Advisory Visit

River Welland, Duddington, Northamptonshire

July 2018

Undertaken by Rob Mungovan

Key findings

- Juvenile brown trout (parr) habitat is limited. The shallow riffles have become degraded in the low summer flows and could be enhanced.
- Many areas are over-deep due to past dredging. Restoration of the former bed level could be undertaken through the importation of suitable stone and gravel in order to restore the bed profile.
- Fallen trees and trailing branches should be retained at water level. If fallen trees present a flood risk they can be securely pinned to the bank.
- Tree-hinging could be used to increase cover at water level (and even below water) and could be combined with a strategic approach to managing the existing tree stock.
- Retain the fully tree-lined reaches due to the value of shade and its cooling affect.
- The invasive non-native plant, Himalayan balsam, was present and should be eradicated.
- The cattle drink is a source of fine sediment input to the river.

1.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the River Welland at Duddington 24th July 2018. The weather conditions were in the midst of a heat wave which had seen no rainfall for approximately 50 days, consequently the river flow was significantly reduced and filamentous algae was reported to be worse than usual. Comments in this report are based on observations on the day of the site visit.

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

The visit was undertaken at the request of the Duddington Fly Fishers. Peter Barham of the Duddingham Fly Fishers, and the Welland Rivers Trust, was present for the visit.

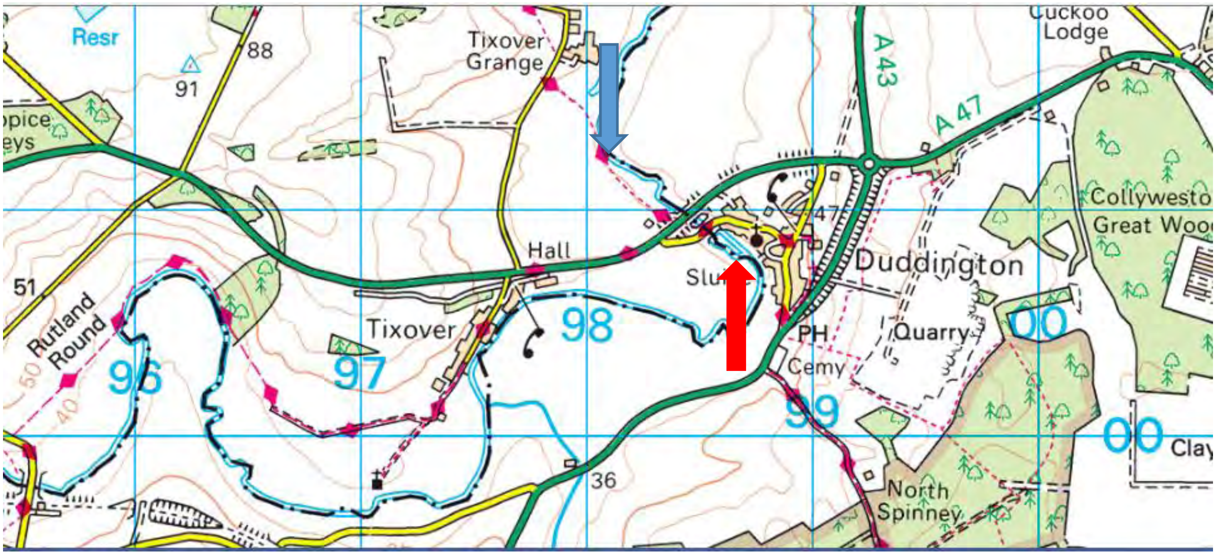
2.0 Catchment Overview

The Welland rises at Sibbertoft in Northamptonshire, then flows generally northeast to Market Harborough, Stamford and Spalding, to reach the Wash near Fosdyke.

The reach visited flows through the Rockingham Forest National Character Area and is typified by a broad, low, undulating ridge underlain by Jurassic limestone. The distinct scarp and ridge of the area are comprised mainly of Jurassic limestones, with shallow or exposed Lincolnshire limestone formation and Northampton sand formation rocks along the river valleys. Boulder clay caps the plateau, giving rise to heavy soils. Historically, the heavy clay soils within Rockingham Forest deterred widespread clearance for cultivation, so many of the woodlands present today are ancient.

