Advisory Visit

Water of Milk – Dumfries and Galloway

Scotland

20/10/2018

Key Findings

- Sheep access to the river banks is preventing the natural regeneration of trees and shrubs that would ordinarily provide protection and consolidation of the banks. Buffer fencing to exclude livestock from the riverbank would therefore be beneficial to not only the habitat of the watercourse but also bank stability.
- Past maintenance of the bank with coarse riverbed material has created a poorly consolidated bank that is susceptible to erosion. The addition of a raised floodbank also constrains the watercourse, increasing the erosive energy of flows within the channel and exacerbating erosion issues.
- Reinstating a more natural earth bank, with a more natural level and profile, that can become consolidated by trees and vegetation and withstand overtopping by elevated flows would be beneficial.

1.0 Background

This report is the output of a site visit to the Water of Milk, a tributary of the River Annan, at the request of the River Annan Trust. The purpose of the visit was to assess options for habitat improvements and riverbank stabilisation in an embanked section of watercourse.

Normal convention is applied with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream. Upstream and downstream references are often abbreviated to u/s and d/s, respectively, for convenience.

2.0 Background

The site visited lies immediately downstream of a much steeper-sided valley section, within a natural floodplain area traversed by numerous low points and former river channels (Fig. 1). Historically, medium and high flows would have regularly spilled out of the channel onto the adjacent land, flows energy and depositing fine sediment (silt) and nutrients. Consequently, the adjacent land is some of the most productive in the area.

Although not visible on the oldest available maps (c. 1850s), it is suspected that the natural course of the channel was altered to create the current watercourse, owing to the elevated position of the current channel above the low point of the valley. Interestingly, even on the oldest maps seen, the floodbank appears along the watercourse, adding weight to the assumption that the channel was already subject to modification by that point in time. This is particularly pertinent when it is considered that the material used to construct floodbanks is often sourced from the bed of the watercourse.

More recently, ongoing efforts have been made to reduce the occurrence of high flows spilling onto the adjacent land through maintenance/reinstatement of the flood bank and channel dredging. While this may seem like the obvious way to manage the land, it is not without issues. Aside from the reduction of natural sediment and nutrient deposition on the adjacent fields, constraining higher flows within a channel increases the erosive forces that are expressed upon the bed and banks. This invariably leads to increased bank erosion and instability and often incision of the channel into its bed (down-cutting) at high flows. The end result being a local impact upon flow rates and erosion but also issues further downstream where peak flows are often higher, owing to the lack of natural flood water attenuation on floodplains in the upper catchment.

Figure 1. Looking from the river bank out across lower-lying areas of the floodplain in the foreground and up to the LB valley side (background).

3.0 Site assessment

Land use at the site is fodder production over the summer with aftermath sheep grazing in the winter. This has allowed a relatively diverse margin of grasses and some herbaceous vegetation to establish along the riverbank, a sheep generally favour grass regrowth in the mown areas over the unmown, rank vegetation of the river margin. The resulting roughness from the vegetation and diverse root-stock of those plants certainly provides some protection to the bank and contributes to improved stability when compared to that of a heavily grazed river margin. However, even the relatively low density, periodic grazing is sufficient to prevent natural tree regeneration. This is a common issue with sheep as, being browsers, they naturally favour young saplings (particularly willow) to even grass regrowth in most situations.

Over time, this denudes a river of bankside shrubs and young trees that would ordinarily provide additional consolidation and protection of the riverbank (as can be observed in the more stable, treed areas of the un-grazed bank right bank). The large, mature trees that remain provide some discrete areas of bank protection, but nowhere near as much as would be provided by a greater abundance and more diverse age structure of trees/shrubs. Without any regeneration to replace those old trees, that benefit will also be lost over time.

