Advisory Visit

River Wyre, Wyresdale Anglers

23/03/2016

Key Findings

- The Wyre has undoubtedly suffered from a legacy of land management issues throughout the catchment (some of which are ongoing). The hydrological regime is governed by the open fells and an online reservoir in the upper catchment which does little to alleviate the flashiness of the spates. Realignment of the channel, weirs introduced to control flow direction, and rock armouring of the banks all have consequences downstream, especially as one or more fail through lack of maintenance or more extreme floods.

- However, historically, the river supported notable sea trout populations. With increased land improvement over recent decades, the productivity of the system should have increased, and water quality assessments from the Environment Agency reflect Good Ecological Status.

- The fishery benefits from good riparian buffering along the majority of its banks, especially toward the upper end but with a severe lack of low cover reflecting management for fishermen rather than fish. With some change in emphasis, this riparian resource could be improved to further promote wild populations of trout, but some guidance of the membership may be required so that the benefits can be realised.

- There is limited access to spawning and nursery habitat in the main river. It is therefore important to maintain access to, and ensure good water quality in, all the small tributaries, and to promote retention of suitable sized gravels in the main stem Wyre.

- There has been a long history of artificial stocking (both with external sources of fish and some wild broodstock); this will affect the capacity of the fishery to produce wild fish. In latter years, stocking has been focussed on the lower beats. This could be formalised further to retain, for example, the top 40% of the fishery as wild fish only. There is a substantial legacy of habitat degradation and stocking to overcome, so wild fish numbers will not bounce back immediately. Plus, membership expectations regarding wild populations, and the size and ease of catching wild fish must be managed.

1.0 Introduction

This report is the output of a site visit to the River Wyre, Lancashire, undertaken by Jon Grey of the Wild Trout Trust. The visit was requested by Wyresdale Anglers, coordinated by Tom Myerscough of the Wyre Rivers Trust. John Marsh (committee member) and Glenn Welsby (river keeper) and Tom were in attendance for the walkover in March, 2016.

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.

	Wyresdale Anglers water
River	River Wyre
Waterbody Name	Wyre - Upper
Waterbody ID	GB112072065821
Management Catchment	Wyre
River Basin District	North West
Current Ecological Quality	Overall status of **Good** ecological status sustained through two assessment cycles from 2009 - 2015
U/S Grid Ref inspected	SD5264753645
D/S Grid Ref inspected	SD4992048014
Length of river inspected	~2800m in total

Table 1. Overview of the waterbody. Information sourced from:
http://environment.data.gov.uk/catchment-planning/WaterBody/GB112072065821

Under the Water Framework Directive (WFD), the Wyre - Upper (GB112072065821) is reported as having no artificial or heavily modified hydromorphological designations. A total of 43.9 km of river or beck drain a relatively small catchment area of 5909.5 ha.

Through two cycles of assessment, it has achieved *Good Ecological Status* overall. It is important to note that five ecological classes are used for WFD Water Bodies: high, good, moderate, poor, and bad. These are assessed against 'ecological status' (or 'ecological potential' in the case of heavily modified water bodies, HMWBs). The status (or potential) of a waterbody is derived through classification of several parameters: water quality, physical condition and barriers, invasive non-native species, fish, and flows and levels. The overall status is then dictated by the lowest score amongst those parameters. The river is a protected area under the Drinking Water Directive.

2.0 Catchment / Fishery Overview

The Wyre Catchment drains a small area in North West Lancashire and features a wide variety of habitats. It is bordered by the Lune catchment to the North and the Ribble Catchment to the South and East. The upper reaches of the catchment are centred on the Bowland Fells. The central part then takes in the Amounderness plain at the base of the fells, which features towns such as Garstang and villages that are situated to the north of Preston. The lower catchment takes in the northern Fylde Coast and the villages of the Over Wyre area such as Hambleton and Stalmine.

The catchment supports a wide variety of flora and fauna; for instance, the estuarine area of the catchment is a key feeding location for many internationally important species of wading bird such as Eurasian oystercatcher and redshank, whilst the mid river is noted for salmon and sea trout. The Bowland Fells at the top of the catchment support many species of bird such as hen harrier, short eared owl and lapwing, along with invertebrate species like the Manchester treble bar moth. The vast majority of the Bowland Fells are within the Forest Of Bowland Area of Outstanding Natural Beauty; those fells also host many SPAs and SSSIs, which are areas of habitat that are nationally designated, in place to protect the flora and fauna that is contained within them (e.g. the Conservation of Wild Birds Directive).

Wyresdale Anglers is in an enviable position of having maintained detailed records of catches and stocking endeavours throughout its history. In conversation with John Marsh and Glenn Welsby, it was noted that while wild salmon and sea trout have certainly featured consistently, the latter species was historically more prevalent. Stocking with brown trout from a variety of sources, including some local broodstock schemes, has also been common-place but varying in number and size of fish stocked, and site of introduction throughout the waters. According to Glenn Welsby, the upper sections have not been stocked in recent years, instead focussing efforts d/s of Corless Mill.

The Club has an excellent ally in Wyre Rivers Trust and it was extremely beneficial that Tom Myerscough could accompany the visit. The Trust should be able to assist in discussions with landowners and sourcing potential funding streams for habitat enhancements.

3.0 Habitat Assessment

Six stretches, including a short section of a tributary, were assessed as a representative sample of Wyresdale Anglers waters.

