Advisory Visit

Harper's Brook, Northamptonshire

January 2018

1.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the Harper's Brook, Lowick, Northamptonshire, on 23rd January 2018. Comments in this report are based on observations on the day of the site visit and discussions with Kevin McArdle (Site Manager).

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.

The purpose of the visit was to advise on the suitability of the Harper's Brook for wild brown trout. Additionally, the owner of Lowick Mill, Mr Geoffrey Anderson, was particularly keen to know if any action could be taken to address the failing mill embankment.

The visit resulted in the inspection of three distinct channels of the Harper's Brook:

1. The mill channel ~450m (Main River)
2. The mill over-flow channel ~100m (Main River)
3. The by-pass channel ~460m (non-Main River)

The visit took place shortly after a flood had passed through and consequently the brook was still running with colour. This prevented the bed from being observed and any wading within it. However, a ranging pole was used to probe the depth and to feel bed substrate.

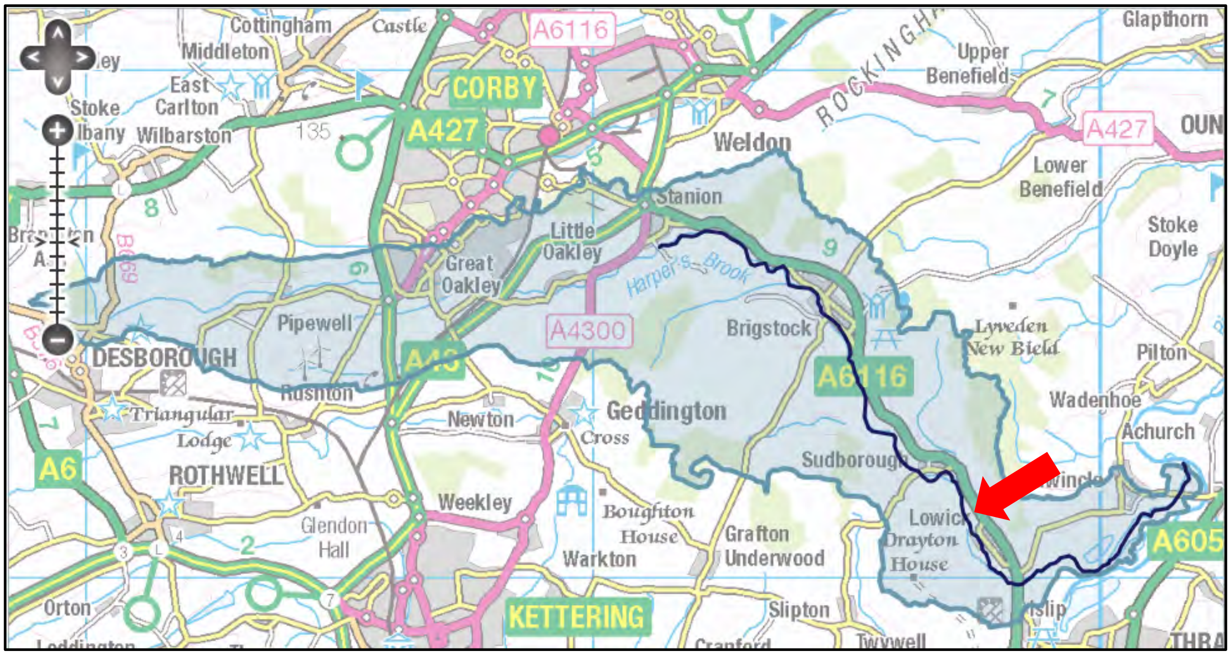
2.0 Catchment Overview

Table 1 summarises the environmental data collected for the Water Framework Directive (WFD) for the Harper's Brook. In the 2016 assessment cycle, it was classified 'moderate' ecological status. Parameters that make up this overall classification include 'good' for fish (2009 data only), 'high' for invertebrates (2009 data only), and 'high' for dissolved oxygen. There are no specific water quality problems known to be associated with the reach visited. Encouragingly, the 2016 assessment cycle did not require investigation of 'other pollutants', it had ammonia classed 'high' (being good) and phosphate as 'moderate'. The biological quality elements were listed as 'high' in the 2009 cycle but had fallen to 'moderate' by 2016. The overall health of the brook appears good which is encouraging given the industrial legacy of mining within the immediate catchment and the industrial town of Corby (a former major steel producer) in its upper reaches. There are no conservation designations relating to the site.

