River Culm, Culm Fly Fishing Club

An advisory visit by the Wild Trout Trust September 2012

1. Introduction

This report is the output of a Wild Trout Trust visit undertaken on the River Culm on the Culm Fly Fishing Club's waters between Hemyock and Culmstock, Devon, national grid reference (NGR) ST138139 to ST101137. The visit was requested by Mr Andy Don, who is a serving member of the Club. The visit was focussed on assessing the habitat and management of the club's waters.

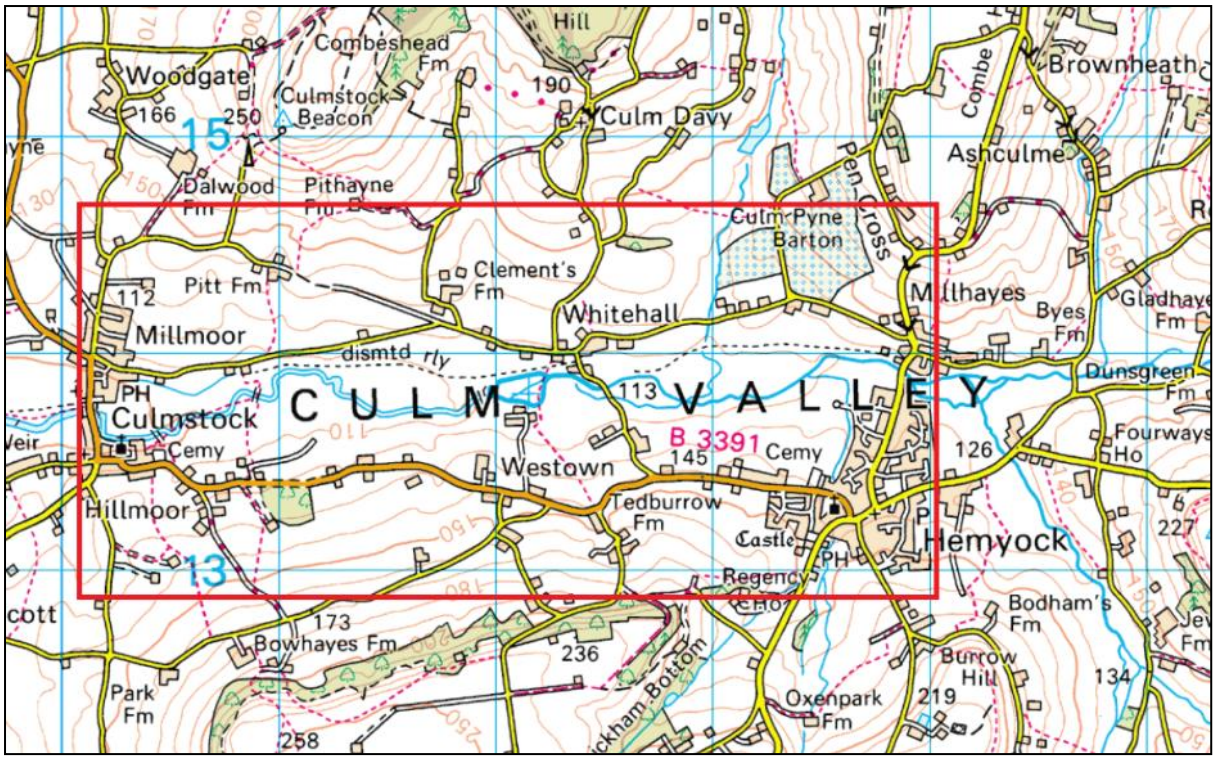

Figure 1: A map showing the Culm Fly Fishing Club's water

This section of the river is classified 'Poor Ecological Status' under the Water Framework Directive with a target of 'Moderate Ecological Status' for 2015. The river is identified in the Environment Agency's River Basin District plan as water body ID no. GB108045014980.

CULM	
Waterbody ID	GB108045014980
Waterbody Name	CULM
Management Catchment	East Devon

River Basin District	South West
Typology Description	Mid, Small, Calcareous
Hydromorphological Status	Not Designated A/HMWB
Current Ecological Quality	Poor Status
Current Chemical Quality	Does Not Require Assessment
2015 Predicted Ecological Quality	Moderate Status
2015 Predicted Chemical Quality	Does Not Require Assessment
Overall Risk	At Risk
Protected Area	Yes
Number of Measures Listed (waterbody level only)	-

Comments in this report are based on observations on the day of the site visit and discussions with Mr Don and members of the Culm Fly Fishing Club.

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

2. Catchment and fishery overview

The River Culm rises from a marshy spring near Culmhead and flows south and then west to Hemyock. The Culm continues west through Culmstock to Uffculme before turning south again and flowing southwest alongside the M5 to Cullumpton, around Killerton Park and on to Stoke Cannon before joining the River Exe on the northern outskirts of Exeter.

The Culm has several tributaries including Madford River (mostly Poor Ecological Status with some Moderate), Bolham River, Fulford Water, Ken Stream, Spratford Stream (all Poor Ecological Status) and River Weaver (Bad Ecological Status).

These waterbodies are failing for three reasons:

- Nutrients
  The predominant catchment land-use is agriculture and increased phosphate levels may be entering the Culm from point source (private sewage treatment etc.), and diffuse (agricultural and road run-off etc.) pollution sources.

