Working with the Calderdale Flood Partnership

Environment Agency

Natural Flood Management Measures

A Practical Guide for Farmers in Calderdale

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Acknowledgements

This guide has been developed to provide simple, clear information on natural flood management measures for landowners and farmers in Calderdale.

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Introduction

The catchment of the River Calder and its tributaries is approximately 390km², much of which is farmland. The River Calder rises in Calderdale flowing through Todmorden, Hebden Bridge, Sowerby Bridge and Brighouse, eventually joining the River Aire at Castleford.

The topography of Calderdale is characterised by open expanses of moorland and blanket bog at high elevation, (see Figure 1) with deep, steep sided valleys. In high rainfall events, runoff from these moors is funnelled into the deep valleys, making the lower lying, more densely populated areas highly vulnerable to flooding.

The Calderdale Boxing Day floods in 2015 demonstrated the significant damage to farmland and communities caused by high rainfall. Over 3,500 homes and businesses were affected[1]. The total economic impact to the Calderdale and Kirklees regional economy was approximately £170 million[2].

There is now much interest nationally in how changes to land management practices across catchments can help to reduce the risk of flooding. Small, low-cost measures taken by farmers and land managers can make a real difference to flooding by:

- Maintaining the capacity of watercourses
- Keeping more water on the hill for longer and out of rivers during high rainfall events.

Once the water is in the river during a high rainfall event, there is less chance of effective intervention.

In addition, these measures are likely to also benefit farmers by reducing incidences of damage to farm property like:

- Prolonged inundation of farmland
- Erosion of farm tracks, fields and river banks
- Loss of agricultural soils and
- Flooding of farm buildings.

Making changes to land management by implementing measures that could help to reduce the risk of flooding is known as natural flood management (NFM).

This guide has been developed to equip landowners and farmers in Calderdale with knowledge of NFM, and show how changes to their land management could reduce the risk of flooding. The guide contains a range of NFM techniques and provides key information to landowners who may wish to install these measures on their land.

Information is also provided on the sources of funding available to assist landowners with implementing NFM measures, as well as details on the permissions and consents that may be required.

[1] Environment Agency Calderdale flood action plan, June 2017 www.gov.uk/government/publications/calderdale-flood-action-plan

[2] Leeds University Economic Impact Assessment of Boxing Day Floods www.see.leeds.ac.uk/uploads/media/Economic_Impact_Assessment_of_Boxing_Day_floods.pdf

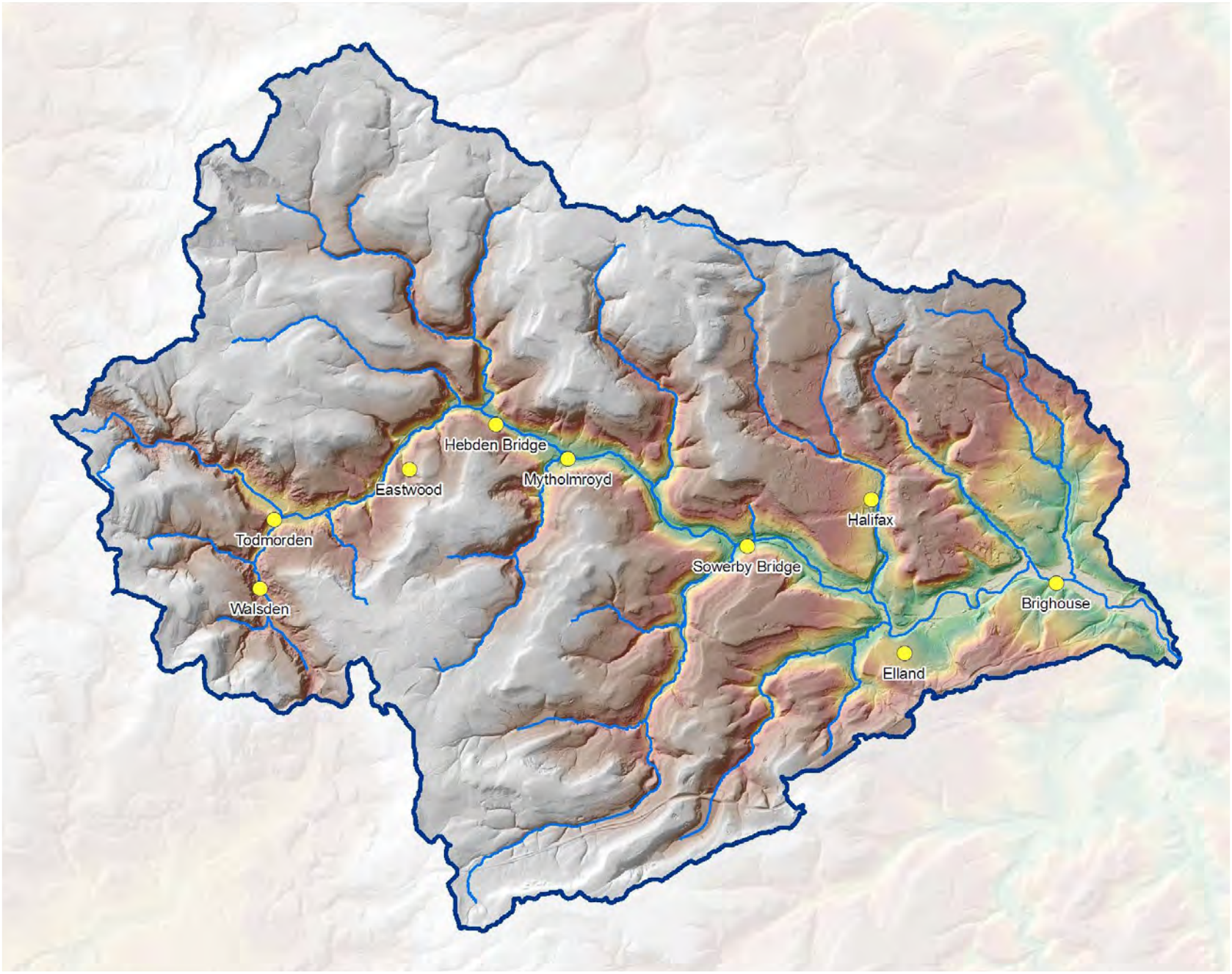

Figure 1: *Catchment of the River Calder. Note that the uplands (in light grey) cover much of the catchment. The more water that can be contained in these areas during a high rainfall event, the lower the risk of damaging floods.*

What is NFM?

NFM is putting in place practical measures which mimic natural processes, to slow down the flow and retain water in the landscape. These measures can work both within and outside of a river channel. NFM is sometimes called “nature based solutions” or “working with natural processes”.

These measures are designed to restore and enhance natural features to provide an optimal range of positive and long lasting impacts on the environment.

NFM aims to:

- **Reduce the downstream maximum water height of a flood (known as the flood peak)**
- **Delay the arrival of the flood peak downstream (known as increasing storm lag time)**
- **Increase the time available to prepare for floods.**

There are four key ways of achieving NFM, and various measures and techniques that can be used to do this:

1. **Increasing soil infiltration** - Free-draining, un-compacted soil will make saturation less likely, potentially reducing surface runoff. In addition, vegetation increases pathways into the soil. Evaporation from soil can also make space for water.
2. **Slowing water** by increasing resistance to its flow, known as increasing ‘roughness’ of the land surface. For example, by planting floodplain or riverside woods, or blocking grips on moorland.
3. **Reducing water flow connectivity** by interrupting surface flows of water, for example, by planting buffer strips of grass or trees, and by interrupting runoff pathways in some places.
4. **Storing water** by using, and maintaining, the capacity of ponds, ditches, embanked reservoirs, channels or land, and by reconnecting the watercourse to the floodplain where beneficial.

There is now information available outlining the evidence base for working with natural processes to reduce flood risk. This information is available on the Environment Agency’s website and contains a range of case studies: www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk

The documents listed below are available on the EA’s websites via the above link. These provide a useful summary of the findings with further information:

- Working with natural processes: summary
- Working with natural processes: one page summaries.

Where NFM measures can be installed across the Calderdale catchment

NFM measures can be installed in various locations across the catchment. Certain measures will be better suited to particular areas of the catchment.

Figure 2 on the next page gives an indication of the locations within the catchment where certain NFM measures will be most appropriate.

