Chapter 7: Freshwater Ecology

Creag Riabhach Wind Farm Extension

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Contents

7 Freshwater Ecology

7.1 Introduction

The potential effects of the Creag Riabhach Wind Farm Extension project, hereafter referred to as the 'proposed development', during construction, operation and maintenance, and decommissioning on Freshwater Ecology receptors are assessed in this chapter. This chapter also includes a review of the potential cumulative effects of other relevant projects.

This assessment and survey (fish habitat survey) have been undertaken by Trex Ecology Ltd, providing independent and objective reporting based upon sound scientific data collection and analysis in accordance with the best practice guidelines and standards of the Chartered Institute of Ecology and Environmental Management (CIEEM). Trex Ecology Ltd has contributed to the assessment with the following survey and associated report, as detailed in **Table 7.1**.

Further competency details of the Project Team, including lead authors for each chapter, are provided in **Chapter 1: Introduction** of this Environmental Impact Assessment (EIA) Report.

Table 7.1 below provides a list of the supporting studies which relate to the Freshwater Ecology impact assessment. All supporting studies are appended to this EIA Report.

Table 7.1: Supporting Studies

Details of study	Locations of supporting studies
Fish Habitat Survey	Technical Appendix 7.1
Creag Riabhach Wind Farm: 2019 Preconstruction fish and invertebrate surveys for Creag Riabhach Windfarm	Technical Appendix 7.2
Figure 7,1. Creag Riabhach Wind Farm extension boundary	Volume 3a
Figure 7.2. Creag Riabhach Wind Farm extension survey sites	Volume 3a
Figure 7.3. Statutory designations within 5km of proposed development	Volume 3a
Figure 7.4. Location of biological monitoring sites for Creag Riabhach Wind Farm	Volume 3a

7.2 Legislation, Policy, and Guidance

The following relevant legislation and guidance relating to Freshwater Ecology were used in the preparation of this chapter:

7.2.1 Legislation

- *European Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats Directive)* - aims to promote the maintenance of biodiversity and, as such, identifies species and habitats for which core areas must be designated as Special Areas of Conservation (SACs). Transposed into UK law by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland). Domestic legislation continues to be aligned after Scotland left the European Union (EU) with the UK through the UK Withdrawal from the EU (Continuity) (Scotland) Act 2021;
- *European Council Directive 2000/60/EC (the Water Framework Directive) (WFD)* - commits European Union member states to achieve good qualitative and quantitative status of all water bodies. Transposed into Scottish law by the Water Environment and Water Services (Scotland) Act 2003. Domestic legislation continues to be aligned after Scotland left the EU with the UK through the UK Withdrawal from the EU (Continuity) (Scotland) Act 2021;
- *Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act, 2003, aka the Salmon Act* - the Act provides for the administration and control of salmon and freshwater fisheries in Scotland by District Salmon Fishery Boards. It makes provision with regard to the methods of fishing for salmon and freshwater fish and provides details of their related offences. Under the Act, it may be an offence to, recklessly or otherwise, interfere with the spawning and migration of anadromous salmonids. It also protects spawning habitats;
- *The Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008*;
- *The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the Habitats Regulations)* – transpose the Habitats Directive into UK law;
- *Wildlife and Countryside Act 1981 (as amended in Scotland) (WCA)* - provides protection to species and habitats, enhanced protection for species listed on Schedule 5, and protection for habitats and plants of national importance through the designation of Sites of Special Scientific Interest (SSSIs);
- *Nature Conservation (Scotland) Act 2004 (as amended) (NCSA)* – places a duty on all public authorities to consider biodiversity in their work, requires Scottish Ministers to produce a biodiversity strategy and list of species and habitats of principal importance for biodiversity conservation in Scotland, and strengthens legislation protecting SSSIs; and
- *Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017* - implements Directive 2001/92/EU in relation to the construction and operation of generating stations and their impact on the environment.

