Conserving and enhancing the rivers of the Trent catchment for people and wildlife

Repton Natural Flood Management (NFM)

Desk-based Assessment

November 2025

Executive Summary

This study evaluates the feasibility of implementing Natural Flood Management (NFM) interventions to reduce flooding in Repton, Derbyshire. NFM aims to attenuate water in the upper catchment during precipitation events, thereby reducing downstream flood peaks.

TRT undertook a desk-based assessment that included hydrological modelling and flow-accumulation analysis to identify locations with NFM potential. Where feasible, each potential intervention was evaluated for estimated floodwater storage volume, cost, habitat creation or enhancement potential, and anticipated timescale to impact.

In total, 56 NFM opportunities were identified across the catchment, along with nine key areas where future land-management practices could enhance water retention and promote infiltration on agricultural land. Most notably, there is significant potential for floodplain-reconnection opportunities upstream of the village, as well as targeted woodland creation to slow surface-water flow from the steep surrounding catchment.

Contract

This report describes the work commissioned by Repton Parish Council. Emily Richardson, Daniel Scott and Scott McKenzie of Trent Rivers Trust completed this work.

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Purpose

The purpose of this study is to provide an indicative summary of the potential opportunities for NFM interventions within the Repton Brook catchment. All proposed measures are subject to ground-truthing. Engagement with landowners and identification of site-specific delivery constraints are beyond the scope of this project.

The NFM opportunities identified through this study should be considered within the broader context of enhancing catchment-wide resilience to flood risk through strategic land use change. Pursuing these longer-term objectives is essential for achieving meaningful and sustainable reductions in flood risk across the catchment.

Revision History

Revision Reference / Date	Amendments	Issued to
Submission 1 / November 2025		Repton Parish Council

Acknowledgments

Trent Rivers Trust (TRT) would like to thank the members of the Repton Parish Council - Tim Hess and Jonathan Sheldon. and coordinating flood warden Kyran Farrell - for their ongoing support, collaboration, and valuable insights throughout the course of this project.

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Abbreviations

AEP	Annual Exceedance Probability
DCC	Derbyshire County Council
DTM	Digital Terrain Model
EA	Environment Agency
ELMs	Environmental Land Management schemes
GIS	Geographical Information System
LLFA	Lead Local Flood Authority
LiDAR	Light Detection and Ranging
NFM	Natural Flood Management
RAF	Runoff Attenuation Features
RNAG	Reasons for not achieving good
SFI	Sustainable Farming Incentive
TRT	Trent Rivers Trust
WFD	Water Framework Directive

1. Introduction

1.1 Project Objectives

The objectives of this project were agreed by Repton Parish Council and The Trent Rivers Trust and constitute of the following:

- A high-level desk study to identify opportunities for implementing Natural Flood Management (NFM) measures across the Repton Brook catchment. The findings will be presented in a summary report, which will provide an update to the scoping work previously carried out by The Rivers Trust (TRT) in 2023.
- Included in the summary report will be a prioritised list of potential NFM interventions. Interventions will be prioritised based on TRT's professional opinion and consideration of multiple benefits.
- Interventions will not be prioritised in terms of flood reduction impact to Repton village itself as this level of modelling and detail is beyond the scope of the study and would incur significant additional costs. Where possible, indicative storage volumes for modelled interventions will be provided.

1.2 Project Background

The purpose of this scoping study is to identify opportunities for implementing Natural Flood Management (NFM) measures across the Repton Brook catchment, to alleviate flood risk downstream in Repton village. It has been outlined to TRT that there are two main observed mechanisms for flooding in the village:

1) overtopping of the Repton Brook within the village; and
2) overtopping of the Bentley Brook, causing flooding along Well Lane.

Flooding is particularly severe alongside Well Lane and under 'The Square' where the brook is culverted through the village (Figure 1). Additional localised impacts have been observed along Hartshorne Road and Watery Lane, upstream of the village. Floodwater has affected roads, domestic gardens, and internal properties, leading to significant disruption, stress, and anxiety for residents.

Figure 1. Flooding of Well Lane in November 2024 (left) and 'The Square' during winter 2023 (right) [image credit: Tim Hess]

1.3 Project Location

The Repton Brook is a tributary of the main River Trent, joining the 'Old Trent Water' immediately downstream of Repton village [SK 30464 27421], which runs north-east and eventually joins the main Trent at SK 31676 28462 (Figure 2). The Repton Brook drains a mixed-use catchment of approximately 23.36 km^2, dominated by arable land use in the lower areas and by woodland in the upper catchment (Figure 3). The catchment is characterised by narrow, steeply sloping valleys with limited space for natural floodplains, resulting in a 'flashy' hydrological response and rapid runoff of surface water following intense rainfall (Figure 4).

The brook downstream of Robin's Cross Lane [SK 31273 25225], through the village, is classified as a statutory Main River. Upstream from this point, the Repton Brook is classified as an 'Ordinary Watercourse'. These designations determine the regulatory authority responsible for different sections of the river: Main Rivers are managed by the Environment Agency (EA), whereas Ordinary Watercourses are managed by the Lead Local Flood Authority (LLFA). In this instance, Derbyshire County Council (DCC) is the LLFA.

The Repton Brook rises east of Woodville [SK 32280 19215]. A major tributary rises west of the B5006, within the woodlands upstream of Hartshorne [SK 34379 20332], and flows east before joining the main Repton Brook near Nether Hall, at the junction of Repton Road and Sandcliffe Road. Several small tributaries drain into the main Repton brook from the west downstream of this point, including interconnected ponds within Bretby Park and the Bentley Brook.

The Bentley Brook rises near Knight's Lane [SK 30015 24636] and drains a small ~1.75 km^2 farmed catchment. During high intensity rainfall, the Bentley Brook contributes to additional flows to the Repton Brook.

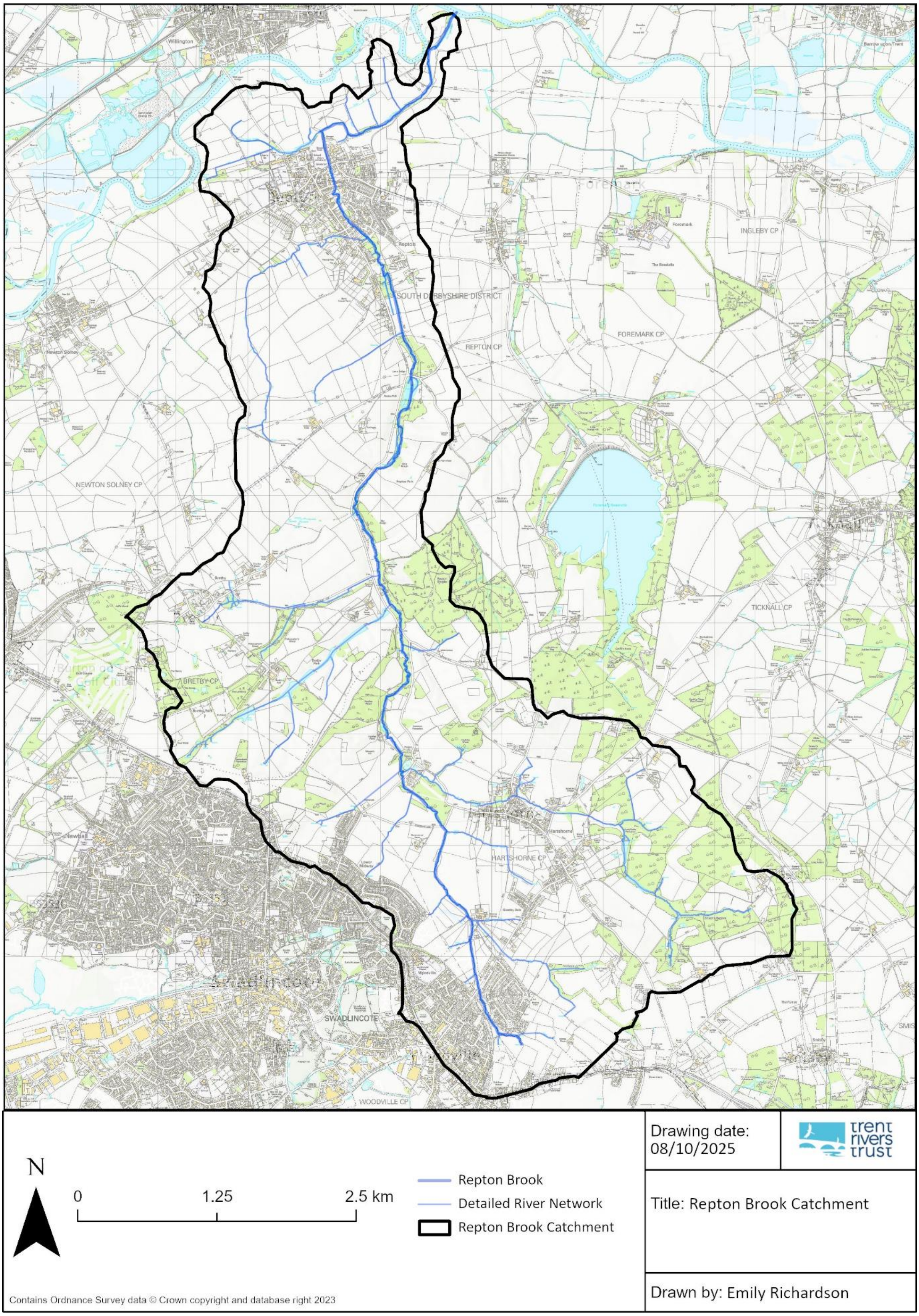

Figure 2. Repton catchment, Derbyshire

Figure 3. Aerial view of Repton catchment, Derbyshire. Highlighting mixed land use.