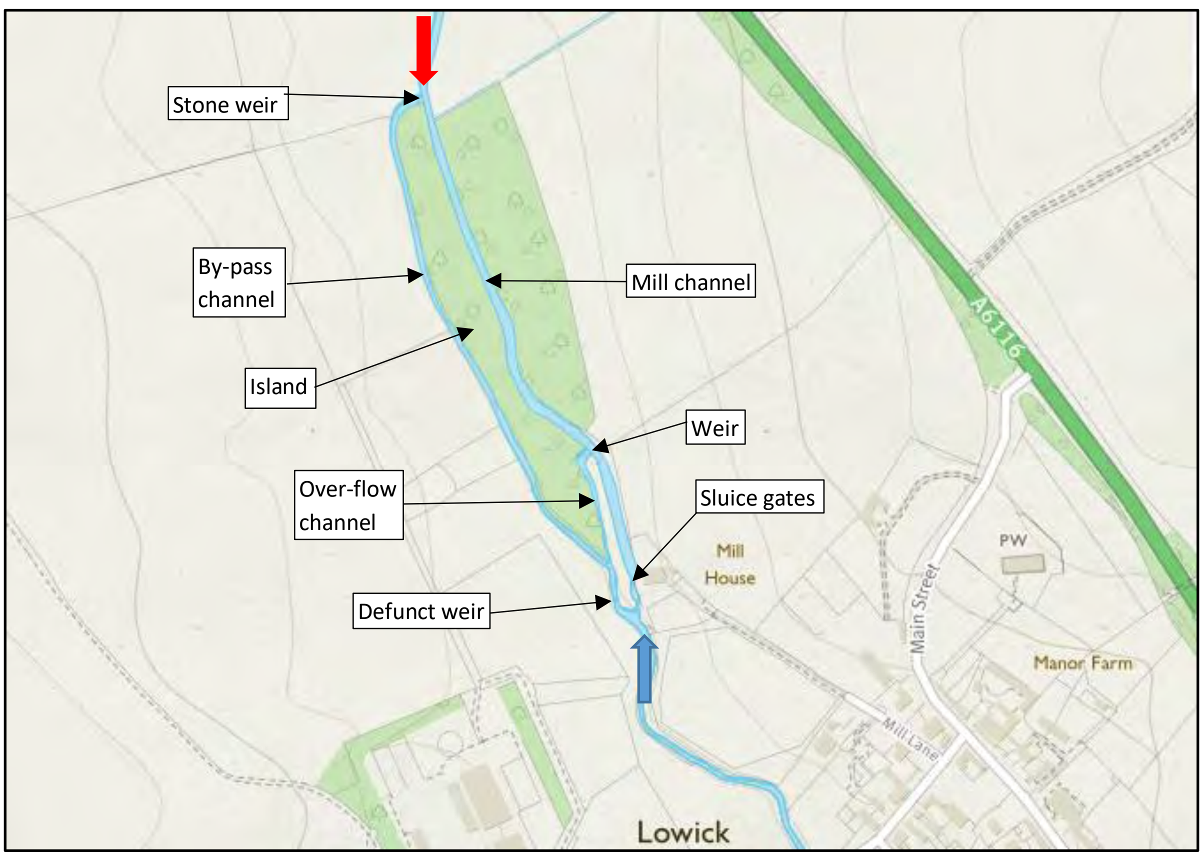
Table 1

	Waterbody details
River	Harper's Brook (Nene Middle Operational area)
Waterbody Name	Harper's Brook
Waterbody ID	GB105032045230
Management Catchment	Nene
River Basin District	Anglian
Current Ecological Quality	Overall status of Moderate ecological status sustained through two assessment cycles from 2009 - 2016
U/S Grid Ref inspected	SP 97262 81377
D/S Grid Ref inspected	SP 97448 80948
Length of river inspected	~1100m in total

Table 1 Data from www.environment.data.gov.uk/catchment-planning/WaterBody/GB105032045230



Map 1 - Location of the Harper's Brook catchment, Northants. Red arrow marks Lowick
Scale 1:200,000, one grid square = 10 km², © Ordnance Survey



Map 2 – Close-up view of the Harper's Brook at Lowick showing the arrangement of the different channels. Red arrow is upstream limit and blue arrow is downstream limit. © Ordnance Survey.

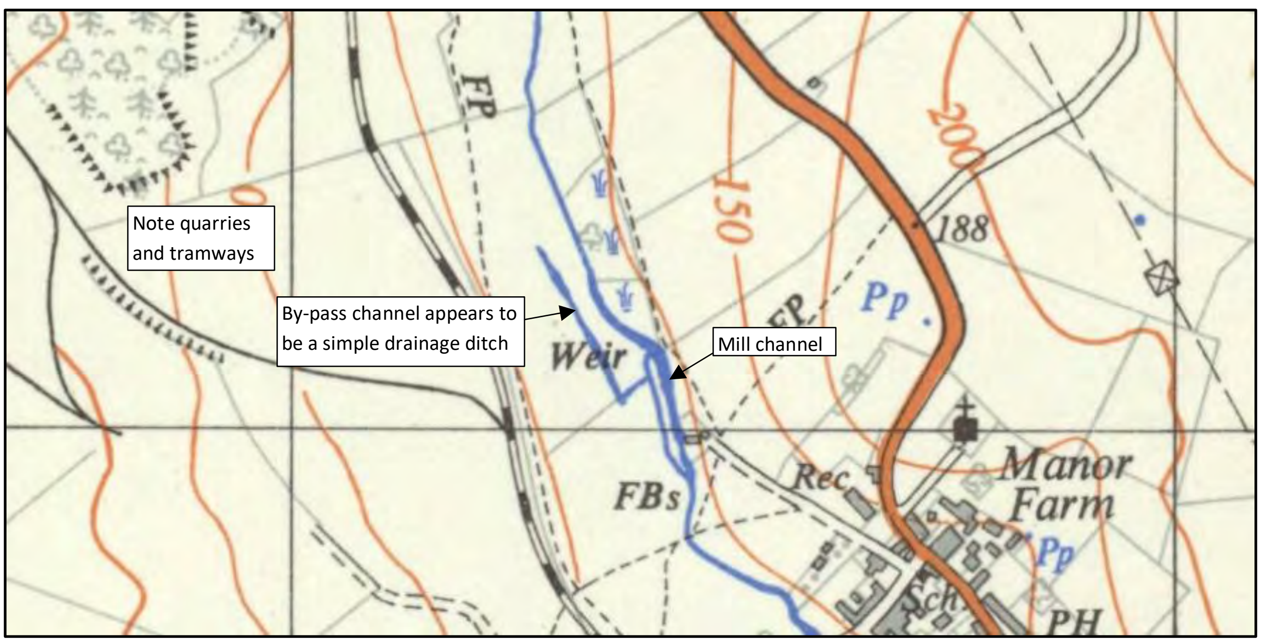
The Harper's Brook rises within the Rockingham Forest National Character Area which is typified by a broad, low, undulating ridge underlain by Jurassic limestone. The distinct scarp and ridge of the area are comprised mainly of Jurassic limestones, with shallow or exposed Lincolnshire Limestone Formation and Northampton Sand Formation rocks along the river valleys. Boulder clay caps the plateau, giving rise to heavy soils. Historically, the heavy clay soils within Rockingham Forest deterred widespread clearance for cultivation, so many of the woodlands present today are ancient.

Land use in the vicinity of the brook is mainly permanent pasture with deciduous woodland and a small amount of arable cultivation. No cultivation extended up to the brook in the reach inspected. The land falls within Countryside Stewardship target areas for farmland birds, particularly tree sparrow, turtle dove and yellow wagtail.

Lowick Mill is ~6km from its confluence with the River Nene north of Islip. Flowing in a south easterly direction, the Harper's Brook is joined by one main tributary from the Geddington Chase. It was not possible to assess whether the brook has free passage for fish to its confluence with the Nene but from inspecting online Ordnance Survey maps it would appear that there are at least three structures that may prevent the free movement of fish, with one structure above the A6116 possibly being an Environment Agency flow gauging structure.

The position of the mill (now completely absent except for the mill pond and sluice) has resulted in the brook being artificially cut to follow a contour thus resulting in a head of water being retained within the mill channel. This head of water would have provided the energy to drive a water wheel. That purpose is no longer required but the mill channel is kept full (elevated) for amenity purposes (see picture 1). ~100m up from the mill sluice is a side channel or over-flow. Historical maps (OS County Series, Northamptonshire, 1885-1891 1:10,560) shows the brook's course to have been much more sinuous above the mill but by 1955 it would appear that the channel had been straightened (see map 3).

Picture 1 – A view of the mill channel (at the mill pond) looking upstream.