- Fish
  Much of the catchment is failing for salmon and trout. Barriers to migration and historic pollution issues are likely population bottlenecks. Habitat quality is also a concern.

- Zinc (Zn)
  Increased zinc levels have been recorded in the Madford River. This has been attributed to naturally-occurring metals in the environment combined with historic dumping of metals in the area. Zinc (in high enough concentration) can be acutely toxic to fish and invertebrates. Fish and other animals have proteins in their bodies that bind to heavy metals in cells in order to reduce their toxicity. Over time this can lead to build up of heavy metal in the food chain (a process known as bioaccumulation). As a result, each step higher in the food chain, the larger the dose predators receive (this is known as biomagnification). In the case of wild trout, it is likely that Zn contaminated invertebrates are forming part of the trout diet. Zinc is water-soluble and could potentially cause harm to exposed trout eggs. Zinc levels in the Culm even if sub-lethal to trout could be having a detrimental effect on the overall ecosystem and acting as a population bottleneck.

The Culm flows over a superficial alluvium geology of clay, silt and sand with an underlying bedrock of the Mercia mudstone group, a red sedimentary stone formed in the early Triassic.

The superficial geology is relatively soft-wearing, allowing the river to carve a meandering path that has shifted over time to deposit a seam of gravel across the floodplain.

The catchment is prone to spate flows that introduce a sudden surge of energy into the system. The combination of soft superficial geology and high-energy spates has historically shaped the path of the river. However, milling and local industry during the last couple of centuries has also influenced a great deal of the Culm's character throughout the catchment.

3. Habitat Assessment

From the upstream boundary of the club waters, the river flows west from Hemyock through grazed fields. The left bank is open grassland whilst the right bank is densely wooded with alder trees and scrubby bushes. Some sections of the right bank run alongside a dismantled railway line. Where this occurs the bank has been reinforced with sleeper and/or stone revetments. The combination of established root systems, vegetated banks and occasional man-made revetments has resulted in the right bank being relatively robust against erosion forces. The left bank by comparison is exposed and vulnerable. The grass monoculture and vertical bank profile mean that soil is stripped out of the bank during fast flows leaving undercut banks that eventually slump into the river and are washed away.

Figure 2: The grazed left bank is a stark contrast to the heavily wooded right bank

The bed consists of large gravels that in places have collected into shoals. This is indicative of active transport of bed material during high flows.

The club has attempted the construction of some large woody debris (LWD) revetments to protect the left bank. In one particular location, spate flows have ripped much of the wood out of a structure despite sturdy angle-iron bars being driven into the bed to retain the material. The river often breaches its banks around this location during high flows to flood the adjacent fields. Specially engineered road and foot bridges have been installed nearby to allow flood waters to pass under the road.

The wide-ranging flow conditions of the river mean that channel geomorphology is particularly active. This means that the river profile is constantly shifting and changing and bed material is probably transported some distance during higher flows. This should be taken into consideration when planning any habitat enhancement works as any installed structures will have to be able to withstand not only the force of the fast-flowing water, but also the abrasion of gravel and large stones carried by the flow.

Figure 3: LWD revetment secured with angle-iron bars

After approximately 500 metres, the river passes into a different field. The left bank is populated with trees whilst the majority of the right bank is grazed pasture. In contrast to the field upstream, the grazing land is fenced off from the river preventing cattle from poaching the margin.

Between the fence and the top-of-bank, a dense bed of nettles, brambles and Himalayan balsam (*Impatiens glandulifera*) has established. In many places this bed has formed an impenetrable hedge that prevents the club's anglers from easily accessing the river.

In many situations, fencing off a riverbank from grazing land is an important method of protecting the margin from poaching and allowing a diverse range of marginal species to establish. However, the Culm through this reach has exceptionally high and steep banks making the margin an almost entirely terrestrial habitat unsuitable for typical moisture-loving marginal species such as meadowsweet (*Filipendula ulmaria*) or sedge (*Carex* spp.).

Figure 4: The river margin is dominated by nettle, bramble and Himalayan balsam

Tree cover varies from dense and dark shade, to open sunlight. Where the river is more heavily shaded, the bankside vegetation is sparser and the river is more accessible to anglers.

Figure 5: Dappled light conditions under bankside trees

The bank characteristics change again through the next field downstream. The banks are much less steep and show some signs of light poaching from cattle. It appears that the banks on both sides have slumped forward but not been washed away. Beds of emergent reed sweetgrass (*Glyceria maxima*) and reed canary grass (*Phalaris arundinacea*) have established in the margins and swathes of water crowfoot (*Ranunculus* spp.) have established in-channel.

Figure 6: Marginal plants established on the slumping banks

The river has no tree cover at all through the upstream half of the field. The sunlight may have helped the marginal and aquatic plants to grow but the river could be vulnerable to over-heating in summer which could have serious consequences for fish populations.

About halfway through the field, the reason why the slumped-in banks have not been washed away becomes apparent. The river is impounded by a tall crump weir that is backing up water and slowing flows upstream. The weir appears to have been installed to divert water through nearby Whitehall Mill. The weir is a complete barrier to fish passage and it is not known if fish can pass through other smaller carriers to bypass the weir.

