Black Brook (West Vale)

Advisory Visit

	Black Brook (A tributary of the River Calder)
River	Black Brook
Waterbody Name	Black Brook from Source to River Calder
Waterbody ID	**GB104027062570**
Management Catchment	Humber AWB
River Basin District	Humber
Current Ecological Quality	Moderate
U/S Grid Ref inspected	SE 07878 20613
D/S Grid Ref inspected	SE 09833 21432
Length of river inspected	2.6 km

Wild Trout Trust Report – Following a Site Visit on 29/04/2019

1. Introduction

A site visit and habitat appraisal of the Black Brook was made at the request of a Neighbourhood Plan committee in Calderdale, West Yorkshire.

Trout are known to inhabit the brook as well as the main River Calder – which the Black Brook joins a short distance below the downstream limit of the visit undertaken for this report.

To define the general process by which Wild Trout Trust (WTT) advice is derived, it is useful to understand that there are three key lifecycle stages of wild trout (spawning, juvenile and adult). By examining sections of watercourse, it is possible to identify if there are either absences – or a lack of access to – habitat that supports each key lifecycle stage.

To put this into context, *there are three types of habitat* that are needed in order for wild trout to complete each one of the *three key lifecycle stages* identified above (Fig. 1). Those varied requirements (Figs. 2-4) create a demand for varied habitat, which is (in turn) vital for supporting a wide variety of species.

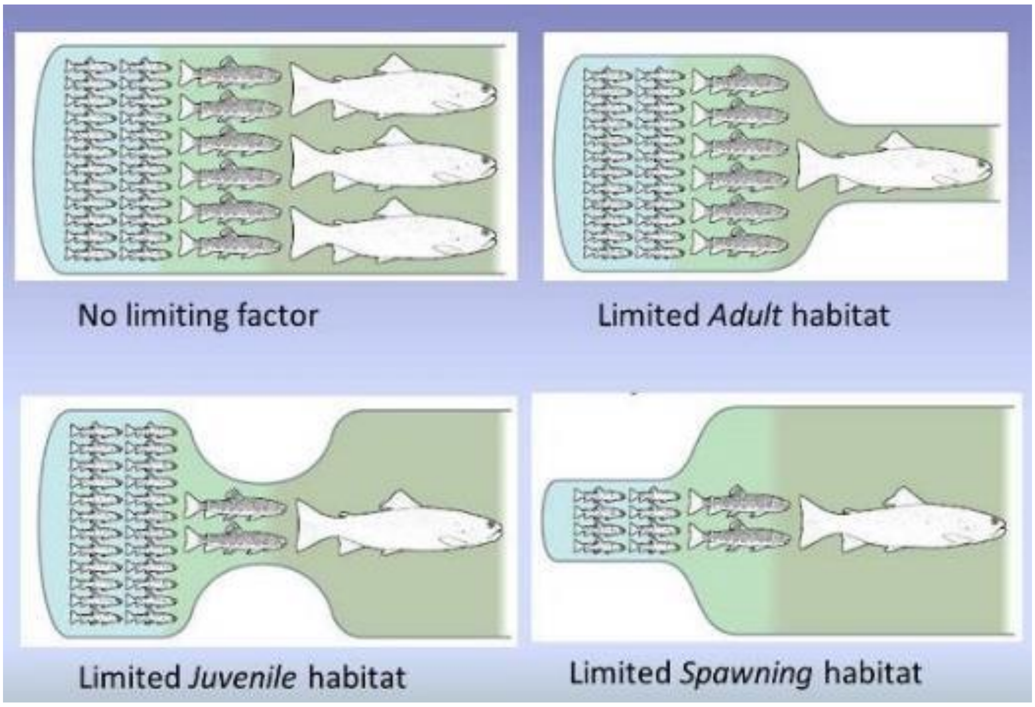

Figure 1: The impacts on trout populations lacking adequate habitat for key lifecycle stages. Spawning trout require loose mounds of gravel with a good flow of oxygenated water between gravel grains. Juvenile trout need shallow water with plenty of dense submerged/tangled structure for protection against 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 cannot make up for a "weak link" in the remaining critical habitat.

