Advisory Visit

River Aire, Skipton Angling Association

August 2016

Key Findings

- The River Aire has been heavily modified historically (straightening, dredging, bunding) and the channel today reflects that detrimental activity; heavily incised and thus disconnected from its floodplain and a trapezoidal cross-section to the channel which results in typically uniform depth and substrate characteristics.
- Impacts of livestock via grazing and via access to the wetted margin at focal points are varied and evident throughout. However, the incised nature actually limits their impacts compared to further upstream.
- Despite this, clean gravels (some appropriately sized and located for spawning) are relatively common in the upper reaches, and maintained that way by growth of water crowfoot.
- Relatively simple and low cost tree management (planting / laying / coppicing, mostly using willow) will improve the riparian habitat for both aquatic and terrestrial fauna provided that any works are protected from livestock influence.
- Straight, uniform sections without weed would benefit from introduction of small-scale interventions mimicking natural woody debris to diversify the habitat.
- Populations of wild trout and grayling are relatively healthy with a good size range of individuals, probably reflecting the productive nature of the underlying limestone geology. However, the simplified habitat makes these populations more vulnerable to extreme events (spates) or predation pressure. Habitat improvements will increase population resilience; e.g. by introducing habitat complexity that fry can use as refugia, they will be less susceptible to washout in spates or predation by birds.
- The Upper Aire project was a 2015 Wild Trout Trust Conservation Awards winner, and so there is impetus in the catchment and an existing support network including the local Environment Agency and the Farming & Wildlife Advisory Group to take habitat improvement work forward.

1.0 Introduction

This report is the output of several site visits to the River Aire, N. Yorkshire, undertaken by Jon Grey of the Wild Trout Trust. The visit was requested by Graeme Waterfall (Chairman) of Skipton Angling Association (SAA), who accompanied Jon (with Dave Martin, Bailiff) on the initial walkover in June, 2016. Jon re-walked further sections in early August, 2016. The main report will deal with those sections visited that are exclusively fished by SAA; an appendix covers additional waters shared with Bradford City Angling Association – see Fig 1.

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.

Fig 1. Map of River Aire sections walked: solid red line – Skipton AA only; dashed red line – shared waters with Bradford City AA. Red asterisks denote upstream extent of point searches of tributaries: Catlow Gill running through Carleton, and Eller Beck through Skipton. Note the severe bunding on the river banks below Carleton Bridge (lower right); see also Fig 2.

	Skipton Angling Association
River	River Aire
Waterbody Name	Aire (Eshton Beck to R Worth)
Waterbody ID	GB104027063033
Management Catchment	Aire & Calder
River Basin District	Humber
Current Ecological Quality	Overall status of **Moderate** ecological potential based upon an overall ecological status of **Moderate** and overall chemical status of **Good**
U/S Grid Ref inspected	SD 98337 50082
D/S Grid Ref inspected	SD 98647 49413
Length of river inspected	~1800m in total

Table 1. Overview of the waterbody. Information sourced from: http://environment.data.gov.uk/catchment-planning/WaterBody/GB104027063033

Under the Water Framework Directive (WFD), the Aire from Eshton Beck to the River Worth (GB104027063033) has the designation Heavily Modified Water Body (HMWB). Through two cycles of assessment, it has achieved *Moderate Ecological Potential* 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 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. However, it is important to note that, in the case of HMWBs, the status of fish (and benthic invertebrates) are often discounted as the HMWB designation already highlights a potential impact on those biological indicators, but as these are of the greatest immediate importance to angling clubs, they should not be overlooked.

For example, a HMWB could have mitigation measures in place to allow it to reach good ecological potential e.g. a fish pass installed on a dam required for hydropower generation, but if water quality is poor due to elevated phosphorus, its overall ecological potential assessment could be moderate, poor or bad depending on the severity of the impact and associated score for that parameter.

The overall status of *Moderate Ecological Potential* was derived from an overall ecological status of Moderate and overall chemical status of Good; i.e. the waterbody is failing.

