Advisory Visit

River Douglas

8th December 2010

Introduction

This report is the output of a site visit undertaken by Paul Gaskell of the Wild Trout Trust to the River Douglas on 8th December 2010. Comments in this report are based on observations on the day of the site visit and discussions with the landowner Paul Kenyon, Keith Jolley and local Environment Agency (E.A.) representative Ian Gaskell who provided extensive information on water quality issues within the inspected reaches.

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left hand bank (LHB) or right hand bank (RHB) whilst looking downstream.

1.0 Catchment / Fishery Overview

The River Douglas rises on Winter Hill in the West Pennine Moors to the east of Manchester and flows for 56 km before joining the River Ribble near the village of Hesketh Bank. Initially flowing south-westwards until reaching the town of Wigan (the area assessed in this report), the river adopts a north-westward course downstream of Wigan to flow via Appley Bridge, Parbold, Rufford and Tarleton. The underlying geology of the headwaters on Winter Hill is the Millstone Grit series with sandstones and coarse gritstones separated by bands of shale. The area was covered by ice during the Ice Age and boulder clay deposited as the ice retreated. In the reaches visited (and all of the surrounding area) the Millstone Grit is overlain by shales, mudstones and thin coals of the Upper Carboniferous Coal Measures. Consequently, much of the historic land use was shaped by coal mining with subsequent industrialisation and attendant transport infrastructure. Although the remains of several navigation locks are present between Parbold and Gathurst, the construction of the Leeds Liverpool canal removed the need for navigation to be maintained on the River Douglas. The main barriers to fish migration now come in the form of weirs associated with the cotton mill industry and culverting of sections of the river to accommodate development (e.g. the culverted diversion of river flow as well as take-off and return of river water supplying Worthington Lakes reservoir complex).

As well as the *relatively benign* physical effects of inert ochreous (iron III oxide) precipitates derived from the coal measure geology (evident around several groundwater upwelling points), there is a significant risk of episodic chemical pollution affecting the inspected reaches. These episodes are thought to originate from the complex of sewer systems taking surface water and sewage from the surrounding area as well as trade effluent from, for example, the Victorian-era dye works adjacent to the A6 road bridge crossing at SD 60211 12622. The ownership and layout of the dye works' sewage system is not well characterised and is a threat to river water quality. A fish kill that was estimated to have been 100% lethal to all fish affected the river for 8 km between Standish and Appley Bridge in July 2009. Included in the mortalities were thousands of the Critically Endangered (IUCN Red List) European eel (*Anguilla anguilla*). In fact, the only fish observed to temporarily escape poisoning were the few eels that were able to climb out onto the dry land of the river bank. Any blockages that arise in the combined sewer system puts the river at extreme risk of periodically receiving toxins present in both foul sewage and trade effluents – even when the river is under low-flow conditions. Such effluents include organic solvents, strong alkalis, heavy metals and other highly toxic components. Clearly, updating and increasing the capacity of the sewer system to buffer high surface water flows *and* improve maintenance of blockage-free conditions is vital to improve the ecological status of the River Douglas. Two high priority Combined Sewer Overflow (CSO) improvements would be those associated with the Wagon and Horses, Addlington and a second, approximately 800m downstream, associated with Harrison's Farm. Both are assets belonging to United Utilities and would require investment in capital works. The severe fish kill cited above originated from the CSO at the Boar's Head in Standish and is on the same system as the previously mentioned overflows. It is calculated that, during this incident (triggered by Chorley Road pumping station power failure that also prevented transmission of warning messages), there were 16 minutes of buffering before toxic material reached the river. Increased capacity of storm tanks on this system would dramatically reduce the occurrence of foul waste overflow into the receiving watercourse (being, instead, returned to main sewer flow in all but the most extreme rainfall). United Utilities have committed to investing in improvements to the Chorley Road facility in response to prosecution over the abovementioned incident.

There are E.A. survey data that record wild, self-sustaining populations of trout both upstream and downstream of the reaches inspected during this advisory visit. Recruitment is thought to take place in the Pearl Brook (upstream in the Addlington area) and Calico brook (downstream in the Appley Bridge area). In fact, localised trout populations appear to be coping better “post-pollution” than the coarse fish species that bore the brunt of the pollution by being more confined to the main river channel. During the site visit, brief kick samples of resident invertebrate fauna revealed numerous shrimp (*Gammarus sp.*), a few predatory caddis larvae (*Rhyacophila sp*.) few olive mayflies (*Baetis sp*.) and numerous net-spinning caddis (*Hydropsyche sp*.). The last of these species were present only as early instar (young) individuals, though the shrimp and predatory caddis were relatively mature (probably older than a year). It is possible that some invertebrates could burrow into the substrate to avoid the worst effects of pollution. Overall, though, it is more likely that invertebrates have benefitted from rapid repopulation through downstream drift (along with some potential for lower sensitivity to the specific toxins responsible for the fish mortality). At any rate, the invertebrate populations show that, in the absence of pollution spills, the **day-to-day water quality** is sufficiently high to support a variety of fish species, including wild trout. Therefore, the existence or creation of sufficiently high quality physical habitat could positively contribute to the population dynamics of trout that are present in the River Douglas system.