Figure 7: A tall crump weir diverts flows through Whitehall Mill

Downstream of the weir (through the lower half of the field) the river flows along an artificially straightened channel and passes under a small bridge. The straightened section consists almost entirely of a long glide and is lacking in habitat diversity. The right bank is densely wooded and these trees have been managed in such fashion that they are of an almost entirely uniform height and width. This has resulted in a channel that is either uniformly shaded or exposed to direct sunlight. A change in management to the trees on the right bank would not only diversify the ratio of light to shade over the stream but would also provide the raw materials to diversify the flows through the straightened channel. Options to improve this reach are discussed in the *Recommendations* section.

Figure 8: Artificially straightened channel with uniform height trees

Downstream of Whitehall Mill, the club's waters resemble those of a famed Dorset chalkstream such as the Piddle or Frome. Swift moving waters flow over clean gravels and swathes of water crowfoot along a naturally meandering stream. On the day of the visit the water was gin-clear and displayed a wide range of flow patterns. In the backwaters of eroded bays a variety of marginal plants have been able to establish but the majority of the banks were dominated by grass. For around 500m downstream, tree cover is again extremely sparse leaving the river potentially vulnerable to over-heating.

This section would benefit from additional tree cover and protection from grazing livestock.

Figure 9: The Culm resembling a chalkstream channel

Near Lower Westown, the footings of a footbridge (possibly the remains of a control structure) pinch the river and accelerate flows. Immediately downstream the river suddenly opens out into wide bays on either bank. This has most-likely been formed by back-eddies during high flows. The river is deep and probably provides a good holding habitat for adult trout. On the right bank, a backwater pool has eroded to form an off-line pond that becomes an online backwater in higher flows. This interesting feature has the potential to be used as an alternative cattle drink and could help to protect the wide bay from further erosion if it were to be properly fenced from cattle.

Figure 10: An online backwater could be modified to form an alternative cattle drink

Downstream from the footbridge and wide pool, tree cover on each bank increases until a dappled mix of shade and open sunlight overlays the stream. Guidance published by the Environment Agency recommends a roughly 50:50 ratio of light to shade in order to maintain suitable freshwater habitat for Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta*) populations that are expected to be at risk from the effects of climate change.

http://www.wildtrout.org/sites/default/files/news/Keeping%20Rivers%20Cool_Guidance%20Manual_v1%20%2023%2008%2012.pdf

Angler access is limited by the dense tree cover and low-lying sallow and scrub. Woody material protruding into the channel is an important habitat feature and any plans to improve access should be sensitive to the shade and cover currently provided. Options for improving access whilst protecting the habitat are discussed in the *Recommendations* section.

Figure 11: Low lying tree cover providing shade and woody habitat

Some short stretches along this reach are without tree cover but still retain the low-lying sallow and hawthorn scrub. Here the banks have a shallow gradient and are fenced from livestock grazing. A community of marginal plant species have colonised the bank. Some Himalayan balsam has established and this should be controlled to prevent it out-competing native species.

Figure 12: Low lying scrub and marginal native plants

The next reach downstream is also tricky for angler access. The banks are very steep and the adjacent land is elevated considerably high above the river. Erosion on the left bank is particularly aggressive as can be observed by the remains of a barbed wire fence that now hangs over a steep drop.

Figure 13: The rate of bank erosion illustrated by a barbed wire fence now suspended over the river

Rapid erosion and deposition has shaped this section into a diverse wild habitat with a broad range of features. Sharp meanders and distinctive pool-riffle sequences are clearly visible and gravel shoals mark the path of braided flood channels. LWD is littered throughout, helping to further diversify flow patterns and shape the complex channel form. The result is an idyllic wild-looking river that should be considered an enviable asset to the fishery. Fishing at locations such as this is likely to be particularly challenging but an extremely enjoyable and rewarding experience for wild fishing enthusiasts.

Figure 14: A wild and varied reach offering a broad range of habitat niches

From an outstanding example of natural geomorphology and wild habitat, the character of the river shifts dramatically just a couple of hundred metres downstream. The river becomes suddenly straightened, very deep and slow flowing. The channel is over-wide and the left bank is near vertical and was at least 1 metre above water level on the day of the visit. This deep pool is a homogenous stretch of river that may provide good holding water for occasional adult fish but is an otherwise poor quality habitat. The steep banks and deep water limit opportunities for macrophyte plants to establish.

Figure 15: A deep, wide and straightened section of river hints at previous land use

At the downstream extent of the deep and wide section, the crumbling remains of a large weir structure are situated on the left bank. The channel is man-made and runs parallel to a now dismantled railway line. At some point, a channel appears to have flowed across the field on the left bank. A shallow divot runs in a meandering line and is populated by moisture-loving plants such as soft rush (*Juncus effusus*).

The unnaturally straight, wide and deep channel, the remains of the weir and the proximity of the railway line suggest that perhaps this part of the river may have once been used to hold water for steam trains. An old map of the site (1889) shows the natural path of the river passing under the railway line and flowing west. Water was taken off at the weir to flow southwest towards Culmstock (the same direction the river presently follows). However, in 1889 the river was a straight line and did not meander in the fashion it does today (www.old-maps.co.uk).