Figure 2. Looking downstream at the erosion site (LB). Note the reasonably well vegetated bank top (left of shot) - sheep generally favour the grass regrowth in the mown areas to the left of shot. However, also notice the lack of trees, shrubs and tree regeneration, with only a few mature trees present. This area of the left bank comprises incohesive, coarse material and is overly steep, with a raised flood embankment on top, all of which is greatly contributing to the erosion issues. Also note the more stable, treed areas on the RB.

Raising of floodbanks along the river may have also allowed the bed level to increase over time through deposition as the river level subsides following medium/high flows. This could actually have led to the watercourse becoming further perched above the adjacent land, as higher banks are then required to contain the watercourse. Any subsequent dredging (removal of bed material) and the of the watercourse then lowers the bed, as does erosion from high flows that are prevented from spilling onto the to the floodplain, creating periodic lowering of the bed and increased susceptibility of the banks to erosion. Manipulating the channel and flows (through dredging and floodbanks) therefore has the potential to create different impacts at different flows/river levels and potentially ongoing issues that are far less prevalent on natural riverbanks.

Repairs to the banks (and floodbanks) with the resulting coarse gravel and cobbles dredged from the channel has also clearly reduced the integrity and stability of the bank, owing to the incohesive nature of that material. Unlike soils, the coarse gravels and cobbles are poor growing material which cannot easily be consolidated by the roots of trees and vegetation, leaving banks that will are far more susceptible to erosion.

Figure 3. Looking upstream at the area of bank erosion (right of shot). Note the raised, relatively steep bank of coarse material. Re-grading this bank with a greater soil component and reinstating a more natural bank-top height and profile along this length would reduce its susceptibility to erosion.

Allowing the watercourse to gradually spill out of a more natural channel onto a well vegetated pastoral field is unlikely to cause significant damage. Consider that out of bank flows already occur during flood conditions, with no detriment to the majority of the field. Providing there is a sufficient sward to prevent erosion along high flow pathways, and livestock have areas of high ground in which to seek refuge, the negative impact of out of bank flows is negligible. Therefore, the value of attempting to prevent a river from utilising its floodplain, rather than accepting and accommodating it is highly questionable, providing flows drains naturally when river levels subside (i.e. they are not constrained behind floodbanks). Fortunately, the site in question appears to drain effectively following a flood, with all of the high flow pathways appearing to connect with a low point in the bank at the d/s end of the field (Fig. 4).

