WILD TROUT TRUST

River Esk Walkover (lower)

(West Cumbria)

Prince Albert Angling Society

5/02/2021

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Key findings

- Much of the River Esk has been significantly modified from a natural state. Realignment and straightening have left many areas unable to create and maintain the diversity of pool and riffle features that should occur. Extended sections therefore provide very uniform habitat (often long shallow sections) as a result.

- Work has previously been undertaken to create depth with weirs and boulder deflectors, but these are generally counterproductive to the development of natural river processes. As with all weirs, many of the structures are now acting as sediment traps, with the pools they create filling with sediment over time.

- Numerous options to reinstate a more natural channel with improved habitat exist. The primary option would be to reinstate sections of the lost river course wherever possible; the feasibility of which will be dependent upon how receptive the landowners and tenants are, and the potential funding opportunities.

- Alongside restoration, in-channel habitat improvements could be initiated to increase flow diversity and develop a better functioning channel. Increasing the availability of structure and cover within the river would increase the fish-holding potential of many areas. However, it is important to recognise that this work would be most effective alongside channel restoration.

- Livestock grazing is a significant issue in several places, degrading bankside habitat and increasing erosion rates. Correspondingly, the bank line is retreating, and areas of the river channel are becoming overwide.

1. Introduction

The Wild Trout Trust (WTT) and local Environment Agency fisheries officer were invited to undertake an advisory visit to Prince Albert Angling Association's (PAAS) water on the River Esk in West Cumbria. Walkovers were undertaken on two consecutive Fridays, and will be reported in separate documents:

This report:

- **River Esk – PAAS (lower)** - walked on Friday 5th February 2021 and covering Black Dub down to Donald's Pool

And the upper section report:

- **River Esk – PAAS (upper)** - walked on Friday 12th February, covering the upstream limit of PAAS water downstream to Black Dub

Both (along with many other previous WTT reports) available for download on the Wild Trout Trust website www.wildtrout.org/map.

Normal convention is applied throughout this report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream. The Ordnance Survey National Grid Reference system is used to identify specific locations. For continuity, the walkover is reported from the upstream limit visited, progressing in a downstream direction.

2. Background

River	Esk (Cumbria)
Waterbody Name	Esk (South West Lakes)
Waterbody ID	GB112074069930
Operational Catchment	Irt-Mite-Esk-Annas
Management Catchment	South West Lakes
River Basin District	North West
Current Ecological Quality	**Moderate** - 'Fail' for Polybrominated diphenyl ethers (PBDE) and Mercury.
U/S Grid Ref inspected	NY 16145 00065
D/S Grid Ref inspected	SD 12202 97533
Length of river inspected (KM)	6

Table 1 Overview of the section visited

Like many West Cumbrian Rivers, the Esk is a naturally high gradient, rainfed river. Its ~25 km course originates around the Scafell Range of the Lake District, before flowing in a south-westerly direction to join the Rivers Irt, Mite and Annas, near Ravenglass and entering the Irish Sea. The geology of the catchment is dominated by tough igneous rock with low permeability which in addition to the steepness, adds to the rate of runoff following rainfall events, creating a river that is subject to high peak and low base flows. The bedrock of the catchment is overlain by areas of peat and till, with alluvium (gravel, sand, silt and clay) becoming more prominent in the lower reaches. These characteristics create a naturally low productivity river, well suited to the production of migratory fish populations.

As with much of the Lake District, upper areas of the catchment are predominantly moorland sheep grazing, with limited tree regeneration and depleted vegetation diversity. Progressing downstream, riparian woodlands become an increasing feature.

Cycle 2 classifications

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Classification Item	2013	2014	2015	2016	2019
Overall Water Body	Good	Good	Good	Good	Moderate
Ecological	Good	Good	Good	Good	Good
Chemical	Good	Good	Good	Good	Fail

Table 2 Current Water Framework Directive classification Esk (South West Lakes).

https://environment.data.gov.uk/catchment-planning/WaterBody/GB112074069960

The section of river covered in this report falls under Water Framework Directive (WFD) waterbody:

- Esk (South West Lakes) - GB531207408400.
    - This waterbody achieves an overall status of 'Moderate' Ecological Status, achieving 'Good' or 'High' for all parameters assessed apart from 'Priority hazardous substances'; for which it fails on 'Polybrominated diphenyl ethers (PBDE)' – most waterbodies fail on this parameter following its recent inclusion in the suite of testing.

3. Habitat Assessment

Figure 1 The lower section of the Esk, from Black Dub to Donald's Pool, has been significantly straightened but also has numerous man-made weirs and flow deflectors installed. These provide some flow variability but create a range of unintended consequences. Here the structure is impeding natural sediment transport between pools and disrupting the flow into Black Dub (SD 13518 97997). It would be far better to allow natural shallower riffle features to form between the pools.

Figure 2. Sheep grazing is contributing to bank instability at Black Dub (note the lack of vegetation) and will hinder attempts to restabilise it (SD 13513 98017). Flow disruption caused by the structure upstream (**Figure 1**) is also contributing to the gravel bar within the channel, forcing flow into the bank. The top of a fallen tree in the river has been cut, reducing its habitat value and diminishing the bank protection it could provide. It is far better to leave fallen trees intact; the rootball acts as an anchor and the diffuse canopy dissipates flow (often turning an area of erosion into an area of deposition).

