WILD TROUT TRUST

Loch Ard tributaries

Aberfoyle Angling Protection Association

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Contents

Key Findings

- Drumlean Burn offers good potential as a spawning and nursery area for trout, as demonstrated by the numerous juvenile trout observed there during the visit. Simple habitat improvements could really capitalise upon this resource by creating more diverse habitat and potentially increasing survival rates. In the longer term, sections of the burn upstream of the B829 road could be restored to a more sinuous course, increasing the length of the burn and the habitat quality. Improvements to fish passage in the upper reaches would also be beneficial.

- Buffer fencing would greatly improve the habitat quality in the lower reaches of Ledard Burn, which are currently heavily grazed.

- Habitat in the lower reaches of the Water of Chon inspected was very good, with a healthy balance of structure, light and shade. Investigation further upstream could be beneficial to ascertain whether excess fine sediment is being supplied to the burn.

1. Introduction

The Wild Trout Trust was approached by Aberfoyle Angling Protection Association to provide habitat assessment and advice on selected tributaries of Loch Ard, in the River Forth catchment, with the hope of improving salmonid recruitment. The visit was undertaken on the 15th May, 2023 and was accompanied by the River Watcher and a member of the committee.

Normal convention is applied throughout this report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream. Specific locations are identified using decimal latitude and longitude (e.g. **56.044896098, -3.16176523829**), which can be pasted straight into Google Maps to identify locations. Figure references within the text of the report are hyperlinked (green font), so holding Ctrl and left-clicking on them will move to that point within the document.

2. Background

Table 1. Waterbody details

River	River Forth
Waterbody Name	Loch Ard
Waterbody ID	ID: 100270
Current Ecological Quality	Moderate – Water quality (all other parameters assessed were scored as good or better)
U/S limit inspected	56.187517, -4.501022
D/S limit inspected	56.181528, -4.43227
Distance inspected (KM)	2

https://www.sepa.org.uk/data-visualisation/water-environment-hub

The upper River Forth catchment, including the ~250-hectare Loch Ard, supports native trout and salmon populations. In addition, pike and perch are also present in the loch, with more recent reports of roach also being present. While once predominantly a salmonid fishery, there has been a more recent trend for coarse fishing on the loch, but wild trout remain, with good recruitment from certain tributaries.

According to the BGS website, the Loch Ard catchment geology comprises mainly metamorphic slate, sandstones and mudstones, often overlain by till, with alluvial deposits within the valleys. This would be expected to produce a relatively neutral pH, medium productivity catchment; however, peat drainage and forestry may reduce pH and, in addition to farming inputs and domestic wastewater, increase nutrient levels.

3. Habitat Assessment

3.1. Drumlean Burn

There are two main tributaries to Drumlean Burn, defined here as RB burn and LB burn when looking downstream. The RB burn was inspected from where it is impounded to create a pond (*Figure 1*), from which point it follows a straightened, realigned course downstream along the Drumlean Farm access track (*Figure 2*). Along the straightened section were a series of additional barriers in the form of undersized and poorly installed, now perched, pipe culverts. These structures not only fragment the watercourse for fish passage but also interrupt sediment transport, leading to blockage of the structures and lowering of the bed level downstream as the bed material transported down the burn is not continually replaced, as it should naturally be (*Figure 3*).

As a consequence of the steepened channel and the reduced gravel supply, the substrate of the burn is much coarser than would occur in a more natural course. The combination of poor accessibility and reduced substrate quality reduce the potential of the RB side burn but, amazingly, it still contained juvenile trout in all of the pools observed, even if in lower numbers than could be achieved in a natural burn. This is testament to the tenacity of brown trout.

Figure 1. The pond and large dam that form the upstream limit of fish movement on the RB burn.

Figure 2. Unnaturally coarse bed, owing to the straightened and steepened channel and a consequent limited capacity to retain finer gravel.

Figure 3. Perched culvert pipes created a series of major barriers for fish. The energy dissipation at the fall did facilitate some retention of the gravels that passed through, but these structures are highly detrimental and should be replaced with much larger, partially sunken structures to facilitate free passage of fish and sediment.

