ARCUS

ACKRON WIND FARM

TECHNICAL APPENDIX A7.4

FISHERIES HABITAT SURVEY

FEBRUARY 2020

Prepared By:

Mhor Environmental Ltd

73 Bellshill Road
Motherwell
North Lanarkshire
ML1 3SJ

T +44 (0)1698 632 217 l E info@mhorenvironmental.com
W www.mhorenvironmental.com

Registered in Scotland No. 623684

On Behalf of:

Arcus Consultancy Services

7th Floor
144 West George Street
Glasgow
G2 2HG

T +44 (0)141 221 9997 l E info@arcusconsulting.co.uk
w www.arcusconsulting.co.uk

Registered in England & Wales No. 5644976

QA	Name	Date	Signature
Author	Leigh Kelly, Mhor Environmental Ltd	10.02.2020 (Draft) 10.04.2020 (Final)	By email.
Reviewer	Nick Wright, Principal Ecologist (Arcus)		By email

Revision	Description	Date of Issue
1	First Issue for Client Review	

TABLE OF CONTENTS

APPENDIX B: PHOTOGRAPHS

1 INTRODUCTION

This Technical Appendix (TA) presents the methods and results of Fish Habitat Surveys (FHS) undertaken to obtain baseline ecological information, to inform the Environmental Impact Assessment (EIA) of the proposed Ackron Wind Farm, hereafter referred to as the 'Development'.

Mhor Environmental Ltd was commissioned by Arcus Consultancy Services Limited (Arcus) to undertake a FHS in September 2019 on their behalf, for Statkraft ('the Developer').

The following terminology is used throughout this technical report:

- The Development: the whole physical process involved in the development of land at Ackron Wind Farm, including wind farm construction, operation and decommissioning (not a piece of land or an area);
- Development Site Boundary (Site): the proposed area of land, provided by the Developer, within which all development works for the wind farm will take place (shown as the red-line boundary in Appendix A, Figure 1). Fish Habitat Surveys were undertaken within and in close proximity to the Development Site Boundary.

1.1 Site Description

The Site is situated approximately 1.5km east of Melvich in Sutherland. Two main watercourses, the Giligill Burn and the Akran Burn, flow through and in close proximity to the Site. Both watercourses flow into the Halladale River a Scottish Environmental Protection Agency (SEPA) classified waterbody, Grade 1 under the Conservation of Salmon (Scotland) Regulations and well known river for Atlantic Salmon (*Salmo salar)*[1]. Various smaller tributaries also flow through the Site.

The landscape in the wider area around the Site is dominated by moorland with farmland to the west and forestry plantation to the northeast.

1.2 River Basin Management Plan

The European Union's Water Framework Directive (WFD) requires all inland and coastal waters within defined river basin districts to reach at least 'good' ecological status/potential by a set deadline[2]. SEPA is the lead authority to ensure compliance with WFD requirements. With input from responsible authorities and other stakeholders, SEPA has coordinated the production of the Scotland River Basin Management Plan (RBMP) to ensure the protection, improvement and sustainable use of the water environment for future generations. The overall aim is for 98% of Scotland's waters to be in a good condition by 2027, to be progressively implemented through three RBMP cycles (2009-2015; 2015-2021 and 2021-2027)[3].

The RBMP has identified the following key pressures on the water environment in Scotland:

- morphological alterations (e.g. modifications to beds, banks and shores as the result of historical engineering and urban development);
- diffuse source pollution (e.g. agriculture, urban development);
- point source pollution (e.g. the discharge of sewage, manufacturing and quarrying);
- abstraction and flow regulation (e.g. alterations to water flows and levels as the result of electricity generation and public water supplies); and

[1] https://www.strathhalladale.com/wp-content/uploads/2018/01/Halladale-2018-River-Report.pdf

[2] EU Water Framework Directive (2000) - Directive 2000/60/EC

[3] https://www.sepa.org.uk/media/163445/the-river-basin-management-plan-for-the-scotland-river-basin-district-2015-2027.pdf (Accessed online – 19/11/2019)

- invasive non-native species.

RBMPs set out how organisations, stakeholders and communities will work together to improve the water environment.

1.3 Objectives

The aim of the Fish Habitat Surveys was to undertake a detailed assessment of watercourse bankside and habitat quality along the Giligill Burn, Akran Burn, Halladale River and various tributaries within and in close proximity to the Site, to obtain detailed information regarding the suitability of watercourses for fish species within the Development Site Boundary. Detailed information obtained from the fish habitat surveys will provide an accurate and robust baseline on which to base the Environmental Impact Assessment (EIA).