3.1 Dolphinholme House Farm – Beat 1

The starting point for the walkover was ~200m above the weir at Dolphinholme House Farm (SD5264753645) and down to the confluence with Damas Gill on the RB. The current weir was installed by Wyresdale Anglers to create a fishing pool, perhaps using the foundations of an historic weir which impounded water for a leat (presumably into a mill) on the LB; it must have been considerably greater in height historically as the leat infrastructure is >1.5m above current river level (Fig 1). Nevertheless, what remains is obsolete. It is a considerable obstacle to free fish passage (a function of the head-loss combined with the relatively wide concrete or stone sill). In addition, the impoundment of water in an overly wide, trapezoidal channel of mostly uniform depth u/s (extending for ~200m; Fig 2) increases the chances of predation by goosander and mink which can hunt more easily where there is a lack of refugia for fish. The weir also prevents free transport of substrate, thereby impacting upon geomorphology d/s. See a WTT video outlining key impacts, here: https://youtu.be/ILofBcLiDts

There was a distinct lack of low cover from riparian vegetation overhanging the water, despite the native mature trees present on both banks; some of these, especially on the RB, could be felled and used as 'tree-kickers' (to emulate natural tree fall and its associated benefits seen later in Fig 5). Tree-kickers are felled trees, introduced wholly or partially to the channel but cabled to their living stump and hence unlikely to move d/s – see Recommendations.

The pool immediately d/s of the weir is deep, containing many large boulders, and is bordered on the LB by a substantial ramp of sorted gravel indicating that there is ample supply of this vital spawning substrate to the river (Fig 3). A notch in the weir focuses the current under low-flow conditions but this does not alleviate its impounding effect sufficiently to avoid the issues mentioned above.

Fig 1. The defunct weir at Dolphinholme Farm is an obstruction to fish passage, causing impoundment and associated hydrogeomorphological issues u/s. The notch appears to be blocked by a single boulder and could be exploited.

Fig 2. Looking d/s to the weir in Fig 1 demonstrating the extent of impoundment and lack of low cover from riparian vegetation. Several trees on the RB could be used as tree-kickers.

Fig 3. Ramp of sorted gravel adjacent to the weir pool demonstrating ample supply of suitable sized spawning habitat from further u/s.

The u/s extent of the historical impounding effect of the weir was judged to be where the channel returned to a more natural sequence of pool−riffle−glide (white line in Fig 4). At the low flow experienced during the visit, the river was meandering naturally within the cobble and boulder bed. A substantial land-slip had occurred over the winter that deposited several large trees into the channel, providing valuable cover and in-channel structure (Figs 4 & 5).

Fig 4. Substantial land slip on LB supplying large woody material into the channel. The uppermost extent of the impounding effect of the weir can be seen at the white line. NB flow was equivalent to low summer level during visit.

Fig 5. The crown of the tree deposited from the landslip (root mass visible bottom left of shot; Fig V). A ramp of sorted gravels has been retained and deposited in its lee, caused by undershot scour acting against the trunk and branches (which also provide valuable low cover). That scour has also deepened a lie for fish next to the trunk.

These should be retained in position as they introduce valuable habitat variability via scour underneath (local deepening; good adult holding habitat), deposition and sorting of gravels d/s (which might be used for spawning under higher flows), diversion of flow across the pool d/s (creating a focussed feeding line), and low cover / refugia amongst the crown branches in which fish can evade predators.

The farm is clearly a point source of organic pollution to the river. A culvert leading from copious quantities of manure was delivering a dribble of water covered in a thick film to the main channel, and there were numerous piles of rubble and plastic-wrapped bales balanced precariously along the top of the bank. Downstream from the farm, the LB was occupied by a field with little obvious buffer strip maintained; indeed the lowest point of the field was clearly used as a vehicular access point to the river bed, and this could act as a focal gutter delivering fine sediments to the river during heavy rain. Extraction of gravels may also be occurring here.

This was the lowest point of inspection on this stretch, at the confluence with Damas Gill (on the RB; Fig 6). According to Glenn, Damas Gill is an important spawning tributary. Certainly, the quantity and quality of the gravels deposited in the mouth of the Gill hinted at this role. Damas Gill enters the main channel in a deep pool and hence provides safer and easier access for spawning fish wishing to ascend. Maintaining access and quality of tributaries such as this will be essential to promote sustainable populations of wild trout.

Fig 6. A deeper pool caused by natural erosion on the outside of the bend. Damas Gill enters on the RB. Note the considerable accumulation of gravel just u/s of the confluence (in the Gill; white ellipse).

3.2 Corless Mill – Beat 2

A ~400m stretch was assessed at Corless Mill (SD5180952990), from the historical infrastructure surrounding the intake for the now defunct mill, and d/s around a sweeping bend below Wyreside Hall. The river has been subject to the introduction of gabions and concrete block revetment to try and reduce erosional scour behind the original stone and later concrete surrounds of the mill leat (Fig 7). However, these hard structures have only enhanced erosion immediately d/s of their position and the vertical banks point towards 'block failure', collapse of the sediments as the toe is eroded away by lateral scour acting on banks that are not consolidated by a deep root-horizon. For more details, please watch this short video that explains and illustrates this effect: https://youtu.be/q7zq1yxaPEA.

Fig 7. The uppermost section visited at Corless Mill where the mill leat infrastructure has been eroded into the river. Gabions are present u/s (white ellipse) but are only exacerbating erosion immediately d/s where there is insufficient root structure in the soils due to livestock access to the very bank top (see Fig 8).

Both banks are open to sheep grazing, and with unfettered access, they have reduced the riparian vegetation to a short sward of grass with no regeneration of trees. Grasses that are continually cropped invest more energy in replacing their shoots and little into their roots; as a consequence, there is little depth and diversity in the root structure. Un-grazed banks allow a diverse array of herbaceous vegetation to develop which provide a complex matrix and structural stability to the bankside soils, thereby providing further resistance to erosion (see Fig 8). Hence the extensive erosion seen at Corless Mill is resultant from several contributing factors.

