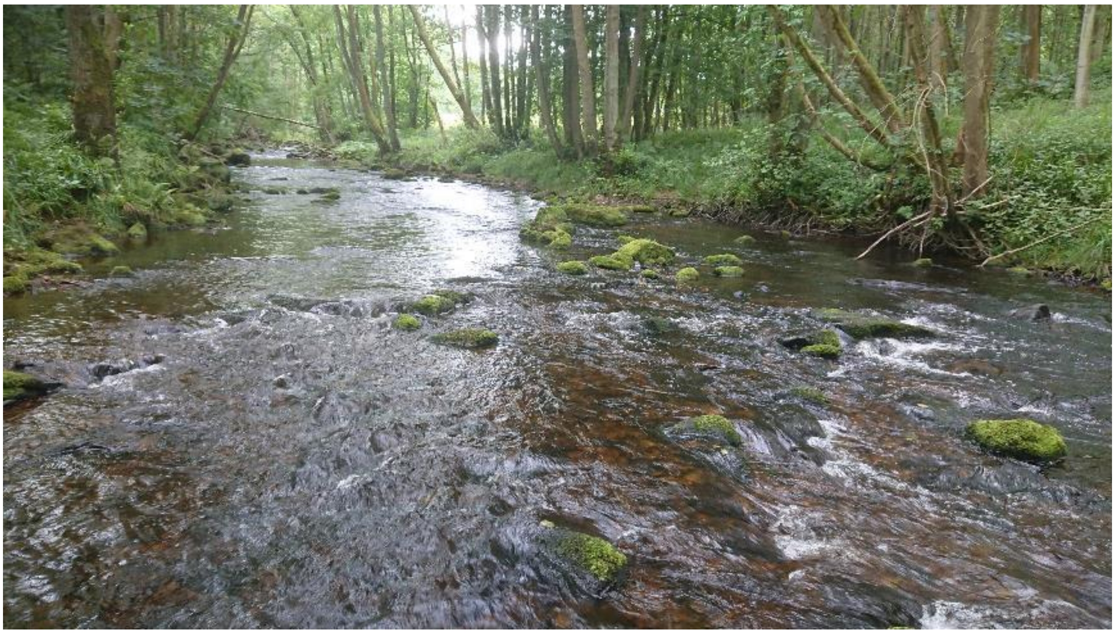
Advisory Visit

R. Burn, R. Ure tributary

Northern Fishing School

July 2019



Key Findings:

- At a glance, the substantial riparian fringes of mostly native vegetation along the River Burn hint at a waterbody in reasonable condition for salmonids and particularly brown trout. Whilst these buffers are indeed a valuable asset to be cherished and maintained, there are underlying issues from a legacy of channel modification (straightening and realignment, and subsequent pinning into position with revetment). Its flow regime is strongly influenced by these modifications, as is the character of the substrate, thereby limiting fish production.

- That said, it would only take some fairly simple measures to improve the quality of instream habitat given the quantity and quality of woody material on the banks. Retaining and sorting gravel to increase and improve spawning habitat (and improve micro-niches for macroinvertebrates – riverflies) will be key.

- The Burn has relatively little infrastructure along its length. However, an on-line fish farm will be having various negative impacts on the river and its ecology, especially associated with the weir that supplies the water. Several bridge footings create minor barriers to passage for trout and salmon, but may be limiting the use of the Burn by less accomplished leapers like grayling.

- The limited number of landowners may simplify negotiations and improve the potential for restoration / improvement projects. Combined with a progressive and dynamic team within Yorkshire Dales Rivers Trust intent on improving habitat along the Ure, the possibilities for the Burn as a truly wild fishery are encouraging.

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1.0 Introduction & Rationale

This report is the output of a site visit undertaken by Prof Jonathan Grey of the Wild Trout Trust to the River Burn at the request of Marina Gibson of the Northern Fishing School. The rationale was to assess in-river and riparian habitat quality, and identify any remedial actions that might be implemented.

Normal convention is applied with respect to bank identification, i.e. left bank (LB) or right bank (RB) whilst looking downstream. Upstream and downstream references are often abbreviated to u/s and d/s, respectively, for convenience. The Ordnance Survey National Grid Reference system is used for identifying locations.

	Northern Fishing School interests
River	River Burn
Waterbody Name	Burn from Leighton Beck to River Ure
Waterbody ID	GB104027069310
Management Catchment	Swale, Ure, Nidd, and Ouse Upper
River Basin District	Humber
Current Ecological Quality	Overall status of **Moderate** ecological potential based upon an overall ecological potential of **Moderate** and overall chemical potential of **Good**
U/S Grid Ref inspected	SE 16657 80040
D/S Grid Ref inspected	SE 23085 79751
Length of river inspected	~8000m

Table 1. Overview of the waterbody. Information sourced from: https://environment.data.gov.uk/catchment-planning/WaterBody/GB104027069310

Under the Water Framework Directive, the Environment Agency considered the Burn at this location to be of *Moderate Ecological Potential* as it is classified as a Heavily Modified Water Body overall. The reasons for not achieving good potential are physical modification and surface water abstraction which appears to have had greatest impact upon fish, currently considered as poor.

2.0 Catchment / Fishery Overview

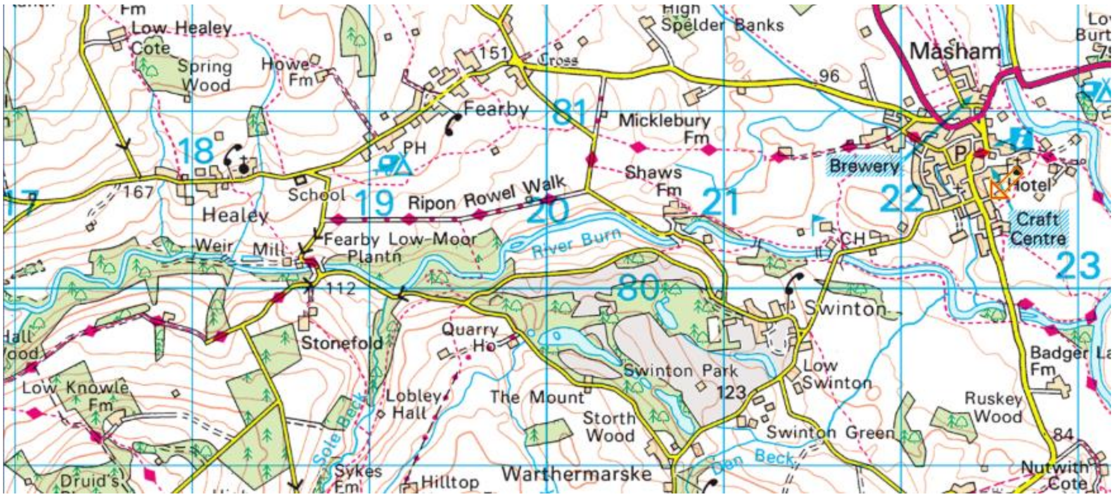

Fig 1. Map showing extent of the R Burn walked for this report, from its confluence with the R Ure to the south-east of Masham up to Leighton Beck in Hall Wood.

The Ure rises within the Yorkshire Dales Natural Area, which lies between the Cumbrian Fells and Dales and the Forest of Bowland to the west, and the Pennine Dales Fringe to the east. It is dominated by gently sloping Carboniferous gritstones, limestones and shales that have been eroded by glaciation to form a broad valley. Limestone bedrock buffers the acidic moorland runoff from the North Pennine Moors but the tributaries are still affected by the heavy tannic staining of water from the peat. The overlying superficial deposits of till and alluvium along the valley result in relatively friable and easily erodible soils.

The area has been used primarily for pastoral agriculture and as a consequence, native woodland cover is scarce, but the Burn catchment appears to have retained a reasonable proportion albeit augmented by plantation. Moorland gripping (digging of extensive drainage ditch networks) has had a marked impact upon the catchment, contributing to increased frequency and intensity of high flow events.

Habitat Assessment

The confluence of the Burn with the mainstem Ure (RB) was well protected by alder trees and maintained sufficient depth of water for uninterrupted fish passage to and from the tributary (Fig 1). The presence of trees on either side is beneficial for two main reasons. They provide low cover for fish as they transition from the relative safety of the larger, deeper Ure into the shallower Burn for larger fish, and vice versa for smaller fish emigrating the Burn. Tree roots also stabilise the banks and maintain the width of the Burn channel in a sufficient pinch to ensure that substrate transported down the Burn during spate flow is 'blown' straight through into the Ure, rather than backing-up and depositing at the mouth, and hence, reducing the depth and opportunities for fish passage.

Fig 2. The confluence of the R Burn (from the RHS of image) with the mainstem Ure at SE 23085 79751 was accessible / passable to fish at low flow and had good low cover from native riparian trees, mostly alder.

The lower reach from Thorpe Rd bridge to the confluence exhibited the hallmarks of historic straightening: rock revetment along the banks, an over-capacity channel with dry substrate to the banks, and almost continual fast glide or riffle characteristics (Fig 3). A straightened channel is steeper and, consequently, water flows faster causing greater erosion, scouring away smaller components of the substrate like gravel and leaving behind a predominance of boulder and cobble. A saving grace for the reach was the decent buffer (>30m in places) of (mostly) native riparian (bankside) vegetation, protecting the channel from any undesirable chemicals and nutrients applied to the improved agricultural land on either side. Further benefits include much needed shade, introduction of leaf litter directly to the Burn for invertebrates to feed upon, and food and shelter for terrestrial invertebrates which will also fall onto the water and contribute to the diet of fish. However, because the channel was over-capacity for the majority of flows, the wetted channel was separated from the bank by dry substrate and hence the vegetation provided scant low cover via trailing / submerged stems or branches, essential refugia for fish from predators and spates. Only the occasional alder root matrix extending from the toe of the bank created such habitat.