The length of river inspected is not formally fished and there are no introductions of hatchery-bred trout to support angling amenity. Site inspection was undertaken in two phases. The first phase focussed on the river flowing through land directly in the ownership of Mr. Kenyon (upstream limit at SD 58236 08164 and downstream inspected limit at SD58423 07628 totalling a reach length of approximately 620 m). A second reach further upstream was also inspected with a view to engaging other local landowners in custodianship/habitat restoration activities (observations made between SD58144 08600 and SD58122 08523 totalling a meandering reach length of approximately 115 m).

For the remainder of the report, the reach in the direct **ownership of Mr. Kenyon** will be referred to as “**Reach 1**”, whilst the section further upstream will be designated “**Reach 2**”. Contemporary land-use at Reach 1 is mature woodland on both banks, whilst Reach 2 is grazed pasture (horses) on the RHB with grassland and patches of woodland on the LHB.

According to the published River Basin Management Plan for the North West River Basin District (http://publications.environment-agency.gov.uk/pdf/GENW0910BSRG-E-E.pdf) the River Douglas is deemed to have “moderate ecological potential” throughout its length. Within the

Douglas catchment, currently 8% of waterbodies are deemed to be at "good ecological status or potential" with a target to increase that to 12% by 2015. Key statements relating to the Douglas catchment include:

"*There are also several industrial sites within the catchment, where hazardous substances have the potential to cause contamination of both land and water. Much of the catchment is designated as heavily modified due to channel realignment and actions are needed to improve habitats for wildlife*"

and

"In implementing the River Basin Management Plan, the Environment Agency will work with partners to improve water bodies through:

- *Promoting best practice initiatives and implementation of codes of good agricultural practice and urban pollution campaigns.*
- *Encouraging the use of appropriately designed Sustainable drainage systems (SuDS) to control run off at source.*
- *Investigations into the (industrial legacy) contaminated land in the catchment and identifying remediation opportunities.*
- *Investigating the impact landfill sites have on the water environment.*
- *Carrying out Water Cycle Studies for the growth points planned in the catchment.*
- *The Environment Agency will be investigating, with partners, waters that are at less than good status.*
- *United Utilities investigating the causes of intermittent discharges to the River Douglas using Integrated Catchment Modelling. Asset improvements at Croston WwTW will improve compliance with Shellfish water guideline standards."*

The following sections of the report assess the physical characteristics of the river habitat and provide suggestions, where appropriate, for its improvement.

2.0 Habitat Assessment

Starting at the upstream limit of **Reach 1** (Fig.1) at SD 58236 08164, a good example of a typical northern English "post industrial" spate stream was evident. The mixture of well developed woodland vegetation and engineered retaining walls is present on many upland trout streams rising from the Pennine Chain.

A

B

Figure 1: Upstream limit photographed from bridge facing upstream (A) and downstream (B).

The cobbled substrate and suitably narrow channel-width combined with sufficient longitudinal bed slope produces a nicely energetic riffle and glide character. Furthermore, a relaxed approach to bank-side tree management has facilitated the development of some excellent habitat features. For example, the tree growing at an angle from within the channel in the background of Fig.1A has promoted some localised scour and current deflection that has produced some lovely variation in depth as well as introducing a more meandering flow within the constraints imposed by the walled far bank. Section 1 is sited within a steep-sided, wooded valley and there are a variety of different particle sizes represented in the substrate, ranging from fine silt/sand up to relatively large cobbles/small boulders. These larger substrate constituents are likely to have arisen from the collapse of various built stone structures in or adjacent to the river. Whatever their source, it is valuable to have this variation – as it produces a greater number of niches available for plants and animal species. It also produces the variation in microhabitat required to support the three key life-stages of trout (spawning, juvenile and adult fish). The river in the area of the upstream limit has in-channel habitat that is particularly suitable for juvenile trout, as well as some holding lies for adult fish. The presence of some shaggy, low, overhanging vegetation e.g. sedge grasses (*Carex spp*.) or low branches and exposed tree roots provides extremely valuable cover for juvenile (and adult) fish. It may be appropriate to augment existing cover with installed brash (section 3.1 "Recommendations").

The riffle and associated downstream pool (Fig.2) a little way downstream of the area pictured in Fig.1, represents some excellent habitat features that are particularly suitable for trout. First of all the turbulent riffle is an excellent source of both invertebrate prey and oxygenation of the water. Secondly the mature woodland riparian (bank-side) vegetation, in the absence of retaining wall features, has allowed the natural meandering inclination of the river to be expressed. The resultant deposition of a gravel bar on the inside edge (RHB) of the bend (Fig. 2A, bottom of frame) is combined with the scouring of a deeper "bend pool" on the outer edge (LHB: Fig.2B). Because the "bend pool" is also overhung by exposed tree roots (Fig. 2B) and low-level vegetation (Fig.3), it makes this absolutely superb trout habitat. With a small intervention, the icing on the cake **could be** the up-ramp of gravel at the tail end of this pool (Fig. 3). This has the potential to provide the spawning opportunities that would enable us to tick our third crucial life-stage off the list. However, whilst trout could attempt to spawn

A

B

Figure 2: Riffle (A) and associated pool (B) showing excellent habitat features in both streambed topography and riparian vegetation

Figure 3: Shallow tail end of the pool pictured in Fig. 2. The shallowing is produced by deposition of gravel (some of which forms the exposed island under these low-flow conditions). Again, excellent riparian vegetation features are evident

on this gravel, it is likely to prove a difficult endeavour (and hatching success rate may be somewhat limited). The reason for this is the relatively poorly "sorted" nature of these gravels (Fig. 4).