Land use in the vicinity of the Welland is mainly permanent pasture with deciduous woodland and arable cultivation. Along the reach walked no cultivation extended to the river, extensive buffer strips (>10m) were observed on the RB. The land use is mainly grassland with some arable.

The Welland received no tributary streams within the reach visited.



Map 1 - Location of the River Welland, Northamptonshire. Red arrow is upstream limit and blue arrow is downstream limit. Scale 1:50,000, 1 grid square = 1 km2, © Ordnance Survey.

	River Welland
River	River Welland
Waterbody Name	Welland – confluence of Langton Brook to confluence of Gwash
Waterbody ID	GB105031050580
Management Catchment	Welland Upper
River Basin District	Anglian
Current Ecological Quality	Overall classification of Poor for the 2016 cycle
U/S Grid Ref inspected	SK 9870100798
D/S Grid Ref inspected	SK 9815301525
Length of river inspected	~1100m in total

Table 1 – Data from http://environment.data.gov.uk/catchment-planning/WaterBody/GB105031050580

Under the Water Framework Directive (WFD), the waterbody is not designated as a 'Heavily Modified Waterbody' and so is assessed against 'Ecological Status'. The waterbody achieves an overall classification of 'poor' due to its rating for phosphates.

Tables 1 and 2 summarise the environmental data collected for the WFD assessment for the Welland. In the last (2016) assessment cycle, it was classified 'poor' ecological status. Parameters that make up this overall classification include 'good' for fish, 'high' for invertebrates (2014), and 'moderate' for physio-chemical quality elements. The 'poor' classification for phosphates has brought the overall quality status down. The extensive macrophyte and algal growth is an indicator of the high phosphate loading of the water. Excessive weed growth may lead to water quality problems particularly in periods of low flow and high temperatures when vegetation can cause a wide diurnal oxygen fluctuation, resulting a sag in dissolved oxygen levels at night. However, during the visit no fish were seen in distress.

Classification Item	2013	2014	2015	2016
Overall Water Body	Moderate	Moderate	Moderate	Moderate
Ecological	Moderate	Moderate	Moderate	Moderate
Supporting elements (Surface Water)	Moderate	Moderate	-	-
Biological quality elements	Good	Good	Moderate	Moderate
Macrophytes and Phytobenthos Combined	-	-	Moderate	Moderate
Fish	Good	Good	Good	Good
Invertebrates	High	High	-	-
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	Moderate	Moderate	Moderate	Moderate
Acid Neutralising Capacity	-	-	High	High
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	Poor	Poor
Temperature	High	High	Good	Good
Specific pollutants	High	High	High	High
Chemical	Good	Good	Good	Good
Priority substances	Good	Good	Good	Good
Other Pollutants	Good	Good	Good	Good
Priority hazardous substances	Good	Good	Good	Good

Table 2 – Data from http://environment.data.gov.uk/catchment-planning/WaterBody/GB105031050580

The reach visited is fished by the Duddington Fly Fishers. They are a syndicate of 10 anglers who have access to seven miles of the Welland. They undertake a low level of stocking placing £500 worth of triploid brown trout into the river (equating to ~70 fish up to ~45cm). The main angling period is from the start of the season up to the mayfly period (June). After that the river is affected by low flows and weed growth. The river holds a population of wild brown trout and redds have been observed by members. Fish, believed to be wild, of up to 4lb are caught in most years.

Downstream of the Duddington reach is Tixover Grange. The river at that location became over-shaded by mature trees and the river's plan form appeared to have been straightened most probably for historic parkland establishment. The river was not walked at Tixover Grange.

The river is not subject to any statutory nature conservation designations.

No signs of otter nor water vole were seen.

