Case study 20

River Ribble floodplain restoration - Yorkshire

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1. Catchment summary

Study location

Long Preston Deeps (Figure 1) is a Special Site of Scientific Interest on the River Ribble, close to Settle in the Yorkshire Dales.

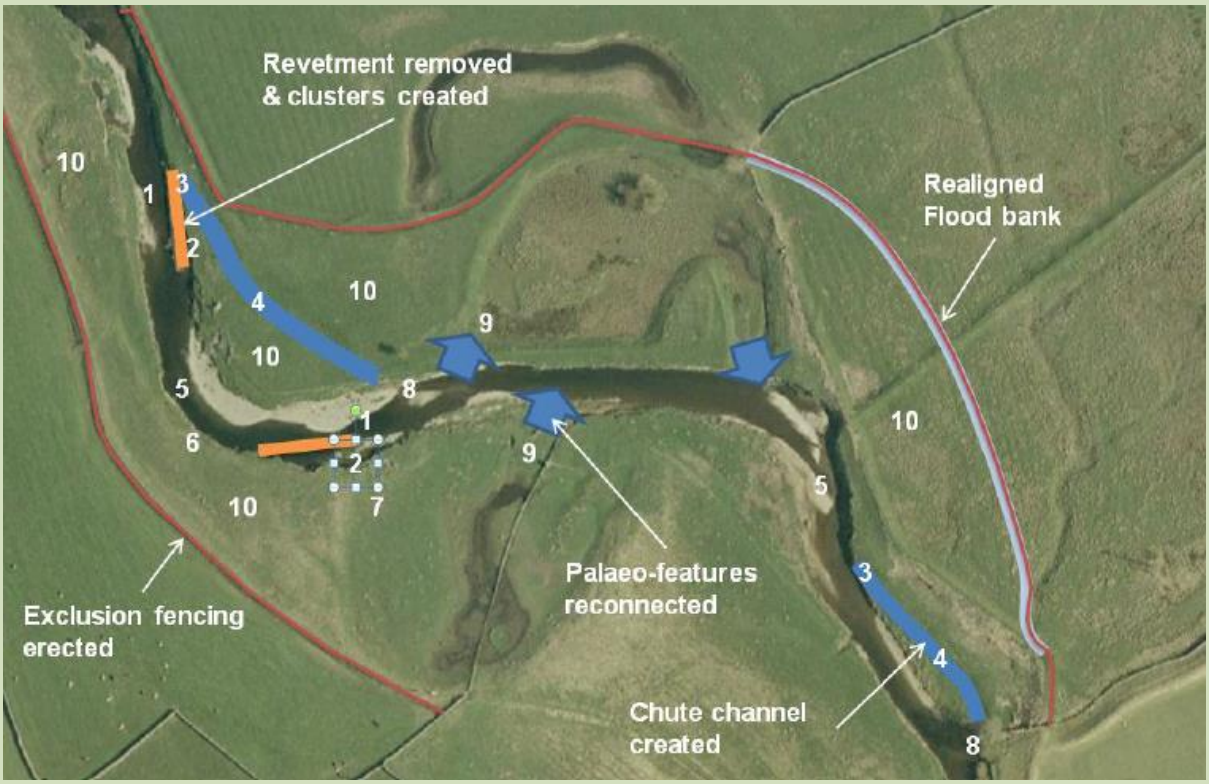

Figure 1: Restoration measures for Long Preston Deeps

Notes: See Table 1 for details of the restoration measures at the numbered sites.

Source: JBA Consulting

Catchment summary

The Water Framework Directive targets identified for the River Ribble in the River Basin Management Plan (RBMP) are to reach 'Good Ecological Status' by 2015, whereas it is currently defined as 'Moderate'.

There have been a range of pressures on the Ribble at this location including:

- the use of bank protection
- flood embankments constraining interaction with floodplain
- channel incision
- generally degraded riparian corridor

Proposed actions identified in the RBMP include:

- specific action to implement a restoration plan along the Long Preston Deeps through physical modification
- flood and coastal erosion risk management measures for realignment of the flood defence and to preserve and enhance the ecological value of marginal aquatic habitat, banks and riparian zone

Study summary

This project aimed to identify river and floodplain restoration measures that involve Working with Natural Processes (WwNP) to improve hydromorphological and ecological condition as identified in the RBMP. This includes restoration of former functional features such as old channels to create new dynamic and diverse habitats. Table 1 lists the 10 restoration measures for Long Preston Deeps, along with the anticipated short- and long-term responses.

Community involvement

Engagement events were held in the town and during site walkovers to discuss the projects with local stakeholders and interest groups such as anglers and landowners.

2. Data summary

Datasets and analysis techniques used

A fluvial audit was performed and new light detection and ranging (LiDAR) data were supplemented with some limited surveying.

Data restrictions

The involvement of the Environment Agency meant that obtaining data such as LiDAR was not a problem.

