Walkover Habitat Survey

Welton Beck, Lincolnshire

November 2016

Contents

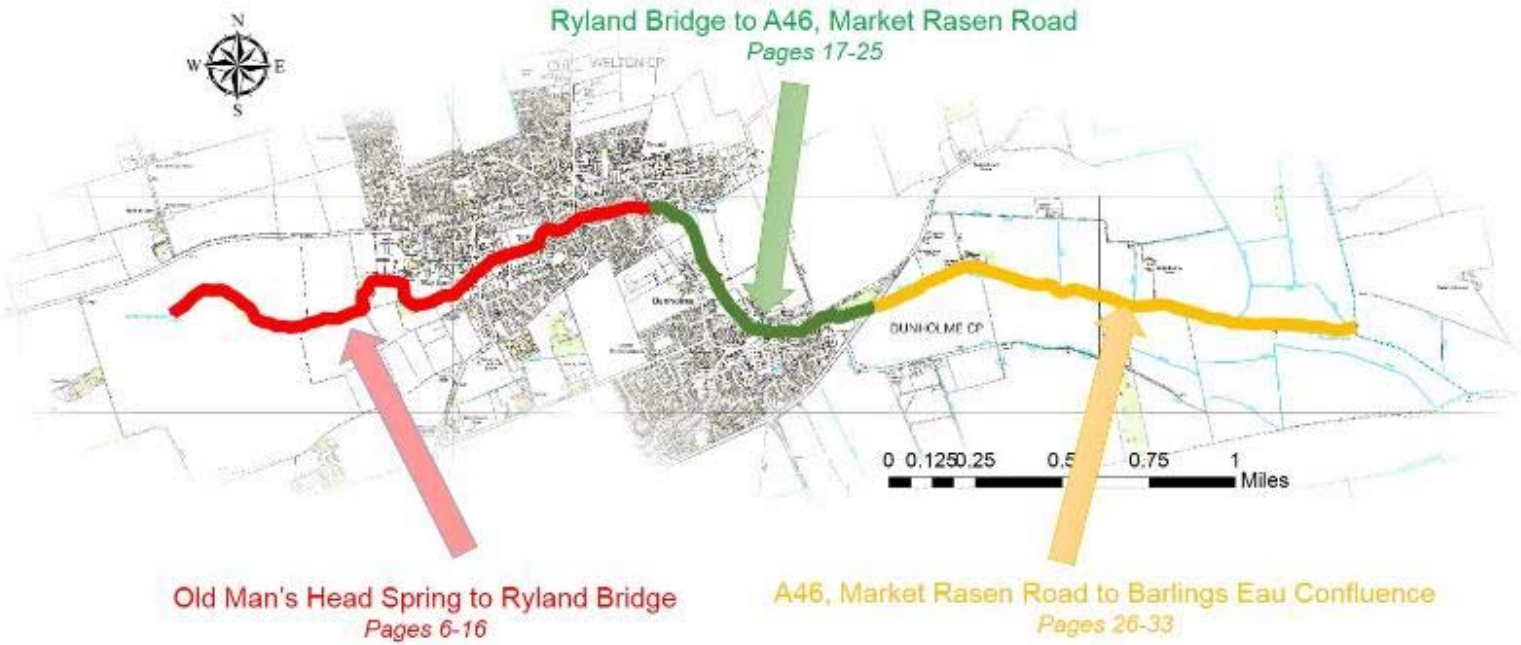
Summary

- Approximately 5 km of the Welton Beck was inspected from the west of Welton village to the confluence with the Barlings Eau. The Beck is a small stream fed by springs from the Lincolnshire limestone aquifer. It has clear water and aquatic plant growth characteristic of calcareous conditions.
- Throughout the course of the beck, the channel has been significantly modified from its natural state, having been straightened, widened, and its course altered. There are few meanders and a pool-riffle sequence is not evident. Instream habitat quality is generally poor, with uniform channel shape, depth and substrate composition, limiting its value for wildlife.
- The most recent (October 2016) fishery survey on Welton Beck in Welton village produced only minnows, stone loach and sticklebacks. If habitat conditions were improved within the Welton Beck, it would support a wider range of fish species (such as trout) which would colonise from the Barlings Eau. This would have a knock-on effect, increasing the chances of the beck supporting more wildlife such as kingfishers, otters, herons and water voles.
- The gradient of the beck within Welton village is relatively steep, lessening in Dunholme and east of the A46. There are no significant impoundments (weirs, sluices, etc.) along the course which would impede fish passage. There is a culvert under a track crossing near the Barlings Eau which requires minor modification to allow fish passage (Photo 37).
- There appears to be an opportunity for a river re-naturalisation project upstream of Welton village (Norbeck Farm), potentially providing improved biodiversity, amenity gains and flood risk reduction through use of natural process.
- Within Welton village there is opportunity to create improved fish habitat by scour pool creation, on the steeper gradient section of the beck.

