

**Report to: SSE Renewables Developments (UK) Ltd**

**Contract No: J509**

**Freshwater pearl mussel survey at  
Gordonbush Extension Wind Farm**



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Gordonbush windfarm (proposed extension):

FWPM survey of Allt a Mhuillinn and Allt Smeorail  
watercourses

September 2013 for NES Ltd



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### Document Revision History

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## 1. Introduction

Freshwater pearl mussels (*Margaritifera margaritifera*) are relative large, non-motile, long-lived invertebrates that live partially buried in the substrate of fast-flowing rivers and burns. They are now in decline globally, and extinct in many UK rivers with the Highlands of Scotland being one of the last strongholds for the species.

The law states that it is an offence to intentionally or recklessly kill, injure, take or disturb freshwater pearl mussels or their habitat.

The project entails works to extend the operational Gordonbush Wind Farm. This has the potential to affect two watercourses, namely the Allt a' Mhuilinn to the west of the site and the Allt Smeorail to the east. Part of the Allt a' Mhuilinn was previously surveyed for freshwater pearl mussels in 2013 prior to work to remove a redundant dam. No freshwater pearl mussels were found during this survey which focused primarily on the section below the dam. The works to remove the dam are now complete and the current survey focused on the area upstream of the former dam location to 100m upstream of the northern extent of the proposed Development.

The Allt a' Mhuilinn lies above Loch Brora at the upper end of the catchment and has been classified by SEPA as "Good Status" with high confidence. The Allt Smeorail lies to the east of Allt a' Mhuilinn and is currently unclassified by SEPA. Both watercourses are part of the River Brora Freshwater Fish Directive protected area and the Strathfleet bedrock localised sand and gravel aquifers drinking water protected area.

Working with machinery in a river has the potential to directly impact freshwater pearl mussels by crushing any individuals that may be in the way or indirectly through increased siltation or pollution caused by accidents or poorly maintained vehicles/equipment. In order to ensure compliance with legislation, it is therefore necessary to carry out a survey for the presence of the species prior to any works that may affect a population.

## 2. Biology

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### 2.1 HABITAT REQUIREMENTS

Research suggests that adult and juvenile freshwater pearl mussels have similar habitat requirements, however, according to Hastie *et al.* (2000) juveniles are more sensitive to environmental disturbance.

The species prefer cobble/boulder dominated substrate with stable patches of clean sand that allows the mussels to burrow (Hastie *et al.*, 2000) and have a preference for fast flowing rivers with water depth 0.3-0.4m and velocities between 0.25-0.75ms<sup>-1</sup>, however the author has found mussels in depths ranging from 0.1m to greater than 1m depth.

Freshwater pearl mussels are filter feeders, gaining their nutrition from organic particles in the water (Cosgrove *et al.* 2000). Bauer (1983) states that levels of silt, suspended solids, calcium and chemical compounds generally associated with enrichment such as nitrate, phosphate and biological oxygen demand are all critical for their survival.

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## 2.2 HOST REQUIREMENTS & DEVELOPMENT

The life cycle of the freshwater pearl mussels is completely dependent on the presence of young Atlantic salmon (*Salmo salar*) and trout (*S. trutta*) (Young & Boon 2000). The glochidia or larvae of the mussels clamp onto the gills of juvenile salmon and trout between spring and late summer. The glochidia subsequently release themselves and bury into the surface layer of the river sediment. Mortality rates are high, however, for those surviving, growth is fast, reaching approximately 4mm after 1 year (Young & Boon 2000). Maturity is reached at 6.5 cm (Skinner *et al.* 2000) and adults may grow to 12-15cm, and may live for over 100 years.

## 3. Methodology

The aim of this survey was to establish the presence of freshwater pearl mussels within the watercourses; Allt a' Mhuilinn and Allt Smeorail.