Figure 3 A weir at the downstream end further interrupts the transport of bed material, leading to shallowing of the pool (SD 13458 97955). It also focusses flow into the centre of the channel when a healthy river flow should be allowed to naturally move back and forth from one outside bend to the other as it progresses downstream – it should not be constrained in the centre of the channel.

Figure 4 Another rock weir structure a short distance downstream creates less of problem for sediment transport but still detrimentally locks the bed in place and unnaturally constrains flow to the centre of the channel (SD 13449 97911).

Figure 5 Impounded water upstream of the next weir structure (SD 13430 97858). Between pools there should naturally be shallower depositional areas of gravel/cobble and riffled water that provide vital habitat for a range of invertebrates and juvenile fish. Instead, that valuable habitat has been degraded in an attempt to artificially create depth. Depth created by an impoundment will always diminish over time as bed material is trapped upstream (see **Figure 6**). Again, the weir focusses flow to the centre of the channel, disrupting the flow approaching the next natural pool downstream.

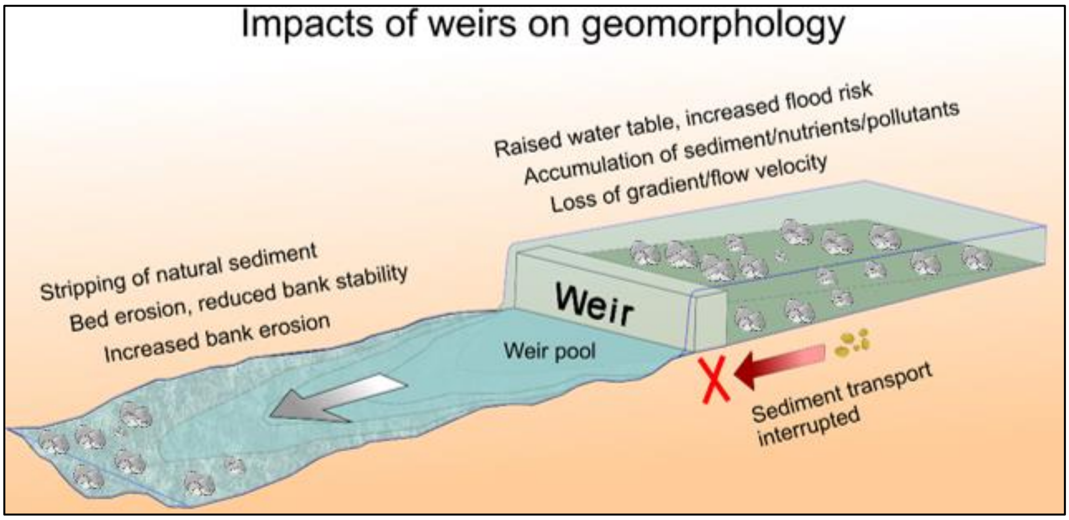

Figure 6 Shows how deeper water created by weirs is only temporary and any depth created is at the expense of flow diversity. The de-energised flow upstream deposits sediment, reducing depth over time as the pool fills up with bed material. Eventually the pool becomes, shallow enough to have sufficient flow energy to transport additional bed material past the weir, but that process remains more erratic than would occur without the weir. Weirs also create negative impacts upon habitat upstream through reduced flow diversity. That is why it is always preferable that pool depth is created and maintained naturally through scour, avoiding full width obstructions like weirs. Moreover, when installed at an existing pool, the reduced gradient upstream (and reduced flow energy) resulting from the raised weir means that the pool is likely to end up even smaller/shallower than before the weir was installed.

Figure 7 Being at a bend, the deep water at Knott End Dub is more naturally maintained by flow and bed scour around the outside bend. Overhanging trees provide valuable shade and additional cover which should be retained – a classic sea trout lie.

Figure 8 Looking back upstream at Knott End Dub (SD 13364 97800), the trees on the LB (right of shot) provide valuable cover, but a history of pruning and natural sloughing has left them lacking low branches. Coppicing one or two trees to use as lodged woody material and laying a small shrub along the bankline (red outline) could help to redress the lack of cover and increase the fish-holding potential of the pool. Planting a couple of goat willow whips in the open sections could also help.

Figure 9 Deflectors (possibly with a full width structure beneath) disrupt the tail of the pool and what would otherwise be a better potential salmonid (particularly salmon and sea trout) spawning area (SD 13343 97792). Deflectors along the RB in the shallow riffle further downstream prevent the predominant flow running tightly along the base roots of the trees (where it would be of greatest benefit), effectively straightening/smoothing out the bend.

Figure 10 In the faster water area downstream: a perfect example of naturally lodged large woody material (LWM). This could be replicated in other areas to increase flow diversity, drive improvements in the bed morphology and provide cover for fish (see **Recommendations**).

Figure 11 Although trees are present around the outside bend of Hazel Dub, there is a scarcity of low branches. While this kind of clearance was once the aim of many angling club work parties to ease casting, greater understanding of fish habitat proves this to be highly counterproductive, reducing the numbers of fish an area is likely to hold. Moreover, an open pool with reduced flow diversity and fewer features is less interesting to fish and easier for predators like cormorants to exploit. Selectively coppicing one or two trees could beneficially reinvigorate low-level branch growth (see **Recommendations**).

Figure 12 A weir (associated with flow gauging) at the tail of the pool creates a minor obstruction and would ideally be replaced by a stand-alone ultrasonic flow gauging, without a weir, to allow completely natural movement of fish and sediment (SD 13068 97799). However, considering the number of more damaging gauging structures nationally, this is low priority. Even in the impounded area, the substrate is relatively coarse, hinting that the high energy of peak flows within the uniform channel, which is incapable of retaining smaller gravel.