Map 3 – Ordnance Survey 1:25,000, 1955 © Ordnance Survey. Sourced from www.maps.nls.uk

Remnants of the old channel still appear as wet undulations within the mill island. The straightening of the brook may have been to facilitate local ironstone mining as a number of tramways and quarries are shown a short distance upstream of Lowick Mill on the OS County Series, Northamptonshire, 1951-1952 1:10,560. The by-pass channel does not show on maps until 1973 (OS 1:2,500 1973), before that point it appears as a drainage channel that most probably collected water from low lying land where the original river course once was. All map references above (except where shown) are from www.old-maps.co.uk

The Harper's Brook at Lowick Mill is clearly in an artificial arrangement with water levels being maintained high for a milling purpose that is no longer required. The historical arrangement of the different water levels and channels is now starting to show signs of failure.

There are no angling clubs on the Harper's Brook but it was reported that angling for coarse fish occasionally takes place. Kevin McArdle reported that chub, roach and brown trout had been caught from the brook. There are no known records of the river having been stocked with trout at the site in question.

It is possible that the brook provides a habitat for water voles. However, no specific field signs were observed especially in view of the recent flood. Water voles and their habitat receive full protection under the Wildlife and Countryside Act 1981 (WCA 1981); as such any works on the site should not negatively affect water voles or their habitat. Otters are known to be widespread the region, and it was not surprising to find spraints deposited upon riverside logs. Otters and their habitat also receive full legal protection under the WCA 1981.

3.0 Habitat Assessment

3.1 General

The land use adjacent to the brook is horse grazed pasture on the RHB of the by-pass channel, the island was poplar woodland which was felled and replanted within the last five years. The woodland clearance has allowed the non-native plant, snowberry (*Symphoricarpos sp.*), to become dominant to the point where it is shading out much of the native flora.

Picture 2 – Following clearance of trees from the mill island the non-native plant snowberry has become dominant to the point where it is out-competing much of the native flora. Its control and eventual eradication should be undertaken.

Picture 3 – The by-pass channel showing the proximity of the fence to the watercourse and the undercut bank that is developing. Note the manure pile in the field.

The mill channel is lined by common reed on the LHB, followed by woodland with arable fields behind. The RHB showed a greater diversity of plant species including occasional common reed, pendulous sedge, lesser pond sedge, nettles and greater willow herb.

Picture 4 – The mill channel with encroachment by common reed.

The grazed pasture was very short with no buffer zone between it and the by-pass channel. The grazing had acted to suppress and remove young trees and consequently the RHB was suffering from erosion and was being undercut.

There was evidence of the pasture being under-drained with a number of pipe outfalls observed. Animals were not able to access the brook, and no direct sources of sediment input were observed (such as watering points). However, a number of (small) manure piles were noted within the pasture and they were considered vulnerable to washout during flood events.

From April 2018 farmers will be subject to new 'farming rules for water' which seek to ensure that farmers manage land to avoid water pollution and to benefit their business. The rules can be found at www.gov.uk/government/publications/farming-rules-for-water-from-april-2018/farming-rules-for-water-overview . Some of the manure piles may have been within 10m of the by-pass channel, which would not be compliant with the new rules.

Downstream of Lowick Mill the brook ran in a single channel, however only a very small length (~20m) was the subject of the visit with interest focused around and above the former mill site. In the vicinity of the mill, the land was used as a garden with a mown lawn. The brook was buffered by ~1m narrow fringe of marginal growth which had been cut to ground level for winter. Removal of standing dead vegetation could have negative consequences for a wide range of invertebrates as vegetation may be important as a food source or as over-winter cover. A reduced abundance of invertebrates may result in less food for fish.

Picture 5 – The harper's Brook downstream of Lowick Mill where it runs in a single channel. The ranging pole marks the height that the recent flood had reached.

Progressing upstream, the mill channel was met by the by-pass channel, which did not appear to have been subject to any recent management and as such offered much greater habitat diversity. The by-pass channel received a small volume of flow from the over-flow channel.

Picture 6 – The view upstream where the mill channel is joined by the by-pass channel. Note the good cover that is provided by the water level willow tree with flood debris.

Picture 7 – The view upstream where the by-pass channel is joined by the over-flow channel. Note the sinuous form of the by-pass channel indicating that natural process are creating channel diversity which will increase habitat diversity.

3.2 The mill channel

The mill channel consists largely of impounded flow which then cascades over sluice gates. Impounded flow is not generally attractive to trout, especially juveniles, who are drawn to faster water habitats. Furthermore, siltation and low oxygen concentrations may make the mill channel unattractive to adult trout (and other fish species).

It would appear that the mill channel is suffering from siltation as a result of the impounding mill sluices and a lack of gradient. Furthermore, flow entering the mill channel reduces its velocity as a consequence of the leakages through the embankment.

Picture 8 – A view of the mill channel looking to where Lowick Mill would have once stood.

The mill no longer stands but the sluice and its gates are still present, holding a head of water ~1.7m. Behind the sluice is a mill pond with a depth of ~1.5m and a width of ~8m. The sluice gates are still fully operational and are raised by Kevin McArdle to allow flood flows through.

The sluice is a paired guillotine steel gate arrangement with the ability to raise one gate independently of the other. The gates opened from the bottom where they fitted securely upon a stone plinth which extended for

~5m with ~0.2m depth of water over it. Downstream of the stone plinth the flow dropped off into the mill pool.

Picture 9 – The sluice gates viewed from downstream. Note that once closed from the bottom the flow moves over the top of the gates creating a fixed height within the mill channel.

Picture 10 – The sluice gates viewed from upstream.

It is very doubtful that fish would be able to traverse the sluice gates when initially opened due to the velocity of water over the smooth stone plinth, and its lack of cover and roughness to aid fish passage. However, once the mill channel has discharged its stored water and conveys only the river flow, the velocity may be less, thus enabling fish to traverse the sluice gates.

It would appear that in recent years the overall flow through the sluice gates has reduced, resulting in a reduction in scour of the mill pool. Deposition within the mill pool has enabled vegetated berms to extend out leading to a natural reduction of the pool.

Picture 11 – The mill channel and the mil pool. The small size of the pool relative to the head of water suggests that main scouring flows have been directed down the by-pass channel for many years resulting in natural encroachment of vegetated berms into the pool.

The mill channel is a particular point of concern for the landowner as its embankment is starting to fall into a state of disrepair. There was a significant amount of water flowing from the elevated mill channel to the lower over-flow channel. In places the flow was following the path of tree roots which had rotted away to enable pipeflow, but it was also evident that in high flow periods the mill channel embankment had been overtopped resulting in scour breaches forming. These breaches have now caused low spots which continue to act as water pathways in flood periods. It was reported that during the time of tree felling upon the island, a large number of tree stems blocked the mill channel, causing the over-topping of the embankment, and that the situation has continued to decline since then.

