Case study 36. Exmoor Mires Partnership

Authors: Morag Angus, Mary-Rose Lane, Richard Brazier

Main driver: Restoring the ecohydrological function of peatlands

Project stage: Implementation/construction

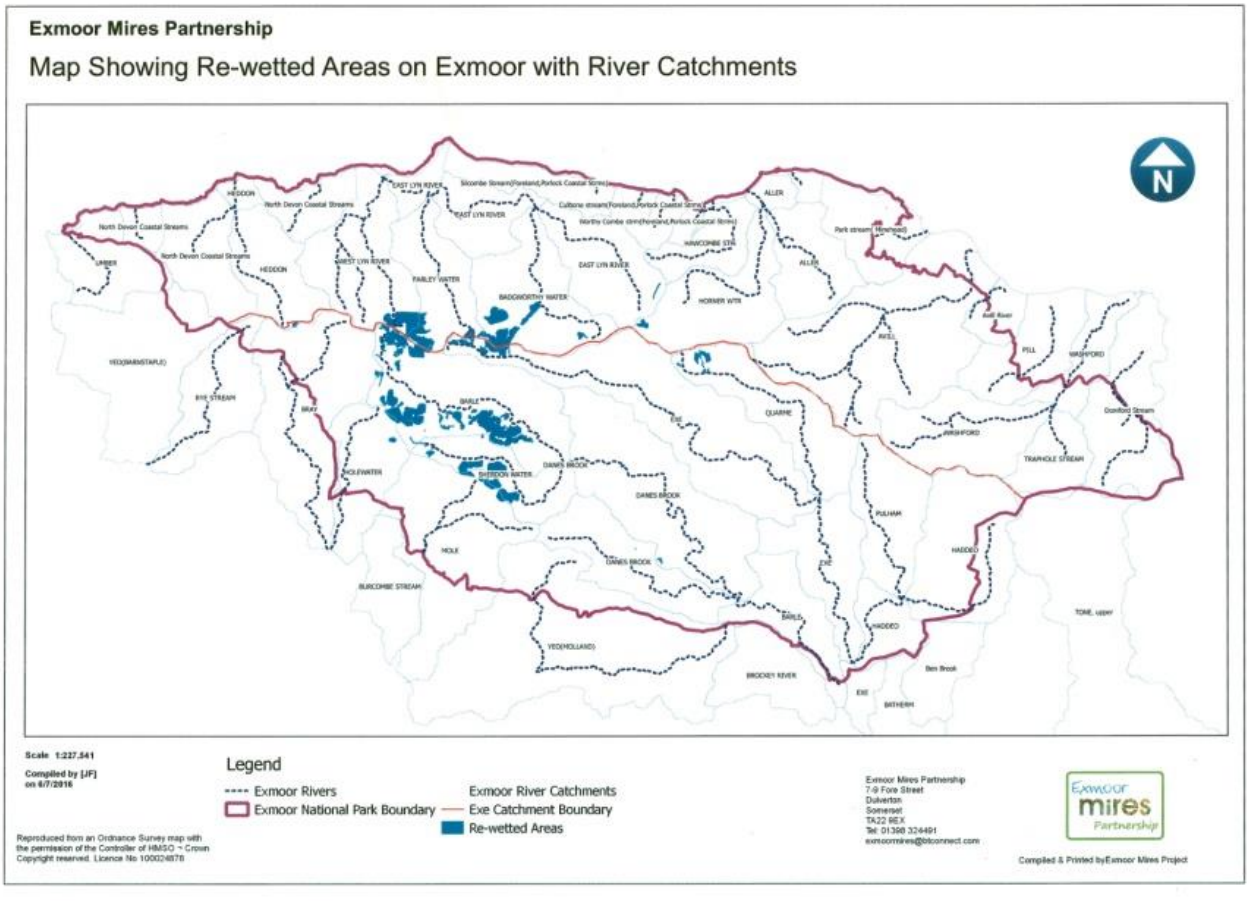
Photo 1: **Restored ditch showing pools formed behind peat blocks and wet areas**

Project summary:

The shallow and maritime peatlands of Exmoor in south-west England (Map 1) have been heavily influenced by human activity over many centuries, with significant areas drained in the 19th and 20th centuries in an effort to improve agricultural productivity. Water is no longer stored as efficiently in the peat. During periods of high rainfall, more water runs off the land and flows downstream into already swollen rivers. In dry periods, river baseflows are poorly maintained. The peatlands have become dry and consequently are losing more carbon (via both fluvial and gaseous pathways) than they accumulate. The quality of water leaving the peat bogs is also deteriorating. The holistic, multiple benefits approach provided by the Exmoor Mires Partnership is helping the peatlands to recover to their more natural ecohydrological structure and function.

- Cost: £4.5 million (2010 to 2020) to restore 3,000ha of peatland, with 1,400ha achieved by December 2016.
- Water storage: A rise in the water table level of 2.65cm on average across the areas monitored and up to 21cm in some deeper peat locations.
- A 33% reduction in storm flow leaving the restored sites, equivalent to 6,630 Olympic sized swimming pools when extrapolated across the total restored area.
- Examination of the hydrograph and flow duration curve at the Spooners monitoring catchment shows a clear increase in base flow levels post restoration.
- Water quality: An overall reduction in the total carbon yield from the restored sites of up to 50% since restoration.
- Biodiversity: 31% of Exmoor peatlands restored to their ecohydrological function, contributing 1,400ha by December 2016 to the national Priority Blanket Bog habitat restoration targets.