7.2.2 Policy

- The IUCN Red Data Book Species - The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria;
- The UK Biodiversity Action Plan (UKBAP) – most recently updated in 2007, superseded by the 'UK post-2010 Biodiversity Framework' and devolved under the NCSA, the UKBAP lists of priority species and habitats are still of value to policymakers;

- *Government Circular 06/2005: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System (Office of the Deputy Prime Minister [ODPM])* – Statutory Obligations and their Impact within the Planning System;
- *National Planning Framework 4* - The latest National Planning Framework emphasises the importance of protecting biodiversity, reversing biodiversity loss, delivering positive effects from development, and strengthening nature networks (Scottish Government, 2023). As part of this, development proposals are expected to contribute towards the enhancement of biodiversity, including restoration of degraded habitats, as well as restoring connections between nature networks (Scottish Government, 2023);
- *Scottish Biodiversity Strategy 2022 to 2045. Tackling the Nature Emergency in Scotland.* (Scottish Government, 2022) – Updated biodiversity strategy, notably aiming to halt and reverse biodiversity loss in Scotland;
- Scottish Biodiversity List (SBL), (NatureScot, 2020) – The SBL is a list of habitats, animals and plants that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland. It was developed to meet the requirements of Section 2 (4) of the Nature Conservation (Scotland) 2004 Act for the conservation of biodiversity and supersedes the UK Biodiversity Action Plan. Public bodies must consider SBL species when reporting on their 'Biodiversity Duty' (as defined and required by the Nature Conservation (Scotland) Act 2004 and Wildlife & Natural Environment (Scotland) Act 2011); and
- *The Highland Council Supplementary Guidance. Highland Statutorily Protected Species – Supplementary Guidance* (2013);
- *Highland Nature Biodiversity Action Plan 2021 – 2026* – This LBAP defines nature conservation priorities, actions and targets for the Highlands;
- *Highland-Wide Local Development Plan. Policy 58 – Protected Species* (2012) - The policy states that where protected species are present, the council will require surveys to be carried out to establish presence, and if necessary, mitigation will need to be implemented to avoid or minimise impacts on species;
- *Highland-Wide Local Development Plan. Policy 59 – Other Important Species* (2012) - The policy states that species listed under the Habitats Directive, UK and Local Biodiversity Action Plans and the Scottish Biodiversity List will need to be considered in terms of adverse effects from proposals;
- *Highland-Wide Local Development Plan. Policy 60 – Other Important Habitats and Article 10* Features (2012) - The policy states that the council will seek safeguarding of integrity features of the landscape which are of major importance because of their linear or continuous structures or combination as habitat 'stepping stones' for the movement of wild fauna and flora. This policy also seeks to protect those habitats which are protected under legislation or conservation plans;

  The proposed scheme falls within the boundaries of the Caithness and Sutherland Local Development Plan, 2018. Chapter 2, Strategy and Policies, consider planning policies relevant to the safeguarding of areas of high-quality nature conservation value and the protection and enhancement of green networks and green spaces.

7.2.3 Guidance

- *Scottish Government Planning Advice Note 1/2013: Environmental Impact Assessment* – Scottish Government Planning Advice Note regarding Environmental Impact Assessment;