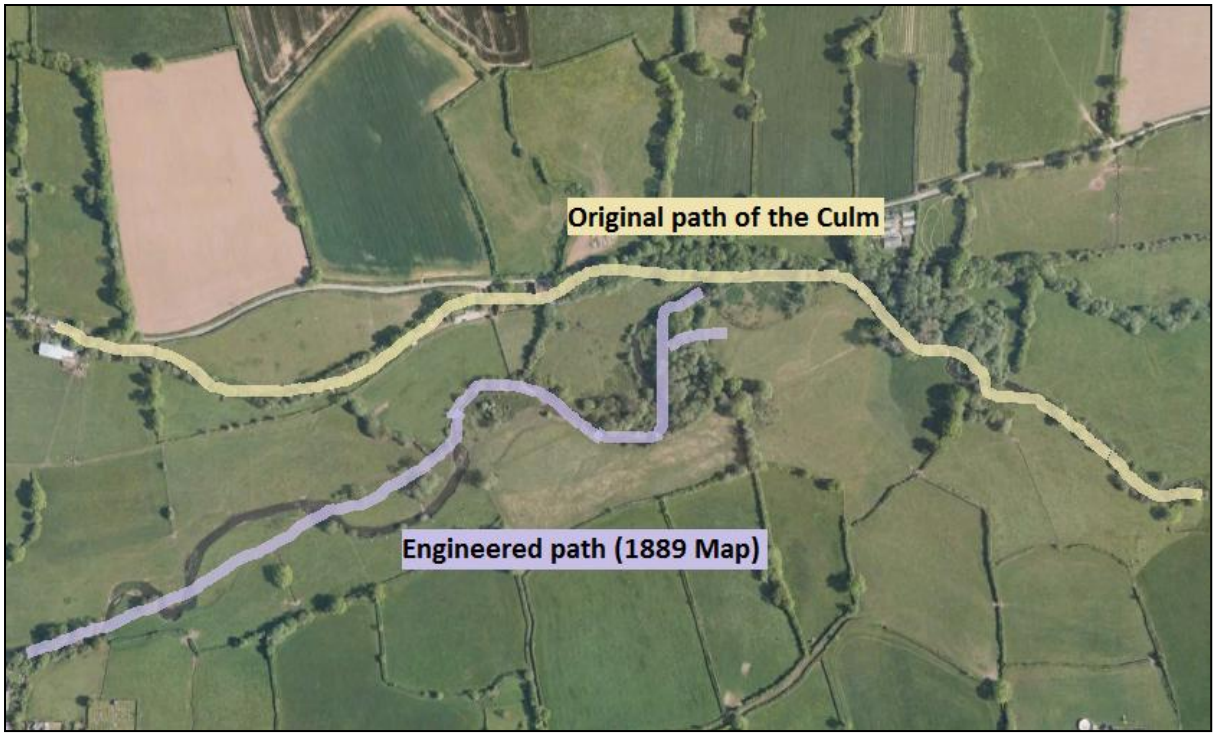

Figure 16: The historic man-made changes to the Culm displayed over modern satellite photography (Google Earth)

Immediately downstream of the straightened reach the river re-gains its wild character and fallen trees and gravel shoals diversify flow conditions. Steep banks are unsuitable for emergent and marginal vegetation and the gravel shoals provide the only opportunity for a marginal community to flourish. Unfortunately, these shoals are unstable features that are regularly shifting and changing under spate flows. There is a general lack of established marginal habitat throughout the majority of the club's water.

Observing the reach flowing southwest towards Culmstock in the present day, it is hard to imagine that the river was ever artificially straightened. The Culm's recovery from a straightened channel to naturally meandering river illustrates the energy in the river during spate conditions.

Figure 17: The once straightened course of the river now follows a naturally meandering path across the floodplain

Excess energy in spate-flow conditions often results in a series of secondary flow patterns within the main flow. Corkscrew-like 'helicoidal' flows form on the edges of pools and transport material from the outside of even the slightest of bends to deposit it on the inside of the next downstream. This is the process by which a straight channel evolves into a meandering river. The more energy in a river, the more turbulent the water and the faster the formation of a meander sequence.