Fig 8. The RB immediately d/s of the mill leat intake showing flaying of the short sward grasses during recent spates. Lack of vegetation diversity and associated root structure due to grazing (here sheep) makes the soils especially susceptible to erosion.

Protecting the RB and forcing the river to bend left (away from the mill; Fig 7) has placed undue erosional stress on the LB (Fig 9), which has succumbed to block failure immediately d/s of some remaining willows (that are protected from grazing). The flow is now diverted back to the RB at an unnaturally acute angle which is leading to increased erosional pressure on the RB (Fig 10). The lack of structure in the soil because of livestock grazing means these soils are easier to erode.

Fig 9. Extensive erosion of the LB by block failure has left ~100m of vertical bank and a distinct ~90° right turn (toward the camera) as the river now hits more resilient substrate.

Fig 10. The sharper redirection of water (from Fig 9) across the original channel path is now exacerbating erosion on the RB d/s and undermining the roots of the mature trees.

The recent shift of the entire river channel at least 20m into the LB (Fig 9) has left extensive gravels and cobbles exposed in the former channel. This coarse substrate has created a braided-channel with shallow pocket water. Juvenile fish will certainly use this habitat, but the reduced proportion of refuge-habitat makes it less likely to support adult trout. There is a distinct lack of riparian cover which is essential not only for the trout instream, but also for emergent aquatic insects to complete their lifecycle. In addition to aquatic invertebrates eaten by trout, many terrestrial insects fall onto the water from bank-side vegetation and become trout prey.

3.3 Street – Beat 3

The next stretch was accessed from the Club's lake fishing car park at SD5188152162, adjacent to a small tributary, Street Brook. Anecdotally, sea trout have been observed cutting redds in the Brook, and since this is completely under the control of Wyresdale Anglers for several hundred metres, it could be the focus of some relatively inexpensive habitat management to improve the potential spawning and juvenile habitat (Fig 11a-c).

Currently, there is relatively little instream structure within the Brook to retain gravels, so this must be improved. Glenn Welsby recalled that attempts to introduce gravels were only partially successful because they were not retained under high flows.

Fig 11. The potential spawning tributary, Street Brook: a) looking u/s at the fishing hut; b) looking u/s from near the confluence; and c) the confluence with the Wyre, marked with a red arrow. NB there is a substantial weir ~40m u/s of the road bridge on the main stem Wyre, just evident under the arch.

While the riparian vegetation is relatively diverse and comprises native perennial species, it could be managed to provide lower cover and ensure more trailing branches to provide refugia for adults whilst spawning and later for fry and parr (Fig 11a&b). The dissipation of flow energy provided by such structure is also likely to facilitate retention of finer substrate. However, access from the main channel must also be considered. Unlike the confluence with Damas Gill (Fig 6), here the access to Street Brook is across relatively shallow water amongst deposited cobbles; the deeper pool under the bridge is unfortunately on the opposite side (RB). It may be possible to introduce a tree-kicker immediately u/s of the road bridge on the RB to divert flow toward the LB and create deeper water at the confluence or manipulate the position of instream boulders to the same effect. This Brook may be particularly important for recruitment since it lies very close to a major obstruction to fish passage; the weir

u/s of the road bridge which was installed to protect the highways infrastructure.

The channel is straightened for ~100m below the road bridge with evidence of block walling on the LB; here, the river passes between old gravel pits excavated during the construction of the M6. As a consequence of historical engineering (block walling), the LB is higher than the RB which retains a more natural gradient. Recent spates have eroded heavily into the LB, again by block failure, and scoured the turf to leave it severely undercut in places (Fig 12). This section has been fenced off recently by Wyre RT but has yet to regenerate a natural diversity of riparian vegetation; as a consequence, with only grass roots *in situ* there has been scant root complexity in place to resist the spate erosion − see Recommendations.

Fig 12. Erosion of the LB on the sweeping bend next to the Wyresdale Anglers fishing lakes. A paleo-channel can be seen on the RB (white arrow). Heavy coppicing of the willows from the RB could provide materials (stakes & whips) for LB rehabilitation. See Fig 13

As the erosion is threatening the integrity of the narrow bank separating the river and the fishing lakes, clearly the Club is concerned. Former channels on the RB (a man-made spawning channel and a paleo channel) could be exploited here if the flow in the main channel can be encouraged to leave the LB and focus more towards the RB (Figs 13 & 14). Mature trees on the LB could be used as tree-kickers to divert the flow, while heavy coppicing of the willows on the RB would a) remove their resistance to spate flow which is probably exacerbating the erosion on the LB, and b) provide stakes and whips which could be used to bolster protection of the LB − see Recommendations.

Fig 13. U/s from Fig 12: a former spawning channel created on the RB is now blocked but could be reinstated. In addition, some of the mature trees on the LB could be used as kickers to divert flow toward the RB, and thereby away from the eroding LB.

Fig 14. Looking u/s to the eroded LB of Fig 12. Scale of large woody material introduced into the channel and the gravel retention in the foreground resulting from the natural 'tree-kicker' effect. This should be retained wherever possible but should be secured tight to the bank. Note the width of river compared to width of exposed gravel bank.

Below the fishing lakes, the river is protected on both banks by mature woodland for several hundred metres but has still been engineered to turn left via an angled weir. The concrete structure of the weir is now severely degraded and while the block work introduces some varied pockets of deep water and sorted gravel bars, the original purpose of the weir to divert flow from the RB is now being circumvented (Fig 15). As a consequence, the RB is being severely eroded because the full force of spate flow is now directed

Fig 15. Looking d/s from the dilapidated weir (concrete bottom left & top right of shot). Without the diversion of the weir, the river is now cutting a more natural curve into the RB.

