Advisory Visit

River Great Ouse

June 2019

1.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan and Tim Jacklin of the Wild Trout Trust to the River Great Ouse at Radclive, Buckinghamshire, on 20th June, 2019. Comments in this report are based on observations on the day of the site visit and discussions with Kye Jerrom of the Environment Agency.

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.

2.0 Catchment / Fishery Overview

The upper Great Ouse was affected by severe pollution incidents in May 2017 and July 2018 between Brackley and Buckingham which resulted in serious damage to the ecology of the river, including an extensive fish kill. The Environment Agency are leading efforts to aid the recovery of the river and this walkover survey was requested following contact from a riparian owner at Radclive, approximately 2km upstream of Buckingham. The aim of the walkover is to identify any opportunities that would facilitate the recovery of the river and improve its ecology in the longer term.

One of the most important factors influencing the recovery of a river after a pollution is the ability of fish to move freely along its course, allowing them to recolonise from unaffected areas. Notwithstanding water quality problems, this connectivity is also important in maintaining healthy fish populations, allowing free movement between the different habitats required for different life stages, over varying spatial and temporal scales. For example, the existence of a trout population in the middle reaches of a river may rely on accessing suitable spawning habitat each winter in headwaters or tributaries several miles upstream. Likewise, their offspring may take around two years to distribute downstream, utilising various feeding and refuge habitats along the way.

Most rivers have barriers to free fish movement in the form of weirs, sluices, channel diversions, etc., and the Great Ouse is no exception. Many of these structures are redundant as far as their original purpose is concerned (often

milling), but the structures and channels often now form part of residential properties. The flow control structures at Radclive form a significant barrier to fish movement and therefore limit the capacity for the river to recover from the recent pollutions.

3.0 Habitat Assessment

Site photographs referred to here are contained in the Appendix.

3.1 Fish migration opportunity

The overriding negative impact upon river habitat at Radclive (and the wider upper Ouse) is the effect of the flow control structures which impound the river and prevent fish access across the site (Figure 1).

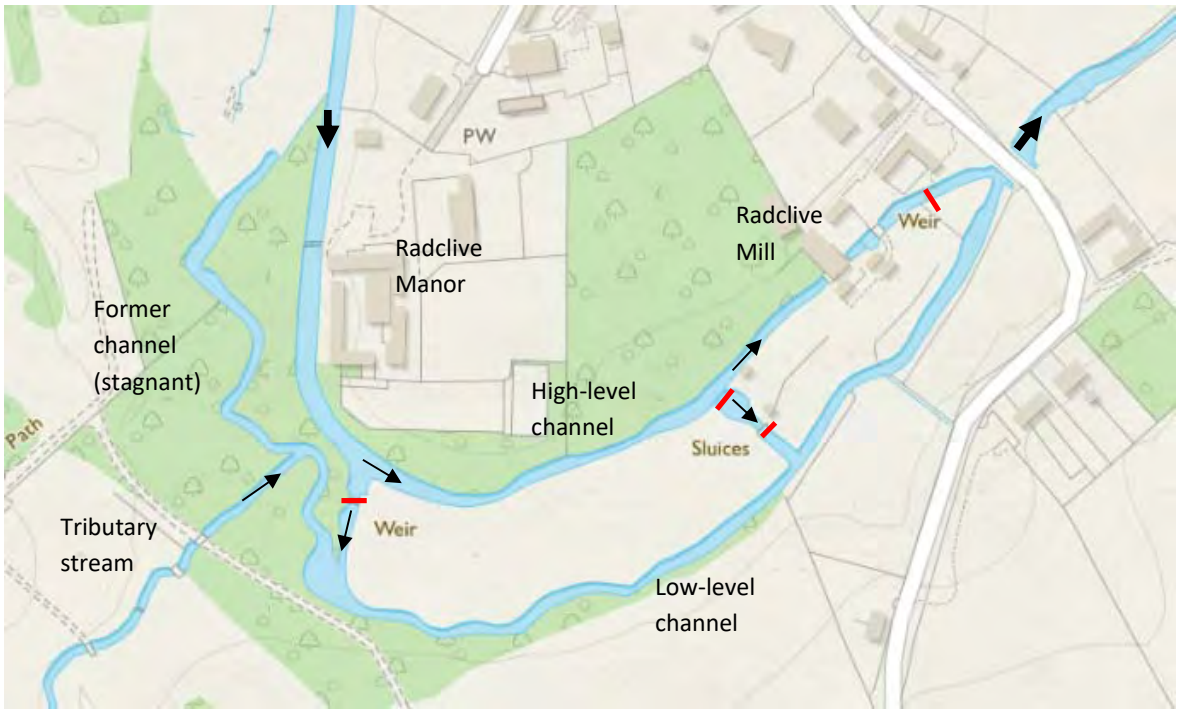


Figure 1 Showing the main flow into and out of the site (bold arrows), the flow splits, a tributary stream (smaller arrows) and the flow control structures (red lines).

