An assessment of hydrological, hydrogeological and geomorphological conditions for the freshwater pearl mussel *Margaritifera margaritifera* for the potential translocation of mussels from Enniscorthy

Part 1 High Flow Survey

DR EVELYN A. MOORKENS

Evelyn Moorkens & Associates

Evelyn Moorkens & Associates
123 Rathdown Park
Greystones
County Wicklow A63 PO42
Ireland

Mobile: 00353 86 8211385
Email: emoorkens@eircom.net

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1.0 Introduction

The freshwater pearl mussel (*Margaritifera margaritifera*) is endangered at a global scale and critically endangered in Europe and Ireland (Moorkens, 2011; Byrne et al., 2009). Populations of this species have undergone severe declines in recent years as a result of a combination of factors including catchment drainage, physical habitat degradation, nutrient enrichment, siltation and pollution.

The translocation of adult mussels is a last resort action, where mussels are present in a situation where they and their habitat are unlikely to survive. The direct movement of adult mussels has been demonstrated to be a high risk activity, thus interactions that increase the number of mussels with a new generation of juveniles and thus lower the risk of translocation are more desirable than moving adult mussels (Killeen & Moorkens, 2016). The method of gaining the added value of a new generation of juveniles, and thus more individuals to trial in different receptor sites, depends on a) the condition of the population and b) the potential for the survival of mussels in a different site.

This process can be undertaken in three ways, based on the condition of the river. Scenario 1 is where the mussel habitat has been restored over a wide area, in this case bankside encystment would provide the resource for potentially high numbers of juveniles to settle and could increase population numbers relatively quickly (Altmueller & Dettmer, 2006). Scenario 2 is where good mussel habitat has been restored in a small number of areas, or limited good habitat remains in the wild, here short term breeding can be used to produce large numbers of freshly excysted juvenile mussels to be placed in the best habitats (Moorkens, 2017a). Scenario 3 is where the river is slowly recovering but not yet to a stage to support young juvenile mussels, here longer term captive breeding can produce a new generation of young mussels to a stage where they no longer need to fully bury in the river bed substrate. These mussels should be used to supplement the remaining mussels in the best habitats where the native adult mussels remain extant.

The purpose of this study is to investigate the potential in the Slaney River to undertake Scenario 2, by investigating the potential for using short term breeding as part of a translocation exercise. In this case, the investigation is to determine the potential for remaining pockets of good juvenile habitat in the vicinity of Scarawalsh Bridge. These habitat pockets could be used to place short-term bred juvenile mussels, using the technique of Moorkens (2017a). A number of spot-checks were undertaken on the Lower River Slaney around Scarawalsh by Ecofact (2016). Live *Margaritifera* were confirmed to be present at Scarawalsh Bridge and also downstream of the N11 road bridge at the River Bann confluence. The Slaney at the River Bann confluence was checked by Moorkens in 2017 and found to be unsuitable for juvenile mussels.

The high flow survey was undertaken on 20th February 2018. The recent flows were relatively high, with data records showing 1.3 to 2.4m from the Scarawalsh Bridge gauge in the 5 weeks before the survey. The 50th percentile is 0.71m and the median flood level is 2.28m.

2.0 Methodology

The following requirements were outlined in the translocation proposal for the Enniscorthy mussels (Moorkens,2017b):

The nearest known site for *Margaritifera* in the Slaney River upstream of the proposed works is an area of preferential flow near Scarawalsh Bridge. Prior to any translocation, the following protocol for field study is proposed:

1. Use aerial photography to identify upstream and downstream limits for field studies.

2. A field study should be undertaken in two parts. Firstly, a **winter** high flow bank walkover should be undertaken to ensure the identified stretches do not have high flow constraints – highly drained and dirty inputs and / or chronic suspended solids issues can be clearly identified in these conditions, as can over deepened or bedrock restricted areas leading to excessively high flows. Caution should be taken as high flowing rivers are dangerous and a safe distance should be kept away from the water, which should not be entered during high flows.

