

Appendix 7.5 Freshwater Pearl Mussel Survey Report

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Alba Ecology Ltd.

**Northwest Yell Freshwater Pearl
Mussel Survey**

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Dr Peter Cosgrove FCIEEM

petercosgrove@albaecology.co.uk

Registered Office: Coilintra House, High Street, Grantown on Spey, Moray PH26 3EN

Tel: 01479 870238, Mobile: 07827 275875

COMMISSIONED REPORT

Summary

NORTHWEST YELL FRESHWATER PEARL MUSSEL SURVEY.

Contractors: Alba Ecology Ltd

BACKGROUND

Scotland is a global stronghold for the freshwater pearl mussel *Margaritifera margaritifera*, a species now fully protected under the Wildlife and Countryside Act (1981) (as amended) of Great Britain. It is also listed on Annexes II and V of the EC Habitats Directive (Council Directive 92/43/EEC) and Appendix III of the Bern Convention. Estimates suggest that Scotland holds a large proportion of the world's remaining viable populations, with several sites of international importance in the north of Scotland.

A proposal for a wind farm development has been made by the Applicant in northwest Yell, Shetland. As part of this proposal, Alba Ecology Ltd. was commissioned to conduct a freshwater pearl mussel survey in a Study Area within the proposed planning application boundary in northwest Yell.

MAIN FINDINGS

- The twelve watercourses were surveyed by experienced and licensed freshwater pearl mussel surveyors in September 2018 led by Dr Peter Cosgrove of Alba Ecology Ltd.
- No evidence of freshwater pearl mussels was found in any Study Area watercourses.
- Some patches of potentially suitable, partly stable, substrate habitat were recorded within Study Area watercourses.
- This report provides survey evidence that no freshwater pearl mussels were present within the Study Area. Consequently, there are no special freshwater pearl mussel sensitivities that need to be considered. Nevertheless, freshwater pearl mussels are highly sensitive to changes in water quality, and if present and undetected (and there is no evidence for this) it will be important to avoid any sources of pollution or runoff from the site during proposed works by following best practice measures when working around watercourses.

1. INTRODUCTION

1.1 Aim

To provide information to inform the proposed wind farm development in northwest Yell, Shetland a freshwater pearl mussel *Margaritifera margaritifera* survey with three main stages was considered necessary.

- Watercourse survey site selection;
- Freshwater pearl mussel survey of all potentially suitable and affected watercourses; and
- Report and recommendations.

1.2 Species background

During the past 100 years, the freshwater pearl mussel has declined throughout its Holarctic range to such an extent that it is now listed as an endangered species (IUCN, 1991). Scotland is a global stronghold for the freshwater pearl mussel, a species which is now fully protected under the Wildlife and Countryside Act (1981) (as amended) of Great Britain. It is also listed on the Annexes II and V of the EC Habitats Directive (Council Directive 92/43/EEC) and Appendix III of the Bern Convention.

Recent estimates suggest that Scotland holds an important proportion of the world's known remaining viable populations (Young *et al.* 2001a; Cosgrove *et al.* 2000a). However, the species has declined in Scotland, with gross industrial and agricultural pollution, over-exploitation by pearl fishermen, decline in salmonid host stocks (the short parasitic larval stage of freshwater pearl mussels is entirely dependent upon salmon and trout fry) and physical river bed habitat degradation due to hydro-electric operations and small-scale river engineering works (Cosgrove *et al.* 2000a).

Freshwater pearl mussels were rediscovered in Shetland in 2002 (Cosgrove and Harvey, 2003; Cosgrove and Harvey, 2005) and so surveys of watercourses holding potentially suitable habitats in Shetland are required to account for this potential sensitivity within the northwest Yell study area.

1.3 Habitat requirements

Freshwater pearl mussels are found in fast flowing rivers and streams, with detailed studies on Scottish freshwater pearl mussel populations suggesting that optimum water depths of 0.3-0.4m and optimum current velocities of 0.25-0.75ms⁻¹ at intermediate water levels are most suitable (Hastie *et al.* 2000). River bed substratum characteristics appear to be the best physical parameters for describing freshwater pearl mussel habitat. Freshwater pearl mussels prefer stable cobble/boulder dominated substrate with some fine substrate that allows the mussels to burrow (Cosgrove *et al.* 2000b). Adult and juvenile mussels tend to have similar habitat 'preferences', although adults are found over a wider range of physical conditions and juveniles appear to be more exacting in their requirements and sensitivity to environmental disturbance (Hastie *et al.* 2000). Juvenile mussels prefer finer stable sediments than adults, particularly clean sand and gravel.

Freshwater pearl mussels live buried or partly buried in the beds of clean, fast-flowing unpolluted streams and rivers and subsist by inhaling and filtering for the minute organic particles on which they feed (Cosgrove *et al.* 2000b). Of specific importance to freshwater pearl mussel survival are detrimental levels of silt, algae, suspended solids, calcium and chemical compounds generally associated with enrichment (eutrophication) i. e. nitrate, phosphate and biological oxygen demand (Bauer 1983). Various types of river engineering work can detrimentally impact the habitat of freshwater pearl mussels (Cosgrove and Hastie, 2001).

Freshwater pearl mussels have a short parasitic larval phase on the gills of suitable host fish. The larvae (glochidia) of *M. margaritifera* are very host-specific and can only complete their development on Atlantic salmon *Salmo salar* or brown trout *Salmo trutta*. Usually juvenile fish (fry and parr) are utilised (Young and Williams 1984). The presence of freshwater pearl mussels in any river therefore depends on salmonid host fish availability. It is usually considered necessary for migratory salmonids to be present within a catchment for freshwater pearl mussels to be present.

2. SURVEY METHODOLOGY

2.1 Survey site selection

On the basis that there are no known historical records of freshwater pearl mussels within the Planning Application boundary (e. g. Cosgrove and Young, 1998; Cosgrove and Harvey, 2005), survey site selection was directed towards establishing the status (presence or absence) of freshwater pearl mussels and habitat suitability within potentially suitable watercourses in the study area containing salmonids that might be affected by works (marked as blue area in Figure 1).

