Advisory Walkover

Powmillon Burn, Strathaven

March 2019

1.0 Introduction

The Clyde River Foundation (Clyde RF) requested input from the Wild Trout Trust to assess potential for habitat improvements along the Powmillon Burn, a tributary of the Avon Water, within the confines of John Hastie and George Allan Parks (from here on simply referred to as the park). This report was compiled by Prof Jon Grey from observations and discussions held with Clyde RF and managers of the park during a site visit in early March, 2019. Overnight rain had raised the water level and coloured the water slightly, to the extent that it was not possible to see the substrate in every reach.

Throughout the report, normal convention is applied with respect to bank identification, i.e. left bank (LB) or right bank (RB) whilst looking downstream. Upstream and downstream references are often abbreviated to u/s and d/s, respectively, for convenience.

Aerial image from GridReferenceFinder.com highlighting the path of Powmillon Burn through the outskirts of Strathaven. The reaches considered within this report are between the two white arrows.

2.0 Habitat Assessment

The following images are used to exemplify available habitat, issues, and opportunities along the Powmillon Burn.

Fig 1. Effectively the u/s limit of the Powmillon Burn under consideration, the weir impounds water to provide an offtake / lade for former milling and currently supplies the lake. It can be considered an impassable barrier to upstream fish migration.

Upstream, the impounded reach was relatively short and aerial imagery of the channel within the pastures shows a naturally meandering channel. Throughout the park, as will be seen in the following images, the banks have been heavily formalised with walling and the channel straightened, thereby increasing the gradient and creating very uniform width, depth, and substrate characteristics.

Here, the LB was walled but the RB was less constrained. As a consequence, and in response to the weir and large boulders disrupting the flow of water, the channel has diversified and created good habitat for many life-stages of trout: deep water for holding adult fish; shallow streamy runs for juveniles; trailing, 'shaggy' vegetation to provide refugia from spate flow and predation; and sorting of substrate into size classes, creating some small pockets of gravel where trout may spawn.

Opportunities: some low growing, shrubby trees like bird cherry, goat willow (sallow) or dogwood could be planted on the RB beyond the fence, to add more overhead cover. These would be easy species to manage by coppicing, and provide excellent resource for pollinators, as well as enhancing aesthetics.

Fig 2. A heavily formalised reach near to the bandstand. The channel has been designed to a constant trapezoidal proportion relative to a fixed width. The straightening and long sweeping bends have caused a steepening of the gradient and, hence, the instream habitat was dominated by continuous shallow riffle. Substrate was mostly distributed evenly across the channel. The few features of note were caused by larger boulders within the channel disrupting the flow

The banks were maintained as short sward grass and therefore there was no cover, the walling effectively severing any ecological tie between the land-water interface.

Opportunities: This is a very 'visible' area of the park with paths on both banks; dogs were being encouraged to play in the water from the inside of the bend where the channel bed was more accessible (white arrow).

- **Diversifying the flow by enhancing the effects of the boulders already *in situ* (upper image, white ellipses), and recreating similar enhancements upstream on the straightened section.**
- **Installation of alternating low-level berms to encourage a more natural sinuous flow path (e.g. green hatched areas in lower image; see Fig 3).**
- **Judicious planting of some trailing vegetation such as native ivy, honeysuckle or bramble in association with the instream structure to provide low cover. This would be of most benefit where the trailing vegetation would cover deeper water.**

Fig 3. The back and side of the Bowling Club, upper and lower panels, respectively. The two ellipses, both to the RB, highlight naturally developing features that would be good to create / encourage / enhance elsewhere.

Upper: finer sediment has been deposited on the inside of the slight bend, slightly narrowing the wetted channel, i.e. the remaining wetted cross-section must be slightly deeper to the outside of the bend. The regular mowing of the grass is removing much beneficial biodiversity – this is despite the fact that the area is not accessible or particularly visible to the public.

Lower: a low berm has developed at the toe of the wall and been colonised by native vegetation; this area appears to be benefitting from 'benign neglect'. The vegetation at water level provides a much more natural land-water interface and good low cover for fish and insects.

Opportunities: with limited public access to this part of the park, any enhancements should provide even greater benefits to fish populations because of lower disturbance. Work here could form part of an experimental study for Clyde RF.

- **Enhance and exaggerate the current berm / deposition bar development.**
- **Increase sinuosity with a complementary berm on the opposite bank (LB) downstream.**
- **Planting of trailing species at judicious points along the wall tops.**
- **Introduction of several individual boulders mid-channel to disrupt flow.**

Fig 4. One of the few locations within the park where the channel width varies, the left-hand bend downstream of the Bowling Club. The pool was actually deeper through the centre of the bend; there was evidence of a berm of vegetation at the toe of the wall around the outside and a notable deposition of finer sediment on the inside (arrow). In a similar fashion to the weir in Fig 1, the greater width afforded between the walls, and the disruption of the flow has led to the development of a point bar mid-channel which has been colonised by plants. Steps down to the water, and a footbridge, make this an ideal demonstration reach (currently exploited by Clyde RF). The relatively natural LB in the lower image offers a clear contrast in habitat to the walled RB.

