

## Appendix 8.3 Fisheries

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## Appendix 8.3 Fisheries

### Introduction

This Technical Appendix has been prepared to accompany Chapter 8 in Volume 1 of the Knockcronal Wind Farm (hereafter the Proposed Development) EIA Report.

It presents detailed methodologies and results of desk studies and field survey completed to establish baseline conditions with regards to fisheries. This was in order to identify any potentially important/critical fish habitat which may be impacted by the Proposed Development and to inform any required changes to scheme design and the requirement for mitigation.

It should be read with specific reference to the following Figures presented in Volume 2 of the EIA Report:

- Figure 8.1: Non-Ornithological Statutory Designated Sites.
- Figure 8.5: Fish Habitat Survey Plan.

The following species of conservation significance are considered:

- European eel (*Anguilla Anguilla*) - Council Regulation (EC) No 1100/ 2007 establishing measures for the recovery of the stock of European eel; listed by IUCN as Critically Endangered, Scottish Biodiversity List (SBL) (Watching Brief Only) and UK Biodiversity Action Plan (BAP) Priority Species;
- Atlantic salmon (*Salmo salar*) - Annex II of Habitats Directive (92/43/EEC), Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003, SBL (Conservation Action Needed & Avoid Negative Impacts) and UK BAP Priority Species;
- brown trout/sea trout (*Salmo trutta*) - SBL (Conservation Action Needed) and UK BAP Priority Species;
- freshwater pearl mussel (*Margaritifera margaritifera*) - Schedule 5 of the Wildlife and Countryside Act (1981) and Annex II of Habitats Directive SBL (Conservation Action Needed) and UK BAP Priority Species;
- river lamprey (*Lampetra fluviatilis*) - Annex II of Habitats Directive, SBL (Avoid Negative Impacts) and UK BAP Priority Species;
- brook lamprey (*Lampetra planeri*) - Annex II of Habitats Directive, SBL (Avoid Negative Impacts); and
- sea lamprey (*Petromyzon marinus*) - Annex II of Habitats Directive, SBL (Avoid Negative Impacts) and UK BAP Priority Species.

### Site Overview

Land within the site is shown in Figures 8.5 in Volume 2 of the EIA Report. The Proposed Development is located approximately 4.8 km south of Straiton, and 17.4 km east of Girvan, in South Ayrshire. There are no designated sites with fish interest within 2 km of the site boundary, with the nearest such site greater than 8.5 km from the site boundary (Loch Doon Special Site of Scientific Interest (SSSI), which is designated for Arctic charr (*Salvelinus alpinus*)).

The habitats within the Proposed Development comprise a mosaic of rough pasture, including acid and marshy grassland, with areas of blanket mire and wet modified bog. Commercial conifer plantations border the Proposed Development to the west, south and east. There is also a small, isolated stand of mature conifers located on-site.

The western site boundary is formed by the Genoch Burn, while the Palmullan Burn and the Water of Girvan lie along the northern boundary, beyond which lies further areas of open farmland.

Habitat along the two proposed access roads is principally commercial conifer plantation, both routes including sections of an existing forestry track but only one route will be progressed and utilised.

A number of minor watercourses tribute through the site boundary, all of which are part of the Water of Girvan Catchment. The most substantial watercourse is the Palmullan Burn, which flows along the western boundary of the site in a predominantly north-easterly direction. The Palmullan Burn is fed by the Shiel Burn, the Knockoner Burn and several unnamed tributaries which flow through the site. The Genoch Burn is also a more substantial watercourse and is fed by an unnamed tributary near to its northern extent, prior to discharging into the Water of Girvan on the north-east corner of the site.

## Methodology

### **Desk Study and Consultation**

A desk study was undertaken to identify the proximity of the Proposed Development to any statutory or non-statutory designated sites for nature conservation and any classified waterbodies and existing fisheries records within the site and surrounding area.

Key desk study sources, search areas and information obtained is summarised in Table 8.1.

**Table 8.1 - Desk Study Sources**

Key Source	Information Sought	Search Area
Sitelink	Statutory designated sites for nature conservation with qualifying fish interests.	Within 10 km of the site boundary.
South West Scotland Environmental Information Centre (SWSEIC)	Existing records of fish, and non-statutory designated sites with fish interest.	2 km from the site boundary.
Linfairn Wind Farm Environmental Statement (ES) Chapter 7	Existing records of suitable fish habitat from baseline surveys.	Study Area is shown on Figure A7.8a – A7.8e of the ES.
SEPA's River Basin Management Plan	Relevant information concerning notable fish habitats.	Site.
The Ayrshire Rivers Trust Fishery Management Plan	Relevant information concerning notable fish habitats.	Site.

### **Field Surveys**

Field survey effort and methodologies were agreed with NatureScot prior to commencement (see Chapter 8 in Volume 1 of the EIA Report, Table 8.1).

A fish habitat survey was completed of all watercourses within the site on 14 July 2020.

The survey aimed to identify any areas of critical fish habitat (i.e. spawning, nursery areas, juvenile and adult holding areas, juvenile lamprey (*Lampetra* spp.) habitat and freshwater pearl mussel habitat).

