

Case study 45. Trawden Natural Flood Management Scoping Study

Authors: Alison Whalley, Kate Morley

Main driver: Flood risk reduction to community at risk

Project stage: Scoping stage, final report due June 2017

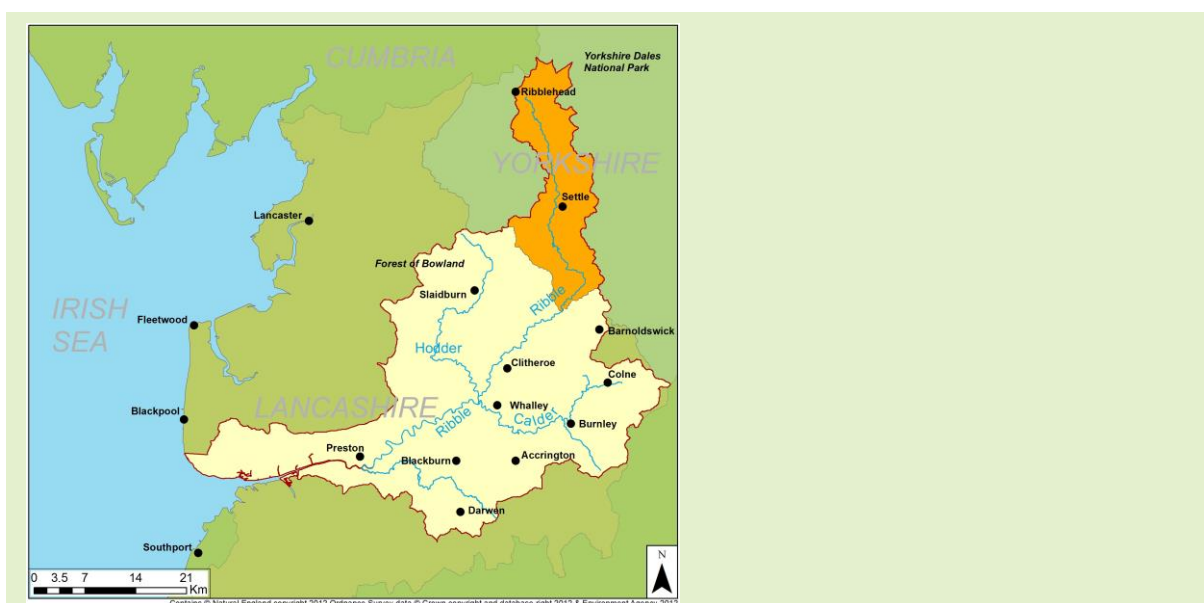
Project summary:

The project will scope out and model NFM interventions that could establish a reduction in flood risk to Trawden, a village at risk of flooding, near Colne in the Ribble catchment in Lancashire (Map 1). The aim is to inform the Trawden Capital Project and identify catchment scale interventions which could add climate change resilience to this scheme. This will be achieved through:

- **Hydraulic modelling:** updating the current flood model to establish potential for Natural Flood Management (NFM). This will be done by: carrying out a review of the hydraulic and hydrological modifications that could be made within the modelling to represent the effects of NFM; establishing the reduction in peak flows that may be afforded by NFM, or failing that the climate change resilience that may be offered.
- **NFM aspirational scoping:** carrying out a geomorphology baseline assessment and a landscape scale assessment of the evidence-based NFM solutions that are possible within the catchment surrounding Trawden, including the modelling of each intervention.
- **NFM prioritisation:** identifying opportunities and methods for priority areas for delivery including social, economic and environmental multiple benefits, match funding and current constraints.

Key facts:

The results of the scoping study are due for publication in June 2017. The key findings will be whether it is possible to reduce flood risk to Trawden through NFM alone, in combination with a proposed traditional capital scheme, or to add climate change resilience to a traditional capital scheme. To date a landscape scale and geomorphological assessment of the Trawden catchment has identified over 150 potential NFM interventions.



Map 1: River Ribble (source: Ribble Rivers Trust)

1. Contact details

Contact details	
Names:	Alison Whalley, Kate Morley
Lead organisations:	Environment Agency Moors for the Future Partnership
Partners:	Partner: Ribble Rivers Trust Contractor: Edenvale Young Associates Ltd Contractor: AECOM
e-mail address:	alison.whalley@environment-agency.gov.uk kate.morley@peakdistrict.gov.uk

2. Location and catchment description

Catchment summary	
National Grid Reference:	X: 391145, Y: 439159
Town, County, Country:	Trawden, Colne, Lancashire, UK
Regional Flood and Coastal Committee (RFCC) region:	North West
Catchment name(s) and size (km²):	Ribble catchment area 11.4m ²
River name(s) and typology:	Trawden Brook (River)
WFD water body reference:	GB112071065160
Land use, soil type, geology, mean annual rainfall:	Mixed land use (moorland and pasture), soil types range from peat to loam over sandstone. Geology includes Millstone grits and Pennine Lower Coal Measures. Mean annual rainfall unknown.

