

WILD TROUT TRUST
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River Axe, Kingfisher Common near Wookey, Somerset



Advisory Visit July 2024

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Contents

1. Introduction	3
2. Catchment overview	4
3. Habitat assessment	7
3. 1. Main River Axe	7
3. 2. Lower River Axe (mill stream).....	20
4. Recommendations.....	22
5. Making it happen.....	23
6. Acknowledgement	24
7. Disclaimer	24
8. Appendix A : Trout habitat	25
9. Appendix B: Tree hinging and similar works.....	29

1. Introduction

This report is the output of a visit undertaken by Theo Pike of the Wild Trout Trust on approximately 1 km (0.6 miles) of the River Axe and its associated mill stream, just upstream of Wookey in Somerset, on 9 July 2024.

A walkover of this site was requested by the owner of Kingfisher Common (www.kingfishercommon.co.uk) and the visit was particularly focused on assessing habitat for wild brown trout (*Salmo trutta*), other fish species, and biodiversity in general.

It is hoped that this will form part of the owner's plans for evolving management of this 27-acre holding from its previous status as grazing land towards a greater diversity of habitat-rich scrub, wildflower meadows, orchards and community food growing.

Comments in this report are based on observations on the day of the visit, as well as discussion with the landowner. Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

At the time of the walkover, river flows were judged to be at moderate summer levels: water clarity was limited, with some turbidity after overnight rain.

For a wider catchment overview, this report may also be read in conjunction with previous walkover surveys of the River Axe at Wookey Hole and Wookey as part of the TWIST (Transforming Waterways In Somerset Towns) project:

www.wildtrout.org/wttblog/twist-reporting-live-from-somerset

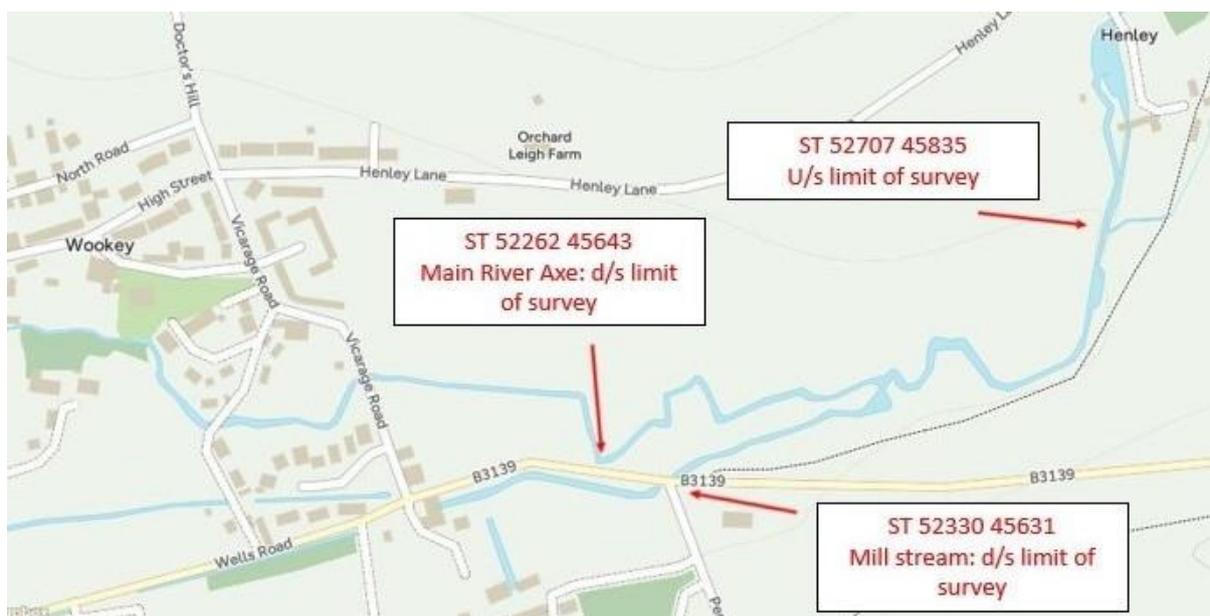


Figure 1: A map showing the River Axe at Kingfisher Common, and its surrounding area

2. Catchment overview

The River Axe is a small limestone river which rises from springs on the heights of the Mendip Hills, and runs over areas of impermeable shale and other rocks before sinking into swallets and reappearing from the limestone at Wookey Hole caves.

From here, the river flows south-west to Wookey, and then broadly west and north-west along the southern edge of the Mendips, and eventually reaches the Bristol Channel at Weston-super-Mare.

River	River Axe
Waterbody Name	Axe – source to Cocklake
Waterbody ID	GB109052021520
Management Catchment	Somerset South and West / Brue and Axe
River Basin District	South West
Current Ecological Quality	Moderate (as at 2022)
U/S Grid Ref inspected	ST 52707 45835 (approx.)
D/S Grid Ref inspected	Main river: ST 52262 45643 (approx.) Mill stream: ST 52330 45631 (approx.)
Length of river inspected	1 km approx.

Table 1: WFD information for the River Axe

Thanks to the extended residence time of water in their underground aquifers, limestone rivers like the Axe are typically somewhat more stable in temperature and flow regime than purely rain-fed systems. When combined with calcium-rich and slightly alkaline water chemistry, these conditions can promote highly productive ecosystems, comparable in many ways to the rich species diversity and abundance of chalk streams.

The overall physical, biological and chemical health of all rivers in the UK is periodically assessed by the Environment Agency for the purposes of the Water Framework Directive (WFD). The most recent assessment (from 2022) can be found via this link:

<https://environment.data.gov.uk/catchment-planning/WaterBody/GB109052021520>

This has not substantially altered since the previous assessment in 2019 (perhaps due to no further data collection) and detailed discussion of the 2019 results can be found in WTT’s TWIST reports for Wookey Hole and Wookey:

www.wildtrout.org/wttblog/twist-reporting-live-from-somerset

The spring source of the Axe at Wookey Hole is the second largest resurgence associated with the Mendips, producing an average discharge of 789 litres per second, and this reliable flow has been exploited for water power and other industrial applications for centuries.

At Kingfisher Common, the river's flow is split into two channels: a northerly course through Wookey to Knowle Moor, and a straighter, more southerly mill stream (sometimes known as the 'Lower River Axe') running parallel to the B3139 road.

