Advisory Visit

River Bure, Blickling Estate, Norfolk

December 2017

1.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the River Bure, National Trust's Blickling Estate, Norfolk on 7th December 2017. Comments in this report are based on observations on the day of the site visit and discussions with James Tibbitts (Blickling Angling Club), Stuart Banks (National Trust) and Emily Long (National Trust).

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

The reach of the River Bure visited is part of a fishery managed by the Blickling Angling Club who rents the fishing rights from the National Trust. Blickling Angling Club stocks 500 brown trout annually in sizes ranging from 1lb to 1¼ lb. The club has 40 members who are able to fish 4 miles of water.

Water clarity was good during the visit. However, severe weather (driving wind and rain) for part of the visit prevented views beneath the water and has affected the quality of some pictures.

2.0 Catchment Overview

The River Bure at Blickling is in the upper reaches of the catchment and is still a relatively small river with an average width of ~6m. It receives flow from a number of tributary streams most notably The Cut above Itteringham, the stream from Mosseymere Wood, the stream from Ramsgate Street and the Black Water. The nearest main town is Aylsham which is over 7km downstream. The Bure sits within a predominately rural catchment and flows south east on to the Broads at Aylsham. The whole of the catchment is a Nitrate Vulnerable Zone for eutrophic groundwater.

The Bure valley falls within the Central North Norfolk National Character Area which describes it as a gently undulating rural landscape.

Like most rivers, the Bure has been modified and straightened over the centuries and contains numerous mills, weirs and sluices. The mosaic of wetland, woodland and grassland habitats found in the river valley provides a diversity of habitat when contrasted with the intensive arable production on the drier soils within more elevated areas of the catchment.

Where the ground water is high, peat soils and alluvium occur. Beyond the river valley, above the chalk, the landscape is freely draining leading to slightly acidic loamy soils.

Land use adjacent to the Bure is deciduous woodland and pasture. The woodland and Rough Pasture Carr showed no signs of active management and included species of oak, ash, willow and alder. The pasture is described as "good quality semi-improved grassland" and falls within a target area for Countryside Stewardship restoration for lapwing and farmland birds. The pasture is shown as being within Countryside Stewardship (source www.magic.gov.uk/website/magic/) and was crossed by a network of drainage ditches. Maps show an extensive network of ditches along the river's floodplain which suggest that this was a former water meadow system.

The River Bure at Blickling is not protected by any statutory nature conservation designations but once it enters the Broads it then becomes part of an internationally protected wetland environment, the Norfolk Broads National Park and Ramsar site. The Broads are also protected under the UK Habitat Regulations as a Special Area of Conservation (SAC) and Special Protection Areas (SPA).