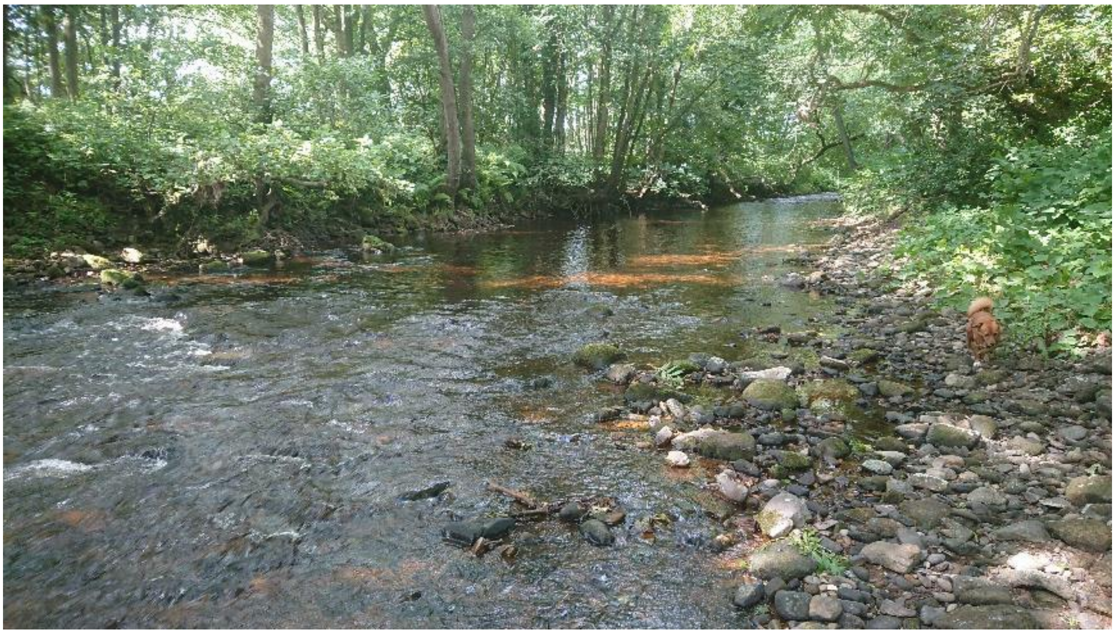

Fig 3. The lower reach of the Burn from Thorpe Rd to the Ure has been straightened and exhibited almost continuous riffle or shallow glide. Note no low cover over the water's edge. The riparian fringe was broad – a good buffer from the imprived pasture on either side, but some extensive stands of the invasive Japanese knotweed were evident.

Some stands of Japanese knotweed were quite extensive. There were few obvious signs of this pernicious invasive species further u/s on the Burn, hence, they probably originated from the Ure and propagules deposited during spate flow; see Recommendations.

Just below Thorpe Rd Bridge, there was a defined split in the channel around a well-established and vegetated island which was probably caused by sediment deposition d/s of the 'pinch' of the bridge (Fig 4). The two channels exhibited very different characteristics, and both are important for different reasons. The minor channel, while probably not 'fishable', provides slower flow characteristics and more shelter for juvenile life-stages, especially the vulnerable fry, whereas the main channel will be favoured by parr and adult fish.

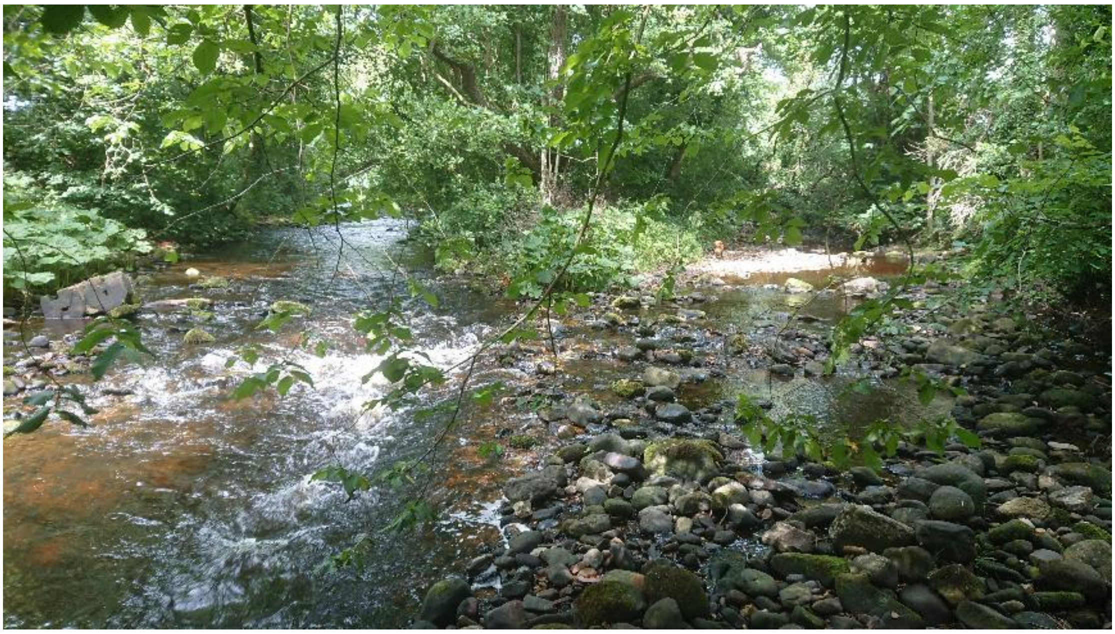

Fig 4. Potentially resulting from sediment deposition d/s of Thorpe Rd bridge (SE 22661 79835), an island had formed with the main channel hugging the RB and a smaller but nevertheless important side-channel to the LB.

Thorpe Rd Bridge presented the first obstacle to free fish passage on the Burn, the extensive footings creating shallow fluming flow beneath the bridge and culminating in being 'perched'; i.e. the substrate d/s of the formal structure having eroded away over time (Fig 5). That erosion has been exacerbated by the impounding effect of the footings on the u/s side, effectively interrupting re-supply of gravel and small cobble.

All riverine fish need to move u/s & d/s during the course of their life: to exploit new / seasonal food sources, to spawn, to relocate after displacement during spates, drought, periods of high temperature or pollution. Such an obstruction may be passable at specific times / flow heights for some species or life-stages, but these windows of opportunity might be 'out of sync' with when fish actually want or need to move. It is these periods when it is not passable that are of concern and can have hidden consequences. We now know for example that such barriers may have genetic consequences for the wider population by 'selecting' which fish make it past the barrier to spawn. Trapped fish repeatedly exerting energy in attempts to leap the barrier are weaker as a consequence and have less energy to put into onward migration or fleeing from predators. Even a seemingly low obstruction can be limiting to weaker swimming / leaping species like grayling. Although the finer structure of the footings was not examined in detail, there are various simple and effective techniques to improve passability.

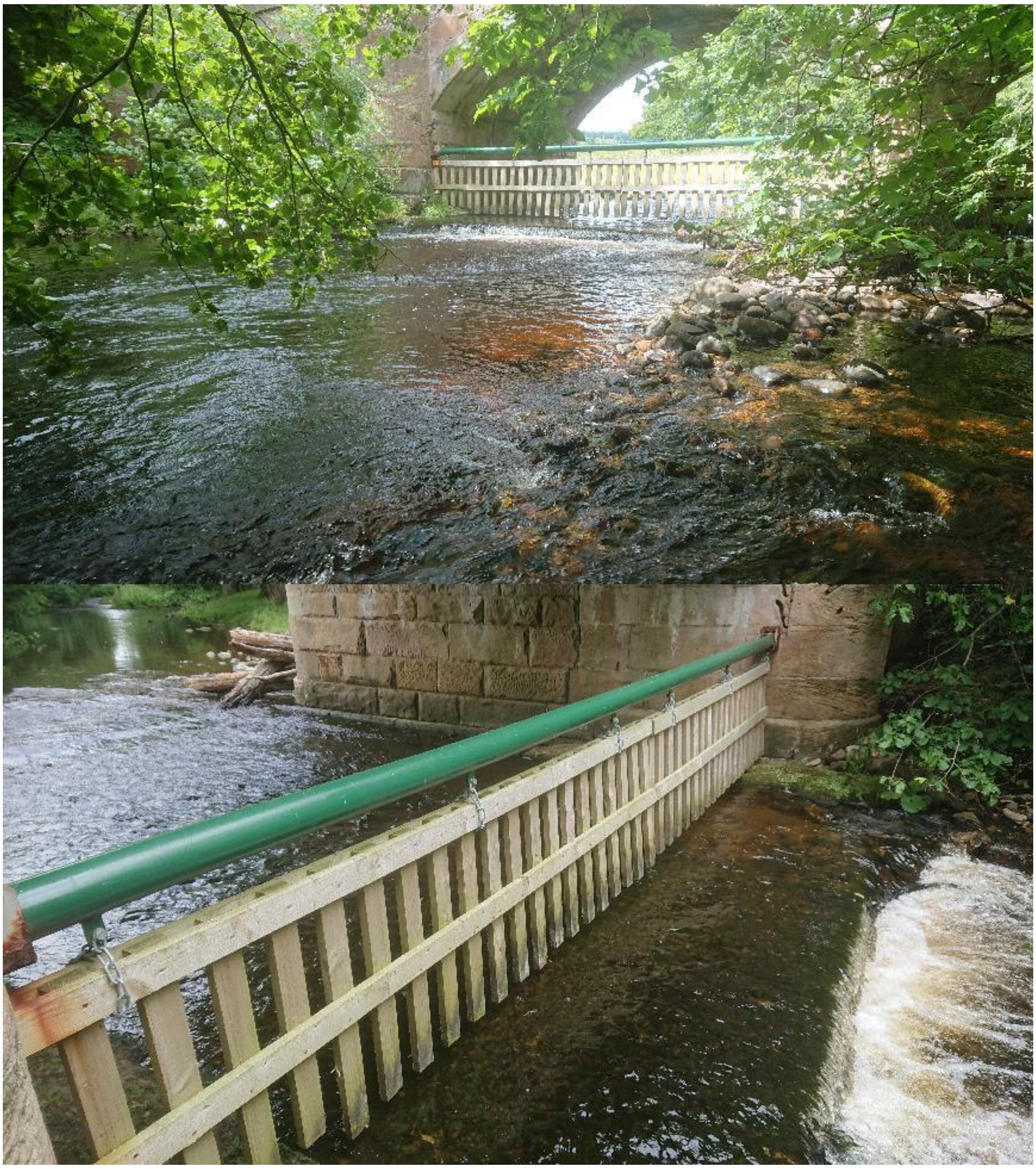

Fig 5. Thorpe Rd Bridge was multi-arched with the majority of flow passing through one aperture. Footings of dressed stone were perched on the d/s side presenting ~15cm headloss into a deep weir-pool. The step combined with a shallow flume of water over the footings for ~10m present an obstruction to fish passage. Note the impounded section u/s. Water-gates prevented stock movement d/s – these always present ongoing maintenance issues, and it is usually more effective (with wider benefits) to simply exclude livestock from the watercourse.