What appeared to be the former natural course of the RB side burn channel crosses the field to the RB side of the track, opposite the pond and still appeared to take some flow/water (as evident by damp ground covered by rushes), which progressed downslope to a livestock shed - located unsuitably close to the watercourse (*Figure 4*). This runs the risk of nutrient inputs to the watercourse (however small/low flow) if livestock are housed there. Livestock housing should be located well away from any watercourse, which should be a requirement under the General Binding Rules, to reduce the risk of pollution. Without the building, it could even be possible to reinstate the original watercourse.

Figure 4. The old course of the RB tributary burn, clearly visible from the low, damp ground and rushes, which flows parallel to the current straightened course. Note the proximity of the sheds.

The LB tributary suffered similar issues, having been realigned and with enriched water seepage across the boggy ground from more livestock sheds (*Figure 5*). Growth of stinging nettles along the boggy ground and bund suggest nutrient enrichment (elevated nitrate level), as does increased algal growth at the point of discharge to the channel. Another access track crossing LB burn was an even more significant barrier to fish and sediment transport, with work ongoing to maintain it free from accumulated gravel (*Figure 6*). Downstream of the pipe was a significant step, almost certainly preventing fish passage upstream (*Figure 7*).

Figure 5. Further sheds adjacent to another area of low-lying wet ground, probably also a paleochannel, with suspected yard/building runoff and elevated nutrients.

Figure 6 (56.187853, -4.44035). Another undersized and now significantly perched culvert. Note the ongoing sediment maintenance burden created by inappropriate watercourse crossings, with the entrained coarse sediment having to be regularly excavated.

Figure 7. Perching at the d/s side of the culvert pipes.

The situation worsened further downstream, where the combination of reduced sediment supply (and almost certainly channel dredging d/s), had created a major step in bed level (head cut) which has worked its way upstream (*Figure 8*) – a feature that is also impassable to fish. With the step at the track crossing pipe and the head cut, the downstream bed level of the channel appeared to be >1m below that of the channel upstream. This fact was also evident by the extent of channel incision downstream, with the bed now located well below the adjacent land and bank top (*Figure 9*). This issue also affected the RB tributary, which joined the LB tributary a short distance downstream, after flowing over the several significant steps.

With high flows less able to dissipate onto the floodplain, the incised nature of the main burn downstream further reduced the channel's ability to retain gravel – an issue that compounds itself over time as the bed lowers. The ideal solution here would be to re-meander the channel and reintroduce natural coarse sediment, raising the bed to a more natural level.

In the short term, benefit could be gained through the installation of diffuse *Woody Material* structures, to dissipate flow energy and increase the deposition and retention of gravel. The bankside trees through this section could provide valuable anchor points for such structures (*Figure 10*).

Figure 8 (56.187878, -4.440153). The head-cut nick point in the channel d/s of the culvert – created by starvation of sediment supply to the channel and, almost certainly, dredging d/s.

Figure 9. The incised channel of Drumlean Burn, with limited ability to retain finer gravel bars and riffles.

Figure 10 (56.187045, -4.439325). Bank stability from trees provide some in-channel features and could provide valuable anchor points from which to secure woody material that could increase coarse sediment deposition.

Despite issues with the chanel morphology, fish were seen in most pools, with stone turning revealing mayfly, stonefly and caddisfly, among other less sensitive species. This further supports the idea that this burn system can and should make a valuable contribution to the trout populations of the broader catchment, particularly if the habitat can be improved.

In wider areas, downstream of bends or natural features in the channel (woody material or tree roots) and as the channel gradient gradually reduced, gravel retention increased, improving the spawning potential of the burn (*Figure 12*). Natural woody material accumulations help to shape the channel, kick-starting geomorphological processes and drive bed scour to create pool features with valuable fish-holding structure (*Figure 13*). The structure that woody material provides within a watercourse is often overlooked but it can greatly reduce the ability of predators to exploit fish populations, in addition to diversifying in-channel habitat.

There was a general issue with livestock access denuding bankside vegetation and preventing natural tree regeneration in all areas upstream of the B829 road. Only one particularly problematic non-native species was observed during the visit, that being rhododendron (*Figure 14*). While this is not considered to be as invasive as some, it creates significant issues of overshading, out-competing most native species - its eradication is advisable.

Figure 11. Slightly out of focus shot of cased caddisfly larvae (white circle) and a flat-bodies mayfly (blue circle).

