



## **Participant questions and researchers answers during presentations**



From MP

I'm aware that it is incredibly difficult for those attempting to model NFM at scale to acquire the necessary data and at the necessary resolution, which already exists, thus making their job nigh on impossible. What will be done to democratise these data far more effectively and widely? This data is, of course, largely collected at public expense.

From Martin Evans

Hi MP...all the data from the projects will be available through the NERC data centre for others to use.

From IM

So happy that Soil is the main focus of this. #soilhealth is the basic starting point!  
It's about getting the basic of soil and land management right first and then building from there  
#soilhealth

From MP

It appears to be getting increasingly clear that 'we' have been doing many things wrong in farming for a few generations. The evidence is getting more compelling, but the key is getting that evidence across to farmers in language they understand and from people whose word they trust.

From Chris Short, CCRI

Excellent point MP and the final months of the LANDWISE project will focus on this.

From LW

we need the food supply chain to take these messages on board too and reflect it in how they work with their producers.

From MP

I suspect many farmers are understanding the message, but many in the food processing and distribution business are far more focussed purely on profit.... and lobbying to that effect.

From Joanna Clark

MP, IM, LW thanks for making those points. Agree.

From IM

This is why Soil Management is key and part of the Farming Rules for Water and Basic Payment Scheme and that's for WQ issues. So slowing the flow works for ALL aspects.

From MP

Indeed. So many potential wins.

And that's just the present... what about the future!

From IM

Anything on the impact of livestock and compaction and infiltration rates?

From Joanna Clark

IM, livestock was on the grassland. Infiltration was done on a selection of field because more time consuming, so we don't have livestock no livestock comparison for that. So many ways to farm! We have picked out a few popular managements, lots to look at still.

From Will Maslanka

Hi IM - We had hoped to complete some fieldwork involving some ground-based and drone-based radar units to look into livestock compaction and soil moisture. Unfortunately, Covid delays and knock-ons meant that we were unable to do this. Hopefully this is something that will be looked at in the future, and that we can link the satellite data with the ground verifications. I suspect that livestock compaction would reduce infiltration and increase the run-off, but I haven't done the research to back this statement up yet!

From JC

Would Sentinel-2 data have given better resolution?

From Will Maslanka

Hi JC - I've looked at Sentinel-2 data, especially with the OSR analysis. While the resolution is better, you can't get soil moisture from the optical data, whereas you can from the radar data of Sentinel-1. Additionally, you cannot see past the Sen2 data, as it is working at optical wavelengths, whereas Sen1 can penetrate through the clouds, and get through to the surface.

From TA

Has work been done to relate these findings back to the root cause of the soil issues? The reason I ask is trying to determine whether the solution is 'NFM' or some form of regulatory activity to avoid capital spend when it may be caused by poor land management - and capital funding NFM as the solution is just using tax payers funding 2x over on the issue.

From AD

How do you deal with temporary surface waterlogging and soil moisture estimated by Sentinel?

From Will Maslanka

Hi AD - I found that when looking through the processed radar data, the temporary waterlogging gave us very high backscatter data. As part of the analysis, I have a quality flag that highlights non-freshwater pixels which look like they are acting like water. That way, I can neglect those pixels, so

that the spatial averaging was calculating the correct thing. I've found that the waterlogged pixels got classed as very high rSSM, which is to be expected for waterlogged/saturated soils.

From AD

Thanks...would those waterlogged pixels contaminate neighbouring pixels?

From Will Maslanka

AD - There is potential for the waterlogged areas to spread across multiple pixels, however the quality assurance flags happen before the spatial averaging, so (if they are flagged), they are removed from the spatial averaging calculation before the rSSM is calculated. I think that the larger 100m pixels that contain the waterlogged areas have very high rSSM values anyway. As part of the rSSM calculation, I've removed pixels that cover urban, suburban, and freshwater areas.

From EE

How did you develop the long-list of NFM measures in the beginning (i.e. leaky dams, river restoration, woodlands etc.) given that there are a spectrum of NFM measures and possible combinations.

From Joanna Clark

EE - the 11 NFM types are from Environment Agency Working With Natural Processes. Within each type there are different ways of delivering that e.g. different soil and land management. We worked with catchment partnerships to prioritise those 11 measures for local catchments.