Picture 12 – A leak point from the mill channel. Note that sheet piling has previously been used in a manner where it is set within the bank (and behind it) rather than fronting the water where it would remove habitat. If sheet piling is to be used this approach should be adopted.

Picture 13 – Significant pipeflow originating from the mill channel.

The mill channel extended upstream to a point where its flow was split. A stone weir pushes flow down the mill channel and overtops down the by-pass channel. The mill channel presented an impounded flow habitat and it was reported that in recent low flow years dense duckweed coverage was a problem. Duck weed growth can be indicative of high nutrient concentrations. It can affect oxygen concentrations if allowed to fully smother the surface of impounded water.

The ingress of common reed into the mill channel suggested a build-up of silt which, if combined with high nutrient loading of the water, will lead to further reed growth across the channel. It did not appear simple to remove the reeds by mechanical means due to limited access. High velocity flow is probably the best means of scouring clean the mill channel of reed and silt.

Picture 14 – The Harper's Brook at the upper point of the visit where the channel is split to form the by-pass channel and the mill channel. (The mill channel is in the foreground.)

Picture 15 – The stone weir which retains a head of water to the mill channel and allows water to flow down the by-pass channel.

3.3 The over-flow channel

At the upper end of the over flow channel was a weir which had a width of ~3.5m and a fall of ~1.7m. Whilst its crest and face appeared in good order, the brick work supporting it was failing. The weir is shown on historical maps dating back to 1800’s and would have taken the over-flow from the mill channel diverting flow around the mill.

The weir showed a lot of pipeflow as a result of tree roots having penetrating into the brick work. On the RHB of the weir was a very large hole that was passing a large volume of water (but not in a manner to facilitate fish passage). Consequently flow over the weir was reduced. The weir presented a total barrier to fish passage at all levels of flow.

Picture 16 – The weir with little flow going over it. The boards could be lifted to allow a greater flow over it.

Picture 17 – Note the large volume of water emerging from the RHB of the weir.

Picture 18 – Note the failing brickwork of the weir support walls and the significant pipeflow emerging from behind it.

Downstream of the weir was a relatively large scour pool which would provide depth cover for various species of fish particularly adult brown trout. However, flow entering the weir pool was dispersed as a result of leakages through the embankment. The weir no longer conveyed the total flow that enters the weir pool. Consequently, it is doubtful that the weir pool receives the same scouring flow that it formerly did.

Habitat in the over-flow channel was poor with little flow diversity. Marginal vegetation had been pushed flat by the recent flood but the ruderal vegetation suggested that in mid-summer the growth is such that it suppresses any true marginal plants and creates a partially shaded channel with little complex habitat at water level.

Picture 19 – The weir pool which currently receives little flow direct from the weir. It was not possible to assess the depth of the pool but if it were still receiving scouring flows then it may provide important depth cover for fish.

Picture 20 – The poor habitat of the over-flow channel.

3.4 By-pass channel

This channel was the most ecologically diverse of the three inspected. It currently needs little intervention with regard to its habitat potential for adult trout.

Wild brown trout require habitat diversity, food, spawning and nursery areas and good water quality. Habitat diversity is created through the action of geomorphic processes which result from gradient and stream power causing erosion and subsequent deposition. Features such fallen trees may locally increase scour, resulting in pools. As sediments are transported they will be deposited according to flow. This may enable the development of riffles (shallow, gravel-rich runs with broken surface water) which are extremely important as spawning areas. Trout (as well as chub, dace and minnows) will spawn upon well-sorted gravels (particularly in the range 15mm to 40mm) that are relatively stable within a river. A pool and riffle sequence is important in river systems as it naturally diversifies the flow and provides habitat for juvenile trout (within the shallow riffles) which keeps them from competing with (or from being eaten by) adult trout. It is quite probable that trout currently use the by-pass channel for all stages of their life cycle.

Picture 21 – Good trout habitat was found in the by-pass channel. The presence of low trailing branches is pushing flow across the channel and increases sinuosity which will assist in sediment transport and bedform diversity. Note the vegetated berm on the right of the picture which would provide important cover for trout fry when they emerge in early spring.

Picture 22 – The by-pass channel as it leaves the rock revetment reach. Note that rock revetments do little to absorb and subsequently slow flow, thus the energy is moved directly on to the reach downstream. This may lead to increased scour (which in this case is illustrated by a widening of the channel).

Picture 23 – Note how the flood flow has caused the marginal vegetation to be flattened. Grasses and reeds cannot hold back flow in a river with gradient; the weight of water will always push its way through. The vegetation will entrain fine sediment which is then colonised by plants (such as the pendulous sedge).

The occurrence of the by-pass channel was an interesting discovery. From reviewing historical maps it does not appear until 1973. It is doubtful that its purpose back then was to aid fish passage; it would have been to convey flood flows downstream, but it is probable that it now serves an important role in that respect.

The brook splits its flow to serve both the mill channel and the by-pass channel. There was no flow control structure, simply a stone weir arrangement, and at the time of the visit it appeared that the majority of the flow was flowing down the by-pass channel. It is possible that in low flows the stone weir pushes more water down the mill channel as that would have retained the amenity purpose of the mill channel (and it would have retained the largest proportion on the flow within the channels that are legally defined as Main River). With regard to fish passage, the establishment of a minimum acceptable flow within the by-pass channel (non-Main River) is important otherwise its ability to function will be compromised.

The stone weir caused a rapid flow to cascade down the by-pass channel. At the time of the visit the cascade was considered passable to brown trout, whether it would be passable to coarse fish species is not clear. The rapid water continued for ~10m and there were limestone blocks armouring the banks to reduce scour and prevent any channel movement. The limestone blocks offered little in the way of marginal habitat, but where some blocks had fallen (or may have been strategically placed) within the channel they had created small areas of pocket water which could ease the passage of many fish species. Due to the water colour and level it was hard to fully evaluate this impact; it is possible that low flow periods could pose problems to fish passage. In terms of a full assessment of the structure's passability a return visit would be required in low flow conditions.

Picture 24 – The start of the by-pass channel. The flow was turbulent but considered passable to adult brown trout.

Picture 25 – Rock revetments used to protect the bank from scour, these actually pass the turbulent flow downstream. In-channel cover was provided by the occasional large rock.

The general form of the by-pass channel was ~3.5m wide with depths ranging from ~0.2m to ~1m. The bed was firm in places with a gravel substrate and a clay bed at other points. The bed level undulated suggesting some form of a pool and riffle sequence being present. One riffle point was observed (with others presumably hidden by the coloured water), it had also provided the fording point by which the island was accessed for logging.