This channel still provides power for flour milling at Wookey's Burcott Mill, before flowing through a series of four other 'mill stream villages' at Worth, Yarley, Henton and Bleadney, and rejoining the main River Axe north of Panborough Moor. In 1086, Domesday Book recorded milling on the present sites of Burcott Mill and Bleadney Old Mill, so it is thought that this mill stream (and thus the presence of the diversion weir at Kingfisher Common) may represent pre-950 Saxon or even Roman era modifications to harness the river for water power.



Figure 2: 1892 map showing the River Axe at Kingfisher Common and its surroundings, including Henley Mill. (Reproduced with permission of the National Library of Scotland)

As well as exploiting the Axe directly for industrial purposes, historic human activities have also affected the river's water quality. Paper mills were often sources of pollution, while limestone karst aquifers like the Mendips continue to be vulnerable to contamination via sinkholes, swallets and quarrying activities. This is exemplified by enduring lead pollution from long-defunct industrial processes at Priddy, which started to impact paper milling at Wookey Hole in the 1860s, and is still noted in ecological surveys (including the Environment Agency's assessments under WFD – see the link above) in this area. In the adjacent Keward Brook sub-catchment, agricultural runoff into swallets on the Mendips supplying resurgence springs at Wells also results in periodic slurry pollution incidents in the city's Bishop's Palace moat.

Today, although fisheries classification studies are still not believed to have taken place on the upper River Axe for WFD assessment purposes, the upper river is known to hold a self-sustaining population of native wild brown trout, and it would be reasonable to suggest that a wide range of fish species could thrive in this part

of the catchment if water quality, quantity, fish passage and habitat issues were successfully addressed.

The UK's wild trout are noted for their genetic variability and potential to produce (over the course of generations) locally-adapted strains which can cope with specific challenges posed by their particular environment - as demonstrated by this recent study of trout in metal-impacted UK rivers:

https://www.researchgate.net/publication/381002419_Living_in_a_post-industrial_landscape_repeated_patterns_of_genetic_divergence_in_brown_trout_Salmo_trutta_L_across_the_British_Isles

In light of the River Axe's history of lead pollution, it is highly probable that its trout population is uniquely adapted to surviving elevated levels of lead which might be fatal for trout not similarly selected to thrive in the river's particular cocktail of heavy metal contamination. The river's trout are therefore potentially irreplaceable, so it would be highly beneficial to assist this population to become as successful and resilient as possible.

From observations during the earlier TWIST surveys, adult trout were certainly present at points high up the system: however, it is likely that fish passage issues such as weirs are currently limiting the population, and would make recolonisation difficult or even impossible, if isolated upstream populations became extirpated by low flows or pollution incidents.

Due to their need for clean, well-oxygenated water, structurally-varied habitat, and free movement between different types of habitat at different life stages, the UK's native wild brown trout makes an ideal indicator species for healthy rivers.

As such, a simple and effective assessment for overall river health can be based around the life cycle requirements of wild brown trout: these are described in detail in Appendix A, and applied throughout the habitat assessment that forms the next section of this report.

3. Habitat assessment

For the purposes of this report, the stretches of river assessed will be described from the upstream to the downstream extent visited.

3. 1. Main River Axe

At the upstream end of the reach visited, the river may have been historically straightened as the overspill channel and /or tail race for Henley Mill's fulling, iron and paper production works, with areas of the adjacent meadow on the RB also potentially used as settling ponds for metalworking processes. For more details of this site's history, see the Somerset Historic Environment Record listing:

<https://www.somersetheritage.org.uk/record/571111#>

Evidence for earthworks associated with these settling ponds (including a bund along the RB of the river, which is also noticeable on the ground) can be seen from LIDAR surveys of the Kingfisher Common area:

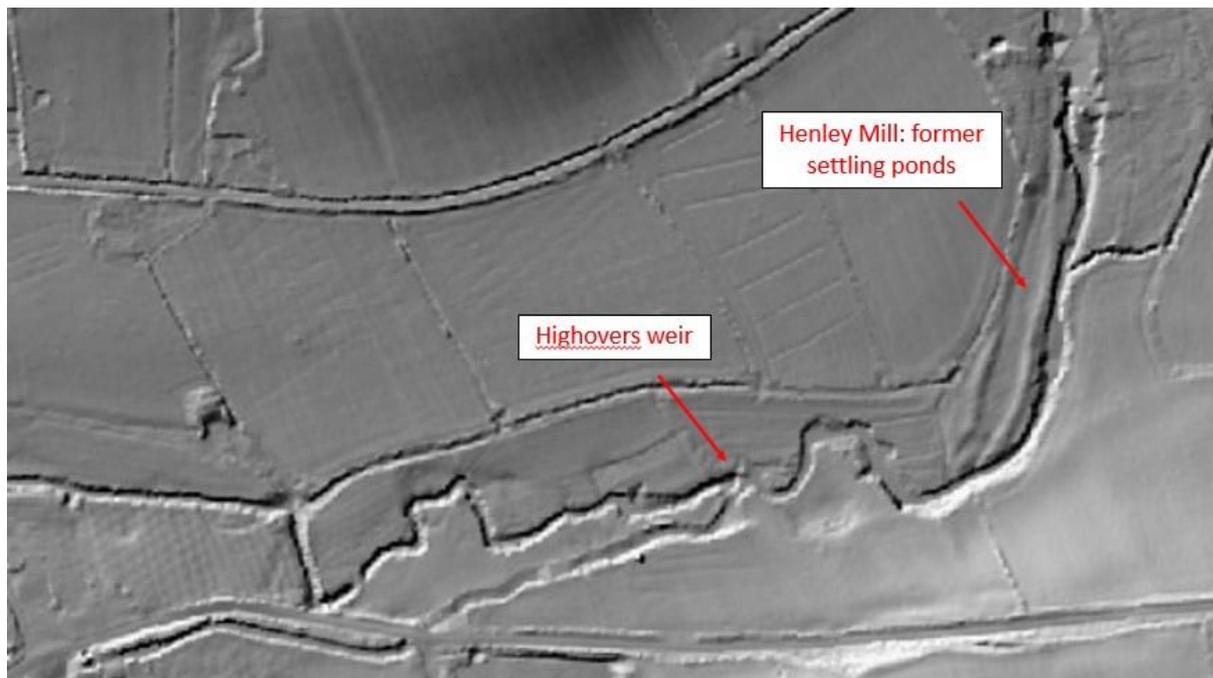


Figure 3: LIDAR survey image of the Kingfisher Common area, showing the extent of earthworks associated with Henley Mill, as well as possible hints of older natural and artificial channel courses



Figure 4: Looking upstream near the gauging weir discussed below: the river is completely hidden from view behind a thick buffer hedge which includes mature trees

As part of the land's previous management for grazing, tall buffer hedges have been allowed to develop along both banks of much of the river's course, both here and downstream. This has had the significant benefit of protecting the banks from poaching by livestock, as well as allowing strong root structures to develop for bank stability - but it has also had the effect of overshadowing the river and making it very dark and tunnelled in many places.