2.0 Catchment / Fishery Overview

The River Aire rises near Malham in North Yorkshire in a landscape dominated by the underlying carboniferous limestone geology. Limestone has a significant influence in providing a nutrient base and typically good clarity water for plant (primary) productivity that further supports a diverse ecology, including abundant invertebrate communities, and where habitat allows, fast-growing, abundant fish populations.

The Aire catchment lies within Natural England's National Character Area (NCA): 21 Yorkshire Dales and is classified from an abstraction perspective as 'water available', including from the underlying Carboniferous Limestone (Aire and Calder Catchment Abstraction Management Strategy, Environment Agency; 2007). Flows generated within the NCA contribute to flooding events outside the area, particularly along the Aire in Leeds, exacerbated by engineered bunds which are particularly prevalent along the length examined.

Most Yorkshire Dales' rivers have been affected by drainage and heavy stock grazing in both the catchments and floodplains, resulting in rapid transit of water and flashy hydrographs with narrow, high peaks and troughs of flow, excessive erosion, and a scarcity of wetland features. There is typically over-supply of cobble and gravel resulting in pools filling in to become uniformly shallow, especially where natural geomorphology is interrupted i.e. behind weirs.

Various UK Biodiversity Action Plan priority species are found in the Aire and its tributaries including eel (*Anguilla anguilla*), brown trout (*Salmo trutta*) and native crayfish (*Austropotamobius pallipes*). Restoring a more natural flow regime, geomorphology, and riparian and in-stream habitat mosaic to the river will certainly assist in fulfilling the ecological aspirations for the upper Aire, which suffers obvious impacts from past land drainage and channel realignment.

In the last round of the Common Agricultural Policy - Countryside Stewardship Scheme (up to 2014), much of the land surrounding the River Aire was in a Higher Level Stewardship (HLS) target area, with some land already signed up to Entry Level Stewardship (www.magic.gov.uk). With this in mind, it is hoped that the next round of new schemes (2016) will also target these areas, and that subsidies may be available to landowners/tenants prepared to enter land into stewardship options such as buffer-fenced river margins.

It may also be that Catchment Sensitive Farming initiatives are running on this land and this is well worth investigating with the local EA, Natural England and Woodland Trust. Such schemes may assist with funding for improvements in riparian land management.

3.0 Habitat Assessment

Historically, the river has been straightened or moved to accommodate road and rail infrastructure, increase conveyance of spate flows, and probably also to create more coherent parcels of land for agriculture. Such interference is always detrimental; a shortening of the channel and hence a steepening of the gradient resulting in increased erosion and leaving the river heavily incised with incredibly steep banks. It appears also to have been dredged to provide material for the earthen bunds evident in the adjacent fields (Fig 2).

Fig 2. The bunding around the pasture edge, immediately d/s of Carleton Stone Bridge which is just visible in the background. The bunds are evident on the map in Fig 1.

The bunds are an attempt to constrain the flow within the channel with the misguided notion of increasing conveyance of spate flow d/s and hence reduce local flooding. All they serve to do is increase the likelihood of flooding further d/s and increase the downward erosion within the channel (further incision) instead of allowing spate energy to dissipate across the floodplain. Fine sediments are retained within the confines of the channel so that as the water level recedes and energy abates, the silt drops out and smothers the cobbles and gravels. Much of this rich sediment should have been deposited onto the flood plain and enhance production there. Hence, the river is effectively dis-connected from its floodplain.

The starting point for the walkover was Carleton Stone bridge at SD9833750082 (Fig 3). There are considerable bank reinforcements both immediately u/s and d/s to ensure that the Aire is passed through the bridge rather than meandering naturally across the wide floodplain. Fortunately the footings of the bridge are sufficiently deep and retain a natural substrate so that fish passage is not an issue. Immediately d/s of the bridge, the river is wider and shallower because of the eddying effect of higher flows around the hard infrastructure. However, there is notable development of sediment bars (some with pioneer vegetation) and retention of suitable-sized (10-40mm) well-aerated gravels that may be used for spawning; indeed, the diversity of structure and weed growth, even with a shallow depth of water is good habitat for juvenile fish (Fig 3).

