Interreg
North Sea Region
Building with Nature

Building *with* Nature

Prof Chris J Spray - University of Dundee

Natural and Nature Based Features Symposium, Edinburgh - May 16th 2019

University of Dundee

Why are we doing this project?

...to make coasts, estuaries and catchments of the North Sea Region (NSR) more *adaptable* and *resilient* to the effects of *climate change*.

Ultimately: To better protect people, communities, infrastructure and economy from the *impacts of flooding and coast erosion*.

Frequency and costs of floods are rising

Doing nothing is not an option!

2000-15 - total damage from floods globally just under **$27bn/year** (Guha-Sapir et al, 2016); and could rise to **$63bn/year by 2050**. In same period c **90k deaths** due to floods

Annual losses across Europe have been estimated at nearly **Euro5,000 million** (Jongman *et al* 2014)

SEPA estimated a cost of **£252** million in expected annual flood damages across Scotland, with 108,000 existing properties at risk of flooding, and an additional 60,000 predicted to be put at risk in the future due to climate change

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EUROPEAN UNION

Lead Beneficiary Rijkswaterstaat

Total budget € 6.800.040

ERDF contribution: € 3.400.000

November 2015 – June 2020

- **Tackling technique** in **13 living labs** in our catchments and at our coasts
- **Upscaling** through business case guidance development
- Active dissemination to governance partners through a **Policy Learning Group.**

Building with Nature philosophy:

The power of nature can be used to help achieve our goals. Knowing the system and being able to work with the forces present will yield an easier adaptable, better sustainable and multi-beneficial situation whilst reducing costs, optimizing benefits and involving stakeholders.

Partnership project for shared learning

Partners

Partner locations

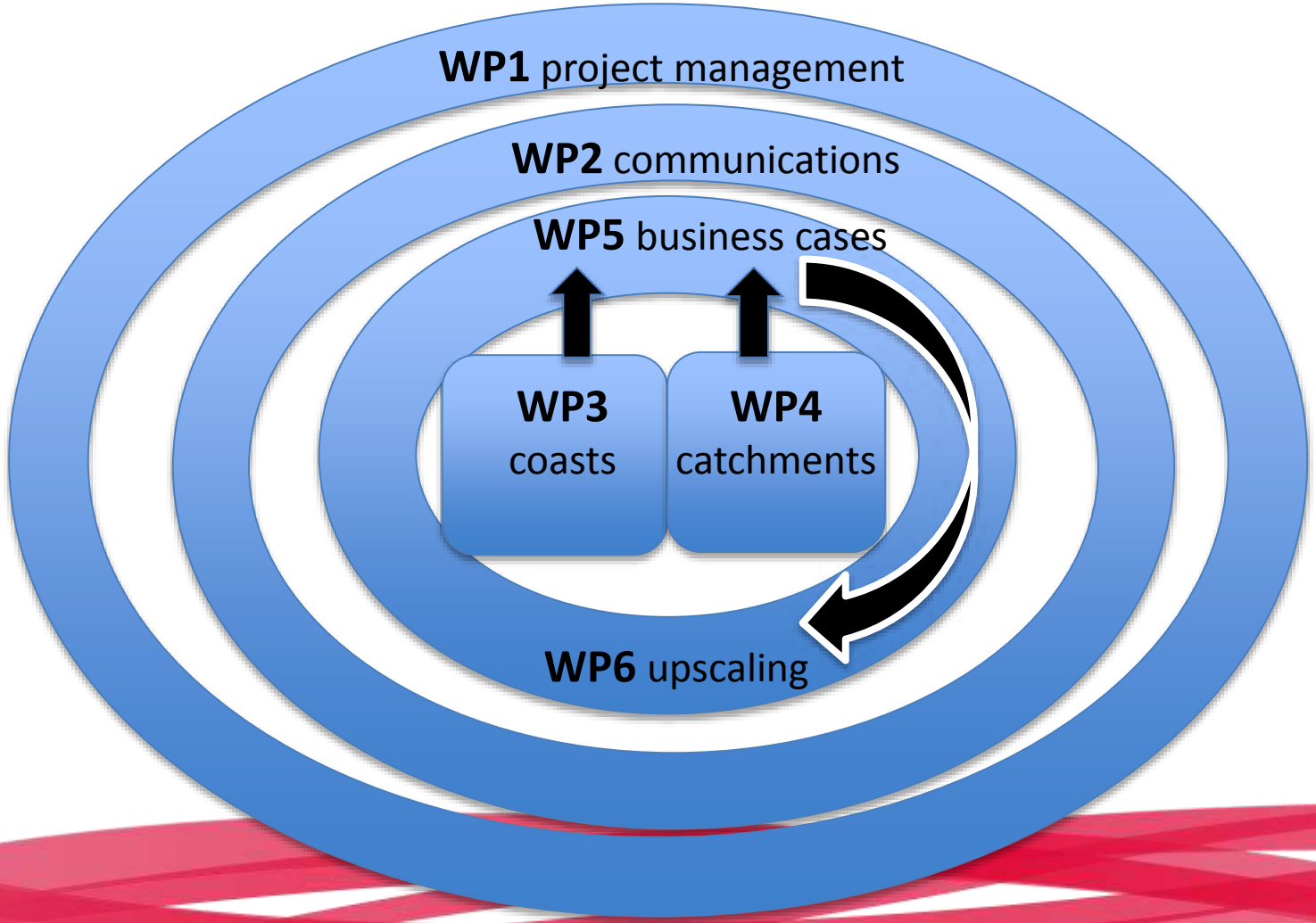
Catchment case studies:

- Scotland
- Sweden
- Netherlands
- Belgium

and

- *Norway*

6 work packages that work together



Approach

1. • **Living laboratories** (WP3 on ***coastal*** work (led by Quirijn Lodder); WP4 on ***catchment*** work, led by Debi Garft)
2. • **Monitor performance** and **analyse cost-benefits** (*business case guidance* WP5)
3. • Explore and overcome **legal and governance barriers** (*Policy Learning Group* WP6)
4. • Explore the **opportunities to apply BwN across the North Sea region** (opportunity mapping WP5, dissemination WP6)
5. • Design guidelines and references for **international uptake** (WPs 2, 3, 4, 5 and 6)

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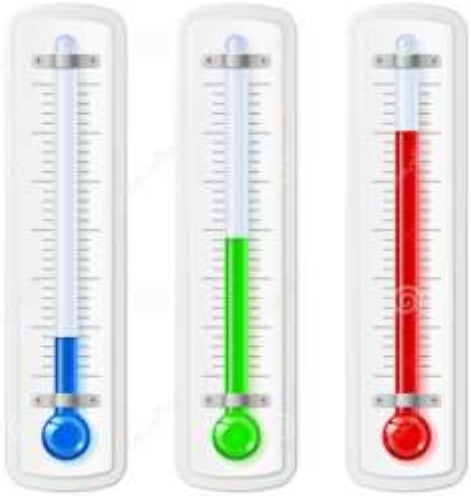


3 Project indicators

- 700 km of new coastline plans based on Building *with* Nature principles - using shared insights, designs and demonstrations of the effectiveness of the methods of Sand Nourishments
- 550 km of new catchment areas managed based on Building *with* Nature principles - using shared BwN techniques as a result of the effectiveness of project demonstrations
- Climate change resilience increase at target sites. 10%

Work Package 3:
Resilient coastal laboratories

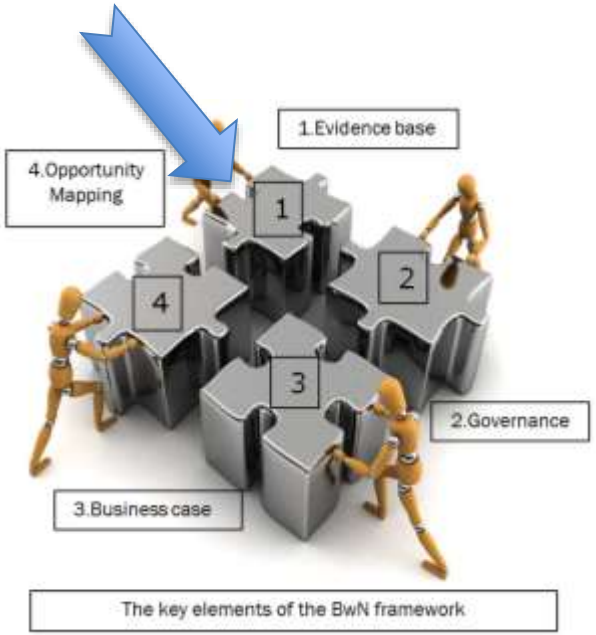
Goals:

+ **Common transnational** evidence base
+ **Demonstrate** BwN/NNBF based climate change adaptation solutions
+ **Justify** investments and **optimise** the **effectiveness** of BwN solutions
+ **Generate** the **evidence-base** to incorporate BwN in **national policy** and investment programmes

Resilient coastal laboratories – Work Package 3

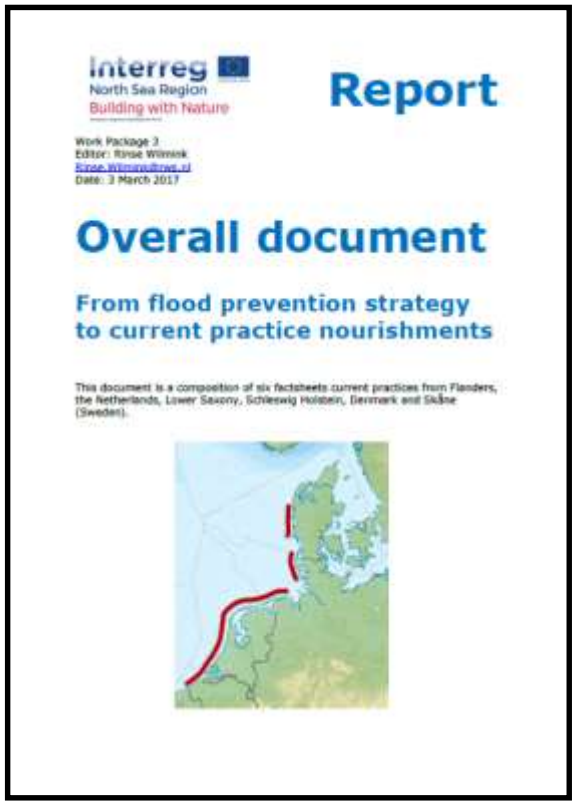
By means off:

+ 8 coastal laboratories
+ Create and share beach and shoreface nourishment best practices (establish transnational knowledge/evidence base)
+ Assess their effectiveness together
+ Assess effectiveness of eelgrass solutions to counteract erosion



The key elements of the BwN framework

Evidence base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Report

Work Package 2
Editor: Rinse Wilmink
Rinse.Wilmink@rws.nl
Date: 3 March 2017

Overall document

From flood prevention strategy to current practice nourishments

This document is a composition of six factsheets current practices from Flanders, the Netherlands, Lower Saxony, Schleswig Holstein, Denmark and Skåne (Sweden).


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Report

Subject: Methodology co-analysis
Date: 5 February 2018
Title: Co-analysis: a shared common approach

Co-analysis of nourishments;