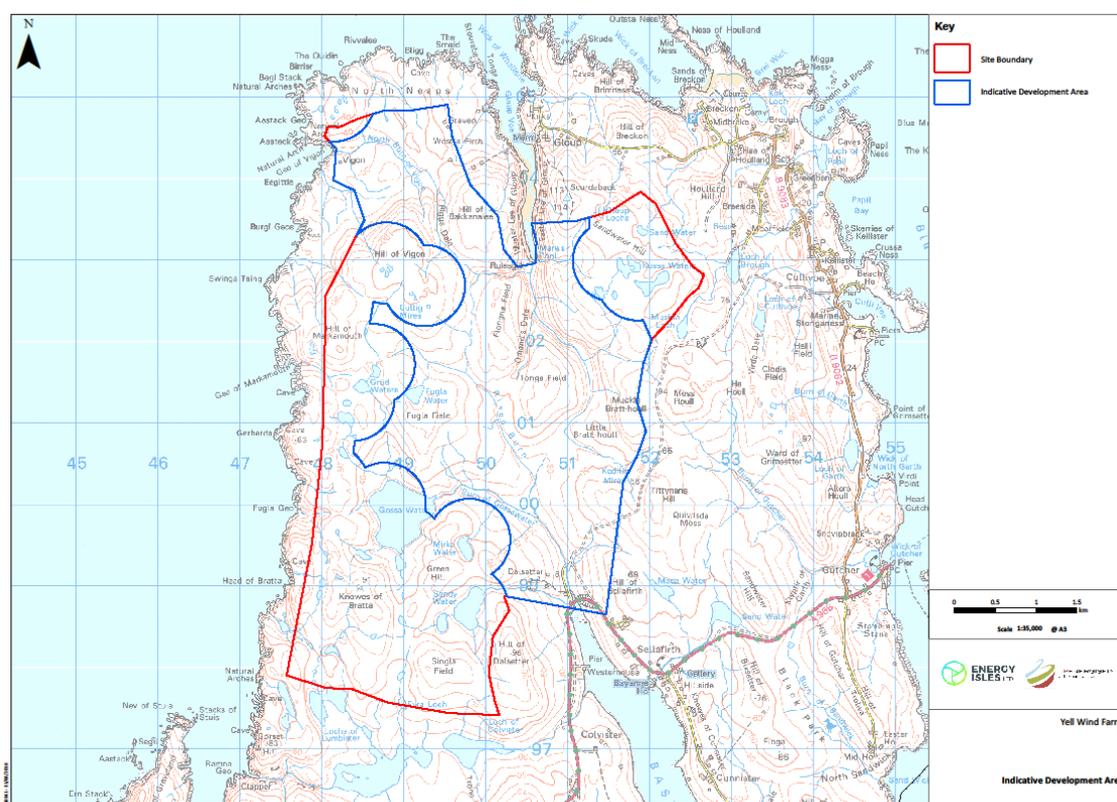


Figure 1. Northwest Yell Study Area (blue line) and application boundary (red line)

Survey site selection was based around knowledge of the species' habitat, host fish requirements, the Study Area and standard SNH guidance for shallow-water freshwater pearl mussel surveys. At the time of the September 2018 survey no proposed watercourse crossings had been identified, so site selection was targeted towards establishing presence or absence of freshwater pearl mussels (as well as habitat suitability) throughout all potentially affected watercourses within the Planning Application boundary. Based on this the following twelve watercourses were selected for survey following an initial survey and assessment of suitable salmonid watercourses in July 2018 by Dr Jon Watt of Waterside Ecology:

- Burn of Gossawater;
- River Burn/Burn of Amframires;
- Burn of Dalsetter;
- South Burn of Dalsetter;
- Burn of Firth;
- Burn of Tongafield;
- Burn of Kedillsmires;
- Burn of Rulesgill;
- South Burn of Vigon;
- North Burn of Vigon; and
- Muskra Burn.

Table 1 provides Dr Jon Watt's habitat suitability assessment for freshwater pearl mussel surveys, which were based on walkover bankside assessments conducted during fish habitat surveys in July 2018.

Table 1. Habitat suitability assessment of potential Study Area watercourses (source: Dr Jon Watt).

Burn name	Habitats	Survey recommended?
Burn of Gossawater	Large stream accessible to sea trout and salmon. Habitat quality generally poor due to peat deposition, but some potentially suitable habitat present downstream of loch.	Yes
River Burn/Burn of Amframires	Large stream accessible to sea trout and salmon. Habitat quality generally poor but stable areas with macrophytes and coarse sand among cobble are present.	Yes
Burn of Rimminamartha (incl Grud Waters)	Small incised channel. Much of flow is in tunnel under turf. Much peat deposition and iron floc. No suitable habitat observed.	No
Burn of Dalsetter	Small pockets of potentially suitable habitat downstream of track. Upstream of track is unstable with shattered cobble substrates covered in peat deposits. Partly flowing beneath turf.	Yes (downstream of track by water works only)
South Burn of Dalsetter	Small stream. Depth typically less than 10cm. Small pockets of stable sand and gravel are present. Due to its small size this burn may be fishless. However, as some potentially suitable habitat was noted a precautionary survey of lower reaches is in order.	Yes
Burn of Firth	Stable sand around mossy cobble and boulder. Host fish appear abundant in lower reaches. Potentially suitable.	Yes
Burn of Tongafield	Large stable boulders with some sand. Some potential for fwpm. Suitable for host fish.	Yes
Burn of Kedillsmires	Very poor. Some potential upstream to HP 511 011. Upstream of this entirely unsuitable.	Yes (to HP 511 011)
Burn of Rulesgill	Very poor but a few tiny pockets of sub-optimal habitat in lower 400m. Remaining reaches entirely unsuitable and likely to be fishless due to lack of access from sea, limited area of very poor habitat and lack of connectivity to any better habitat.	Yes (first 400 m)
Burn of Hadigill	Entirely unsuited and almost certainly fishless. Unstable boulders and shattered cobbles in lower 150m give way	No

