

## **The Eddleston Water Project - measuring the effectiveness of restoring a sub-catchment of the Tweed**

14:00 **The Eddleston Water Project: aims & policy context** - Chris Spray (University of Dundee)

14:15 **Designing practical restoration works on the Eddleston Water and making them happen** Hugh Chalmers (Tweed Forum) and Carolyn Mills (cbec)

14:40 **Surface Water Monitoring** - Tom Ball & Andrew Black (University of Dundee)

15:00 **Measuring the contribution of groundwater and soil water to flooding** - Alan McDonald (BGS)

15:20 **Geomorphology and ecology monitoring** - Chris Bromley (SEPA)

15:40 **Discussion and summing up** - Chris Spray (Chair)



University of Dundee

**Cbec Ltd**



# The Eddleston Water Project: aims & policy context

## Pilot Catchment Study Science underpinning National policy

- **Flood risk management** -  
Flood Risk Management  
(Scotland) Act 2009
- **River habitat restoration**  
Water Environment & Water  
Services (Scotland) Act 2003

Both look to reconnect damaged  
rivers to their catchments



Chris Spray Scottish Freshwater Group 30 Oct 2014



# Landscape scale conservation of river systems - wider view

- River catchments offer *major opportunities for restoring delivery of a range of benefits (ecosystem services)* to local communities and wider society at the landscape scale
- This is exemplified by *both 'top down' government initiatives* (such as those to improve the ecological status of water bodies under the Water Framework Directive) and *'bottom up' voluntary initiatives*, as exemplified by the work of Tweed Forum with local land managers
- The Eddleston Water project is a key component of the **Scottish Government's commitment to promoting a sustainable approach to water and land management** and to restoring habitats and promoting 'natural flood management'
- The scientific challenges are (a) *restoring functionality* (b) *monitoring and proof of impact* and (c) *community buy-in*

# The Eddleston Water Project

## Partnership Approach

Phase I: Scoping study - 2009/10

Phase II: Base line monitoring & planning 2010 - 2012

Phase III: Implementation & Monitoring 2013 - 2015.....



Environment Agency

Scottish Natural Heritage



Tweed Foundation



Forest Research

Cbec Ltd

**The Land owners and Community**

# Eddleston Water – subcatchment of Tweed 69 sq kms

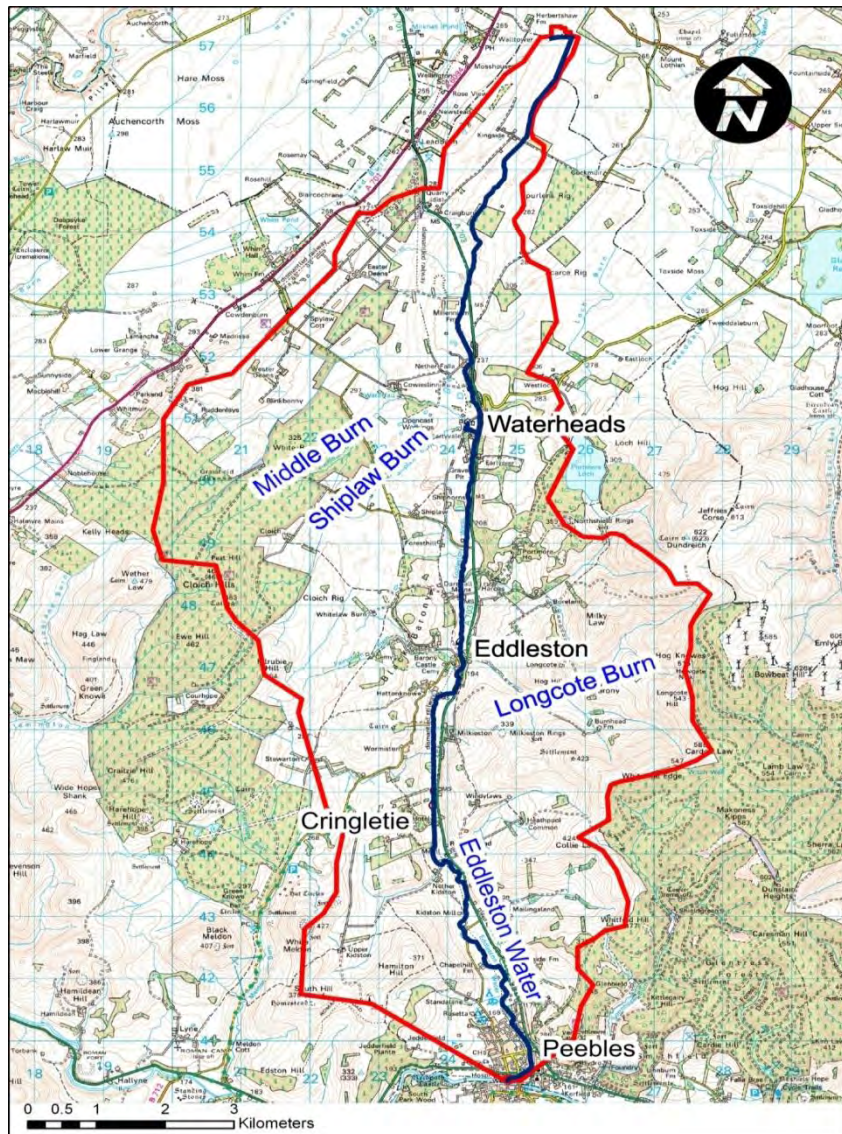
- Tweed length: 156 kms
- Catchment: 5,000 sq kms
- Scotland 84%; England 16%
- Mainly agricultural & valley towns
- 130,000 population, tourism, farming (sheep & cereals), Salmon, Rugby, Tweed woollens



Natural Flood Management projects in the Tweed catchment



# Eddleston Water – historically suffered major changes



- **Eddleston** a typical Scottish catchment, with long history of agricultural land management
- Fractured greywackes mantled with highly variable covers of till, fluvio-glacial outwash and peat
- Annual precipitation: 850 mm (valley floor)-1500 mm (summits)
- Simple river system - steep slopes on either side of main stem, with distinct sub-catchments.