Coastal state indicators and driving forces

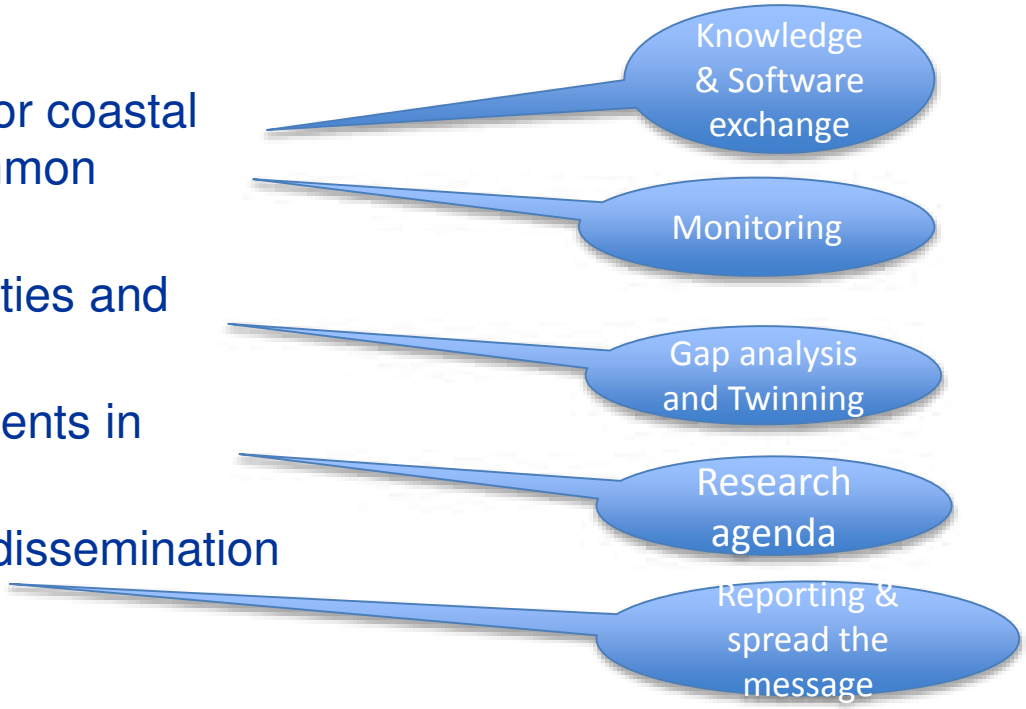
A shared common approach

Date: 05/02/2018
Status: Final version

Key elements for the uptake of the concept of BwN/NBS in Europe (EC,2015)

What about WP3?

+ National analysis for coastal labs based on common approach
+ Identify communalities and differences
+ Suggest improvements in evidence base
+ Active knowledge dissemination
+ ….



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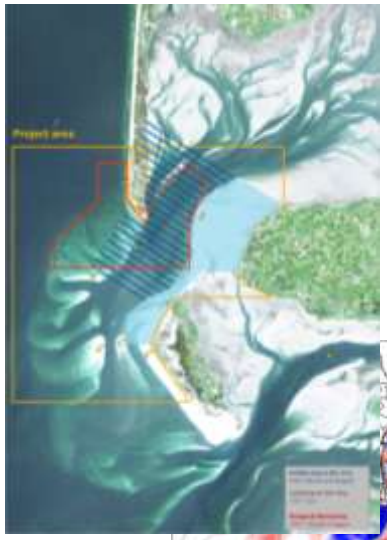
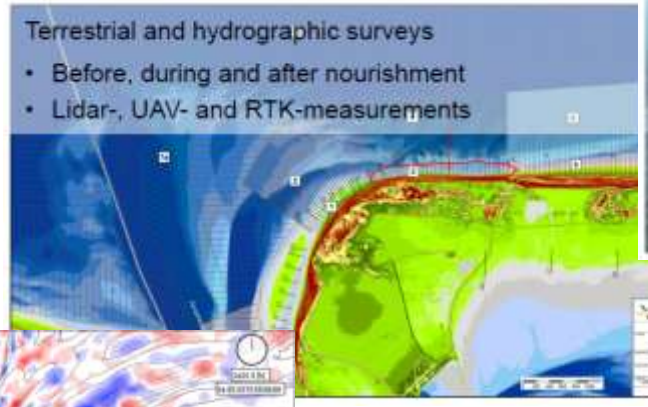
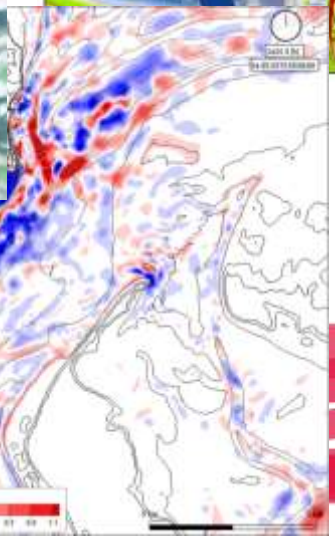
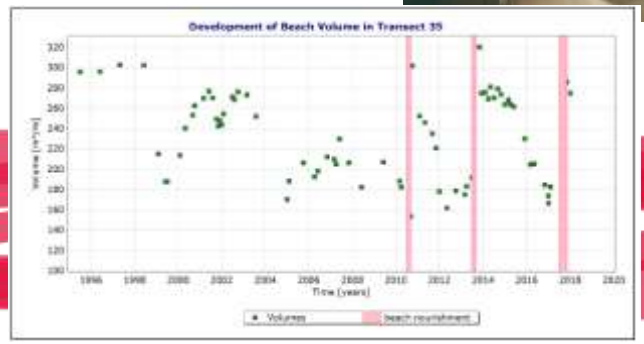
A lot of examples and shared interests!