	to steep entrenched channel, gorge and bedrock. Upstream of the gorge the channel is incised peat giving way upstream to wet flush.	
Burn of Glipapund	Scoured channel between steep peat bank faces. Much bedrock alternating with hard embedded cobble/hardpan. Gives way upstream to peat channels with much iron floc. No suitable habitat recorded.	No
Kussa Waters outflow stream	Small stream 1-5cm deep. Much of flow beneath turf in lower reaches. Gives way to simple peat channel peat/pipes upstream. No suitable habitat present.	No
Burn of Omand's Dale	Tiny incised peat channel with a few areas of bedrock and hardpan. Unsited to fwpm or host fish.	No
North Burn of Vigon	Mainly very poor. However, stream is stable in many reaches and a few pockets sand are present among mossy boulders. It is possible that the burn is inaccessible to migratory salmonids and it may be fishless (none seen during fish habitat survey). However, as there may be some potentially suitable mussel habitat a precautionary survey is recommended in the reaches downstream of HP 489 043.	Yes (to HP 489 043 only)
Burn of Rigadale	Very poor. Some potentially suitable habitat upstream to HP 493 037. Precautionary survey.	Yes (downstream of HP 493 037 only)
South Burn of Vigon	Obstacles just upstream of NTL may be impassable. Stable mossy cobbles in lower 200m then some reaches of stream with potential for host fish (none seen). Rest of channel is either scoured or simple incised peat without mineral hard substrates. May be fishless. Precautionary survey lower 400m.	Yes (lower 400m only)
Burn of Grudale	Not accessible from sea. Some hard substrates compacted with peat deposit in lower 250m. Further upstream mainly simple incised peat channel. Not suited to fwpm. Almost certainly fishless.	No
Burn of Midge Glen	Tiny first order stream. Not accessible from sea. Unsited host fish or fwpm.	No
Burn of Skeldigill (Gloup Lochs)	Inspected from 700m downstream of redline boundary up to loch. Mainly a simple incised peat channel with a thin layer of sand. Some patches of hardpan. Unsuitable for fwpm or host fish in surveyed reach.	No
Burn of Sandwater	Inspected from 700m downstream of redline boundary up to loch. Some patches of hardpan in lower part of survey reach. This gives way upstream to incised peat. Unsuitable for fwpm or host fish in surveyed area.	No
Muskra Burn	Flows below ground in many places. Accessibility from loch is uncertain due to peat pipes. A few small pockets of spawning habitat for host fish present. Very poor for fwpm. Upstream of HP 527 025 the channel is either filled with sphagnum or is a simple peat pipe. Precautionary survey lower 400m.	Yes (first 400m above Loch of Brough only)
Burn of Lysda Mires	Appears inaccessible from Loch of Brough. Mix of sphagnum-filled channel and simple incised peat channel. Not suited fwpm or host fish.	No

2.2 Survey methodology

The watercourse was entered and searched for freshwater pearl mussels, where Health and Safety conditions allowed, using an adapted version of the standardised shallow-water survey methodology, as described in Cosgrove and Young (1998) and Young *et al.* (2001b) and recommended by SNH <http://www.snh.gov.uk/docs/A372955.pdf>.

A general survey was made of the selected watercourses and their substrate types within the survey reaches, by walking along the bank and/or by wading in the water using thigh waders. The aim was to identify specific areas that were most likely to harbour mussels using information on their habitat preferences from previous studies and experience. Once an apparently suitable area was found, the watercourse was entered at the nearest point and a 50m transect search conducted, concentrated in the most favourable substrate types so as to optimise search efficiency. The searches were conducted in the following manner to ensure compatibility with other surveys and the standard SNH recommended methodology:

- Searches were made using a glass-bottomed viewing bucket;
- Viewing was conducted under favourable conditions i. e. bright light, clear water, low flow regime;
- Searches were made in water sufficiently shallow for safe wading;
- Searches were made in an upstream direction, checking favourable sites e. g. in the shelter of cobbles, boulders or overhanging banks;
- Loose debris and trailing weed were moved gently aside but no disturbance of the river bed was required; and
- The substrate in each transect was recorded and classified using the standard Wentworth Scale (1922).

If a live mussel pearl mussel was found within a 50m transect then a systematic search should be made as follows. At 10, 20, 30, 40 and 50m along the 50m transect, a 1m x 1m quadrat should be laid on the substrate. All mussels visible within the quadrat should be counted. Loose stones and debris are then dislodged to reveal any hidden mussels and in particular to search for any juveniles. Measurement of the mussels allows a size/age profile to be produced. It is particularly important to establish whether juvenile mussels are present, indicating active recruitment at that location. A pearl mussel is considered a juvenile if it is <65mm long; mussels <20mm long are likely to be under 5 years old and their presence is especially important as they indicate recent successful recruitment. All the mussels are measured and returned to their approximate original position. The number of visible mussels counted in each quadrat should be expressed as a proportion of the total number present, including hidden mussels.

For each 50m transect, site details were recorded in a standardised manner on a form. These details include an eight figure grid reference, average width and depth(m), substrate composition (based on the widely used Wentworth Scale (1922), e.g. cobble, pebble, granule, coarse and fine sand etc), substrate stability, main types of adjacent land-use, bankside vegetation and any evidence of impacts.

2.3 Mussel abundance categories

For conservation reporting purposes, standard criteria were used for describing the abundance and status of the pearl mussels in the transects, based on counts of visible mussels (Cosgrove *et al.*

2000a). Any description of the conservation status of a mussel population must refer to the current ability of that population to recruit juveniles. The relative abundance and status terms used in this report (Table 2) match those used in previous survey work and are therefore based on the recommended SNH terminology and, importantly, are directly comparable to those used on all other Scottish pearl mussel Site Condition Monitoring (SCM) assessments.

Table 2. Standard relative abundance terms and codes for 50m x 1m transect counts.

Visible mussels per 50m x 1m transect	Terminology	Abundance code
0	Absent	E
1-49	Rare	D
50-499	Scarce	C
500-999	Common	B
1000+	Abundant	A

3 RESULTS

The twelve watercourses were surveyed under SNH licence (No 33634) for freshwater pearl mussels in September 2018 by Dr Peter Cosgrove, a highly experienced freshwater pearl mussel surveyor. The water levels were low and clear and the weather was bright and sunny providing ideal conditions throughout surveying. No live mussels or empty/dead freshwater pearl mussel shells were found within the twelve watercourses surveyed. However, areas of potentially suitable ‘in-stream’ habitats were present in some of the reaches surveyed.