From TA

Did the modelling look at soil condition and use this to inform the baseline?

From Anne Verhoef

Hi TA, about soil condition: the fieldscale model runs were run for 3 years to allow the model to reach equilibrium soil moisture content. Those first 3 years were not used in the analyses. Soil moisture content was updated on a daily basis, via the rainfall inputs and water losses based on the calculated water balance.

Representative soil hydraulic properties were used to distinguish between the soils

From SY

Is it according to you, flood waters contributing to improvement arability and productivity of soil?

From David Macdonald - BGS

SY's question - No, the opposite, flood waters will erode soils and potentially damage crops.

From Joanna Clark

You can read the full poem version and other poems here

<https://landwise-nfm.org/2022/06/27/flow-upstream-downstream/>



From Martin Evans

PROTECT's video - <https://www.youtube.com/watch?v=t1gGSK80Q0A>

From DI

Where was the sphagnum used for planting sourced from?

From Martin Evans

Sphagnum was sourced as greenhouse grown plugs available commercially.

From EB

What was the total cost and timescale for installing the measures?

From Chris Dean

Some of the questions here cover 20 years of work and £50m of investment working to resolve the most degraded blanket bog landscape in Europe, so a bit difficult to answer in a chat line worth visiting [www.moorsforthefuture.org.uk](http://www.moorsforthefuture.org.uk) there is a lot of information about sphagnum inoculation techniques water table monitoring, lots of NFM stuff and a large amount of information on our restoration story. The results here are relevant to the whole of the 750km area covered by MFFP.

From MP

Originating from Saddleworth, I'm very familiar with how badly degraded the moorland/peatland was. What sort of percentage of bare peat did you start with and what is the same measurement now? Ditto for the Pennines generally?

From Martin Evans

Kinder was over 30% bare peat before restoration...across the Pennines this would be lower as Kinder is amongst the most eroded sites.

Measures are installed relatively quickly (days for our sites).

From NE

How fast is the water table rising after rainfall at each of the sites? Great looking results, just curious!

From Martin Evans

Water table rises very rapidly after rainfall...1-2 hours in a good storm.

From MP

Were the timber gully blocks the 'letterbox' or V notch type, or a mixture? Did the type of dam affect sediment supply into the system?

From David Milledge

MP - the timber gullies that Emma discussed were classic V notch (actually a small rectangular notch) type rather than letter box design.

From MP

What were the approximate catchment sizes for the results you presented?

From David Milledge

MP - The catchments discussed were approximately half a hectare (4500-7100 m<sup>2</sup>) or about the size of a football pitch.

From MP

Are the blocks benefiting from the constant input of material at Kinder compared to Stalybridge?

From David Milledge

MP - Yes, the blocks at Stalybridge receive considerably less peat sediment than those on Kinder.

From CP

What magnitude of events do these results relate to?

From David Milledge

CP - The largest of the storms shown by Martin for Stalybridge caused localised flooding downstream in Manchester (not widespread flooding but some localised flooding).

From LW

I presume there are trade-offs for peats restoration and resilience and carbon emissions with the piped dams?

From Martin Evans

Re the carbon impact...yes lower water tables not so good in that respect but typically gullies only affect water table a couple of metres from the drainage line so the re-vegetation and stabilisation is more important from the carbon perspective.

On the carbon front we also see water table rising across the hillslopes in response to re-vegetation this is the more important water table contribution to storing carbon because it affects more of the catchment

From MP

Important to appreciate the carbon sequestration impact as well as the FRM / attenuation / flood peak reduction effects. Not forgetting ecosystem benefits!

From ML

Is there any data on whether the peat dam pools were already full before storm events, or whether there was capacity in the pools, compared with the capacity available in the piped pools?

From Martin Evans

ML, yes we do see events where there are two storms in quick succession where the impact is reduced...this is particularly where getting the pipe diameter right is important to optimise drawdown.

From Adam

Hi ML, most of the peat dams are built in a chain along existing flow lines. When they overtop, runoff flows into the next pool. But with the reprofiled/revegetated peat dam, it is more akin to overland flow than channel flow between the dam pools.