Figure 4: Poorly-sorted gravels that currently limit the spawning value of this feature

In other words, the deposited substrate is an aggregated mixture of fine sands, silt, pea gravel and larger flint-like pieces. This homogenised "cake mix" of particle sizes means that there is very little potential for gaps to exist between larger, ill-fitting lumps of gravel. Such gaps (that must remain free of sand or silt blockages) are vital if eggs laid within a gravel mound are to be continually irrigated by oxygenated water.

In the absence of continual "through-gravel" irrigation, trout eggs will suffocate. Therefore, installation of structure that promotes localised bed-scour (Fig. 5) and associated deposition of loose, fluffy and "sorted" gravel mounds is required (e.g. section 3.1 and 3.2 "Recommendations"). Such structures also promote "through-gravel" flow of water through the mounds of deposited material (dotted arrow, Fig. 5).

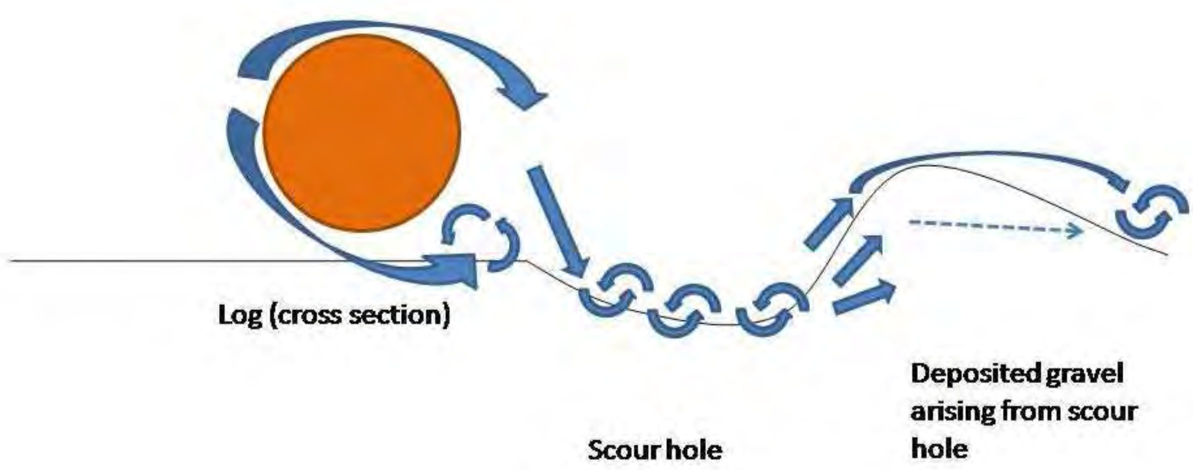

Figure 5: Schematic of log structure installed to promote localised stream bed scour. The deflected flow (blue arrows) throws a mound of gravel up and particles settle out according to their size. The largest settle in the fastest flows and finer particles deposit as the current speed diminishes. This spontaneous self-sorting process gives rise to gravel patches consisting of the correct particle sizes for spawning (approx. 20-50 mm diameter) that are free from silt and sand

After a gently meandering section downstream from this riffle/pool sequence, the channel enters a long, artificially straightened section (approx 150m long) with slow, impounded flows (Fig. 6). The impoundment is the result of what appear to be the remains of an old weir structure at the lower limit of the straightened channel. The slowing of the current has removed the capacity of the river to achieve the alternating lateral scour and deposition processes evident in Fig.2. Consequently, the riffle/pool sequence disappears and is replaced by a single long, straight pool. Whilst not ideal, it does provide suitable habitat for adult trout, a provision that is made more attractive by the presence of several partially submerged fallen trees (Fig. 6). These are still attached to their root systems on the bank – and consequently pose little threat of breaking free to cause blockages that would adversely affect the risk of flooding downstream. Features such as this exemplify the high value of submerged large woody debris (LWD) to stream ecology. Increased structural diversity provides cover for adult fish and increases the variety of microhabitats available for all species. Through time, the decomposition of wood also provides food for organisms that have evolved to utilise this resource.

Figure 6: Straightened and impounded reach, but with stable LWD projecting into the margins of the LHB (flow is left to right of frame). Ideal cover for adult fish

It may be possible to reintroduce a degree of cross-sectional variation in both physical structure and current flow by deliberate installation of LWD in a staggered, alternating pattern on both LHB and RHB margins. The additional cover will also provide a greater degree of insurance against excessive predation of tenuous fish populations (section 3.1 “Recommendations”). A more ambitious project could be considered on the back of capital investments to reduce episodic pollution. In such a case, importation of gravel substrate, combined with LWD flow deflectors, could be used to produce a linear sequence of mid-channel pools and riffles (providing spawning, juvenile and adult trout habitat within the same reach). The LWD would need to be sited so as to help retain imported gravel during spate flows (section 3.1 “Recommendations”). The gradual shallowing towards the tail of this straightened section at the putative former weir (Fig. 7; river bends to the left below the slight impoundment) would help to promote the retention of gravels in combination with the installed structures.

Figure 7: The shallow downstream limit of the straightened section is mostly obscured by trees to the right of the frame.