WP4
Catchment case study aims

- Consider ***what we mean by Building with Nature*** (BwN) across river catchments in ***different environments*** with ***different pressures.***

- Identify the ***gaps in our collective knowledge*** and discuss how best to fill them.

- Better understand ***monitoring and modeling techniques***.

WP4 BwN Catchments

Building with nature in river catchments is about:

Understanding how water moves through a catchment, from source to impact and how we can manage that flow by creating, enhancing or restoring the natural characteristics of the environment.

BwN WP4

Catchment case study projects and partners

- **Scotland** - **Eddleston Water Project** - **Scottish Government, Scottish Environment Protection Agency (SEPA), Tweed Forum**
- **Sweden** - **Restoration of streams, Heisingborg, catchment area of Raan - Lansstyrelsen Skane**
- **Belgium** - **Flood prevention in Kleine Nete catchment** - **Flanders Environment Agency**
- **Netherlands** - **Room for the River** - **Rijkswaterstaat**
- ***Norway*** - ***Norwegian Water Resources and Energy Directorat***

Restoration of streams catchment area of Råån, Sweden

Study of the effects of constructed wetlands, flood plains and two-stage ditches in the whole catchment area

Uses modelling and monitoring in specific locations

Development of methods to identify flood risk prone locations.

Restoration of streams catchment area of Råån, Sweden

Activities:

- ***Hydrological modelling*** of the effects of constructed measures (restoration of channelized streams, constructed wetlands) compared to channelized streams
- **Monitoring of biological structures, biodiversity and hydrological function** in two – stage ditches of different design and ages
- Development of ***methods to identify flood risk prone location***s (GIS analyses)

River restoration Kleine Nete:

Creating ecological flooding zones at recreation areas

Kleine Nete: canalized water course since 1960

More efficient water evacuation, resulting in

- Increased flood risk downstream
- Lower groundwater levels upstream
- Decline of ecology
- Loss of water storage capacity
- Embankments close to the river vulnerable to erosion

Search for possible water storage areas upstream

Valley of Kleine Nete is ecologically very valuable

→ River restoration using Building with Nature approach

FLANDERS ENVIRONMENT AGENCY

River restoration Kleine Nete:

Creating ecological flooding zones at recreation areas

Two recreation areas (economic function)

- Camping site Korte Heide
- Amusement park Bobbejaanland

⟶ innovative solutions for multifunctional use of space

⟶ create a win-win situation for both the river and the recreation areas

Project to start up within Interreg – Building with Nature

The Eddleston Water Project

Scottish Government long-term empirical study

- Scale – 70 km2
- Variety of typical land use types
- Good source-pathway- receptor model
- Substantial modification over time – 'bad' ecological status due to straightened channel
- Flooding issues in Eddleston and Peebles

Aims

- investigate the potential of **reducing the risk of flooding** to the communities of Eddleston and Peebles by ***restoring natural features*** within the catchment
- **improve the river habitat** for wildlife and fisheries
- work with **landowners and communities** to maximise the benefits they gain from such work, **while maintaining farm business productivity/profitability.**

Achievements to date

Monitoring network – establish baseline and measure impact

- Surface water
- Groundwater
- Ecology - fish, invertebrates, plants
- Ecosystem services
- Economic

BwN measures:

Upland (Source) areas:

Constructed 116 high-flow log structures to restrict flow and recreate a basin mire

Planted 207 hectares with >330,000 native trees

Created 28 upstream run-off attenuation features and ponds

Valley/Floodplain (Pathway) areas:

1 km contour planting of hedges

Created one floodplain pond

Re-meander 2.8 km of river, and reconnect with the floodplain

Side channels as river restoration measure: Netherlands:

Why side channels?

