

# **HOLDING WATER: Highlights from UK Natural Flood Management case studies**



**Presented by Dr Mark Wilkinson,  
The James Hutton Institute, Aberdeen, UK.**



# Winter 2013 floods



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## Drowning in money: the untold story of the crazy public spending that makes flooding inevitable

Every year billions are spent in Britain and Europe on policies that wreck homes and lives through flooding



George Monbiot  
The Guardian, Monday 13 January 2014 17:15 GMT

 Jump to comments (836)



'Vast amounts of public money are spent every year on policies that make devastating floods inevitable.' Illustration by Daniel Pudles

# Vision for Natural Flood Management in Scotland:

*Promote rural and urban landscapes with space to store water and slow down the progress of floods*

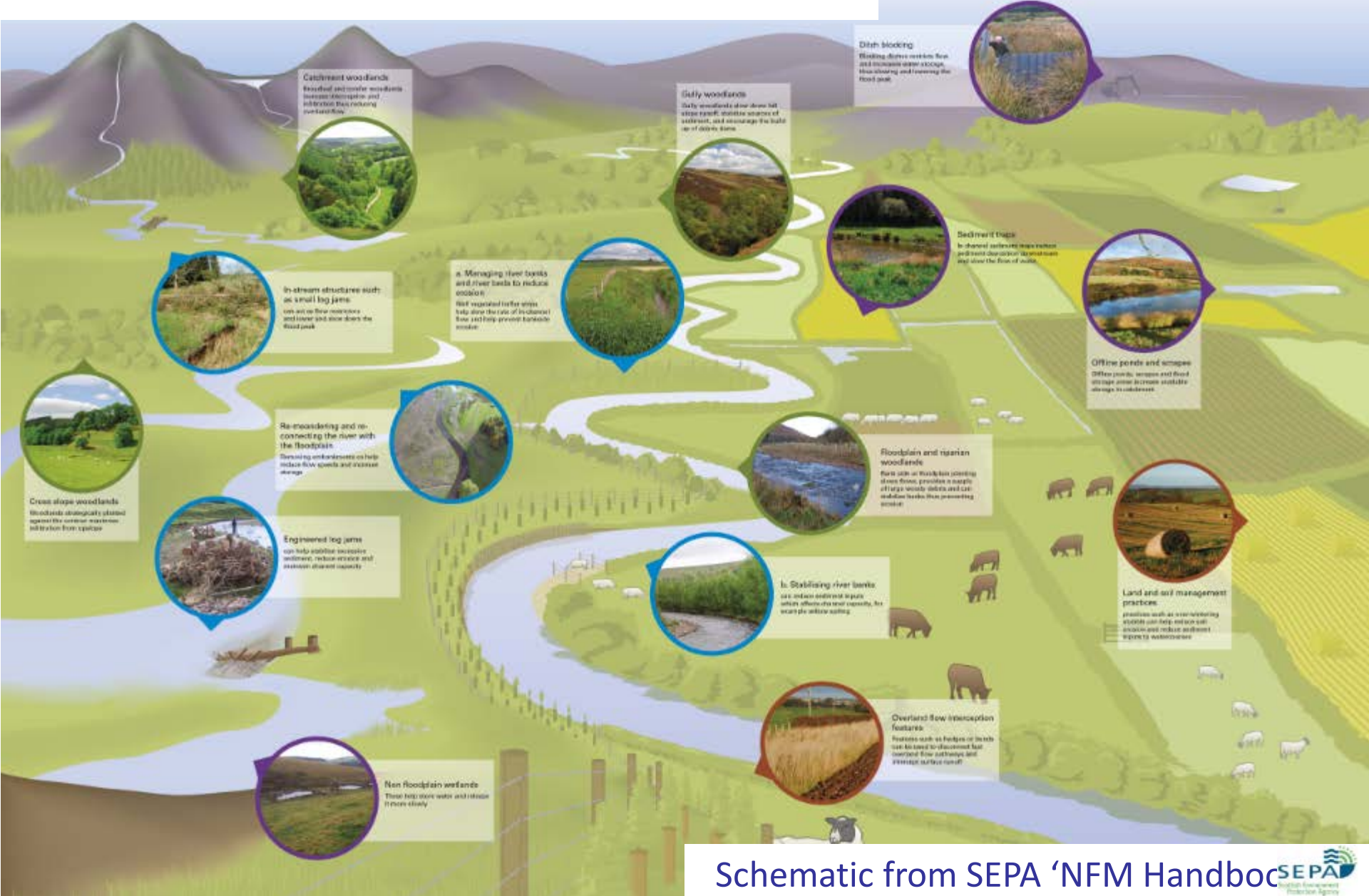


# Sustainable flood risk management

- Alternative way: alongside traditional “hard engineering” techniques: not the ‘silver bullet’ but a component of a wider package of methods
- Sustainable flood risk (and drought) management through **Natural Flood Management (NFM)** or **Green infrastructure** or **Runoff Attenuation Features (RAFs)** or **Catchment Systems Engineering (CSE)** or **Working with Natural Processes (WWNP)** or **Natural Engineering (NE)** or **Natural Water Retention Measures (NWRM)** (EC) – Many definitions.
- Above share common goal - Aim to reduce flood peaks and timing **through attenuation** and deliver multiple benefits: Holding water



# NFM features within a catchment



Schematic from SEPA 'NFM Handbook' 

Aim to reduce flood peaks and timing through attenuation and deliver multiple benefits

# Does it work?

- A key science and policy question is “to what degree does NFM reduce flood peaks at the catchment scale?”:

## Evidence

- How to upscale local evidence to the catchment scale?:

## Impacts

- Complexity, confidence and uncertainty: **Risk**
- Multiple benefit catchment based approach: **Holistic thinking**

*Working with all catchment stakeholders is key –  
fundamental to delivery (bottom up approach)*



# Case study – Belford catchment

- The village of Belford, UK: Many flood events (6km<sup>2</sup> catchment)
- Susceptible to flooding from short duration intense periods of rainfall during multiday events.
- Alternative approach of **managing runoff** in the catchment put forward