3. The second field study should be undertaken during **summer** low flows, and an assessment should be made for river bed habitat suitability and quality, including:

    a. River bed habitat suitability for adults and juveniles – clast range, compaction, scour levels
    b. River bed habitat condition – algal and macrophyte levels (Refer to *Margaritifera* regulations 2009)
    c. Adult mussel numbers present
    d. Near-bed velocity (refer to Moorkens & Killeen, 2014)
    e. Redox potential (refer to Geist & Auerswald, 2007)
    f. Suitable receptor sites should be mapped carefully and photographed.

4. A hydrological, hydrogeological and geomorphological risk assessment of the local mini-catchments supporting the proposed translocation sites should then be undertaken to assess the resilience of the local catchment area in its role to protect against sediment and nutrient pollution, and against the exacerbation of drought conditions (particularly through artificial drainage of the upper mini-catchments), and its ability to protect the mussel population through appropriate detritus food production and delivery (sufficient connectivity of undrained land delivering positive juvenile mussel nourishment), and, where appropriate, the replenishment of stone of favourable clast sizes. This study is not constrained by season.

More detailed field studies assessments are summarised in Killeen & Moorkens (2016) and Moorkens (2017a). It must be understood that if all investigations at a site gave positive results, it is likely that a good population of *Margaritifera* would be likely to occur there already. However, the balance of positive and negative results provide the best indication not only of which sites are likely to result in success, but also what sort of ongoing conservation management might best improve the location for sustainable juvenile survival over time.

This high flow survey comprises parts 1 and 2 of the above requirements.

The methodology for Part 1 was a desktop study of aerial mapping (from Google maps).

The methodology for Part 2 comprised a walkover survey of the river checking for flow patterns, local land conditions and drain inputs. These were tabulated and photographs taken of the river and riparian areas in high flow conditions.

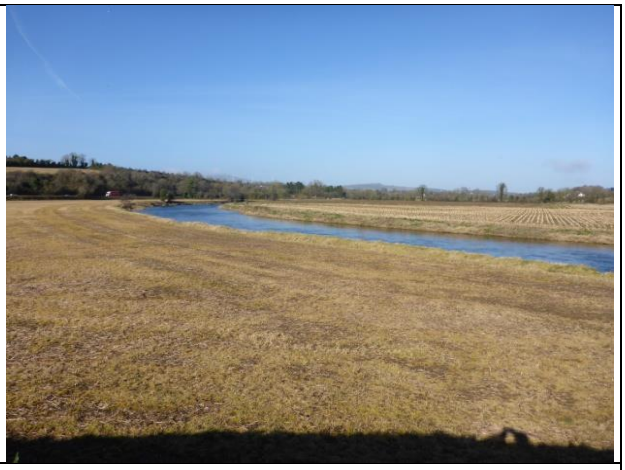
3.0 Results

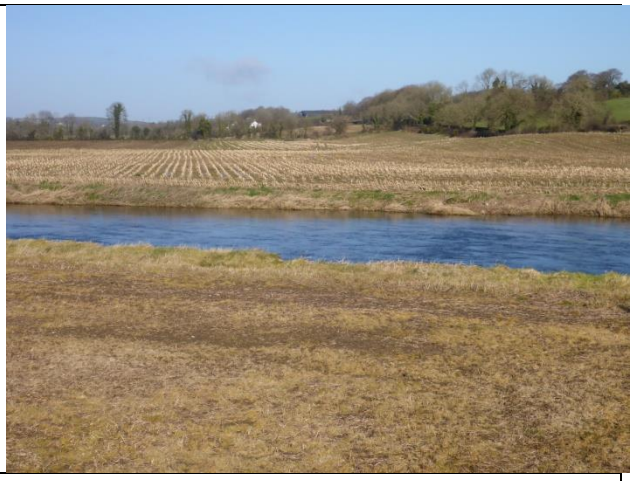
The desktop study of aerial mapping (from Google maps) showed that the river stretch between Scarawalsh Bridge and the N11 bridge had the best potential for *Margaritifera* habitat. The very intensive agriculture and the low variation in the river channel upstream and downstream of these bridges made the potential habitat area quite restricted. The next positive habitat area is likely to be a further 7km upstream of Scarawalsh Bridge. The area around the Bann confluence was deemed to be unsuitable for juvenile mussels following a visit in 2017. Mussels here are likely to have been washed down from the population resident in the River Bann.