The river channel is divided into a high-level channel, in which the water level is controlled by impounding structure(s) at Radclive Mill (Photos 35 – 36), and a low-level channel which receives water from a tributary stream (Photos 13 – 16) and at two points where the high-level channel overspills

(Photos 17-18 and 27-31). The high and low-level channel converge below Radclive Mill, just upstream of the road bridge; any fish seeking to move upstream from this point will quickly reach a dead-end whichever route is chosen.

An abandoned channel with standing water extends upstream from the low-level channel beyond the confluence with the tributary stream (Photos 8 – 12); this may be part of the original river course prior to modification for milling. There is an opportunity to greatly improve fish passage across the site at Radclive by restoring flow to the abandoned channel via a new overspill and re-prioritising flows across the site; this is discussed in more detail in the Recommendations section.

3.2 High level channel

This channel is a man-made cut along a contour to provide a head of water at Radclive Mill (Photos 1 – 7). The uniform shape and low gradient of this artificial channel means it has limited habitat potential and lacks the features found in a natural river (pool-riffle sequence, well-sorted bed material and a variety of depth and flow patterns). Whilst the nature of the channel means it is unsuitable for trout spawning and juvenile habitat, it is capable of holding adult trout and coarse fish species.

Features which enhance the potential to hold fish include low cover over (and trailing into) the water provided by bushes and trees alongside the river (Photo 6). Fish feel secure beneath the cover provided by the trailing vegetation and rafts of debris which collect against them; these should be retained.

The shade provided by the higher canopy of bankside trees helps to keep water temperatures down in summer (important for coldwater species such as trout), but can also prevent the growth of aquatic vegetation (Photos 1 – 2). Banks of reeds and rushes pinch the channel width and provide variety to flow patterns and depths (through scour) in an otherwise uniform channel. Striking a balance between light and shade will provide the best of both worlds and there are opportunities to ‘hinge’ some trees into the river margins to enhance low cover and reduce shading (Photos 4 and 7). Dead trees should be left standing for biodiversity benefits (woodpeckers, etc.).

3.3 Low-level channel

The low-level channel (and the abandoned channel upstream) are probably the former course of the Great Ouse prior to its diversion for milling. Presently, the low-level channel receives its flow from the golf course tributary stream (Photos 13 – 16) and overspills from the high-level channel downstream of Radclive Manor (Photos 17-18) and upstream of Radclive Mill (Photos 27-31).

The golf course tributary has some reasonably good habitat for a short section, with coarse gravel substrate present. Stone-turning here revealed live bullhead (*Cottus gobio*) and a variety of invertebrates which may be an important source for recolonising the river downstream.

The overspill downstream of Radclive Manor consists of a concrete weir structure (EA-owned) with a 5-m wide crest approximately 1.6m above downstream bed level. Downstream of the weir face are a series of concrete block flow breakers and a concrete base extending a total of 11m downstream. A bridge crosses the channel a short distance downstream of the weir. The structure is a totally impassable barrier to upstream fish movement and a very significant barrier to downstream movement.

The low-level channel was free-flowing (no impoundments) and had more varied habitat than the high-level channel, but the incised and over-sized nature of the channel indicates past dredging which restricts habitat quality. A variety of habitat improvement techniques could be used here including bank re-profiling, riffle creation, channel narrowing and shade/cover management as noted in Photos 19 – 26.

The second overspill from the high-level channel (upstream of Radclive Mill) consists of a dilapidated penstock sluice at the exit from the high-level channel which appeared to be stuck at a fixed aperture/flow (Photos 30 - 31). Approximately 25m downstream of the penstock is a ford consisting of three pipes set into a concrete crossing (Photo 27 – 29). These structures are impassable to fish moving between the high and low-level channels.

At Radclive Mill it was not possible to fully inspect the river as nobody was at home. Observations from the road and driveway revealed two weirs downstream of the mill and there may be more underneath or upstream of the mill building.

