Advisory Visit

Bog Burn (Bathgate Water)

River Forth Catchment

Stirlingshire

Undertaken by Gareth Pedley

Key findings

- Major straightening and realignment have greatly reduced the habitat quality of the Bog Burn throughout much of the section inspected.
- The lesser dredged sections have begun to recover naturally through erosion and deposition, and the encroachment of marginal vegetation, but the worst affected areas will require intervention to achieve meaningful habitat improvements in the foreseeable future.
- Habitat improvement options ranging from the introduction of pinned brash to artificial flow deflectors, and even major channel restoration with an excavator may be appropriate to address the issues at the various sites.

1.0 Introduction

This report is the output of a site visit to the Bog Burn (River Forth catchment) in Stirlingshire. The visit was undertaken for the Forth Fisheries Trust (FFT), to provide an overview of options that could be undertaken on areas of realigned and straightened watercourse.

Normal convention is applied with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) when looking downstream. The Ordnance Survey National Grid Reference system is used to identify specific locations, and upstream and downstream are often abbreviated to u/s and d/s, respectively, for convenience.

2.0 Catchment/Site Overview

The burn was visited in areas around the outskirts of Bathgate, near Morrison's supermarket. This is in an urban catchment with large areas of remade ground alongside the watercourse highlighting its industrial history. Straightening and dredging have left the channel overly straight and uniform and lacking a natural geomorphological regime. Consequently, the quality of habitat poor. Some areas are now beginning to recover through the development of more natural erosional and depositional features, often assisted by the colonisation of aquatic, and emergent vegetation. Salmonid populations are known to be present locally, u/s of the reach inspected, as confirmed by FFT surveys.

3.0 Habitat Assessment

3.1 Section 1 (NS 98556 67699 - NS 97970 67541)

Two years on from a previous WTT visit and report (www.wildtrout.org/sites/default/files/private/Forth%20Fisheries%20Trust%20report_0.pdf), it can be seen that the channel alongside the golf course has changed little (Figs 1a and 1b). Emergent vegetation provides some in-channel diversity but the overall change and improvement in habitat quality is negligible. Unsympathetic cutting and maintenance of vegetation is likely to be inhibiting natural improvements but more active intervention is required to significantly improve the habitat. Confirming whether invertebrate and fish populations are present within the reach could add further weight to the value of any proposed scheme. The availability of a natural sediment supply to the reach is likely to influence the habitat quality of any restored channel sections but improvements could be made through gravel introduction, providing that installed structure or channel diversity and the flow diversity that is created is sufficient to retain it.

Figure 1a. Looking d/s at Bog Burn in 2017 - Little change when compared to the state observed in 2015 (below – Fig. 1b). There is possibly some slight scour/erosion in areas (red circle), driven by the emergent vegetation constricting the channel (blue circle) and diverting flow into the RB (yellow arrow indicating flow path and direction). However, the channel remains straight and lacking variation.

Figure 1b. Bog Burn alongside the golf course during the previous, 2015 WTT visit. The red circle indicates the area highlighted in Fig. 1b.

Towards the d/s end of the section depicted in Figure 1, a subtle right and left hand bend in the channel (Fig. 1a – green circle) provides improved habitat, a feature that could be replicated throughout the reach (see section **4.0 Recommendations**). The ultimate quality of the habitat provided here will always remain limited if the vegetation mowing continues. A 1-2m buffer of unmanaged land should be provided adjacent to the watercourse. Doing so would allow habitat improvement even if no further work is undertaken and could create ideal habitat for water voles (known to be present) which is currently scarce.

Figure 3. Photo taken looking back u/s, standing on top of the culvert. A subtle right and left bend (red circle) already present within the channel that could be replicated in other areas too improve the form and function of the channel.

Downstream of the culvert, emergent vegetation has been allowed to develop from the RB side. On over-capacity/dredged channels, emergent vegetation can encroach across the entire width if low flows are insufficient to prevent their growth. It is therefore beneficial to create or encourage a sinuous channel with a more natural capacity which will be 'self-cleansing'. As with u/s, an unmanaged buffer should be left along both banks. Diverse vegetation provided along unmaintained banks (as depicted in Fig. 4, on the RB) is prime water vole habitat but could be improved further for all wildlife with a habitat restoration project.

