Lathkill (Waltonian Angling Club)

Advisory Visit

River	Lathkill
Waterbody Name(s)	Lathkill (Source to Bradford)
Waterbody ID(s)	**GB104028058450**
Management Catchment	Derwent Derbyshire
River Basin District	Humber
Current Ecological Quality	Moderate
U/S Grid Ref inspected	SK18090 65711
D/S Grid Ref inspected	SK21064 65888
Length of river inspected	3.25 km

Wild Trout Trust Report – Following a Site Visit on 12/07/2018

1. Introduction

A site visit and appraisal of the River Lathkill in upper Lathkill Dale was undertaken at the request of the local angling club (Waltonian Angling Club). The club has taken on the waters as a new addition to the club's fishing in the last two years.

Under the Water Framework Directive (the scheme currently used to assess Ecological Status and Ecological Potential of our surface waterbodies in Britain) the surveyed reach is identified as part of waterbody GB104028058450.

Remarkably the Lathkill is not identified as "heavily modified" according to official Environment Agency (EA) records on the classification of the river to the Water Framework Directive. However, the number of weirs and significant channel realignment (sometimes creating a channel that is "perched" above the level of the valley bottom) make that designation difficult to understand or justify.

The Environment Agency data held for this waterbody indicate that it has an Ecological Status of 'Moderate' according to the most recent assessment in 2016 – with a failure of the water body for the priority substance "lead and its compounds". That measured chemical status (resulting from historic mine-workings) does not appear to be obviously reflected in the invertebrate populations surveyed in this watercourse.

Throughout this report the Left Bank (LB) and Right Bank (RB) are identified when facing in a downstream direction while "upstream" and "downstream" are, hereafter, abbreviated to "u/s" and "d/s" respectively.

2. Site Assessment

Figure 1: Looking u/s from the d/s limit of the survey towards a series of impounding structures (weirs) originally installed to aid retention of fish stocked into the river for anglers (by creating similar conditions to the rearing pond environment)

The upper river was examined over a 3.25-km reach which varied quite significantly in character. In an effort to capture the range of conditions present in this reach, multiple spots representing broadly typical examples of each type of habitat present were visited and photographed in a d/s to u/s sequence.

The d/s limit of this visit was at National Grid Reference (NGR) SK 21064 65888 (Fig.1). The open, grazed LB and wild/varied RB is typical of this lower section with the channel characteristics strongly defined by the series of 19th century "fishing weirs" (e.g. Fig. 2).

Figure 2: A stepped series of "fishing weirs"

As well as the influence of the weirs that hold back water and riverbed material, the channel shape and course have been engineered using stone "revetments" (reinforcing walls). The combination of the slowed flow and widened/straighter channel creates a sediment trap for finer sand and silt as well as gravels. The overall effect is to create quite uniform conditions with very little variation in depth or flow over the cross-section of the river (e.g. Fig. 3).

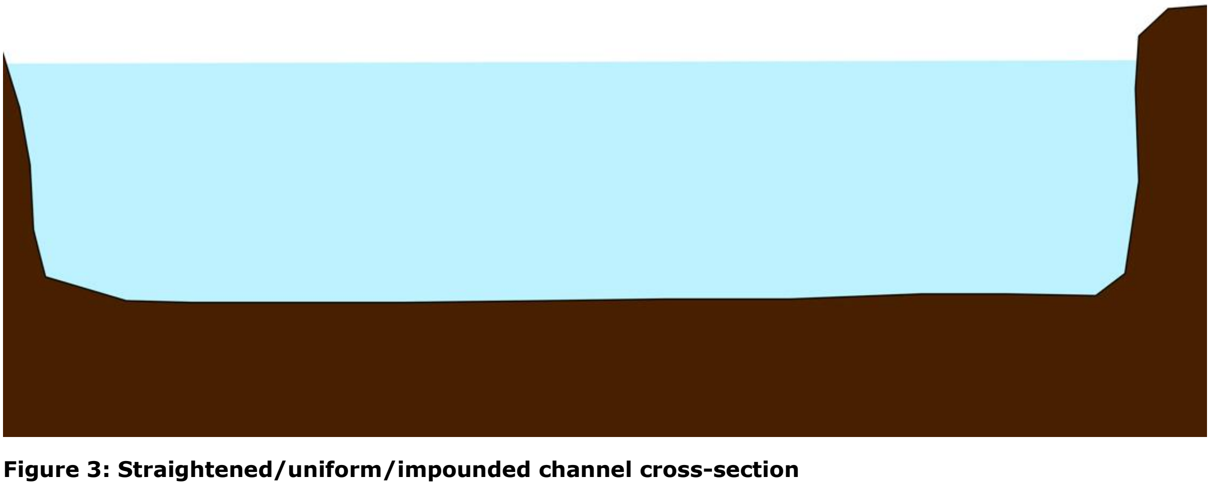

Figure 3: Straightened/uniform/impounded channel cross-section

The accumulation of those nutrient-rich sediments (which in a free-flowing river would disperse d/s) leads to smothering of gravels and also increases algal growth in places where there is a spike in nutrient concentrations. This can lead to reduced dissolved oxygen concentrations – particularly in warm and/or low-light conditions (when respiration rate is greater than photosynthesis).

