Pillhill Brook, Monxton, Hampshire

An Advisory Visit by the Wild Trout Trust, March 2014

Contents

Introduction

This report is the output of a Wild Trout Trust visit undertaken to the Pillhill Brook at Monxton, Hampshire (National Grid Reference: SU 31292 44419 to SU 31414 44518) in March 2014. The visit was requested by Mr. Chris Sparkes on behalf of the land owner Mr. Hugh Corroon. The visit was primarily focussed on options to improve the river habitat for wild brown trout (*Salmo trutta*) and to improve fish passage.

Comments in this report are based on observations on the day of the site visit, and discussions with Mr. Sparkes, Mr. Corroon and Tom Davis of the Wessex Chalk Streams and Rivers Trust (WCSRT).

Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank or Right Bank whilst looking downstream.

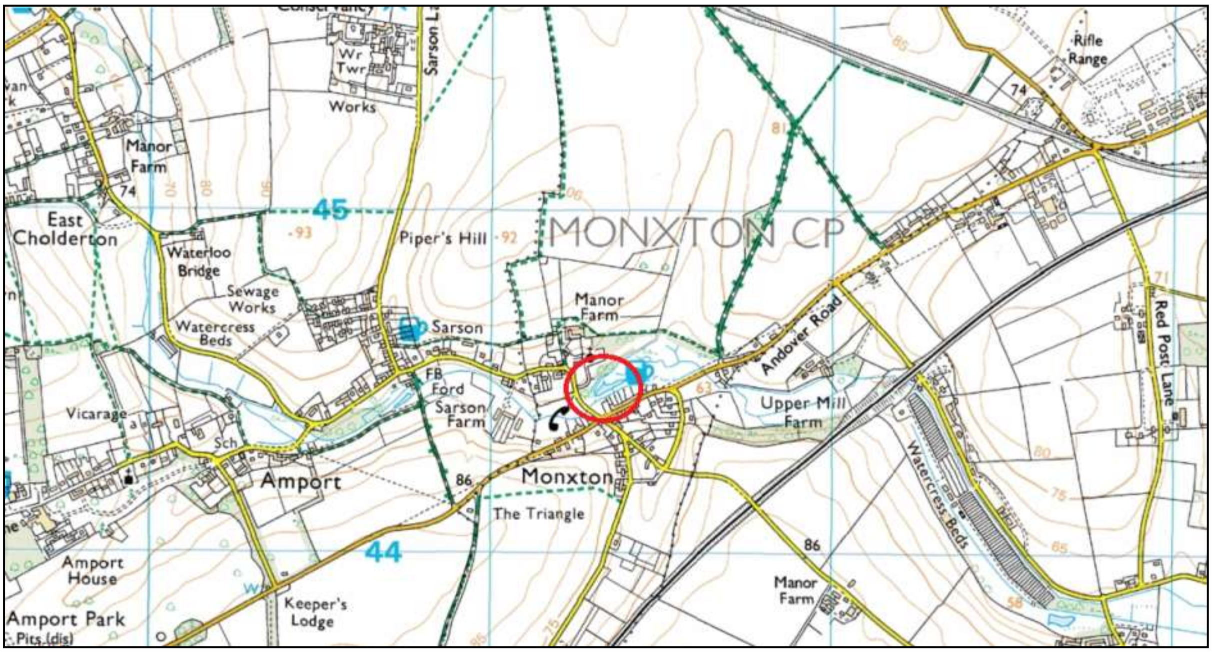

Figure 1: A map showing the reach of the Pillhill Brook visited

Catchment and Fishery Overview

The Pillhill Brook is a chalkstream tributary of the River Anton, itself a tributary of the River Test. The Pillhill Brook rises upstream of Fyfield, flowing in a roughly south easterly direction before entering the River Anton to the south of Andover. Total length of the Brook is some 9km. As with most of the wider River Test catchment, the Pillhill Brook rises from and drains a catchment consisting of various forms of chalk bedrock. This provides relatively stable flows which are generally gin-clear when not affected by surface run-off. From the source, the stream supports flourishing chalk stream plant and invertebrate communities which in turn support good populations of fish (including brown trout), mammals and birds. However, unlike the River Test, neither the Pillhill Brook nor the River Anton is designated as a Site of Special Scientific Interest (SSSI).

