Project Proposal

Backstone Beck, River Wharfe, Ilkley

September 2015

1.0 Introduction

This report is the output of two site visits undertaken by Jon Grey of the Wild Trout Trust and is a follow up to an Advisory Visit (AV) report for Ilkley Angling Association (Gareth Pedley, 2013) which can be accessed here:

http://www.wildtrout.org/av/river-wharfe-ilkley

The first visit was in the company of Stephen Fairbourn (Club President) and David Martin (Club Secretary and fishing guide) to highlight a particular site, but the river level was relatively high and access was restricted. A second visit was then conducted under low water conditions in the company of Dan Turner of the Yorkshire Dales Rivers Trust, to discuss partnership potential for any proposed work at the site.

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) while looking downstream. Upstream (u/s) and downstream (d/s) are also abbreviated for convenience. Locations are noted using National Grid References.

2.0 Background and rationale

Backstone Beck is a short tributary of the River Wharfe which enters an ephemeral side channel of the main river running to the south of Beanlands Island (just d/s of the Yorkshire Water Sewage Treatment Works) in Ilkley. The Beck is within the watercourse 'Wharfe from Barben Beck/River Dibb to Hundwith Beck' (GB104027064257), classified by the Environment Agency (EA) as a Heavily Modified Waterbody (HMWB) under the Water framework Directive. This is likely to be, at least in part, due to the sections of channel realignment and the barriers that impact upon its ecology and geomorphology. As a HMWB, the watercourse is assessed against 'ecological potential': it is currently failing on chemical quality.

Ilkley AA do not stock their waters and wish to promote wild populations. The Beck was selected specifically for this visit because Gareth Pedley (AV, 2013) had highlighted a paucity of appropriately sized spawning gravels for trout and grayling within the main-stem Wharfe. Hence, access to smaller tributaries might be particularly important for sustaining wild fish populations and any such waters within Ilkley AA boundaries (and indeed beyond) should be managed to maximise their potential. A major obstacle to fish passage in and out of the Beck is found immediately at the confluence with the Wharfe (SE1279348244): a double culvert of concrete pipe which is perched above a sloping apron of concrete (Figs 1&2). The purpose of the visits was to ascertain potential for spawning within the Beck and propose remedial action for better fish passage at the culvert.

Figure 1. The perched culvert at the mouth of Backstone Beck as it enters the R Wharfe. High flows cascade onto a sloping apron.

Figure 2. The perched culvert under low flow conditions showing the extent of the degrading sloping apron, and generally poor state of repair of the whole structure. Note the walling on the LB has been undermined by flood waters and is near to collapse.