In contrast, natural channels create much more varied habitat over their cross-sections. The processes of erosion and deposition (which are blocked by weirs and artificial stone banks) create a wider range of opportunities for plants and animals. A quick example of this is shown in Figs. 4 and 5:

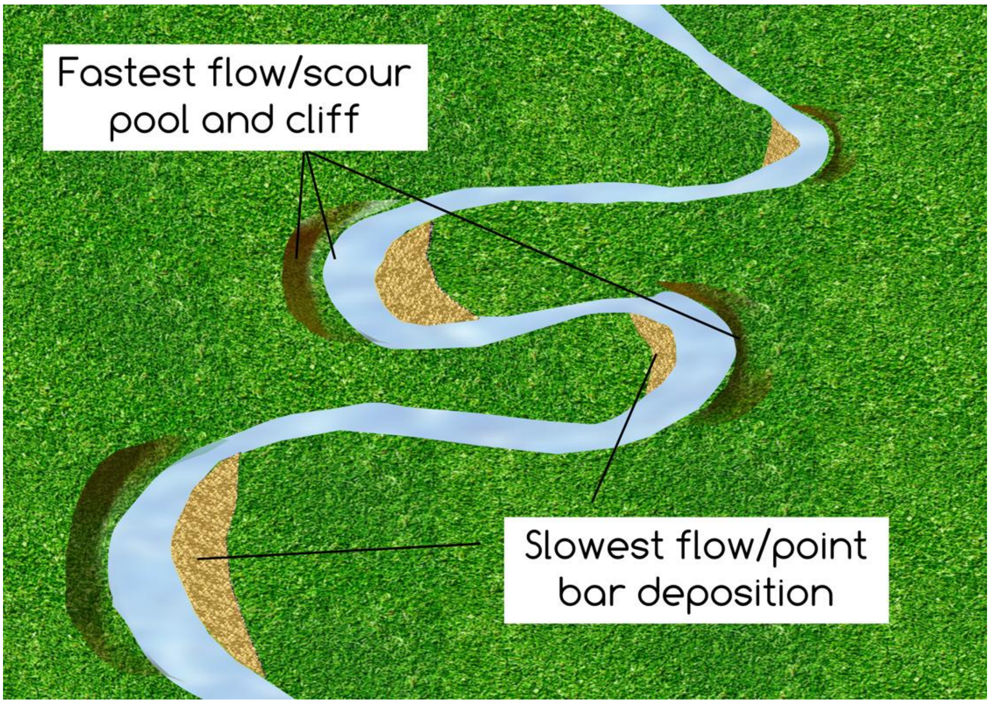

Figure 4: Broad overview of erosion and deposition creating river features which create great habitat for trout and a wide variety of plants and animals. The faster flow on the outside of each bend "digs" out and maintains deeper pools and that riverbed material is deposited d/s as riffles and "point-bars"