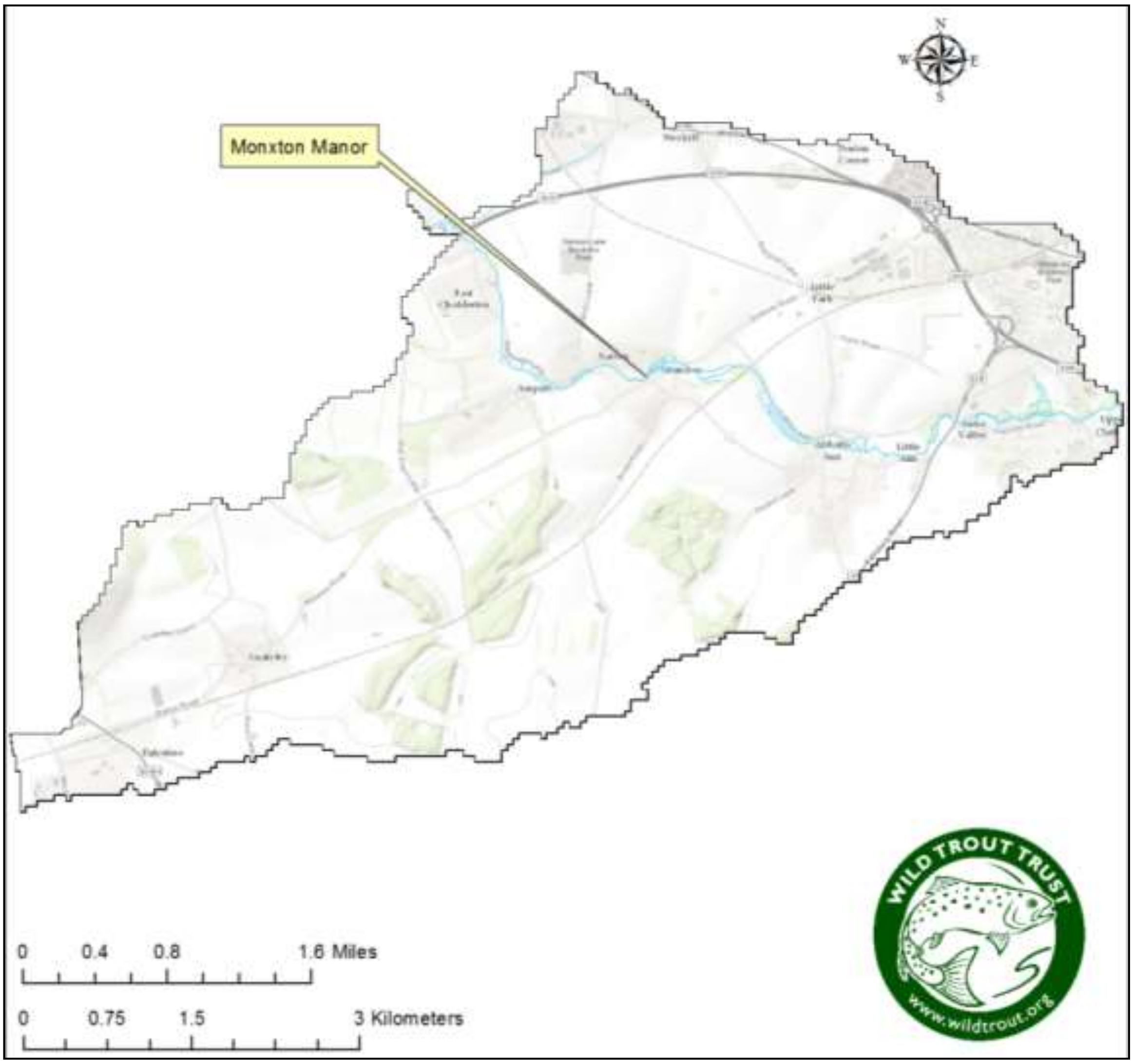

Figure 2: A map showing the extent of the Pillhill Brook catchment

The catchment for the Brook is relatively small, draining the land between Grateley to the southeast, Weyhill to the north, a small part of Andover to the northwest and upper Clatford to the west (Figure 2).

Under the EU Water Framework Directive (WFD), Pillhill Brook (Waterbody ID: GB106039017350) is currently listed as being in 'Moderate' ecological condition, meaning it is failing WFD targets. The ecological failure is being driven by poorer than expected fish populations. The Environment Agency is tasked with bringing all natural rivers in England up to 'Good' condition and presently the river is predicted to achieve this target by 2015.

Like many English chalk streams, the Pillhill Brook is perceived to be affected by groundwater abstraction which may result in low flows during dry periods.

Table 1: WFD Information for the Pillhill Brook

Pillhill Brook	
Waterbody ID	GB107042022790
Waterbody Name	Pillhill Brook
Management Catchment	Test and Itchen
River Basin District	South East
Typology Description	Low, Small, Calcareous
Hydromorphological Status	Not Designated A/HMWB
Current Ecological Quality	Moderate Status
Current Chemical Quality	Does Not Require Assessment
2015 Predicted Ecological Quality	Good Status
2015 Predicted Chemical Quality	Does Not Require Assessment
Overall Risk	Probably At Risk
Protected Area	Yes
Number of Measures Listed (waterbody level only)	1

Habitat Assessment

At the upstream boundary of Mr Corroon's water, the Brook flows out from under a clear-span road bridge. On the RB a small green is used as a community recreation area. A combination of lawn mowing right up to the bank edge and the footfall of people, dogs and probably waterfowl accessing the river have severely eroded the bank. This has inhibited the establishment of marginal and bankside plants and caused the channel to widen.

True marginal species are an important component of the river ecosystem and provide food and shelter for a range of invertebrates, small mammals and birds. A 'shaggy' bank margin also provides important refuge habitat for juvenile trout. The widening of the river has caused a reduction in flow speed which has resulted in a uniformly flat channel profile. This leaves the channel vulnerable to becoming over-shallow during periods of low flow.

Figure 3: Bank erosion on the RB has reduced habitat quality and the ability of the channel to adapt to low flows

A few metres downstream the flow is divided between the natural river and a wide mill leat. Holding up a head of water to supply the old leat is a small stop-log weir. Under the flow conditions observed on the day of the visit, the weir was passable to trout but under low-flow conditions the weir becomes an impassable barrier (Pers. Comm. Hugh Corroon). The weir is in a state of dilapidation and the river is cutting its way around the structure (Figure 4).

Figure 4: The weir is in poor condition and the river is cutting around the sides

In terms of habitat, the best outcome for trout and biodiversity in general would be if the weir were to be completely removed. This would help ensure the reach below the weir (which has a far greater habitat value) does not become depleted of flow during dry periods and would facilitate both fish passage and the natural transport of river sediments. However, the leat flows along a number of neighbouring properties including the beer garden of The Black Swan pub and is undoubtedly an important feature to the riparian residents. A potential solution to the weir is proposed in the *Recommendations* section.