Fig 16. D/s from the dilapidated weir, the RB is subject to considerable erosion despite mature trees in the riparian zone because the full energy of the spate flow is directed there now the weir has gone.

at it (Fig 16). This is despite the diversity of mature trees and understory plants in the riparian strip providing a complex root matrix. The river is simply trying to revert to a more natural path, formerly constrained by the weir, and it can be best visualised in Figure 17, using a map.

There are many mature trees deposited on the main gravel bar, effectively sitting mid-channel. It might be possible, with some trimming of the root masses, to winch some to the sides where they should be secured in position (pinned or cabled to existing trees) to help protect the bank and provide valuable instream cover (Fig 18). Some are already partially buried indicating substantial deposition on the gravel bar, and these are probably best left. The benefits of woody material to create diversity of depth and flow can be clearly seen in the patterns of scour and deposition around the trunk now high and dry (Fig 18 mid panel).

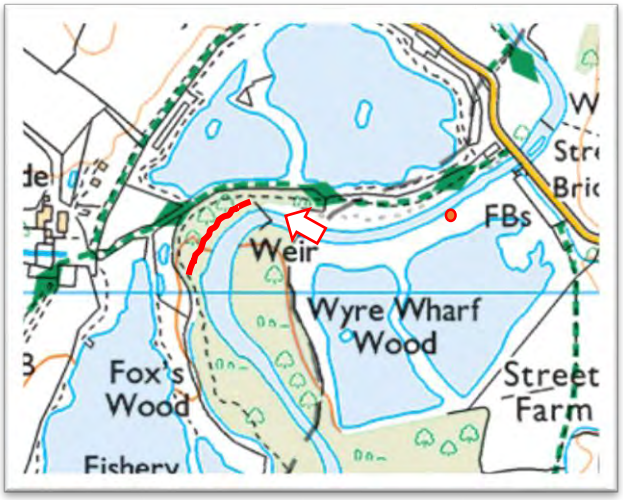

Fig 17. The purpose of the weir to divert flow left is clearly seen from this map, as is the effect of the weir to artificially widen the channel d/s. Now that the weir is gone, the direction of flow is indicated by the red arrow and the RB is now being eroded all along the red line. The red circle indicates approximate position of Fig 12.

Fig 18. Three panels: Looking d/s, mature trees deposited across the former channel and the river now cuts from RB to LB over hundreds of tonnes of deposited cobbles and gravels which may look dramatic but provides valuable in-channel diversity and important terrestrial and aquatic invertebrate habitats.

Where the river is running against the banks, there is some good quality habitat for trout: varied depth, boulder obstructions, trailing vegetation. It is important to retain low cover in places and refrain from removing lower overhanging branches to appease fisherman who are worried about losing the odd fly.

3.4 *SD5146351462 – Beat 4*

From a track bridge at Wyreside Lakes Fishery to the M6 bridge, a section of ~700m was assessed. The fringe of riparian trees on both banks at the top of this section was narrow but in good condition, ie mature and a mix of native species with some understory present. The river is cutting back and forth across its spate channel in relatively natural meanders (Fig 19). However, it was clear that many of the low branches had been cut back presumably to improve access for casting; this should be curtailed in favour of laying some of the more pliant species (willow and to a certain extent, alder) to provide sporadic patches of low cover to hold fish (Fig 20).

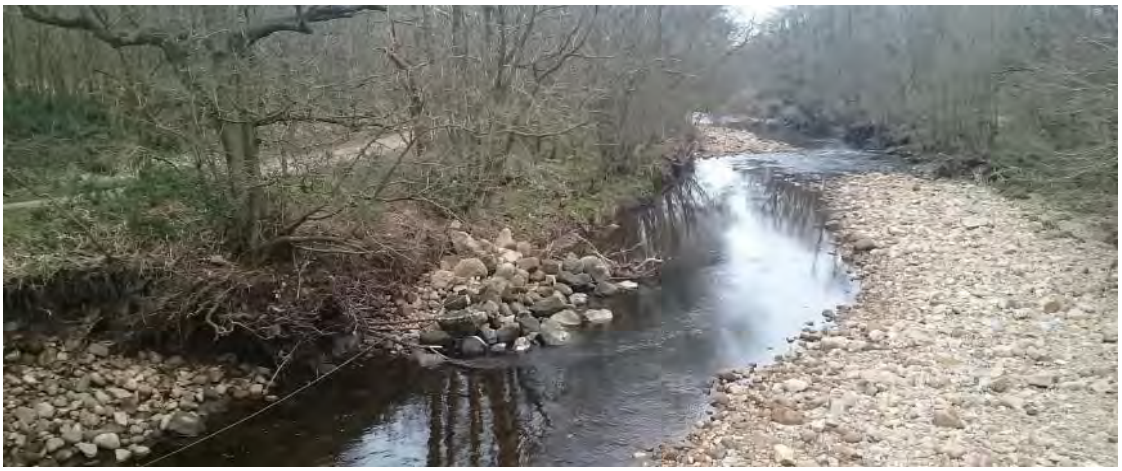

Fig 19. The river now meandering back and forth across its spate channel. There is evidence of historic boulder revetment throughout these stretches.

In addition to stimulating important low level canopy regrowth, laying or coppicing a small proportion of the riparian trees will allow some dappled light to reach the water surface and potentially boost instream production slightly, and to diversify the canopy structure to the benefit of aquatic and terrestrial insects. Both of these will ultimately benefit wild trout populations through provision of better resources.