Radclive Bridge could be improved for fish passage as noted in Photo 34, although this is a lower priority compared to restoring fish passage across the wider site.

3.4 Abandoned channel

The abandoned channel extends upstream from the low-level channel and golf course tributary, almost meeting the existing main river channel on the RH bank opposite Radclive Manor. The channel is overgrown and dry in parts and wet in others, and the upper end of it may form a boundary with the golf course. In places it has been widened to form ornamental ponds and the non-native invasive aquatic plant, New Zealand pigmy-weed (*Crassula helmsii*) is present, probably imported with plants brought in from a garden centre (see www.nonnativespecies.org/factsheet for more information). It is recommended that this is controlled before it spreads, by physical removal by hand or rake whilst the infestation is small. The removed plant should be disposed in a bin, not composted.

4.0 Recommendations

4.1 Fish Passage

The most significant improvement that can be made is to enable fish passage across the site, which is currently not possible.

A common perception of improved fish passage is by the construction of passes (or 'ladders') across existing barriers which are left in place. This approach has a plethora of disadvantages including high construction costs, ongoing maintenance (prone to blockage), ongoing ownership and liability, limited effectiveness (only certain species and sizes can pass) and retention of the impounding structure and associated poor habitat.

An alternative approach which overcomes or reduces these disadvantages is to create (or restore) a nature-like channel by removing or bypassing the obstructions. In the specific case of Radclive, a potential project could consist of:

- Construction of a new overspill from the RH bank of the main river channel into the head of the abandoned channel (Figure 2). This overspill could be engineered to take a fixed range of flows (according to river flow) and allow fish passage across it.

- Re-modelling of the abandoned channel into a nature-like channel, suitable to accommodate the fixed range of flows.
- Modification of the existing overflow(s) from the high-level channel to prioritise flows over the new overspill sited upstream. In effect the existing weir overflow (d/s of Radclive Manor) would become a flood relief overspill, only coming into play during high flows. Modification of flows via the second overspill (u/s of Radclive Mill) could also be considered. Existing flows under the mill could be preserved.

Detailed flow modelling* is required to inform potential options and it is recommended that an options and feasibility study is undertaken by a suitably qualified contractor (*check whether any flow models already exist which could be used).