Immediately u/s of the bridge, the impounded section was shallow and wide with no focal flow path and little cover for fish. Without defined flow, sediment had deposited uniformly across the channel. These undesirable channel characteristics were further exacerbated by both banks being heavily grazed by livestock (horses present during the walkover; Fig 6). The understory vegetation was reduced to a predominance of short-sward grasses, which, when continually cropped by grazing, invest energy in replacement of shoots rather than generation of roots. Hence, cropped banks only have a very shallow root matrix present in the soil which offers little resistance and resilience to spate damage or livestock trampling. There were no self-set trees evident either; these are typically browsed

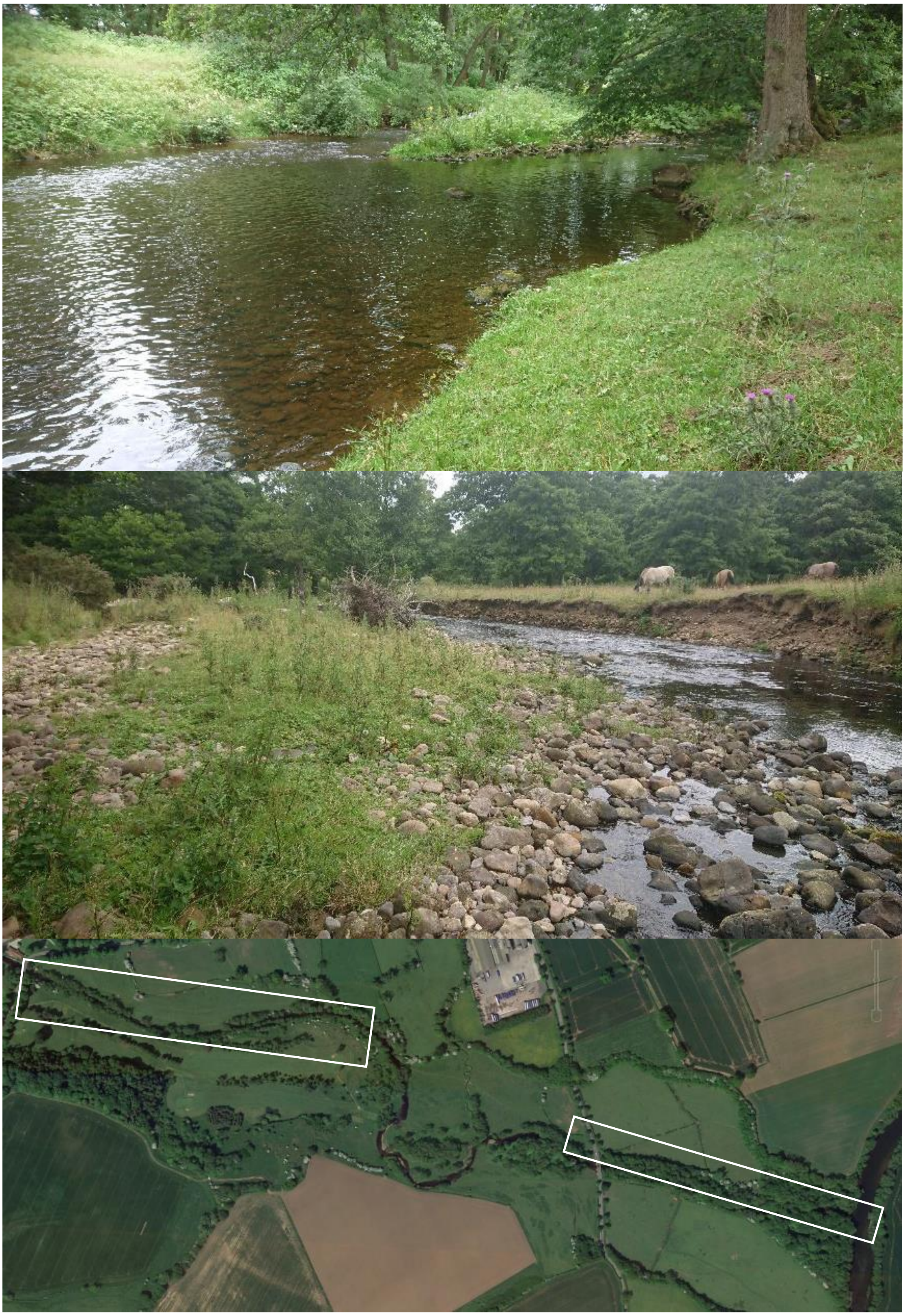

Fig 6. U/s from Thorpe Rd Bridge, livestock had free access to the bank edge for ~750m. Consequently, erosion was rife and cover limited to mature trees. Note lack of root matrix in the soil on the RB (mid panel). Google Earth image (lower panel) demonstrates the meandering Burn where the banks have been weakened by livestock, between the heavily straightened /realigned sections u/s & d/s (in white boxes).

preferentially because they are relatively nutritious compared to grasses. Thus, despite some mature tree coverage near to the waterline, there were no saplings in line for the future. Rather perversely, the reduction in bank stability facilitated by livestock access in this reach appears to have rekindled geomorphic process and the river has begun to meander again (Fig 6: lower panel). The nascent meanders and active deposition bars in the Google Earth image hint at how dynamic the river should be between Leighton and the Ure, rather than the straightened reaches or long-sweeping bends constrained by revetment. It should be remembered that erosion (and subsequent deposition) is a natural process, providing the river with essential substrate, but unfettered livestock causes excessive erosion rates. Removing the influence of the livestock would allow the banks to revegetate, improving the root matrix, increasing resilience and slowing the erosion to a natural rate, while still allowing for dynamism.

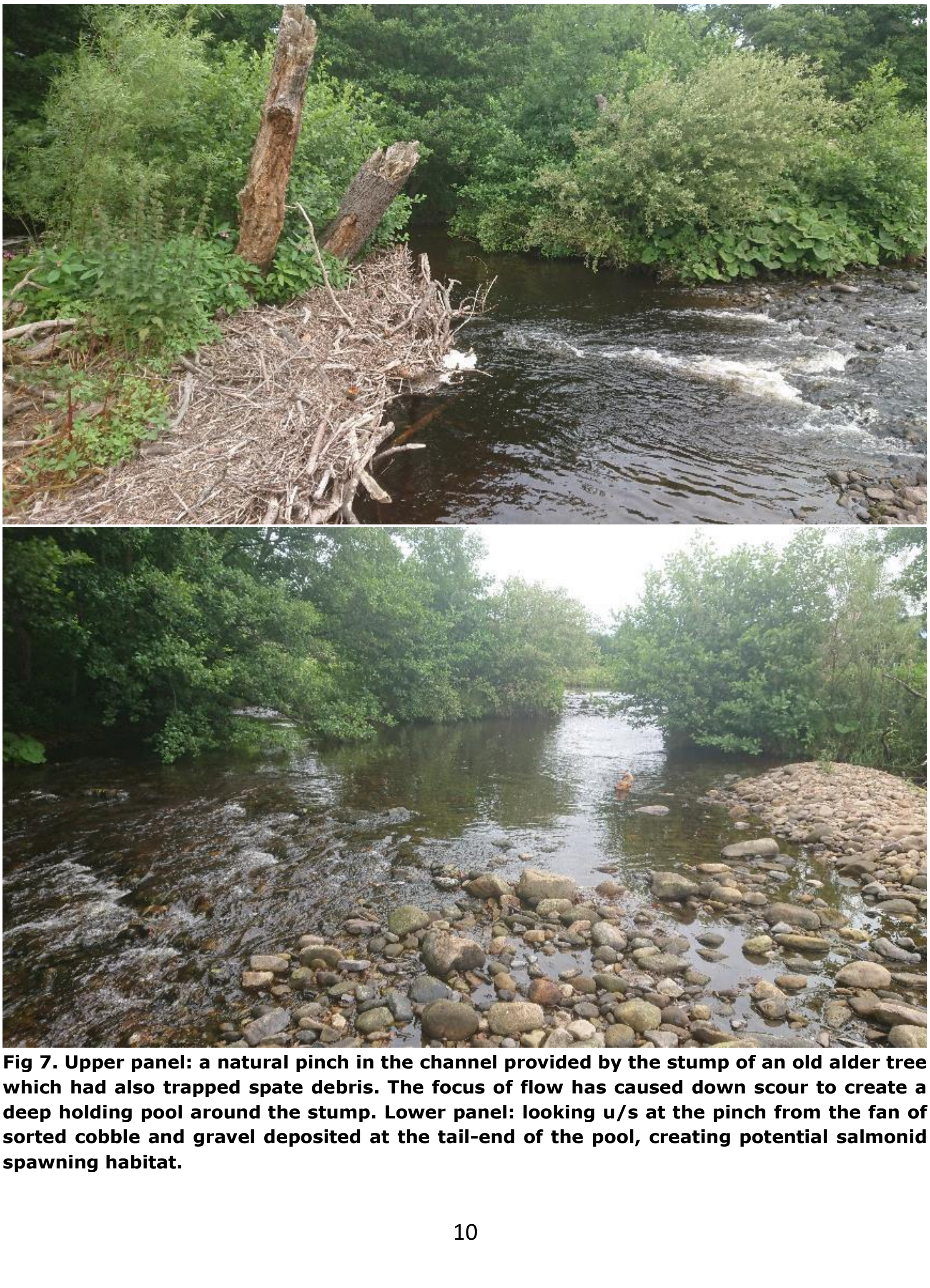

Fig 7. Upper panel: a natural pinch in the channel provided by the stump of an old alder tree which had also trapped spate debris. The focus of flow has caused down scour to create a deep holding pool around the stump. Lower panel: looking u/s at the pinch from the fan of sorted cobble and gravel deposited at the tail-end of the pool, creating potential salmonid spawning habitat.

Within the grazed reach, there was one dead alder and a few saplings beyond the reach of browsing (Fig 7) that were creating some wonderful habitat features. A large mat of debris had pushed up against the trees, probably helping to protect them from livestock, and forcing the flow down and around the obstruction, scouring a deeper pool and depositing a fan or ramp of sorted substrate on the d/s side. The sorting element is crucial for creating suitable spawning habitat: heavier sediment deposited first and finer sediments last.