Key facts:



Map 1: Location map for Exmoor Mires Partnership with Simonsbath, Somerset (SS7778439304) as the central point

1. Contact details

Contact details	
Names:	Morag Angus, Exmoor Mires Partnership Mary-Rose Lane, Environment Agency Richard Brazier, University of Exeter
Lead organisations:	Exmoor Mires Partnership
Partners:	Environment Agency, Natural England, South West Water, Historic England, Exmoor National Park Authority, University of Exeter, non-governmental organisations and representatives from farming community
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2. Location and catchment description

Catchment summary	
National Grid Reference:	SS7778439304 (central point)
Town, County, Country:	Exmoor towns and villages, Devon and Somerset, UK
Regional Flood and Coastal Committee (RFCC) region:	South West
Catchment names and size (km^2):	Exe catchment: work in Exe - Quarme (47.9 km^2), Exe Quarme - Haddeo (19.1 km^2), Upper Barle (36.1 km^2), Middle Barle (41.7 km^2), Lower Barle (16.3 km^2) and Quarme (22.6 km^2) subcatchments North Devon Streams catchment: work in Badgworthy (25.48 km^2), Farley Water (16.7 km^2), Heddon (17 km^2), Upper East Lyn (19.5 km^2), Lower East Lyn (15.56 km^2) and West Lyn (24.26 km^2) subcatchments West Somerset Streams catchment : work in Horner Water (22.9 km^2) subcatchment
River names and typology:	The physical works are taking place on man-made ditch systems dug to drain the peatland headwaters of the rivers/streams listed above. No interventions are being installed in the watercourses themselves. The steep headwater streams rise on shallow peats underlain by sandstones and slates.
Water Framework Directive water body references:	GB108051020570, GB108051020590, GB108051020500, GB108051020580, GB108051020611, GB108051020600, GB108045020930, GB108045020880, GB108045020870, GB108045020920, GB108051020220, GB108045020890, GB108045015100.

Land use, soil type, geology, mean annual rainfall:	Agricultural Peats, old and new red sandstone, Devonian slates and shales Average annual rainfall at Simonsbath: 1,768mm

3. Background summary of the catchment

Socioeconomic/historic context

In an effort to improve agricultural productivity, the peatlands of Exmoor have been heavily influenced by human activity over many centuries, with significant areas drained in the 19th and 20th centuries. Other land management practices such as peat cutting, moorland burning, varying grazing levels and deforestation have all lead to the peatlands and surrounding habitats becoming ecologically and hydrologically degraded. However, this also tells the story of human history on Exmoor. Today the values people place on the open moorland are wide-ranging and diverse, and so the Exmoor Mires Partnership works in the context of a landscape that is valued in many ways.

Flood risk problem(s)

Historic flood events such as those recorded in Dulverton between 1952 and 2012, along with the 1952 Lynmouth floods, have seen these communities affected by flooding. The links between land use and flood risk have not been specifically modelled on Exmoor. Exmoor is covered by JFLOW, a basic national level modelling of the flood zones. In 2011, however, the Exmoor Mires Partnership established 2 monitoring catchments to investigate the relationships between damaged and restored shallow peatlands and flow responses. After 3 years of post-restoration monitoring at the headwater catchment scale, research at the University of Exeter is focusing on extrapolating to the larger catchment and eventually moorland scale. This will help improve understanding of whether this work will benefit communities at risk of flooding on Exmoor.

Other environmental problems

- **Water quality**. High levels of dissolved organic carbon (DOC) discolour the water and increase its acidity. South West Water extracts water directly from the River Exe and the cost of water treatment is ultimately passed on to the bill payers.
- **Habitat**. A significant proportion of the Sites of Special Scientific Interest (SSSI) on Exmoor and Priority blanket bogs were in unfavourable condition. Loss of both botanical and faunal species has been recorded over many decades on Exmoor.
- **Historic environment**. Artefacts are exposed and features lost as peat degrades and is washed away. Knowledge of the historic environment on high Exmoor was generally limited and under recorded until the Exmoor Mires Partnership led investigations and research into this area.

4. Defining the problem(s) and developing the solution

What evidence is there to define the flood risk problem(s) and solution(s)

Peatland restoration began on Exmoor in the 1990s in response to a perception among the angling community that the River Exe was increasingly spatey. A small-scale project was initiated to understand whether perceived changes in river flows were directly related to land use change on the moorland. This small project ran from 2000 to 2010, and led to the current integrated partnership with monitoring to understand what multiple benefits could be realised by the restoration of Exmoor's shallow peatlands. SSSI condition assessments showed degraded blanket bogs and moorland bird surveys recorded a reduction and loss of important breeding waders and moorland birds.

The partners at the beginning were open to exploring a range of problems that gradually became informed

by best practice and scientific evidence. The partnership has evolved over the 16 years to date from working from best professional judgement to now helping inform national standards and evidence-led peatland restoration.

The multiple benefit approach has meant that flood risk management is just one benefit that can be addressed while putting in place a whole range of ecosystem services. It is now an integral part of a range of sustainable land management practices.

What was the design rationale?

The Exmoor Mires Partnership was designed in line with the following multiple benefit objectives.

Objective 1

- Hydrological regime change: re-establishment of natural stream flows in the headwater tributaries of the Exe and associated Exmoor catchments

Increased storage and retention times of surface waters should result in local modifications to the existing hydrology with small-scale reductions in peak flows, elevated baseflows and reduced water velocities. The buffering capacity of restored wetlands may contribute locally to the reduction of environmental damage associated with extremes in flows.