2.1 Backstone Beck

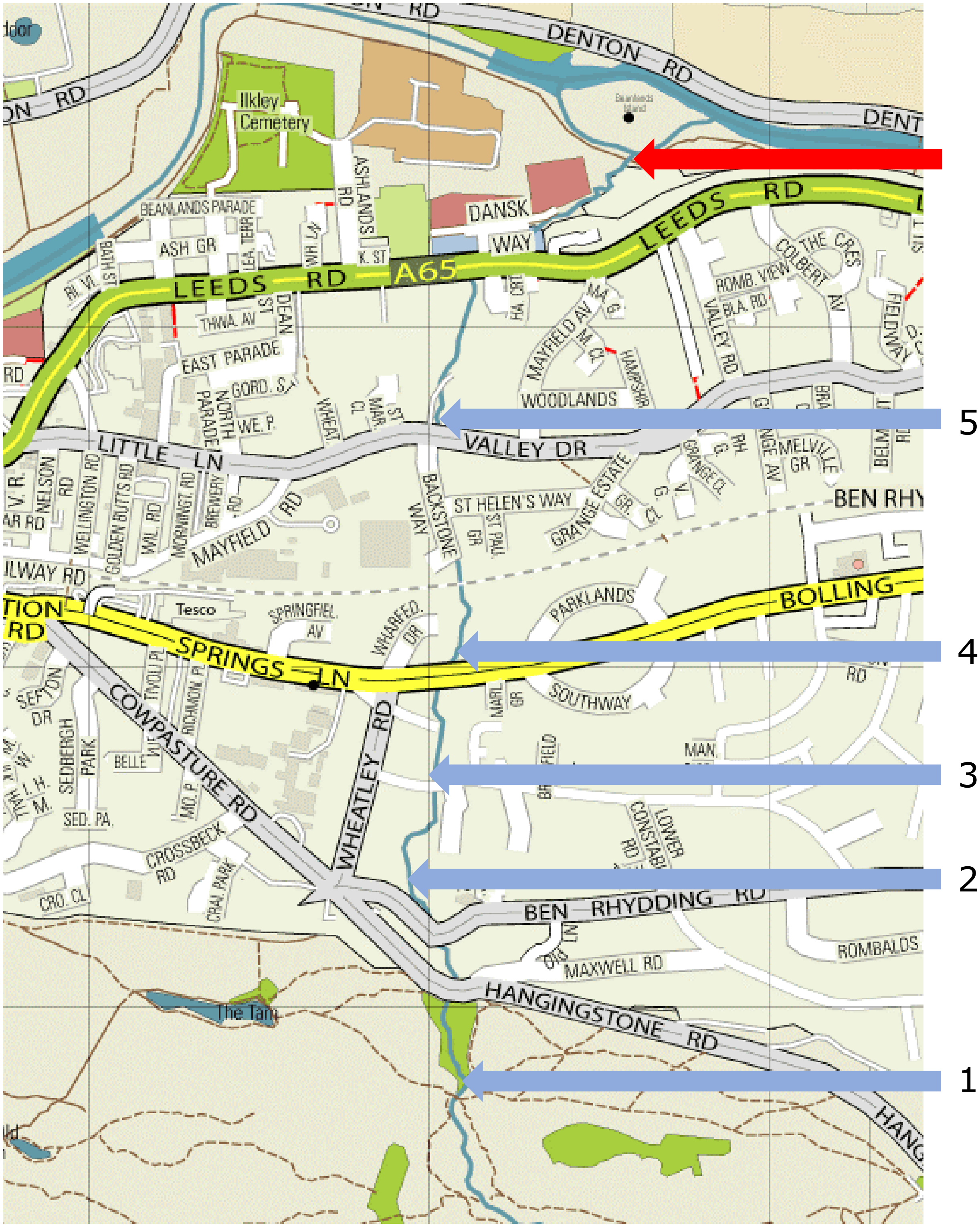

Figure 3. Map of Backstone Beck showing points accessed (numbered blue arrows) and position of the culvert (red arrow). Map created in streetmap (www.streetmap.co.uk).

The Beck was walked from SE1255546891 (arrow 1; Fig 3) in a d/s direction to arrow 2, and then a series of "spot checks" were conducted at each site indicated by the remaining arrows. The15m section of beck immediately u/s of the culvert (Fig. 3; red arrow) was also examined. At arrow 1, the Beck is of such a high natural gradient that it was deemed impassable to trout, and so it was not assessed any further u/s. Three impassable, man-made obstacles were noted between arrows 1&2: The culverts allowing Hangingstone Rd (Fig 4) and Ben Rhydding Rd (Fig 5) to pass over the Beck; and a vertical walled waterfall of approximately 4m at arrow 2 (Fig 6).

Figure 4. The stone-floored culvert under Hangingstone Rd. The head loss over the entire length of the stone-flooring (which extended approximately 25m u/s of the culvert), and including the step at the d/s side was estimated at ~5m.

Figure 5. The concrete-floored culvert under Ben Rhydding Rd. Headloss estimated at ~1.8m.

Figure 6. Looking d/s over the walled waterfall, with an estimated headloss of ~4m.

