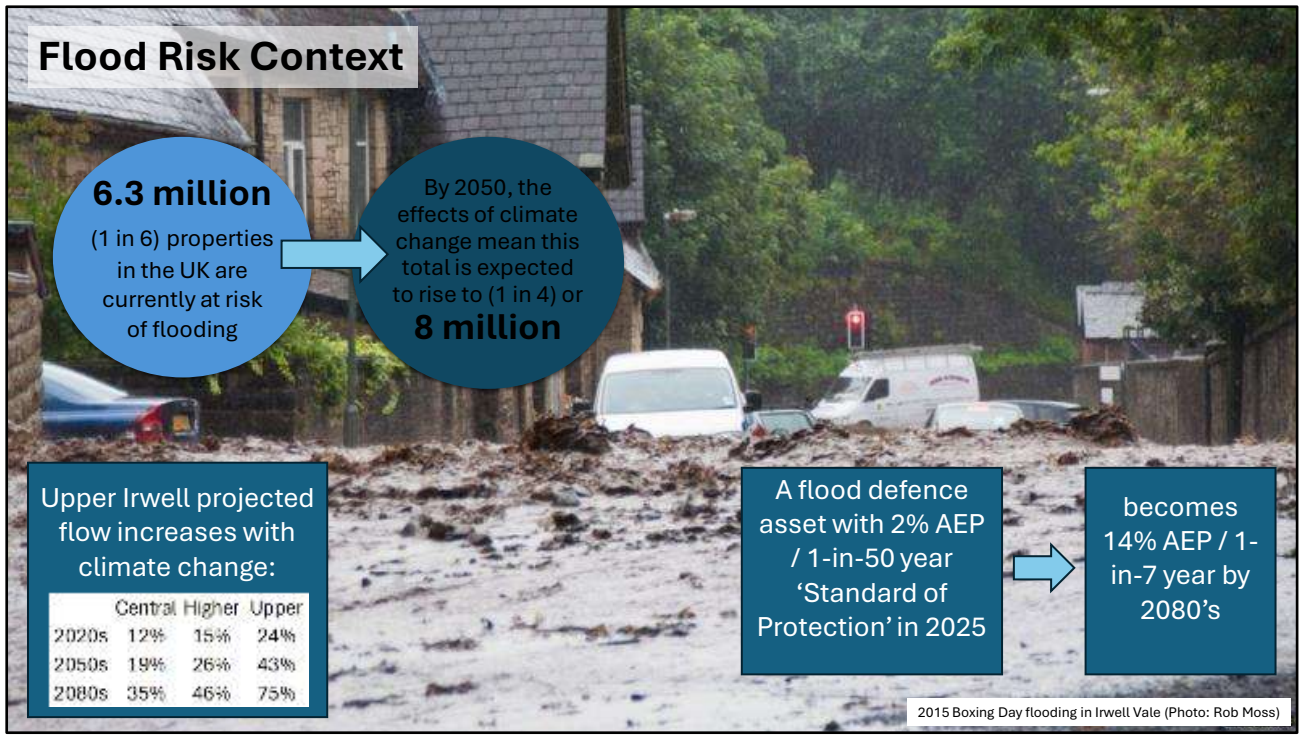
Bollin Valley NFM (Natural Flood Management)

Nature based solutions to build climate resilience for farmers, landowners and communities at risk of flooding

Rob Dyer
NFM Manager, The Mersey Forest

merseyforest.org.uk



- The effects of climate change are increasing at pace. At present 1-in-6 properties in the UK are at risk of flooding, which amounts to 6.3 million properties total. In 24-years time, in 2050, the effects of climate change will increase these figures to 1-in-4 or 8 million properties.
- To give these figures some context, the risk of your home being burgled is statistically 1-in-100 per year in the UK, whereas risk of flooding is currently 1-in-6, so significantly higher.
- As an example within the Greater Manchester, Merseyside & Cheshire area – the Upper Irwell (north of Manchester) has some alarming projected increases in flow over time. The middle scenario for emissions, gives 46% increase in flows for the Upper Irwell by 2080.
- This means a flood defence measure which has a currently protects against flooding up to a 1-in-50 year storm, will be reduced to a 1-in-7 year storm by the 2080's.
- And some catchments have higher Climate Change increases. For example, within the Mersey Forest area, the Upper River Weaver is projecting 106% increases in flow by 2080.
- So, if we don't invest in nature-based interventions and work in collaboration with landowners across catchments upstream of Communities at Risk, we risk going backwards.