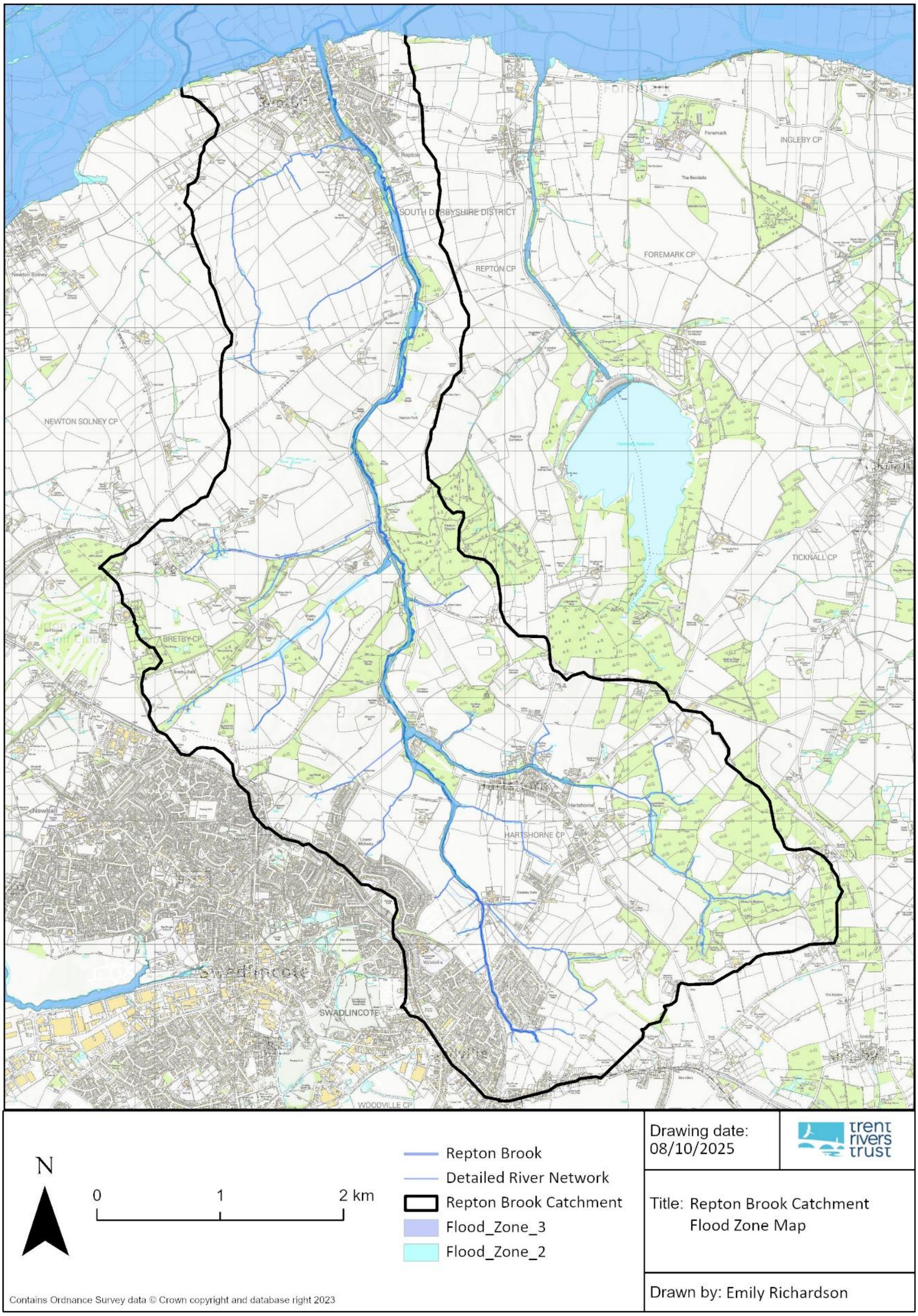

Figure 4. Flood zone map for Repton catchment, Derbyshire

1.4 Water Framework Directive

The Water Framework Directive (WFD) is a piece of European Union legislation that was adopted in 2000 and aims to protect and improve the quality of water resources across Europe. The WFD was transposed into UK legislation in 2003, with the goal that all water bodies (rivers, lakes, groundwater and coastal waters) achieve “Good Ecological Status” by 2027. Different classification elements are ranked, with further details on ‘Reasons for not achieving good’ (RNAG) listed by activity and business sector.

The ‘Repton Brook Catchment (trib of Trent) Water Body’ operational catchment is currently designated as having ‘Poor ecological status’. The water body has experienced degradation in several ecological classification elements between 2013 and 2022. ‘Macrophytes and Phytobenthos Combined’ are now classified as ‘Poor’, having previously scored ‘Moderate’ in 2014. RNAGs for this classification element include diffuse source pollution from rural land management. Additionally, listed under ‘Physio-chemical quality’ element, ‘Phosphate’ has declined from ‘Good’ to ‘Moderate’.

These classifications are, however, likely to be based on assessments of the Main River sections within the operational catchment but can still provide valuable context for the tributaries and the wider environment. Where relevant, NFM recommendations incorporating broader environmental benefits, including those affecting water quality, will be made.

2. Methodology

2.1 Previous Work

In 2023, TRT partnered with Derbyshire Wildlife Trust (DWT) on the 'Derwent Connections' project, funded through the Green Recovery Challenge Fund. The overall aim of the project was to identify woodland-creation opportunities and NFM potential throughout the Derwent catchment. TRT' s role was to scope specific catchments at flood risk, following consultation with the EA and the DCC flood risk team.

Following meetings with Repton Parish Council, TRT carried out walkovers and engaged with landowners within the catchment. TRT also engaged with Natural England's Catchment Sensitive Farming Officer (CSFO) to support with landowner engagement beyond the project's end, with the aim of exploring opportunities for farmers to participate in stewardship schemes that would minimise their impact on watercourses while alleviating flood risk. The findings presented in this summary report will provide an update to the scoping work previously carried out in 2023.

2.2 NFM desk-based Assessment

A desk-based assessment was conducted using high-level opportunity-mapping techniques to analyse flow connectivity and accumulation. Land designations and protected sites, including Countryside Stewardship areas, SSSIs, and Local Wildlife Sites (LWS), were reviewed using DEFRA's Magic Map application (DEFRA, 2023) to identify potential constraints on future works.

No site surveys were undertaken; instead, aerial imagery from Google Earth informed NFM recommendations by providing insight into current land use. Ecological and heritage surveys were outside the scope of this feasibility study, but any subsequent interventions would require these surveys before works commenced.

SCIMAP, developed by Durham University, is a tool that maps sediment risk and flow connectivity within a catchment using 5 m LiDAR data. The analysis identifies areas of high flow connectivity based on land topography and soil type, indicating where overland flow is likely to occur and where NFM interventions could be most effective in intercepting runoff. Red areas in the model outputs highlight regions of higher flow connectivity, which can be prioritised for further investigation. To explore these areas in more detail and validate the SCIMAP findings, additional modelling was carried out using SCALGO Live.

SCALGO Live is an online tool that uses 1 m LiDAR and allows users to manipulate detailed terrain data and pre-prepared surface water analyses to test the impact of introducing various surface water management measures, such as bunds and floodplain reconnection areas. The tool helps users to visualise how flow will be redirected and water detained as a result of their interventions.

2.3 Project Limitations

Some assumptions were made during the desk-based assessment and subsequent data analysis. Performing surface water analysis using SCALGO Live assumes every drop of rainfall, which hits the surface of the earth, is moved downstream in accordance with the terrain model, filling up depressions on the way. In hydrological terms, this means that 100% of the rainfall is converted to runoff. This is seldom the case in reality as hydrological losses such as infiltration will happen prior to runoff occurring.

The impact of artificial drainage systems is also not considered in this analysis. Whilst the impact of buildings on surface water flow paths are considered in SCALGO Live analysis they are assumed by default to be 10 m tall with a flat roof.

It was assumed that any proposed bunds have a vertical face, when in reality it will be sloped, and as such the volume of the bund may be overestimated. The method for calculating the storage potential of the bund also assumed that no excavation will take place. During construction, soil from within the storage area is often used, and so the method would slightly underestimate the storage capacity of the feature in this regard. The results generated in this manner provide an indication of the possible storage capacity and given that all bund storage capacities are calculated in this way and are compared between potential interventions, it can be considered worthwhile and of benefit to the feasibility process.

3. Results

3.1 Desk-based Assessment

Soilscapes

The upper catchment is dominated by slowly permeable, seasonally wet, acid loamy and clayey soils. Clayey soils have a low infiltration capacity, which restricts downward water movement and promotes overland flow. These soils are also prone to seasonal waterlogging; during wet periods they become saturated, further limiting drainage and generating high surface runoff. As a result, streams within these areas tend to rise and fall rapidly following rainfall events.

The lower catchment, downstream of the Greysich Lane and Repton Road confluence, is characterised by freely draining, slightly acid loamy and sandy soils with relatively high infiltration capacity. Despite this, during periods of heavy rainfall, rapid runoff from the upper catchment can still overwhelm the lower sections. NFM should be prioritised in the upper catchment to reduce rapid runoff and soil erosion. In the lower catchment, maintaining drainage efficiency and utilising floodplain connectivity to store water where appropriate are key strategies. Coordinating upstream and downstream interventions is essential to achieve holistic catchment management and enhance resilience to high rainfall events (Figure 5).

SCIMAP

SCIMAP analysis shows areas upstream of the village within the upper Repton Brook catchment with high flow connectivity (Figure 6). This analysis is based on the topography of the land and soil type. This analysis predicts where soils are most likely to become saturated during rainfall events and indicates how susceptible the area is to generate overland flow. This helps us to determine where surface water flows are expected to be greatest and therefore where NFM interventions could be best implemented to target and intercept runoff (as well as helping with sediment and nutrient trapping for water quality purposes). These areas were targeted for modelling of NFM features in SCALGO Live. Areas of high connectivity, highlighted in red, are evident in steep upper catchment as well as in the Bentley Brook sub-catchment.

DEFRA Magic Map

There are several mid-tier Countryside Stewardship agreements within the catchment, particularly in the Bentley Brook sub-catchment and areas around Bretby. Active agreements cover both farmland and areas of woodland. These stewardship agreements could influence the delivery of NFM interventions, especially where the construction of storage features may alter habitats or conflict with existing stewardship requirements. Such considerations would need to be fully addressed in future design and delivery phases of work.

A MAGIC Map search did not identify any designated Local Wildlife Sites (LWS) or Sites of Special Scientific Interest (SSSI) within the catchment that would constrain NFM delivery. However, any NFM measures proposed within woodland areas in the middle and upper catchments will need to be assessed in the context of existing woodland management plans and associated stewardship agreements.