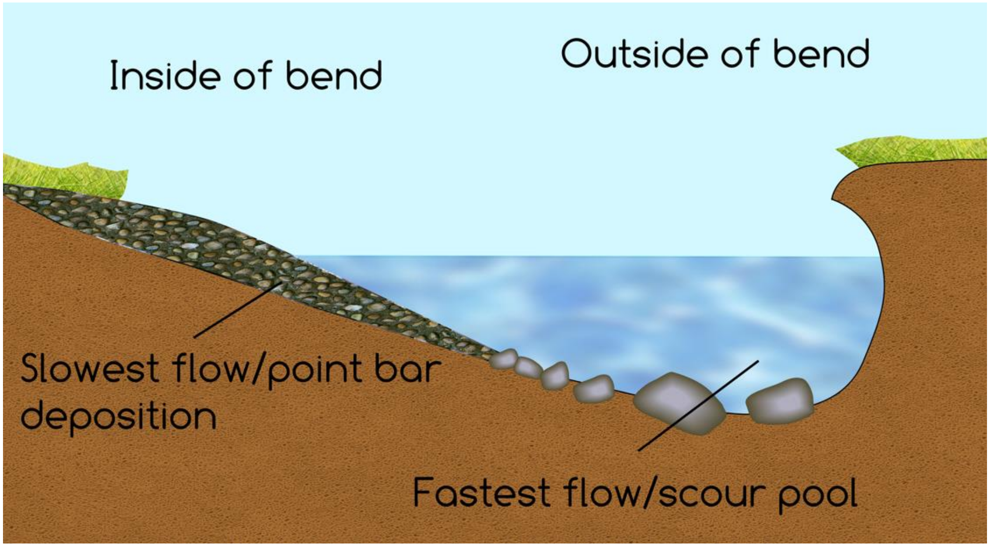

Figure 5: The effect of scour pool (erosion) and point-bar (deposition) on habitat structural variety. As well as separating large and small particles (e.g. sand and cobbles), the depth and flow velocity also varies much more over the cross section compared to the example shown in Fig. 3.

As well as the preferences of different animal species for particular conditions, plants also vary a lot in their habitat preferences. Those preferences include the size of particles in the riverbed, the current speed/depth, nutrient concentrations and many other factors. Of course, with plants there is also an obvious difference in the tolerance for shade across different species (see later in this report for additional detail).

Overall, the take-home message is that increased structural variety creates more opportunities for different species of plants and animals. That variety in habitat structure is also vital for trout to be able to complete their lifecycles naturally within the river. To highlight this, the following diagrams give examples of the different types of habitats that trout need to access during their full lifecycle:

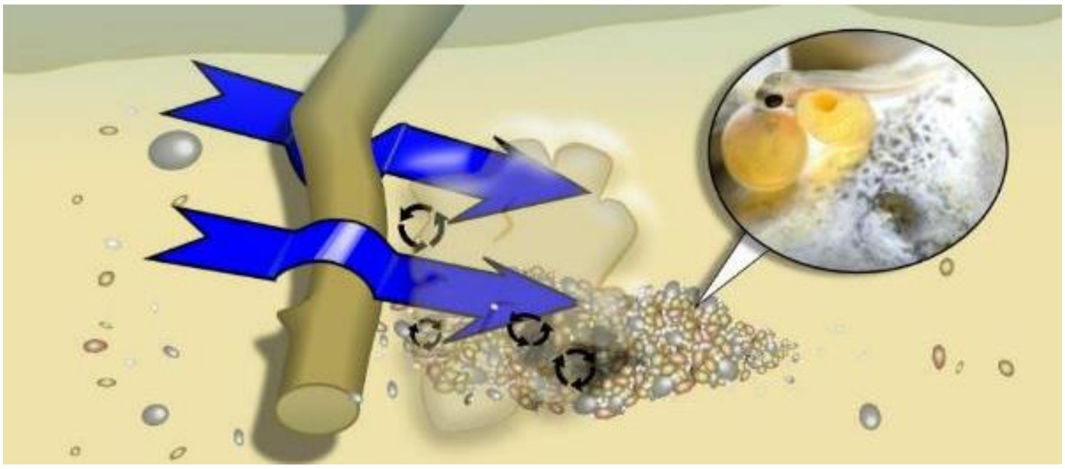

Figure 6: Features associated with successful trout spawning habitat include the presence of silt-free gravels. Here, the action of fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of river-bed that results in silt being washed out from between gravel grains. A small mound of gravel is deposited just below the hollow that is created by focused flows. In the silt-free gaps between the grains of gravel it is possible for sufficient oxygen-rich water to flow over the developing eggs and newly-hatched "alevins" to keep them alive as they hide within the gravel mound (inset) until emerging in spring.

Figure 7: Larger cobbles and submerged "brashy" cover and/or exposed fronds of tree roots provide vital cover from predation and spate flows to tiny juvenile fish in shallower water (<30cm deep). Trailing, overhanging vegetation also provides a similar function and has many benefits for invertebrate populations (some of which will provide a food supply for the juvenile fish).

Figure 8: The availability of deeper water bolt holes (>30cm to several metres), low overhanging cover and/or larger submerged structures such as boulders, fallen trees, large root-wads etc. close to a good food supply (e.g. below a riffle in this case) are all strong components of adult trout habitat requirements. Note how, even in the winter when there are no leaves on the trees, the branches provide some shade and cover.

Within the series of stepped weirs on the Lathkill, the main source of any structural variation comes from the central slots which provide some bed scour and a speeding of the current in the centre of the channel (e.g. Fig. 9). These effects are extremely localised though, and are effectively achieved at the expense of flow diversity within the impounded channel u/s – the majority of the habitat remains extremely uniform. In the absence of the series of impoundments, the total area of high quality habitat for trout and a wide range of other species would be substantially increased.