The protection afforded to freshwater pearl mussels means that if mussels are likely to be found, then a licence must be obtained from Scottish Natural Heritage (SNH) in order to survey for the species. The following investigation was carried out under Animal Conservation License No. 13384, by Greg Fullarton with Imogen Young acting as health and safety assistant.

SEPA river level data was first obtained from the nearest gauging station (River Brora at Bruachrobie) to ensure the river was low enough to survey and the Met Office weather forecast monitored to ensure favourable survey conditions.

The methodology followed the SNH's "Freshwater mussels survey protocol for use in site-specific projects". This involved conducting a general survey of the river and its substrate types, by walking the banks and/or by wading in the water with the aim of identifying specific areas most likely to harbour mussels. Once suitable habitat was identified then the careful and systematic wading of representative stretches of river was undertaken, using a bathyscope (glass bottomed bucket – see Figure 1) to allow a clear view of the channel while looking for the presence of individuals on the river bed.

Both positive and negative results are recorded and the fully documented methodology is described in full within the SNH protocol.





**Figure 1 Use of bathyscope to view river bed.**

On the Allt a' Mhuilinn, given the recent survey earlier in 2013, prior to the removal of the dam, the survey area extended from the location of the former dam to 100m upstream of the Development site boundary. On the Allt Smeorail, the survey extended from 500m downstream of the lowest part of the site boundary to 100m upstream of the uppermost part. Both surveys also included tributaries where they could be affected by the works.

#### **4. Constraints**

The main constraints for carrying out a freshwater pearl mussel survey are accessibility, flow conditions, good light and water clarity. The weather on both 13<sup>th</sup> September 2013 and 27<sup>th</sup> September 2013, when the surveys were carried out, was dry on both occasions with little rain in the preceding week. Consequently the river level was considered to be at normal level. The Allt Smeorail was clear for its entire length and the majority of it could be easily surveyed with the exception of a short (100m) bedrock gorge section that was considered to be unsafe to access. While the water on the Allt a' Mhuilinn was considered to be generally clear, significant accumulations of diatom scum / green algae debris (identified via microscopy) had occurred following the long dry summer period and this had been mobilised due to some light rain during the previous day, consequently the bed of the river was obscured in places and in the slow flowing glide sections the water clarity was very poor.

These constraints were however considered to have minimal bearing on the outcome of the survey and it was thus considered that the timing and level of survey effort was sufficient to provide a robust assessment, although the possibility of populations

within inaccessible parts, or the areas of poor water clarity, cannot be completely ruled out.

## **5. Results and Discussion**

Consultation with SNH confirmed there was a breeding population of freshwater pearl mussels within the River Brora catchment, further to the west, but no survey data was available for the watercourses within the survey area.