All stretches of watercourses with a gradient of  $\geq 6\%$  are considered to be unsuitable or non-productive fish habitat for Atlantic salmon and brown/sea trout. Mills (1973) found that gradients of  $< 3\%$  were favourable for Atlantic salmon; whilst sea trout were found to spawn in streams with gradients up to  $4\%$ . Most populations of lamprey occur where the average stream gradient is 1.9 to 5.7 m/km, being rarely found where gradients exceed 7.8 m/km or  $0.78\%$  (Maitland and Campbell, 1992). Whilst gradients of  $\geq 6\%$  are considered to be typically unsuitable for fish fauna, it is recognised that small, isolated, populations of brown trout may occur in locally suitable habitat in stretches with steeper gradients.

The watercourses within the site boundary were systematically walked (including in-stream inspections where required) and the habitats mapped according to the classification presented in Table 8.2. Watercourses along the access roads were also walked and checked, and habitats mapped.

Specifically, the habitat survey focused on the identification of the following:

- Spawning habitat for salmonid and lamprey species;
- Nursery habitat for lamprey species;
- Areas of habitat important for juvenile salmonids (fry and parr);
- Areas of habitat important for adult holding areas; and
- Areas of suitable substrate and flow conditions for supporting freshwater pearl mussel.

The habitat classification used in this study is based on the Scottish Fisheries Co-ordination Centre’s Habitat Surveys Training Course Manual (SFCC, 2007), the Environment Agency’s Restoration of Riverine Salmon Habitats Guidance Manual (Hendry & Cragg-Hine, 1997), a review of key habitat requirements for other species of conservation significance including lamprey, salmonids and freshwater pearl mussel (e.g. Maitland, 2003; Hendry & Cragg-Hine, 2003; Skinner et al. 2003).

Each watercourse was walked in full across its extent within the site. Detailed analysis was undertaken at sample points within any diverse geomorphological and hydrological conditions within each watercourse. Samples were taken at each of the representative sections of each watercourse. The following information was collected at each sample location: channel gradient; substrate composition (% bedrock, boulders >256 mm, cobbles 65-256 mm, pebbles 4-64 mm, gravel 2-4 mm, coarse sand 0.5-2 mm and fine sand/silt/peat <0.5 mm); average wetted channel width (m); average depth (m) and turbidity (1 [clear] – 3 [turbid]). Any potential barriers to fish movement within watercourses were also recorded. A photograph was taken at each sample point.

**Table 8.2 - Fish River Habitat Classifications**

Cat.	Habitat Type	Description	Species Suitability
<b>1</b> <b>1a</b> <b>1b</b> <b>1c</b>	<b>Unsuitable</b> <b>Steep &gt; 10 % gradient</b> <b>6-10 % gradient</b> <b>Other – ephemeral, shallow drains, dry beds</b>	Usually 1 <sup>st</sup> – 2 <sup>nd</sup> order watercourses with steep gradient, <sup>3</sup> 6 % slopes (often substantially greater), abundant bedrock, lack of fixed substrates, high velocity (e.g. headwaters/rivulets). Also includes less steep ephemeral stretches (e.g. headwater sources), shallow drains and modified watercourses with dry beds.	No productive fish habitat, although some species may migrate through these areas (also refer to 7. Rapids) depending on whether they represent a migration barrier.
<b>2</b> <b>2a</b> <b>2b</b>	<b>Spawning Habitat</b> <b>Salmonids</b> <b>Lamprey</b>	Stable “gravels” of minimum 15-30 cm depth, optimal 20-30 mm, not compacted or with excessive silt/sands (<20 % by weight) for salmonids. Lamprey spawning habitat where “gravels” include sands. Often at tail end of pools or upstream ends of riffle-runs ensuring oxygenated substrate.	Spawning habitat - Atlantic salmon (c. 9 m <sup>2</sup> per pair) and sea/brown trout; lamprey.