The purpose of the fisheries habitat survey was to:

- Provide a baseline fisheries habitat report to assess Fish Utilisation Potential (FUP) and Fish Habitat Quality (FHQ) of watercourses within the Development Site Boundary, including an assessment and searches for lamprey and freshwater pearl mussel (*Margaritifera margaritifera)* habitat. Assessment criteria is based on various characteristics recorded within surrounding habitats detailed in section 3.3;
- To determine the requirement for further surveys (including targeted electrofishing surveys); and
- Use the baseline information for future comparison studies, potentially required during the Development construction and post-construction phases.

1.4 Survey Locations

A total of ten survey locations were assessed for fisheries habitat potential based on professional judgment and potential impact zones within the catchment. During the walkover, habitats were characterised and split into sections detailing specific fish habitat suitability and fish utilisation potential.

Survey locations are presented in Table 1 (below).

Table 1: Fisheries Habitat Survey Locations

Watercourse	Survey Location ID	Downstream Limit	Upstream Limit
Giligill Burn	AK1	NC 91468 63893	NC 91515 63893
Giligill Burn	AK2	NC 91633 63750	NC 91679 63699
Giligill Burn	AK3	NC 90920 64196	NC 90964 64205
Giligill Burn	AK4	NC 90186 63970	NC 90241 64019
Trib of Giligill Burn	AK5	NC 89923 63318	NC 89995 63330
Trib of Giligill Burn	AK6	NC 90798 63182	NC 90846 63179
Akran Burn	AK7	NC 90015 62469	NC 90056 62500
Akran Burn	AK8	NC 90166 62636	NC 90214 62625
Akran Burn	AK9	NC 90666 62300	NC 90697 62267
Halladale River	AK10	NC 89465 61685	NC 89489 61709

See Figure 1 (Appendix A) for a map showing the survey locations and Appendix B for photographs.

2 HABITAT REQUIREMENTS

Habitat requirements of species covered within this report are presented below.

2.1 Salmonids

The physical habitat requirements of juvenile salmonids (brown trout (*salmo trutta*) and Atlantic salmon) have been subject to a considerable amount of detailed study[4],[5],[6],[7]. Trout and salmon spawn in late autumn and early winter, depositing their eggs in redds which they excavate in gravel and pebble substrates. Spawning depth can range from 5 cm to 90 cm[8], but it is likely that habitat is selected on the basis of suitable substrate and flow rather than depth per se.

Eggs are often deposited in areas of accelerating flow, such as the tails of pools and glides, upstream from riffles. However, in upland streams eggs may be deposited in any areas of gravel that can be physically moved. A good supply of oxygen is essential for eggs to develop and this is facilitated by a flow of water through the gravel. Clogging with fine sediment such as silt and fine sand reduces water flow resulting in egg mortality due to lack of oxygen.

Egg survival is also affected by redd 'washouts' during winter spates – the direct, physical, scouring out of eggs from the gravel. Substrate stability, the dynamics of water flow and the weather all determine the extent of siltation and washouts.

After hatching the young fry remain in the gravel as alevins, absorbing nutrient from the remaining yolk sac. On emergence, usually between March and early May, young fry disperses from the redds and set up territories which they defend aggressively. Salmon fry prefer fast flows (>20 cm/s) and favour areas with surface turbulence (riffle habitat). They require a rough bed of pebble, cobble and gravel.

Trout fry prefer areas of relatively low velocity water near the streambed and often inhabit slower flows than salmon fry. Cover from stones, plants or debris is required and good cover is essential for maintaining high fry densities.

Salmon that have survived their first winter (parr) prefer deeper water than fry (typically 15-40 cm) and a coarser substrate often consisting of pebbles, cobbles and boulders. Trout parr generally favour areas of relatively low current speed where cover is available. Juvenile trout are often to be found in cover alongside the banks, in undercuts, among tree roots or in marginal vegetation. Cover remains important for adult trout and salmon particularly in smaller streams. In larger rivers and lochs this may be less important, as deep water provides refuge.

[4] Crisp, D.T. 1993. The environmental requirements of salmon and trout in fresh water. Freshwater Forum, 3(3): 176-201.

[5] Hendry, K & Cragg-Hine, D. 2003. Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7, English Nature, Peterborough.

[6] Klemetsen, A., Amundsen, P-A, Dempson, J.B., Jonsson, B., Jonsson, N., O'Connell, M.F. and Mortensen, E. 2003. Atlantic salmon Salmo salar L., brown trout Salmo trutta L. and Arctic charr Salvelinus alpinus (L.): a review of aspects of their life histories. Ecology of Freshwater Fish, 12, 1-19.