Fig 20. Although both banks now have a decent semi-natural riparian strip, close inspection revealed much evidence of historic pruning of low branches creating the arching effect seen in both panels above, and a consequent absence of low or important trailing cover, particularly along the LB.

The riparian owner on the RB d/s has historically introduced boulders to prevent erosion and seems to be in the process of introducing a considerable amount of concrete blocks (Fig 21). This is illegal without consent from the Environment Agency (unless it is designated as Ordinary Watercourse). Hard engineering tends to create additional problems: at the local scale, at both u/s and d/s ends of any structure, as eddies of flow diverted around the hard surface create erosion; and furthermore, effectively forcing the energy of the river from where it is being applied will lead to consequences elsewhere d/s as has been seen already in Figures 7-10 and 15-17. Indeed, it is probably contributing to the erosion seen d/s on the LB just above the M6 bridge.

As outlined above, the river at 'normal' flows is meandering within a spate channel which comprises mostly boulders, cobbles and gravels deposited in bars, and consequently it is even more important to retain and manage riparian vegetation where it actually overhangs the river to maximise cover and feeding opportunities for trout. It was a pity that one of the very few mature willows actually providing low cover and trailing branches was cut rather than laid (Fig 22).

Fig 21. Introduction of boulder and concrete blocks to prevent erosion of the RB. See reference to video on page 9.

Fig 22. Beneficial overhanging willow (at arrow) cut rather than laid – this rare habitat feature is now lost and will take many years to replace.

Another potentially important spawning tributary enters the main channel from the LB ~120m u/s from the M6 bridge. Foxhouses Brook, like Damas Gill, enters the Wyre on the outside of a bend and hence there is deeper water at the confluence making it easier for fish to access (Fig 23). Planting up the LB u/s and d/s of the confluence with willow whips will not only protect the banks but also provide cover for fish approaching the confluence. While not directly under the control of Wyresdale Anglers, it would be beneficial to engage with the landowners along Foxhouses Brook so that habitat quality can be maintained along its lower reaches.

Fig 23. Confluence of Foxhouses Brook with the mainstem Wyre, on the outside of a bend means that there is deep water from which fish can potentially access the spawning tributary.

3.5 SD5028550217 – Scorton Lake, Beat 5

The river was next inspected d/s of the M6 at beats 5 & 6, with a couple of point inspections over a ~750m stretch. The first was along an avenue of trees which would benefit from not being pruned of low branches, and with some laid as tree-kickers into the channel (Fig 24). The RB is more natural in this respect but the flow is focussed toward the LB and consequently the benefit of the low cover is lost partially over shallow water which will not hold adult fish; fry and parr will still benefit.

Fig 24. Long series of glides where the trees on the LB have clearly been managed to remove low branches. The stretch would benefit from one or two of these trees being felled and secured tight against the bank to diversify flow and increase refugia.

Below the series of glides is a major weir which has a single baulk angled across its face, and a fish pass constructed at the LB. The latter is now obsolete; the weir crest has been breached, and the

baulk serves to divert flow to the LB and affect the deposition of substrate downstream (Fig 25). This is now a complete obstruction to fish passage under normal flows and probably still impassable to the majority of fish under higher flows. Removal would also reinstate a more natural sediment transport regime through the section.

Fig 25. The weir next to Clevelymere: upper panel looking u/s at the damaged crest, baulk, and dry fish pass; lower panel d/s at the vast deposit of substrate.

At the lower points inspected, there were some excellent and some less beneficial examples of former habitat management. There were many places where willow had been successfully laid and it was evident that in those places, it had withstood the recent spates, protected the bank d/s and was providing low cover over the water; fantastic, some more large patches of this could be done in places throughout the entire waters of the Club. However, some stands of willow had been chopped back and the stems removed. Mowing of grass along the bank top to provide a path for fisherman is essentially recreating the damaging effects of livestock grazing and if a path is required, it should be set further back from the bank to allow the beneficial fringe of riparian plants to flourish. Routing a path along

the very edge of the bank also increases the disturbance that fish will experience. Introduction of boulder piles is now causing scalloping erosion in the LB, so these should be redistributed to provide adult trout lies elsewhere. The LB has been rock armoured, presumably to protect the track alongside; see Figure 26 panels.

Fig 26. Examples of habitat management: upper panel looking u/s at mowed LB compared to relatively natural RB, note also the rock armouring of the LB; mid panel – fantastic laying of willow; lower panel looking d/s at scalloping of LB caused by boulder placements, and note erosion of mowed bank top.

Fig 27. Natural river form resumes as the river hits a natural barrier (hill) on the RB, and low lying scrub and debris provide fantastic cover and feeding opportunities for trout.

One of the most natural and diverse areas of habitat was encapsulated in Figure 27 where the river was unconstrained by armouring and the vegetation was also fairly natural and unmanaged (unkempt). While perhaps slightly more challenging for anglers, this pool and riffle had considerably greater holding capacity than many other sections seen. While it was noted that riparian owner on the RB may have less than desirable designs for the riverbank immediately u/s, it is this sort of mosaic of habitat that will most benefit wild populations and could easily be aspired to elsewhere through sensitive management. A patchy, light-touch approach to hinging and tree-kicker use can provide a win:win situation: useful cover and structure for the fish, a diverse canopy that benefits the river corridor biodiversity, and creates enticing gaps into which a cast can be made!

3.6 SD4992048014 – Beat 8

A ~200m section of the lowest beat was accessed where Wyre Rivers Trust have implemented some fencing and tree planting (Fig 28). This will undoubtedly be beneficial to both aquatic and terrestrial organisms in the future. The channel itself is without much natural character, and again is constrained by artificial structures; groynes to protect the nearby road (Fig 29). Without any mature trees nearby, it will be difficult to introduce woody material as kickers to diversify the channel. To complement the formal tree planting already undertaken, it would be beneficial to increase the plant diversity at the toe of the banks by pushing in willow whips or stakes wherever possible; some will take, some will not, but those that do will improve

bank stability and start to provide low cover immediately, which can be exploited further at a later stage by laying and coppicing.