# Distinct character of the current landscape

Sources



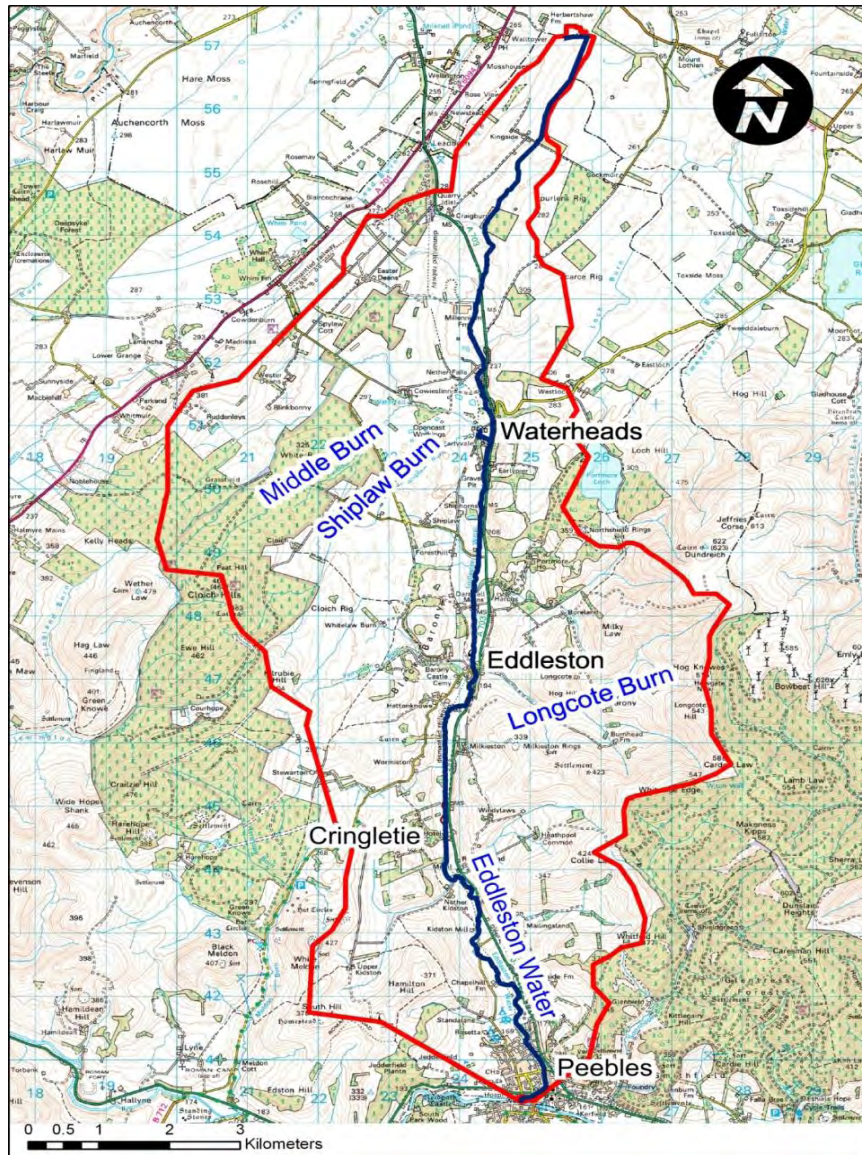
Pathways



Receptor (Peebles)



# Eddleston Water – water management challenges



Long history of river and flood plain management – for agriculture mainly – and of **flooding** (1723, 1777, 1792, 1831, 1846, 1865, 1881, 1891, 1897, 1908, 1914, 1926, 1948, 1956, 1977, 1986, 1988, 1991, 1997, 2000, 2005, **2012**)

**EU Conservation status** as a ‘Special Area for Conservation’ - as a

- ‘Ranunculus type’ river,
- Atlantic Salmon
- Lampreys
- Otters.

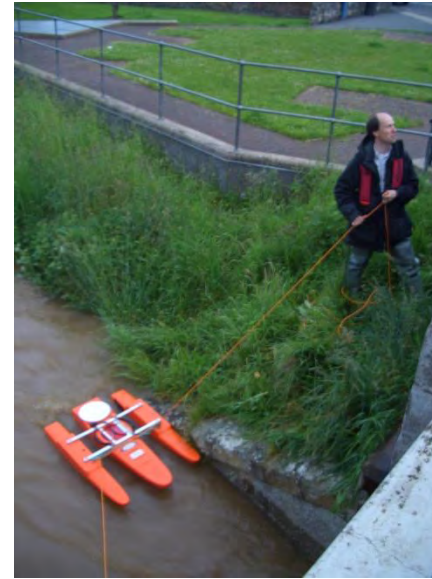


Classed as ‘bad’ ecological status under the **EU Water Framework Directive**:

- channel morphology
- aquatic plants (medium)



# ***Characterisation and current status: flood risk***



**Peebles –  
March  
Street, June  
2012.**

**Linfall  
Bridge, 2012**



# Overall Aims of Eddleston Water project

... “to restore river and its whole catchment whilst at the same time promoting livelihoods of those who derive income from the sustainable management of farms, forests and fishery”:

- improved physical habitat
  - reduction in flood risk
- 

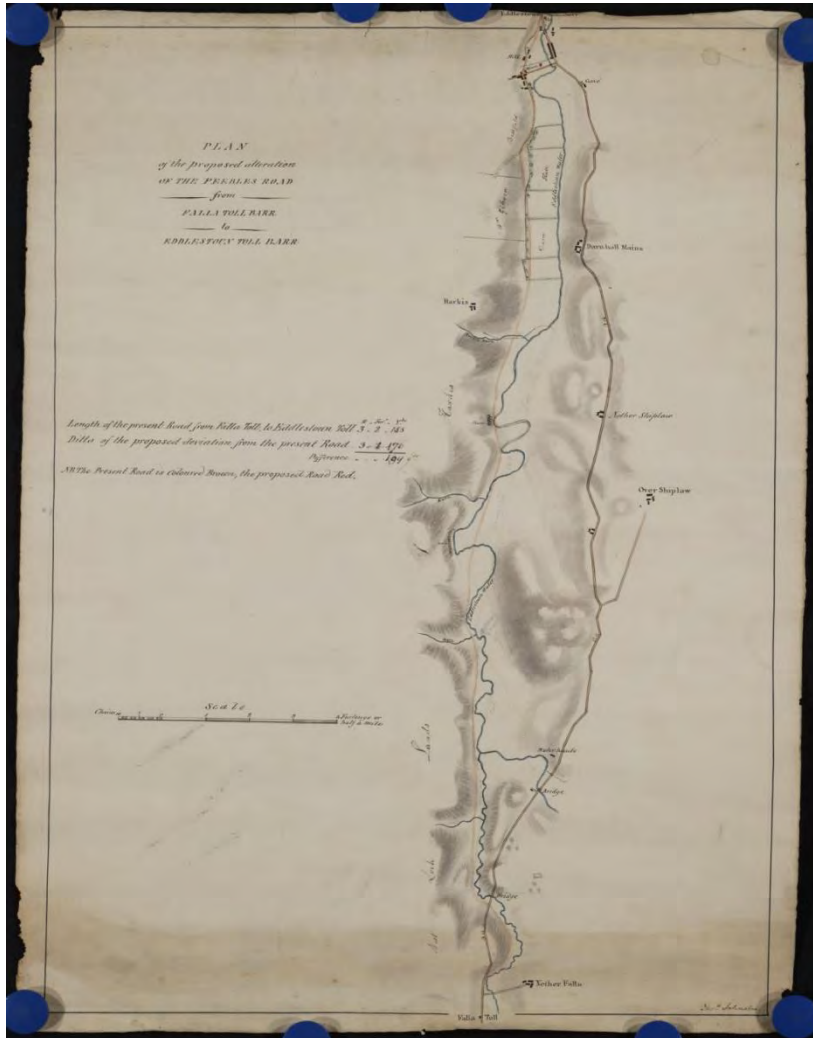
.....whilst *promoting sustainable management* of the local farms, fisheries and forestry interests,

.....and *enhancing biodiversity and recreational opportunities* for residents and tourists.

# Currently fails Water Framework Directive status: - BAD

## Historical channelisation and loss of floodplain connectivity

Toll road map: - old course 1790's



Roy Map

Main stem sinuous c.1750: but extensively channelised by 1811 or earlier

**WFD Status currently failing due to:**

**Hydro-morphology = Bad status**

**Macrophytes = Moderate status**

# Key Policy Objectives

**Aim: to answer key national policy questions concerning the costs and benefits of 'restoring' our rivers and their catchments for people and for wildlife**

- **Can we reduce the risks of flooding to local communities by changing the way we manage our land and rivers? – and if so, by how much?**
- **Can we improve habitats and meet the requirements for 'good ecological status' under the Water Framework Directive?**
- **What techniques and ideas work best? – and where?**
- **What other benefits can be delivered alongside these – for landscape, water quality, climate change resilience, recreation, fishing, tourism, etc?**
- **What are the costs of restoration?**
- **How do we do so, whilst also maintaining a prosperous and sustainable farming community and local businesses?**

# Eddleston Water Restoration Scoping study (July 2010)

## (a) Detailed characterisation of the catchment

## (b) Output Recommendations:

- Plans for physical restoration of channel and floodplain
- Proposals for interventions to achieve flood risk reductions
- Value for money and priorities for action
- Stakeholder engagement

## (c) Monitoring Plans

Werritty, Ball, Spray, Bonell, Rouillard & Archer (Dundee university)  
and Bowles & Moir (cbec)



# Detailed Hydro-morphology of the whole river length

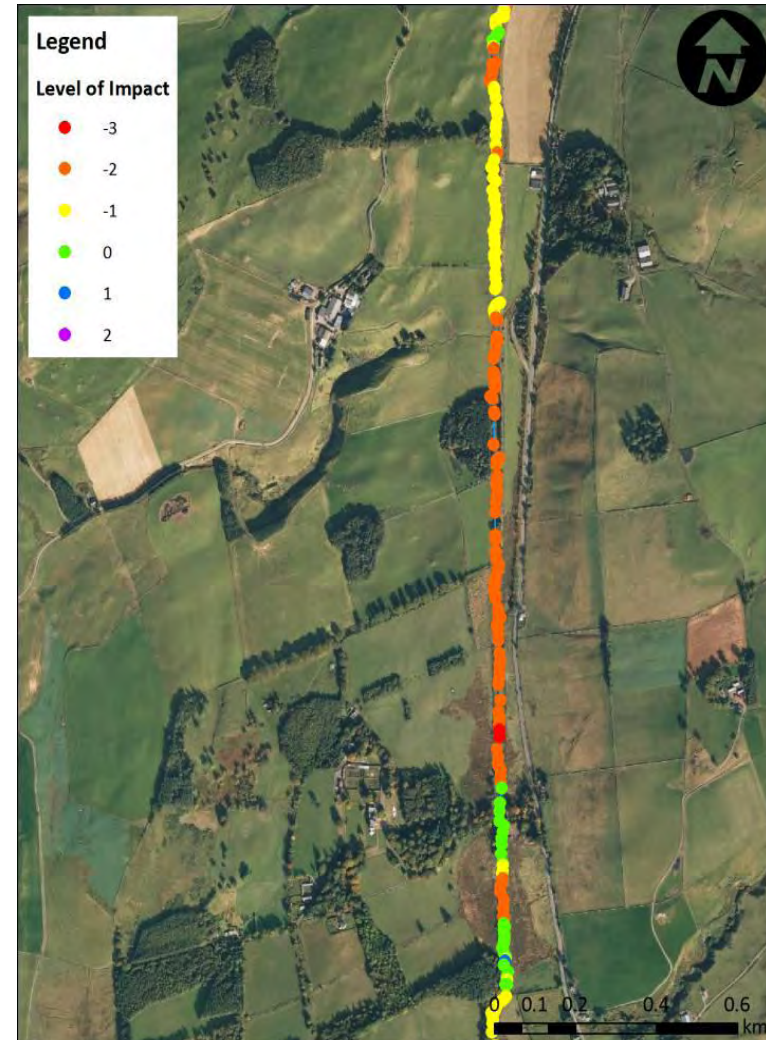
## Detailed survey (MImAS) - Bad ecological status