Figure 12. Gravel deposition in wider, lower energy areas of the channel. More of this material could be retained in other areas through the installation of woody material.

Figure 13. A rare example of natural woody material on the burn, creating a nice deeper scour pool and retaining gravel.

Figure 14. Rhododendron – an invasive, non-native species that should be eradicated to prevent further spread.

For ~200m upstream of the B829 road, the channel was significantly realigned and straight, with correspondingly uniform riffle and glide habitat, lacking pools and providing greatly underperforming habitat. Although a negative, this situation does at least create a great opportunity to quickly and easily improve the habitat quality. As for further upstream, the presence of bankside trees offers scope to install various types of *Lodged Woody Material*, and the stable banks with gravel substrate are perfectly suited to *Pinned Woody Material* type structures (*Figure 15* & *Figure 17*). These could significantly improve habitat in the short-term.

Figure 15. The uniform width, uniform depth 200m u/s of the B829 road. Greater occurrence of structure and pools could be created through the installation of various types of Woody Material*.*

In the longer term, options could be explored to undertake more major channel restoration through breaking the current burn out of the LB embanked channel and creating a new re-meandered watercourse through the low-lying, adjacent LB land (*Figure 16*). The already wet nature of that ground makes it relatively low grade for agriculture and moving the watercourse to a lower point in the valley may even improve the general drainage, while also allowing more regular use of the floodplain to 'temporarily' store flood water that can then recede back into to the channel more easily as flows decrease. This could create a positive impact upon flood storage with little or no detriment to land drainage, possibly even a positive one.

Figure 16. The low ground to the left of shot offers an opportunity to improve habitat quality and naturalise flows by reinstating a more sinuous channel across the field, if the landowner were amenable to the idea.

Figure 17. Looking u/s from the B829 road: continual glide, with no in-channel structure or deeper holding water.

Alongside the B829, the burn remains straightened, but numerous trout were still observed, particularly in the sections with at least some sinuosity and bed scour/depth created by woody material or trees (*Figure 19)*.

Figure 18. A pinch point between two trees focussing flow into the centre of the channel and driving bed scour to maintain a pool - with several fish observed to be in residence.

After ~300m alongside the road, the burn turns beneath the road, through an undersized culvert (*Figure 19*), although it appeared to be maintaining itself (or being maintained) in a clear state and affording free fish passage at the time of the visit. It would be worth monitoring this structure to ensure that it always provides free fish passage as, unimpeded, fish will move around a catchment throughout the year to use various habitat.

The lower gradient, more sinuous nature of the channel downstream of the road already provided improved habitat, with deeper pools and discrete gravel bars creating good invertebrate and salmonid spawning habitat (*Figure 20*). The availability of woody material and overhanging/trailing structure increased with progression downstream, but could still be beneficially increased in several places (*Figure 21* & *Figure 22*).

In the very lower reaches, the abundance of woody material is ideal, with great cover structure, scoured pools and dappled shade for fish (*Figure 23*), as the burn meanders among bankside willow trees (*Figure 24*). Access upstream out of the loch was unimpeded and should naturally maintain itself with the naturally floodplain-connected, un-incised channel.

Figure 19. The somewhat undersized road culvert. This should be maintained clear to ensure free fish passage at all times – not just during spawning times.

Figure 20. Within the naturally wider, more sinuous and lower gradient channel d/s of the road, valuable pools and riffles created a range of high-quality habitat. Note the finer gravel that was retained, offering spawning potential for a range of trout sizes.