- *Scottish Planning Circular 1/2017 guidance on the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017)* - Gives guidance on the 2017 Regulations, which transpose the Environmental Impact Assessment (EIA) Directive into the Scottish planning system;
- *A Handbook on Environmental Impact Assessment, Version 5* (Historic Environment Scotland and SNH, 2018) – Guidance to be followed when undertaking EIA published by SNH (now NatureScot) and HES;
- *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine* (CIEEM, 2018);
- *Land Use Planning System SEPA Guidance Note 4: Planning Guidance on Windfarm Developments* (SEPA, 2012);
- *Scottish Government (2021), Monitoring watercourses in relation to onshore wind farm developments: generic monitoring programme;*
- SEPA (2018a). *Pollution Prevention Guidelines: Dealing with spills. Guidance document PPG 22 produced by SEPA, NIEA and the EA*;
- SEPA (2018b). *Supporting Guidance (WAT-SG-75). Sector-Specific Guidance: Construction sites. Version 1*;
- SEPA (2021). *The Water Environment (Controlled Activities) Scotland Regulations 2011 (As Amended): A Practical Guide. Version 8.5*;
- *The Highland Council Supplementary Guidance. Highland's Statutory Protected Species* (2013);
- *Electricity Act 1989 – sections 36 and 37: applications guidance* - This good practice guidance sets out the procedure for applications for onshore generating stations and overhead lines under sections 36 and 37 of the Electricity Act 1989, where the development concerned is development requiring environmental impact assessment;
- *Guidance on the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000*;
- *Guidance on Electricity Works (Environmental Impact Assessment) (Scotland) Amendment Regulations 2008*;
- *Assessing the Cumulative Impact of Onshore Wind Energy Developments* (NatureScot, 2021); and
- Good Practice During Wind Farm Construction (Scottish Renewables *et al.,* 2019).

7.3 Scoping and Consultation

Scoping and consultation have been ongoing throughout the EIA process and have played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the proposed development given the requirements of the regulators and their advisors.

Relevant comments from the EIA Scoping Opinion provided by Scottish Ministers, The Highland Council (THC), Marine Scotland Science (MSS), NatureScot (NS), Kyle of Sutherland District Salmon Fishery Board (DSFB) and The Northern DSFB are summarised in **Table 7.2** below, which provides a high-level response on how these comments have been addressed within this EIA Report.

Table 7.2: Summary of Consultation Responses Specific to Freshwater Ecology

Consultee	Summary	Specific actions
Scottish Ministers	Fisheries Management Scotland have developed advice which should be fully considered throughout the planning, construction and monitoring phases of the proposed development. Baseline Fish Surveys are to be agreed with the local District Salmon Fishery Board and Fisheries Trust.	Acknowledged. Acknowledged. The Boards have approved the scope as per the comments below within this table.
The Highland Council	The EIAR needs to address the aquatic interests within local watercourses, including downstream interests that may be affected by the development, for example increases in silt and sediment loads resulting from construction works; pollution risk/incidents during construction; obstruction to upstream and downstream migration both during and after construction; disturbance of spawning beds/timing of works; and other drainage issues. The EIAR should evidence consultation input from the local fishery board(s) where relevant.	Full details of the baseline freshwater ecological surveys are provided in EIA Report **Technical Appendix 7.1** with the inclusion of embedded mitigation measures detailed within this chapter. Response from the local fishery board is provided within this table.
NatureScot	The proposal lies close to the River Naver SAC, protected for its Atlantic salmon and freshwater pearl mussel. Given the proximity of the proposal, it will be very important to consider and assess any direct and indirect impacts to the SAC in context of the site's conservation objectives. In particular, a clear explanation of how the Applicant will ensure sediment does not enter any watercourses flowing into the SAC will be very helpful. We agree with the proposed scope of the ecology as described in section 6.3 of the Scoping Report dated April 2022.	Full details of the baseline freshwater ecological surveys are provided in EIA Report **Technical Appendix 7.1**. With the inclusion of embedded mitigation measures detailed within this chapter. Acknowledged.
Marine Scotland Science	The proposed development straddles the river catchments relating to the Northern and Kyle of Sutherland DSFBs, Kyle of Sutherland Fisheries Trust and the Flow Country Rivers Trust. It is important that the proposals are conducted in full consultation with the Board/Trust. Due to the potential for such developments to impact on migratory fish species and the fisheries they support, FMS have developed, in conjunction with Marine Scotland Science, advice for DSFBs and Trusts in dealing with planning applications.	The Boards have been consulted, and their responses are provided below within this table. Acknowledged.