- High impact channel realignment 37%
- Low impact channel realignment 15%
- Embankments and floodwalls 26%
- Loss of bankside riparian vegetation 14%

## Implications for restoration:

- Enables targeting of interventions
- u/s good value, inexpensive meanders
- d/s selected re-meandering & embankments
- Can improve to moderate & potentially good

## Cringeltie and Lake Wood



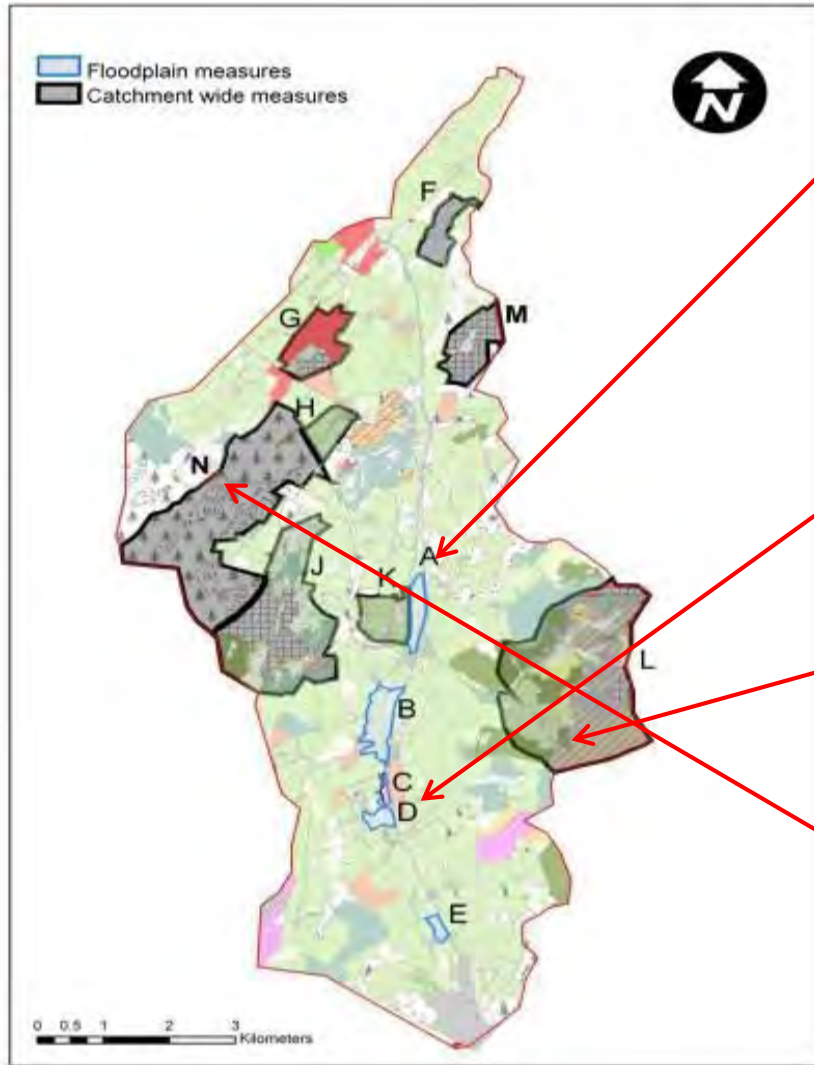
# Contribution to achieving NWRM objectives - including EU directives – and benefits the measures deliver (1)

## WFD Status Change:

- **Bad** status now improved to **Poor** status – due to re-meandering and tree planting  
Original loss of system capacity due to numerous pressures:

Zone	Activity	Activity Impact (%)	Total Impact (%)
Channel	High Impact Channel Realignment	30.12	78.87
Channel	Embankments and Floodwalls no Bank Reinforcement	22.19	78.87
Channel	Low Impact Channel Realignment	13	78.87
Channel	Riparian Vegetation	7.11	78.87
Channel	Grey Bank Reinforcement	1.7	78.87
Channel	Pipe and Box Culverts	1.44	78.87
Channel	Green Bank Reinforcement and Bank Reprofilng	1.2	78.87
Channel	Impoundments	1.06	78.87
Channel	Bridges	0.62	78.87
Channel	Set Back Embankments and Floodwalls	0.33	78.87
Channel	Intakes + Outfalls	0.07	78.87

# Identified different options to restore functionality, reduce flood risk and improve habitats – in sources and pathways