How to reduce flood risk?

Traditional hard engineering solutions (e.g. flood walls) are often unviable due to:

- Size of structures required to give an appropriate 'standard of protection' wont fit in the available space
- The costs of these types of structures are too high

In many cases, our only option is to look upstream of a 'community at risk' to:

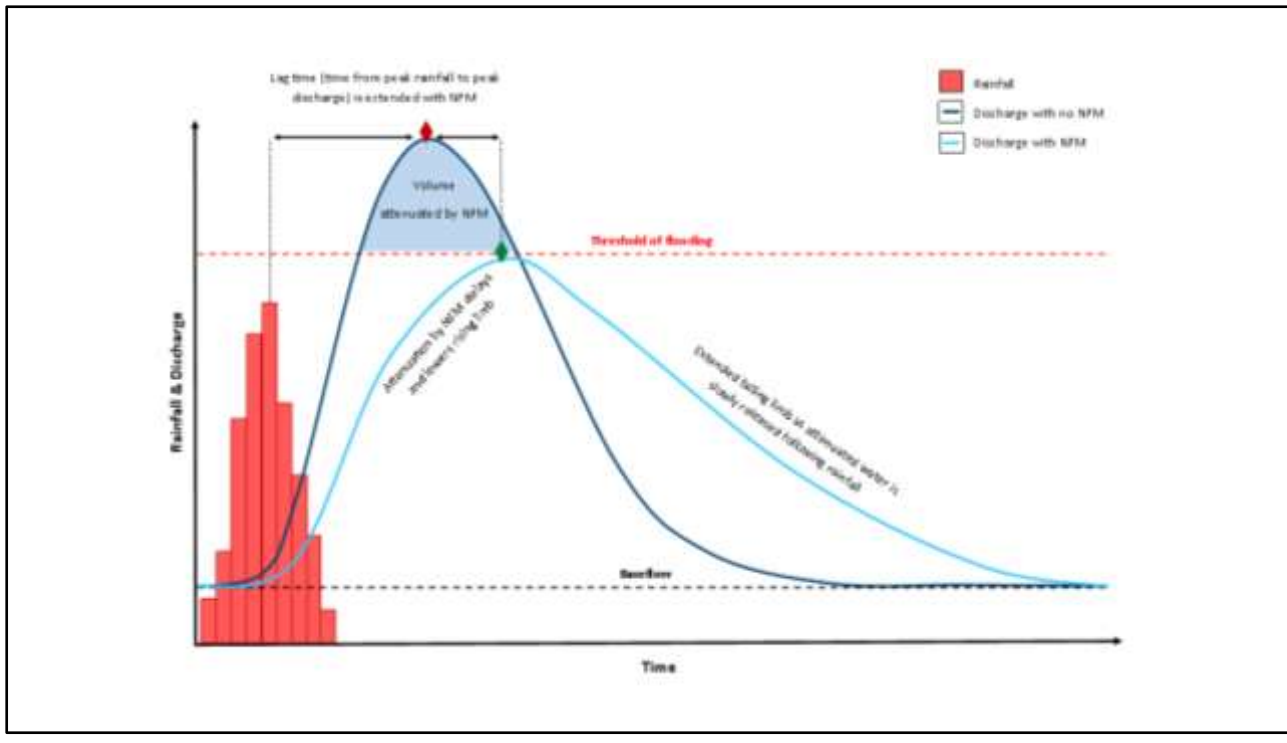
- 'Slow the flow'
- Temporarily store water in suitable locations within the landscape

Natural Flood Management (NFM)

NFM focuses on the catchment upstream of flood risk areas and aims to reduce flood peaks downstream by:

- Slowing the flow in ditches/streams/rivers/surface runoff routes
- Temporarily holding flood peaks in the landscape with slowed release
- Intercepting rainfall with trees and other vegetation
- Increasing infiltration into the soil

Crucially, the more interventions we can spread across a catchment, the better the results are likely to be.