Therefore, the field investigation concentrated on the approximate 300m of river flowing on each side of a large island located between the two bridges, from S98336 45064 to S98426 44827.

The results are shown in Table 1.

Table 1 High flow walkover survey results at Scarawalsh Bridge site.

1. Upstream of Scarawalsh Bridge Upstream of the bridge, the river is fast flowing and uniform, with intensive riparian management to the banks at either side (a, b). Unsuitable for juvenile mussels. All 6 eyes of Scarawalsh Bridge were flowing on the day of the survey (c).	 a



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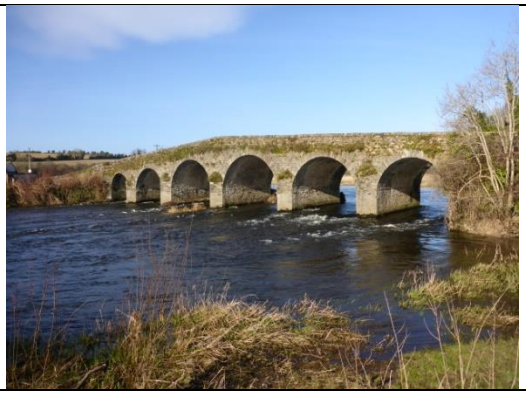

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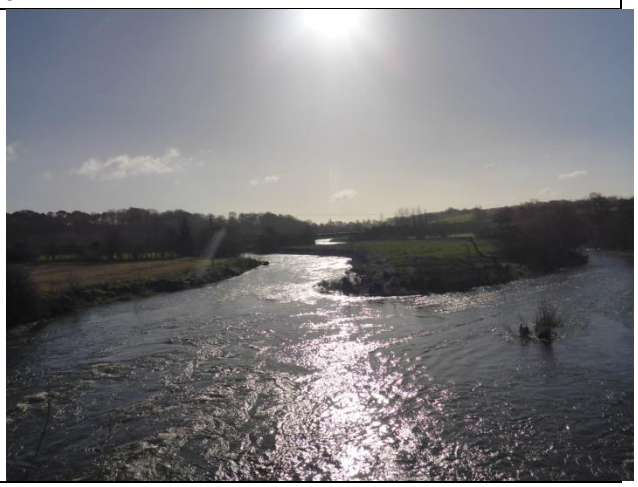
2. Downstream of Scarawalsh Bridge, upstream of Island

The pull of flow in the area upstream of the island is quite strong but with potential to be protected from scour in the winter flows.

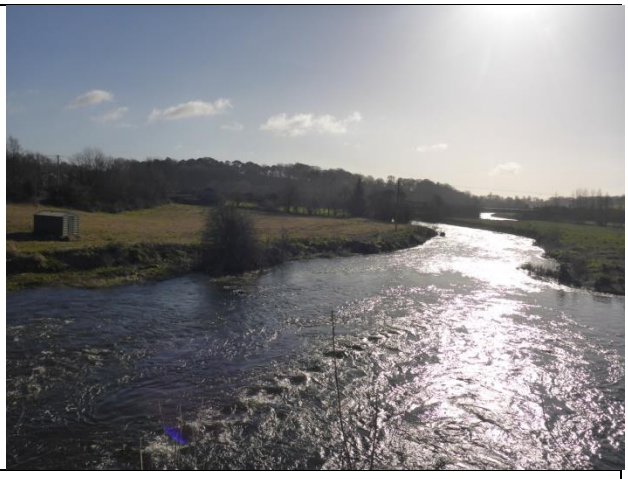
This area merits low flow investigations.



3. Channel to the left of the large island.

The left branch appears to have higher flow than the right branch, and thus may carry the main river discharge, and thus preferential flows suitable for *Margaritifera*. Both the island banks and the land river banks are low enough to support flooding and thus prevent mussels from scouring out of their habitat (a).