Access downstream from the waterfall was restricted and confined investigations to the spot checks indicated on Figure 3. At arrows 3, 4 and 5, and for the short section immediately u/s of the culvert at the confluence (red arrow in Fig 3), the hydromorphology of the Beck appeared quite natural with pool-riffle sequences typical of a high gradient headwater stream. Gravels in the 10-40mm diameter range (and hence of an appropriate size for spawning fish) were evident. The riparian (bankside) vegetation provided ample low and trailing cover, good refugia for juvenile fish and invertebrates alike. No fish were seen during the visit.

It was impossible to determine the extent and 'naturalness' of the substrate in further culverted and open sections between arrow 5 and the confluence because the Beck flows extensively through private land. With that caveat, the total extent of water for trout spawning in Backstone Beck is estimated at just over 1km. Trout are reported from the lower sections of the Beck by Ilkley club members. As the passage of fish u/s from the Wharfe is extremely unlikely due to the perched culvert in Figs 1&2, it is surmised that these trout are part of a small resident population, and a proportion of their progeny is likely to drift d/s into the main-stem Wharfe over time. Hence, it is worth maintaining and managing the habitat within the lower reaches of Backstone Beck to maximise their breeding potential. If the culvert at the confluence can be made passable to fish, it would create valuable spawning and juvenile habitat for fish from the main river.

The culvert is in a considerable state of disrepair. Brickwork on the d/s face of the structure, surrounding the two concrete pipes, is failing. The sloping concrete apron is degrading and breaking away. There is considerable erosion on both banks, and as noted in the legend of Fig 2, the stone wall on the LB has been completely undermined, exposing the roots of the riparian trees; this will eventually lead to the loss of the trees and further associated damage to the bank during future spates. The two pipes each consist of 2x ~3m sections, and the d/s sections have tipped at a greater angle, again likely due to the disrepair of the whole structure. Unfettered access to the edges of the structure from the Dales Way footpath is causing erosion of the soils surrounding the stone and brickwork.

2.2 Culvert options

The best solution is clearly complete removal of the culvert and replacement with a clear-span bridge or a single, over-sized, sunken culvert. This will alleviate any potential problems with raised bed level and blockage that small diameter (currently ~ 0.9m) pipes are susceptible to, so should actually reduce flood risk. Removal of the current structure (with an estimated headloss of ~1.3m; Fig 7) would result in some bed level adjustment over time (as substrate would move naturally under reinstated geomorphological process). To ameliorate any incision u/s, the remnants of the structure should be left *in situ* immediately d/s to partially infill the scour pool that has developed from the perched culvert and create a roughened bed to help trap the mobilised material.

Access along the Dales Way, from the Yorkshire Water site, is feasible with a small excavator. One short length of wide diameter culvert, buried to a minimum of 1/3 diameter at the current bed level d/s will allow development of natural substrate throughout. Funds for either the Council, a Council preferred contractor, or an independent contractor overseen by WTT or YDRT, should be sought on the basis of maintaining the Dales Way as well as environmental enhancement.