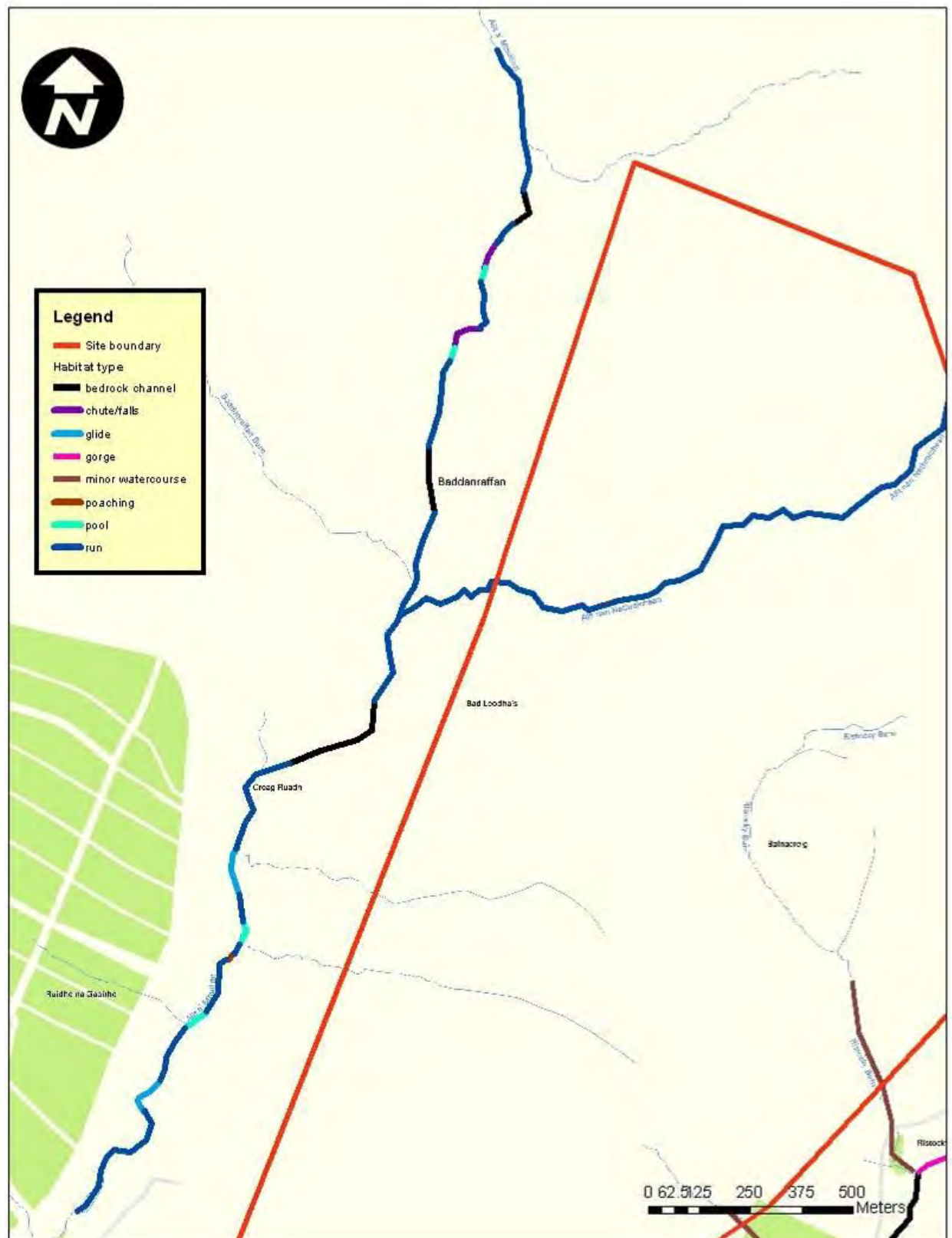
### **Allt a' Mhuilinn and tributaries**

No mussels, shells or shell fragments were found although areas of suitable habitat were identified throughout the length of the watercourse.

There was no evidence of macrophyte growth. Bryophytes and filamentous green algae were the only sign of in-channel plant growth. This is indicative of a typical Highland nutrient poor river.

A number of fish ranging from juvenile to adult (trout) were observed throughout the survey and the presence of signs of otter suggests a good fish population capable of supporting a viable freshwater pearl mussel population. Numerous juvenile frogs were also identified during the survey.

A map of the survey area and main habitat types encountered is provided below in Figure 2.



**Figure 2 Freshwater Pearl Mussel Survey Areas – Allt a' Mhuilinn (Contains Ordnance Survey data © Crown copyright and database right 2012).**



The survey commenced at the site of the old dam structure at GR 2832 9124 (Figure 3). The structure formerly caused a largely impassable obstacle to fish passage, with its removal during 2013 now allowing free passage of fish.



**Figure 3 Site of former dam and start of survey.**

The survey section proceeded with long run sections interspersed with occasional laminar flow glides (Figures 4 and 5). The glides were difficult to survey due to the large amount of suspended algal / diatom material in the water which partially obscured the river bed. The run sections, however, were all possible to survey, although they also had a thick coating of this material. Initially it was suspected the material could be sediment derived, however, microscopic analysis following the survey showed that it was the remains of photosynthetically derived material and not the result of pollution.