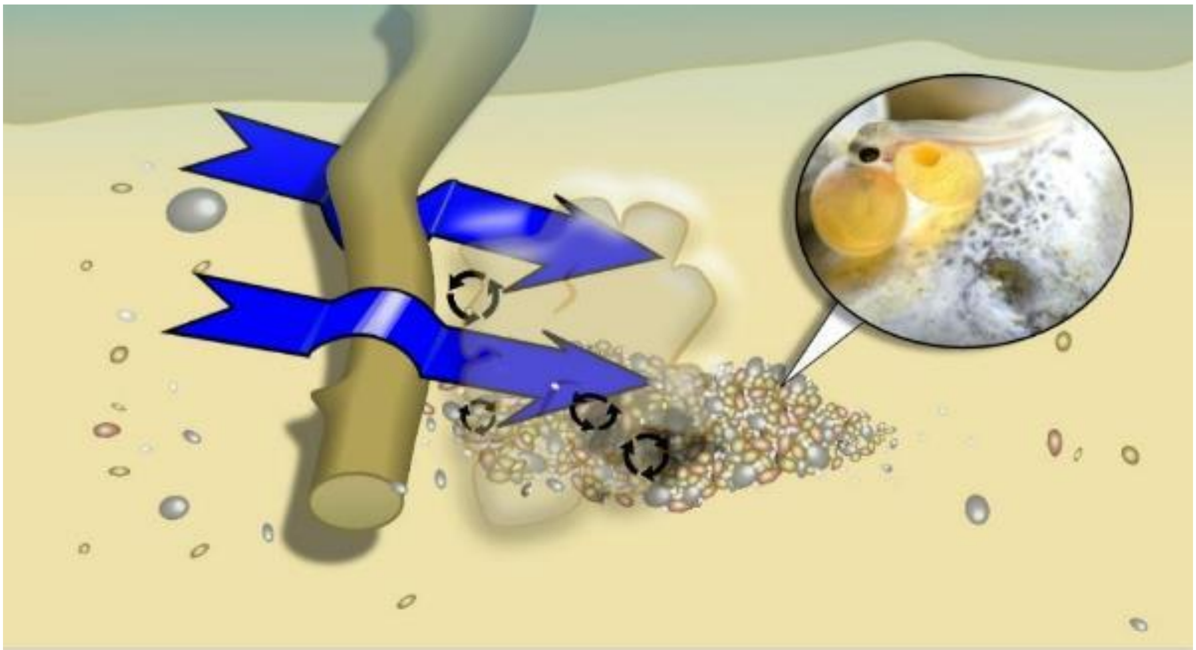

Figure 2: Features associated with successful trout spawning habitat include the presence of silt-free gravels. Here the action of fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of river-bed that results in silt being mobilised from between gravel grains. A small mound of gravel is deposited just downstream of the hollow dug by focused flows. In these 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 within the gravel mound (inset) until emerging in spring.

Figure 3: Larger cobbles and submerged "brashy" cover and/or exposed fronds of tree roots provide vital cover from predation and spate flows to tiny juvenile fish in shallower water (<30cm deep). Trailing, overhanging vegetation also provides a similar function and diverse bank-side vegetation has many benefits for invertebrate populations (some of which will provide a ready food supply for the juvenile fish).

Figure 4: The availability of deeper water bolt holes (>30cm to several metres), 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 and with prey likely to fall from overhanging tree canopy in this case) are all strong components of adult trout habitat requirements.

With these broad descriptions of the elements of spawning, juvenile (nursery) and adult trout habitat in mind, measures to address the issues identified during the survey can more easily be described. 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.

2. Habitat Assessment

The downstream limit of this visit was the B6112 road bridge at Clayhouse Park, where a diverse riparian understory plant community indicates the benefit of efforts to control Himalayan Balsam infestations that dominate much of the Calder catchment (Fig. 5).

Figure 5: Looking upstream from the bridge at the Downstream Limit of the visit

The benefits of Himalayan Balsam control to wildlife are evident both above and below ground:
https://himalayanbalsamdotcabidotorg1.files.wordpress.com/2013/06/himalayan-balsam-infographic.pdf
The brook is classified as "Heavily Modified" under the Water Framework Directive and the historic realignments (and reinforced stone banks) of the channel are obvious.

The most recent assessment of the Ecological Potential (the classification for heavily modified waterbodies that replaces "Ecological Quality") returned a value of "Moderate" with Fish and plant communities failing to reach "Good Ecological Potential":
https://environment.data.gov.uk/catchment-planning/WaterBody/GB104027062570
A number of impacts were noted that include point-source phosphate pollution, trade discharge(s) and physical modifications to the channel.