To allow more light into the river for primary production in the aquatic food web, careful 'skylighting' should be considered: opening gaps in the dense foliage and canopy to create more dappled shade and allow more light into the river corridor. Depending on location, a ratio of 40:60 light:shade is currently considered to be a reasonable target for a productive watercourse where aquatic macrophytes might become established, with proportionately more light over shallow riffled areas, and more shade over deeper pools.

At the same time, it is very important to note that maintaining a significant level of shading is essential for keeping water temperatures cool, especially in small rivers like the Axe, and is likely to become increasingly important with future climate change.

In the course of careful skylighting efforts, individually selected trees could be 'hinged' and secured into the margins of the river as 'large woody material' (LWM), in a process much like aquatic hedge laying. This is designed to imitate natural

processes of tree fall (often also naturally instigated by beaver activity) which will increase complex woody in-river habitat for the benefit of fish and aquatic invertebrates.

Alongside water quality and quantity, the habitat benefits provided by plentiful in-river LWM are often overlooked, but natural woody materials in rivers are a vital component of river health. Indeed, as a result of historic tidying and over-zealous flood risk reduction, most UK rivers are functionally starved of LWM. Increasing the amount of LWM in the Axe at Kingfisher Common will be an important aspect of securing a healthy local environment in the future.



Figure 5: Looking downstream (left) and upstream (right – image courtesy of EA) at the Henley Wookey gauging weir, which is likely to pose a barrier to movement of most fish species under most flow conditions

At ST 52701 45806, approximately halfway down this straightened stretch of river, there is a concrete compound-type weir structure, with an additional back channel on the LB. It is understood that these are owned by Bristol Water, having been constructed in the 1950s to measure flows that allow abstraction further downstream at Brinscombe: the EA and its predecessors have also collected data here since the mid-1990s (pers. comm. EA, August 2024).

As shown in the right-hand image above, the gauging structure is 'a type of flume with a hump in the bed, and a groove cut into the centre which goes down to bed level' (pers. comm. EA, August 2024).

The structure of this weir does not appear to be as extreme as some larger 'flume-type' gauging stations on other Somerset rivers, but given its age, it is unlikely to have been designed with fish passage in mind, and is likely to present a barrier to most fish under most flow conditions. The width of the narrow central notch was presumably calculated to ensure that upstream levels were maintained over a comparatively wild range of flow scenarios: thus, at high flows, water velocity through the central slot may be high and problematic, even for larger fish, while at low flows, lack of depth may limit the size of fish that can use the notch, and the shallow, exposed area downstream may also present a behavioural deterrent.

Overall, some larger fish may be able to pass at medium and low flow conditions, but could struggle at precisely the time when they might be triggered to migrate in higher flows. If maintaining upstream levels is not considered critical, it may be possible to slice away one side of the notch to widen it, thus moderating flow velocities through the notch under conditions when fish are more likely to move. At the same time, it would also be beneficial to roughen the wing wall / spillway interface for improved eel migration.

Meanwhile, the back channel is thought to have been built as an alternative flow pathway, to facilitate dewatering the main channel for maintenance. Although the sluice boards at the upstream end of this back channel are understood to be deteriorating (pers. comm. EA, August 2024), it is also unlikely to have been designed to function as a fish pass.

In general terms, whatever the purpose of any individual weir or dam, these structures cause problems for rivers because they impound long stretches of very slowly-moving water, where sediment carried in suspension drops out of the water column uniformly across the stream bed, and habitat quality and diversity are severely degraded. Such conditions can sometimes provide sufficient deep-water habitat for small numbers of adult trout and other species (until the deep water inevitably fills with sediment) but are generally unsuitable for gravel spawning fish, fry and juveniles.

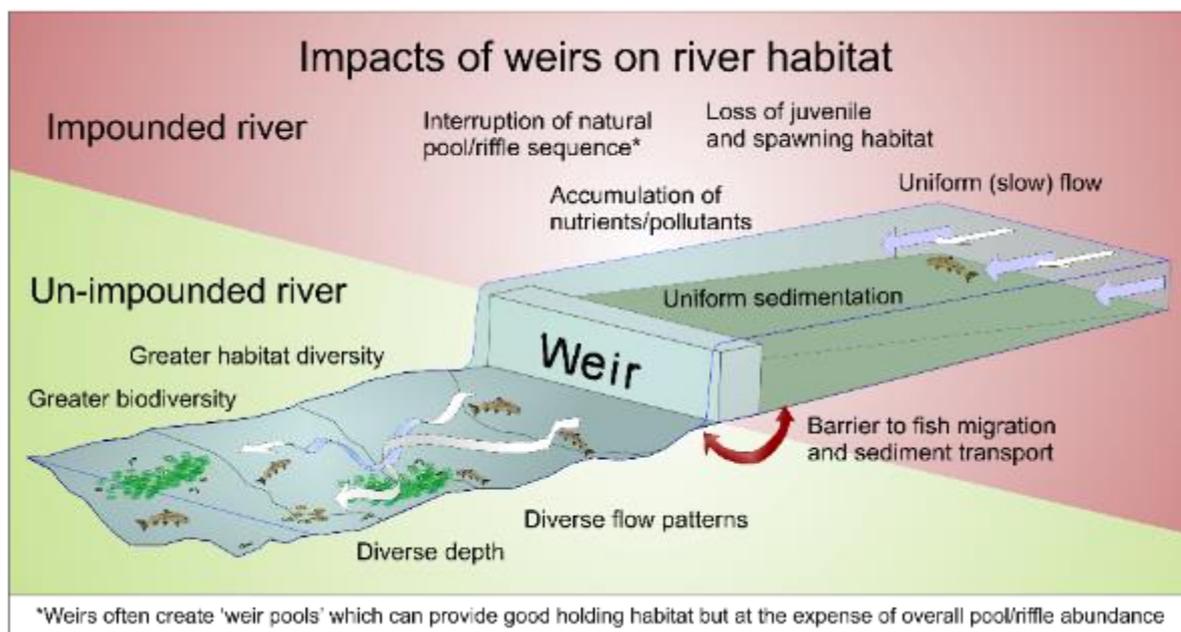


Figure 6: An illustration showing the impacts of weirs on habitat quality

Weirs are often significant barriers – or even complete obstacles – to fish passage, preventing many species from moving up and down rivers freely to fulfil the different stages of their life cycles. Weirs also interrupt the natural transport of river sediment. This can cause the river downstream to become depleted of coarse sediment, and increase rates of bed and bank erosion in an attempt to compensate for the interrupted supply of suitable gravel and cobbles.