Having a wide variety of NFM measures implemented at different locations across the catchment will provide the best potential for reducing flood risk.

Landowners and farmers should communicate and collaborate with local councils and regulatory agencies, to help ensure that NFM measures are implemented effectively whilst balancing current land use interests across the catchment.

Figure 2: *Heptonstall, Calderdale. IMAGE © Natural England*

Additional benefits

Many of the NFM measures proposed have other benefits, to either the farmer directly or the public generally.

Benefits for land managers

The main benefits for land managers from activities which deliver NFM include:

- Reduction of soil loss across the holding
- Increased soil and riverside land stability
- Increased soil fertility and reduction in fertiliser and pesticide run-off, reducing costs
- By improving soil structure, water can be retained in soils for longer, reducing the risk of summer drought
- Improved water quality for stock and wildlife, which can help to meet the requirements of the EU Water Framework Directive.

Benefits for wider landscape and society

Additional benefits for wider landscape and society:

- Improvement of water quality
- Less sediment in rivers downstream
- Reducing pollution downstream
- Improvement of habitat for wildlife
- Economic benefits derived from higher landscape quality such as tourism, business investment and diversification
- Better opportunities for outdoor recreation and associated health and wellbeing benefits
- Creates environments that are more resilient to climate change
- Some of these measures, such as woodland creation and restoration of blanket bog habitat, absorb carbon from the atmosphere and store it in the landscape.

Limitations

NFM is not the complete solution to flooding but is one of many tools needed to manage flood events. Used in conjunction with other flood management solutions, like hard engineering, it will have a beneficial impact on reducing the flood peak downstream. Research at a number of small scale catchments has shown this to be the case.

Improving soil health is particularly important

Many measures for improving soil health for NFM will have multiple benefits to farm businesses, such as:

- Increased soil stability
- Improved drainage
- Reduced erosion
- Increased soil fertility because fewer nutrients are lost
- Reduced cost of inorganic fertilisers
- Increased vegetation for grazing.

Improving soil health can increase the depth that water is absorbed to from 10cm to 30cm. This significantly increases the volume of water that can be absorbed by and stored in the soil. This is not the same as when soils in poor health become water-logged.

When soil, the commodity that allows food to be produced, is eroded from land, it fills up the watercourses downstream, reducing their capacity and making flooding more likely. This is costly to remove, and can also affect fisheries and fish breeding.

Natural England have developed a form for undertaking a risk assessment on whether your farm is at risk of soil erosion, which may be needed as part of a Countryside Stewardship application: www.gov.uk/government/uploads/system/uploads/attachment_data/file/598316/CS-runoff_and-soil_erosion.pdf

Soil health in the uplands

Soil health in the uplands can be especially poor in areas of exposed peat. Blanket bogs in the uplands are natural wetlands. As they dry out, they become more susceptible to wildfire and erosion, and lose their capacity to store water. Peat soils entering watercourses can also discolour water. Treating this discolouration is costly and can result in raised water bills[3].

The Calderdale catchment includes blanket bogs, other peat soils, acid loamy upland soils, and freely draining acidic upland soils[4]. Stabilisation and revegetation of blanket bog and peat soils is crucial for improving soil health (See Figure 3).

Restoration of peatland has had significant improvements on storm-flow behaviour in the South Pennines, including:

- Increasing storm-flow lag times by up to 267%
- Reducing the peak storm discharge by up to 37%
- Reducing Particulate Organic Carbon in water by over 90%, in comparison to bare peat catchments[5].

These improvements to soil health can benefit farmers and landowners by increasing land value, and increasing the potential of ecosystem service provision on land, which may attract future funding.

Research undertaken by Natural England into valuing the ecosystem services provided by uplands, under different land use and management interventions, suggests that for every £1 spent in the catchment, society benefits by £2.96[6].

Further information is available on the importance of soils for NFM:

The East Devon Catchment Partnership – Soils and Natural Flood Management
eastdevon.gov.uk/flooding/soils-and-natural-flood-management/

Figure 3: *IMAGE © Moors for the Future Partnership. Top: Open peatland before restoration. Black Hill, West Yorkshire, 2004. Bottom: Peatland after restoration. Note the standing water. Black Hill, West Yorkshire, 2017.*

[3] IUCN Peatland Programme – Demonstrating Success, Yorkshire Water and Keighley Moor project www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/IUCN%20Demonstrating%20Success%20Booklet_0.pdf

[4] A useful tool is the Land Information System (LandIS), which can help identify which soil areas are in your area.

[5] Restoration of Blanket Bogs; flood risk reduction and other ecosystem benefits; Final Report of the Making Space For Water project, Moors for the Future Partnership, 2015.

[6] Valuing land-use and management changes in the Keighley and Watersheddles catchment, Natural England, 2012.

Using this guide

The implementation of NFM measures can vary in terms of complexity, cost, and the benefits provided. This guide provides advice on the range of NFM measures available, the benefits provided and key information for landowners and farmers to consider which measures might be appropriate for their land. Information is also provided on the potential sources of grant funding available to help support the work.

Intervention level

In this guide the various NFM measures are grouped into three different levels of intervention:

Level 1

NFM measures requiring minimum or no consultation with authorities such as the Environment Agency or other organisations. These measures are usually low cost, simple to install but effective. These measures provide an excellent foundation for achieving both NFM and a host of additional benefits to landowners.

Level 2

NFM measures requiring a certain level of consultation and possibly consent with authorities. These measures are a mix of low to medium cost. They may need contractors' help to install them.

Level 3

NFM measures that involve a lot of design and are targeted to certain locations within the catchment. They may require planning permission, consents from authorities and in most cases, involve professional water management consultant advice. These measures are usually high cost and need contractors to install them.

Information provided about each NFM measure

Each NFM measure is described in terms of:

- The purpose of the NFM measure and the desired effect on the landscape
- Where across the catchment the NFM measure is applicable
- The benefits provided to the landowner and farmer and
- Suggestions and considerations for implementing the measure.

Information on the likely setup and maintenance costs for each NFM measure is provided. These costs have been placed into categories, with a definition provided. These costs categories are intended to be approximate guidance and are not definitive. Costs will vary depending on the scale of implementation.

Set up costs

Low

The landowner or farmer can implement the NFM measure with minimal advice, equipment and specialist guidance.

Medium

Requires some raw materials, specialist equipment or expert involvement.

High

Requires significant raw materials, specialist equipment or expert involvement.

Maintenance requirements & costs

Low

Mostly involves routine inspections and light management which can be undertaken by the landowner or farmer.

Medium

May occasionally require expert advice or equipment (e.g. <10 years).

High

Expert advice or equipment may be required frequently (e.g. <5 years).

Intervention level 1

Cross drains in farm tracks

IMAGE © Yorkshire Dales National Park Authority. NFM Measures – A Practical Guide For Farmers.

Tracks provide a significant transport pathway for water and sediment. This creates problems with erosion of the track and deposition of sediment on farmland, roads or watercourses. Tracks are costly to repair but are essential to the farm. A cross drain is a system to move water across a path or route and can be used to collect run-off from a vulnerable area. Water can be diverted to places of vegetation to slow down the flow.

NFM purpose

Diverts main pathway of water, reducing flow volume, velocity and sediment load. When used with a sediment trap can slow the flow of storm water significantly.

How you do it

On steep slopes or where run-off volume is high, a number of cross drains will be required, located at specific intervals along the track.

Can be linked with swales and sediment traps alongside the track to encourage sediment to drop out of the water. Also prevents sediment being washed onto grassland. The size of the cross drain will depend on local conditions. Small drains are typically 0.1 x 0.1m, constructed of concrete, wood or clay pipe. For heavy rainfall, 0.2 x 0.2 drains can be constructed from stone or wood.

Site suitability

Throughout catchment. Tracks on steep hillsides, adjacent to yards, roads or within close proximity of a water course.

Benefits

- Farm tracks suffer from less erosion and last longer
- Stone and sediment caught in traps can be re-used on the track, saving time and money
- Potentially reduces pooling of water at the end of the track.

Level of maintenance

Low – Cross drains should be inspected, cleaned out, or reshaped to original capacity after each major storm.

Set up cost

Low

Maintenance cost

Low

Intervention level

1

Funding

Payments are available under Countryside Stewardship for Mid and Higher Tier providing the land is eligible.