Downstream of the weir the channel bends sharply to the right and is then artificially straight and relatively uniform in width. The uniformity of the channel plan form (bird's eye view) contributes to a relatively uniform cross section. The bed is relatively flat and flows are uniformly laminar. The reach lacks distinct pool and riffles and consists almost entirely of shallow 'glide' habitat. Under the flow conditions observed during the visit, fine sediment was being swept out of the centre of the channel and deposited in the margins. This is a beneficial process which ensures that a gradient of different habitat conditions is maintained. Certain animal species (such as mayfly (*Ephemera danica*) and brook lamprey (*Lampetra planeri*)) prefer silty conditions, whilst others (such as Yellow May Dun, *Heptagenia sulphurea* and bullhead, *Cottus gobio*) prefer clean gravels. Ensuring that a good diversity of conditions is present will also ensure that a good diversity of species is present. This will help provide wild trout with a range of prey throughout the year. Trout also need clean gravel in which to cut a redd (nest) to spawn.

However, it should be noted that the visit followed the wettest winter on record and flows were uncharacteristically elevated. It is reasonable to infer that under average flows the physical uniformity of the channel will result in more uniform distribution of fine sediment. This will limit biodiversity and may also impact on the quality of potential spawning habitat.

Figure 5: The channel below of the weir is straightened and lacks physical diversity

Fortunately, both banks are relatively shallow in gradient. The LB in particular is very low, providing a gentle transition between the terrestrial and aquatic environments. This allows for a succession of emergent and marginal plants to establish and provides an excellent 'shaggy' margin habitat. A range of invertebrates associated with different marginal plants are likely to be present which will boost biodiversity and supplement the diet of resident fish, birds and mammals. Shaggy margins also provide excellent refuge habitat for juvenile trout where they can evade predators and each occupy a small territory.

Although the bank gradient is generally good, some properties on the RB have installed toe boards and have mowed lawns right up to the bank edge. This is locally diminishing marginal habitat quality and biodiversity and the practice should be dissuaded if possible (Figure 6). The shallow root structure of a grass monoculture can also leave banks vulnerable to erosion as boards rot away.

Figure 6: Mown lawns and toe boards reduce marginal biodiversity and can leave banks vulnerable to erosion.

Occasional bankside willows (*Salix* spp.), alder *(Alnus glutinosa*) and elder (*Sambucus nigra*) provide a good diversity of light conditions but low overhead cover is absent. Wild trout are naturally photophobic (light-fearing) and favour low-lying overhead cover to lie up in as this offers them protection from piscivorous birds such as grey herons (*Ardea cinerea*).

There is also a lack of in-stream large woody debris (LWD). The river ecosystem evolved over millions of years around trees periodically falling into rivers. Fallen wood not only provides habitat and food for a range of fish and invertebrates but also helps to power the morphology of the river and increase habitat diversity. Flows deflected around and/or over and under large limbs and trunks are locally accelerated and scour the bed and banks. This redistributes bed material and increases depth variation and bank sinuosity. This action can help to naturally 'sort' bed material as the finest particles are carried the furthest downstream whilst larger cobbles drop out of suspension sooner. The result is an area of gravel graded by size and swept clean of fine sediment. Well-sorted gravel at the tail of a scour pool is perfect spawning habitat for trout, especially if the pool has some overhead cover where fish can hold up for an extended period (Figure 7).

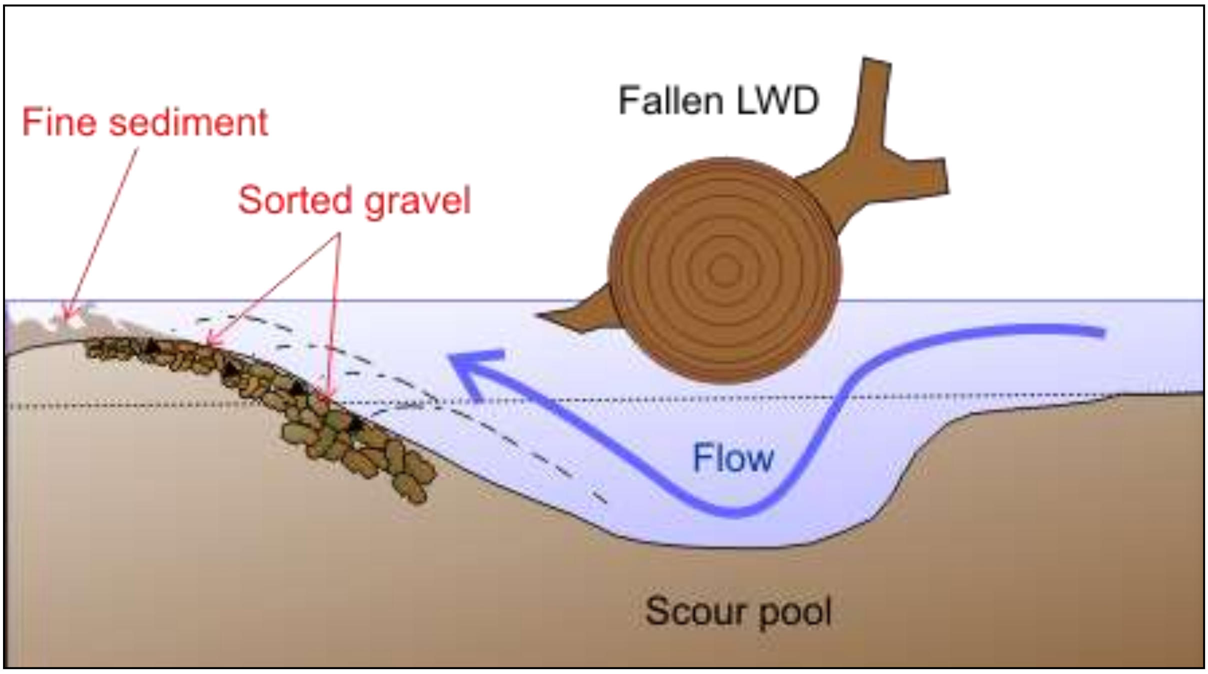

Figure 7: Longitudinal stream section showing that Large Woody Debris (LWD) across the channel can often result in the cleaner, well-sorted gravel