- There are opportunities for the creation of a two-stage channel (low-flow channel within the existing large capacity channel) to improve in-stream habitat at the following locations: recreation ground area (Photo 4); the reach alongside the pond (Ryland, Photo 15); within the village (subject to flood risk assessment), downstream of Beck Lane to the A46 (Photo 24) and selected sections downstream of the A46.

- A search of Lincolnshire Environmental Records Centre data, centred on the Beck, was requested by Lincolnshire Rivers Trust in October 2016 and includes recent records of the following species associated with aquatic habitats: water vole. There are also older records (1995) for brown trout and eel. The full search report is available from marie.taylor@lincsrivers.org.uk.

Index of Sections Highlighted in this Walkover Report



Introduction

This report is the output of a site visit undertaken by Tim Jacklin of the Wild Trout Trust and Marie Taylor of Lincolnshire Rivers Trust to the Welton Beck, approximately 10 km north of Lincoln, on 10th and 28th November, 2016. Comments in this report are based on observations on the days of the site visits.

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left hand bank (LHB) or right hand bank (RHB) whilst looking downstream. Specific locations are identified using the Ordnance Survey National Grid Reference (NGR) system, for example, Watery Lane ford, Dunholme (TF 02342 79424).

Catchment Overview

The walkover survey was conducted to identify opportunities for habitat improvement along the Beck which could form part of the potential Lincolnshire Limestone Becks project, a partnership project currently under development.

The Welton Beck is a small stream which rises at Old Man's Head Spring (SK 99687 79449) to the west of Welton village and flows eastwards through the villages of Welton and Dunholme to join the Barlings Eau (a tributary of the River Witham) near Reasby (TF 05179 79366). The Beck is groundwater fed, flowing off the Lincolnshire limestone. In certain situations Limestone fed catchments can have discharge pattern similar to a surface water fed system, i.e. more responsive to rainfall than would be expected. This is likely because of conduit flow through fissures in the limestone as has been found to be the case on the nearby Dunston Beck.

Welton Beck forms part of the Barlings Eau waterbody under the Water Framework Directive. The Directive sets all water bodies the target of achieving good status or good potential by 2027 based on ecological health and water quality. Welton Beck is a small tributary of the larger Barlings Eau, hence the overall classifications for the waterbody may not reflect more localised conditions in the Welton Beck. For example, the waterbody classification for fish in 2015 is "High", but the most recent (24/10/16) electric fishing survey on Welton Beck in Welton village produced only minnows, stone

loach and sticklebacks. If conditions were improved within the Welton Beck, it would support a wider range of fish species (such as trout) which would colonise from the Barlings Eau.

River	Welton Beck
Waterbody Name	Barlings Eau
Waterbody ID	GB105030062290
Management Catchment	Witham (Operational catchment: Lower Witham)
River Basin District	Anglian
Current Ecological Quality	Overall status of **Moderate** ecological potential in assessment cycle 2015, **Poor** in 2009.
U/S Grid Ref inspected	SK 99687 79449
D/S Grid Ref inspected	TF 05179 79366
Length of river inspected	~6 km

Habitat Assessment

Throughout the course of the beck, the channel has been straightened and there were no meanders nor a pool-riffle sequence evident at any point. In-stream habitat quality is generally poor, with uniform channel shape, depth and substrate composition.

Old Man's Head Spring (SK 99687 79449) to Ryland Bridge (TF 01893 79957)

The very upstream part of this section was not inspected during this visit, but was visited by Environment Agency staff in summer 2016 (Photo 1). Downstream from the spring head the channel runs through a pond, then appears to have been recently cleared of vegetation. The channel is straightened and has a uniform depth and width, but is not deeply incised.

There are opportunities here to create variation in the instream habitat using the “dig and dump” technique, berm creation and bank re-profiling.

Figure 1 Plan of beck upstream of Welton village, near Norbeck Farm. The pond here appears on the 1966 Ordnance Survey 1:2500 map, but is absent from the 1956 1:10560 map indicating its approximate construction date. It is sited over two springs marked on the latter map.