More information is available online: www.gov.uk/countryside-stewardship-grants/cross-drains-rp5

Intervention level 1

Increasing soil permeability & reducing soil compaction

IMAGE © Yorkshire Dales National Park Authority. NFM Measures – A Practical Guide For Farmers.

Soil compaction occurs when soil is squashed into an impermeable layer. This can occur due to high livestock densities and the movement of farm machinery. Soil compaction reduces the amount of water that can infiltrate into the soil, increasing the rate and volume of water flowing across the surface. In addition, where land is highly trampled by livestock and the sward is very short, issues are exacerbated (because of the speed that water flows over the surface) and increased erosion is likely.

Soil compaction often occurs around gateways and water troughs, which can become very compacted and muddy due to frequent use.

NFM purpose

Reducing the compaction of soils means that they are better able to absorb water, helping to alleviate flooding and improving land drainage.

How you do it

Techniques include:

- Mechanically aerating soils using spiked aerators

  Undertake minimal tillage for arable crops or when considering re-seeding
- Managing crop rotation and reducing livestock density through livestock rotation
- Avoid using heavy machinery on wet soils to further protect from compaction
- Creation of hard standing areas or regular moving of feed and water troughs can help reduce localised soil compaction
- To create a hardstanding area, the soil must be dug to a depth of at least 150mm and the areas extended around the trough to at least 2.5 m wide. A geotextile membrane can be laid down before the harcore and edged with timber.

Site suitability

Any field below the moorland line. Fields close to a watercourse and used for winter grazing are most significant.

Priority should be given to sites with a high risk of run-off.

Benefits

- Reduces run-off and soil compaction over a wide area
- Improved fertiliser uptake and reduced fertiliser input needed
- Promotes strong root growth
- Improved soil quality including improved heat and stress tolerance
- More efficient crop growth
- Increased grass cover due to longer water availability
- Reduction of muddy areas in key locations
- Improves water quality by reducing runoff and soil loss into streams.

Considerations

- Possible change of livestock rotation patterns.

Level of maintenance

Low

Set up cost

Low

Maintenance cost

Low

Intervention level

1

Intervention level 1

Increasing soil permeability & reducing soil compaction (cont)

Funding

Payments are available for hard bases under Countryside Stewardship, Mid and Higher Tier providing the land is eligible.

Payments cannot be claimed for hard bases within 10m of a waterway or under livestock housing that is not associated with feed or drinking.

More information can be found online:
www.gov.uk/countryside-stewardship-grants/hard-bases-for-livestock-drinkers-lv3

Additional information

Guidance on soil management:
www.gov.uk/guidance/soil-management-standards-for-farmers

www.nfuonline.com/cross-sector/environment/soil/assessing-and-addressing-soil-compaction/

ahdb.org.uk/projects/documents/ThinkSoils.pdf

Intervention level 1

Winter cover crops

IMAGE © Natural England

Winter cover crops are non-cash crops that can be grown on land that would otherwise be left bare over the winter months after harvest. Cover crops help to reduce nitrate leaching on land that would normally be left bare or down to stubbles during winter, and may also reduce the risk of potential pollutants, such as sediment and nutrients, being carried into neighboring watercourses.

NFM purpose

Winter cover crops help to reduce overland flow, prevent soil erosion and increase the health and permeability of soil.

How you do it

Sow any plant that can grow throughout the winter. Do not destroy until immediately before establishment of following spring crop. You can use phacelia, vetch, ryegrass, grazing rye, barley and mustard, or a mix of these depending on local conditions and needs.

Site suitability

Lower catchment. Only applicable on arable land. Works well on sloping fields adjacent to watercourses, and wherever water is seen to flow across the surface in high rainfall.

Benefits

- Slows runoff by increasing land roughness
- Conserves soil moisture
- Prevents soil erosion
- Returns nitrogen to the soil, reducing fertiliser costs
- Deep rooting plants will improve the soil quality over the years by loosening compacted soils, improving the nutrient content and increasing soil biological activity
- Cover crops can be used in CAP Ecological Focus Areas and crop diversification, if you use 2 species of crop.

Considerations

- Using cover crops may require altering the arable rotation away from winter seeding towards spring.

Level of maintenance

Low

Set up cost

Low

Maintenance cost

Low

Intervention level

1

Funding

Payments are available under Countryside Stewardship for Mid and Higher Tier providing the land is eligible.

More information is available online: www.gov.uk/countryside-stewardship-grants/winter-cover-crops-sw6

Additional information

Certain types of cover crop can be grant aided through the Countryside Stewardship Scheme: www.gov.uk/government/publications/countryside-stewardship-mid-tier-including-water-quality-capital-items-manual

Basic Payments Scheme (BPS) guidelines: www.gov.uk/guidance/bps-2017

www.cfeonline.org.uk/5-winter-cover-crops/

Intervention level 1

Invasive species control

IMAGE © Richard Lewis, creativecommons.org/licenses/by/2.0/legalcode

Removal of invasive, non-native species of plants will help to ensure healthy, diverse vegetation throughout the catchment. Invasive species such as Himalayan balsam can establish on river banks and will outcompete the native plant species and destroy understory vegetation. Himalayan balsam then dies down in winter, leaving river banks free of vegetation and therefore susceptible to run-off and erosion. Japanese knotweed and rhododendron can have a similar effect.

NFM purpose

Controlling invasive species and allowing native species to re-establish will ensure maximum absorbtion capacity of soil and reduce run-off and erosion.

How you do it

Physical control, such as removing plants and disposing of them off-site, or chemical control, by spraying with herbicide. Seeds are often carried down the river, so it is best practice to start at the head of the catchment and work downstream. This will help control invasive species on a catchment scale.

Site suitability

Throughout catchment. Riverbanks.

Benefits

- Ensures maximum absorption capacity of soil
- Reduces runoff and erosion
- Removes competition for native plants allowing deep rooted native species to colonise
- Reduces the risk of invasive species colonising areas further down the catchment.

Level of maintenance

Medium – Regular maintenance may be needed depending on effectiveness of control methods.

Set up cost

Low Medium

Maintenance cost

Medium

Intervention level

Level 1/ 2 depending on type of control.

Funding

Payments are available under Countryside Stewardship for land that is grazed and located next to ditches, rivers or streams under the SW11: Riparian management strip option.

This is providing the land meets the requirements. This option however must address other factors in addition to invasive species, such as restricting livestock access to the watercourse.

More information can be found online: www.gov.uk/countryside-stewardship-grants/riparian-management-strip-sw11

Additional information

himalayanbalsam.cabi.org/what-is-himalayan-balsam/

Environment Agency Guide on Aquatic and Riparian Plant Management - Controls for Vegetation in Watercourses: evidence.environment-agency.gov.uk/FCERM/en/Default/FCRM/Project.aspx?ProjectID=B081237C-AF90-4E75-B74B-586A6C254709&PageId=a0fe6dfc-506a-452c-9bff-a7ec06b4e6b0

Intervention level 1

Watercourse buffer strips

IMAGE © Yorkshire Dales National Park Authority. NFM Measures – A Practical Guide For Farmers.

IMAGE © Derbyshire Wildlife Trust

Creating strips of vegetation alongside streams, ditches and rivers can provide a barrier to help restrict the flow of storm water, and prevent soil, sediment and nutrient loss from fields. These buffer strips often work with fencing, to provide a barrier restricting livestock from accessing both the banks of the stream or river and the watercourse itself. Pasture pumps can be used in combination with buffer strips to provide livestock with access to water.

NFM purpose

Buffer strips can increase surface roughness, slowing the flow of storm water and increasing infiltration. They also reduce soil and nutrient loss from fields and stabilise the banks of watercourses reducing erosion. This in turn will improve water quallity in streams and reduce the build up of sediment in water courses further down the catchment.

How you do it

Careful management of the strip of land directly adjacent to the stream, to maintain native vegetation and exclude livestock. In order to give livestock access to water, consider installation of pasture pumps.