Objective 2

- Hydrochemical process change: changes to patterns of run-off and improvements in water quality of surface waters (suspended solids, colour, turbidity, pH, metals, nutrients and organics)

Increased storage in the restored mires may, when they are not saturated, reduce the speed of hydrograph response to rainfall, rates of erosion and stream sediment load (quality and quantity) and the risk of significant changes to channel morphology and consequential impacts on the stream biota.

Objective 3

- Wetland habitat and biodiversity: a more natural hydrology, active peat growth, reduced erosion, increased habitat extent and biodiversity, and wetting of previously drained wetland

Rewetting should improve the quality, diversity and structure of vegetation and associated wildlife. Within SSSIs, this will help achieve and maintain favourable condition – a government target. For blanket bog and valley mires, it should improve conditions for breeding waders subject to localised extinction or extremely low population densities. Increased open water, including bog pools, will enhance invertebrate, amphibian and bird numbers.

Objective 4

- Riverine habitat and aquatic ecology: re-establishment of natural stream flows, reduction in bank and peat erosion, and rewetted marginal vegetation

More natural flows may reduce the risks of extreme flow events, result in improved river water quality and provide riverine conditions more conducive to protected species such as the Atlantic salmon, otter and river jelly lichen.

Objective 5

- Global warming/climate change mitigation and adaptation: reverse the role of damaged peatlands from being net carbon dioxide producers into net carbon dioxide accumulators, and achieve net stability in methane production

Active peat growth should halt oxidation and increase carbon dioxide absorption from the atmosphere and will combat global warming by mitigating against increases in carbon dioxide levels. Methane production may rise initially after restoration, but may become more similar to undrained peat bogs in time. Restoration should increase the ability of these habitats to survive long-term climate change.

Objective 6

- Historic environment protection and enhancement: better knowledge of the historic environment and better preservation of palaeo-environmental deposits

Increasing peat wetness and reducing peat and soil erosion will help to ensure continued survival of these fragile archives of land use and vegetation history. The adoption of sensitive procedures and working

methods such as comprehensive site surveys and watching briefs will record and protect archaeological features, sites, palaeo-environmental deposits and monuments.

Objective 7

- Partnership working: effective collaboration between land managers, partners and other stakeholders

Representatives of stakeholders in project governance and an adequately staffed project team enable effective communication and networking. Added value occurred through the associated Moor-to-Sea project, part of Exmoor National Park Authority's Heritage Lottery Fund sponsored Moorland Landscape Partnership. This ran between 2012 and 2015, and linked communities in the catchment with moors in the headwaters. The Exmoor Hill Farm Project also provides opportunities for communication.

Objective 8

- Education and knowledge transfer: enhanced understanding and information on hydrological, hydrochemical and ecological process interactions

A formal Knowledge Transfer Partnership will enable the flow of knowledge and understanding of the hydrological function of peatland systems from the University of Exeter into the water industry and the regulating agencies, contributing to the debate on the principles and practices that underpin sustainable catchment management.

Objective 9

- Socioeconomic reward: sustainable funding for land managers to provide incentives for restoration of moorland wetland

Restoration is a long-term process and land manager involvement should be secured to achieve maximum hydrological, ecological and land management benefits. Agri-environment agreements currently form a major contribution to farm profitability on Exmoor and provide secure funding for 10 years in a changing economic climate.

Quantification of improvements in water quantity, water quality and carbon storage may help establish appropriate rewards for landowners in the 2015 to 2020 water price limits set by the Water Services Regulation Authority (Ofwat). Quantification of the possible positive effects of peatland rewetting on agricultural pests, access and grazing quality may help to establish sustainable peatland management for multiple benefits as a viable option for land managers.

Objective 10

- To maintain the key characteristics of open moorland landscapes and restore sites where landscape condition is eroded.

Where ditches are to be restored, restoration will aim to integrate seamlessly into the natural landform and vegetation with minimal visual effects. Eroded ditches and gullies will be restored to achieve a more consistent vegetative cover, reduce areas of bare peat and restore land to more natural profiles. Landscape and visual effects will be assessed and monitored throughout restoration works.

Objective 11

- To provide economic benefit to South West Water customers

Sustainable upland catchment management and the consequential improvement to water quality and supply should bring operational cost savings to South West Water and its customers.

Project summary	
Area of catchment (km^2) or length of river benefitting from the project:	3,000ha
Types of measures/interventions used (Working with Natural Processes and traditional):	Habitat restoration through ditch blocking with peat and/or wood
Numbers of measures/interventions used (Working with Natural	Ditch blocking: 15,000 blocks installed by December 2016

Processes and traditional):	
Standard of protection for project as a whole:	The project was initiated and designed with other drivers in mind (for example, SSSI condition, water storage and quality linked to public water supply) at a time when the Flood and Coastal Risk Management (FCRM) community was not engaged with the process, even though project partners understood the potential multiple benefits including Natural Flood Management (NFM). So although the project is not as linked to property protection as it could have been, it does provide a very useful baseline for future expansion of the coverage of mires work that will help the link to be made in the future. This point is discussed in more detail in Section 9 Lessons Learnt.
Estimated number of properties protected:	See comments above

How effective has the project been?

Overall, the Exmoor Mires Partnership has led to the multiple benefits outlined in the objectives being achieved. The following are of particular note.

