# Advisory Visit

## River Granta, Babraham, Cambridgeshire

## October 2019

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## Key issues

- The river is disconnected from its floodplain and flows within an incised and straightened channel.
- Much of the river has poor habitat. Habitat enhancement measures could be deployed to enhance the river’s low-flow channel and sinuosity. A simple habitat enhancement scheme could be worked-up between the Babraham Research Campus and the Wild Trout Trust to address the poor habitat.
- A lack of marginal vegetation due to the use of herbicide control was observed in the lower reaches of the visit. The river was also particularly devoid of fallen woody debris. Dialogue should be established with the Environment Agency about more environmentally sensitive vegetation and woody debris management to balance ecological needs and perceived flood risk.
- Much of the river is over-shaded. A management plan should be agreed so that important trees are retained, and others managed to allow light to the river where beneficial.
- The weir presents a barrier to the movement of fish over a wide range of flow conditions, interrupts sediment transfer and impounds flow, increasing flood risk to Babraham Research Campus. The weir should be removed, or partially cut through (notching) to reinstate natural flows and sediment transport.

## 1.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the River Granta at the Babraham Research Campus (BRC). A BRC representative was present for the duration of the visit which was undertaken on the 24$^{th}$ October 2019. Comments in this report are based on observations on the day of the visit and its known history. The purpose of the visit was to advise on the suitability of the river for wild brown trout, and to consider measures that could be implemented to improve habitat for trout and other biodiversity.

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream.

## 2.0 Catchment Overview

Table 1 summarises the Water Framework Directive (WFD) data for the River Granta. The overall classification is 'moderate' ecological status. Parameters that make up the classification include 'moderate for macrophytes and phytobenthos, 'good' for fish and 'high' for invertebrates (the lowest scoring attribute usually driving the classification).

The Granta is a medium sized (29km long) chalk stream with a brown trout population present throughout its length. The catchment falls mainly within the East Anglian Chalk National Character Area. It has a chalk geology overlain with deposits of clay, sand and flint gravel. The main land use is one of intensive arable cultivation, yet a few river valley meadows remain together with wet woodland alder carr. The land use changes subtlety in the lower reaches, with the intensity of development increasing as the outskirts of Cambridge are approached. The steep nature of the hills forming the upper parts of the catchment can make the river prone to run-off which has caused flooding to parts of the BRC in the past. A large flood storage area has been constructed in recent years to alleviate flooding of the site.

The Granta has been modified by humans for centuries. The building of Babraham Hall resulted in the river being canalised and impounded by a weir to create a landscape feature. The weir has been substantially rebuilt within the last decade. The parish of Babraham is reported to contain the only floated water meadow system in Cambridgeshire. Yet today very little of the layout remains due to a lowered water table and development. As with many chalk streams in the region, over-abstraction for public water supply has had a significant impact on river flow. At the time of the visit, the river was experiencing prolonged drought leading to exceptionally low flows. The Environment Agency (EA) has maintained water through its river flow augmentation scheme with an outfall operated upstream at Linton. Without augmentation, flow would have dried up; in early September the river was dry at the lower reaches in Stapleford. The rainfall through October has been noteworthy with ~150% of the long-term average but it has barely made a difference to river flow due to the depleted chalk aquifer.

| | **Waterbody details** |
|---|---|
| **River** | River Granta |
| **WFD Waterbody Name** | Granta |
| **Waterbody ID** | GB105033037810 |
| **Management Catchment** | Cam and Ely Ouse |
| **River Basin District** | Anglian |
| **Current Ecological Quality** | Overall classification of **Moderate** for 2016 |
| **U/S Grid Ref inspected** | TL 50797 50605 |
| **D/S Grid Ref inspected** | TL 49514 51413 |
| **Length of river inspected** | 1.83 |

Table 1 Data from https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033037810