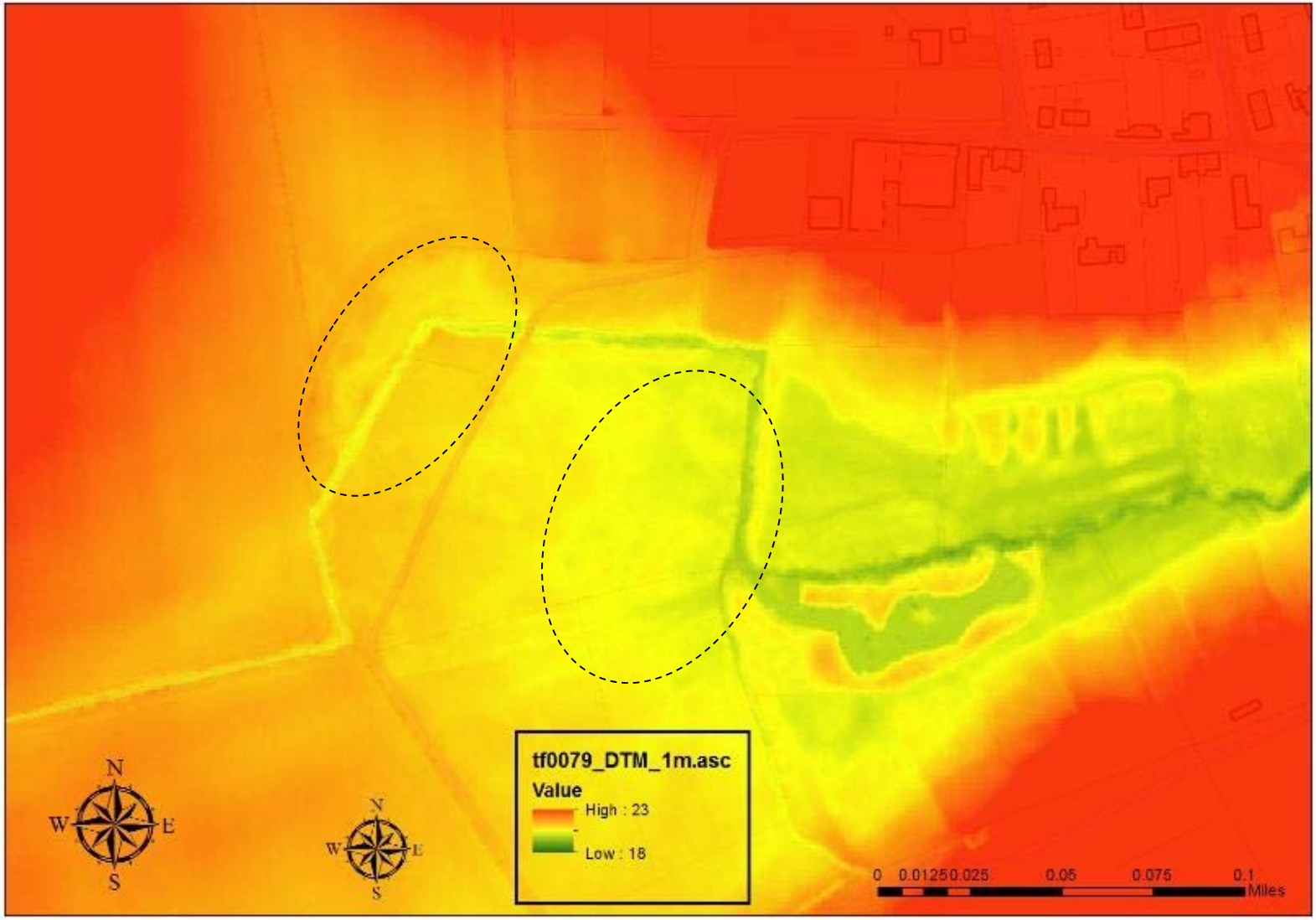


Figure 2 LiDAR map of same area as Figure 1 showing relative land levels. The spoil banks from the pond excavation can be clearly seen around its edges. There is some evidence of a former meandering beck course (within dashed ellipses), pre-dating the obviously straightened and re-routed existing course.

Photo 1 Upstream of Welton village, summer 2016 (Picture: David Hutchinson)

Photo 2 View upstream from Lincoln Road bridge (TF 01124 79624) towards Vicarage Lane bridge. Note the low bridge.

Photo 3 View downstream from Lincoln Road bridge. A very straight, relatively steep river channel.

Photo 4 Recreation ground area (TF 01315 79742)

Photo 5 Downstream end of the recreation ground, near footbridge (TF 01420 79836)

Photo 6.View upstream from bridge on The Grove (TF 01494 79852)

Photo 7 Culvert pipes under bridge on The Grove.

Photo 8 View downstream from bridge on The Grove (TF 01494 79852), with a deeper scour pool area immediately below the culvert.

Photo 9 View upstream from Ryland Bridge, Dunholme Road (TF 01889 79953)

Photo 10 Limited conveyance capacity through the culverts under Ryland Bridge.

Photo 11. View downstream from Ryland Bridge, Dunholme Road (TF 01889 79953).

Figures 1 and 2 show a section of the Beck upstream of the village near Norbeck Farm. The river has evidently been straightened and possibly re-routed at some point in the past, although this was prior to the 1886 Ordnance Survey 1:2500 map. Map dates also show the pond was constructed in the late 1950s / early 1960s. The LiDAR map (Figure 2) shows some lower-lying areas that may indicate a former meandering course of the beck. Subject to scoping work and landowner agreement, there is potential to carry out a river re-naturalisation project in this vicinity; this could involve re-meandering the river course and re-connecting the floodplain, which would provide benefits both wildlife and potential flood protection benefits to the village (slowing the conveyance of water into the village and providing upstream floodwater storage).