An eroded area just downstream of the bridge in the vicinity of the gauge is unsuitable habitat (b). Dense weed is visible under and at the surface in this area (c).



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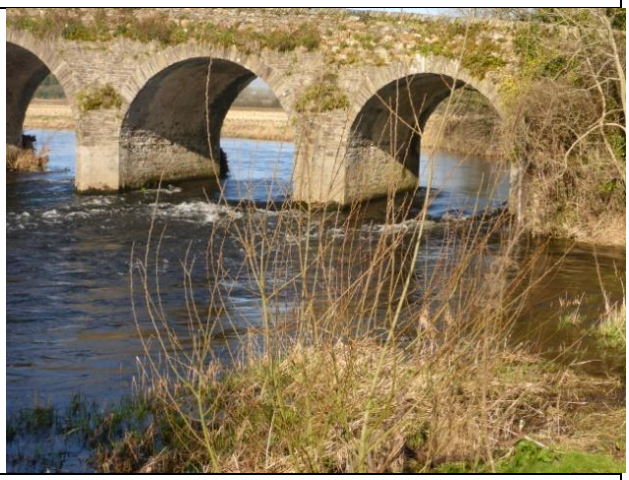

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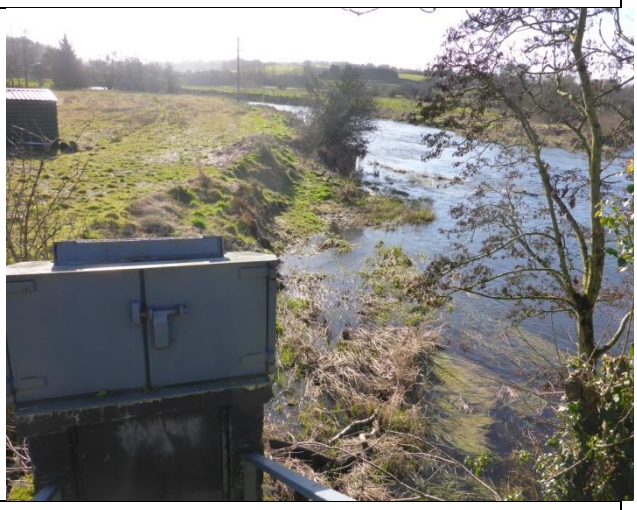

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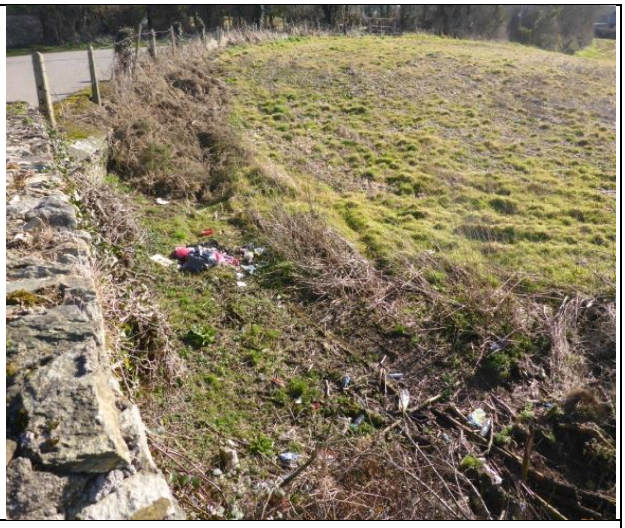
4. Terrestrial habitat at left bank

The terrestrial habitat along the left channel area is relatively intensive, but it is managed as grassland, not arable as was the case upstream of the bridge.

There was rubbish accumulating in the field from where it has been thrown from the bridge (a). A local walker told us this was a constant problem, and there had been everything from household rubbish to a car dumped in this field. This is a source of concern.

The winter debris line demonstrates that the river retains the ability to flood into this field, which is a positive indication that flows are suitable and not scouring (b).