From CD

Need to understand that the application of Gully blocks is only the start of the process which takes the energy out of the system and allows vegetation growth in the gully. In older treated gully systems the vegetation is probably now having more effect than the original installation.

From Martin Evans

CD I agree...as the blocks block up with sediment their permeability decreases and this increases their efficacy but it is still the case that probably the roughness impact is more important so the role of blocks in re-vegetation is important.

From CD

Yes, I agree Martin what we need to understand is that all of the techniques we use have a positive benefit on each other and none on their own are a complete answer.

From CF

While I love this research showing us more, I have strong reservations about pipes through dams, especially peat dams. These dams aim to raise the water table, but a pipe specifically restricts that rewetting capacity.

From JG

Good point CF, we need to improve how we communicate NFM effectiveness and when it's/not an appropriate solution.

From DM

Agree with CF - for example in the scheme of things a reduction in flood peak of 10cm can mean the difference in someone getting flooded or not in our catchments. That might be tiny in the scheme of things in terms of total volumes and flows but it's enough to make a difference to people suffering from flooding.

From CF

We have to see the detail and the wider picture simultaneously.

From AF

Think CF is correct, the multi-benefits of NFM are so far reaching that looking through a singular lens can hamper take up. That being said, it is perhaps a reflection of the silo'd funding routes.

From Martin Evans

CF...the blocks in gullies do much more than raise water table...this can be a relatively minor effect in large gullies...in a way this is the multiple benefits point that CD was making. Having said that there is some further work to do on optimising the size of pipes vs how high in the dams they go to maximise both benefits.

From PS

There is clearly work to be done in relating NfM interventions to other benefits and how they can be co-designed - how we address the funding to develop both the understanding and frameworks to do this is (for me) an open question.

From AF

CF - Totally agree on the demand for blocks for rewetting. Do you think the space for dams with pipes is more on the fringes where the benefit of blockage is perhaps coupled with preventing continued erosion and degradation?

From MB

This cost benefit analysis point is key! From a practical perspective, particularly when we are assessing the benefits that can be realised through to secure funding in order to deliver these. Would be interested to know the thoughts of the team on critical considerations and variables when trying to realise these benefits in practice

From CF

Hi AF, Yes, I'm more in favour of piped dams off the tops of the peaty hills, where restoration has so much to offer and so far to go.

From CF

Martin, I was referring to those peat dams which aim to disperse water outside the gullies, those which do reach the top of the gully. These are the ones which I'm most uncomfortable about putting pipes in.

From Emma and Martin

Hi CF, yes I agree in very small channels (grip blocking or small gullies) where we can spill water onto the moor surface pipes would come more clearly into conflict with this aim...a lot of the gully blockins we are dealing with is in deep gullies where a 50cm deep block is a metre or more below the height of the gully edge...here the WT impact is more marginal and pipes make more sense.

From CF

Thank you Emma and Martin for that clarification, that's a useful distinction for these works. MFFP deal with a lot of these close -to-surface gullies.

From CW

Very happy to see this data and modelling on the impact of storm return period.

From MP

Does the Scenarios work at Glossop enable you to advocate an optimal sequence of which changes to employ when, within the given micro-catchments? If so, is this of significance?

From David Milledge

MP - It does enable us to examine intervention scenarios with different spatial configurations to prioritise intervention types and locations BUT we haven't yet done that. The first objective was to find out whether it made any difference at all for the quite extreme (but possible) scenario of intervention everywhere that it could be done.

From MP

Do you have any problems with the shooting or the burning in the areas you are studying?

From Martin Evans

MP, burning and shooting can present challenges in terms of when we can access sites but between Moors and helpful landowners, we have navigated this.

From ML

I'm assuming these results are largely for deep peats? Is that right?

From David Milledge

ML: That's correct.

From Martin Evans

ML, yes this is all deep peats...we have some woodland data on shallower peaty soils that we haven't finished working on yet but all the micro-catchment work is deep peat.

From SJ

Great 5 point summary at the end from PROTECT, would be really useful to have a top 3-5 key findings and a top 3-5 next steps / unanswered questions from each of the projects.