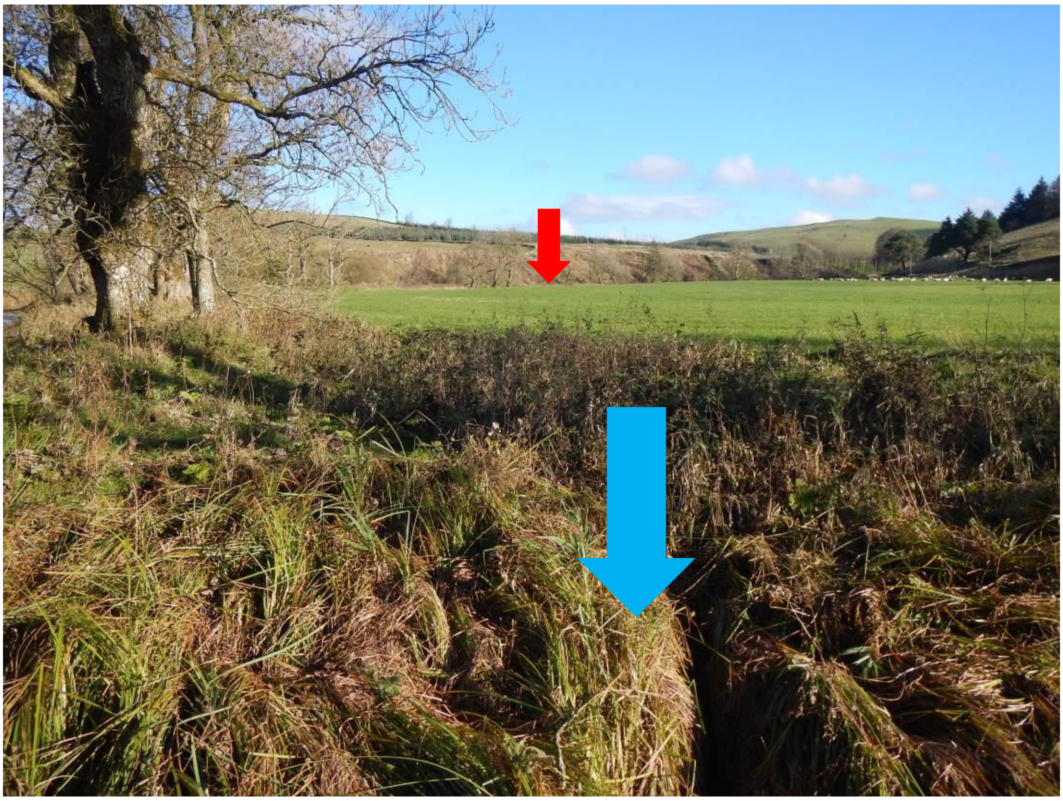

Figure 4. Looking upstream across the floodplain, from the low point of the field, at which out of bank flows return to the watercourse (blue arrow), up towards the point that river flows overspill (red arrow).

4.0 Recommendations

There are various actions that could be taken at this site to establish a more naturally stable channel, better sediment conveyance, improved land drainage and higher quality habitat. Relocating the watercourse to the lowest area of the valley bottom with a river restoration scheme would alleviate most of the problems identified at the site (see example Appendix A). However, this would bisect the field, leaving only a small, isolated land parcel on the right bank side. Owing to the high agricultural value of the field locally, this may only be viable if an alternative, financially viable use for the resulting right bank side land parcel could be devised. Seeking environmental subsidy payments for that land and/or development of the areas as a native deciduous plantation may be an option, for which there are likely to be a range of incentives available. This would require further discussions with the landowner.

If river relocation cannot be negotiated, another option would be to remove the excess coarse gravel and cobble material from the eroding bank area and repair it with a lower gradient, predominantly soil faced bank that can be planted with shrubs and reseeded/re-turfed. Gravel and cobble material resulting from the work could be reintroduced to the channel (if kept separate or mechanically separated from sine soil/silt) or used to fill the areas from which the soil for reinstating the new banks is sourced (this should be well back from the watercourse).

The height of reinstated bank should also be lowered, removing the floodbank and reinstating a more natural, even bank-top height. This will allow gradual overtopping of high flows along an extended length of bank, rather than in one localised area, where there is a greater risk of erosion (as occurs at present). Allowing the water to overspill naturally across a longer section riverbank will also create a more gradual loss of flow energy, rather than a dramatic loss within a short section that has potential to increase sediment deposition and block the channel. If such deposition did occur, it is likely to deflect even more water out of the channel and onto the adjacent field. For these reasons, all areas of the raised flood embankment should ideally be lowered and temporary utilisation of the floodplain by peak flows embraced as a predictable and easily manageable occurrence.

Being in Scotland, both the channel and bank alterations are likely to require Controlled Activities Licensing (among others) and all appropriate permissions and licences should be obtained prior to undertaking any work. Any major channel and bank excavation work should ideally be undertaken well within the growing season (April to August), so that recolonisation with vegetation can occur rapidly following planting and reseeding, to minimise the period that the reworked banks are left vulnerable to erosion. Undertaking this work within the dormant season would leave the banks susceptible to erosion until the growing season, when natural consolidation of the banks by vegetation can begin.

In conjunction with improvements to the banks, excluding livestock from the riverbank would be a necessity (and highly beneficial even without the bank improvement work), to allow the bank to revegetate and for trees to establish that will improve bank stability in the long term. The fencing should be installed as far back from the watercourse as possible through negotiation with the landowner, but should ideally be set a minimum of 5m back from the watercourse, or at the field-ward side of the bank top, whichever is the furthest.