The river at this location and up to the start of the Allt nan Nathraichean was approximately 4m wide and 10cm deep. There were no signs of significant bank or channel resectioning throughout the survey and, with the exception of the location of the former dam, the river was considered to be largely unmodified.



**Figure 4 Looking onto run section from glide.**



**Figure 5 Slow laminar flow glide section.**

The survey carried on with the river forming long run sections crossed by a recently constructed deer fence with a water gate (Figure 6). Minor evidence of poaching was noted on the river just upstream of this point (Figure 7). No livestock were seen and it was thought this had been caused by deer.





**Figure 6** Run section, crossed by deer fence with water gate.



**Figure 7** Minor poaching of bank.

A large pool was noted (Figure 8) containing adult trout. This water was highly discoloured and unable to be surveyed properly. Upstream of this was a large, active point bar (Figure 9) with an actively eroding sandy bank face opposite.





**Figure 8 Large pool – discoloured water**



**Figure 9 Large active point bar with actively eroding sandy bank face opposite.**

The river continued upstream mainly as run sections with exposed boulders in channel (Figure 10) until it reached the main tributary, the Allt nan Nathraichean (Figure 11). Just above the confluence, the main river narrowed to 2.5m width and averaged 20cm depth. The main tributary flowed near to the existing Gordonbush Wind Farm site, however, there was no difference in levels of discoloration upstream



and downstream of the confluence, again suggesting that the result of the loading of the water was not the result of run off from the wind farm site.



**Figure 10 Run section – valley becomes more steep-sided.**



**Figure 11 Main tributary joins the river**



Continuing upstream, the channel continued as a run, with the valley sides becoming steeper (Figure 12), before coming to a large pool directly below a bedrock chute section of approximately 1.5m height (Figure 13) which was considered to still be passable to trout.



**Figure 12 steep sided section, river narrows.**



**Figure 13 Bedrock chute section with large pool**



This was followed by a steep sided bedrock channel section which contained some tree cover (Figure 14).



**Figure 14 Steep sided bedrock channel**



**Figure 15: Pool with minor falls / steep chute above (c. 2m)**

The rest of the survey area upstream and downstream was nearly devoid of bankside tree cover with moorland heath being the main land use. Upstream of this section was a two stage bedrock falls or steep chute with a large pool below (Figure 15). The lower part was around 2m high while the upper part (Figure 16) was around 2.5 high.



The upper falls/chute will present an obstacle to fish under some, if not all flow conditions.



**Figure 16: 2.5m chute/ falls section**



**Figure 17: Run section with further bedrock chutes.**

Upstream of the falls was a further steep sided run section with further smaller bedrock chutes (Figure 17). Upstream of this, the valley opened out with a more

gentle slope and the river became narrow (approx. 1.5m, 10cm deep) with signs of active deposition (Figure 18) until the upstream extent of the survey. The upper tributary had no flowing water and was no more than a wet flush (Figure 19).



**Figure 18: Upstream section of survey – shallow, narrow, active channel.**



**Figure 19: Upper tributary – no water flowing, wet flush only.**

The survey returned downstream and continued with the main tributary, the Allt nan Nathraichean, which flowed in a sinuous, unmodified manner through very steep, near gorge like terrain (Figure 20). The channel was approximately 1.5m wide and 10cm deep showing signs of active sediment deposition along its length (Figure 21).



The channel was considered to be highly mobile and less suitable for freshwater pearl mussels than the main Allt a' Mhuilinn. This continued all the way to the confluence (Figure 22), above which was a disused river crossing.