The channel was ecologically interesting in so far that it had numerous trailing branches, in-channel large woody material (LWM) and marginal cover at water level. Trailing branches are particularly important as overhead cover for a wide range of fish, especially trout, creating micro-pocket water and increasing the available number of lies within a river for trout. The branches also present opportunities for invertebrates to fall into the channel where they become food for fish. Branches that extend into the water may provide a means for some aquatic invertebrates to return beneath the water in order to lay their eggs.

Picture 26 – Large woody material (LWM) caught up on tree branches. Whilst this type of feature may look untidy it is very important habitat for a wide range of invertebrates, and it will be used by juvenile fish as cover in high flow periods and by adult trout for cover in normal flow conditions. This type of mid-channel LWM is also creating flow patterns around it thus increasing lateral scour.

The presence of LWM is extremely important within a waterbody. It increases the available surface area on to which algae will grow and undertake photosynthesis thus starting off a nutrient cycle. The algae can also become a source of food for invertebrates thus increasing the total biomass that a river can support. LWM can also provide underwater cover, offering protection for fish against otters or fish-eating birds. LWM is also a key element in kick-starting geomorphic processes such as bed and bank scour, leading to the development of natural river features such as pool and riffle sequences. Furthermore, the sorting of bed load material will encourage the marginal deposition of fine sediment or may enable it to be deposited upon the floodplain when out-of-channel flow is experienced.

The presence of flood debris indicated how high the recent flood had come up and whilst the debris can look unsightly it is important to realise that once debris is caught up (and often termed 'wrack') it actually creates shelter in which fish, especially juveniles, will take cover in during flood events.

Picture 27 – LWM providing marginal cover and flow diversity.

Due to the diversity of flow within the by-pass channel it was apparent that berms were forming as a result of sediment deposition and subsequent colonisation by vegetation. The native marginal plants of reed canary grass, pendulous sedge and greater willow herb were present and are important as they will provide cover for a wide diversity of both terrestrial and aquatic invertebrates which in turn may provide food for fish.

Picture 28 – Good habitat diversity for brown trout is provided by a vegetated berm (right), LWM at water level creating overhead cover (left) and a tree with wrack against it which will create bed scour (middle).

Near to the end of the by-pass channel was a defunct weir. Its purpose was believed to have been associated with a hydraulic ram for water supply. The weir structure no longer held back a head of water but its brick side walls remained and a smooth concrete bed ~3m was present. The defunct weir was not thought to present a barrier to fish except in very low periods when the level over the concrete may become an issue.

Picture 29 – The defunct weir which did not appear impound flow at the time of the visit.

4.0 Recommendations

4.1 General

The grazed pasture extends to the top of the by-pass channel bank. The establishment of an un-grazed grass buffer zone would be beneficial, as it would act to slow the movement of any surface water run-off, would act as a sink to fertilisers or pesticides applied to the pasture; and importantly, it would enable tree saplings to establish which in turn would aid bank stability and act as future sources of LWM.

A water vole survey should be undertaken in summer months to determine whether voles are present within the mill channel (and any other area that may be the focus of future work), and if so, where they are residing. The occurrence of an extensive water vole population would have to be thoughtfully integrated into any future work. Work would have to demonstrate no net loss of overall water vole habitat and available territories.

The garden areas of Lowick Mill were, as one might expect, maintained to a high standard with dead vegetation cut back for winter. However, similar to the establishment of a buffer zone, the retention of uncut swathes of standing vegetation through winter would provide a greater degree of cover for invertebrates and small animals.

Each of the three channels are reviewed next with an option(s) for their management presented. Please note, the options are only based on one visit and further advice from a water engineer and/or geomorphologist should be sought before making adjustments. Some alterations may also be subject to permission from the Environment Agency and as such they should be consulted prior to any change taking place.

It may also be possible that the options could be used to engage the EA's Fisheries, Biodiversity and Geomorphology team in habitat improvement works especially if fish passage and geomorphic processes could be further enhanced, and if work could assist the EA in improving the Harper's Brook with regard to Water Framework Directive objectives.

4.2 Mill channel

Option 1 – using flow to cleanse the mill channel

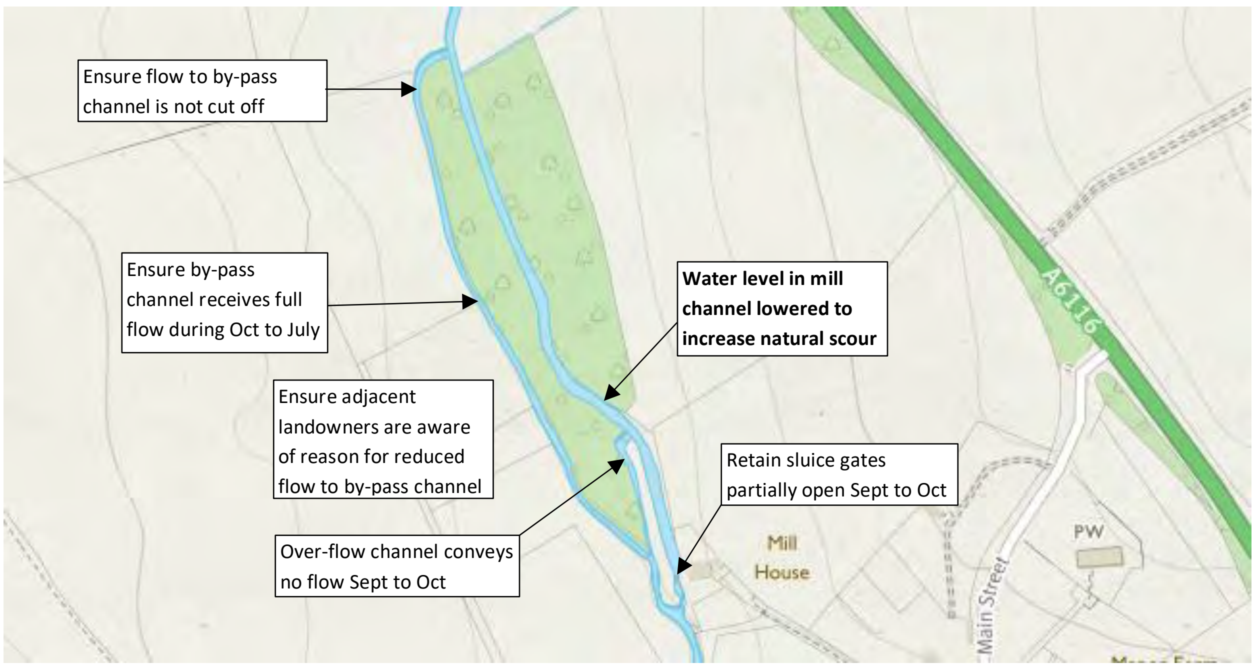
It may be possible to address sedimentation within the mill channel by the use of the sluice gates, which control the level upstream and consequently the volume of water that is drawn down the channel. If the gates are left in a partially open position through the months of September to October, it would be possible to lower the head of water and to allow a greater proportion of the brook's flow through the mill channel, which if combined with higher flow periods may bring about natural cleansing of the mill channel. That silt laden flow would be allowed to continue downstream where natural processes would enable it to be sorted and distributed. This approach has the risk of potentially cutting off the entire flow to the by-pass channel if the mill channel head is dropped too far and/or if flow is too low to be split between two channels.