In-channel structures/flow deflectors could be installed to move the dominant flow pathway from one bank side to the other, to scour and maintain a sinuous channel. Deflecting the flow more acutely into the

emergent vegetation on the RB, possibly in conjunction with some light cutting, could help to develop bends towards the RB. If funding were available, the more aspirational dig and dump channel restoration would be ideal, coupled with the input of gravel to reinstate a more varied bed.

Figure 4. Encroachment of emergent vegetation, primarily from the unmanaged RB side. Allowing vegetation growth on and from both banks would be beneficial. Alternatively, or in addition, in channel structure could be installed to help divert the flow from one bank to the other. Note the much higher quality water vole habitat provided by the unmanaged RB.

3.2 **Section 2** (NS 97970 67541- NS 97396 67913)

Much of the land on the right bank d/s of the golf course appears to be disused, with numerous channels and pools offering potential areas for major channel restoration. While none of the channels would provide significant habitat improvement if reinstated in their current condition, they could represent alternative routes for an improved, restored watercourse of increased length (therefore natural gradient and more habitat), providing that contaminated land is not prohibitive.

A pipe bridge at NS 97458 67691 appears to pose a small obstacle to fish passage but is not suspected to prevent fish access from d/s. The u/s end was not inspected, which should also be undertaken, ideally looking through the entire culvert to check for steps and ascertain its full passability. Its installation is far from best practice, which would be clear-span (ideally) or a single, 1/3-sunken structure.

Figure 5. An inappropriately installed pipe crossing. Any watercourse crossing should be clear-span or a single sunken structure that allows the free passage of bed material and hence development of a natural bed within it.

Where the Boghead Burn joins Bog Burn, additional fine sediment input (possibly runoff from construction work visible further u/s) was clearly evident and should be investigated (Fig. 6). In addition to the potential of the broader area, the straightened sections of Boghead Burn and Bog Burn around the confluence provide good potential for a small channel restoration scheme within the areas of rough land adjacent, which may have less potential contamination risk (Fig. 7).

Figure 6. The Boghead Burn (NS 97399 67736) appears to be a source of poor water quality/fine sediment and requires further investigation.

Figure 7. The areas of rough ground around the Boghead Burn and Bog Burn confluence may offer an opportunity for channel restoration.

3.3 **Section 3** (NS 97396 67913 - NS 97282 68071)

A short distance further d/s, around the footbridge, the channel becomes further over-capacity with a lowered bed level, slow, deep water and silty substrate. The channel proportions and shading from LB trees appear to be limiting the growth of emergent vegetation (Fig. 8), which could potentially be improved by selective tree thinning. However, to achieve a notable improvement, areas of the channel will require a significant reduction in capacity, ideally bed raising/reinstatement. Areas like this are likely to remain overly deep and lacking in coarse substrate for the foreseeable future unless that material is reintroduced to the system, as a supply u/s and/or locally. Channel capacity could be reduced in discrete areas by securing tree tops (canopies), obtained through tree thinning, within alternating margins. These would create areas of narrowing to encourage a more sinuous flow pathway and scour and deposition.