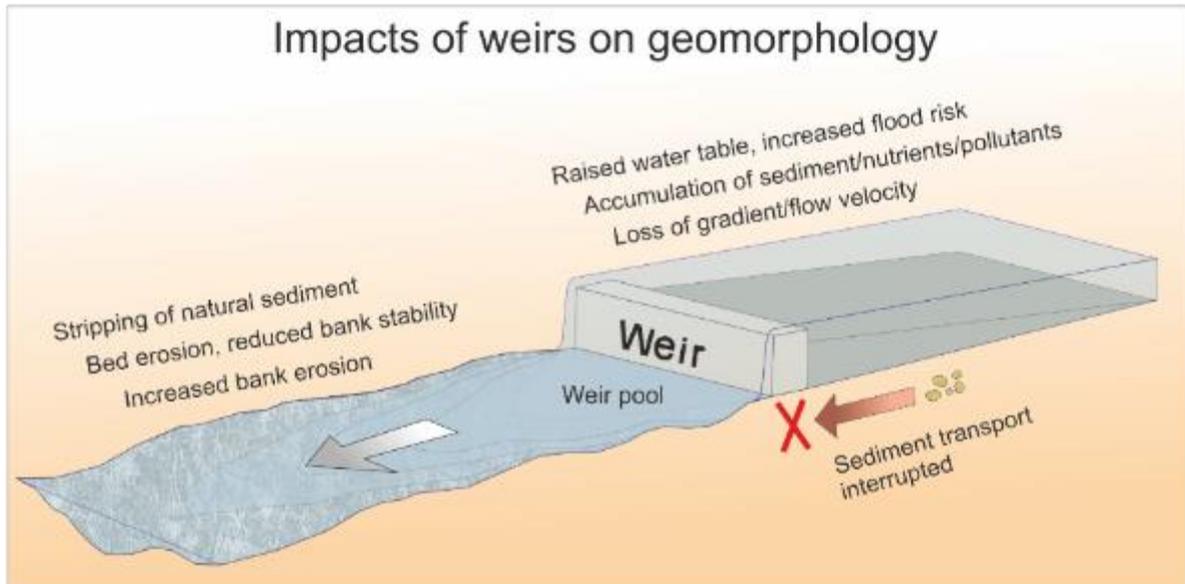


Figure 7: An illustration showing the impacts of weirs on river geomorphology

Overall, seeking to remove this weir completely would certainly be the best solution for the upper River Axe and its ecology, and all possible options should be investigated with Bristol Water and the EA. For example, the artificial nature of both concrete channels at this gauging station, and their fixed cross sections, would almost certainly make the whole site an easy candidate for upgrading to ultrasonic / hydroacoustic flow gauging:

<https://twitter.com/EnvAgencyMids/status/1281240869023121408>



Figure 7: A stand of Himalayan balsam pulled at Kingfisher Common. To help ensure effective clearance, plants should be snapped between the root ball and the lowest node of the stem, to prevent further growth, before being piled up to compost away from the immediate working area and any watercourses

Around NGR ST 52685 45742, it was good to see that the landowner and colleagues have been actively pulling Himalayan balsam (HB). Other HB plants were also noted growing in various areas around Kingfisher Common.

HB is a damaging invasive non-native species: a tall, shallow-rooted plant which spreads with floating, spring-loaded seeds which can be ejected up to 7 metres from the parent plant. It grows in dense monoculture stands that shade out native species before dying back in winter, leaving bare soil without perennial root structure to help resist erosion. Riverbank erosion can contribute significantly to riverbed sedimentation (one recent study suggests a rate of 10 tonnes per km per year) smothering gravels, invertebrates and fish eggs. More generally, HB also reduces biodiversity by suppressing native plants with allelopathic compounds in the soil and attracting insects to pollinate its flowers preferentially with its strong scent and prolific nectar.

Extensive areas of HB monoculture can be brought under control by repeated strimming or mowing, with hand-pulling as a follow-up measure. For smaller areas, or greater selectivity when HB is growing among other more desirable plants, hand-pulling is a tried and tested means of control and eventual eradication, as well as an excellent form of community engagement.

For sustainable long-term results, a catchment-scale approach is required: the furthest upstream extent of the infestation should be located, with a systematic programme of eradication designed to progressively push HB further and further downstream, and eventually out of the catchment completely. In practice, this may need to include investigation of the Priddy Ponds area, the point from which HB is suspected to have spread downstream through the hydrological catchment since the 1970s.

In general, HB seeds appear to survive in the soil for around 3 years, so it may be necessary to revisit previously infested areas for at least this length of time. For best results, areas of infestation should also be revisited repeatedly through the growing season, up to the time of the first frosts in autumn, to prevent late-germinating plants from flowering and setting a seed bank for the next year.

Once pulled or strimmed, HB plants should be piled up to compost well away from any watercourses, with the stems snapped between the root and the first node of the stem to prevent resprouting: the fleshy plants will desiccate quickly, and experience shows that few seeds will survive this process to germinate in future years.

In recent years, efforts have been made to introduce suitably co-evolved varieties of rust fungus as a biocontrol for HB:

<https://www.cabi.org/projects/biological-control-of-himalayan-balsam/>

However, these have not yet achieved widespread levels of success, and strategic hand clearance is still considered to be the most effective approach.

No other INNS were noted in the course of this Advisory Visit, but Japanese knotweed (JK) is known to be present upstream. Any future management plan for Kingfisher Common should include remaining alert for HB, JK, giant hogweed, floating pennywort, American signal crayfish, American mink and other damaging INNS.