Figure 9: Note the large "ponded" areas with mats of soft, nutrient-enriched sediment and thick film of "periphyton" (single-celled plants such as algae which grow on leaves, rocks and other surfaces). Note also the small area of variation provided by the narrow tongue of faster flow (left of frame). Finally – the value of the unmanaged vegetation on the RB is evident – both as "cover" habitat but also notice the shading effect creating clear patches in the weed. In combination, more varied/scouring flow and the effect of patchy shade would reduce or remove the need for weed cutting (and the associated problems with disturbance and loss of invertebrates attached to weed)

The other problem with the central slots in the weirs is that they do not extend down to bed-level – this creates two main problems. Firstly, it does not improve the d/s transport of riverbed material (i.e. the source of varied habitat creation) and secondly the weirs remain as significant barriers to fish passage.

Even where a proportion of fish are able to ascend a barrier there are still many which are unable to progress u/s to find spawning areas or even simply to disperse and utilise other habitat (something that is not easy to appreciate when *some* fish are seen successfully passing the weir). For those fish that successfully pass u/s, the efforts of throwing themselves out of the water against different parts of the weir increases risks of injury and exhaustion (and this may reduce or remove their ability to breed once they reach the spawning beds and leave them far more susceptible to disease and mortality). With a series of barriers in a short section of river, the effects of failure to pass and compromised breeding success of fish that do reach spawning beds are cumulative and can be significant. Preventing fish from easily dispersing to fully utilise and repopulate all of the available habitat will also almost certainly limiting the number of fish the river can support.

Given those constraints, the high value of the cover and structural variety created by the unmanaged RB vegetation is amplified. In addition, the clean/mineral-rich water is also a great boon to aquatic life. For those reasons, any trout that do successfully emerge from the spawning beds as juveniles will have rich feeding and also access to structural "cover" from both the aquatic plants and some of the trailing marginal vegetation. This may offset *some* of the negative impacts of simplified/impounded river habitat, but that offset can be fragile in the face of increased predation around the impoundments (e.g. when harsh winters force fish-eating birds from their usual stillwater hunting grounds).

That predation effect in impounded/simplified habitat can occasionally be seen in the unusual incidences of adult trout shoaling together in a "bait ball" when pressured by a flock of cormorants (for example). Usually – trout are extremely solitary in their approach to avoiding predation; unlike shoaling fish such as grayling. However, in slow/deep pools with little variation in flow velocity trout will sometimes shoal up as a last resort.

There are examples where the weirs and associated artificial banks are beginning to be naturally bypassed by processes of erosion (e.g. Fig. 10).

Figure 10: Bypass channel beginning to form (right of frame) via bank erosion on the grazed LB at SK 20841 66044

As a bare minimum, refraining from rebuilding those reinforced stone banks or otherwise reinstating the weir over the full width of the channel is advised. This will undoubtedly create ecological benefits. Eventually, bypassing via erosion will give a slightly more meandering course to the river as well as improving ease of fish passage and allowing some d/s movement of gravels to become re-established.

A particularly large weir – and associated sluice – create some complex challenges for river-management at SK 20780 66082. The (relatively rare) trout "bait balling" has been reported by river managers in this deep/relatively simple, slow-flowing habitat. Lower summer flows here are also exacerbated by the loss/diversion of water u/s due to the creation of underground "soughs" where the water disappears deep underground – the subject of a campaign by the Friends of Lathkill Dale:

https://www.facebook.com/groups/275499379256215

Those low-flows (and build-up of nutrient-rich sediment behind weirs) encourage the closing of the sluice to retain water-depth. However, at spawning time there is an argument to open the sluice to enable at least improved u/s passage of fish – but the costs and benefits of that action are not clear cut.

In fact, the situation highlights the extreme complexity in balancing competing pressures on these heavily-modified river environments. A big problem with opening up the sluice to allow breeding access is the timing of the d/s release of the accumulated (nutrient-rich) sediment to coincide with breeding efforts by trout. Smothering effects of fine sediment – compounded by algal blooms that also reduce oxygen concentrations – will have a negative impact on the success of breeding that fish attempt d/s of the sluice. The associated release of large volumes of organic matter also greatly increase the issues with enrichment and algal growth in the river d/s, further impacting upon the broader fish and invertebrate populations of the Lathkill.

Figure 11: Deep, mineral-blue lagoon where trout can sometimes "bait ball" in response to predation pressure (note accumulation of sediment and dead vegetation u/s of the sluice).