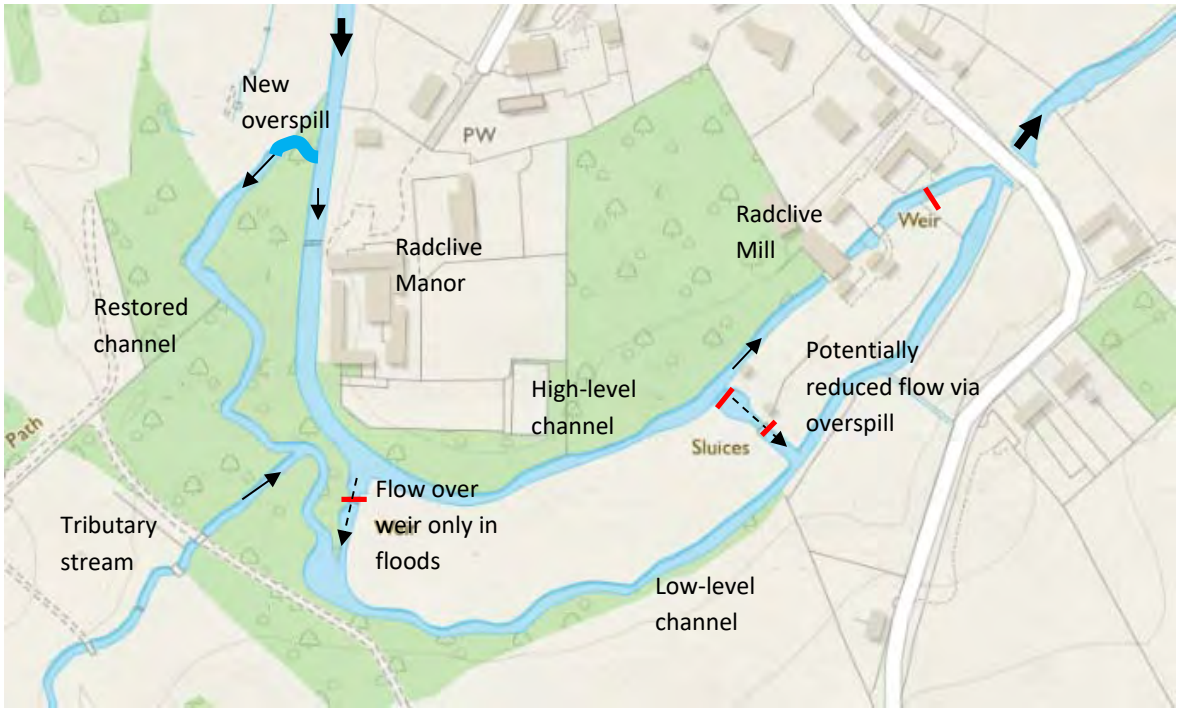


Figure 2 Indicative diagram of re-prioritisation of flows presently following the existing overspill(s) via a new, fish-friendly overspill into a restored channel, whilst maintaining existing flows under Radclive Mill. Subject to detailed flow modelling and design.

The creation of a bypass channel as described above is not a complete solution to fish passage across the site because a fish approaching from downstream still has the option of two routes, one of which (the high level channel under the mill) would still have obstacles to migration. It is

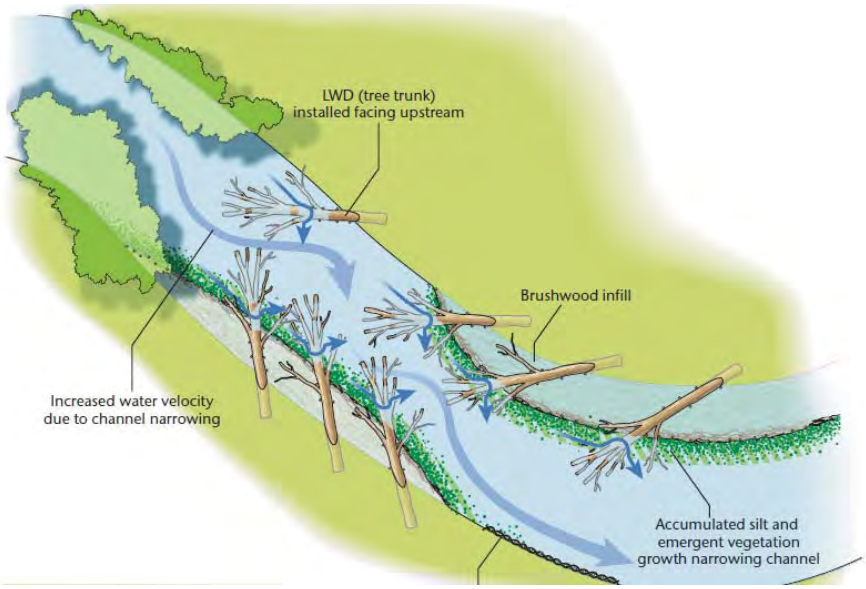
recommended that the flow control structures at Radclive Mill are inspected in more detail and considered as part of any fish passage improvement project.

4.2 Other habitat improvements

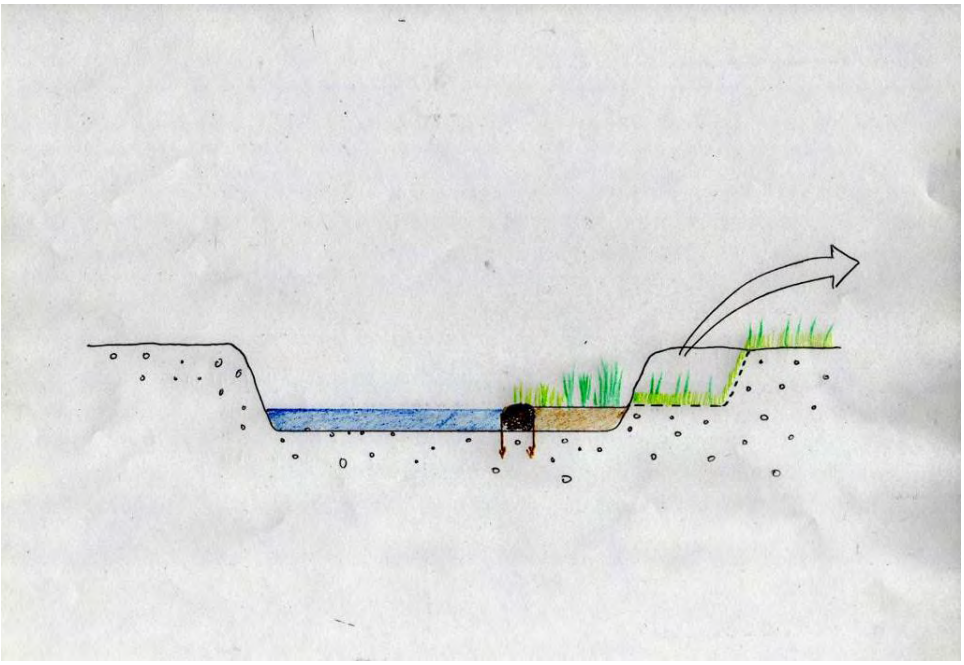
- Examples of the habitat improvement techniques mentioned above are given below. Where the river channel is over-wide and shaded, hinging and laying trees and creating brushwood shelves will introduce more variety to the river channel shape and encourage growth of aquatic plants. Where the river channel is deeply incised, bank re-profiling with an excavator could be used to create an inset floodplain and introduce more variety to the channel.