Fig 3. Looking u/s (upper panel) and d/s (lower panel) from Carleton Stone Bridge. Note the considerable stone reinforcement of banks to force flow through bridge arches. There is a deeper pool d/s of the vegetated bars with a tail of sorted gravels, and the mix of depths and flow velocities provide good habitat for juvenile fish.

Dense stands of the invasive non-native species, Himalayan balsam (*Impatiens glandulifera*), are evident on both banks and especially immediately below the confluence of Eller Beck which joins the mainstem Aire on the LB ~100m below Carleton Stone Bridge (Fig 4). Balsam is an annual, relying upon enormous production of seeds each year to recolonise areas. It has little in the way of root structure and rapid tall growth means that it tends to readily outcompete native plants. As a consequence, when it dies back in autumn, there is no understory and no root matrix within the soils of the banks to provide physical resilience to erosion during spates.

Fig 4. Looking u/s to the mouth of Eller Beck (blue arrow) almost hidden beneath a stand of willow. Note the dense beds of Himalayan balsam on both banks, partially controlled by grazing on the RB.

Despite Eller Beck flowing through the town of Skipton, it is formed from a multitude of smaller tributaries, some of which have very high water quality and good riparian habitat, and hence provide a network of spawning streams. Limited natural channel characteristics were evident where the beck is allowed to meander and braid (see Fig 5), but as can be seen from the map (Fig 1), it has been straightened and over-widened for much of its lower reaches and hence excess erosion, grazing to the bank edge and livestock access are all contributing to a higher than natural sediment load which is smothering the bed.

Fig 5. Looking u/s from the highest spot check point, the road bridge over Eller Beck (upper panel) where, despite the walling and formalised true LB, the beck is meandering and braiding around deposition bars. Lower panel: straightened, over-wide section looking d/s from same road bridge and highlighting excess sediment in the channel. Good low cover on the true LB.

Connectance is a major issue. There are two considerable obstacles to free fish passage (and geomorphological process, the natural supply of gravels to the main river); an Environment Agency gauging weir ~25m u/s of the confluence (Fig 6), and a further step weir ~250m further u/s (Fig 7). Weirs alter the free flowing character of the beck u/s by impoundment and prevent free transport of substrate, thereby impacting upon geomorphology d/s. Channels tend to be overly wide and homogenous in depth and character - see a WTT video outlining key impacts, here:
https://youtu.be/ILofBcLiDts

Fig 6. Highly modified channel walls (and hence lack of low cover) to constrain the course of the beck over the gauging weir just visible (top right). Note, as the channel is overly wide, and the weir impounds the beck for ~50m u/s, there is marked deposition of substrate.

Fig 7. Step weir at SD9848550304. Image taken from P. Gaskell's 2012 report for Aire Rivers Trust.

Below the confluence with Eller Beck, the Aire is forced to the right by stone walling at the foot of the bank, and remains constrained by bunding on both banks for over 1km to the railway bridge. For the uppermost ~200m, the river is generally shallow with limited riffles and pools attempting to form in an overly wide, straightened, engineered channel (Fig 8). Anecdotal evidence suggests that the area quality of clean gravels has recently declined and silt now smothers a greater extent. Several mature willows (*Salix capraea* and *S. fragilis* – goat and crack willow, respectively) are well established and where they are close to the water line, provide some low cover for fish refuge, some trailing and broken branches to create small but vital flow diversions, and introduce leaf litter and woody debris for aquatic invertebrates (as well as foraging and nesting / roosting sites for terrestrial organisms).

Fig 8. Straightened shallow section demonstrating incised, trapezoidal channel caused by dredging and bunding. Silt is evident at the edges but riffles in the distance maintain clean gravels.

