WILD TROUT TRUST

Advisory Walkover

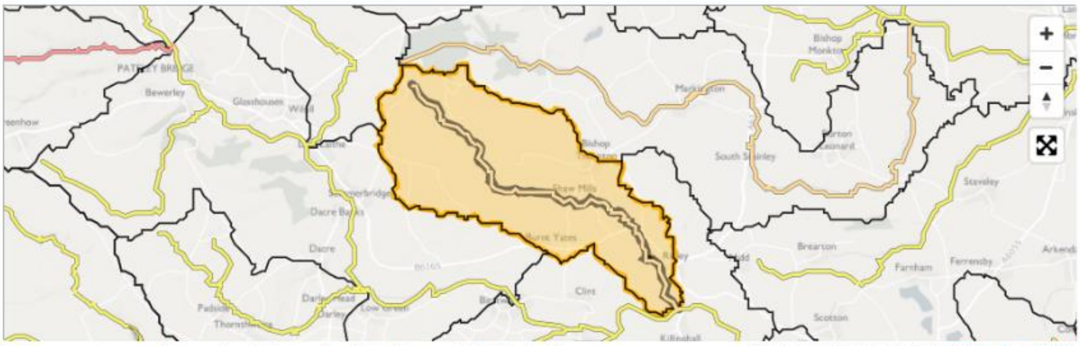
Thornton Beck, R Nidd (GB104027063850)

Prof J Grey (jgrey@wildtrout.org), July 2020

1.0 Introduction

The following is a brief report based upon observations during a walkover of Thornton Beck at Shaw Mills, carried out by Prof J Grey at the invitation of local residents. The rationale was to identify any issues for the perceived decline in health of the watercourse, a focal point of the village.

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. The Ordnance Survey National Grid Reference system is used for identifying locations.



Thornton Beck Catch (Trib of Nidd)

Overview

Download Water Body as CSV / GeoJSON

Overall classification for 2016

Poor

Id	GB104027063850
Type	River
Hydromorphological designation	not designated artificial or heavily modified
NGR	SE2523262655
Catchment area	2458.75 ha
Length	12.294 km
Surveillance Water Body	No
Catchment area	24.588 km2

Map & data extract from:
https://environment.data.gov.uk/catchment-planning/WaterBody/GB104027063850

The EA data give an overall classification of 'Poor' ecological status driven primarily by the failing for Macrophytes & Phytobenthos (plants and algal biofilm that forms on the rocks); Fish only achieve Moderate in the last assessment and prior to that, also Poor. Reasons for Not Achieving Good status (RNAGs) are listed as point & diffuse source pollution from agriculture and the water industry, as well as physical modification (redundant mill infrastructure).

2.0 Habitat Assessment

A series of images are used to exemplify the key issues identified during the walkover, progressing from the uppermost site in a downstream direction. Some detail is given in the legend for each figure, and more can be found in the summary following on.

Fig 1. Looking toward Thornton Beck (dashed white indicative line) from the upstream extent of the walkover at High Mill; SE 25180 62667. There was a clear distinction in the vegetation at the bottom corner of the field (more lush green 'triangle') indicating potential scope for better connection of the beck with its floodplain in that area.

Fig 2. Impounded water above the weir (Fig 3) extended for ~100m – deeper, sluggish water that had encouraged the deposition of fine sediment. The reach was heavily overshadowed by wall revetment on the LB parallel to the road, and by mature but historically coppiced trees bordering 'the lagoon' on the RB (top left of image). Re-coppicing selected stems would encourage new low growth as cover near the water, plus diversify the canopy structure.

Fig 3. Upper: the dam associated with the lagoon created head-loss of ~1.2m. The weir face was relatively smooth and intact but the apron below was badly degraded, presenting a severe impediment to fish passage (in either direction) and to sediment transport downstream. The building of a bailey bridge for plant to access the lagoon had clearly damaged the integrity of both banks upstream of the weir and introduced finer soil and imported angular gravel.

Lower: looking downstream from the weir through a section of relatively mature trees growing from the toe of the bank, the beck retained some relatively natural characteristics eg diverse cross-sectional profile, sediment sorting, low cover from the banks. Note however, the removal of part of the horizontal woody material to the foreground, presumably to reduce perceived flood risk although such action rarely reduces flood risk. All it does is maintain high conveyance, getting the water more quickly to the village. Those trailing branches would have trapped debris thereby preventing it reaching the pinch-points downstream in the village where risk of blockage and hence flooding is greater.

