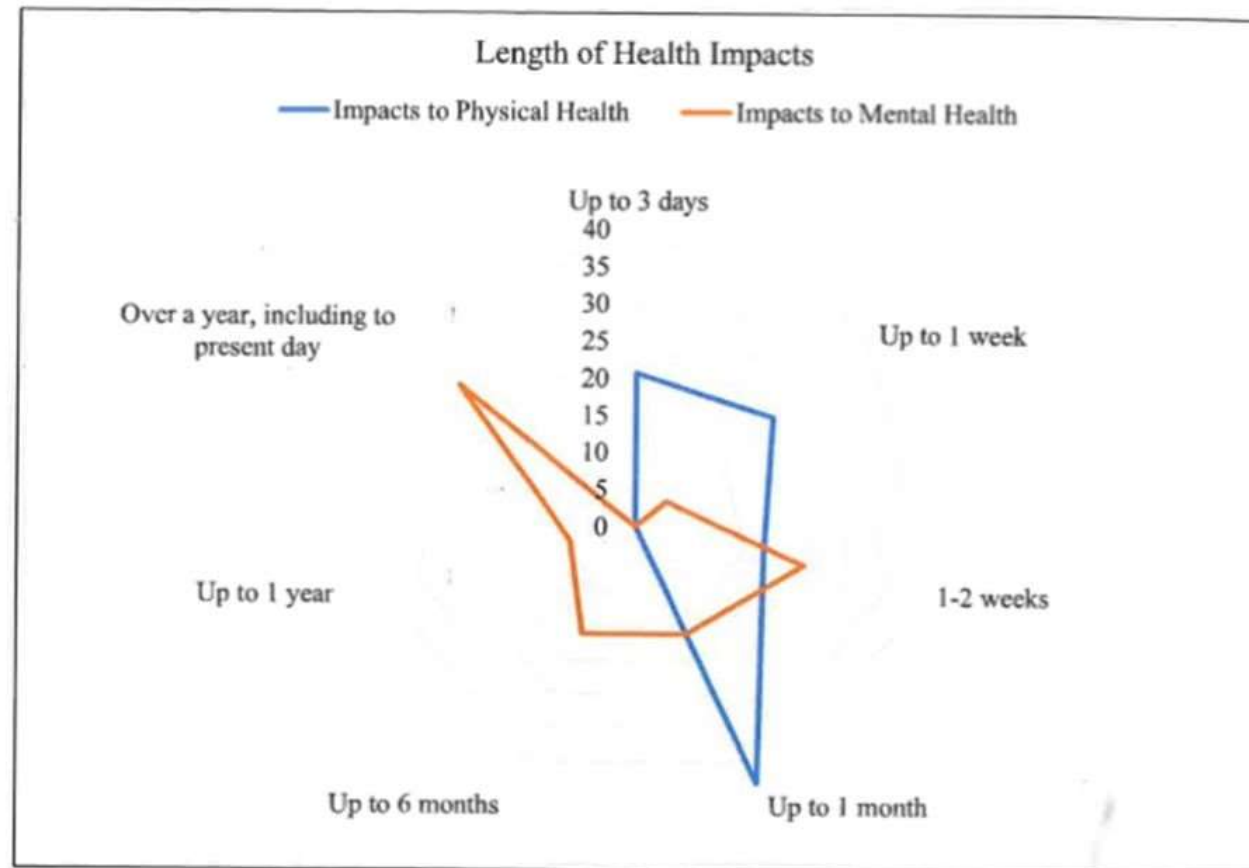


Figure 6.3 Comparison of Mental Health Impacts Experienced by Flooded and Non-flooded respondents

(Paul, E 2018)

Impacts to Mental Health last longer than Physical Health



Need for long-term health strategies

Figure 6.4 Comparison of Length of Health Impacts experienced by Flooded respondents

(Paul, E 2018)

Mental Health and Displacement/Temporary Accommodation:

**Effectiveness of flood
recovery management**

“The [temporary accommodation] system was a joke...At the start it was arranged in one week blocks...[After being relocated 9 times in 10 months] my wife and I were going crazy, arguing every day...The council were useless...It wasn’t so much the flood itself [that was stressful] but the management afterwards. The [temporary accommodation] booking system needs to be longer term.” (Comrie resident)

**Challenges
previously held
view females more
likely to suffer**

Mental Health Impacts and Gender:

“Men tend to suffer in silence until the problem gets worse...so I’d say they’re more at risk of [flood-related] health problems than women” (Comrie Medical Centre)

**Potential
disproportionate
impact on an often
deemed low priority
demographic**

Mental Health Impacts and Age:

“[I experienced] bouts of crying, but never when my family were around...It’s been an awful time and I have been close to edge regularly throughout but managed to keep sane for the sake of my family...I’ve not spoken locally about anxiety and depression...I haven’t been keen on publicity through all this” (Comrie resident)

“Too much paperwork, phone calls and dealing with insurance issues whilst trying to put family first meant I came last” (Cathcart resident)

(Watt, K. 2015)

Perception of Responsibility for Flood Protection



Glasgow City Council: *"...the primary responsibility for flood protection rests with the property owner and by extension the occupier"*

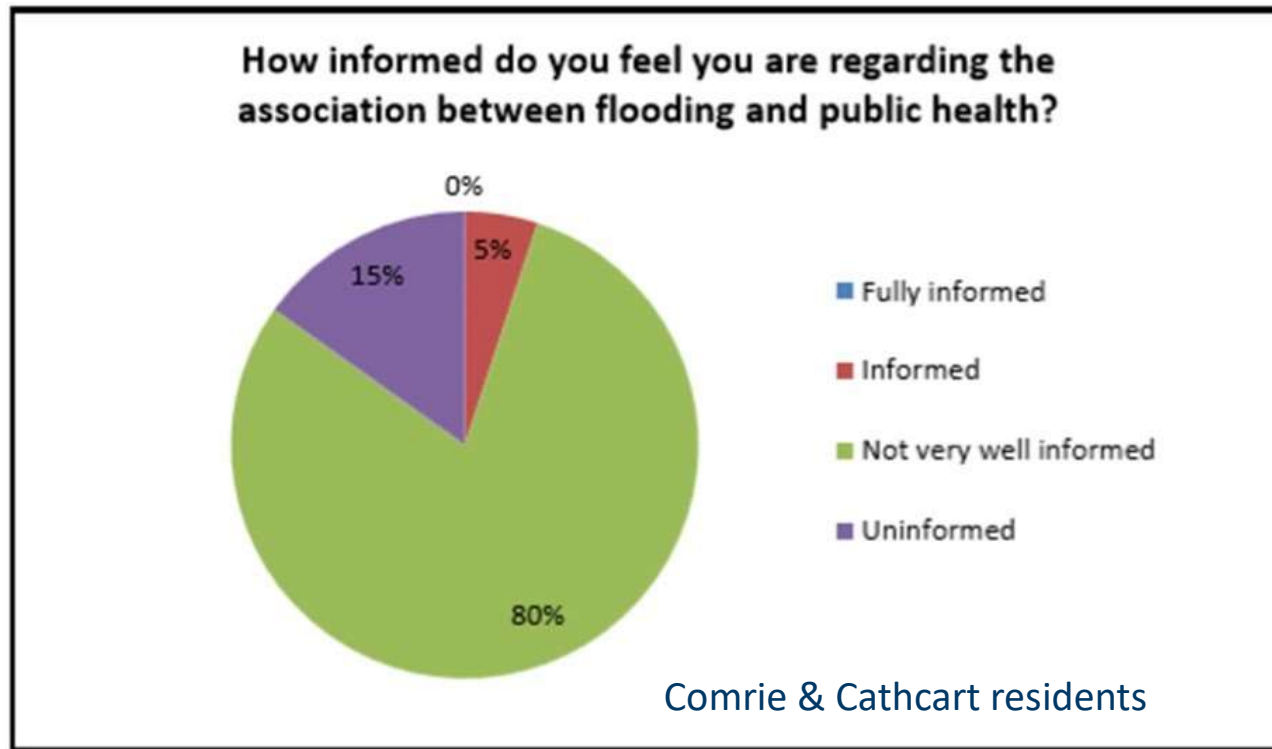
SEPA: *"It is your responsibility to manage your own flood risk"*



Can result in failure to take action to protect own properties in response to flood risk communication
(e.g. Henderson et al., 2022)

Mental Health and Flood Warnings:

"There was no time, no time at all, or warning and that was what was so stressful and frightening about it all and it is long-term. I'm more anxious now..." (Cathcart resident)



Advocates for increased research and investment in understanding and raising awareness of the public health impacts of climate extremes in Scotland

Mental Health and Community:

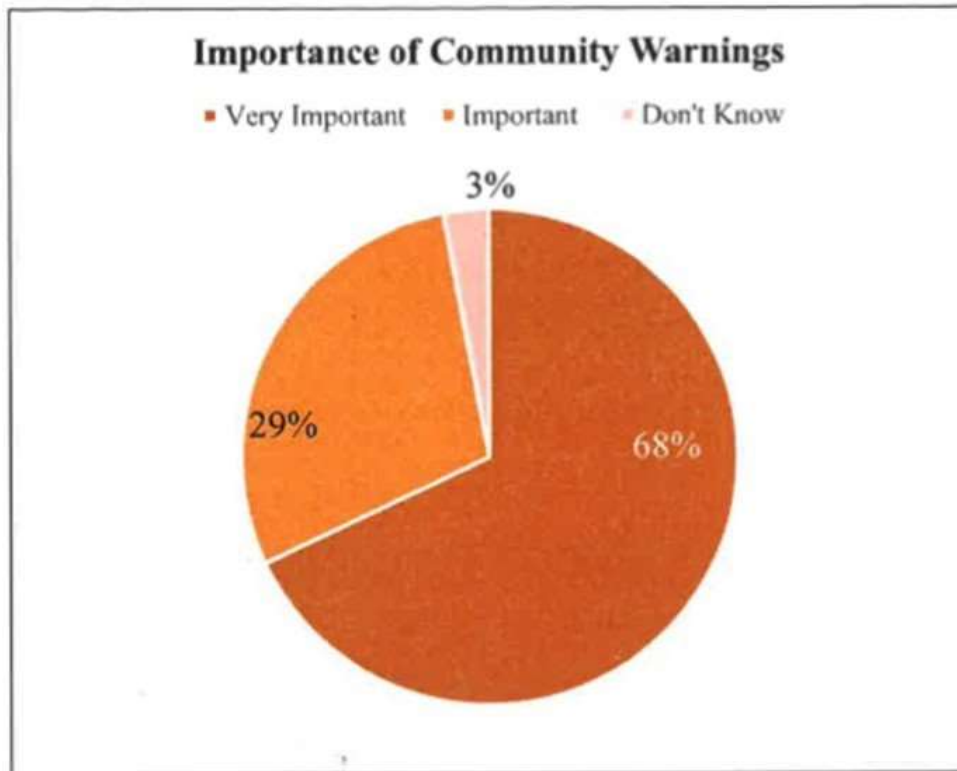


Figure 7.1: Importance of Flood Warnings according to total respondents

"It was very humbling. The camaraderie [between flood victims] was great, it was a shared experience and it kept us going" (Comrie resident)

"It's important to not sit alone. It's the isolated ones that have suffered" (Comrie Medical Centre)

Crucial role of community support in flood emergency management – reducing social demoralisation and marginalisation

(Paul, E., 2018)

Drought



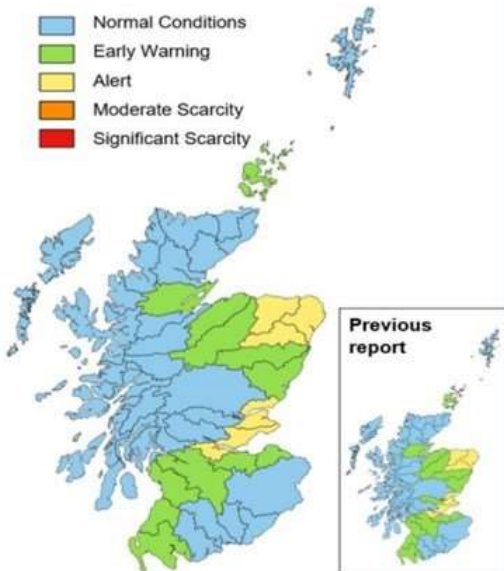
For the future of our environment

Water Scarcity Report

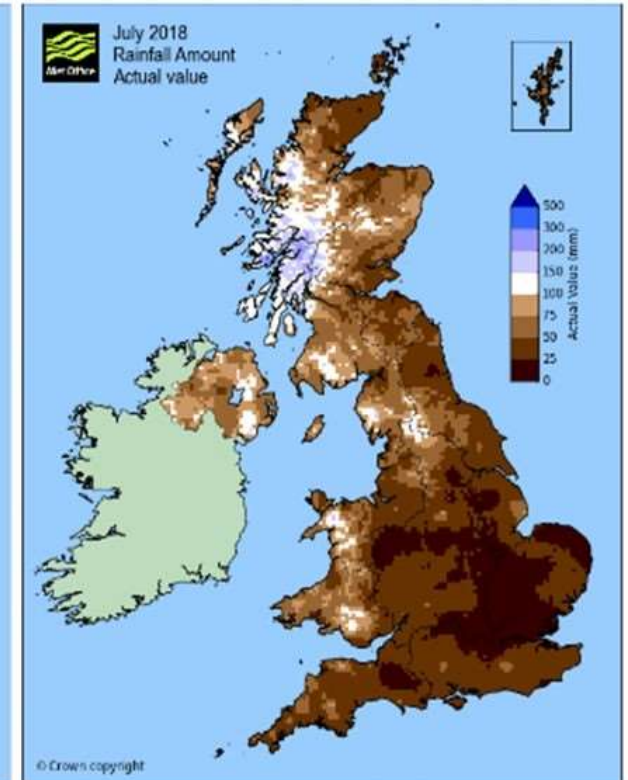
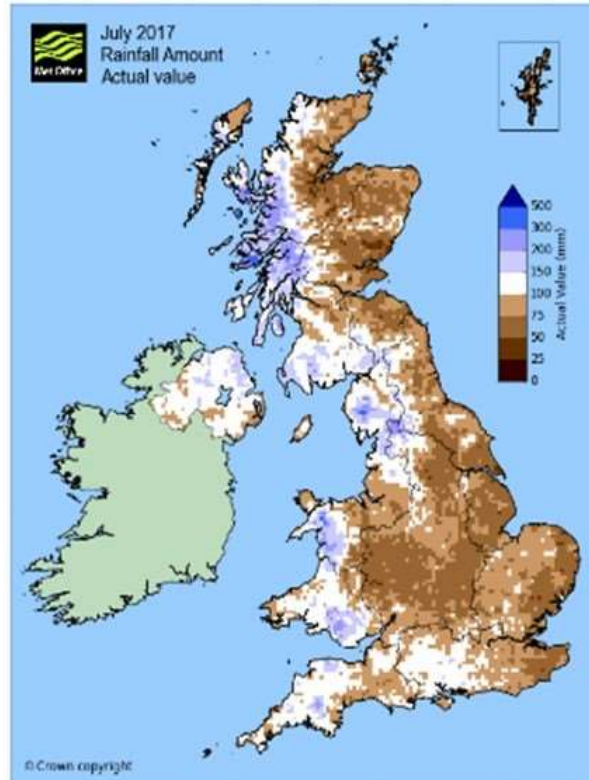
14th September 2023

Water scarcity levels - This week

- Normal Conditions
- Early Warning
- Alert
- Moderate Scarcity
- Significant Scarcity



©SEPA. Some features of this information are based on digital spatial data licensed from the Centre for Ecology and Hydrology © NERC (CEH). Contains OS data © Crown copyright [and database right].



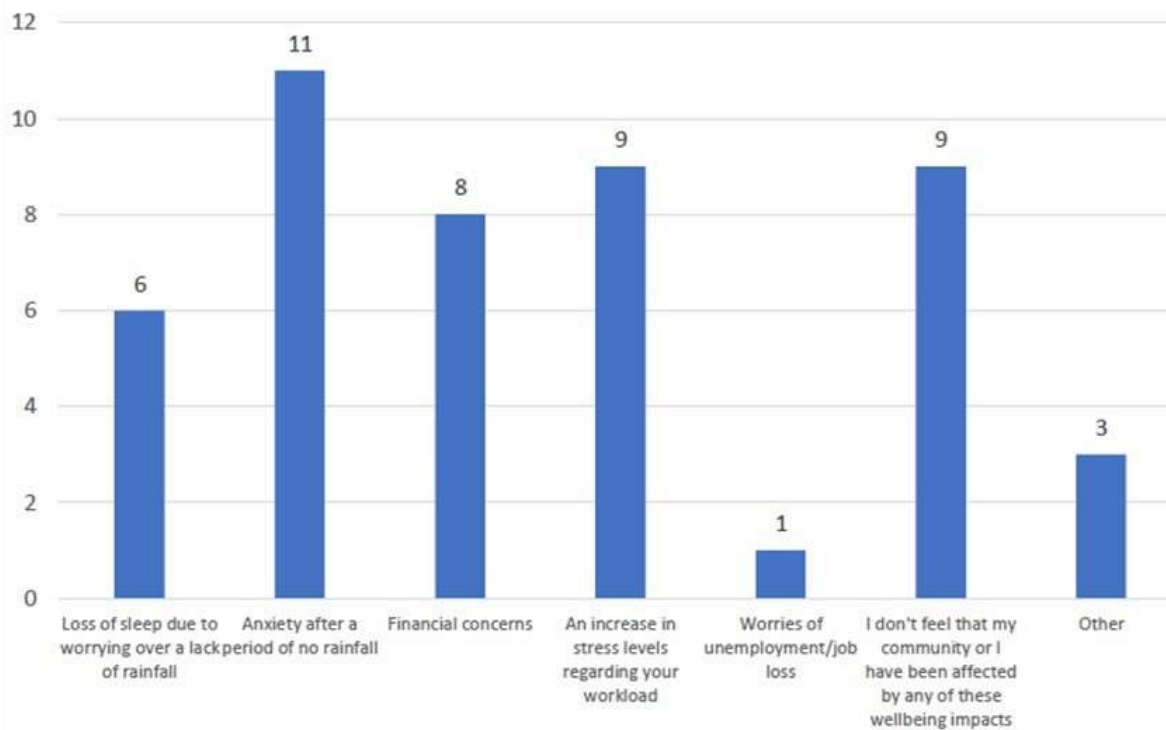
Social/public health impacts of drought? – particularly for agricultural areas and people on private water supplies

Mental health impacts of the rural/farming community as a result of climate changes?

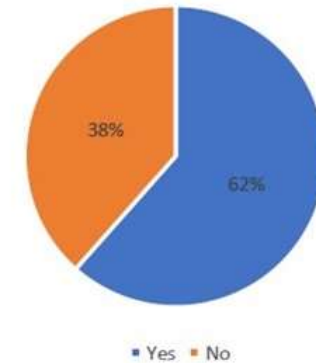
Impacts on other industries such as distilleries?