When sandbags and sympathy are not enough...Belford 'bereft' after floods

10 Thursday, July 13, 2001

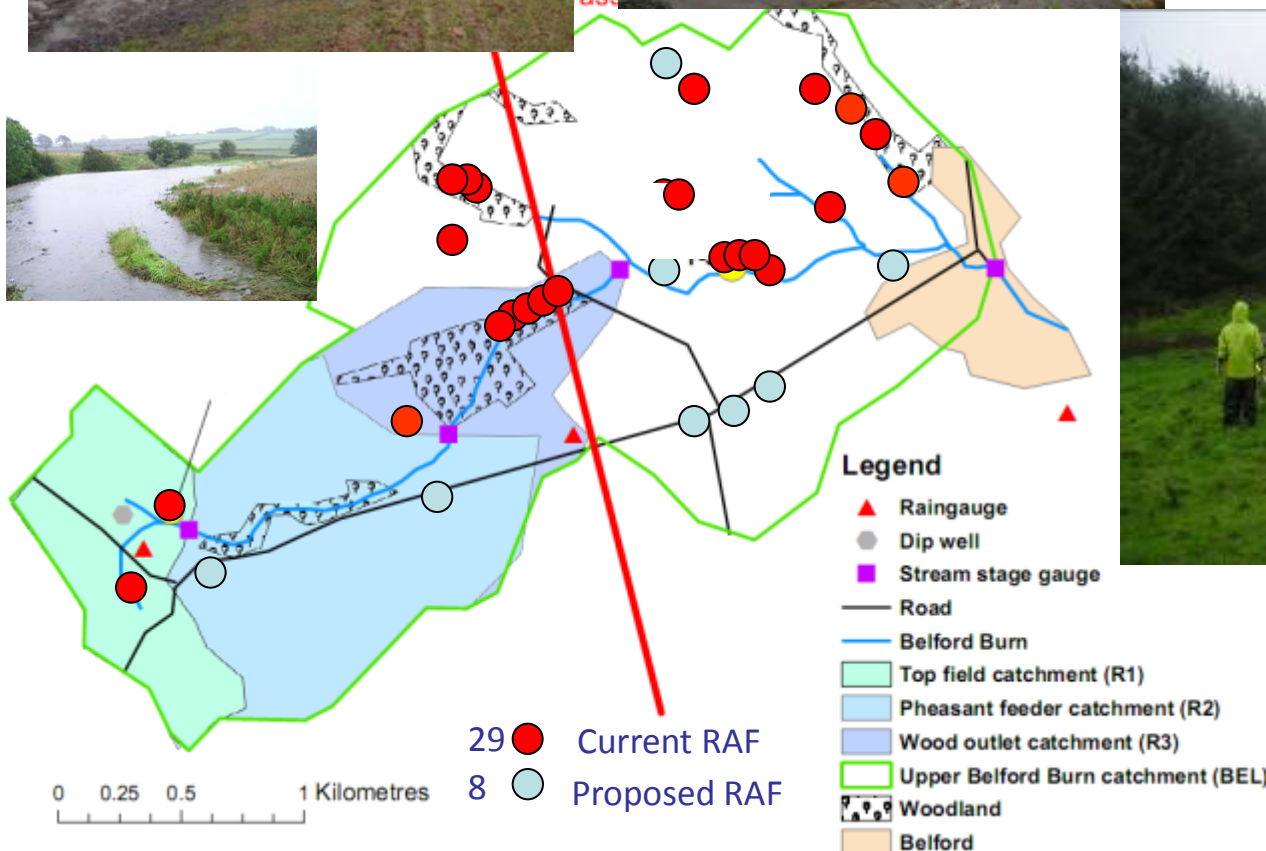
Belford finds itself under water — an not for the first time either..!