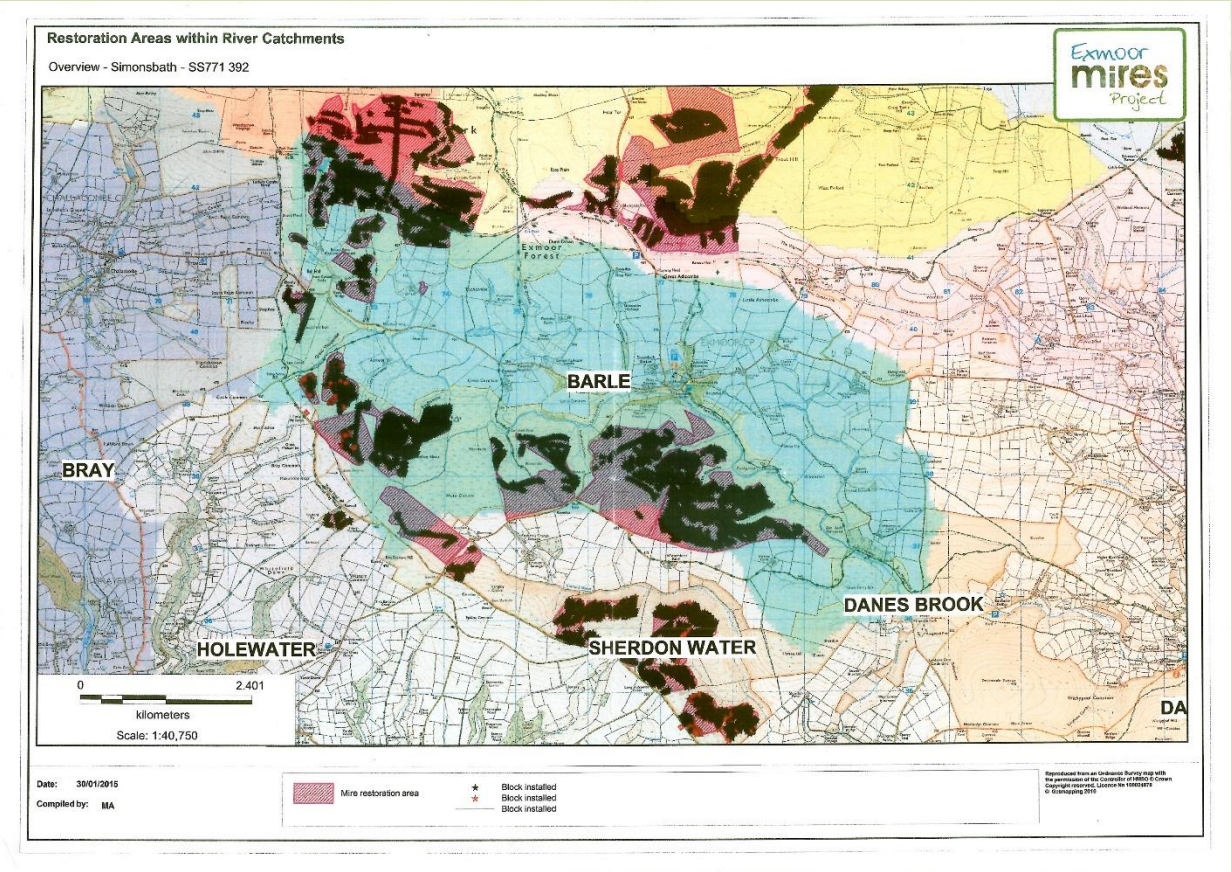
- Water storage: there has been a rise in the water table level of 2.65cm on average across the areas monitored and up to 21cm in some deeper peat locations.
- A 33% reduction in storm flow leaving the restored sites, equivalent to 6,630 Olympic sized swimming pools when extrapolated across the total restored area.
- Examination of the hydrograph and flow duration curve at the Spooners monitoring catchment shows a clear increase in baseflow levels post-restoration.
- Water quality: an overall reduction in the total carbon yield from the restored sites by up to 50% since restoration.
- Biodiversity: 31% of Exmoor peatlands restored to their ecohydrological function, contributing 1,400ha by December 2016 to the national Priority blanket bog habitat restoration targets.
- Physical NFM measure: peat blocks and peat/wooden blocks that are installed in the ditches and peat cuttings are effective in storing water and diverting water out of the ditches across the land surface, rewetting the peat. This is particularly noticeable on the downslope and within a 4m distance from the ditch.

The project is still active and extensive data continue to be gathered that will inform the growing understanding of the response of these shallow peats to restoration measures.

There is a growing understanding within the FCRM community that habitat restoration as an NFM intervention is a potential contributor at some scale to reducing flood risk and that having the evidence through monitoring is important.

5. Project construction

How were individual measures constructed?



Map 2: Main areas of restoration, Simonsbath, Somerset, SS7778439304 (central point)

Restoration plan

A ‘restoration plan’ is compiled for all sites under consideration for mire restoration on Exmoor (Map 2). This starts as a draft plan and is revised as required until a final plan is agreed by all those involved in the consultation process. The plan incorporates and considers all the following elements.

1. Restoration plan

This has 4 main elements:

- site location
- introduction (basic outline of place, findings and plans)
- site work plans and maps (overview and detail)
- monitoring and research (overview of project research and site-specific overview)

2. Site research

- Historic environment: compiled by the project's Historic Environment Officer using existing historic environments records (held by the Exmoor National Park Authority), commissioning of any required walkover surveys and site-specific research as required.
- Ecology: complied by project team using existing databases (Natural England's MAGIC interactive map, County Wildlife Site, Local Biodiversity Record Centre data, existing project survey data) and on-site surveys.
- Landscape assessment: complied by project team based on sing assessment and fixed point photographs to consider and monitor change.