Consultee	Summary	Specific actions
	We would strongly recommend that these guidelines are fully considered throughout the planning, construction and monitoring phases of the proposed development.	
Kyle of Sutherland District Salmon Fishery Board	The Kyle of Sutherland District Salmon Fishery Board are content with the approach as outlined in the supporting information and have no further comments to make at this stage.	Acknowledged.
The Northern District Salmon Fishery Board	The Northern District Salmon Fishery Board have no comment to make at this stage. The aquatic data needs are adequately covered in the scoping report and the proposed new development poses no further risks to freshwater fish beyond those of the original development.	Acknowledged.

7.4 Baseline Survey Methodology

This section describes the location of the survey area and provides an overview of the methods used to carry out the Freshwater Ecology desk study and fish habitat survey. The results from all surveys are used in order to provide the baseline descriptions for the assessment in **Section 7.6**. Further details of survey methods and results are presented in **Technical Appendix 7.1** and associated annexes.

7.4.1 Study Area

The impact assessment focuses on the potential effects on Freshwater Ecology receptors arising from the proposed development.

The site boundary of the proposed development, in context with the original development is shown in **Figure 7.1** with site layout and survey sites (E01 and E02) shown in **Figure 7.2**. The guidelines for Ecological Impact Assessment (EcIA) require that the surveyed site includes all areas where significant effects could occur throughout the life of the project. The 'zone of influence' of the proposed activities upon different habitats and species varies greatly, but 500m is considered to be an appropriate distance to take into account the potential effects upon habitats for Freshwater Ecology surveys.

In addition, a fish habitat survey would generally be undertaken to encompass any watercourse crossing point required as part of a development, along with 100m upstream of that point and 500m downstream. However, the three tributaries of the River Vagastie, which drain the site, are very steep and unlikely to support salmonid spawning habitat. Therefore, two survey sites were selected on the River Vagastie, which would be the downstream receiving channel of any potential impacts from the proposed development and comprised two 500m extents. These two sites are shown in **Figure 7.2**.

The desk study encompasses the site plus consideration for the potential for migratory fish to access the site from connecting watercourses.

7.4.2 Desk Study

A detailed desk study was undertaken of the existing literature and data relating to Freshwater Ecology. The desk-based study was undertaken in January 2023.

This information was used to give an overview of the existing ecological environment within the site and surroundings, provide information on sensitive habitats and provide information on statutory sites designated for their ecological interest. This information was used to put habitats known from the proposed development into context in terms of their ecological importance.

The sources outlined in **Table 7.3** are existing data sets and literature with relevant coverage to the proposed development. They relate to the potential for migratory fish to access relevant channels, the observed fish density of certain species, the presence of protected areas, and the WFD status classifications of Water Bodies (WBs), which the proposed development may impact. Information on all relevant species is not available as data for non-salmonid fish species are not presented within the National Electrofishing Programme for Scotland (NEPS) Shiny app.

Table 7.3: Data sources

Title	Source	Year	Purpose
Protected species and habitats	NatureScot Site Link	2022	Identify relevant protected areas/species.
Water Framework Directive	SEPA Water Environment Information Hub	2022	Identify current WFD status.
Barriers to fish migration	Marine Scotland – National Marine Plan Interactive Map (NMPI)	2022	Identify channel barriers to fish migration.
Salmon distribution map	Marine Scotland – National Marine Plan Interactive Map (NMPI)	2022	Salmond distribution map.
National Electrofishing Programme for Scotland	Marine Scotland Shiny App R	2019	Most recent salmon distribution data from National programme.

Review of Existing Information for Creag Riabhach Wind Farm

Although Creag Riabhach Wind Farm (CRWF) started commissioning in November 2022, construction activities are still taking place on-site. A considerable amount of information has been gathered during work on CRWF, relevant to the assessment of the proposed development.

As detailed in the Scoping Report and supported by the Fishery Boards (see comments in **Table 7.2**) the following was used in addition to the sources listed in Table 7.3 to establish the current Freshwater Ecology baseline and undertake the impact assessment.