However, they also attract the attention of cattle for shade, as browse, and as access points to the river (Fig 9). The continual poaching (trampling) of the banks is a double-edged sword. In such an engineered channel, the gradual re-profiling of the banks allows some better, if limited connection between the river and its floodplain. However, these focal points also cause considerable soil ingress, especially during high rainfall events as they form gutters into the river. There is also the introduction of excess nutrients via faecal matter which contributes to the proliferation of nuisance algae and an oxygen demand from bacterial metabolism in the water.

It might be beneficial in this situation, where the channel is so incised, to continue to allow cattle access to the water's edge but lay some of the mature willow trunks thereby preventing the cattle from walking along the bank foot. There is sufficient room to get the river path meandering again at low-flows within the constraints of the engineered, trapezoidal channel – see Fig 9, lower panel; this may be achieved using low cost interventions under the exemptions of the new Environmental Permit Regulations – see Recommendations.

Fig 9. Upper panel: cattle accessing the river bed especially around mature willow trees. Lower panel: cattle access the full length of bank toe here; a positive aspect is that there is sufficient space for the low-flow channel to meander within the confines of the bunded banks.

The ~800m section above the railway bridge, and indeed for many hundreds of metres d/s of that bridge are so deeply incised by dredging and bunding that flow is barely discernible (Fig 10). There are incredibly deep holes in the bed where the boulder clay has been gouged into during spates because the flow energy is constrained within the bunds. These holes may be deep also because the river is being starved of cobble and gravel substrate as geomorphological process is strangled upstream; all the weirs on the system may be preventing the natural resupply of material down-river, post-dredging. The only habitat features of note are the sporadic stands of mature willow. As most of these comprise multiple trees or multiple trunks, some could be laid parallel to the bank, i.e. along the channel, to encourage deposition of finer sediments in their lee, and introduce some further flow diversity under low-flow conditions. The idea is to emulate natural tree fall, as can be seen in the lower panel of Fig 10. As the name suggests, crack willows naturally crack and lay under their own weight, but generally remain alive and will reinforce the sediments where they fall via adventitious roots. There were three sizeable brown trout holding station around this one branch, whereas none had been seen in the 800m u/s.

Fig 10. Upper & mid panels: the almost canal-like sections with barely discernible flow above the railway bridge. Lower panel: a cracking crack willow branch that is still viable, and introducing much needed habitat and flow variability in an otherwise uniform channel.

Appendix to Wild Trout Trust Advisory Visit conducted by Prof. Jon Grey July-August 2016

Shared waters on the Aire between SD9704150575 (upstream limit, Heslaker Lane) and Carleton Stone Bridge (SD9834050085). Bradford City and Skipton Angling Associations

The u/s limit of the Aire assessed was where the Catlow Gill enters from the RB; Heslaker Lane constrains the Aire along its RB for ~320m u/s of this confluence. For almost the entire length to Carleton Stone Bridge, the RB is reasonably well buffer-fenced whereas the LB is unprotected from livestock access. This results in an obvious difference in bank profile: the LB is typically vertical as the grass is grazed up to the very edge and the bank tends to collapse due to block failure, leaving a narrow strip of soil at the bank toe which is colonised to varying degrees; the RB typically has a more gradual slope to the river as a consequence of the greater diversity of riparian vegetation creating a better root matrix to support the bank and resist erosion. As a consequence, the condition of the riparian habitat is generally better on the RB except for the dense stands of Himalayan balsam which affect both banks to varying degrees.

Through historic straightening and dredging, the channel has become trapezoidal in cross-section. This results in the uniform distribution of bed materials, an unsorted 'cake-mix' which is typically low quality habitat for invertebrates as well as lacking in structure required for spawning substrate. The saving grace for the majority of the upper reach is the growth of macrophytes such as *Ranunculus* spp. (water crowfoot) which forces the water around the plant mass, thereby concentrating flow into narrow channels which removes the finer silts and effectively cleans the gravels in between (Fig A). Swan grazing is reducing this valuable function in some stretches.