- Access: compiled by project team using existing databases (Exmoor National Park Authority Public Rights of Way, Open Access and 'known routes') and on-the-ground surveys.
- Land management: compiled by project team in discussion with landowner, tenant and Natural England.
- Funding: compiled by project team following discussion with Higher Level Stewardship (HLS) agreement holder and Natural England, the Environment Agency and any project funders.

3. Restoration methods: compiled by project team and updated if/as and when the methodology changes.
4. Timings of work: drawn up by project team and updated as schedule of works develops.
5. Costs: compiled by the project team using set formulas and anticipated rates, and updated as restoration plan/consultation plan is revised.

Consultation process

The draft restoration plan compiled by the project team is sent out for formal consultation with the following:

- landowner
- Exmoor National Park Authority – Conservation Officer (landscape), Conservation Officer (wildlife), Access and Recreation, Ranger, Historic Environment Officer, Head of Conservation and Recreation, land agent
- Natural England – Lead Adviser Land Management (Exmoor)
- Environment Agency – Biodiversity Technical Specialist (Devon)
- tenant farmer

A period of 3–4 weeks is given for formal comments to be returned. Meetings are arranged with any of the parties listed above to go through the plan as and when required; this usually depends on the size and complexity of the plan.

The draft plan is delivered by hand to the farmer to provide an opportunity to go through the plan, explaining each section, the processes involved in the plan and the implications of the proposals. Site visits to discuss the works allow for on-the-ground discussion. This can lead to alterations of the plan, such as further access works being incorporated or areas of ditch blocking being taken out of the plan. Farm visits sometimes held with the Natural England adviser present to facilitate discussions around the ability or not for the works to be entered into the agreement holder's agri-environment plan and the availability of capital work funds from Natural England.

There can be several farm visits and meetings with consultees involved to get from draft to final version.

Once all comments are received and all consultees are in agreement, the final plan is produced and work can begin. Photo 2 shows an example of some of the construction work.

Photo 2: Cons**truction of wooden block** u**sed to block drainage ditch, November 2014 (source: Exmoor Mires Partnership)**

How long were measures designed to last?

Works installed on-the-ground are designed to last for ever with minor maintenance required. The aim is to return the habitat to a healthy functioning system by assisting natural recovery to achieve maximum benefits.

Were there any landowner or legal requirements which needed consideration?

- Landowner consent and licences to operate on their land
- HLS agreement holder consent
- SSSI, Schedule Ancient Monument consents
- Memorandum of Agreement between the Environment Agency, Natural England, Exmoor National Park Authority, South West Water and Historic England set up to ensure governance and legal obligation to the Exmoor Mires Partnership
- Monitoring site wayleave with landowner
- Intellectual property rights agreements

6. Funding

Funding summary for Working with Natural Processes (WWNP)/Natural Flood Management (NFM) measures	
Year project was undertaken/completed:	2010 to 2020
How was the project funded:	South West Water: PR09 and PR14 Environment Agency: FCRM and Water Framework Directive Natural England: HLS capital works
Total cash cost of project (£):	South West Water: £3.5 million Environment Agency: £470,000 Natural England: £700,000 Natural Environment Research Council/Technology Strategy Board: £200,000 (monitoring) University of Exeter: £60,000 (monitoring)
Overall cost and cost breakdown for WWNP/NFM measures (£):	South West Water: £2 million (monitoring), £1.5 million (project delivery) Environment Agency: £150,000 (monitoring), £320,000 (NFM measures) Natural England: £700,000 (NFM capital works construction)
WWNP/NFM costs as a % of overall project costs:	23%
Unit breakdown of costs for WWNP/NFM measures:	£729 per hectare of ecohydrogically restored peat to date
Benefit–cost ratio (and timescale in years over which it has been estimated):	See Section 9 Lessons Learnt. If the level of reduction in risk provided by the project is not specified then traditional FCRM benefits cannot be calculated. It would be possible to make a rough estimate of a maximum of 5 houses at £30,000 per /house damages figure and come up with a

	'benefit' figure purely for the FCRM benefits, but that omits the wider environmental improvements that should be factored into the calculations. Need more guidance on how to calculation the benefit to cost ratio if the project has not already specified this.

7. Wider benefits

What wider benefits has the project achieved?

Appendix 1 shows a poster with an overview of wider project benefits.

How much habitat has been created, improved or restored?

A total of 1,400ha of SSSI blanket bog and valley mire habitat had been restored by December 2016.

8. Maintenance, monitoring and adaptive management

Are maintenance activities planned?

Monthly volunteer work parties check the status of the ditch blocks installed and carry out do minor repairs. Sites are being audited with the intention of costing the required maintenance works with the intention of seeking allocation of funding for this post 2020.

Is the project being monitored?