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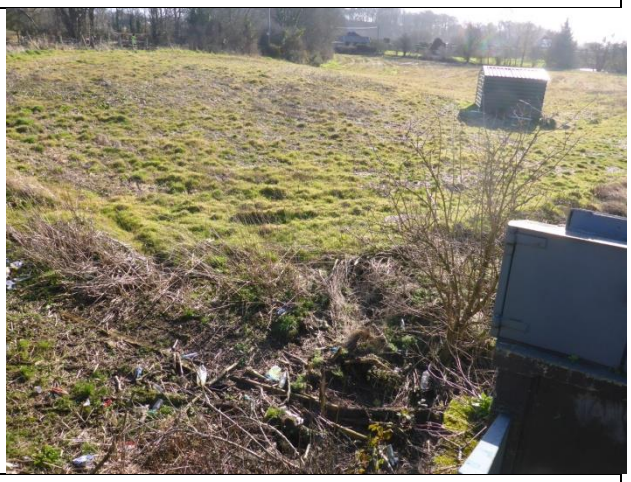
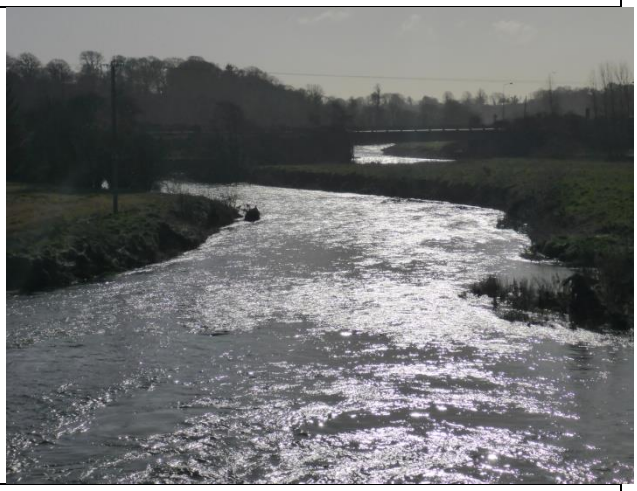


b

4. Further downstream along left channel (a)

There has been some erosion in the past with two-tier bank heights and isolated island areas that were once part of the main left bank (b-d).

Depending on the preferential flows during low flow periods, this area may have potential habitat.



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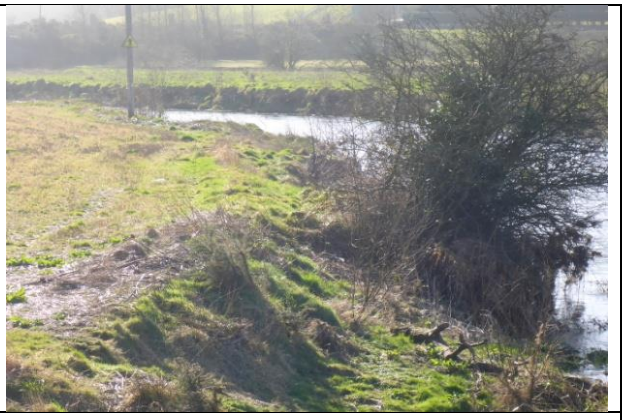

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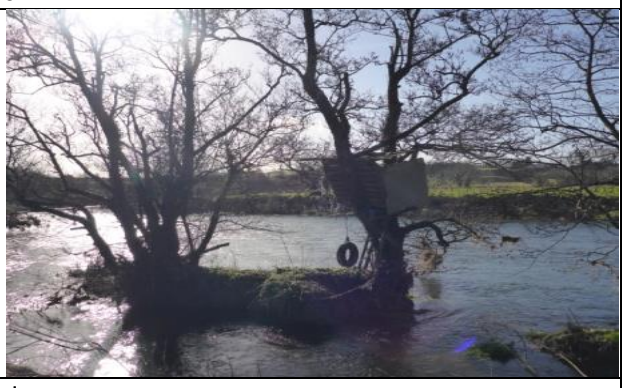
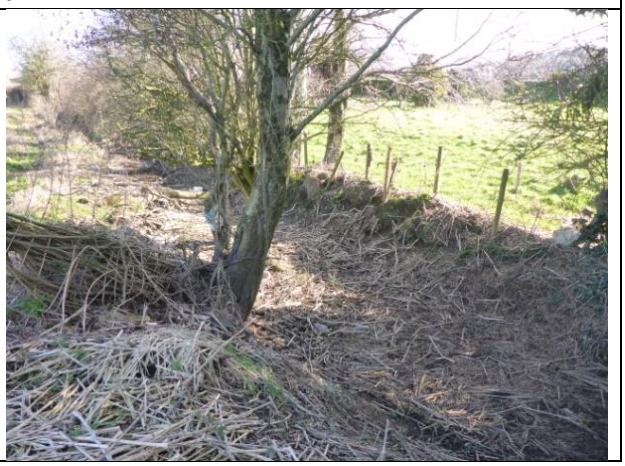