Opportunities: downstream from the footbridge presents ideal study location for contrasting natural v unnatural banks, but as the LB (natural) is under private ownership, there is little to consider in this report. Upstream of the footbridge, there is scope for enhancement.

- **Exaggeration of the deposition bar, encouraging it downstream.**
- **Placement of individual boulders to disrupt flow.**
- **Pinned logs, placed parallel and tight to the bank to provide cover for fish.**

Fig 5. The lower reaches within the park appeared to be slightly narrower and hence retained a greater depth of water. The integrity of walling of properties to the LB was suspect. A slight step in the walling of the LB had allowed some natural vegetation to colonise and this provided some low trailing cover (upper). Indeed, in the lower image was evidence of some of the only low-branched cover along the whole reach, especially beneficial as this was over deeper water and hence good habitat for larger adult fish.

Maintaining a short sward of grass along the RB top has clearly reduced resilience to spate flow and led to erosion scalloping (both images). Continually cutting grass shoots means more energy is invested in replacing those shoots rather than roots. Allowing a more diverse 'buffer' of native wildflowers to develop would diversify the root matrix and bind the soil together more effectively, plus better for the wider ecology e.g. pollinators. It can be managed as an attractive feature without becoming too formal, and reduce footfall right to the edge of the bank top (also a contributor to the erosion issue).

Opportunities:

- **Low berms (as previous) on the straight sections using the current depth profile of the channel as an indicator for where to position them to best effect. This section might also present an opportunity to site two narrow berms opposite each other to 'pinch' the channel, rather than create meanders by placement on alternating banks.**

3.0 Recommendations

The following proposals can be viewed as modular. In isolation, each will provide some benefit but used complementarily, the benefits to both instream and terrestrial ecology will be greater.

3.1 Disrupting or diversifying flow

The use of structure to impede flow and hence diversify flow patterns around that structure has knock-on effects to the surrounding substrate via scour and deposition (visible in Fig 2). Physical habitat diversity begets biological diversity, be it microbial, plant, insect or fish. Different life-stages also require different habitat characteristics.

It is most often achieved using woody material (debris) pinned in to the channel to mimic natural wood fall (trunks / limbs) which would occur if there was natural woodland present on the banks. Used in this way, wood has a finite life-span but is primarily used as a kick-starter for processes which would ultimately be taken on by natural wood fall over time. In a heavily managed situation like the park, it may be more appropriate to consider placement of boulders arranged to simulate the same shapes as depicted in Fig 6. Boulders also occur naturally within the channel as depicted in Fig 1 and noted downstream of Strathaven. An alternative might be the installation of a J-hook or cross-vane structure (Rosgen: http://www.hydrology.bee.cornell.edu/BEE4730Handouts/Rosgen_Vanes.pdf) to provide grade control in the artificially steep channel and provide much lacking depth variation, but this would require slightly more engineering. It is important to stress that when using either wood or boulders, these are modest features, ~30cm high and not occupying more than 25% of the channel width, so that they do not increase local flood risk. They are also aligned (30^{o} to the flow) in an upstream direction to reduce the risk of erosion to the bank immediately downstream.

Placement of individual boulders more to the mid-channel to disrupt the flow would also create habitat diversity, the scour pools used by larger fish and the retained gravels potentially used for spawning. The placement of these should be sufficiently far apart so they are not seen as 'stepping-stones' and they should be sufficiently large so they cannot be moved by members of the public. From an avian perspective, such features are especially favoured by grey wagtail and dipper from which to forage for emerging insects.