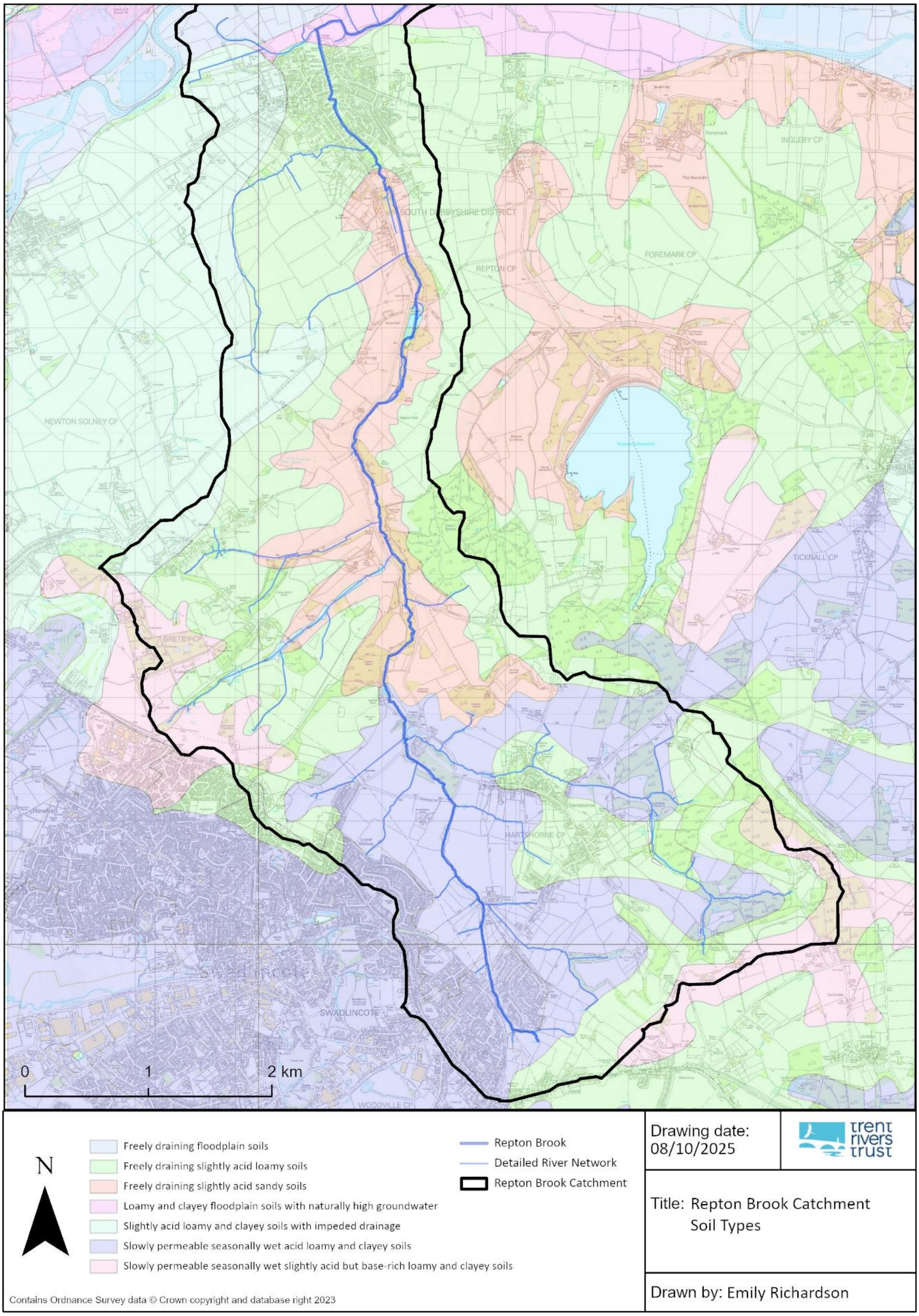

Figure 5. Soil types in the Repton catchment (LandIS, 2025)

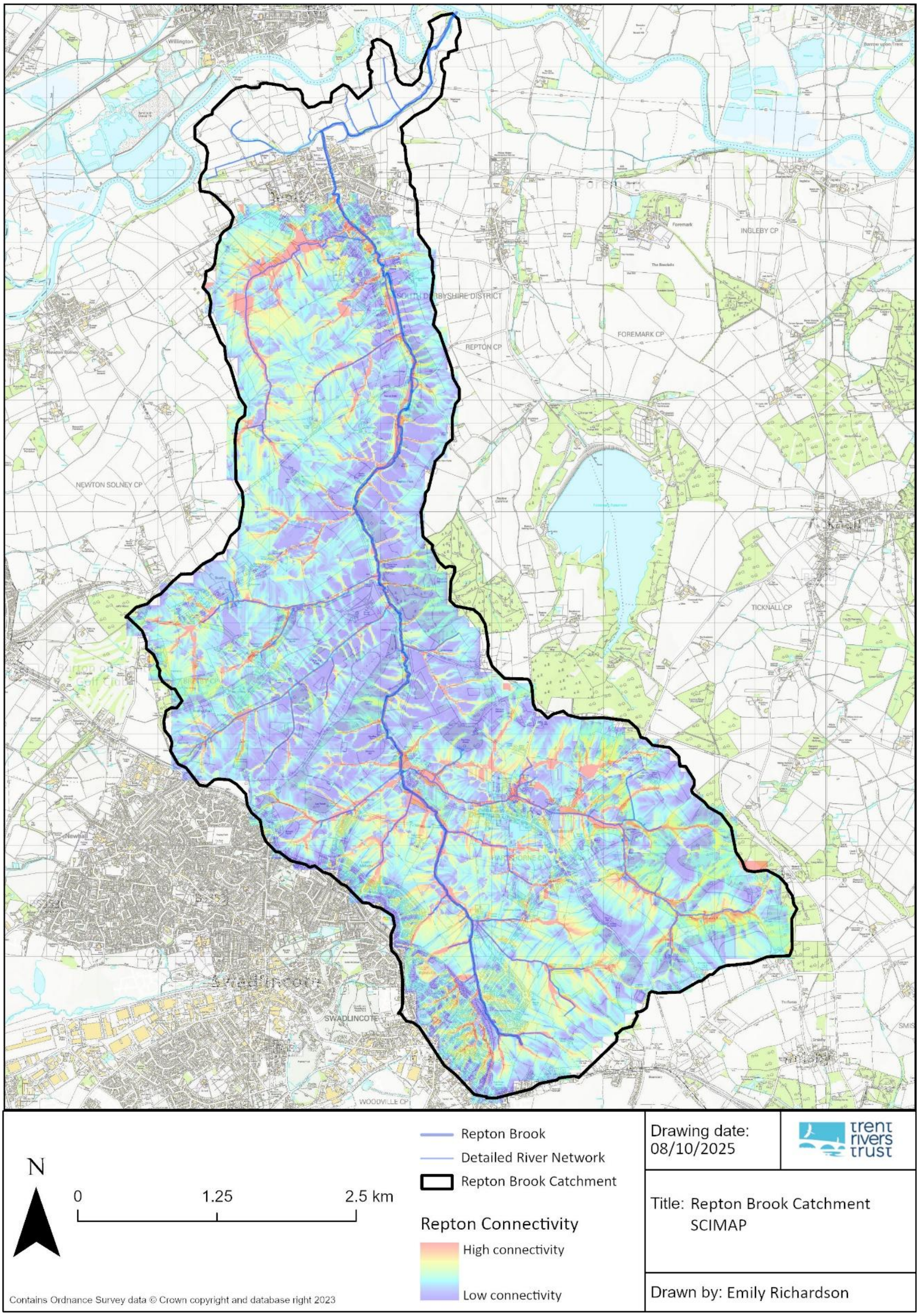

Figure 6. mySCIMAP of the Repton Brook catchment. Areas of high flow connectivity are indicated by the red, yellow and lighter blue shading.

3.2 NFM Intervention Opportunities

NFM measures are designed to work with natural processes to temporarily store water within the upper catchment, gradually releasing it once flood peaks have passed (Figure 7). This can significantly reduce flood risk for downstream communities while also offering broader environmental benefits, such as habitat creation, sediment capture, and pollution reduction.

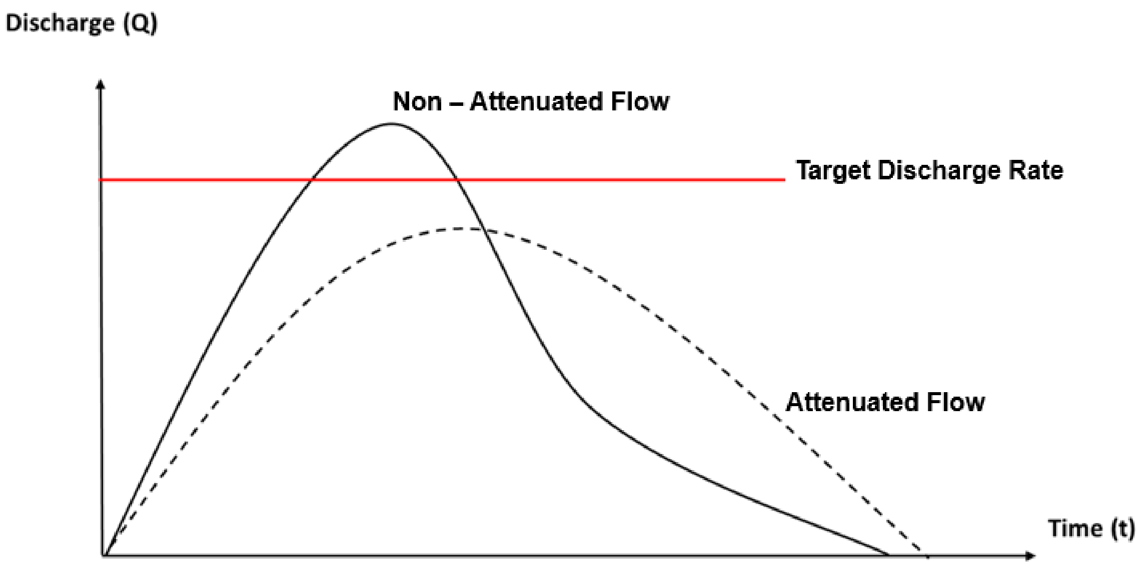

Figure 7. Attenuation of flow using Nature Flood Management (NFM) on a flood hydrograph

A range of NFM interventions has been proposed across the Repton Brook catchment. This section explains how these interventions function and highlights the additional benefits they offer. Standard convention has been applied when describing the left-hand bank (LHB) and right-hand bank (RHB), which are defined when looking downstream in the direction of the river's flow: the LHB is the bank on the left when facing downstream, and the RHB is the right.