Coarse woody debris (CWD) in the form of branches and brushwood is also important. CWD locally slows flow, creating a depositional environment that traps fine sediment (Figure 8). This provides habitat for silt-loving species and marginal plants. It also provides excellent refuge habitat for juvenile trout and provides an area of slackened flow where trout can conserve energy and dart in and out of faster flows to snatch passing prey.

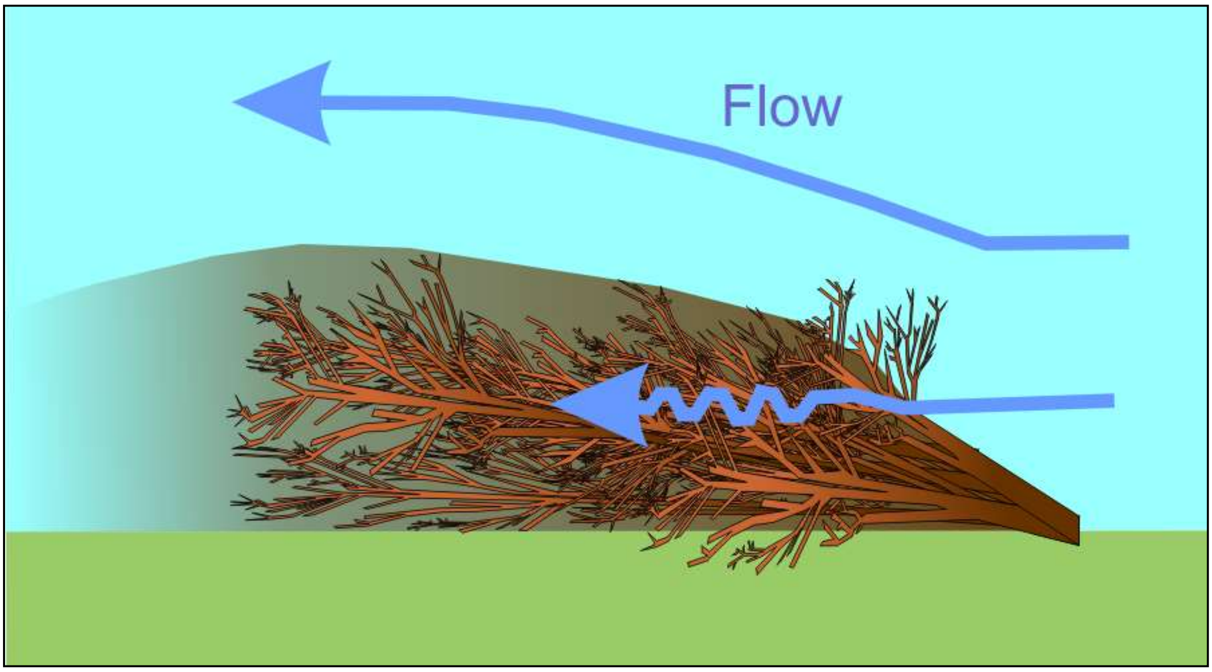

Figure 8: Plan view of a stream section showing that brushwood in the channel naturally slows flows and traps sediment.

The scouring effect of in-channel LWD and CWD helps to create a sinuous flume of fast-flowing water that meanders through the channel. This eventually scours a relatively deep trench in the bed which becomes the very bottom of the valley known as the 'thalweg'. This trench acts as a low-flow channel which allows the river to naturally self-narrow during low flows and retain both depth and water velocity (Figure 8). A river with a well-pronounced thalweg is said to have a 'two stage' channel.