3.0 Habitat Assessment

The visit commenced at the downstream of end the fish pass at Duddington Mill (pic 1). The fish pass has been constructed to provide a naturalistic pool/cascade channel to allow fish to ascend the weir that retains a head of water behind the mill. The fish pass has been constructed from large limestone blocks which should weather-in given time and should become partially vegetated as plants gain a foothold in cracks and trail down to the water. The fish pass also appeared to have an eel pass attached to it which is strange as one would have expected the channel to have been passable for eels if it had been designed to be passable for coarse fish species (the dominant species in this reach of the Welland). The occurrence of the eel pass simply introduces an additional maintenance requirement.

Pic 1 – The outfall from the fish pass channel. The fish pass was competed in 2013.

As the river was followed downstream its width varied from ~4m to ~6m with a maximum depth of ~1m. The banks were relatively steep and provided only a minimal vegetated fringe. Vegetation upon the banks (where not shaded) was dominated by nettles and willow herb. Where the bed rose there were shallow glides (possibly riffles in better flow conditions). The shallow glides were dominated by coarse substrate which contained a high percentage of fines. It is doubtful that these glides could provide suitable spawning and parr habitat in their present condition.

Tree coverage was extensive in a number of locations which suppressed the vegetation growth within some pools and provided important water cooling.

Whilst shade is important for keeping rivers cool, too much shade will suppress the growth of aquatic and marginal plants. This can lead to a reduction in plant diversity and a subsequent decline in invertebrate numbers. Thus a balance needs to be struck. Furthermore, fine sediment input may increase as banks are left bare of vegetation and become prone to erosion if tree roots are not able to bind fine sediment.

Pic 2 – A short distance downstream of the fish pass the channel was shaded by willows. The shade cast prevented the channel from becoming extensively choked, and it cooled the water.

Pic 3 – This glide (or low energy riffle) barely has enough water velocity to cleanse algae from the surface of the pool. Narrowing the channel through a combination of berm creation and flow deflectors may energise the flow suitably to keep the pool clear.

Pic 4 – Slower and deeper glides were becoming dominated by common club rush. The most sustainable means of addressing their growth would be to undertake bed raising with imported gravel and stone to create a self-cleansing channel that is in a better balance with the flow velocities normally conveyed by the river.

As the historic Duddington bridge was approached a favoured angling glide was pointed out (pic 5). That glide is ~3.5m in width and ~0.8m deep, and was not excessively weeded-up. It might be possible to use the channel dimensions for proposing new glide habitats.

Pic 5 – There was one glide of ~20m in length that was still able to maintain an open channel. The bed varied from ~0.7m to ~1m with a width no greater than ~3.5m.

Upstream of the Duddington bridge the bed rose to form a riffle (pic 6). It is likely that the bed rise is actually the original bed level and was not dredged for fear of damaging the bridge footings. The occurrence of a raised bed provides a very useful template for bed restoration extending upstream to the tail of the weir pool downstream of the fish pass.

Pic 6 – A riffle is present immediately upstream of the Duddington bridge, most probably indicating the original bed level.

The channel is shallow and wide downstream of the bridge for ~15m (pic 7). Water cress was growing from the LB and will provide some degree of natural narrowing and marginal cover throughout the summer months. The weeping willow on the RB is suppressing marginal growth and subsequent narrowing from the RB.

Wide shallow areas (riffles) can be important for invertebrate production and fish spawning, and should not be narrowed without understanding how they perform at normal flow conditions. However, at the time of the visit, the shallow areas could be enhanced through the use of flow deflectors to increase water velocity and bed scour.

Pic 7 – The view from the Duddington bridge. Note the input of fine sediment from the cattle drink (red arrow). Sediment will increase the river's nutrient loading. The occurrence of filamentous algae (blue arrows) is indicative of high nutrient loading, especially of phosphates.

The bed of the channel immediately below the bridge was abundant in coarse substrate but it was overlaid by high amounts of sand and silt, in addition to brown algae (pic 8). Increased water velocity may enable the river to cleanse itself better. The author was informed that the river is usually in better condition at this location in a normal flow year.

Pic 8 – The bed downstream of the bridge consisted of coarse substrate overlain by sand and algae.