[7] Youngson, A & Hay, D. 1996 The Lives of Atlantic Salmon. An illustrated account of the life-history of Atlantic salmon. Swan Hill Press, Shrewsbury.

[8] Neary, J.P. 2006. Use of Physical Habitat Structure to Assess Stream Suitability for Brown Trout: A Case Study of Three Upland Scottish Streams. Ph.D. Thesis, University of Stirling, October 2006.

2.2 Lampreys

A recent review of lamprey ecology is provided by a study by Maitland in 2003[9]. Adult lampreys aggregate to spawn and extrude their eggs into 'nests' excavated in the riverbed. Suitable spawning substrate varies between species. Brook lampreys spawn in areas of coarse sand and gravel while the larger species select areas of gravel, pebble and cobble. After hatching the young lamprey larvae, known as ammocoetes, drift downstream with the current. They settle in nursery habitat consisting of fine, soft substrate in well oxygenated, slow flowing water. The ammocoetes are blind and feed on fine particulate matter such as diatoms, algae and bacteria. Ammocoetes spend several years in this muddy nursery habitat before metamorphosing (or transforming) from larval to adult form. The larvae of river and brook lamprey are indistinguishable from one another. Following transformation, it becomes possible to distinguish between them on the basis of morphology and colouration[10]. Upstream migrating lampreys may be prevented from reaching spawning grounds by both natural and man-made barriers. They are weak jumpers, so can be prevented from moving upstream by relatively low vertical barriers.

2.3 Freshwater Pearl Mussel

Freshwater pearl mussels are found in fast flowing rivers, with detailed studies on Scottish freshwater pearl mussel populations suggesting that optimum water depths of 30-40 cm and optimum current velocities of 0.25-0.75ms-1 at intermediate water levels are most suitable[11].

Riverbed substrate 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[12]. 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[10]. Juvenile mussels require fine stable sediments, 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[11]. Of specific importance to freshwater pearl mussel survival are levels of silt, suspended solids, calcium and chemical compounds generally associated with enrichment (eutrophication) i.e. nitrate, phosphate and biological oxygen demand[13].

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 or brown trout.Usually juvenile fish (fry and parr) are utilised[14]. 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. This is typically the case, however occasionally, where historical river captures have occurred, freshwater pearl mussel populations are sometimes isolated from present day migratory salmonids e.g. by impassable waterfalls and have survived this isolation by utilising host

[9] Maitland, P.S. 2003. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

[10] Gardiner, R. 2003. Identifying Lamprey. A field key for Sea, River and Brook lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

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

[12] Cosgrove, P.J. Hastie, L.C. and Young, M.R. 2000. Freshwater pearl mussels in peril. British Wildlife 11: 340-347.

[13] 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.

[14] Young, M.R. & Williams, J.C., 1984. The reproductive biology of the freshwater pearl mussel Margaritifera margaritifera (Linn.) in Scotland I. Field Studies. Archive für Hydrobiologie 99: 405-422.

resident brown trout. Thus, all sites capable of containing native salmonids can potentially hold freshwater pearl mussel populations[13].

3 METHODS

3.1 Desktop Study

A detailed desktop study was undertaken to identify species present, watercourse classifications and any statutory, non-statutory or designated/classified sites, relevant to the aquatic environment, within 2km of the Site Boundary.
The following web-based sources were utilised for this:

- Scottish Natural Heritage (SNH) website[15] - information provided covered the location of any designated sites, statutorily protected species or habitats;
- Scottish Environment Protection Agency (SEPA) website[16] - information provided covered classified and designated waterbodies under the Water Framework Directive (WFD) and Freshwater Fish Directive (FFD);
- National Biodiversity Network (NBN)[17] – information provided covered localised species records, and focused on legally protected and ecologically significant species;
- Scotland's Environmental Web[18] - managed by the SEPA, information provided covered environmental information and data on Scotland's environment;
- Marine Scotland[19] – National Marine Plan Interactive; and
- Google earth[20] – satellite imagery provided detailed maps used during fieldwork.

3.2 Dates and Survey Conditions

Fisheries Habitat Survey was conducted between the 7th and 8th of September 2019. Survey weather conditions were good, with moderate water levels and good water clarity.

3.3 Fisheries Habitat Survey Methods

A FHS was carried out by Leigh Kelly BA MRes MIFM (Member of the Institute of Fisheries Management) of Mhor Environmental Ltd (Scottish Fisheries Co-Ordination Centre (SFCC) Qualified Electrofishing Team Lead and Salmonid Habitat Surveyor). Monitoring information collected following field surveys was used to undertake a detailed assessment of fish habitat quality and utilisation potential, for each survey location (Table 1).