3. Background summary of the catchment

Socioeconomic/historic context

An initial assessment of Trawden Brook was carried out in March 2015. The assessment identified traditional options that could be used to reduce flood risk. Options included:

- Option 1 – do nothing. The hydraulic modelling review notes available show that to do nothing would reduce the level of protection to lower than 1 in 50 year at Trawden. This suggests that if the do nothing approach were to be adopted then the likelihood of flooding will increase.
- Option 2 – do minimum (enhanced maintenance). There would still be a risk of blockages at crossing points along the watercourse.
- Option 3 – weir removal, new retaining walls and existing wall repairs (1 In 100 year standard of protection). This option includes the provision for removal of the 2 weirs that are situated on the watercourse, the inclusion of new retaining walls and the repair of the existing walls.

- Option 4 – new walls, raise and repair existing walls (1 in 100 year standard of protection). This option includes the provisions of new walls (both masonry and retaining) and the raising and repairing of the existing walls along the watercourse.
- Option 5 – flood storage areas (1 in 100 year standard of protection). This option includes the provisions of 2 flood storage areas, one located upstream of Colne Road on Beardshaw Beck and the other upstream of Church Street on Trawden Brook.

Before agreeing a preferred option based on the initial assessment, a further option was created in the by developing the Trawden NFM Scoping Study 2015-2017.

Catchment information

Trawden Brook forms part of the upper reaches of the River Calder catchment draining off Boulsworth Hill as a series of steep bedrock influenced headwater streams before amalgamating just after the Pennine Way to form a confined pool-rapid channel flowing into the village of Trawden, where it is joined by Beardshaw Beck draining agricultural land to the east. The steepness of Trawden Brook, impervious geology (Millstone grits and Pennine Lower Coal Measures) and the extensive artificial moorland drainage network mean that the river exhibits a flashy flow regime rapidly rising to peak following heavy rain.

There have been 2 recent flood events in 2000 and 2001. The largest documented flood occurred in 1927 with further historic flooding in 1947 and 1960. There are no formal flood defences in Trawden although some sections of wall serve as flood defences.

Land use in the catchment is confined to moorland sheep and cattle farming across Boulsworth Hill, giving way to pasture on the lower slopes again with sheep and cattle farming dominating. Pockets of valley woodland occur in the Cloughs below the Pennine Way.

The steep narrow headwater streams are generally step-pool in nature with steps composed of either bedrock and/or boulder clusters. Many of these watercourses have undergone historic headward extension, resulting in an increase in the length and complexity of the drainage network which will have led to an increase in peak discharge and a more rapid rise to peak in the catchment. As the gradient lessens, the channels become more alluvial for a short stretch on the lower slopes of Boulsworth Hill combining to form the main Trawden Beck after the Pennine Way where the river flows through a strongly confined valley as a series of pools and rapids with frequent bedrock outcrops. This character continues to Trawden where it becomes heavily engineered.

Floodplain areas are generally small in extent, confining flood flows through to the village of Trawden. Similarly the lower valley slopes remain steep and heavily grazed encouraging rapid surface run-off into the watercourses.

Much of the local development within Trawden is situated within close proximity of the brook which has led to it being consistently modified throughout this stretch. In most cases the modifications to the brook have consisted of raising the walls that sit alongside the channel. There are also a number of properties both residential and commercial that contribute towards forming the channel banks.

Of particular interest with regard to the flood behaviour of the river is the historic extension of watercourses within the catchment. The drainage of the lower eastern side of the catchment is via an artificial channel extension; numerous extensions have also occurred in the headwaters either by direct ditch and channel cutting or headwater gullying and piping induced by ditching. Elsewhere, road and track drainage and subsurface drainage have increased the rate and volume of surface run-off in the catchment.

Historic mining in the catchment using the hushing process has also altered the landscape of the upper catchment, creating numerous poorly defined channels across wetland zones on the lower slopes of Boulsworth Hill. These features are of historical significance. Figure 1 summaries the geomorphology of the Trawden Brook catchment.