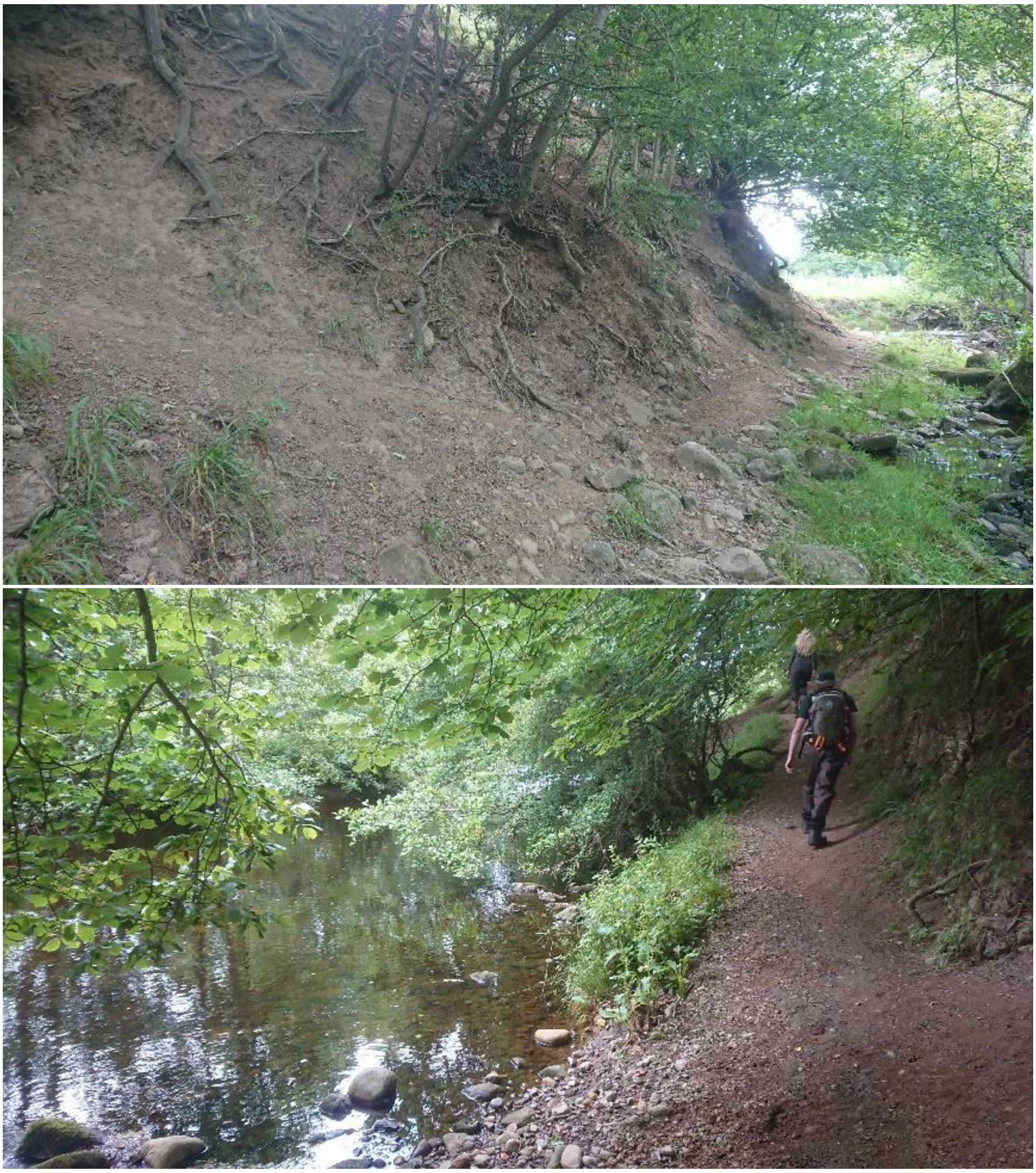

Fig 8. Tracking & grazing by livestock (primarily sheep) and the proximity of the footpath to the river probably contributes considerable fine sediment to the channel – diffuse pollution.

Where the Burn had been pinned against one side of the valley, the proximity of the footpath and concentration of sheep tracks and grazing across the steeper ground had caused issues of fine sediment ingress to the channel. There were several focal points where this diffuse pollution was evident (Fig 8). Prevention of stock access with a short fence (plus stile or gate) to an area with very poor grazing potential would rectify the situation quickly and easily.

The presence of trees, even when restricted to one bank, provided vital habitat along the straightened lower reaches bordering the golf club. Low branches and complex submerged roots provided good cover, especially where the branches shaded deeper water (Fig 9). Such habitat will provide micro-niches for a greater density of trout and should be protected; any attempts to 'tidy' them will reduce the holding capacity of the river. There was still a notable lack of large woody material in the river *per se*, which could easily be rectified given the raw materials to work with along the banks – see Recommendations.

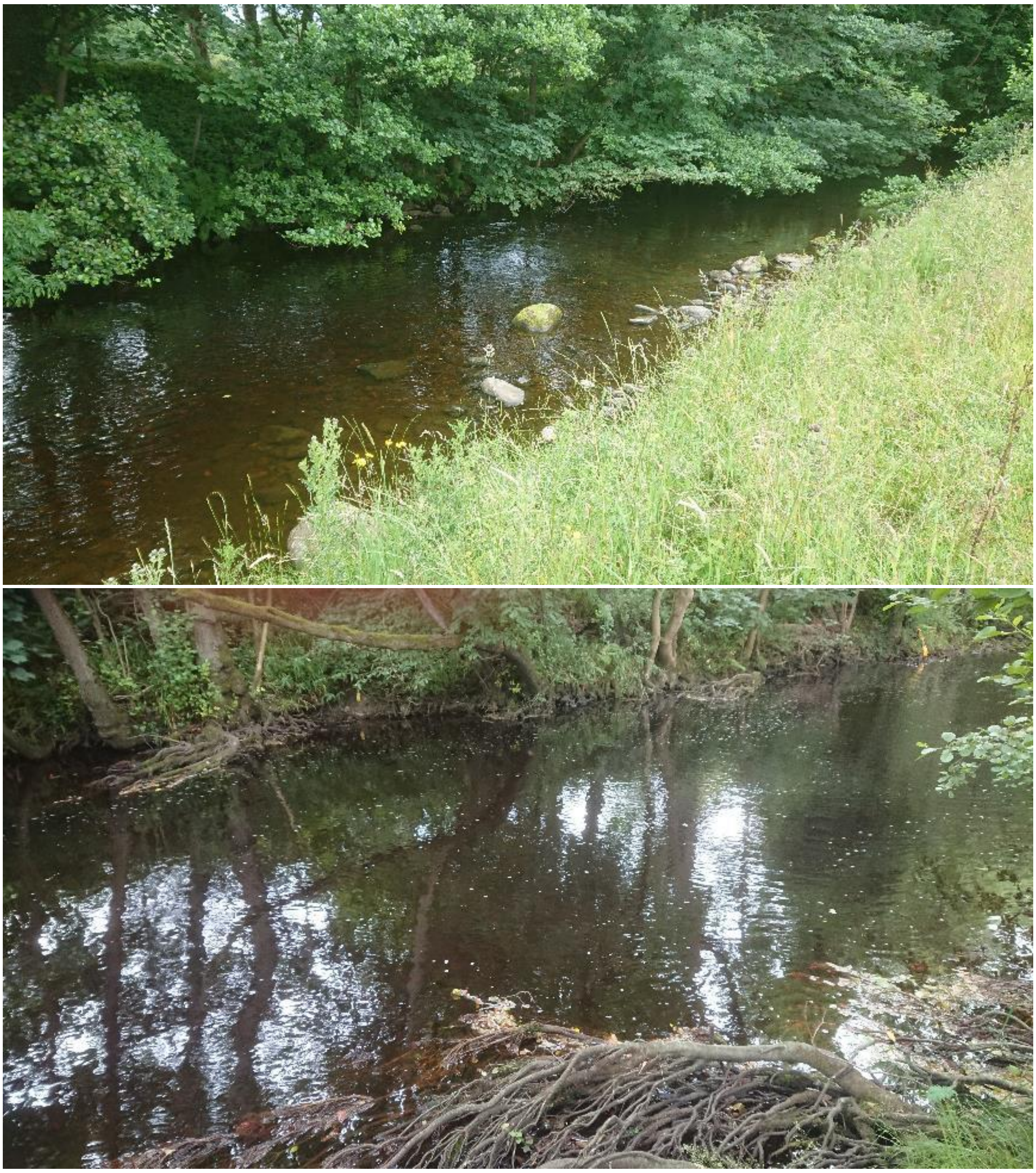

Fig 9. Examples of low and submerged cover provided by native tree branches and roots, essential for most of the life-stages of salmonids, and especially where one bank is open to livestock grazing and hence devoid of cover.

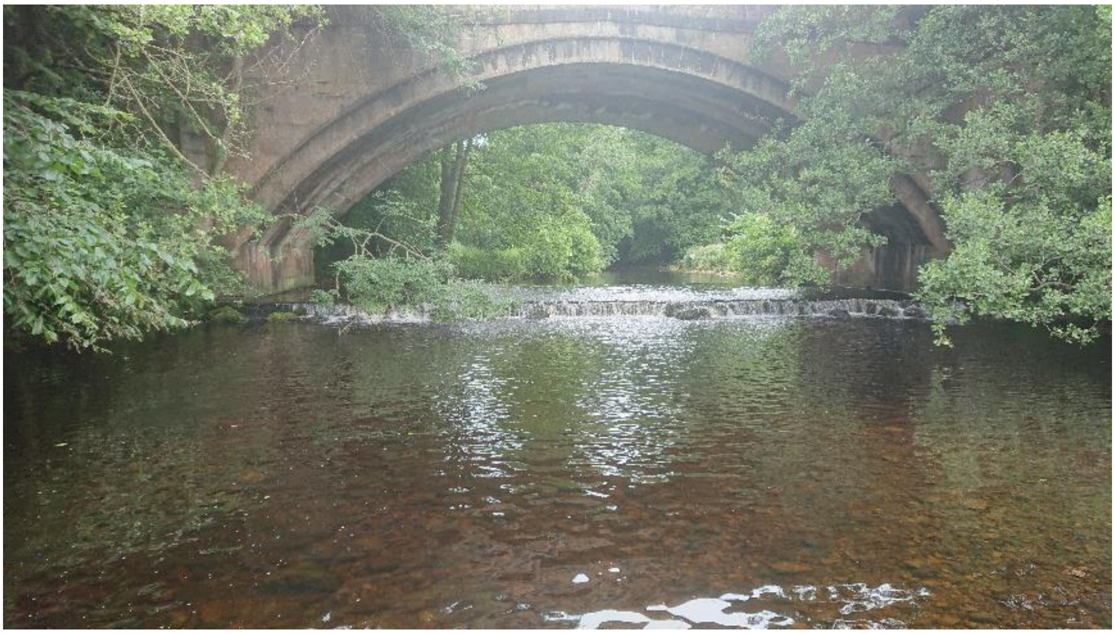

Fig 10. Swinton Rd Bridge at SE 21643 80172 has created a weir pool beneath the perched bridge footing (similar to that in Fig 5) and thus reduces passability for fish.