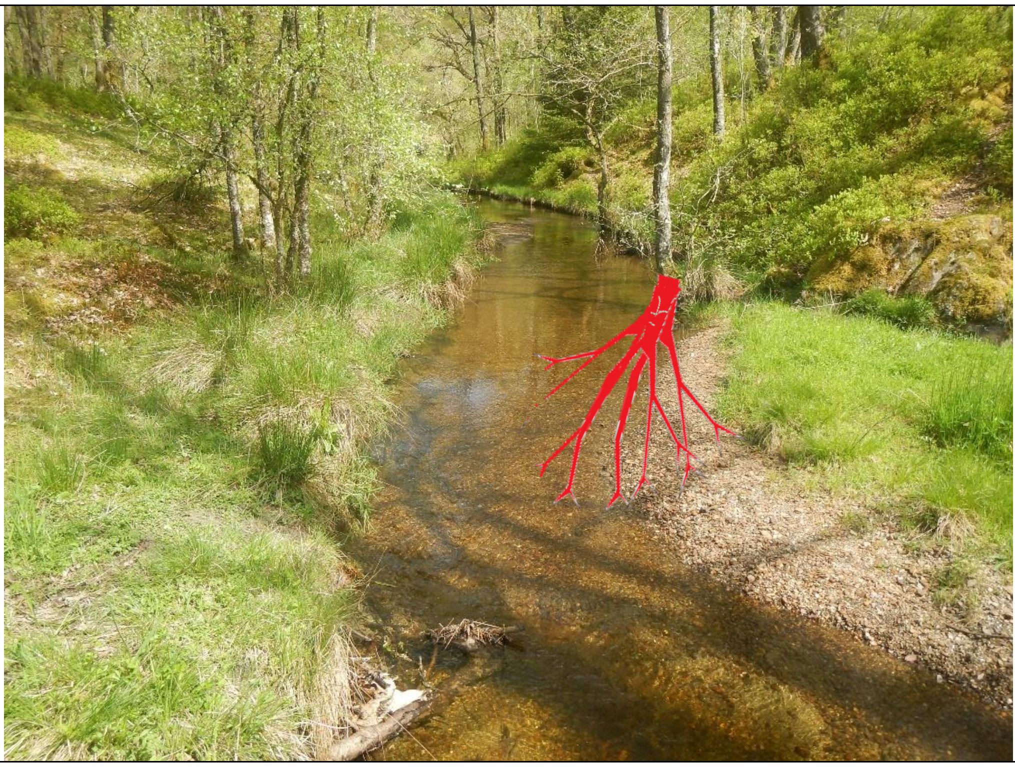

Figure 21. The natural sinuosity of the channel and fish cover could be enhanced here with the addition of woody material. The bankside trees provide a great anchor point for Pinned Woody Material (red diagram).

Figure 22. One or more trunks of the RB willow (white circle) could be laid down into the channel by Hinging, to increase structural diversity.

Figure 23. Natural woody material accumulation driving bed scour and pool creation. This could be replicated with habitat structures.

Figure 24. A healthy balance of light and shade over a naturally meandering channel, between bankside willows.

Ledard Burn

A short section of Ledard Burn was inspected downstream of the B829. Access beneath the road for fish appeared adequate (as well as could be ascertained from the bank) and should allow utilisation of the watercourse upstream as juvenile habitat, and potentially for spawning (*Figure 26*). In many areas, the bed was coarser than is required for trout spawning, suggesting that the burn experiences high peak flows in comparison to its base flow, possibly owing to land drainage/forestry drainage upstream. Where bankside trees trailed into the channel, the associated flow energy dissipation assisted retention of finer gravels (*Figure 27*).

The potential for more structure to become established (particularly from the LB side) was reduced by livestock access to the banks, restricting tree growth and bank stability. Associated historic erosion was almost certainly contributing to the channel appearing overwide and shallow, although relatively stable in most places now (*Figure 28*). Grazing of bankside vegetation reduces species diversity and natural tree regeneration, along with causing more of the plants' energy to be diverted into replacing lost foliage than maintenance of diverse root systems. For this reason, grazed banks are generally far more susceptible to erosion than un-grazed/buffer fenced banks.

Figure 25. What appeared to be free passage beneath the road bridge.

Figure 26. In many areas, the substrate of the channel was too coarse for salmonid spawning. Modified channels upstream and increased land drainage could contribute to this through increased peak flows and associated coarse sediment transport. Equally, barriers upstream could also starve the burn's supply of gravel.

Figure 27. Some gravel was retained at bends, where trailing vegetation was also likely to dissipate high flow energy, but the channel generally lacked gravel.

Figure 28. The overwide and generally shallow channel, lacking deeper pool habitat.