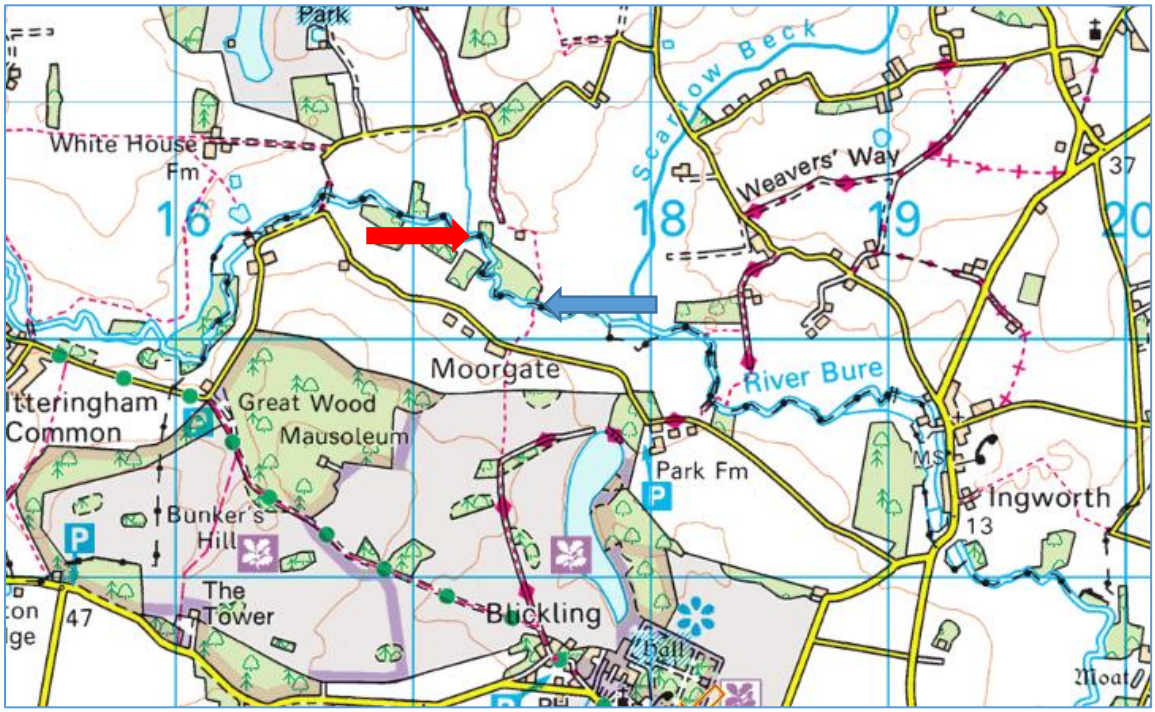
The Bure no longer holds the white-clawed crayfish at Blickling. Unfortunately it holds a large population of non-native invasive signal crayfish (*Pacifastacus leniusculus*).

The Bure is known to hold a population of water voles (*Arvicola amphibious*) and it is likely that they are present at Blickling. Water voles and their habitat receive full protection under the Wildlife and Countryside Act 1981 (WCA 1981), as such any works on the site should not negatively affect the water voles nor their habitat.

Otters (*Lutra lutra*) are known to be present on the Bure although no field signs were found at the time of the visit. Otters and their habitat receive full legal protection under the WCA 1981.

Bats are very likely to be in the vicinity of the Bure. Bats may roost in trees, within rot holes, stem fissures and/or peeling bark. If such trees are to be removed to facilitate river improvements then the potential for damage or

destruction of bat roosts must be considered. Bats and their habitat receive full legal protection under the WCA 1981.



Map 1 - Location of visit to River Bure near Blickling, Norfolk. Red arrow is upstream limit and blue arrow is downstream limit. Scale 1:50,000, one grid square = 1 km², © Ordnance Survey.

Map 2 – Close-up view of River Bure showing its sinuous planform and associated water meadow system. Red arrow is upstream limit and blue arrow is downstream limit. © Ordnance Survey.

Table 1 summarises the environmental data collected for the Water Framework Directive (WFD) for the River Bure. In the last (2016) assessment cycle it was ranked as overall 'poor' ecological status. Parameters that make up this overall ranking include a 'poor' ranking for fish, a 'high' for biochemical oxygen demand and invertebrates, and a 'good' ranking for dissolved oxygen and phosphate. There are no specific water quality problems known to be associated with the reach visited. No specific pollutants are listed and the chemical elements are listed as 'good'. This may suggest that it is the physical habitat of the watercourse limiting fish populations, particularly salmonids.

Table 1

River	Bure
Waterbody Name	River Bure (Upstream of confluence with Scarrow Beck)
Waterbody ID	GB105034055690
Management Catchment	Broadland Rivers
River Basin District	Anglian
Current Ecological Quality	Overall status of **Poor** ecological status in the 2016 assessment cycle and **Poor** in the 2009 assessment cycle.
U/S Grid Ref inspected	TG 17309 30339
D/S Grid Ref inspected	TG 17503 30139
Length of river inspected	~570m in total

Table 1 Data from http://environment.data.gov.uk/catchment-planning/WaterBody/GB105034055690

The Estate had recently undertaken some ditching work to the drainage system (the defunct water meadow system) that runs alongside the Bure. This work revealed a mix of valley peat, flints and chalk.

Picture 1 – Recent ditching work has revealed valley peat, alluvium and fractured chalk and flint. It is doubtful that any gravel could be from within the site.