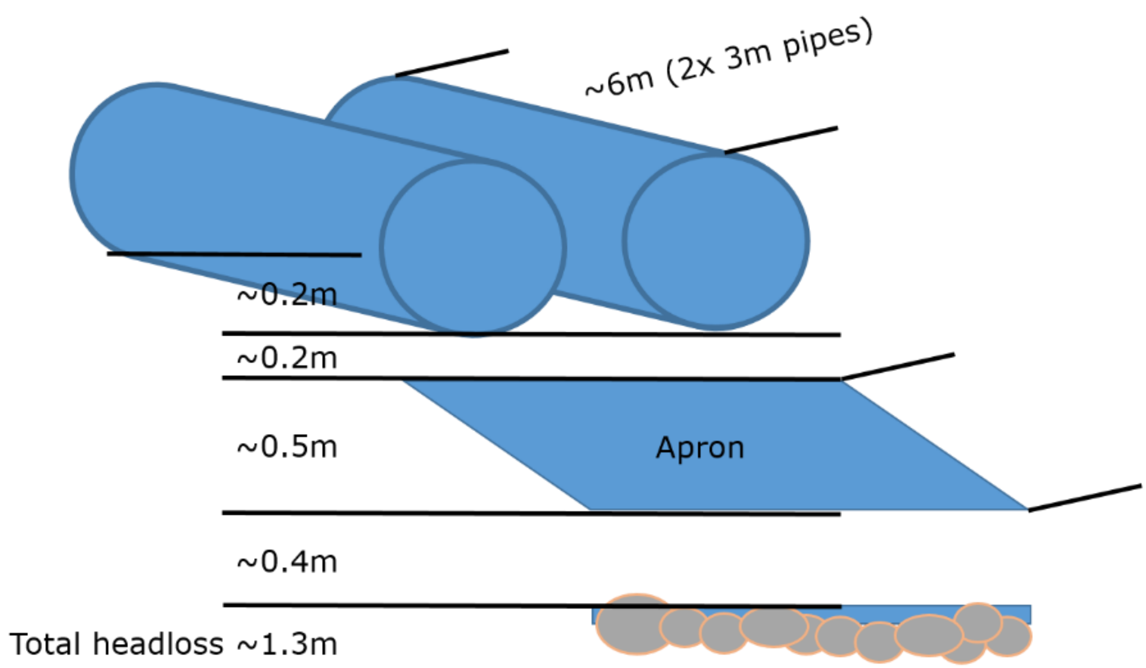

Figure 7. Schematic of culvert in current condition.

A cheaper solution could be to infill the scour pool d/s of the culvert with a simple rock ramp (a range of substrate from gravel to large boulders) to reduce the current headloss (Fig 8). The depth required, from the current bed level to the d/s lip of the culvert pipes, is 1.1m. Ideally, the new bed level should be sufficiently high to slow the flow through the pipes, thereby increasing the depth within the pipes (one pipe more than the other to increase the range of passable flows); this could be achieved by installing the u/s end of the ramp to a greater elevation than the bed of the culverts or creating a notched baffle at the mouth of the pipes.

The scour pool is ~3.5m wide by 4.5m long and so judicious use of a matrix infilled with the degraded wall (Fig 2), and boulders (as large as possible that can be 'man-handled') from the Wharfe could form a 'rock ramp' to the culvert. However, this design is difficult to execute so that it works at low flows; it may act as a colander as the water percolates down rather than flows across the top in the desired manner.