More information on how to use and maintain buffer strips is available online as part of options under the Countryside Stewardship Scheme:

SW1: 4m to 6m buffer strip on cultivated land
www.gov.uk/countryside-stewardship-grants/4m-to-6m-buffer-strip-on-cultivated-land-sw1

SW2: 4m to 6m buffer strip on intensive grassland
www.gov.uk/countryside-stewardship-grants/4m-to-6m-buffer-strip-on-intensive-grassland-sw2

SW4: 12m to 24m watercourse buffer strip on cultivated land
www.gov.uk/countryside-stewardship-grants/12m-to-24m-watercourse-buffer-strip-on-cultivated-land-sw4

Site suitability

Throughout catchment, especially on grazed land next to streams and ditches that suffer from high sediment loads.

Benefits

- Prevents agricultural chemicals, sediment and nutrients reaching the watercourse, reducing waste
- Can be designed to straighten irregular field edges, enhancing crop operations
- Can reduce effects of spray drift
- Reduces risk of erosion and loss of valuable topsoil by stream
- Reduces risk of livestock acquiring waterborne diseases
- Can reduce overland flow impacting roads and neighbouring properties
- Improves water quality of stream
- Strengthens riverbanks
- Wildlife habitat creation. Buffer strips can also qualify as Ecological Focus Areas (EFAs) under the Common Agricultural Policy (CAP) greening requirements
- Can also be planted with trees to increase benefits for NFM and to increase value for wildlife.

Considerations

- Requires installation of means of livestock to access water
- If the strip is to be fenced from grazing, there may be reductions in eligible land area under the Basic Rural Payments Scheme.

  If a fence is within 3m of the middle of the river or field boundary then the eligible area remains unchanged.

Intervention level 1

Watercourse buffer strips (cont)

Level of maintenance

Low – Buffer strips should be checked for invasive species. Implementation next to main rivers may require alternate consent.

Set up cost

Low

Maintenance cost

Low

Intervention level

1

Funding

The Countryside Stewardship Scheme contains a range of buffer strip, grass margin and riparian management strip options.

More information is available online:
www.gov.uk/countryside-stewardship-grants

Additional information

Basic Payment Scheme information:
www.gov.uk/government/collections/basic-payment-scheme

www.cfeonline.org.uk/1-grass-buffer-strips-next-to-a-watercourse-or-pond/

Environment Agency Rural Sustainable Drainage Systems Report:
www.yorkshiredalesriverstrust.com/wp-content/uploads/2014/12/RSuDS.pdf

Intervention level 1

In field buffer strips

In field buffer strips are grass strips placed along the boundary, or across the middle of a large field. These buffer strips offer several benefits for NFM and when used next to existing features such as hedgerows, woodland and dry stone walls, they will provide habitat for wildlife, and form links or corridors between other habitats.

NFM purpose

Buffer strips in fields reduce overland flow by increasing surface roughness. They also increase infiltration, and prevent sediment, soil and nutrient loss.

How you do it

Using native grass species establish or maintain a 4 to 6m wide grass buffer strip. These can be placed on field boundaries and next to existing hedgerows, woodland, and drystone walls. Maintenance of field buffer strips will depend on the land use, but fertilisers and manures should not be used.

More information on how to use and maintain buffer strips is available online as part of options under the Countryside Stewardship Scheme:

SW1: 4m to 6m buffer strip on cultivated land: www.gov.uk/countryside-stewardship-grants/4m-to-6m-buffer-strip-on-cultivated-land-sw1

SW2: 4m to 6m buffer strip on intensive grassland: www.gov.uk/countryside-stewardship-grants/4m-to-6m-buffer-strip-on-intensive-grassland-sw2

Site suitability

Throughout Catchment. On arable land at risk from soil erosion.

Benefits

- Prevents agricultural chemicals, sediment and nutrients reaching the watercourse, reducing waste
- Can be designed to straighten irregular field edges, enhancing crop operations
- Can reduce effects of spray drift
- Reduces risk of erosion and loss of valuable topsoil
- Can reduce overland flow impacting roads and neighbouring properties
- Wildlife habitat creation. Buffer strips can also qualify as Ecological Focus Areas (EFAs) under the Common Agricultural Policy (CAP) greening requirements.

Considerations

- Can impact livestock movements through fields
- If the strip is to be fenced from grazing, there may be reductions in eligible land area under the Basic Rural Payments Scheme. If a fence is within 3m of the middle of the field boundary then the eligible area remains unchanged.

Level of maintenance

Low

Intervention level 1

In field buffer strips (cont)

Set up cost	Maintenance cost
Low	Low

Intervention level

1

Funding

The Countryside Stewardship Scheme contains a range of buffer strip, grass margin and riparian management strip options for eligible land.

More information can be found online:
www.gov.uk/countryside-stewardship-grants

Additional information

Environment Agency Rural Sustainable Drainage Systems Report:
www.yorkshiredalesriverstrust.com/wp-content/uploads/2014/12/RSuDS.pdf

www.cfeonline.org.uk/2-in-field-grass-strips-to-avoid-erosion/

Intervention level 2

Field boundaries

IMAGE © Yorkshire Dales National Park Authority. NFM Measures – A Practical Guide For Farmers.

Planting new hedgerows, or restoring historic dry-stone walls that follow the natural contour of the slope, will reduce overland flow and encourage infiltration. Hedgerows and dry-stone walls can be combined with buffer strips to further increase the NFM benefit and create additional habitat for wildlife.

NFM purpose

Planting new or restoring old hedgerows and repair and restoration of dry-stone walls can block overland flows, reduce soil erosion and diffuse pollution. Planting of hedgerows that follow the contours of the land can intercept and slow run-off.

Hedgerows and dry-stone walls can also be used to direct or control movement of animals and machinery away from areas vulnerable to erosion.

How you do it

November is generally the best time to plant new hedgerows; however, if planting into clay soils wait until March. Planting should not be undertaken in freezing weather or waterlogged ground.

If the landscape is characterised by single-species hedgerows then the planting mix should reflect this. If not, then one of the following species should make up the planting mix:

- hawthorn
- blackthorn
- hazel.

No one species should make up more than 70% of the total. If new hedgerows are planted consider linking existing hedgerows and habits.

Fence off the plants if sheep, cattle or horses graze the land. Keep fences far enough away so the hedgerow can grow at least 1.5m in width. Rabbit netting may be needed, either on its own or with stock fencing, if there is a known problem with rabbits or hares. Tree shelters can also be used.

Prepare the ground along a 1.5m wide strip to provide good soil conditions and as little competition from other vegetation as possible.

Plants should be:

- 2-year-old transplants
- at least 450mm to 600mm high
- planted in a staggered double row 40cm apart with a minimum of 6 plants per metre
- kept clear of weeds until they are established.

Remove individual guards and tree shelters once the plants are established.

Trim the newly planted hedge in at least the first 2 years to encourage bushy growth, allowing the hedge to become taller and wider at each cut.

Prevent livestock and grazing animals from damaging the hedge by setting fencing at least 1.2m from the centre of the hedge, or, if there is a bank, as close to the base of the bank as possible.

Intervention level 2

Field boundaries (cont)

Site suitability

Throughout catchment. Particularly across steep-side fields where run-off is known to occur. Not suitable on blanket bog. Suitable where hedgerows have been lost from an area or become fragmented.

Benefits

- Reduces runoff and prevents loss of fertilisers and pesticides
- Reduces soil erosion and encourages infiltration
- Creates wildlife habitat and important food supplies
- Works well with buffer strips
- Creates shade and shelter for livestock
- Can prevent animal to animal contact, reducing the spread of disease.

Considerations

- Can impact livestock movements through fields

Level of maintenance

Medium – Newly planted hedgerows will require annual maintenance. New hedgerows should be trimmed in at least the first 2 years to encourage bushy growth, allowing the hedge to become taller and wider at each cut. Competitive weeds should be controlled (including brambles, nettles and grasses) during the first growing season.

Set up cost

Medium

Maintenance cost

Medium

Intervention level

2

Funding

Countryside Stewardship Scheme capital grants (mid and higher tier) are available such as:

BN11: Planting new hedges

BN12: Stone wall restoration

More information is available online:
www.gov.uk/countryside-stewardship-grants/planting-new-hedges-bn11

www.gov.uk/countryside-stewardship-grants/stone-wall-restoration-bn12

Intervention level 2

Contour bunds and detention basins

IMAGE © Moors for the Future Partnership.

Contour bunds are low earth mounds that are built following the contour of the slope. These work most effectively when constructed across known runoff pathways which appear after heavy rainfall. Through creating the contour bund a detention area is made, where water can be retained and allowed to disperse through a combination of infiltration into the soil, evaporation and slow release.