The leftwards bend of the river below the straight section is flanked on the LHB by an old mill building (Fig. 8). This is the effective lower limit of the reach owned by Mr. Kenyon (**Reach 1**). The bouldery riffle that is present in front of the Mill provides some interesting habitat with a variety of substrate sizes represented. Where the full force of the current is buffered by larger stones and in the margins, there are good opportunities for juvenile trout to thrive. However, as with many post-industrial rivers, the majority of fish movement into the reach will be via downstream drift from stations further upstream. Impassable weir and culvert structures are known to be present between this section and the spawning that occurs in the Calico Brook below this reach. Investigations into the potential to facilitate fish passage are strongly recommended (section 3.3, "Recommendations").

Figure 8: Mill building and the head of the riffle close to the downstream limit of Reach 1

A drive upstream to **Reach 2** took us out of the steep, wooded valley. Here the land on the RHB is grazed by horses right up to the river margin and the river sits in a broad flat floodplain at the valley bottom. Whilst the land on the LHB appears to be ungrazed, there is a lack of bankside trees for much of the inspected reach. Mr. Kenyon indicated that the land here is the product of artificial spoil dumping, which would explain the relative lack of mature woodland on this bank. In addition to a lack of deep root matrices to bind the substrate together, the land here is dominated by extremely soft sands. With an apparently less steep longitudinal bed slope than **Reach 1**, the combination of all these characteristics results in a more meandering channel (all other things being equal the less steep a river, the more it is likely to meander). Unfortunately, given the relatively unconsolidated nature of the banks, this has lead to extensive inputs of fine sand into what, otherwise, would be a predominantly loose gravel bed (Fig. 9). Whilst a proportion of the sand derives from upstream sources, it is apparent that the excessive erosion within the reach is likely to be responsible for the smothering of potential spawning gravel.

Figure 9: Facing upstream towards a section where trees are present on the LHB. Downstream of this location a wider tract of treeless floodplain dominates. The collapse of the soft, grazed RHB and the unconsolidated LHB is evident in the vertical sandy bank-faces in the foreground of the picture

The potential for enhancement is illustrated by the habitat patches formed around natural examples of LWD (Fig.10). Submerged branches have shaped local scour and deposition processes to create a varied "humps and hollows" topography to the stream bed. In addition, finer substrates have been accumulated in the patches where the brash has slowed the current sufficiently. These patches of scour and deposition create far greater variation in microhabitat compared to the more uniform, blanket-like accumulation of sediment of Fig.9. Where habitat is uniform, fewer species are adapted to the smaller subset of available conditions.

Figure 10: Natural LWD creating pinched "scouring flow" on the near bank, whilst promoting deposition of a "point bar" below the previously eroded vertical bank in the lee of the brash. The brash also provides excellent cover for juvenile and adult fish. In addition, good sorting of stream-bed gravels is evident around the submerged branches

Figure 11: Gravel mounds thrown up by bed scour that could potentially support successful trout spawning

Clear scope for habitat improvements lie in a combination of grazing exclusion and supportive tree planting to produce a well-vegetated “buffer strip” of at least 5 to 8 m width on the RHB. This should be complemented by soft revetment techniques to slow the rate of bank erosion. With these measures in place, sand inputs would be reduced to a level where installations of LWD could best create good spawning habitat. An ideal candidate reach to undertake a trial of these techniques is shown in Fig. 12. See section 3.2 “Recommendations” for specific details on suggested techniques. It would be important to monitor the rate of bank erosion in trial “revetted” reaches, as the overall aim is a slowing rather than a cessation of the process. It is obvious from Figs. 10 and 12 that bank erosion is an important source of gravels as well as sand – and so complete eradication of the process is undesirable. The extent of mitigating works should be tuned to achieve the appropriate balance.

Figure 12: Ideal candidate reach for grazing exclusion and bank revetment (left of frame) along with installation of LWD to produce mid-channel scour-pool habitat with the attendant downstream deposition of well-sorted and irrigated spawning gravels

Judging by the plentiful native understory vegetation present in the woodland of Reach 1 downstream, there is not yet a monoculture of the invasive Himalayan balsam (*Impatiens glandulifera*) in this region of the river. However, it is worth considering that any grazing exclusion programme may make vegetated buffer strips more readily colonised by such invasive plants. To this end, it may be best to allow short-term seasonal access to grazing animals. Please see the following section for specific recommendations.

3.0 Recommendations

3.1 Reach 1

The primary bottleneck on this reach is the availability of high quality spawning gravels. Given the lack of access (due to upstream culverting) to the next confirmed spawning tributary upstream (Pearl Brook) – this is a crucial issue. The best opportunity to release this bottleneck is the simple installation of several mid-channel logs pinned in a scattered arrangement to the stream bed on the unsorted gravel ramp featured in Figs. 3 and 4. These could be simple single "mini logs" (Fig.13) or "mini upstream "V"s" (Fig.14)

Figure 13: Mini log pinned perpendicular to the current promoting localised scour (in this case "undershot scour" of flows squeezed underneath the log). Note the welded washer caps on the ends of the 2-m long steel rebar pins driven into the stream bed to secure the log. Flow is from lower left to upper right of frame