This is an example flood hydrograph which shows the relationship between rainfall and discharge for the same storm event with and without NFM.

- The red bars indicate rainfall over time starting more slowly before peaking in intensity and then dropping off again.
- The 'lag time' is the length of time between peak rainfall and peak discharge, which shows how 'flashy' a catchment is through the whilst that water makes its way into watercourses and flows downstream.
- The dark blue line shows discharge under a no NFM scenario which is a faster responding catchment giving a higher peak discharge, more quickly after rainfall and which relatively quickly returns to normal 'baseflow' – giving a 'flashier' response to a given rainfall event.
- By comparison, the light blue line which shows discharge following installation of NFM measures shows a lower and slower peak discharge, taking longer to return to typical 'baseflow' after the event.

We can't make the rain disappear – we still need to get the same amount of water though the system, but by slowing it down and storing it temporarily in the landscape so that it drains more slowly, we can reduce peak flood levels.

Benefits beyond flood risk

NFM can also offer additional benefits to you as landowners, the environment and local community. For example:

- Improved water quality/sediment reduction could help meet requirements for *Farming Rules for Water*.
- Increasing water storage could help to increase farm resilience to drought.

Many NFM interventions also feature as options on Countryside Stewardship schemes, offering capital and ongoing revenue funding (depending on the scheme) for interventions installed and maintained.

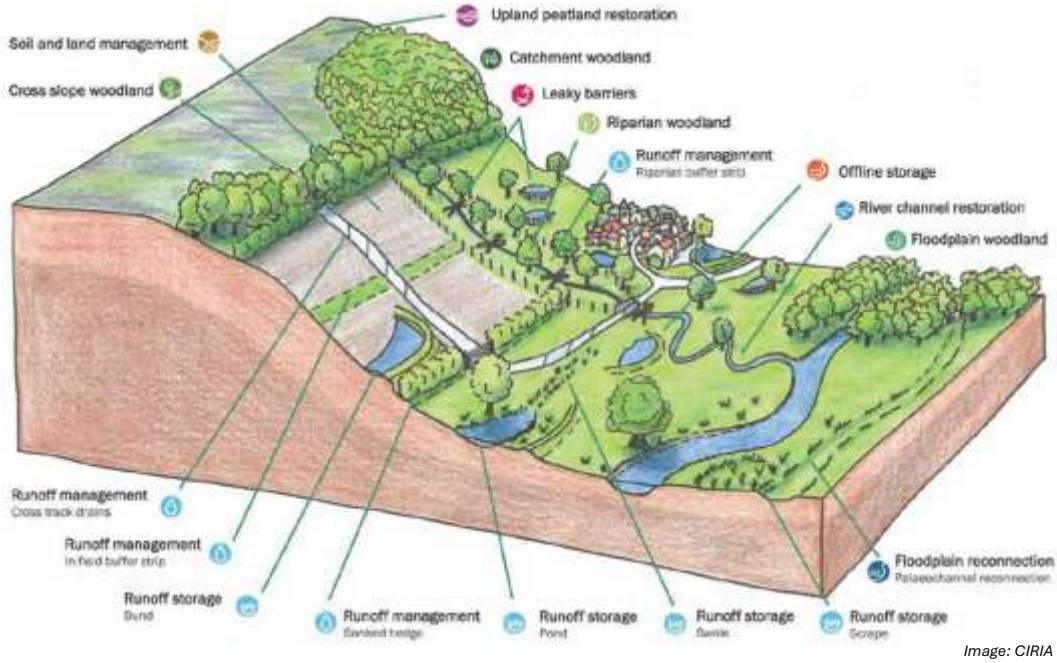


Image: CIRIA NFM Manual

Leaky dams


Large multi-stack leaky dams across a disused reservoir base at Two Lads, Smithills Estate.


Multi-stack leaky dams in series at Far Bank End Farm, Whitewell Brook.


Multi-stack leaky dam at Peers Clough Farm, Whitewell Brook.


Wall of logs living leaky dam with willow beginning to grow in at Colliers Moss, St Helens.


Wall of logs leaky dam in construction at Peers Clough Farm, Whitewell Brook.