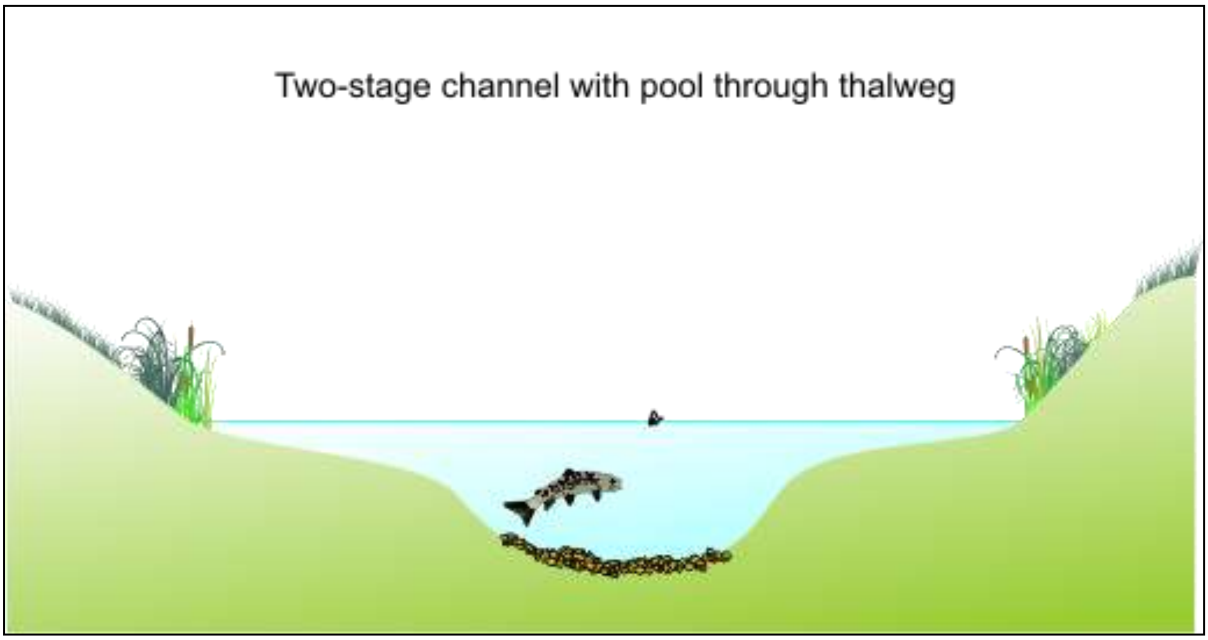

Figure 9: An illustration of a two stage channel cross section with a deeper 'low-flow' channel holding trout during low flows.

Fortunately, there is ample bankside tree cover to site-win woody debris material. For most rivers a roughly 50:50 ratio of direct sunlight to dappled shade is recommended in order to maintain a good balance between temperature regulation and in-stream plant productivity. In chalk streams however, the clear flow and productive water chemistry gives rise to an unusually high abundance and diversity of river plants. For these ecologically important habitats a ratio of roughly 70:30 direct sunlight to dappled shade is recommended.

One of the most important river plants is water crowfoot (*Ranunculus* spp.). This is one of the key primary producers in the chalk stream food web. Water crowfoot was noticeably absent from the reach which may suggest that the fast flows that the crowfoot family favours may not be reliable during the summer growth season. As well as providing habitat for freshwater invertebrates that graze on algae colonising the plant, water crowfoot also help to elevate water levels during summer months and provides superb cover for fish.

By introducing some structure into the channel and encouraging the river to adjust to better suit average flows, it should be possible to maintain sufficient flow velocities to support a healthy water crowfoot community. Examples of techniques appropriate for the reach are outlined in the *Recommedations* section.

Conclusions

The reach of the Pillhill Brook visited is lacking in the physical diversity required to maximise its potential as a bio-diverse habitat able to support a secure and healthy wild trout population. The flow split between the visited reach and the old mill leat, combined with a uniform channel plan form and profile mean that the reach is presently vulnerable to low flows and may not be able to support a healthy river ecosystem and habitat for brown trout during drought conditions.

The weir that divides flow between the two channels is also a significant obstacle to fish passage which may prevent fish escaping the reach during low flows.

Fortunately, conditions could be greatly enhanced using existing tried and tested techniques.

Recommendations

In order for the section of the Pillhill Brook visited to achieve its full potential as a rich and bio-diverse wild trout habitat the following actions are recommended:

1. The weir shown in Figure 4 should be replaced with a stepped series of bowl-shaped retained gravel reject riffles. This technique has been successfully used to improve fish passage on other rivers.
   The technique involves driving a series of lines of sweet chestnut stakes across the river at roughly 100mm centres and stacking large flint cobbles (Figure 10) behind each line. Each line can then be back-filled with flint gravel rejects to form a step. The head loss over the existing structure should be spread out over a series of small steps with a head loss of

approximately 100mm. The retaining wall at each step should be lowest at the centre sloping up towards each bank. This will ensure that a smooth flume of water flows over the centre of each step allowing for easy upstream passage (Figure 11).

Figure 10: A large flint cobble (picked out of the river near the existing stop-log weir).

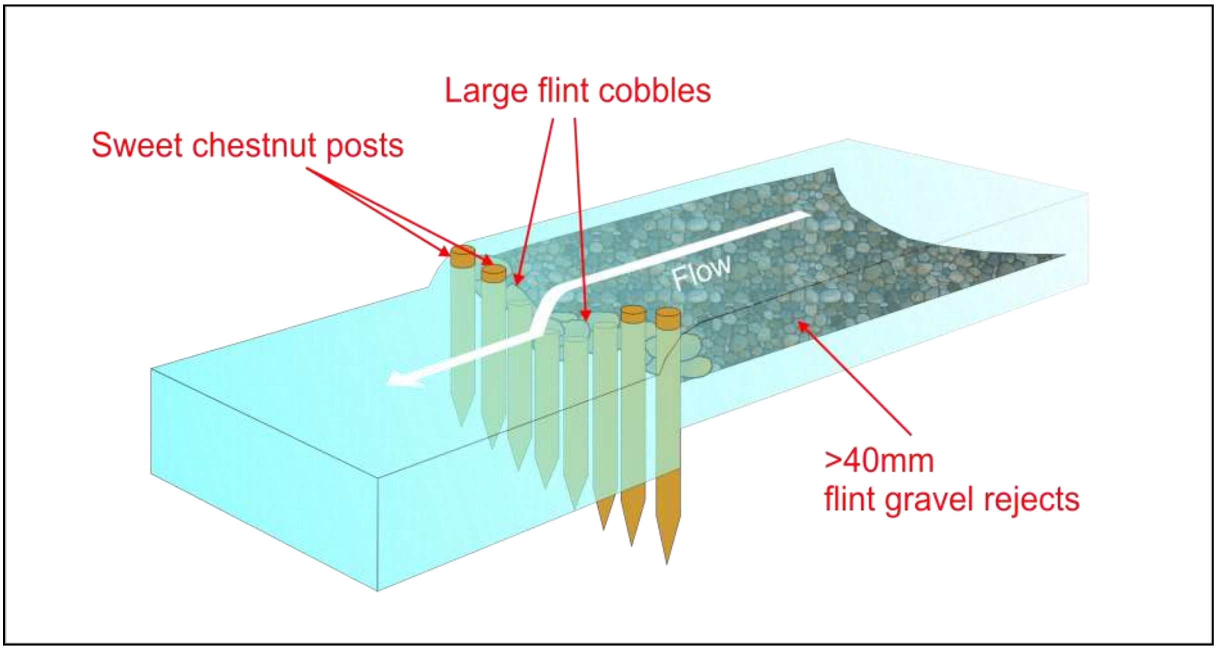

Figure 11: An example illustration of a single retained gravel 'step'