Additionally, if the sluice gates are left partially open and the head of water behind reduced, the velocity may be reduced to a point whereby the sluice becomes passable to fish. This could mitigate for the reduction in flow to the by-pass channel.

If the above approach is adopted then one must not:

- drain the by-pass channel to the point where fish become stranded and/or exposed to predators,
- upset adjacent landowners who may express concern at the lack of water and may have a legal right to receive the water,
- diminish flow when it is needed for fish spawning and nursery (late October to late July).

This approach is not without risk to the river environment.

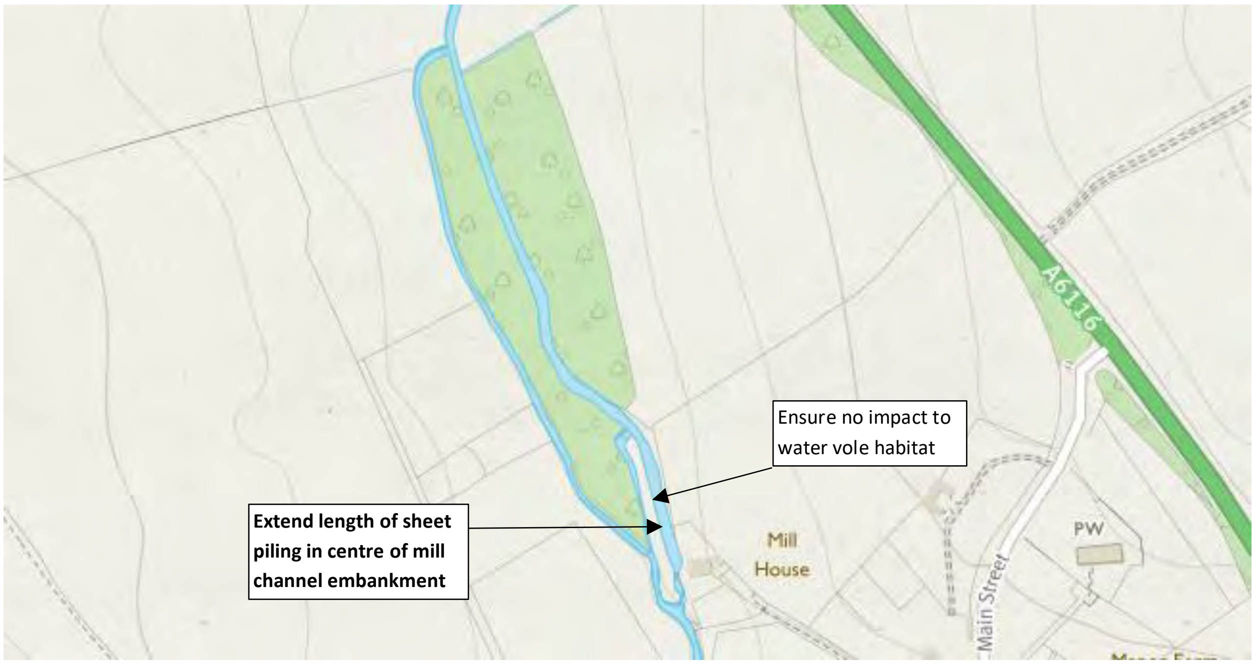


Map 4 – Option 1, using flow to cleanse the mill channel. © Ordnance Survey.

Option 2 – repairing the embankment

The mill channel embankment was repaired in 2004 by the Environment Agency who used sheet steel piling (see pictures 8 & 12), and the work is still considered satisfactory. The landowner reports that the Agency are not in a position to undertake such work. The use of sheet piling to fix the leak points would appear to be the most sensible approach as it would give a durable and watertight finish and piling could be driven into the centre of the embankment (subject to detailed engineering survey) so that the natural frontage of the banks are retained. If sheet piling had to be delivered near the water's edge then it would be possible to mitigate its harm through the use of pre-planted coir rolls and further earth to create a new bank habitat in front of any piling.

In the 'do nothing' scenario leakage through the mill embankment and around the weir structure will continue to worsen. Only reducing the pressure (by lowering the head of water) will ease the situation. The pipeflow points will not repair themselves and it is advised that independent engineering advice is sought as to the best way to make good the situation.

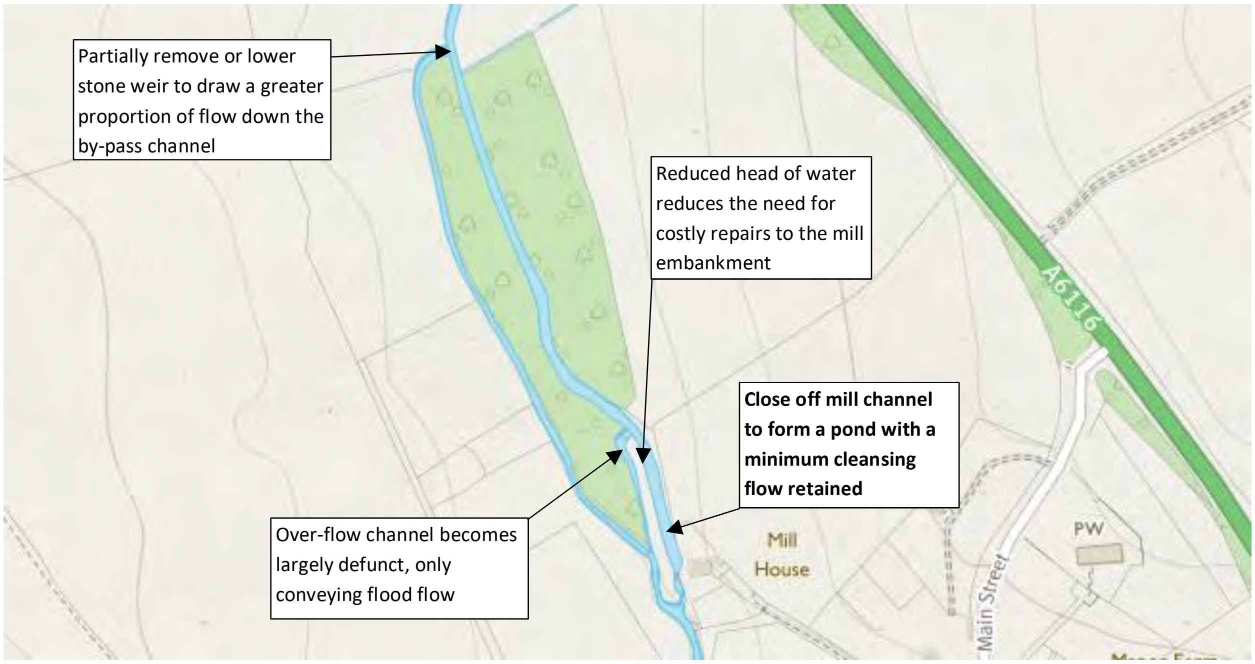


Map 5 – Option 2, repairing the mill embankment. © Ordnance Survey.

