Project Proposal

River Peffrey, Ross and Cromarty

March 2011

Contents

1.0 Introduction

This report is the output of a site visit undertaken by Tim Jacklin of the Wild Trout Trust to the River Peffrey on 24-25th March, 2011. Comments in this report are based on observations on the days of the site visit and discussions with Simon McKelvey (Director, Cromarty Firth Fisheries Trust and Conon District Salmon Fisheries Board), Marcus Walters (Moray Firth Sea Trout Project Officer) and Merryl Norris (British Trust for Conservation Volunteers).

The aims of the visit and this report are:

- to identify priority areas for in-stream habitat improvements;
- to provide sufficient details to support a consent application to SEPA under the CAR regulations;
- to assist the Moray Firth Sea Trout Project in producing and submitting a detailed, costed project proposal to the SEPA restoration fund.

Previous reports on the River Peffrey were produced in July 2009 (WTT Advisory Visit by Andy Walker[1]) and April 2010 (River Restoration Centre, Martin Janes[2]). These reports should be read in conjunction with these proposals and contain relevant background information.

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 Upper Catchment – Ben Wyvis to Achterneed Saw Mill

The upper catchment is on the slopes of Ben Wyvis where commercial forestry is the predominant land use. The Forestry Commission sit on SEPA's Area Advisory Group and have indicated they are willing to undertake management to reduce the impact of forestry upon the watercourse as detailed in the Forestry and Water best practice guidelines, including creation of conifer-free buffer zones along watercourses; drain blocking; and hardwood tree planting. The upper catchment was walked to identify such opportunities, starting from a forest road crossing at National Grid Reference NH 46486 62078 and progressing downstream. Detailed findings are presented in Appendix 1.

Many of the forest drains entering the river run down steep valley sides. It is important to emphasise that where these drains are to be blocked, this is done back from the crest of the slope on the relatively flatter ground within the forests and not immediately alongside the watercourse or on the valley slope.

In addition to creating buffer zones alongside watercourses, consideration should be given to mixed planting of hardwood trees and conifers well back into the plantations. The presence of deep-rooted hardwoods which can be left in place during felling will buffer against sediment and nutrient mobilisation when conifer felling takes place.

3.0 In-stream habitat improvements

The remainder of the Peffrey catchment was inspected with a view to identifying and specifying opportunities for in-stream habitat improvements. The RRC (2010) and WTT (2009) reports describe the habitat characteristics of each section of river in more detail. The main issues affecting the in-stream habitat are past straightening and re-alignment of the river channel; probable lowering of the river bed; the constraint of the river corridor by embankments (levees) and agricultural land use; and high levels of fine sediment supply (sands and silts). These alterations have resulted in a river which lacks a varied depth profile (predominantly shallow), lacks larger sizes of bed sediments (boulders and cobbles) and has poorly-sorted bed sediments; all these factors adversely affect the ecology and fishery quality of the river.

A good example of the contrast between good quality habitat and that affected by the above factors can be seen by comparing the section of river from the tree shelter belt upstream of Blaininich down to the A834 (notwithstanding the 200-m section illegally engineered), and a typical straightened section (e.g. downstream of Fodderty).

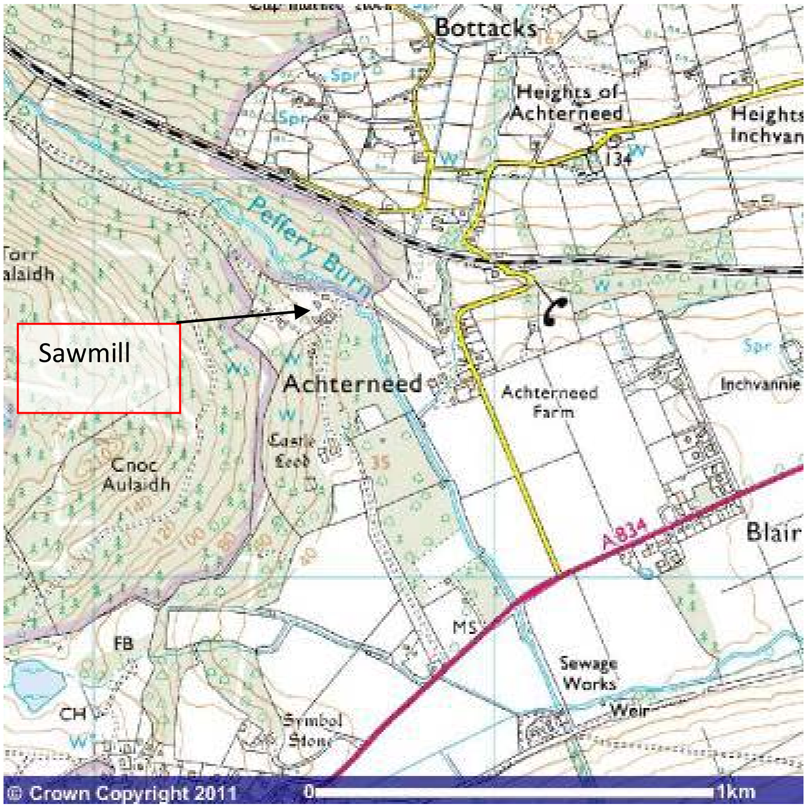
The options for improvement can be considered on two levels:

- Alterations to the plan-form and bed levels of the river, i.e. creating more room for the river corridor and re-introducing sinuosity and a natural pool-riffle sequence. This is the preferred option for long-term river restoration and works with natural processes.
- Alterations to the bed level of the river using instream structures, i.e. changing the depth profile within the existing channel.