Stepping back to assess this situation – the full range of ecological problems of habitat-simplification, sediment/nutrient accumulation and fish passage at this location stem from the presence of the large sluice-weir. Consequently, the best ecological outcome would be to return the river towards its pre-19th Century condition by removing the impounding structures. In ecological and geographic terms, the current situation is a very recent and artificially-imposed change – and this obviously applies to all of the stepped fishing weirs in Lathkill Dale.

At the time of the visit, there was no discernible flow passing over or through the next sluice weir u/s from the weir shown in Fig. 11. The stonework was completely dry and the u/s water-surface was far below the crest of the weir (Fig. 12). At the same time, there was no movement of the floating leaves d/s of the weir that would indicate flow occurring through the structure.

Figure 12: Stationary water above and below this weir indicates a total physical separation of the habitat above and below this structure. The large increase in water depth (and hence pressure) upstream of the weir could potentially also worsen the losses of surface water through the riverbed. This water loss to underground soughs is a critical issue in Lathkilldale and is highlighted later in this report.

It should be noted that, even though the visit coincided with one of the most significant summer droughts of recent times, the groundwater flow in the Lathkill was relatively high. The u/s reaches that commonly dry out and disappear below-ground at this time of year were still maintaining flow within the surface river-channel.

Above the weir shown in Fig. 12, the river changes character and enters a more wooded setting with fewer weirs compared to the 11 weirs within approximately 200m between SK2105665879 and SK2069166072. There is then a gap of around 150m before the next structure (a small sluice).

The channel is generally much narrower (e.g. Fig 13) and – although impoundments are much less frequent – however, there are many places where lower impounding structures still degrade the river's habitat potential. The old sluice structure (mentioned above) is just d/s of the image shown in Fig. 14 and the associated reed-swamp habitat is an obvious result of the impoundment and associated sediment accumulation.

Figure 13: Narrower watercourse (often branching around mid-channel islands), providing some excellent juvenile trout habitat

Figure 14: Swamp habitat resulting from sluice impoundment

Figure 15: Old sluice structure that still negatively affects the habitat of the watercourse (even with the gate open)

Continuing u/s to SK 20021 66148 there are more examples of silt/clay bed substrate and reed growth (Fig. 16) and with a dried "leat" (channel into which water would be diverted to provide a head of water) around 50-m further u/s (Fig. 17). Even though the impounding structures are far more spread out in this wooded section of the upper Lathkill, the channel has still been extensively modified and "steered" along particular paths to service the mining and related activities that were carried out in the Dale.

Figure 16: Artificially increased deposition of rich lime silt, tufa particles, detritus and mud within the impounded flow

Figure 17: Dried leat adjacent to the footpath. The combined actions of weirs and sluice-gates would previously have been used to divert and control water flows that supported the mining and associated activities carried out in the Dale.

The greatly simplified pool and riffle habitat at SK19623 66105 is a good example of the impact artificial straightening and reinforcing the channel with stone walls creates (Fig. 18). There is a corresponding lack of bends and deeper pool habitat in many areas.

Figure 18: Both LB and RB are artificially created from blocks of stone and the channel is very straight - forming a linear sequence of pools with some cobble riffle habitat also present (e.g. right of frame)

A very striking feature of the vegetation throughout the visited reach was the apparent lack of Himalayan Balsam and other highly dominant, invasive/non-native plant species. This is an extremely precious condition given the blanket spread of such species in many comparable river corridors in the UK. On the one hand, flagging this up to the general public might invite malicious introductions of such plants. However, it is worth highlighting the need for strict bio-security efforts within clubs and societies who regularly use the dale. Specifically, members need to avoid the accidental transfer of seeds or soil in the ridges of boot-soles or folds of outdoor clothing. It would be advisable for anglers to maintain separate clothing/footwear for use in areas where Himalayan Balsam (as well as Japanese Knotweed and Giant Hogweed) are present versus river corridors from which they are absent. Similar considerations would also help to protect the native white clawed crayfish in the river d/s that are highly susceptible to disease and competition from non-native signal crayfish.

At SK 19433 65937 some large woody material has previously been installed in an effort to diversify flow and riverbed erosion and deposition processes (Figs. 19 and 20). There could be value in extending such efforts to many of the straightened locations on the river u/s of the fishing weirs section. However the top priority would be to explore whether revetments and other modifying structures could be removed and more natural river processes encouraged (including the occurrence of natural woody material within the channel).

Figure 19: Log staked into position within the stream and generating localised bed-scour as well as providing in-channel cover.