A combination of methods developed by Hendry and Cragg-Hine[21] and those developed for the river/fisheries habitat surveying[22],[23] were adopted. During the field survey the watercourse and the surrounding habitats were characterised and assessed according to the following criteria:

- Predominant channel substrate and flow-types;
- Habitat features;
- Modifications to the channel and banks;

[15] www.gateway.snh.gov.uk (accessed online 23/11/2019)
[16] www.sepa.org.uk (accessed online 20/11/2019)
[17] www.searchnbn.net (accessed online 20/11/2019)
[18] https://map.environment.gov.scot/sewebmap/ (accessed online 20/11/2019)
[19] https://marinescotland.atkinsgeospatial.com/nmpi/ (accessed online 29/11/2019)
[20] http://earth.google.co.uk (accessed online 20/11/2019)
[21] Hendry K, Cragg-Hine D (1997) - A Guidance Manual. APEM Ltd, Fisheries Technical Manual 4, R & D Technical Report W44, Version 1.0/07-97. R & D Project 603.
[22] Environment Agency (2003) - River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual: Environment Agency, Bristol.
[23] SFCC (2007) - Fisheries Management SVQ – Habitat Surveys Training Course Manual.

- Channel vegetation types;
- Vegetation structure of the banks and banktop; and
- Land-use.

The habitat was then defined as described in Table 2 below.

Table 2: Fisheries Habitat Classification

Habitat Type*	Classification
Spawning habitat	Stable gravel approx. 20 cm deep (up to 90 cm deep[7]) that is not compacted or contains excessive silt. Substrate size with a diameter of 1.3 to 10.2 cm.
Salmon Fry (0+) habitat	Shallow (<20 cm) and fast flowing water indicative of riffles and runs with a substrate dominated by gravel and cobbles.
Salmon Parr (1+) habitat	Riffle-run habitat that is generally faster and deeper than fry habitat (15-40 cm). Substrate consists of boulder, cobbles and gravels.
Trout Fry (0+) habitat	Slow to medium flowing shallow water with a substrate dominated by pebbles and smaller cobbles, often concentrated at stream margins.
Trout Parr (1+) habitat	Variety of substrate sizes; undercut banks, tree roots, big rocks; deeper, slower water.
Lamprey spawning habitat	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt (but may contain some sand). Substrate size varies from gravels to pebbles.
Juvenile lamprey habitat	Optimal: Stable fine sediment or sand ≥15 cm deep with low water velocity and the presence of organic detritus/plant material. Sub-optimal: Shallow sediment (<15 cm deep), often patchy and interspersed among coarser substrate.
Eel Habitat	Variety of habitats including streams, rivers, and muddy or silt-bottomed lakes during their freshwater stage.
Freshwater Pearl Mussel	Small sand patches stabilised amongst large stones or boulders in fast-flowing streams and rivers.
Riffle	Fast flow with significant turbulence and generally less than 10 cm deep, broken standing waves at surface and audible.
Run	Fast flow with limited turbulence and generally less than 30 cm deep, unbroken standing waves at surface and silent.
Glides	Smooth laminar flow with little surface turbulence and generally greater than 30 cm deep.
Pool	No perceptible flow. Shallow pool ≤0.3 m – Deep pool >0.3 m
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth.
Obstructions to migration	Impassable falls, weirs, bridge sills etc. shallow braided river sections preventing upstream migration during low flows.

** If significant amounts of different habitat types were found to co-exist in the same section, these habitat classifications were adequately described. For example, in the case of salmonids, fry and parr habitat is classified as juvenile habitat. Where parr habitat is mentioned this refers to habitat that has principally been identified as habitat more suited to parr than fry, however habitually contains a lower quantity of fry habitat and habitat which is suited to both fry and parr. Habitat characteristics for Lamprey adopted Maitland (2003)[24]. Habitat characteristics for freshwater pearl mussel were also recorded adopting methods by Hastie (2003)[25].*

[24] Maitland, PS (2003). Ecology of the River, Brook and Sea Lamprey. Conserving

[25] Skinner, A, Young M & Hastie L (2003). Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough.

4 RESULTS

4.1 Desktop Study

4.1.1 *Designated Sites*

From SNHs Sitelink and Scotland's environmental web, no designation or non-designated sites associated to the aquatic environment were recorded within 2km of the Site.

Other sites not directly linked to the aquatic environment within 2 km of the Site include, Caithness and Sutherland Peatlands – Special protection area (SPA), North Caithness Cliffs – SPA, Caithness and Sutherland Peatlands – Special area of conservation (SAC), Strathy Coast – Sites of Special Scientific Interest (SSSI), West Halladale – SSSI, East Halladale – SSSI, Red Point Coast – SSSI and Sandside Bay – SSSI.