Figure 13 Much of this reach has been straightened (SD 13064 97805 - SD 12732 97949), with a notable loss of pools and deeper water. Some of the river's paleochannels (old course) are still visible within the woodland and options for restoring them should be investigated. Even allowing adjustment of the riverbanks would be a great improvement on the uniform channel. The occurrence of low and trailing cover increases, and the available habitat is gradually improving as a result, becoming more likely to hold fish. However, the channel remains uniform in depth and width.

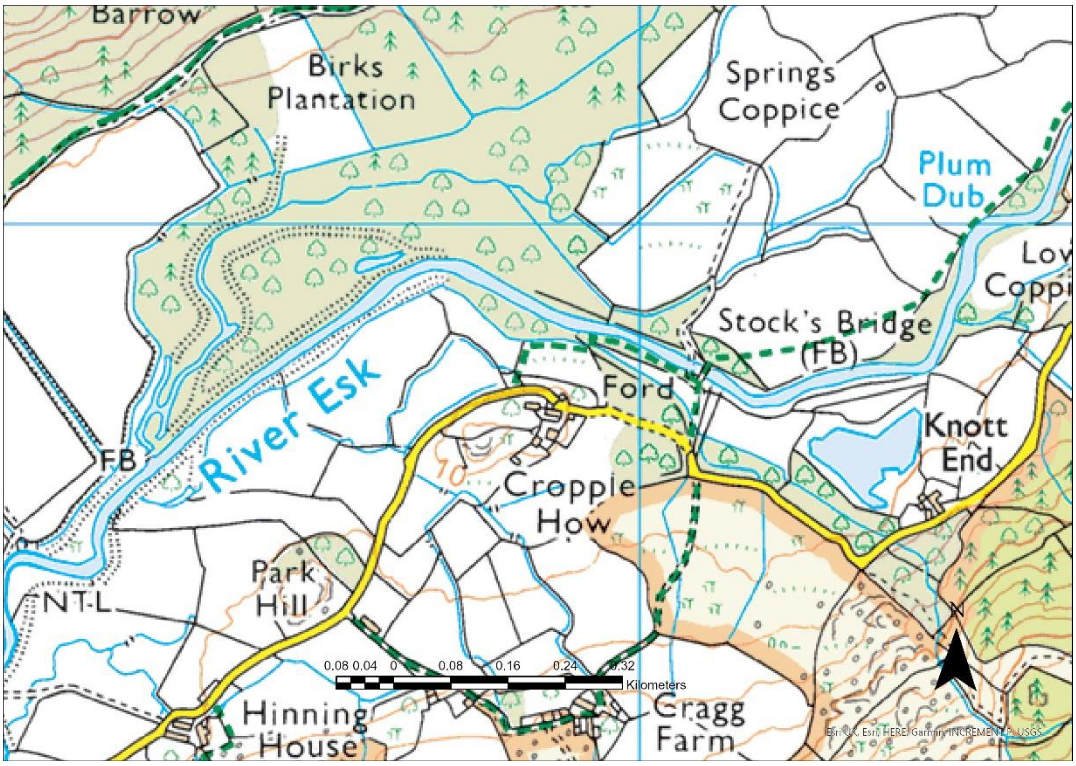

Figure 14 Shows the current Ordnance Survey 1:25k map and the course of the river.