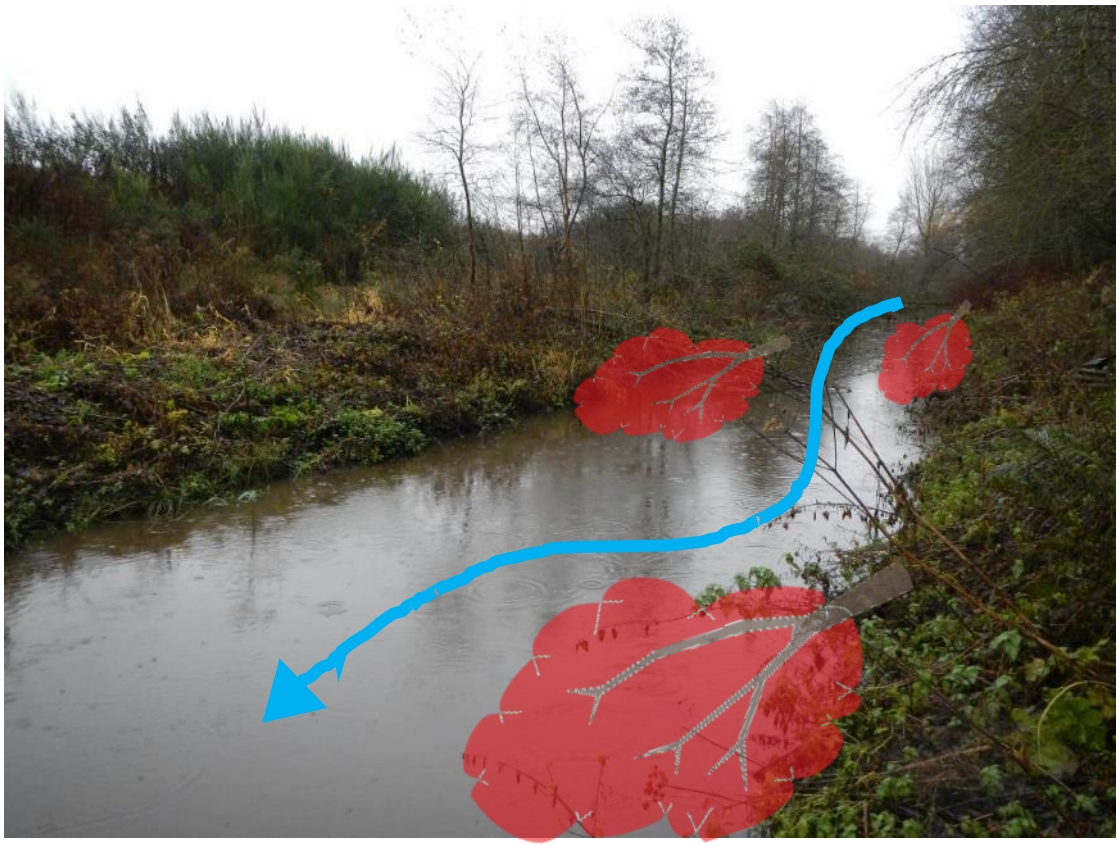

Figure 8. The further over-capacity channel d/s of the Boghead Burn requires narrowing in discrete areas (possibly as depicted with red tree outlines) to diversify the flow (blue arrows) and encourage scour and deposition.

3.4 **Section 4** (NS 97282 68071 - NS 97112 68292)

Alongside Morrison's supermarket the improvement of a wider but shallower (less dredged) channel with natural vegetation encroachment is clear, where the burn is now naturally developing a more sinuous course (Fig. 8). This process could be enhanced with in-channel structures but as it is currently developing well unassisted, it may be better to simply monitor the recovery and only intervene if the recovery stalls.

Figure 9. With natural vegetation growth and encroachment, many channels will begin to recover over time. The rate is often dependent upon the extent of modification, flows received and sediment supply, along with light penetration to facilitate the growth off marginal and emergent vegetation.

4.0 Recommendations

Channel restoration to a more natural, sinuous course and gradient, with a natural/augmented supply of sediment is ideally required on all sections to achieve optimal habitat quality. Alternatively, there are smaller-scale improvements that could be undertaken on each section if full restoration is infeasible. A combination of the actions discussed may be applicable to each section but, owing to the significantly degraded nature of the burn, the greatest level of intervention that is affordable and feasible is likely to be the most beneficial.

It will be vital to consider the presence of water voles within each section and the potential for creating a negative impact upon them. Any work undertaken should therefore also seek to create and improve water vole habitat. Reinstatement of a more naturally functioning and less insensitively maintained watercourse should help to achieve this.

Figure 10 provides an overview of the five sections, the recommendations for which follow.