- Often applied in Room for the River program
- Under investigation in Delta program
- Uncertainties about rate of sedimentation/erosion
- Effects important for safety and shipping
- Ecological benefits
- Subject of research program RiverCare

Side channel Klompenwaard, Waal river, near bifurcation point

Side channels as river restoration measure:

Activities:

- Inventory of existing side channels
- Analyzing behavior of previously constructed side channels
- Hydraulic and morphological monitoring
- Model analysis and comparison with field observations

Western channel, Gameren (river Waal), The Netherlands

WP4 Partners reviewed potential areas for collaboration

- Techniques of BwN building and implementation – design, location and build
- Operation and maintenance
- Costs of BwN measures – installation & whole life
- How to assess effectiveness?
- How to assess benefits
- How to assess non-flood benefits
- Novel techniques
- Monitoring programmes & protocols
- Production of reports and policy briefs
- Academic publications
- Mutual training and field exchanges
- ……..

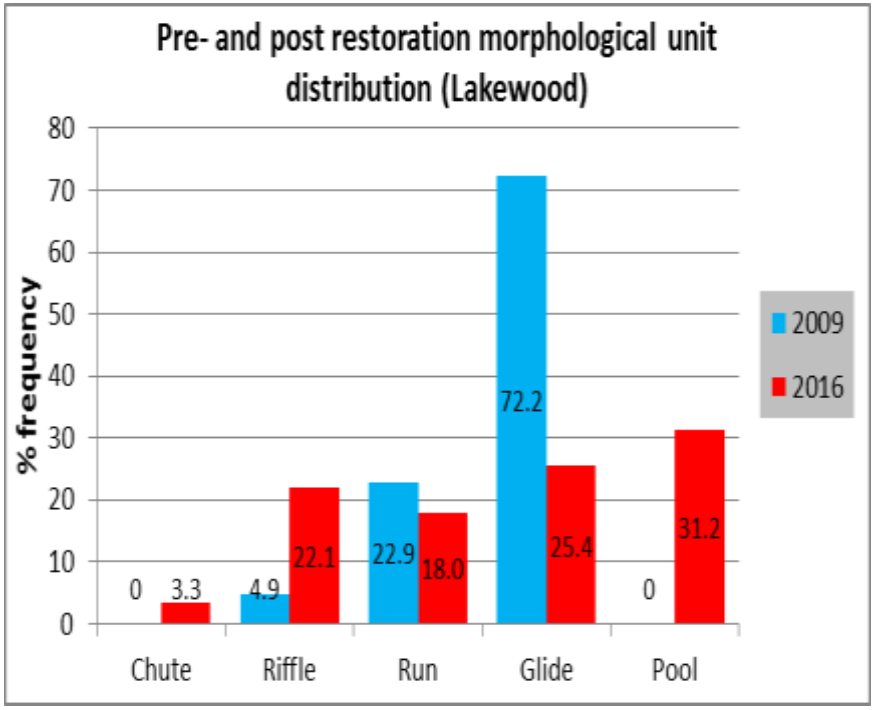
Transferable individual Project learning to other partners – Eddleston Water

Linking hydro-morphological changes to the river channel for NFM with ecological response

An increase in overall ***physical diversity of habitats*** within **re-meandered sections,** and an increase in habitat area

An increase in the extent of ***spawning habitats for salmon***, due to changes in the spatial distribution of favoured micro-habitats, and in ***fish size***

A rapid recolonization of re-meandered ***channels by aquatic macroinvertebrates***



Pre- and post- restoration morphological unit distribution. Numbers represent percentage cumulative length of each morphological unit.