3.1. Burn of Gossawater

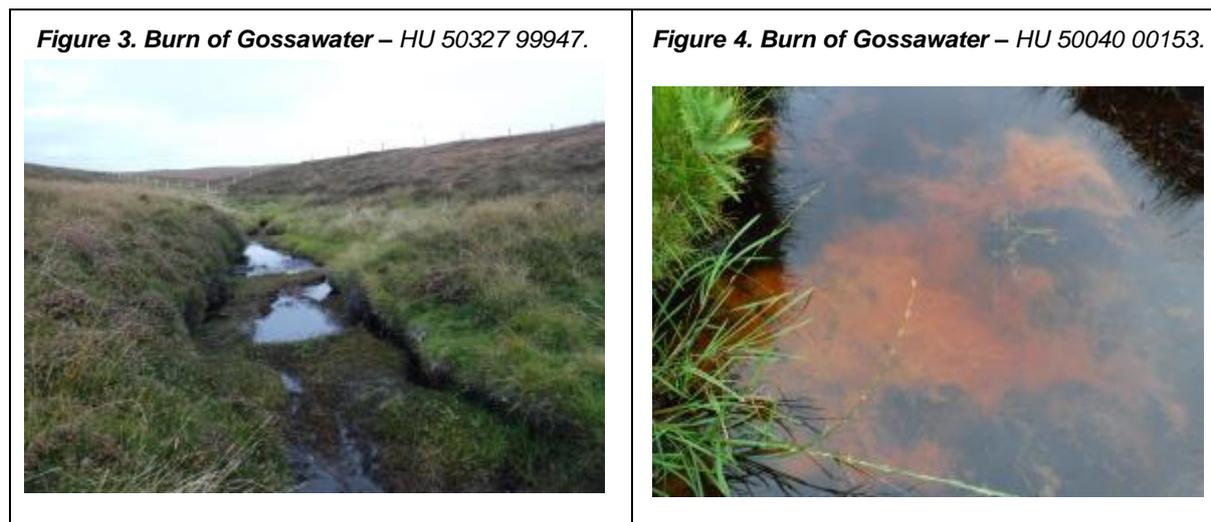
The Burn of Gossawater is small, permanent watercourse in the middle of the study area, flowing north to south. The lower, middle and upper reaches have a relatively gentle gradient. Stable large-medium sized substrates dominate (Figure 1), although some deeper, slow peat dominated reaches were also present (Figure 2). Some of the lower-middle reaches held small pockets of potentially suitable pearl mussel habitat. In the upper reaches (above the confluence with the River Burn) the watercourse mostly becomes very shallow and wholly unsuitable (Figure 3). The substrate in many of the reaches was covered in thick iron stained filamentous algae (Figure 4). The catchment lies within an area dominated by sheep grazing and degraded blanket bog. Host fish were present.

Figure 1. Burn of Gossawater – HU 50970 99202.



Figure 2. Burn of Gossawater – HU 50637 99761.





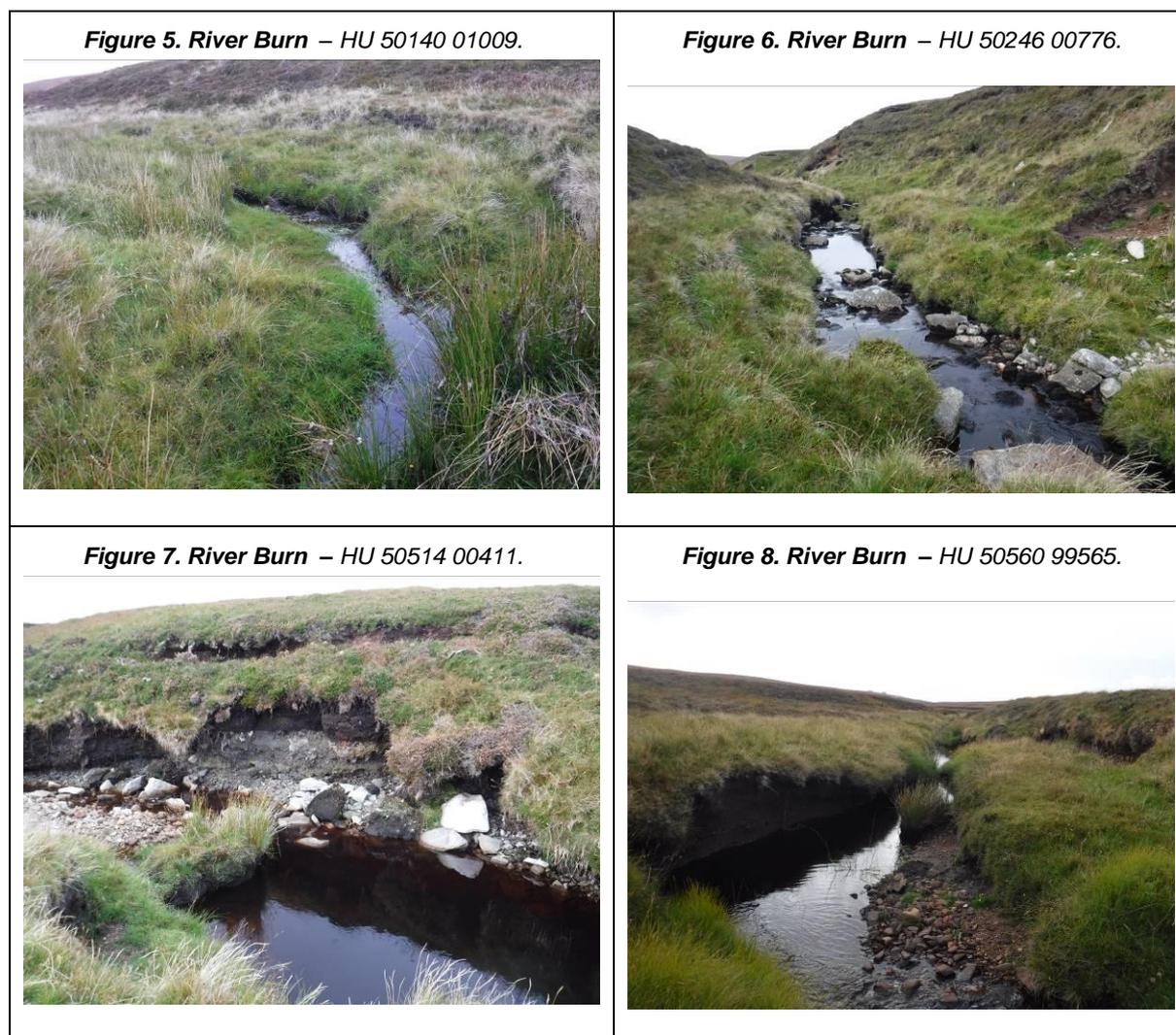
No live or dead pearl mussels were found during searches of the Burn of Gossawater. Table 3 provides a summary of the typical Burn of Gossawater habitats.

Table 3. Typical Burn of Gossawater habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
e.g. HU 50970 99202		Stable				3m	0.2m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		20%	30%	25%	15%	10%			
Comments: Mostly unsuitable, but some patches of potentially suitable substrate habitat. Host salmonids recorded.									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
e.g. HU 50327 99947		Partly stable				1.5m	0.05m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate			10%	40%	20%	15%			15%
Comments: Very shallow and small substrates, often little more than a 5cm deep trickle. Unsuitable. Host salmonids recorded.									