Fig 4. Examples of the numerous small watercourses contributing flow to Thornton Beck: upper – at the lagoon impoundment wall; and lower – crossing under Law Lane to the east of the village. All of those observed were in part straightened (ie increasing conveyance) and exposed to livestock poaching and grazing, leading to fine sediment ingress to the beck. Ideally these should be fenced off.

These shallow watercourses, without any shade, will warm rapidly and even if they retain water will probably be inhospitable for fish fry and invertebrates for much of the summer.

Fig 5. Upper panel: The straightened reach between the lagoon and the village was reasonably well protected by stock-proof fencing, allowing establishment of a buffer strip of native herbage and encroaching Himalayan balsam. There was surprisingly little natural regeneration of trees which would be beneficial here, especially upon the RB to provide shade.

Lower panel: When possible, access points for livestock to the beck should be avoided because they always create a focal point for erosion, fine sediment ingress and nutrient enrichment. Alternative methods or sources of watering (pasture pumps; gravity feed; mains etc) could be explored. If drinking bays like this are unavoidable, then the base and approaches should be formalised with stone of appropriate size to minimise the effect of poaching, and post & rail fencing to the sides would prevent further erosion which would otherwise ever-widen the bay.

On this reach, there was relatively little tree cover so some judicious planting with locally sourced native species such as hawthorn, blackthorn or goat willow would be beneficial.