3.0 Habitat Assessment

The riparian land use was considered good with regard to the general condition of the river. The presence of mature woodland led to a network of tree roots holding the bank stable along much of the LHB. The RHB is generally dominated by permanent pasture which is fenced to prevent animals grazing the marginal vegetation. This fenced buffer zone/anglers' path retains good marginal growth in places but areas that have been strimmed right up to the water's edge provided reduced riparian habitat quality. It would be beneficial to retain a greater marginal fringe.

A reason for the Advisory Visit being undertaken was the belief that signal crayfish are causing habitat degradation. The visit supports that view.

The pathway of damage is summarised as:

- Signal crayfish burrow into the alluvial banks.

- The burrow network extended back >75cm and creates a 'honeycomb' network beneath the anglers' path.
- The burrow network collapses under the weight of anglers.
- Slab failure occurs resulting in large sections of bank collapsing into the river.
- The bank material is then washed downstream resulting in a widening of the channel.
- The material is then deposited within slower reaches of the river leading to a smothering of the river bed with silt and sand.
- The widened channel then has less energy to scour away fine sediments, thus turning a gravel dominated river into one which is fine sediment dominated.

Picture 2 – Note how the ranging pole has been sunk into the bank, it had been pushed through a network of crayfish burrows.

Picture 3 – Note the slab failure collapse that is happening to this area of bank as crayfish burrows cause it to become weakened.

Picture 4 – Note how the bank (the anglers' path) has slumped down as crayfish burrows have reduced its structural integrity.

Picture 5 – Note how large chunks of the alluvial bank have been lost due to the burrowing action of crayfish.

As such, a number of recommendations with regard to increasing a river's resilience to crayfish are included in the recommendations.

The impact of signal crayfish is significant, as it is reducing the extent of vegetated marginal cover for invertebrates and fish (especially young fish). The club also reported that crayfish have affected the growth of aquatic vegetation. Where fine sediment settles, it can have a very negative effect upon the bed substrate and fauna. The sediment (silt and sand) has the effect of smothering the existing substrate and blocking the interstices between the gravel particles. This reduces interstitial flow significantly, degrading habitat for many species of aquatic invertebrate and potentially trout fry should spawning take place in the reach. The Bure receives a high loading of fine sediment, particularly sand, which is difficult for low-energy rivers like the Bure to mobilise due to particle weight. The material therefore tends to form bars which roll along the bed rather than being scoured away in high flows.

Picture 6 – Note the extensive sand deposition which is smothering the river bed and moving downstream in bars.

Picture 7 – Again, note the extensive sand deposition which is smothering the river bed and moving downstream in bars.

Picture 8 – Note the extensive sand deposition which is smothering the river bed and moving downstream in bars. This problem occurred throughout the reach inspected.

It was encouraging to see that no cattle watering was being allowed from the river. Cattle drinks can be a significant source of sediment and nutrient release to a river.

Within the reach visited there is no arable cultivation alongside the river. This is encouraging as it alleviates the risk of run-off or spray drift from agricultural practices. It is not known whether agricultural nutrient enrichment is a particular problem in the wider catchment. However, the fact that the river is within a Nitrate Vulnerable Zone flags up the river's susceptibility to agricultural practices. If excess algal growth is observed in the river, especially in spring, then that could be indicative of nutrient enrichment and should be monitored for.

Whilst the main reason for bank collapse is considered to be from burrowing crayfish, it was also felt that the tree canopy in places was starting to shade out marginal vegetation.

Picture 9 – The effect of shade cast by riparian trees is starting to restrict marginal growth. Note the gap in the reed sweet grass which is believed to be in response the shade cast by the oak tree.

Picture 10 – The effect of shade cast by riparian trees is also visible in this picture. Note the gap of vegetation which would have otherwise been growing beneath the hazel (red arrow) and upon the opposite bank (blue arrow). Additionally the growth on the LHB is mainly nettles. There is a minimal fringe on the RHB. In an unshaded environment one would expect significant marginal growth to extend out from the LHB and to be forcing the flow against the RHB as flow is drawn though this reach between two large meanders. This problem occurred on many of the reach's meanders.