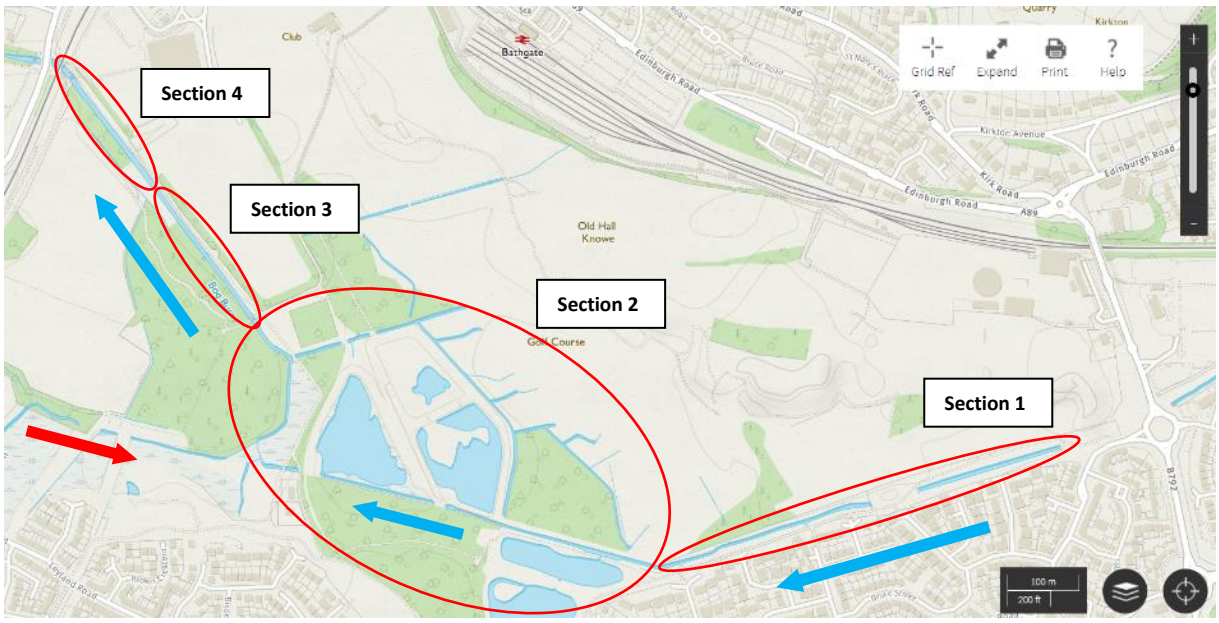

Figure 10. Annotated map showing the four sections of the Bog Burn (https://osmaps.ordnancesurvey.co.uk/55.90247,-3.64182,15/pin). The blue and red arrows indicate direction of flow on the Bog Burn and Boghead burn respectively.

4.1 Section 1

Significant re-meandering is likely to be infeasible in this section, owing to the close proximity of the golf course and adjacent housing, so a more restricted 'dig and dump' type channel restoration (Fig. 11 & 12) is recommended. A large excavator could be deployed in several ways, depending upon the type, but a sufficiently long-reach machine could potentially work from the bank top or even from within at the channel straddling the watercourse. Alternatively, a Batemag-type excavator with adjustable legs could be set to compensate for the slope of the bank.

The excavator would be used to dig material from one bank (to create an outside bend and deeper pool) and place it against the other bank to create channel sinuosity, increasing channel roughness but not altering its overall capacity. The creation of wider, shallower areas at the d/s end of the pools would be beneficial, so that gravel supplied from u/s (or any that is installed) can be retained to create shallower riffle features. As a larger project, the steep, uniformly sloping banks could even be set back to create variability and a more functional two-stage channel (i.e. a terrace on one or either side of the current wetted channel); however, this may require the removal and disposal of spoil that could make it cost prohibitive. That work should have been undertaken at the time of the channel creation and landscaping.

Flood risk assessment will be required prior to any work, owing to the proximity to residential housing, but the channel appears to be of sufficient capacity to facilitate the alterations. Indeed, the two-stage channel suggestion would actually increase capacity and thereby further reduce

flood risk and the overriding flow throttles are almost certainly the culverts, so flood risk is not anticipated to be a major issue.