## Selected options/measures:

**A:** breach/set back embankments, new fence margins, riparian woodland, wet woodland,

**C:** re-meander channel - Cringeltie

**L:** Reduced stocking density, tributary woodland, floodplain forest – Longcote burn

**N:** create ponds, wetlands, riparian woodland block ditches, engineered log jams – Middle burn

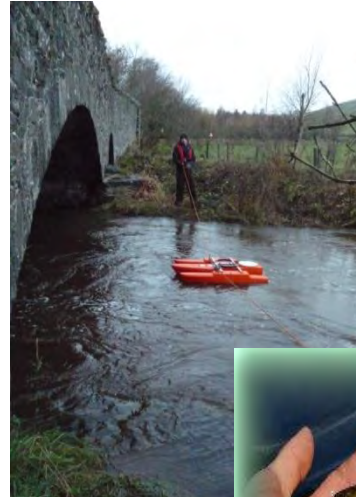


# Monitoring Programme developed focussed at multiple benefits

## Catchment wide and at scale of Individual Interventions

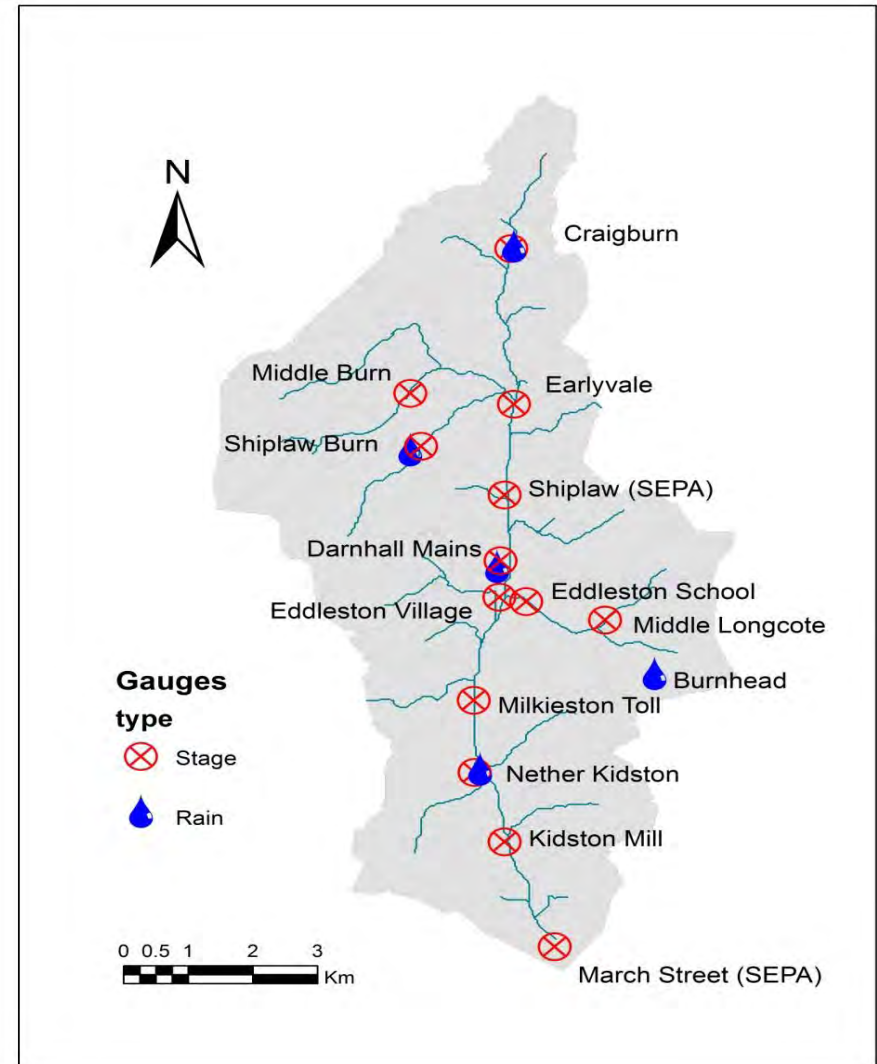
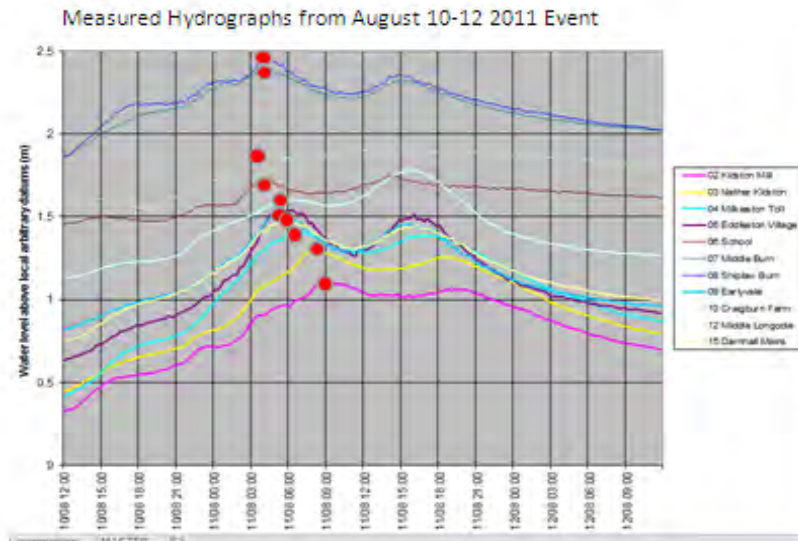
### Measuring:

- Precipitation and weather
- Flows and river Levels
- Groundwater
- Physical stream habitats and hydro-geomorphology
- Ecology – plants, fish, invertebrates
- Acceptability to local farmers



# New Monitoring network for Catchment flood flows

- Installed a new detailed Hydrometric Network to record river levels and flood flows. Also Weather stations
- Identification of how and where flood runoff is initiated and its conveyance downstream, causing flooding



# Monitoring the impact of re-meandering the river – detailed ecology

## Ecology surveys of re-meanders 2011/13

- Experimental sites - Cringeltie & Lake Wood
- Control sites (upstream & downstream)

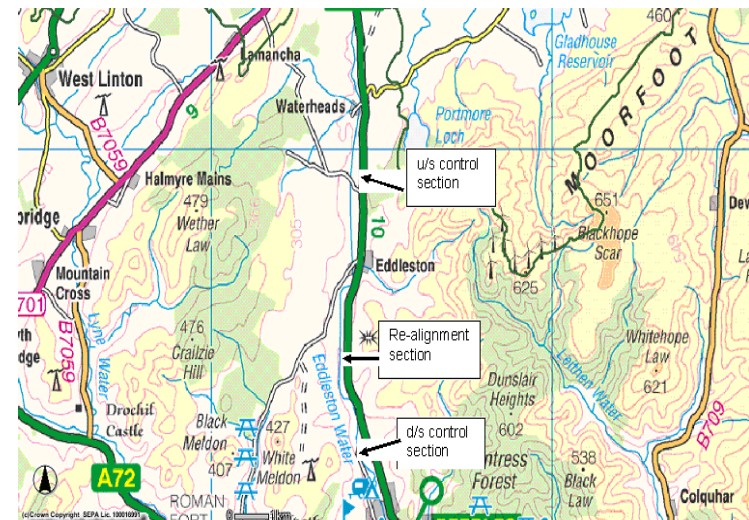
**Aquatic invertebrates** surveyed 2012 and 2013