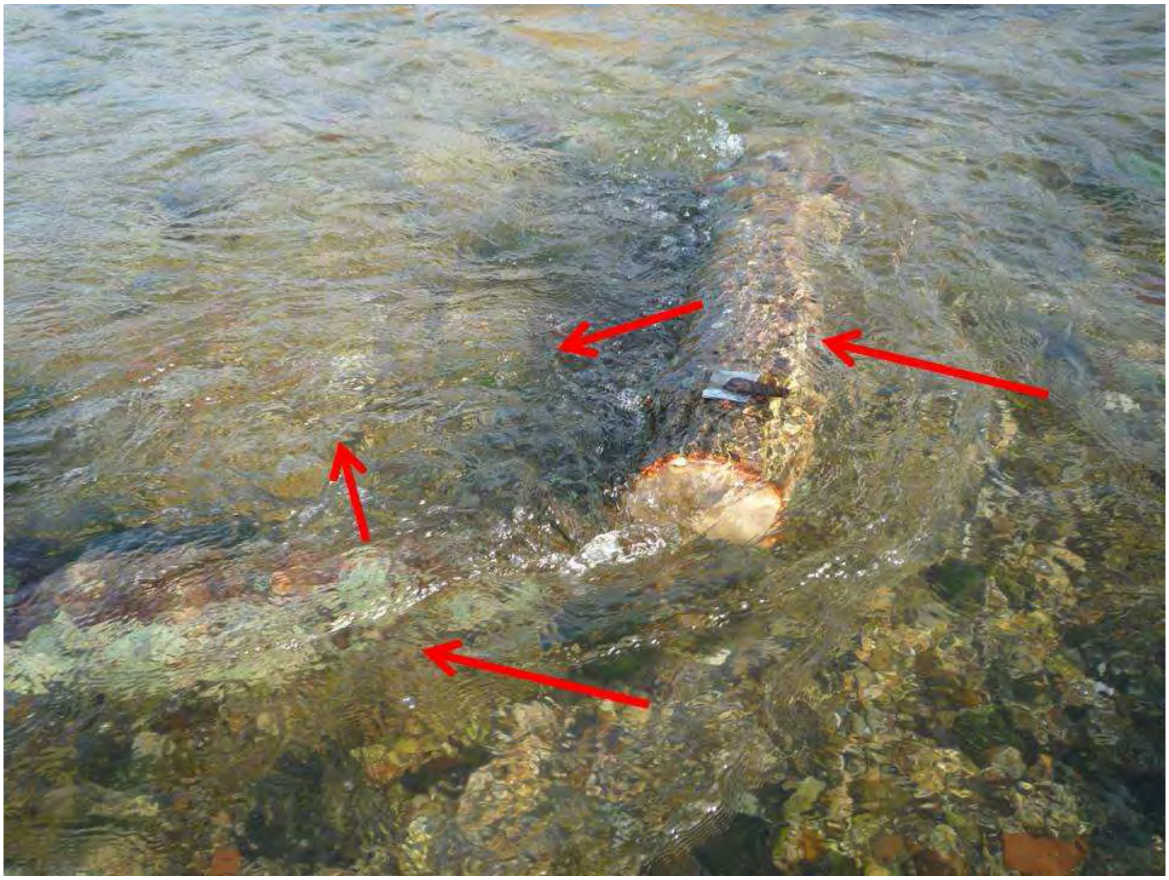

Figure 14: Mini upstream "V" flow deflector. Red arrows indicate flow and show how it is focussed (counter intuitively) inwards on the downstream (leftward) side of the structure. As with the previous technique, both undershot and overshot scour can operate, depending on variations in the flow depth

Although of secondary importance in this instance (due to the presence of some suitable existing cover), it would be important to maximise the survival chances of emergent fry. A simple adaptation of hedge laying techniques to "hinge" bankside scrub vegetation into the margins of the stream where the depth is around 30 cm or less would quickly and easily achieve this (e.g. Fig. 15). Similarly, the generation of additional physical variety (in both structure and current flow) could be achieved in the long, straightened pool section (Figs. 6 and 7) by introducing a series of cabled tree "kickers" on the left and right banks (Figs. 16 and 17). Arranging these in a staggered fashion will promote more meandering flow, whilst arranging in a matching pair on opposing banks will achieve a degree of channel "pinching". Both pinching and meandering the flow are desirable and should be incorporated where possible; providing wider biodiversity benefits in addition to their potential value to wild trout populations.


Figure 15: Hinged brash to produce marginal cover for juvenile fish


Figure 16: Tree kicker attached to its own stump via 12-mm braided steel cable and cable crimps