Downstream of the bridge a perched ditch met the river (suggesting how much bed lowering may have occurred during dredging). The ditch had been dredged earlier this year resulting in a large number of stones being removed from its base. Consequently the soft base of the ditch has been disturbed as animals have sought water, resulting in silt entering the river. The stones could be collected and placed back in the base of the ditch or be placed within the adjacent cattle drink to provide some hardstanding to reduce silt input.

Pic 9 – This small feeder ditch is a significant source of fine sediment to the river.

Throughout the length of the reach visited herbicide had been used to control broad-leaved plant growth beneath the fence, it also extended down the slope of the bank (pic 10). The use of herbicide in this manner is detrimental for a number of reasons. Firstly, the herbicide is killing off the bankside and marginal plants that are host to a wide diversity of invertebrates. Those invertebrates may in turn may become food for fish. Secondly, bankside plants will be contributing to bank stability. Thirdly, the bankside plants control the run-off of soil particles which may otherwise enter the river.

Pic 10 – Herbicide has been used extensively to kill vegetation at the top of bank beneath the fence. The use of scaffold poles also detracts from the naturalness of the river side setting. Electric sheep netting would be a better alternative.

After the shallows downstream of the bridge there is a large pool. The pool could benefit from further cover to increase habitat for adult fish. The placement of tree-top flow deflectors would be suitable and may enable the scouring flow to be deflected further downstream rather than dissipated at the head of the pool.

Pic 11 – A deep (~1.5m) and wide (~8m) pool above the A47 bridge. This pool appears to receive scouring flow from the shallow reach downstream of Duddington bridge.

Pic 12 – This pic was taken ~10m downstream of pic 11. The water velocity has slowed enabling bur reed to become established mid-channel together with a floating raft of reed sweet grass (red arrow) and filamentous algae. This is not what is expected in a river fished for wild brown trout.

The A47 bridge results in an over-wide channel (~12m) and a consequential further slowing of the flow. The bridge's footings are formed of stone setts in concrete which provides minimal habitat for vegetation. Whilst the relatively high level of the bridge deck cast little shade, due to depth and poor marginal habitat very few plants grew beneath the bridge. As such there was no natural narrowing of the channel. Yellow water lilies were growing mid-channel along with bur reed where the bed was not too deep. Long deep reaches have little flow diversity and are not going to support high numbers of wild brown trout due to poor habitat diversity and competition.

Pic 13 – Trailing willow branches at water level provide an important habitat for both fish and invertebrates.

Downstream of the A47 bridge the channel becomes more sinuous. The increasing sinuosity aids sediment transfer with consequential deposition at margins, and berm formation on the inside of some meanders. This is desirable but it was clear that sheep were able to graze the riparian plants (mainly reed sweet grass) as many had been reduced in size and now provide less cover. The soundness of the fence should be checked.

As the water velocity slowed and the channel deepened once more, common club rush became particularly prevalent with stands mid-channel further slowing the flowing. The mid-channel stands of vegetation collected drifting plant matter and algae.

Pic 14 – A riffle with water crowfoot growth almost entirely smothered by filamentous algae.

Occasional riffles were observed and represent important juvenile brown trout habitat in a river much restricted in such habitat. Sadly at the time of the visit the water crowfoot had been almost overgrown by filamentous algae (pic 14). Water crowfoot is important for retaining water depth, increasing in-channel cover, providing shade, and for providing a spawning substrate for many coarse fish species. The plant is typical of clean swift flowing rivers.

Tight amongst the banks where the trailing reed sweet grass overhung, there was a clear pathway for flow and it is these runs that juvenile trout will be occupying. However, as the river has becomes affected by hot weather and low flow, competition for these lies will increase.