- Large woody debris is an important part of a well functioning natural water network it is often removed to avoid damage to infrastructure. Finding a way to safely make space for this is important not only for flood risk reduction but also habitat through the shelter wood provides aquatic life and flow variation it encourages, driving many natural hydrological processes.
- Leaky dams anchor large woody debris to prevent washout and can take many different forms but are typically either:
    - Smaller permeable structures when located in watercourse.
    - Larger less permeable structures when located on surface runoff pathways.
- They slow the flow without fully blocking the channel as the lowest horizontal timbers will be set just above winter baseflow level allowing normal flows to pass unhindered. This is also very important to maintain fish passage.
- As water levels rise during a larger storm, flows will start to hit the structure, slow and back up behind it. The leaky nature of these dams means water is released but more slowly, so reducing downstream flood peaks.
- Incorporating living material (typically willow) into every dam is critical to ensure that they become living structures, rather than only decaying timber with a fixed lifespan.
- Leaky dams are usually low-cost and low-impact individually but can be very beneficial if used in series.
- Ideal for locating in existing or newly planted woodland as long term we want natural tree fall into channels to eventually take over from constructed interventions.

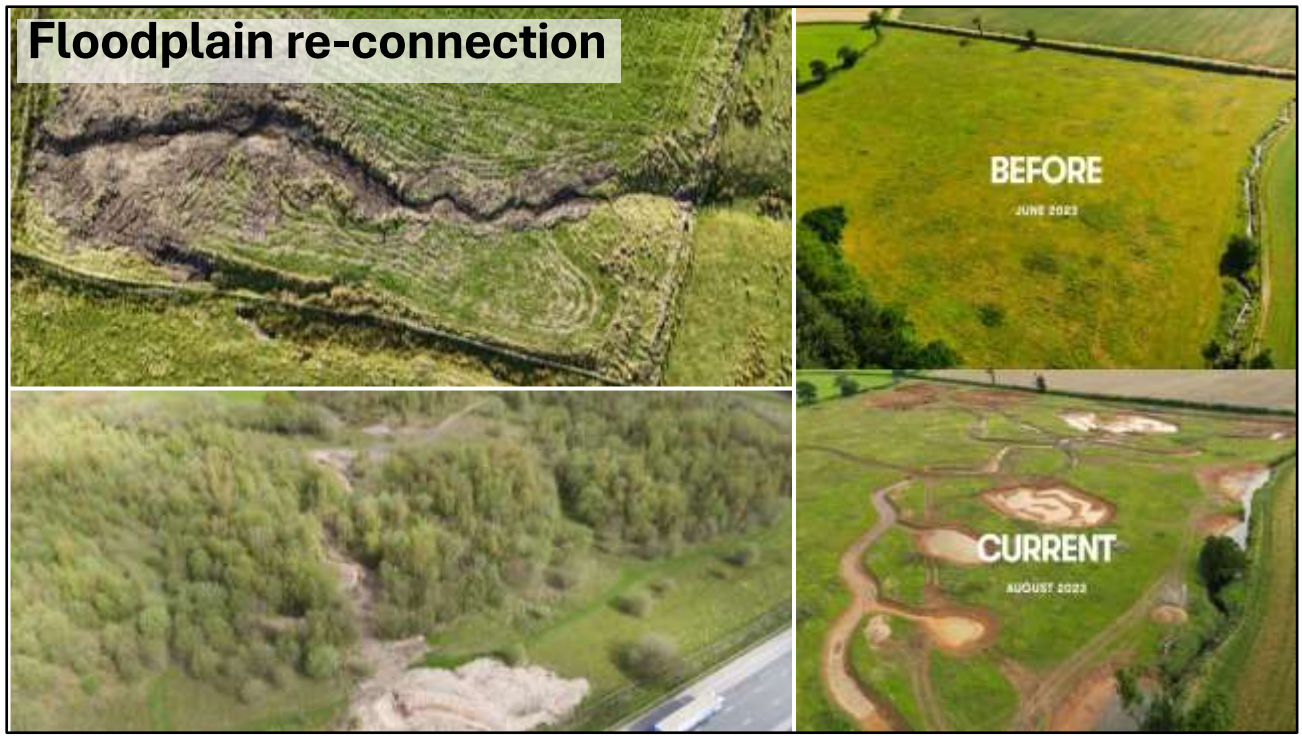
- Bunds are low earth embankments designed to temporarily store or divert floodwater.
- They can hold water back on floodplains or in upper catchments, releasing it gradually often through a pipe sized to throttle flows at the threshold for damaging flooding downstream.
- Can take many forms but importantly if designed well, will only hold water during heavy rainfall allowing the land to be productive for most of the year.
- Equally, if retaining more water is an aim for a landowner (to provide drought resilience), the outlet pipe can be set higher to allow water to be held for longer, whilst also providing some storage capacity during larger storms.
- Critical considerations are ensuring a good factor of safety against failure – making these too large can introduce hazards from a wall of water scenarios were they to fail.
- So, we limit height to 1m max, avoid storing very large volumes of water behind them and ideally build in series so there is redundancy in numbers.