The relatively steep longitudinal bed-slope is allowing some recovery of in-channel riverbed morphology within the confines of the straightened channel (Fig. 6).

Figure 6: Stone bank revetments on the near bank (LB) contrasting with the deposited gravel, cobble and sand "point bar" on the opposite bank (RB). This is a result of the channel having enough gradient so that, during spate conditions, there is sufficient energy to redistribute relatively large cobbles and small boulders

There are also some trailing and overhanging branches from small trees and shrubs – which should be retained due to their value as shelter from predation.

Where channels are steep enough (and experience sufficient flows) to substantially redistribute their bed-materials, then there is a greater potential for recovery of varied physical habitat. However, such recovery can be very limited within extensively-modified channels. The more severe constraints on ecological recovery are found in straightened channels with solid walls and/or with structures such as weirs that hold back or "impound" water.

Some of the habitat-value of natural structures that create greater "hydrological roughness" (i.e. structures that "scramble" and slow down strong spate flows) can be seen in Fig. 7.

Figure 7: The tree roots and leaning stem at SE 09972 21382 have created a dense, complex matrix of coarse woody material - as well as promoting deposition of a gravel bar.

In ecological terms, lower-value, uniform habitat commonly results from highly modified channels – particularly those with an artificial "box-shaped" cross-section. The lack of variation in depth over a cross-section results in low diversity of flow velocity, flow depth and riverbed particle-size. In turn, that creates fewer different habitat "niches" that could be occupied by a variety of species. In Fig. 7, it is easy to see how the roughness created by the tree has significantly diversified flow-depth, flow-velocity and substrate particle-size.

The natural detritus that has accumulated within the matrix of branches and roots (or "brash") also forms an important basis for a large proportion of the food-web of rain-fed/soft-water rivers. A major proportion of the products of photosynthesis that support food-webs in streams like the Black Brook comes from the deciduous leaf-litter. Therefore, another important function of hydrologically-rough structures in steep streams is the increased retention of vital leaf litter.

Unfortunately, that roughness also reveals when there are periodic discharges of raw/untreated sewage into the river (e.g. via sanitary towel "rag waste"). This was evident within the brash pictured in Fig. 7 and indicates that there are likely to be periodic challenges to water quality due to discharges from the combined sewer network. Ensuring that this system is working as well as possible is an important factor in protecting the water quality of trout streams such as the Black Brook. Blockages in combined sewers and also misconnections to the surface-water drain network are very common sources of pollution to watercourses.

As well as refuge-habitat and leaf-litter retention benefits, tree roots are also important in shaping river channels by creating differences in the susceptibility of banks to erosion. Where only shallow-rooting plants grow, the banks are more easily eroded (important in the formation of meanders). Deeper roots associated with mature trees have a comparable effect on riverbank soils to the function of steel rebar in concrete. The reinforcement and resistance to breakdown of tree roots on the outside of river bends are an important factor that encourages a river to dig downwards and create pool habitat. That reinforcement can also be an important factor in the protection of surrounding infrastructure in developed areas such as Clayhouse Park and its surroundings (e.g. Fig. 8).

Figure 8: Refuge habitat and bank reinforcement that is protecting stone-walls and the built environment behind is created by the tree roots visible in the centre/background of this image at SE 09714 21323

Heading upstream, across the road, some tree maintenance works (pollarding) was evident at SE 09625 21264. It is notable (and to be encouraged in future) that the tree limbs that extend laterally over the river have been left intact (Fig. 9). As well as continuing to supply "subsidies" of terrestrial invertebrates and leaf litter to aquatic foodwebs, the shade and refuge from predation are also important functions of those overhanging branches.

In addition, particularly for shallow rivers with dark beds, the patches of shade created by low tree cover are vital for cold-water specialist species of invertebrates and vertebrates (including trout).

Figure 9: Low, overhanging branches left behind - good practice for pollarding trees adjacent to watercourses

Good tree cover was also evident around the channel where it is crossed by a small footbridge at SE 09581 21222 – albeit in one of the most extensively modified and constrained sections (Fig. 10). Fish were observed in the deeper, slow-flowing water created by the walled channel upstream of a bend.