in partnership with

Environment Agency

# Instrumentation and mitigation

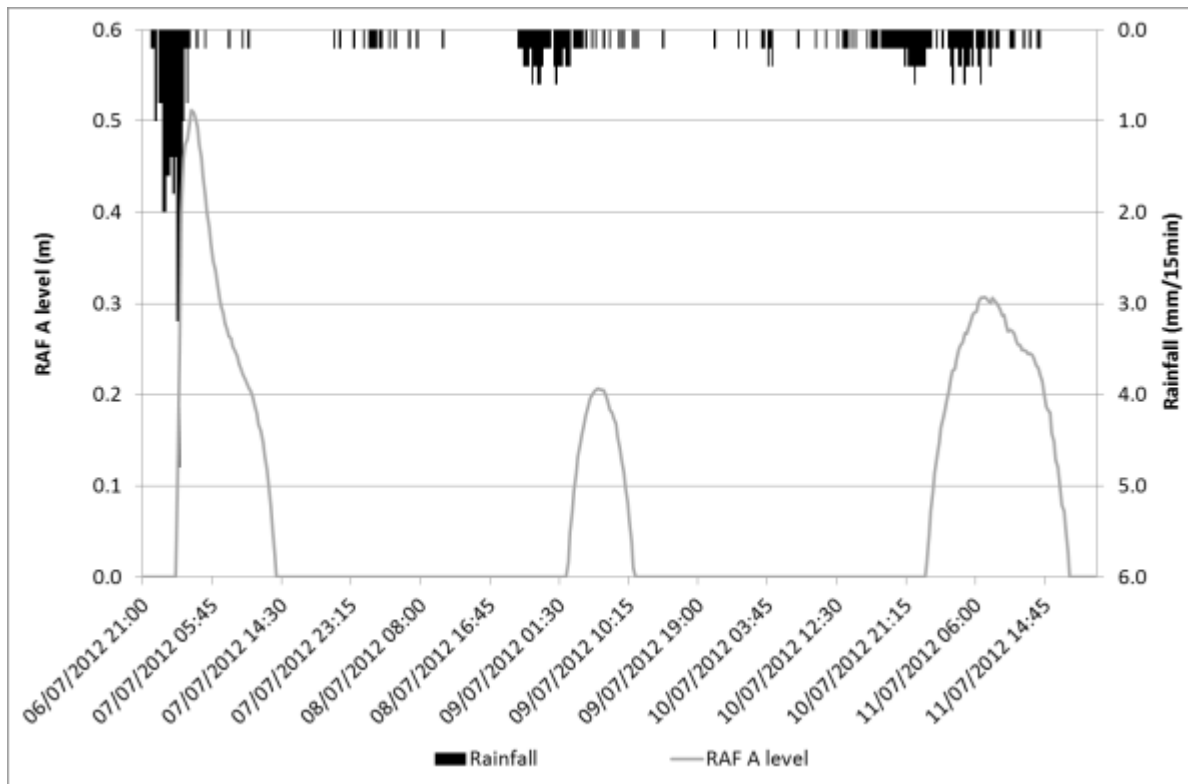






# RAF performance during convective event

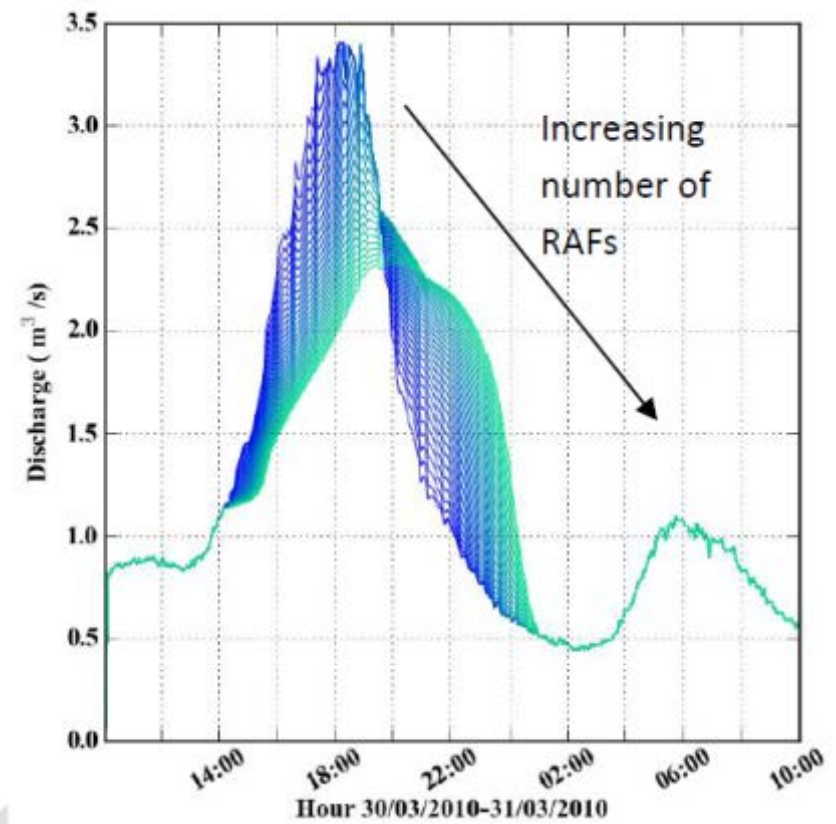
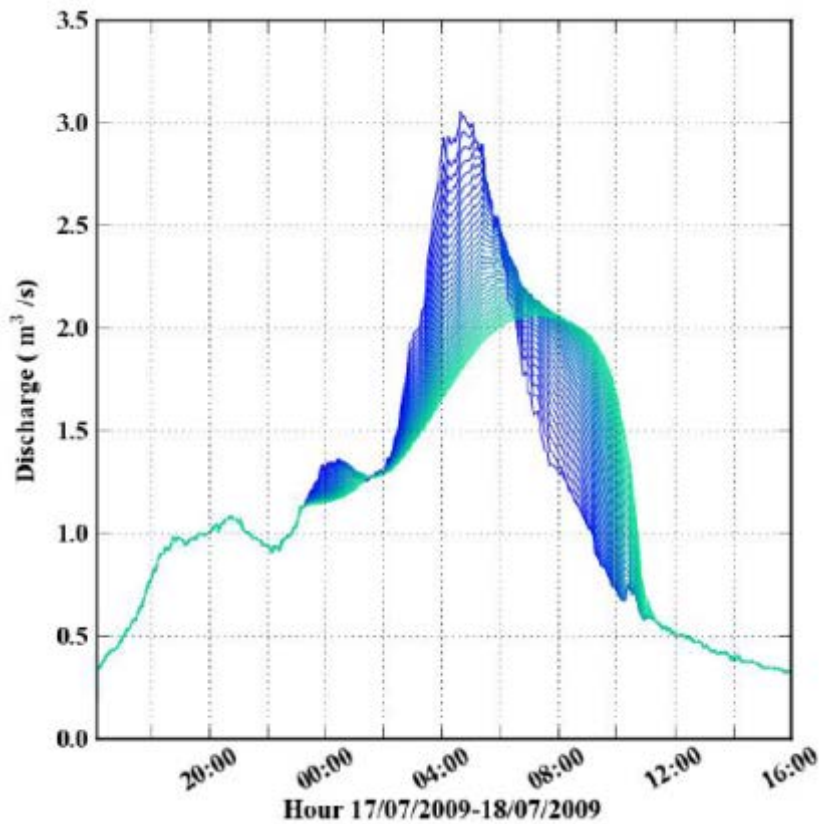
- RAF (490m<sup>3</sup>) disconnecting rapid runoff in steep arable field (0.12km<sup>2</sup>)
- **7 July 2012: 27mm in 1.5 hours: 2 hours pond reached peak level**
- 0.99 tonnes of sediment were retained in feature during an event on 11<sup>th</sup> January 2011, the equivalent of 91 kg ha<sup>-1</sup> (Palmer 2012).