The project monitoring at Aclands and Spooners headwater catchment scales began in 2010 and will continue until 2020. Additional monitoring was set up at the Long Holcombe site in 2015 and will also continue until 2020. A holistic approach has been developed at all 3 of these sites to monitor the following environmental variables:

- Hydrology: water table monitoring at 200 locations across the 3 sites, flow monitoring at 8 nested scales across the 2 headwater catchments (Aclands and Spooners) and rainfall as part of 2 metrological stations located in the Aclands and Spooners catchments
- Water quality: DOC, colour, humic to fulvic acid ratios and pH monitored at 8 locations within the Spooners and Aclands catchments
- Greenhouse gas monitoring: carbon dioxide and methane are monitored at multiple, paired and replicated sites across the Aclands and Spooners sites, as well as historically restored sites across Exmoor
- Vegetation monitoring: ongoing until 2020 (Photo 3)
- Moorland bird survey: every 6 years – next survey due in 2020
- Invertebrate monitoring: next survey due in 2019
- Agricultural impact: monitored in the Aclands and Spooners catchments to evaluate livestock behaviour, herbage yield and herbage quality as a function of moorland rewetting, tick and liver fluke activity as a function of rewetting

See Section 10 Bibliography and the Exmoor Mires Partnership website (www.exmoormires.org.uk) for details of monitoring plans, networks, equipment and results peer-reviewed in the scientific literature.

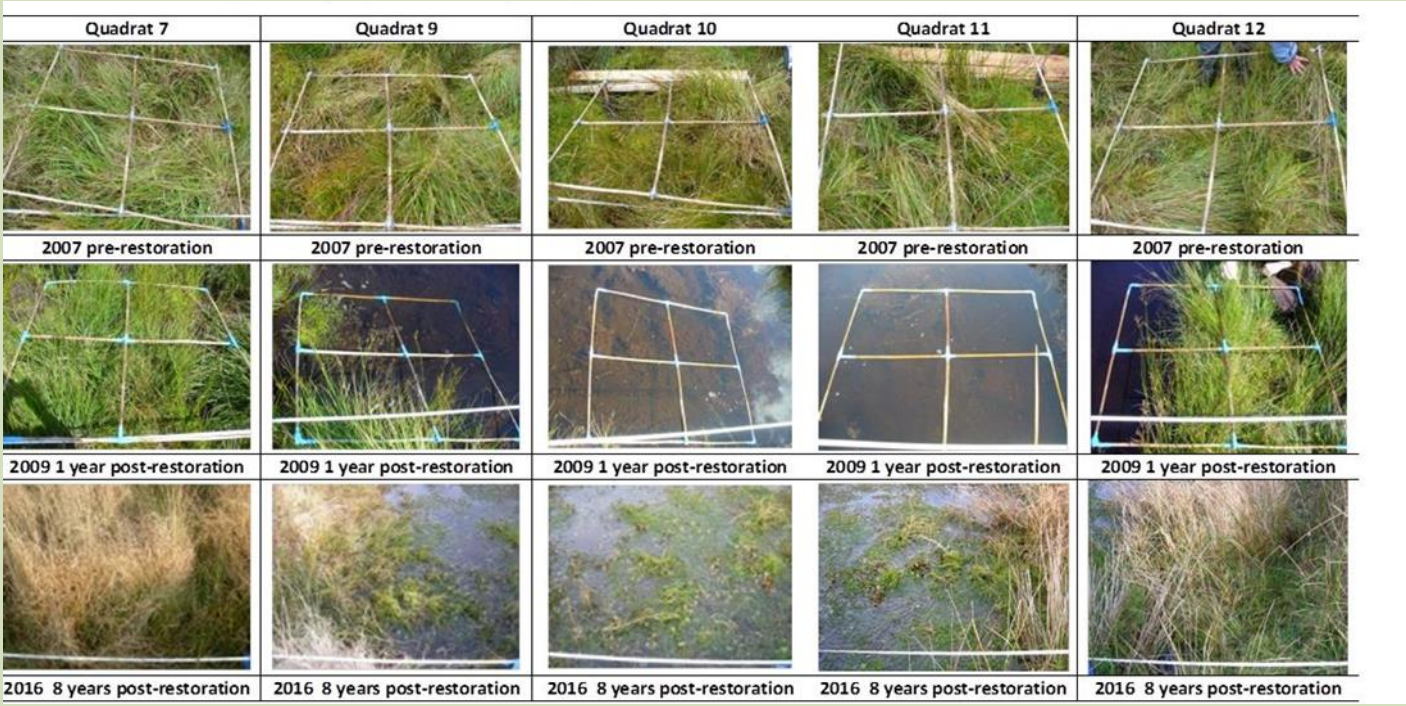


Photo 3: Exe Valley vegetation monitoring showing how the site has rewetted between 2007 and 2016 (source: Exmoor Mires Partnership)

Has adaptive management been needed?

The aim is to return the habitat to a healthy functioning system by assisting natural recovery to achieve multiple benefits. At present, only minor maintenance works are required but evidence from site audits, lessons learnt and an analysis of monitoring and research data indicate that further adaptive land management interventions are required to achieve complete ecohydrological peatland restoration.