Drought

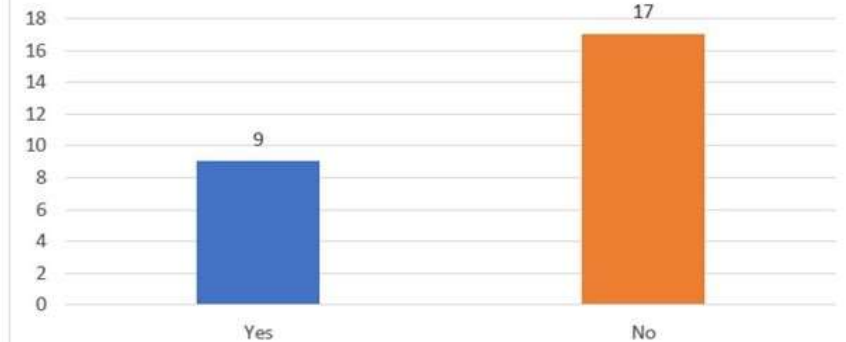
Wellbeing issues felt by farmers in Scotland



Have you ever experienced any issues relating to drought? (farmers)



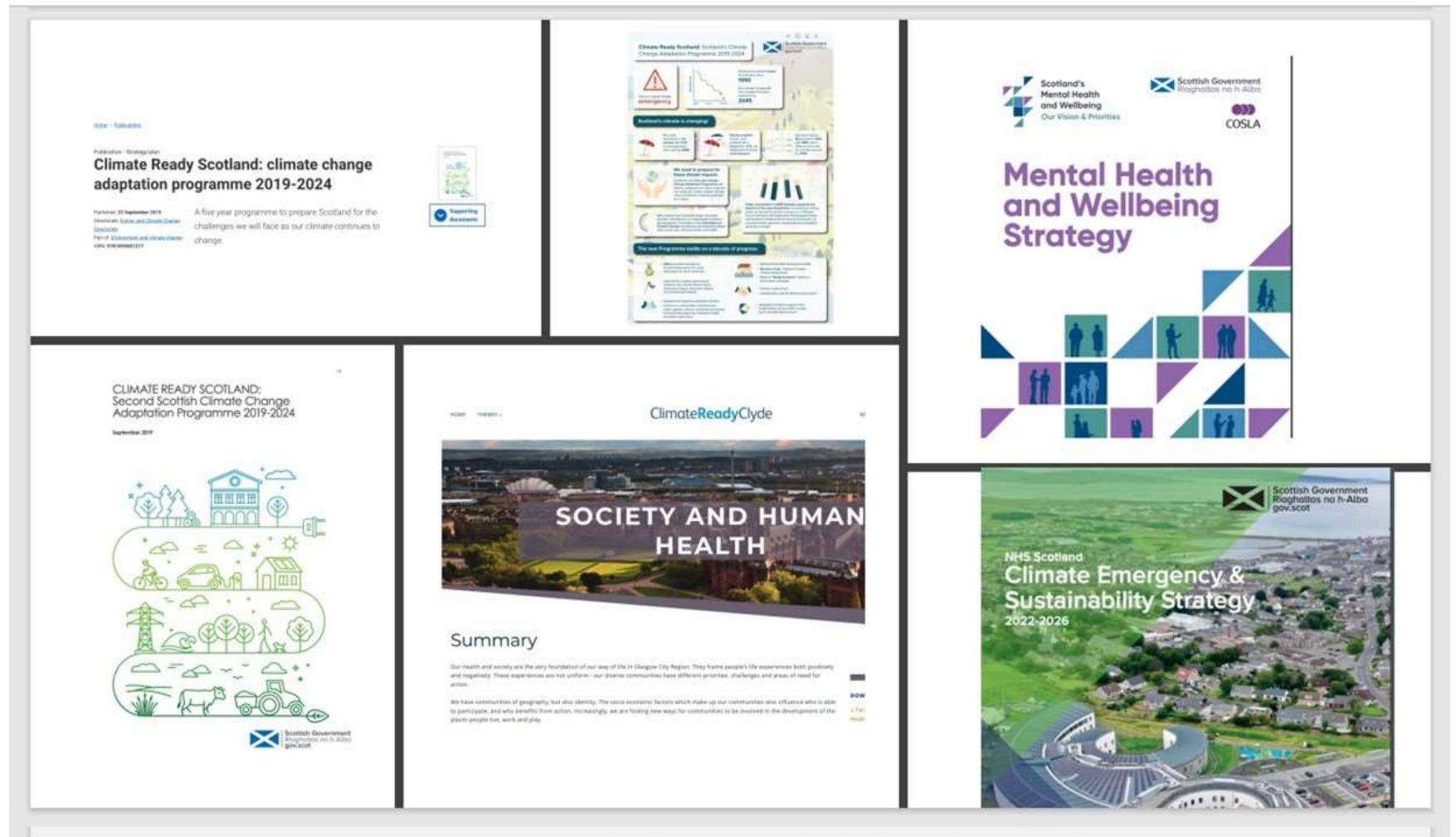
Do you believe that the risk of a drought/water scarcity event in your area will increase in the future? (farmers)



“2018 was a particularly bad year for mental health issues with concerns of the cost/availability of animal feed for the winter” NFUS Policy Manager

Thomas, B. (2021). Climate change and drought risk: the effects on water users in Scotland

What can Scotland do?



UK and Scotland need more climate change and public health research

Current CREW project with Dr Claire Niedzweidz, School of Public Health, University of Glasgow

Building Public Health Resilience to Fluvial Flooding in Scotland

Dec 2023-March 2024

ESRC-SGSSS-funded Interdisciplinary Steers PhD with Prof Hester Parr, School of Geographical & Earth Sciences, University of Glasgow
'Rain rain go away ... come back another day': **Understanding Scotland's changing relationships between climate change and mental health.**

PhD due to commence Sept 2024.

University of Glasgow **Climate Change and Mental Health Research Network**



Scottish Graduate School of Social Science
Sgoil Cheumnaichean Saidheans Sòisealta na h-Alba



Economic
and Social
Research Council



Scottish Funding Council
Promoting further and higher education

GLASGOW UNIVERSITY CLIMATE CHANGE AND MENTAL HEALTH NETWORK



Conclusions

- A need for further research of physical and mental health impacts of climate change in Scotland and implement into localised flood emergency management
- Increased cross-sectoral collaborations particularly between public health and environment experts: a need to integrate climate change and health policies
- Greater emphasis on preparedness measures and establishment of long-term community-based support networks
- Evaluations of effectiveness of different intervention strategies
- Raise public awareness of physical and mental health impacts of climate change, particularly flooding, drought & heat stress, and conduct research into behavioural contexts underpinning individual risk and barriers to behavioural change/ uptake of interventions



Thank you for listening



Thanks to:

- University of Glasgow researchers: Kirstin Watt, Eilidh Paul, Beth Thomas
- Our questionnaire and interview participants
- Funders
- Sniffer for opportunity to present

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   **@UofGlasgow**



#FRM2024

Scotland's Flood Resilience Conference 2024

Session 6: Enabling resilience in communities

Dr Juliet de Little, Environment Agency



Working in partnership to help reduce the risk from flooding through the application of robust evidence

Valuing the mental health impacts of coastal change

Dr Juliet de Little,
Senior Scientist, FCERM Research Team

Presentation structure

- Overview of EA FCERM team
- Project overview
- Stakeholders and partners
- What we plan to do
- Reflections
- Questions or comments

About the FCERM research team

We operate the [Joint Flood and Coastal Erosion Risk Management Research and Development Programme](#) with Defra, Natural Resources Wales, and Welsh Government.

We work with the academic community to translate research into policy and practical advice for flood risk professionals.

Quick stats:

- 48 active research projects, including mental health costs of coastal erosion
- 393 project pages on [GOV.UK](#)
- 78 active partnerships (universities and funders)
- £291m value of active partnerships

Project overview: valuing the mental health impacts of flooding

Influences

- Builds on previous project, '[A method for monetising the MH costs of flooding](#)' published by EA in 2020
- EA economics colleague completed MSc on this project topic in September 2023



Aim

- Develop economic guidance for *including and valuing the mental health impacts of flooding in appraisal mechanisms*

Stakeholders and project partners

The project team is engaging with partners and projects working in a similar area and will be supported by a steering group with membership to cover these activities.

Coastal Transition Accelerator Programme (CTAP) projects, specifically in East Riding of Yorkshire and North Norfolk

Resilient Coasts - Great Yarmouth and East Suffolk (part of the FCRIP projects)

Improving Climate Psychological Preparedness for Coastal Communities (RIPPLE project, UEA)

Local Government Authorities (LGA) coastal adaptation group

Mental Health Impacts of Flooding – Project Groundwater (FCRIP)

What we plan to do



Produce a literature review, since there is currently little data and literature on mental health impacts of coastal change



Identify existing methodologies or mechanisms which may be able to quantify mental health impacts of economic appraisal



Conduct primary research, the details of which will be shaped by the previous stages



Translate research into usable guidance for appraising and valuing the mental health/wellbeing impacts of coastal erosion in a range of scenarios



Contribute to enhanced case for considering the less tangible or harder to measure aspects of coastal change (and climate impacts more broadly)

Reflections

- This project matters. It is an exciting and important piece of work that has potential to make significant impact on coastal erosion communities and for climate adaptation more broadly
- This project is complex to plan for, as the methodology and data collection unfold with time and understanding. If you would like to stay in contact, please let me know
- There is lots of activity going on in this area which challenges, relates to and reinforces this work, please let me know your experiences, thoughts, or networks!

Thanks for listening. Any questions or comments?

To browse our research libraries and stay in touch, please visit our website using the QR code or at:

<https://www.gov.uk/government/organisations/flood-and-coastal-erosion-risk-management-research-and-development-programme>



For anything project-related, please contact me at:

juliet.delittle@environment.agency.gov.uk

For anything programme related, please contact the research team at:

fcerm.evidence@environment-agency.gov.uk

Delivering benefits through
evidence



#FRM2024

Scotland's Flood Resilience Conference 2024

Session 6: Enabling resilience in communities

Dr Carly Maynard, SRUC



A scenic view of a coastal town, likely Oban in Scotland, featuring colorful buildings, a church spire, and a harbor with boats. The text 'Community Action for place-based flood resilience' is overlaid in white.

Community Action for place-based flood resilience

Dr. Carly Maynard

Carly.maynard@sruc.ac.uk

Scotland's Rural College

RESAS SRUC D2-1

Why research flooding in coastal communities?

Coastal communities face multiplicity of
flooding impacts

Small and remote communities face
particular challenges

... but can also be very active and self-sufficient

Attributes needed for flood resilience

**Vulnerability of remote coastal communities
to water challenges: Perception, valuation
and coping mechanisms**

Two flooding case studies:

Isle of Luing

Tobermory, Mull

Isle of Luing



- Coastal erosion and storm damage
- Pluvial flooding
- Sea level rise
- Community Trust and Community Council – bid to replenish shoreline with slate excavated from local mine
- Multi-pronged project
- Funding: HES, HIE, local donations

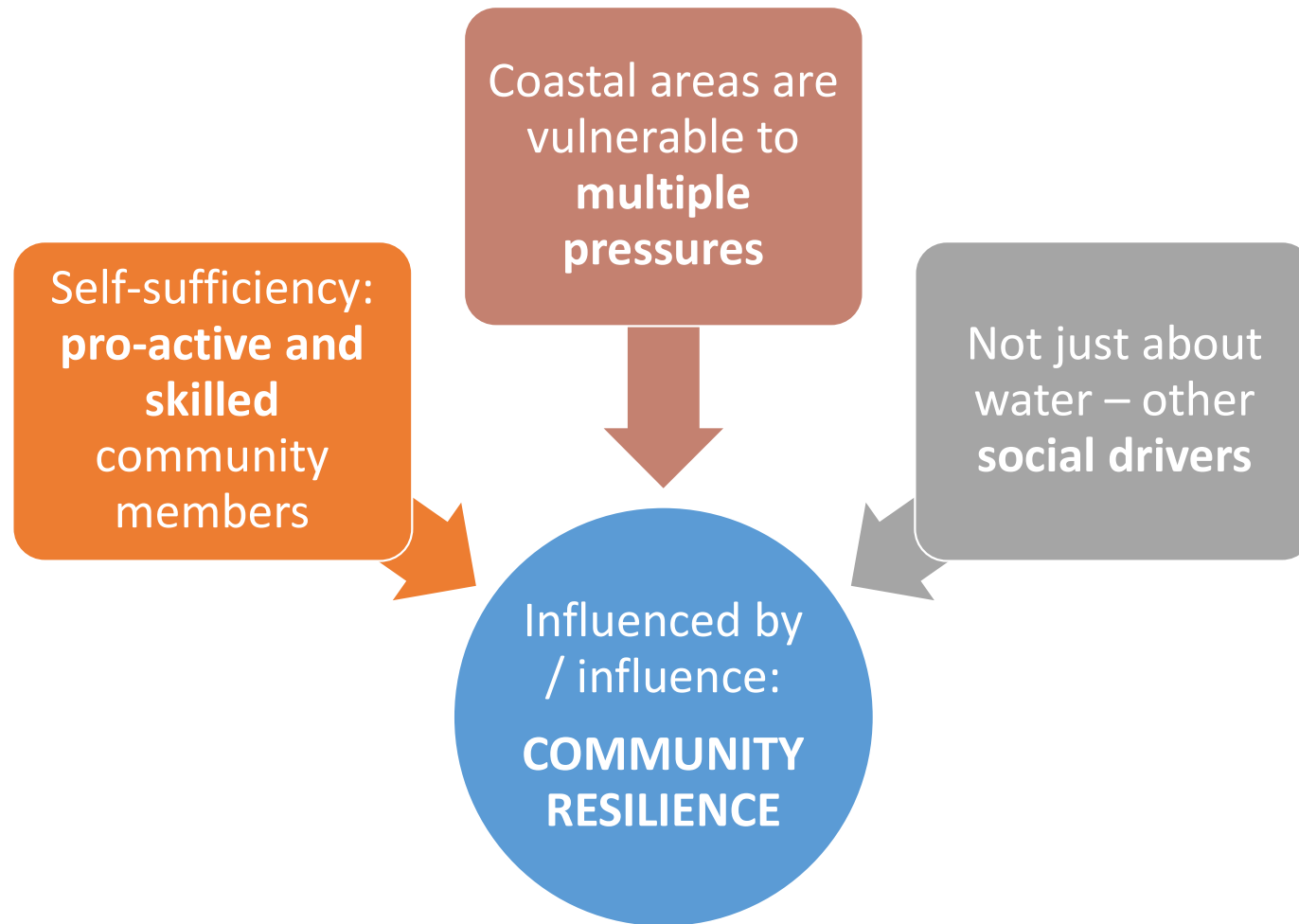
Tobermory



- Flood risk from high tides esp. Spring Tides
- Possible pluvial risk from adjacent river
- Harbour has history of flooding
- Harbour Association (community company) campaigned for low sea wall
- Council installed 500mm sea wall as part of new safety railing, with 600mm flood gates



Common Themes



Challenges



Lessons learned

Need to have the right people to advocate for the community

There is a place for different forms of knowledge

Try to make efficiencies (e.g. link projects)

Invest in the longevity of social capital

Consider communication format – learn what works

Foster good relationships

Timing is important

How can we progress?

Policy to link funding pots?

Networked funding communications

Social knowledge exchange networks
(social learning)

Place-based policy that supports small communities to **adapt** to their circumstances

Communication tools to support small communities in dealing with emergencies

Take home message


Social capital often fuels small communities



But this can be hindered by national scale policy and funding mechanisms



Sharing experiences and being prepared and adaptable can be some ways to address these issues



Joined up thinking on policy and funding also helpful

Further details and next steps

- Contact: carly.maynard@sruc.ac.uk
- Dissemination workshop: 13th March, 2pm (online)



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Scotland's Flood Resilience Conference 2024

Session 6: Enabling resilience in communities

Dr Fiona Work, Edzell Community Group

Peter Walls, Edzell Community Group



Developing a resilient community



Edzell Flood Group

**Dr Fiona Work and
Peter Walls**

December 2012: insider story

- 44 properties
- 1 million pounds of damage
- Wishop Burn
- Difference between council and community findings related to insurance and selling properties
- Longest decanted villager- 10 months
- Edzell Flood group formed January 2013
- No further property damage since the group formed



Who are we?

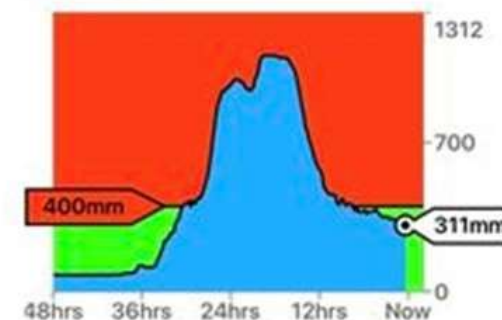


Resilience means to us

- “It is widely accepted that flooding cannot always be prevented, but flood impacts can be mitigated or reduced by adhering to resilience principles such as adequate preparation, or learning from past events”. (McClemont et al 2020 p1170)

RiverTrack Communities

Wishop Burn, Edzell



Edzell



Met Office

Weather warning



Yellow warning for Central, Tayside & Fife

Rain

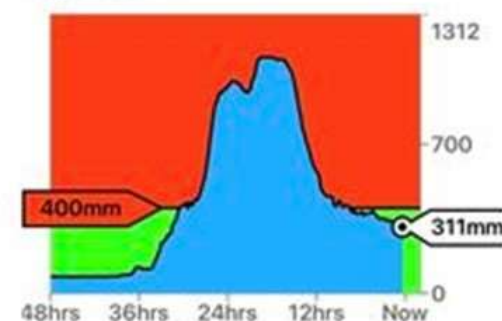
Supporting resilience

Live flooding information

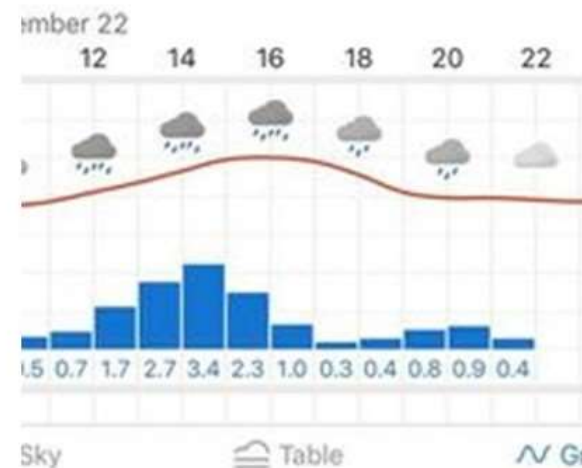


RiverTrack Communities

Wishop Burn, Edzell



Edzell



Met Office

Weather warning



Yellow warning for Central, Tayside & Fife

Rain

Clock Started

7 minutes

10 minutes

ongoing

- 22 minutes



Debrief events

- Core team immediate de-brief and full group meeting is decided
- Feedback becomes feed-forward
- Action plans reviewed
- New 'lists' of resilient actions
- Full Edzell Flood group meeting (if required)

Feedforward

- Working with farmers
- Working with Dalhousie Estate and SEPA
- Planting trees to counteract deforestation
- Naturalisation and non-engineering solutions
- Holding pond to slow movement through village
- Raising more funds through partnership applications



References

- McCLEMONT et al. 2020. Flood resilience: a systematic review. Journal of environmental planning and management. Vol 63.Issue 7. pp



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Audience Q&A

www.slido.com #Floodresilience2024



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Coming up next...