See Wilkinson et al. (2013) *International Journal of River Basin Management*

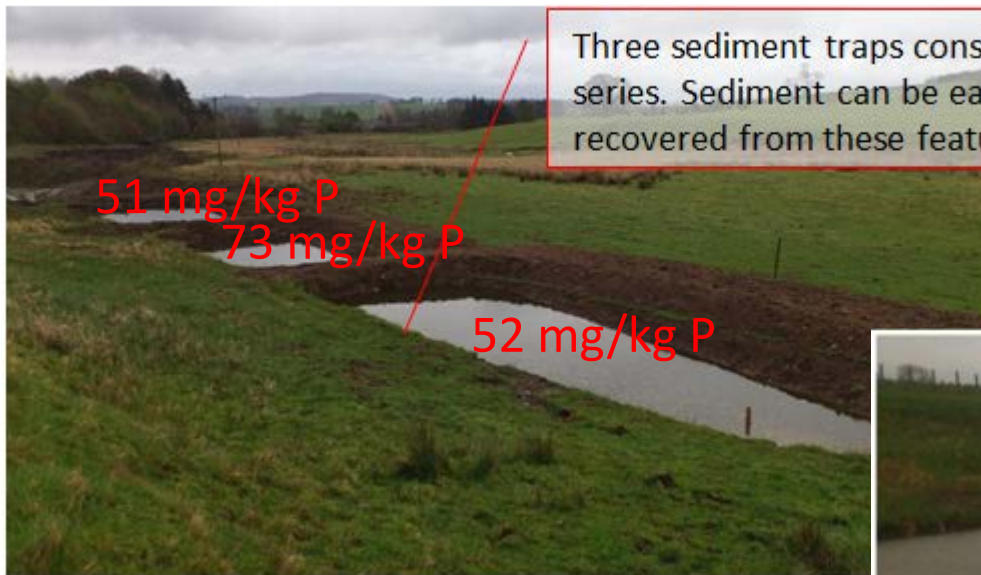
# Impact of a pond: modelling

- Discharge reduction  $\sim 30\%$  for 35 ( $\sim 500\text{m}^3$ ) offline ponds at scale of  $3.5\text{km}^2$ : Effective volume required  $\sim 30,000\text{m}^3$ .



# Optimisation of RAFs for WQ

**Netherton, Northumberland** – an NFM feature designed for flood and drought management improving water quality and biodiversity

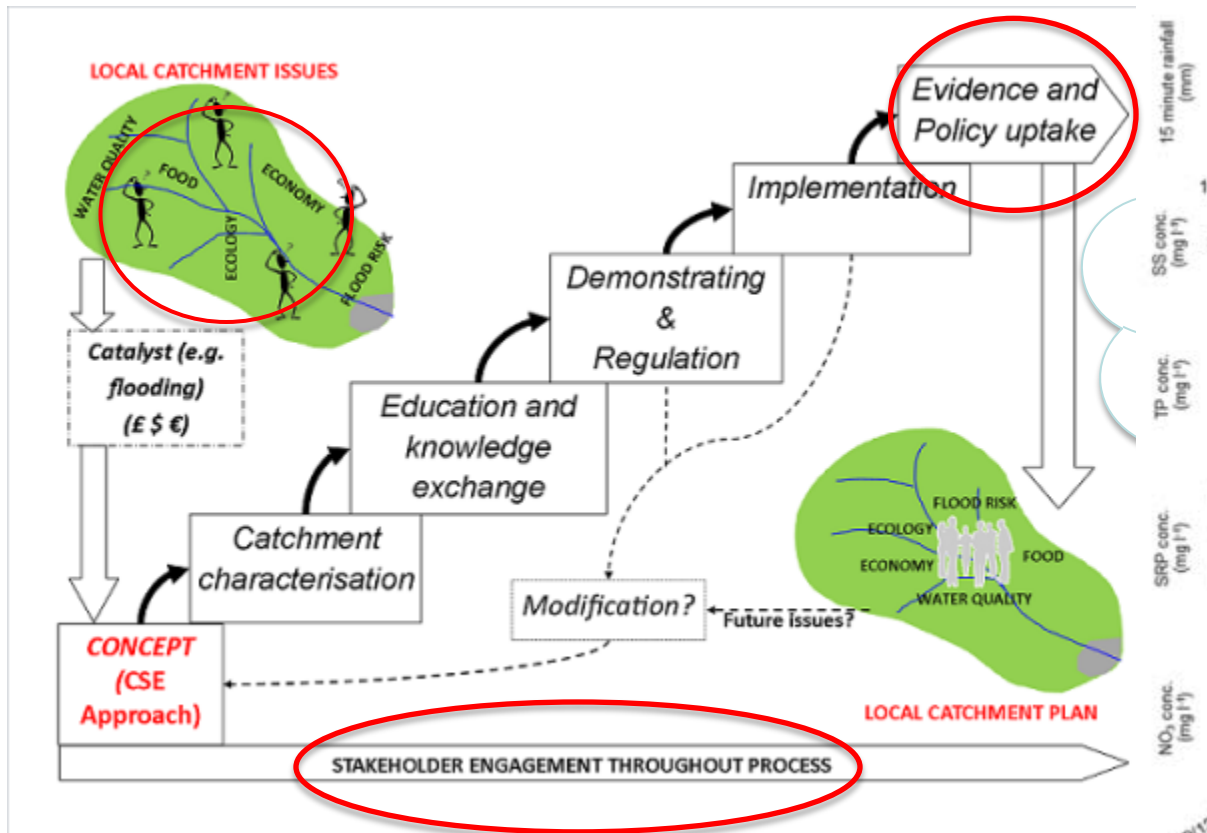


Three sediment traps constructed in series. Sediment can be easily recovered from these features.