Cat.	Habitat Type	Description	Species Suitability
		Can also be found at end of weir pools.	
<b>3</b>	<b>Riffle</b>	Shallow (< 20 cm) and fast flowing, with upstream-facing wavelets which are unbroken (although often some broken water), with substrate dominated by gravel and cobbles.	Fry (0+) habitat – Atlantic salmon/ brown trout/sea trout.
<b>4</b> <b>4a</b> <b>4b</b>	<b>Run</b> <b>Shallow (&lt; 0.5 m deep)</b> <b>Deep (&gt;0.5 m deep)</b>	Generally deeper (20-40 cm) and less steep bed compared to riffle, with substrate of boulders, cobbles and gravels. Usually disturbed, rippled surface. Often located immediately downstream of riffle.	Mixed salmonid juvenile habitat. Fry (0+) & Par (1+) habitat - Atlantic salmon/ brown trout/sea trout.
<b>5</b> <b>5a</b> <b>5b</b>	<b>Glide</b> <b>Shallow (&lt;0.5 m deep)</b> <b>Deep (&gt; 0.5 m deep)</b>	Shallow gradient stretches with smooth laminar flow with little surface turbulence and generally > 30 cm deep; water flow is silent. Often located below pool.	European eel; non-productive salmonid habitat, although may provide some shelter for adults.
<b>6</b> <b>6a</b> <b>6b</b> <b>6c</b>	<b>Pool</b> <b>Plunge/Scour pool</b> <b>Meander pool</b> <b>Weir/bridge pool</b>	No perceptible flow, eddying and usually > 100 cm deep. Substrate with high proportion of sand and silts. Often located on the outside of meanders, but includes natural scour or plunge pools and artificial weir pools.	Adult refugia Atlantic salmon, sea/brown trout, European eel.
<b>7</b> <b>7a</b> <b>7b</b> <b>7c</b>	<b>Rapids</b> <b>Steep - &gt;10 % gradient</b> <b>Moderate - 6-10 % gradient</b> <b>Low - &lt;6 % gradient</b>	Sections of relatively steep gradient with fast currents and turbulence, with mixed flow types, including free-fall, chutes and broken, with obstructions such as large boulders, rock outcrops and falls.	Negative feature for migratory species and may pose a migratory barrier; elvers and eels limited to velocity of <0.5 m/sec and 2.0 m/sec respectively; lamprey to 2 m/sec.
<b>8</b> <b>8a</b> <b>8b</b>	<b>Banks of fine sediment of silts and sands</b> <b>Optimal</b> <b>Sub-optimal</b>	Limited flow (sometimes back-flow) allowing deposition of silts/sands, not anoxic, with/without riparian trees. Optimal habitat is stable fine sediment and sand 15 cm deep with some organic detritus. Sub-optimal habitat includes small areas of deposited silts/sands behind boulders.	Lamprey ammocoete nursery and adult refuge.
<b>9</b> <b>9a</b> <b>9b</b>	<b>Vegetation features</b> <b>Riparian trees (tunnel)</b> <b>Flow constriction</b>	Closed woodland canopy forming tunnel vegetation, in-stream emergent boulders, stands of aquatic and floating vegetation,	Tunnel riparian trees may be negative feature for salmonids, although tree roots and fallen trees may

Cat.	Habitat Type	Description	Species Suitability
9c	<b>Aquatic macrophytes</b>	stands of emergent (usually marginal) vegetation, LWD forming dams, etc.	provide refugia for Atlantic salmon/ brown trout/sea trout and European eel. Aquatics/emergents provide cover for fish, particularly juveniles.
9d	<b>Emergent macrophytes</b>		
9e	<b>Large woody debris</b>		
10	<b>Obstructions to migration</b>	Impassable waterfalls, rapids, flow constrictions, weirs, bridge sills, culverts, shallow braided river sections, pollution preventing upstream migration.	All migratory species; impassability varies between species. Leaping ability: <3.7 m Atlantic salmon; <1.81 trout; European eel and lamprey none.
11	<b>Other features</b>	Includes other channel features, with side channel (connected to main channel) and backwaters. Artificial channels may comprise either man-made banks and/or beds.	Side channel/backwater often important refugia for juveniles. Artificial channels have limited diversity and are often non-productive fish habitat.
11a	<b>Side channel</b>		
11b	<b>Backwater</b>		
11c	<b>Artificial channel</b>		

### Study Area

The Study Area included all watercourses identified within the site boundary, shown in Figure 8.5 in Volume 2 of the EIA Report.

### Personnel

The survey was undertaken by Mr C Nisbet who is a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM) and fully trained on fish habitat survey as part of Level 3 Management of Electrofishing Operations qualification as accredited by the Scottish Fisheries Coordination Centre (SFCC). He has undertaken fish habitat surveys at comparable sites for over 16 years.

### Limitations

The fish habitat survey was completed within the normal range of flows for watercourses in the geographical area, as defined by Scottish Environmental Protection Agency (SEPA).

The survey is therefore considered not to be subject to any significant limitations.

## Results

### Desk Study

This section provides details of existing fish information and existing records of fish identified within and in proximity to the Proposed Development from desk study sources listed in Table 8.1.

### Statutory Designated Sites

This section should be read with reference to Figure 8.1 in the EIA Report.

A review of Sitelink identifies that the Proposed Development does not form part of any statutory designated site for nature conservation with qualifying fish interests.

Table 8.3 summarises statutory designated sites with fish features of interest located within 10 km of the Proposed Development.

Distances specified within Table 8.3 are taken from the site boundary to the designation boundary at its nearest point.

**Table 8.3 - Designated Sites for Nature Conservation**

*SSSI – Site of Special Scientific Interest*

Designated Site	Distance / Orientation	Qualifying Fish Interests
Loch Doon SSSI	8.8 km, east of site boundary.	<ul style="list-style-type: none"> <li>▪ Arctic charr.</li> </ul>

#### **Non-Statutory Designated Sites**

There are no non-statutory designated sites with qualifying fish interests within 2 km of the Proposed Development.