The bridge carrying Swinton Rd over the Burn (Fig 10) had similar footings to those on Thorpe Rd (Fig 5) and causes similar issues in terms of perching and impoundment. The latter was evident for ~100m u/s, creating a deep, sluggish glide of little habitat value, with heavy boulder revetment along the LB.

Indeed, habitat throughout the golf club's influence was a real curate's egg. There was a (thankfully) short stretch where natural vegetation had been pared right back and it resembled a barren canal. In direct contrast, the channel both d/s and u/s of the manicured stretch was extremely diverse in terms of riparian cover (Fig 11). Another split in the channel around a small island, and the appearance of bedrock in one or two places also diversified the channel morphology, despite it still being straightened and hence unnaturally steep in gradient. Again, as in the straight reaches d/s, fast riffle / glide dominated and the channel would benefit markedly from flow being interrupted by introduction of large woody material, especially as there was copious amounts to be found on both banks (Fig 12). Where wood has fallen and been allowed to remain, for example along Havernook Lane (Fig 13), the resultant excellent quality habitat mosaic comprises: deeper holding pools for adults scoured beneath or alongside trunks and root boles; ramps of well-oxygenated gravel, ideal for redd creation and better quality habitat for clean water specialist macroinvertebrates; slackwater for fry; and shallow riffles and pocket water for juveniles / parr.

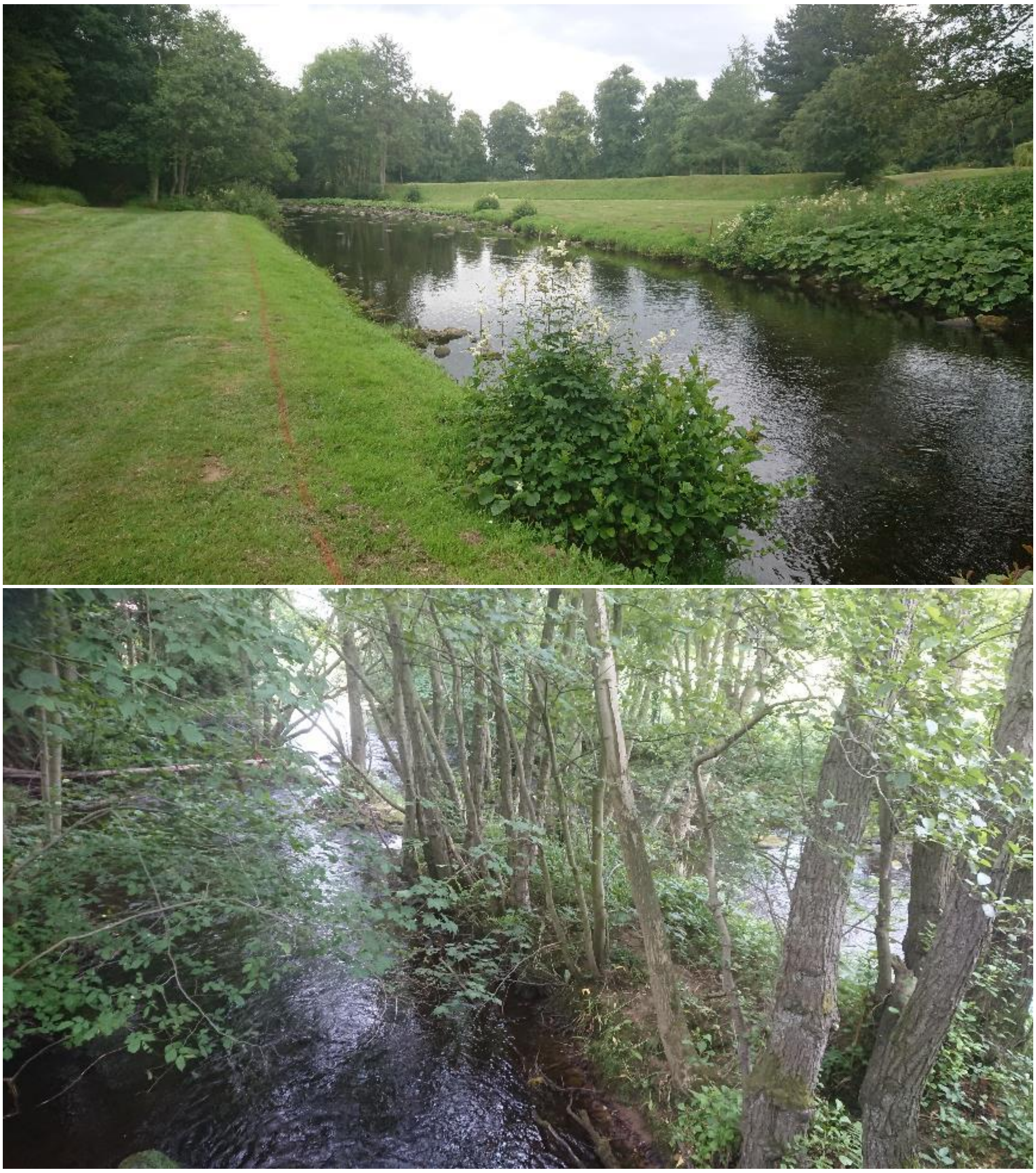

Fig 11. Compare & contrast: Upper panel depicts a manicured straightened stretch managed by the golf club, unnaturally wide and devoid of flow or cover, which is immediately u/s of a naturally split channel (lower panel) fringed with alder and heaving with habitat diversity!

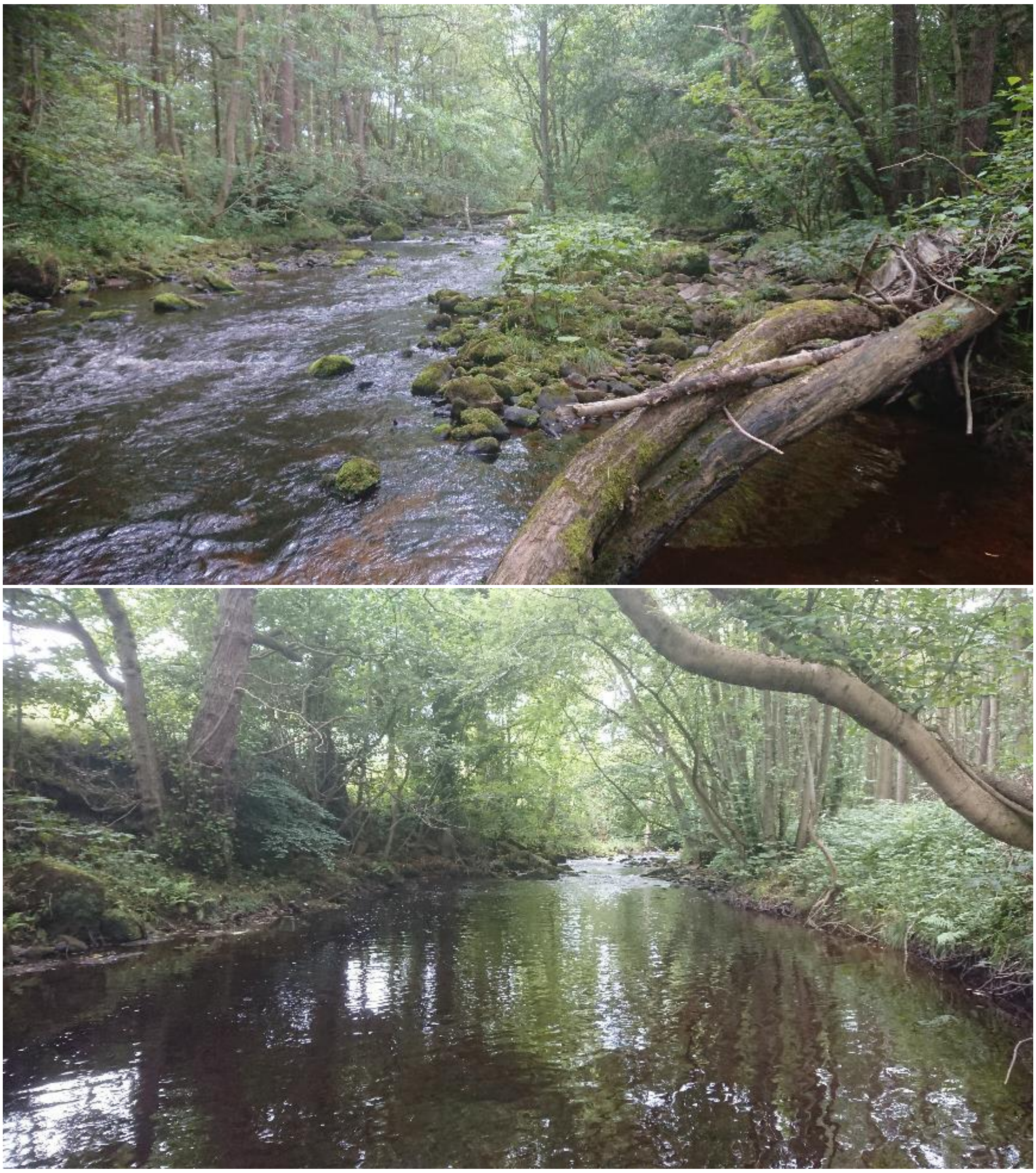

Fig 12. Bordering the golf club for ~300m, and u/s for another ~350m, the Burn has been historically straightened and pinned to one side of the valley by boulder revetment. Despite substantial fringing of native deciduous trees on both banks (and some plantation), there was relatively little evidence of woody material in the channel. Habitat was dominated by continuous fast riffle and glide, and larger boulders interrupting the flow created pocket water ideal for parr.

Fig 13. While still straightened by proximity to Havernook Lane, along this reach there was a greater influence from natural falls of large woody material which divert flow and instigate scour & deposition to create a habitat mosaic providing for all life-stages of salmonids.