d

5. Dry drain entering river at S 98410 44945

This ditch would be likely to be a source of fine sediment when running wet, although this may not happen very often. It is unlikely that there will be good habitat found downstream of this point in the left hand channel.

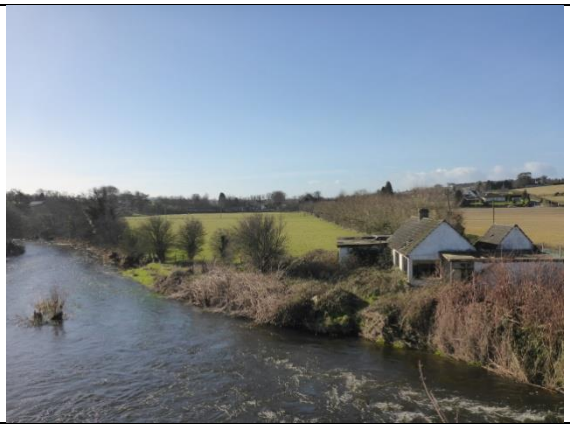


6. Channel towards the right bank downstream of Scarawalsh Bridge.

Vegetated, relatively high banks are present between the old house and the river just downstream of the bridge (a).

The flow is straight and rather shallow towards the channel to the right of the island (b).

Probably unsuitable as habitat in this area.



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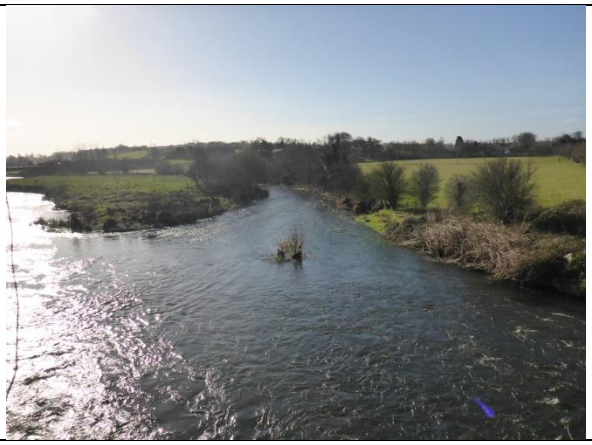
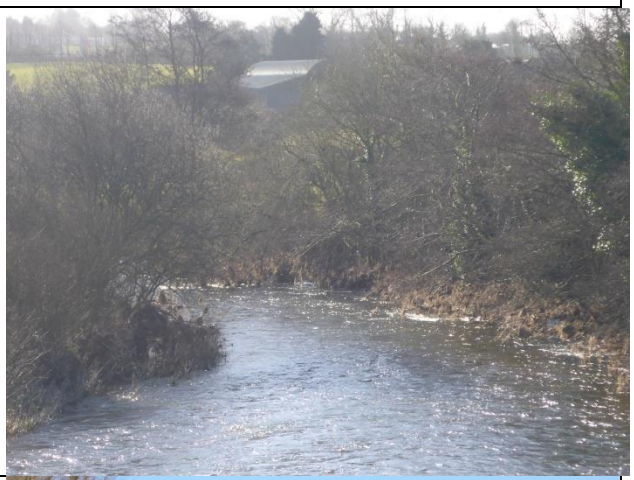