Review and testing of Hydrological and Hydraulic Models – using the rich data and survey information from the Eddleston catchment

Aims of modelling

1. To evaluate the **most appropriate approach to modelling the effectiveness of NFM measures** at the reach scale in attenuating peak flows.
2. To **determine**, based on the literature, **the 'best of breeds' approaches to modelling measures that cannot be tested using the data within the catchment**

Final Objectives

To develop a **combined hydrologic and hydraulic model of the Eddleston Water catchment (2D)** that can be used to:

- test the cumulative effectiveness of existing measures in reducing catchment scale flood risk over a range of events
- develop scenario analysis for evaluating the potential effectiveness of future measures within the catchment
- **provide a scientifically well founded and fully documented model for future use and sharing with Building with Nature partners and**

Joint Partnership learning –
led by different projects

Netherlands - Rijkswaterstaat

Using the catchment case studies to **explore if it is possible to develop an Evaluation Framework for Nature-based Solutions** – one that addresses issues of:

- Efficiency of a project
- Effectiveness of a project
- Process/social support of a project
- Flexibility of a project

Where to go next?

- Elaborate proposed Evaluation Framework (indicators)
- Apply framework to a large set of existing NBS and "grey" solutions
- Define typologies of challenges and of NBS
- Finally: connect the dots!

https://go.usa.gov/xETZ7

Joint Partnership learning –
led by different projects

Scotland – Governance

Working jointly across WP4, we examined governance factors that influence the introduction and implementation of Natural Flood Management within river catchments

- The degree to which **Natural Flood Management (NFM) is 'required' and promoted** by government, and the enthusiasm with which it is met by diverse stakeholders is **constrained by the nature of flood risk itself** and by **how this is perceived**
- Notwithstanding major differences in this framing of flood management, we report **widespread enthusiasm for partnership working to deliver** NFM integrated with options for **wider multiple land-management benefits**
- **Governance differences influence collaboration** of relevant stakeholders, **impacting the uptake** and ease of delivery of NFM measures
- Effective progress requires stakeholder engagement that encourages the inclusion of a **'bottom-up' approach**, an ideal in governance that, at least at a local level shows evidence of success in delivery of NFM, though challenges remain from a national perspective.

WP5:
Business case development

Comprehensive scoping: involving all potentially relevant relations and stakeholders by assessing the actual and potential network of ESS

Opportunity mapping: identifiying potential BwN concepts for further exploration, based on a limited number of indicators, as initation of the design process.

Design optimization: enabling added values across a wide range of stakeholders and handling uncertainties

Valuation and financial engineering: value estimation and capturing if needed by proposing new financial mechanisms

Management arrangements: that cover use, adaptive development and handling of risks and unforeseen developments

WP5:
Business case development - results

BC guideline: general approach, guidelines and examples covering all steps from scoping and opportunity mapping up to implementation and subsequent management and adaptive development, with special attention to BwN relevant aspects (e.g. undercertainties, variation, nature legislation, multiple use) and the need for design optimisation matching local needs and system characteristics

Opportunity mapping: an overview of BwN concepts, in all their possible variants, and an assessment of their potential based on key questions, key performance indicators and their general cost and benefits across all relevant ecosystem services.