Option 3 – closure of the mill channel to form a pond

An alternative approach to consider is to close off the mill channel so that it does not receive the silt laden water or the excessive duckweed and organic matter. The point of closure would be downstream of the leak points, however a small cleansing flow could be retained to the mill channel. The mill channel would now more closely resemble a true pond which could be drained and cleaned out, and then filled as required. This approach could lessen the need for repair to the mill embankment as leaks would not affect water retention in the pond area.

The above approach would necessitate the majority of the brook's flow to be permanently diverted down the by-pass channel. This would enable a more natural flow regime and plan form to be established on the brook again; one that is not subject to an impoundment and barriers to sediment transport. This approach would see the over-flow channel become largely defunct, with it only conveying flow in flood periods. Re-establishing the Brook in its natural course should be a high level aspiration.



Map 6 – Option 3, closure of the mill channel to form a pond. © Ordnance Survey.

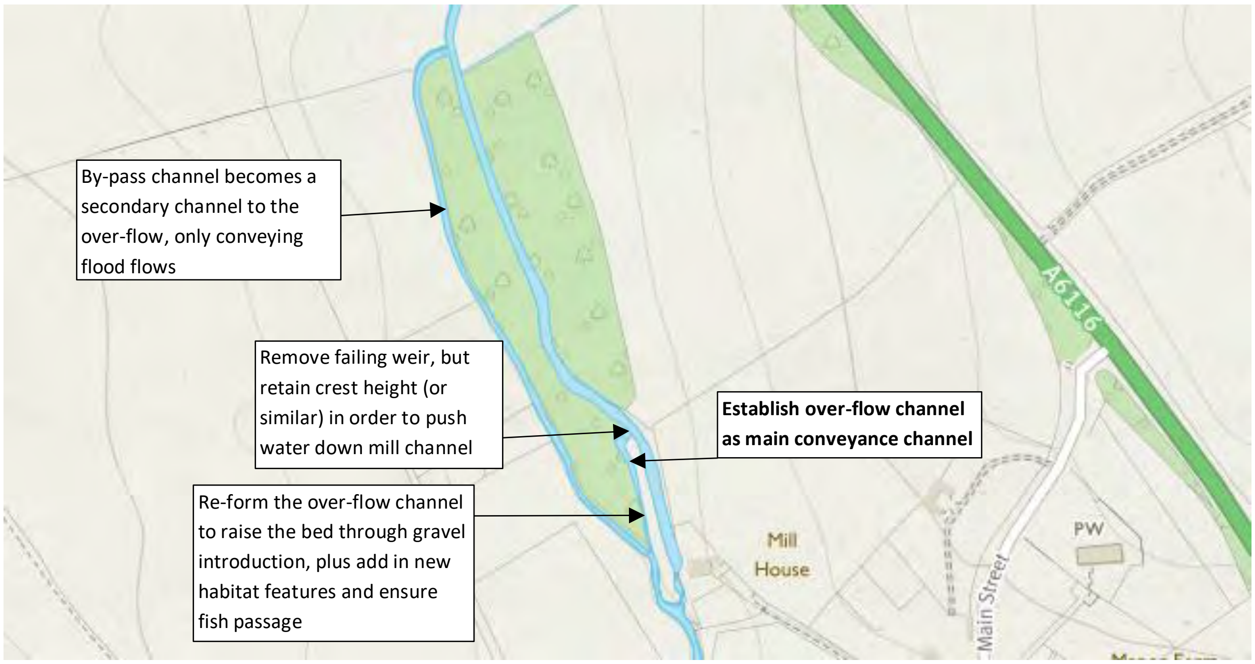
4.3 Over-flow channel

Option 4 – establishment of the over-flow channel as a main conveyance channel.

The weir at the start of this channel is in a poor state of repair (see pictures 17 & 18) and it is possible that its supporting walls could collapse leading to a total loss of water in the mill channel. Only by dropping the level in the mill channel can the hydraulic pressure be reduced on the weir structure.

If costly repairs are to be avoided then removal of the weir might be worthy of consideration. With the weir removed the over-flow channel could take the place of the by-pass channel but the fall of ~1.7m at the weir would need to be overcome. That could be addressed by raising the bed level of the over-flow channel to bring it up by ~1.7m over a suitable length (most probably the full ~110m) so that an acceptable gradient is achieved. By effectively lining the over-flow channel with suitable stone and compacting it, it may be possible to alleviate the need to address water leaks through the mill embankment as the stone might plug the leaks if laid deeply and firmly enough.

The over-flow channel could then become a gravel-lined stream which would provide a spawning and nursery habitat for fish, especially trout.



Map 7 – Option 4, closure of the mill channel to form a pond. © Ordnance Survey.

4.4 By-pass channel

Option 5 – establishment of a minimum acceptable flow to both channels

Low flow conditions could be exacerbated by a dropping water level in the mill channel (created by leaving the sluice open). If that situation occurs, then fish passage should be maintained by establishing a minimum acceptable flow to both channels. This is particularly important if adjusting flow regimes in the autumn as brown trout will be migrating ahead of their spawning season (October to January).

Adjustment of the flow regime may be achieved by lowering the head created by the stone weir. That would necessitate the mill channel being held a lower level which would take pressure off the mill embankment.