The former option is possible in some parts of the river without impinging upon land currently used for agriculture (identified in sections below), but for the majority of the river sections examined would require widening the river corridor into fields. Landowners and tenant farmers are key to the success of this option. It may be possible to consider the option under flood alleviation measures to protect Dingwall. It is understood a hydro-brake (dam across the floodplain to throttle back floodwaters upstream of the town) is being considered as part of a ring road development; this would inevitably involve compensation payments for the impact upon agricultural land affected. A more sustainable and environmentally sound option would be to re-naturalise the river habitat within a wider river corridor, thus providing increased flood storage, improved river habitat and certainty over adjacent land use. The flood water would be accommodated along a defined linear, re-naturalised storage area (for which farmers would receive compensation), rather than in an area across the valley which would restrict the land use in that potential ‘reservoir’ area and potentially have a deleterious effect upon fish migration.

The latter option (for in-stream habitat improvements within the existing river corridor) involves the introduction of different types of simple structure. These structures are described in Appendix 2 and could be incorporated into the areas below, as described.

3.1 *Sawmill to River Gauging station (Section B – RRC report)*



The river channel gradient here reduces from approximately 1 in 50 (2%) on the section upstream of the sawmill, down to 1 in 160 (0.62%). From the sawmill bridge (NH 48661 59671) downstream, this section has clearly been straightened and probably moved from its original course (RRC, 2010). Stone revetment is present in places as are a stone embankments or levees, particularly along the LHB adjacent to arable fields.

The RHB upstream of the A834 road is wooded and provides some scope for re-alignment of the river channel and re-modelling of the plan-form (to introduce some sinuosity) over approximately 400 m, without affecting the arable land on the LHB (Photo 1). A project to achieve this would require a survey of levels and design by a fluvial geomorphologist, plus landowner consent. The table below gives an approximate indication of costs of such an option:

	£
Project management	5000
Levels survey	2000
Detailed design and modelling	10000
Landowner liaison and legal agreement	1000
Consent application	1000
EIA	1000
Construction - Forestry works	5000
Construction - Excavation	10000
Construction - Design supervision	5000
Construction - Environmental supervision	3000
Contingency	5000
Total	**48000**

Figure 1 Indication of potential areas for re-naturalising the river channel – for illustrative purposes only. Not to scale.

On the sections of channel which are more constrained by adjacent land-use, in-channel structures (Appendix 2) could be used to create depth variation. The 200-m section of river from the A834 bridge to the sewage works would be suitable and up to five structures could be incorporated here, spaced 35 – 40 metres apart. A further ten structures could be incorporated upstream of the A834 if the realignment project is not taken forward.

Cost: Five / fifteen structures at £260 each £1300 / £3900

Other areas for improvement in this section are:

- Improvement of the flat-V gauging station weir for fish passage (Photo 2). This issue was identified in the WTT (2009) report and is being addressed by CFFT, SEPA and Scottish Water (owners of the structure) by building a pre-barrage to raise downstream water levels and drown out the lip which has formed. Further improvement may be possible using Hurn-type baffles or re-designing the gauge according to new ISO (26906:2009) and British Standard designs for compound gauging and fish pass structures. Further details can be found in the Environment Agency Fish Pass Manual[3] (pages 147 and 216 respectively).

- Improvement of fish passage through the culvert under the sewage treatment works track. A lip has developed at the upstream end of the culvert here. Simple baffles fixed to the base of the culvert as described in the WTT (2009) report[1] would be appropriate here. An example of a similar project on a tributary of the River Wear is illustrated below (Photo 3).

- The ditch entering the river on the RHB immediately upstream of the above culvert is an obvious source of fine sediment (Photo 4) which needs to be addressed. The ditch has been recently cleared out and has arable and livestock agriculture on each bank which is the most likely source of the sediment.

Photo 1 Wooded section of river downstream of the saw mill

Photo 2 Gauging weir – currently an obstacle to fish migration

Photo 3 220-mm concrete kerbs thru-bolted to the bed of a culvert to ease fish passage (River Wear tributary, Co. Durham; Photo: Lloyd Atkinson).