**Figure 20: Main tributary upstream of power lines, flows within a gorge.**



**Figure 21: Showing active channel within main tributary.**





**Figure 22: Looking downstream on main tributary towards Allt a' Mhuilinn.**

## **Allt Smeorail**

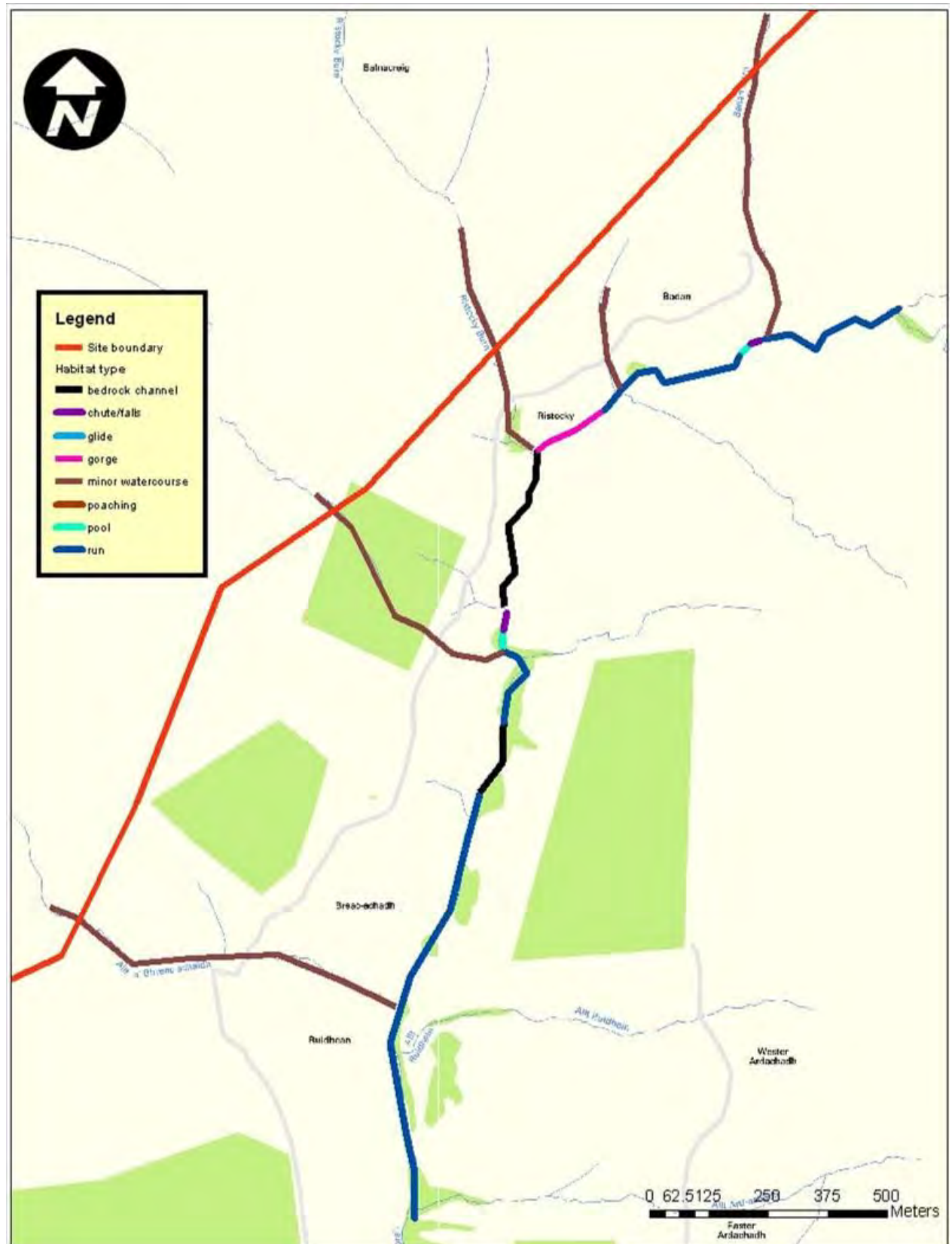
No freshwater pearl mussels, shells or shell fragments were found within the Allt Smeorail. The middle and upper area of the survey section contained large amounts of bedrock which limited the potential for freshwater pearl mussels, however, the lower section was considered to provide excellent freshwater pearl mussel habitat, with many areas of finer sediment in between larger cobbles and boulders.