Where the river banks receive direct sunlight the marginal vegetation was well developed and diverse and the riverside plants provide important marginal cover (even in winter). It was reported that the fishery is subject to annual work which sees paths maintained and bankside vegetation tidied-up. On the day of the visit the retained marginal growth was considered as achieving an acceptable balance between access and cover.

Picture 11 – Good marginal vegetation occurred where the channel receives direct sunlight. The marginal plants are able to narrow the channel resulting in a cleansing flow with the ability to transport sand and silt.

The in-channel vegetation is dominated by unbranched burr reed (*Sparganium emersum*), which can become very dominant in rivers to the point where it can prevent angling from late July if not managed. Furthermore, the burr reed has the habit of reducing flow velocity and increasing sediment deposition.

It has been reported by the club that herbicide (with EA consent) is used to control burr reed growth. Consideration should be given to whether this control method is sustainable or whether physical intervention of the river is required to bring more diverse flow conditions which naturally maintain a more desirable balance of aquatic plants. There are small patches of river

water crowfoot (*Ranunculus sp*), starwort (*Callitriche sp*) and lesser water parsnip (*Berula erecta*). All of these plants would be expected in chalk rivers; however, the dominance of burr reed suggests low flow velocities and fine sediment enrichment. One would hope that the three later species would be co-dominant.

Owing to the timing of the visit, the marginal plants were in the process of die-back. However, the following species were observed: watercress (*Nasturtium officinale*) water forget-me-not (*Myosotis scorpioides*), branched burr reed (Sparganium erectum), reed canary grass (*Phalaris arundinacea*) woody nightshade (*Solanum dulcamara*) and lesser pond sedge (*Carex acutiformis*).

The presence of large trees along the river is desirable but it is also important to maintain a diversity of direct sunlight and shade. This issue could be reviewed in summer with shade-casting trees marked for laying, thinning, pollarding or crown lifting.

Mature trees are highly desirable, not just as cover for invertebrates which in turn may fall in to the river, but as sources of large woody debris (LWM) to the channel, which is extremely important. LWM provides cover for fish and invertebrates, and can also kick-start the processes of scour and sediment transport, thus aiding natural geomorphic processes.

No active tree management was observed during the visit. In addition to managing mature trees together with the understorey species of hazel, consideration should be given to new planting to ensure that as old trees are lost a new stock is coming through.

The river's morphology was attractive and visually interesting. Whilst the river's width could be considered to have an average at ~6m, there were some sections that were narrowed by marginal vegetation to produce faster glides with widths nearer to 4m. The majority of the largest meanders had widths in excess of 12m. This may be in response to high flow, or possibly now due to shading of marginal vegetation as it was noted that few had vegetated meander point bars.

Picture 12 – Note the lack of a vegetated meander point bar (where the ranging pole is). A vegetated bar is normally present on the inside of meanders. In addition to narrowing the channel and forcing a cleansing flow against the outside bend, it would also act to entrain fine sediments as they are transported downstream.

However, the overwide meanders were acting as sand traps with flow in places taking the path of least resistance rather than sweeping flow against the outside of a meander as one would expect. The silting up of deep meanders with sand is taking away deeper lies from the river and will have an impact upon the numbers of adult trout. This will lead to increased competition between fish, especially stocked fish who tend to favour slower pools due to them be less fit than wild fish. Furthermore, dominant wild fish may have to spend more time chasing off stocked fish from such pool habitats.

The river had been dredged in the past as levees of dumped material were present with semi-mature trees growing upon them (see over for picture 13).

Picture 13 – Note the raised levee which the ranging pole is being held on. If the dredged material has a high gravel content it might be suitable for re-use within the river. But removing many semi-mature trees to source it might not be desirable or cost effective.

The angling club does not know when the river was dredged. Despite the dredging, the river still exhibits many meanders, suggesting that it was not straightened (possibly due to it having a water meadow system). The dredging has resulted in some meanders having raised promontories (see picture 14 over page).