From Vicarage Lane downstream past the church to the recreation ground, the beck is straight, relatively steep and bordered by private residences (Photo 3). The instream habitat here is poor, being uniformly shallow and lacking deeper pools. The habitat could be greatly improved here by constructing pools using various types of low weirs from timber or stone. It is important to note, these are specialised structures set at a low level to create bed scour downstream of the structure, <u>not</u> impound water upstream. Their use is

limited to straight, heavily-modified stream channels like this and they are not recommended for meandering or low-gradient channels.

At the recreation ground the beck widens (Photo 4) and remains uniformly shallow with poor instream habitat. The left bank has been armoured with paving slabs which give way to a natural earth bank with progress downstream. There is potential here to narrow the channel and re-profile the left bank to a shallower angle (removing the slabs); this would create a two-stage channel, retaining conveyance for flood flows but improving habitat in the narrower, summer flow channel.

Downstream of the recreation ground the beck is confined alongside gardens again, then passes under a road culvert at The Grove (Photos 6 – 8). The flow conveyance capacity of this culvert appears quite small and this is a common theme of other bridges over the beck. There is a deeper scour pool present downstream of the culvert created by the funnelling effect of the flow through the culvert; this is similar to the effect that would be created by the weir structures mentioned above.

About 500m of the beck was inaccessible between The Grove and Ryland Bridge, flowing through private residences. Looking upstream from Ryland Bridge (Photo 9), there appears to be scope for introducing constructed pools as mentioned above, if landowners were willing. The bridge has particularly limited conveyance capacity in the culvert underneath (Photo 10).

Ryland Bridge (TF 01893 79957) to A46 Market Rasen Road (TF 02961 79508)

Downstream of Ryland Bridge, the beck is largely confined between walls of gardens (Photo 12) before reaching a more meandering section in a wooded area alongside a pond on the left bank (Photos 13, 14). The pond is fished by Scunthorpe Pisces Angling Club; there may be scope for fishery improvements here, such as peg refurbishment, via rod licence income streams (Photo 14). The instream habitat in the beck is better through the short meandering section, with deeper scour pools located on the outside of bends adjacent to mature trees.

With progress downstream, the bank-full channel has evidently been widened and deepened (Photos 15 – 17) creating a large capacity for higher flows. As further upstream, the brook is uniformly very shallow and has poor in-stream habitat. The gradient in this section is however lower, hence it is not suitable for constructed pools as recommended further upstream. Low-level flow deflectors on alternating banks, to mimic the natural channel dimensions is the best approach here. In some areas the beck has begun to re-establish its natural dimensions within the larger channel, depositing sediment on the inside of bends which has become vegetated to form berms (Photo 15). The channel maintenance carried out within this section has retained the berms, trimming only the taller vegetation such as rushes. In more shaded area, berms have not developed, presumably because of the lack of light preventing growth of aquatic vegetation.

Building upon the natural processes of low-level channel narrowing is recommended here. The outside edges of the berms could be defined with brushwood bundles, then back-filled with material excavated from the river bed and/or reprofiling the banks to a shallower angle. The overall capacity for containing high flows would be retained, whilst greatly improving instream habitat.

From Watery Lane ford downstream through Dunholme, the beck largely has walled banks and is uniformly shallow and artificially wide, to provide conveyance for higher flows and protect properties from flooding. The in-stream habitat is consequently very poor (Photos 17 – 21). There may be scope for creating a two-stage channel within this reach, although careful consideration would have to be given to flood risk. It may be possible to install some softer, vegetated edging within the channel in the less shaded areas.

Downstream of Beck Lane ford there is a short section of steeper channel, with much coarser bed substrate than elsewhere (Photo 23), then an approximately 200-m section down to the A46 which is lower gradient and has been widened and deepened creating a large capacity for higher flows, similar to the section alongside the pond mentioned above (Photos 24 – 25). As further upstream, the brook is uniformly very shallow and has poor in-stream habitat. Some natural vegetated berms have been allowed to develop and cutting of taller vegetation has been carried out (similar to the previously mentioned section). Low-level flow deflectors on alternating banks, to mimic the natural channel dimensions is again the best approach here, back-filling with river bed and/or bank re-profiling material.

Photo 12 Downstream of Ryland Bridge, the channel is mostly confined between walls alongside gardens of residential properties.

Photo 13 More natural section of the beck at grid reference TF0207079898

Photo 14 Pond alongside the beck at TF0211879876, fished by Scunthorpe Pisces Angling Club.

Photo 15 A greatly widened and deepened bank-full channel, with in which the beck has begun to re-establish its natural width and some sinuosity, creating vegetated berms on the inside of bends. Sensitive channel maintenance here has retained the low berms, trimming back just taller vegetation such as reeds and rushes (arrow).