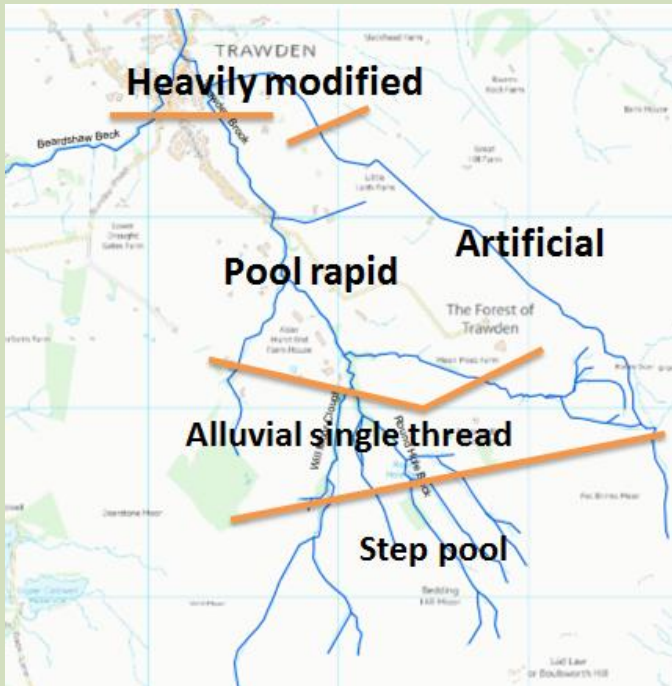


Figure 1: Geomorphology: changing channel type across the Trawden Brook catchment

Flood risk problem(s)

The Environment Agency prepared an initial assessment report in March 2015 for Trawden Brook. During the initial assessment, no NFM measures were proposed. The assessment utilised an existing model that was originally developed as part of the Environment Agency’s Section 105 (S105) floodplain mapping study in 2001. This original model was a 1D ISIS model. The model was updated in 2009 to 2010 to update the Environment Agency national flood map.

Hydrology

The original S105 study used the Flood Studies Report method to estimate peak flows up to the 1 in 100 year event including climate change. The hydrology was updated in 2009 using the then latest Flood Estimation Handbook (FEH) methodology, the recommended approach for the types of catchment being the FEH statistical method.

The peak flow estimates for design events up to the 1 in 100 year climate change event were derived using the FEH statistical method using WINFAP version 2 software. The 1 in 1,000 year flow was estimated using the hybrid approach, using a growth factor derived from the ratio of the 1 in 1,000 year to the 1 in 100 year flow using the Revitalised Flood Hydrograph (ReFH) method.

Results

The available hydraulic model shows that properties flood from:

- 1 in 50 year return period (70 residential properties and 11 commercial properties)
- 1 in 75 year return period (75 residential properties and 11 commercial properties)
- 1 in 100 year return period (78 residential properties and 12 commercial properties)

History of flooding

The earliest recorded historical flooding event in Trawden was in 1927; this was also the largest flood event in the village to date with flood levels on Rock Lane reaching 1.5m high. One description of the event reads: 'Rock Lane deluged by a vast roaring torrent of water which at one point reached a depth of 5 feet'; however, there is no further information available regarding this particular event.

The next recorded event was in 1947 where Trawden is described as having its properties undercut by flooding; however, this was due to flooding from Colne Water rather than Trawden Brook. Another flood

event was believed to have taken place in the late 1960s (August 1967) but there is no official record or information relating to this date.

The most recent events to have taken place were in 2000, 2001 and 2004. In 2000, 3 properties were recorded to be flooded at depths of between 0.3m and 1m, and in 2001 a further 14 properties were recorded flooded. 2004 saw both Burnley Road and Colne Road flooded.

These more recent flood events occurred mainly because of blockages at structures crossing the watercourse caused by debris that was washed down from upstream. This resulted in banks overtopping and flows heading overland towards the lower parts of Trawden, where they reached the affected properties.

Other environmental problems

The Water Framework Directive water body classification (for 2015 cycle 2) is moderate, with the objective to be good by 2017.

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

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

Evidence of flooding is obtained from modelling, historic flood maps, photos, catchment walkovers, a desk-based review and expert judgement.

The initial assessment identified a number of traditional options that did not provide cost benefit. Therefore the Environment Agency and the North West RFCC worked together to develop the objectives for the scoping study. Building on previous Defra evidence on NFM, the Environment Agency worked with the Moors for the Future Partnership as lead partner to deliver the objectives.

The process to produce the scoping study was developed between the Environment Agency and Moors for the Future. In addition to the revision and recalibration of the flood risk model and the geomorphology assessment, a number of other tasks were included to produce a holistic scoping study for Trawden. This included:

- liaison with the Ribble Life Catchment Partnership Board
- summary reports to identify easy wins for working with land managers and funding opportunities which could potentially provide match funding, should a scheme be approved

Moors for the Future will make recommendations for a monitoring plan including methods, delivery and timescales. The Ribble Rivers Trust was also brought on board as project partners to incorporate its local knowledge and data in the project.

At this stage in the project, the landscape scale assessment (through desk-based study and site visits with Moors for the Future, AECOM and Environment Agency officers combined with geomorphological assessment) has been completed and produced recommendations on which measures would be suitable. Following submission of this initial recommendations report, Edenvale Young is in the process of modelling the potential NFM interventions.