Fig A. Water crowfoot (*Ranunculus* spp.) stands pushing the flow about and keeping gravels clean. Note the close cropping of the plant by mute swans (*Cygnus olor*).

There is also sporadic introduction of habitat diversity from small clumps of mostly goat willow (*Salix caprea*); some of these trees are rooted at the toe of the bank and thus provide vital low cover via trailing branches, which also help to diversify flow by pinching the channel and create scour holes underneath which are excellent holding spots for larger fish (Fig B). It is important also to consider the role these trees play as focal points for mating swarms of aquatic insects, thereby keeping the insects close to the banks and providing cover for them during inclement weather before they lay their eggs back in the river.

Fig B. An example of excellent quality habitat provided by goat willow. The root mass will provide physical structure to stabilise the bank, and the low growing and trailing branches not only provide cover but diversify flow and depth by 'pinching' the channel width.

The downstream impacts of a pinch-point are exemplified by the footbridge at SD9739450464 where the Aire is essentially forced into a narrow aperture, and 'blows out' a pool immediately below. The material scoured from the pool has deposited to form an island, ramps of well-sorted substrate and effectively braiding the channel into two separate paths which are formed of clean, bright gravel beds (Fig C). The island is now well vegetated, helping to consolidate its structure. While flow is stronger in the channel to the LB and presents more classic river habitat, the slower flow in the channel to the RB is a useful refuge area for juvenile fish, especially during spate flows.

Thus, the presence of submerged aquatic plants, the bridge, and the few willows are the only 'hard' features which create resistance to the flow in the trapezoidal channel and produce depth and flow diversity in an otherwise uniform environment. To create better, diverse habitat, it is these features and functions which need to be emulated or reintroduced where appropriate, especially in the straighter sections.

Fig C. Upper panel: the island (braiding) within the channel immediately below the pinch-point introduced by the footbridge from Carleton to Ings Lane. Lower panel: looking u/s from near the foot of the island along the channel hugging the true LB. Note clean gravels, water crowfoot growth and cover from shaggy bankside vegetation, although also note presence of Himalayan balsam.

At several points, livestock has accessed the river bed and caused considerable erosion of the LB (Fig D). While this trampling and poaching introduces fine soil and nutrients, viewed in the context of an increasingly constrained and incised channel, the localised widening and connection point for the river to its floodplain is actually beneficial. One way to nullify some of the negative aspects of such access points would be to introduce a pinch-point via paired log-deflectors or by laying of willow trunks (if present); this should focus the flow through the gap and also provide a nearby depositional environment (in the lee of the deflector) where the fines may accumulate and eventually consolidate.

Fig D. Looking u/s (upper) and d/s (lower) from mid-river at a cattle access point on the LB. Note the considerable growth of aquatic plants in the wider, shallow channel.

The channel becomes more incised with distance d/s; the banks are much higher and steeper by Carleton Stone Bridge and access to the riverbed is tricky. This does mean that the vegetation is largely unhindered by livestock grazing, even on the unfenced section, and hence the plants at the waterline create a shaggy margin, ideal for fish cover (Fig E). However, it also means that because spate energy rarely overtops the banks and dissipates onto the floodplain, erosion continues downwards and exacerbates the incision, and as a consequence, the lower reaches are typically deeper and slower flowing. It is especially important to retain even relatively small features near to the toe of the bank to provide some heterogeneity in the channel, e.g. the retention of a long-dead tree trunk (in Fig F) provides sufficient flow deflection to allow the consolidation of a vegetated bar immediately d/s.

Fig E. Looking u/s from near Carleton Stone Bridge at the heavily incised channel. Note the slight pinch from a willow (blue arrow) on the RB has caused variation in the depth and flow immediately d/s.