4.1.2 *Water body Classification*

In 2015 SEPA classified the Halladale River - waterbody ID 20614 as having an overall status of Moderate with Medium confidence, with an overall ecological status of Moderate and overall chemical status of Pass. There is currently one pressure identified on this water body - Morphological Alterations. No deterioration from moderate status must occur, unless caused by a new activity providing significant specified benefits to society or the wider environment. Associated protected areas include River Halladale - FRESHWATER FISH (EXISTING). Associated groundwaters include North Highlands. The watercourse is not heavily modified, and considered to be natural, lowland, is small sized, and organic in nature[26].

4.1.3 *Species Records*

From the NBN Gateway, it is clear that fish species records are limited for this area with Atlantic salmon *Salmo salar*, brown/sea trout *Salmo trutta sp.* and European eel *Anguilla anguilla* were identified.

Six records for Atlantic Salmon and 4 Brown/sea trout were identified in the Halladale River.

Four records of Lamprey Sp. and two records of European eel were also identified.

One records for Freshwater pearl mussel was identified within 2km of the Site although further information is confidential and was not available. Therefore, it cannot be confirmed if the records are associated to the watercourses surveyed.

Marine Scotland – National Marine Plan Interactive tool verified that Atlantic salmon are present within the Akran Burn and Halladale River.

4.1.4 *Aerial Photography/Habitats*

From the aerial photography, it is clear that a range of habitat types are adjacent to the proposed works area. These range from farmland, moorland, woodland, road, bridges and areas of peatland.

4.2 Fisheries Habitat Survey Results

Table 3 presents a summary of the prominent habitat characteristics recorded during the FHS (September 2019). Results of the FHS are presented in Figure 1, (Appendix A) and present the FUP and FHQ and each survey site.

Table 3: Fisheries Habitat Survey Results

[26] apps.sepa.org.uk/wbody/2012/20614.pdf (Accessed online – 29/11/2019)

Survey Location ID	Fish Utilisation Potential	Fish Habitat Quality	Characteristics
AK1	Low	Poor	Not considered suitable for fish. Impassable collapsed culvert/ drain within survey section. Flow type predominantly run/pool sequences. Wet width approx. 1 m. Depth ranging from 15- 40 cm. Predominately silt with gravel/pebble throughout. Poor instream cover. Good bankside cover. Land use is moorland/dense bracken. Disused quarry adjacent.
AK2	Low	Poor	Not considered suitable for fish. Impassable collapsed culvert/ drain downstream. Flow type predominantly slow glide. Wet width approx. 1 m. Depth ranging from 10- 40 cm. Predominately silt with gravel/pebble throughout. Poor instream cover. Good bankside cover. Land use is moorland/dense bracken. No defined channel in places.
AK3	Low/ Moderate	Poor/ Moderate	Salmonid Parr habitat. Flow type predominantly run throughout. Average wet width ranging between 0.75-1.5 m. Depth ranging from 10-30 cm. Cobble/pebble/gravel substrate with limited bedrock in places. Moderate/poor instream cover. Land use is moorland and road.
AK4	Moderate	Moderate	Salmonid Parr habitat. Flow type predominantly run throughout. Average wet width ranging between 1-1.5 m. Depth ranging from <10-40 cm. Boulder/pebble/gravel substrate with bedrock in places. Moderate instream cover. Double culvert (A836 crossing) within survey section – considered passable. Brown trout parr observed below culvert. Upstream section is considered poor habitat quality due to narrowing of channel and silt deposits. Land use is moorland and road.
AK5	Low/ Moderate	Poor/ Moderate	Not considered suitable for migratory fish. Flow type predominantly run/riffle/glide sequences. Wet width approx. 1.25 m. Depth ranging from <10- 30 cm. Predominately silt with gravel/pebble throughout. Section downstream is considered to be moderate habitat quality. Poor instream cover. Good bankside cover. Small section considered sub-optimal lamprey habitat. Land use is moorland and area of dense scrub.
AK6	Low/ Moderate	Poor/ Moderate	Limited juvenile salmonid habitat. Flow type predominantly run with step pool in places. Average wet width ~1 m. Depth ranging from <10-30 cm. Cobble/pebble substrate with limited boulder. Areas of silt/ organic matter covering substrate. Moderate instream cover. Land use is moorland and conifer plantation downstream.
AK7	Moderate/ High	Moderate	Juvenile salmonid habitat with areas upstream of bridge considered suitable for spawning. Flow type predominantly run/riffle/glide with step pool in places. Average wet ranging between 3-6 m. Depth ranging from 10-60 cm. Cobble/pebble substrate with boulder in places. Good instream cover. 30% Canopy cover. Land use is farmland/ grazing with forestry upstream.