Around Swinton Moor, the river has occasionally circumvented the historic boulder revetment and the introduction of that material back into the channel (from it where it might have originated anyway) has created further habitat diversity, pinching the channel and creating pocket water (Fig 14). Active removal of revetment to reinstate a more natural channel and invigorate other river processes is being explored in a project by Yorkshire Dales Rivers Trust in the Upper Wharfe.

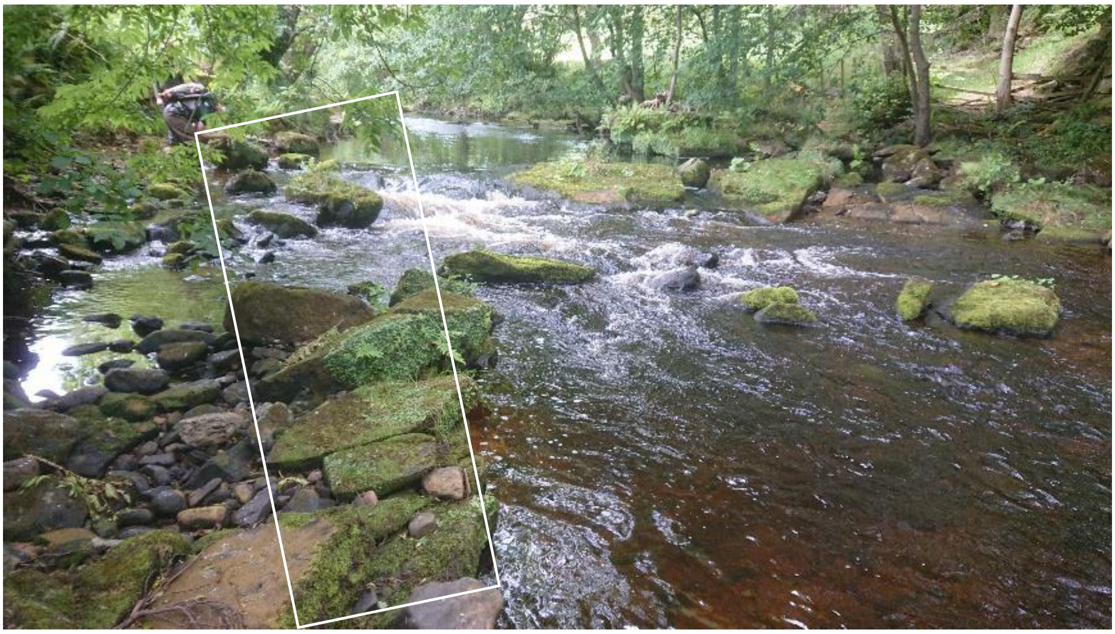

Fig 14. Pinned to one side of the valley at Swinton Moor (around SE 19971 80307), the boulder revetment of the formalised bank-line (highlighted in the white box) has failed over time and that material is now providing some benefit – here, pinching the flow into a natural chute and discharging into a pool below.

There was clear evidence of livestock along the RB of Swinton Moor. A dilapidated fence at the u/s end of the field clearly still offered some protection as the riparian fringe was dominated by bracken and native shrubs (Fig 15) but the majority of the bank throughout the field was reduced to grass and mature tree cover. This reach exemplifies a livestock paradox in river restoration. The trampling of the RB by cattle has reduced the unnaturally incised nature of the channel and created a gentler bank profile which will allow spate energy to dissipate more readily. However, continued access has led to poaching and associated fine sediment ingress (diffuse agricultural pollution), and the vegetation remains depauperate as noted before, especially in the lack of self-set trees. The disbenefits outweigh the benefits to the river in most instances.

Throughout the plantations, there was a distinct lack of woody material in the channel, hinting at active management to remove it which is a pity in an area of such low flood risk (Fig 16).

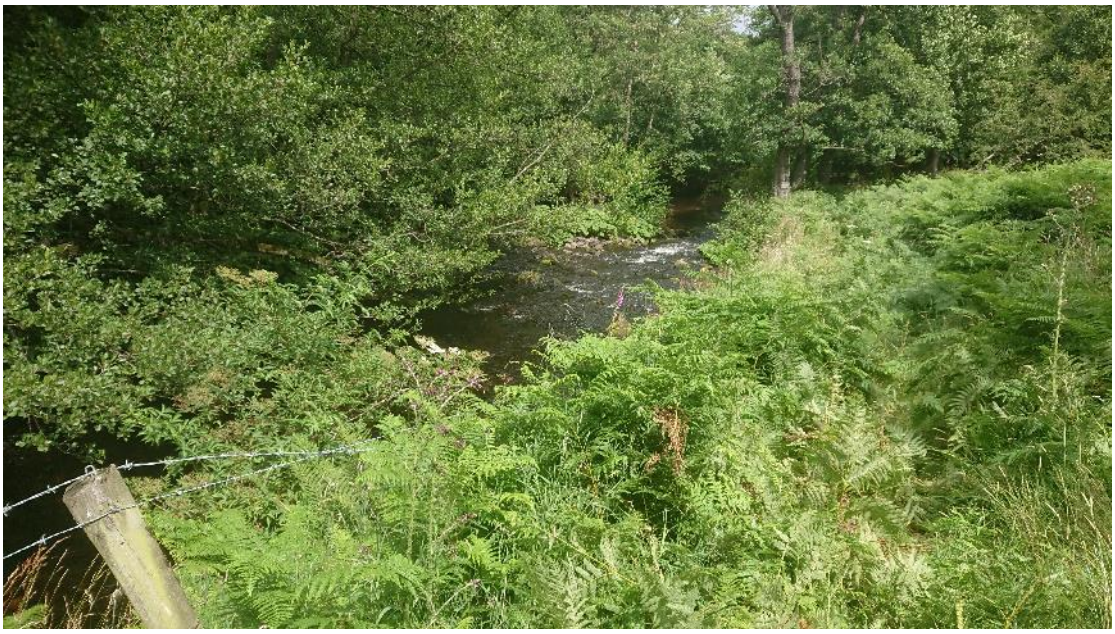

Fig 15. At the boundary between Fearby Low Moor Plantation and Swinton Moor (SE 19787 80175), the Burn was split again around a sizeable island, creating channels of very different morphology. Native woodland dominated the LB while the RB was at first dominated by bracken and hawthorn scrub before giving way across Swinton Moor to bare understory due to livestock (cattle) access.

Fig 16. The Burn within Fearby Low Moor Plantation appeared to be slightly impounded, assumed due to deposition and creation of the island (Fig 15), or perhaps realignment along a contour line.

There were few tributaries to the Burn of any significant size until Sole Beck. Numerous springs and seeps, some obviously emanating from relatively nutrient rich limestone bedrock, were noted throughout. These small systems, the majority certainly fishless, are probably far more important as rich sources of macroinvertebrates for the Burn. While Sole Beck was of a size and character that could hold and produce salmonids, it was unfortunately disconnected from the Burn by a substantial ford at its confluence (Fig 17).

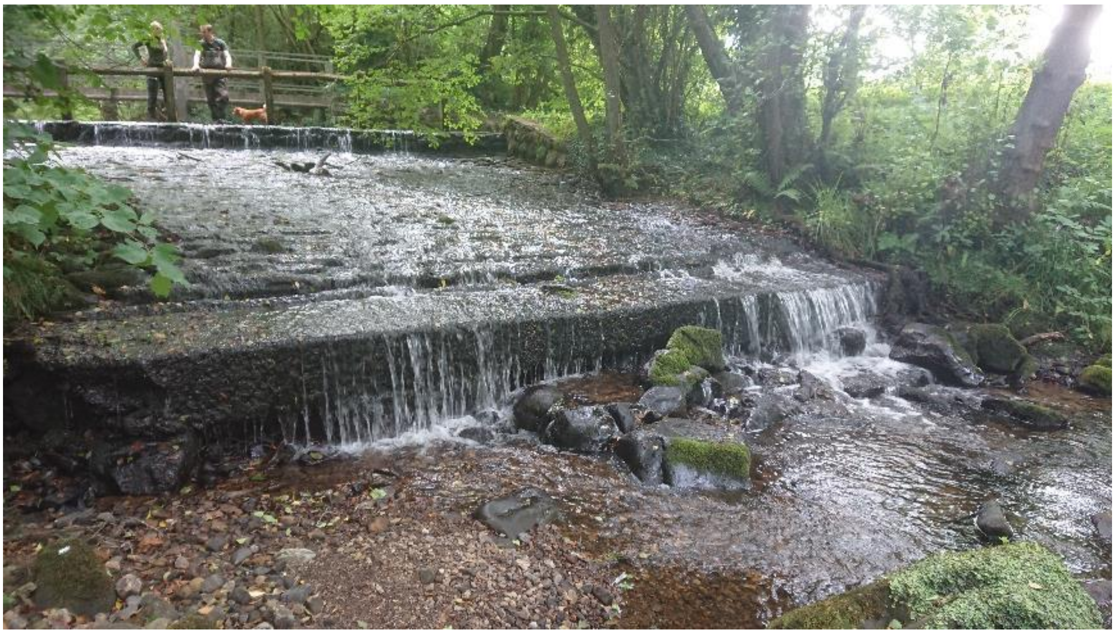

Fig 17. At SE 19143 79948, Sole Beck and another un-named watercourse entered the Burn from the RB but both had been made impassable by the construction of a ford.

The construction of a mill (prior to 1853: Healey Cotton Mill) at the Swinton Saw Mill (sic) site resulted in major changes to the Burn, the legacy of which continues to this day. For ~600m, the channel was noted to be robbed of a considerable proportion of its flow, diverted by a large weir along the mill leat to what is now a fish farm. As this is a flow-through system, the farm will be introducing a plethora of undesirable nutrients and chemicals in its effluent, as well as escapee fish, their parasites and diseases. Further impacts include the formalisation of a ford, a low-head obstruction caused more by the shallow depth across it, and the issues to geomorphology and fish-passage at the weir itself (Fig 18).

The weir was fitted with a baulk pass which relies on the burst swimming speed of a fish sufficiently powerful to overcome the force of water flowing down the angled chute. Such a design is highly selective in which species or individuals may pass, and very inefficient overall. For example, with the lower end perched above the river, it was impassable at the water level observed which probably equates to ~80% of the time. Removal would be the ideal as it would restore all the flow to the Burn as well as reinstate connectivity for both sediment and fish. Any ‘improvement’ to the fish pass is effectively a last resort, not a good solution.