Detention basins can be designed so that the area is normally dry and can remain productive, as well as providing an opportunity for reclaiming soil and nutrients, or be designed to encourage the development of wetland habitat.

NFM purpose

Creation of bunds across known run-off pathways can intercept water flowing over the ground, slow the flow and redirect runoff.

Bunds can also be used to direct or control movement of animals and machinery away from compaction sensitive areas. Detention basins slow, store and filter water.

How you do it

Design of bunds should take into account the contour of the surrounding land, the position in the landscape, and the soil type. Detention areas should be sized for the area draining into it. Specialist advice may be required.

Site suitability

Mid and lower catchment. Small valleys and slopes prone to run-off during flood events.

Benefits

- Directly intercepts and redirects runoff
- Reduces soil erosion and diffuse pollution
- If bunds are grassed and permanent, they can provide additional wildlife habitat
- Bunds can be engineered in such a way as to provide access to fields in times of flood which would otherwise be inaccessible
- Detention basins and bunds provide opportunity for nutrient reclamation.

Considerations

- Can impact livestock movements through fields
- Can make cutting and mowing practices more complex
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands, is not considered to be a temporary flooding event as the land is not being maintained in a state suitable for grazing or cultivation which is the primary eligibility factor for BPS.

Level of maintenance

Medium – Require regular inspection to ensure that they are intact and the area behind the bund is not filled with silt.

Intervention level 2

Contour bunds and detention basins (cont)

Set up cost	Maintenance cost
Medium	Medium

Intervention level

2

Funding

Countryside Stewardship Scheme grants (capital items) for mid and higher tier are available for eligible land such as:

RP9 Earth banks and soil bunds

RP7 Sediment ponds and traps

More information is available online:
www.gov.uk/countryside-stewardship-grants/earth-banks-and-soil-bunds-rp9

www.gov.uk/countryside-stewardship-grants/sediment-ponds-and-traps-rp7

Additional information

Environment Agency Rural Sustainable Drainage Systems Report:
www.yorkshiredalesriverstrust.com/wp-content/uploads/2014/12/RSuDS.pdf

Intervention level 2

Erosion control on slopes and banks

IMAGE © Treesponsiblity

Different materials such as fascines (bundles of sticks) and geotextiles can be installed on slopes to stabilise areas at risk of erosion, and assist the establishment of vegetation.

NFM purpose

These materials are used to strengthen slopes and riverbanks, trap sediment, reduce soil loss and provide a structure to allow additional vegetation to establish.

How you do it

Fascine structures can be made according to the scale of the slope or riverbank under management. They can be constructed in a series of rows on a slope, within an erosion scar or landslide, or as a bank running alongside a river or stream. Local woodland managers can provide fascines made from thinnings.

Geotextiles are usually natural mesh sheets which can be installed in the soil to hold it together and facilitate vegetation. Geotextiles can be purchased in quantities according to the needs of the local site.

Site suitability

Throughout catchment. Steep slopes, riverbanks, anywhere prone to erosion.

Benefits

- Reduced erosion and reduced transfer of sediment into rivers
- Reduced runoff
- Allows establishment of vegetation for long term stabilisation.

Level of maintenance

Low – Inspection may be needed to ensure that the installation remains in place and that vegetation is re-establishing on the slope.

Set up cost

Medium

Maintenance cost

Low

Intervention level

2

Additional information

www.treesponsibility.com

www.treesponsibility.com/wp-content/uploads/2013/09/SOURCE-2015-booklet.pdf

Intervention level 2

Leaky barriers

IMAGE © Moors for the Future Partnership.

Leaky barriers can be constructed in a variety of locations across the catchment. These structures are often built from logs and woody materials and are placed in streams or ditches to hold back water. Where possible, these structures are designed to mimic the natural complexity of rivers and create a variety of habitats and flow conditions.

NFM purpose

Leaky barriers slow and divert flood flows and allow increased infiltration of water into the soil. They are designed to slowly drain trapped water once the flood flow has passed.

Leaky barriers are set above normal stream level so only flood flows are blocked. A network of leaky barriers work well on a local scale to control channel flows.

How you do it

Large logs can be laid across small streams in a cross formation and wedged into position. Smaller woody material can be wedged in between the large logs. To maximise impact, it is recommended to place more than one leaky barrier at different locations across the land holding.

If possible use locally sourced wood from the catchment.

Debris bundles can also be constructed in wooded areas to further roughen the surface of the floodplain and trap overland flows.

Site suitability

Throughout catchment, often alongside wooded areas in smaller watercourses. Leaky barriers work well alongside other woodland measures such as understorey planting.

Leaky barriers can also be constructed in ditches in open farmland, as well as in small upland ditches in open land, away from woodland and flowing channels. Due to possible effects on fish passage, In-ditch barriers are more suited to small watercourses and ditches where fish passage is less important, or where the watercourse runs dry during the summer months.

Benefits

- Delays flood peaks further down stream
- Traps sediment
- Can provide additional habitat for fish and invertebrates
- Low cost and effective
- Can be designed to incorporate a silt trap, improving water quality
- Reduces runoff.

Considerations

- Risk of woody material moving further downstream
- It is recommended to consider the potential impacts downstream and to follow design standards (such as those available from the Forestry Commission)
- Surrounding land may need to be capable of withstanding periodic flooding due to spill over when there is a high rainfall event
- Requires consent of Lead Local Flood Authority (LLFA).

Level of maintenance

Medium – May require periodic checking to ensure the integrity of the leaky barriers and remove any sediment or blockages where necessary. High longevity if well maintained.

Intervention level 2

Leaky barriers (cont)

Set up cost	Maintenance cost
Medium	Low

Intervention level

2

Funding

Funding is available through the Woodland Improvement Grant (WIG): www.forestry.gov.uk/ewgs-wig

Countryside Stewardship Scheme grants (capital items) for mid and higher tier are available for eligible land such as:

RP12: Check dams

More information is available online: www.gov.uk/countryside-stewardship-grants/check-dams-rp12

Additional information

Sussex Flow Initiative report: www.woodlandtrust.org.uk/publications/2016/09/water-sussex/

Case study at Pickering: www.forestry.gov.uk/pdf/FR_STF_Pickering_P2_May2015.pdf/$FILE/FR_STF_Pickering_P2_May2015.pdf

Intervention level 2

Online (in stream) ponds

IMAGE © Newcastle University

Online (in stream) ponds are a depression or basin on land through which a water channel flows. This feature can be designed to store some water permanently, depending on the individual requirements.

NFM purpose

Provides water storage capacity during storm events. The water slowly drains from the pond once the flood period has passed.

How you do it

Construction of a basin or ditch connected to the stream. Construction can depend upon the local needs of the site. The pond can include an armoured spillway to avoid erosion damage when overtopped.

Site suitability

Mid and lower catchment. Next to streams and rivers where exisitng field drainage structure allows for additional storm water storage. May not be suitable in areas where groundwater contamination is an issue.

Benefits

- Reduces run-off
- Removes sediment from the channel which can be reused on the farmland
- Can be designed to incorporate a silt trap, improving water quality
- The depth and speed of drainage can be manipulated according to the needs of the farmer
- The pond can act as a year round wetland providing additional wildlife habitat
- Retention of water is also beneficial in times of drought.

Considerations

- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands, is not considered to be a temporary flooding event as the land is not being maintained in a state suitable for grazing or cultivation which is the primary eligibility factor for BPS.

Level of maintenance

Medium – Requires maintenance for removal of sediment and debris, that can vary from monthly to yearly according to need and whether the pond has a sediment trap. The pond may also require management of vegetation.

Set up cost

Medium

Maintenance cost

Low

Intervention level

2

Additional information

The Runoff Attenuation Features Handbook (Newcastle University and the Environment Agency, 2011): research.ncl.ac.uk/proactive/belford/papers/Runoff_Attenuation_Features_Handbook_final.pdf

Intervention level 2

Offline flood water storage areas

IMAGE © Yorkshire Dales National Park Authority. NFM Measures – A Practical Guide For Farmers.

Offline flood water storage areas are areas of land adjacent to water courses, that are adapted to capture and store flood waters during periods of high flow. These are often situated within a flood plain, and can be designed to hold some water permanently, which may add to the wildlife value of the land.