Cycle 2 classifications

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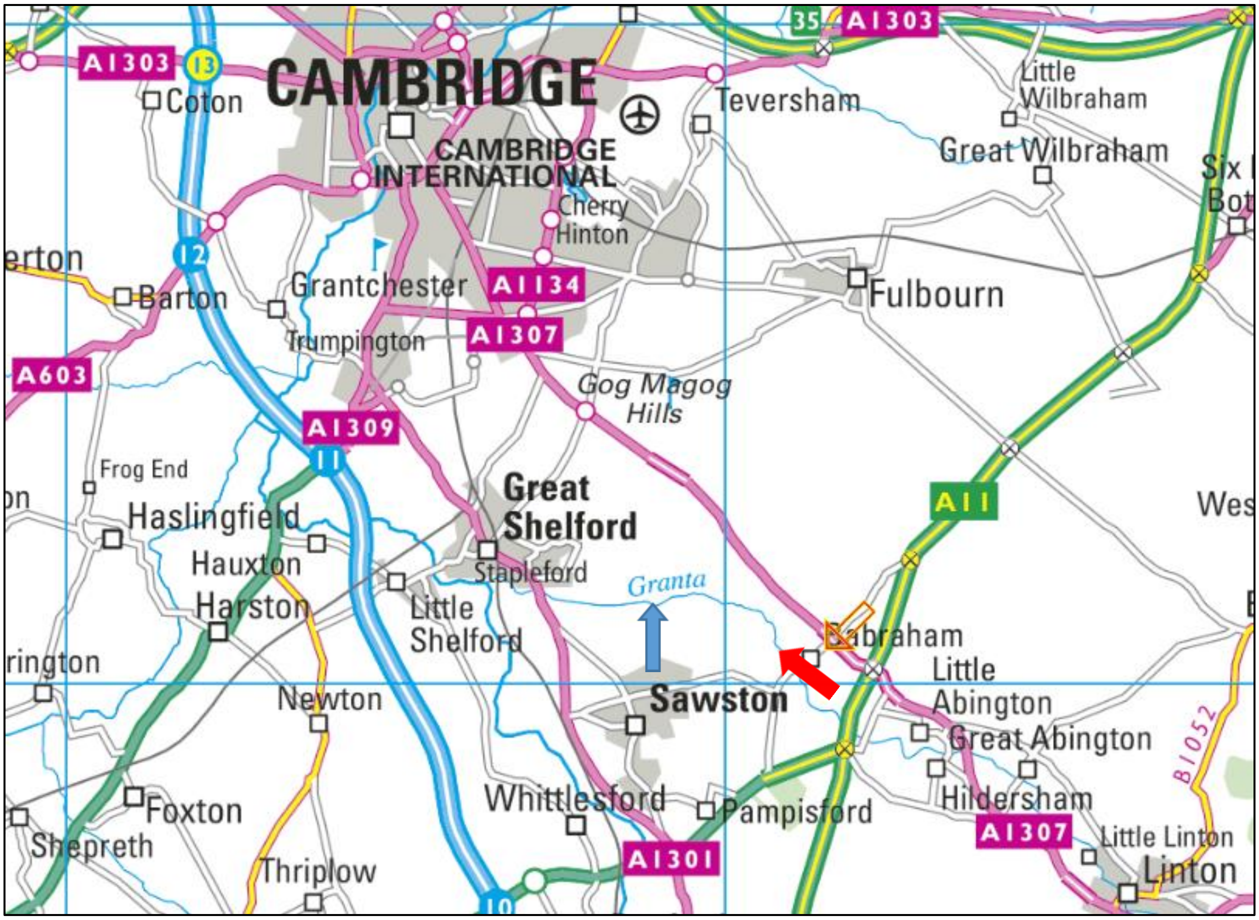
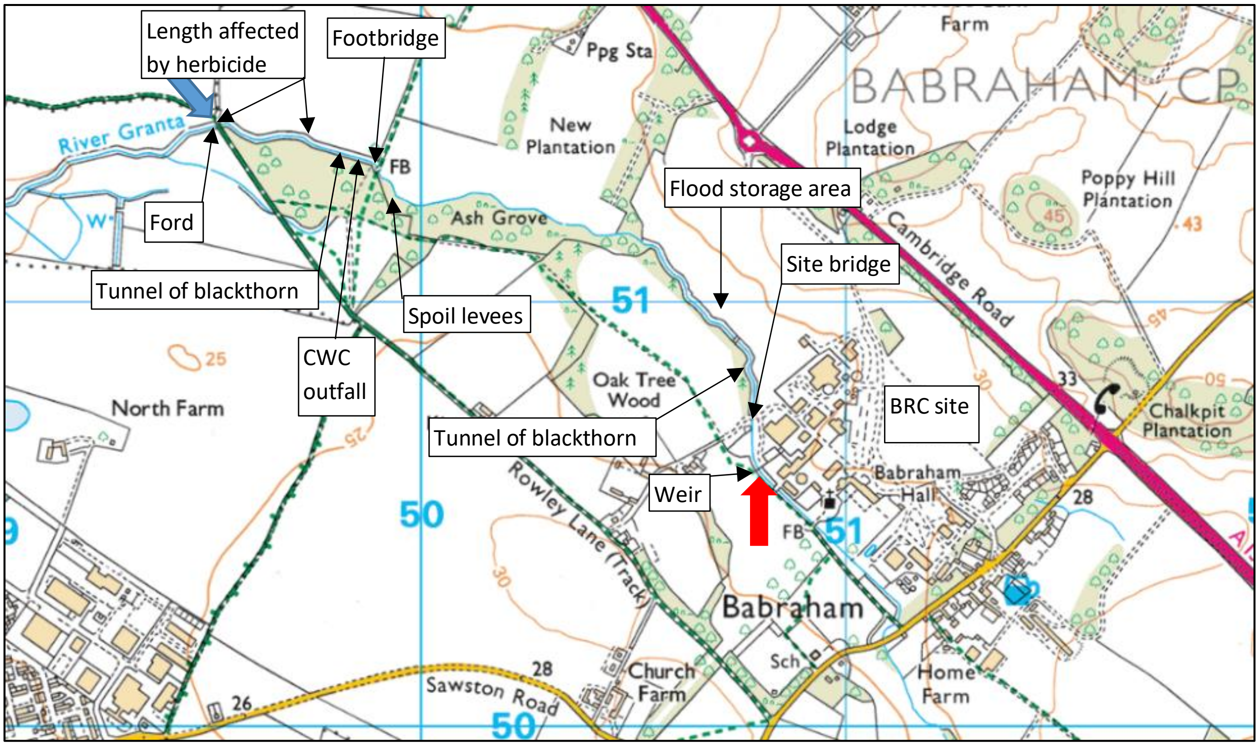
| Classification Item | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| **Overall Water Body** | Good | Moderate | Moderate | Moderate |
| Ecological | Good | Moderate | Moderate | Moderate |
| Biological quality elements | Good | Moderate | Moderate | Moderate |
| Macrophytes and Phytobenthos Combined | - | Moderate | Moderate | Moderate |
| Fish | Good | High | Good | Good |
| Invertebrates | Good | Good | Good | High |
| Hydromorphological Supporting Elements | Supports Good | Supports Good | Supports Good | Supports Good |
| Hydrological Regime | Does Not Support Good | Does Not Support Good | Does Not Support Good | Does Not Support Good |
| Morphology | Supports Good | Supports Good | Supports Good | Supports Good |
| Physico-chemical quality elements | High | High | Moderate | Moderate |
| Ammonia (Phys-Chem) | High | High | High | High |
| Biochemical Oxygen Demand (BOD) | High | High | High | High |
| Dissolved oxygen | High | High | High | Good |
| pH | High | High | High | High |
| Phosphate | - | - | Poor | Poor |
| Temperature | High | High | High | High |
| Specific pollutants | High | High | - | - |
| Chemical | Good | Good | Good | Good |

Table 2 Data from https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033037810




Map 1 – The River Granta in its local context. Red arrow is upper limit, blue arrow is downstream limit of visit © Ordnance Survey.




Map 2 – Key locations and features along the River Granta at the Babraham Research Campus. Red arrow is upper limit, blue arrow is downstream limit of visit. © Ordnance Survey.

The BRC controls ~2km of the River Granta through its grounds downstream of Babraham village. The EA undertakes maintenance of the river under its permissive powers. The EA undertook woody debris clearance in spring 2019 which has been followed-up by the application of herbicide to some stands of marginal vegetation (acknowledged in correspondence with the EA Flood and Coastal Risk Management). Evidence of marginal vegetation die-back was observed during the visit.

The Cambridge Trout Club secured an agreement to fish the river in 2018; it is doubtful that any angling took place in 2019 due to the exceptionally low flow. The river has not been stocked with any fish species for many years.