Session 7:

Community and individual flood resilience

CIWEM PFR training – booked participants only, Salisbury room



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Scotland's Flood Resilience Conference 2024

Lunch and Market Place



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Scotland's Flood Resilience Conference 2024

Session 7: Community and individual flood resilience

Chair: Iris Krammer, SEPA



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Scotland's Flood Resilience Conference 2024

Session 7: Community and individual flood resilience

Emma Ash, Consumer Scotland

Lillie Ashworth, Consumer Scotland



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Independent Consumer Research

Emma Ash – Water Policy Manager

February 2024

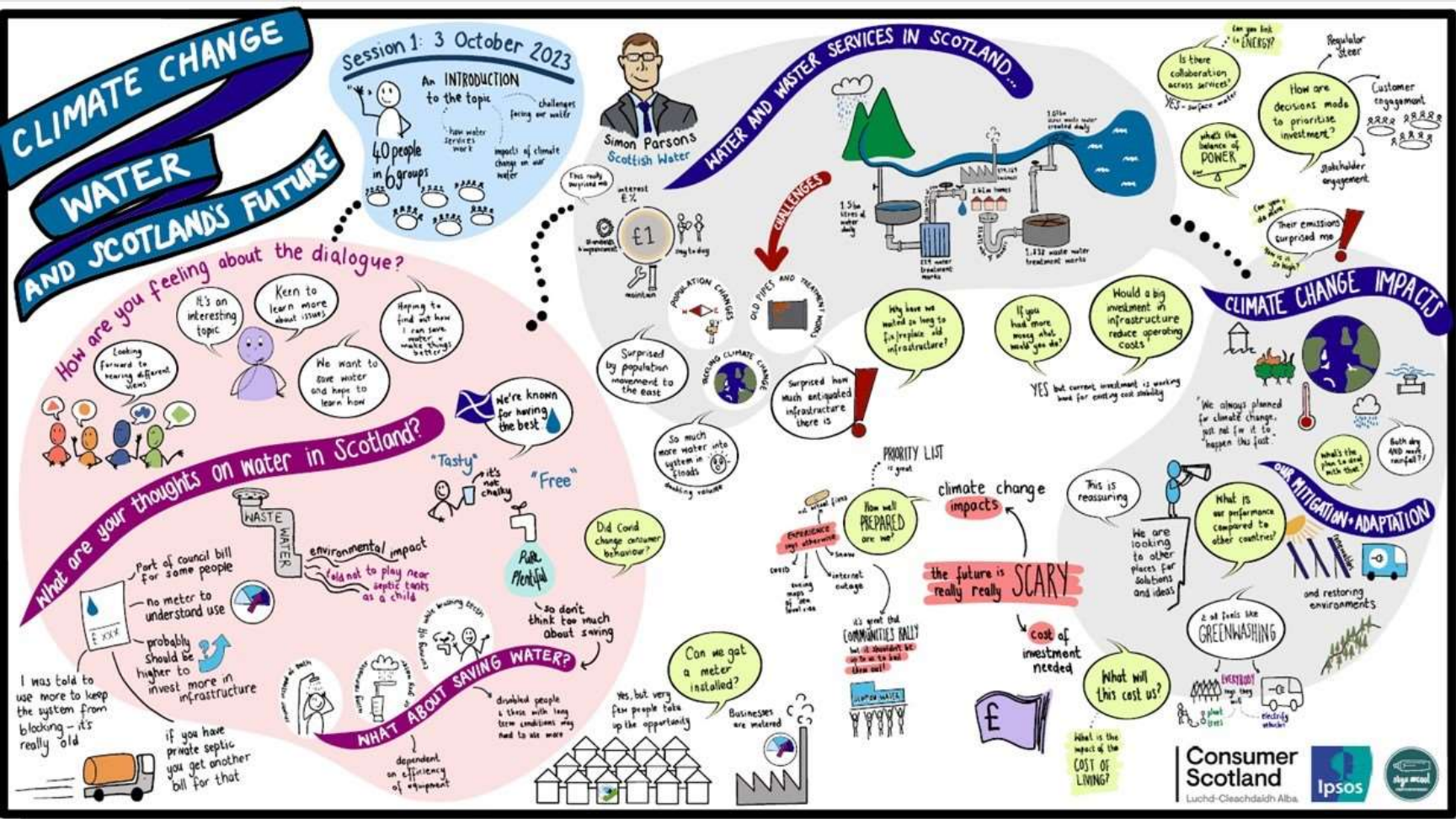
Consumer Scotland

Consumer Scotland is the statutory and independent body for consumers in Scotland

Some of our functions include:

- **Increasing the extent to which consumer matters are taken into account by public bodies**
- **Promoting the sustainable consumption of natural resources and other sustainable practices**
- **Advancing inclusion, fairness prosperity and other aspects of wellbeing in Scotland**

The Question... How should we deal with the impacts that climate change is having – and will have – on water in Scotland?



"Climate change isn't going to stop while we work it out."

Our approach to this research

- We worked with Scottish Government, Scottish Water and others to plan and deliver independent research
- We commissioned Ipsos to undertake the deliberative research and create space for a public dialogue of complex, multi faceted topics
- We held 5 online workshops over 2 months (October & November). The same participants attended throughout
- Key stakeholders fed in throughout the process, to support:
 - The development of materials
 - To provide expertise and present information to participants
- Publishing the report and our policy recommendations later in spring

Drainage and wastewater – The issues

The challenges

- Climate change is increasing the intensity of rainfall
- Putting pressure on the drainage network
- Population growth and urban creep are reducing land that can soak up rain
- Ageing assets

Without adaptation

- 60% increase in the amount of properties at risk of sewer flooding by 2050
- 20% increase in spills to the environment by 2050
- Towns and cities exposed to increasing flood risk rainfall intensities set to rise by 35% by 2100

What did participants discuss

Struck by the amount of green space paved over each year

Raingardens make the problem & the solution more visible

Some felt flooding can affect more deprived areas and those reliant on public transport

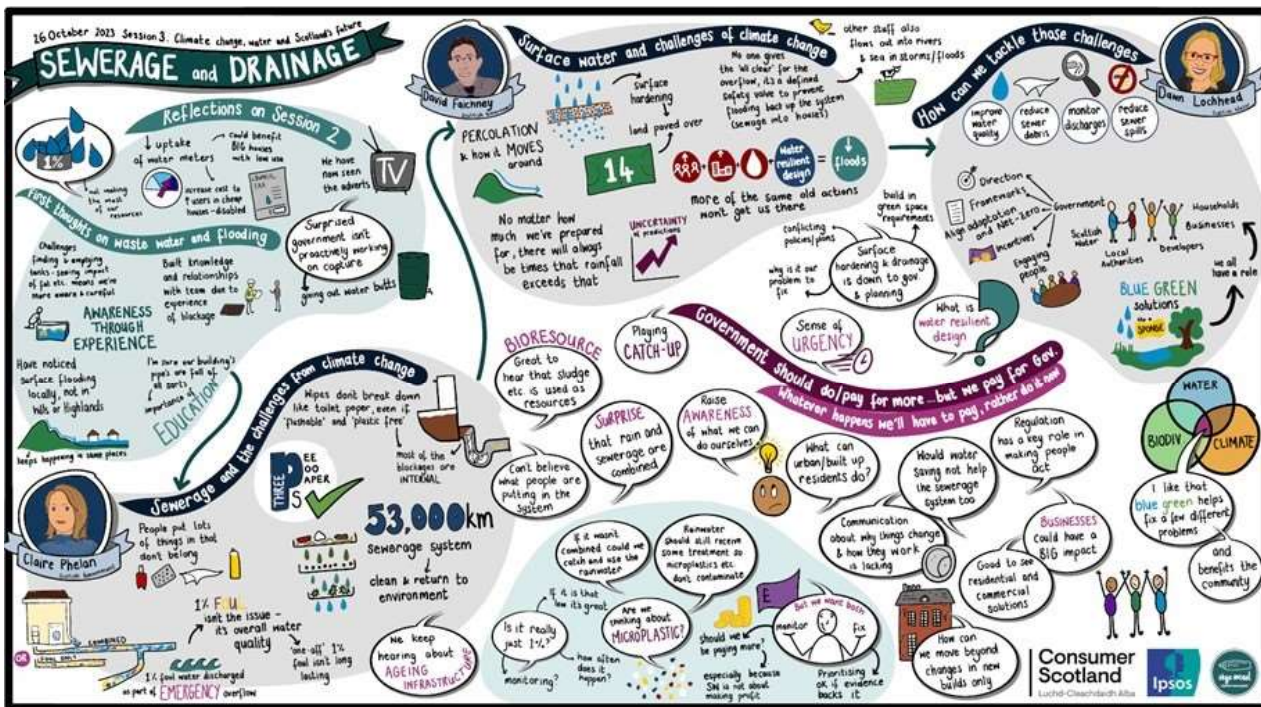
What are the costs of a new approach to drainage – Need transparency in pricing

Actively involve and work with the community - They will have some great local knowledge!

Barriers:
Lack of awareness
Lack of interest
Lack of incentives

EVERYONE has a role
But NEED leadership

Communities want to initiate BGI solutions

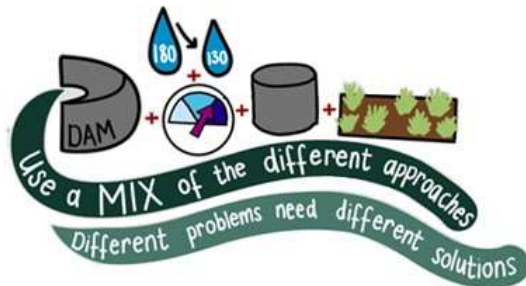


Key findings from the participants discussions

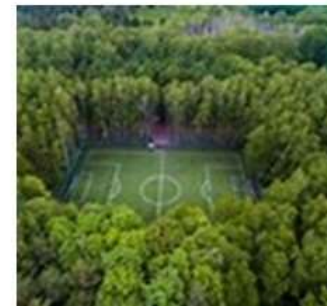
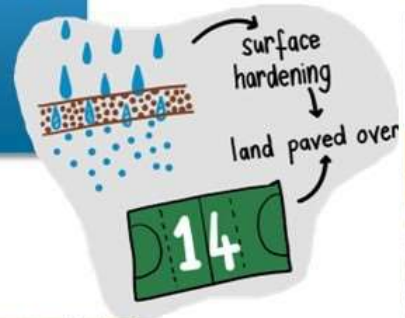
- Surface water flooding was seen as a significant issue
- Hard engineering solutions are sometimes necessary, though there are concerns about expense and disruption
- Positive about blue-green infrastructure solutions, particularly their community benefits
- Communities should be at the centre

MUST work with COMMUNITIES

MUST THINK LONG-TERM



IDEAS - How can we support and enable people to engage differently with rainwater?



Consumer Scotland

**“How can we, or your organisation,
support and enable people to engage differently with
rainwater?”**



www.slido.com
#Floodresilience2024

Thank you

Emma Ash

emma.ash@consumer.scot



#FRM2024

Scotland's Flood Resilience Conference 2024

Session 7: Community and individual flood resilience

Clare Johnstone, TCV Scotland



How TCV is supporting community and individual resilience



Clare Johnstone

Senior Project Officer - EPIC Project,
Clackmannanshire

Flood Resilience Officer - Scotland



The Conservation Volunteers



For people and green spaces: a thriving network for everyone



Flood resilience officer role

- Work in partnership to raise awareness of flood risk.
- Involve local communities to record useful information about local watercourses.
- Support communities in building resilience.

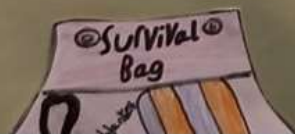
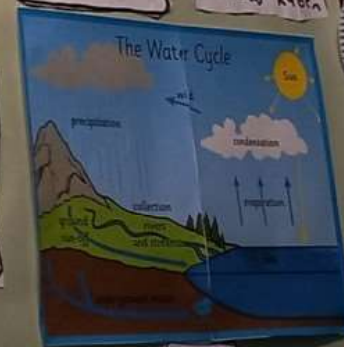
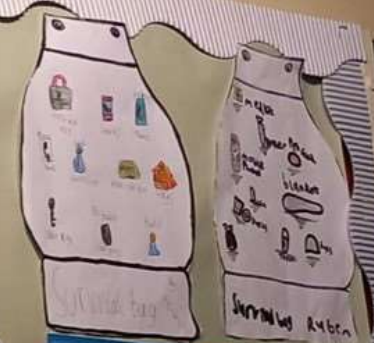




Work in partnership to
raise awareness of
flood risk.



Water Management



map.rivertrack.org/location/men:



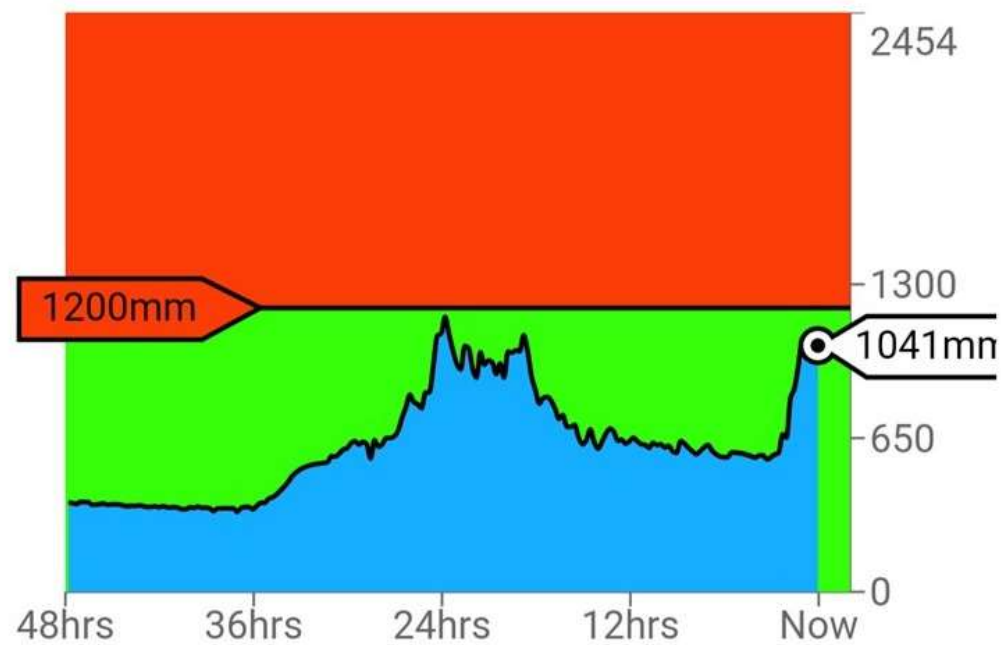
18



RiverTrack

Communities

Menstrie Burn, Menstrie





Involve local communities to record useful information about local water courses.



Involve local communities to record useful information about local water courses.





Support communities in building resilience





I Dig Trees – free trees for communities

Year	Trees for community led planting
2019	52,450
2020	37,700
2021	108,550
2022	158,500
2023	95,050 YTD
Total	452,250





Free Community Network membership

Access to specialist *conservation* group public liability and accident insurance.

Funding support.

Discount on conservation handbooks.

Support and guidance of range of topics.

Free listing of contact details on TCV website.



National charity, local reach: FK10

Found 65 activities

Activity key

 Big Green Weekend	 Green Gym	 Practical conservation activity
 I Dig Trees: Tree Planting	 Health walk	 Children's activity
 Training or workshop	 Food growing activity	 Community event or activity
 Wildlife surveying activity		



Any questions?

Contact details:

Clare Johnstone

TCV Flood Resilience Officer – Scotland

Clare.Johnstone@tcv.org.uk

TCV Website: <https://www.tcv.org.uk>





#FRM2024

Scotland's Flood Resilience Conference 2024

Session 7: Community and individual flood resilience

Cath Brew, Red Plait Interpretation



Reimagining Resilience

with
'Scottish Flood Forum in a Box'

Cath Brew
Red Plait Interpretation

www.redplaitinterpretation.com



“Things you can do to prepare for flooding”





Places pressures on local authorities

Impacts residents harder personally
– not prepared for flooding emotionally

Greater property damage

50% renters – no flood insurance

Underinsured

The Challenge

Can we shift their behaviour to seek help BEFORE a flood?

What is Heritage Interpretation?



What is Heritage Interpretation?



Vindolanda Museum, Hadrian's Wall



Rescue Dogs are the Best

There is a common misconception that rescue dogs are problem dogs. In fact, most dogs come to us because their owner's circumstances change and they can no longer look after their beloved pet.

All our dogs need new homes. Did you know that rescue dogs are the best dogs to own? They come micro-chipped, vaccinated, neutered and with one month's insurance.

If you are looking for the perfect addition to your family, speak to our Kennels Team today.

STEP 1
Does your lifestyle suit owning a dog?

STEP 2
Complete an application form

STEP 3
Talk to the Kennels Team


STEP 4
Let us help you find your match

STEP 5
Pay the adoption fee


STEP 6
Head home with your new companion

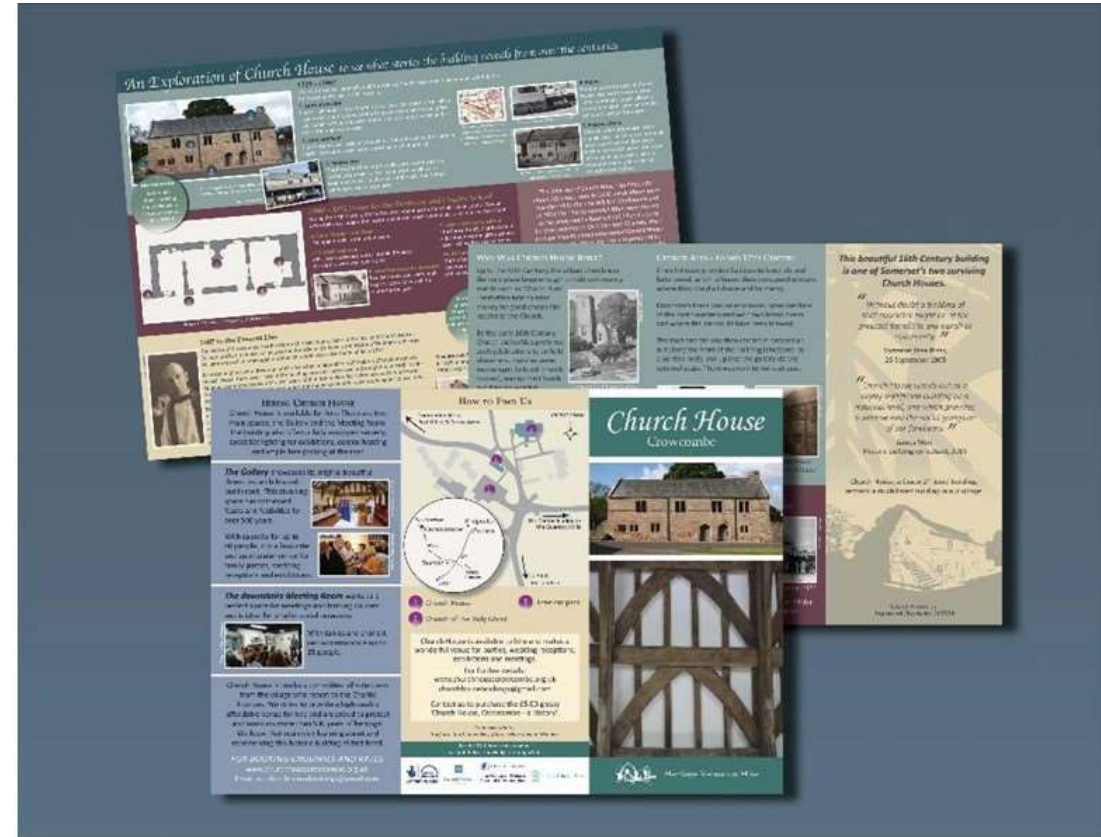
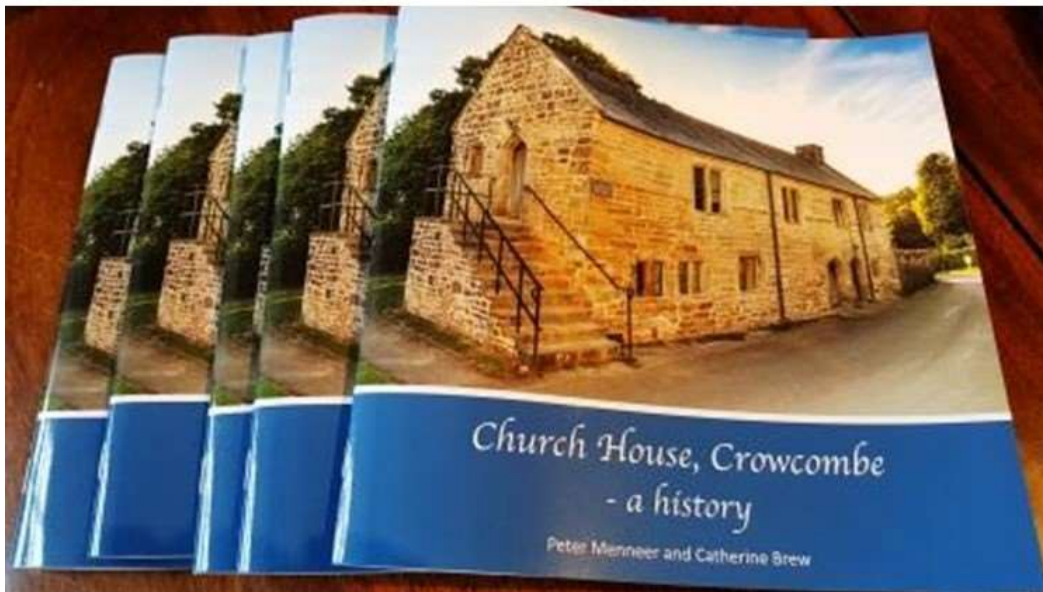


A WORKING LIFE
STILL DESERVES
A GOOD LIFE



Goats





Church House, Crowcombe



RNLI interpretation



PLANNING a WAY FORWARD

WHAT? Context and challenges

WHO? The audiences

HOW? Methods of communicate and delivery

WHAT?