Photo 4 Tributary burn which is a source of fine sediment to the river

3.2 River Gauging station to Watergate (Section C – RRC report)

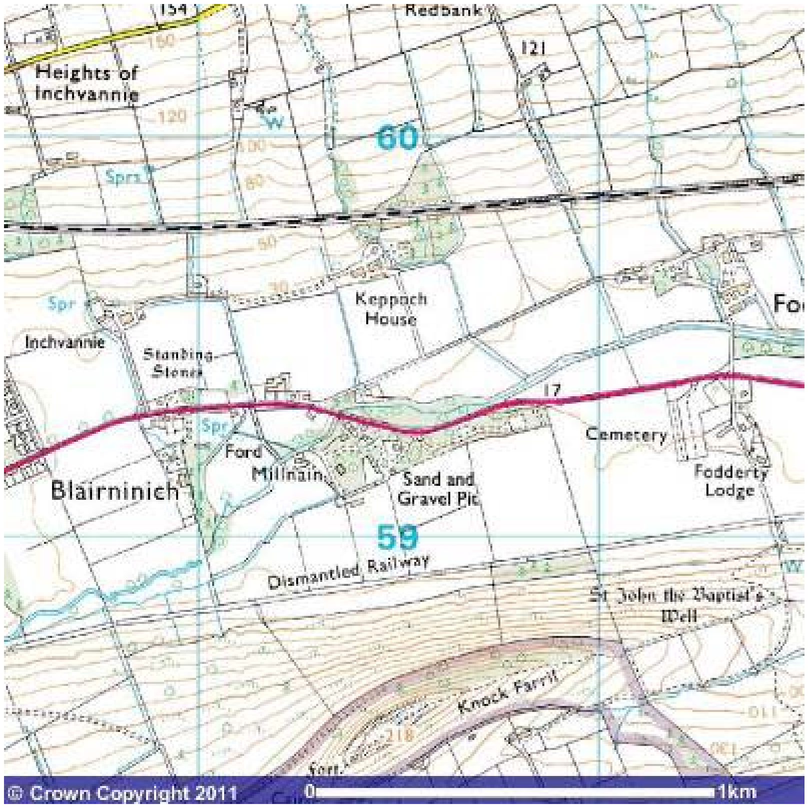
This 700-m (approx.) section has a straight channel with a steeper gradient than the section upstream of the sewage works and a raised embankment on the LHB; the right bank is the steep-sided valley edge. Predominantly this reach is shallow and lack depth variation (Photo 5), although there is some reasonable in-stream habitat, particularly where fallen trees have lodged in the channel creating bed and bank scour.

This section lends itself to the introduction of large woody debris (LWD) because it is in a deep channel and flood risk is therefore low. Cross-channel logs (Appendix 2) plus some less formal structures, such as trees "hinged" into the watercourse would be appropriate here. Twenty in-stream structures could be included in this section, spaced 7 channel width apart.

Cost: 20 structures @ £260 each £5200

Photo 5

3.3 Watergate to A834 bridge Millnain (Section D – RRC report)



Apart from the upper 200-m section affected by unlicensed channel straightening works, the habitat on this section of river is very good, as highlighted in previous reports (RRC, 2010; WTT, 2009). The dimensions of the river here (river corridor width – flood prone area; height of channel in relation to floodplain; meander frequency and amplitude; etc.) should be used as a template for the design of full river restoration options in other sections.

Restoration of the 200-m section noted above would have costs in the order of magnitude similar to the Achterneed section (3.1 above) – maybe 30% less because it is a shorter, more accessible section.

3.4 *Millnain (A834) to Docherty Road (Section E RRC report)*

The wooded section immediately downstream of the A834 road bridge has good in-stream habitat with meanders, gravel side bars and shoals, floodplain connectivity and in-channel large woody debris. There is a reasonably broad strip of woodland from the A834 road to the river on the RHB (about 30 m) and from the arable fields on the LHB (about 20 m) – this gives the river room to meander and create natural in-stream features. There are occasional areas within this section where the river has been straightened and in-stream structures could be used (e.g. NH 50711 59317).

With downstream progress the river becomes more constrained between embankments and takes on similar characteristics to the stretch upstream of the sewage works – uniform, straight and shallow (e.g. around NH 51074 59489 down to Fodderty House road). In-stream structures (Appendix 2) are appropriate here, particularly the K-dam, wedge dam and flow deflectors. Photo 6 shows a tree leaning into the channel which has created some rare depth and flow diversity in this reach; it gives a good indication of the dimensions for introduced structures. Site selection should take account of the presence of the naturally occurring features which are developing some better habitat and complement rather than try to replace these.

Photo 6 A tree and its root mass has created some flow and depth variation here – good habitat and a good template for the dimensions of introduced structures.

Downstream of Fodderty House road bridge the river is embanked and on the LHB between the embankment and the fields is a drainage ditch running parallel to the river. The ditch bottom appears to be lower than the river bed at the upstream end but joins a tributary burn just downstream of the railway bridge. The entire stretch of river from Fodderty House road bridge to Brae road bridge is a uniform, straight, shallow riffle/glide suitable for in-stream structures (Appendix 2). Beyond Brae road bridge the river gradually grades into a deeper, slower, lower gradient glide with finer sediment on the bed. The section from here to Docherty Road was not inspected apart from a short section upstream of Docherty road, where in-stream habitat is similar, but with no trees on the embankments.

The section of river from Fodderty House road bridge down to Docherty road has potential for a full river restoration approach involving the removal (or setting back) of embankments and restoration of natural river processes. Incorporation of such a project within the ring road / Dingwall flood protection works may be possible. A feasibility study involving a levels survey, outline design and landowner/tenant consultation would be the first step.

In the meantime, the following in-stream structures are recommended:

From approx. downstream edge of woodland below A834 bridge to Fodderty House road bridge (500 m)