Scrapes, ponds & constructed wetlands

Wetland/large scrape in construction at Bank Farm, Cheshire, with leaky barriers in a small stream forcing water out of bank and into the wetland.

- These measures provide temporary or permanent water storage, reducing peak flood flows.
- They slow runoff by collecting surface water and increasing the length of flow pathways.
- Support attenuation and infiltration and can act as sediment traps reducing sediment load in watercourses which can be a major flood driver (as channel capacity is reduced).
- When combined with floodplain reconnection they can provide controlled out-of-bank storage.
- Offer multiple benefits beyond flood resilience including: water quality improvement (through sediment capture and nutrient uptake), drought resilience, habitat creation, landscape, and amenity.

Floodplain re-connection



Many watercourses in the UK have been heavily modified over recent history, straightening and deepening channels, or even completely realigning the course of a river. This disconnects the river from its floodplain, reduces the complex flow variety that should be present in a natural river system, favouring instead faster straighter flows speeding water downstream. Straightening channels also reduces the channel's capacity to hold water as there is a shorter distance it needs to travel. Any watercourse has a floodplain – from a typically very narrow strip immediately next to the channel in steeper upland systems, to the more easily recognisable wide flat floodplains in the lower reaches of a catchment and allowing flows in a channel to spill out onto the floodplain at a lower threshold means flows are slowed and potentially temporarily stored on the floodplain. Some NFM measures that could reconnect a river with its floodplain might be:

- **De-culverting:** many watercourses have been routed underground in the past and these watercourses are effectively dead as they have little to no habitat value, and are speeding water off the land through buried pipes or stone culverts. Daylighting these, and introducing a more sinuous path with a shallower and wider channel will slow the flow and allow water to spill onto the floodplain more easily.
- **Bank lowering:** to encourage flows onto the floodplain at a lower threshold
- **Re-meandering/re-wiggling:** re-instating a more sinuous path for the river channel. This could be anything from engineered meanders using an excavator, which still isn't natural but is getting the river closer to it's natural state and mimicking natural processes. Right through to a 'Stage 0' approach, where the existing channel is filled in, pushing water onto the floodplain and with no further intervention, allowing it to find it's own course and establish new channels naturally.
- **Slowing the flow on the floodplain:** where flows are already spilling out of channel, riparian/floodplain tree planting or installation of large woody debris/scrapes/bunds across flow paths can help to further slow and temporarily store water.

Trees benefit flood risk reduction in a number of ways:

- Interception of rainfall by canopy, stems, branches and evaporation back to the atmosphere
- Increased infiltration through root systems creating good soil structure
- Direct uptake by the tree through its root system
- Increased capacity of soil to hold water through increased soil organic matter
- Increased surface roughness to slow the flow of water that does run off over the surface when soil becomes saturated

Trees can be an incredibly useful tool to help manage flooding as well as all the other benefits we know they bring. For example, planting trees on a riparian corridor or floodplain where we want to hold back water will help to increase surface roughness, slow the flow and push water further onto the floodplain. Likewise, on surface runoff pathways, (e.g. across a field where water sheets off the land during heavy rainfall), a cross-slope hedge/shelter belt could help slow surface water flow.

The Future

- We need to deliver more NFM across the Bollin catchment to keep pace with climate change and have a meaningful impact on flood risk.
- We want to work with landowners and farmers to develop plans which work for you – enhancing your business, reducing flood risk and providing as many additional benefits as possible.
- If you're interested in learning more please get in touch:

rob.dyer@merseyforest.org.uk