- The public contact SFF after talking to local authority
- Only 18 of Scotland's 32 local authorities (56.25%) identify SFF as a core source of support and flooding advice

WHO?

CORE AUDIENCE:

Adults at risk of flooding



Single Parent

- Child the main priority
- A few friends near by
- More risk averse
- Relies on public transport
- No disposable income
- Higher education
- Works part time
- Limited time – likes to learn through social media



Elderly Couple

- English not 1st language
- Financially comfortable
- Physical health restrictions
- Own vehicle
- Family live elsewhere
- Didn't grow up in Scotland
- Retired professionals
- Prefer to learn new information together



4th generation family

- Lots of friends and relatives nearby
- Know Scotland well
- Agile and easily mobile
- 'Seen it all before'
- Double income min. wage
- College educated
- Enjoys outdoor activities for whole family

1:4 adults in Scotland have low literacy skills.



HOW?

Interpretation Aims and Objectives

1. What are the most important stories?
2. What are the public most interested in?
3. What does the Scottish Flood Forum need and want to communicate?

The amalgamation of these three components provides the messages to be communicated. Ideally, these three elements combine to create a holistic message.

- Emotional - what we want people to feel

Interpretive Objectives

EMOTIONAL OBJECTIVES

Audiences will:

1. Feel safer in their homes with a sense of readiness for all eventualities
2. Feel more comfortable going away on holidays and leaving their homes
3. Feel empowered to make informed choices when purchasing home insurance
4. Be grateful for having access to a range of free information which helps them to protect their families, properties and businesses
5. Appreciate the Scottish Forum and the quality of support it provides
6. Feel positively connected to the landscape and value the story of water in Scottish culture
7. Deem their communities to be cohesive, working together with a strong sense of resilience and autonomy



HOW?

Interpretation Aims and Objectives

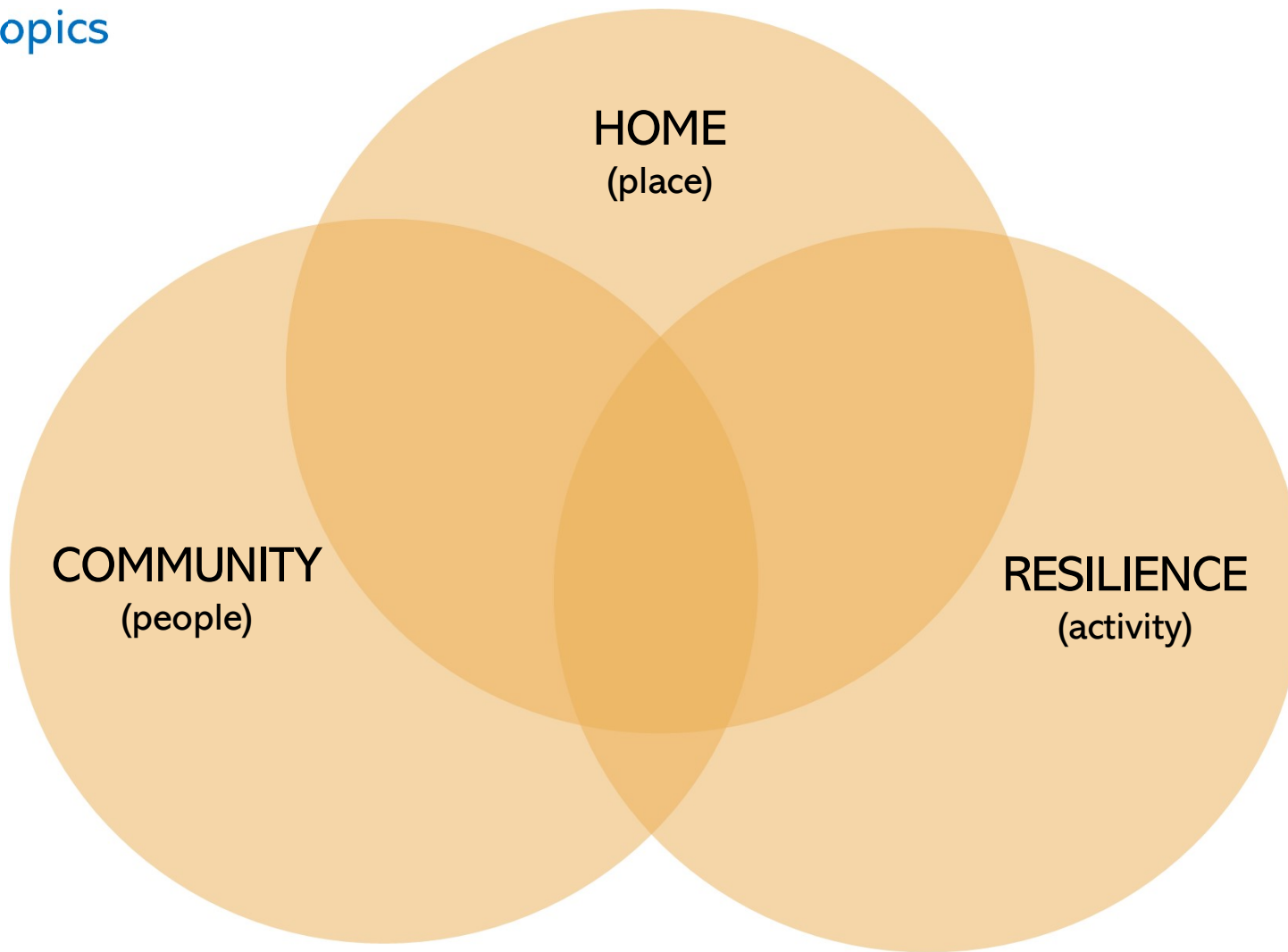
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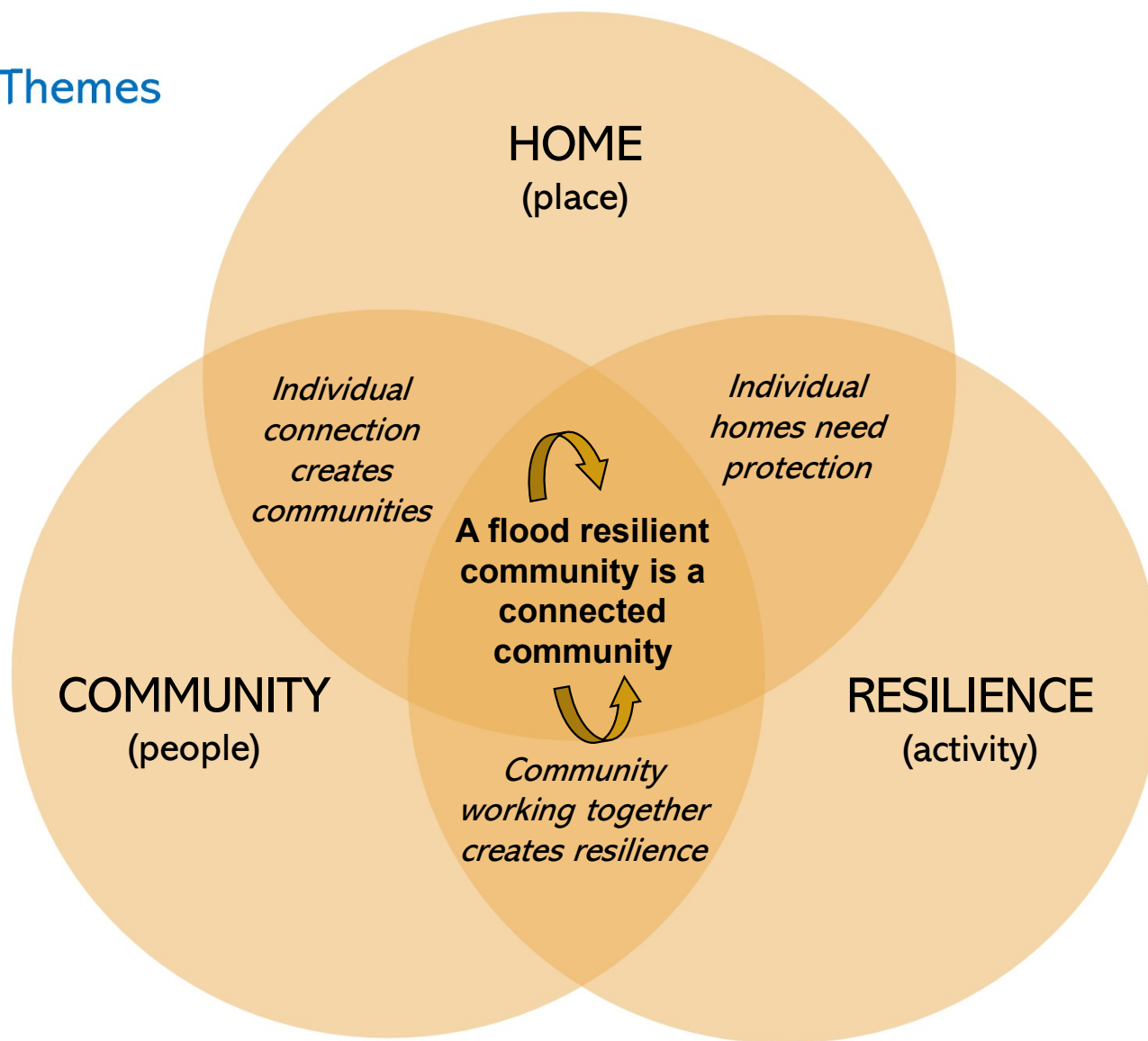
- Emotional - what we want people to feel
- Learning - what we want them to know; facts
- Behavioural - what we want them to do; actions
- Organisational - what we want for SFF