If the by-pass channel is retained in its current form then it should have its habitat further enhanced for brown trout. Simple tried and tested techniques of the following could be applied:

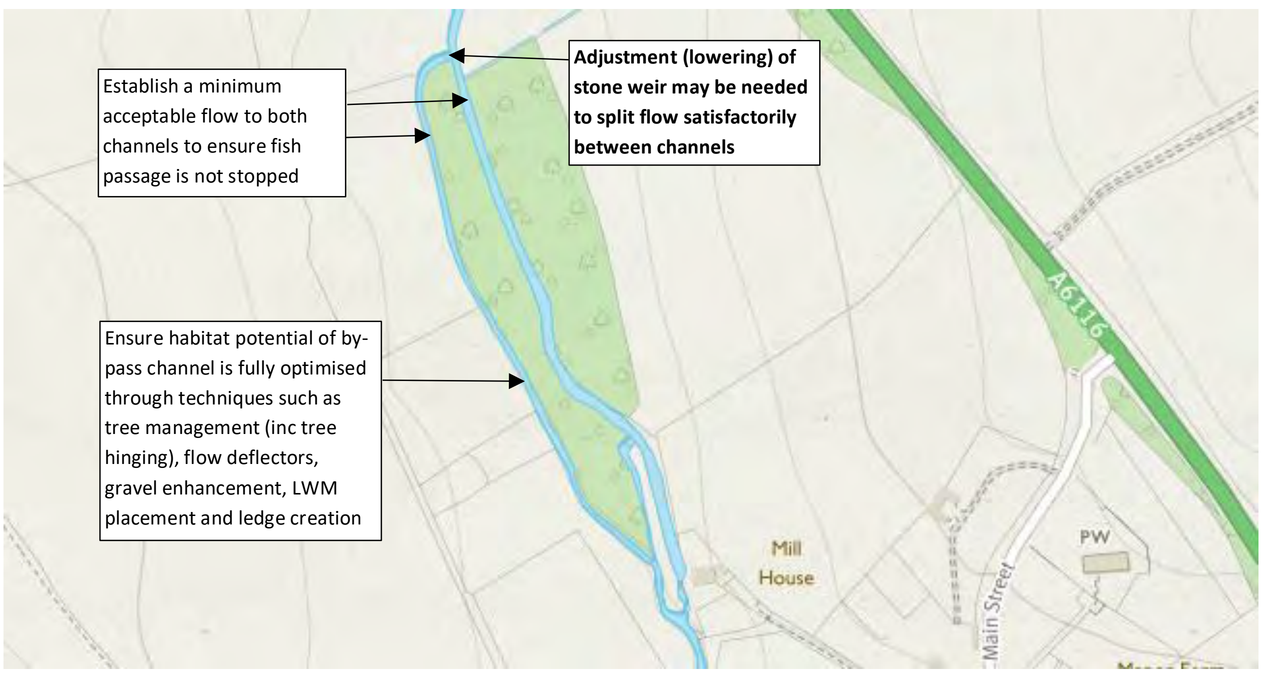
- Tree management – in places the canopy of dense trees was preventing good marginal growth from establishing. Canopy management by crown thinning, crown lifting, tree hinging (similar to hedge laying), pollarding or even coppicing would be beneficial in order to create areas of dappled shade. A general rule is to retain some shade over pool habitats and to allow sunlight to riffles and fast glides.

Picture 29 - An example of tree hinging, a simple and effective technique for increasing cover in a river.

- Tree planting – the RHB showed very few trees and there is clearly space for some planting. The use of quick growing species such as crack willow would be good for some immediate cover and bank stabilisation. The use of common alder would provide a slower growing species that in time would provide excellent bank stability and marginal cover as its dense root system extends into the channel.
- Brushwood berms – these features can be created following tree works. A brushwood ledge is an excellent means of creating complex cover at water level. The brushwood lattice will provide many niches for invertebrates and small fish and in time will entrain silt. The silt and lattice work then provides a rooting substrate for plants to become

established. In time (~3yrs) the brushwood ledge will become a vegetated berm if exposed to full sunlight.

- Flow deflectors – these features can be used to increase flow diversity within a channel. They can be simple log deflectors or tethered tree stems. The complex flow that arises from such features aids scour and sediment transport within the channel.
- Gravel enhancement – the channel clearly contained deposits of gravel at some locations. Due to the high water level at the time of visit it was not possible to assess the quality of the gravel. If the gravel is considered to be sub-optimal (due to an excessively large particle size, compaction and/or high silt content) it is possible to rectify the matter. This can be through the introduction of new gravel, or through water jetting the existing gravel to loosen compaction and flush out fine sediment from within it. Following such works it would be necessary to identify the original cause of the gravel's deterioration so as to aim for a sustainable solution.



Map 8 – Option 5, adjustment (lowering) of the stone weir to ensure minimum acceptable flow to both channels. © Ordnance Survey.

Picture 30 – Examples of low level brushwood berms created on the River Misbourne following tree thinning work. Brushwood berms can be used to protect banks from erosion, to create in-channel sinuosity and to entrain silt and sand.

Picture 31 – Examples LWM fixed to the bed on the River Wylye. The pieces of large timber create both underwater scour to sort sediments and a broken water surface which promote oxygenation and provide cover. The by-pass channel could be further improved for trout by adding such features to it.

Picture 32 – An example of a former defunct channel (on the River Cam at Byron's Pool) which was lined with gravel to raise the bed to enable the creation of a new fish by-pass channel. The work has also provided an additional ecologically diverse channel.

The option that is most beneficial to brown trout is option 3 (closure of the mill channel to form a pond) as it would enable the already ecologically diverse by-pass channel to be fully utilised as the main pathway of flow. However, a combination of options may be a more favoured way forward. For example, option 3 may need to be combined with option 5 so that the correct level of flow is established within different channels. It is likely that a compromise position will need to be arrived at. That compromise will need to seek the retention of the historic amenity value of the mill site but still enable flood flows to connect with the flood plain, for sediment transfer to take place and for fish to move freely along the Harper's Brook.

5.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the Harper's Brook require written Environment Agency (EA) consent prior to their implementation, either in-channel or within 8 metres of the bank.

The Wild Trout Trust can provide further assistance in the following ways:

- Assisting with the preparation and submission of an Environmental Permit to the EA (formerly referred to as Land Drainage or Flood Defence consents).
- Running a training /demonstration day to demonstrate the techniques described in this proposal.

We have produced a 70 minute DVD called 'Rivers: Working for Wild Trout' which graphically illustrates the challenges of managing river habitat for wild trout, with examples of good and poor habitat and practical demonstrations of habitat improvement. Additional sections of film cover key topics in greater depth, such as woody material, enhancing fish stocks and managing invasive species.

The DVD is available to buy for £10.00 from our website shop www.wildtrout.org/product/rivers-working-wild-trout-dvd-0 or by calling the WTT office on 02392 570985.

The WTT website library has a wide range of materials in video and PDF format on habitat management and improvement: www.wildtrout.org/content/library

6.0 Acknowledgement

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7.0 Disclaimer

This report is produced for guidance; 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.