No signs of water voles were seen, but they were not specifically looked for. Water voles have been recorded from the river at the lower limit of the site, and above the weir where the river is impounded and provides a stable water level. The majority of habitat observed was unsuitable for water voles due to shade, poor marginal growth and bare banks. Otter spraints were found. Otters are known to be very active along the Granta. Otters and water voles, as well as their habitat, receive full legal protection under the Wildlife and Countryside Act, 1981.

Numerous crayfish holes were observed although the banks tended to have a degree of armouring against burrowing provided by a seam of gravel. The holes are believed to be from the invasive non-native signal crayfish which is present in the river. Signal crayfish pose a threat to native biodiversity through disease transfer, competition, and displacement. The native white-clawed crayfish has been recorded upstream of the site within the last decade. Signal crayfish must not be moved to other watercourses nor to new sites along the Granta.

## 3.0 Habitat Assessment

The visit started at the site of a ford crossing (TL 49526 51416). The ford was the focus of habitat improvement work led by the author in a previous role. It was pleasing to see that the gravel bed, which overlays concrete reinforcement, was still *in situ* (pic 1). Where marginal growth narrowed the channel, water crowfoot grew (pic 1, inset). Water crowfoot provides important physical structure for retaining a head of water, creating flow diversity, increasing cover, and as spawning substrate for many coarse fish, as well as habitat and food for numerous invertebrate species. The plant is typical of clean, swift-flowing rivers. It was also interesting to observe that the re-graded banks have remained grass-dominated, and have not been colonised by nettles and other ruderal species. Nettles tend to dominate the riparian vegetation along much of the river which is a consequence of dredging followed by the spreading of nutrient enriched spoil.

Pic 1 (TL 49526 51416) – The lower limit of the visit, the ford environs provide good marginal cover and a gravel bed suitable for trout to spawn upon (when stronger flow returns).

Above the ford, the river was canalised. Its width was largely uniform at ~3m with steep banks, little sinuosity and few marginal plants. The bed was covered in fine silt which smothered the gravel. The lack of scouring flow allowed Canadian pondweed and algae to dominate the open water (pic 2).

Pic 2 (TL 49547 51427) – The river has poor flow diversity, lacks sinuosity and has impoverished habitat. Note the faggot constructed flow deflector (red arrow).

Upstream of the ford, the first stand of trees was encountered after ~50m. Trees are hugely important for rivers, with their canopies providing summer shade which aids water temperature regulation (thus providing a degree of climate change resilience). A high number of terrestrial invertebrates inhabit tree canopies and some of those will fall on to the water to become food for fish. Trees also drop organic matter into rivers (whether it be leaves, twigs or larger limbs) which provide valuable structure, cover and food for aquatic invertebrates, initiating nutrient cycling and increasing the diversity of food webs. Tree roots are also crucial in maintaining bank cohesion and stability.

The management of shade requires careful consideration. In hot periods shade can bring benefit, but when excessive, it limits the growth of marginal plants which are important for retaining bank strength and controlling fine sediment input. The trees present interesting opportunities for habitat management to address the lack of flow diversity and the balance of shade versus open habitat.

The first occurrence of habitat enhancements, a faggot flow deflector, was found. It is reported to have been installed by the EA ~5 years earlier as an in-house training event (pers. comm. James Hooker, EA Fisheries team). The flow deflector had not had any significant effect on bed scour due to it being constructed from faggot bundles which were allowing flow through the woody material as opposed to concentrating the entire flow around, and over, the structure. Furthermore, the deflector should have been extended further out into the channel to achieve a greater effect.

As the tree canopy reduced, nettles and other ruderal vegetation tended to dominate the riparian zone. A few grasses trailed down to water level but there was no noticeable emergent marginal vegetation. Himalayan balsam was observed (pic 3), an invasive non-native species which has the capacity to dominate native flora and suppress soil-binding grasses. When the balsam dies-back in winter, it leaves riverbanks bare and prone to erosion. The river through the site is currently the focus of a balsam control programme co-ordinated by BRC staff when time is available. Few flowering plants were seen which was very encouraging.

Pic 3 (TL 49609 51386) – Nettles continued to dominate the bankside flora with occasional Himalayan balsam plants present. Note the lack of marginal vegetation.

Moving further up into a wooded reach, the river exhibited bedform variation as a result of gravel bars but still lacked sinuosity. Bedform variation produces flow variation, enabling the river to transport and redistribute fine sediment which can smother a gravel bed, reducing the number and diversity of niches for aquatic invertebrates. Importantly, brown trout need clean and stable gravel (particularly in the size range 10-40mm) to spawn upon. With their eggs remaining in the gravel for up to 100 days before the fry emerge, trout eggs are very susceptible to mortality from siltation or physical disturbance. Illustration 1 shows the life cycle of the brown trout.