3. Model summary

Catchment processes investigated

There was no quantified assessment of the impacts on flood risk as it was seen that setting back flood embankments into rural land would only benefit downstream flood risk and not increase flood risk to people or property in this rural location. Because there would only be increased frequency of flooding to the restored floodplain only a qualitative assessment was made.

The following processes were considered:

- Run-off generation mechanisms and patterns
- Sediment sources, pathways and receptors
- Effects of in-channel barriers along river systems – includes impacts of bridge/culvert blockages and failures
- Effects of longitudinal barriers which disconnect rivers from their floodplains during flood events
- Catchment and land use change

Model assumptions

A fluvial audit was the main tool used to develop the restoration plan. Further quantified assessment work was not required due to the nature and risk of the proposed restoration measures. The main outputs of the fluvial audit included:

- a record of historical flood events
- physical changes such as flood banks that have produced significant hydrologic or geomorphic responses
- a list identifying ‘potentially destabilising phenomena’ capable of triggering changes in future

Data and model outputs

The main form of data gathering for this study was a fluvial audit. This consisted of a detailed geomorphological assessment of the Ribble at Long Preston Deeps and the wider catchment, recording both qualitative and some quantitative information about the river form and processes. Pressures on the river system that are causing geomorphological issues were recorded. This led to identification of measures to improve the conditions of the wider water body (see Figure 1 and Table 1).

The main output of a fluvial audit is two lists. The first records historical events and changes that produced significant hydrologic or geomorphic responses. The second list identifies 'potentially destabilising phenomena' capable of triggering changes in future. Both helped with the design for the restoration measures put in place in this project.

Detailed hydraulic modelling was not carried out due to the remote rural location of this site and the increase in flood storage through the setting back of the flood banks.

Model performance

Failure of the newly set back flood banks was not modelled. In the event of failure, the flood banks protect agricultural land rather than property (see Figure 2). The long-term monitoring put in place will be useful for assessing the effectiveness of the restoration against the long-term aims set out in Table 1.

Figure 2: Set back flood embankment during construction, looking upstream

Source: JBA Consulting

Table 1: Restoration measures for Long Preston Deeps

ID	Measure	Short-term response	Long-term response
1	Cluster creation	Rapid micro-habitat creation and increased flow diversity	Development of vegetated bars Flow channel bifurcation
2	Revetment removal	Bank erosion processes restored	Lateral channel migration mitigated by floodplain woody vegetation
3	Chute channel creation	Stripping of entrance sediments Realignment of chute entrance Coarsening of bed material	General lowering of chute elevation Improved flow connectivity
4	Chute channel creation	Redistribution of chute sediments Micro-habitat creation Chute entrance/exit change	Development of diverse chute morphology and sedimentology
5	Chute channel creation/ flood bank realignment	Increased gravel bed stabilisation	Increased gravel bed stabilisation
6	Chute channel creation	Reduced lateral erosion	Bank stabilisation and vegetative development
7	Palaeochannel reconnection	Localised natural palaeofeature reconnection	Rejuvenation of palaeomeander and associated habitats
8	Chute channel creation	Accumulation of flushed fines	Development of convergence
9	Chute channel creation	Rapid vegetation development Flow differentiation	Slow silt accumulation Micro-habitat creation
10	Exclusion fencing	Development of ungrazed floodplain vegetation	Planned woody vegetation planting combined with naturalisation of the floodplain herbaceous plants will develop into riparian zone woodland with associated impacts on channel stability

Notes: See Figure 1 for the location of each restoration measure.

Source: JBA Consulting

4. Lesson learnt

Choice of tools

The study highlights the importance of a fluvial audit in identifying sustainable restoration plans in the river and floodplain. It demonstrates that modelling is not always required to identify suitable measures, although it is typically required to assess flood risks where there are greater potential impacts in terms of property and people.

Catchment scale and typology

This was a reach scale design of a restoration plan with further phases for the river identified as part of the fluvial audit for ~5km of the river system.

Wider benefits

Hydromorphological and ecological improvements have been provided and were predicted as part of the scheme assessment. The improved hydromorphological diversity will improve the resilience of the system to low and high flows. Increased gravel deposition will improve habitat quantity and variance within the channel. A wetter local floodplain will increase floodplain habitat and floral diversity. Woodland planting in the floodplain has also been carried out in those areas opened up in the floodplain and fenced off from cattle.

Future research needs

The fluvial audit was useful to help understand river forms and processes, to identify suitable restoration measures and to determine system response to restoration. Decisions made based on the fluvial audit undertaken to understand the river system have subsequently been confirmed using monitoring. The site has quite detailed long-term aims and it would be interesting not only to monitor these but also to try to reproduce the adjustment of the system using a detailed sediment transport model.

The benefits of the restoration measures are widely understood, mainly through other case study examples rather than publications or research.

5. Bibliography

JBA CONSULTING, 2011. Long Preston restoration summary – final report. Report to the Environment Agency.

Project background

This case study relates to information from project SC120015 'How to model and map catchment processes when flood risk management planning'.

It was commissioned by the Environment Agency's Evidence Directorate, as part of the joint Flood and Coastal Erosion Risk Management Research and Development Programme.

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