**Macrophytes** surveyed 100m sections at Cringeltie, Lake Wood and control sections

**Channel hydro-morphology** surveys in 2013

## Implications for restoration:

Establishes a very detailed base-line for analysis of the impact of abiotic changes in the physical features of the river channel on the biotic communities – links geomorphology & ecology



# Impact of changes on catchment land use: -tree planting costs

## 2012 Completed Practical Works Costs

Darnhall: fencing, planting, pond creation.  
£7,688

Burnhead: riparian fencing/planting  
£10,598

Portmore: riparian fencing/planting  
£24,799

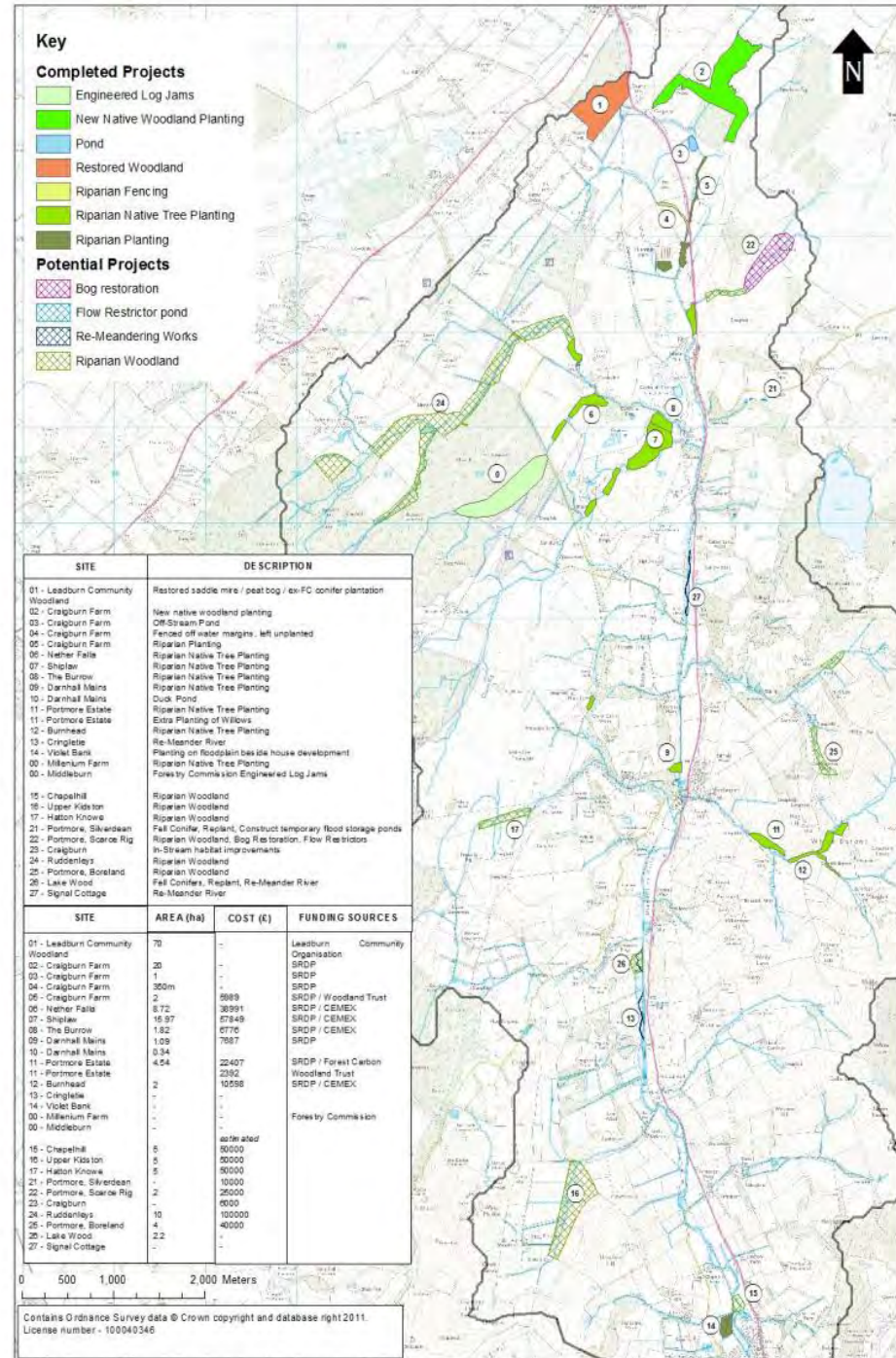
Shiplaw Burn: Fencing/planting  
£62,405

Nether Falla: fencing/planting  
£38,990

The Burrow  
£7,412

Craigburn farm: planting water margins.  
£5,989

**Total Costs catchment planting (2012)**  
**£157,881**



# Physical works on the ground - new meanders Autumn 2013



# Physical works on the ground - new meanders Autumn 2013



# Physical works on the ground - new meanders Autumn 2013



# Trabajo físico sobre el terreno- meandros September 2014





# Monitoring the impact of re-meandering the river – detailed hydro-morphology measurements

- **Detailed sediment sampling** and assessment of channel structure and form at Cringeltie, Lake Wood and 2 control sites
- **Matching ecological surveys** of species abundance and diversity at all sites



# Social challenges – Opportunities and Barriers to restoration

conducting a series of studies designed to answer some of the questions posed above. This will mean that members of the team may be seen working in and along the river, mapping it and taking measurements. Others will be talking with farmers, land-owners and those at risk of being flooded to seek their views. We very much hope that, if invited, you will assist the team from Dundee University in their investigations.


The outcome of the study will be a report (completed by the end of the year), which will identify opportunities for both restoring the physical condition of the river and reducing the risk of flooding. No actual works will be commenced or undertaken without more detailed studies and the involvement of local communities.