From Emma and Martin

If you'd like to find out more about the first four years out on Kinder (i.e. the step change I mentioned) you can read all about it here:

<https://www.sciencedirect.com/science/article/pii/S2589915518300063>

and Salim's modelling work on the same period here:

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020WR029209>

and what all this means for other ecosystem benefits here:

<https://www.sciencedirect.com/science/article/pii/S0048969719305765>





From MP

Anything interesting around aspect (linked to temp) Trevor?

From Trevor Page

Hi MP - the link with aspect is more likely to be associated with humidity effects associated with rain shadows in the winter. But there will be more of an aspect effect with solar radiation for summer events (ours were October to January).

From Tom Nisbet

Trevor - any thoughts on why scatter in data is less for larger events?

From Trevor Page

Definitely could be as we have fewer data. But also could be large events tend to have more similar meteorological conditions.

From Tom Nisbet

Did you consider the effects of conifer, rather than broadleaved woodland?

From Trevor Page

Tom, we have only considered deciduous trees for now, but we could consider any land cover.

From SJ

Where are the changes in peak flow on these graphs representing spatially within the catchment? Is it at a downstream flood receptor (e.g. community/property at risk), or another downstream point e.g. where the catchment being monitored joins other watercourses?

From Barry Hankin

SJ, we have looked at spatially distributed changes to hydrographs, especially upstream of communities at risk.

From Paul Smith

SJ, The Gowan reach plots were on an internal reach of the catchment model which is a headwater subbasin of ~15km<sup>2</sup>. The combined impact plot at the end was for downstream boundary of the catchment (~209km<sup>2</sup>) which is near Kendal.

From DK

Is there an optimum return period that these types of NFM are most effective?

From Paul Smith

DK - we've been running past event periods (winters of 2005, 2009 and 2015) if you drop me your email in private chat I'll look at the event that most closely matches 1-100 yr and send you the plots.

From Paul Smith

DK - good question about effectiveness at different return period, we have some simulation data that might allow us to answer that we haven't done the analysis yet.

From TA

Barry - are you able to elaborate on that answer some more please? Interested in the scale we're talking about for some of those Storm Desmond examples. Are they from the upper portion of the catchment or are they an average, or more as some of us will need, from the bottom where the risk is?

From Barry Hankin

I think it pertains more to the proportion of the watershed draining to a catchment at frequent risk of flooding, so naturally it's easier to target smaller catchments where you can achieve say that 7-8% PROTECT showed.

From TA

Sorry to labour this Barry, but what scale/distribution were those graphs showing then? Just trying to understand where the scale of % difference could sit between large/small events at a catchment scale from the data shown.

From Barry Hankin

Perhaps we can talk offline as i'm not sure which plots you mean - we have only been able to show a small number of results for some of the sites here, please also see the publications Nick highlights.

From PW

The location of NFM interventions within catchments is a key consideration. The peak is sourced from the "middle third" of the catchment - in very general terms. It follows that if we wish to reduce the peak, interventions should be focused on the "middle third" of catchments - which is not always easy.

From DB

Replying to PW: We currently intervene with NFM where the land ownership allows. Hopefully under ELMS, with incentivisation (rather than being penalised by reduced farm payments), we will have more opportunities, and can put the interventions in the best locations.

From JK

Management impacts of large scale woodland interventions may have greater impact on scaling than the intended benefit of the intervention. this impact of management choices can be positive or negative! At scale much greater integration with socio-cultural research needed.

From Paul Smith

In terms of open data I also highlight the session at the British Hydrological Society national meeting <https://www.lancaster.ac.uk/lec/graduate-school/professional-training/bhs2022/>

From Ann Kretzschmar

the EA Are working on a project which will be making very large amounts of high resolution data freely available. The EA open data project is being demonstrated at BHS2022.

Q-NFM mini-video (6min extended version):

<https://bit.ly/3yIOot1>

Wet-canopy evaporation animation (3min):

<https://bit.ly/3AojOWN>

NERC Q-NFM journal paper outputs:

<https://www.lancaster.ac.uk/lec/sites/qnfm/qout.htm>

From MP

I'm interested in how the storage is represented in the model/models? Other than assuming the 10 hour lag time, can you change the rate of drainage through altering the physical characteristics of the storage intervention (I.e. outlet pipe diameter and feature depth)? Moreover, for representing floodplain reconnection features, are you able to explicitly target flows above which features are able to fill (i.e. through passive offtakes for example)?