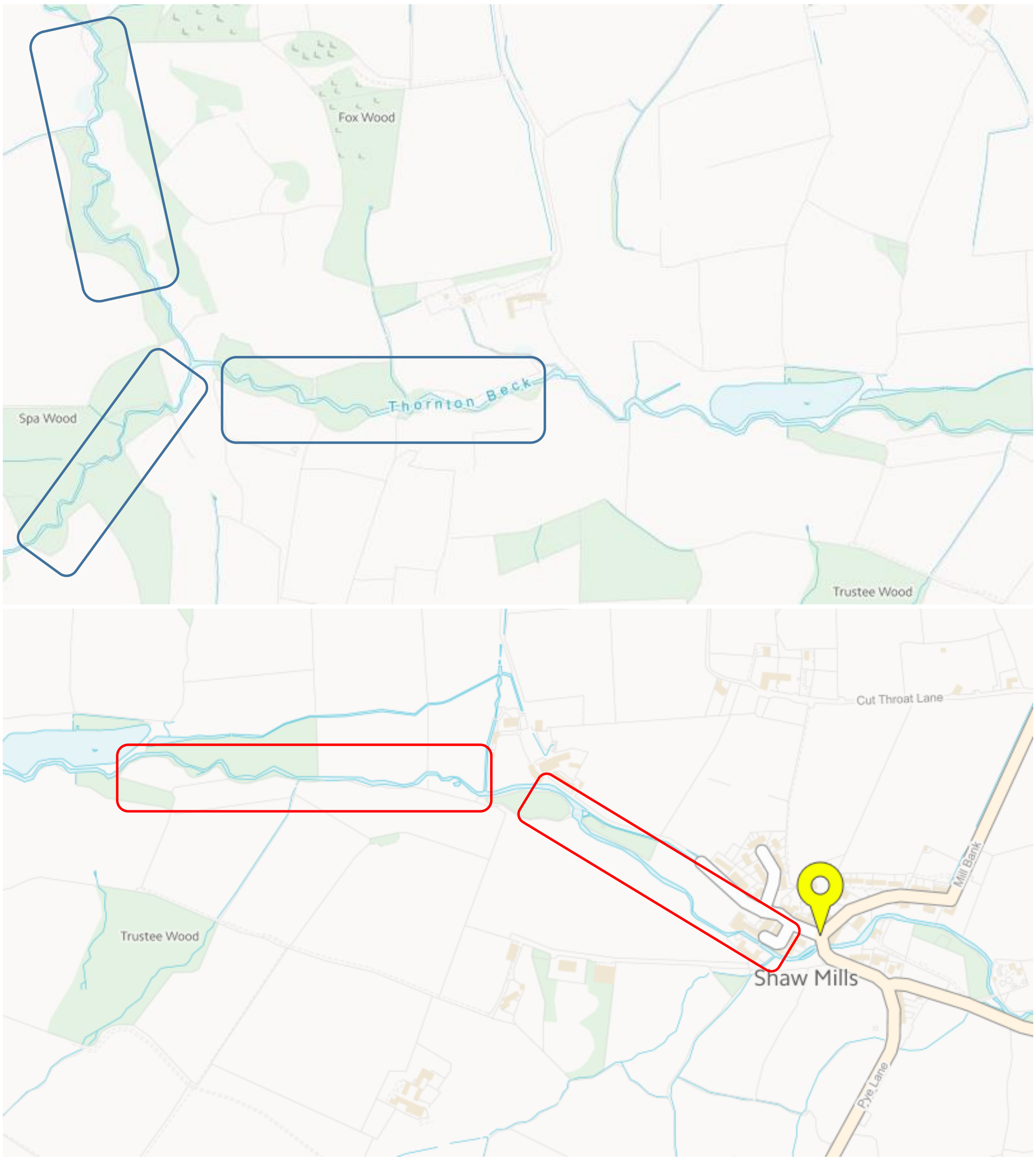


Fig 6. Maps of Thornton beck upstream of Shaw Mills (derived from the Flood Zone Map: link). Upper panel: upstream of the high dam, where the beck still exhibits a relatively sinuous course, especially highlighted within the blue rectangles.

Lower panel: downstream of the high dam, effectively encompassing the reaches of the beck that have been realigned and straightened in between the various mills (highlighted by the red rectangles).

Fig 7. The extent to which the beck between the lagoon and the village has been realigned and perched to the north side of the valley for historical mill infrastructure is clearly exhibited by the potential floodplain zones typically spreading to the south (link).

Fig 8. Evidence of some limited functionality in the Thornton Beck channel – one of the few bends in between the lagoon and the village where flow focussed to the outside of the bend is causing valuable scour, and there was subsequent deposition on the inside of the bend. However, the proportions of the channel were still remarkably consistent: one might expect a narrowing of the channel through the bends.

Note the prevalence of Himalayan balsam on this reach.

Fig 9. Looking u/s and d/s (left & right panels, respectively) from the bridge in Low Mill Court highlighting the straightened and constrained nature of the beck through the development.

Fig 10. Looking u/s from the Pye Lane bridge at a point bar of deposited material (now stabilised with vegetation) that appears to have been artificially enhanced at the u/s end. Such channel modification will obviously affect the capacity and flow regime and requires sanction from the relevant authority – in this case, the Environment Agency, as Thornton Beck is designated 'main river' up to the weir in Fig 3.

Fig 11. Looking u/s and d/s from the 'sheep wash', a ford at SE 25976 62326 just off Law Lane and the lower extent of the walkover. The channel and riparian strip were more naturally varied below the confines of the village (aside from the walling to the RB immediately d/s), although Himalayan balsam was rife in the understory. Several otter spraint were noted on the large boulders u/s, mostly comprising the remains of signal crayfish.

Aerial images of the catchment demonstrate that while the beck generally has ample tree cover along its banks, the likelihood is that: the fringe is only 'one tree wide'; the trees will all be of a certain age and therefore the canopy rather regular; there will be a lack of self-set regeneration unless livestock is excluded and/or there is sufficient light getting past the uniform canopy. Thus, in fenced reaches, it would be worth considering some light coppicing in a few select areas.

Habitat summary

As the name suggests, Shaw Mills developed historically around the harnessing of Thornton Beck for hydropower. To generate sufficient head of water to power the mill wheels, the beck was repeatedly dammed, realigned and straightened, and water abstracted and returned at various points. The majority, if not all of the milling infrastructure is now redundant. However, the legacy of that shackling of the beck remains today and impacts upon the natural heritage. Unfortunately, it does not do so in isolation but in conjunction and interactively with other stressors, such as agricultural intensification or changes in land management / development, invasive species, and climate change.

Dams / weirs: structures designed to create a 'step' within the beck introduce a plethora of issues. They alter the characteristics of the beck, impounding the water above (slowing and deepening the reach and encouraging deposition of sediment; Fig 2) and creating faster water below thereby increasing erosive power while simultaneously interrupting the transfer of sediment from upstream to replace that eroded; Fig 3. They impede or completely block the passage of fish in both u/s & d/s directions thereby introducing a selective pressure which might only affect certain species, or size / age classes within a species, fragmenting populations, preventing movement for feeding or spawning, or recolonisation of reaches denuded by flood / drought flows or pollution events. Impounded and simplified reaches also tilt the balance of nature in favour of predators of fish by making prey easier to catch, thus reducing fish abundance.