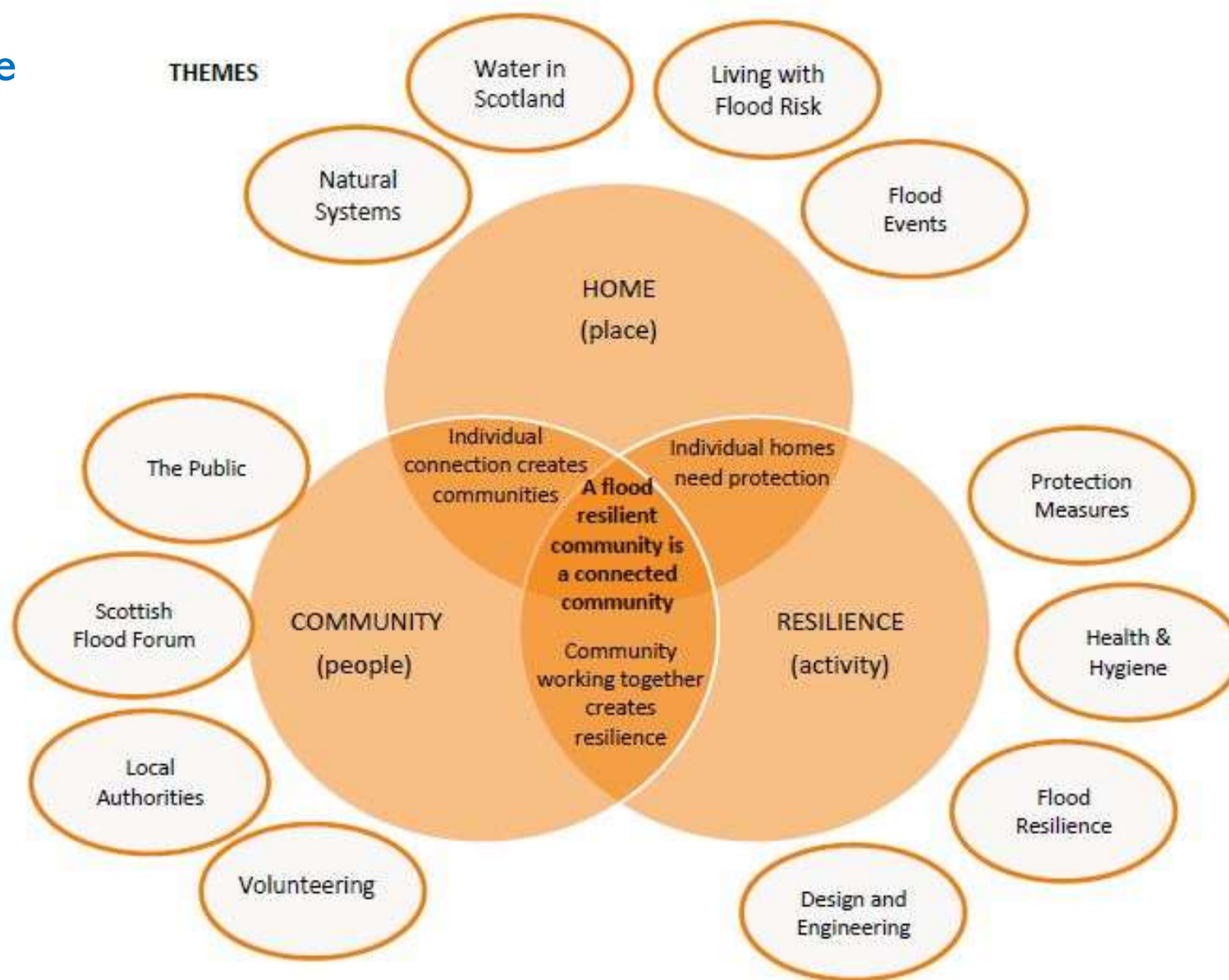
Interpretive Topics



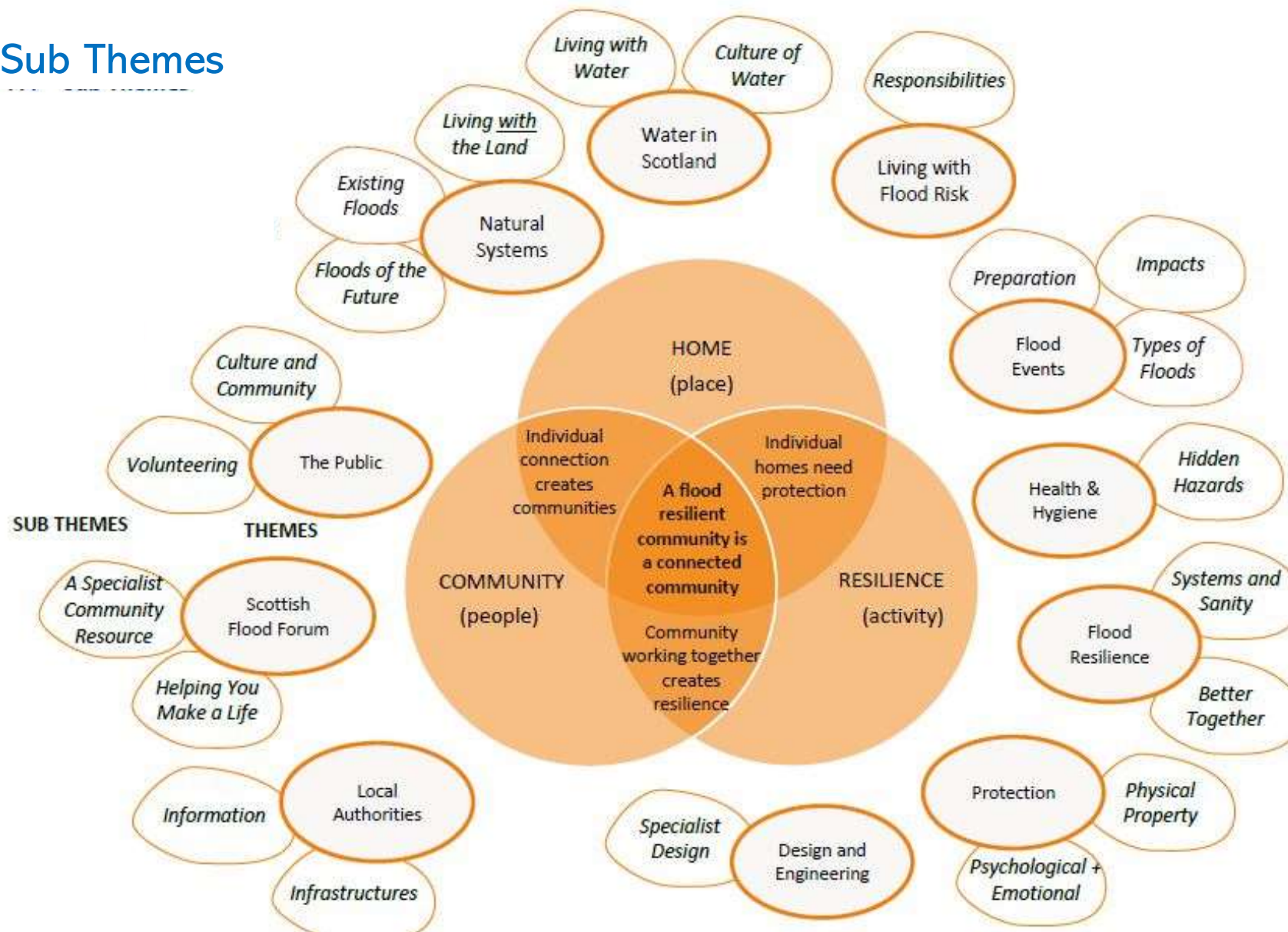
Interpretive Themes



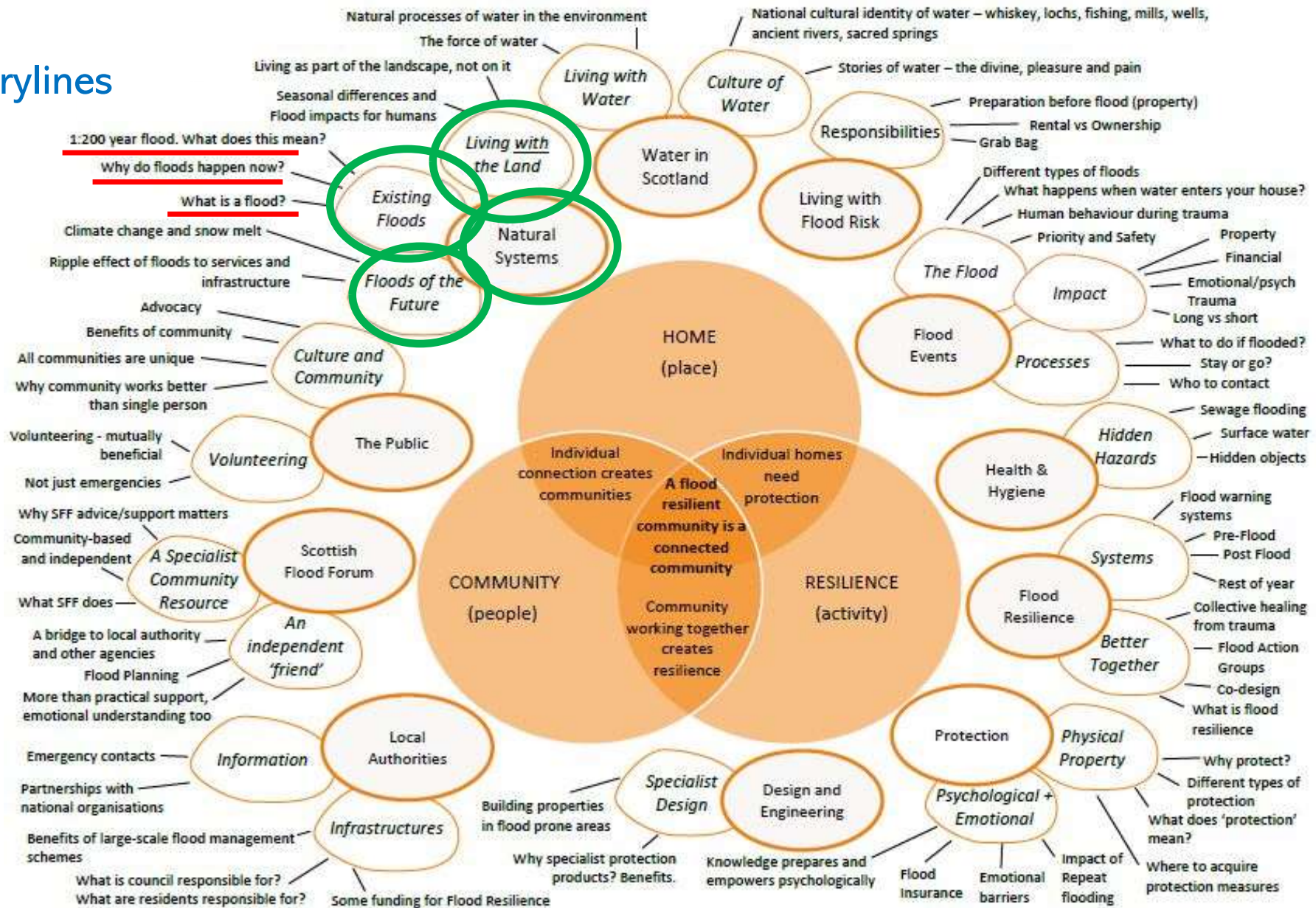
Interpretive Themes



Sub Themes



Storylines



QUESTION:

How do we best communicate all the desired messaging, objectives, themes and storylines with the targeted audience?





Benefits of 'in a box'

- Mobile – easily transportable
- Accessible and removes barriers
- Easily adaptable
- Range of ages
- Range of learning styles and language abilities
- Staff satisfaction and autonomy

“I love the box with its endless possibilities”

“It adapted wonderfully to all age groups”

“Interaction with the public was good and the added interest was noticeable”

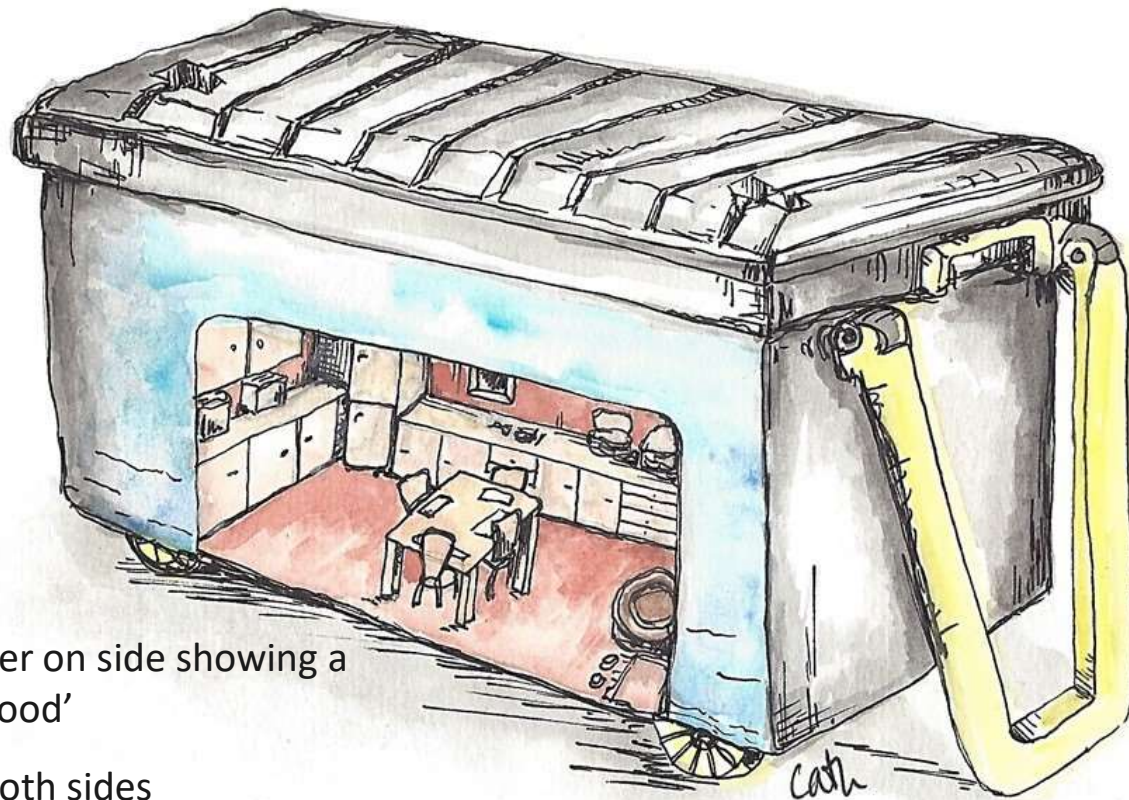


THE BOX



- 'Really Useful' Box
- 160 litres
- 105 cm x 50 cm x 51cm
- Weight 7.5 kg
- Easily mobile with wheels and handle
- Internal dividers

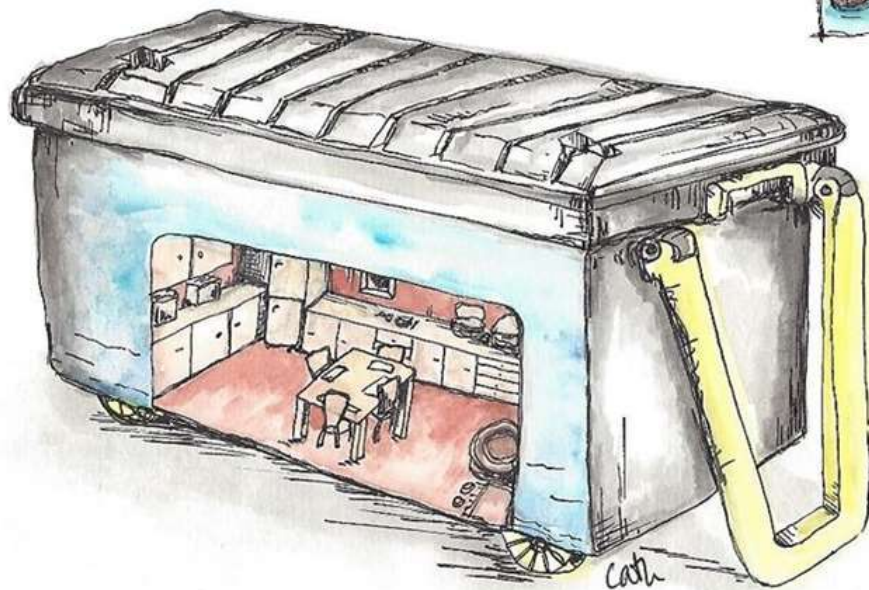


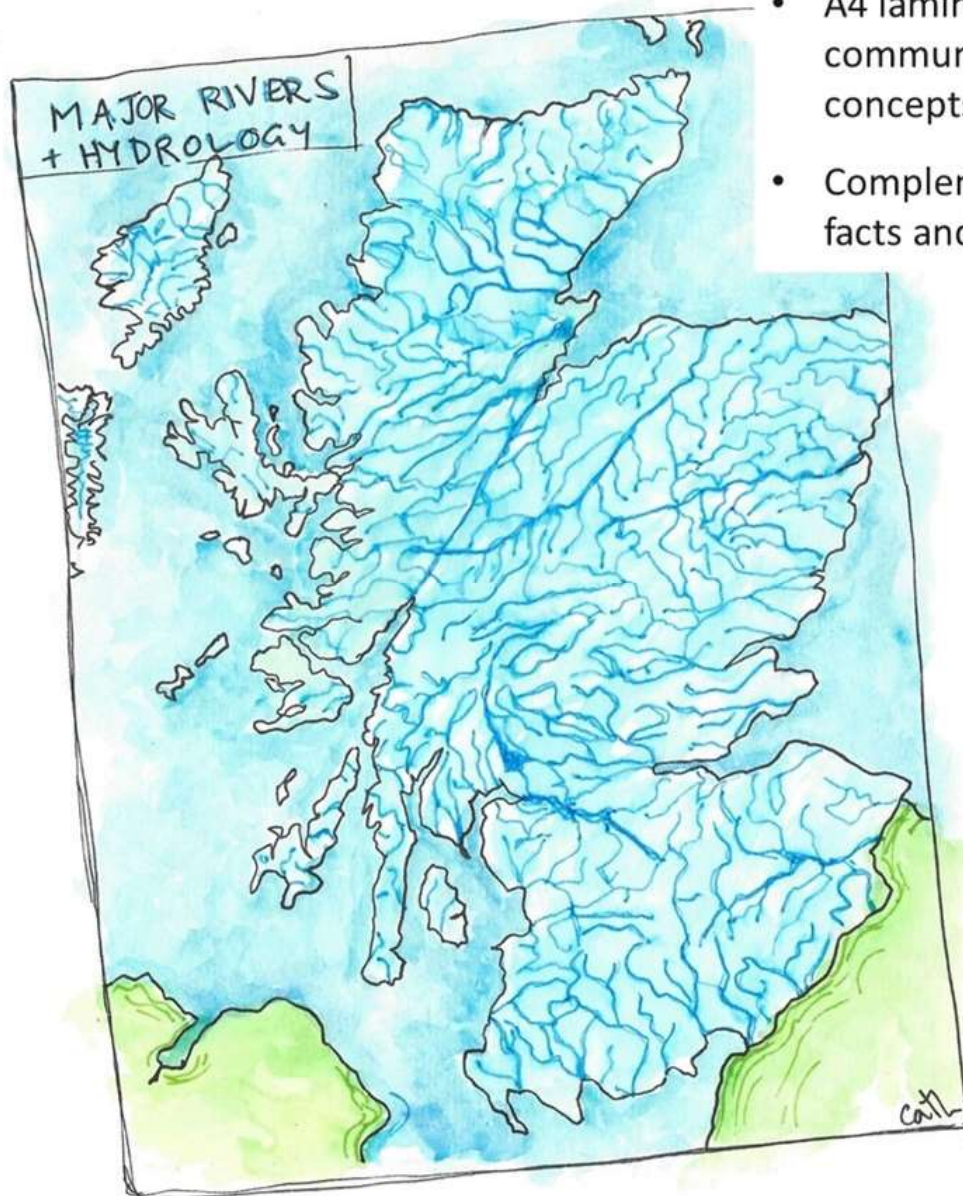


- Graphic sticker on side showing a home and 'flood'
- Graphic on both sides



- Interpretation themes (stickers) on top of the box
- Designed to fill the central ridges
- Imagery – photographs or illustration





- A4 laminated images to communicate a range of concepts
- Complemented with notes, facts and figures.



- A4 laminated images showing 'real life' examples
- Includes notes, facts and figures for explainer



- Sensory activities for all learning styles
- Can be used in isolation or with the box



- What do you need in your 'grab bag'?
- Small objects in the feely bag to choose from
- Incorrect and correct objects to initiate a conversation

STAY OR GO?

Risk assessment activity to help the public determine the conditions to leave their home or stay.

① EMOTIONS

- NERVOUS - never flooded
- CONFIDENT
- NERVOUS - flooded
- PTSD from previous
- Relaxed - ignorant

② FLOOD TYPE

- BLOCKED DRAIN
- RIVER RISING
- STREET FLOODED
- WHOLE AREA
-

③ PHYSICAL

- Insured
- Flood gate
- vent covers
- renter, not owner
- own sandbags

④ CONTEXT

- Disabled
- Home alone with kids
- No car
- A place to stay
- Elderly family lives there
- Child with 'special needs'
- Part of local resilience group.



① EMOTIONS

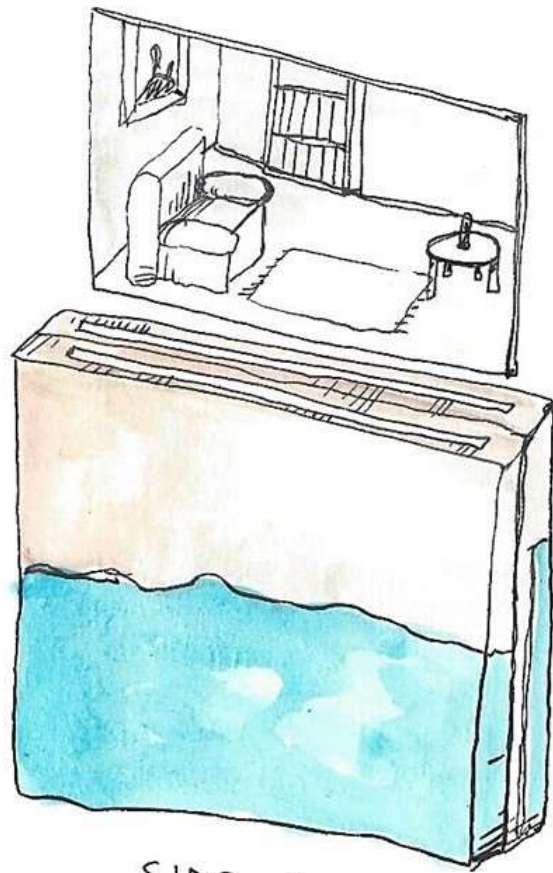
② FLOOD TYPE



③ PHYSICAL

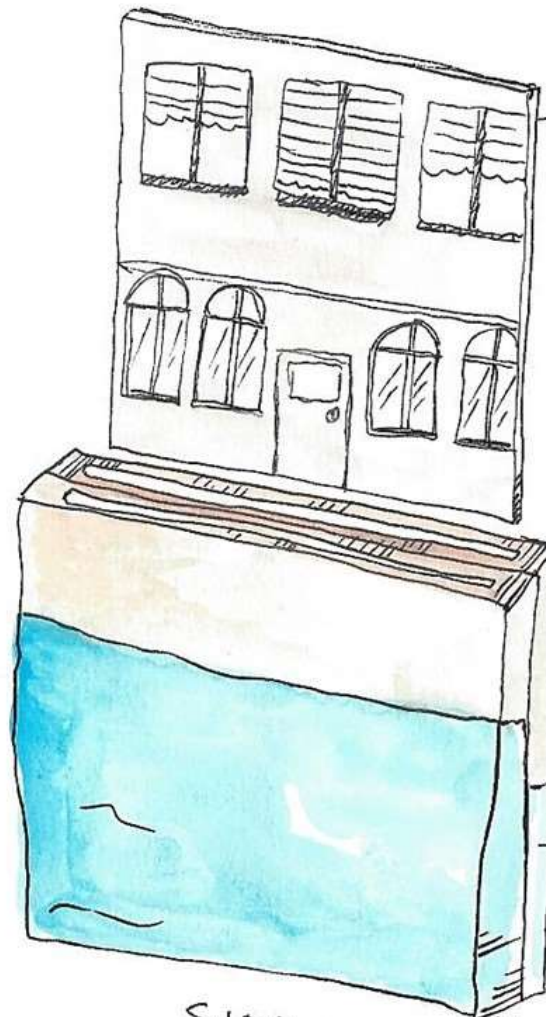


④ CONTEXT



SIDE 1

"REGULAR"



SIDE 2
"1:200"

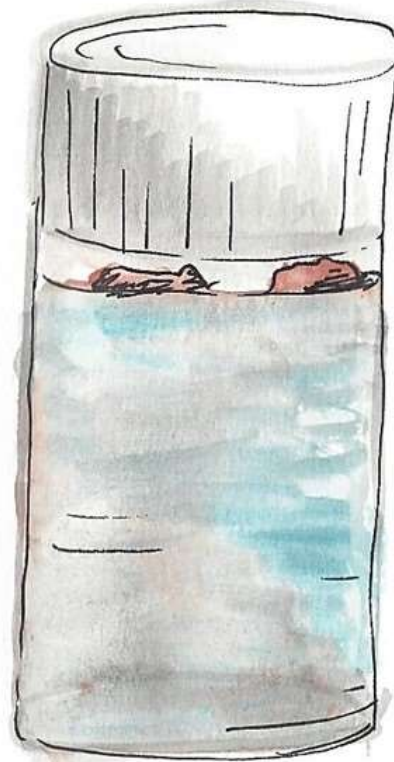
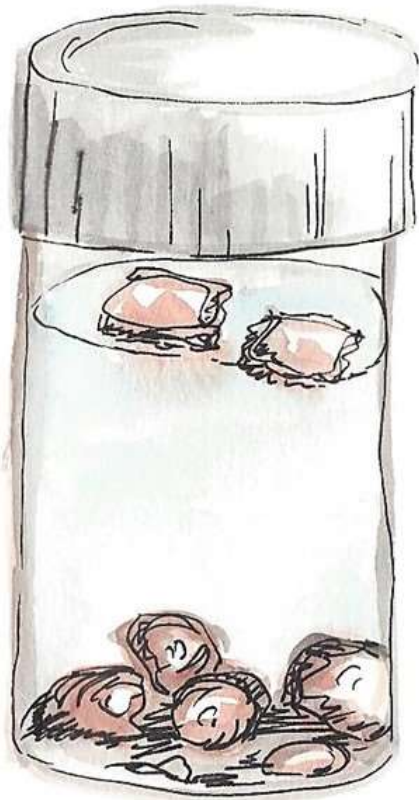
catz.

scenes of home
various to be included

Perspex or similar

enclosed water
showing flood
level.

- Bespoke object designed to explore flood levels in a house
- Clear material (Perspex or recycled plastic?)
- Used in conjunction with a tape measure to use on body.



- An activity to talk about the danger of hidden objects in flood waters.
- Stones and floating objects in jar with sandy/dirt.
- Shake up to show how quickly they disappear



SENSORY UNDERSTANDINGS

Sounds:

- silence – an empty flooded street
- water rushing
- Emergency workers calling out
- the dehumidifier going 24/7

Smells:

- 'dungeon mildew'
- 'slimy sewer'
- 'musty'
- 'acrid rubbish'
- 'blocked urinal'

QUESTIONS?

www.redplaitinterpretation.com



slido

 #FRM2024



Audience Q&A

www.slido.com #Floodresilience2024



#FRM2023

Coming up next...