3.2. River Burn/Burn of Amframires

The River Burn/Burn of Amframires is a small tributary of the Burn of Gossawater in the middle of the Study Area, flowing from northwest to southeast (e.g. Figures 5-6). There were lots of collapsed banks and instream peat due to the effects of sheep grazing and trampling pressure (e.g. Figure 7). Most reaches were wholly unsuitable (e.g. Figure 8), but there were occasional small patches of potentially suitable small substrates in some locations. The catchment lies within an area dominated by sheep grazing and degraded blanket bog. Host fish were present.



No live or dead pearl mussels were found during searches of the River Burn/Burn of Amframires. Table 4 provides a summary of the typical River Burn/Burn of Amframires habitats.

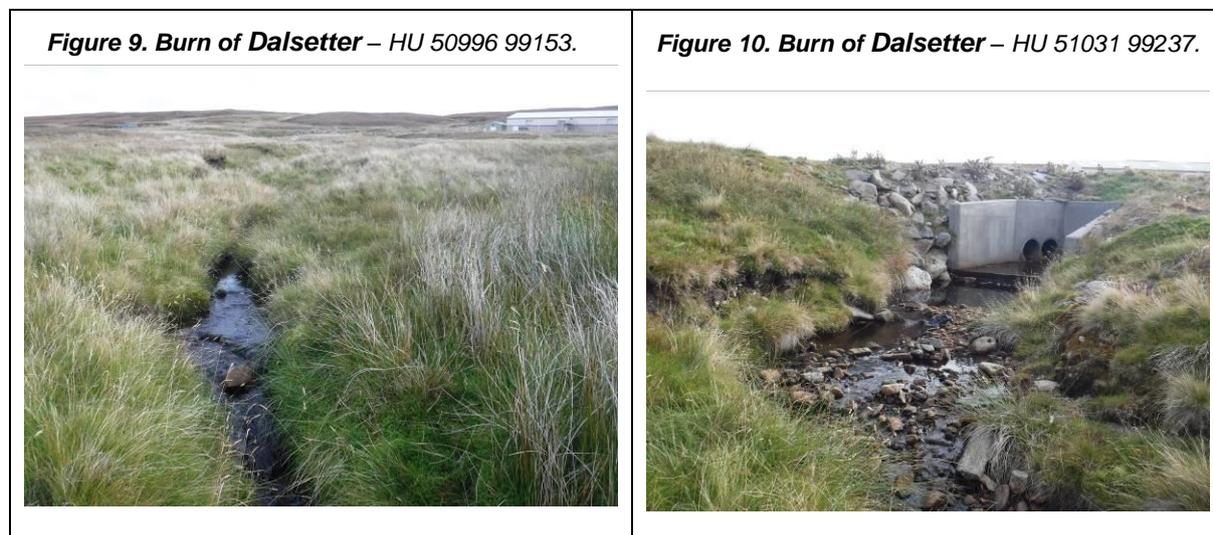
Table 4. Typical River Burn/Burn of Amframires habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 50246 00776		Partly stable				1.5m	0.25m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		15%	30%	25%	10%	10%			10%
Comments: Mostly unsuitable substrates, with tiny pockets of partly stable and potentially suitable substrates. Host salmonids recorded. Lots of macrophytes.									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HU 50560 99565		Partly stable				2m	0.3m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		+	20%	50%	10%	10%			10%
Comments: Unsuitable substrates. Deeper peaty reaches with lots of algae and fungi. Host salmonids recorded.									

+ = present, but less than 5%.

3.3. Burn of Dalsetter

The Burn of Dalsetter is a tiny, wholly unsuitable watercourse at the southern edge of the Study Area. The lowest 20m held host fish (Figure 9), but it was unclear if further upstream reaches did. The watercourse reach identified for survey stopped at an impassable culvert (Figure 10) by a waterworks. The catchment lies within an area dominated by sheep grazing and degraded blanket bog.



No live or dead pearl mussels were found during searches of the Burn of Dalsetter. Table 5 provides a summary of the typical Burn of Dalsetter habitats.

Table 5. Typical Burn of Dalsetter habitat summary

Location surveyed		Substrate stability				Width		Depth	Land use/riparian vegetation	
HU 50996 99153		Stable				0.5m		0.2m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat	
Substrate		10%	20%	25%	20%	5%			20%	
Comments: Wholly unsuitable substrates. Tiny watercourse with insufficient flows. Host salmonids recorded.										
Location surveyed		Substrate stability				Width		Depth	Land use/riparian vegetation	
HU 51031 99237		Stable				1m		0.15m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat	
Substrate		+	20%	45%	25%	5%			5%	
Comments: Wholly unsuitable substrates. Too shallow. No host fish recorded.										

3.4. South Burn of Dalsetter

The South Burn of Dalsetter at the southern edge of the Study Area was too small and shallow, with insufficient flows for pearl mussels and its width was mostly too narrow to use a viewing bucket (Figures 11-12). The catchment lies within an area dominated by sheep grazing and degraded blanket bog. No host fish were recorded.



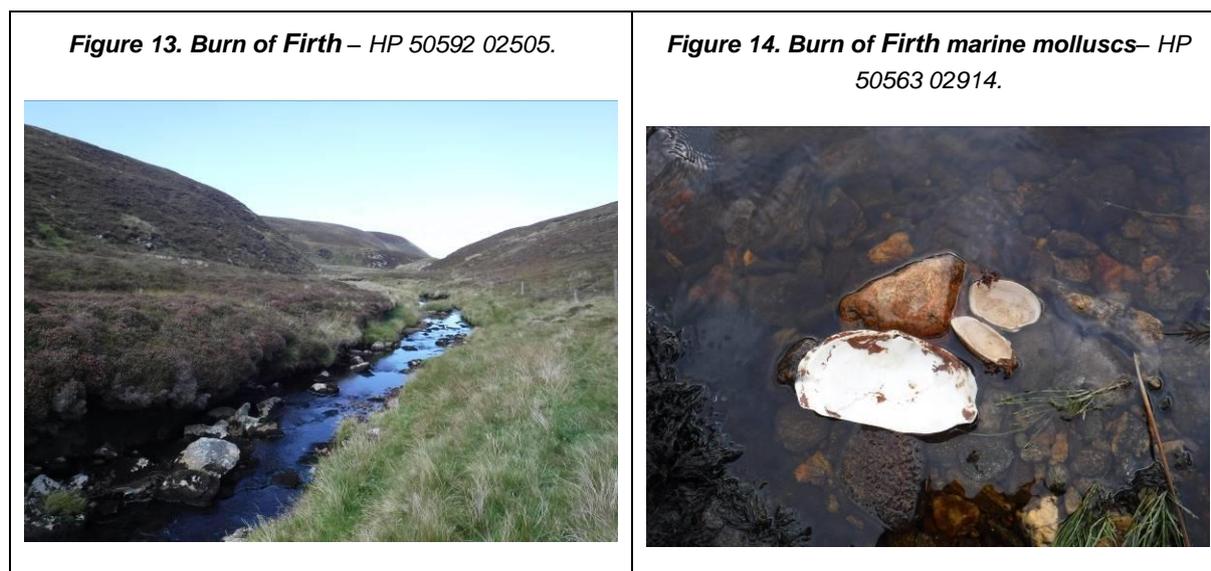
No live or dead pearl mussels were found during searches of the South Burn of Dalsetter. Table 6 provides a summary of the typical South Burn of Dalsetter habitats.