Figure 10: Good riparian cover but heavily modified and impounded flow.

The channel modification has artificially slowed the flow in this section, and the high loading of sand and silt was notable. In areas with faster flow, the relatively high levels of fine sediment packed into the gaps between gravels on the riverbed also indicated elevated inputs of sand and silt (a point that is picked up later in this report).

Another good example of naturally-occurring refuge habitat was noted at SE 09444 21140 – where a split tree-trunk had resulted in some nice, trailing and submerged cover (Fig. 11). These features, and the benefits they provide, are what we seek to mimic when we install structures such as “tree kickers” – which are deliberately placed and secured versions of natural processes.

Figure 11: A naturally-occurring "tree kicker" feature on the LB (left and centre of frame)

Upon a revisit to this location, it was noted that on the LB just below the bridge there was a patch of sewage fungus (which actually consists of bacterial colonies e.g. https://en.wikipedia.org/wiki/Sphaerotilus_natans). This is an indication of localised organic pollution that may be coming from a nearby outfall (possibly under the bridge) or may reflect organic waste derived from the adjacent land-use (e.g. pigeon lofts).

Continuing upstream to an industrial yard at SE 09422 21127, the river sits within a steeper-sided valley – and is flanked by industrial land on both the LB and RB. Here a service pipe crosses the river (Fig. 12) and several trout were noted to be rising in the pool at this location. Their size appeared to be relatively small – which is obviously an indication of breeding within the stream (a positive sign). Further investigation into the fish population structure within these reaches may indicate the extent to which episodic pollution and fish-kills may occur. In conjunction, monitoring of the invertebrate populations would also broadly indicate what the “day to day” water quality is - as well as picking up the influence of any episodic pollution.

Figure 12: The river at SE 9422 21127 is flanked on both sides by industrial land – which can pose increased threats of accidental pollution/sediment inputs. The self-set riparian trees and vegetation are benefitting this reach by creating diverse habitat in both terrestrial and aquatic zones of the river corridor

A short drive upstream to the next reach to be investigated at SE09081 20958 revealed a deep bend-pool at the foot of a local resident's garden (Fig. 13).

Figure 13: Deep bend-pool

Just to the right of the frame in Fig. 13, there is a riffle and pool sequence with mature riparian woodland vegetation (Fig. 14).

Figure 14: Good habitat immediately downstream of the pool pictured in Fig. 13

While the pool shown in Fig. 13 has significant depth (and is therefore likely to be of potential value to adult trout), there is very little submerged or overhanging cover to protect against predation.

The greater habitat complexity and availability of more cover in the downstream reach illustrated in Fig. 14 is of significant value in protecting and maintaining more diverse floral and faunal communities.

Continuing upriver to SE 09083 20884, some good tree root and tree cover habitat was noted (Fig. 15). The localised shaping of the riverbed created by "undershot scour" – where water is squeezed underneath a curved tree trunk and root-system – is clearly evident in Fig. 16.

That scouring effect not only creates diversity in the depth and velocity of the river – but it also helps to flush out fine sediments from between the gravel particles at that location. Mounds of silt-free gravel result in much higher egg survival for gravel-spawning species such as trout – so the action of localised-bed scour is very important to their survival prospects.

Since the watercourse is relatively small at this point, those processes of localised scour, complex cover and localised shading are essential for maintaining a diverse range of aquatic and terrestrial species within the river corridor. Shallow water, low flows and high extremes of summer temperatures all combine to create substantial threats to coldwater specialist species such as trout and many insects of upland streams. The structural diversity of the stream-bed also critically depends on that process of directed scour and deposition of bed materials.

Figure 15: Low overhanging marginal cover on the RB and a series of mature trees/root systems on the LB.

Figure 16: Undershot scour creating a pool within a shallow section of the brook N.B. the associated high quality refuge habitat created by the submerged tree roots in the centre of the frame

The LB in this section has previously been grazed by cattle (though the future of grazing at this site is currently uncertain). There is a degree of fragility associated with the lack of succession of trees along that LB – which consists of a single line of veteran trees. The grazing of seedlings would prevent the replacement of those older trees once they reach the end of their lives. That would also remove the variation in bank-resistance to erosion (and the localised undershot bed-scour) that currently generate varied habitat. Allowing cattle to browse right down to the riverside also promotes increased fine sediment and faecal matter inputs into the watercourse.