Keynote speech: Nature-based solutions for a
climate-nature crisis





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Scotland's Flood Resilience Conference 2024

Refreshments and Market Place





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Scotland's Flood Resilience Conference 2024

Keynote speech: Nature-based solutions for a
climate-nature crisis





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Clive Mitchell, NatureScot





#FRM2024

Scotland's Flood Resilience Conference 2024

Keynote speech: Nature-based solutions for a
climate-nature crisis

Dr Heather Reid, NatureScot Board Member



**Scotland Flood Resilience
Conference, Friday 9 Feb 2024
Dr Heather Reid**



By Leaves We Live ...

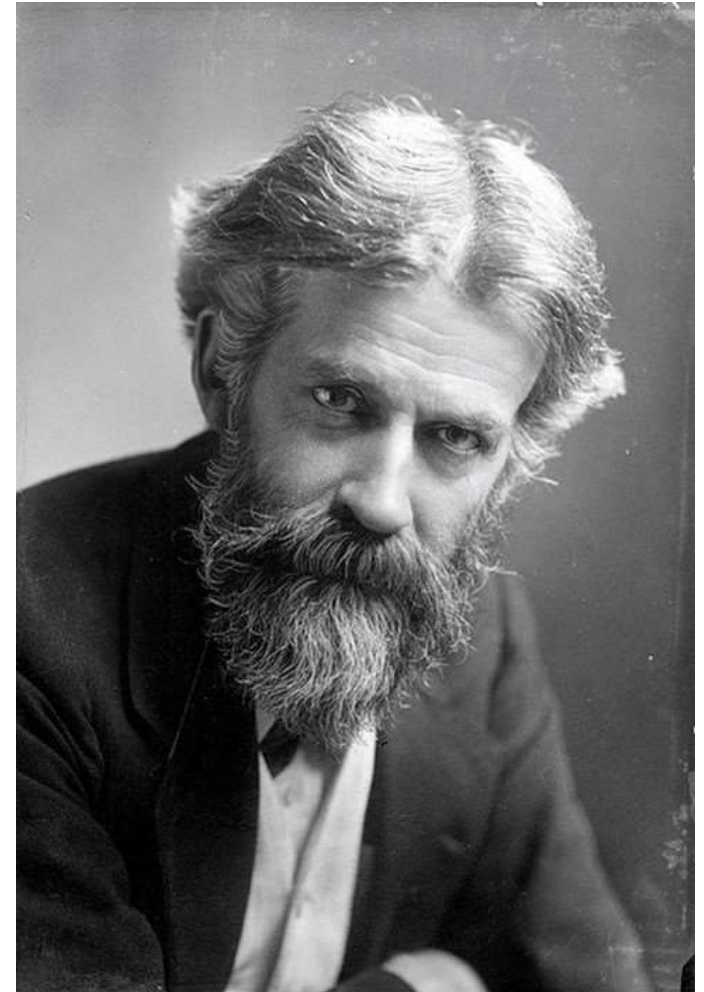
This is a green world, with animals comparatively few ... and all dependent on the leaves.

By leaves we live.

... not by the jingling of our coins,
but by the fullness of our
harvests.

Sir Patrick Geddes, 1919

(Scots polymath - botanist, environmentalist, educator,
peace campaigner & town planner)

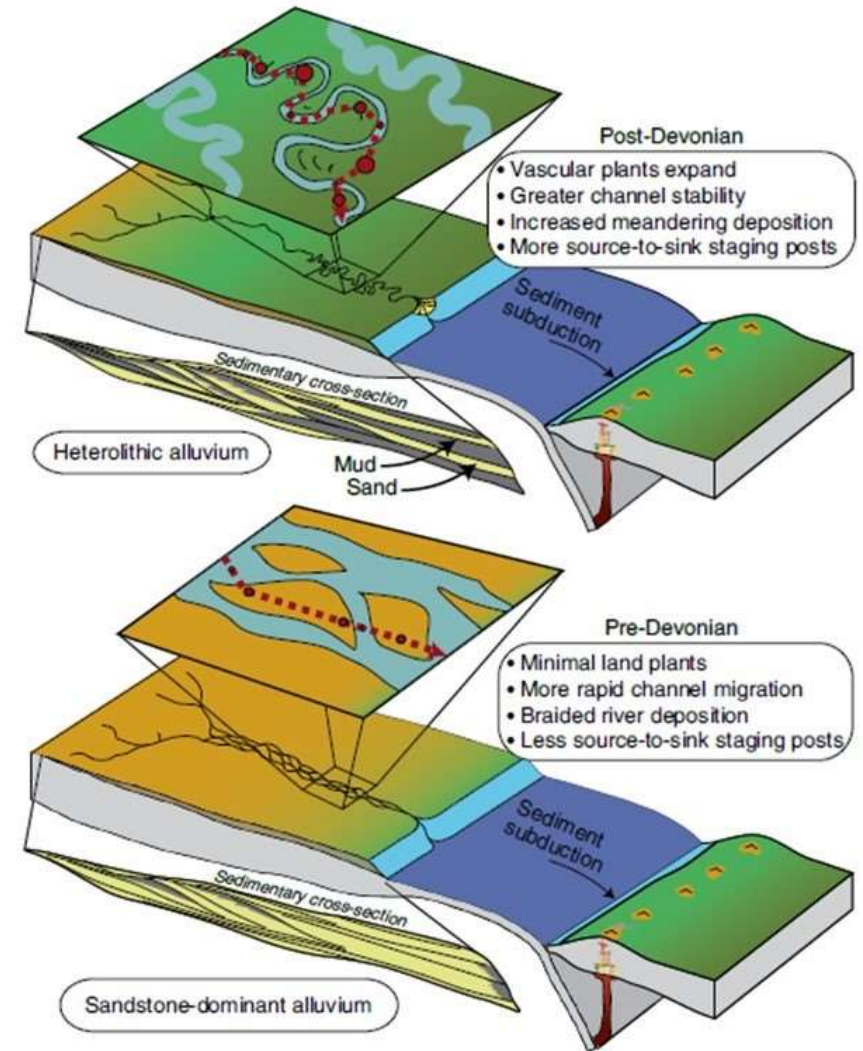


Leaves, soils, water and the modern C cycle

Meandering rivers in marshes and muds

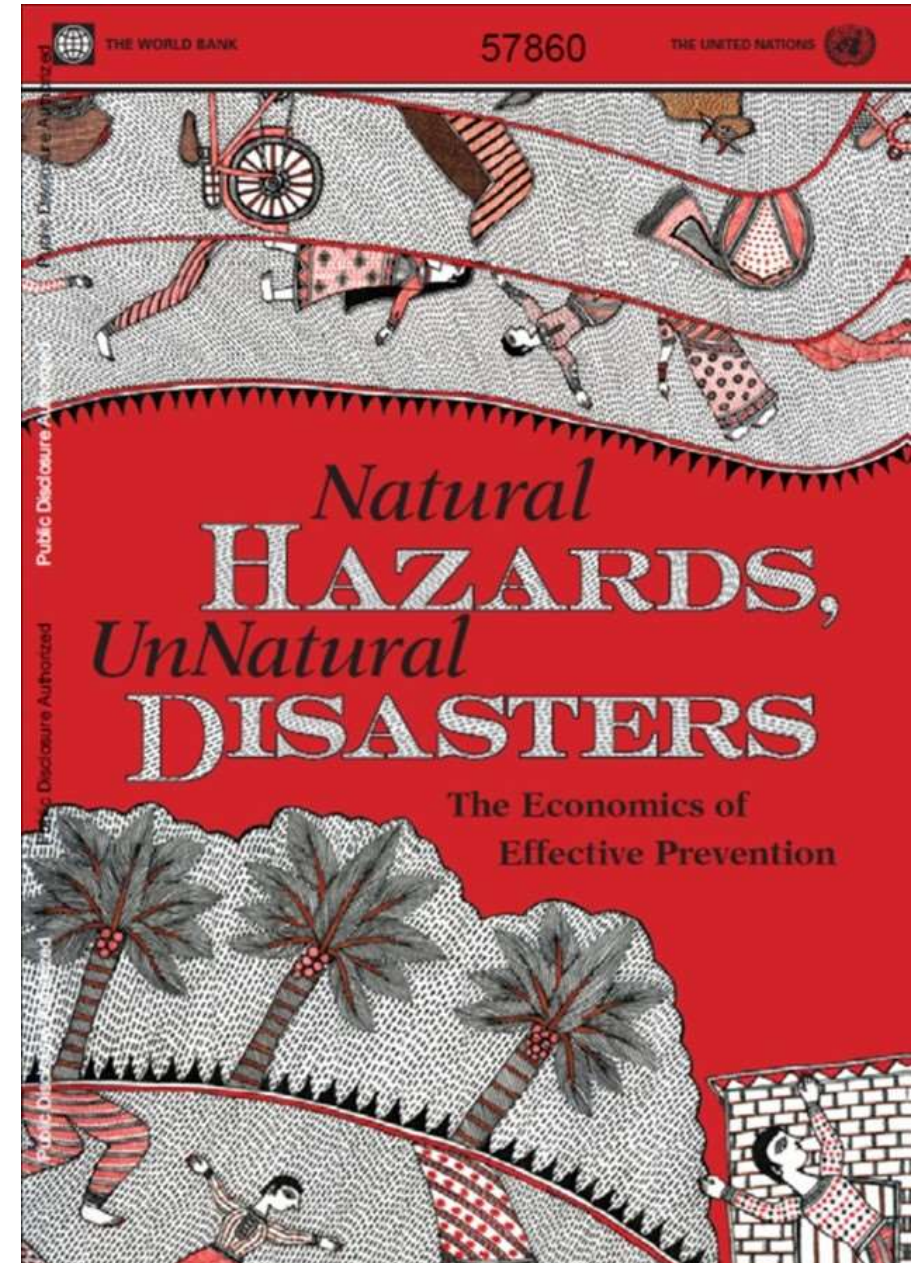
380 m.y.

Braided rivers in sands and gravels



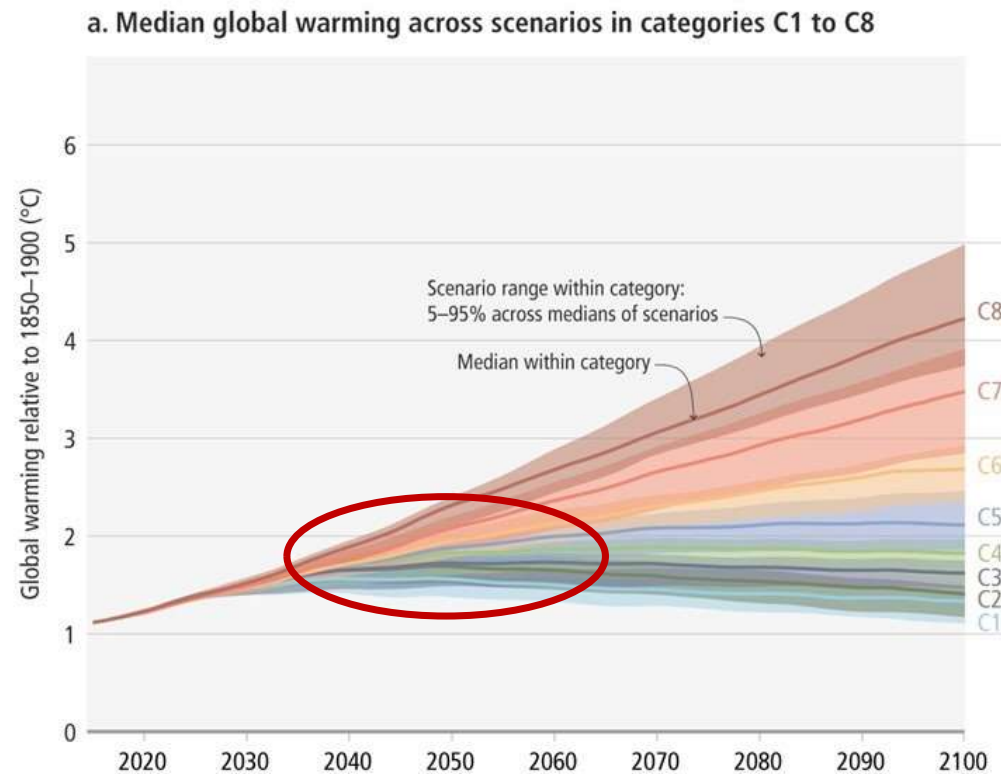
Climate risks: Natural hazards, UnNatural Disasters (2010)

Acts of God
But not evenly distributed
Something else is going on...



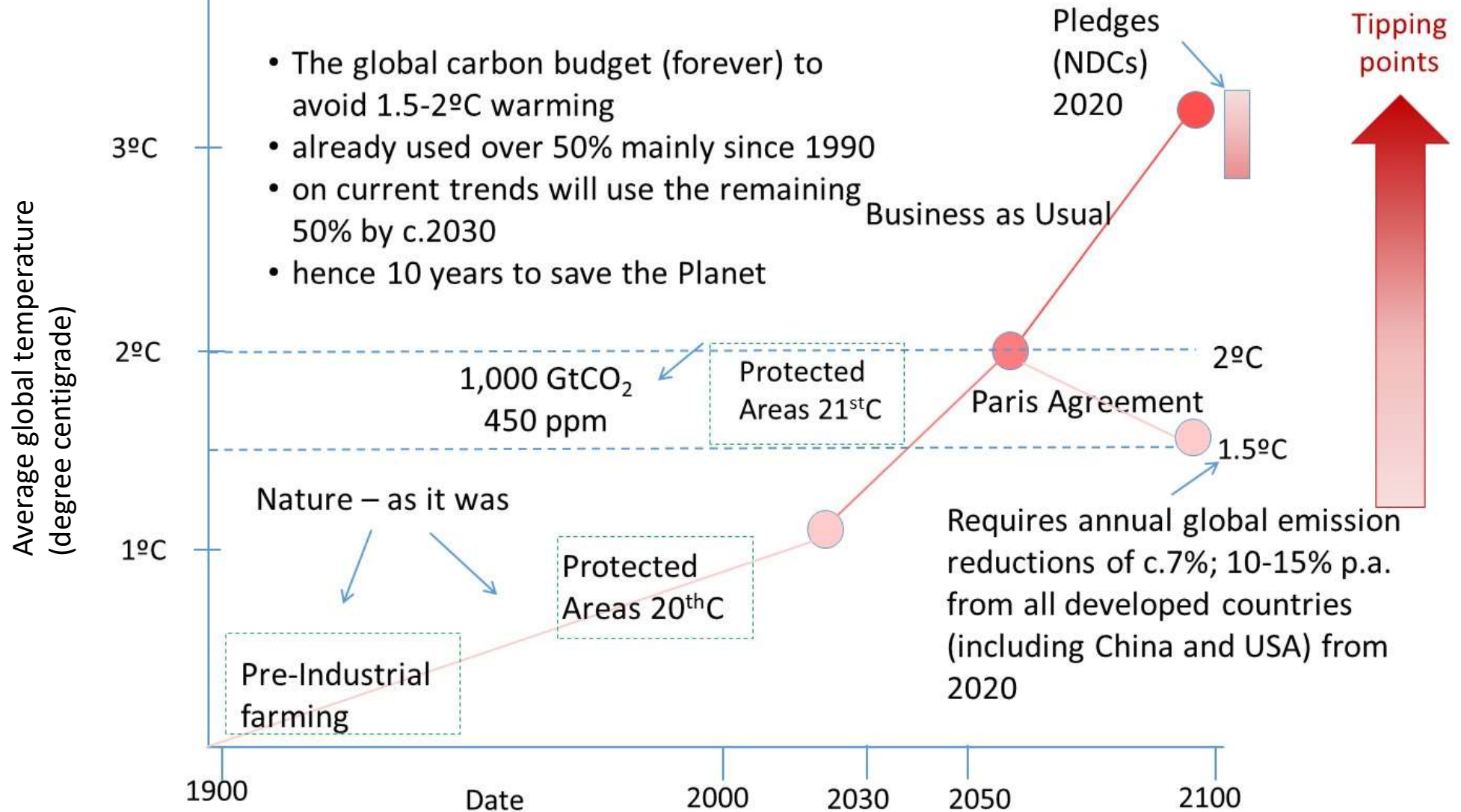
Intergovernmental Panel on Climate Change IPCC global warming pathways for the 21st Century

The range of assessed scenarios results in a range of 21st century projected global warming.

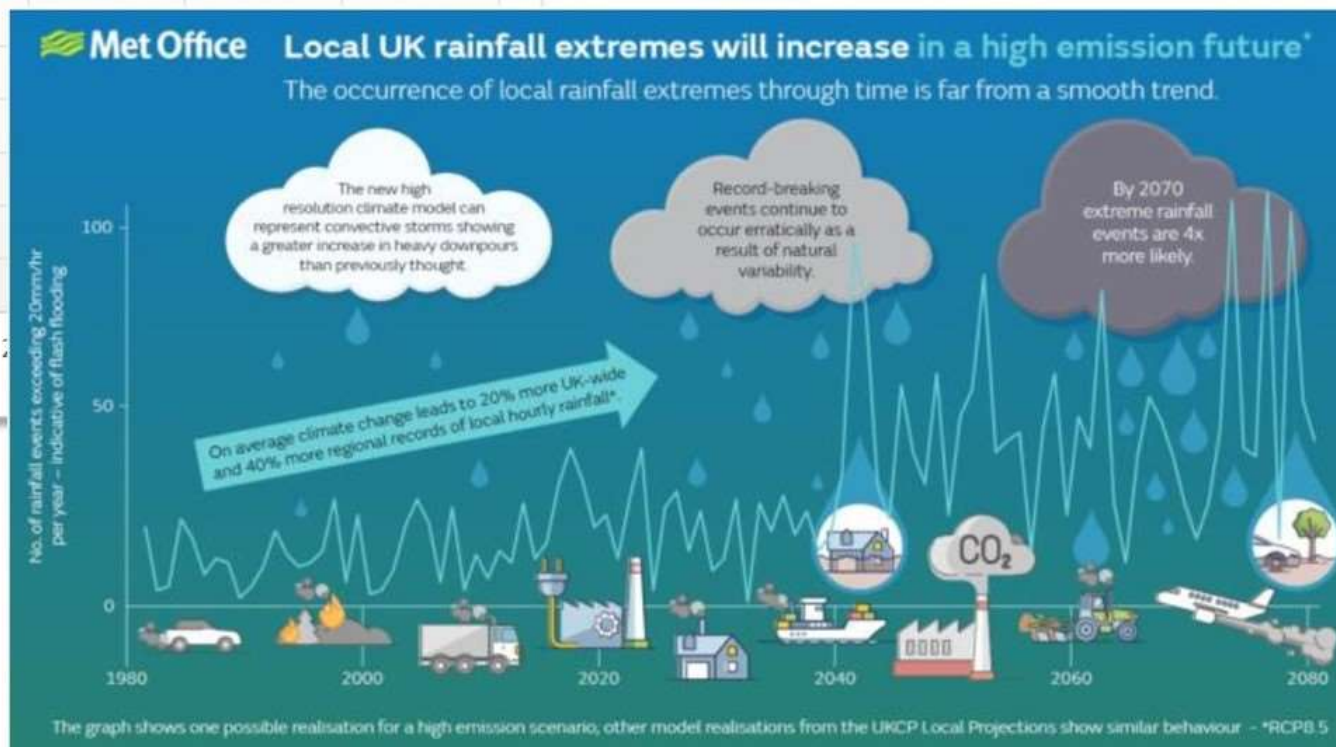
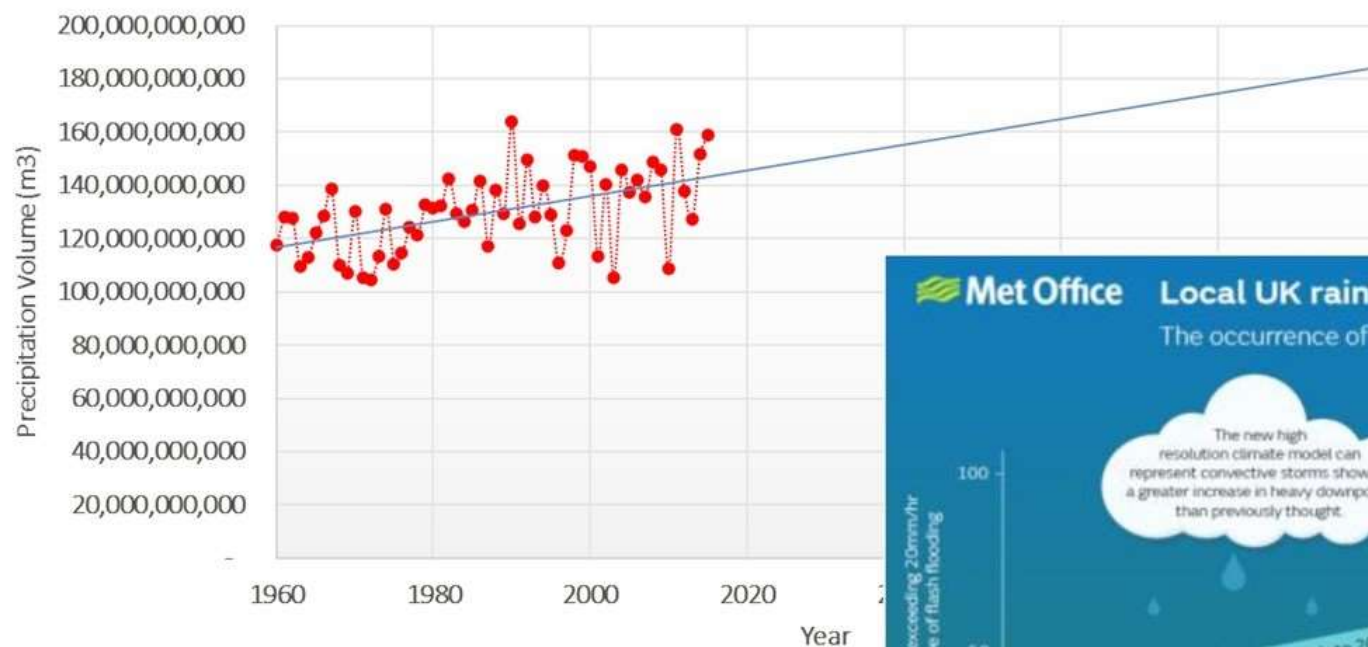