Photo 16 In more shaded sections, vegetated berms have been unable to develop because of lack of light.

Photo 17 Watery Lane ford (TF0233479417)

Photo 18 Section downstream of Watery Lane ford.

Photo 19 Section upstream of Market Rasen Road bridge.

Photo 20 Road bridge culvert at Market Rasen Road (TF0247779346)

Photo 21 Section alongside Market Rasen Road.

Photo 22 Ford on Beck Lane (TF0277279446)

Photo 23 Steeper section of channel downstream of Beck Lane, with a coarser gravel substrate.

Photo 24 TF0287379467 between Beck Lane and the A46. A maintained, large capacity bank-full channel within the beck has begun to re-establish its natural width via vegetated berms, largely against the RH bank (left of picture). Sensitive channel maintenance here has retained the low berms, trimming back just taller vegetation such as reeds and rushes.

Photo 25 As above, illustrating the very shallow uniform habitat.

A46 Market Rasen Road (TF0296179508) to Barlings Eau confluence (TF 05179 79366)

The beck runs through a concrete-bedded culvert under the A46 (Photo26) with a small step on the upstream side and very shallow water. This is a barrier to fish passage at low flows and simple notched low wooden baffles downstream of the step would improve this.

Downstream of the A46, the beck passes through agricultural land before joining the Barlings Eau some 2 km downstream (Photos 29 – 38). The channel is maintained to preserve its land drainage function, hence is incised and straightened and has generally poor in-stream habitat. Any habitat improvement works within this reach would have to be carried out in conjunction with the body responsible for channel maintenance to ensure the drainage function and ecological improvements are sustained in the long term. Monks Wood (Photo 34), a community woodland creation project by www.nettlehamwoodlandtrust.co.uk is present on the left bank at TF 04318 79467. There may be opportunities for working with this group to adopt a section of the beck for improvement.

The Barlings Eau is known to have a reasonable fish population, including trout, so ensuring a free pathway for fish to migrate upstream through the Welton Beck is important. The route is relatively free of obstructions, but the occasional culvert under farm tracks (Photo 37) has become perched above the downstream water level. Raising the bed level and hence water level of the beck immediately downstream of the culvert by introducing a mat of cobbles/coarse gravel would overcome this quickly and easily.

Photo 26 Upstream end of culvert under A46 (TF0294979512). Short length of concrete –lined channel with a low lip. One or two notched baffles downstream of the lip would make it more passable by fish.

Photo 27 Downstream end of A46 culvert. No obstruction to fish passage.

Photo 28 View upstream from footbridge at TF0312079571

Photo 29 Culvert at farm track crossing (TF0337779647). No obstruction to fish passage. A deeper pool has formed below the culvert and sticklebacks were observed here.

Photo 30 Sewage works discharge (TF0343879630) onto a concrete pan on the river bed.

Photo 31 Fine silt accumulated upstream of the slight impoundment at the STW discharge.

Photo 32 Rubble mat downstream of the STW discharge

Photo 33 Typical section of the beck further downstream beyond the sewage works.

Photo 34 Monks Wood, a community woodland creation project by www.nettlehamwoodlandtrust.co.uk (TF0431879467)

Photo 35 Typical view of the Welton Beck in the lower reaches; slightly impounded upstream of a culvert leading to sediment accumulation and emergent vegetation encroachment.

Photo 36 Typical view of the Welton Beck in the lower reaches; slightly faster-flowing and coarser sediment downstream of a culvert.

Photo 37 Farm track culvert which is perched and a barrier to upstream fish movement, potentially restricting fish movements from the Barlings Eau up into the Welton Beck. (TF 04807 79385).

Photo 38 Confluence with the Barlings Eau

Opportunities for Habitat Improvements

The following sections give examples of river habitat improvement techniques that have been used elsewhere, along with where they might be used for projects on the Welton Beck.

River re-naturalisation projects

These are large capital projects which involve significant alterations to previously engineered channels, re-creating meanders and re-connecting the river with its floodplain. Figure 3 and Photos 39 – 41 illustrate such a project carried out on the River Glaven, Hunworth, Norfolk in 2010.