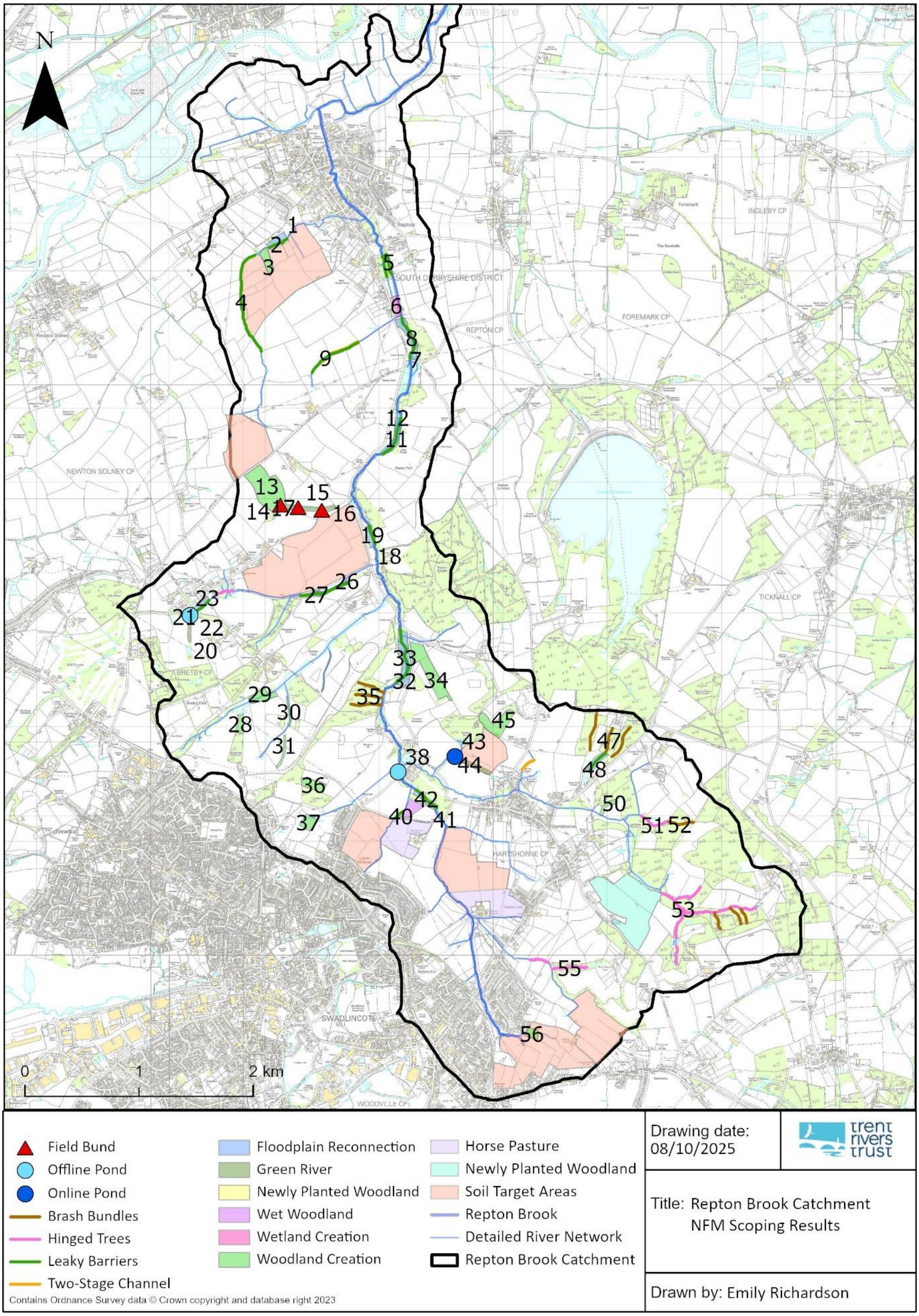

Figure 8. NFM Opportunities in the Repton Brook catchment

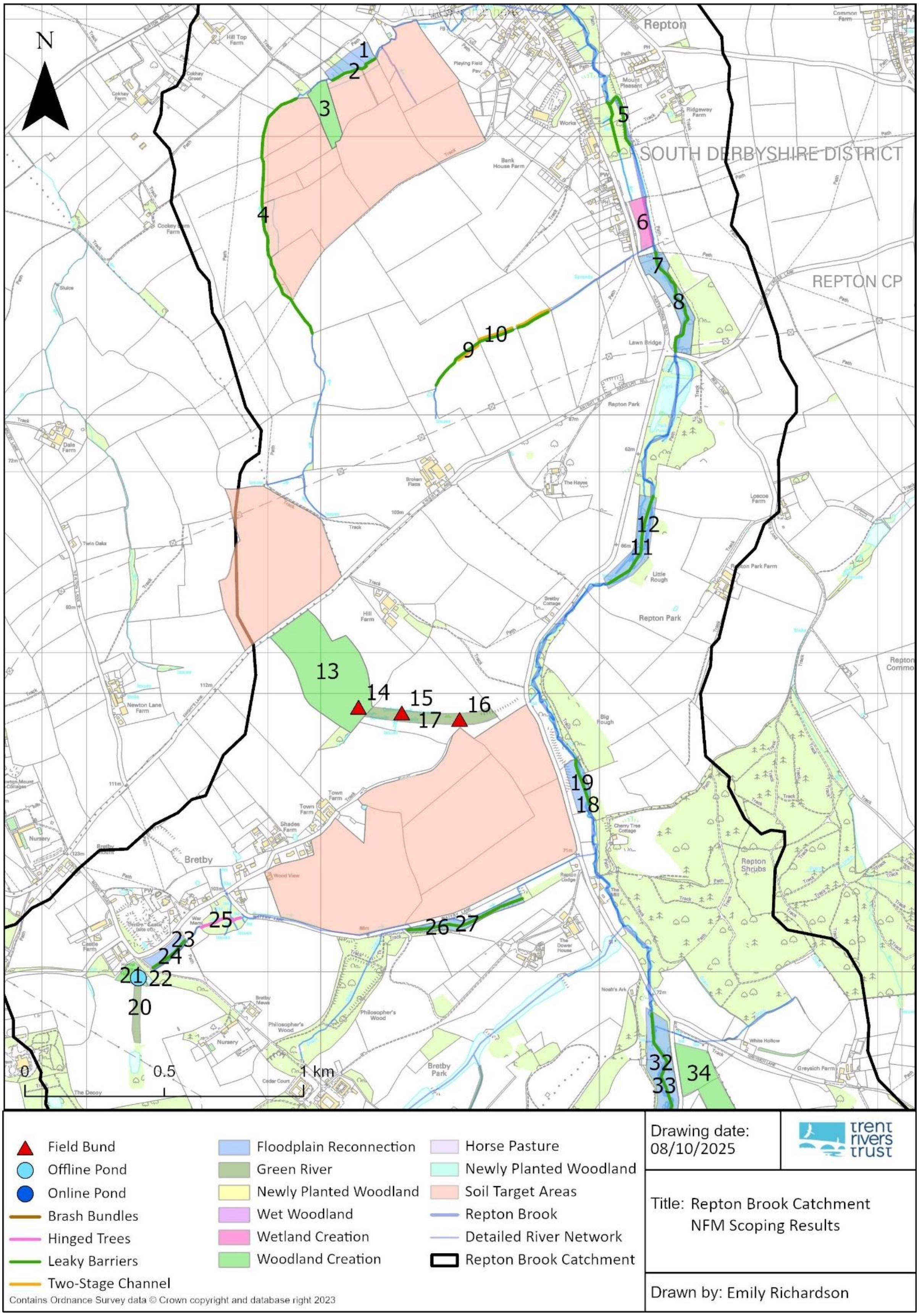

Figure 9. NFM Opportunities in the Repton Brook catchment (north)