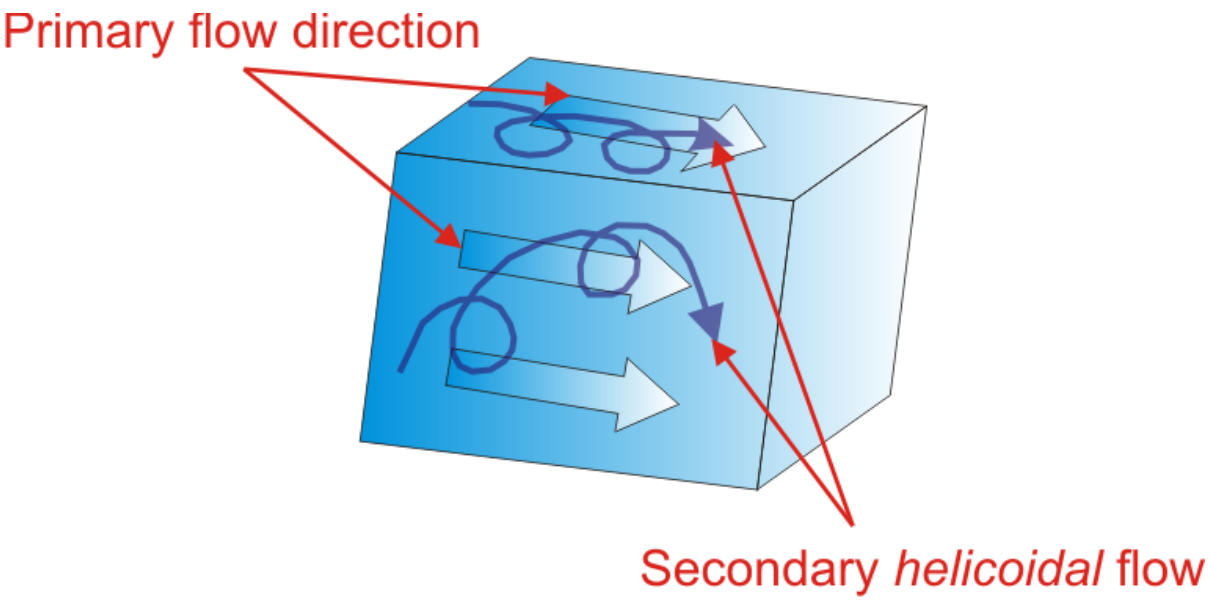

Figure 18: Helicoidal flow patterns within the main flow

This meandering section of the Culm flows through open grazing fields. Tree cover is minimal and marginal plants are limited by steep banks and grazing livestock. Where trees are present they provide much-needed cover for fish and low-lying sallows also introduce woody habitat which can be an important refuge for fry. A rapid rate of erosion on the outside meanders is balanced by a similarly rapid rate of deposition. The rapid erosion combined with the presence of cattle mean that there is a general paucity of marginal habitat. However, the erosion has exposed a gravel seam in the bank that is helping to replenish the gravel bed and create shallow, fast-flowing riffles that support patches of water crowfoot.

4. Conclusions

From the observations made during the advisory visit and some brief research into the background of the river, a number of conclusions have been made.

- There is a general lack of marginal habitat along the Culm Fly Fishing Club's waters. The steep and high banks create an abrupt transition between the aquatic and terrestrial habitats and provide very little opportunity for emergent and marginal plants to establish. Fencing along the river appears to have been erected in areas with particularly steep banks (possibly to prevent livestock falling down the bank). This has resulted in the unchecked growth of terrestrial species such as nettles and brambles. Himalayan balsam is also a problem in un-grazed areas. Where the banks are less steep they are predominantly unfenced and so are heavily grazed by livestock. There is also very little marginal rough grassland habitat. An un-mown/un-grazed buffer along the upper bank is an important habitat in the lifecycle of many river flies.

- Tree cover is sporadic. Some reaches are completely exposed to direct sunlight without even marginal plants to provide shade. Areas where tree cover is abundant are unmanaged and have difficult access. Where tree management has been undertaken, the canopy appears to have been uniformly trimmed. This results in uniform shading as opposed to the ideal

dappled light shade ratio that provides the best conditions for wild brown trout.

- The weir near Whitehall Mill is a barrier to fish passage. If fish cannot bypass the weir via the mill or the other small carrier to the south then this structure will be fragmenting fish populations within the club's waters.

- The Culm catchment appears to suffer water quality issues resulting from diffuse pollution sources. This may be affecting invertebrate populations and limiting food availability for fish. This is a complex issue that requires a catchment scale approach to resolve.

5. Recommendations

In order for the Culm Fly Fishing Club's water to achieve its full potential as a wild fish habitat, the following actions are recommended:

- At present many of the tall and steep banks are fenced from livestock whilst the lower banks are left exposed to grazing animals. If possible, land owners along the club's waters should be engaged and encouraged to consider fencing-off areas of bank with more shallow gradients. This could allow marginal species to establish at the water's edge and an area of rough grassland to establish on the upper bank. Alternative cattle drinking arrangements should be considered including making use of backwaters such as shown in Figure 10 or the use of pasture pumps.
  Areas of bank protected by fences will usually require some annual maintenance (strimming, brushcutting etc.) to prevent monocultures of nettle or Himalyan balsam. Fences will also require maintenance from time to time. These are factors that will need to be considered when planning any fencing-off of the riverbank.

- Tree planting along some of the less wooded reaches would help to introduce more cover and shade into the fishery and could also introduce a few more invertebrates. Terrestrial insects often fall from tree branches into streams and can be an important part of a trout's diet.

The root systems of bankside trees help to stabilise banks and provide effective erosion resistance. Blocks of woodland (or at least wide margins of vegetation) in strategic areas could provide some valuable erosion protection. Funding may be available to help with tree planting (see page 22 of Keeping Rivers Cool).

- Small-scale and selective tree works should be undertaken with a goal of creating a diverse range of canopy heights (and therefore a diverse range of light conditions). A 5-year rotational programme will be of greater benefit than a large-scale programme in terms of both management and habitat quality. Through some of the less accessible reaches, some sympathetic tree works could be undertaken to create access points for anglers and allow enough space to cast. This could also include some 'skylighting' to allow some patches of sunlight into the river where required.

  Brashy material left-over from such works could be used to create dense marginal mattresses that could be planted up with marginal species trans-located from elsewhere on the river. This type of structure secured to the bed in depositional areas (such as on the inside bend of meanders) will trap sediment and quickly develop into a dense bed of marginal plants.