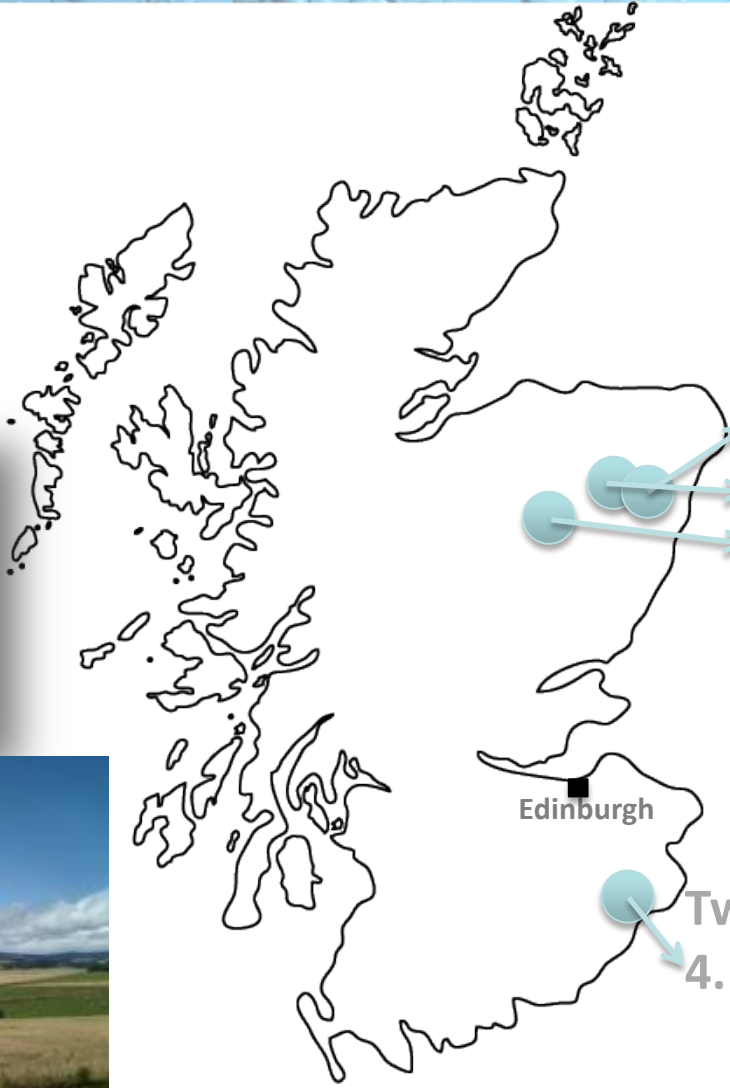
# A catchment management framework

- The previous slides highlighted key findings from Belford. This has led to the development of a framework for catchment management.



- Evidence: both quantitative and qualitative.
- Evidence from other case study catchments.
- = Confidence (at this scale).

# James Hutton Institute headwater research sites



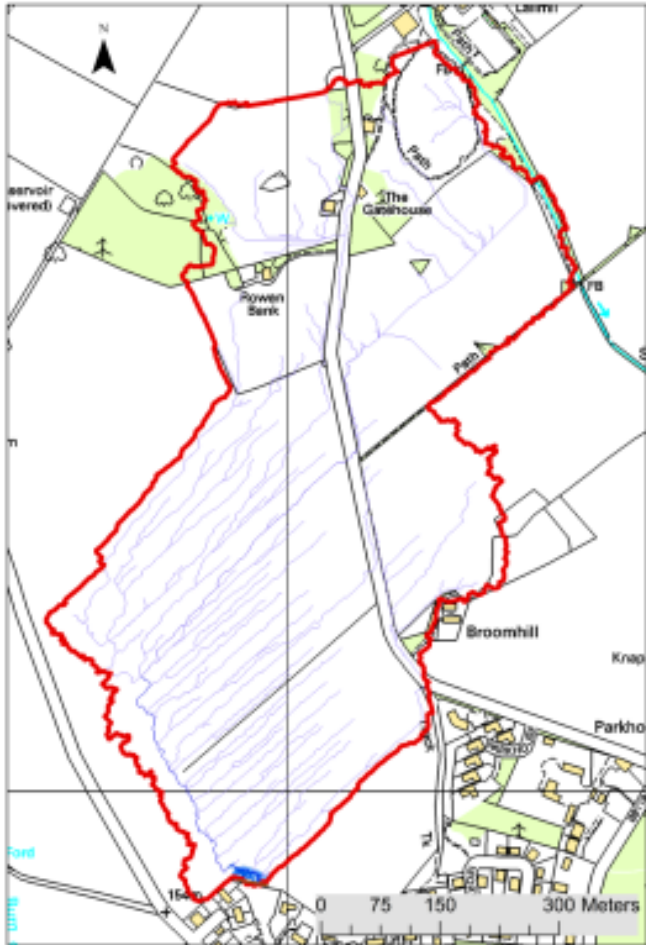
## Dee catchment, Aberdeenshire:

- 1. Tarland Burn
- 2. Logie Burn
- 3. River Dee at Mar Lodge

## Tweed catchment, Scottish Borders:

- 4. Bowmont Water

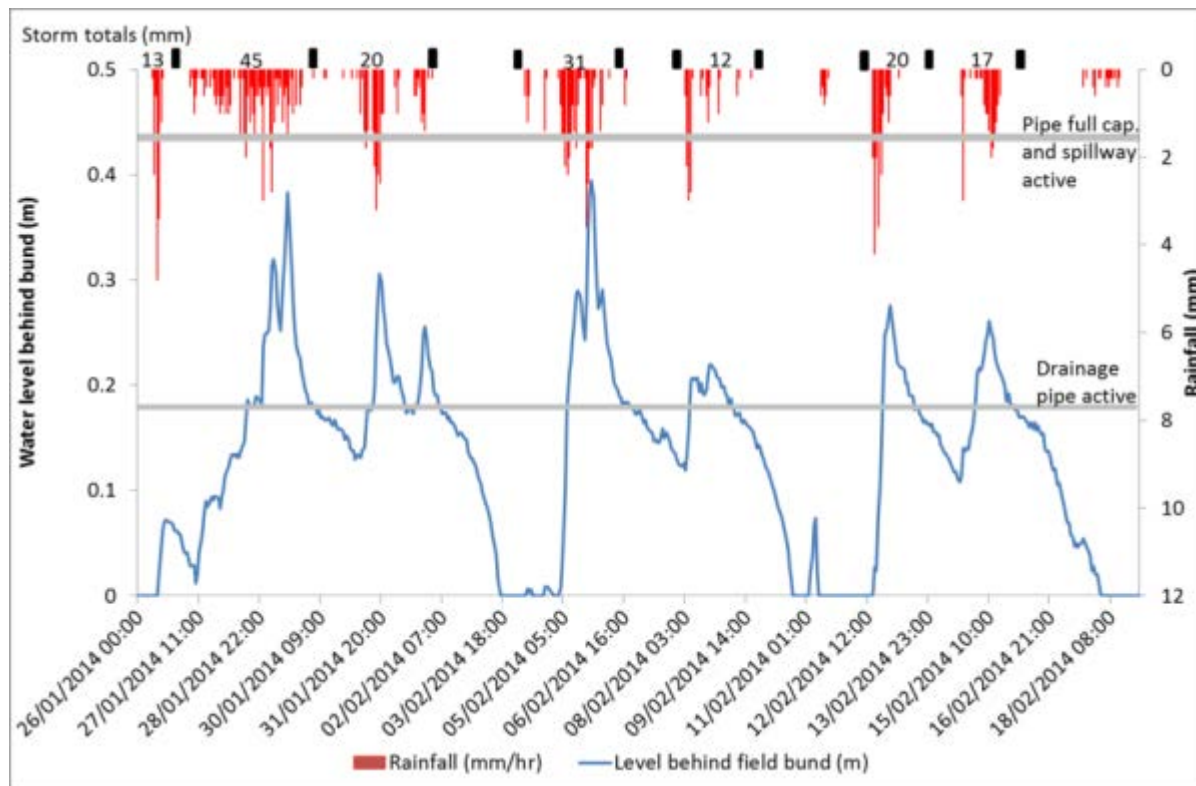
# Tarland overland flow disconnection



- Storage area located using guidance tool (Farm PLOT)  
*Wilkinson and Quinn (2010) SAC/SEPA CONF. PROC.*