Hinging and laying trees into the river margins to narrow the channel and reduce shading (left) and brushwood shelf (right) to narrow the low-flow channel.

Smaller trees and branches partially cut and laid to create good cover. Inset: example of steeply angled back-cut to create a hinge.



Illustraion of the principle of using riparian trees and introduced brushwood margins to pinch the channel width. Trees can be hinged in a downstream direction to achieve the same effect.



Schematic of bank re-profiling, utilising the spoil arising for channel narrowing (backfill behind an introduced brushwood margin) and removing surplus from the floodplain. This creates an 'inset floodplain', essentially a low margin which improves riparian habitat by providing a more natural, wide transition from aquatic to terrestrial habitats. It also makes a more convenient access for angling.

Bank re-profiling in progress on the Etwall Brook, Derbyshire.

5.0 Making it Happen

There may be opportunities to develop and implement some of the recommendations in partnership with the Environment Agency and/or the Upper and Bedford Ouse Catchment Partnership (https://ubocp.org.uk/) and it is recommended that this report is shared with them.

Further assistance from the Wild Trout Trust is available in the form of:

- Working in partnership with other organisations to investigate the feasibility and progress a fish passage / river restoration project, subject to available funding.
- Helping obtain the necessary consents from the Environment Agency for carrying out in-stream works.
- A practical visit, which involves a visit from a WTT Conservation Officer to demonstrate the techniques described. This enables recipients to obtain on-the-ground training regarding the appropriate use of conservation techniques and materials, including Health & Safety, equipment. This will then give projects the strongest possible start leading to successful completion of aims and objectives. Recipients will be expected to cover travel expenses of the WTT attendees.

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 http://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: http://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.

Appendix – Site Photographs and Locations

Figure 3 Picture locations

High-level channel

Photo 1 Deep silt with little marginal vegetation due to shade.

Photo 2 Marginal vegetation was present where light penetrated through canopy.

Photo 3 Accumulated coarse woody material retained silt in the margins and deflected the flow against the opposite bank adding a little flow diversity.

Photo 4 Riparian trees provided shade to the water, reducing temperatures. Terrestrial invertebrates will fall into the river from the canopy providing food for fish. Some trees here could be laid over into the water to improve low cover.

Photo 5 Dead (or dying) trees should not be removed. They are valuable habitats and provide a source of large woody material (LWM) for the river which can initiate geomorphic processes such as scour. LWM can also provide cover to fish from high flows and predators.

Photo 6 View from bridge looking downstream, the river was almost 2m deep. Trees trailing down to water level provide overhead cover for fish (arrows) – leave it in place.

Photo 7 View from bridge looking upstream. The dense tree cover here could be reduced and some trees 'hinged' into the river margins to provide cover. Aim for a ratio of 60:40 shade-light.

Abandoned channel

Photo 8 An historic channel was found leading away from the river (looking downstream). The channel could be engineered to provide a by-pass channel around the mill and weir structures. A by-pass channel would aid the river's natural recovery of its fish populations.

Photo 9 The abandoned channel almost cuts back to the River Great Ouse.

Photo 10 Parts of the abandoned channel had been widened to create pond habitats. This area contained the non-native invasive plant New Zealand pigmyweed (*Crassula helmsii*). Extreme care must be taken not to spread it, it would be wise to remove it whilst it is only a small amount.