WTT has further detail on the issues with weirs here: https://www.wildtrout.org/news/weirs-and-their-impact-life-river

Realignment / straightening: often results in the channel being 'perched' ie not in the lowest point of the valley but pinned to one side to provide a head of water (for mills) or a more manageable plot for agriculture (Figs 5-7). Hence, there is always an element of revetment / introduction of artificial banks to retain the channel on a specific course instead of allowing the channel to respond naturally and dynamically to changes in flow and substrate over time. The difference can be seen in Fig 6 for sections above (relatively natural meandering course) and below (realigned and straightened) the High Mill dam.

Channelling water in a straight line reduces transit time, increases the gradient and hence increases the erosive power. Combined, these modifications exacerbate flood risk in the village. From an ecological perspective, straightened and walled banks disconnect the beck from its floodplain, retaining the erosive power within the channel rather than allowing it to dissipate across the valley floor. It also retains more uniform flow, and consequently, the bed substrate and cross-sectional depth profile are generally less varied than in channels predominantly formed by natural geomorphological processes. That erosive power either strips out the finer sediments completely or jumbles it up into a uniform 'cake-mix' rather than sorting it into discrete areas based upon size / density. It also prevents the retention / accumulation of leaf litter, a key food and refuge resource for many of the invertebrates near to the base of the food web.

Diffuse agricultural pollution: whereas the majority of Thornton Beck observed during the walkover was protected by livestock exclusion fencing, creating a reasonable buffer zone, the smaller tributaries were more exposed (Fig 4). Poaching / trampling by sheep, cattle or horses, and heavy grazing pressure can all create erosion hotspots (Fig 5) and lead to the ingress of fine silt that smothers gravel and blocks the pores between larger stones and cobbles. The degree to which the bed was impacted suggests that the problem is widespread further up the catchment and a scan of satellite imagery revealed larger fields, fewer hedgerows and apparently narrower buffer strips that could intercept fine sediment run-off to the north and west of the village. Some soil ingress is undoubtedly associated with Himalayan balsam – see below.

Water quality issues are further summarised here: https://www.wildtrout.org/content/about-trout-challenges#quality

Invasive species: Himalayan balsam (*Impatiens glandulifera*) was proliferating in many areas along the bank. As an invasive non-native species, the competitive dominance of this annual plant negatively impacts upon the integrity of the riverbank – it can quickly retard native species during summer but aside from nectar (and even that is of lower quality) does not provide any of the other ecosystem goods and services that native plants would. After dying back in winter, it leaves the banks devoid of native plants and without any root matrix remaining in the soil, and hence vulnerable to erosion (exacerbating inputs of fine sediment that can smother spawning gravel). Further negative impacts upon riverbank flora fauna can be found here:

https://himalayanbalsam.cabi.org/latest-news/himalayan-balsam-impact-on-invertebrates/

And

https://www.wildtrout.org/wttblog/plant-invasions-and-trout-rations

Signal crayfish was also present and this species may have detectable influences on the ecology of streams, for example via predation or competition with other invertebrates, and via ecosystem engineering capabilities (burrowing and fine sediment resuspension thereby influencing turbidity); all these impacts are density dependent. However, no specimens were observed directly via stone-turning for a cursory assessment of 'riverfly' community - only the presence in otter spraint was noted. Unless present at an extremely high density, crayfish is a relatively low priority compared to other stressors identified here.

To put the findings of the habitat assessment into context, it could be helpful to refer to the requirements of three key life-cycle stages of our sentinel species, the brown trout: spawning, juvenile and adult (Fig 12). Each stage requires specific habitat features that are necessary for successful completion. Consequently, there is a requirement for good connectivity such that the fish can migrate between habitat features to complete the life-cycle. Connectivity is thus incredibly important.