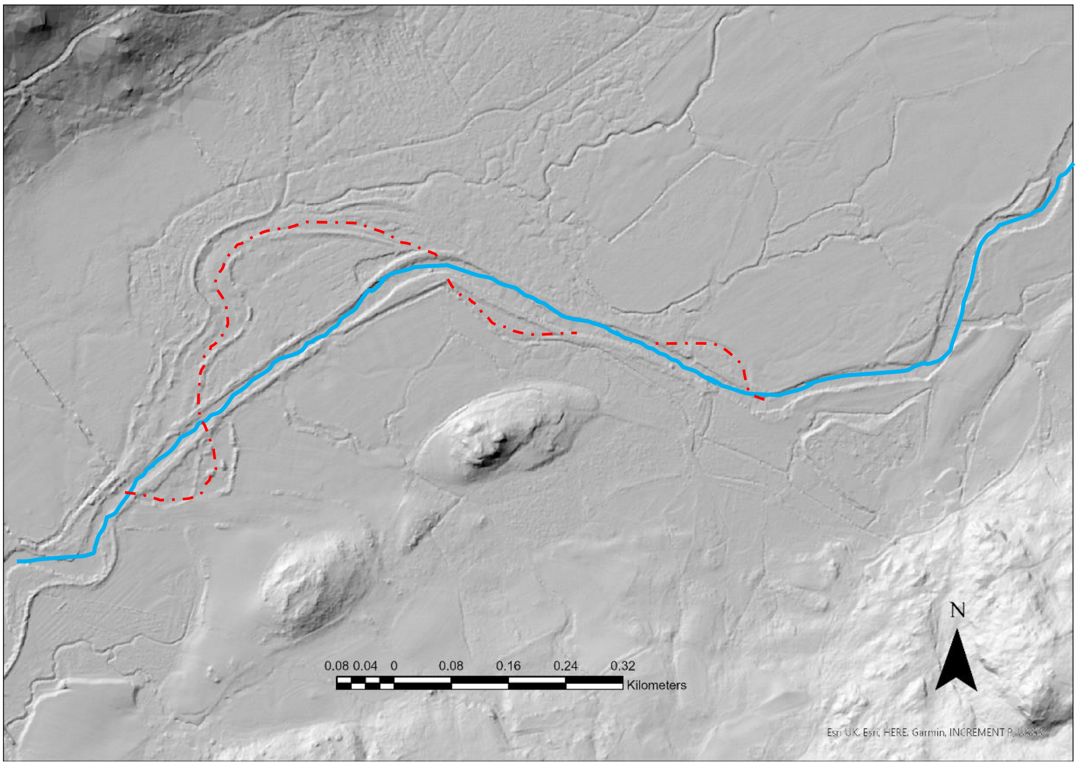

Figure 15 Shows the Environment Agency's 2019 LiDAR (Light Detection and Ranging) map of the same area as Figure 14. LiDAR is a laser scan of the ground made from an aeroplane which shows the relative level of the ground (and water). This clearly highlights the current, straightened and uniform channel (solid blue line) and the much longer, more sinuous and variable areas of the lost natural course (red dashed line). The potential to reinstate any of these areas could not only increase the availability of habitat, through increased channel length, but also greatly increase the quality of any associated habitat (including areas upstream and downstream).

Figure 16 More examples of naturally lodged woody material within this reach. The scour associated with this lodged branch has created a small pocket of deeper water, a good demonstration of how increased flow diversity can create fish-holding features. Replicating this feature with larger material could create larger features and help to move the flow around within the channel. Numerous options for installing woody material in the channel were observed between Hazel Dub and Donald’s pool.

Figure 17 At a slight bend in the channel, the natural creation of depth along the outside of the bend (although far less than on a natural, more sinuous meander) provides some habitat improvement. The overhanging/trailing trees further improve the habitat of the area and should be preserved. Planting to create additional overhanging cover would be beneficial (see **Recommendations**).

Figure 18 Where groups of tree trunks occur (in this case mainly alder), they create ideal locations for installing lodged woody material (see **Recommendations**). The ideal locations and size/extent of any structure would be dictated by existing in-channel structures. The aim is to maximise the sinuosity of flow while not overcrowding the channel (which could lead to one structure counteracting the next).

Figure 19 In the area, around Cropple Howe, the fenced woodland is allowing tree regeneration to occur. Particularly notable is the presence of young willows which, owing to their palatability, are often the first tree species to be lost through sheep grazing (as has occurred elsewhere). Some of the larger/more mature trunks could be laid (similar to hedge laying) further into the channel to increase flow diversity (see **Recommendations**).

Figure 20 The remains of a resistivity fish counter at The Flatts (SD 12811 979050). While it does not create a major barrier to fish or sediment, a fixed cross section in the riverbed reduces its ability to adjust and remain free from fine sediment/silt. The level bed cross-section also distributes flow across the channel, encouraging uniformity of the bed up and downstream. The best solution would be to remove the structure, allowing natural flow patterns and sediment transport to re-establish.

Figure 21 Downstream of other trailing branches, smaller gravel is deposited in the river margin and what is suspected to be the remains of a redd was observed. This is not the ideal location for a redd (and was partially exposed at lower flow on 12th Feb). However, it demonstrates the value of increasing flow diversity within the channel and the lack of suitability for spawning within other areas.

Figure 22 The bend at Buttress Pool helps to maintain depth, although the channel is still significantly realigned and restationed here. The river course pass through the woodland, further into the right bank, with one or more sizeable bends and several smaller meanders. This constitutes a significant loss of habitat length and quality in the area.

Figure 23 Two weirs have been installed downstream of Buttress Pool (SD 12649 97917 & SD 12617 97889). These structures rob the pool upstream of flow energy, focussing it immediately downstream of each weir. As a result, you get a short deep pool that is less valuable to fish or angling, as the de-energised pool tail fills with depositional material. When that is coupled with unnatural funnelling of flow to the channel centre (creating dead areas at either side downstream), and additional weirs downstream which impound flow, the issues are compounded (see **Figure 24**).