Photo 11 The abandoned channel was clearly wide at some point in its past, now it is little more than a marshy depression.

Photo 12 The abandoned channel was almost lost to vegetation where it met with the golf course stream. However, beneath the vegetation a wide sediment-filled channel was still evident.

Photo 13 A tributary stream emerging from the Buckingham Golf Club had much potential as a nursery stream for the Gt Ouse. The coarse substrate could provide spawning opportunities for fish such as brown trout, minnow, dace and chub – especially if enhanced with further gravel ranging in size from 10-40mm.

Photo 14 Stone turning confirmed a reasonable diversity of aquatic invertebrates and a bullhead fish (red circle). The discovery of fish and invertebrates is critical to the river's natural re-population following the pollution events.

Photo 15 The golf course stream had surprisingly good habitat but only for a short distance.

Photo 16 The golf course stream became silty as a its gradient dropped, and it has almost certainly been dredged at some point in its past thus removing the coarse substrate that is important for cover and fish spawning.

Side weir

Photo 17 The side weir (viewed from upstream) splits the river channel downstream of Radclive Manor. The weir is a relatively recent construction and its purpose is to move flood flow away from the mill down the low-level channel. It was hard to assess the proportion of flow that is split but it appeared to be 50:50 at low-flow.

Photo 18 The weir viewed from below. This EA structure poses a complete barrier to the natural movement of fish and other riverine wildlife.

Low-level channel

Photo 19 The low-level channel was too large for the flow that it conveyed, consequently the bed contained a high volume of fine sediment.

Photo 20 The confluence of the golf course stream (arrow), showing the relatively small volume of water currently contributed from this source to the low-level channel.

Photo 21 Riparian tree could be managed to increase light to encourage marginal growth, which would stabilise silt beds.

Photo 22 An outcrop of course substrate was found providing a valuable habitat. Unfortunately, the channel was wide, so the velocity was not too high, this was allowing fine sediment to settle over the stones. Simple habitat enhancement techniques using adjacent woody material could be deployed to increase cover and to speed up the velocity.

Photo 23 Where light reached the river and the bed was shallower aquatic plants diversified in-river habitat. The left bank shelved gently down to the river. Other parts of the bank could be reshaped to provide a better grade to the water's edge and to increase the river's inundation zone (a two-stage channel could be created).

Photo 24 River looking upstream, note the shade suppressing plant growth.

Photo 25 River viewed downstream, note the dense plant growth. This part of the low-level channel had a number of veteran pollard willows along it (red arrow).

Photo 26 A dense stand of branched bur reed indicates where fine sediment is accumulating. It could be possible to replace the bur reed with stone and gravel to shallow river, creating a riffle. Riffles provide important spawning areas for a range of fish.

Mill take-off

Photo 27 A channel remained which was probably the original side-channel around the mill allowing the miller to adjust flows. The channel had been dammed to create an ornamental feature with two 45mm pipes conveying the majority of flow. However, a third, lower pipe was present in the middle.

Photo 28 Close-up of the third pipe.

Photo 29 The pipe arrangement had a control structure for the 3rd pipe (it was unknown if it could be adjusted). The whole structure currently provides access to the land beyond (which is effectively an island).

Photo 30 A penstock sluice controls the volume of flow into the overspill channel above Radclive Mill. The structure presented an impassable barrier to the movement of fish.

Photo 31 The downstream view of the penstock structure showing dilapidated blockwork.

Low-level channel (continued)

Photo 32 The river became wide and relatively shallow and contained dense beds of aquatic plants (Potamogeton sp). This area could be possibly be enhanced through the addition of stone and gravel to the bed to create riffle habitat.

Photo 33 A dense stand of marginal bur reed (red circle) suggested a channel with an accumulation of fine sediment at its margins but depth mid channel.

Photo 34 Radclive bridge presented a potential barrier to the movement of fish. In high flows the arches would convey fast water, in low-flow the concrete sill of the arches becomes too shallow. A series of simple baffles could be installed to increase the low-flow depth through the middle arch, or baffles could be installed to push the entire low-flow down the central arch.

Photo 35 The view from the bridge looking upstream. The low-level channel (left) converges with the high-level (mill) channel (right). A short distance up the mill channel was a simple weir with a height estimated to be 0.4m (not seen).

Radclive Mill

Photo 36 Another small weir was present in front of the mill. A full inspection of the channel arrangements at the mill was not possible as nobody was at home.