If grazing were to be resumed, therefore, it would be advisable to create a fenced buffer strip to promote the formation of a varied stream-side understory and woodland vegetation. The increased porosity of the soil would provide a dual function of intercepting fine sediment/faecal matter inputs during rainfall events – as well as increasing the soakaway effect of rainfall which can help to reduce flash flooding (e.g. https://youtu.be/00tcTY_UEk4).

It is possible that significant inputs of fine sediment could originate from dairy farming upstream. Where vegetated buffer strips are absent (and especially where cattle have access to the river), sediment input is greatly increased. In addition, the potential for nutrient enrichment is also greatly increased where grazing is extensive and there are runoff pathways from fields directly into rivers. It is also possible for subsurface field drainage pipes to bypass buffer strips – so the picture is far from simple.

There are also a number of additional, significant challenges to water quality along the Black Brook. These include runoff from industrial sites (and particularly from ongoing/new development sites), discharges from the combined sewer network and misconnections to surface-water drainage as well.

Figure 17: Previously-grazed land on the LB (far bank) and footpath on the RB (near side). Note also the artificial straightening of the channel to conform to land-use

The proximity of the reach pictured in Figs. 15 and 17 to the local school was discussed during the visit (in the context of creating a more formalised rural walking route to and from school for local attendees).

In addition, potential was noted for the use of the river in an "outdoor classroom" capacity – with particular mention of the WTT "Mayfly in the Classroom" project: https://www.wildtrout.org/content/mayfly-classroom.

A significant barrier to both upstream/downstream movement of fish – as well as the essential downstream transport of riverbed material – was recorded at SE 08609 20800 (Fig. 18).

Figure 18: The weir at SE 08609 20800 represents a complete barrier to upstream fish migration under almost all flow conditions. Many fish, including trout, need to migrate from their adult habitat to reach suitable spawning habitats

As well as the basic need to move between habitat types throughout their lifecycle, trout (and other fish species) also benefit from access to the full range of potential mates within their breeding population.

Restricting the potential flow of genes between different parts of what should be one, large breeding population carries increased risk of genetic impacts on the resilience of future generations of offspring.

In line with comments made earlier in this report, the potential for large inputs of fine sediment exists at new development sites such as the one at SE 08474 20752 (Figs. 19 and 20). The potential for runoff pathways for sediment in surface water during rainfall should be investigated – and appropriate controls put in place where necessary.

Figure 19: Part of the development site where topsoil runoff is likely to cause a problem for the Black Brook

Figure 20: Development site, photographed facing upstream

The natural steepness of the valley sides at SE 08116 20639 have allowed an extensive woodland corridor to develop (Fig. 21).

Figure 21: Steep-sided valley with more limited potential for development or farmland - allowing mature woodland to persist for a greater width on both sides of the channel than is typical for the Black Brook

There are multiple biodiversity benefits (e.g. rare beetle habitat in the form of standing dead wood) to having more extensive and varied vegetation surrounding streams and rivers. Many aquatic species complete their lifecycles in terrestrial vegetation – and many terrestrial predators prey on aquatic species. The provision of dappled light and shade is also increasingly important to buffering extreme high temperatures associated with a changing climate.

The second major barrier and impoundment noted during the visit was the sluice gate at SE 07901 20598 (Fig. 22) which serves and controls the pond associated with the adjacent industrial plant (Fig. 23).

Unlike the previous barrier, this sluice appears to still be performing a function in providing a controlled supply of water to the pond. Whether the water-level in the pond could be maintained and regulated by an alternative means (and which does not rely on impounding the river) would be worth investigating.

Similarly, establishing whether the pond is critical to the functioning of the industrial plant – or whether alternative means may exist of meeting its required function – are also important enquiries to make.

The tackling of impoundments and water quality issues are two of the most significant opportunities to protect and improve the Black Brook. In many locations, there is very little opportunity to achieve significant restoration of natural meandering characteristics – due to the existence of surrounding infrastructure.

Figure 22: Sluice at SE 07901 20598

Figure 23: Pond served by the impoundment created by the sluice in Fig. 22

The upstream limit of the visit was at SE 07878 20613 and consisted of cow pasture at the bank-top with a livestock fence to prevent access to the brook (Fig. 24).