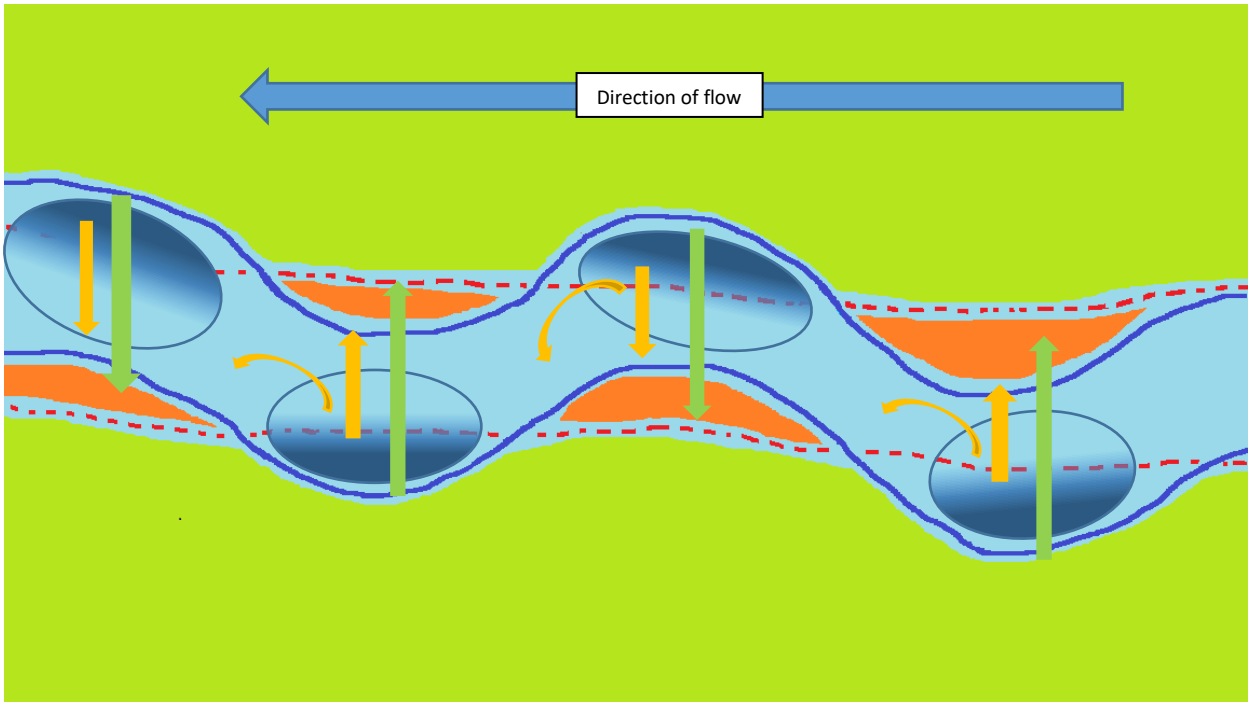

Fig 11. A simple 'dig and dump' type restoration. The dotted red lines represent the original straightened channel. The dark blue lines represent the course of the improved, more sinuous channel. The dark to light blue graded ellipses represent deeper pool to shallower areas that would be dug into the bed. Green arrows show the movement of material dug from the bank and bed to create the inside of the bend/berms (orange area). Any gravel generated would be used to create riffles d/s (curved yellow arrow) and gravel bars on the inside of the bends (straight yellow arrows) - additional gravel could also be imported.