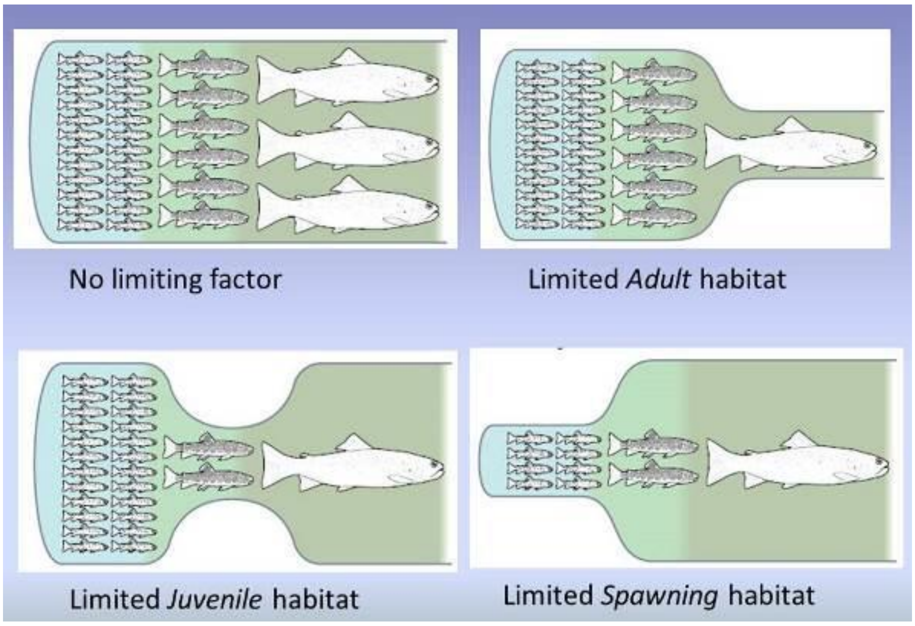


Fig 12. Bottlenecks on trout populations lacking adequate habitat for key life-cycle stages. Spawning trout require loose mounds of gravel with a good flow of oxygenated water between gravel grains. Juvenile trout need shallow water with plenty of dense submerged/tangled structure for protection against predators and wash-out during floods. Adult trout need deeper pools (usually >30cm) with nearby structural cover such as undercut boulders, sunken trees/tree limbs and/or low overhanging cover.

Excellent quality in one or two out of the three crucial habitats cannot make up for a weak link in the remaining critical habitat.

From the perspective of wild trout as a sentinel species, there appear to be two major habitat limitations to robust, self-sustaining populations. Firstly, the poor retention and sorting of gravel of a suitable size for spawning. This is compounded by the fine loam and clay of the catchment and associated inputs of fine materials.

Secondly, the opportunity for scour-pool creation (safe hidey holes for adult trout) has been reduced by the historic realignment and revetment of the channel. Scour pools would typically form on the outside of bends, with deposition of material on the inside of each bend forming a gradation in depth from shallow to deep, but a combination of straightening and gradient reduce the habitat to continuous shallow riffle.

Unfortunately, connectivity is not great! There is at least one impassable barrier separating the trout population in Thornton Beck from the mainstem R Nidd (at Ripley Castle lake) and maybe several others associated with mills and road crossings between Ripley and Shaw Mills. So, to all intents and purposes, the population at Shaw Mills is isolated.

3.0 Recommendations

The proposals suggested here may be aspirational rather than achievable at least in the short-term, but it would be remiss of WTT as a conservation organisation not to highlight the ‘gold-standard’.

- *The weir* is a redundant feature needlessly maintaining an artificially high water-level and increasing flood risk to the adjacent cottages. Removal should be the aim as it returns all the natural processes of unhindered fish and sediment movement without any maintenance issues, and would lower the water level thereby reducing the risk of flooding. The proximity of the road and buildings constructed after the weir was *in situ*, plus the capping of the lagoon and the undetermined waste contained within, all could potentially be undermined and would thus require assessment on that basis. Alternatives to ease fish passage are available and could be explored but of course do not address issues of impoundment, sediment transport, flood risk and ongoing maintenance. Given the size of other weirs lower down the catchment though, the structure may be deemed of low priority for attention from the Environment Agency.

- *Realignment / straightening / perching* – full channel restoration, ie allowing the beck to return to the natural low point in the valley, may be feasible but requires considerable buy-in from relevant landowners plus potentially some engineering to get the beck back into the artificially positioned channel before it reaches the village. However, to counter the lack of sinuosity within the current channel and instigate diversity in cross-sectional profile is relatively simple and low-cost (although will require scrutiny and assessment for flood risk by the relevant authority: Environment Agency on main river below the lagoon; North Yorks CC on ordinary watercourse above).
  Such projects are ‘bread & butter’ for WTT Conservation Officers; we can help with the necessary consenting and offer practical guidance during a river workshop to coordinate and train volunteers from the village. Structure such as large woody material (to simulate natural wood fall) can be introduced for the water to work against and around. Any material should be tethered or pinned into position using tried and tested techniques; in some instances, pliant species can be hinged or laid and thus retain a living ‘anchor’ point.