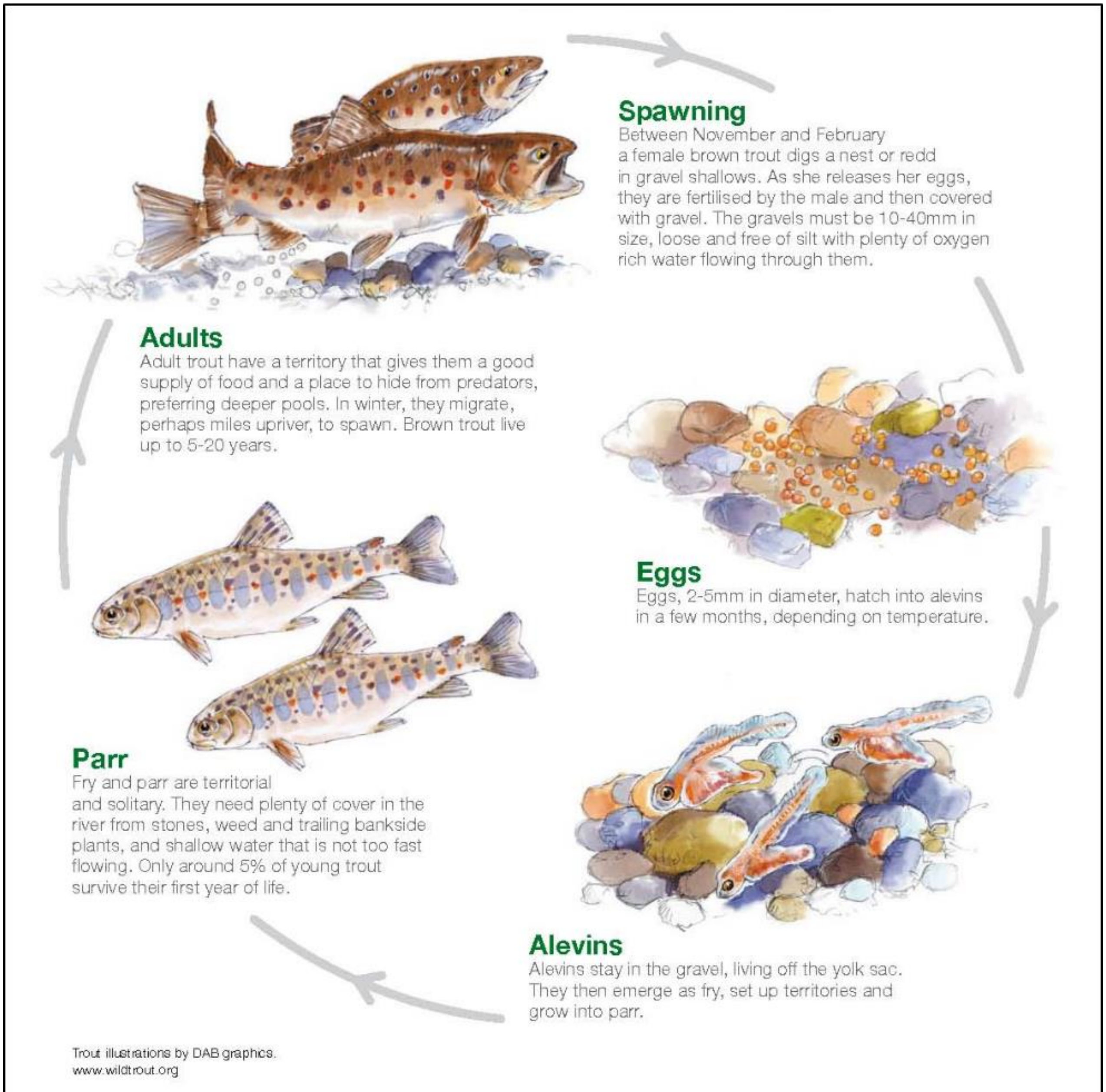



Illustration 1 – The life cycle of the brown trout.

The gravel within the wooded reach was very silted due to the low-flow conditions. Encouragingly, the gravel was not compacted, and it is likely that it will become cleansed once normal flow returns. The gravel, once clean, should provide good spawning opportunities for brown trout.

The tree dominance reduced at TL 49653 51391, and the river became unshaded. However, the lack of marginal vegetation was surprising. The EA herbicide control programme was considered to be the cause. Remnants of dying vegetation were observed, together with some yellow discolouration of nettle leaves (pics 4 & 5). The water colour had a brown tint consistent with rotting organic matter (pic 6). The use of herbicide by the EA on the Granta is not considered to provide any significant level of flood protection, yet the removal of marginal plants will negatively impact upon bank stability, fine sediment input and biodiversity. Herbicide causes the decomposition of a plant *in situ* (pic 7), consuming oxygen from the water, placing a further unnecessary stress upon the diminished flows of the river. The repeated use of herbicide is thought to be the reason for the reduced occurrence of marginal plants in the Granta.

Pic 4 (TL 49653 51391) – A stand of dying vegetation (red oval) and discoloration of nettle leaves as a result of herbicide drift.

Pic 5 (TL 49681 51395) – Note the yellowing of the nettle leaves, a river choked with pond weed and algae, and poor-quality habitat.

Pic 6 (TL 49701 51392) – Note the brown tint to the water, believed to be from organic matter rotting down.

Pic 7 (TL 49714 51394) – The remains of a stand of watercress (red oval) killed-off by herbicide and now almost entirely rotted away.

The river became tree-lined and shallow, with the depth varying from ~0.3m to ~0.05m with a width up to ~4m. The gravel bed could be seen to contain a mix a coarse and fine material which was poorly sorted and not suitable for trout spawning.

It was encouraging to find further evidence of habitat enhancement work; this time in the form of tree hinging of blackthorn (pic 8). Tree hinging is a technique favoured by the Wild Trout Trust for delivering instant woody cover at water level. Trees (large or small) are cut to produce an effect similar to hedge laying. Species such as willow and hazel respond particularly well. Laying retains a living hinge that secures the cut stem to the tree stump so structural strength is retained. With the tree-top laid at water level, it provides excellent over-head cover, flow deflection and, if beneath the surface, increased habitat for aquatic invertebrates and cover for fish against predators.

Pic 8 (TL 49742 51382) – Tree hinging of blackthorn.

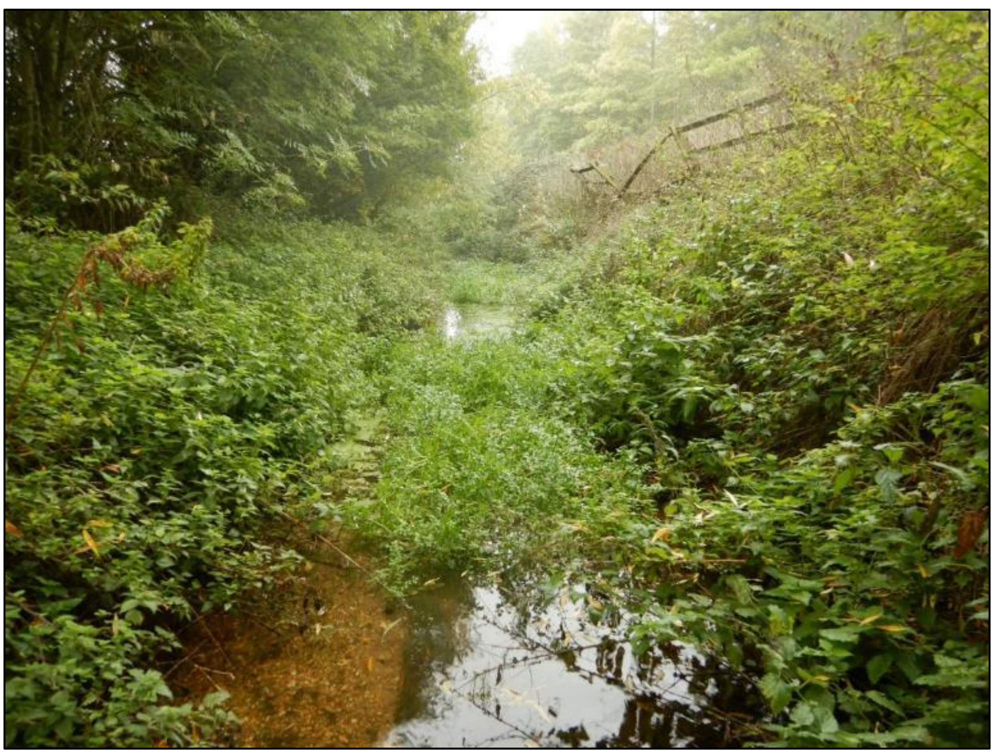
The river widened out to ~5m with a gravel bar present. The shallow margins were colonised by lesser water-parsnip, but unfortunately the majority of the stand was dying, assumed due to herbicide application (pic 9). The Granta is in a poor a state of management up to this point.