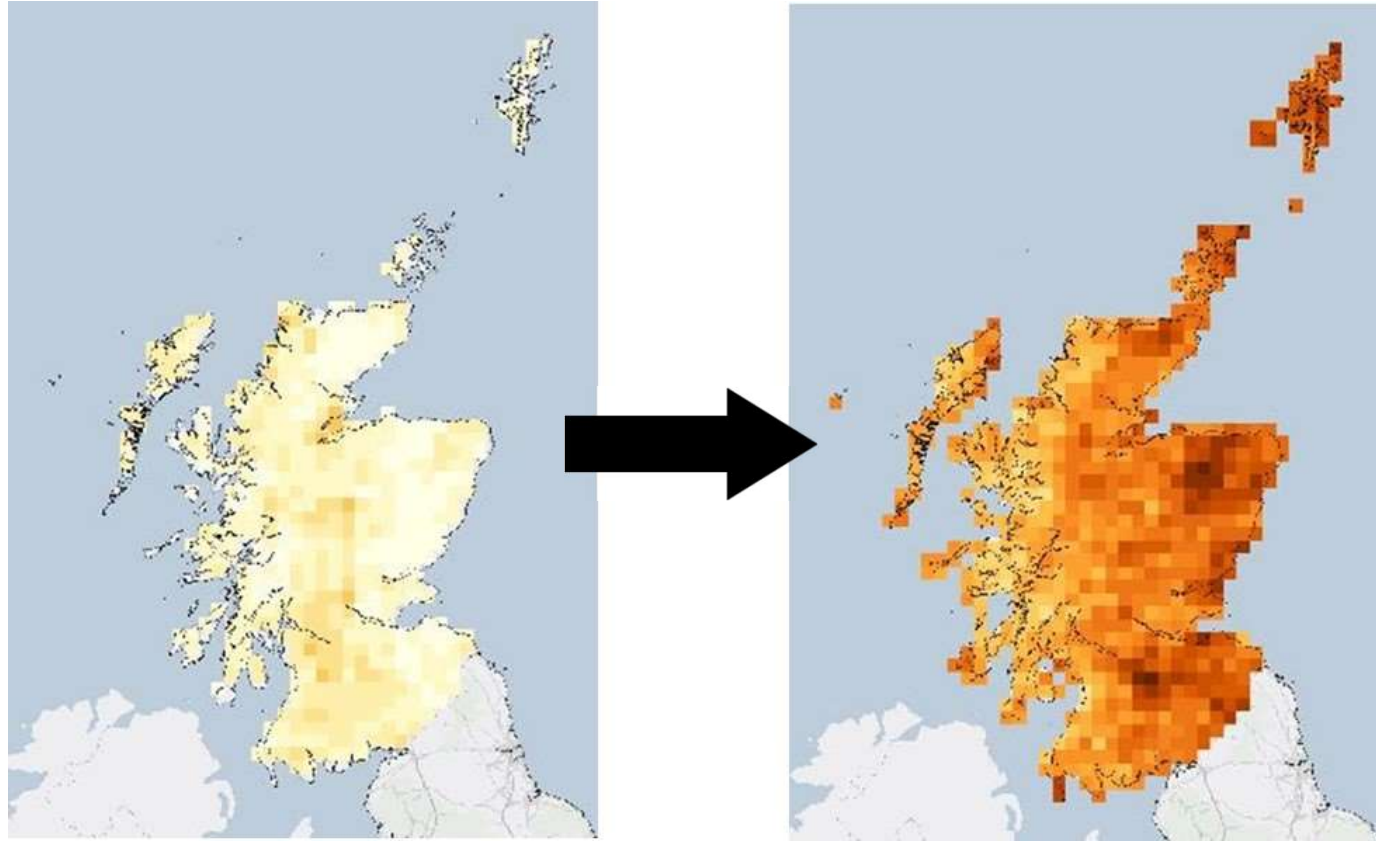
Current promises,
if all delivered,
including support
for developing
countries

The Climate and Nature Emergency

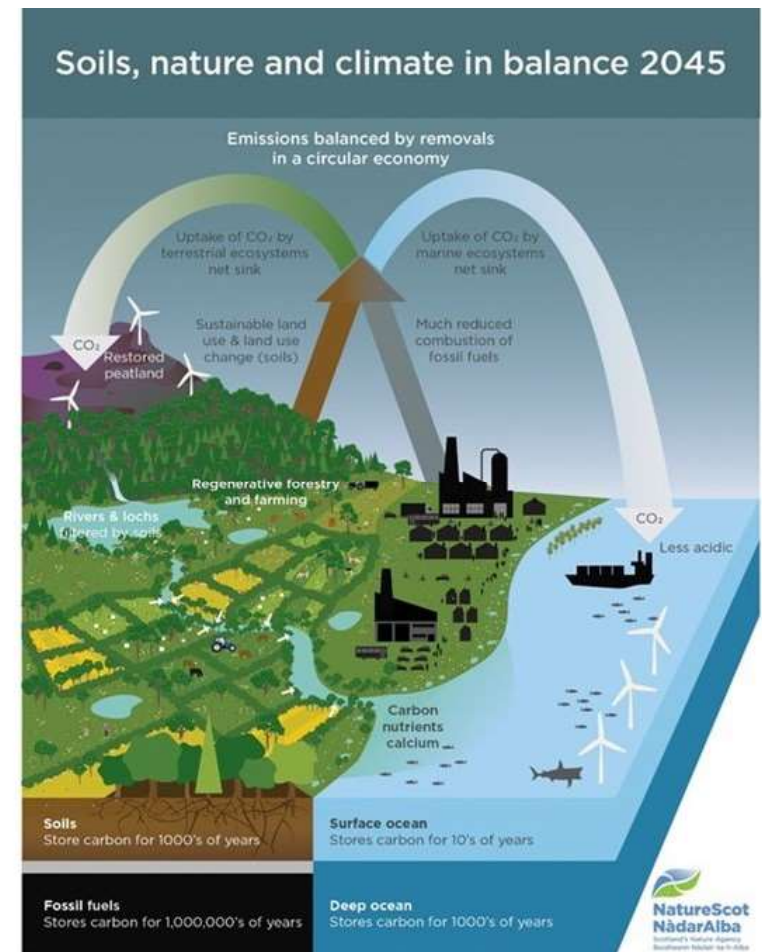
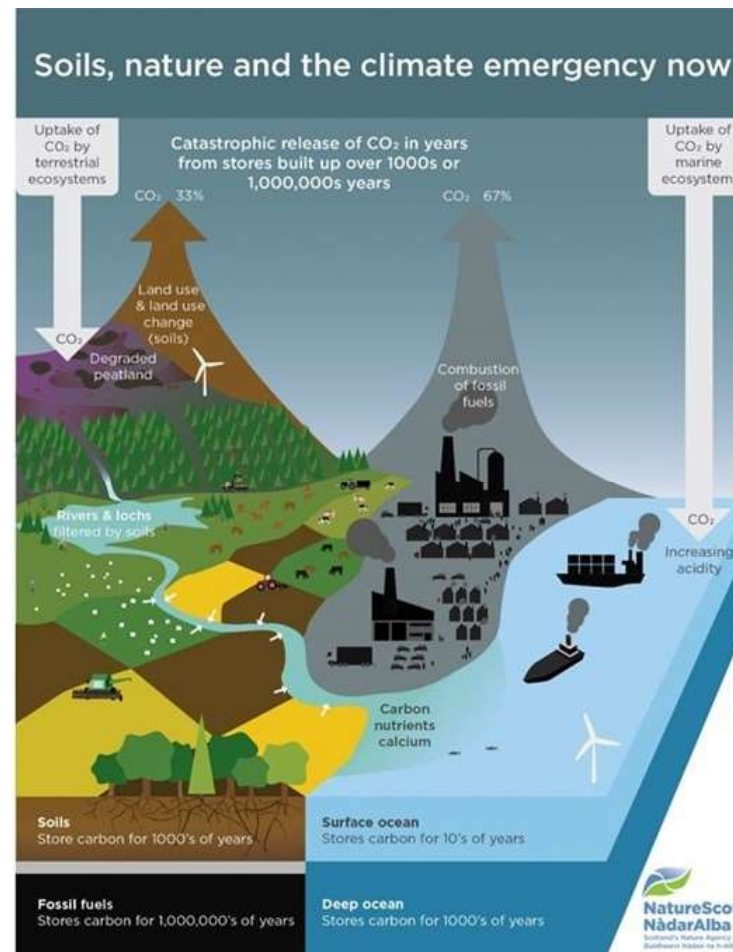
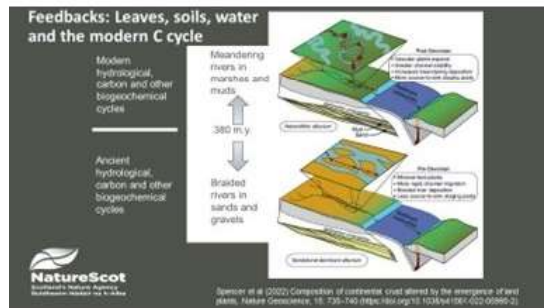


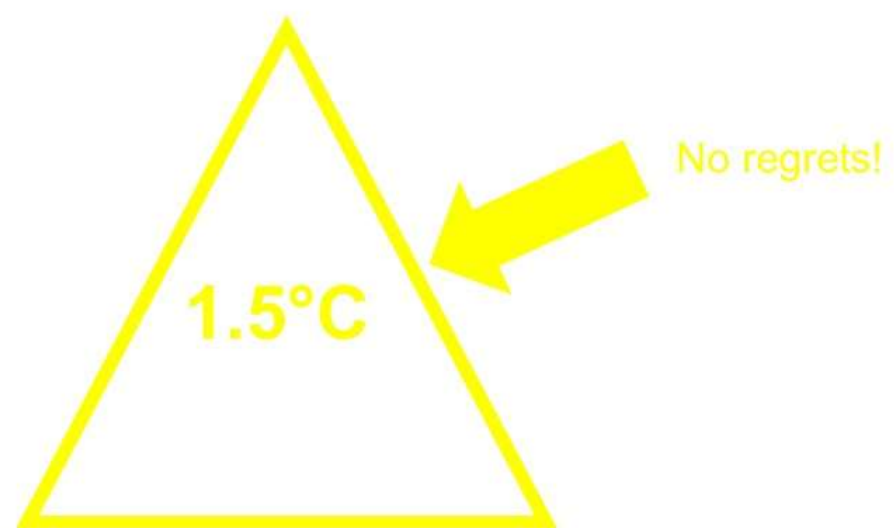
Scotland's total precipitation volume 1960 - 2015 (m3) and predictions to 2100





Land use change – Scotland – past/present and future





2023

Headlines



Average 15% decline in species' abundance

For 407 terrestrial and freshwater species, abundance across Scotland has fallen by 15%, on average, since 1994.



Average 15% increase in the distributions of invertebrate species

Distributions of 2,149 invertebrates increased by 15% on average since 1970. This was driven by climate change and large average increases in the distributions of aquatic insect species that support freshwater nutrient cycling.



Strong decreases in plant and lichen distributions

Since 1970, the distributions of 47% of flowering plants, 62% of bryophytes (mosses and liverworts) and 57% of lichens have decreased, compared to 27, 25 and 34% of flowering plants, bryophytes and lichens respectively, that have increased in distribution.



49% decline in average abundance of Scottish seabirds

The abundance of 11 seabird species in Scotland has fallen by 49% on average since 1986. These results pre-date the current outbreak of Highly Pathogenic Avian Influenza.



11% of species are threatened

Of 7,508 species in Scotland that have been assessed using IUCN Red List criteria, 11% have been classified as threatened with extinction from Great Britain.

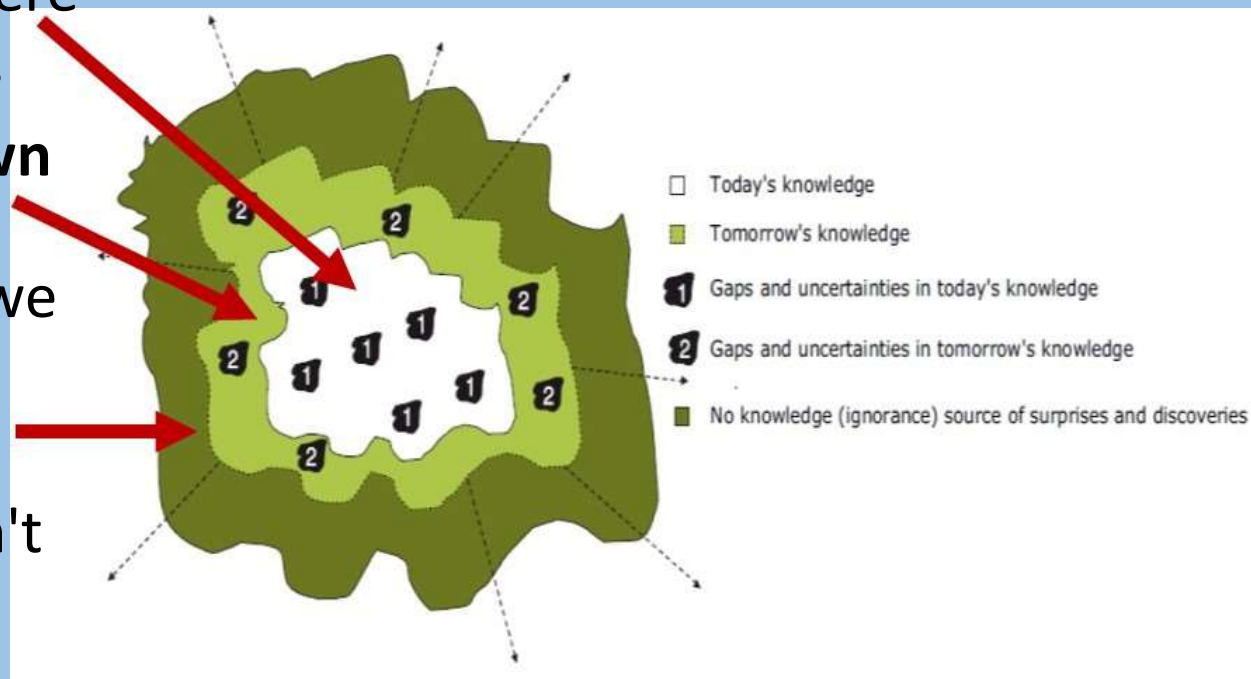
Grayling, Paul Sawyer (rspb-images.com); Fulmar, Richard Carlyon (rspb-images.com); Emerald Moth, Phil Formby / WTML; Capercaillie, Ben Andrew (rspb-images.com); Norwegian specklebelly, Andy Acton

Risk – uncertainty – resilience (what we know...)

Managing risk
1-1.5°C
Resilience
1.5°C+

- There are **known knowns**; there are things we know we know.
- We also know there are **known unknowns**; that is to say we know there are some things we do not know.
- But there are also **unknown unknowns**—the ones we don't know we don't know...