6 structures @ £260 each	**£1560**

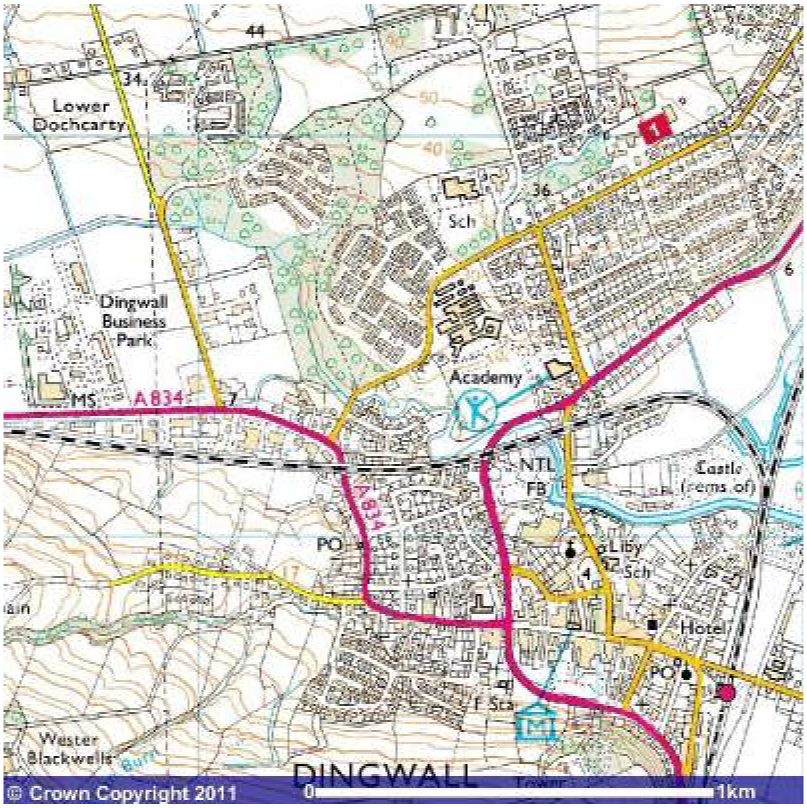
Fodderty House road bridge - Railway Bridge (650 m)

15 structures @ £260 each	**£3900**

Railway Bridge – Brae bridge (500 m)

10 structures @ £260 each	**£2600**

3.5 *Docherty Road to tidal limit (Section F – RRC report)*



This reach of the river is divided into two section in the RRC report[2], F1 (woodland section) and F2 (town section). There are large amounts of fine sediment blanketing the river bed throughout this section and large amounts of litter and discarded trash within the river channel. The accumulation of fine sediment on the river bed is likely to be a combination of the decreasing gradient of the channel and the increased rate of supply of fine sediment from land use upstream (forestry, arable agriculture). There are different opportunities for in-stream habitat improvement within these river sections compared with further upstream; the structures described in Appendix 2 would not work here because of the lower gradient. "Tree sweepers" or brushwood bundles (Figures 2, 3) could be used to promote channel narrowing (in the woodland section) and depth variation. Trash clean-ups are being carried out in this area and should be continued to promote community awareness and responsibility for the watercourse.