Similarly to Allt a' Mhuilinn, there was no evidence of macrophyte growth, with bryophytes and filamentous green algae being the only sign of in-channel plant growth. Although there was some evidence of sedimentation from decaying diatoms and algae in the upper section, it was considered to be much less prevalent than that encountered on the Allt a' Mhuilinn.

A number of fish ranging from juveniles to small salmonid parr were observed throughout the survey, as well as various signs of otter, thus suggesting a good fish population.

A map of the survey area and main habitat types encountered is provided below in Figure 23.

**Figure 23: Freshwater Pearl Mussel Survey Areas – Allt Smeorail (Contains Ordnance Survey data © Crown copyright and database right 2012).**





The lower survey section consisted mainly of run sections (Figure 24) within an active channel with evidence of sediment deposition (Figure 25). There was good bank-side tree cover throughout this section. This provides useful channel shading, as well as being a source of large woody debris, which was in evidence in several areas of the lower and middle survey section. The habitat in this lower section was considered to be excellent for freshwater pearl mussels, although none were found.



**Figure 24: Downstream extent of survey, good habitat with good bankside tree cover**



**Figure 25: Run section with small side bar.**



The channel then became bedrock with a large pool and minor 1m high falls, which were considered passable to fish (Figure 26). The channel then returned to a run section with active deposition (Figure 27), containing good freshwater pearl mussel habitat. The river width was fairly uniform throughout the survey area at 4m wide and averaging 25-30cm deep. Some of the pools were in excess of 1m deep. Beyond the riparian tree cover the predominate land use was a mixture of bracken and moorland heath.



**Figure 26: Pool with bedrock channel – minor 1m falls in the distance**



**Figure 27: Run section with extensive deposition (side bar)**



The survey continued upstream with slow flowing glide sections (Figure 28) in between runs and another large pool with a 2m high falls/cascade within a bedrock channel (Figure 29), which was considered passable to fish.



**Figure 28: Glide section, good bank side tree cover**



**Figure 29: Pool with 2m falls/cascade within bedrock channel**



The bedrock channel continued upstream within a steep sided valley form (Figure 30). These bedrock channel sections offer poor freshwater pearl mussel habitat. There were three deer fences crossing the watercourse, which had been recently constructed with water gates which allowed free passage of fish and otters (Figure 31). Within these fenced sections there were at least two areas of bank poaching by deer.



**Figure 30: Typical run section within steep sided bedrock channel**





**Figure 31: One of three water gates within channel – fully accessible to fish**

The steep sided bedrock channel dominated the middle survey section (Figure 32) culminating in a short inaccessible gorge section (Figure 33).



**Figure 32: Bedrock channel run in mid section of survey area.**





**Figure 33: Inaccessible bedrock gorge section**

The upper section of the survey area was dominated by runs (Figure 34) with the valley shape gradually become less steep and the extent of tree cover becoming reduced (Figure 35) although there were also still significant areas of bedrock present.



**Figure 34: Typical run within upper section of survey area**



**Figure 35: Run near up end of survey area – valley becomes shallower with less tree cover**

The upper run section culminated in c.3m high falls with a large pool below (Figure 36). This is likely to form a significant barrier to upstream trout migration although might be passable to salmon if present. The survey ended with an open run section flowing into a section with denser bank side tree cover (Figure 37). Over the length of the survey it was considered that the upper and middle section offer generally inferior freshwater pearl mussel habitat due to the predominance of bedrock substrate, while the lower section generally offered excellent habitat.