#### **Existing Records of Fish Species - SWSEIC**

No records of protected or notable fish species were returned from SWSEIC.

#### **Existing Records of Protected or Notable Fish Habitat - Linfairn Wind Farm ES**

A summary of the surveys undertaken to support the Linfairn Wind Farm ES Chapter are presented in Table 8.4.

**Table 8.4 - Survey Summary which Supported the Linfairn Wind Farm**

Survey Type	Dates	Results
Fish Habitat Survey	July 2014	<ul style="list-style-type: none"> <li>• Watercourses typically unsuitable for fish due to a number of factors, including small size, poor substrate quality, seasonal low flows and presence of barriers to movement.</li> <li>• Potentially suitable fish habitat restricted to potential parr habitat along Balbeg and Palmullan Burn, and a small section of potential fry habitat along Balbeg Burn.</li> <li>• Watercourses were not suitable for freshwater pearl mussel.</li> </ul>

#### **Field Surveys**

This section presents the results of baseline field surveys, including an overview of the watercourses within the site and their suitability of supporting protected or notable fish populations.

The European Water Framework Directive (WFD) requires that surface waterbodies in member states are classified according to ecological status. SEPA's River Basin Management Plan website (<https://www.sepa.org.uk/data-visualisation/water-environment-hub>) confirms the status of the following watercourses within the site as illustrated on Figure 8.5 in Volume 2 of the EIA Report:

- W1 – Unnamed tributary of the Palmullan Burn: Unclassified;
- W2 – Unnamed tributary of the Palmullan Burn: Unclassified;
- W3 – Unnamed tributary of the Palmullan Burn: Unclassified;
- W4 – Sheil Burn: Unclassified;
- W5 – Palmullan Burn: High Ecological Status/High Access for Fish Migration;
- W6 – Knockoner Burn: Unclassified;
- W7 – Unnamed tributary of Knockoner Burn: Unclassified;



- W8 – Unnamed tributary of Knockoner Burn: Unclassified;
- W9 – Unnamed tributary of Knockoner Burn: Unclassified;
- W10 – Unnamed tributary of Sheil Burn: Unclassified;
- W11 – Unnamed tributary of Sheil Burn: Unclassified;
- W12 – Unnamed tributary of the Genoch Burn: Unclassified;
- W13 – Genoch Burn: Unclassified;
- W14 – Unnamed tributary of Genoch Burn: Unclassified;
- W15 – Unnamed tributary of Genoch Burn: Unclassified; and
- W16 – Water of Girvan: Good Ecological Status/High Access for Fish Migration.

The known distribution of fish in the geographical area is summarised in the Fishery Management Plan (Ayrshire Rivers Trust, Undated), which is considered in the assessment within this Technical Appendix.

#### **W1, W2 & W3 – Unnamed Tributaries of the Palmullan Burn**

W1, W2 and W3 all flow in a north-westerly direction into the Palmullan Burn at the north-western site boundary (Figure 8.5 in Volume 2 of the EIA Report).

The burns are minor unclassified tributaries whose sources drain from Sheil Bog in the centre of the site. W1 and W2 had little to no flow at the time of survey and channels which were barely distinguishable and for the most part choked with soft rush *Juncus effusus* vegetation. W3 was a little more defined, but was still minor. All three burns lie on moderately steep terrain and have predominantly peaty stream beds, further limiting their suitability for fish fauna. The burns are all tributaries of the Palmullan Burn, which discharges into the Water of Girvan in the north-eastern corner of the site.

Environmental data from W1, W2 and W3, including channel dimensions, gradient and substrate composition, are included from four sample points (two for W1 and one for W2 and W3), given in Tables A1.1 – A1.3 of Annex 1. Photographs from the sample points are given in Annex 2.

W1 – W3 are considered to comprise Category 1c Other – ephemeral, shallow drains, dry beds and provide negligible fish habitat.

#### **W4 – Sheil Burn**

The Sheil Burn is located in the west of the site (Figure 8.5 in Volume 2 of the EIA Report).

The Sheil Burn is the main tributary of the Palmullan Burn. Its source lies in Sheil Bog in the south of the site. There is a waterfall present, which presents an obstacle to fish migration. The watercourse has a varied structure and flow conditions and is considered to be suitable for supporting a non-migratory population of brown trout.

Environmental data for the Sheil Burn, including channel dimensions, gradient and substrate composition, are included from four sample points, are given in Table A1.4 of Annex 1. Photographs from each of the sample points are given in Annex 2.

The Sheil Burn has a naturally meandering channel for most of its length. The burn has a wetted width of between 0.4 m and 1.8 m with an average depth (at time of survey) of 0.3 m.

The burn is comprised of a headwater section with a steady Category 4 run flow bounded by emergent soft rush vegetation, which increases in scale to a watercourse with a varied flow structure. There are Category 7 waterfalls present and although they are lower than the leaping abilities of Atlantic salmon and brown trout, they may still pose migration barriers as the small pools at the base of fall features are unlikely to be substantial enough for migratory fish to achieve burst speeds required to leap between sections. There are also sections of Category 3 riffles and Category 4 runs present, which provide suitable habitat for juvenile

salmonids. Substrate type throughout the burn is typified by a dominance of peat in the headwater section, with a greater mix of substrate types (mainly boulder, cobble and pebble) over the remainder of the watercourse.