Pic 9 (TL 49743 51381)– Herbicide has been applied to this stand of lesser water-parsnip.

Further examples of EA habitat enhancement work were found. This time, brushwood ledges had been constructed in less shaded locations. Consequently, the silt and sand entrained amongst the ledges was colonised by marginal vegetation (pic 10). Brushwood structures are beneficial for the river as they provide complex cover for fish, increase invertebrate habitat, and can protect against bank erosion, can provide in-channel sinuosity and may control fine sediment input.

From this point upstream (TL 49723 51391) the river lost the feel of a "maintained drain" and started to have a greater occurrence of marginal and aquatic vegetation, with areas of clean gravel present (pic 11). Notably, the water had lost its brown tint. It is supposed that the EA did not use herbicide above this point.

Pic 10 (TL 49743 51738) – The remnants of a brushwood structure that has entrained fine sediment and become partially colonised by vegetation.



Pic 11 (TL 49753 51372)– The river provides good marginal cover, clean gravel and has lost the brown tint to the water.

In stark contrast to the “maintained drain” reaches seen downstream, the river was more open with banks that graded down to water level at a relatively shallow angle, providing  opportunities for plants to find a niche. It was hugely encouraging to see lesser water-parsnip growing from both banks, narrowing the channel and creating in-channel sinuosity (pic 12). This enhances flow diversity, aids sediment transport and increases habitat diversity. The trailing of bramble onto the water provided important overhead cover when no other woody material was present (due to the EA having removed it in the spring).

The occrence of fallen sticks, branches and tree limbs, togther with the organic matter that they collect, may look unsightly to some but the presence of such material is of great importance within rivers. Collectively such material is referred to as Large Woody Material (LWM). LWM leads to an increase in the surface area on to which a biofilm (algae, bacteria and other microbes) can grow. In turn, the biofilm may become a source of food for invertebrates, increasing the total biomass that a river can support. LWM also provides underwater cover, offering protection for fish against otters or fish-eating birds. LWM can also provide natural flow deflection which may locally increase a river’s velocity assisting cleansing of the gravel bed, but correspondingly slowing it elewhere around the structure. Where LWM presents no flood risk it should be retained as it improves hydraulic roughness within the channel. Where possible, fallen trees should be secured in the river margins to provide habitat cover. There was scope for this where the cross-sectional area was greater and banks were lower. The only LWM present was that placed by the EA ~5 years ago with much of it now in a state of degradation, soon to be lost (pic 13).


Pic 12 (TL 49803 51358) – Lesser water-parsnip enhances flow sinuosity.


Pic 13 (TL 49807 51357) – A flow deflector was the only LWM present in this reach of river.

Whilst the shade provided by trees and shrubs is of importance to the river, it must be balanced against the lack marginal vegetation. A tunnel of blackthorn

~50m long presents a degraded habitat beneath it (pic 14). Only 2 trailing branches provide any degree of habitat cover. The flow beneath the shrubs lacks diversity resulting in poor sediment sorting and a uniform bedform.

Pic 14 (TL 49817 51353) – Only 2 trailing branches provide habitat. This reach is significantly over-shaded and too wide for the flow normally conveyed.

A blue outfall pipe was observed, which on the 6th September 2019 was seen by the author to be discharging clear water to the river. BRC staff had not seen the pipe discharging and advised that the pipe is owned by Cambridge Water Company (CWC) and is used for "flushing" from a water tower/reservoir at Sawston. The addition of clean water to the river in a period of exceptionally low-flow was welcomed.

Above the discharge pipe the LB became steep to the point where it was unstable, resulting in an earth exposure (pic 15). Eroding banks inputting fine sediment are not necessarily desirable, but the exposed bankface provides a potential kingfisher nest site and should be retained. Minor habitat work to expose further bare earth could increase the chances of kingfisher nesting at the site, as would the installation of artificial kingfisher nest chambers. In the relatively flat Cambridgeshire landscape the occurrence of suitable nest sites is known to be a limiting factor to kingfisher distribution.

Pic 15 (TL 49859 51339) – Eroding banks may be used by nesting kingfisher.

A “clean” gravel glide was observed beneath a stand of horse chestnut trees (pic 16). Upon closer inspection by using one’s foot to dislodge the sediment (inset pic), it became apparent that the gravel was poorly sorted and contained a high proportion of fine sediment. At present, this area represents poor spawning habitat.

The horse chestnut trees cast much shade which suppressed understory vegetation on both banks (except for some elder bushes opposite). Consequently the banks were bare and a source of fine sediment input (pic 17). Removal of the elders would allow more light to the river which may initiate marginal growth, aiding bank stability. Furthermore, using an excavator the toe of the bank could be pushed down and out in order to create a narrowed-down low-flow channel with a wider cross-sectional area to convey flood flows.

Pic 16 (TL 49870 51340) – The gravel bed contains a high proportion of fine sediment and is unsuitable for trout to spawn upon.

Pic 17 (TL 49882 51337) – The elder growth should be removed leaving the bank to be re-graded to create an enhanced a low-flow channel.