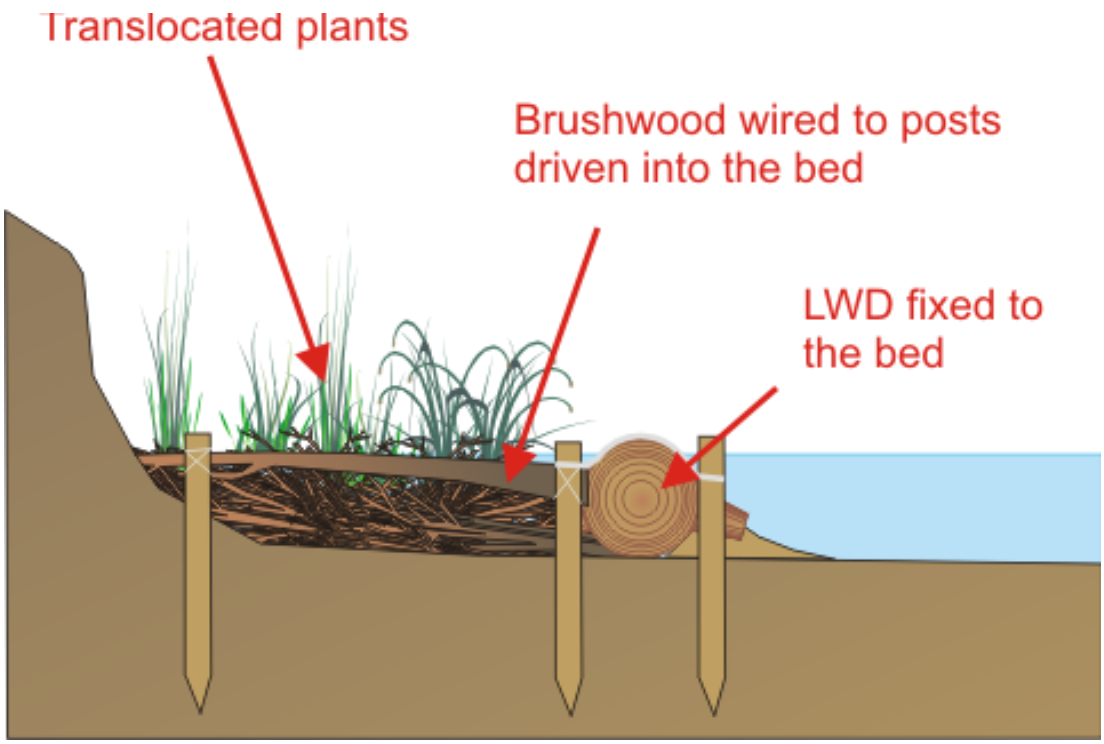

Figure 19: Coarse Woody Debris (CWD) marginal mattress

Figure 20: An example marginal mattress made with live willow

- The club has already done a sterling job of utilising LWD to create anti-erosion revetments. This type of work is warmly encouraged as a means of introducing more woody habitat into the river and repairing erosion problems

without resorting to environmentally unfriendly 'hard engineering' techniques. The design previously used by the club could be improved by incorporating a sloping cross section. This will make the structure more resistant to flood flows by presenting a smoother face to the flood flows and limiting the hydraulic pressure within the structure that could otherwise lead to revetments being dismantled under turbulent conditions.