Water of Chon

A short section of the Water of Chon was walked upstream of the main road crossing in Kinlochard. The Water was much larger than the others inspected, with greater spawning potential for any salmon making it that far upstream. The coarse cobble and boulder substrate, with bedrock outcrops and a healthy array of bankside trees/low branches, created naturally high-quality habitat for both juvenile salmon and trout (*Figure 29*). Limited trout spawning potential was observed, owing to the coarseness of the bed but also to a lack of sorting of the smaller cobble and gravels (*Figure 30*). This was partially a consequence of the channel type, but additional woody material within the channel could drive more bed scour and sorting.

Stone turning revealed a similar diversity of invertebrates as on the other tributaries, with most that would be expected, including mayflies, stoneflies and caddisflies (*Figure 31*). While such inspection is only basic, it does provide an indication that the water quality is adequate to support those species, and considering their relative abundance, it is likely that this is the case over the medium-long term. It is difficult to guess what it was like further upstream, but the cover, light and shade regime is pretty much ideal in the section inspected (*Figure 32*).

Figure 29. Naturally coarse bed and diverse flow created good juvenile salmonid habitat.

Figure 30. Limited bed sorting reduced the potential for salmonid spawning, but it remained reasonably good quality.

Figure 31. Various cased caddisfly larvae (white circle) and a stonefly nymph (blue circle).

Figure 32. Trailing tree roots, low overhanging cover, diverse flow and a good balance of light and shade from the main tree canopies. Great quality juvenile salmonid habitat.

In wider areas of the channel, there were signs of fine sediment accumulation (*Figure 33*). While this would be expected to an extent in such areas, there is usually scope to limit anthropogenic inputs of fine sediment on most catchments and it may be worth undertaking inspections further upstream to identify sources such as livestock access/erosion, forestry drains, and track crossings and roads.

The bridge of the road crossing in Kinlochard appeared to be built on a natural bedrock feature, which creates a chute/fall that is a small obstacle to fish passage but will be passable in a range of flows (*Figure 34*). There is a general presumption against altering natural obstacles within watercourses, so the limited impediment that it does cause should simply be accepted as a consequence of naturally diverse habitat.

Figure 33. Fine sediment deposition in the margin at a wider section. This may indicate elevated inputs further upstream and further inspection would be beneficial.

Figure 34. The road bridge in Kinlochard created no additional impediment to the already rugged bedrock outcrop on which it sits.

4. Summary

Despite concerns of a lack of trout recruitment to Loch Ard, numerous juvenile trout were observed within the tributaries that were inspected, particularly in the Drumlean Burn, where there was significant scope for habitat improvement. Simple techniques like installing woody material could improve the form and function of the channel in the short-term, but there would also be potential for restoring the channel to a more natural course and improving sediment and habitat connectivity through the removal of man-made obstructions. Fish access further up the LB burn tributary of Drumlean Burn could potentially be increased by addressing the perched culvert and nick point in the bed, which would then make the channel upstream worthy of habitat enhancement too.

The general land use upstream of the B829 road on Drumlean Burn and in the lower reaches of Ledard Burn was not conducive to good riparian habitat, with livestock grazing greatly denuding the banks of herbaceous vegetation and saplings and leaving them at increased susceptibility to erosion. It would be beneficial to install buffer fencing and exclude livestock wherever they currently have access to the tributaries, to promote a healthy riparian zone with tree regeneration.

5. Recommendations

The following actions are recommended:

- Undertake habitat enhancement on Drumlean Burn through the installation of *Woody Material* to kick-start geomorphological process on the straightened and incised sections.
  - Prime location (the ~ 200m u/s of B829)
    - **56.1853, -4.438458** to **56.18356, -4.436975**
  - D/s of pipe culverts, to aid coarse sediment retention within the channel
    - **56.187803, -4.440113** to **56.185838, -4.43851**
  - Additional site (d/s of B829)
    - **56.182863, -4.432125** to **56.18168, -4.432148**
- Investigate options to restore a more sinuous channel to the straightened and degraded sections of Drumlean Burn (**56.1853, -4.438458** to **56.18356, -4.436975)** and replace the perched culverts (as per *Black Beck channel restoration*). This is likely to be a long-term aspiration requiring negotiations with the landowner, but increasing numbers of this type of scheme are being undertaken around the UK, often for surprisingly reasonable costs.
- Investigate potential fine sediment inputs further upstream on the Water of Chon. This could be simple visual inspection of forestry drainage discharges, track crossings and land use (e.g. grazed fields/erosion).
- Install buffer fencing wherever livestock have access to the watercourses (predominantly the upper part of Drumlean Burn and lower reaches of Ledard Burn).
- Undertake further investigation of the burns further upstream than inspected to have a general look for barriers and fine sediment inputs that could be addressed.
- To really preserve the wild trout populations and, in particular, the larger spawning component, consider introducing a catch and release policy for all trout. This would remove the temptation for anglers to take 'the odd fish', which in reality usually means many more than is assumed and also, usually the most valuable, larger spawning stock. Left in the fishery, those individuals have great potential to provide a valuable contribution to future generations whilst growing even bigger