Above the footbridge, the riverbed comprised undulating gravel bars with pools, short riffles and glides. A pool and riffle sequence is important in a river as it naturally diversifies the flow and provides habitat for juvenile trout (within the shallow riffles) which keeps them from competing with (or from being eaten by) adult trout which favour the pools. The gravel was well-sorted, and free of excessive fine sediment. The gravel bed at this location was suitable for trout to spawn upon.

The river flowed through a mix of open and closed canopy, with a few medium sized sycamore trees present (pic 18). The sycamores are suitable for tree-hinging which would reduce the effect of shade, provide immediate overhead cover at water level and enhance flow diversity.

Pic 18 (TL 49908 51310) – A sycamore tree suitable for hinge-cutting to provide immediate cover and flow diversity.

Walking through the adjacent woodland (established within the last 20 years), evidence of extensive dredging became apparent with large piles of gravel-rich spoil placed along the LB forming very significant levees to 1.5m high (pic 19). By removing material that was once beneath water and placing it above water (on the floodplain) the capacity of the floodplain has been reduced by the corresponding volume of spoil excavated from the river. Levees prevent rivers from connecting with their floodplains and stop water flowing back to a river. It may be possible to utilise the spoil levees to create new marginal features. Some spoil may even contain enough gravel to enable the restoration of features such as riffles. When scoping any habitat enhancement or restoration, the removal and/or use of the spoil levees should be considered to achieve floodplain re-connection.

Pic 19 (TL 49918 51281) – Very large spoil levees (red arrow) are present along parts of the river and showed the extent of previous dredging activity. Removal and re-use of the spoil levees would allow floodplain reconnection.

A location was reached that was clearly a popular spot for people to enjoy the river. Consequently, the banks were eroded by dogs and people, creating a source of damaging fine sediment input. It would be possible to address the bank erosion with carefully placed logs and faggot bundles to sensitively reinforce the bank, and to close-off some evolving slides. Of note was some brushwood held by long lengths of wire which had become loose and presented a hazard to people and their dogs (pic 20). The WTT can demonstrate ways to fix structures in place which minimise risk to river users.

Pic 20 (TL 50748 50907) – This faggot bundle has been effective in stopping bank erosion, but the fixing wire (red arrows) has become slack and poses a hazard.

The bedform showed a greater extent of variation, with deeper pools (to 0.70m) providing depth refuge during the drought period. The presence of watercress upon the gravel riffles provided enough cover to sustain juvenile trout (pic 21).

At the crest of a riffle it was noted that a large amount of organic matter had accumulated. The organic matter was viewed by BRC staff as a problem and something to be removed. That view is not shared by WTT. Organic matter harbours a high number of aquatic invertebrates which in turn provide food for fish and birds. As flow increases through the autumn the material will be moved again. As it accumulates it will act to deflect flow, thus initiating geomorphic processes of scour, transport and deposition (even if in miniature). The material should not be removed unless it presents a threat to water quality (such as in hot periods with declining flow).

Pic 21 (TL 50086 51253) – An example of a pool (blue oval) and riffle habitat (blue arrow).

The river became lined by pollard willows with their roots providing good underwater cover for both fish and invertebrates (pic 22). The roots also give bank strength where people and dogs access the river. Occasional plants of pendulous sedge provided the most notable marginal cover where shade suppressed most vegetation. Pendulous sedge is a useful plant for marginal cover, particularly where recreational pressure suppresses other plants. Its tussock growth form makes it is resilient to trampling, and it is not readily grazed by deer nor rabbits.


Pic 22 (TL50225 51219) – Willow tree roots provide important underwater cover and bank strength.

Interestingly, a point was reached where the width was ~5.5m with trees casting shade. Consequently, the in-channel flora was limited (pic 23). That view contrasted starkly with the view immediately above it (pic 24), where light reached the river and vegetation grew resulting in abundant marginal cover.

Pic 23 (TL 50289 51217) – A stark channel with no cover; a consequence of shade and LWM removal.

Pic 24 (TL 50289 51217) – The same location of river as pic 23 but looking upstream; light reaches the river initiating beneficial vegetation growth.

The tree cover increased again and suppressed marginal vegetation (pic 25). The RB retained a near vertical angle which has provided a nesting site for kingfishers. Clearance of vegetation from the bank-face could make it more suitable. Alternatively, bank scour could be initiated by tethering a felled tree on the LB to create scour on the RB. The felled tree could be positioned to create bed scour as well. The cross-sectional area of the river at this location was relatively wide so flood flow should not be impounded by any structure positioned across the channel. Furthermore, out-of-bank flow would move through the adjacent woodland due to the relatively low LB.

Pic 25 (TL 50510 51159) – The cross-sectional area of the channel was wide at this point which makes it suitable for in-channel structures without adversely affecting flow conveyance.

On approaching the BRC site, the river was relatively open and the true RB lower than other reaches. A vegetated berm narrowed the channel providing an important sink point for fine sediment. Without vegetation colonising and stabilising the sediment, it may be otherwise deposited on the riverbed where it can degrade invertebrate and fish spawning habitat, or it may be deposited in pools causing them to shallow. The development of natural vegetated berms reflects insufficient flow energy within the dredged and overwide channel and a return to proportions governed by the flow available, effectively enabling a low-flow channel to evolve. This improves a river's resilience to climate change, especially prolonged periods of drought. High flows may scour away berms leaving a widened river cross-section again, with the potential for the process to repeat depending on flow experienced over time.

The bed of the river at TL 50572 51106 remained relatively free of fine sediment, and occasional plants of water crowfoot were present suggesting that even in an exceptionally low-flow year, the Granta has the capacity to sustain flow-sensitive plants and  flow-sensitive species such as trout. The river then became deeper again (most likely due to past dredging) and lacked flow diversity and bed scour. Consequently, the riverbed was choked by organic matter and fine sediment.

Pic 26 (TL 50572 51106) – The Granta near to BRC, note the wide vegetated berm (red arrow) and the water crowfoot plants (red circle).

The tree cover over deeper pools was desirable, especially a stand of field maple (pic 27), which in addition to providing cover, provides bank strength and habitat amongst the root network. The general approach should be to retain shade and cover over pool habitats, and to allow riffles and glides to be open so that marginal and aquatic vegetation can grow in the shallow water environments. The branches of the field maple which extend over the river should not be taken-off. If a greater degree of in-river cover is needed, then it would be possible to hinge-cut some branches to provide underwater cover.