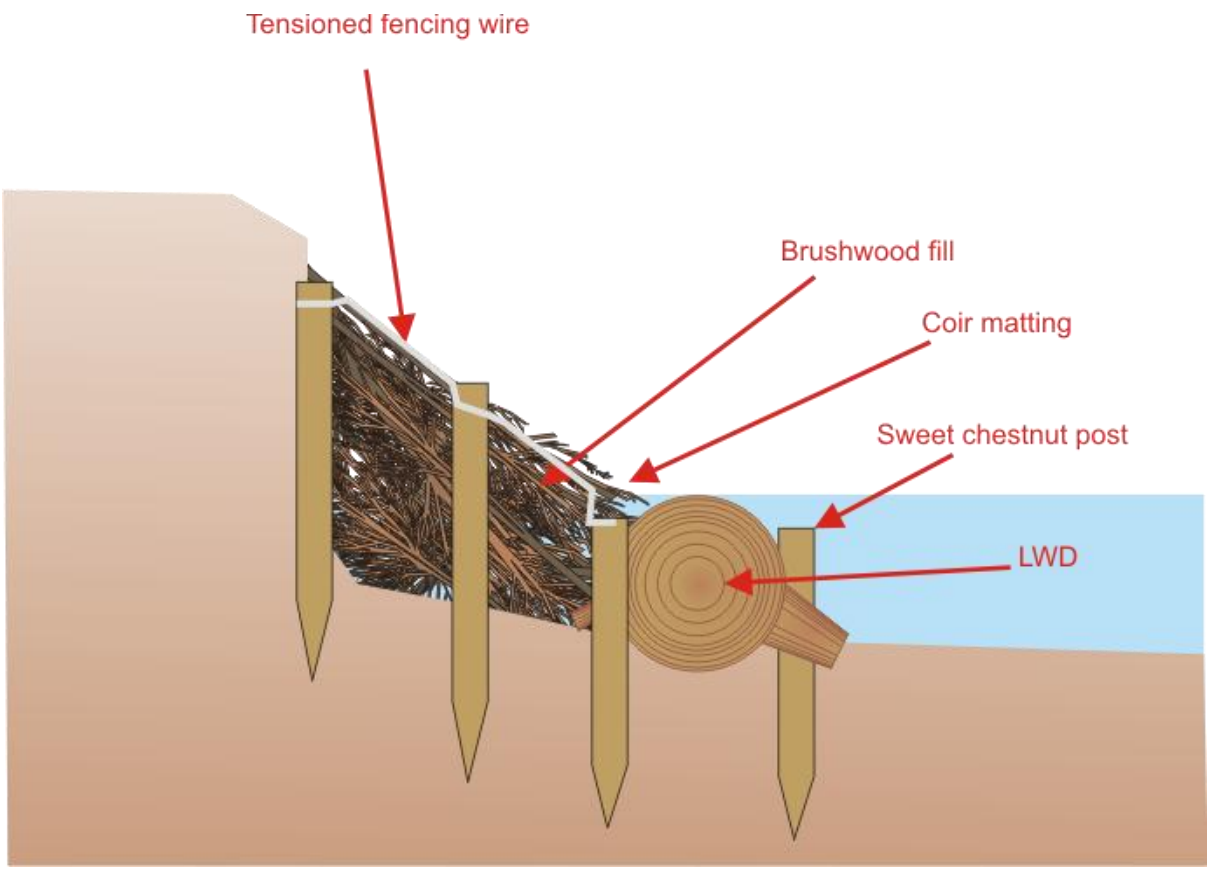

Figure 21: A LWD and brushwood sloping revetment

Another option could be to use some imported gravel. Coir matting (an inexpensive biodegradable geotextile made from woven coconut husk) can be used to create an enclosed cell that can be back-filled with gravel. Live willow stakes could then be driven through the structure to help anchor the revetment. By the time the coir has rotted away, a dense willow root system will be holding the structure together and growing stronger every year.