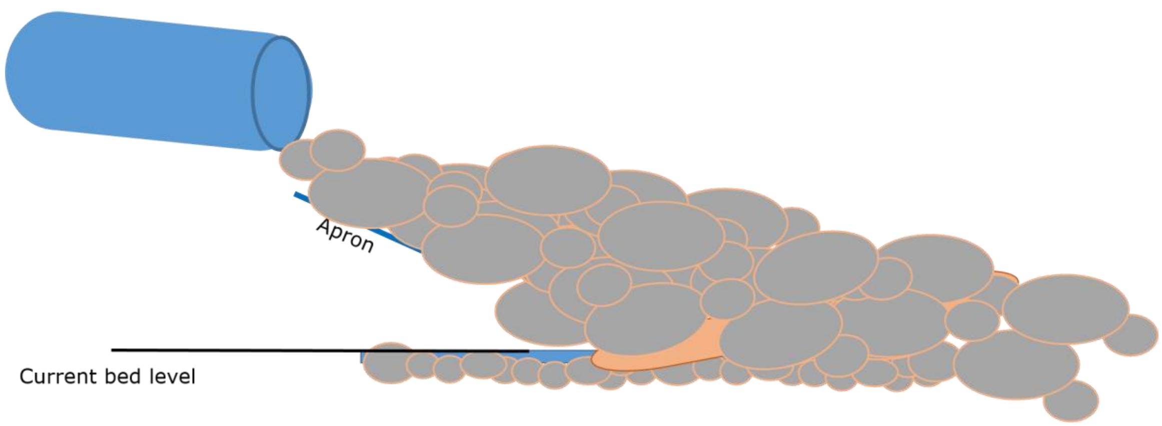

Figure 8. Schematic of debris infill to current scour pool below culvert: a mix of large wood to form a secure matrix infilled with locally won boulders. The gaps will fill in naturally over time with supply of material from Backstone Beck.

The second solution (Fig 8) will need consent from either the local Environment Agency office or the Council, depending upon whether the scour pool is classified as part of the 'main river' Wharfe or 'ordinary watercourse' Backstone Beck.

Overall, the first solution offers a more reliable route to meaningful improvement, being maintenance-free and with a reduced risk of future blockage and associated flood risk.

2.3 Ephemeral side channel

Backstone Beck enters an ephemeral side channel of the R Wharfe as it flows to the south of Beanlands Island. The channel was flowing on the first visit, but stagnant (u/s) of the Beck confluence on the second visit. Obviously, Backstone Beck provides flow to the lower section of this channel and it re-joins the main-stem Wharfe approximately 150-200m d/s at the tail of the island. Aside from the swamping of riparian herbaceous vegetation by Himalayan balsam, the riparian tree cover is generally good and there is considerable amounts of large wood overhanging and laying into the channel providing a diverse array of cover and flows.

However, more could be done to improve and maintain the quality of this habitat, certainly as juvenile refugia, and even potential spawning habitat (given that it is likely to be flowing consistently with Wharfe water during the spawning period). Currently, it is overly wide for the flow provided by Backstone Beck alone, and would benefit from the introduction of a more structured two-stage channel; low flows are catered for in a narrower channel while high flows take up the full cross sectional area (Fig 9).

In places, the flow is meandering around natural wood and debris obstructions despite being within the over-capacity channel. This needs to be emulated throughout the length to focus flow at low water levels to keep potential spawning substrates free from finer sediments. Rearranging some of the boulders found *in situ* or installing low brash berms to create pinch points (narrowing the channel but easily overtopped in high flows), and laying (hinging) some of abundant willow at a shallow angle $<30^{o}$ into and along the sides of the channel will provide further low cover and focus the flow of water. The simple solutions above could be easily achieved with dedicated man-power; laying of material into the watercourse should be discussed with the Environment Agency, but there is an abundance of material naturally *in situ* already which can be used as a supporting argument.

Figure 9. The ephemeral side channel (in high flow) as it re-joins the Wharfe d/s of Beanlands Island. Overlaid is a schematic of a two-stage channel. As seen, the water fills the complete cross-sectional area, but in low flows, is focussed into the more appropriate, smaller dimensioned channel. Here, being on a bend, the deeper channel should be encouraged towards the outside bank as would naturally occur.

3.0 Summary of Recommendations

Location	Recommendations
Perched culvert	1. Contact the Council to discuss the state of the culvert and seek assistance in replacing the structure with a clear-span bridge or sunken culvert (or alternative). Lodge request with Council for consultation prior to any repairs / works on the culvert. This is likely to be from a maintenance perspective of the Dales Way. 2. Monitor for deterioration of structure by fixed point photography 3. Investigate potential for infilling of the scour pool to essentially raise the bed d/s and overcome the 'perch'.
Ephemeral side channel	1. Create more structured two-stage channel to cater for Beck only flows, and Wharfe & Beck flows, by creating pinch points and low-level obstructions on alternate sides of the channel (for sinuosity). 2. Lay existing willows to provide low cover as well as creating obstructions in 1, above.

4.0 Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programme in England, through a partnership funded using rod licence income.

5.0 Disclaimer

This report is produced for guidance only. No liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon comments made in this report.