Contrastingly, a long length of dense blackthorn was present which provided too much shade and little in-river cover. It would be possible to manage the blackthorn to reduce shade, and to provide cover at, and below, water level. Cutting the blackthorn at ~1m height would enable it to be managed like a hedge in future, and larger shrubs could be pulled down towards the water to provide cover and flow diversity.

Pic 27 (TL 50776 50876) – Field maples provide overhead cover and shade to a pool habitat.

The reach of river immediately above and below the site bridge was entirely covered by duckweed (pic 28). The plant had been covering the river above the weir but had been moved downstream *en masse* following river clearance by BRC staff in the vicinity of the weir. This is indicative of the exceptional low-flow and nutrient enrichment. The plant could be washed further downstream but that is simply moving the problem on, compounding it as the plume of duckweed becomes greater. The plant should be left to be dispersed by flow and die-back from frost.

Pic 28 (TL 50784 50812) – Duckweed smothering the river due to exceptionally low flow.

Alongside the BRC, previous river enhancement structures were found. Pre-planted coir rolls set on hazel faggots were used to narrow the channel and to provide marginal habitat. The original work appears to have been topped-up by recent brushwood addition.

Pic 29 (TL50784 50685) – A well-constructed brushwood ledge providing marginal habitat.

The weir at TL50795 50612 was the upstream limit of the visit (pic 30). It retains a head of water ~1.2m and represents a barrier to the migration of all fish species over a wide range of flow conditions. The occurrence of steps down the weir limits the effect of bed scour, consequently there was no significant scour pool below the weir (except for one discrete area). The weir pool had been entirely covered by fool's watercress until its recent removal by BRC staff (releasing the duckweed which collected downstream). A shoal of dace (~5 up to 20cm) was observed in the weir pool, suggesting that the dominance of fool's watercress may not have been the problem that it appeared to be.

Weirs disrupt the natural process of sediment transfer along a river, acting as traps for coarse sediment (refer to illustrations 2 & 3 below). With a paucity of coarse gravel supply, the riverbed below a weir is prone to down-cutting (or incision) as bed material is washed downstream without a regular supply from upstream.

The weir should be removed or partially cut through (notched) as it is a barrier to fish movement, prevents natural river processes and represents a very significant flood risk to the BRC. Removal of the weir would have huge beneficial effects for the river (leaving the EA gauging station 310m upstream as the next barrier to be addressed). If the historic setting of Babraham Hall is important then it would be possible to remove the weir and retain similar water level by raising the bed extensively throughout 310m reach. Detailed investigation would need to be undertaken.

Pic 30 (TL50795 50612) – The weir: a total barrier to fish migration and a flood risk.

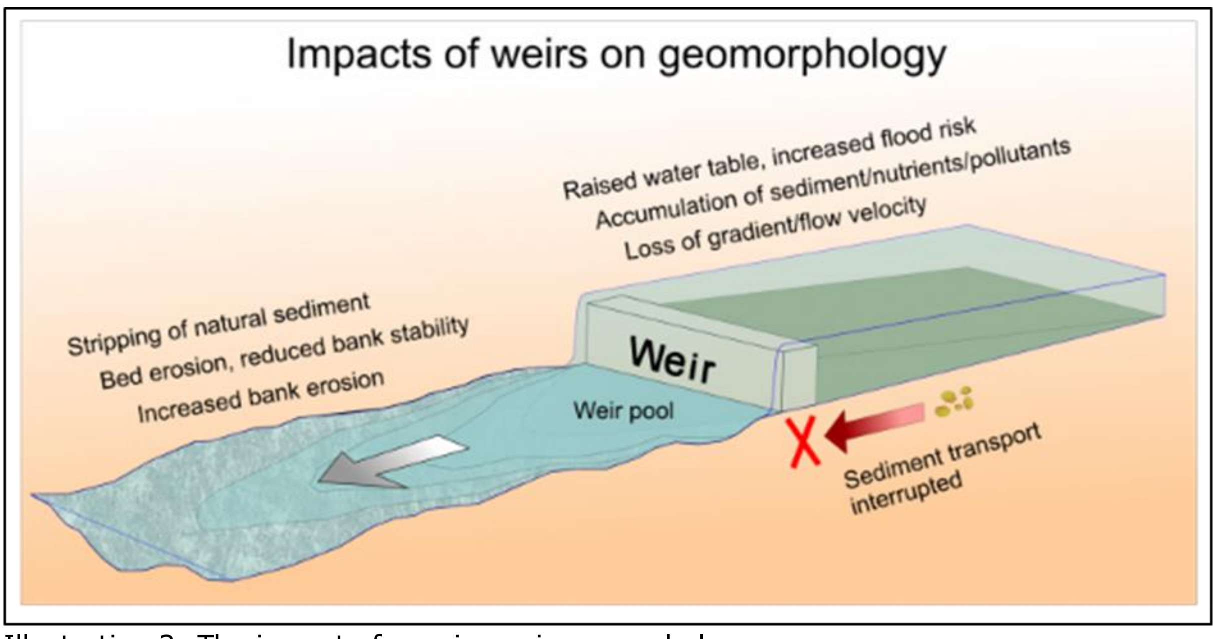



Illustration 2: The impact of a weir on river morphology.