Table 6. Typical South Burn of Dalsetter habitat summary

Location surveyed		Substrate stability				Width		Depth	Land use/riparian vegetation	
HU 50892 98765		Stable				0.5m		0.2m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat	
Substrate			15%	45%	20%	10%			10%	
Comments: Unsuitable substrate. Tiny, insufficient flows. No host salmonids recorded.										
Location surveyed		Substrate stability				Width		Depth	Land use/riparian vegetation	
HU 50905 98808		Stable				0.3m		0.15m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat	
Substrate			10%	30%	10%	30%			20%	
Comments: Too shallow. No host salmonids recorded.										

3.5. Burn of Firth

The Burn of Firth is a small-moderate sized watercourse in the northern part of the Study Area (Figure 13). It flows from south to north into Mare’s Pool in Gloop Voe. Only the lower part of this watercourse is called Burn of Firth and it becomes the Burn of Tongafield 1km upstream of the sea. The Burn of Firth held some patches of potentially suitable and stable substrate habitats. The catchment lies within an area dominated by sheep grazing and degraded blanket bog. Host fish were present.



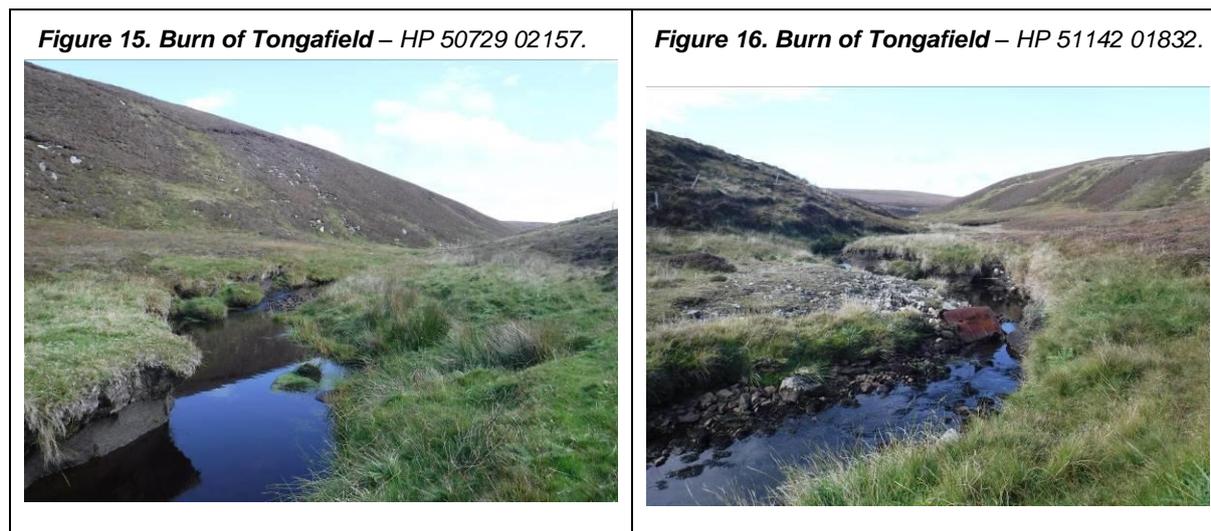
No live or dead pearl mussels were found during searches of the Burn of Firth. However, two dead marine mollusc shells were found within the watercourse in a lower section that was mostly freshwater, but possibly brackish (Figure 14). The shells are likely to have ended up in the burn either taken there by an otter *Lutra lutra* or perhaps by a bird (e.g. gull, crow etc.). **These shells were not *Margaritifera margaritifera*.** Table 7 provides a summary of the typical Burn of Firth habitats.

Table 7. Typical Burn of Firth habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 50563 02914		Stable				4m	0.25m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		5%	10%	30%	25%	30%			+
Comments: Brackish? Potentially suitable substrates. Host salmonids recorded. Two mollusc shells (marine spp. found within survey reach).									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 50592 02505		Stable				3m	0.2m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		35%	15%	30%	10%	10%			+
Comments: Potentially some small patches of suitable substrates. Lots of macrophytes present. Mostly stable, but some collapsed banks due to sheep. Host salmonids recorded.									

3.6. Burn of Tongafield

The Burn of Tongafield is the upstream extension of the Burn of Firth and flows from south to north. The lower part of the burn (Figure 15) held some sub-optimal pearl mussel habitats, but the upper part of the burn became unstable and unsuitable (Figure 16). The catchment lies within an area dominated by sheep grazing and degraded blanket bog. Host fish present.



No live or dead pearl mussels were found during searches of the Burn of Tongafield. Table 8 provides a summary of the typical Burn of Tongafield habitats.

Table 8. Typical Burn of Tongafield habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 50729 02157		Partly stable				2m	0.2m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		30%	20%	20%	20%	10%			+
Comments: Mixed sized and partly stable patches of sub-optimal pearl mussel habitat, with macrophytes present. Host salmonids recorded.									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 51142 01832		Unstable				1.5m	0.15m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		20%	30%	10%	20%	10%			10%
Comments: Unsuitable and quite unstable habitats in many locations. Host salmonids recorded.									

3.7. Burn of Kedillsmires

The Burn of Kedillsmires is the upper most section of the Burn of Tongafield. Based on the O/S 1:25000 map it is not clear where one burn ends and the other one begins. Regardless, the Burn of Kedillsmires is a slow flowing, narrow peaty channel (with regular bank collapses into the watercourse) and was considered wholly unsuitable for pearl mussels (Figures 17-18). The water was too dark to see to the bottom of the water in many areas, but hand ‘feel’ searches resulted in plumes of peat silt sediment being released into the water column – highly indicative of unsuitable substrate habitats. The catchment lies within an area dominated by sheep grazing and degraded blanket bog.