Picture 14 – Note the raised ground as a view back to the river is taken. Raised features such as this could (subject to an environmental permit) be pushed back in to the river to aid the process of meander point bar development and geomorphic processes such as meander scour and sediment transport.

Picture 15 – Note the short riffle (blue arrow) as a result of local scour which occurred after a meander. This location also had a well-established marginal fringe which was maintaining a channel width of ~5m with subsequent diversity of flow (instead of smooth laminar flow which was observed in many over-wide locations).

Deep pools (up to 1.5m) were often associated with the longest meanders. The bed material consisted of gravel ranging from 20mm to 60mm in a well sorted manner. However, the gravels were suffering from extensive smothering by sand (see pictures 6 to 9).

The river banks are generally low at the water's edge and graded back through marginal vegetation to the anglers' path, then rising further to the adjacent pasture on the RHB. The woodland areas tend to be on lower ground, were shading is limiting the growth of vegetation growth and bare alluvial bank faces can be seen. The river appears to have good connectivity to its floodplain with no flood barriers observed (except for an occasional dredging mound).

Picture 16 – Note the relatively low ground level of the adjacent pasture land. The river has the ability to connect to its flood plain relatively easily in most locations.

There was one low stone weir (see over for picture 17). This feature had been constructed many years ago and its purpose was to funnel low flows, and to create a local area of broken water. This feature is not considered beneficial to the river as it is hindering sediment transfer (especially of coarser material). In low flow periods, the weir may create an area of broken water immediately downstream of it, but it will be impounding a section immediately above. The benefit of local scour associated with a weir is almost invariably negated by the degraded (impounded) habitat above it.

Picture 17 – A low stone weir constructed from large flint stones. Note how the feature is covered by fine sediment and retains a “head” of sand upstream where additional fine sediments are deposited. This structure will also be providing adult crayfish habitat. This structure should be taken out or at the minimum have its central third removed so that the stones act as a throttle point to flow rather than impeding it and sediment transfer.

Overall, the river had an appearance of channel and bedform stability. The most active forces appeared to be the burrowing habit of crayfish and the consequential smothering of the bed with sand.

In a number of locations there were fallen tree limbs which catch vegetation and create flow diversity. These features are excellent holding areas for trout and where they occur they should be retained and managed (i.e. made secure with posts and wire). The creation of similar such features would benefit the river’s natural processes and increase the fish holding capacity of the river (see over for picture 18).

Picture 18 – Large woody material has fallen into the channel. It has then collected floating matter which is turn will be harbouring invertebrates and provides overhead cover for trout.

Picture 19 – Large woody material has fallen into the channel and has collected further floating matter. This natural occurrence can be easily replicated by the technique of tree laying (or hinging) to increase the trout holding capacity of the river.

Picture 20 – At this location live woody material has caused debris to build-up against it. In addition to the benefits listed above this material will be forcing the flow of water downwards as it moves past it, thus increasing bed scour.

Whilst the signal crayfish are believed to be causing an input of silt and sand within the fishery, land management practices within the wider catchment should be considered. It may be possible that further inputs of sand are being transported from upstream and are simply settling out in a reach that is already starting to suffer the effects of over-widening due to the discussed factors.

The angling club have not observed trout spawning within the river. If trout were to find suitable substrate to spawn upon (there were a number of suitable locations but they were limited in their extent) then the issue of fry and parr survival must be considered. At present the limited number of shallow riffles would push juvenile fish into the adult habitat where they would be susceptible to predation. This population bottleneck should be addressed if a sustainable brown trout population is to be established.