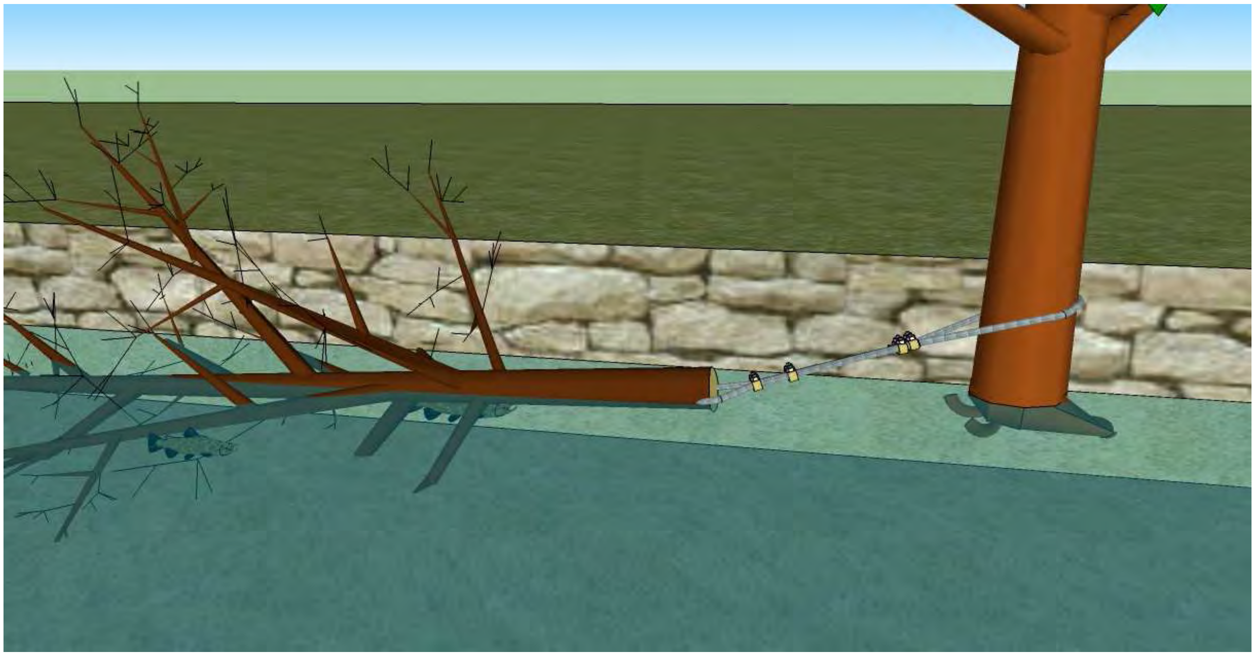

Figure 17: Illustration of tree kicker structural cover and example of one possible cable anchor attachment

In the event that the required **reduction in episodic pollution risk** can be achieved, a more ambitious approach might be subsequently adopted in the straightened pool section. It might be desirable to import spawning gravel of 20 – 50mm diameter (Fig. 18) and to use installed LWD to retain as well as sort the installed substrate (Figs. 19 and 20).

Figure 18: Importation of 20-50 mm gravels to provide spawning substrate

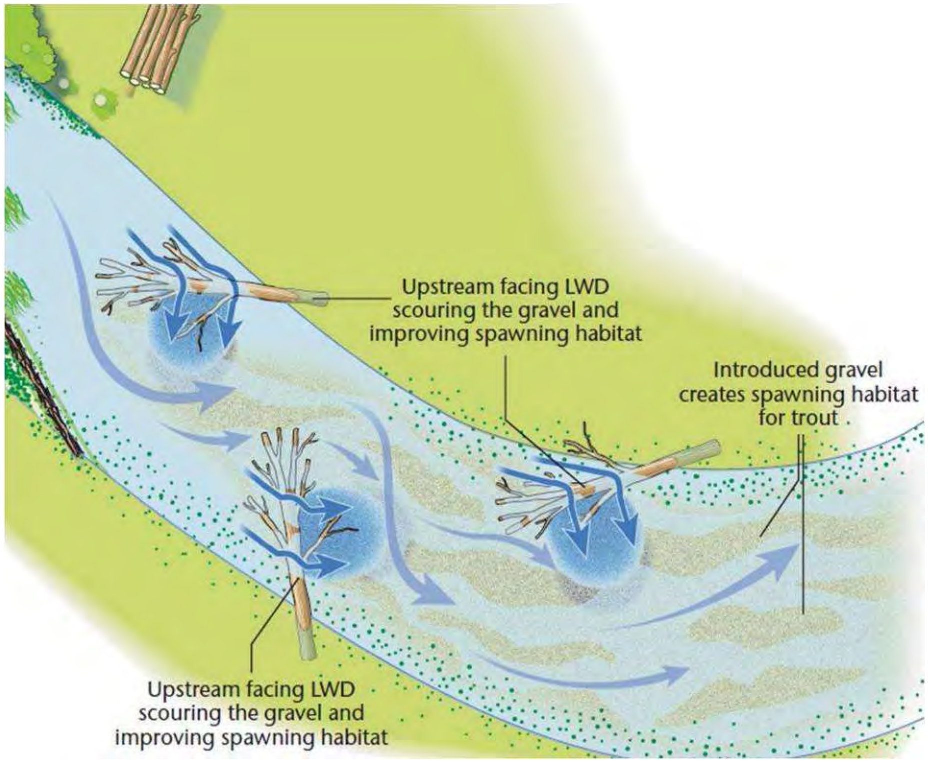

Figure 19: Installation of a staggered series of alternating upstream facing flow deflectors will both help to retain installed gravels as well as promoting localised scour and sorting

Figure 20: Upstream V (in this case constructed from brash bundles) used to produce mid-channel scour of gravels (pale area). Note that gravel will be trapped and retained on the upstream side of each deflector. This trapping effect can be enhanced by attaching buried reinforcing geotextile (wire mesh) that extends 2- 3 metres upstream from each deflector.

3.2 Reach 2

In the event that the appropriate landowners can be engaged, the creation of an ungrazed buffer strip along the RHB of Reach 2 is potentially extremely valuable. As mentioned in the habitat assessment, short term (1 to 2 weeks per year) grazing access would be the ideal scenario. This could be achieved either by incorporation of access gates in the stock proof fencing or by use of temporary electric fencing. If neither arrangement is practical, then fencing is still certainly worthwhile on Reach 2. It would be advisable to undertake a watching brief to guard against Himalayan balsam seedling germination (easily removed by simple hand pulling prior to seed-setting in late summer). A more complete guide to the issues associated with invasive plant species is available from the WTT in section 3.1.1 in the following link: http://www.wildtrout.org/images/PDFs/Urban_Manual/urban_section3_habitat%20projects%20on%20your%20river.pdf

On both the LHB and RHB where there is a shortage of tree cover, it could be appropriate to plant live "whips" of scrub species such as goat willow (*Salix caprea*) at points along the river margin. With the absence of excessive grazing pressure, the development of a healthy marginal vegetation with a broad range of canopy heights will provide excellent habitat for a range of aquatic and terrestrial species. It will also promote much greater resistance to runaway bank erosion.