Figure 20: Although pictured at low-flow levels, under higher flows some valuable redistribution of bed-materials (and increased sinuosity of flow) have resulted from the stable introduction of large woody material. The benefits of these existing structures would be greatly improved by the breaking up of bank revetments and encouraging natural channel profile recovery.

The best results from introduced woody material tend to come from installed material that most closely resembles natural deadfall. Ideally this will be undertaken in conjunction with restoration of surface flows and revetment removal. Within the wooded section there are many opportunities to create more diverse flow within the straightened sections of river. For the most part there is no cause for concern over flood risk because of the ample surrounding flood-plain, lack of development within that floodplain, low gradient and the ease with which any structure can be securely anchored.

Figure 21: Typical heavily-modified (straightened) section of channel which would benefit from more meandering flow and greater variation in cross-sectional depth and current-velocity- especially if this were to be achieved by breaking up the stone bank revetments.

There is an issue of a short section of the river channel being slightly "perched" above the true valley-bottom (i.e. around SK 19345 65811). In this case it appears that the channel has been shifted slightly up the valley side in the direction of the RB to accommodate the access track (Fig. 22). If breaking out and re-meandering perched sections leads to the river disappearing into an underground sough – then there is a good argument to ensure that does not happen.

Figure 22: Straightened and "perched" channel where the river-bed is raised above the land to the left (photograph taken facing DS at SK 19345 65811.

However, the most valuable habitat and biodiversity outcome would be to re-meander the river and incorporate an alternative track to provide sustainable access.

At the u/s limit of the wooded section at SK18528 65805 a weir has recently been repaired and modified (Fig. 23). The purpose of the repair (and potential for future modification) is not clear at this time, so further enquiries are needed in order to establish the parties involved. Under its present condition the structure is impounding a significant reach of water and also represents a barrier to fish passage, preventing fish migration and dispersal.

Figure 23: Weir at the u/s limit of the woods that encompass both LB and RB of the river corridor.

Another long impoundment (estimated to be a reach of more than 100 m) results from the structure at SK 18357 65765 (Fig. 24).

Figure 24: Slot cut into a structure which will help the u/s channel to re-grade over time

The original height of this structure was much greater and spanned the full width of the channel. Now a slot that extends down to the level of the u/s river-bed had reduced that impounding effect. Over time, and with sufficient flows, this will help to re-grade the riverbed to a steeper longitudinal slope.

The channel below this gap in the main structure is shown in Fig. 25 which has the appearance of being associated with the original function of the weir. As with the erosion that is beginning to bypass the weir shown in Fig. 10, encouraging this process will help to regrade the riverbed u/s of the offending structure.

Figure 25: Channel below the breached weir crest shown in Fig. 24.

The u/s limit of the visit for this report was the waterfall at SK18090 65711 (Fig. 26). This has the appearance of a natural waterfall and would, as a result, be the only natural barrier to riverbed material transport and fish passage. As well as having 10,000+ years to achieve an equilibrium of riverbed material erosion and deposition processes, the frequency of those natural barriers is clearly far lower than the multiple artificial weirs encountered in this visit. The irregularity of natural structures also invariably makes them far more passable than artificial ones.

In contrast, structures that have been in place for a little over a century are poorly passable and are still likely to be thousands of years away from approaching equilibrium. This means that the removal of the more recent, artificial impoundments will tend to return the river towards the pre-modified conditions relatively quickly.

Throughout the visit, a relative lack of ideal spawning substrate for trout was noted. This is likely to stem from several causes. First of all, the rock-armouring of the riverbanks will cut off the normal supply of gravel into the stream. The modification of the channel's dimensions – when coupled with the impounding effect of weirs – often leads to low flow velocities that favour fine silt deposition. In those silt-accumulating reaches (where there is insufficient variation in current velocity over the cross-section of the channel to mobilise silt), gravels will be smothered.

Conversely, in straightened sections that are correspondingly steepened, there is little opportunity for any in-stream gravels to be accumulated. The lack of bends reduces the channel "roughness" and, with a steeper gradient, creates a "chute" effect which does not allow gravel to be retained in that section.

For the Lathkill in particular, the high mineral content of the water stemming from the geology of the aquifer (which lead to its exploitation for mining) creates some additional issues for spawning substrate. The precipitation of mineral carbonates onto the surface of solid objects creates so called tufa "oncoids" which resemble rounded limestone pebbles.

Those oncoids are generally much less dense than true gravel particles of the same diameter – and so are more easily washed away. This may create additional challenges to retaining spawning-substrate in this particular watercourse.