Is there a paper published on these findings yet or is that in preparation?

From Keith Beven

MP - At the moment the storages are treated as linear stores with a specified mean retention time (there is some evidence from our observations that this is appropriate). So this is implying that the design has been chosen the correct "pipe size" to give that retention time. There will be tools available for the design of storage elements to test out some possibilities for a site before implementation.

From Barry Hankin

We used a range of models, having different functionality. The hybrid modelling approach allows explicitly for all those things you mention.

From Paul Smith

MP, In the simulations shown at the end of the presentation (by Keith) the hillslope storage is represented as a linear tank with a time constant of 10h. The 10h is a parameter in the model so could be altered to represent other drainage characteristics. As Barry has said to represent the flood plain connectivity, we have used a hybrid modelling approach.

From MP

`Thanks both, I'd be interested to read more about this so I can understand more fully - are there any publications yet?

From Paul Smith

MP, No publications on the Kent work yet. Others from the project are listed on

<https://www.lancaster.ac.uk/lec/sites/qnfm/qout.htm>.

Details of Dynamic Topmodel used can be found at

<https://waturnumbers.github.io/dynatop/>

From JK

There's important work to be done on the cumulative impacts of flooding, impacts of maximum floods all in relation to landscape resilience. Then exploring understandings within the context of lived and worked landscapes! Some interdisciplinary work needed.

### **Next Steps**

From CA

Wendy- Great overview. Do you have any links to NERC strategic plan you could share please?

From Wendy Matcham - NERC UKRI

Current delivery plan

<https://www.ukri.org/wp-content/uploads/2020/09/NERC-250920-DeliveryPlan2019.pdf>

New one in progress now to be published towards the end of 2022.

From JK

Paul, the NERC resilience funding and the like are an example of potential funding as it takes a broader view. What is needed now is academics drawing together colleagues across disciplinary boundaries to address these challenges.

From Barry Hankin

As a practitioner, I've undertaken quite a lot of CBA and Natural Cap Assessment for NFM. one issue here is that the programme scope did not include economics, but we have modelled across probabilities and integrated this in some projects to understand residual risk - that can be based on £ or e.g. annual average peak flow reduction to understand 'change to risk'.

From MB

Thanks Barry, an interesting point definitely something that the EA could consider the approaches when quantifying how we unlock grant funding.

From JK

Integrated land management approaches would help place work in context of improvements in the multiple functions of interventions where economic cost/benefit is not the only (and rarely the primary) driver.

From MP

Way back around 2010, STF in Pickering had some interesting discussions around value of ecosystems services. While caution is needed not to put a price on everything and the value of not much, sometimes politicians only understand ££££s.

From Tom Nisbet

Another comment, a number of the presentations have steered away from including conifer woodland as an NFM measure or been reluctant to highlight results. As a scientific community, we should not shy away from considering all measures and leave it to policy makers and others to determine the acceptability of these!

From JK

There's great work on citizen science approaches to level monitoring (see Seibert et al)

From DM

Would be helpful if there was more research/info on lowland catchments in the south to learn from.

From Paul Smith

Also keep an eye out for sensor systems targeting community ownership and cheap maintenance e.g. <http://rivertrack.org/>

From MP

You might be interested in Chris Uttley's approach for Stroud District Council - also in conjunction with NT at the Ebworth(?) estate.

From JK

Then, look at features / catchment best practices, engage with land managers as what can be effectively implemented and then spend any money on supporting communities monitoring and then adapting implementations....

Herefordshire NFM program has good examples of land manager engagement and monitoring.

From IM

Who is the end user will be different too? Meaning the language will need to be appropriate.....  
And how does it fit with ELMS and all the other asks on Land managers/farmers?

From MP

ELMS is a real problem, as everyone wants to know the devil in the detail, but it isn't there.

From MP

Academic community have an increasingly important role to perform. Epic shared challenges involve identifying what optimal benefit looks like in a range of key situations and habitats and being able to evidence how and why this may differ from something which may make a beneficial contribution (of lesser value).