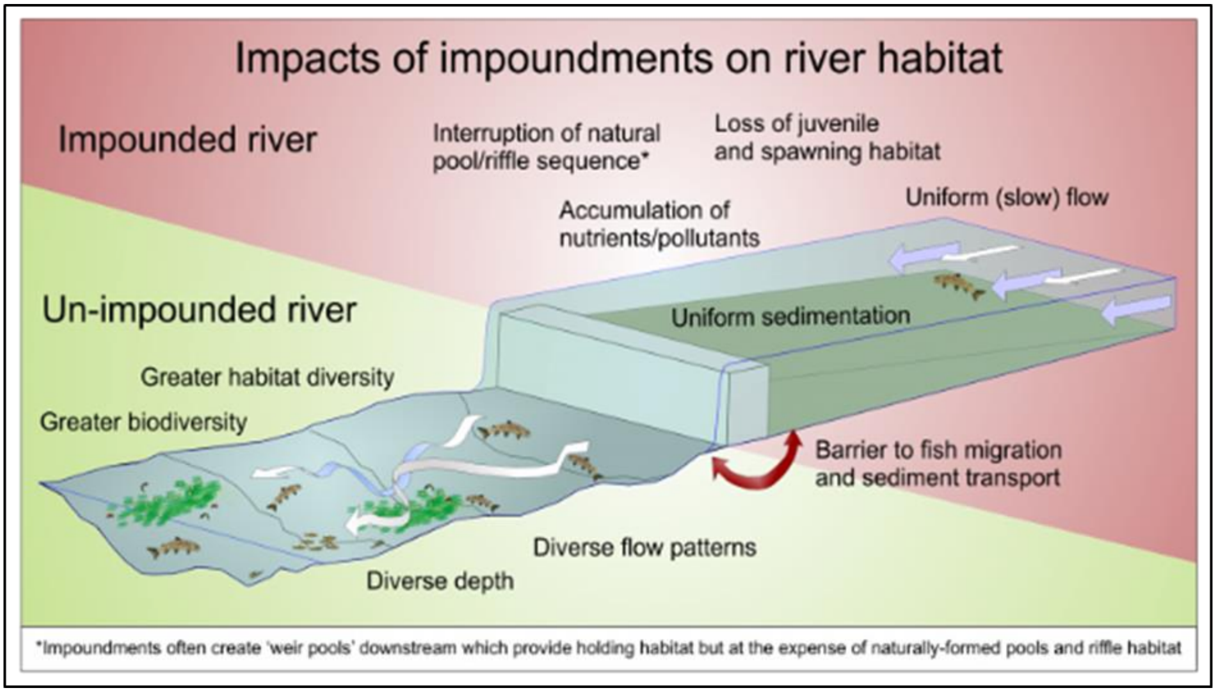


Illustration 3: The impact of a weir on river habitats.

It was concerning that no brown trout were observed. The low-flow, in addition to long lengths of degraded habitat and potentially low oxygen concentration, is likely to have restricted their distribution. Furthermore, the poor habitat quality and lack of water would have left all fish species vulnerable to predation. The return of better flow will do much to rectify some of the Granta's problems but fundamentally, the river requires habitat restoration, better floodplain connection and barrier removal if it is to function properly and provide a wide range of niches for the biodiversity that it should be able to support.

## 4.0 Recommendations

The lower reaches of the river showed little flow diversity, lacked LWM and had very limited marginal vegetation. Furthermore, the river as a whole lacked sinuosity. That is probably a consequence of the river having been realigned for the establishment of a water meadow system, and for landscaping associated with the Hall. Measures to enhance and increased sinuosity will lead to flow diversity, better sediment transfer and increased ecological niches.

The tree stock would benefit from management to vary its age and height structure, but the need to retain cover for shade and water cooling is important. Strategic removal/hinging/crown raising of trees at intervals along the most shaded parts of the river should be worked up into a plan for future work.

A scheme could be worked-up to provide guidance on suitable management and habitat enhancements. The delivery of such work could be implemented by BRC staff under guidance from WTT. Simple habitat enhancement and restoration techniques could be deployed using:

- Brushwood ledges: these features can be created following tree works. A brushwood ledge provides complex cover at, and below, water level. Brash from tree thinning is pinned against the bank in alternating directions or increasing stem thickness, and is securely wired down or held with battens. The brushwood lattice provides niches for invertebrates and small fish, can create sinuosity, aids silt entrainment and provides a rooting substrate for plants to establish. In time (~3yrs) the brushwood ledge will become a vegetated berm if exposed to full sunlight.

Pic 31 – A low-level brushwood ledge created following tree thinning. Brushwood can be used to protect banks from erosion, to create in-channel sinuosity and to entrain silt and sand. They are particularly effective for enhancing low-flow rivers.

- Flow deflectors: these features can be used to increase flow diversity and bed scour. They can be simple log deflectors or tethered tree stems.

The complex flow that arises creates depth variation, initiates sinuosity, provides cover and aids sediment sorting.

Pic 32 - A flow deflector used to focus flow and scour into the centre of the river.

- Tree-hinging would be a simple first approach to managing the tree stock whilst providing cover at water level (pic 33). The process and benefits of tree-hinging has already been discussed on page 15.

Pic 33 - An example of tree hinging, a simple and effective technique for increasing cover in a river.

The river is disconnected from its floodplain. Firstly, as result of an incised channel from past dredging, and secondly due to levees which prevent over-topping of the banks. Removal of levees would assist the movement of floodwater onto the floodplain especially on the left bank.

Re-grading of the river’s banks could enhance the low-flow channel, allow better floodplain connection, create new marginal habitats and improve the overall feel and setting of the river.

Pic 34 – Before and after views of bank re-grading work on the River Shep to enhance floodplain connection and low-flow resilience.

The Himalayan balsam control is to be applauded and appears to be having results; it should be continued to eradicate the plant before it becomes dominant throughout the BRC reach.

The removal of the weir (or its partially notching) should be investigated with options put forward for consideration. Removal will allow fish passage, sediment transfer and reduce flood risk to BRC with no on-going maintenance issues or costs.

The River Granta through BRC is a degraded chalk stream with much potential to be enhanced to bring biodiversity gain and to improve its aesthetics. The fact that fish were observed (albeit not trout) is encouraging and points to its potential. It would not take too much effort to improve the river through the management of the tree stock and utilise the brash and timber for in-river structures. The WTT could work with BRC to produce a project proposal as a next step to taking forward a package of improvements.

## 5.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the River Granta require written EA consent prior to their implementation, either in-channel or within 8 metres of the bank.

The Wild Trout Trust can provide further assistance in the following ways:

- Assisting with the preparation and submission of an Environmental Permit to the EA (formerly referred to as Land Drainage or Flood Defence consents), or by identifying appropriate exemptions to take forward small-scale habitat improvement works.
- Running training days to demonstrate the techniques described in this proposal.

We have 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 material, enhancing fish stocks and managing invasive species.

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

The WTT website library has a wide range of materials in video and PDF format on habitat management and improvement:
www.wildtrout.org/content/library

## 6.0 Acknowledgement

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## 7.0 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. Accordingly, no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon comments made in this report.