Should you have any questions or information that could be of interest to the Dundee University team,


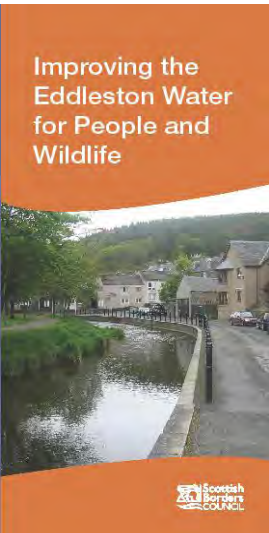
**please contact:**  
 Professor Alan Werritty (School of Social and Environmental Sciences, University of Dundee, DD1 4HN, tel 01382 385084); or  
 Luke Comins (Tweed Forum, South Court, Drygrange Steading, Melrose, Roxburghshire TD6 9DJ, tel 01896 849723).

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- **Interviews with key stakeholders:** Scottish Govt, SEPA, Tweed Forum, Scottish Borders Council, SNH, Tweed Foundation, Scottish Water, NFU(Scotland), Scottish Wildlife Trust, RSPB, Country Landowners Business Association.

In August 2009 the Tweed Forum invited the University of Dundee to undertake an initial study on how the Eddleston Water might be restored, so that it reduces the risk of flooding in Peebles and the village of Eddleston, and provides a better habitat for wildlife.

This forms part of a major initiative by the Scottish Government and Scottish Environment Protection Agency (SEPA) to improve the status of all of Scotland's rivers by improving their physical condition to support wildlife (restoring them to a more 'natural' condition), and by slowing their flow (where possible) to reduce the risk of flooding downstream.


Increasingly the public wishes to see rivers returned to a more 'natural' state and flood risk reduced by means that are both cost-effective and sustainable over the long term. Neither of these goals is easy to achieve as some of the science and technology required for successfully restoring rivers is still in its relative infancy. The valley of the Eddleston Water is an ideal location in which to explore these ideas for the following reasons:

- Much of the main stem of the river was straightened in the mid 19th century when the Edinburgh to Peebles railway was constructed
- This has resulted in a poor habitat for wildlife (notably salmon) and has increased the speed with which water running off the surrounding hills (generated by rain storms on the higher ground) flows onto the main valley floor and downstream to the communities of Eddleston and Peebles.

The overall goal of the initial scoping study is to explore ways in which:

- conditions for wildlife could be improved (eg by restoring the former meanders and improving the habitats within the river channel itself); and
- the downstream flood risk could be lessened, by reducing the rate at which runoff is generated from the surrounding hills and by slowing flood waters as they pass down the river, before reaching Eddleston and Peebles.

Over the next two months, a team from Dundee University (working closely with Scottish Borders Council) and under the direction of the Tweed Forum) will be



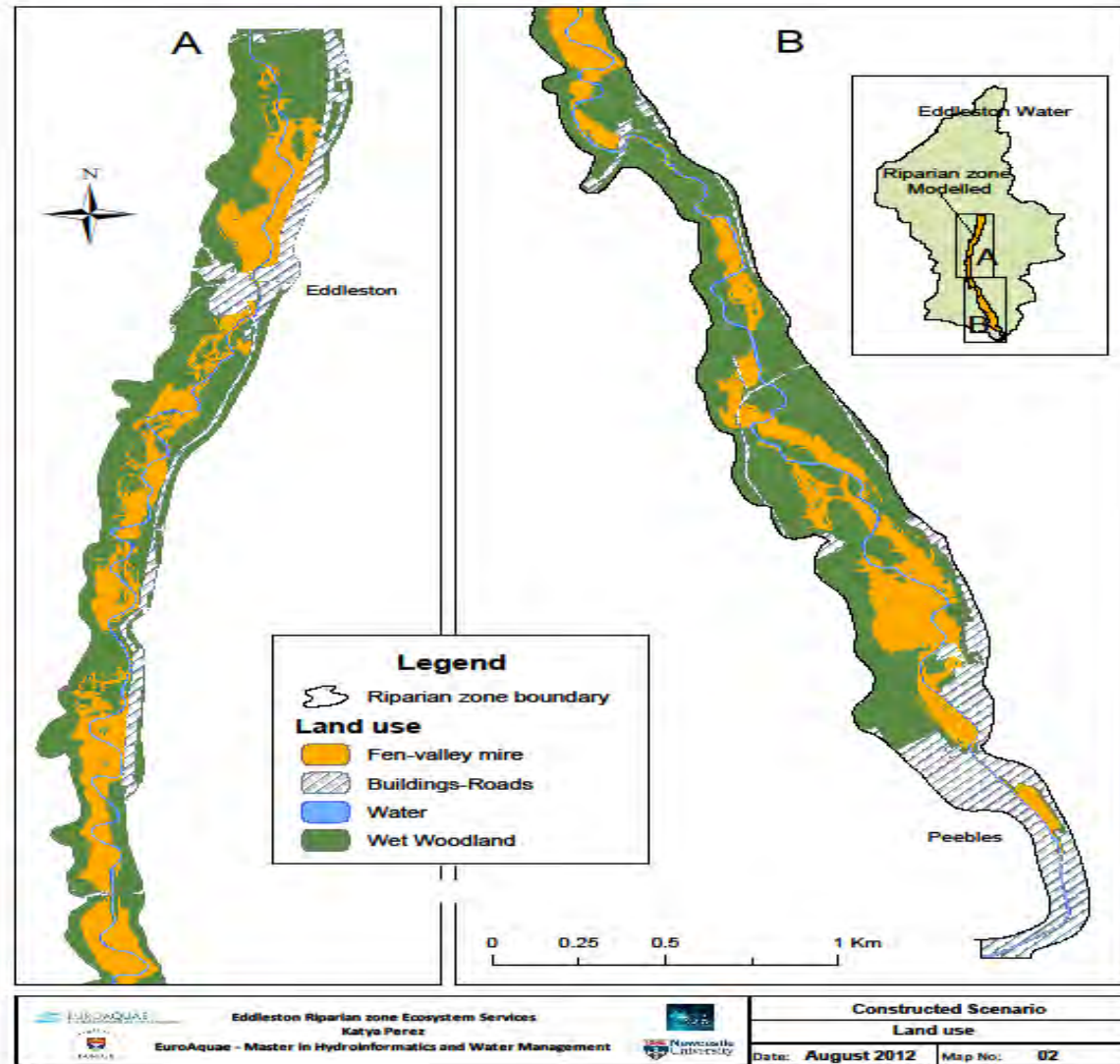
- **Interviews with landowners** (three floodplain and two upland famers) middle-aged, male, long-term landowners in the valley (>30 years) with several sources of income.
- **Literature review**
- **On-going study on Farm businesses and NFM measures across Tweed**