# Initial findings from Tarland bund

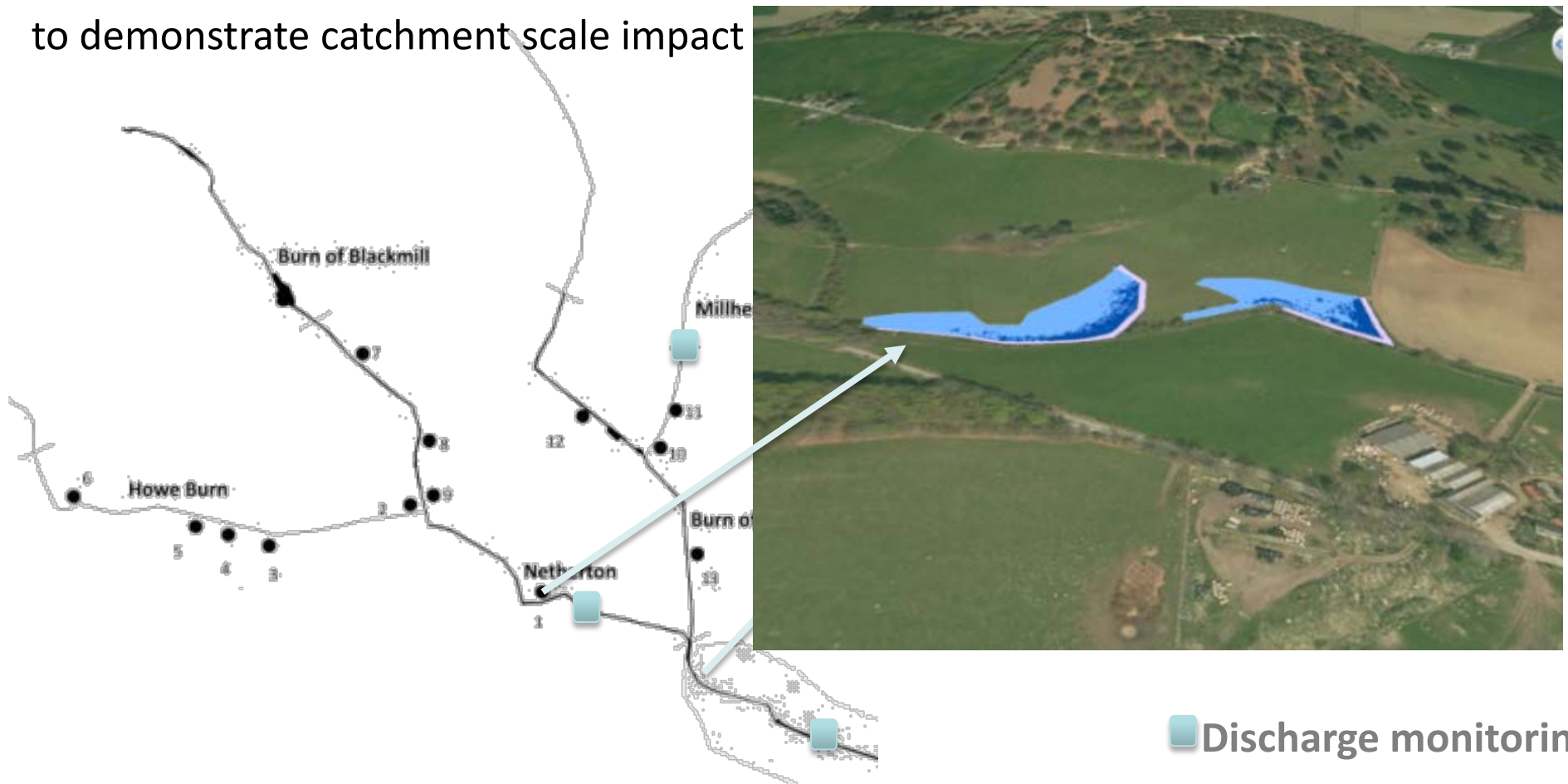
- Overland flow collected from upslope arable fields (38 ha).
- Bund effectively draining after large storm events - additional storage capacity for following events.
- Sediment depths monitored