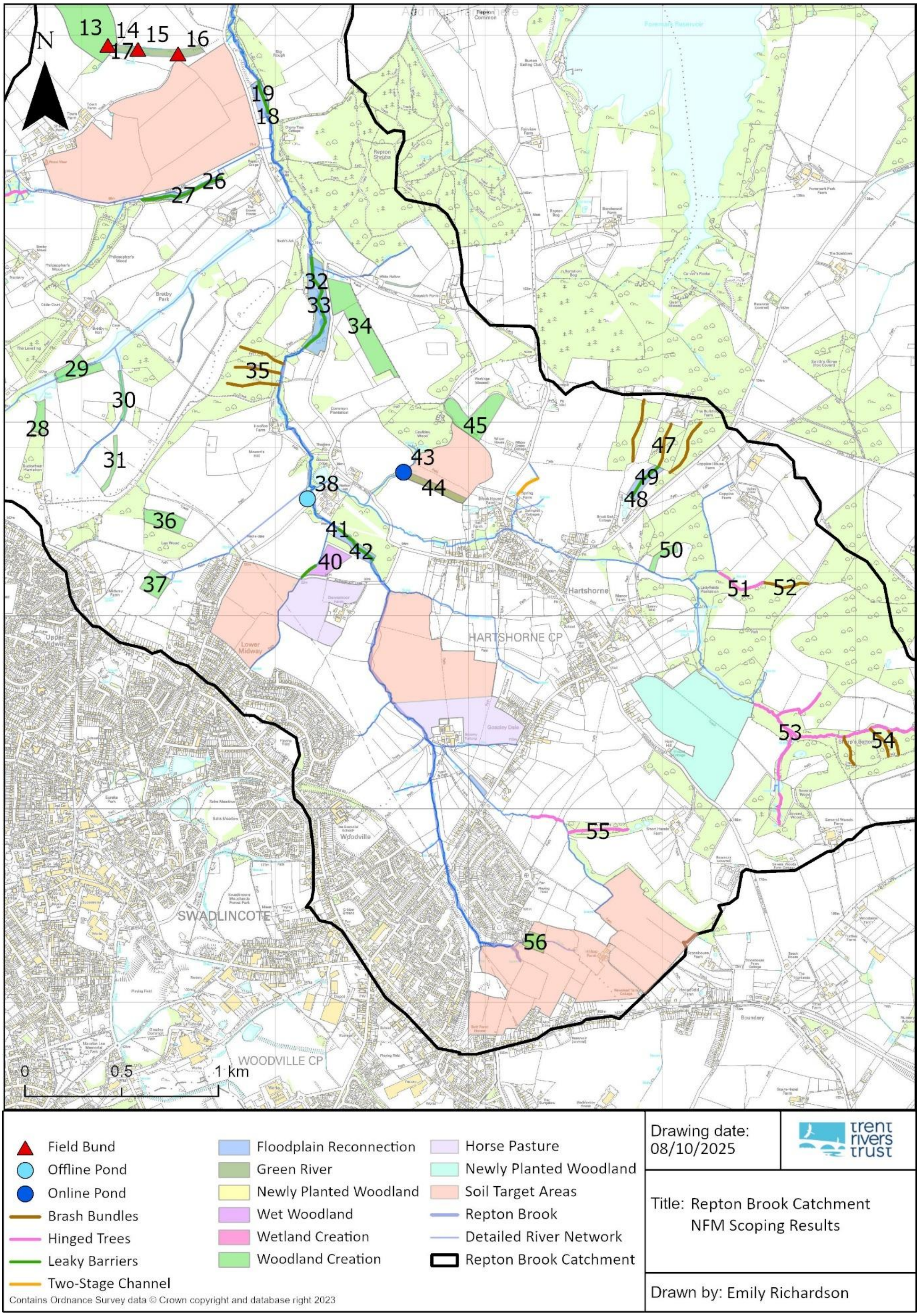

Figure 10. NFM Opportunities in the Repton Brook catchment (south)

Table 1. NFM opportunities in the Repton Brook catchment.

Site	Intervention Type	Details
1, 2	Floodplain Reconnection / Leaky Barriers	Minor excavations and bank top leaky barriers could be used to encourage water out of ditch into low, wooded areas on the left-hand bank. Large wood debris (LWD) could be pinned across the floodplain to slow flows further.
3	Woodland Creation	Strategic planting of narrow grassland area to increase surface roughness, slow flows and increase infiltration.
4	Leaky Barriers	Upstream of floodplain reconnection areas, the Bentley Brook may be suitable for the installation of leaky barriers across the ditch to increase high-flow attenuation and introduce additional channel roughness.
5	Leaky Barriers	Leaky barriers could be installed in the woodland immediately upstream of the village to increase high-flow attenuation and add roughness to the channel.
6	Wetland Creation	Natural materials, such as Large Woody Debris (LWD) could be used to deflect flows out of the Repton brook. A 'Stage Zero' wetland could be created on the left-hand bank.
7,8	Floodplain Reconnection / Leaky Barriers	Leaky barriers could be used to encourage water onto the floodplain within the woodland, downstream of Robin's Cross junction.
9, 10	Leaky Barriers / Two- Stage Channel	The ditch that runs east towards Hartshorne Road could be modified to creation additional in-channel storage using a two-stage channel. Within the two-stage channel, leaky barriers could be strategically placed to encourage water onto the newly created benches of the channel.
11, 12	Leaky Barriers / Floodplain Reconnection.	Leaky barriers could be used to encourage water onto the floodplain within the woodland.
13	Woodland Creation	Strategic planting of narrow grassland to increase surface roughness, slow flows and increase infiltration.
14, 15, 16, 17	Field Bunds /Green River	Install sequence of x3 low field bunds (max. 1 m) along flow path. Allow in-field buffer strip to establish to create a natural 'green river' which can be planted with additional trees. Flow path currently discharges directly onto the main road; interventions will help to slow flow.
18, 19	Floodplain Reconnection / Leaky Barriers	Leaky barriers could be used to encourage water onto the floodplain on the low-lying left-hand-bank in this location.
20	Green River	Topography not suitable for Runoff Attenuation Feature (RAF) therefore allow in-field buffer strip to establish to create a natural 'green river' which can be planted with additional trees.

Site	Intervention Type	Details
21	Woodland Creation	Strategic planting of arable field corner to increase surface roughness, slow flows and increase infiltration.
22	Online Pond	Increase capacity of existing low-lying area to store surface flows
23, 24	Floodplain Reconnection / Leaky Barriers	Leaky barriers could be used to encourage water onto the floodplain on the low-lying left-hand-bank. Flooding frequently occurs along Water Lane, the small culvert (SK 29756 23200) is easily overwhelmed and overtops onto the road, therefore slowing flows by utilising floodplain storage will help to reduce the impact of flooding.
25	Hinged Trees	The woodland area lies wet as it is fed by several natural springs. Trees could be selectively hinged within the woodland to slow flows before they reach the Watery Lane culvert.
26, 27	Floodplain Reconnection / Leaky Barriers	Leaky barriers could be used to slow flows within the ditch that runs parallel to Watery Lane, and deflect high flows to existing low-lying areas on the floodplain.
28, 29	Woodland Creation	Strategic planting along flow path to increase surface roughness, slow flows and increase infiltration.
30, 31	Woodland Creation	Strategic planting along flow paths. Steep sided valley creates topography unsuitable for RAFs.
32, 33	Floodplain Reconnection / Leaky Barriers	Leaky barriers could be used to encourage water onto the floodplain in the woodland that runs adjacent to Repton Road.
34	Woodland Creation	Flow accumulation mapping highlights significant flow path through this area. Woodland planting through this steep valley would help to increase surface roughness, slow surface runoff and increase infiltration.
35	Brash Bundles	Flow mapping indicates surface flow pathways through Hoofies Wood. Brash bundles could be installed across flow paths to intercept and slow water before it reaches the main brook, particularly in the gentler sloping areas within the woodland.
36, 37	Woodland Creation	Strategic planting along flow paths. Steep sided valley creates topography unsuitable for RAFs.
38	Offline Pond	Construct pond in field corner to capture surface flows from arable field. Pond could be constructed with outlet draining into Repton brook within wooded area directly behind it. Intervention ground truthing would need to investigate possibility of culverted watercourse through field.
39, 40	Leaky Barriers / Wet Woodland	Potential to use ‘ditch-block’ style leaky barriers to encourage water out of the ditch, onto the floodplain and dissipate slowly through the woodland that runs parallel to Dunnsmoor lane.

Site	Intervention Type	Details
41, 42	Floodplain Reconnection / Leaky Barriers	Leaky barriers could be used to encourage water onto the floodplain through the woodland. Ground assessment of downstream weir would need to be incorporated.
43	Online Pond	Natural attenuation basin could be enhanced to create additional storage at the top of the ditch.
44	Green River	Flow mapping highlights major flow path. Topography not suitable for RAF therefore allow in-field buffer strip to establish to create a natural 'green river' which can be planted with additional trees.
45	Woodland Creation	Strategic planting along flow paths. Steep sided valley creates topography unsuitable for RAFs.
46	Two-Stage Channel	The bank on the right-hand-side of the ditch could be modified to a stepped 'two-stage' feature to increase channel capacity during higher flow events.
47	Brash Bundles	Brash bundles could be laid across visible surface flow paths within gentler sloping areas of woodland to intercept flows and slow water.
48, 49	Floodplain Reconnection / Leaky Barriers	Flow accumulation modelling suggests location where multiple flow paths from the woodland converge. Leaky barriers could be used to encourage water onto the floodplain, slowing water down before it enters the ponds downstream, which then feed a ditch that is culverted under Ticknall Rd.
50	Woodland Creation	Strategic planting along flow path. Steep sided valley creates topography unsuitable for RAFs.
51, 53, 55	Hinged Trees	Several areas in the upper catchment may be suitable for tree hinging which would create temporary barriers to slow the flow of water within the channels.
52, 54	Brash Bundles	Brash bundles could be laid across visible surface flow paths within gentler sloping areas of Sharp's Bottom woodland to intercept flows and slow water.
56	Woodland Creation	Small area of strategic planting along flow path at top of catchment.

3.3 NFM Intervention Details

Field Bunds

Runoff Attenuation Features (RAFs) are designed to increase the area for overland flow to attenuate, before slowly draining into the adjacent ditches or watercourse. These features help to increase the residency time of peak flows, reducing flood risk downstream. Offline ponds, online ponds and field 'bunds' can all be categorised as RAFs.

Field bunds are banks of earth (typically less than 1m in height) designed to temporarily store water in areas where surface runoff has the potential to deliver large volumes of water to the river channel quickly (Figure 11). They are suited to both grassland and arable settings, typically constructed along field margins at the base of slopes or field corners to minimise the loss of productive farmland. It is important to note that bunds do not stop runoff but slow and hold back water by releasing it slowly into the river using a constricted outlet pipe. A generic bund profile is shown within the appendices (Appendix A).

The steep slopes and narrow valleys of the Repton Brook catchment significantly constrain opportunities for field bund creation. Bunds require gently sloping ground to provide adequate storage, but the catchment's topography limits potential attenuation volume and reduces construction feasibility. Rapid runoff from surrounding slopes would also accumulate quickly behind any bund, increasing hydraulic pressure and associated risk. Consequently, few suitable locations were identified. The proposed field bunds (014, 015, and 016) are therefore designed to operate as a sequence of features, complemented by green river creation and upstream woodland planting, providing a more holistic approach to flow-path management.

Figure 11. Field bund in a livestock field [image credit: TRT]

Offline / Online ponds

Ponds are created within or alongside the watercourse to provide additional storage areas. They can be classified as either 'online' or 'offline'. Online ponds are permanently wet features that increase in capacity during high flow events (Figure 12). whilst offline ponds are typically dry but capture water during high flow events allowing it to slowly infiltrate into the ground, or flow is controlled back into the watercourse.

There is potential within the catchment for new ponds to be created within existing low depressions to retain greater volumes of water during heavy rainfall events. Any ponds installed should be monitored to ensure they do not negatively impact the watercourse, such as by increasing erosion around pond outlet. As with field bunds, opportunities for pond creation are limited in the catchment due to topography constraints.

Figure 12. Offline pond in field corner [image credit: TRT]

Leaky Barriers

Leaky barriers are designed to replicate natural obstructions within watercourses, such as trees or branches that have fallen into the channel. By design, they restrict flow and allow water to drain gradually from the area impounded behind them. The precise placement of leaky barriers is dependent on on-site factors, including tree roots, bank stability, existing erosion, and the proximity of infrastructure. As a result, individual locations are not identified as part of the opportunity mapping. Standard design examples are provided in Appendix B; however, leaky barriers can take a variety of forms depending on site conditions and the materials available. All designs should be completed in consultation with the landowner to minimise impact on the adjacent land.