Fig 28. Barren banks with little overhanging riparian vegetation and hence little holding habitat, especially as the channel is overly wide and uniform in depth and substrate here.

Fig 29. Looking u/s at channel variability instigated by artificial groynes to divert flow. Note tree planting on LB but lack of cover at the water edge.

4.0 Recommendations

The Wyre is a relatively short river which is supplied by an upper catchment almost devoid of tree cover, the Bowland Fells. It is also below Abbeystead Reservoir. Reservoir flow regulation (or lack of same) during spate conditions will control the dynamic process of channel structure and, consequently, determine which species can/cannot thrive. Despite the Environment Agency classifying it as having no artificial or heavily modified designations (under the Water Framework Directive), the amount of bank revetment, installation of weirs and channel realignments to cater for bridges, mills etc, that was observed is comparable to the Aire in North Yorkshire which *is* classified as Heavily Modified. It is suspected that much of the bank work has been done, and continues to be done, without consultation and consent from the relevant authority (EA). This lack of joined-up thinking is probably exacerbating the erosion effects seen during the visit, as actions taken to protect one section of bank *will* have consequences further down the system. It should also be noted that the river was seen at a level equivalent to low summer flow, less than three months after the worst flooding sustained in living memory. Rates of erosion and deposition have been unprecedented and it will be interesting to see how the river 'settles' into its new, arguably more natural course in many stretches.

Wyresdale Anglers are in an enviable position in that they have historical records to draw upon for reference, and a keeper with a wealth of personal experience of the river and its continual evolution. Below is a series of generic suggestions with some examples of where they could be initiated. Many of these are already being implemented on the fishery somewhere, so perhaps could be prioritised differently depending upon the aspirations of the Club.

4.1 Tree Work

Some sections of the Wyre have fantastic cover from bankside trees. Others have clearly been subject to pruning and tidying, which may reflect pressure from rods to make casting easier! This energy could be more sensitively and efficiently applied to maximise habitat potential for the benefit of fish rather than fishermen. It should be noted that fish rarely feed within deep cover; they sit on the fin adjacent to it, so when they are feeding they are reachable with a fly (and would not be there in such density, if at all, in the complete absence of the cover).

4.1.1 Pruning of low branches

There is some evidence of historic pruning, which should be resisted in future. While slightly more challenging to cast to and between, it should be remembered that the benefits to leaving low cover and thereby providing more lies for fish per unit area, greatly outweighs the cost of the odd fly. More importantly, it provides a greater number of fish to aim at. There is obviously a need to inform club members about such a change in management to ensure everyone understands why this is beneficial.

To counteract the effects of historical pruning, sporadic coppicing (ie one or two trees amongst a group to ensure some are left standing) can be undertaken to initiate low-level regrowth. This also creates diversity in the canopy structure which will benefit a wide swathe of the river corridor biodiversity from invertebrates to birds and bats.

4.1.2 Planting

Planting is recommended wherever there is a lack of low cover and structure along the river margins, particularly within the fields that have been subject to prolonged livestock access (e.g. Corless Mill & Dolphinholme Farm). Other barren stretches of note were the grassed banks next to the fishing lakes at Street, the track edge on Beat 6, and to complement that undertaken by Wyre RT on the lowest sections. It will be most effective if trees are trained over into the channel. It would be beneficial to include a range of native deciduous species but willow is by far the easiest to transplant and manipulate (and it's free if there is a plentiful local supply). Note that adequate fencing is key to protect such measures, as without it, any planting is likely to be browsed by livestock.

The quickest and easiest way of planting willow is by pushing short sections of willow whip or sections of stake into the ground, using locally sourced material. This can be undertaken at any time of the year, but will have the greatest success if undertaken within the dormant season, shortly before spring growth begins (ideally late Jan-March). Whips should be planted into soft, wet earth/sediment so that there is a greater length within the ground than out of it, to minimise the distance that water has to be transported up the stem; 30-40cm of whip protruding from the ground is sufficient, providing that it receives light past the other bankside vegetation. Live willow stakes can be hammered deep into the bank and may provide greater structural stability under spate conditions. This approach will be essential to restabilise the fenced section of LB at Street, between

the river and the lakes (Fig 12); materials can be coppiced from the RB opposite with the added benefit of reducing flow resistance there during spated. Stakes should be hammered into the stone bed just above the low waterline, but ensuring the stake end reaches below the waterline. The top of the bank is probably too dry for willow but should be planted up densely with native species as soon as possible to ensure root structure is in place for next winter. Clearly Wyre RT have already planted up some of the lower beats, and the keeper has been introducing willows into a few specific areas to great effect. Further advice and support could be sought from The Woodland Trust. See their guidance manual for 'Keeping rivers cool', here: http://www.woodlandtrust.org.uk/publications/2016/02/keeping-rivers-cool/

4.1.3 Laying

Where trees are already established along the bank, habitat improvements can be achieved by laying trunks, or selected branches down into the watercourse to increase low cover and in-channel structure. This has occurred naturally at various points but living wood and woody debris appears to have been removed or 'tidied'. The laying method is usually limited to pliant species e.g. willow, elm, hazel, hawthorn and small alder, but some others can be laid carefully. The process involves cutting part way through the stem/trunk, a little at a time (like laying a hedge), until it can be forced over (Fig 31). The depth of the cut should be limited to only that which is required to bend the limb over, to retain maximum strength in the hinge. Note, the aim would be to lay the trunks parallel to the bank and maintain a healthy hinge, i.e. the trunks are living and well attached, so as not to increase perceived flood risk.