# A potential projected (modelled) flood regulation land use scenario

## Flood risk regulation scenario, using NFM techniques:

Farming in the floodplain is replaced by Wet Valley Woodland - max flood retention & high Mannings 'n'

River course has now been “re-meandered”, based on course of the old river and embankments “removed”



# Multiple benefits? - Ecosystem Services selection

Flood regulation prioritised, other services chosen as most relevant for this scenario:

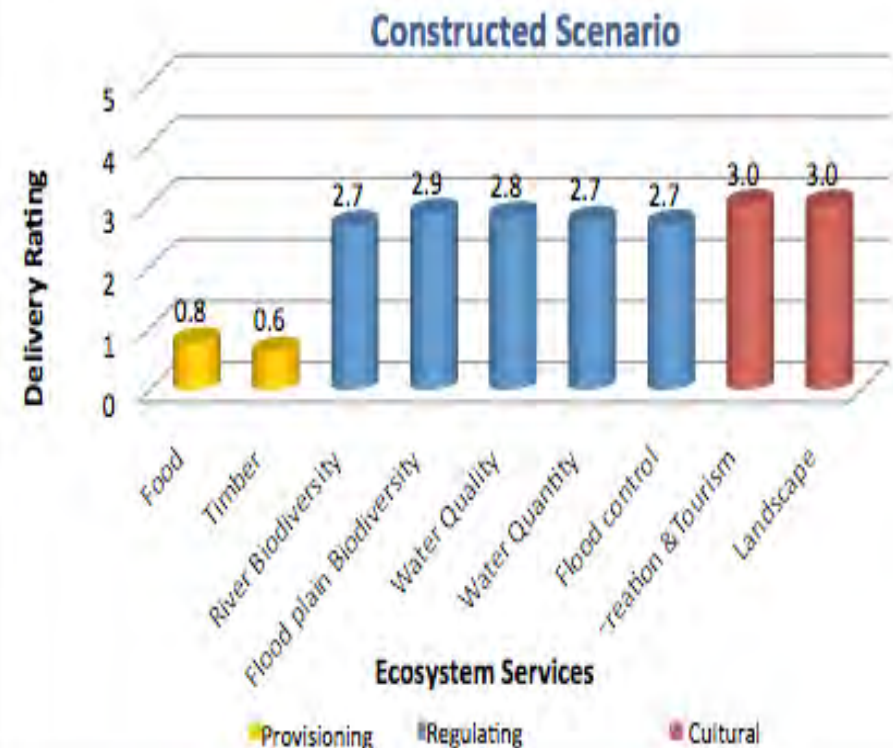
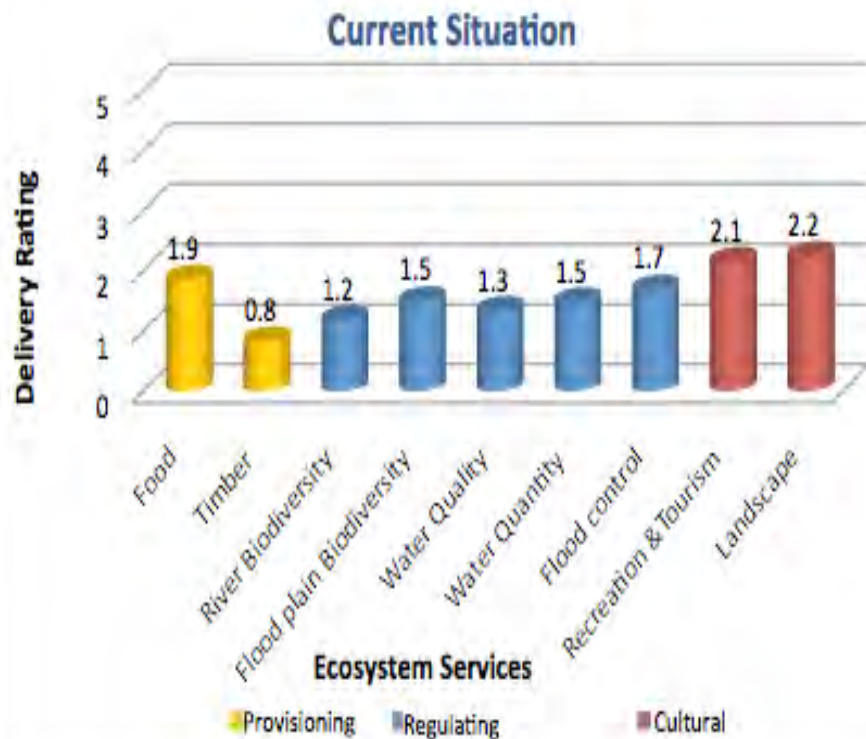
Provisioning	Regulating	Cultural
Food	Water Quality	Recreation & Tourism
Timber	Water Quantity	Landscape
	Flood control	
	Flood plain biodiversity	
	River biodiversity	

# Ecosystem service scores – but is it worth it?

Changing land use to promote NFM gives enhanced flood regulation....  
→ But other services also impacted positively/negatively in new scenario

*But what are costs and benefits – what restoration is ‘worth’ doing?*

*2014 – assessing Cost-Benefits & costs avoided in flooded communities*



# Eddleston Water - unique monitored pilot catchment for ‘proving’ the value, costs and benefits of restoring functionality and processes at a catchment scale

## Integrating Science and Policy at the catchment scale

River flow and flood gauges

Ground water surveys and boreholes

Rainfall and weather stations

River habitats and hydro-morphology

River biology – fish, plants, invertebrates

Land-owner & community engagement

Ecosystem service initiative

Long-term funding  
and a successful  
Partnership Approach

## Long term Value