Leaky barriers can be constructed in ditches on farmland. This style of leaky barrier allows water to pass unobstructed under normal flow conditions, but trap water behind them during periods of high flow, occupying space within the ditch or narrow watercourse and slowing peak flows (Figure 13).

Figure 13. Leaky barrier in arable ditch, encouraging water to temporarily attenuate in the upstream area behind the barrier [image credit: TRT]

Leaky Barriers and Floodplain Reconnection

Floodplain reconnection allows for restoration of natural hydrological connectivity, increasing floodwater storage to decrease flood peaks and reduce flood depths. Allowing the channel to occupy the floodplain under peak-flow conditions can also directly benefit in-channel habitats as this encourages sediment deposition, reducing the amount of suspended sediment in-channel and improving local water quality. By increasing the connectivity between the river and the floodplain, this can further aid ecological resilience during the summer months with better flow regulation, and during the winter to provide storage areas.

The narrow, steep-sided valleys that characterise the Repton Brook catchment present topographic constraints that limit opportunities for floodplain reconnection. Where suitable areas have been identified, leaky barriers can be used to facilitate this process. These barriers can be installed so that the logs span both banks of the watercourse, allowing them to activate during higher flows. When the barriers come ‘online’, they temporarily raise upstream water levels and encourage flows to spill naturally onto the wider floodplain (Figure 14).

Figure 14. Leaky barrier constructed across bank top to encourage water onto surrounding floodplain. [image credit: Ben Tonkin, Environment Agency]

Hinged Trees

Mature trees are partially cut or notched at the base (often at a slight angle), allowing them to fall in a controlled manner without uprooting completely. When a tree is hinged, it remains partially attached to the stump and can fall over into the floodplain or valley. The tree remains alive and continues to grow, but it's position and structure change (Figure 15).

Trees can be strategically hinged in woodlands in the upper catchment, within valleys that are prone to seasonal water accumulation. They act as temporary barriers to slow down or redirect the flow of water, helping to accumulate sediment and organic matter which further limits flow. These are a relatively low-maintenance option as once positioned and anchored they can provide NFM benefits with minimal upkeep.

Figure 15. Example of hinged trees in woodland along flow path [image credit: TRT]

Brash bundles

Brash bundles are made from closely tied branches and sticks that produce a leaky structure that traps water behind them during periods of high surface flows. They are typically laid across active, visible surface flow paths to intercept and slow water running across fields and through ephemeral drainage ditches (Figure 16). Due to their simple construction they are quick to build and install but should be securely staked to ensure they do not wash downstream. A sequence of bundles is typically installed along the length of a flow path to maximise their impact.

Brash bundles could be beneficial in the upper woodland areas of the Repton Brook catchment by helping to slow surface flows entering the main brook and its tributaries, thereby reducing the rate at which water is conveyed downstream. The suitability of locations for brash bundles is subject to ground truthing to confirm the presence of flow paths and to ensure that proposed sites lie on slopes that are not excessively steep.

Figure 16. Picture of a brash bundle across a flow path [image credit: TRT]

Wetland Creation

Floodplain wetlands are designed to accommodate runoff water that otherwise may discharge into a watercourse, acting as a storage area during peak flows. The water is then able to drain slowly after the peak event. The best locations for wetlands and wetland scrapes are areas that lie wet naturally. Wetlands offer additional benefits as they improve water quality by providing natural filtering services, removing sediments and pollutants. They also provide a wildlife rich habitat to support a range of aquatic and terrestrial species (Figure 17).

A 'stage zero' restoration approach could be used to create a floodplain wetland (006) in the lower catchment. Natural material could be used to block section of the main brook, redirecting flows on the low left-hand bank and allowing water to spread naturally across the floodplain. Large Woody Debris (LWD) could be introduced on the floodplain to help distribute flows more evenly by deflecting and dissipating water, creating multi-thread channels across the wetland and increasing water storage capacity, thereby reducing downstream flows (Figure 18). As this section of the Repton Brook is designated as 'Main River', flood modelling would be required prior to capital delivery to meet permitting requirements.

Figure 17. Example of wetland scrapes to attenuate water and provide additional habitat [image credit: TRT]

Figure 18. Pinned LWD on floodplain [image credit: National Trust, Somerset Rivers Authority; JBA]

Two-Stage Channels

Two-stage channels are designed to simulate active floodplains, in higher flows the benches will flood and slow water, allowing sediment to be deposited and for increased channel capacity during higher flow events. Creation of a two-stage channel involves the alteration of the channel cross-section. Modifying the banks from a traditional ditch trapezoidal shape to a stepped feature with benches either side of the channel. Over time, the benches should be allowed to grow with plants that tolerate wet soils and periodic inundation, which provide bank stability and channel roughness (Figure 19).

Figure 19. Two-stage channel along arable ditch, providing additional storage capacity [image credit: TRT]

Wet Woodland

For NFM purposes, wet woodland pockets can be encouraged within larger, drier woodlands to help slow the flow of water and aid infiltration into the soil, reducing overall surface runoff and improving water quality (Figure 20). Leaky barriers can be used to encourage the flow of water through suitable woodlands. Wet woodlands are a rare and unique habitat that supports a variety of important species including marsh tit, willow tit and other invertebrates.

Figure 20. Wet woodland habitat [image credit: TRT]

3.4 Land Management and Land Use

Woodland Creation

Woodland creation supports NFM by increasing infiltration, slowing surface runoff, and enhancing temporary water storage within soils and floodplains. Trees and ground vegetation add surface roughness, intercept rainfall, and reduce downstream peak flows. When planned using a "bigger, better, more joined-up" approach, woodland creation also strengthens ecological connectivity and resilience, helping to deliver both flood risk reduction and wider conservation benefits.

Clough woodlands are typically found in steep-sided ravines on the edge of open moorland, providing shelter within an otherwise exposed landscape. Although the Repton catchment does not contain moorland, a similar approach can be applied to make effective use of its steep-sided valleys for NFM.

Green River

A 'Green River' is a shallow, vegetated flow path on the land surface that uses natural topography and vegetation—such as grassland, woodland edges, hedgerows, or wetland corridors—to slow runoff, increase infiltration, and spread water across the landscape. By increasing surface roughness and encouraging water to move more slowly through the catchment, green rivers help to attenuate peak flows, reduce downstream flood risk, and enhance opportunities for natural sediment deposition (Figure 21).

Figure 21. Green river with field bund and newly planted trees to add roughness [image credit: TRT]

Soil Target Areas

Agricultural land management can improve catchment flood resilience by reducing surface runoff entering the river network. By enhancing soil structure and promoting infiltration, the land is able to store more water, while also reducing soil erosion and the transfer of sediment and nutrients (Figure 22). Areas identified as 'Soil Target Areas' highlight locations where improving soil health and infiltration capacity would provide the greatest NFM benefits, and future engagement with landowners in these areas should focus on opportunities for implementing such improvements

Figure 22. Surface flow path across arable field with exposed bare soil over winter [image credit: TRT]

Some examples of techniques for managing soil compaction include reducing grazing pressure, over-seeding with herbal leys and clover mixes, or mechanically aerating the soils. A sward lifter is a piece of grassland subsoiling equipment designed to relieve soil compaction beneath the grass sward (the surface layer of grass and roots) without damaging the pasture. This 'aerating' action helps to improve drainage, root growth, and soil compaction. The sward lifter is most effective on sheep or horse grazed pasture but can also be used on arable or former arable land. In the context of the Repton catchment, a sward lifter could be utilised on the horse-grazed pasture at the top of the catchment, if slopes are not too step, or within the formerly arable areas in the Bentley Brook catchment.

Environmental Land Management Schemes

The Environmental Land Management (ELM) scheme in England supports farmers in adopting sustainable practices, provides payments for environmental benefits rather than just for land farmed. More than ever, farmers require incentives to manage their land differently and a more integrated approach is needed for the delivery of NFM at catchment-scale. ELMs payments can be utilised to help deliver NFM, providing a long-term cost-effective solution to maintenance of NFM schemes whilst ensuring that flood resilience efforts are integrated with broader environmental goals.

The ELM scheme is divided into three main components: Sustainable Farming Incentive (SFI), Countryside Stewardship Higher Tier (CSHT) and Landscape Recovery (LR). SFI provides a flexible approach, offering 102 land-based payments operating through 3-year agreements that have proved popular with farmers. SFI has been closed to new applications as of 11 March 2025 with a re-formed version of the scheme planned to re-open in 2026. Full details of the new offer (what actions will be eligible, payment rates, land-use or business size eligibility, etc) are yet to be published.

Higher Tier (HT) options intend to provide funding for more ambitious environmental projects with 5 – 20-year agreements. Due to their complexity and scale of delivery, HT options require consultation with either Natural England (NE) or the Forestry Commission (FC) and significant development time. A feasibility study and implementation plan are also required before application submission. Currently, HT pre-application discussions are invitation only, however applications for funding to undertake feasibility work are open to everyone.

More time is needed to understand how viable these options are as a mechanism of NFM delivery moving forwards. For additional context, examples of SFI (subject to change in 2026) and HT options with NFM benefit that could be of interest to landowners in the Repton catchment are listed below:

SFI: Buffer strips

Vegetation buffer strips typically contain long grasses, trees or shrubs. They provide a barrier to intercept overland flow, increasing surface roughness as well as increasing interception of rainfall and water infiltration. They also prevent soil, sediment and nutrient loss from fields, helping to improve water quality and reducing a build-up of sediments further downstream in the catchment. Riparian buffer strips are created alongside watercourses or ditches. On grazed pasture, riparian buffer strips often work with fencing, restricting livestock from accessing the banks of the river which reduces the impact of bank poaching.

SFI: Grassy Field Corners or Blocks

Grassy field corners are marginal areas within an arable or temporary grass field where tussocky grass is allowed to develop so an intact sward is present throughout the year. This adds to surface roughness and water infiltration potential, alongside the habitat benefits. These blocks can be placed strategically on field corners along flow paths to help infiltration of water and reduce runoff in key locations. Blocks can be established on arable or horticultural land either through sowing or natural regeneration, where species such as cocksfoot and timothy are good to include due to their tussocky attributes.