Figure 26: Waterfall at the u/s limit of the visited reach

There are, however, large supplies of gravel in the surrounding steep slopes of mining spoil heaps which could potentially be used to offset some of the reduced supply caused by armouring the banks. Feasibility and success of gravel introduction (and all other potential recommendations made in Section 3) will depend strongly on the available flow of water. The special circumstances relating to that flow are highlighted in italics as follows:

The reaches u/s of the sites considered in this report lead to the Magpie mine and related underground sough systems. A drive to return perennial flows to the upper Lathkill would significantly improve the potential for improvement of the in-stream ecology. The low/no flow issues occur every summer above Over Haddon resulting *in rout juveniles being rescued and relocated d/s by the Environment Agency and the landowners. The water disappears into a sough-system under the river bed and it has been the subject of restoration plans for a considerable period of time. The drivers for restoration include the Special Area of Conservation (SAC), Site of Special Scientific Interest (SSSI) and National Nature Reserve (NNR) designations of Lathkill Dale. However, restoration is complicated by the Scheduled Monument status of the mines and soughs (and potentially conflicting preferences of different user-groups, residents and other people with an interest). Consequently, it is recommended that those reaches (and specific issues) are subject to additional investigation, reporting and recommendations. It is easy to see how an increase in volumetric discharge and availability of water will fundamentally shape the river and its ability to create high-quality, diverse habitat. It should therefore be a priority aspiration for the upper river.*

With that in mind, the specific details of enacting measures suggested in the following section need to account for likely future flow scenarios. Therefore, these recommendations are defined broadly enough to allow for future, more specific, project proposals to be developed.

3. Recommendations

N.B. *Any and all works will be subject to a variety of legal permissions that include, but are not limited to, landowners (and all parties involved in the management of the Haddon Estate d/s), regulatory authorities for the watercourse (which could be local council, Environment Agency etc.) and other stakeholders such as local volunteer/user groups.*

A list of measures that are recommended for the visited sections of the Lathkill include:

- The reinstatement of as many natural river processes as possible (this provides the best ecological outcome and hence is the preferred option) via:
  - Removal of weirs and stone revetments (and associated reinstatement of erosion and deposition processes that create higher quality habitat)
  - Restoration of surface flows by tackling losses to the mining/sough system (subject to further report/advice)
  - Assisting a rapid recreation of good quality habitat via the stable installation of natural woody features such as root-wads, stable log-jams and large dead-fall (all in-keeping with all its conservation designations and the naming of National Nature Reserves as a specific priority for Natural England in the 2014-2019 period)
  - Installation of a fenced buffer strip with effective livestock exclusion to control the bank-side erosion/impacts of over-grazing on the LB in the field adjacent to the 11 fishing weirs is highly recommended (mown "rides" can be maintained if necessary to maintain access for anglers and preserving a view of the river – but these measures should also prioritise the retention of sufficient marginal cover)
  - Instigation of supportive planting with appropriate native species within the fenced buffer strip adjacent to the fishing weirs

Some assistance/intervention to create structure and sinuosity within the naturalised channel produced by the above actions is likely to be required. Various techniques – including stable large woody material and construction of low marginal brushwood mattresses - are available to meet those aims. A sketch that indicates the broad layout of suggested interventions is given in Fig. 28.

In all restoration/habitat creation (or any future management) scenarios the following measures are extremely important to pursue:

- Maintain the biosecurity (with particular respect to non-native, invasive species) in and around the river corridor
    - Fishery members should be required to either use a dedicated set of footwear that is only used on the upper Lathkill OR to fastidiously clean their footwear so that no seeds, soil or mud can be transported from other locations into Lathkill Dale
    - Following Check, Clean, Dry protocols could also help to protect against other forms of invasive biota and the diseases they may carry: http://www.nonnativespecies.org/checkcleandry/
    - Sharing these policies with other constituted groups that regularly use Lathkill Dale (for instance walkers or cavers) is also likely to help to preserve biosecurity for as long as possible

In specific instances that a particular structure cannot be removed within a foreseeable timescale it is advised to:

- Investigate each weir for opportunities to notch, bypass or otherwise modify so as to increase transport of riverbed material (this will naturally improve the ability for aquatic fauna to easily swim u/s and – crucially - d/s to meet the changing needs of their lifecycle).