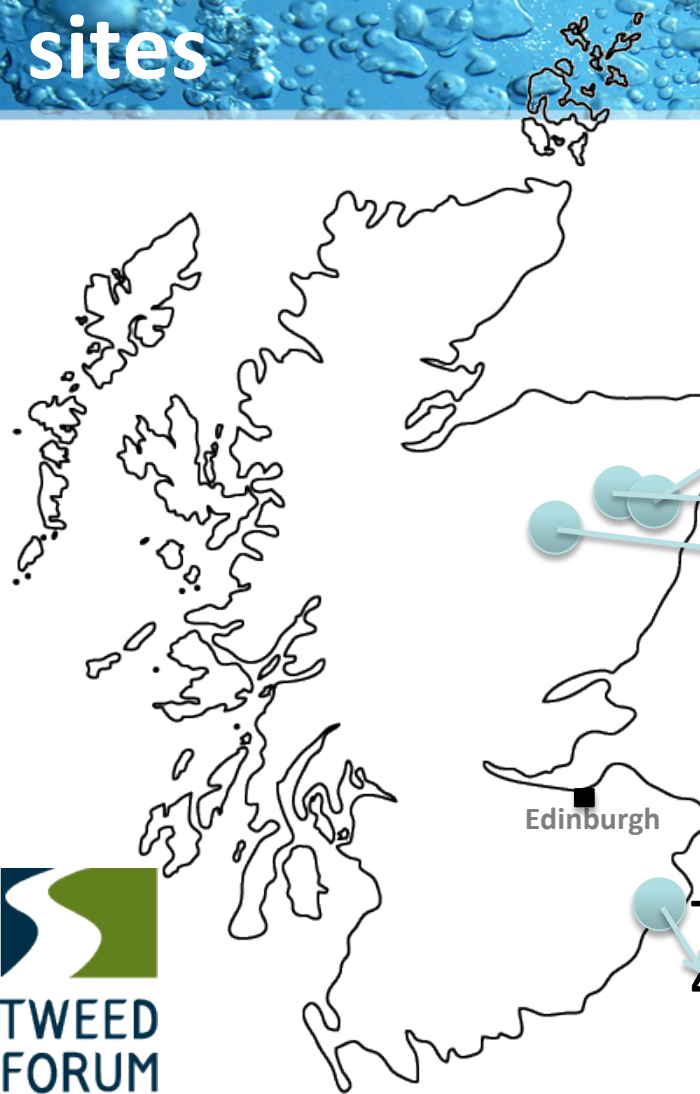
# Prediction at the sub-catchment scale

- Modelling (coupled 1D and 2D hydrodynamic model) and visualisation tools to demonstrate catchment scale impact



- Preliminary results: network of ponds ( $4,000\text{m}^3$ - $6,000\text{m}^3$ ) attenuate flows by as much as  $\sim 12\%$  (1 in 2 year design event).

# James Hutton Institute headwater research sites



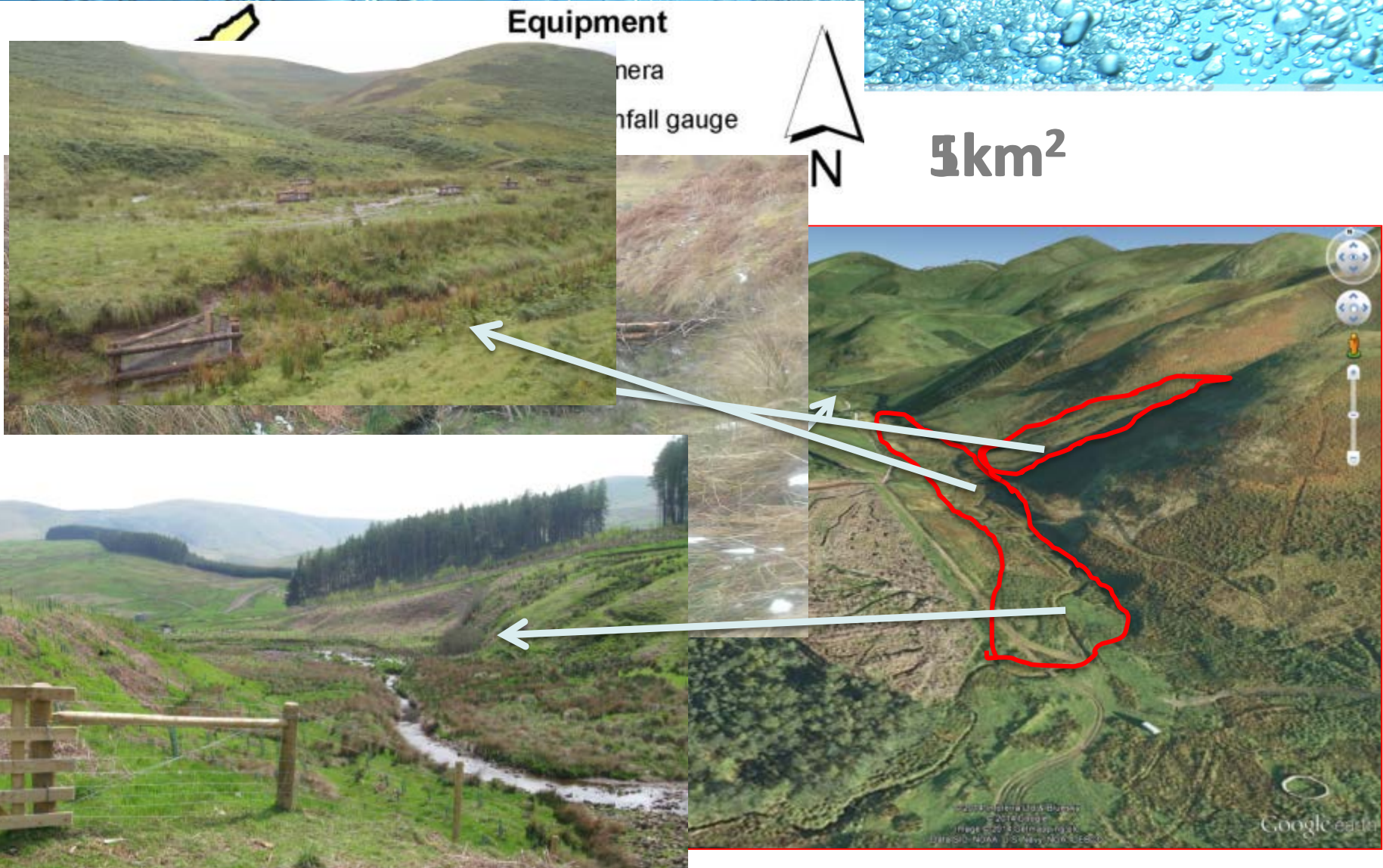
Dee catchment, Aberdeenshire:

1. Tarland Burn
2. Logie Burn
3. River Dee at Mar Lodge

Tweed catchment, Scottish Borders:  
4. **Bowmont Water (87 km<sup>2</sup>)**



# Bowmont - source management



**Utilise small floodplains in our headwater catchment**

# NFM map database

- Centre of Expertise for Water (CREW): NFM section

<http://www.crew.ac.uk/>



## Case Study Sites

Select Management Measure

<Any> ▼

Apply



## Other case studies include:

- Holnicote, Somerset
- Pickering, North Yorkshire
- Moors for the future, Pennines
- Eddleston catchment, Borders
- Allan Water, Perthshire
- Eden Catchment, Cumbria
- Netherton Burn, Northumberland
- Great Ayton, North Yorkshire
- ...and many more sites!