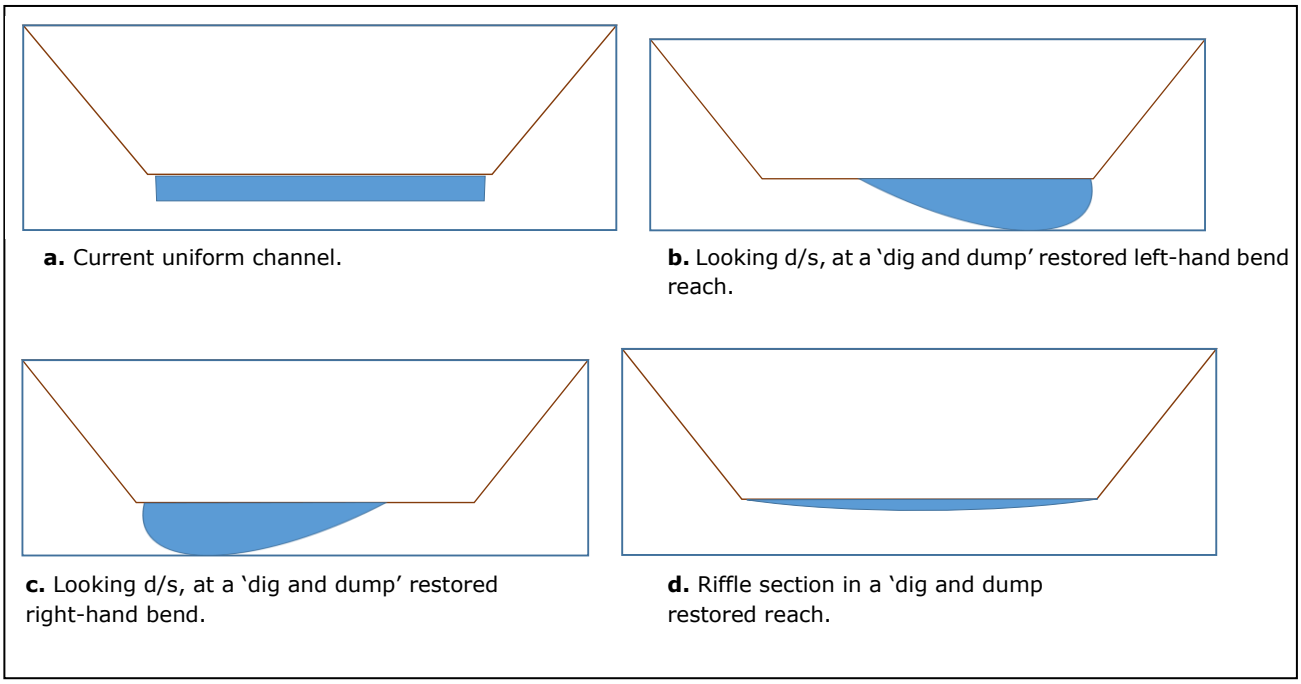

Figure 12a-d. A simplified visualisation of the current, uniform channel cross-section (a) and the nature-like features that could be created using the dig and dump technique (b-d). The cross-sections are indicative and not drawn to scale.

If large-scale 'dig and dump' proves to be infeasible or funding is limited, more modest improvements could be achieved undertaking similar work using hand tools. This could be trialled with volunteers in a workshop type scenario, as has been undertaken previously in serval English rivers including the River Glaven (Fig. 13a - d). The proposed design for the channel would remain the same but the scope of the work might have to be reduced slightly owing to the limitations of working without machinery. Nonetheless, significant improvements can still be achieved, particularly on a heavily modified channel like the Bog Burn.

Figure 13 a-d. A range of channel improvements undertaken by hand, employing a light, 'dig and dump' approach. Note how in d), an u/s deflector has been used in conjunction with the movement of substrate to retain material and create a greater pinch point. Photos courtesy of Ian Shepherd.

The hand 'dig and dump' work could be complemented by the installation of in-channel structures, to drive scour into the emergent vegetation (where present) and bed (to create depth variability) and banks (to increase channel sinuosity). These needn't be complex structures as the intention is simply to create more diverse, erratic flow and encourage some channel/bank destabilisation. Log deflectors (Fig. 14) brash (Fig. 15), brash bundles or even boulders/boulder clusters could be installed on alternating banks. If wooden structures are employed, they would be pinned to the bed with posts and secured with wire. If desirable, they could even be partially dug into the bank, reducing the potential for scour in the wrong areas.

The recommendation would be to use single, alternating structures, rather than paired deflectors, which constrain flows and scour in an artificially straight line toward the centre of the channel. Paired deflectors may initially create some depth but fail to increase the sinuosity of the flow pathway. Consequently, more of the scoured material is likely to be transported through the d/s reach at higher flows, rather than being deposited. If the flow is more varied, and the scour and deposition more alternate (one side of the channel to the other), there is greater potential to establish a varied bed topography, which will ultimately improve the quality of in-channel habitat.