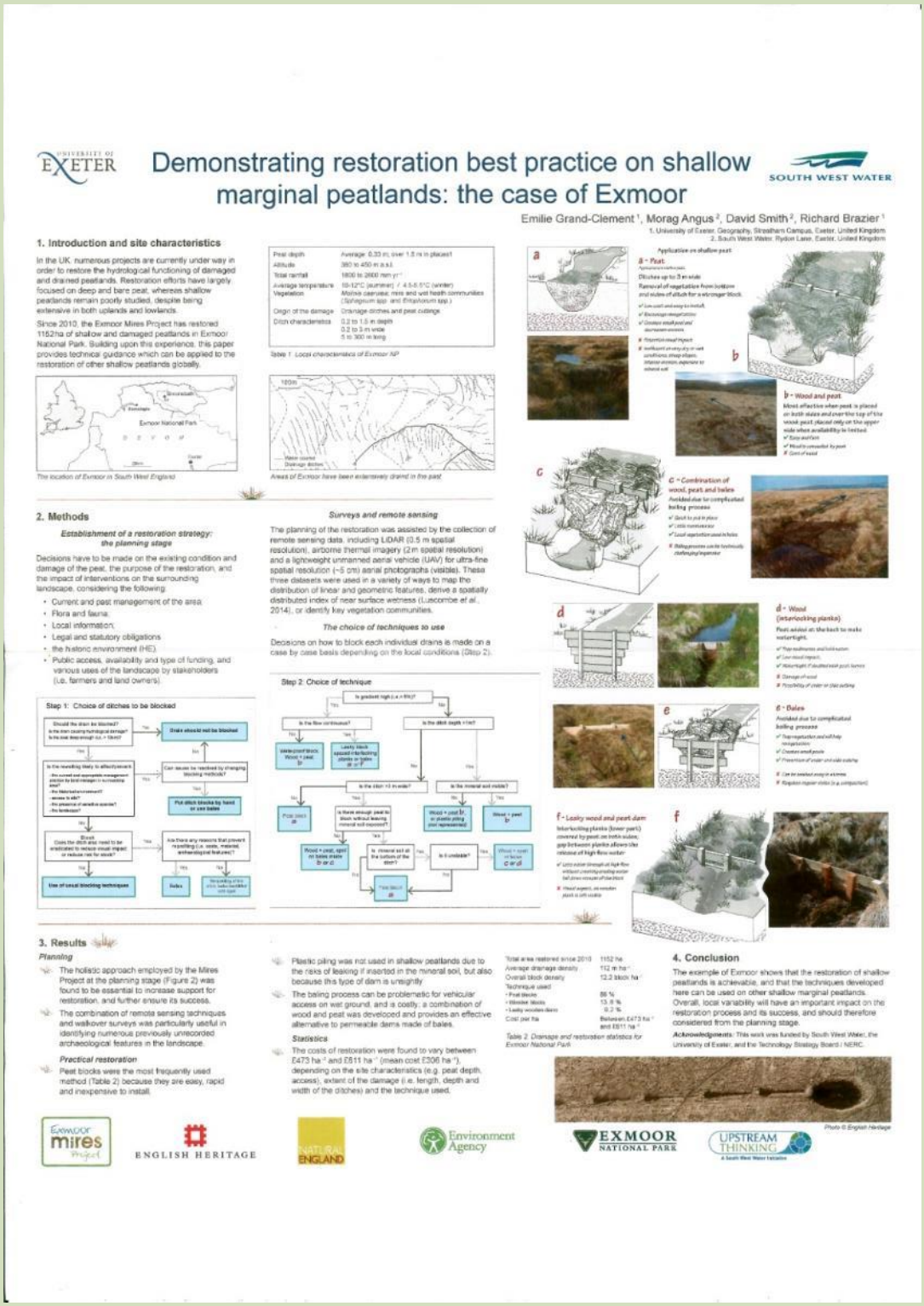
The poster reproduced on the next page demonstrates how various ditch blocking techniques have been adapted to suit ground conditions and lessons learnt.

9. Lessons learnt

What was learnt and how could it be applied elsewhere?

Lessons learnt in running the project itself

- Include as many stakeholders as you can think of at the initial project development stage.
- Think holistically so all ecosystem services and wider benefits are considered.
- Have early discussions and involvement with the landowners and land managers so that all financial benefits and impacts can be fully understood but not overstated. Otherwise these can dominate any discussions in the future.
- A flexible adaptive approach by project partners and staff on-the-ground is vital.
- Effective and appropriate communication is needed.
- There needs to be clear interpretation and access to scientific evidence.
- A diplomatic and adaptive personality is needed to find constructive solutions to all the varying requirements of the different stakeholders in order to implement peatland restoration.



Lessons learnt about incorporation of NFM approach into FCRM delivery:

- The Exmoor Mires Partnership was developed with a range of objectives a decade before the FCRM community engaged with assisted natural recovery and WWNP. Ideally, the project would have been able to specify the reduction in risk, standard of protection and benefit–cost ratios as outputs. The partners, including the Environment Agency's Fisheries, Biodiversity and Geomorphology (FBG) team, were clear that to engage the FCRM community it was necessary to collect evidence of the changes habitat interventions within the damaged peat could make to stream flow, peak and baseflow hydrographs. A detailed monitoring programme was designed by the Environment Agency and developed further by the University of Exeter; after 3 years of post-restoration monitoring this now focuses on extrapolating the data to the larger catchment and eventually moorland scale. This will help understanding of whether this work will benefit communities at risk of flooding around Exmoor and

whether it is possible to start specifying the standard of protection and benefit–cost ratios. The work also highlighted the differences between the shallow peatlands of Exmoor and deeper peatlands of Dartmoor, which differ again from northern peatlands.