Figure 8: Good adult trout habitat including deep water, undercut banks naturally reinforced with tree roots, and shaggy river margins seen upstream. The turbidity of the water, still at comparatively low flows despite overnight rain, may indicate wider issues of fine sediment ingress into the upper Axe catchment: for example, runoff from roads or ploughed fields

As the River Axe curves round to flow north-west at NGR ST 52623 45707, the overshadowing so prevalent further upstream is reduced, and the narrow river channel runs out into a wider and deeper pool (perhaps a scour hole associated with a previously fallen tree).

Together with 'shaggy' margins provided by overhanging bramble bushes, and an undercut bank supported by the linear root system of a large ash tree, this pool should provide good habitat for adult trout (and indeed a fish was seen to take an insect from the water surface adjacent to the tree roots during this walkover). Rough shaggy river margins, and the diversity of life that they harbour, are extremely important for the health of rivers and their aquatic communities, and every effort should be made to avoid bankside 'tidying' as part of future management regimes at Kingfisher Common.

In due course, it is possible that the ash tree will succumb to ash dieback disease, and may fall into the river. If this happens, it would be very valuable to retain as much LWM as possible within the channel - rather than automatically seeking to remove the whole tree, as standard river management practices might have suggested in the past. (See Appendix B for links to WTT's detailed guidance on LWM structures which use woody material to improve river habitat).



Figure 8: An area of bank which is now re-vegetating well after livestock poaching – preventing further ingress of silt into the river: water crowfoot can also be seen on the gravel riffle

At NGR ST 52580 45743 (also shown on the front cover of this report) downstream of the deep pool, a wide gravel riffle had previously been used as a livestock ford, with significant historic 'poaching' apparent on both banks.

With the abundance of sunlight reaching this unshaded area, strong growths of water crowfoot and watercress were apparent – creating braided channels between stands of vegetation, and potentially even developing a semi-permanent mid-channel island. Areas like these, with such a diversity of habitat types, offer ideal spawning and juvenile habitat for gravel-spawning fish such as trout. Water crowfoot, and the community of invertebrates which live in its complex, fronded structure, also makes a significant contribution to filtering excessive nutrients and other pollution out of the water column. Meanwhile, watercress has an important role in maintaining the depth of flows by pinching the channel when water crowfoot dies back, as part of its annual life cycle, later in the year.

In the time since grazing ceased, significant recovery has taken place on the RB – with grasses, water mint and other riparian species re-growing strongly. The LB, in an erosive area on the outside of the bend, appears to be re-stabilising less rapidly. It is possible that the slower recovery is partly due to dogs accessing the river at this point, creating 'dog slides' which are unable to re-vegetate, and soon

become significant inputs of fine sediment into the river. Pet flea treatments can also harm aquatic ecology:

<https://www.wildtrout.org/news/more-bad-news-about-pet-flea-treatment>

Similar 'dog slide' type bank erosion was also observed on the LB of the offtake to the mill stream at Highovers weir. If possible, dog walkers should be encouraged not to let their pets into the river at either location, perhaps by means of informative signage. If problematic erosion accelerates, the bank toes could be protected with staked and wired LWM, and the faces of the banks could be replanted with plugs of suitably deep-rooted native plants, with defensive dead hedges designed to reduce access on the bank tops above. Alternatively, one or both of these locations could be formalised as a dog dipping areas, with stepped log and gravel 'beaches' to minimise erosion and input of fine sediment.



Figure 8: Rock and wire gabion revetments: additional soft, trailing cover (and visual enhancement) could be provided by planting goat willow whips, to be hinged over into the channel in future

At NGR ST 52541 45702, as the river curves towards Highovers weir, the LB is extensively revetted with stone and wire gabion work around the outside of the bend. This may be designed to prevent erosion and subsequent lateral movement of the channel, with consequences for the flow control structure just downstream.

Although the revetment is unnatural, and interrupts the natural processes of erosion which supply the river with gravels and allow it to migrate around its

floodplain, removal may not be feasible for the reasons suggested above. However, some low trailing cover is already present, and it should be possible to further soften flows around this curve by planting willow whips in the bank, with the aim of eventually hinging them into the channel, in a downstream direction, to 'slow the flow' and provide complex, trailing woody habitat for fish, birds and insects. Goat willow or grey willow (sallow) are recommended for this intervention (instead of eg cricket bat willow, which will soon grow over-large and become an ongoing management issue).



Figure 9: Highovers weir, seen from downstream: a complete barrier to migration for all fish species. Note also the likely 'dog slide' bankside erosion, above the weir at top right of this photo

At NGR ST 52511 45710, Highovers weir occupies the site of a flow control structure which may have been operational since the 10th century (although no listing of any kind can be found on the Somerset Historic Environment Record).

The orientation of the weir shows how flows were historically directed south towards the mill stream, leaving the more natural northern course of the river as a 'relief channel' for excess higher flows. Today, the Highovers weir sluice is controlled by the Environment Agency: it is understood that this sluice is usually closed in winter and opened in summer to balance flows down each course of the river, but there are no specific target flows for either channel (pers. comm EA, August 2024).

Additionally, approximately every 4-5 years, or when sediment accumulation above Highovers weir threatens to constrict flows into the mill stream channel, the EA conducts gravel clearing operations in this area. These gravels are deposited in the main river channel immediately downstream of the weir, to ensure continuation of sediment transport processes. At the time of writing this report, the next gravel clearance is scheduled to take place in week commencing 12 August 2024 (pers. comm. EA, August 2024).

Despite the intermittent nature of such formalised gravel replenishment downstream of the weir, and the time elapsed since the EA's previous clearance operation, it is interesting to note that the mix of cobbles, gravels and finer sediments did not seem unduly depleted at the time of this Advisory Visit. This may suggest that high flows in the Axe are energetic enough to carry sediment over the structure (or through the sluice gate) in sufficient quantity to maintain some sediment transport – and / or that the upstream pool has reached an equilibrium by infilling (which will shortly be interrupted again by gravel clearing operations), thus enabling a sporadic sediment supply over the weir at high flows.

Although the large boulders dumped below the vertical face of the weir might conceivably provide enough turbulence for salmonid fish to surmount it at the very highest flows, to all intents and purposes the sluice and the current weir structure are a total barrier to fish of all species. As such, for the reasons described above, it would be very beneficial to investigate enhancing fish passage at this weir, for all species of fish including eels.