Figure 24: Cattle and bank-top fenceline at the upstream limit of this visit

3. Recommendations

Here are some recommended actions based on the findings of this report. Prior to listing those recommendations, please pay attention to the important information relating to permissions:

N.B. *Any and all works will be subject to a variety of legal permissions that include, but not limited to, landowners, regulatory authorities for the watercourse (which could be local council, Environment Agency or even drainage boards) and other stakeholders such as bodies responsible for underground services that may be affected by works.*

- Continue with (and extend if appropriate) control of Himalayan balsam
- Don't change the current practices that allow overhanging vegetation to develop and persist! (including the selective pollarding practices noted during the visit)
- Undertake training in invertebrate identification that allows water quality to be assessed so that problems can be identified and improvements or declines can be monitored
    - For the Black Brook, the standard Riverfly Partnership monitoring protocols would be highly appropriate (http://www.riverflies.org/rp-riverfly-monitoring-initiative)
    - Comparisons of results above and below suspected problem spots and also between the upper (more rural) reaches and the industrialised areas will all be extremely valuable
- Investigate and tackle (with the involvement of the Environment Agency) the source of sewage fungus at SE 09444 21140 (including investigations

of Combined Sewer Outfall performance (via utilities company), potential for misconnections to surface water drainage system, surrounding land-use)

- Require Utilities company staff to remove sanitary-product waste accumulating below the discharge point of their asset outfall(s) (which is a seldom-enforced statutory responsibility)
- Seek to remove the weir at SE 08609 20800 (Fig. 18) e.g. https://youtu.be/3Io6yqMgMT4
- Explore the development/installation of submerged and trailing cover in the bend pool (Fig. 13) via:
    - Planted (perhaps via wall-mounted basket) trailing sedge grasses or riverside plants of comparable trailing habit at the normal waterline height
    - Anchored and completely submerged tree crown cover (perhaps using one or more discarded Christmas trees)
- Seek fish population survey records from local Environment Agency Fisheries and Biodiversity personnel to track potential episodic and severe pollution incidents
- Consider undertaking Mayfly in the Classroom projects with the local school
- Both before and after heavy rainfall – examine the potential pathways for fine sediment to enter the watercourse from adjacent developments and existing industrial yards (and control/mitigate/remove any input routes so identified) for example:
    - Interception of runoff using "silt wattles" (see image on this link https://www.constructionwashout.com/75-gator-guard/product)
    - Be aware of the use of "fascines" (and the importance of proper track/path location) in this guide produced by Treesponsibility: http://www.treesponsibility.com/wp-content/uploads/2013/09/Understanding-the-Hebden-Water-Catchment-LOW-RES.pdf
- Consider establishing grazing exclusion (or cessation of mowing if grazing is not to be reinstated) to create a vegetated buffer strip on the previously-grazed fields
    - Alternative sources of livestock watering can be obtained by using pasture pumps to raise water from the river – or by installation of mains-water troughs (which also have the added benefit of reduced disease incidence rates)
    - Leaving un-mown buffer strips of several metres (ideally 5 channel widths where this is possible – but even 3 to 5 metres may be beneficial) can be combined with supportive planting of locally-appropriate trees and riverside, understory vegetation)
- Investigate whether the pond at SE 07901 20598 is still a required asset (and if so):
    - Investigate whether there is an alternative water source to feed the pond other than the current sluice

The WTT is willing to provide support (within its capacity) to help meet these recommendations. We'll also work to provide assistance in establishing contact with appropriate partners in instances where the required support is beyond our own capacity.

We are often able to provide demonstration and training in delivering the basic recommendations made in our Advisory Visit (AV) reports (like this one). This commonly takes the form of a "Practical Visit" (PV) where one or more of our Conservation Officers help you to carry out habitat improvement measures that we recommend in our AVs. A significant component of PVs is the training we provide that allows you and your partners to deliver similar works under your own steam.

Demand for PVs is high and are subject to the availability of our Conservation Officers (and our ability to identify supportive funding for staff time, mileage and materials).

For any clarifications on the observations and recommendations given in this report (or any other related questions/comments) please feel free to contact me on pgaskell@wildtrout.org.

4. Acknowledgement

The WTT thanks the Environment Agency for supporting the advisory and practical visit programmes (through which a proportion of this work has been funded) in part through rod-licence funding.

5. 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.