Following the completion of this work, the model will be run and all interventions ranked in order of effectiveness in reducing peak flows. A prioritisation workshop is scheduled to take place to discuss the results, incorporating local knowledge and additional data in order to take recommendations forward.

By running models which look at the effect of each potential NFM measure in isolation enables us to compare the peak flow in the centre of Trawden against the baseline model.

What was the design rationale?

This section will be completed once this information is available.

Project summary	
Area of catchment (km²) or length of river benefitting from the project:	Catchment area 11.4km ²
Types of measures/interventions used (both WWNP and traditional):	Case study to be updated once known
Numbers of measures/interventions used (both WWNP and traditional):	Case study to be updated once known
Standard of protection for project as a whole:	Case study to be updated once known
Estimated number of properties protected:	Case study to be updated once known

How effective has the project been?

Early indications within the project have demonstrated that there are opportunities to work with land managers within the upper catchment regarding NFM measures on their land. Recent work completed by Natural England details how Countryside Stewardship (payments and capital grants) can be used to reduce the risk of flooding ([CS Flood Infographic](#)). This information helps to build both a social, economic and environmental case for such measures.

To date the study has also demonstrated the range of interventions which could be implemented over a catchment of this size, including floodplains storage, in-channel interventions, grip and gully blocking, woodland and riparian creation and peatland restoration.

The study has highlighted the limitations of modelling as a means of showing the effectiveness of NFM in reducing peak flows across the Trawden catchment. Barriers to modelling all of the interventions have included evidence gaps for the infiltration parameters for the soils within the catchment, in this case the blanket peat in the upper catchment. Gully blocking in the upper catchment could also not be modelled due the inability of the model to represent small features in the 1D model.

5. Project construction

Not yet constructed

6. Funding

Funding summary for Working with Natural Processes (WWNP)/Natural Flood Management (NFM) measures	
Year project was undertaken/completed:	Scoping study 2015 to 2017
How was the project funded:	RFCC Local Levy Partnership match funding through Moors for the Future
Total cash cost of project (£):	£95,000
Overall cost and cost breakdown for WWNP/NFM measures (£):	Information not available at this stage
WWNP/NFM costs as a % of overall project costs:	Information not available at this stage

Unit breakdown of costs for WWNP/NFM measures:	Information not available at this stage
Cost–benefit ratio (and timescale in years over which it has been estimated):	Information not available at this stage

7. Wider benefits

What wider benefits has the project achieved?

Initial results of the modelling intervention work were presented to a range of interested parties from within the EA; this was followed by a discussion on how interventions could be prioritised for their contribution towards multiple benefits. For example how riparian woodland creation could help to reduce peak flows, add climate resilience, reduce diffuse pollution and enhance biodiversity.

How much habitat has been created, improved or restored?

Information not available at this stage

8. Maintenance, monitoring and adaptive management

Information not available at this stage

9. Lessons learnt

What was learnt and how could it be applied elsewhere?

Although the scoping study will not be completed until June 2017, some lessons learnt can be derived from delivery to date.

- It has been a learning process in bringing together a number of different experts on an innovative project (geomorphology, landscape scale assessment and flood modellers), and understanding and combining different languages and terminology to ensure that the project can achieve its objectives.
- Having a degree of flexibility in the process and its associated timescales has been a benefit to the project. As this is an innovative project, there is a need to be receptive to questions and tasks which emerged, for example, the inclusion of a task to look at how and why NFM interventions are prioritised.
- It is important to define who the audiences are for the study's reports and set the format accordingly early on within the project. The Trawden NFM Scoping Study has 3 distinct audiences: the Environment Agency's Flood and Coastal Risk Management (FCRM) team; the Environment Agency Programme Team; and the Catchment Partnership (Ribble Life). The information presented by the scoping study must be able to satisfy all of them.

The study has highlighted the limitations of modelling in order to produce a shopping list of NFM interventions for the catchment. It has not been possible at this stage for the modellers to accurately model all of the interventions which were recommended through the geomorphology and landscape scale assessment, due to gaps in available literature to inform the parameters of the soil types in Trawden. Evidence gaps have been identified, particularly in relation to the infiltration into the soils of the upper catchment (blanket peat).

10. Bibliography

AECOM, EDENVALE YOUNG, ENVIRONMENT AGENCY AND MOORS FOR THE FUTURE PARTNERSHIP, 2016. *Trawden catchment NFM scoping study. Unconstrained NFM opportunities.* Unpublished report.

Trawden Catchment NFM scoping study. Unconstrained NFM Opportunities. AECOM, Edenvale Young, Environment Agency, Moors for the Future Partnership 2016.

Project background

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