Fig 23. An example of hinged willow.

4.1.4 Tree kickers

Many of the straightened and especially the impounded sections would benefit from more serious intervention to reinstate natural hydrogeomorphological process. A tree kicker is essentially mimicking natural tree fall but placing it specifically where it can be most beneficial, and importantly, securing it so that it is not a flood risk. A tree is felled either into position (or winched) so that it is close to parallel to the bank and with the crown d/s. The trunk is secured via high-tensile steel cable to either its own stump or to another living trunk nearby; the cable point needs to be as low as possible, and the cable as short as possible so that the whole trunk does not ride up and get deposited on the bank during the first spate. The crown may be trimmed to reduce the impact of the kicker. Where nearby trees are present, the felled trunk can be made extra secure if it is laid between its own stump (u/s) and the trunk of the next tree (d/s); from above, on the LB, this looks like **%**.

Table 2: Specific examples of sites for tree kickers.

#	Fig #	Bank & Rationale
1	1-4	RB: u/s & d/s of the weir, the channel will benefit from introduction of low cover, flow diversity and some opening of the mature canopy.
2	11	RB: immediately u/s of bridge to divert flow toward confluence with tributary.
3	13	LB: to divert flow towards two former channels on RB and away from erosional zone d/s on the LB.
4	20	L&RB: diversify the cover and channel morphology on a section historically pruned so it has no low cover.
5	24	LB: currently just glide habitat so one or two kickers will diversify the habitat.

4.2 **Fish passage issues**

Several weirs are present throughout the Club's waters. All constitute an obstruction to the free passage of fish. Consider not only the requirement of energy to physically overcome the barrier (if possible), but also the time and energy expended in failed attempts, physical damage, and increased risk of predation both above and below the weir. There is also the consideration of differing abilities of different life stages to ascend or descend such barriers. In an ideal

world, these should *all* be removed to allow free passage, as well as reinstate geomorphological connectivity. However, as at least one is *in situ* to control the river prior to a road bridge (Fig 11), it is unlikely that it will be removed in the short/medium term but there should be the requirement from the Environment Agency to consider an obstruction of this size for fish passage easement, i.e. a pass. There is plenty of space to do so on either bank; while this will not reinstate the geomorphological connectivity, it will hopefully improve fish passage.

4.3 Tributaries and spawning habitat

There was scant evidence of suitable spawning habitat in the main stem Wyre; the majority of the bed comprises gravels, cobbles and boulders in an unsorted matrix. Hence, to maximise the potential of the wild populations of trout, maintaining the quality of spawning habitat in the smaller tributaries is of paramount importance. Unfortunately, little of the land along those tributaries is directly under the control of the Club, but should be explored via sympathetic land owners. Small tributaries contribute disproportionate benefits to main river systems (partly because their length contributes enormously to the total of the whole network) and because the ratio of marginal habitat to open water is greater.

The Wyre does contain suitably sized gravels for trout spawning (15-40mm) but retention points are few and far between. There are good examples of where natural laying of woody material has caused deposition of gravel bars with some appropriately sized material; letting the power of the water effectively sort these gravels according to size is most efficient. The low cover also provides refugia for spawning fish and emerging fry. Hence, more habitat work to manage the trees to emulate this process would provide greater spawning opportunities.

It was mentioned that gravel has been periodically added to some of the tributaries but it gets washed out over time. Instead of adding gravel manually, it is probably worth manipulating the habitat to retain it. Managing woody debris and manipulating boulders to create such sorted gravel ramps within the tributaries is much simpler than in the mainstem and a good starting point would be the Street Brook.

If the Club wishes to pursue the introduction of spawning substrate, then, especially on Street Brook, it could be beneficial to widen the channel slightly and 'key in' some larger cobbles/small boulders to

form a rock-ramp that would retard the loss of introduced gravels (as well as slowing the transit through that section of any gravels entering the reach from upstream). This could be extended to a 'retained riffle' design that utilises a very low step to raise the overall bed level and reduce the bed-slope slightly at that location.

NB: It is equally important to ensure good access from the mainstem into the tributaries for the ascending adult fish, and making sure there is plenty of complex habitat on the edges for the fry and parr to evade predation.

4.4 **Fencing**

Wyre RT have already installed considerable lengths of fencing to exclude livestock and protect regenerating riparian vegetation. The only other section that could probably benefit from fencing to increase resilience to erosion is at Corless Mill. Negotiations regarding fencing will have to be undertaken with any tenant farmers. Besides the environmental benefits there are likely to be benefits from a land maintenance / animal husbandry perspective as well such as deciduous shelter belts and reduced costs of treating waterborne parasites. Some incentives may be available through agri-environment schemes.

Existing lengths of fencing should be maintained / repaired to ensure that they continue to fully exclude stock, particularly sheep which will gain access through the smallest of gaps. Sheep, although small, probably have a greater impact on the river. Sheep may cause less physical damage with their hooves but their browsing/grazing style crops any growth back almost to ground level, leaving very little ground coverage or root structure remaining. Fence maintenance is especially important to check in fields that are only sporadically used for livestock; it is easy to forget to check the integrity of these.

4.5 **Pollution**

Diffuse pollution sources from silt and soil ingress were not particularly apparent on the main river as, aside from Corless Mill, livestock access is restricted and the riparian fringe is mostly well developed. It would be interesting to check the condition of the potential spawning tributaries in this regard. The culvert at Dolphinholme Farm was noted by Tom Myerscough during the visit.