b

7. Right hand limb of river at island area.

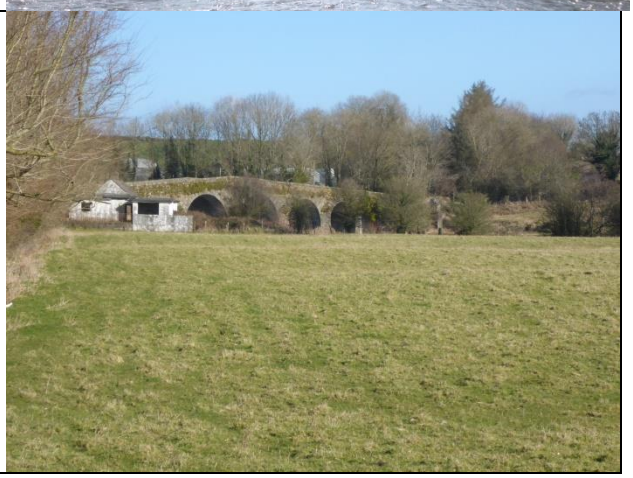
The right hand limb appears to have the minor flow and although it looks suitable at high flow, it needs to be checked for potential at low flows.

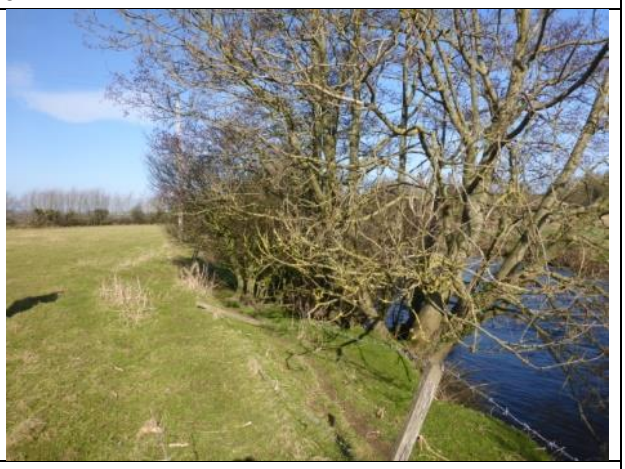
There are trees growing on both the land and the island banks for most of the length of this limb.

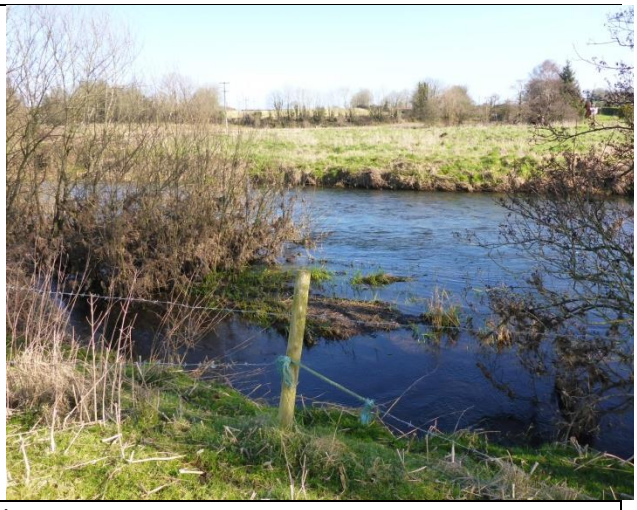


8. Land use at right limb area

There is rather intensive sheep grazing in the fields next to the right limb (a, b), and a farmyard is present near the lower end of the right limb (c).