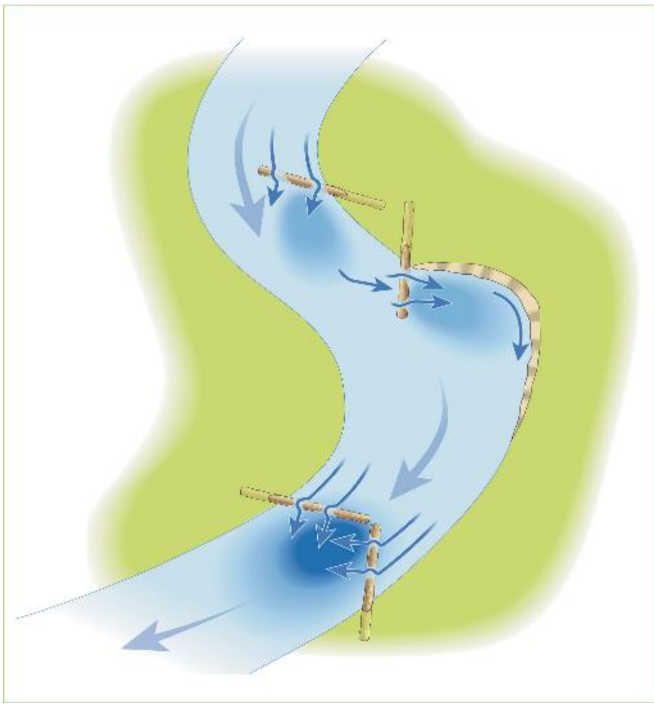

Fig 6. Conceptual diagram of use of woody material as deflectors, but boulders can achieve the same effect. From the top of the figure:

Upstream angled – diverts flow to the centre of the watercourse, and creates localised scour; locating deflectors on opposite banks of a straightened section, but off-set in position can create sinuosity of flow without eroding the banks.

Downstream angled – diverts flow toward the bank, increasing likelihood of erosion and can be used to increase sinuosity of the entire channel. NOT TO BE USED HERE.

Paired upstream angled – focuses more flow to the centre and creates a deeper scour pool with associated ramp of sorted substrate further downstream.

3.2 Enhancement of a two-stage channel

Currently, the trapezoidal channel is overly straight and uniform. In some areas, deposition of fine sediment and colonisation with plants (generally on the inside of the bends) has already led to a natural recovery of the channel to more appropriate dimensions (e.g. Fig 3). However, under typical flow conditions, the channel is over-capacity: too wide and hence the water depth generally too shallow; see Fig 7.

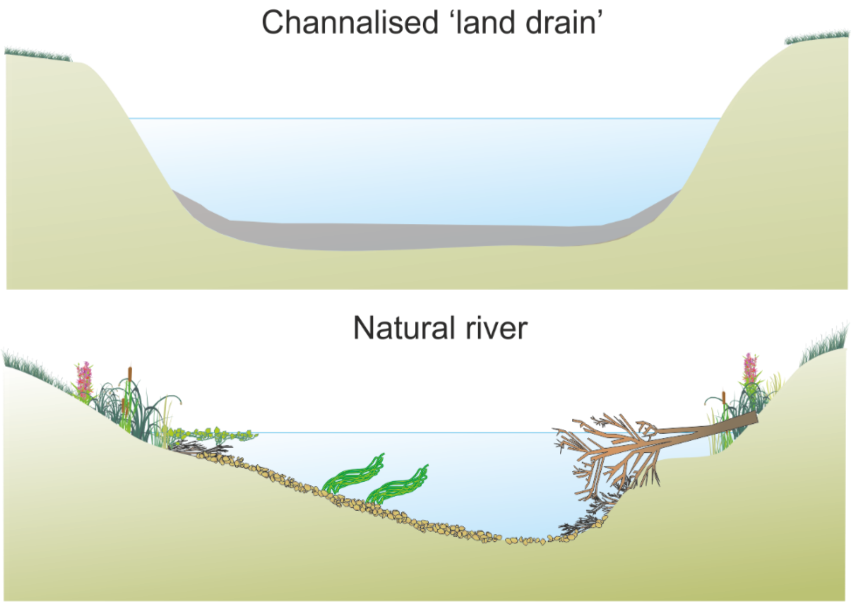

Fig 7. Simplified, uniform dimensions of a trapezoidal channel designed for conveyance of water, as compared to the diversity found in a natural channel.

Creation of a two-stage channel, i.e. a meandering low flow channel within the confines of the engineered walls significantly improves opportunities for biodiversity while not increasing flood risk (in cross-section profile - Fig 8, and in creation – Fig 9).

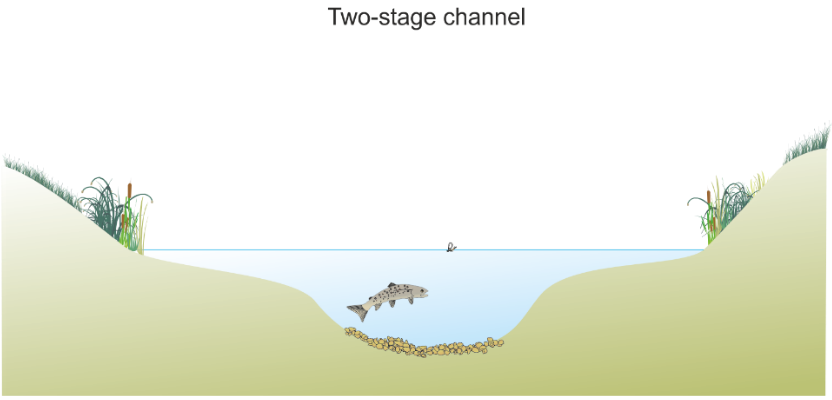

Fig 8. Cross section of a watercourse with a two-stage channel wherein water is confined to the deepest point during low flows but can accommodate a much greater volume under spate conditions.