# For example; Holnicote, Somerset

- A range of different NFM measures installed in this catchment -

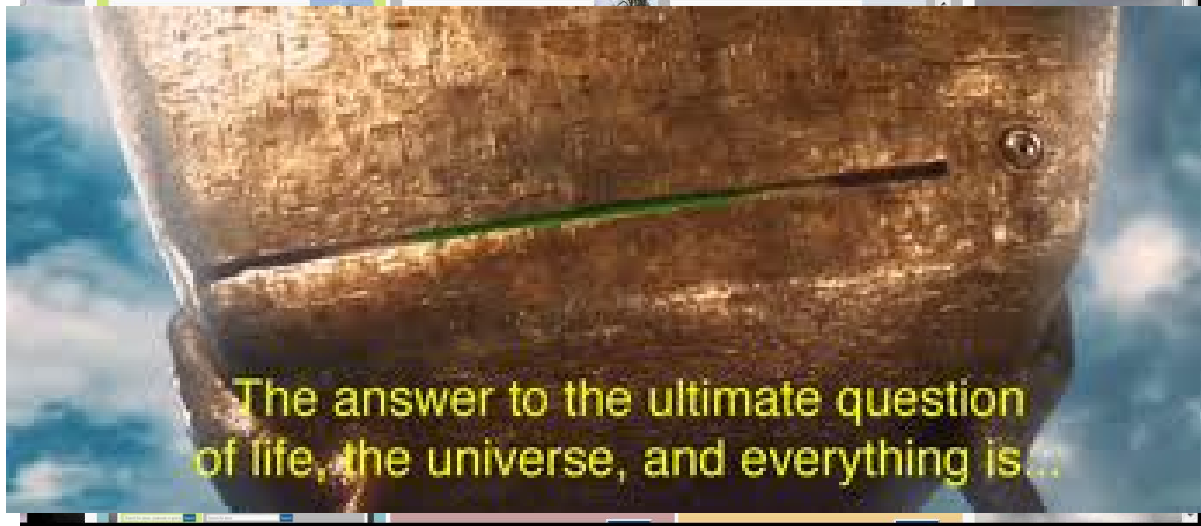
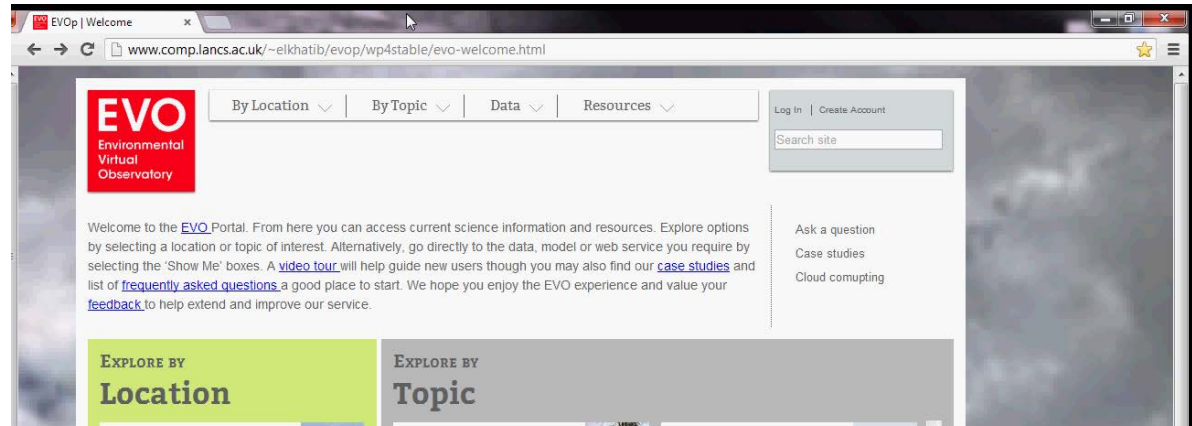
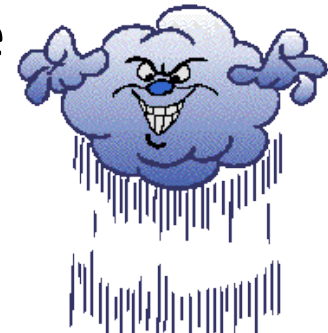
<http://www.youtube.com/watch?v=3MbkfVQs8Z8>.



# Using the cloud?



- Cloud computing offers a unique way in order to share knowledge, data and models to a variety of end users



See: [www.evo-uk.org](http://www.evo-uk.org)

# Summary

- NFM is a more sustainable way of managing runoff in flashy head water catchments: low cost and offers multiple benefits.
- Disconnection of runoff pathways at source can reduce flood peaks locally and capture sediment. However, these features need to be managed
- It is the collective network of RAFs, rather than individual features, that aim to provide flood mitigation.
- Knowledge is globally transferable.

## Visualisations from *land-en-water.be*

Welkom   Wie we zijn   Wat we doen   Contact

land-en-water.be

### Maatregelen

Water en modder vloeien naar beneden. Wat boven gebeurt, beïnvloedt beneden, niet omgekeerd. Het evenwicht van het watersysteem moet worden aangepakt van bron naar monding, niet omgekeerd. Hieronder kunt u een animatie bekijken die het werk van land-en-water.be in (bewegend) beeld brengt

Gingelom

Velm

Situatie zonder maatregelen

Situatie met maatregelen

# Co-authors and Acknowledgements



- Steve Addy, Helen Watson, Sohan Ghimire, Carol Taylor, Yvonne Cook, Marc Stutter – James Hutton Institute **(work in the Bowmont and Dee catchments)**
- Paul Quinn, Jennine Jonczyk, Nick Barber, Alex Nicholson, Gareth Owen and Mike Palmer – Newcastle University **(work in the Belford catchment)**

## Acknowledgements

- Scottish Government (RESAS)
- Tweed Forum (Bowmont Catchment)
- Dee Catchment Partnership (Dee Catchment)
- Phil Welton/Peter Kerr (Environment Agency/Northumberland Rivers Trust)
- ALL LANDOWNERS INVOLVED IN THESE PROJECTS