Survey Location ID	Fish Utilisation Potential	Fish Habitat Quality	Characteristics
			Spanned bridge (A897 crossing) within downstream section with concrete abutment and raised lip. Potential barrier is very low flows.
AK8	Moderate/ High	Moderate/ Good	Juvenile salmonid habitat. Flow type predominantly run/riffle/glide sequences. Average wet width ~3 m, ford recorded in section wet width 4.5m. Depth ranging from <10-40 cm. Cobble/pebble substrate with areas of boulder/gravel. Area of potential spawning habitat recorded left bank. Moderate instream cover. Land use is moorland and area of grazing.
AK9	Moderate/ High	Moderate	Salmonid Parr habitat. Flow type predominantly run/glide sequences. Average wet width ~1.5 m. Depth ranging from 20-60 cm. Cobble/pebble substrate with limited boulder and gravel. Moderate instream cover. Land use is moorland, bracken and grazing.
AK10	High	Good	Adult/Juvenile salmonid habitat with patches of potential spawning habitat. Large pool at beginning of section – fish recorded leaping downstream. Flow type predominantly run with riffle/glide sequences throughout. Average wet width ~10+ m. Depth ranging from <10-75 cm and 150 cm at large pool. Cobble/pebble/gravel with limited boulder. Moderate instream cover. Land use is grazing. Embankment unstable at places.

5 EVALUATION OF RESULTS

5.1 Fisheries Habitat Survey (Salmonid Fish)

5.1.1 *Giligill Burn*

This burn flows from southeast to northwest, draining the eastern side of the Site. The lower reaches from the Giligill burn flow adjacent to and beneath the A863. The upper and mid reaches of the burn (AK2) were classed as having low FUP and poor FHQ due to various habitat characteristics considered unsuitable for salmonids. It is unlikely that juvenile fish would be present within this section. There was a collapsed culvert/ field drain at survey location AK1 which is considered likely to prevent upstream/ downstream migration. The watercourse improves slightly at survey location AK3 however areas remain low FUP and poor FHQ with the classification being increased to moderate downstream.

At the double culvert (A836 crossing), survey location AK4, the FHQ and FUP improves to moderate. However, a 3m falls was recorded downstream which is considered to be a potential barrier to migratory fish (NC 90008 63551). Due to the steep embankment it was judged as being unsafe to descend, therefore the barrier could not be fully assessed.

The majority of all survey locations within the Giligill Burn had combinations of flow types, depths and variable substrates considered unsuitable for migratory fish. The downstream section below the potential barrier was not surveyed and may be suitable for juvenile salmonids.

5.1.2 *Tributary of Giligill Burn*

This burn drains the centre of the Site flowing from south to west into the Giligill burn. Gradient is largely moderate, and the burn flows over moorland/ grazing habitat at the upstream end, through a forestry plantation into farmland downstream. The burn is approximately 1.25 m in wet width. The channel is incised through peat upstream and the substrate is either silt/ gravel or cobble/ pebble with limited boulder. Depth is mainly less than 10 cm with deeper sections of 30 cm. The habitat in the survey reach is predominantly unsuitable for salmonid production (survey location AK5) however small sections of the burn are considered suitable for resident brown trout (survey location AK6).

5.1.3 *Akran Burn*

The Akran Burn flows from southeast to west, draining the southwest corner of the Site. The upper reaches flow through moorland and are considered suitable for salmonid populations. The lower reaches of the burn flow through moorland and grazing habitat with areas of dense bracken throughout. The burn here (survey location AK9) is considered suitable for salmonid populations. The downstream end of this burn flows through farmland and a small woodland (survey location AK8 before crossing the A897 road beneath a spanned bridge (survey location AK7).

The concrete abutment recorded at the bridge may prevent upstream migration during periods of low flow however the potential barrier is considered passable during moderate to high water levels. Small patches of spawning habitat was recorded throughout survey locations AK7 and AK8.

5.1.4 *Halladale River*

The Halladale River is out with the Development Site boundary however the Giligill and Akran Burns both flow into this river. The survey location, AK10, is considered suitable for salmonid populations and classed as having high FUP and good FHQ, spawning habitat was also recorded within this section. This Halladale River is of importance to local Atlantic salmon and sea trout populations and any negative impact on water quality could have a significant impact of the salmonid species present.

5.2 Lamprey Suitability

Limited suitable habitat for juvenile lamprey was identified during the habitat survey of sampled watercourses. A small section was recorded within survey location AK5 however this was insulated. Due to the information obtained during the desktop study lamprey cannot be scoped out. However, lamprey are considered unlikely to be present/if they are, in very low numbers.