Figure 10: The main River Axe downstream of Highovers weir

Further downstream of Highovers weir, between NGRs ST 52511 45710 and ST 52262 45643, the channel of the River Axe displays a naturally meandering plan form with pools, riffles and very abundant gravels. As previously noted upstream, the river is heavily shaded by the height and thickness of the mature hedges on the bank tops, but there should be abundant opportunities for selective skylighting (which could be identified via a future walkthrough of the channel in low water).

Some woody material was already present in the channel: introducing arisings from skylighting works, in the form of hinged, lodged or staked LWM, would help to increase localised scour, deposition and particle sorting into a range of consistent sizes – an important aspect of providing different species of fish with silt-free gravel of appropriate sizes for successful spawning.

As above, see Appendix B for links to WTT's detailed guidance on LWM structures which use woody material to improve river habitat.

3.2. Lower River Axe (mill stream)



Figure 11: The mill stream, looking downstream from Highovers weir: compare the straightness and uniformity of this channel with the much more naturalistic and dynamic channel shown in Figure 10

Downstream of the diversion structure at Highovers weir, the engineered mill stream channel between NGRs ST 52513 45705 and ST 52330 45631 is characteristically uniform, straight and incised (although almost immediately perched above the level of the northern river channel) - having been designed to deliver a high and steady flow of water to the mill villages of Worth, Yarley, Henton and Bleadney.

As seen upstream at Kingfisher Common, the banks have been protected from livestock poaching by thick hedges. In the less heavily shaded reaches, stands of water crowfoot have become established, and at least one naturally skylighted area was noted where a large tree had fallen (perhaps as a result of ash dieback disease).

Although milling channels like these were never intended to provide complex habitat (and the channel still has an industrial function for Burcott Mill) it should be perfectly possible to improve ecological performance without negatively impacting other interests.

As described above, selected bankside trees could be hinged into the margins of the channel, while naturally fallen LWM should be left in place if possible, or (if

absolutely necessary) winched and staked parallel to the bank. More formal flow deflectors could also be installed in suitable locations to kick-start scour and deposition: skylighting will also help water crowfoot and other emergent vegetation to perform a similar function. All these interventions should help to mitigate the unnaturally uniform shape of the channel (which may also have been maintained in the past by dredging).

At the downstream end of this stretch, the mill stream flows out of Kingfisher Common under the B3139 road bridge towards Burcott Mill: however, at the time of the visit, no impoundment effect from the mill was observed this far upstream.



Figure 12: The mill stream as it approaches the lower boundary of Kingfisher Common. Note how plants like water crowfoot and water cress have established themselves in this 'skylighted' area, helping to mitigate the otherwise uniform profile of the channel

4. Recommendations

The following table provides a summary of recommended actions to improve the health of the Kingfisher Common stretch of the River Axe for wild brown trout, other fish species, and biodiversity in general.

Opportunities	Locations	Recommended actions
Fish passage barriers	Henley Wookey gauging weir, Highovers weir	Engage with Bristol Water and EA to investigate options for fish passage enhancements
Skylighting	Tunnelled reaches of river channel	Identify selected trees for felling or hinging (prioritise skylighting shallow riffle areas of channel)
Tree hinging and LWM augmentation	Tunnelled reaches of river where LWM is lacking for habitat and gravel sortation	Identify suitable locations for tree hinging and adding LWM; retain naturally fallen LWM when opportunities arise
Bank erosion potentially associated with 'dog slides'	ST 52580 45737 and ST 52513 45704	Monitor for recovery and reduce dog access if possible; or potentially formalise one or both of these areas as 'dog dips' with gravel beaches etc
Wire and stone bank revetment	Upstream of Highovers weir	Soften hard engineering and visual appearance by planting goat willow whips, and eventually hinging into the channel
INNS	Kingfisher Common generally	Remain alert for appearance of INNS and take steps to manage / eradicate them if they appear
Community engagement	Kingfisher Common generally	Involve local residents in environmental monitoring and habitat improvements
Water quality and aquatic invertebrate monitoring	Suggested key location: upstream of Highovers weir flow division	Training and accreditation for riverfly monitors via Bristol Avon Rivers Trust (training and data hub for the wider TWIST project)
Wider catchment working	River Axe catchment generally	Engage with other stakeholders in the Axe catchment (eg upstream at Wookey Hole) for whole-catchment approach to INNS etc

5. Making it happen

Potential funders for delivering future projects to improve the health of the River Axe through Kingfisher Common could include Wessex Water, Somerset Rivers Authority, and specific EA funding pots related to improving the WFD status of the Axe. Further information about these funding streams should be available via the Somerset Catchment Partnership.

The creation of any structures within 'Main Rivers' or within 8m of the channel boundary (which may be the top of the flood-plain in some cases) normally require a formal Environmental Permit from the Environment Agency. This enables the EA to assess possible flood risk, and also any possible ecological impacts. The headwaters of many rivers are not designated as 'Main River', in which case the body responsible for issuing consent will be the Local Authority. In any case, contacting the EA early and informally discussing any proposed works is recommended as a means of efficiently processing an application.

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>

A focused Trout in the Town Urban River Toolkit (which also contains many valuable insights for general community engagement) is available at:

<https://www.wildtrout.org/content/trout-town>

There is also the possibility that the WTT could help via a Practical Visit (PV). PV's typically comprise a 1-3 day visit where WTT Conservation Officers will complete a demonstration plot on the site to be restored.

This enables recipients to obtain on the ground training regarding the appropriate use of conservation techniques and materials, including Health & Safety, equipment and requirements. This will then give projects the strongest possible start leading to successful completion of aims and objectives.

Recipients will be expected to cover travel and accommodation (if required) expenses of the WTT attendees.

There is currently a big demand for practical assistance and the WTT has to prioritise exactly where it can deploy its limited resources. The Trust is always available to provide free advice and help to organisations and landowners through guidance and linking them up with others that have had experience in improving river habitat.

An important source of income which helps to fund the WTT's work is our Annual Spring Auction. The auction is our biggest fundraising event and includes fishing days, tackle, books, art and more. Many of our AV and PV recipients subsequently help us with auction lots each year, and we're very grateful for this extra support. To donate a lot, please contact WTT via Christina Bryant @ office@wildtrout.org

6. Acknowledgement

The Wild Trout Trust would like to thank the Environment Agency for their continued support of the Advisory and Practical Visit programme in England, through a partnership funded using rod licence income.

7. 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.