SFI: Herbal leys

Mixed species herbal leys with deep rooting species can improve the soil structure and de-compact the soil. Through the establishment of a diverse range of species, including deep rooting species, the soil can be enhanced with greater amounts of carbon, soil organic matter and therefore greater water storage potential.

SFI: Low-density agroforestry

Agroforestry involves incorporating trees within an arable or grassland field (Figure 23). The style of planting is normally in rows, but it can be within clumps across a field too. Low-density planting is an average of at least 51 trees per hectare. This option could be used to maintain the current agricultural land use, whilst also seeing the benefits of trees in the disruption of overland flow paths. Tree planting over time will increase infiltration rates and surface roughness, as well as adding to habitat provision.

Figure 23. Example of agroforestry, showing a row of trees in a grass field. Image taken from Woodland Trust - credit Tom Statton.

HT: Arable Reversion

Arable reversion is where land is taken out of crop production and converted to grassland where it is either grazed with livestock or cut for hay. This is a suitable option for floodplains or land close to ditches that have poor drainage and regularly lie wet. Grassland is usually more able to tolerate floodwater than arable land. A dense grass sward in at-risk fields will help to stabilise the soil, reduce nutrient losses and reduce surface runoff to help reduce the risk of flooding. Reverted fields can bring less profitable areas out of cultivation to reduce overall input and cultivation costs for farmers. If a species-rich grassland can be established, this has further benefits to grazing livestock and other local wildlife.

HT: Flood mitigation on grassland

Flood mitigation on grassland can range from simply allowing the grassland to store water during flood events, including letting the water spread across the floodplain and naturally subsiding, to creating topographical features such as scrapes, ponds and bunds in grassland to store water after high rainfall. These features can store water in peak flows and slow the flow of water downstream.

4. Recommendations

4.1 Decision-making Matrix for NFM interventions

In order evaluate the proposed interventions in terms of priority, a decision-making matrix was formulated to weigh multi-beneficial factors against each other. Each intervention is considered in regard to the benefits to the local community in terms of the amount of storage (where possible) and flood benefit, cost, landowner willingness, the potential for habitat creation / enhancement, and the timescale for implementation.

As the desirability of each of the metrics is qualitative, except for the amount of storage, each was given a score from 1 – 5, where 1 is least desirable and 5 the most desirable. To rank each of the interventions against one another, the sum of these metric scores is presented as a "Benefit Score", allowing comparison and prioritisation. Table 2 correlates each score to the potential benefits for each benefit category. Note that NFM features act collectively across the landscape and just because a particular intervention has a lower score, it does not mean that it is necessarily less important for the landscape.

Table 2. Decision matrix justification table (please note that maintenance costs of NFM interventions have not been accounted for in the decision-making process).

Rating	Cost	Storage / Flood Benefit	Landowner Willingness	Habitat Creation	Timescale
1	>£75,000	Little-no benefit for flood reduction	Will not tolerate interventions / no contact made	No habitat creation	Impact realised over 25 years
2	£50,000 - £25,000	Marginal impact on flood reduction	Not keen on interventions / will need more time or engagement	Localised, low quality habitat	Impact realised over 10 - 20 years
3	£10,000 - £25,000	Adequate impact on flood reduction	Had contact with landowner, broad NFM intervention discussion / more time to think	Localised, good quality habitat	Impact realised over 5 - 10 years
4	£1000- £10,000	Good impact on flood reduction	Discussed in detail with landowner / would like further details / funding information	Wider good quality habitat and links with surrounding habitat	Impact realised over 1-5 years
5	<£1000	Large impact on flood reduction	Has fully agreed in principle to intervention	Valuable / BAP habitat created for multiple species linking across the catchment	Instant impact upon implementation

Table 3. Decision-making matrix to prioritise NFM interventions

Site	Intervention Type	Estimated storage volume	Flood Benefit	Cost	Landowner Willingness	Habitat Creation / enhancement	Timescale	Benefit Score
1, 2	Floodplain Reconnection / Leaky Barriers	150 m^3	3	4	1	2	5	15
3	Woodland Creation	1.4 ha	3	4	2	3	3	16
4	Leaky Barriers	n/a	3	4	2	2	5	16
5	Leaky Barriers	n/a	3	4	1	2	5	15
6	Wetland Creation	Detailed designs required 1200 m^3	4	3	3	4	4	18
7,8	Floodplain Reconnection / Leaky Barriers	600 m^3	4	4	1	3	5	17
9, 10	Leaky Barriers / Two- Stage Channel	312.5 m^3	3	4	2	2	5	16
11, 12	Leaky Barriers / Floodplain Reconnection.	800 m^3	4	4	1	3	5	17
13	Woodland Creation	8.4 ha	3	4	1	3	3	15
14, 15, 16, 17	Field Bunds /Green River	Detailed designs required ~650 m^3	3	4	1	2	4	14
18, 19	Floodplain Reconnection / Leaky Barriers	375 m^3	3	4	1	3	5	16

Site	Intervention Type	Estimated storage volume	Flood Benefit	Cost	Landowner Willingness	Habitat Creation / enhancement	Timescale	Benefit Score
20	Green River	n/a	2	4	1	2	4	13
21	Woodland Creation	0.6 ha	3	4	1	3	3	14
22	Online Pond	100 m^3	2	4	1	3	4	14
23, 24	Floodplain Reconnection / Leaky Barriers	250 m^3	3	4	1	3	5	16
25	Hinged Trees	n/a	2	4	1	3	5	15
26, 27	Floodplain Reconnection / Leaky Barriers	300 m^3	3	4	1	3	5	16
28, 29	Woodland Creation	0.8 ha / 1.7 ha	3	4	1	4	3	15
30, 31	Woodland Creation	0.5 ha / 0.5 ha	3	4	1	3	3	14
32, 33	Floodplain Reconnection / Leaky Barriers	600 m^3	4	4	1	3	5	17
34	Woodland Creation	5.6 ha	4	4	1	3	3	15
35	Brash Bundles	n/a	2	5	1	2	5	15
36, 37	Woodland Creation	1.6 ha / 1.3 ha	3	4	1	3	3	14
38	Offline Pond	60 m^3	2	4	1	3	4	14

Site	Intervention Type	Estimated storage volume	Flood Benefit	Cost	Landowner Willingness	Habitat Creation / enhancement	Timescale	Benefit Score
39, 40	Leaky Barriers / Wet Woodland	n/a	3	4	1	3	5	16
41, 42	Floodplain Reconnection / Leaky Barriers	300 m^3	3	4	1	3	5	16
43	Online Pond	250 m^3	2	4	1	3	4	14
44	Green River	n/a	2	4	1	2	4	13
45	Woodland Creation	3.4 ha	3	4	1	3	3	14
46	Two-Stage Channel	250 m^3	2	4	1	2	5	14
47	Brash Bundles	n/a	2	5	1	2	5	15
48, 49	Floodplain Reconnection / Leaky Barriers	150 m^3	2	4	1	3	5	15
50	Woodland Creation	0.6 ha	3	4	1	3	3	14
51, 53, 55	Hinged Trees	n/a	3	4	1	3	5	16
52, 54	Brash Bundles	n/a	2	5	1	2	5	15
56	Woodland Creation	0.8 ha	3	4	1	3	3	14

4.2 Interpretation of the Decision-making Matrix for NFM interventions

The decision-making matrix (Table 3) summarises the Benefit Scores of proposed NFM interventions across the catchment. Overall, interventions utilising leaky barriers to support floodplain reconnection scored consistently well, achieving Benefit Scores of 16 or 17. This is due to their suitability within the catchment context and the scale of storage they can provide.

While some features will require detailed modelling and design to ensure their effectiveness, several interventions (including leaky barriers, brash bundles, hinged trees, and certain floodplain reconnection measures) are relatively low-cost and straightforward to implement, often using locally sourced materials.

No formal landowner engagement was undertaken during this phase of work. However, existing engagement led by Repton Parish Council provided helpful insight, influencing the landowner-willingness scoring for interventions proposed near the village, where progress has already been made. Intervention 006 is considered the most impactful individual measure due to its potential flood benefit, habitat creation and landowner amenability.

Many of the proposed interventions could deliver immediate benefits or demonstrate measurable flood-reduction impact within five years. Although woodland creation has a longer lead-time before delivering hydrological benefits, such opportunities should still be pursued—particularly in areas of the catchment where alternative NFM options are limited.

Although developing flood-storage areas within a steep catchment presents challenges, opportunities remain to promote floodplain reconnection. These can be complemented by in-channel measures—such as leaky barriers and hinged trees—to enhance temporary water storage and attenuate peak flows. A programme of distributed, catchment-wide interventions is generally more effective than isolated individual features and should be encouraged.

Most suggested interventions also have relatively low implementation costs, typically under £10,000 per feature, with opportunities for economies of scale when multiple features are delivered along the same watercourse reach. All interventions will require ground-truthing, and it should also be noted that all capital works will require ecological and heritage surveys. Features directly connected to the watercourse will be subject to a drainage consent from Derbyshire County Council (charged per feature). Some interventions may also require planning permission, subject to consultation.

5. Next Steps

TRT recommends that the long-term strategy for the Repton Brook catchment focuses on close collaborating with the EA and DCC to secure funding when it becomes available, followed by renewed engagement with landowners across the catchment. Landowner willingness is a critical factor in the successful delivery of NFM measures, and engagement should be undertaken sensitively to maintain trust and maximise the likelihood of participation when funding opportunities arise. Current challenges for the farming community, including limited ELMs payment options and changes to the Family Farm Tax, make careful engagement particularly important.

A practical approach to engagement is the organisation of a free, local farm event open to the wider farming community. Such an event can demonstrate the links between NFM and sustainable farming practices, particularly highlighting how improved soil health supports both productivity and flood management outcomes.

A suggested itinerary for the event could include:

1. **S**oil Health and Herbal Leys – a local agronomist delivering a talk on improving soil health using herbal leys, focusing on how diverse plant species can enhance soil fertility
2. (Optional Site Visit) Soil Structure Talk – Visual Evaluation of Soil Structure (VESS) assessment of soil aggregation and overall health
3. Overview of Natural Flood Management (NFM) and how this can be maximised using Sustainable Farming Incentive options – delivered by TRT

At previous events, TRT has offered British Agricultural Standards Institute (BASIS) and National Register of Sprayer Operators (NRoSO) points to attendees as an incentive, helping maintain professional certification and ensuring best practice in agricultural operations

Such events provide opportunities to identify landowners interested in participating in NFM measures. Information from the event can be cross-referenced with the scoping report, allowing TRT to approach landowners in a targeted yet non-intrusive manner. Additionally, the event may highlight opportunities for shared agricultural resources, further promoting cooperation, community engagement, and strengthened farmer networks within the catchment. Aligning the event with the reopening of the SFI ELMs scheme in spring 2026 is recommended to maximise participation and interest.