5.3 Freshwater Pearl Mussel Suitability

Limited suitable habitat for freshwater pearl mussel was identified during the habitat survey of sampled watercourses: small sand patches stabilised amongst large stones or boulders in fast-flowing streams and rivers. It is considered unlikely that freshwater pearl mussel are present.

6 RECOMMENDATIONS

To ensure compliance with relevant environmental legislation and implementation of good working practices and appropriately inform the EIA, the following recommendations are provided.

6.1 Fully Quantitative Electrofishing Surveys

To provide baseline data for future monitoring, it is recommended that fully-quantitative electrofishing surveys are completed at various survey locations (including but not limited to – AK3, AK4, AK5, AK6, AK7, AK8, AK9 and AK10 plus an additional survey location downstream of the confluence between the Halladale River and Akran Burn).

Change in fish numbers alone may not provide compelling evidence of Development impacts without corroborating evidence from control sites, monitoring of freshwater invertebrates or hydrochemistry, and/or direct observations of pollution incidents e.g. by an Ecological/Aquatic Clerks of Works. Nevertheless, the inclusion of fish as part of a spatially harmonised aquatic monitoring programme remains worthwhile, as salmonid species sensitive to water quality changes are present in most streams within the Development Site Boundary.

6.2 Construction and Post-Construction Monitoring of Aquatic Ecology

As part of an ongoing monitoring assessment of potential impacts which may occur as a result of the Development, it is recommended that pre-construction (baseline) fish fauna and aquatic invertebrate surveys are undertaken. Should results of the baseline surveys indicate salmonid populations, it is recommended that a construction and post-construction fish fauna and aquatic invertebrate monitoring plan is produced (utilising suitable survey sites plus two control sites).

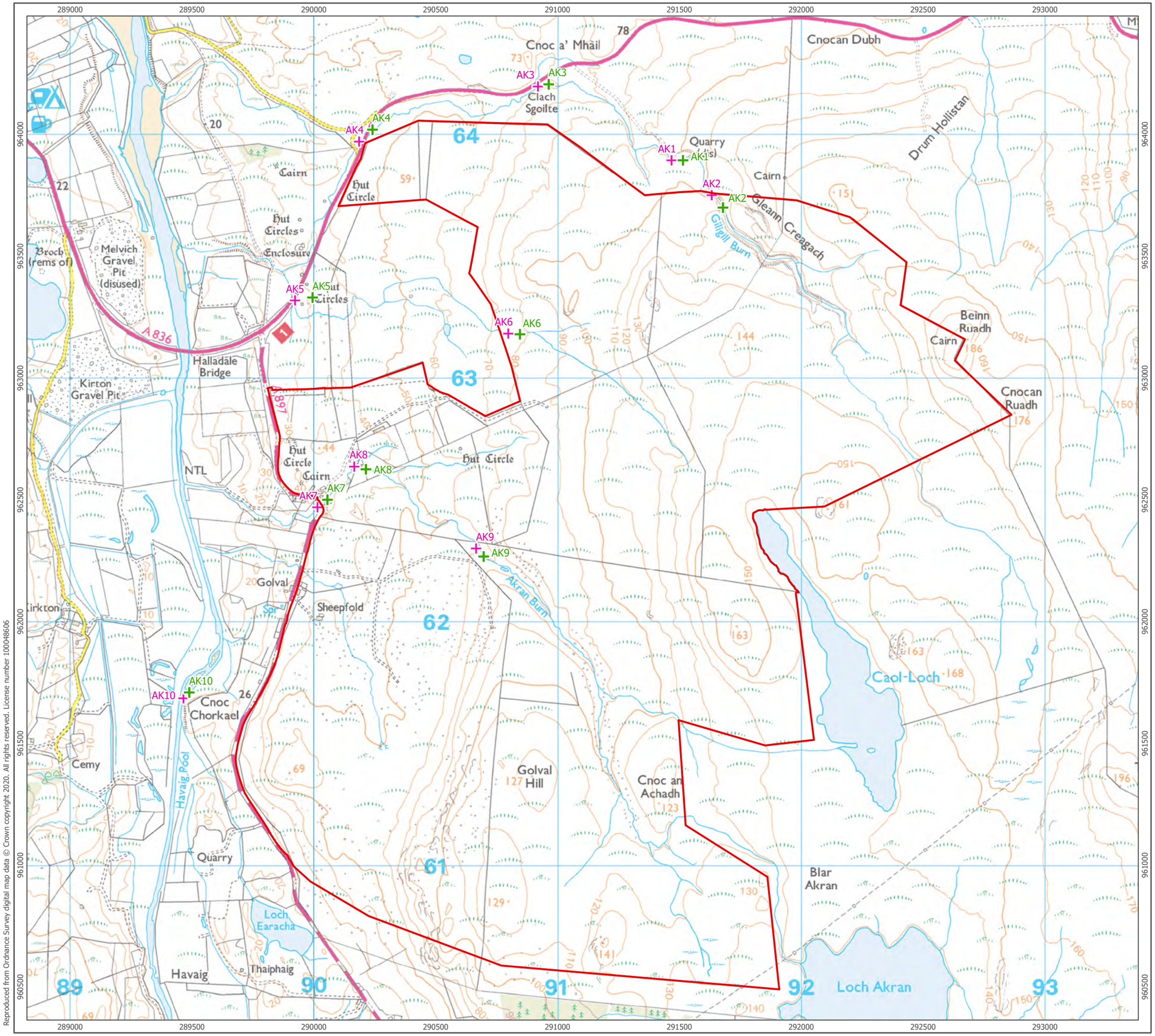
The suggested monitoring schedule would include the following:

- Fish fauna – annually during construction (summer) and post-construction Year 1 (summer) and Year 2 (summer); and
- Aquatic invertebrates – annually during construction (spring/autumn) and post-construction during Year 1 (spring/autumn) and Year 2 (spring/autumn).

It is also recommended that the Ecological/ Aquatic Clerk of Works with knowledge of the water environment is appointed during major works. The Ecological/ Aquatic Clerk of Works should undertake water quality monitoring as part of their role.

APPENDIX A: FIGURES

Figure 1: Survey Locations



P:\Projects\Ecology\Projects\3138 Ackron Ecology\3138 Ackron Ecology.aprx\3138-REP-155 Fig01 Fish Habitat Survey Locations

ARCUS

Site Boundary

Fish Habitat Survey Locations

+ Downstream Limit

+ Upstream Limit

1:15,000 Scale @ A3

0 250 500 m

NORTH

Produced By: ST	Ref: 3138-REP-155
Checked By: NW	Date: 13/11/2020

Fish Habitat Survey Locations
Figure 1

Ackron Wind Farm
Fisheries Habitat Surveys
Technical Appendix 7.4

APPENDIX B: PHOTOGRAPHS

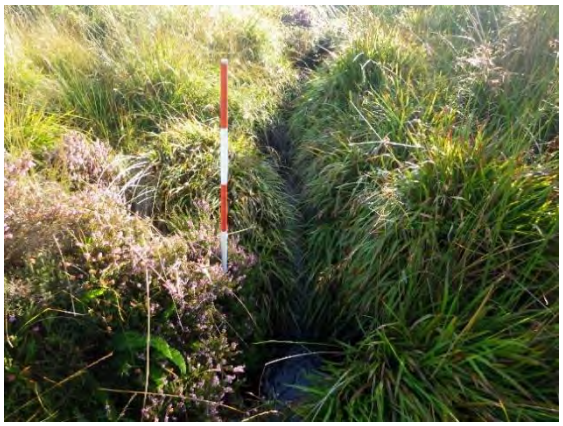
	
Plate 1 – AK1 (facing downstream)	*Plate 2 – AK1 (collapsed culvert)*
	
Plate 3 – AK2 (facing downstream)	Plate 4 – AK3 (facing downstream)
	
Plate 5 – AK4 (facing downstream)	Plate 6 – AK4 (culvert)

	
Plate 7 – AK5 (facing upstream)	Plate 8 – AK6 (facing downstream)
	
Plate 9 – AK7 (facing upstream)	Plate 10 – AK8 (facing upstream)

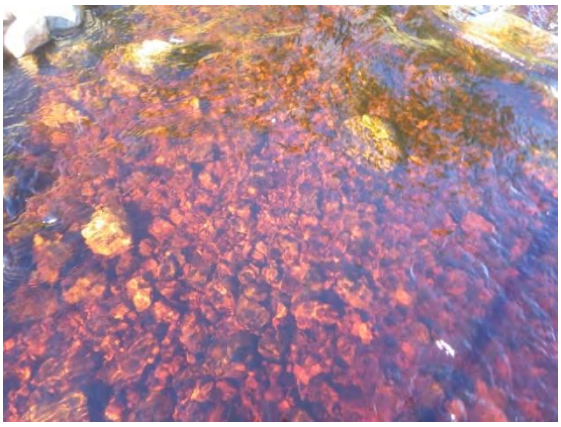



Plate 11 – AK8 (potential spawning habitat)	Plate 12 – AK9 (facing upstream)

	
Plate 13 – AK10 (adult holding pool)	Plate 14 – Giligill Burn (potential barrier)