No high calibre Category 2a salmonid spawning habitat was noted for Atlantic salmon or sea trout (also in part due to instream waterfall obstacles), and isolated patches of gravel therefore more suited to small numbers of brown trout.

The Category 7 waterfall and steep sections are likely to preclude the presence of migratory lamprey species (sea and river lamprey), and no specific areas of Category 2b Lamprey spawning habitat or Category 8 marginal fine Sediment lamprey ammocoete nursery habitat were noted during the habitat survey.

#### **W5 – Palmullan Burn**

The Palmullan Burn is located to the northern boundary of the site.

The Palmullan Burn is a main tributary of the Water of Girvan and is classified as having high ecological status and high access for migratory fish. The burn discharges directly into the Water of Girvan at the north-eastern edge of the site. There are no impassable barriers to fish migration known to be present downstream of the site, and the Palmullan Burn is known to support populations of both Atlantic salmon and sea trout. The Palmullan Burn has a wetted width of between 3m and 8m, with a depth (at time of survey) of between 0.10 m and 1 m. Channel gradient at its confluence with the Water of Girvan is approximately 1 %, with an increase of up to 5 % along its extent along the northern site boundary.

Environmental data from the Palmullan Burn, including channel dimensions, gradient and substrate composition, are included from four sample points, are given in Table A1.5 of Annex 1. Photographs from each of the sample points are given in Annex 2.

The burn comprises a range of flow conditions with Category 3 riffle, Category 4 run, Category 5 glide, Category 6 pool and Category 7 rapids all present. The base of the channel comprises a range of substrates from areas of gravel suitable for spawning salmonids to pebbles, cobbles and boulders. There is also very good bankside cover from riparian trees providing shade and refugia for fish fauna.

The Palmullan Burn is considered to be high quality fish habitat, suitable of supporting migratory and non-migratory salmonid species at all stages in their life cycle from spawning to adulthood. The combined areas of gravel and faster riffle sections, combined with access opportunities for migratory salmonids mean sections of the Palmullan Burn are also suitable for freshwater pearl mussel, which are known to be present within the upper reaches of the Water of Girvan. There is also some Category 2b lamprey spawning habitat present, although there is a lack of suitable depositional marginal fine sediments (Category 8) providing suitable ammocoete (lamprey) nursery habitat.

#### **W6 – Knockoner Burn**

A small section of the Knockoner Burn (W6) lies within the site. This section of the W6 comprises a minor channel which extends to 0.4 m in width (0.2 m deep). The banks are dominated with soft rush vegetation interspersed with spearwort *Ranunculus flammula* which lie on peaty soil banks. W6 flows into the site from the west and comprises Category 4 run flow conditions over a peat and gravel substrate across its extent within the site. It tributes into the Shiel Burn (W4).

W6 is an unclassified watercourse and environmental data from this watercourse, including channel dimensions, gradient and substrate composition, are included from a single representative sample point, given in Table A1.6 of Annex 1. Photographs from the sample point are given in Annex 2.

Due to its minor scale and peaty upland habitats W6 is considered to offer suboptimal fish habitat, and is likely to support small numbers of non-migratory salmonids only. It is considered unlikely to support migratory fish due to the presence of waterfalls on the Sheil Burn (W4) lower down the catchment.

#### **W7, W8 and W9 Unnamed Tributaries of the Knockoner Burn**

W7 – W9 all tribute into the Knockoner Burn (W6), which then discharges into the Sheil Burn (W4).

All are unclassified watercourses. Environmental data for W7 – W9, including channel dimensions, gradient and substrate composition, are included from representative sample points for each, given in Tables A1.7 – A1.9 of Annex 1. Photographs from the sample points are given in Annex 2.

W7 and W8 are almost identical in structure, comprising narrow channels for the most part, over shallow to moderate gradients (typically between 1 % and 3 %) with Category 1c shallow headwater habitat over peat at their origins and Category 4 run flow conditions over a gravel/pebble base. Both tributaries also contain localised waterfall sections (Category 7, rather than Category 10) with pools formed at the bottom of these features. They are both suitable for supporting small populations of migratory brown trout, but their suitability for migratory species is limited by the presence of waterfalls in the Sheil Burn (W4) further down catchment.

W9 is a more minor tributary with an almost imperceptible channel which better fits into Category 1c Other – ephemeral, shallow drains, dry beds and provides no suitable fish habitat.

#### **W10 and W11 – Unnamed Tributaries of the Sheil Burn**

W10 and W11 are un-named watercourses, comprised of very minor channels running through blanket bog. The banks are dominated by soft rush and bog-moss *Sphagnum spp* developed on peaty soils on a shallow gradient (~1 %). These watercourses are located on the plateau in the southern section of the site.