Fig F. Retention of the dead trunk has protected the LB immediately d/s and created a vegetated bar.

Catlow Gill, like so many other small and seemingly inconsequential tributaries, should not be overlooked for its potential as spawning habitat, and hence making a contribution to the production of the wider Aire fish populations. It contains appropriately sized gravels and decent riparian cover for at least 100m u/s of its confluence, and could easily be managed to create even better habitat primarily for the egg, swim-up and fry life-stages.

4.0 Recommendations

The Aire is a naturally productive river and contains a food base that supports considerable populations of trout and grayling (and other species too). Historic and relatively recent engineering modifications to the channel to allegedly alleviate flood potential mean that habitat is the limiting factor to even better fish production, and some modifications are unlikely to be circumvented; for example, the flood defence bunds. However, there is scope for habitat improvements which will increase the resilience of the fish populations and provide even better sport for SAA which should not impact upon perceived flood risk; indeed, many could probably be instigated under the new exemptions to environmental permits.

4.1 Tree Work

4.1.1 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. It will be most effective if trees are trained over into the channel. Most native deciduous species would be beneficial but willow is by far the easiest to transplant and manipulate, and to maintain at an appropriate size to have the desired management effect. If any planting is to be undertaken near to the bank tops then adequate fencing is key to protect trees which will be targeted for browsing by livestock.

The quickest and easiest way of planting willow is by pushing short sections of willow whip or short sections of stake into the ground, using locally sourced material (which is free!). 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. Keeping the stem at a low angle to the water (to aid transpiration), and also angled d/s so that it creates less resistance during spates and will not be ripped out before the roots are established are important considerations. Live willow stakes can be hammered deep into the bank and may provide greater structural stability under spate conditions. Planting in clumps, alternately positioned from one bank to the other can introduce some sinuosity within the channel under low-flow condtions.

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/

4.1.2 Laying

Where trees are already established along the bank, habitat improvements can be easily achieved by laying the trunks, or selected branches down into the watercourse to increase low cover and in-channel structure. The laying method is usually limited to pliant species such as willow, elm, hazel, hawthorn and small alder, but some others can be laid carefully. Small to medium shrubs tend to work best. 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. The depth of the cut should be limited to only that which is required to bend the limb over, as this will 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.

4.2 Fish passage issues

There are no fish passage issues on the sections of the mainstem Aire that were examined for this report, but access to the tributaries is hindered in many cases, especially at Eller Beck. As noted in the Habitat Assessment section, angling clubs should not overlook the importance of small tributaries to wild fish production in their waters. The Environment Agency gauging weir near the mouth of Eller Beck is a considerable obstruction, and is still functional as a gauge for the water level monitoring network. However, as has been recently demonstrated at Eshton Beck, u/s near Gargrave, gauging weirs can be made passable to fish, and so options for Eller Beck gauge should be explored and pursued. With regard to the stepped weir at SD9848550304, Paul Gaskell (WTT) reported to Aire Rivers Trust in 2012 that: *Removal of this structure would be a significant and costly undertaking – but would bring huge benefits to both in-channel habitat and connectivity. This is certainly a case where a gradual approach (i.e. removal in at least 3 separate phases) and an assessment of the response of the upstream watercourse to the* *removal of each part of the structure over at least 6 months before proceeding with the next phase. An alternative, and less radical approach, would be to install pre-barrage easements that could be bolted to the stepped face of the weir. This approach could be coupled with a more moderate notching (i.e. partial removal) of the structure. This notching could provide at least a proportion of the habitat quality benefits associated with increased flow velocities upstream of the barrier. Alternatively, the apparent "perched" nature of the channel on the left hand bank may offer an opportunity to cut a bypass channel through the meadow. This may be perceived as a benefit by the landowner as it would be likely to reduce the attractiveness of the weir pool to trespassing anglers that are currently causing a nuisance.*

4.3 Pollution

Diffuse pollution from silt and soil ingress is a problem wherever livestock have access (causing guttering to the river) and their poaching and trampling directly erodes banks. There are several discharge pipes entering the Aire from various parts of Skipton (both storm overflow and STWs). These should be monitored, as should the smaller tributaries which may be treated as drains in some instances.