Complex considerations of heritage versus ecological value should not be avoided. As well as the basic "remove" or "retain" options – it is important to consider:
- Notching (down to bed level)
- Facilitating localised erosion of the LB to bypass structures

In all restoration/habitat-creation scenarios there will be options to:
- Use tree "kickers" (e.g. Fig. 27) to
    - create instant submerged cover in deeper/simpler habitats (lower beat)
    - produce meandering flow and influence cross-sectional depth/flow velocity variations in shallower, un-impounded but straightened sections (upper beat) – N.B. tree kickers can be easily scaled down to appropriately match smaller channels
- Stake Large woody material in specific locations/orientations to
    - mimic stable natural deadfall
    - create localised bed-scour/aid in the creation of meandering flow
    - retain and "sort" spawning gravels
- Select and/or plant scattered patches of marginal saplings/tree limbs and hinge them into/over the river margins to
    - Create refuge from predators
    - Generate patches of low/no weed-growth
- CONSIDER "seeding" upper-beat areas with spawning gravels (sourced from limestone spoil) during dry periods (to be distributed and "sorted" during periods of high flow)

Figure 27: Newly-installed tree kicker anchored with braided steel cable at the u/s end and untethered at the d/s end (to move up and down with changing water levels). A variation on this technique could use a cabled, bank-side anchor-point combined with staking of the main trunk and limbs at a desired angle to the current to create scour. A guide to installation and the typical effects of a tree kicker can be seen in this video: https://vimeo.com/72720550.

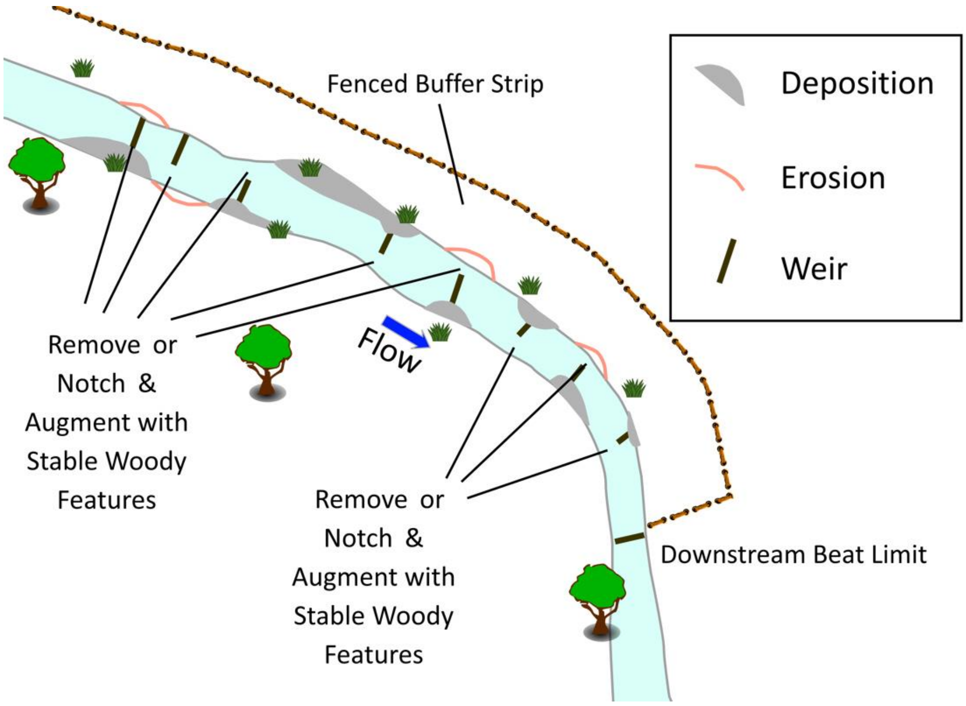

Figure 28: Indicative sketch of combined weir-removal (or modification), augmentation with woody material and localised erosion. The overall aim is to create a more sinuous channel with greater cross-sectional variation in depth, current velocity and substrate particle sizes.

The next steps to begin putting the advice into practice will be to gather information on the likely future flow scenarios (with respect to the loss of surface water to underground soughs). Personnel from the local community and Haddon Estate have already begun investigations and they should be supported in the aspiration to see the River's natural flows reinstated. Further to that, separate project proposals should be developed with the support of the WTT for:

1. Straightforward woody material and vegetation management measures (and potential gravel introduction)
2. Weir removal/alteration projects

Substantial funding applications are likely to be required to support any weir removal and alteration proposals, whereas the other activities are likely to be relatively low cost (but will, of course, still require funding). Biosecurity measures and simple hinging activities can be adopted without the need for detailed project proposals.

For any clarifications on the observations and recommendations given in this report (or any other related questions/comments) please feel free to contact me on pgaskell@wildtrout.org.

4. Acknowledgement

The WTT thanks the Environment Agency for supporting the advisory and practical visit programmes (through which a proportion of this work has been funded) in part through rod-licence funding. The support of Waltonian Angling Club Ltd. for this visit is also acknowledged with thanks.

5. Disclaimer