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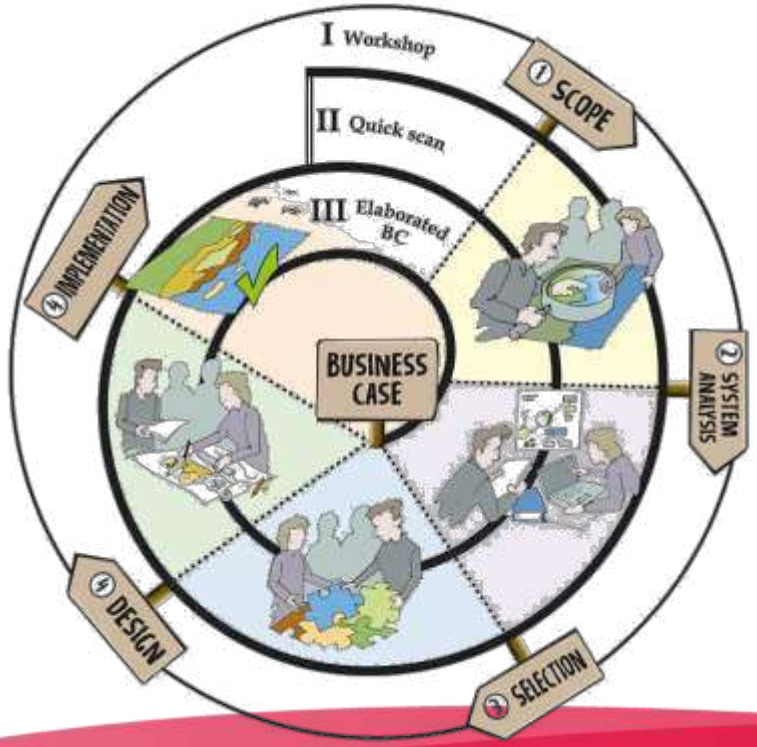
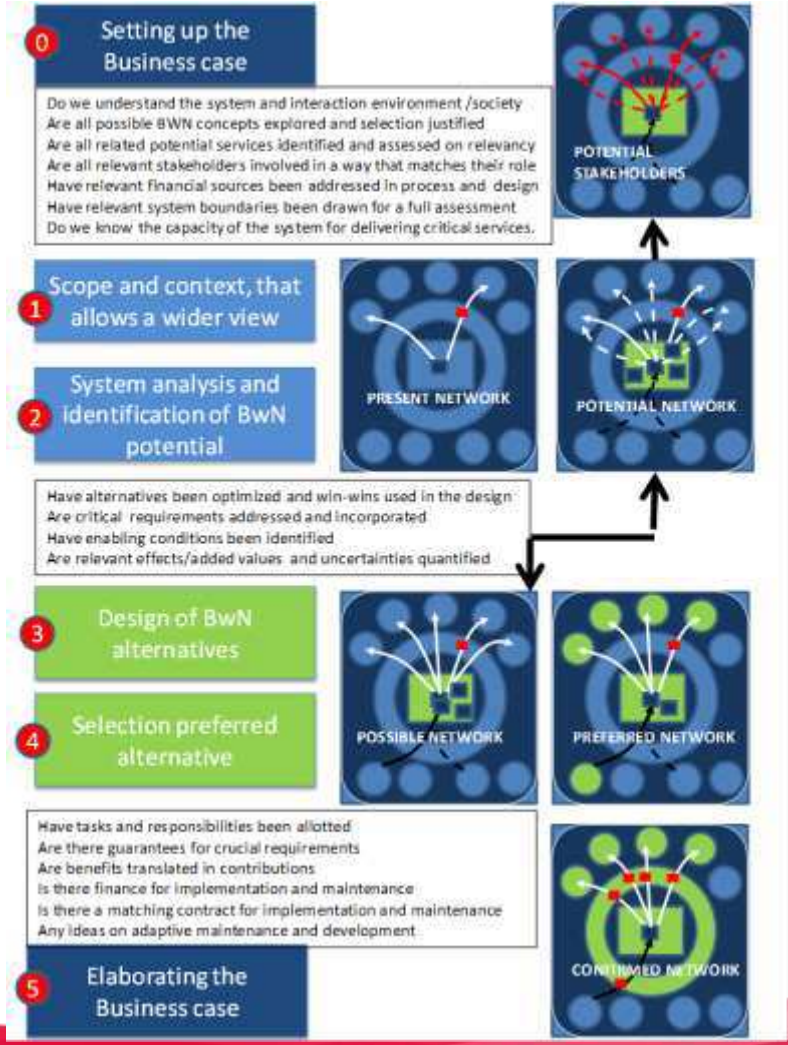
WP5: business case development





Conclusion:
Our project is about

- **Protecting** people, properties, communities, infrastructure, businesses…
- **Active research** – learning from doing
- **Collaborating to collect a robust evidence base** for BwN techniques - what doesn't work is as important as what does work.
- **Sharing that knowledge base** in our own communities and wider.
- **Demonstrating the value of working together!** Learn from each other but also challenge each other.

Thank you

With thanks to the funders and supporters of the work on Eddleston Water and all the other Building *with* Nature catchment case studies covered in this presentation; to my colleagues and partners in Work Package 4; and to colleagues in other Work Packages who have all helped and provided information for this presentation.

For further information on Building *with* Nature see:
https://northsearegion.eu/building-with-nature/

For information on the **Eddleston Water Project** see:
http://www.tweedforum.org/projects/current-projects/eddleston

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