Discharges should be monitored for organic pollution and reported via the Environment Agency hotline, potentially via the Wyre Rivers Trust to avoid direct conflict with a land owner.

4.6 **Invasive species**

Himalayan balsam was observed at the lowest site and all Club members should be encouraged to follow simple biosecurity protocols to ensure they are not transporting propagules u/s from this point; consider installing a warning sign on the access gate. Individual plants should be carefully pulled to remove the roots when found, before the plants have chance to flower and develop seed pods. Eradication of heavy infestations requires a co-ordinated approach from u/s but controlling local infestations will certainly help.

Tom Myerscough has produced detailed information on controlling invasives in the Wyre RT publications.

4.7 **Stocking**

The basic elements are all *in situ* for a wild fishery to flourish on the Wyre so long as habitat improvements are made on the degraded sections to form contiguous good habitat, the fish passage is improved at current bottlenecks, and the spawning tributaries are looked after. There may be opportunities to focus management of the fishery more on the wild rather than stocked fish. Adding stocked fish on top of existing wild populations increases the stress on those wild populations, both directly and indirectly. The WTT understands that not everyone within an angling club has the same aspirations; some wish to pursue wild fish in wild places and are not fazed by issues of fish size or number, while others just want to catch big fish, fairly easily. The following section highlights the issues of artificial stocking on wild trout populations.

The native trout populations of Britain possess great genetic diversity, making them amazingly resilient to changing environmental conditions. This has enabled them to thrive in rivers since the last ice age (without human interference) and they should continue to do so in the future if we can limit our impact upon them and their habitats. However, in the latter part of this period (50-100 years), the human environmental impact has increased exponentially, with major issues arising from the way in which

riparian land is managed (e.g. intensification of agriculture) and how rivers are managed (e.g. dredging to increase flood conveyance, and denuding vital habitat to reduce perceived flood risk or to ease angler access to rivers).

To compound habitat related issues, direct interference with wild fish populations has also increased via hatchery fish introduced to rivers. Stocked fish (both diploid *and* triploid) are affected by domestication and unnatural selection, even within one generation in the hatchery (*so this includes fish from wild brood-stock schemes*). Having grown and survived in an unnatural captive environment (concrete raceway, earth pond or tank), they are poorly adapted for the very different conditions of a natural river. Adaptation to a farm environment is cumulative, with the wild traits (genetic diversity and behaviours), and survival rates in the wild decreasing with each generation in captivity. The forced mating that occurs in a hatchery also bypasses vital chemical and visual aspects of sexual selection that exist to ensure mate compatibility and maximise the fitness of wild fish.

It's a *'catch 22'* situation: if stocked fish don't survive long enough to reproduce in the wild, or are infertile (triploids), they are just an additional impact upon the ecosystem (as the river only has a limited amount of resources: food and space); if they do survive long enough to breed then they have the potential to suppress wild fish production through 'hybridisation', as their offspring (*including crosses with wild fish*) have much poorer survival than the native, wild fish.

Well managed, natural river habitats (without stocking) have a far greater capacity to produce and support healthy fish populations, at all life stages. From emerging out of the gravel, wild trout disperse throughout the available habitat to find territories appropriate to their individual size and dominance. They constantly compete to maintain a 'pecking order' which ensures the dominant fish maintain priority over the best lies, where drifting food is the easiest to intercept for the least energy expenditure. They will remain (often for years in the case of a large, dominant fish) until displaced by another more competitive individual or until they die (or are removed).

This ensures that the available habitat is always used to best effect. In addition, as salmonid survival is density dependant, the greater the habitat variation and abundance available (cover and in-channel structure), the greater the number of trout that will survive each year and the more fish a reach can hold. For this reason, maximising the occurrence of those features and avoiding unnecessary tidying/pruning ensures that the river holds the maximum number of

fish possible under the given conditions (something not possible through stocking).

In contrast to wild fish, stocked fish are often transient and select less energy-efficient lies; they, therefore, lose condition and tend to leave or die within a few months (sometimes weeks) of being stocked. In the meantime, however, they cause increased competition and potentially displace wild fish.

It must also be remembered that, even without stocking, the river will be naturally re-populated. Wild trout spawning and recruitment means that new fish are produced within, and enter into a river section each year for anglers to catch. These new naïve fish may often be the smaller ones, but the overall greater population resulting from appropriate management will provide sport for fish of all sizes. Note that introducing stocked fish can easily disrupt this balance: the habitat required for five 0.5kg stocked fish may have originally supported many more wild fish, in a range of sizes from parr upwards.

Although it may appear counterintuitive at first, for all of the above reasons, stocking can often lead to less fish within a river by suppressing the wild population (particularly if undertaken year upon year), whereas wild fisheries have the potential to support much greater overall fish populations. Consequently, most angling clubs actually report increased catches after ceasing stocking (see the many case studies that are accumulating on the WTT website link below).

To further safeguard natural fish populations, catch and release fishing is advisable, for both resident and migratory species. This need not be mandatory but will greatly assist in preserving valuable wild spawners and improving salmonid production. Consider the fact that the larger, 'trophy' fish caught may have taken several years to reach that size but possess the characteristics necessary to survive well in the wild. If these fish are returned, they have a good chance of attaining even larger size and reproducing many times, further enhancing angling opportunities.

A detailed, referenced explanation of this rationale can be found on the Wild Trout Trust website in the Trout Stocking section (www.wildtrout.org/content/trout-stocking).

5.0 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 a flood defence consent 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

The WTT officer responsible for fundraising advice is Denise Ashton: dashton@wildtrout.org

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

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

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7.0 Disclaimer

This report is produced for guidance only; 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.