- Pre-application fish and freshwater pearl mussel surveys (undertaken in 2012);
- Baseline data provided from 2014 and 2017 by Naver Fisheries/Northern DSFB and Kyle of Sutherland DSFB;
- Pre-construction fish surveys (undertaken in 2018 and 2019 by Trex Ecology Ltd);
- Pre-construction aquatic invertebrate surveys (undertaken in 2018, 2019, and 2020 by Trex Ecology Ltd); and
- Operational phase fish and aquatic invertebrate monitoring surveys (ongoing, having commenced in 2021 and undertaken by Trex Ecology Ltd). These are based on the aquatic monitoring programme established for the original CRWF development and detail provided in the 'Creag Riabhach Windfarm; Windfarm construction and operational Fish Management Plan (McDermott, 2018)[1]'.

7.4.3 Fish Habitat Survey

The fish habitat surveys were undertaken on the 03 of March 2022 in suitable weather conditions and low flows.

The surveys were undertaken following an expanded and updated version of the Hendry & Cragg-Hine (Environment Agency, 1997)[2] approach to identify important fish features. This approach applies more general habitat criteria from methods such as RHS (Raven et al., 1998)[3] as opposed to the deterministic and potentially subjective fish life history stage designations (e.g., 0+ salmon habitat) from the 1997 document. The recorded habitat features can then be assessed with a specific focus on the species of interest, allowing for a much more comprehensive multispecies habitat assessment, as opposed to salmonid only, and is regularly used in Scotland for Planning purposes. A complete inventory of base habitat features is presented in the **Technical Appendix 7.1**.

The survey extent comprised two separate 500m extents on the River Vagastie, labelled as E01 and E02, adjacent to the upper and lower works area (see **Figure 7.2**).

7.4.4 Future Baseline

In accordance with EcIA best practice, the baseline used for the assessment is not simply the survey results but an interpretation of these, taking into account future changes that are likely to occur – i.e., the baseline

1 McDermott, T. (2018), Creag Riabhach Windfarm; Windfarm construction and operational Fish Management plan. Technical report prepared for Caledonian Conservation Ltd.

2 Environment Agency (1997), Restoration of riverine salmon habitat. EA Fisheries Technical Manual 4. EA Bristol.

3 Raven PJ, Holmes NTH, Dawson FH & Everard M. (1998), Quality Assessment using River Habitat Survey Data. Aquatic Conservation Marine and Freshwater Ecosystems. 8:477-499.

at the time the proposed development is constructed, operational, and decommissioned (CIEEM, 2018)[4]. There are no proposed land use changes, however climate change may have an impact on the future baseline for fish as described below.

The approach used to undertake the baseline surveys provides a time-invariant description of the potential for channels to host the species of interest based on the presence of key, discrete habitat elements linked to their specific life history stages. Using this approach reduces the dependence of relying on the unpredictability of the fluctuations in fish population dynamics in terms of their presence and distribution and impacts on their survival from anthropogenic issues and climate change.

However, Atlantic salmon *(Salmo salar)*, in particular, are undergoing severe declines across their range, despite cessation in widespread exploitation of the species as a food resource in high seas and local fisheries. These declines are linked to a host of factors within the marine and freshwater environment (Bull *et al.,* 2022)[5], and while Atlantic salmon is not on an extinction pathway as a species, significant reductions in the numbers are ongoing in Scotland.

Climate change predictions for rivers in Scotland (Jackson *et al.,* 2018)[6] show that the River Vagastie may be subject to the highest maximum temperatures, which are very likely to impact all native fish species. The absence of widespread riparian shade and water utility diversions may be a considerable issue for the future of the catchment. Given the lifecycle of the proposed development and the receptors present, it is possible that a widespread reduction in abundance would be recorded in the absence of any further works in the catchment. Therefore, systematic decreases in Atlantic salmon should be expected throughout the lifecycle of the proposed development. A more in-depth future baseline in relation to climate change is discussed in detail the Carbon Assessment section in **Chapter 14: Other Issues**, of this EIA Report.