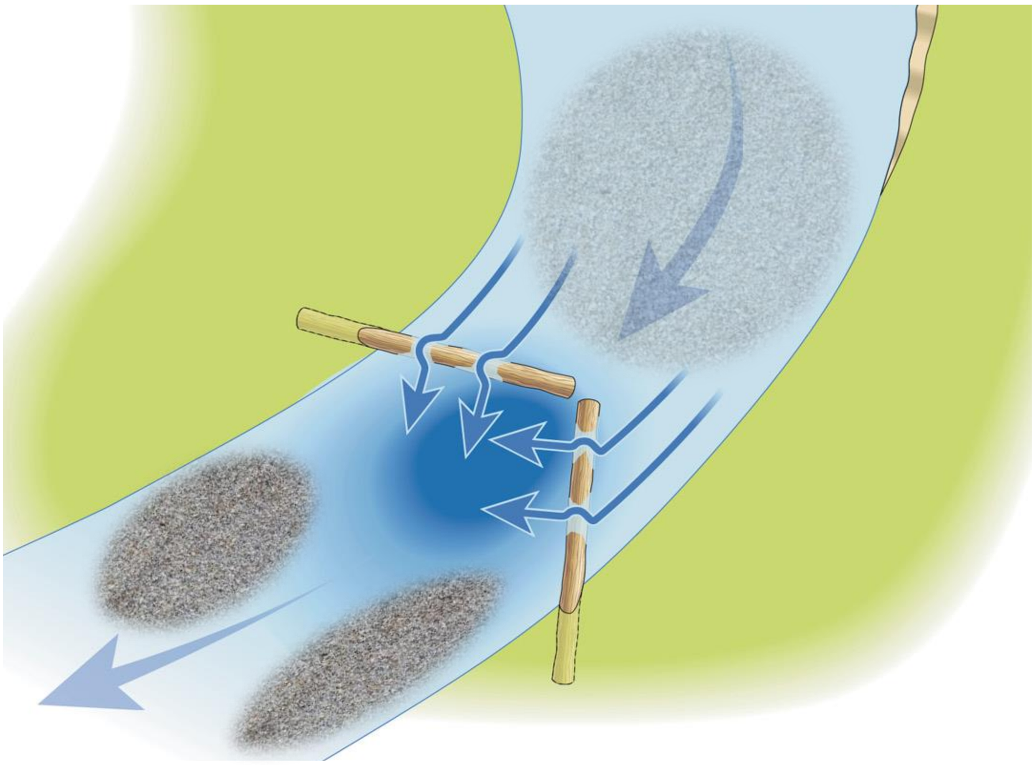

Figure 24 Shows how full-width structures reduce flow energy, leading to uniform deposition across the pool upstream. Turbulence will create depth immediately downstream of the structure but fails to maintain a natural pool profile with a gradual tail (also reducing the potential for salmonid spawning). Focussing flow into the centre of the channel (through a central notch, upstream 'V' or horseshoe) also reduces flow energy at either bank side downstream, often leading to areas of deposition at either side. These scenarios are not beneficial to the creation of high-quality pool habitat, as the highest velocity flow should naturally pass round the outside bend unimpeded.

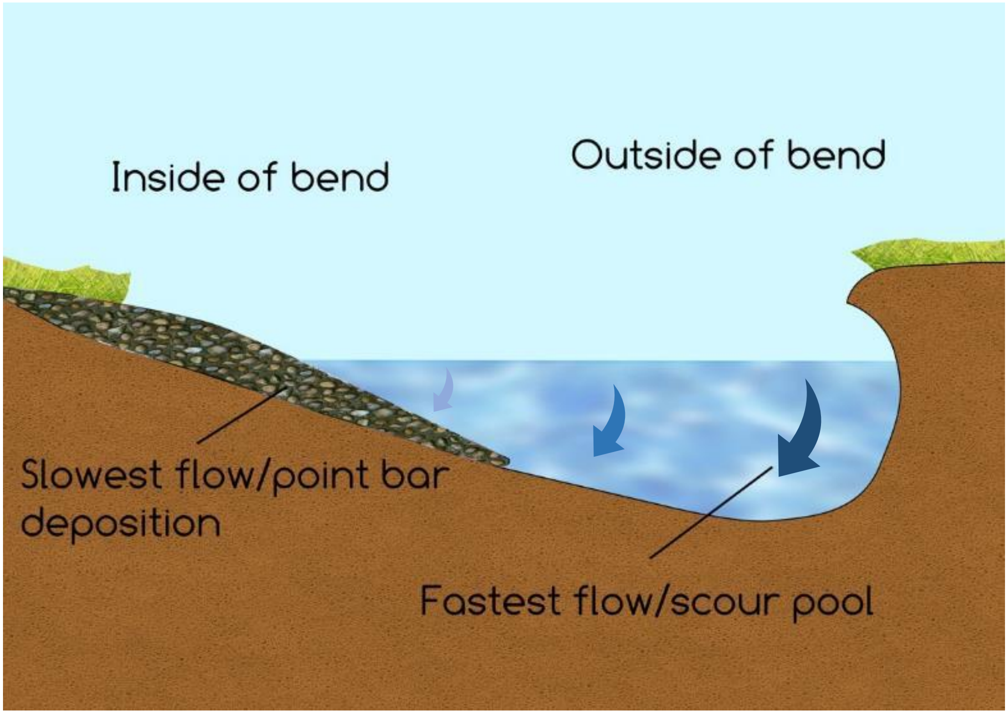

Figure 25 A natural pool cross-section. Deposition is beneficially on the inside, where it helps to focus flow to the deeper outside bend. A natural pool, on a bend, is therefore self-maintaining through scour. It can adjust to the flows experienced and creates sustained depth, unlike a weir or impoundment that leads to unwanted deposition in the deeper area and shallowing over time. This cross section is also more resilient to low water as flow is always encouraged through the deepest area.

Figure 26 The next set of paired deflectors downstream funnel flow down the centre of the channel. A better outcome would be to deflect the flow from one bank side to the other (SD 12581 97866). Flow deflectors can have a role within a modified channel such as this, but better habitat would be achieved with partial width, offset structures; these create a more sinuous flow route down the river and self-maintaining depth. Further Improvements could be achieved by installing lodged woody material, which complements offset single deflectors far better than paired deflectors. Ideally at least one side of this deflector should be removed.

Figure 27 Bankside willows continue to provide natural improvements and material that could be consolidated with additional material to create more influential flow deflection structures.

Figure 28 A partially submerged (at high flows) birch tree offers another potential anchor for a deflector (SD 12406 97744).

Figure 29 At the outlet from the largest lost paleochannel, there is great potential for laying willows into the channel from the RB to diversify flow and trap gravel. This would then push more of the flow over to the far bank, creating more scour and depth there (SD 12320 97672).