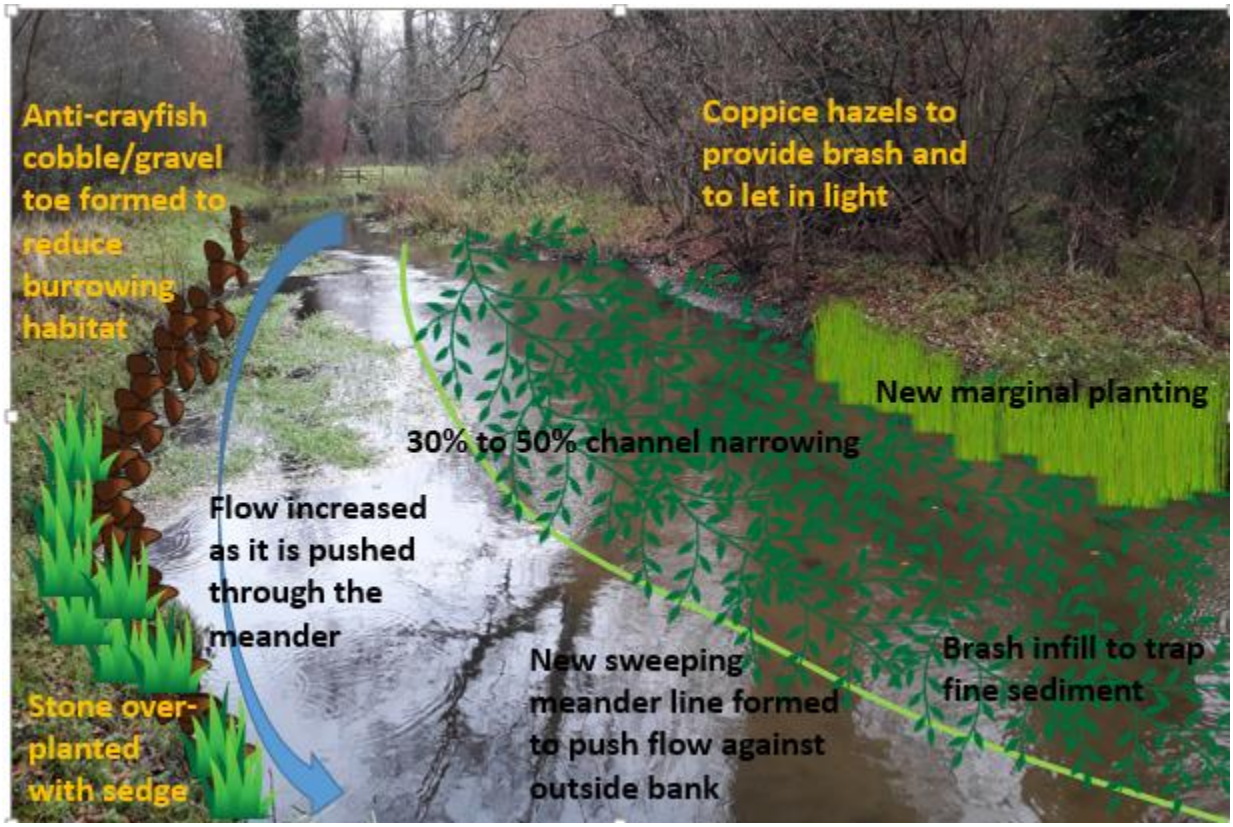
4.0 Recommendations

The presence of LWM within the channel should be welcomed, seen as valuable habitat and be positively managed. There were a number of fallen tree limbs which were gathering plant matter against them. These natural habitat enhancements can be secured using posts and wire, and do not require the consent of the Environment Agency if one is reducing the flood risk posed by such occurrences.

Consideration should be given to introducing further LWM in order to increase scour of sand from the bed. Mobilising the sand will only be truly beneficial if it has a point for sediment entrainment (or else it will continue to move down river as sand bars). One means of fixing the sand would be to create low level brash berms or to introduce flow deflectors. Berms should be set below the river's lowest level and be relatively open fronted with material aligned so that it encourages deposition within the structure it.

Picture 21 – Examples of low level brash berms created on the River Misbourne following tree thinning work. Brash berms can be used to protect banks from erosion, to create in-channel sinuosity and to entrain silt and sand.

The river is overwide in many locations. Channel narrowing using brash berms to re-align the flow within the existing channel would be beneficial. This could form the basis of a significant restoration project on this reach which would see tree thinning used to provide a source of woody material used for the benefit of the river.



Picture 22 – An annotated picture to illustrate how various habitat enhancement approaches could be used to improve the River Bure's wild brown trout holding capacity.