Legal permissions may be required before commencing work on site. These are not limited to landowner permissions but may also involve regulatory authorities such as the EA, lead local flood authority and any other relevant bodies (eg Natural England and Forestry Commission) or stakeholders. Alongside permissions, risk assessment and adhering to health and safety legislation and guidance is also an essential component of any interventions or activities in and around your river.

8. Appendix A : Trout habitat

Due to their need for clean, well-oxygenated water, structurally-varied habitat, and free movement between different types of habitat at different life stages, the UK's native wild brown trout makes an ideal indicator species for healthy rivers. These characteristics mean that a simple and effective assessment for overall river health can be based around the life cycle requirements of brown trout.

As a result, identifying and noting the presence or absence of habitat features that allow trout to complete their full life cycle is a very practical way to assess overall habitat quality (Figure 2). By identifying the gaps (i.e. where crucial habitat is lacking), it is often possible to design actions to solve those habitat bottlenecks.

To put all this into context, there are three main habitat types required for wild trout to complete each of their three key life cycle stages. This creates a demand for varied habitat, which is vital for supporting a wide diversity of other species too.

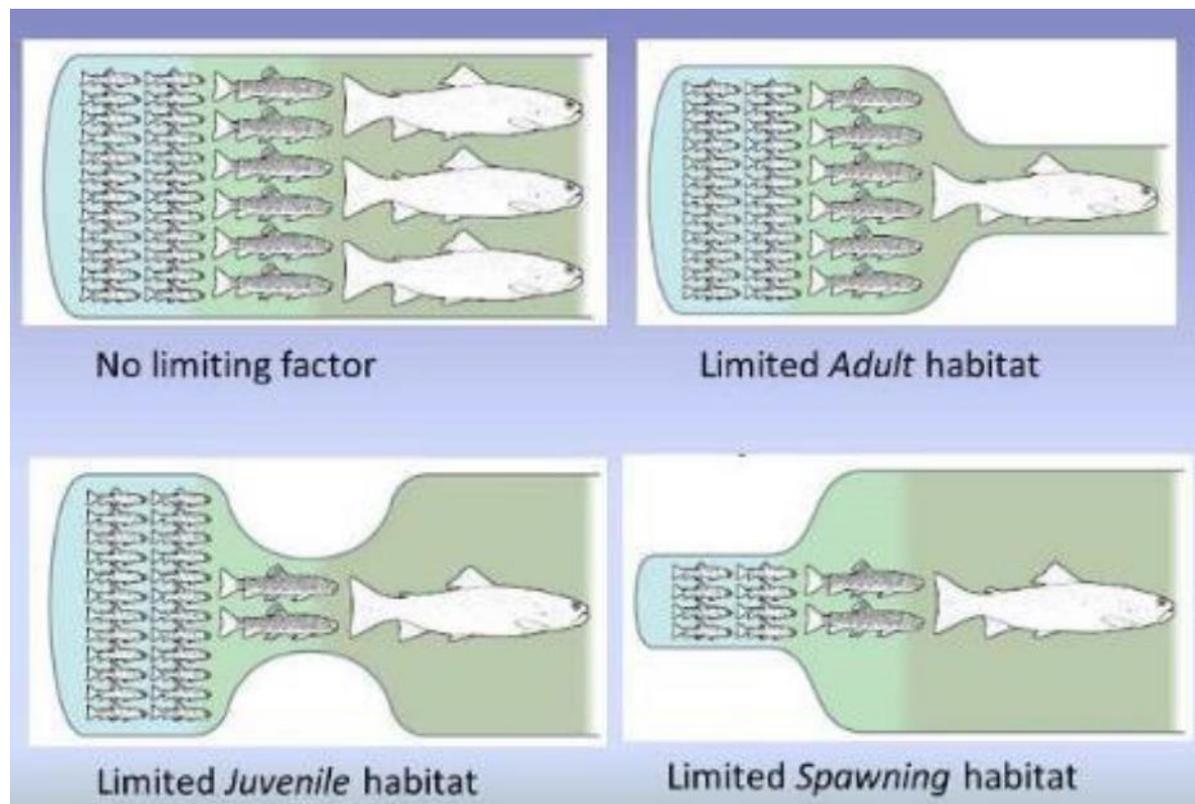


Figure 2: The impacts on trout populations lacking adequate habitat for key life cycle stages. Spawning trout require loose gravel with a good flow-through of oxygenated water. Juvenile trout need shallow water with plenty of diverse structure for protection against predators and wash-out during spates. Adult trout need deeper pools (usually > 30cm depth) with nearby structural cover such as undercut boulders, sunken trees/tree limbs and/or low overhanging cover (ideally trailing on, or at least within 30cm of, the water's surface). Excellent quality in one or two out of the three crucial habitats may not mitigate a 'weak link' in the remaining critical habitat.