An improved marginal buffer strip of vegetation could also be augmented by "soft" bank revetment techniques (e.g. Figs. 21 and 22). The extremely high surface area to volume ratio of brash acts as a "brake" on rapid spate flows. Therefore, as well as physically reinforcing the banks, it also prevents damaging eddying and "bouncing" of high speed currents into undefended downstream banks. The braking effect also tends to accumulate sediments and, consequently, further promote re-vegetation of previously eroded banks. A variety of sources of suitable brash are available, and include the arisings from coniferous plantation management, discarded Christmas trees that are collected by council waste-disposal services as well as material that can be obtained on site from existing woodland. Where coniferous brash is available, it is often the preferred material due to its very high density of side branches.

Figure 21: "Soft" brash revetment techniques (left of frame) used to slow erosion as well as providing cover for invertebrates and juvenile fish. The brash is secured between stakes that are driven into the stream bed and river bank using fencing wire.

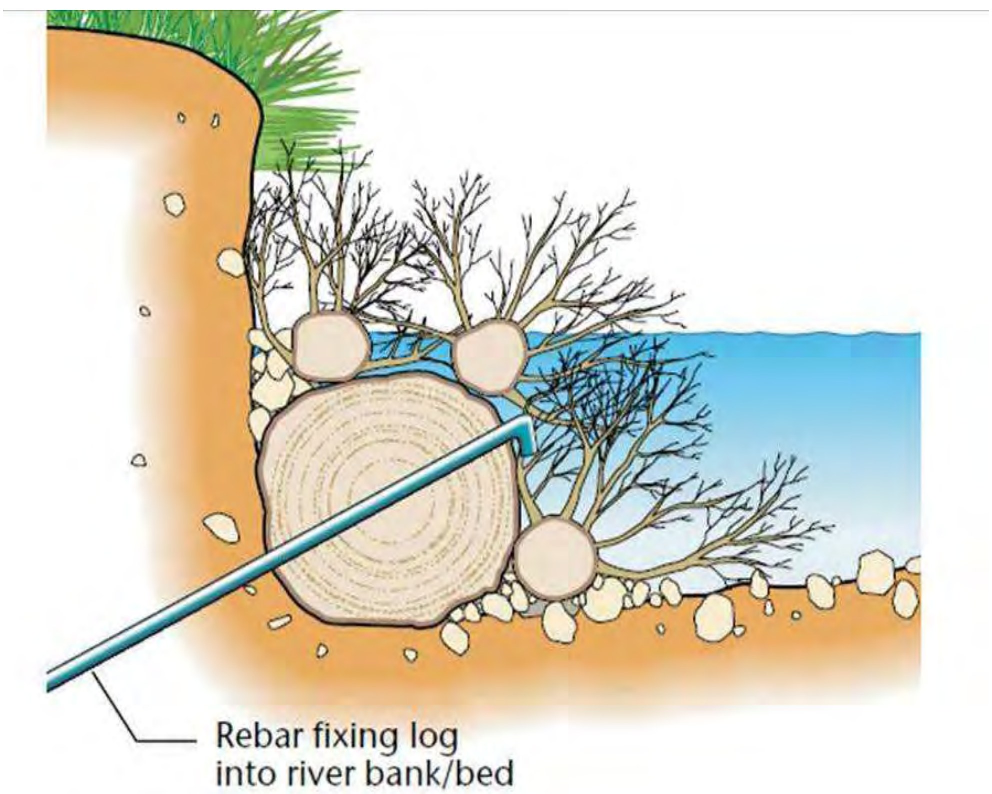

Figure 22: Cross section of one potential method of bank revetment. In this case, using logs and brash (brash is nailed to the logs)

Following the establishment of marginal vegetation and soft revetment, the installation of LWD (e.g. Figs. 19, 20 and 23) to sort gravels would, again, be an enormously valuable solution to the current lack of high quality spawning habitat.