Wild brown trout require diverse habitat, food, spawning and nursery areas as well as good water quality. Vital aspects of habitat diversity are created through active geomorphic processes which are a product of gradient and stream power, causing erosion and subsequent deposition. As sediments are transported they will be deposited according to flow. This may enable the development of riffles which are extremely important as fish spawning areas. Trout (as well as chub, dace and minnows) will spawn upon well-sorted gravels (particularly in the range 15mm to 40mm) that are relatively stable within a river. Pool and riffle sequences provide valuable habitat diversity for juvenile trout (within the shallow riffles and glides) which keeps them from competing with (or from being eaten by) adult trout (who tend to favour the cover of deeper water). From observing an adult trout, it is clear that trout are using the deeper pool habitats. Whilst adult trout can use deep water with relatively strong flows, juvenile trout need to seek out areas away from adults. They will often find such habitat in shallow riffles or densely vegetated margins. The Welland did not have extensive riffles. Whilst adults may be able to find spawning areas it is considered that juvenile habitat is currently acting as a bottleneck to the river containing greater numbers of wild brown trout.

Pic 15 – A shaded pool habitat where a large trout (~40cm) was seen together with a number of chub.

Pic 16 –Berms provides an important transition from the dry top-of-bank habitat to the damp marginal habitat. The gradual transition increases the available niches for specialised plants and invertebrates.

Fallen trees, large branches and stems are collectively referred to as large woody material (LWM). The presence of LWM is extremely important within a river. It increases the available surface area on to which algae will grow and undertake photosynthesis thus initiating nutrient cycling. The algae can also become a source of food for invertebrates thus increasing the total biomass that a river can support. LWM can also provide underwater cover, offering protection for fish against otters or fish-eating birds. LWM is also a key element in kick-starting geomorphic processes such as bed and bank scour, leading to the development of natural river features such as pool and riffle sequences (where gradient allows). Furthermore, the sorting of bed load material can encourage the marginal deposition of fine sediment or may enable it to be deposited upon the floodplain when out-of-channel flow is experienced.

Pic 17 – The occurrence of trees trailing down to water level should be encouraged as this type of feature provides excellent overhead cover for fish.

Fallen trees can be managed to retain their habitat value by winching them to a secure bankside position and securing them with stakes and/or cable rope. Where riparian trees require thinning and their habitat potential as fallen LWM would otherwise be removed, a technique known as tree-hinging can be used (pic 18). Tree-hinging is similar to hedge laying in that it retains a living hinge that secures the cut stem to the tree stump. The hinge continues to allow the tree to live so structural strength is retained. With the tree-top laid at water level it provides excellent over-head cover, flow deflection and a spawning substrate for many coarse fish. These two approaches would be suitable for some of the trees within the reach visited.

Pic 18 – An example of tree hinging, a simple and effective technique for increasing cover in a river.

Trailing branches are particularly important as overhead cover for a wide range of fish, especially trout, creating micro-pocket water and increasing the number of lies within a river. The branches also present opportunities for invertebrates to fall into the channel where they become food for fish. Branches that extend into the water may provide a means for some aquatic invertebrates to return beneath the water in order to lay their eggs.

Sheep grazing presents a problem to river banks. Sheep graze plants to a very low level, repeated grazing often results in only grasses surviving. Tree saplings are completely grazed-off resulting in a loss of the future tree stock. With only grasses to bind the soil, run-off can result in the release of fine particles from the soil to the river, and without any strong root system (that trees would provide) the banks become susceptible to collapse. That situation is occurring along this reach of Welland, and whilst the banks may reach a shallower angle (which was cited as desirable for the anglers) the toe of the bank is unprotected. An unprotected bank is likely to be washed away in high flows resulting in a large volume of fine sediment entering the river. Fine sediment will degrade the riffles and fill the pool habitats.

Pic 19 – Although a fence is in place sheep have been able to graze to water level. A fault line is emerging beneath the fence. Once the ground becomes wet it is likely that rotational slumping will occur along the fault line resulting in the loss of a substantial volume of bank material to the river. Even without bank failure, the over-grazed soil has left fine sediment to be washed into the river.


Pic 20 – At some locations the excessive plant growth appeared to be holding back the flow resulting in almost static conditions.


Pic 21 – Total channel tree coverage provides an important refuge area for fish and prevents total encroachment by vegetation.


Pic 22 – Himalayan balsam is present throughout the majority of the reach, but at its lower end it was starting to form dense monoculture stands.