W10 and W11 are unclassified watercourses and environmental data, including channel dimensions, gradient and substrate composition, are included from representative sample points for each, in Table A1.10 and Table A1.11 of Annex 1. Photographs from the sample point are given in Annex 2.

W10 and W11 are considered to comprise Category 1c Other – ephemeral, shallow drains, dry beds and provide negligible fish habitat.

#### **W12 – Unnamed Tributary of the Genoch Burn**

W12 is an un-named and unclassified watercourse, comprising a minor channel (< 0.5 m) in an area of acid flush and blanket bog developed on peaty soils on a moderate gradient (~ 3 %). The watercourse is a headwater and is choked with soft rush vegetation over a peaty substrate. It tributes into the Genoch Burn on the eastern boundary of the site.

Environmental data from W12, including channel dimensions, gradient and substrate composition, are presented in Table A1.12 of Annex 1. Photographs from the sample points are given in Annex 2.

W12 is considered to comprise Category 1c Other – ephemeral, shallow drains, dry beds and provide negligible fish habitat.

#### **W13 – Genoch Burn**

The Genoch Burn (W13) is a tributary of the Water of Girvan but is not itself a classified watercourse. W13 is a varied watercourse with a wetted width of 0.4 m – 1 m and a depth (at time of survey) of 0.10m and 0.5 m. At its lower extent up to its confluence with the Water of Girvan it flows along a straightened section with Category 4 run and Category 3 riffle flow conditions, over a substrate comprised of gravel, pebble and cobble. Beyond its lower, straightened section, the burn is naturally meandering and contains a further Category 3 riffle section of the channel, over exposed boulders and cobbles, with areas of gravel in between, providing suitable spawning and juvenile habitat for salmonid fish. The Genoch Burn then lies within a steep gorge habitat to the south (with an instream gradient of > 10 %), a Category 10 obstruction to migration.

Environmental data from W13, including channel dimensions, gradient and substrate composition, are included from five sample points, are given in Table A1.13 of Annex 1. Photographs from each of the sample points are given in Annex 2.

Only the lower extent of W13 is suitable for migratory fish fauna, and offers spawning and juvenile habitat, there are also isolated patches of sub-optimal freshwater pearl mussel habitat contained within patches of gravel. There is a lack of Category 8 fine marginal sediments suitable for nurse lamprey habitat throughout.

The upper, steeper section of W13 is not suitable for migratory fish, but contains isolated shallower areas, which may support low numbers of non-migratory brown trout.

#### **W14 – Unnamed Tributary of the Genoch Burn**

W14 is similar to W13 in its lower section (c. 200 m) prior to discharging into the Genoch Burn. It has a Category 3 riffle and Category 4 run flow type over this section and there are areas of suitable spawning gravels present within the substrate. Its upper section is very steep (> 10 % gradient) and, as a result of this the upper section of W14 is largely unsuitable for fish fauna. W14 is 0.5 m – 0.75 m in width and has a depth of 0.10 m – 0.30 m.

Environmental data from W14, including channel dimensions, gradient and substrate composition, is included from two sample points, given in Table A1.14 of Annex 1. Photographs from the sample points are given in Annex 2.

There is a 200 m section of the lower extent of W14 which has some suitability for supporting spawning and juvenile salmonids and there are no access barriers present. The remainder of the watercourse is unsuitable for fish fauna. This section is considered to be too minor in nature to be favoured by freshwater pearl mussel and there is a lack of suitable habitat for lamprey species.

#### **W15 – Unnamed Tributary of the Genoch Burn**

W15 originates from a peaty spring on Sheil Bog prior to discharging down a steep valley (> 10 % gradient) for the majority of its extent until it tributes into W14. W15 is 0.4 m to 0.9 m in width and has a depth of 10 – 25 cm.

Environmental data from W15, including channel dimensions, gradient and substrate composition, is included from a single sample point, given in Table A1.15 of Annex 1. A photograph from the sample point is given in Annex 2.

W15, due to the steep gradient of its lower reaches is largely unsuitable for fish fauna.

#### **W16 – Water of Girvan**

The Water of Girvan runs along the north-eastern boundary of the site.

Water of Girvan and is classified as having good ecological status and high access for migratory fish. The Water of Girvan discharges into the Atlantic Ocean at Girvan on the west coast. There are no impassable barriers to fish migration known to be present downstream of the site, and the Water of Girvan is known to support populations of both Atlantic salmon and sea trout. The stretch of the Water of Girvan within the survey area has a wetted width of between 14 m and 18 m, with a depth (at time of survey) of 0.4 m and > 1 m. Channel gradient is very shallow (< 1 %) along its extent along the north-eastern site boundary.

Environmental data from the Water of Girvan, including channel dimensions, gradient and substrate composition, are included from four sample points, are given in Table A1.16 of Annex 1. Photographs from each of the sample points are given in Annex 2.

This section of the river largely comprises deep glide (Category 5) conditions, although there is also an area of Category 3 riffle and Category 4 run also present. The base of the channel comprises a range of substrates from areas of gravel suitable for spawning salmonids to pebbles, cobbles and boulders. There is also very good bankside cover from riparian trees providing shade and refugia for fish fauna.