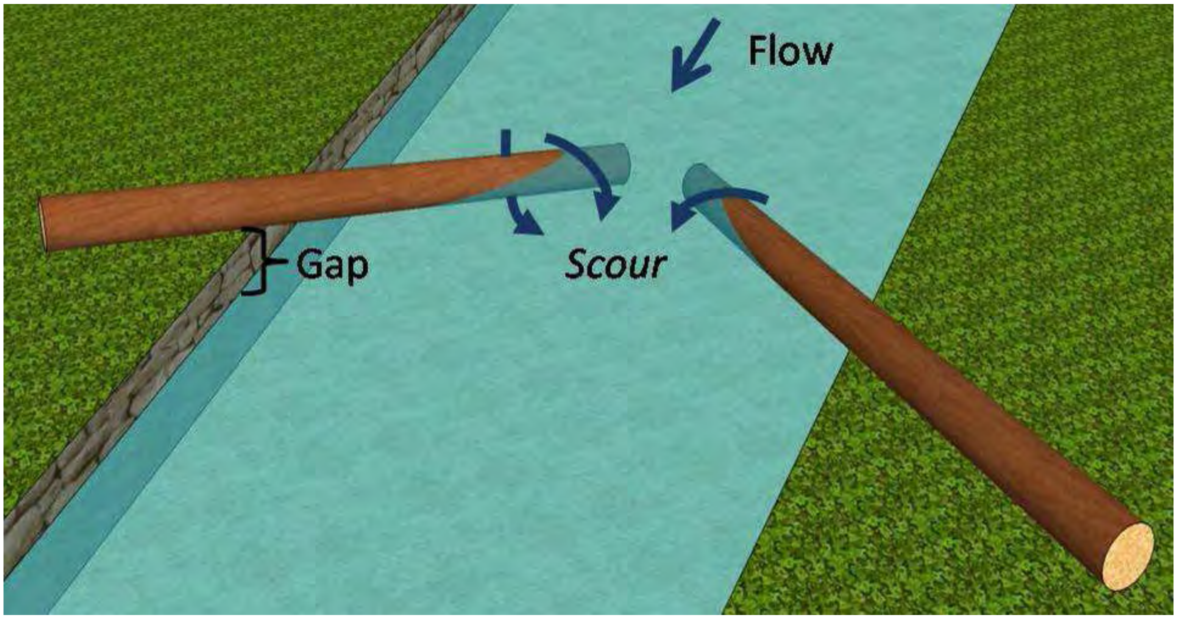

Figure 23: Upstream "V" deflectors arranged with elevated bank-side ends of each logs. This arrangement improves the scouring operation of the deflectors at a variety of flow depths

The suggested arrangement for an initial trial section at SD 58144 08600 is given below (Fig. 24):

Figure 24: Suggested arrangement of brash revetment (blue shading) and upstream "V" log flow deflector (red shading)

3.3 Broad context recommendations

Longer-term aims can be pursued in parallel with the reach-specific goals set out in the preceding two sections. A valuable first step would be to make contact with local E.A. fisheries personnel to establish the most relevant criteria for failing to meet "good ecological potential". Specifically, it would be of great value to understand whether connectivity (i.e. fish passage) between the reaches assessed in this AV report and both the Pearl Brook and Calico Brook has been identified as a criterion for ecological status failure. Moreover, it is worth establishing if there instances of wild trout occurring in the main river. Once the "currently-known" distribution of wild trout is characterised in nearest tributaries and main-river reaches, connectivity and water quality issues for relevant River Basin Management Plan (RBMP) "waterbodies" should be collated. The information can provide robust rationale for funding bids and associated campaigns to tackle the failure criteria.

Irrespective of whether connectivity appears in the RBMP, the feasibility and funding for structures that can facilitate the passage of fish is worth investigating. As well as potentially costly solutions such as formal fish pass construction (with compulsory programme of monitoring) or demolition of impounding structures, it may be possible to install simpler "easement" measures to both culverts and weirs (e.g. Fig. 25). Typically, the aim is to break down an impassable vertical "head loss" into several smaller jumps via the creation of one or more "pre-barrages". Local stone or cheap wooden baulks can be anchored in place to achieve this and the notches that allow overspill should be designed so as to produce smooth, non-turbulent plumes of water. Where easements are proposed to be fitted below culvert outfalls, the potential for fish to progress through the culvert must first be assessed. If the in-culvert flow is too fast and shallow for fish to sustain the swimming speed necessary to overcome the obstacle, there is clearly no point in pre-barrage construction unless the culvert itself can be modified. Section 5.1 of the "Upland Rivers Habitat Manual" gives more details on suitable culvert modifications as well as advice on connectivity issues (http://www.wildtrout.org/images/PDFs/Upland_Manual/uplands_section5.pdf)

A

B

Figure 25: Impassable culvert blocking upstream progress of sea trout (A) fitted with a simple wooden baulk "easement" (B). Note the offset of the notches to provide respite for fish making the leap into the lower pre-barrage pool. Note also the smooth lip and edges of each notch to produce a solid plume of water to help fish to swim up

4.0 Making it Happen

All works detailed in section 3 will have a legal requirement for Land Drainage Consent whereby the E.A. assesses both the flood risk and biodiversity implications of work carried out in watercourses (or within 8 m of the channel boundary) that are designated as "main river". Contacting your local E.A. flood risk assessment team and requesting the necessary forms is the first step in this process and the WTT can advise on its completion. The WTT also offers assistance on obtaining funding for works (via our funding and communications officer, Denise Ashton). Denise can be contacted on dashton@wildtrout.org. There may also be small bursaries available from the WTT to help kick start funding campaigns.

The WTT could help to start a programme to carry out these recommendations. Physical enhancement works could be started with the assistance of a WTT 'Practical Visit' (PV). PV's typically comprise a 1-3 day visit where WTT staff will complete a demonstration plot on the site to be restored. We will give you training regarding the appropriate use of conservation techniques and materials, including Health & Safety equipment and requirements. This will then give you the strongest possible start to carrying out the rest of the project. The WTT can fund the cost of labour (two/ three man team) and materials (max £1800). Recipients will be expected to cover travel and accommodation expenses.

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 clubs, syndicates and landowners through guidance and linking them up with others that have had experience in improving trout fisheries.

5.0 Acknowledgement

The WTT would like to acknowledge funding from the Environment Agency in support of the "Advisory Visit" and "Trout in the Town" initiatives.

6.0 Disclaimer

This report is produced for guidance only and should not be used as a substitute for full professional advice. Accordingly, 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 comments made in this report.