As an invasive non-native species, Himalayan balsam presents a serious risk to the Welland. The plant is spread by seeds and is very adept at colonising riverbanks. Once present, its tall growth enables it to outcompete many native plants. The balsam then establishes monocultures further reducing low-growing species, such as grasses, which are crucially important for binding the soil. Furthermore, balsam dies-off in the winter leaving riverbanks almost completely devoid of vegetation and prone to erosion by rain and scour. It is far better to undertake control of balsam when it is in low numbers before it becomes a problem.

The use of LWM in the form of brushwood mattresses could help to speed up deposition and consolidation of fine sediment. Stable silt bars then provide an opportunity for colonisation by vegetation and provide further marginal habitat for invertebrates.

Pic 23 – Selective narrowing and/or the use of flow deflectors could retain water velocities capable of preventing the establishment of algae upon the water crowfoot.

Pic 24 – opposing bankside trees provide total cover to the channel. Strategic tree planting could establish similar stands of trees for the future benefit of the river.

4.0 Recommendations

The river is limited in juvenile brown trout habitat. The shallow glides present an opportunity for safe in-channel working. It would be possible to conceive a habitat enhancement scheme to increase the juvenile trout holding potential of the river through the application of approaches such as flow deflectors, brushwood berms and the fixing of LWM to the bed. The WTT would be able to provide further support on this issue. These habitat enhancement approaches alone cannot bring about true river restoration

The river has been over-dredged and Duddington Mill prevents the downstream transfer of coarse sediment. The river is unable to restore its proper bed profile without significant intervention. The newly constructed fish pass means that the mill and its associated weir will stay in place. The usual approach to addressing historic dredging is to undertake bed restoration through the placement of gravel and stone. However, it may be possible to utilise the bank material (if it is clay) to undertake a cut-and-fill exercise. This would see the cross sectional area of river widened to create a 2-stage channel and the spoil (clay) being used to raise the riverbed, followed by its immediate top-dressing with gravel. This approach would significantly reduce the amount of material needed to be brought to site, would reduce the total cost and could provide some additional flood storage capacity.

Restoration of the river bed to the level that is was pre-dredging would enable the establishment of proper sediment transfer through the processes of scour and deposition. The reach of river upstream of Duddington bridge back to the fish pass would be suitable for bed raising as the weir in that reach of river already controls the upstream level, and hence defines the extent of flood risk as opposed to the river bed itself. Before river bed restoration can be properly proposed it would be advisable to undertake longitudinal bed and bank level surveys in order to better understand the bed gradient and top-of-bank heights. The EA may also have cross sections used to inform the recent fish pass work, and they may even have pre and post dredging surveys. Gravel (to create riffles) has been placed into the Welland downstream of Harringworth viaduct. It has been successful in terms of diversifying flow and providing juvenile brown trout habitat.

Tree planting could address bank instability in the medium to long term. Any tree planting would need to be set-back to allow the trees to establish a strong root system before the bank becomes unstable. Alternatively (or in combination), quick growing willow species could be grown at the toe of the bank with the intention of laying them to give a greater degree of bank protection once they are above top of bank height. Trees particularly valuable for planting adjacent to rivers include willow species, common alder, native black poplar and hazel.

Tree management should also have regard to the need to retain trees, particularly over pools, for their shading to aid summer cooling and for controlling vegetation growth. Trailing branches at water level should not be removed unless absolutely necessary as trailing branches will increase the number of lies within a river for brown trout.

A low number of fallen trees were present and represent important habitat features. Regard should be given to stabilising those that can be retained. Trees can be winched to the sides (and even be partially underwater), and then be staked into position (cable rope can be used if extra strength is needed). To remove naturally occurring fallen trees would result in habitat degradation.

The Himalayan balsam should be eradicated through pulling or strimming (below the first growth nodule) in order to prevent it from forming further extensive monocultures.

5.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the Welland 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).

- Running a training /demonstration day 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/product/rivers-working-wild-trout-dvd-0 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

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programme in England, through a partnership funded using rod licence income.

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.