4.4 Tributaries and spawning habitat

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. Certainly Catlow Gill is worthy of further investigation into its use as a spawning tributary. An electrofishing survey could be conducted to ascertain the extent of its use.

To emulate natural pinch-points and treefall where there is no living wood available, paired deflectors or individual stub deflectors could be installed on the straight, wide, shallow, trapezoidal reaches: short (<2m), well anchored / pinned trunks of wood (<400mm diameter); see Fig 11. The purpose of such installations would be to cause small-scale, localised scour and 'hummocking' of the bed, thereby focussing and retaining smaller gravels in their lee (see WTT video, here: https://vimeo.com/32317564). They might also introduce an element of sinuosity to the flow under low-flow conditions. Angling the deflectors u/s focuses flow toward the middle of the channel (i.e. away from the bank and hence reduces erosion risk there), when they are overtopped. In terms of perceived flood risk, because these structures are relatively small (<5% of bank height) and occupy <50% of the cross-sectional channel width, they are completely overtopped during high spate flow.

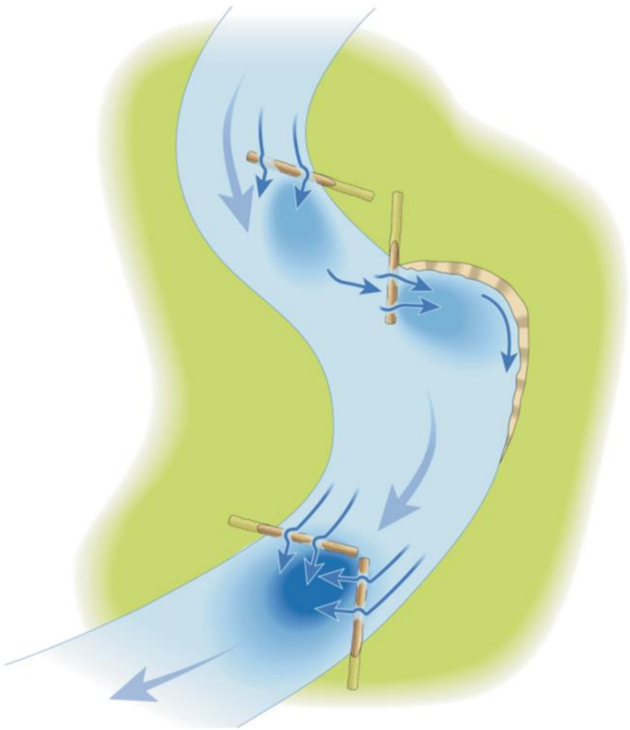

Fig 11. Conceptual diagram of use of woody material as deflectors. From the top of the figure:

Upstream angled – diverts flow to the centre of the watercourse, and creates localised scour; locating deflectors on opposite banks of a straightened section, but off-set in position can create sinuosity of flow without eroding the banks.

Downstream angled – diverts flow toward the bank, increasing likelihood of erosion and can be used to increase sinuosity of the entire channel.

Paired upstream angled – focuses more flow to the centre and creates a deeper scour pool with associated ramp of sorted substrate further downstream.

4.5 Invasive species

Himalayan balsam was the only invasive plant observed but it is extensive. It appears to increase in density ~2km u/s at Inghey Bridge where a small tributary enters from near Skipton Auction Mart. Eller Beck is clearly a different source. Eradication is difficult without a coordinated approach from the u/s end. The club should engage with any initiatives to try and control its growth and future spread. Anglers should be encouraged to follow simple biosecurity protocols to ensure they are not transporting propagules u/s; consider installing a warning sign on the access gate.

Seek advice from Yorkshire Wildlife Trust on management.

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

6.0 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.

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.