- One lesson learnt from peatland projects across the UK is that, in order to understand the multiple benefits of habitat interventions, it is important to understand the local significance of the habitat(s) being worked on and the local implications for managing flood risk. For example, the peatlands of south-west England are different in form and function and history of damage from the peatlands in northern England. So in south-west England across Exmoor, Dartmoor and Bodmin Moor there is no significant history of damage to the peat from the Industrial Revolution as there is in the Peak District, and so the interventions and ecohydrological response will also be different. The value of having projects investigating and implementing relevant and sustainable restoration techniques across the range of peatlands makes it possible to begin to understand the relationships the UK's uplands have to delivering multiple benefits, ecosystem services and what NFM measures are appropriate in different locations and scales.
- The peatlands of south-west England are recognised by the IUCN Peatland Programme's Commission of Inquiry (Bahn et al. 2011) as being the most vulnerable in the UK to the impacts of climate change, due to their southerly position. Restored peatlands are considered to be more resilient to climate change and are one tool in managing future risks (Bahn et al. 2011).
- For the Environment Agency, there is a lesson to be learnt in recognising the disconnect – now gradually lessening – between its FBG and FCRM functions, and in understanding what FBG-led projects can deliver for FCRM. This may largely be around the language used – understanding that the habitat creation or restoration is the intervention (or NFM) that can provide (for example, a proportion of the flood storage required) and not just an 'add on' for wildlife or other ecosystem services.
- Working together is important across functions and disciplines. It is vital to develop and understand a common language so that, regardless of whether the benefits of WWNP and using NFM measures are thought to be real or not, these benefits are followed through by developing stronger evidence to inform future work.

Future research

There are three points to remember in relation to future research.

- For the Exmoor Mires Partnership the research is not finished and will continue to provide more evidence until 2020. Long-term funded monitoring (ideally before any interventions happen) is essential. The resulting robust evidence will ensure that the local, national and international story can be told.
- It is recognised that the information to prove the case on a catchment, moorland wide or communities at risk scale is not yet available. To achieve this, the Environment Agency and others need to recognise the relevance of this research and integrate it into their understanding of the contribution NFM measures can make to flood risk.
- Collaboration between the Environment Agency and the University of Exeter has been a huge success in establishing the monitoring, its delivery and the analysis of the data using experts from both organisations. There is a continuous need for greater collaboration, sharing of data and how information is communicated.

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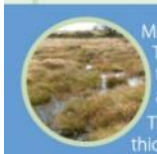
Project background

This case study relates to project SC150005 'Working with Natural Flood Management: Evidence Directory'. It was commissioned by Defra and the Environment Agency's Joint Flood and Coastal Erosion Risk Management Research and Development Programme.

Appendix 1: Exmoor Mires Partnership poster highlighting the wider benefits of the project

The Exmoor Mires Project



Mires are found where peat develops due to wetness. They are also known as bogs, peatlands and fens and they have unique plants associated with them, such as sphagnum mosses and sundews.

The moorlands of Exmoor have developed mires and a thick blanket of peat due to the wet climate during the last 5000 years. This is a rare and unique habitat:

The British Isles have 20% of all the blanket bog in the World.

The Exmoor Mires Project is working towards restoring dried out mire or bog sites on over 2000 hectares of Exmoor's moorland.

Many kilometres of old ditches and peat cuttings will be blocked up. The end result will be wetter peatlands with drainage scars stitched back together.

We work with partner organisations, local farmers and local communities to achieve this.

Keeping the peat wet will help it withstand climate change. This will help to retain the moor, protecting the landscape and historic past stored in the peat for everyone to enjoy in the future.

Plants:

These are some of the mire plants that make up a blanket bog:

Sphagnum can be made up of up to 70% water!

Wildlife:

Re-wetted mires have more bog plants, insects, amphibians, reptiles, and more food for birds and wildlife. The newly created bog pools also provide drinking water during dry periods.

The restored site at Blackpitts is now home to the largest upland population of dragonflies in Somerset, along with lots of frogs (which are food for adders and otters), and moths.

Snipe is a rare bird species, and breeding pairs have been observed at two restoration sites which previously did not have any breeding records.

Restoration work:

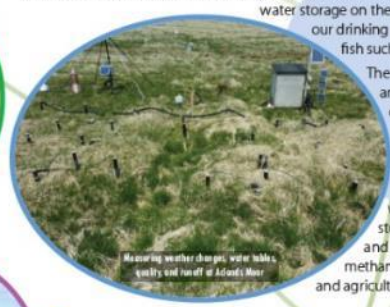
Archaeology:

The unique, water-logged environments of mires are often able to preserve materials such as wood, leather, and even flesh after thousands of years. This provides opportunities to investigate aspects of the past for which evidence rarely exists.

Science:

Peat is all carbon and water, so mires are huge carbon stores. But dry peat releases carbon dioxide (CO_2) into the atmosphere through oxidation and into rainwater runoff as dissolved carbon and particles (brown colouration). Re-wetting creates healthy peat which can absorb CO_2, helping to reduce the global greenhouse effect.

Mire re-wetting improves water quality through natural filtration, and increases water storage on the moor. This all improves our drinking water and the rivers for fish such as salmon.



The Universities of Exeter and Bristol are carrying out some world leading research on the effects of moorland ditch blocking. They are looking at changes in water quality and storage, carbon storage and sequestration, methane, vegetation, wildlife and agricultural productivity.

Community involvement:

The project is involved in many ways to engage the whole community: School activities and events in the holidays are a fun way to learn about the science of peatlands; there are walks and talks, as well as competitions and arts and crafts. Other opportunities include training days, surveying and practical conservation. Perfect for anyone who enjoys the great outdoors!

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Thank you to all the partners, farmers and landowners who have supported the project.

EXMOOR NATIONAL PARK · UPSTREAM THINKING · Moorland · Exmoor mires Project