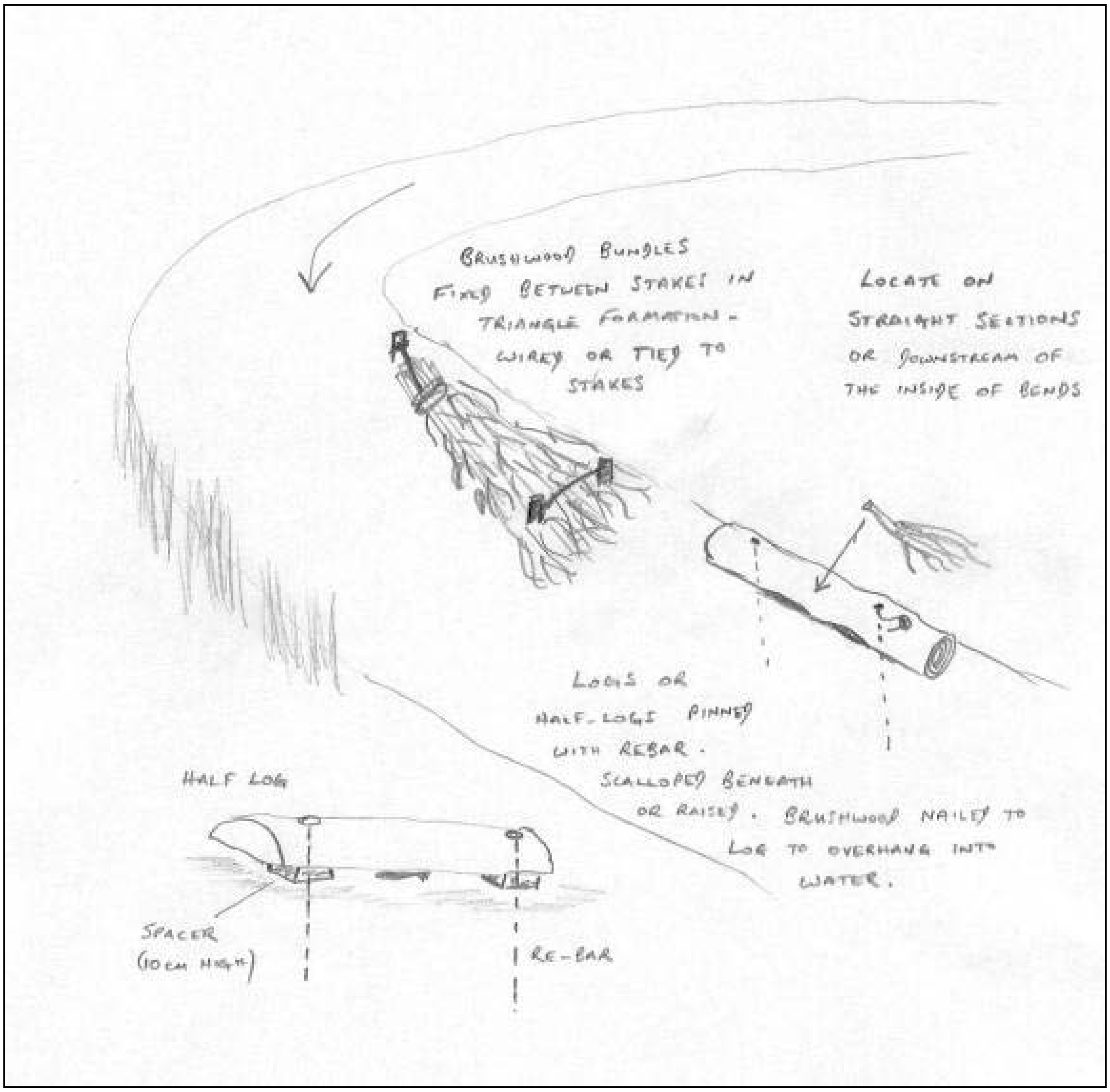

BRUSHWOOD BUNDLES
FIXED BETWEEN STAKES IN
TRIANGLE FORMATION -
WIRED OR TIED TO
STAKES
LOCATE ON
STRAIGHT SECTIONS
OR DOWNSTREAM OF
THE INSIDE OF BENDS
LOGS OR
HALF-LOGS PINNED
WITH REBAR.
SCALLOPED BENEATH
OR RAISED. BRUSHWOOD NAILED TO
LOG TO OVERHANG INTO
WATER.
HALF LOG
SPACER
(10 CM HIGH)
RE-BAR

Figure 2

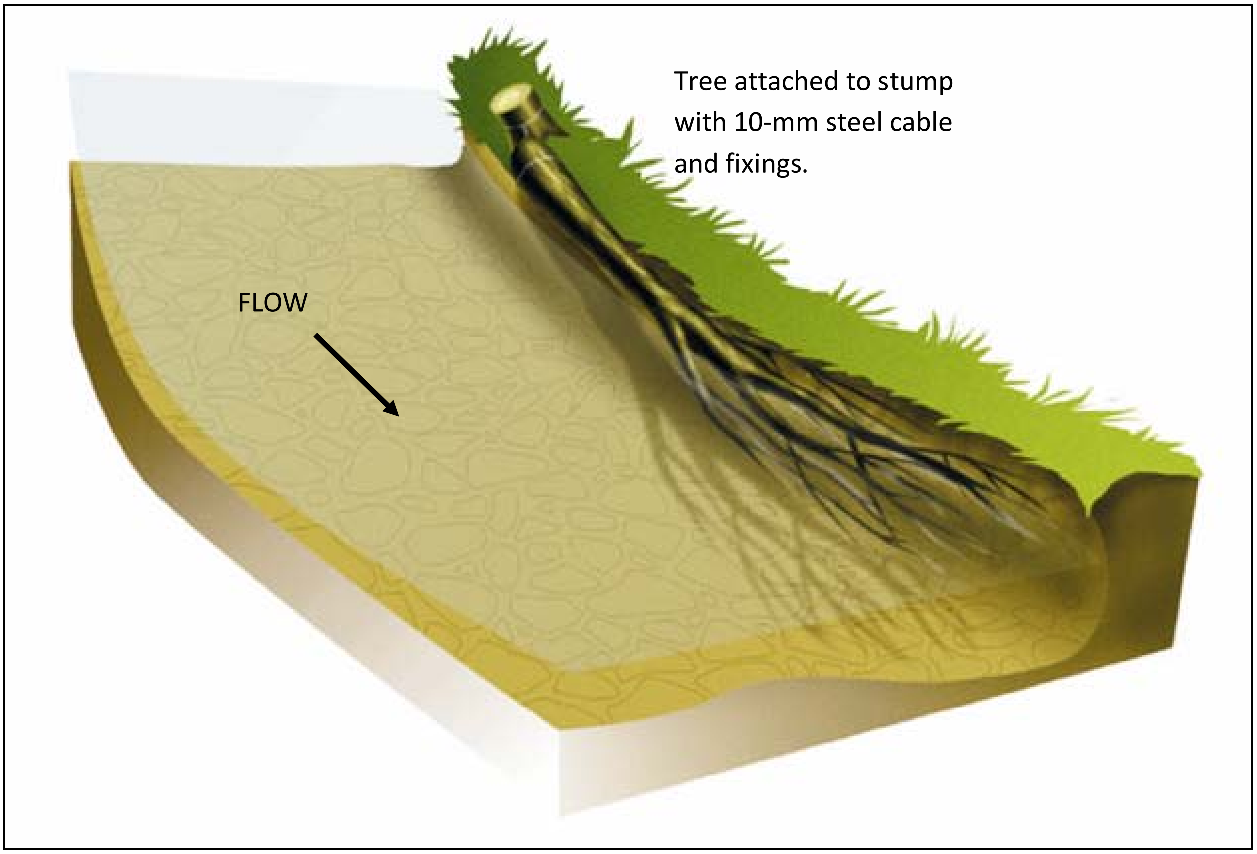


Figure 3 Tree sweeper or tree kicker

4.0 Summary of in-stream habitat structures proposed

Location	Number of structures	Cost (£)
Section B – Achterneed - STW	15	3900
Section C Gauging station to Watergate	20	5200
Section E	31	8060
TOTAL	**66**	**17160**

5.0 Disclaimer

This report is produced for guidance only and should not be used as a substitute for full professional advice. 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.