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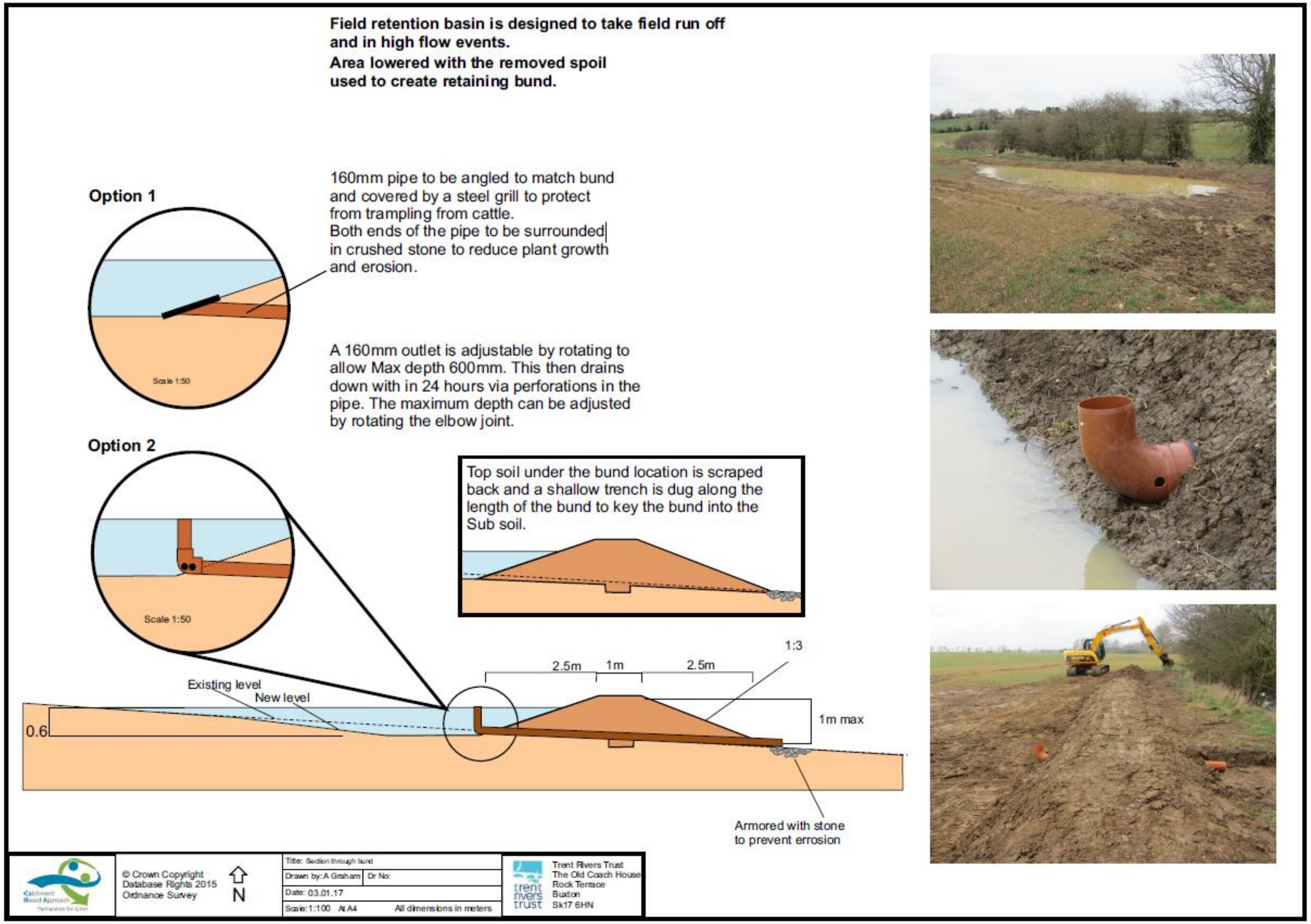
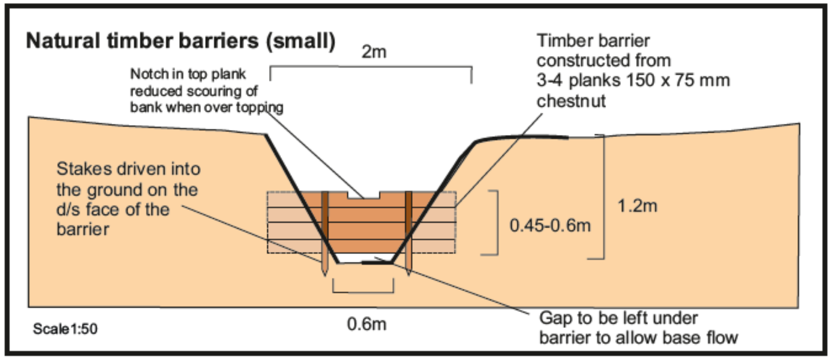
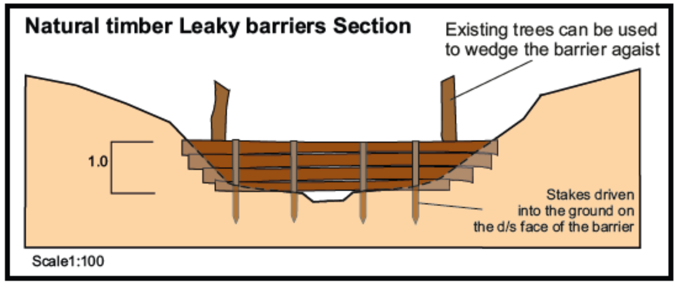
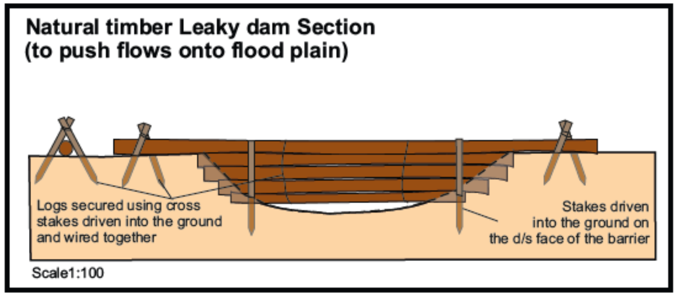
Appendix A: Bund Design



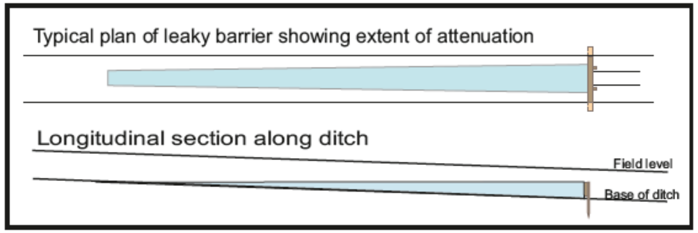
Appendix B: Leaky Barrier Design







Natural timber ideally locally felled is more appropriates for wider watercourses or woodlands. Here if the opportunity allows it may be possible to divert flow on to the woodland floor.
The barrier may be extended into the woodland to increase the area of attenuation.
If timber has to be brought onto site chestnut provides a durable material



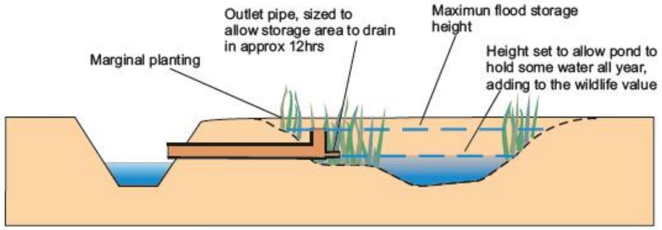
N

Title: Section through bund	
Drawn by: A Graham	Dr No:
Date: 03.01.17	
Scale: 1:100 At A4	All dimensions in meters

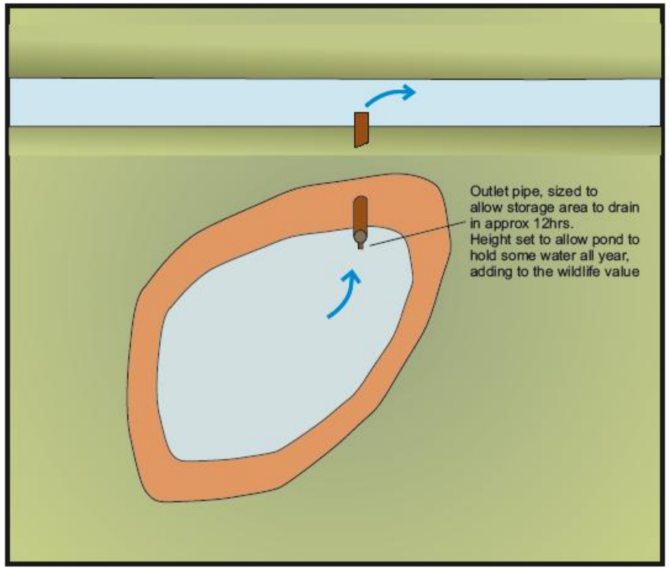
Trent Rivers Trust
The Old Coach House
Rock Terrace
Buxton
Sk17 6HN

Appendix C: Pond Design

Examples of 2 stage pond outlets



This NFM feature is suitable for existing ponds or newly built ponds. The ponds is designed to have a base level determined by a small outlet. As the pond fills during high rainfall events this small outlet is insufficient to drain the pond thus acting as a storage area. A larger bore pipe acts as an overflow if levels rise too high.



Catchment Based Approach	© Crown Copyright Database Rights 2016 Ordnance Survey 100024198	Title: Pond - storage	Trent Rivers Trust
	N	Drawn by: A Graham Drw Ref 11	The Old Coach House
		Date: 24.03.20	Rock Terrace
		Scale: 1:100 At A4 All dimensions in meters	Buxton Sk17 6HN