NFM purpose

Flood water is directed out of the watercourse and into a pre-constructed storage area. The flood water is then stored temporarily and is released back into the watercourse in a controlled manner. This provides extra storage capacity for water during flood events.

How you do it

Offline flood water storage areas require specialist design and construction and a suitable site needs to be selected. It is recommended to create an irregular shape for water storage and inlets, outlets and spillways will need to be constructed. A liner may be required. Offline flood water storage should drain within 6-10 hours, so that there is storage available in the eventuality of multi-day extreme flood events.

Site suitability

Throughout the catchment near to watercourses. At the bottom of the slopes, particularly in fields draining to a single corner.

Benefits

- Removes sediment from the channel which can be reused on the farmland
- The depth and speed of drainage can be manipulated according to the needs of the farmer
- Can be a valuable community asset if well designed
- Provides rich wildlife habitat
- Retention of water is also beneficial in times of drought

Considerations

- Requires land
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands, is not considered to be a temporary flooding event as the land is not being maintained in a state suitable for grazing or cultivation which is the primary eligibility factor for BPS.

Level of maintenance

Medium – Requires maintenance for removal of sediment and debris, that can vary from monthly to yearly according to need and whether the pond has a sediment trap. Management of vegetation may also be required.

Set up cost

High

Maintenance cost

Low

Intervention level

2

Intervention level 2

Offline flood water storage areas (cont)

Funding

Countryside Stewardship Scheme grant options for higher tier are available for eligible land such as:

SW12 making space for water

More information is available online:
www.gov.uk/countryside-stewardship-grants/making-space-for-water-sw12

Additional information

The Runoff Attenuation Features Handbook (Newcastle University and the Environment Agency):
research.ncl.ac.uk/proactive/belford/papers/Runoff_Attenuation_Features_Handbook_final.pdf

Intervention level 2

Woodland creation

IMAGE © Moors for the Future Partnership.

Planting new woodland in appropriate areas across the catchment offers benefits for NFM as well as providing important wildlife habitat.

Woodland can be planted in different locations across the catchment:

- Clough woodland is mixed broadleaf woodland located on steep valley sides on uplands and moors
- Riparian woodland is located by the riverbank, in between the water course and adjacent land and is commonly made up of broadleaf species. Clough and riparian woodland in the uplands can be a mix of oak-birch, alder-ash or birch, mixed with other upland plants such as bilberry and purple moor-grass
- Floodplain woodlands are suited to mixed species or short rotation coppicing / short rotation woodland.

NFM purpose

Woodlands increase surface roughness and water interception. Planting of trees on stretches of the floodplain increases the roughness of the overland flow pathway, slowing the flow of water during a flood event and providing many other benefits.

How you do it

Species selection and planting is site specific and can be adapted according to the landowner's woodland management objectives. Where possible, planting should be targeted to link up with existing woodland habitat to create wildlife corridors.

Woodland creation works well alongside the leaky barriers technique.

Bringing woodland into a woodland management plan can open access to funding for other woodland NFM features such as leaky barriers.

Site suitability

Throughout catchment. Priority areas for woodland creation to reduce the risk of flooding downstream can be identified.

Benefits

- Increases roughness of the land, increasing water interception and uptake
- Roots stabilise and strengthen the soil
- Reduced runoff preventing loss of fertilisers, sediment and pesticides
- Shelters and shades livestock
- Reduces lamb mortality
- Provides habitat for terrestrial wildlife
- Improves stream quality for fish and aquatic wildlife
- Improves water quality by reducing runoff and preventing loss of fertilisers, pesticides and sediments
- Improves amenity value.

Considerations

- New planting will need protecting from livestock grazing.
- Potential change in eligibility for Basic Payment Scheme, however if woodland creation is funded through Countryside Stewardship, the BPS payment is retained as long as the land in question has been used to claim payments in 2008.

Level of maintenance

Medium – Management should involve a maintenance programme for older trees in the area. Can require compliance with other legislation. Long term stewardship required with woodland management for maximum NFM benefit.

Intervention level 2

Woodland creation (cont)

Set up cost	Maintenance cost
Medium	Medium

Intervention level

2

Funding

Countryside Stewardship Scheme grant funding is available under a range of options for eligible land.

The Countryside Stewardship: Woodland Creation Grant Manual 2017, outlines information on the woodland creation grant, agreement terms and payment rates. This is available online: www.gov.uk/government/publications/countryside-stewardship-woodland-creation-grant-manual-2017

Additional information

Case study at Pickering: www.forestry.gov.uk/pdf/FR_STF_Pickering_P2_May2015.pdf/$FILE/FR_STF_Pickering_P2_May2015.pdf

Forestry Commission UK Forestry Standard: www.forestry.gov.uk/ukfs

Intervention level 2

Management of existing woodlands & understory planting

IMAGE © Newcastle University

Good management of existing woodlands can help deliver benefits for NFM. Planting small trees and shrubs in open areas in existing woodland will increase surface roughness, slowing the flow of water during a flood event.

NFM purpose

Understory planting of small trees and shrubs in existing woodland increases the surface roughness and slows overland flow pathways.

How you do it

Planting of native species such as:

- Holly
- Blackthorn
- Hawthorn.

In areas of open understory, it is recommended to avoid invasive species.

Site suitability

Throughout catchment in existing woodland, especially along known overland flow pathways.

Benefits

- Increases potential of woodland to offer flood mitigation without extending areas of woodland
- Roots stabilise and strengthen the soil
- Reduced runoff preventing loss of fertilisers, sediment and pesticides
- Provides habitat for terrestrial wildlife.

Considerations

- Loss of open space in the woodland
- Potential loss of grazing land if livestock are excluded
- Potential change in eligibility for Basic Payment Scheme, however if woodland creation is funded through Countryside Stewardship, the BPS payment is retained as long as the land in question has been used to claim payments in 2008.

Level of maintenance

Medium – Can require compliance with other legislation. Long term stewardship required. Low general maintenance for existing woodland. For newly created woodland, thinning and weeding may be required.

Set up cost

Medium

Maintenance cost

Medium

Intervention level

2

Funding

Countryside Stewardship Scheme grant funding is available under a range of options for eligible land.

The Countryside Stewardship: Woodland Creation Grant Manual 2017, outlines information on the woodland creation grant, agreement terms and payment rates. This is available online: www.gov.uk/government/publications/countryside-stewardship-woodland-creation-grant-manual-2017

Additional information

Forestry Commission UK Forestry Standard: www.forestry.gov.uk/ukfs

Intervention level 2

Sediment traps

IMAGE © Moors for the Future Partnership.

A sediment trap is a containment area that interrupts the flow path and allows silt and sediment to settle. A sediment trap can be simply an excavation with an inlet and an outlet, or a more complex series of chambers. Sediment traps are unlikely to provide significant flood prevention on their own, but provide very useful function when used in conjunction with other measures.

NFM purpose

To slow the flow and detain water containing sediment and allow space for sediment to settle, removing it from runoff.

How you do it

A small excavation is created, usually with a gravel outlet. Rocks and vegetation around the outlet will protect against erosion. Access will need to be provided for dredging. Generally the larger the basin, the greater the removal efficiency. The design should accommodate peak flows.

Site suitability

Throughout catchment. Can be used around or upslope of other NFM measures. Adjacent to or within ditches.

Benefits

- Can be scaled up or down according to needs of site
- Suitable for small drainage catchments
- Improves water quality
- Retains washed off top soil allowing for respreading
- Enhances longevity of other NFM measures such as in-ditch barriers and ponds.

Considerations

- Land and maintenance requirement
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands is not considered to be a temporary flooding event as the land is not being maintained in a state suitable for grazing or cultivation which is the primary eligibility factor for BPS.

Level of maintenance

Low – Regular maintenance including removal of sediment will be required.

Set up cost

Low – depending upon scale and complexity.

Maintenance cost

Low

Intervention level

2

Funding

Countryside Stewardship Scheme grants (capital items) for mid and higher tier are available for eligible land such as:

RP7: Sediment ponds and traps

More information is available online: www.gov.uk/countryside-stewardship-grants/sediment-ponds-and-traps-rp7

Intervention level 3

Blocking grips and gully systems in moorlands

IMAGE © Moors for the Future Partnership.