**Figure 36: Upper falls, 3m**



**Figure 37: Upper extent of survey**

The tributaries of the Allt Smeorail were all very small (c. 0.5m wide, 10cm deep) with poorly defined channel with little or no tree cover (Figure 38) and all offered very poor freshwater pearl mussel habitat





**Figure 38: Upper tributary – poorly defined channel, unsuitable habitat for freshwater pearl mussels**

## **6. Conclusion and mitigation**

The survey was considered to be sufficiently robust to conclude that it is unlikely that there are any freshwater pearl mussels within the survey area. The Allt a' Mhuilinn has been previously surveyed prior to the removal of the dam and is considered unlikely to contain freshwater pearl mussels. Although there were no populations or individuals identified on the Allt Smeorail, given the quality of habitat in the lower section of the survey area it is entirely plausible that there may, however, be unrecorded populations downstream of the survey area.

Provided suitable mitigation is undertaken aimed at protecting the aquatic environment then, even if present lower down the catchment, an impact would be considered unlikely.

It is recommended that the following measures to protect the aquatic environment are implemented during the works:

1. Relevant pollution prevention guidelines (PPGs) be followed throughout the course of the works to avoid pollution of the watercourses and specifically PPG5, works and maintenance in or near water and PPG6, working at construction and demolition sites. PPGs are identified in section 7 of this report. The main potential route for pollution to enter will be via the tributaries

and it is especially important that these are protected from pollution and siltation.

2. A construction method statement to be produced detailing measures to protect and minimise the impact upon the aquatic environment which should be approved in advance by SEPA.
3. A designated refuelling area should be established at least 10m from the river, any of its tributaries, drains, or area of wetland. The same conditions should apply to any storage areas for waste or materials.
4. An Ecological Clerk of Works (ECoW) should be employed at key stages of the works to ensure mitigation measures are complied with and to provide environmental advice on site.
5. The contractor should produce a contingency plan for dealing with spills and environmental incidents on site. Spill kits should be available on site and in all vehicles and staff trained in their use.



## 7. References & further reading

Bauer, G. 1983. Age structure, age specific mortality rates and population trend of the freshwater pearl mussel (*M. margaritifera*) in North Bavaria. Archiv für Hydrobiologie 98: 523-532.

Cosgrove, P.J., Young, M.R., Hastie, L.C., Gaywood, M. & Boon, P.J. 2000. The status of the freshwater pearl mussels *M. margaritifera* Linn. in Scotland. Aquatic Conservation: Marine and Freshwater Ecosystems 10: 197-208.

Hastie L.C., & Young M.R. (2000) Conservation of the Freshwater Pearl Mussel 2. Relationship with Salmonids. Conserving Natura 2000 Techniques Series No. 2

Hastie, L.C., Boon, P.J. & Young, M.R., 2000. Physical microhabitat requirements of freshwater pearl mussels *M. margaritifera* (L). Hydrobiologia 429: 59-71.

Langan, S, Cooksley, S, Young, M, Stutter, M, Scougall, F, Dalziel, A, Feeney, I, Lilly, A and Dunn S. (2007). The management and conservation of the freshwater pearl mussel in Scottish catchments designated as Special Areas of Conservation or Sites of Special Scientific Interest. Scottish Natural Heritage Commissioned Report No.249 (ROAME No. F05AC607).

Pollution Prevention Guidelines:

PPG 1 General guide to the prevention of pollution (July 2013)

PPG 2 Above ground oil storage tanks (August 2011)

PPG 5 Works and maintenance in or near water (October 2007)

PPG 6 Working at construction and demolition sites (May 2012)

PPG 7 Refuelling facilities (July 2011)

PPG 8 Safe storage and disposal of used oils (February 2004)

PPG 18 Managing fire water and major spillages (no date given)

PPG 21 Pollution incident response planning (March 2009)

Scottish Natural Heritage: Freshwater mussels survey protocol for use in site-specific projects <http://www.snh.gov.uk/docs/A372955.pdf>

Skinner A., Young M., & Hastie L (2000) Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No.2

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