Figure 17. Burn of Kedillsmires – HP 51229 01503.



Figure 18. Burn of Kedillsmires – HP 51104 01321.



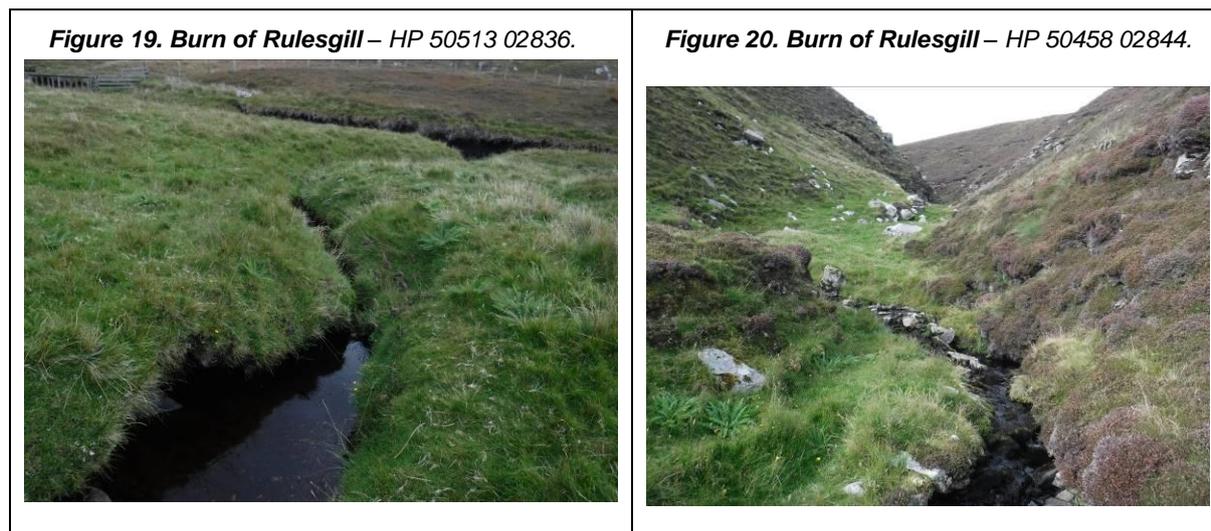
No live or dead pearl mussels were found during searches of the Burn of Kedillsmires. Table 9 provides a summary of the typical Burn of Kedillsmires habitats.

Table 9. Typical Burn of Kedillsmires habitat summary

Location surveyed		Substrate stability					Width	Depth	Land use/riparian vegetation	
HP 51229 01503		Unstable					0.75m	0.3m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat	
Substrate	Water too dark to be certain, but 100% peat in areas checked.									
Comments: Unsuitable peat dominated substrate. No host salmonids recorded.										
Location surveyed		Substrate stability					Width	Depth	Land use/riparian vegetation	
HP 51104 01321		Unstable					0.5m	0.25m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat	
Substrate	Water too dark to be certain, but 100% peat in areas checked									
Comments: Unsuitable peat dominated substrates. No host salmonids recorded.										

3.8. Burn of Rulesgill

The Burn of Rulesgill is a tiny and wholly unsuitable watercourse that flows west to east and enters the lowest most reach of the Burn of Firth at the old, abandoned crofting settlement of Rulesgill. The lowest reach (ca. 100m), was unstable and of a gentle gradient, but was too shallow (Figures 19). It was also full of sheep bones and immediately adjacent to a sheep holding and dipping station. Further upstream, the burn became steep sided and torrential in a small gorge (Figure 20). The catchment lies within an area dominated by sheep grazing and degraded blanket bog.



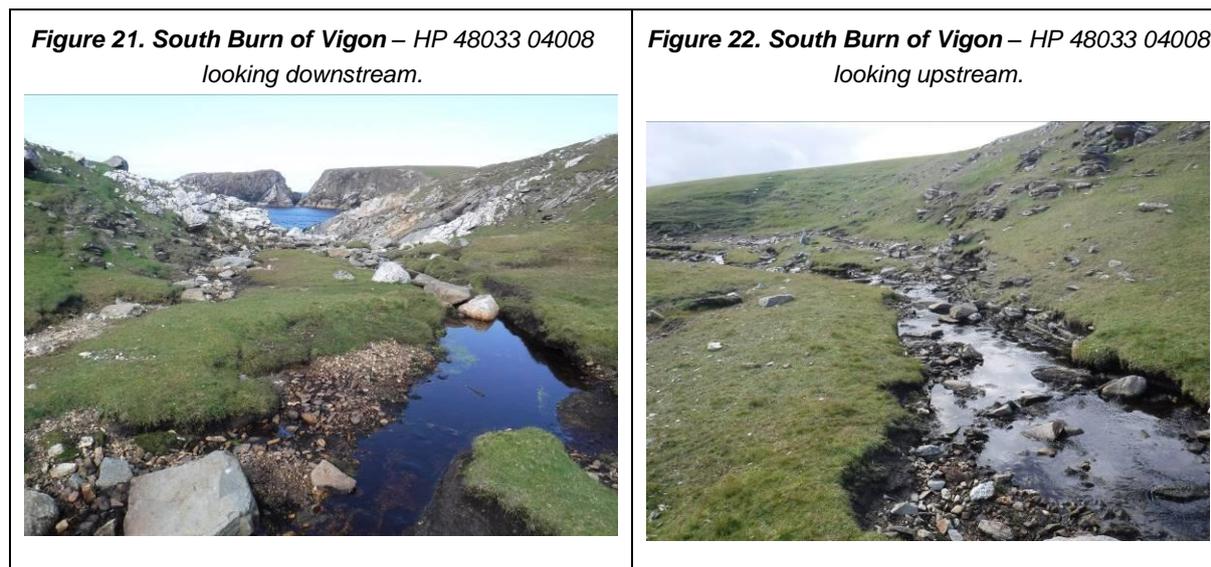
No live or dead pearl mussels were found during searches of the Burn of Rulesgill. Table 10 provides a summary of the typical Burn of Rulesgill habitats.

Table 10. Typical Burn of Rulesgill habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 50513 02836		Partly stable				0.5m	0.15m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		10%	30%	40%	10%	10%			+
Comments: Unsuitable substrates. Lots of macrophytes. No host salmonids recorded.									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 50458 02844		Stable				0.75m	0.1m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		45%	35%	10%	10%	+			
Comments: Unsuitable substrates in small steep sided gorge. Too shallow and small. Lots of sheep bones. No host salmonids recorded.									