6.0 References

1. **Wild Trout Trust (2009)** Advisory Visit Report to River Peffrey. Prepared by Andy Walker. www.wildtrout.org
2. **River Restoration Centre (2010)** River Peffrey, Dingwall – Options for demonstration project sites considered within a catchment-wide context. Prepared by Martin Janes; rrc@therrc.co.uk
3. **Environment Agency Fish Pass Manual: Guidance Notes On The Legislation, Selection and Approval Of Fish Passes In England And Wales (2010)** http://publications.environment-agency.gov.uk publication no. GEHO 0910 BTBP-E-E (downloadable PDF).

Appendix 1

Details of observations from Forestry Commission sections of the upper catchment.

Table A.1 Location of forest drains:

British National Grid Reference	Comment
NH 46457 61810	Forest drain enters RHB – needs blocking (back on flatter ground beyond the fall of the valley slope)
NH 46468 61678	Forest drain flows through plastic culvert pipe over into the valley LHB.
NH 46422 61560	Drain enters LHB.
NH 46395 61251	Drain enters RHB at d/s grid reference – almost self-blocked.
NH 46589 61062	LHB drain – carrying a lot of sediment and draining large area of hillside.
NH 46628 60971	RHB network of drains confluence here and enter river
NH 46788 60773	LHB drain
NH 46936 60534	LHB drain/gully – major sediment source evident from sediment fan across valley floor here.
NH 47280 60414	LHB drain
NH 47404 60352	LHB drain
NH 47693 60284	RHB drain
NH 47797 60184	RHB drain
NH 47921 60112	RHB drain
NH 47982 60076	LHB drain – off steep slope; needs blocking back from crest of slope.

Table A.2 Areas where creation of watercourse buffer zones (conifer free) and hardwood planting are required

Upstream NGR	Downstream NGR			
NH 46344 61349	NH 46628 60971			Section requiring conifers pulling back from watercourse and broad-leaved tree planting. Some areas are clear-felled and opportunity is there for re-structuring; others have mature conifers present.
NH 46628 60971				Better broad-leaved cover from here downstream, but some conifers too close to RHB.
NH 46755 60789				Burn confluence LHB. Burn very heavily shaded going back from main river – needs buffer zones along the burn. Continuing downstream on main river, very densely conifer-shaded section with lots of fallen broad-leaved trees in river channel. Needs wider buffer zone to give broad-leaves space to mature.
NH 46936 60534	NH 47076 60491			Wooden bridge area – conifers too close.
NH 47797 60184				Conifers very close to watercourse and lots of fallen broad-leaved trees in channel. Needs buffer zone creating.
NH 48000 60073				Tributary LHB – needs conifers taking back from the edge of tributary – very heavily shaded.

Table A.3 Other observations

Upstream NGR	Downstream NGR			
NH 49686 62078 (forest road)	NH 46479 61856 (burn confluence)			Conifers 5 – 10m back from edge of burn, steep bed gradient. No forest drainage to the burn evident. Deer tracks common
	NH 46457 61810			Impassable falls.
NH 46457 61810	NH 46468 61678			Steep-sided valley/gorge with birch woodland; conifers well back from watercourse. Impassable falls present. .
NH 46468 61678	NH 46422 61560			Good mixture of birch, ash and willow present here on valley sides; not much regeneration (due to deer grazing).
NH 46344 61349	NH 46395 61251			Gradient lessens and habitat change coinciding with forest road crossing (wooden bridge – full span, no obstruction to fish migration). RHB felled, good buffer width present. Hardwood trees required in replanting scheme. LHB mature conifers close to the burn. Needs buffer zone creating.
NH 46788 60773				Significant waterfalls – valley steepens
NH 46818 60648				Railway line bridge – gradient lessens downstream of here. Good in-stream habitat; valley floor wet and spongy and dominated by broad-leaved trees.
NH 47186 60462				Burn confluence RHB. Some excellent instream habitat in this area.
NH 47404 60352				Debris dam caused by fence sagging into the river
NH 48188 59966				Concrete wall partway across valley bottom – possibly part of old dam (related to sawmill?).

Appendix 2

Structures for use in confined channel situations

All the following structures are constructed from logs which are drilled and pinned to the river bed using steel rebar.

1. K-dam and Wedge dams

Designed to concentrate flow and scour on the river bed downstream of the structure.