With regard to the signal crayfish issue, the creation of brash berms could provide further cover for adults. The club may wish to undertake a similar approach to that done on the River Lambourn at Hunts Green (see www.therrc.co.uk/sites/default/files/projects/p306.pdf). At that site the river was narrowed and a firm base of mixed-grade gravel was firmly bedded against the bank toe to produce a small bar which prevented scour from the river and burrowing by crayfish. This work was done extensively (>1mile). It has significantly reduced the adult holding capacity of the river which has led to a collapse in crayfish numbers (although not total elimination). However, the Bure is a more challenging river to undertake such work upon but it may be possible to strengthen some banks whilst undertaking a habitat enhancement scheme.

Picture 23 – The firm base created by compacted gravel against the bank toe had significantly reduced the burrowing opportunities for adult crayfish on the River Lambourn.

Picture 24 – On the River Lambourn, the compacted gravel bar had also been extended out to create a low level berm. That enabled marginal vegetation to grow out in to the channel producing natural channel narrowing at a range of water heights.

The river did not appear to be deficient in natural gravel. There were many exposures of coarse bed material, some local scour areas could even be suitable for brown trout spawning. Gravel cleaning methods, such as raking or water jetting, are not considered appropriate at present due to the problem posed by the excessive amount of sand. Gravel cleaning would simply introduce more sand into the water column, and the cleaned patches would become covered with sand again.

Tree management is considered necessary as it is evident that some trees are now casting shade which is reducing marginal growth. Additionally, if banks are left bare they are prone to erosion and can become sources of sand and silt input. Tree management should be combined with the

technique of tree hinging. This technique sees trees (large or small) cut to produce an effect similar to hedging laying, but in this instance the trees are laid so as to provide instant overhead cover for fish. Many riparian trees and shrubs were viewed as suitable during.

Picture 25 – Trees with much potential to be hinged, thus providing instant overhead cover and flow deflection whilst reducing marginal shade. Note the missing marginal vegetation where the tree canopy casts shade (red arrows).

Picture 26 – An example of tree hinging, a simple and effective technique for increasing cover in a river.

A means of assessing the impact of signal crayfish upon the fishery could be through the application of the Riverfly Partnership's Angler's Monitoring Initiate (AMI). By monitoring groups of invertebrates and taking an estimate of their abundance over a period of time trends or even declines in invertebrate numbers may be observed. Dialogue should be had on this matter with the Environment Agency initially to see if they hold any data. More information about AMI can be found at www.riverflies.org/

Trapping of signal crayfish is only likely to impact upon the adults. It requires very intensive effort and must be maintained. Trapping is therefore not seen as an effective control for this river. Physical adjustment of the current habitat may bring about better results.

A water vole survey should be undertaken in summer months to determine whether voles are present within the reach, and if so, where they are residing. The occurrence of an extensive water vole population would have to be thoughtfully integrated to any future work.

The use of herbicide to control the growth of unbranched bur reed should be reviewed. Firstly, if the plant is still present in large volumes is the control working? Secondly, could the herbicide (presumably glyphosate) be having any detrimental effects upon the river's ecology, particularly the other aquatic macrophytes. There is a growing body who are questioning the extent to which glyphosate should be labelled as safe to use in water: www.foeeurope.org/sites/default/files/press_releases/foee_5_environmental_impacts_glyphosate.pdf Physical adjustment of the channel form to increase the flow rate may result in a longer term solution to the dominance of unbranched burr reed.

The low stone weir should be removed, or at the very least, have its central third removed. Removal will enable the meander pool above it to experience higher flow velocities with a consequential increase in the river's ability to transport and sort its load. If channel narrowing is required at this location then consideration should be given to the use of brash berms, LWM flow deflectors or bank realignment (combined with anti-crayfish measures). At present the large stones will be providing excellent cover for adult crayfish.

5.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the River Bure require written Environment Agency (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 with National Trust and angling club 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 debris, 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

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7.0 Disclaimer

This report is produced for guidance and not for specific advice; no liability or responsibility for any loss or damage can be accepted by the Wild Trout

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