Figure 30 The deflector on the outside bank (red circle) is counterproductive, effectively straightening out the flow pathway around the bend.

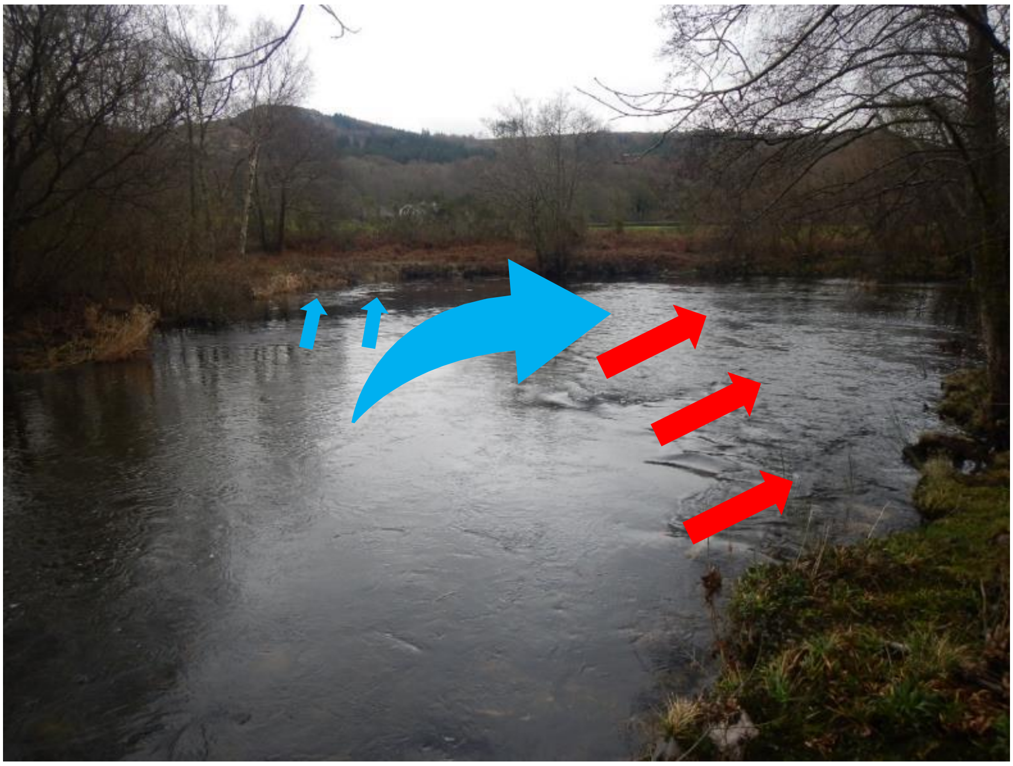

Figure 31 The Downstream extent of the walkover was Donald's Pool (SD 12234 97538). With minimal sediment storage in the confined and straightened ~1200m of channel upstream (other than trapped by the weirs), large volumes of bed material are deposited here after each flood, this being the first large pool. The situation is made worse by the boulder structure at the upstream end. This effectively acts as a downstream deflector to any flow overtopping it, encouraging that flow to fan outward, with some cutting the bend (red arrows). However, the structure is also deflecting sediment, which gets funnelled down the centre. Without the structure, the predominant flow should just pass around the outside of the bend (blue arrow) where it would maintain the pool that adjusts, depending upon the flow and sediment received. Instead, the flow dynamics of the pool here are severely disrupted.