and providing sport for many more anglers. Once killed, any potential contribution ceases.

6. Further assistance

The WTT may be able to offer further assistance such as:

- WTT Practical Visit
    - Where recipients require assistance to carry out the improvements highlighted in an advisory report, there is the possibility of WTT staff conducting a practical visit. This would consist of 1-3 days' work, with a WTT Conservation Officer(s) teaming up with interested parties to demonstrate habitat enhancement methods (e.g. tree kickers and willow laying etc.). In these examples, the recipient would be asked to contribute to reasonable costs (day rate, travel and subsistence costs of the WTT Officer).
- Advice and support (alongside other partners) in developing and initiating channel restoration projects.

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

https://www.wildtrout.org/content/wtt-publications

We have also produced a 70-minute DVD called 'Rivers: Working for Wild Trout' which graphically illustrates the challenges of managing river habitat for wild trout, with examples of good and poor habitat and practical demonstrations of habitat improvement. Additional sections of film cover key topics in greater depth, such as woody debris, enhancing fish populations and managing invasive species.

The DVD is available to buy for £10.00 from our website shop www.wildtrout.org/shop/products/rivers-working-for-wild-trout-dvdhttp://www.wildtrout.org/shop/products/rivers-working-for-wild-trout-dvd or by calling the WTT office on 02392 570985.

7. Acknowledgements

The WTT would like to thank the William Grant Foundation for supporting our advisory and practical visit work in Scotland.

8. 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 must be sought before commencing work on site. These are not limited to landowner permissions but will also involve regulatory authorities such as the Scottish Environment Protection Agency, local Council – and any other relevant bodies 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 fishery.

Appendix A

Woody Material

Pinned Woody Material

Figure 35. Large woody material securely pinned in place with sturdy stakes. The benefit of this technique is that it can be used without nearby trees as an anchor point. Posts (white ellipses) are driven into the bed and/or bank to secure the material, with the butt ends u/s, as material would usually come to rest. Utilisation of this technique is usually in more sheltered inside bends, where it can be incredibly effective at increasing sediment deposition to reshape an over-capacity channel.

Figure 36. Willow secured with two live willow pegs (red dashed lines), created from forked branches, that were driven into the bed on a slight upstream angle. Although slightly obscured in the picture, the pegs were driven into clefts of the right side branch (and its side branches).