2. The channel below the weir should be narrowed and greater sinuosity introduced. This can be achieved by laying site-won brushwood into the channel margins to create a series of 'D-shaped' (roughly semi-circular) brushwood shelves.

The outline of each shelf can be simply marked out with sweet chestnut stakes following the areas of existing deposition (Figure 12). This will ensure that the new structures work with the existing river processes, quickly consolidating fine sediment. The lifespan of each shelf should then be sufficient for colonising plants to replace the brushwood and form more permanent marginal beds. Brushwood structures installed in erosive conditions will not last more than two or three years.

Figure 12: Brushwood shelves should be installed in existing areas of deposition (outlined with yellow dashes)

Brushwood should be simply laid down with the butt ends pointing upstream. Once the area behind the stakes is packed with brushwood, long straight pieces should be laid across the brush angled slightly upstream. Each of these should be attached to stakes at both ends with galvanised fencing wire and the stakes driven further into the bed to pin down and compact the brushwood (see example Figure 13).

Ideally the riverside edge of each shelf should be lower than the bankside edge so that the shelf gently slopes up towards the bank (See illustration Figure 14).

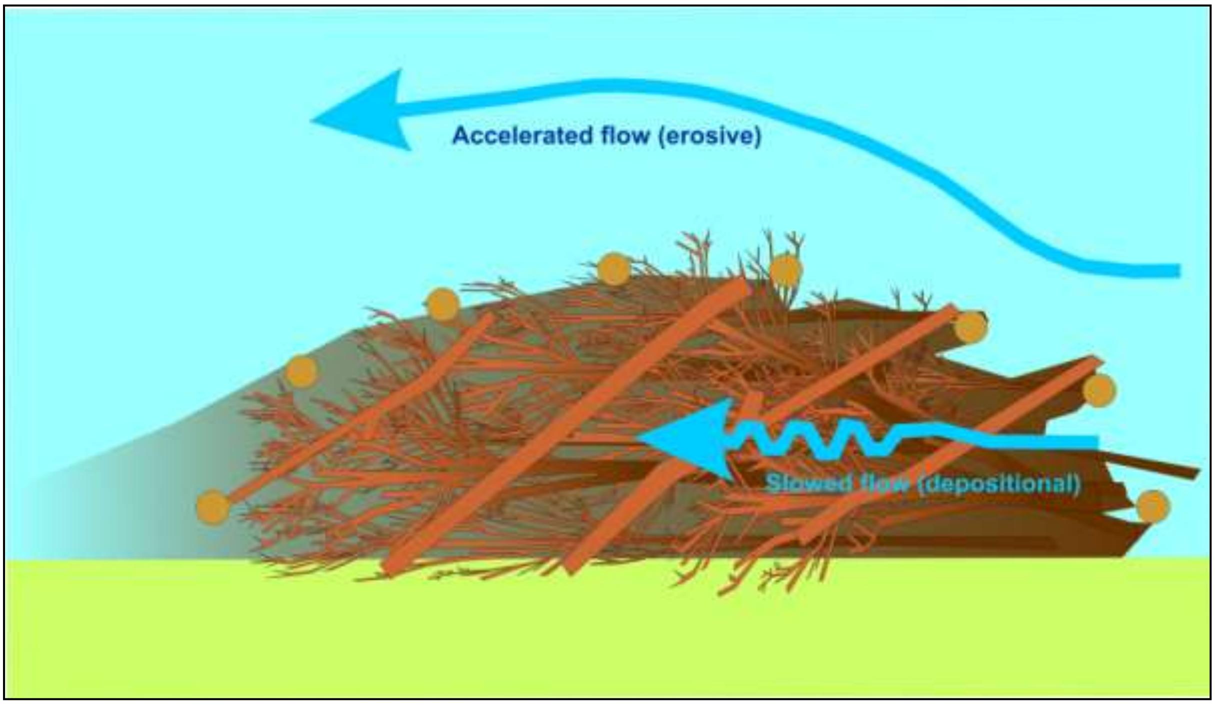

Figure 13: A brushwood shelf (plan view) consisting of brushwood laid on the bed and pinned down with long, straight crosspieces