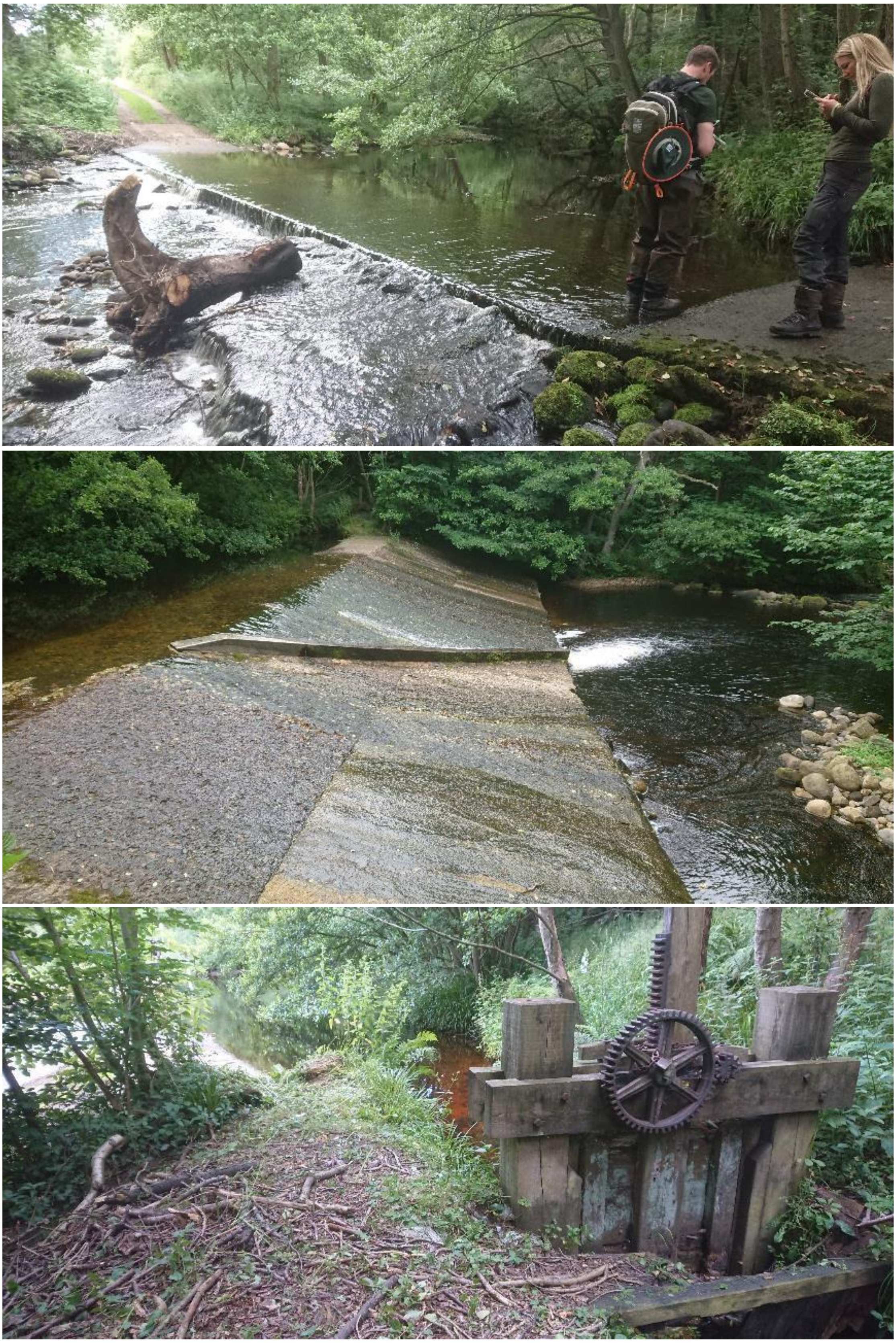

Fig 18. Assorted infrastructure formerly associated with Swinton Saw Mill which has since been converted into a fish farm, all of which degrade the environment for wild fish and the wider ecology. Upper panel: a concrete ford which, being d/s of the weir used to offtake water for the fish farm, had very little water going over it. Mid panel: the sizeable weir, completely impassable at the flow height observed, with baulk pass of questionable design and efficacy. Lower panel: the sluice-gate at the offtake with no apparent screen in place to prevent escapees from the fish farm entering the river. NB – there could have been (unseen) ample preventative measures in place elsewhere.

Above the weir and beyond its long impoundment reach, the Burn flowed through a mixture of plantation and native deciduous woodland managed for game rearing. There were several track-crossings, semi-formalised using concrete railway sleepers which, while less than ideal, created less of a barrier to fish passage than the previously observed bridge footings because they were irregular in form and thereby offered focal flow paths and retained sufficient depth (Fig 19). Each track crossing was still preventing free movement of fish and substrate, and impounding the river upstream, albeit for a short distance because of the gradient.

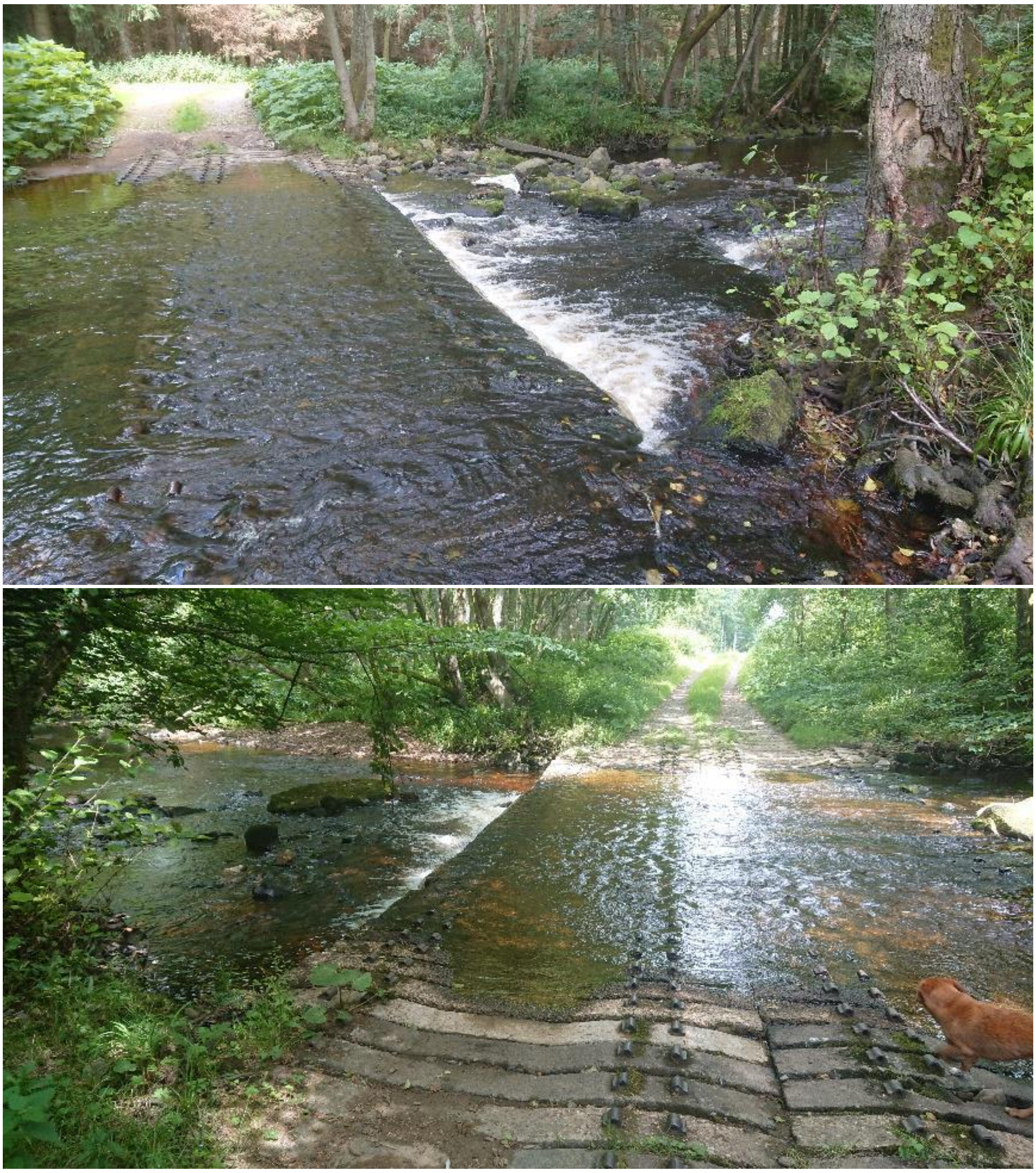

Fig 19. Examples of track-crossings made from concrete railway sleepers which have interrupted sediment transport, impounded albeit short reaches of the Burn, and created obstructions to fish passage.

On the approach to Leighton (Pott) Beck, the RB retained mixed larch and deciduous cover while the LB opened to improved pasture (Fig

20). Unfortunately, various lengths of walling and/or fencing had not been maintained and sheep had gained access to the LB – there was a notable decrease in plant diversity and sward height, and more obvious signs of associated fine sediment accumulation on the bed.

The confluence of Leighton Beck with the Burn was accessible to fish. Despite the short length of Leghton Beck below Leighton Reservoir, there appeared to be a plentiful supply of gravel (of a suitable size for resident trout to spawn in: 10-40mm) at the mouth. Whether this was actually indicative of quality spawning habitat within the beck or simply evidence of excessive erosion and periodic wash out by reservoir releases would require further investigation.

Fig 20. From SE 17453 80062, the LB understory was degraded and there was a corresponding paucity of self-set trees. Breaches in the walling and fencing had allowed livestock (sheep) unfettered access and the bed of the Burn was noticeably impacted by fine sediment as a result.

The short reach examined u/s of Leighton Beck to Leighton Bridge was classic pocket water dominated by large boulders within the channel, ideal for parr (Fig 21). The water-gated bridge created a pinch-point and hence a deeper pool but from thereon u/s it was assumed that the Burn, tightly constrained in a naturally narrow and steep-sided valley, would maintain a pocket water character for several kilometres.

Fig 21. Another island immediately below Leighton Bridge (SE 16656 80037) split the channel into two branches, and while not viewed directly, it was assumed due to the channel proportions and later consultation online that there would be little other than parr habitat further u/s.