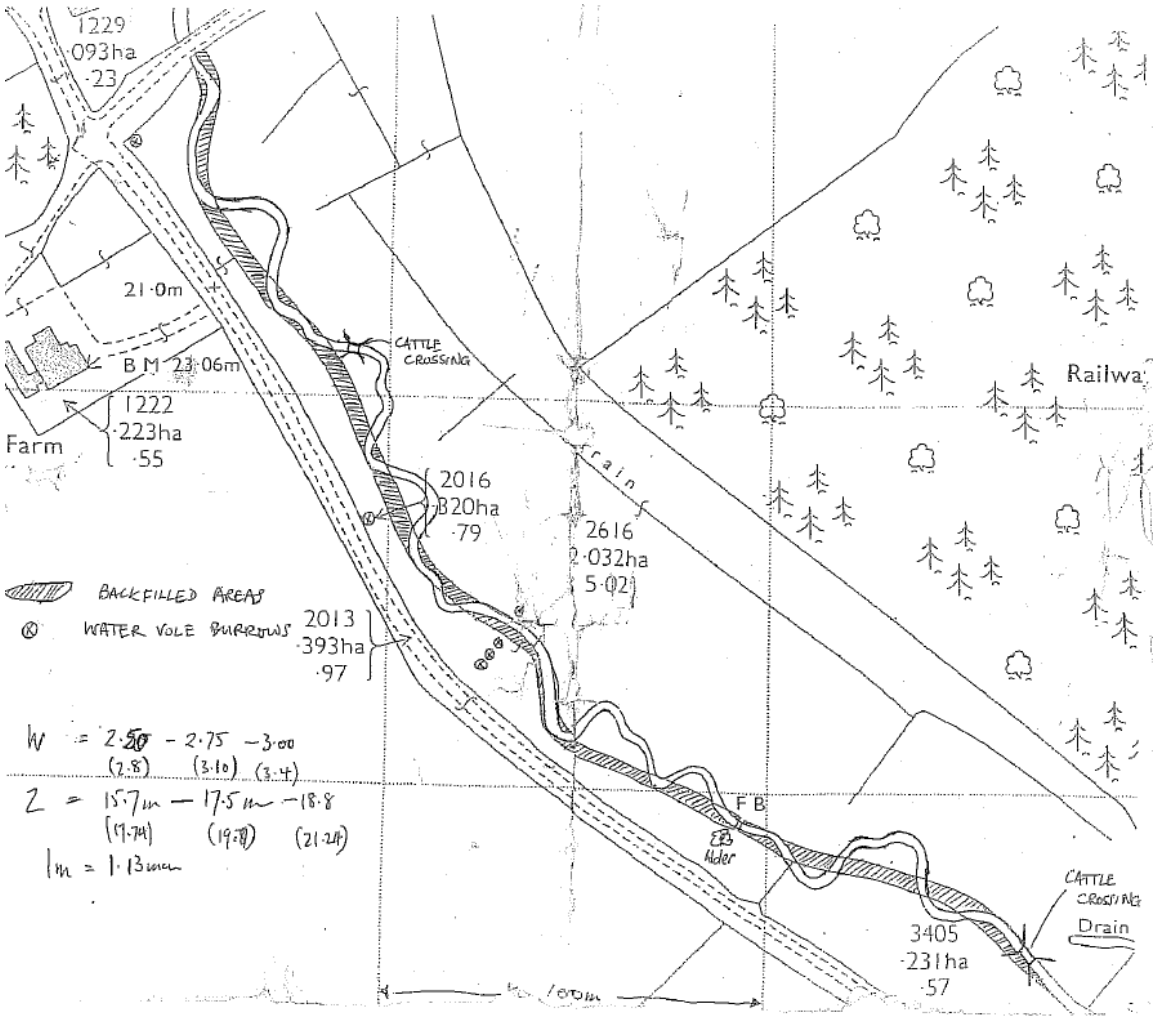


Figure 3 Plan of river re-naturalisation project carried out on River Glaven, Hunworth, Norfolk. Shaded line is the original engineered channel, open line is the new, restored course. The engineered channel was back-filled with spoil excavated from the new channel. (River flowing SE to NW).

Photo 39 Typical condition of River Glaven pre-restoration – straightened, incised channel disconnected from the floodplain and lacking a pool-riffle sequence.

Photo 40 River Glaven at Hunworth immediately post-restoration. Original channel course indicated by dashed line. (Picture: Ross Haddow)

Photo 41 River Glaven at Hunworth four years post-restoration, in flood conditions, illustrating flood storage function of the reconnected floodplain (Picture Ross Haddow).

Projects of this kind have the potential to reduce flood risk to downstream reaches by providing greatly increased storage capacity for floodwater (on the floodplain) and slowing the flow (in a longer, meandering, lower gradient channel). There are also significant benefits for wildlife and fish, and increased visual and recreational amenity value.

Links to other projects similar to Hunworth are provided in Appendix 1. Depending upon scale, the costs of such projects are in the region of £150K – £200K. A project similar to the above could be feasible on the Welton Beck upstream of the village, subject to further investigations and landowner agreement.

Channel narrowing

Creation of a low-flow channel, by establishing marginal shelves (berms) within the over-widened, engineered channel. This creates a two-stage channel, providing improved habitat at low flows, but retaining the larger

channel capacity for flood flows. The materials used are generally natural (brushwood bundles, coir fibre rolls) but stone may be used in some circumstances (for example where staking natural materials to the river bed is impossible). The berms are back-filled with material excavated from the river bed or from re-profiled banks, or with brushwood which naturally accumulates silt. The berms can be planted or left to colonise naturally.