European eel *(Anguilla Anguilla)* is also generally in decline, particularly linked to glass eel recruitment into river systems. Overall patterns of this species should continue to be understood throughout the proposed development lifetime.

7.4.5 Difficulties and Uncertainties

A multi-tiered approach was undertaken to gather information on the sensitive receptors within the Freshwater Ecology study area, involving a habitat survey at two sites and a desk-based study which included

4 CIEEM (2018), Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.2 – Updated April 2022. Chartered Institute of Ecology and Environmental Management, Winchester

5Bull, C., Gregory, S., Rivot, E., Sheehan, T., Ensing, D., Woodward, G. & Crozier, W. (2022), The likely suspects framework: the need for a life cycle approach for managing Atlantic salmon (Salmo salar) stocks across multiple scales. ICES Journal of Marine Science. 79, 1445-1456.

6 Jackson, F.L., Fryer, R.J., Hannah, D.M., Millar, C. & Malcolm, I.A. (2018), A spatio-temporal statistical model of maximum daily river temperatures to inform the management of Scotland's Atlantic salmon rivers under climate change. Science of The Total Environment 612, 1543-1558.

a review of the baseline data gathered for the CRWF Planning Application and associated Fish Monitoring Plan (FMP) which are relevant to the proposed development. It is considered that this provides a robust baseline for the impact assessment to be undertaken.

It is considered that where there are significant data gaps, these have been appropriately mitigated to avoid significant limitations to the impact assessment. Although the baseline information was completed 2018, construction monitoring surveys in 2020-2022 has shown no change in the baseline.

7.5 Impact Assessment Methodology

This assessment covers all potential impacts identified through the scoping process and any further potential impacts that have been highlighted as the EIA has progressed. It should be noted that impacts are not necessarily relevant to all stages of the proposed development.

The approach adopted for the assessment of ecological impacts on Freshwater Ecology is in line with published best practice guidance for EcIA produced CIEEM and therefore differs from that described in **Chapter 2: EIA Approach and Methodology**. These guidelines set out the process for assessment through the following stages:

- Determination of the importance of ecological features through desk study and surveys;
- Identification and characterisation of potential effects to determine level of impact;
- Assessment of likely significant impacts;
- Identification of requirement for measures to avoid and mitigate (reduce) these impacts;
- Identification of any monitoring requirements; and
- Assessment of the significance of any residual impacts after mitigation.

7.5.1 Determining Importance

According to the CIEEM guidance, determining which ecological features are important and should be subject to detailed assessment is one of the key challenges in the Ecological Impact Assessment (EcIA) process. Ecological features can be important for a variety of reasons and may relate, for example, to:

- Quality or extent of designated sites or habitats;
- Habitat/species rarity;
- The extent to which they are threatened throughout their range; or
- Their rate of decline.

The level of importance of ecological features identified at the site has been determined using the criteria defined in **Table 7.4**. In line with CIEEM guidance, these criteria have been determined with regard to statutory requirements and policy objectives for biodiversity.

In addition, where relevant and where information is available, use is made of contextual information about the distribution of habitats and species, and species abundance, including trends based on historical records. As available quantitative data on a particular habitat or species may be limited, particularly below the international and national level, the evaluation of importance may also involve an element of professional judgement.

Evaluations are based upon a combination of information gathered via the desk study and field survey results, along with professional experience and judgement. Social and economic factors are also considered when assessing ecological features if appropriate.

Features of negligible importance have not been carried forward for assessment.