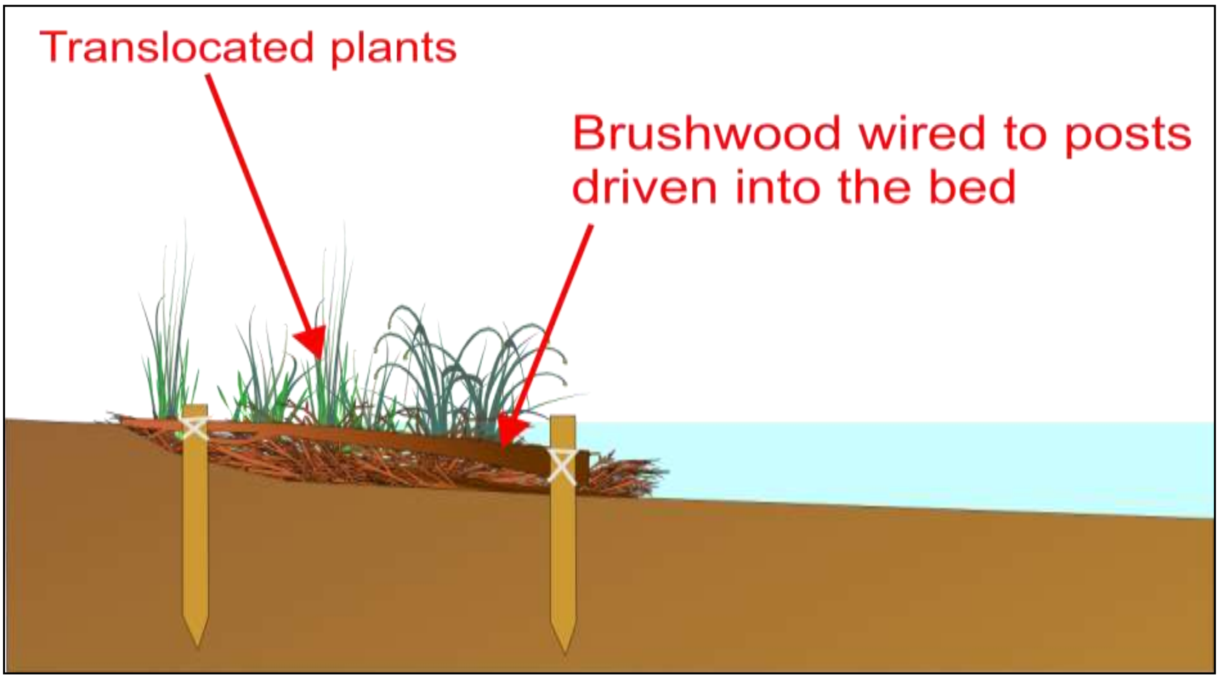

Figure 14: A cross section illustration of a brushwood shelf sloping down into the river

These structures are preferable to woven brushwood structures as they present a gentle gradient instead of a vertical face. This will encourage a succession of emergent and marginal plant species to colonise the structure. The brushwood at the riverside edge should also be left 'shaggy' in order to provide refuge habitat for small and juvenile fish.

3. Opportunities should be sought to 'hinge' bankside trees into the river to both act as flow deflectors and to form more sparse brushwood cover in areas of deposition. By mimicking how a tree might naturally topple into the stream, LWD/CWD habitat can be introduced in a fashion that wild trout are perfectly evolved to exploit. By leaving the tree attached at the base it should survive and will require very little securing, though it will require some ongoing maintenance. The tree in Figure 15 is an example such an opportunity.

Figure 15: An example of an existing tree that could be hinged into the river.

4. LWD should also be introduced to act as flow deflectors to kick flow left and right across the channel and increase scour through the thalweg. Simple log deflectors (as pictured in Figure 16) alternating from bank to bank will work but ideally, more complex-shaped pieces of LWD should be used to maximise flow diversity.

   To fix LWD into the river, drive sweet chestnut stakes in pairs at both ends of the log. Wire between the stakes across the width of the log and then drive the stakes in further to secure the LWD in place.

   Water flowing over a log will be deflected at 90° from the angle of the log across the channel. For this reason, deflectors should be positioned pointing slightly upstream so that flows are deflected into the centre of the channel as opposed to the bank.

Figure 16: An example of a simple log deflector. Note the bankside edge is keyed into the bank and the log slopes down into the river. The stream flows from left to right in this picture.

Figure 17: Complex woody debris deflecting flow across the channel but also providing both overshot and undershot scour.

When introducing flow deflection and scour, it is important to remember that in a natural river system, water flows fastest on the outside of a meander. Material is picked up by the flow and deposited as a riffle a short distance downstream. As a result, the channel will develop a 'tick-shaped' cross section (Figure 18). This should be encouraged to occur where possible.