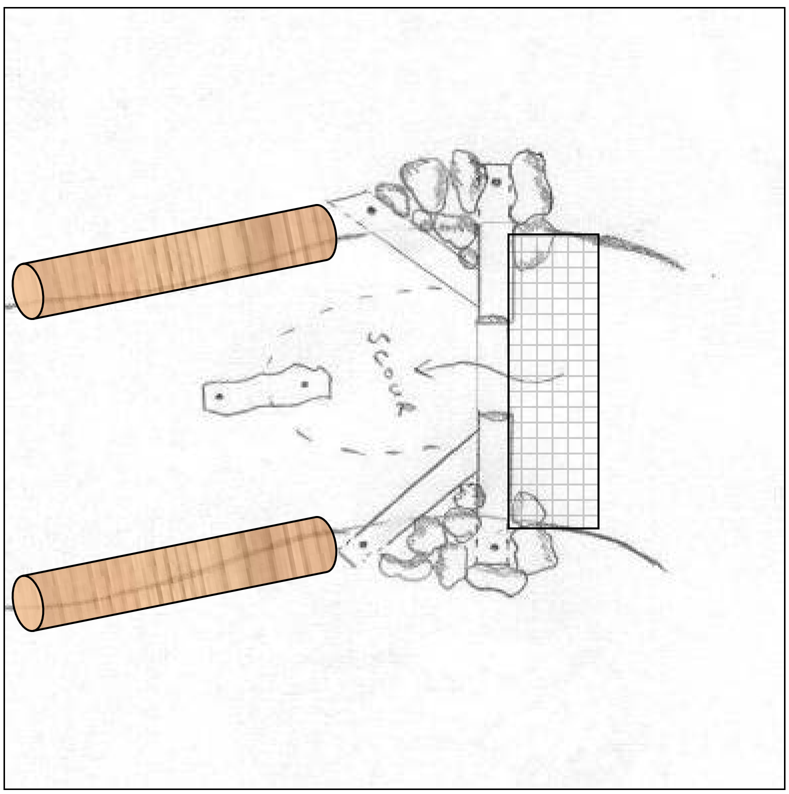


Figure A2.1 K-dam plan. Logs or boulders may need to be positioned along the banks downstream of the structure to protect against scour. Wire mesh can be fixed to the upstream edge of the cross-log and buried in the river bed to prevent undercutting. A cover log or boulder can be placed in the downstream scour pool.

Figure A2.2 K-dam schematic from Hunt (1993) *Trout Stream Therapy*.

It is important to think about the structure in 3-dimensions and consider the height of the “wings” at the sides. These should be high enough to concentrate high flows through the centre of the structure and create bed scour, and robust enough to prevent high flows cutting behind them. Logs should be keyed well into the banks.

Wedge dams are a variation on the K-dam:

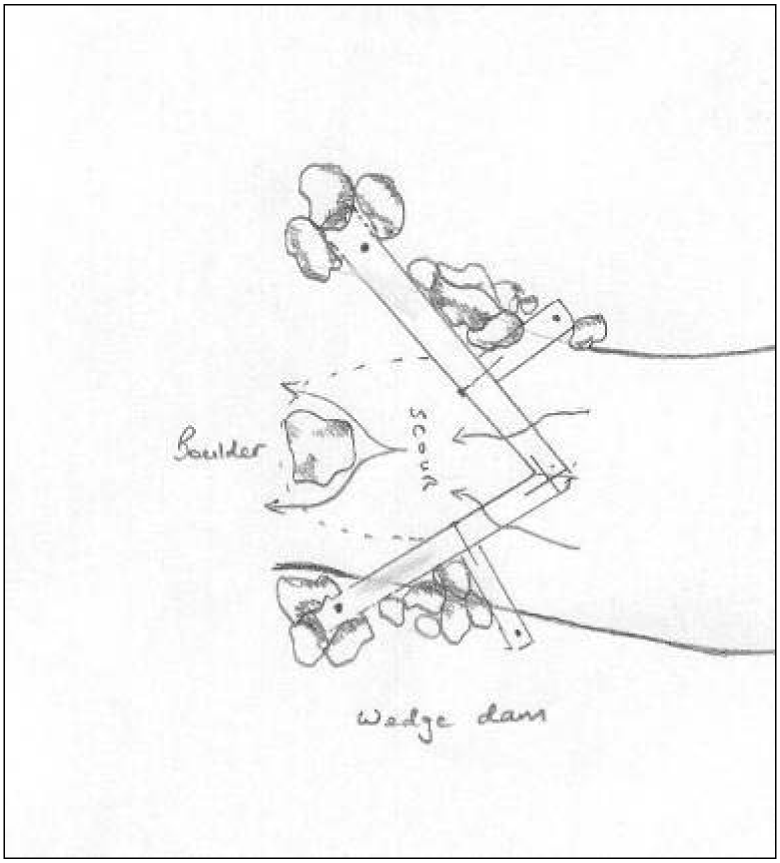


Figure A2.3 Wedge dam

2. Flow deflectors

   Flow deflectors can be constructed from logs and/or rocks. In confined channels where bank erosion is undesirable, they should be positioned pointing upstream to direct high flows to the middle of the river channel. Also, the opposite bank should be reinforced with log or boulder revetment to protect against erosion, particularly where the rock-filled deflectors are used.

   The rock-filled triangular deflectors should be sufficiently high to prevent high flows weiring over the top and eroding the same bank on the downstream edge. Low log deflectors should drown out at higher flows, preventing this effect.

   Paired or single deflectors of both log and log/rock types can be used depending upon the effect being sought.