The example below shows the technique in an urban environment, using stone to define the outer edges of the berms. Photos 42 – 43 show the before and after of a scheme using natural materials on the upper Witham, Easton.

Areas on the Welton Beck where this technique could be used include the recreation ground area, the reach alongside the pond (Ryland), within the village (subject to flood risk assessment), downstream of Beck Lane to the A46 and selected sections downstream of the A46.

River restoration carried out in Midsomer Norton illustrating the principles of narrowing the channel with low, vegetated shelves. Top left (before), top right (during) and left (after 1 year). http://restorerivers.eu/wiki/index.php?title=Case_study%3ARiver_Somer_channel_enhancement,_Midsomer_Norton

Photo 42 River Witham, Easton (before works).

Photo 43 River Witham, Easton (after channel narrowing works).

Pool creation

On straightened sections of channel with sufficient gradient, pools can be created by building low weir-like structures within the channel. There are various designs, but the purpose of all is to focus the stream energy on scouring the river bed downstream of the structure, not impounding water upstream. Photo 44 and Figure 4 show examples. Areas of the Welton Beck where this technique could be used are the straight, steeper gradient sections within Welton village (alongside the church and potentially upstream of Ryland Bridge). The gradient of the channel and spacing of the structures is critical and specialist advice should be taken before installation.

Photo 44 Low, stone crescent weir in a previously drained, lowland limestone stream in Ireland. Note the focus of stream energy to scour the bed downstream.

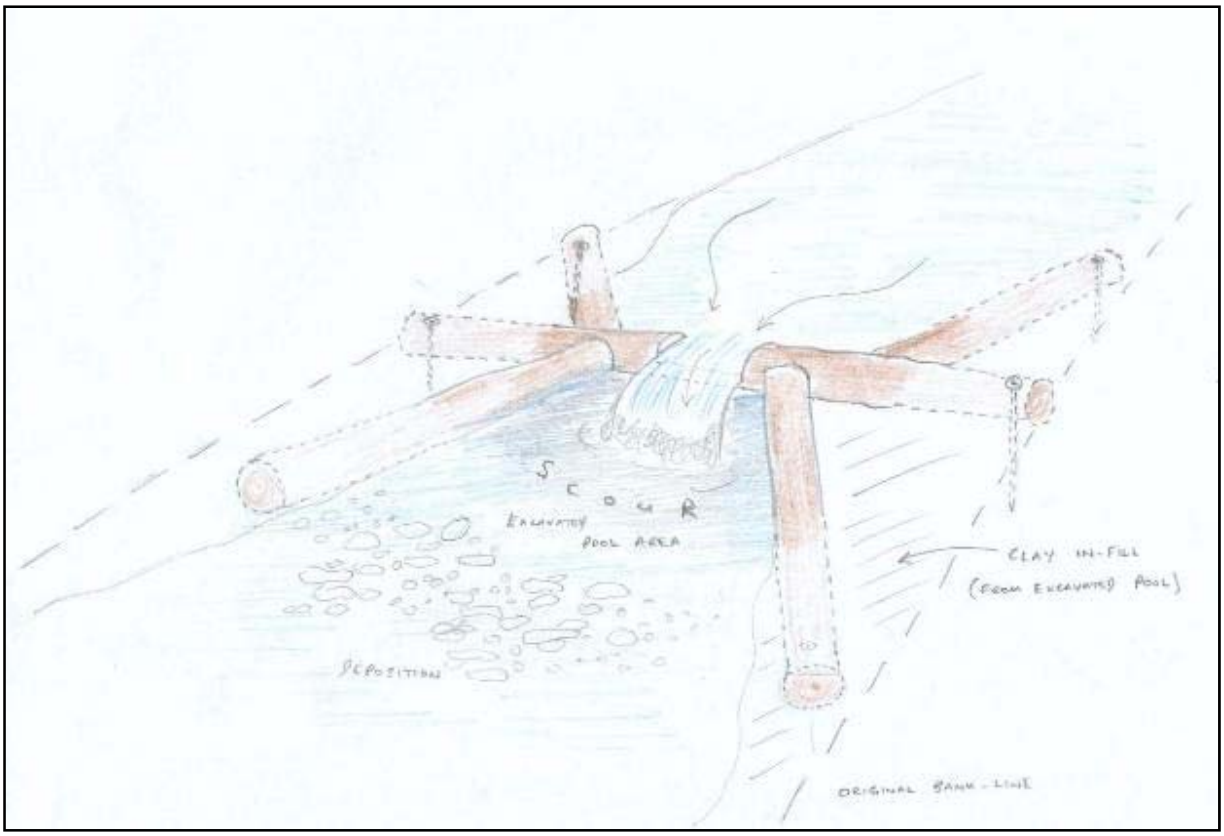


Figure 4 Schematic of a K-dam, a log built structure to create pool habitat in straightened reaches.