3.9. South Burn of Vigon

The South Burn of Vigon is a small, very shallow, unstable and unsuitable northwest flowing watercourse in the northeast of the Study Area. Occasional pockets of partly stable, macrophyte dominated habitat were present, but they were considered insufficient for pearl mussels (Figures 21-22), as was water depth. No host fish were recorded. The middle to upper reaches of this watercourse went underground (through peat pipes) for much of its length as was considered unsuitable (as per Jon Watt) and so was unsurveyed. The catchment lies within an area dominated by sheep grazing and degraded blanket bog.



No live or dead pearl mussels were found during searches of the South Burn of Vigon. Table 11 provides a summary of the typical South Burn of Vigon habitats.

Table 11. Typical South Burn of Vigon habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 48033 04008		Mostly unstable				2m	0.1m	Rough grazing/peat bog	
Substrate	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
		20%	20%	30%	15%	15%			
Comments: Unsuitable substrates in lower surveyed reaches closest to sea. Mid-upper reaches underground (in peat pipes) not surveyed. No host salmonids recorded.									

3.10. North Burn of Vigon

The North Burn of Vigon is a small shallow northwest flowing watercourse in the northwest of the Study Area. There were lots of macrophytes throughout all reaches with some partly stable and potentially suitable mixed sized substrate habitats (Figures 23-24). The catchment lies within an area dominated by sheep grazing and degraded blanket bog.



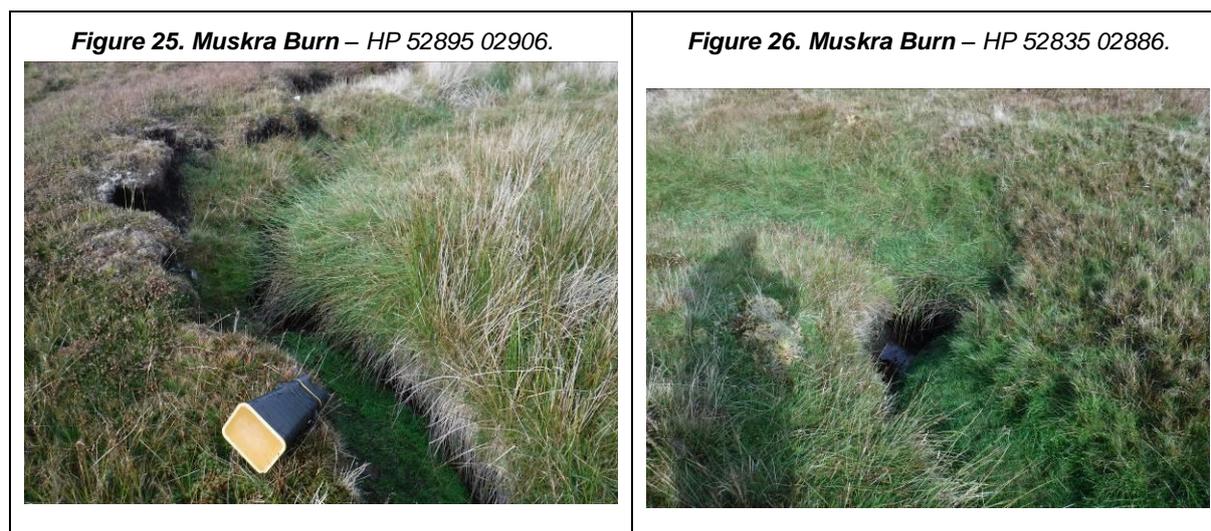
No live or dead pearl mussels were found during searches of the North Burn of Vigon. Table 12 provides a summary of the typical North Burn of Vigon habitats.

Table 12. Typical North Burn of Vigon habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 48357 04302		Partly stable				1m	0.25m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		15%	15%	40%	15%	15%			
Comments: Sub-optimal substrate habitat. No host salmonids recorded.									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 48589 04417		Stable				0.5m	0.2m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate				30%	30%	30%			10%
Comments: Patches of suitable small sized substrate habitat. No host salmonids recorded.									

3.11. Muskra Burn

The Muskra Burn is a tiny northeast flowing watercourse in the east of the Study Area which flows underground throughout most of its length before entering the west side of Loch of Brough. There does not appear to be enough flow for pearl mussels; the depth was very shallow. Consequently, the watercourse was assessed as wholly unsuitable for pearl mussels. The catchment lies within an area dominated by sheep grazing and degraded blanket bog.



No live or dead pearl mussels were found during searches of the Muskra Burn. Table 13 provides a summary of the typical Muskra Burn habitats.

Table 13. Typical Muskra Burn habitat summary

Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 52895 02906		Stable				0.5m	0.1m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate		10%	15%	30%	15%	10%			20%
Comments: Unsuitable substrates. Not enough flow, too shallow. No host salmonids recorded.									
Location surveyed		Substrate stability				Width	Depth	Land use/riparian vegetation	
HP 52835 02886		Stable				<0.5m	0.05m	Rough grazing/peat bog	
	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Silt	Peat
Substrate					10%	50%			40%
Comments: Unsuitable substrates. Not enough flows, most of channel underground in peat pipes. No host salmonids recorded.									

4. DISCUSSION

4.1 Summary of results

The twelve selected watercourses were surveyed using SNH recommended standard shallow-water methodologies under ideal survey conditions. The relative abundance and status of all surveyed Study Area watercourses was classified as E 'Absent'. The sample based survey methodology used does not search every square metre of river bed, so it is conceivable that a small number of freshwater pearl mussels may have remained undetected somewhere within the survey reaches e. g. perhaps hidden under boulders or in deep, dark peaty pools or underground in peat pipes. However, the use of experienced surveyors meant that potentially suitable habitats were thoroughly searched. It is highly unlikely (although hypothetically possible) that freshwater pearl mussels occur in the surveyed reaches where no mussels were found.

These limitations would apply to any freshwater pearl mussel survey carried out using the standard methodologies because it is a sample-based survey and not a complete census. Such a census

would require the destructive searching of all loose substrate, including all potentially suitable habitats to search for hidden mussels. Census work of this nature is not carried out in Scotland due to the endangered status of the species and its legal protection, as well as Health and Safety considerations.

4.2 Implications of results

There is no evidence that freshwater pearl mussels are present within the Study Area. Consequently, there are no particular freshwater pearl mussel sensitivities that need to be considered. Nevertheless, freshwater pearl mussels are highly sensitive to changes in water quality, and if present and undetected (and there is no evidence for this) it will be important to avoid any sources of pollution or runoff from the site during proposed works by following best practice measures when working around watercourses.

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