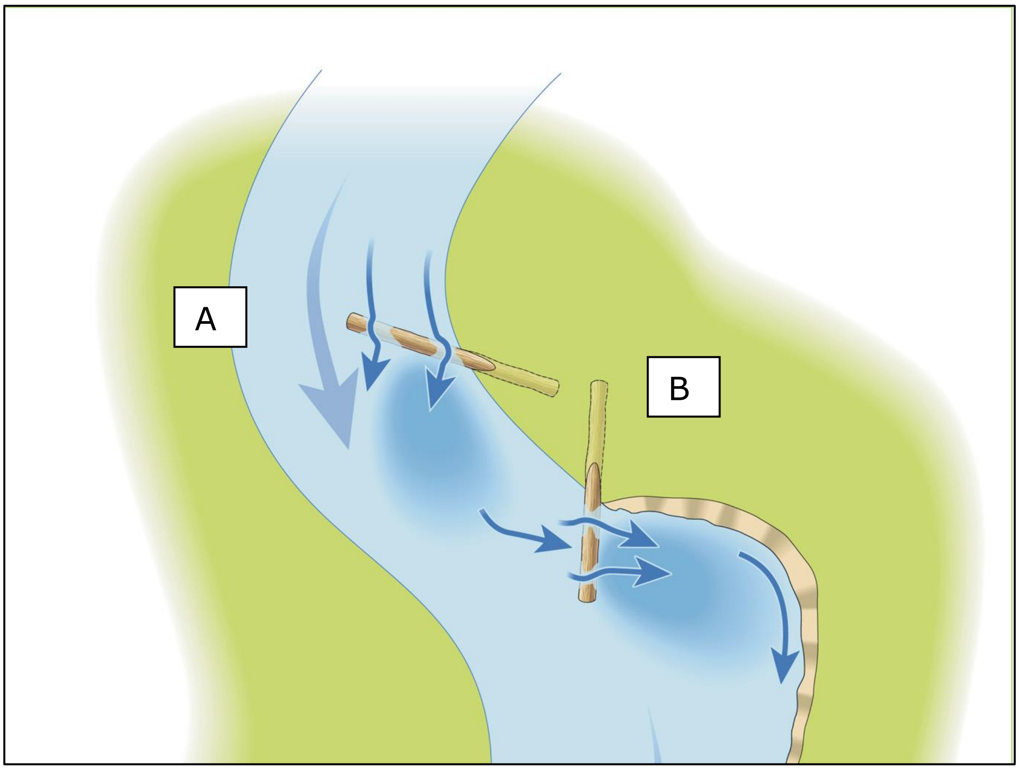

Figure 32 Shows the impact of upstream and downstream facing deflectors. Note how the upstream deflector (A) turns overtopping flow towards the centre of the channel and the downstream deflector (B) turns overtopping flow towards the bank. In the case of the inside bend at Donald's Pool, part of the structure is acting as a downstream deflector, causing a portion of the flow to cut the corner. Flow deflectors, though relatively simple are often misunderstood, making them a higher risk management tool than simply installing more diffuse natural features.

4. Summary

The major issues affecting upon the river section walked are:

- Significant channel straightening and re-sectioning, resulting in a lack of bends. Consequently, the river has a reduced ability to create and maintain deeper pool areas, and to distribute sediment storage naturally throughout the reach. Creating more discrete areas of natural deposition on one bank side or other could actually benefit the channel morphology, moving the flow around more.

- The weirs and poorly located boulder structures disrupt natural flow diversity and geomorphological processes in many areas, with associated issues of artificially increased deposition in the wrong areas, and associated pool shallowing.

- There is an increased availability of low/trailing cover in some areas of this reach, but the prime angling pools (where it could create the greatest benefit) are open, likely owing to a long history of tree pruning and maintenance. This is counterproductive habitat management: although it may make casting easier, it will limit the fish-holding potential of those areas and reduce the overall quality of the fishing.

- Livestock access to the riverbank is contributing to bank instability at the upstream end of this section.

5. Recommendations

Livestock should be excluded from the riverbank around Black Dub, to allow a diverse strip of riparian vegetation to develop. This would improve bank stability and manage the existing erosion but also create a range of benefits to biodiversity, including provision of additional habitat for invertebrates, thereby improving the ecology of the river and providing more food for fish.

The primary recommendation is to reinstate more natural flow diversity and develop a self-maintaining river channel. This would ideally be achieved by restoring the lost paleo-channels through river restoration wherever possible. Reinstating more bends would reduce the channel gradient and initiate more natural sediment storage throughout the degraded reaches. In turn, this would aid the formation of natural pools and riffles and reduce the issues where an oversupply of sediment currently results in hot-spots of excess deposition. If restoration is infeasible, encouraging some carefully selected areas where lateral (bank) erosion could be allowed would help to improve the form and function of the channel. These options will obviously require further detailed discussions with the landowner(s), angling club and further advice from the Wild Trout Trust and/or Environment Agency.

Without either of the above treatments (and also alongside any such work), reinstating more flow diversity by creating a more sinuous inset flow pathways (within the existing channel) could deliver improvements (although far less dramatic than full restoration). Removing or significantly modifying the existing weirs and boulder structures within the river would also help significantly in reinstating a more natural channel morphology and self-maintaining pools. Even carefully selecting several structures and creating appropriately located bed-depth notches within them, would be beneficial as an initial step. This could help to demonstrate the benefits of allowing free sediment transport and demonstrate the case for further work. Again, further discussion and possible explanation may be required around these recommendations.

In addition, some simple techniques for habitat improvement are identified in the following section of this report and a summary table of locations where those recommendations would be beneficial can be found in the **Appendix**.

5.1. Low cover and in-channel structure

Where multiple trees are present, the occasional trunk can be cut and used to create a habitat enhancement feature, with no significant detriment to the overall habitat. For pliable species like willow, hazel and elm, this could entail partially cutting through the trunk, so that it remains attached and can be laid into or along the channel (Figure 33).

Figure 33 Willow hinged into the river margin to increase cover and structure. The method involves quickly cutting part way through the first two thirds of the stem, then continuing until it collapses down over the river. The depth of the cut should be limited to only that which is required to bend the stem over, as this will maintain maximum size and strength of the hinge and the health of the tree/shrub.

Alternatively, a tree can be felled to create a coppice, encouraging low-level regrowth from the stool, providing material that can be lodged between two or more standing trunks (Figure 34), or hung over another tree if a ‘V’ branch is available (Figure 35). Any felling or cutting of trees should be undertaken under further guidance (possibly through a WTT habitat workshop) as it would be easy to denude areas already lacking cover if the wrong trees were tackled.

Figure 34. A lodged flow deflector: securely but naturally lodged in place between two upright trees (red circle). The technique can utilise a single pole (primarily to increase scour) or a branched limb (to create greater flow dissipation and deposition). The elevated butt end (bank end) reduces the potential detrimental bank scour usually associated with downstream deflectors as a through-flow is maintained along the bank.

Figure 35. Medium-sized, lodged woody material, securely anchored by the 'V' of the branches against an upright tree.

Felled trees can also be tethered as downstream facing tree kickers (Figure 36 & Figure 37), where the butt of the tree is attached to its stump with strong cable. This is a highly effective method, but it is generally best to avoid the use of man-made materials, so where possible, the lodged material options may be a more natural choice.