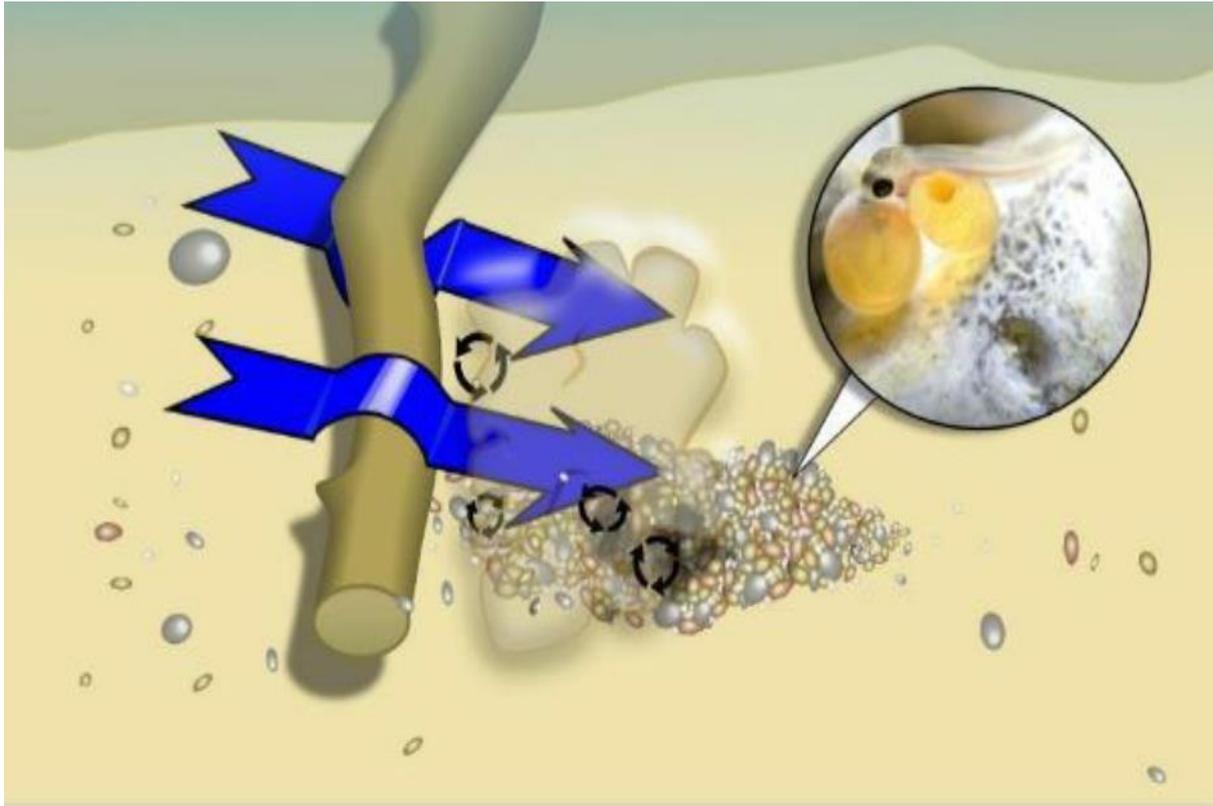


Figure 3: Successful trout spawning habitat requires relatively silt-free gravels. Here, the action of a fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of riverbed that results in silt being washed out from between gravel grains. A small mound of gravel is deposited just below the hollow scoured out by focused flows: this mound will be selected by trout to dig a 'redd' for spawning. In the silt-free gaps between the grains of gravel it is possible for sufficient oxygen-rich water to flow over the developing eggs and newly-hatched 'alevins' to keep them alive as they hide within the gravel mound (inset) until emerging in spring.

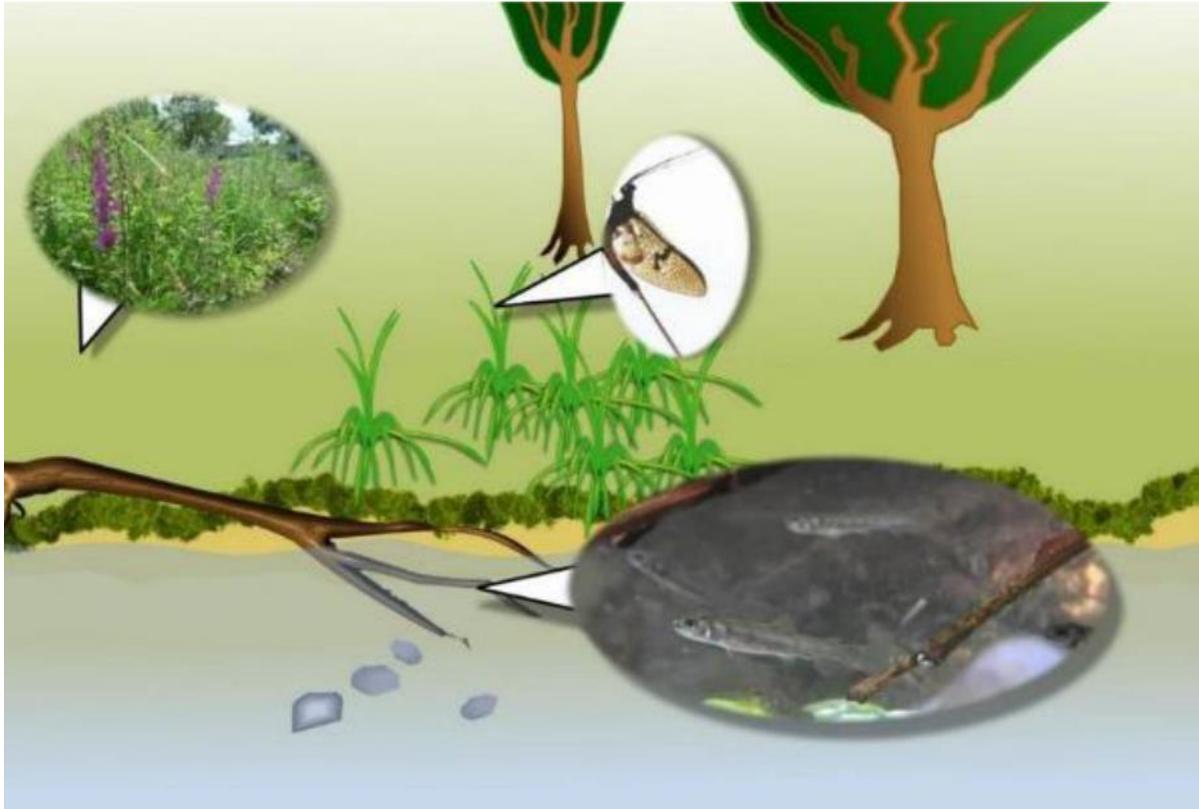


Figure 4: Larger cobbles and submerged 'brashy' cover and/or exposed fronds of tree roots provide vital cover from predation and spate flows for tiny juvenile fish in shallower water (<30cm deep). Trailing, overhanging vegetation also provides a similar function, and has many benefits for invertebrate populations (some of which will provide a ready food supply for the juvenile fish).



Figure 5: The availability of deeper water bolt holes (>30cm), low overhanging cover and/or larger submerged structures such as boulders, fallen trees, large root-wads etc. close to a good food supply (e.g. below a riffle in this case) are all strong components of adult trout habitat requirements.

9. Appendix B: Tree hinging and similar works

The Wild Trout Trust website contains detailed guidance on improving river habitat, including 'habitat sheets' providing details on using woody material in beneficial ways.

The summary web page is here:

<https://www.wildtrout.org/content/habitat-improvement>

Structure-specific 'habitat sheets' include:

Tree hinging:

<https://www.wildtrout.org/assets/img/general/Habitat-Sheet-Hinging.pdf>

Tree kickers:

<https://www.wildtrout.org/assets/img/general/Habitat-Sheet-Kicker.pdf>

Lodged LWM:

<https://www.wildtrout.org/assets/img/general/Habitat-Sheet-Lodged-WM.pdf>

Pinned woody material:

<https://www.wildtrout.org/assets/img/general/Habitat-Sheet-Pinned-Woody-Material.pdf>