Donald Rumsfeld, 2002



EEA (David Gee) Late Lesson from Early Warnings – the precautionary principle (2001 and 2013)

Peatland restoration



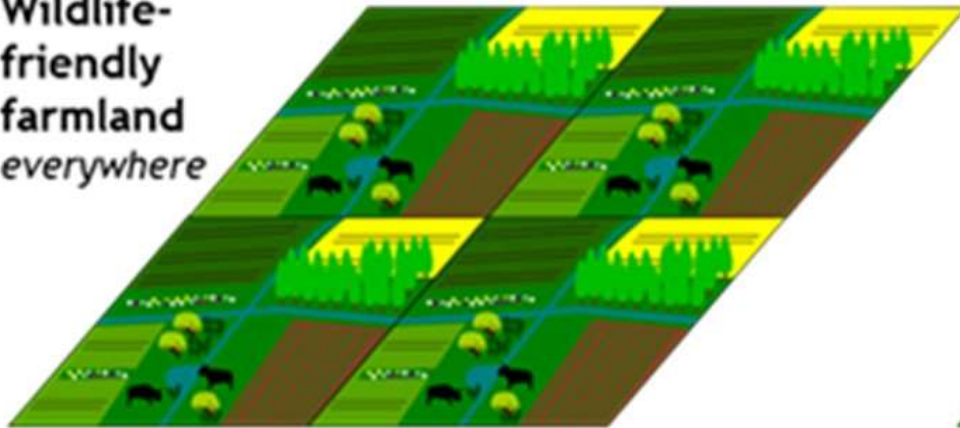

NatureScot
Peatland
ACTION

Regenerative farming



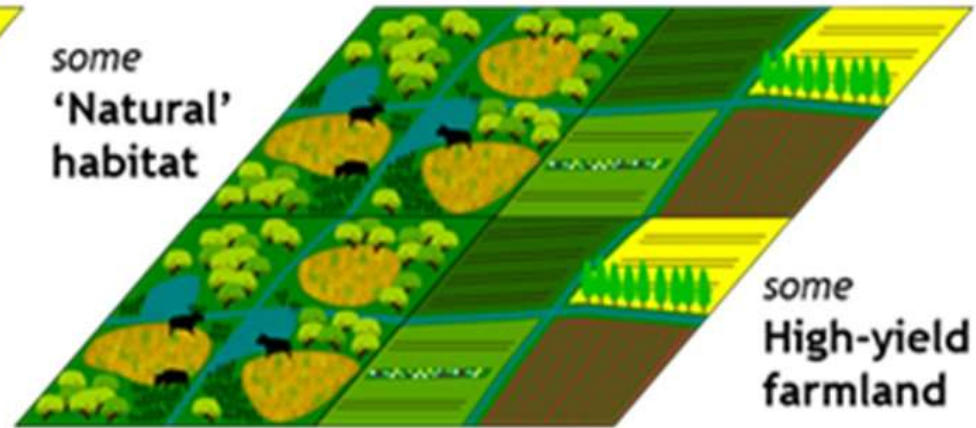
Land sharing

Wildlife-
friendly
farmland
everywhere



Land sparing

some
'Natural'
habitat



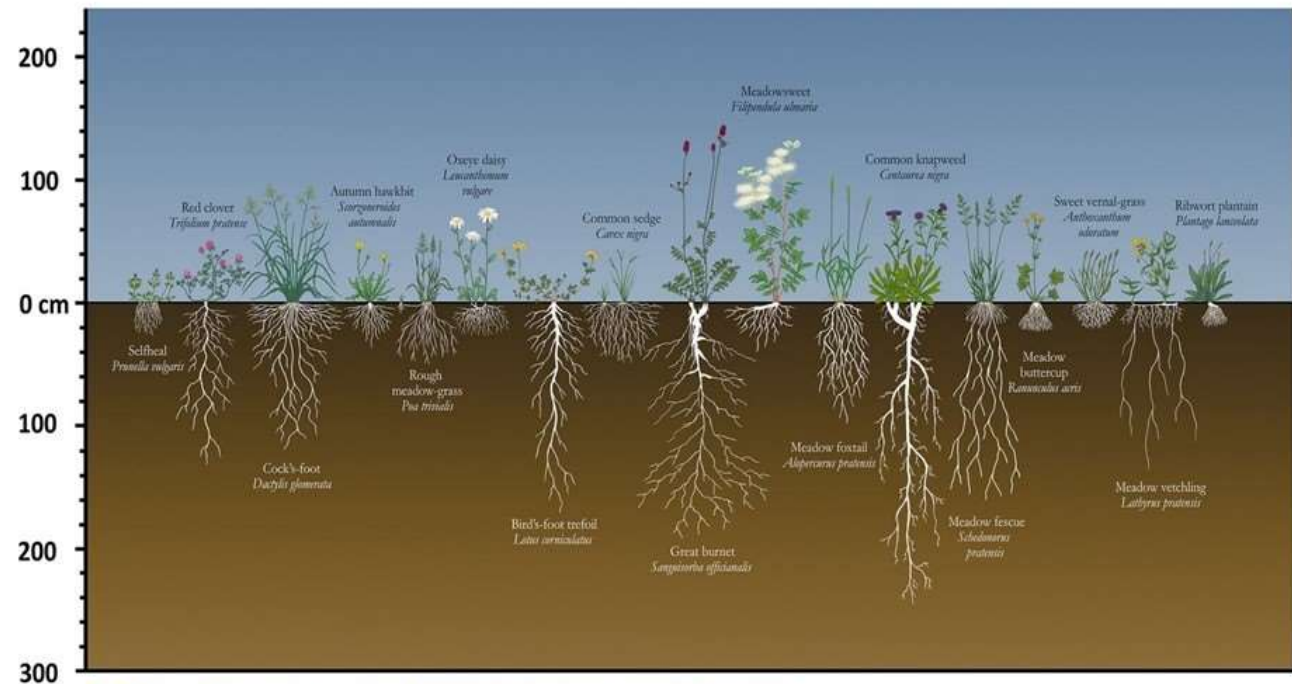
some
High-yield
farmland

Flood Plain Meadows



Beaver dam

From Shoots to Roots: revealing the above and below ground structure of meadow plants



www.floodplainmeadows.org.uk www.open.ac.uk/ees
 Artwork by Vicky Bowskill with botanical expertise from Dr Irina Tatarenko
 © Open University

Restoring woodlands and hedges

Woodland

- Overgrazed
- Simple structure
- Lacks diversity
- Weak sink for greenhouse gases



Woodland

- 'Ungrazed'
- Complex structure
- Rich diversity
- Strong sink for greenhouse gases
- Retains moisture/ arrests flow

Understory: the undersold story

Hedge

- Simple structure
- Lacks diversity
- Weak sink for greenhouse gases



Hedge

- Complex structure
- Rich diversity
- Strong sink for greenhouse gases
- Wind

A82 landslide



Photo courtesy of Ground Engineering



Photo courtesy of BEAR Scotland

Corrour – working estate and large-scale restoration

ACTIONS

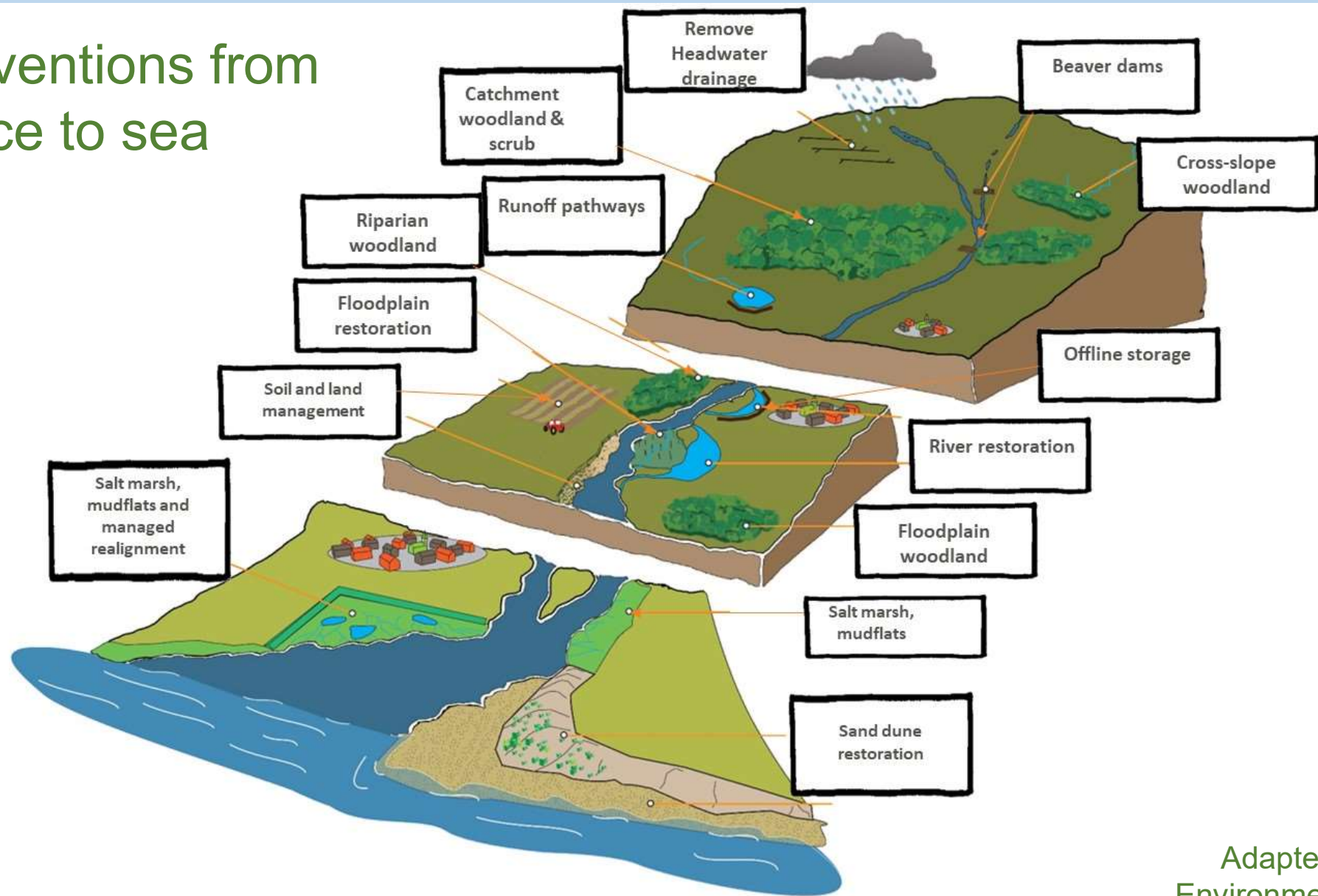
- 23,000ha upland estate managed holistically
- Deer reduced by 86% over 15 years
- No sheep grazing on Corrour
- Tree regeneration increased by 3-fold to 600 seedlings/ ha over 15 years

OUTCOMES

- Reduction in soil erosion and local flooding
- Restoration of montane species e.g. woolly willow
- Peatland restored
- Viable deer stalking business



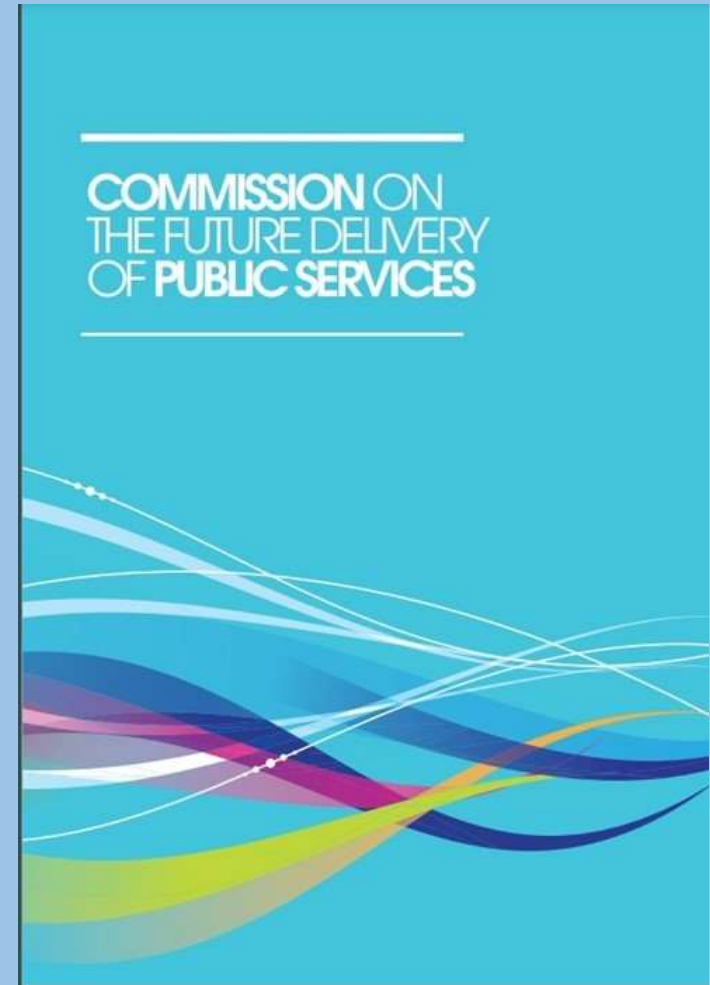
Interventions from source to sea



Adapted from the
Environment Agency

The Governance Challenge

getting the right people
to do the right thing
to the right degree
in the right place
at the right time!



collaboration and preventative spend

Preventative spend: the challenge (Joseph Malins)

C. 1895!

The Fence or the Ambulance—Which?

BY JOSEPH MALINS.

'Twas a dangerous cliff, as they freely confessed,
Though to walk near its crest was so pleasant;
But over its terrible edge there had slipped
A duke, and full many a peasant:
So the people said something would have to be done,
But their projects did not at all tally.
Some said, "Put a fence round the edge of the cliff;"
Some, "An ambulance down in the valley."

(plus 7 verses)

"Come, neighbors and friends, let us
If the cliff we will fence we might



Prevention

Complex
evidential
pathways; hard
to demonstrate
impact

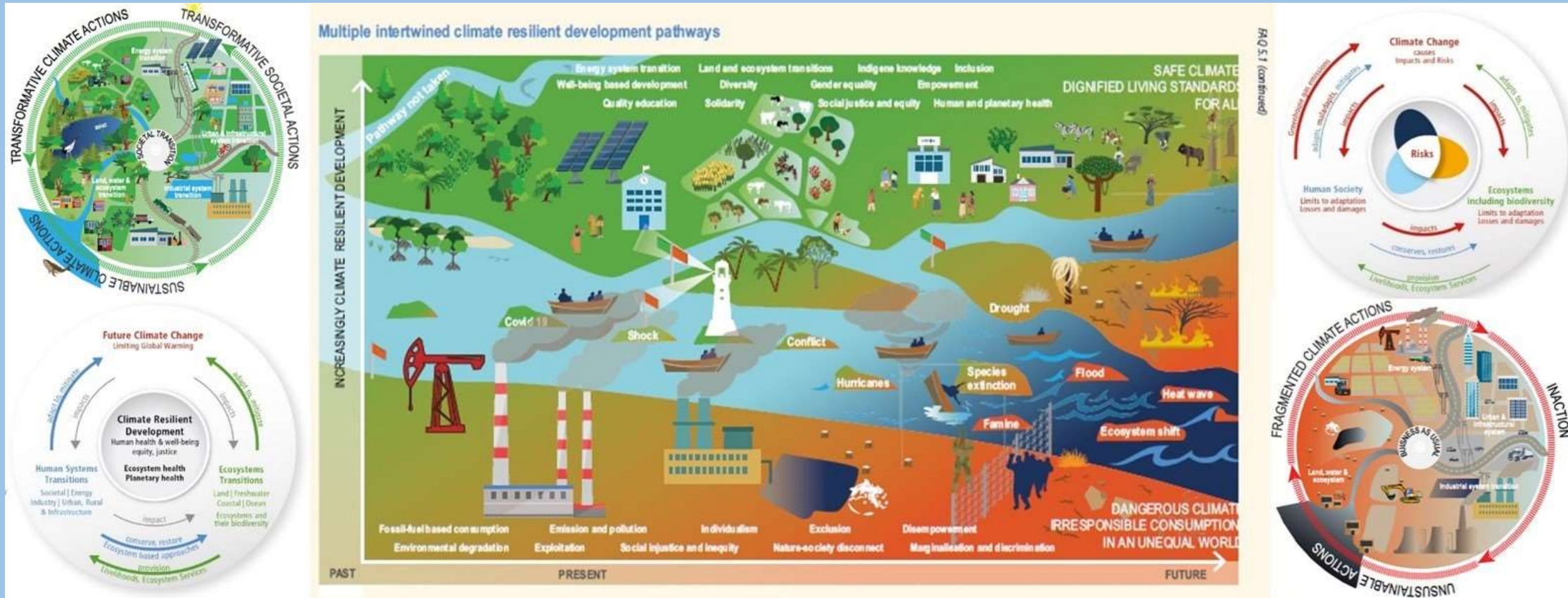
Tomorrow

Reactive

Direct cause-
effect;
demonstrate
impact

Now!

Climate risks: Climate resilient and Dangerous climate pathways



Source:

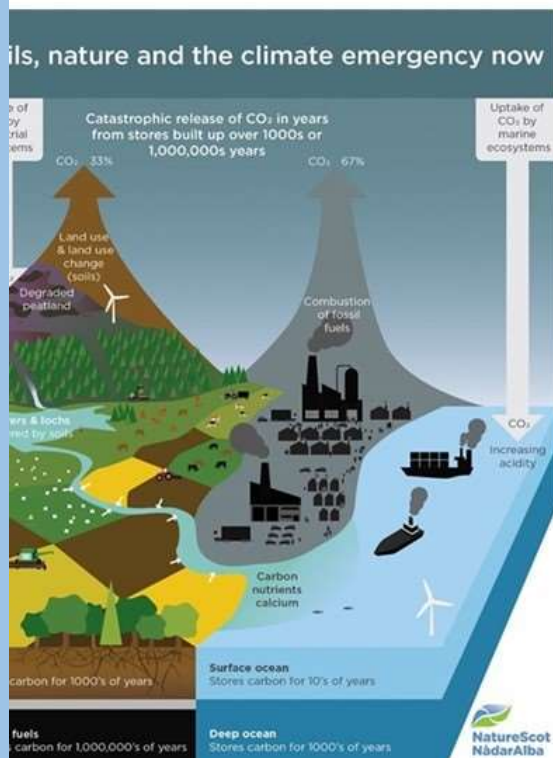
https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter18.pdf

Intergovernmental Panel on Climate Change (IPCC) - Climate Change 2022 – Impacts, Adaptation and Vulnerability – Fig SPM.1

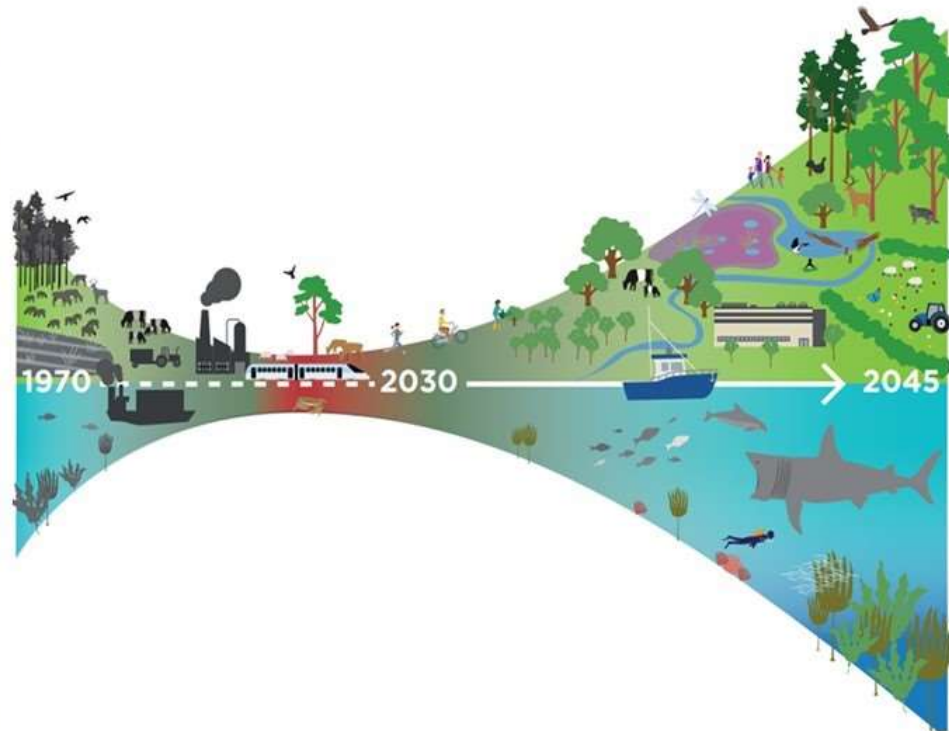
Land use change – Scotland – past/present and future



Transforming land use



Nature-poor
Net source of emissions
Vulnerable to climate risks



Nature-rich
Net sink for emissions
Resilient to climate risks



#FRM2024

Scotland's Flood Resilience Conference 2024

Ruth Wolstenholme, Sniffer



Scottish Government
Riaghaltas na h-Alba
gov.scot



#FRM2024

Scotland's Flood Resilience Conference 2024

Thank you for attending





Scotland's Flood Resilience Conference 2024



Scotland's Flood Resilient Future



Scottish Government
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