Figure 4 Upstream pointing paired flow deflectors

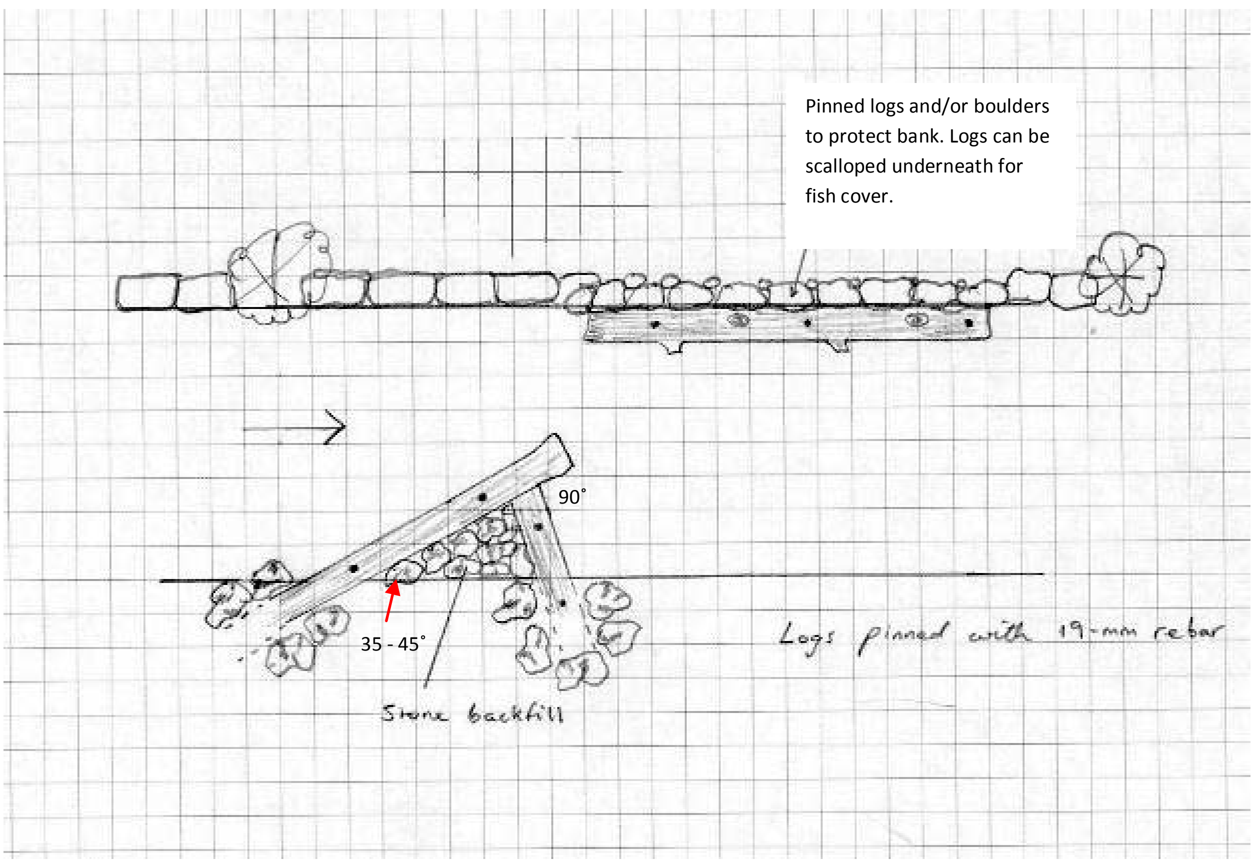


Figure 5 The wing deflector should extend a maximum of one-third of the way across the channel

3. Cross-channel logs

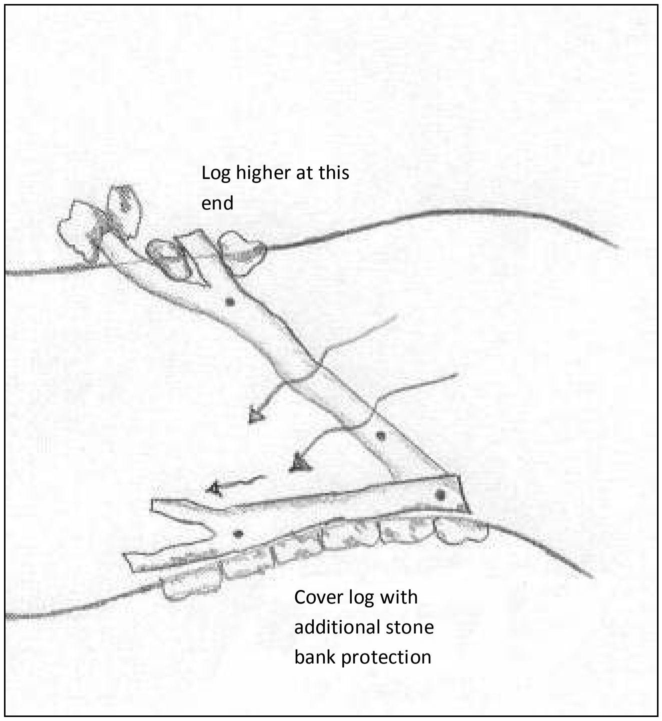


Figure 6 Cross-channel log

Several variations on the cross-channel log can be used to achieve bed scour and cover, mimicking naturally occurring large woody debris. Follow the general principle of positioning the cross-log as illustrated (with its downstream end higher than the upstream end) to avoid bank scour.

A good natural example was seen on the Peffrey just downstream of the A834 road bridge (above the sewage treatment works) – Photo 7.

Photo 7 Natural cross-channel log creating downstream scour pool and sorted gravel ramp. Note the tree/debris accumulation acting as a "raised end" on the downstream end of the log (arrow).

Bill of quantities for construction of above structures:

One-off costs (tools, equipment)

Item	No.	Unit cost	£
Wood auger (e.g. Stihl BT45)	1	400	400
22-mm bits (400mm length)	5	30	150
hand brace (for freeing stuck auger bits)	2	25	50
Chainsaw	1	500	500
Hand tools (Sledge hammers, spades, fencing pliers/wire cutters, hand			150

hammers)			
Wheel-barrows (for moving rocks)	2	50	100
TOTAL			**1350**

Approximate cost of materials/labour per structure

	No.	Unit price £	£
19-mm diameter steel reinforcing bars (1.5 m length) with welded end caps	12	10	120
Sheep netting fencing mesh	10m	0.6	6
Chicken wire – 1 roll	10m	0.6	6
Fencing staples (30mm) 5kg	20	0.04	0.8
Logs – sourced on site			
Rocks – sourced on site			
Labour BTCV	Half day	250	125
TOTAL			**260**