A series of dams can be used to block grips (man-made drainage channels) and gully systems (naturally occurring drainage channels) in moorland areas. This raises the water table, creating a habitat for plant species, especially Sphagnum mosses, which help the bog act as a water storage facility. This work is often undertaken in conjunction with work to restabilise blanket bog which may require revegetation and inoculation with moorland species.

Gully blocking is particularly applicable on drained moorland and in grips or gullies that are actively eroding.

NFM purpose

Blocking of grips and gullies aims to convert traditionally drained moorland back to active blanket bog. This reduces run-off and slows water down during flood events.

How you do it

Different types of dams can be used. These include heather bales, machine built peat dams, plastic dams, stones dams and timber dams. Specifics for dam installations can be found in the fact sheet links below.

Site suitability

Upper catchment, in areas of drained and eroded moorland.

Benefits

- Slows the flow of water, raising the water table
- Re-wetting reduces severity of wildfire
- Reduced soil erosion and reduced transfer of sediment into rivers
- Can reduce the need for hard engineering flood risk measures lower down in the catchment.

Considerations

- Can alter access to moorland.

Level of maintenance

Low – Well implemented grip and gully blocking work requires minimal maintainence. Periodic inspection of some dam types may be beneficial. In bare peat areas on blanket bogs, revegetation of gullies and grips in addition to blocking is encouraged.

Set up cost

Medium – dependent on scale and complexity. Will require specialist help for a technical assessment before installation. There are peatland restoration partnerships which can advise on funding for these interventions.

Maintenance cost

Low

Intervention level

3

Funding

Moors for the Future Partnership funding information: www.moorsforthefuture.org.uk/working-with-private-landowners

Yorkshire Peat Partnership (YPP): www.yppartnership.org.uk

Factsheets are available that give detail on the different types of dam and their relative strengths and weaknesses: www.moorsforthefuture.org.uk/factsheets

Managing blanket bog: www.moorsforthefuture.org.uk/blanket-bog-land-management-guidance

Intervention level 3

Stabilisation and revegetation of blanket bogs

IMAGE © Moors for the Future Partnership.

Creating or maintaining stable, vegetated blanket bog with a high water table on moorlands reduces the volume and slows the flow of water flowing off high ground. Water flows rapidly from exposed peaty soils, whereas active blanket bogs dominated by Sphagnum mosses and other moorland species can significantly increase absorbtion and slow the flow of water.

NFM purpose

Maximises the amount of water that can infiltrate peat soils and be stored by vegetation structure.

How you do it

Depending on extent of degradation, bare peat is stabilised with heather brash or geotextiles, treated with lime, seed and fertiliser mix to knit the surface, and then treated with moorland species including Sphagnum mosses to produce a functioning blanket bog.

Site suitability

Upper catchment. Areas of degraded blanket bog characterised by bare peat or dominated by heather or native grasses, sedges and rushes (graminoids) without a healthy mix of moorland species including Sphagnum mosses.

Benefits

- Reduced risk of wildfire
- Reduced erosion and reduced transfer of sediment into rivers can reduce the need for hard engineering flood risk measures lower down in the catchment
- Improved biodiversity benefit for moorland species.

Considerations

- Removing livestock such as sheep from targeted areas of habitat restoration in upland areas, can be a requirement for success.

Level of maintenance

Low – High longevity.

Set up cost

Medium – dependent on scale and complexity. Will require specialist help for a technical assessment before revegetation. There are peatland restoration partnerships which can advise on funding for these interventions.

Maintenance cost

Low

Intervention level

3

Intervention level 3

Stabilisation and revegetation of blanket bogs (cont)

Additional information

Moors for the Future Partnership funding information:
www.moorsforthefuture.org.uk/working-with-private-landowners

Yorkshire Peat Partnership (YPP):
www.yppartnership.org.uk

Factsheets are available that give detail on stabilisation and revegetation of blanket bogs:
www.moorsforthefuture.org.uk/factsheets

This work is often undertaken in conjunction with rewetting the area which may require blocking of grips and gullies:
www.moorsforthefuture.org.uk/sites/default/files/Bare_Peat_Re-vegetation_AW.pdf

www.moorsforthefuture.org.uk/repairing-bare-peat

Managing blanket bog:
www.moorsforthefuture.org.uk/blanket-bog-land-management-guidance

Moors for the Future Partnership:
www.moorsforthefuture.org.uk/our-team

Intervention level 3

Wetland creation

Wetlands are normally shallow ponds and marshy areas covered almost entirely in vegetation. They are designed to accept run-off water that otherwise may discharge into a watercourse and to hold it for long enough to allow sediments to settle and for pollutants to be removed through plant uptake and breakdown in the soil.

Wetlands can also provide significant biodiversity benefits. Designs for wetlands vary widely and can range from single-celled wetlands to systems with multiple stages.

NFM purpose

Wetlands improve water quality by providing natural water filtering services, thereby removing sediment and pollutants from the water. Wetlands can also act as a water storage area during time of flood, and can reduce the flood peak down stream.

How you do it

Wetlands should be designed with a significant storage capacity. Seasonality should be considered when selecting plant species.

Wetlands should not be created in areas where they may pose a flood risk to nearby property. This is because of the role they play as flood water storage areas.

Site suitability

Throughout catchment. Simple wetlands are more suited to a small-scale intervention plan on a single farm whereas more complex multi-staged wetlands can be designed in larger areas of the catchment.

Benefits

- Effective removal of water contaminants including suspended solids and pathogens
- Functions well in cold conditions
- Retention of water year-round
- Can be a valuable community asset if well designed
- Possible creation of nature reserve and educational visits
- Provides rich wildlife habitat.

Considerations

- Requires land and maintenance
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands is not considered to be a temporary flooding event, as the land is not being maintained in a state suitable for grazing or cultivation which is the primary eligibility factor for BPS.

Level of maintenance

Low – Requires regular checking and removal of sediment if necessary. If the wetland becomes a community asset there may be need for communications with the community.

Set up cost

High – Dependent upon site and specialist advice.

Maintenance cost

Low

Intervention level

3

Funding

Countryside Stewardship Scheme grant options for higher tier are available for eligible land such as:

SW12 making space for water

More information is available online:
www.gov.uk/countryside-stewardship-grants/making-space-for-water-sw12

Additional information

Yorkshire Wildlife Trust:
www.ywt.org.uk

Intervention level 3

River and floodplain restoration

IMAGE © Yorkshire Dales National Park Authority. NFM Measures – A Practical Guide For Farmers.

Restoration of rivers and floodplains to a more natural state by removal of artificial engineering works and reversing alterations. Works can include restoration of meanders, removal of embankments, restoration of original river shape and revegetation with native species.

NFM purpose

To enhance the natural water retention capacity and function of the river and surrounding floodplain. To connect the river with its floodplain, to slow the flow and detain water for longer, and to reduce erosion caused by unnatural river behaviour.

How you do it

River and floodplain restoration generally requires collaboration with other stakeholders and experienced contractors.

Previous meanders and curves in the water course can be identified by historic aerial photographs and maps. The greatest benefit is achieved by targeting installation to wide, flat areas where there is little risk to property or infrastructure. A phased approach is necessary to enable controlled diversion of flow into the restored river course.

Site suitability

Lower catchment, in rivers and floodplains, where channel alteration and/or engineering has taken place.

Benefits

- Constrained channels have higher energy so bank erosion can be accelerated, and if embankments fail the effect is dramatic and can result in land loss and debris being deposited on the floodplain. Allowing more natural lower energy flooding reduces risk of bank and embankment failure, soil loss and enables land to drain back into the channel rapidly as levels fall
- Removes need for maintenance of artificial engineering works
- Reduces the peak flow at sensitive locations such as road bridges or residential areas
- Can be achieved naturally in some cases, with minimal interventions to kick-start the process
- Provides rich wildlife habitat
- Wider community value.

Considerations

- Alteration of current channel form requires land
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands is not considered to be a temporary flooding event, as the land is not being maintained in a state suitable for grazing or cultivation which is the primary eligibility factor for BPS.

Intervention level 3

River and floodplain restoration (cont)

Level of maintenance

High – The process of restoration can take many years. The Countryside Stewardship SW12 making space for water option is about supporting farmers to let river channels "flex" as they would do naturally. This option lasts for 20 years, instead of the standard 5 years for the grant scheme, because the work needs a high level of change. Areas of restoration will need to be monitored over time to identify if any modifications are required to the restoration work.