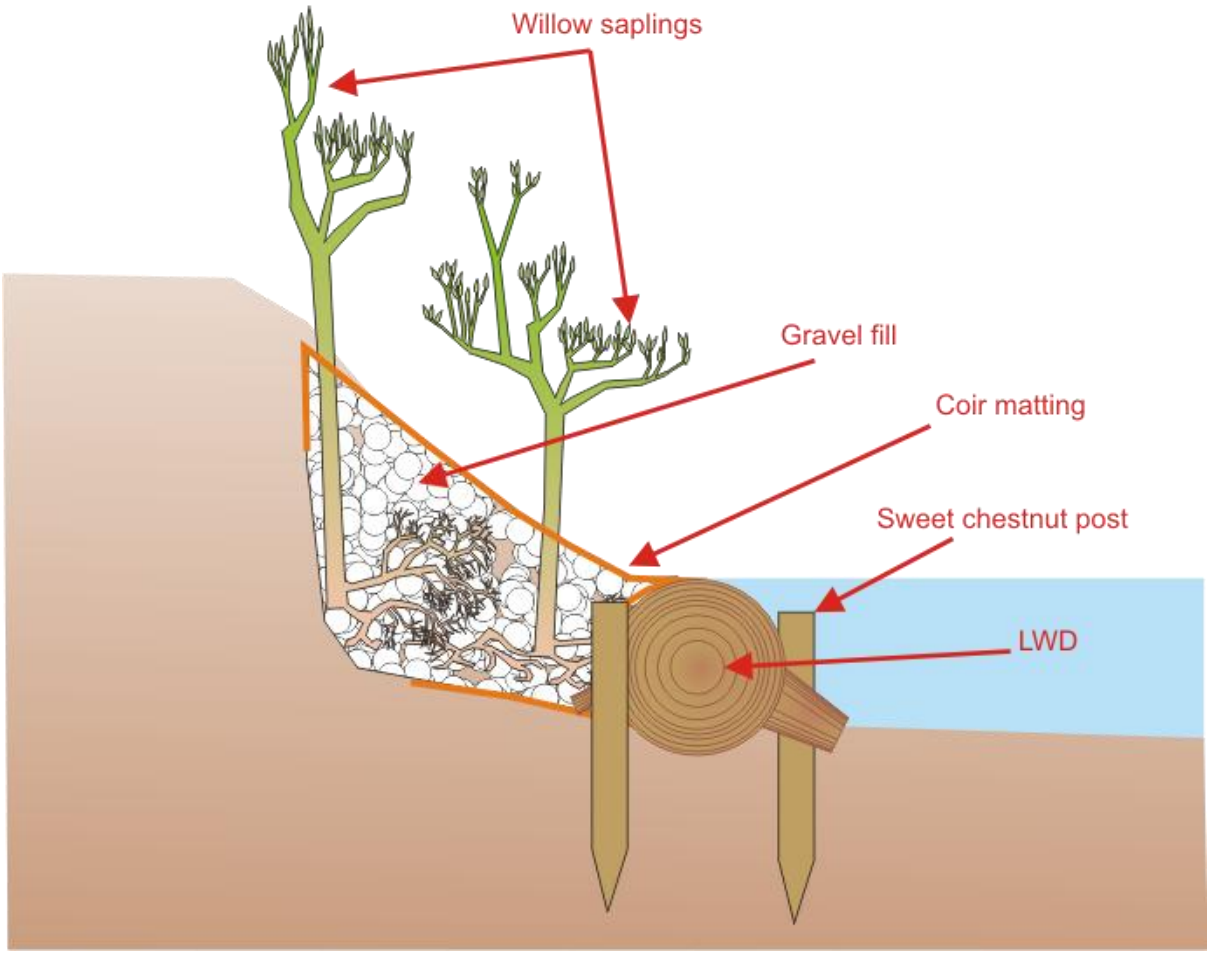

Figure 22: A gravel-filled alternative with live willow saplings

- The weir near Whitehall Mill is a barrier to fish passage. It is recommended that the potential for fish to bypass the structure via the mill stream or a small stream located to the south be fully investigated. If a suitable alternative route is not available, options to improve fish passage should be explored. The weir could be removed or lowered to ease fish passage through the system. This may however, have the consequence of depriving flow through the mill. Alternatively, the weir could be modified to ease fish passage by means of timber baulks fixed to the downstream face to raise water depth over the structure.

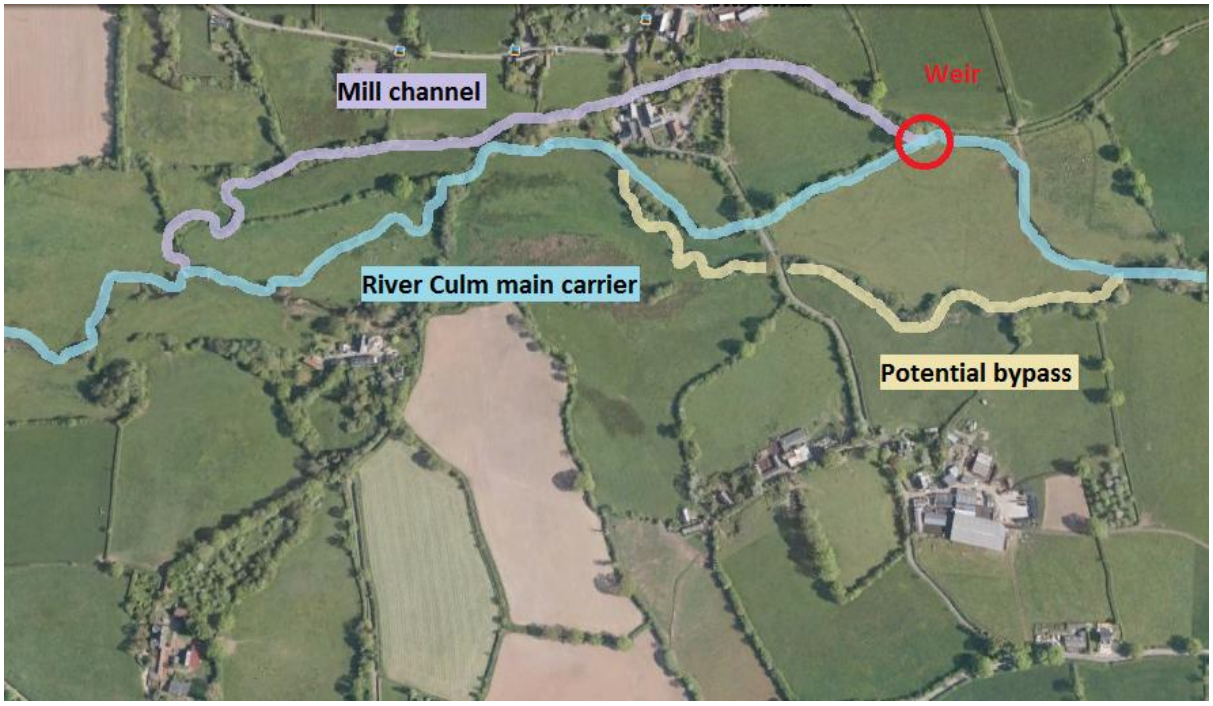

Figure 23: The location of the weir near Whitehall Mill and possible bypass channels

- The Culm has an obvious Himalayan balsam problem that will need to be addressed in order to preserve the biodiversity and stability of the riverbanks. Himalayan balsam is an aggressively invasive species that can out-compete many native marginal species. This can result in a monoculture along the riverbank and reduce habitat diversity. Balsam is also an annual plant with shallow roots. When it dies-back in winter months, banks are left bare and vulnerable to erosion.

  Many clubs have significantly reduced the impact of balsam by organising work parties to pull the plants from the soil in the late spring before they go to seed. Some success has also been reported from programmes of repeated strimming above the first node on the stem.
  Alternatively, Himalayan balsam can be sprayed with a glyphosate-based herbicide. This requires permission from the Environment Agency and should be undertaken by an NTCP qualified contractor.

6. Making it happen

There is the possibility that the WTT could help to start a project via a Practical Visit (PV). PV's typically comprise a 1-3 day visit where approved WTT 'Wet-Work' experts will complete a demonstration plot on the site to be

This will enable project leaders and teams 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 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 through guidance and linking them up with others that have had experience in improving river habitat.

Acknowledgement

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

Disclaimer