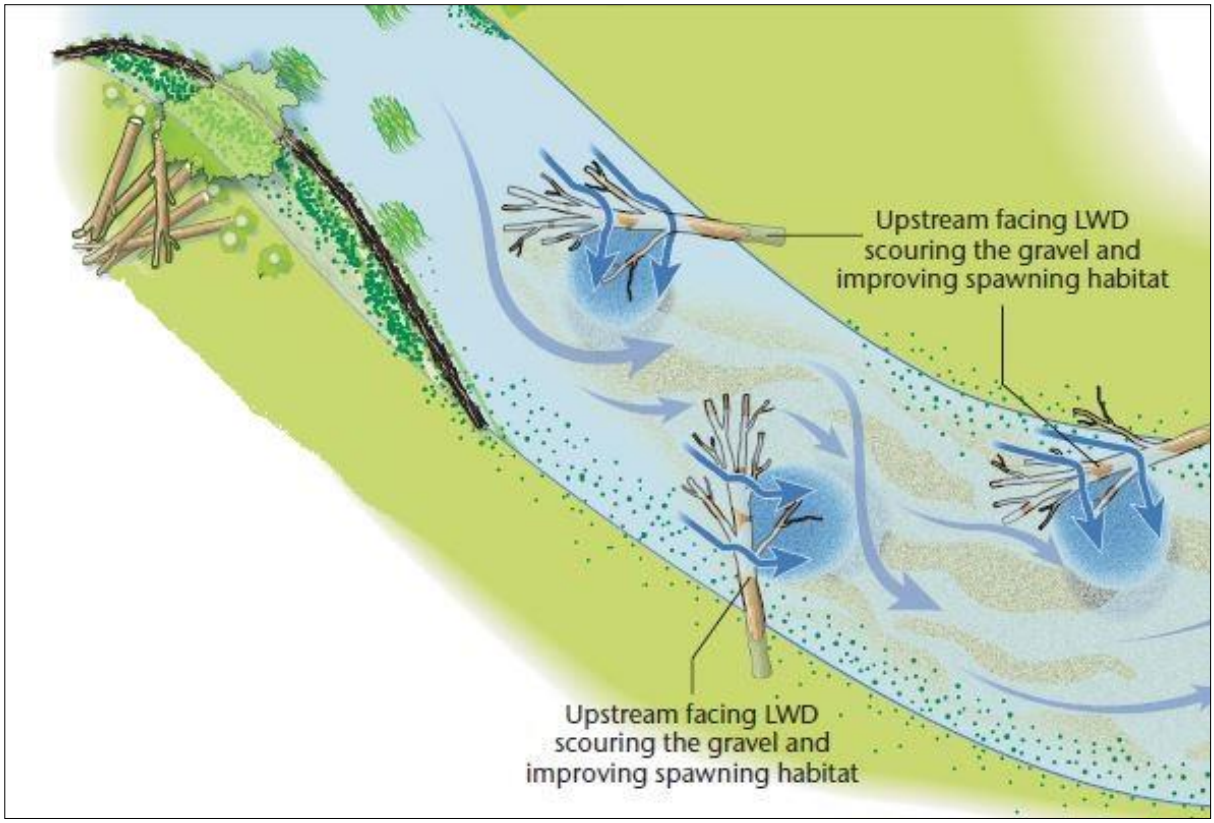

Figure 14. Upstream flow deflectors employed to create flow diversity. In the case of Bog Burn, where some destabilisation of the banks is actually beneficial to create a more sinuous course (even d/s facing deflectors that encourage d/s erosion might be worth trialling). This example depicts a diffuse type u/s deflector but solid/single log deflectors would also work well in this particularly uniform channel where maximum flow deflection and scour would be desirable.

Figure 15. Pinned brash could also be employed to take up channel capacity in areas and enhance areas of scour and deposition to diversify the channel.

With all deflector options, the extant lack of channel sinuosity and width variability is likely to limit retention of any scoured material further d/s, but over time (or with some 'dig and dump'), as flow is deflected into the bank they should develop a more varied channel. Owing the extent of modification in this reach, and the limited potential to negatively impact upon the habitat, it may be worth trialling a range of the aforementioned deflectors if mechanical 'dig and dump' restoration is not undertaken.

All of the potential 'dig and dump' and in-channel structure options would benefit from introduction of 10-40mm gravel to help reinstate a more natural substrate. Ideally, the bed of the entire section would be dressed with the gravel, creating discrete raised areas to provide riffles. If less material is available, the next best option would be to install raised gravel riffle areas between pool features. This would provide semi-natural features and greatly improved habitat quality, accepting the limitations of a generally straightened channel. Gravel could be supplied to an excavator from the bank top by a dumper or wheelbarrowed-in if machinery is not used.

Aim to achieve at least 150mm depth of gravels at the riffles to provide potential for salmonid spawning and more diverse invertebrate habitat, but it must be ensured that a significant impoundment to the flow is not created. The dig and dump method in particular (owing to the cost and level of

intervention) would greatly benefit from the addition of substrate, making the cost of such a project that far more worthwhile.