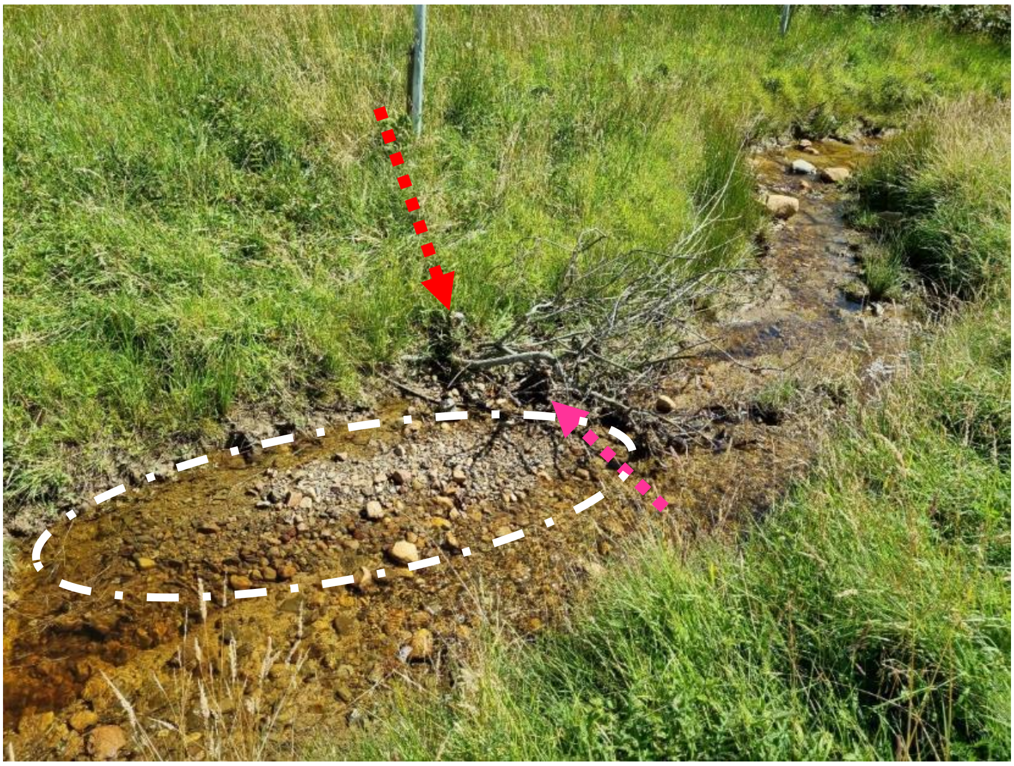

Figure 37. Although difficult to see, willow pegs were driven through this woody material down into the bed (red dashed line) and horizontally into the bank (pink dashed line), securely fixing it on two planes. In this instance, the structure aided gravel retention upstream (white ellipse).

Lodged Woody Material

Lodged woody material replicating the natural occurrence of trees and limbs lodged against or between standing trees and hinging, which replicates trees and branches that come to rest in the river margin.

Figure 38. Lodged woody material flow deflector. Note how the two upright sycamore stems lock the pole in place. The more pressure that is exerted by flow, the greater the friction becomes. This cannot wash out unless the well-rooted supporting trees give way, which is highly unlikely.

Figure 39. Another variation of lodged woody material, or hanger. This technique is equally secure as the standard lodged woody material. A hybrid of the two techniques can also be applied.

Hinging

Tree trunks can be cut and hinged to create an enhancement feature, with no significant detriment to the overall habitat. The technique entails cutting partially through the trunk leaving 1/3 – 1/4 uncut, so that it remains attached but can be hinged over, into or along the channel (Figure 40). It works particularly well with willow, elm, thorns (hawthorn or blackthorn) and hazel, but only willow will thrive with its canopy partially submerged.

Figure 40. Willow hinged into the river margin to increase cover and structure. The method involves cutting part way through the stem, quickly through the first two thirds, then continuing until it collapses or can be pushed down over the river. The depth of the cut should be limited to only that which is required to bend the stem over, as this will maintain maximum size and strength of the hinge and the health of the tree/shrub.

Appendix B

Willow whip planting

Following livestock exclusion, selective planting of willows as whips/cuttings would be useful at any open locations that lack tree cover; on the inside of bends to encourage deposition or on the outside of bends to create cover feature trees or drive bed scour. Being fast growing and easy to establish, willow planting could rapidly increase cover and provide material to be hinged into the channel in later years.

The easiest way of establishing new willow saplings is by pushing sections of freshly cut whip or branch into areas of wet ground, ideally around the waterline where there is plenty of moisture available. Whip planting can be undertaken at any time of the year but will have the greatest success during the dormant season, shortly before spring growth begins (ideally late Jan-March).

Whips should be planted so that the majority (~2/3) is within the ground, to minimise the distance that water has to be transported up the stem initially, before a substantial rootstock develops. Planting on a shallow d/s angle eases water transport within the developing tree (which starts without any root) and reduces the potential for it to catch flood debris and be ripped out. Leaving 300-400mm of whip protruding from the ground is usually sufficient, providing they protrude well past the surrounding vegetation (to allow access to light). Whips of 5mm-25mm diameter tend to take best, but even large branches can be used. If undertaken during the growing season, care should be taken not to use whips with excessive foliage, which greatly increases the rate of transpiration and can lead to the whip dehydrating before the supporting root system develops.

Appendix C

Black Beck channel restoration

Black Beck – Low-lying ground pre restoration.

Black Beck – during restoration / channel excavation.

Black Beck – shortly after completion.