Fig 9. A constructed two-stage channel creating a sinuous low flow-path. The low berms on either side are quickly overtopped during spate flow and hence do not significantly reduce the carrying capacity of the channel.

Low berms on spate streams like the Powmillon Burn can be created and quickly stabilised using rock rolls and pre-planted coir rolls or pallets pinned into position using rebar (see links and videos of a project conducted successfully on a similar sized and similar gradient waterbody, the Porter Brook, in the Appendices). In such an engineered system, there will be a requirement for removal of any tree saplings that take hold in the vegetated berms. Native species such as flag iris, marsh marigold, hemp agrimony, purple loosestrife and pendulous sedge, which are attractive to insects and human visitors alike, have evolved to cope with spate inundation and die back to a low level over winter. They will quickly cover the edge of the rock roll with trailing stems, thereby providing vital low cover for fish fry and insects.

There is space to consider alternating placement of berms from one bank to the other, thereby creating meanders, and to place them directly opposite each other to 'pinch' the channel and create a deeper run in between. As the burn widens out again downstream of the pinch, it should cause a ramp of deposited gravel which is the ideal habitat for spawning trout.

3.3 Cover

Natural vegetation cover at either the toe or the top of the bank is scarce within the park. Vegetated berms (described above) would improve low cover. Planting some trailing species at the top of the bank in discrete areas (e.g. ivy or bramble) that cascade down to the water surface and provide refugia would enhance the holding capacity of the reach. If used in conjunction with a narrow buffer zone of other flowering species along the bank top, it would help to reduce erosion at the top of the wall and improve aesthetics, as well as improve safety (discouraging people from walking along the edge) and reducing grass mowing costs.

Instream cover can be enhanced using cover logs. Essentially, these are just logs from native tree species pinned parallel to the bank. Tight to the bank provides refugia from avian predators, spate flow and shelter from the sun. Placing them out in the channel (still parallel to the bank) creates safe lies from which fish can feed with more confidence. To retain them in position, they should be pinned with rebar (cross-drilled at the upstream end so that the bar opposes rotational forces; a single vertical bar at the d/s is sufficient). Using logs of <30cm diameter and <2m length reduces the risk of causing a blockage downstream in the unlikely event that it breaks free.

3.4 Fish passage at barriers

Although outside the remit of this report, it should be pointed out that the weirs at either 'end' of the park, certainly the upstream end, impede fish passage for the majority if not all of the time. Those fish residing within the park are essentially restricted in their movement. Displacement downstream during a spate event, or removal of the population by pollution will have long-term effects given the low opportunity for recolonisation (which is probably occurring at present from upstream). Given the footfall within the park, this presents an ideal opportunity to engage and educate the public about such barriers, and leverage funding to improve fish passage.

3.5 Monitoring

Three 'experimental units' could be created and compared via monitoring within the park: control reaches, those without any interventions; demonstration reaches with habitat enhancements; and sanctuary reaches, featuring the same habitat enhancements as demonstration reaches but located in the relatively inaccessible areas (e.g. behind the Bowling Club) and not subject to demonstration events. One might hypothesise that simple measures of ecological integrity e.g. invertebrate community composition and abundance, fish density etc should exhibit improvement from control to demonstration to sanctuary status.

4.0 Examples of similar works

Examples of projects undertaken by or with input from WTT recommending techniques or structures pertinent to the Powmillon Burn:

Porter Brook, Sheffield, an urban pocket park

- https://youtu.be/XgcTIeRj4WY
- https://youtu.be/GqTb3HdfGfU
- https://www.salixrw.com/solution/flooding-erosion-prevention-sheffield/ includes more links to rock rolls, coir rolls and coir pallets.

Creation of a two-stage channel in an engineered flood relief channel - https://www.wildtrout.org/content/river-avill-project

5.0 Making it Happen

Works within river require assessment and permission from the relevant authority. Early engagement with that authority can often help with the smooth progression of a potential project.

As the site lies within a heavily engineered channel and an urban setting, considerable effort should be made to check for services that might be buried beneath the channel and which might be affected by some of the proposed techniques, particularly pinning of materials.

WTT can help draw up more detailed plans for specific locations with the interested parties, as well as oversee the installation of features, perhaps via a series of practical demonstration days.

6.0 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 guidance made in this report.