The Water of Girvan is considered to be high quality fish habitat, suitable of supporting migratory and non-migratory salmonid species. There are known recent records of freshwater pearl mussel within the upper reaches of the Water of Girvan and the faster flowing area is suitable for this species. There are also some Category 8 depositional marginal fine sediments present, which provides suitable ammocoete nursery habitat.

## Summary

Functional fish habitat within the study area is relatively restricted within watercourses of the site, with the Palmullan Burn along the northern site boundary and the Water of Girvan, along the north-eastern site boundary providing the highest quality fish habitat.

Most of the watercourses flowing through the site offer negligible fish habitat, with only restricted areas of suitable fish habitat within these onsite watercourses.

The Palmullan Burn and Water of Girvan which flow along the periphery of the site offer suitable habitat for migratory and non-migratory salmonid species at all stages of their life, and the Palmullan Burn also supports some suitable lamprey spawning habitat. The Water of Girvan is known to support populations of Atlantic salmon and brown trout, and there are records of freshwater pearl mussel in the upper reaches of the Water of Girvan.

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## Annex 1 – Environmental Data

**Table A1.1 - Environmental Data from Sample Locations from W1**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 37572 00944	1	0	0	20	15	10	0	55	0.25	0.2	1	>6%	1c
NS 37619 00806	2	0	0	15	20	15	0	50	0.3	0.15	1	>6%	1c

**Table A1.2 - Environmental Data from Sample Locations from W2**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 37500 00467	3	0	0	25	20	0	5	50	0.25	0.2	1	>6%	1c

**Table A1.3 - Environmental Data from Sample Locations from W3**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 37473 00407	4	0	5	10	30	10	5	40	0.50	0.15	1	>6%	1c

**Table A1.4 - Environmental Data from Sample Locations from W4**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 37159 00685	5	0	30	40	25	5	0	0	1.8	0.25	1	1-2	4a
NS 37133 00656	6	0	25	20	20	10	5	0	1.5	0.3	1	1-2	3
NS 36966 00338	7	0	40	30	20	5	5	0	1.5	0.35	1	1-2	4a
NS 36980 00053	8	0	0	0	20	5	10	65	0.4	0.2	1	1-2	4a

**Table A1.5 - Environmental Data from Sample Locations from W5**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 37298 00806	9	0	0	0	0	10	10	80	3.5	0.25	1	2	3
NS 37379 01189	10	100	0	0	0	0	0	0	3	>1	1	5	6a
NS 37790 01574	11	0	10	25	30	25	5	0	7	0.25	1	1	4a
NS 38455 01592	12	0	35	45	15	5	0	0	8		1	1	5b



**Table A1.6 - Environmental Data from Sample Locations from W6**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NX 36834 99940	13	0	0	0	0	5	5	90	0.40	0.2	2	1	4

**Table A1.7 - Environmental Data from Sample Locations from W7 – Un-named**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NX 36909 99767	14	100	0	0	0	0	0	0	0.3	0.15	1	>10	1b
NX 36898 99755	15	20	40	30	10	0	0	0	2	>1	1	3	6a
NX 36660 99516	16	0	10	10	10	15	5	50	0.35	0.3	1	1	4
NX 36700 99348	17	0	0	0	5	5	0	90	0.25	0.25	1	1	4
NX 36785 99111	18	0	0	0	0	10	0	90	0.3	0.25	1	1	4

**Table A1.8 - Environmental Data from Sample Locations from W8**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NX 37598 99096	19	0	0	0	5	10	0	85	0.3	0.25	1	1	4
NX 37369 99322	20	0	0	0	10	15	0	75	0.4	0.35	1	1	5a

NX 37276 99428	21	0	0	0	5	10	0	85	0.3	0.25	1	1	4
NX 37094 99626	22	20	40	30	10	0	0	0	2	>1	1	3	6a

**Table A1.9 - Environmental Data from Sample Locations from W9**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]- 3[turbid])	Channel Gradient (%)	
NX 37284 99670	23	0	0	0	5	5	5	85	0.2	0.1	1	1	1c

**Table A1.10 - Environmental Data from Sample Locations from W10**

Location		Substrate composition (%)							Channel information				Habitat Type
Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]- 3[turbid])	Channel Gradient (%)	
NX 37651 99601	24	0	0	0	0	0	0	100	0.3	0.20	1	1	1c

**Table A1.11 - Environmental Data from Sample Locations from W11**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/ Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]- 3[turbid])	Channel Gradient (%)	
NX 37593 99858	25	0	0	0	5	10	0	85	0.4	0.3	1	1	1c

**Table A1.12 - Environmental Data from Sample Locations from W12 – Un-named**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NX 38704 99763	26	0	10	15	20	5	0	50	0.25	0.02	1	3	1c