WTT has produced a series of useful 'How to…' videos which includes the rationale and techniques for creating tree-kickers and log pinning, available here:
https://www.wildtrout.org/content/how-videos

- *Diffuse agricultural pollution / soil ingress* can be easily countered by preferably excluding livestock from watercourses (because alternative solutions to watering are available) or substantially limiting access and formalising those points (ie drinking bays; Fig 5). Once excluded, natural regeneration of native herbage within the buffer strip should be relatively rapid (although Himalayan balsam will probably require control; below) which will provide greater structural integrity to bank soils via a complex and diverse root matrix and absorb run-off from fields carrying fines and nutrient pollutants.
  Buffer strips offer a multitude of further benefits aside from preventing the loss of soil from the land, such as 'hydraulic roughness' helping to slow the flow of flood waters, shade to keep the water cool, provision of refugia, nesting sites and food for a plethora of wildlife and pollinators, and aesthetics from banks of native wildflowers and grasses. There are benefits to farmers as well: retaining soil on the land or reducing the likelihood of waterborne disease transmission in livestock. Options for fencing should be explored along all watercourses (eg Fig 4), not just Thornton Beck, and there are several potential avenues of supportive funding for fencing.

- *Tree planting & management* - in conjunction with the protection of buffer strips, some tree planting could be undertaken in those areas which are currently highly straightened and exposed (eg Fig 5) using appropriate species (hawthorn, blackthorn, alder, bird cherry, rowan, hazel). Note, to be effective, tree planting requires adequate and lasting protection from livestock browsing.
  Community groups can apply to organisations like The Woodland Trust or Trust for Conservation Volunteers for free or heavily subsidised 'tree-packs', and tree planting is an excellent engagement exercise. However, it is always worth maintaining dialogue with the Yorkshire Dales Rivers Trust (and not just on tree matters) as they will have access to larger schemes and different pots of funding. In addition, to counter the 'one tree wide', same age fringe along much of Thornton Beck, in the

local environs at least, some light coppicing of selected trunks would be beneficial to create gaps and encourage low regrowth. To avoid a negative impact from this work, limiting the coppicing to one in every 10 trunks would be beneficial.

- *Balsam bashing* – an extremely beneficial task to undertake that could form the basis of community engagement with the beck in the first instance is the strimming or hand-pulling of the Himalayan balsam. It may be possible to co-ordinate with organisations like the local Wildlife Trust or River Trust to bolster numbers if required. Top-down control is obviously most effective so it will be worth engaging with local landowners upstream to gain access and perhaps undertake a survey to note the upstream extent of the balsam soon while it is obvious. However, it is also important to realise that control rather than eradication at the local patch scale is both sufficient and extremely valuable at the broader landscape scale (eg http://urbantrout.blogspot.co.uk/2014/07/volunteer-action-on-urban-river.html). This holds even if an upstream source of recolonisation exists (if subsequent efforts at control are undertaken within the village environs).
  Several local angling clubs on the Nidd and Aire are reporting success in markedly reducing the density of balsam stands over 3-5 years. Indeed, Knaresborough Anglers who have fishing rights on the Nidd at the confluence of Thornton Beck have already indicated that they could loan brush-cutters & PPE for the purpose of helping to control balsam.

4.0 Making it happen

The WTT may be able to offer further assistance:

WTT Project Proposal - Further to this report, the WTT can devise a more detailed project proposal report. This would usually detail the next steps to take and highlight specific areas for work, with the report forming part of an Environmental Permitting Regulations / Land Drainage Consent application. It could potentially be used directly as a funding application eg for Fishery Improvement Funding, an Environment Agency programme which 'recycles' rod licence money toward improvement projects.

WTT Practical Visit - Where recipients need assistance to carry out the kind of improvements highlighted in an Advisory Visit report, there is the possibility of WTT staff conducting a practical visit. This would consist of 1-3 days work, with a WTT Conservation Officer teaming up with interested parties to demonstrate the habitat enhancement methods described above. The recipient would be asked to contribute only to reasonable travel and subsistence costs of the WTT Officer. This service is in high demand and so may not always be possible.

WTT Fundraising advice - Help and advice on how to raise funds for habitat improvement work can be found on the WTT website - www.wildtrout.org/content/project-funding

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

http://www.wildtrout.org/content/index

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 stocks and managing invasive species.

The DVD is available to buy for £10.00 from our website shop http://www.wildtrout.org/product/rivers-working-wild-trout-dvd-0 or by calling the WTT office on 02392 570985.

5.0 Acknowledgement

The WTT would like to thank the Environment Agency for supporting the Advisory Visit programme.

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.