Culvert easement

Where culverts have become perched and a drop between upstream and downstream river bed and water levels has occurred, this can impede free movement of fish and natural sediment transport. To rectify this, the culvert could be replaced with a larger diameter structure (larger pipe or box culvert, Photo 45) set well below bed level. Alternatively, the river bed downstream of the culvert can be raised by introducing stone/gravel to raise downstream water levels (Figures 5 – 6). On the lower reaches of the Welton Beck towards Barlings Eau, the culvert (Photo 37) could be modified in one of these ways.

Photo 45 Large diameter culvert set well below river bed level to allow continuity of the natural river bed, tributary of River Lymn, Lincolnshire.

Figure 5 Before. A culvert in the Sussex Ouse catchment which was a big problem for trout migration, because of its perched position and high velocities during elevated flows.

Figure 6 The same site after the river bed was raised downstream of the culvert with imported stone and gravel.

Please note it is a legal requirement that all the works to the river require written consent from the Environment Agency (main river) or Local Authority (non-main river) before undertaking any works, either in-channel or within 8 metres of the bank.

Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programme in England.

Disclaimer

This report is produced for guidance and not for specific advice; no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon guidance made in this report. Accordingly, no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon comments made in this report.

Appendix 1 – Examples of river restoration projects involving channel realignment and the principles of natural river geomorphology.

- River Glaven, Bayfield Hall, Glandford, North Norfolk.

Creation of a 1.2-km long nature-like channel bypassing an estate lake. Completed in September 2014. www.wildtrout.org/content/bayfield-project-river-glaven.

- River Glaven, Hunworth, North Norfolk

Restoration of a straightened 400-m long section of river, including meander creation and restoration of a pool-riffle sequence. Land owned by Stody Estate, subsequently included in Higher Level Stewardship. www.wildtrout.org/content/river-glaven

- River Bain, Donington on Bain, Lincolnshire

Project led by Lincolnshire Chalk Streams Project which involved realigning the river to bypass a former mill. www.wildtrout.org/content/river-bain-project

- River Witham, Stoke Rochford, Lincolnshire

A partnership project between Environment Agency, Wild Trout Trust and landowner Neil McCorquodale which created a new 600-m channel around a weir on the upper River Witham www.wildtrout.org/news/new-old-section-channel-river-witham.

Glossary

Bank-full	The point when , during high flows, the river channel is at full capacity and any further increase in flow results in water spilling onto the **floodplain**. At bank-full flows, the river has its greatest power (for example, for erosion).
Bank re-profiling	Changing the slope of a river bank to a different angle. Usually used on channels previously engineered for drainage/flood reduction, to create a shallower bank angle on the inside of a bend. This helps restore more natural flow patterns and habitats.
Berm	A shelf in the margins of a river. Berms form in channels that have been engineered to be wider than their natural width. They can also be created as part of habitat improvement measures (see **two-stage channel**).
Conduit flow	The flow of groundwater through cracks and fissures in the geology (for example, limestone); this flow is quicker than the more gradual seepage in porous rocks (for example, chalk).
Conveyance	The capacity of a channel to transport water. Straight, smooth channel have a greater conveyance than meandering, rough channels.
Dig and dump	A habitat improvement technique used on previously engineered, lowland rivers involving the re-shaping of the river bed with an excavator. Deeper pools are dug and the resulting material used to pinch the width of the channel upstream, fluming the flow into the pool to maintain its depth.

Easement	A term describing a range of low-tech, low cost techniques to improve the ability of fish to cross barriers (e.g. weirs, culverts) in a watercourse.
Floodplain	The flat land adjacent to a watercourse that is inundated during higher flows. Watercourses engineered for drainage overtop into the floodplain less frequently than unaltered watercourses (the former are often described as disconnected from their floodplain). Floodplains can store floodwater and hence protect downstream areas.
Habitat	The natural environment in which a species or group of species lives and complete their life cycle.
LiDAR	An acronym for Light Detection and Ranging, a surveying method which measures distance with a laser light. Often carried out from an aircraft, it allows terrain maps to be compiled showing differences in height to a high resolution (30 cm or better).
Pool-riffle sequence	In low to moderate gradient rivers, the natural sequence of deeper pools separated by shallow riffles of broken water. **Scour pools** form on the outside of meanders and riffles form on the straighter sections of channel in between. The pool-riffle sequence is the basis of good in-stream habitat in lowland rivers, but is often disrupted or destroyed by engineering for drainage (e.g. river straightening).
Scour pool	A pool formed by flow directed either laterally or obliquely against a partial channel obstruction or bank. Often found on the outside of a meander bend in a river.
Two-stage channel	A channel engineered to have a smaller capacity channel within a larger one. The smaller channel mimics the dimensions (and better habitat) of the natural watercourse, containing low to medium flows.

	Higher flows overtop the small channel but are retained within the larger channel. The channel therefore works at two different stages of flow.