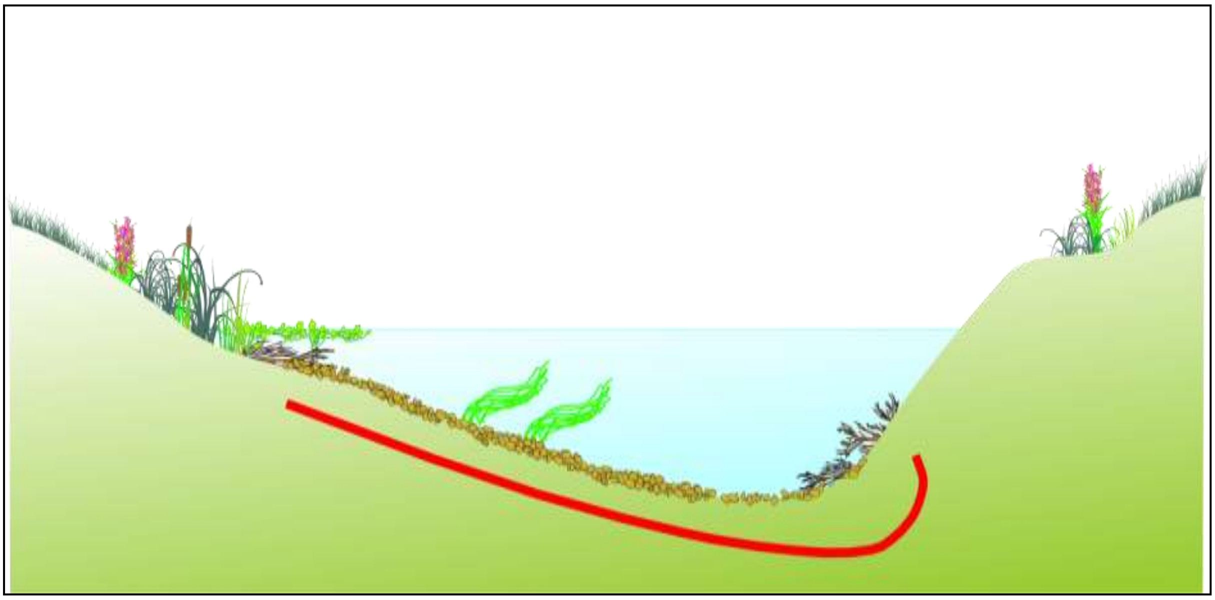

Figure 18: A natural 'tick shaped' channel cross section formed on a meander

5. In order to further drought-proof the reach, occasional deep pools could be encouraged to form by the introduction of one or two pairs of deflectors positioned in a 'V-shaped' formation with a small gap between them (Figure 19). The size of the gap can be determined by eye. The deflector pair should pinch flow through the gap without impounding the flow upstream.

Figure 19: An example of a pair of deflectors in an upstream-facing V formation

This formation will focus scour into the bed at the centre of the channel and gradually shape a pool with potentially good spawning habitat at its tail.

6. The eroded area at the upstream boundary of the reach could be repaired by installing low-lying brushwood shelves as prescribed above. However as the bank is regularly accessed it would be wise to include some formalised gravel access ramps where people and dogs could access the river without trampling the brushwood or causing further erosion. Dogs will generally favour accessing the river via the gravel ramps and should avoid the brushwood.

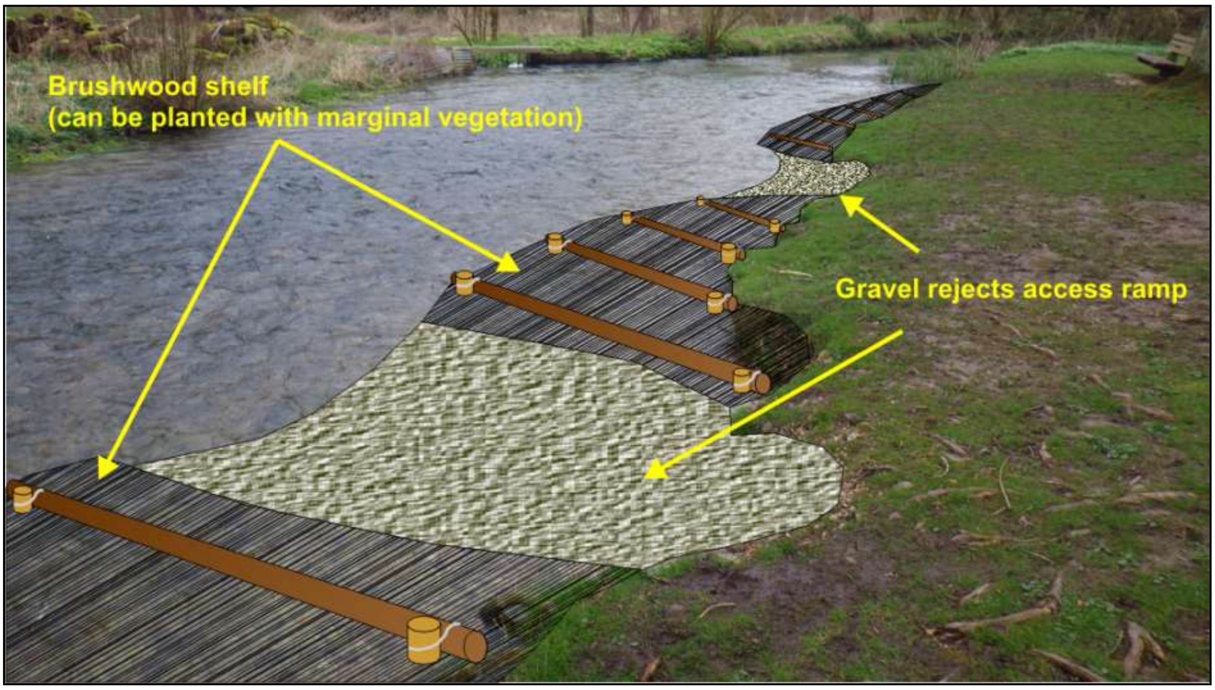

Figure 20: An illustration of how a brushwood shelf and gravel ramp bank repair might look

These actions should improve the habitat of the reach whilst also improving fish passage and the resilience of the habitat to low-flow conditions.

Making it Happen

The WTT website library has a wide range of free materials in video and PDF format on habitat management and improvement:

http://www.wildtrout.org/content/index

The Wild Trout Trust has also 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 debris, enhancing fish stocks and managing invasive species.

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

There is also the possibility that the WTT could help via a Practical Visit (PV). PV's typically comprise a 1-3 day visit where WTT Conservation Officers will complete a demonstration plot on the site to be restored.

This enables recipients to obtain on-the-ground training regarding the appropriate use of conservation techniques and materials, including Health & Safety, equipment and requirements. This will then give projects the strongest possible start leading to successful completion of aims and objectives.

Recipients will be expected to cover travel and accommodation (if required) expenses of the WTT PV leader.

There is currently a big demand for practical assistance and the WTT has to prioritise exactly where it can deploy its limited resources. The Trust is always available to provide free advice and help to organisations and landowners

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