There are many options for the fencing but all would have to be designed to be sheep-proof, while also accommodating water over-spilling from the river channel at higher flows. The most appropriate types of fencing include:

- Post and rail, which will withstand most flood water and can be made even more resilient by tacking the rails onto the field-ward side of the posts with oval nails. That way, if debris accumulates on the rails high flows will simply dislodge the affected rails, which can simply be replaced when the water subsides. This is far easier and cheaper than replacing long sections of damaged fence. Post and rail is relatively expensive and may be best used in the areas most susceptible to flooding.

- Clippex fencing offers another alternative, whereby wires can be unclipped and raised or replaced easily. However, this option could potentially require more regular maintenance (e.g. lifting of the wires prior to high water) and so may constitute a greater management burden. The ability to easily reinstate or replace damaged wires is a big positive of this type of fence.
- Post and 7 strand plain wire (ideally with battens between the posts to prevent sheep pushing through the wires). This a more traditional solution for areas that experience overland flow.
- Stock netting would only be suitable in some areas, where minimal overland flow is expected as it has a greater tendency to trap debris and become damaged during high flows.
- Water gates (as are used in fences crossing a watercourse), to be installed in areas where out of bank flows are expected. Watergates are incredibly effective in low areas of a field which form flow pathways, even if they are well away from any permanent watercourses. Their ability to adjust and accommodate high flows makes them very versatile but they are also expensive, so are usually deployed in specific problem locations.

The most resilient solution is likely to consist of either traditional 7 plain strand wire fencing with battens between the posts, or Clippex plain wire, for the majority of the fence (if located strategically, stock netting may be possible in some areas). Where necessary, the aforementioned fencing should be substituted for sections of post and rail or a water gates (as appropriate) in areas where the flows spill out of the channel and/or return to it at the d/s end (see Fig. 4). One or two access gates would also be beneficial within the facing to allow removal of livestock should they get into the buffer. The purpose of the gates should not be to deliberately allow sheep into the buffer strip as this would very rapidly negate the benefit of the fence, resulting in a loss of vital tree/shrub regeneration.

Tree planting would be beneficial within any areas that are buffer fenced and should include a range of locally native species. The suitable species could include, but are not limited to, willow, alder, rowan, hawthorn, hazel, oak, field maple and elm.

Locally sourced willow can be easily transplanted by cuttings taken from nearby shrubs. The quickest and easiest way of establishing willow trees is by driving short sections of freshly cut willow into the ground. This can be undertaken at any time of the year, but will have the greatest success during the dormant season, shortly before spring growth begins (ideally late Jan-March).

Whips should ideally be planted into soft, wet ground so that there is a greater length within the ground than out of it, to minimise the distance that water has to be transported up the stem; 30-40cm of whip protruding from the ground is sufficient. Whips of 5mm-25mm diameter tend to take best, but even larger branches/stems can be used. If taking cuttings during the growing season, care should be taken not to leave excessive amounts of foliage on the whips as these greatly increase the surface area of the plant and can lead to their dehydration. The whips need not be panted vertically, leaving the protruding end facing d/s will reduce the potential for catching debris and reduce the gradient up which water has to be transported from the developing root system.

5.0 Further information

The WTT website library has a wide range of free materials in video and PDF format on habitat management and improvement:

www.wildtrout.org/content/library

We have also 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/shop/products/rivers-working-for-wild-trout-dvd or by calling the WTT office on 02392 570985.

6.0 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 A

River restoration

A1. Realigned channel in normal summer flows, before restoration.

A2. Straightened, realigned channel over-spilling into the low point of the valley in high winter flows, before restoration.

A3. Normal winter flows during restoration.

A4. Normal summer flows during restoration - reconnection phase.

A5. Normal summer flows shortly after reconnection phase of the restoration.

A6. Low summer flows after reseeding and vegetation regrowth.