	a  b 
	c
9. Right hand limb riparian area The riparian area at the land side has barbed wire fence and is tree lined along most of the length (a). There has been some bank erosion. The island bank is low and suitable for flooding during high flows (b). Some of the bank area is bare but there are trees present along some of the stretch (c).	 a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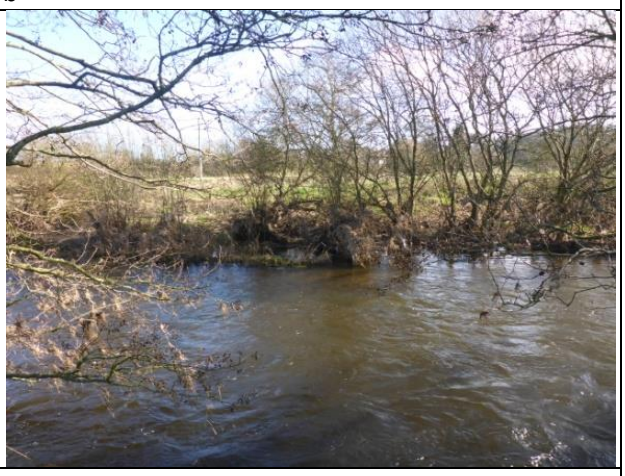
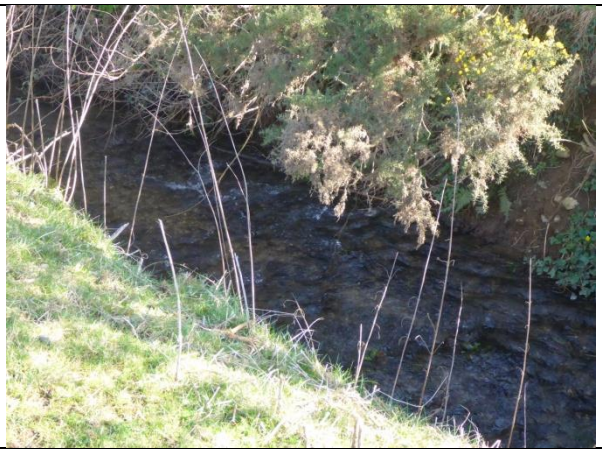
	
	c
10. Waterbody entering river at S 98403 44828 (a) The stream is rather muddy where it enters the river (b, c). The presence of clean habitat downstream of this point is unlikely.	
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	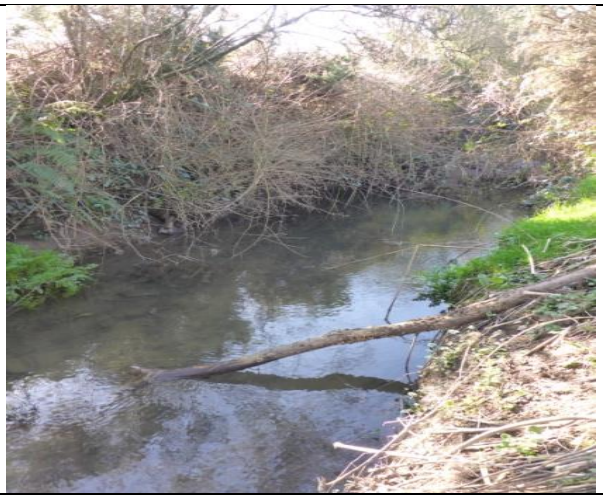
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	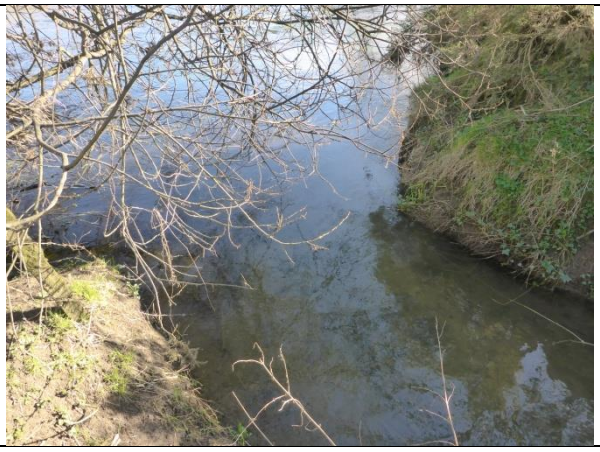
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4.0 Discussion

The results of the high flow survey is that potential for juvenile *Margaritifera* habitat has been demonstrated and the studies should be moved forward with a low flow survey at the appropriate time from May 2018 onwards.

The instream low flow survey should concentrate on the area from Scarawalsh bridge to the dry ditch entry into the left limb and the stream entry into the right limb.

5.0 References

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