3.0 Recommendations

The historical legacy of straightening and realignment within the valley remains and imparts a steeper channel subject to excessive erosional forces during spates, with reduced opportunities to accrue new gravel and retain that gravel within the system. That said, the riparian zone offers a substantial buffer from agricultural and other minor anthropogenic practices in the valley for the majority of its length and could be better used to improve the habitat in-channel. It is paramount that this is maintained, protected, and sensitively managed to maximise the potential of the fishery. Work to improve the Burn could be quite easy to achieve as there are relatively few landowners. At the wider catchment scale, it is important that support for organisations like the Yorkshire Dales Rivers Trust (YDRT) is maintained to help tackle broader issues such as 'slowing-the-flow' via natural flood management at the very top end of the system, and tackling invasive species. The Burn could be a flourishing wild fishery provided it can be protected from undesirable inputs from the fish farm and ill-conceived stocking promoted by local fisheries groups. Improvements to fish passage would also help to maximise the contribution from wild fish populations.

3.1 Riparian Management & Invasive Species

The banks were remarkably free of invasive species, aside from the Japanese knotweed noted below. This must be treated via herbicide stem-injection (best during autumn as energy is withdrawn to the roots) as mechanical removal increases the risk of propagules spreading. The knotweed was mapped and data submitted via Yorkshire Wildlife Trust's INNS-mapper tool online.

To recap on the value of a diverse native flora for rivers, they impart multiple ecosystem benefits:-

- Plants introduce 'hydraulic roughness' – under higher flows, the water has to flow around and through the vegetation, thereby slowing the flow and trapping debris.
- Trailing vegetation on the water surface provides low cover and refugia for fish and invertebrates from predators and spate flow, shading, egg-laying substrate for river fly species (and some coarse fish), as well as structure to help insects emerge from & return to the water. Submerged and low growing branches may obstruct local flow to such an extent as to encourage deposition of sediments downstream and hence diversify channel cross-section.

- A diverse assemblage of plants will also impart greater physical stability to bank soils and resilience to erosion during spates via a diverse root matrix 'knitting' the soils together. Hence, it is important to control Japanese knotweed which, as an invasive annual plant, outcompetes native vegetation, develops a monoculture, and leaves banks bare during the winter.
- A rich riparian fringe provides feeding, reproduction sites, and shelter for a host of insect and other invertebrate life which may ultimately contribute to the diet of fish and birds, and contribute important ecosystem services such as pollination. Leaf litter deposited directly into the river provides sustenance for many valuable shredding and filtering species such as *Gammarus* shrimp and caddis flies.

The simplest and most effective means of restoring the native vegetation along the banks is to exclude livestock, which will for the most part improve the health & welfare of stock as well. The native seedbank will quickly restore degraded sections if given half a chance. If watering of stock is a concern, then there are various techniques available (mains supply where available, pasture or ram pumps, solar-powered pumps). Any troughs should be sited sufficiently distant from the waterbody so that faeces and poaching of soils do not affect water quality. That is why drinking bays are a poor option as desire lines of compacted / poached soil develop from repeated access to a focal area, ultimately guttering water and soil plus faeces into the river in wet conditions. Cows are five times more likely to defecate when they are stood in water (useful pub quiz knowledge!), again causing nutrient issues at a point source.

If there are concerns over lost revenue due to fencing, then it is possible to offset such via grant schemes such as Woodlands for Water, specifically promoted within the North East & Yorkshire:

https://www.gov.uk/government/news/reduce-flood-risk-with-the-woodlands-for-water-scheme

Obviously, this would require negotiation between the landowner / tenant farmer depending upon location, but the benefits to all are wide-ranging. Trees and their low-lying branches or submerged roots provide important fish holding features, and are also crucially responsible for some of the deposition features. Pruning or 'tidying up' of such material should be resisted. While there may be occasional lost tackle, far better to have a feature to cast to that holds fish than no feature with fewer or no fish. Further advice can be found in the WTT video on tree management:

http://www.wildtrout.org/content/how-videos#tree

3.2 Instream habitat diversification

In conjunction with riparian management above, existing trees can be used to diversify instream habitat. Good examples of this were along the Havernook Lane reach (Fig 13) where large woody material had been retained within the channel but were rare elsewhere. This not only increases hydraulic roughness (as the riparian plants do) but encourages localised scour and deposition to diversify channel morphology and provides refugia. Laying or hinging of appropriate pliant species such as willow or elm at a downstream angle $<30^{o}$ to the bank retains a living attachment point and reduces undue stress on the hinge during spate flows.

A larger scale solution is to use a tree-kicker, simulating natural tree fall but limiting any perceived flood risk by tethering it *in situ*. A tree kicker secured within a river margin (Fig 22) has accumulated sediment within the crown and in its lee d/s, providing beneficial channel narrowing.

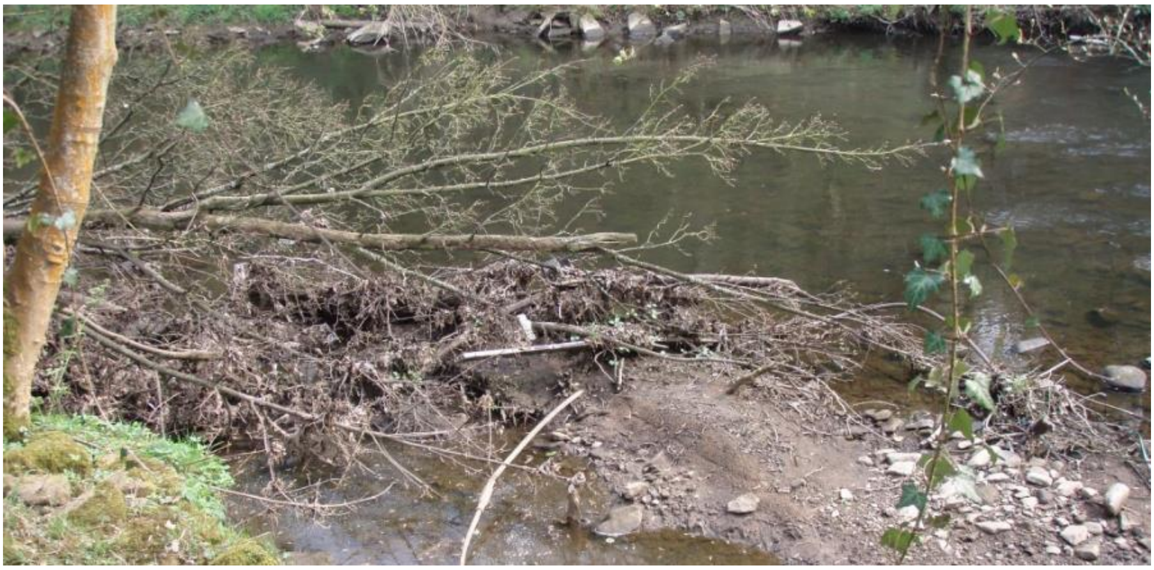

Fig 22. The impacts of a tree kicker.

A tree kicker is created by felling a tree to lay in the margins almost parallel to the bank and preferably already in an area of modest deposition to encourage stability of the ensuing structure. However, it must be cabled securely to an appropriate anchor point (usually its own living stump) to prevent any risk of mobilisation and transport. Depending upon the local situation, it is also possible to wedge or interlock fallen material amongst other living trunks to prevent further movement. Installation of tree kickers is an exemption under the EA environmental permitting regulations; WTT can advise on these and has produced a video on secure tree kicker installation:

http://www.wildtrout.org/content/how-videos#tree%20kicker

3.3 Spawning habitat provision

For substrate spawning fish, lack of appropriate spawning substrate is inherently limiting and a lack of access to suitable spawning habitat will lead to population collapse – see Connectivity below. The main issue on the Burn is supply and retention of appropriately sized spawning gravel in appropriate places. The straightening and revetment of the river identified throughout results in gravel being flushed out during spates and not replaced by natural erosion of the banks, respectively. Tree kickers and hinged trees will help to sort and retain gravel.

Various nascent projects led by WTT / Yorks Dales RT are underway within the Yorkshire region specifically examining resupply of gravel to rivers that have had their supply-lines severed, e.g. below dams or behind revetment. The outputs of these will hopefully inform projects on other rivers soon.

3.4 Connectivity

The footings of the various bridges can be made more passable with relatively low-cost techniques. Bolting wooden or stone baffles to the structure to provide an attraction flow (a focal point for fish where the majority of water is concentrated) and simultaneously creating a greater water depth over the footings which will improve passability. Options such as these have been bespoke-designed for numerous waterbodies around Yorkshire.

The major obstacle was the weir supplying the offtake to the fish farm and this business currently negates its removal (the gold standard approach). The baulk pass *in situ* appears deficient to improve fish passage in any meaningful way. A headloss of this size on a spate river requires a more substantial, better engineered solution such as rock ramp or by-pass channel, or even a technical fish-pass to overcome the various issues. With that comes associated cost and value-for-money considerations within the context of the wider Ure catchment.

Unless the viability of the fish farm falters, the weir is likely to remain and so it is important to manage and improve other aspects of habitat for all life-stages of fish both u/s and d/s of the weir in mitigation. Stocking, often mooted in reparation for such a structure (e.g. Kielder), has been proven time and again (including for Kielder and the Tyne, and elsewhere on the Ure) not to be a viable alternative and has further numerous negative impacts on wild fish. See the WTT position paper at:

www.wildtrout.org/assets/files/library/Stocking_position_2012_final.pdf

3.5 Pollution

There were no obvious point sources of sewage pollution seen and little evidence of any further excess nutrient influxes. However, on a heavily shaded watercourse like the Burn, the typical tell-tale signs such as silk weed (green filamentous algae) are hard to detect. Any suspicious discharge of discoloured or malodorous water should immediately be reported via the EA hotline (0800 807060).

4.0 Making it Happen

The WTT may be able to offer further assistance:

- WTT Project Proposal - Further to this report, the WTT can devise a more detailed project proposal report. This would usually detail the next steps to take and highlight specific areas for work, with the report forming part of an Environmental Permitting Regulations application.

- WTT Practical Visit - Where recipients are in need of assistance to carry out the kind of improvements highlighted in an advisory visit report, there is the possibility of WTT staff conducting a practical visit. This would consist of 1-3 days work, with a WTT Conservation Officer teaming up with interested parties to demonstrate the habitat enhancement methods described above. The recipient would be asked to contribute only to reasonable travel and subsistence costs of the WTT Officer. This service is in high demand and so may not always be possible.

- WTT Fundraising advice - Help and advice on how to raise funds for habitat improvement work can be found on the WTT website - www.wildtrout.org/content/project-funding

In addition, 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/library

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 stocks 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.

5.0 Acknowledgement

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.

6.0 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.