Ensuring there is an unmanaged buffer along the watercourse would also allow the broader habitat quality of the area to develop significantly. It will be important to improve public perception of the watercourse so that people value it as a valuable wildlife corridor, rather than being seen as a drain or flood relief channel. This is particularly pertinent in light of the dwindling local water vole populations. Developing a project that also benefits such a charismatic creature could be an ideal way of engaging the local community.

4.2 Section 2

The section d/s of the golf course offers great potential for a full restoration scheme and is definitely worth further investigation. Around the confluence the Bog Burn and Boghead Burn (and u/s and d/s), there is, alternatively, the potential for a smaller restoration and realignment project. The ground in that area is rough/un-managed, so an impact upon the adjacent land use is unlikely. The main pitfall with this course of action is the potential for encountering contaminated land or buried services, but this option should definitely be pursued. The source of the fine sediment input on the Boghead Burn also requires further investigation.

4.3 Section 3

Installing alternating tree deflectors is the quickest, easiest and cheapest way to re-energise and diversify flow within the overcapacity channel (as annotated in Fig. 8). There may even be the possibility of laying occasional suitable (pliable) trees into the channel (Fig. 16), although flood risk could be a concern, so ensuring that the structures are anchored securely would be vital.

Ascertaining the flows/water levels of the burn in flood conditions would inform suitability of in-channel structures. In the absence of local flow gauging, fixed point photography of a water level board (Fig. 16) installed somewhere in the reach coupled with a trail cam set to take pictures at 15 minute intervals could provide valuable flow monitoring that could be compared to local gauge data to ascertain peak flows. This technique could be used as a guide to the range of water height fluctuation on all sections and help determine the requirement for more detailed flow/flood modelling.

Figure 16. Where pliable species of tree are present (red circle), there may be opportunity to lay branches into the water as pinned brash/deflectors. A trail cam trained on a water level board (red circle) could be used to monitor flows (potential flood levels) before undertaking any work.

4.4 Bog Burn alongside Morrison's Supermarket

Where the channel is already actively recovering alongside Morrison's, the recommendation is to simply monitor the natural adjustment which is already delivering habitat improvements (as shown in Fig. 9). Basic monitoring of the channel development could be undertaken with fixed point photography. This can be achieved automatically with a trail-cam to create a time-lapse series or more simply by marking a location (a tree or installed post) from which photos can be taken at regular (*c*. 3 to 6-monthly) intervals. Installing additional marker points (coloured pegs or posts) within the channel and depositional features could be another effective way of accurately monitoring changes to the channel and vegetation, if required, but the basic photography is possibly sufficient. As with all sections, the introduction of more-natural substrate would be beneficial.

4.5 Downstream of Whitburn Road (Bathgate Water)

A short section of the Bathgate water was very briefly inspected as it is the site of a planned major river restoration. There are possible issues with contaminated land there which could inhibit the scheme but it is to be hoped that it does not prevent the project - full channel restoration remains the best option for habitat improvement at that site. If the full channel

realignment and restoration work is prevented, a combination of the options described for the other sites could also be employed there, possibly only requiring the in-channel structures as the already more dynamic flows and channel should respond well to simple flow deflectors. These could be quickly and easily devised during an onsite workshop, providing permissions for the basic structures employing natural materials were already obtained.

5.0 Making it Happen

WTT may be able to offer further assistance such as:

- WTT Practical Visit
    - Where recipients are in need of assistance to carry out the improvements highlighted in an advisory visit report there is the possibility of WTT staff conducting practical visits or workshops. This would consist of a WTT Conservation Officer(s) teaming up with interested parties to demonstrate habitat enhancement methods (e.g. tree kickers, tree laying, deflectors etc.). The recipient would be asked to cover the time and reasonable travel and subsistence costs of the WTT Officer.

- Project assistance
    - For larger-scale project work, there may be the possibility of a WTT conservation officer providing technical support and guidance where required. This would be dependent upon staff availability and should be discussed well in advance.

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

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/product/rivers-working-wild-trout-dvd-0 or by calling the WTT office on 02392 570985.

6.0 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.