**Table A1.13 - Environmental Data from Sample Locations from W13**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 38850 00084	27	30	20	30	15	5	0	0	0.4	0.3	1	5	3
NS 38859 00206	28	100	0	0	0	0	0	0	0.6	0.25	1	>10	10
NS 38739 00659	29	20	25	30	20	5	0	0	0.9	0.4	1	3	4a
NS 38588 00901	30	0	40	30	25	5	0	0	1	0.3	1	1	3
NS 38809 01194	31	0	15	40	30	15	0	0	1	0.45	1	1	3/4a

**Table A1.14 - Environmental Data from Sample Locations from W14**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 38590 00972	32	0	0	30	50	15	5	0	0.75	0.1	1	1	3/4a
NS 38494 00951	33	0	20	25	30	20	5	0	0.5	0.3	1	3	3/4a


**Table A1.15 - Environmental Data from Sample Locations from W15**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 38355 00685	34	0	25	40	20	10	5	0	0.85	0.25	1	>10	7a

**Table A1.16 - Environmental Data from Sample Locations from W16**

Location		Substrate Composition (%)							Channel Information				Habitat Type
Co-ordinates	Photo/Sample No.	Bed-rock	Boulders >256 mm	Cobbles 65–256 mm	Pebbles 4 – 64 mm	Gravel 2 – 4 mm	Coarse Sand 0.5 –2 mm	Peat/Fine Sand/Silt <0.5 mm	Av. Wetted Width (m)	Av. Depth (m)	Turbidity (1 [clear]-3[turbid])	Channel Gradient (%)	
NS 38824 01419	35	0	30	40	20	5	0	0	15	0.4	1	<1	5a
NS 38722 01421	36	0	20	40	30	10	0	0	14	0.7	1	<1	5b
NS 38687 01429	37	0	15	35	25	25	0	0	14	0.4	1	<1	3/4a
NS 38617 01464	38	0	15	25	20	10	5	25	18	1	1	<1	8a/5b

## Annex 2 – Photographic Plates

Watercourse sample points	
<p>W1 – Unnamed tributary of the Palmullan Burn: Sample Point 1</p> 	<p>W1 – Unnamed tributary of the Palmullan Burn: Sample Point 2</p> 
<p>W2 – Unnamed tributary of the Palmullan Burn: Sample Point 3</p> 	<p>W3 – Unnamed tributary of the Palmullan Burn: Sample Point 4</p> 



W4 – Sheil Burn: Sample Point 5



W4 – Sheil Burn: Sample Point 6



W4 – Sheil Burn: Sample Point 7



W4 – Sheil Burn: Sample Point 8



W5 – Palmullan Burn: Sample Point 9



W5 – Palmullan Burn: Sample Point 10



W5 – Palmullan Burn: Sample Point 11

W5 – Palmullan Burn: Sample Point 12





W6 – Knockoner Burn: Sample Point 13

W7 – Unnamed tributary of Knockoner Burn:  
Sample Point 14



W7 – Unnamed tributary of Knockoner Burn:  
Sample Point 15

W7 – Unnamed tributary of Knockoner Burn:  
Sample Point 16





W7 – Unnamed tributary of Knockoner Burn:  
Sample Point 17



W7 – Unnamed tributary of Knockoner Burn:  
Sample Point 18



W8 – Unnamed tributary of Knockoner Burn:  
Sample Point 19



W8 – Unnamed tributary of Knockoner Burn:  
Sample Point 20



W8 – Unnamed tributary of Knockoner Burn:  
Sample Point 21



W8 – Unnamed tributary of Knockoner Burn:  
Sample Point 22





W9 – Unnamed tributary of Knockoner Burn: Sample Point 23



W10 – Unnamed tributary of Sheil Burn: Sample Point 24



W11 – Unnamed tributary of Sheil Burn: Sample Point 25



W12 – Unnamed tributary of Genoch Burn: Sample Point 26



W13 – Genoch Burn: Sample Point 27



W13 - Genoch Burn: Sample Point 28





W13 – Genoch Burn: Sample Point 29



W13 – Genoch Burn: Sample Point 30



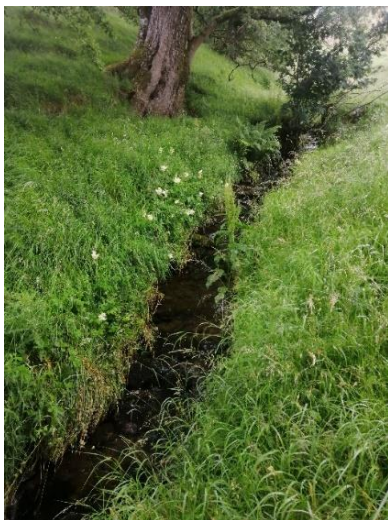
W13 – Genoch Burn: Sample Point 31



W14 – Unnamed tributary of Genoch Burn: Sample Point 32



W14 – Unnamed tributary of Genoch Burn: Sample Point 33



W15 – Unnamed tributary of Genoch Burn: Sample Point 34





W16 – Water of Girvan: Sample Point 35



W16 – Water of Girvan: Sample Point 36



W16 – Water of Girvan: Sample Point 37



W16 – Water of Girvan: Sample Point 38