Figure 36. A perfect example of how the diffuse canopy of a tree kicker can be employed to diversify flow and increase deposition in the river margin. Here, the structure focusses flow down the far side of the channel, maintaining depth with no negative impact upon the downstream transport of gravel. The structure itself creates valuable high flow refuge for fish. This kind of technique is designed to kick-start processes that will continue to develop long after the initial structure degrades. The same effect can also be achieved with the other techniques for installing in-channel woody material.

Figure 37. A basic tree kicker setup, using 4000 kg breaking strain cable and two pairs of cable clamps. The webbing strap in the background is used to pull the kicker close to the stump for fastening but is removed once the cable is fully fixed in place.

5.2.Tree planting

Tree planting with a range of native species would also be beneficial in any areas where livestock are excluded, to kick-start regeneration of greater diversity along the river. To complement the general planting with mixed native deciduous species (alder, aspen, oak, rowan and thorns, among others), willows could be planted strategically to rapidly create cover and provide material for laying into the channel in years to come.

The easiest way of establishing willow is by pushing short sections of freshly cut willow whip into areas of wet ground, ideally close to the waterline where plenty of moisture is available to the initially rootless sapling. Whip planting can be undertaken at any time of the year but will have the greatest success during the dormant season, shortly before spring growth begins (ideally late Jan-March) but can prove successful throughout the year in damp ground. This kind of planting should be undertaken sparingly to avoid overpopulation by willows.

Whips should be planted so there is a greater length (~2/3) within the ground, to minimise the distance that water has to be transported up the stem. Planting them on a shallow d/s angle will also ease water transport within the developing shrub and reduce the potential for it catching flood debris and being ripped out. Leaving 300-400mm of whip protruding from the ground is sufficient, providing they protrude well past the surrounding vegetation (to allow access to light). Whips of 5mm-25mm diameter tend to take best, but even large branches can be used. If undertaken during the growing season, care should be taken not to leave excessive amounts of foliage on the whips as these greatly increase the rate of transpiration and can lead to the whip dehydrating before the supporting root system can develop.

6. Further information

The WTT may be able to offer further assistance such as:

- Further dialogue with PAAS committee and members to discuss the habitat issues and potential solutions highlighted in the report. This could be in the form of additional site visits or presentations (face to face or online), to provide an opportunity for questions about any of the topics raised or general fishery management queries.

- WTT Practical Visit
    - Where recipients require assistance to carry out the improvements highlighted in an advisory report, there is the possibility of WTT staff conducting a practical visit. This would usually consist of 1-3 days' work in the river, with a WTT Conservation Officer(s) teaming up with interested parties to demonstrate habitat enhancement methods (e.g. tree kickers and willow laying etc.).

In these examples, the recipient would be asked to contribute to the reasonable travel and subsistence costs of the WTT Officer.

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

www.wildtrout.org/content/wtt-publications

We have 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 populations and managing invasive species.

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

Acknowledgements

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programme in England, through a partnership funded using rod licence income.

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.

Appendix

Table 3 Recommendations

Observation	Photo (If required)	Priority (1-3)	Location	Proposed action
Boulder structures upstream and downstream of Black Dub	 **Figure 1**	2	SD 13343 97792	Removal or modification of these structures to reinstate natural pools and riffles.
Overgrazing/bank destabilisation (RB)	 **Figure 2**	2	SD 13513 98017	Install appropriate buffer fencing. This is given a priority 2, as the impact is mainly on the landowner/tenant. The river channel/habitat would benefit through development of the bend. Fallen trees should be left intact.

Two boulder structures upstream between Black Dub and Knott end Dub	 **Figure 4**	2	SD 13449 97911 & SD 13430 97858	Removal or modification of these structures to reinstate natural pools and riffles.
Potential habitat improvement (LB)	 **Figure 8**	2	SD 13364 97800	Increased cover could be provided by very selective coppicing and willow whip planting.
Boulder deflectors at the tail of Knott End Dub and downstream	 **Figure 9**	1	SD 13343 97792	Removal or modification of these structures to reinstate natural pools and riffles. These could be an ideal candidate for removal as they are currently only impounding sediment and water upstream; however, their removal would not bring such great improvement as removing some of the others.

More potential river restoration(s)	 **Figure 13**	1/2	SD 13064 97805 - SD 12202 97533	1. Investigate options to restore paleo-channels. 2. As a minimum, seek to establish more flow diversity with in-channel structure through tree laying and lodged woody material.
Potential habitat improvement (RB)	 **Figure 18**	2	SD 12895 97870	It would be easy to cut a trunk here and instal it between the other trunks as lodged woody material.
The remains of a disused fish counter	 **Figure 20**	2	SD 12811 979050	Ideally, this disused man-made structure should be removed from the river to reinstate natural processes.

2 weirs, impounding flow	 **Figure 23**	2	SD 12649 97917 & SD 12617 97889	Removal or modification of these structures to reinstate natural pools and riffles.
Paired deflectors inhibiting the development of beneficial habitat features.	 **Figure 26**	2	SD 12581 97866	Removal or modification of these structures to reinstate natural pools and riffles. Options to remove or at least modify a portion from one or other side to improve in-channel flow and allow free sediment transport downstream.
Potential habitat improvement	 **Figure 28**	2	SD 12406 97744	Ideal location for lodged woody material.

Potential habitat improvement	 **Figure 29**	2	SD 12320 97672	Ideal location for tree laying and lodged woody material.
Counterproductive structures in-channel	 **Figure 31**	2	SD 12234 97538	Removal or modification of these structures to reinstate natural pools and riffles.