Once restored, the level of maintenance should generally be low, as the river can function naturally.

Set up cost

High – Dependent upon site. Specialist advice on funding may be needed.

Maintenance cost

Medium

Intervention level

3

Funding

Countryside Stewardship Scheme grant options for higher tier are available for eligible land such as:

SW12 making space for water

More information is available online:
www.gov.uk/countryside-stewardship-grants/making-space-for-water-sw12

Additional information

The Scottish Environmental Protection Agency Natural Flood Management Handbook:
www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf

The River Restoration Centre Manual:
www.therrc.co.uk/MOT/Final_Versions_%28Secure%29/3.6_Dearne.pdf

www.therrc.co.uk/MOT/Final_Versions_%28Secure%29/1.11_Highland_Water.pdf

Consents and permits

Undertaking certain intervention measures for NFM may require consent prior to construction. This section gives information on the types of permits and consents required and who these will need to be obtained from.

Permits for works in main rivers and floodplains and consents for works in ordinary watercourses

Intervention treatments proposed to be undertaken on main rivers, floodplains and ordinary watercourses will require consents or permits prior to construction. The type of consent or permit required will be dependent on the type of watercourse.

Measures that are to be implemented on a main river or floodplain will require a permit from the Environment Agency. Measures that are to be implemented on an ordinary watercourse will need consent from the Local Lead Flood Authority.

It is recommended to implement each NFM measure to standard construction dimensions to enable faster approval. Standard construction dimensions for NFM measures can be found in design standards and additional material from the Environment Agency, Moors for the Future Partnership, the Forestry Commission and other organisations found in the Contacts section below.

Consents for works on land with protected status

Intervention treatments that are proposed to be undertaken on land with protected status such as Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC) and Special Protection Areas (SPA) will require Natural England consent. Interventions on SAC or SPA land will also require a habitat regulations assessment from Natural England.

However on land with protected status, if permission is sought for interventions from another statutory body such as the Environment Agency, or from work the local council has approved through the planning application process, then a separate consent will not be required from Natural England (if the statutory body or local council have consulted Natural England as part of the process).

Planning consent

Planning consent may be required when constructing larger structures as intervention measures for NFM. A discussion about proposed work should be held with the local planning authority prior to construction.

Scheduled Monuments

Consent will also be required for intervention measures proposed to be undertaken on or near to Scheduled Monuments.

Information on land with protected status

It is possible to find out whether your site has protected status by searching online using the websites listed below and by contacting the appropriate regulatory agencies using the contact details outlined in the table on the next page.

www.gov.uk/guidance/protected-areas-sites-of-special-scientific-interest

www.magic.gov.uk/home.htm

Summary table of consents and contact details for regulatory agencies

Feature	Permit/Consent required from	Contact information
Main river (including its flood plains and flood defences)	Environment Agency	**Environment Agency** Telephone: 03708 506 506 Email: enquiries@environment-agency.gov.uk www.gov.uk/guidance/flood-risk-activities-environmental-permits
Ordinary watercourse	Local Lead Flood Authority	**Local Council** www.gov.uk/find-local-council
Scheduled Monument	Historic England	**Historic England** Telephone: 0370 333 0607 historicengland.org.uk/advice/planning/consents/smc/
Site of Special Scientific Interest (SSSI)	Natural England	**Natural England** Telephone: 0300 060 3900 Email: enquiries@naturalengland.org.uk www.gov.uk/guidance/protected-areas-sites-of-special-scientific-interest
Special Area of Conservation (SAC) or Special Protection Area (SPA)	Natural England (will require a Habitats Regulation Assessment)	**Natural England** Telephone: 0300 060 3900 Email: enquiries@naturalengland.org.uk

Sources of funding and grants for NFM intervention measures

The table below provides information on potential sources of grant funding to implement NFM measures.

Scheme	What is available?	Further Information
Natural England Countryside Stewardship	Most of the measures listed in this guide are able to be funded through Countryside Stewardship. There is different funding available for different types of NFM measures. Some measures such as gully blocking are only applicable within Higher Tier Countryside Stewardship.	www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management
Forestry Commission Woodland Carbon Fund	Grants are available of up to £6,800 per hectare to create new woodland, or up to £8,500 per hectare for granting permissive access across the woodland (dependent on its location).	www.forestry.gov.uk/england-wcf
Forestry Commission Woodland Improvement Grants (WIG)	When bringing woodlands under woodland management plans, landowners are able to apply for Woodland Improvement Grants for woodland NFM features such as leaky woody dams.	www.gov.uk/government/publications/countryside-stewardship-woodland-management-plan-grant-manual-2017
Woodland Trust MOREWoods	Assistance is available to private land managers who are looking to plant up to 500 trees - providing • tailored advice • grants and funding • trees and protection Grants of up 60% costs are available.	www.woodlandtrust.org.uk/plant-trees/large-scale/

Contacts details for more information

If you are interested in installing NFM measures on your land and would like more information and help, here are useful contacts for getting in touch.

Organisation	Contact details
Slow The Flow Calderdale	Email: secretary@slowtheflow.net slowtheflow.net
Calderdale Metropolitan Borough Council	Telephone: 01422 288001 Email: customer.first@calderdale.gov.uk
Moors for the Future Partnership	Telephone: 01629 816581 Email: moors@peakdistrict.gov.uk
Environment Agency	Telephone: 03708 506 506 Email: enquiries@environment-agency.gov.uk
Yorkshire Peat Partnership	Telephone: 01904 659570 Email: info@yppartnership.org.uk

Organisation	Contact details
Forestry Commission	Telephone: 0300 067 4000 Email: fe.england@forestry.gsi.gov.uk
Natural England	Telephone: 0300 060 3900 Email: enquiries@naturalengland.org.uk
The Woodland Trust	Telephone: 0330 333 3300
Rural Payments Agency	Helpline for queries on eligibility of features for BPS: 03000 200 301

References and further information

The Environment Agency

Environment Agency Flood Action Plan for Calderdale:
www.gov.uk/government/publications/calderdale-flood-action-plan

Environment Agency Working with natural processes to reduce flood risk:
www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk

Environment Agency Rural Sustainable Drainage Systems:
www.yorkshiredalesriverstrust.com/wp-content/uploads/2014/12/RSuDS.pdf

Natural England

Natural England Countryside Stewardship:
www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management

Moors for the Future Partnership

www.moorsforthefuture.org.uk

Moors for the Future Private Landowners Information:
www.moorsforthefuture.org.uk/working-with-private-landowners

Making Space For Water Project:
www.moorsforthefuture.org.uk/making-space-water

Fact Sheets on Gully Blocking:
www.moorsforthefuture.org.uk/phase-6-gully-blocking

Managing blanket bog:
www.moorsforthefuture.org.uk/blanket-bog-land-management-guidance

Yorkshire Peat Partnership

www.yppartnership.org.uk

References and further information (cont)

Additional references

Scottish Environmental Protection Agency, Natural flood management handbook: www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf

Newcastle University and the Environment Agency, Runoff Attenuation Features, 2011: research.ncl.ac.uk/proactive/belford/papers/Runoff_Attenuation_Features_Handbook_final.pdf

LEAF, 2013. Simply sustainable water: www.leafuk.org/resources/000/691/685/SSW.pdf

Natural England, 2010. Farming in the uplands for cleaner water and healthier soil: publications.naturalengland.org.uk/publication/9031

Published work by Forest Research scientists on flooding, woods and water: www.forestry.gov.uk/fr/floodingbiblio

FC Tree Selection Tools (Ecological Site Classification): www.forestry.gov.uk/website/forestresearch.nsf/ByUnique/INFD-5V8JDG

EIA Woodland Creation: www.forestry.gov.uk/forestry/infd-6dfl55

National Trust: From source to sea, Natural Flood Management; the Holnicote experience: www.nationaltrust.org.uk/holnicote-estate/documents/from-source-to-sea---natural-flood-management.pdf

Forest Research: Slowing the flow at Pickering: www.forestry.gov.uk/fr/infd-7zuclx

Stroud Natural Flood Management/Rural Sustainable Drainage scheme: www.stroud.gov.uk/environment/flooding-and-drainage/stroud-rural-sustainable-drainage-rsuds-project