Table 7.4: Criteria for Evaluation of Importance Level of Habitats and Species

Importance Level	Criteria	Examples
Very high	Internationally important habitats, or species that are part of an internationally important population	• An internationally designated site, candidate site, or an area meeting the criteria for an international designation (e.g. an SAC). • Large areas of priority habitat listed under Annex I of the Habitats Directive, and smaller areas of such a habitat that are essential to maintain the viability of that ecological resource. • A regularly occurring, nationally significant population of any internationally important species, listed under Annex II or Annex IV of the Habitats Directive.
High	Nationally important habitats, or species that are part of a nationally important population	• A nationally designated site, or area meeting criteria for national level designations (e.g., a SSSI). • Significant extents of a priority habitat identified in the Scottish Biodiversity List (SBL), or smaller areas which are essential to maintain the viability of that ecological resource. • A regularly occurring, regionally significant population of any nationally important SBL priority species, or species listed under Schedule 1 or Schedule 5 of the Wildlife and Countryside Act, Annex II or Annex IV of the Habitats Directive.
Medium	Regionally important habitats or species that are part of a regionally important population	• Viable areas of key semi-natural SBL priority habitat. • A regularly occurring, locally significant population of any nationally important SBL priority species, or species listed under Schedule 1 or Schedule 5 of the Wildlife and Countryside Act, Annex II or Annex IV of the Habitats Directive. • Sites which exceed the local authority-level designations but fall short of SSSI selection guidelines, including areas of semi-natural woodland exceeding 0.25ha.
Low	Habitats or species that are part of a locally important population	• Areas of semi-natural ancient woodland smaller than 0.25ha. • Sites of Importance for Nature Conservation or equivalent sites selected on local authority criteria. • Local Nature Reserves. • Other species of conservation concern, including species under the Local Biodiversity Action Plan, in this case the Highland Biodiversity Action Plan (HBAP). • Areas of habitat or species considered to appreciably enrich the ecological resource within the local context (e.g. species-rich flushes or hedgerows).
Negligible	Common and widespread habitat or species of little or no intrinsic nature conservation value	• All other species and habitats that are widespread and common and which are not present in locally, regionally, or nationally important numbers, or habitats which are considered to be of poor ecological value (e.g. commercial forestry).

7.5.2 Identification and Characterisation of Potential Effects

In line with CIEEM guidance, reference is made to the following characteristics when describing potential ecological effects:

- Nature of impact: whether an impact is positive/beneficial to habitats (e.g. by improving habitat structure) or to species (e.g. by increasing species diversity or extending habitat) or negative/detrimental to habitats (e.g. by direct habitat destruction) or to species (e.g. by loss of or displacement from suitable habitat);
- Extent: the spatial or geographical area over which the effect may occur;
- Magnitude: the size, amount, intensity and volume. This should be quantified if possible and expressed in absolute or relative terms (e.g., the amount of habitat lost or percentage decline in a species population);
- Duration: the length of time the activity occurs over. This should be defined in relation to ecological characteristics (e.g., a species lifecycle) as well as human timeframes. It should also be noted that the duration of an activity may differ from the duration of the resulting effect (e.g., if short-term construction activities cause disturbance to Atlantic salmon during their breeding period, there will be long-term implications from failure to reproduce that season);
- Reversibility: an irreversible effect is one from which recovery is not possible within a reasonable timescale, or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation;
- Frequency: the number of times an activity occurs. This may influence the resulting effect; and
- Timing: the time of year during which the activity occurs. This may result in an effect on an ecological feature if it coincides with critical life-stages or seasons (e.g. fish migration).

The timescales of potential effects on ecological features are considered. Incorporated into this evaluation is the reversibility of the effect, which is based on the duration of the impact, or the time required for the feature to return to baseline pre-construction conditions (Regini, 2000)[7]. Knowledge of how rapidly the population or performance of a species is likely to recover following loss or disturbance (e.g., by individuals being recruited from other populations elsewhere) is used to assess reversibility, where such information is available.

The following definitions have been applied with regard to timescales:

- Immediate: within approximately 12 months;
- Short-term: within approximately one to five years;
- Medium-term: within approximately six to 15 years; and
- Long-term: more than 15 years.

7 Regini, K. (2000), Guidelines for Ecological Evaluation and Impact Assessment. Ecology & Environmental Management In Practice, Bulletin of the Institute of Ecology and Environmental Management.

Table 7.5 below indicates all of the potential direct and indirect impacts assessed with regard to Freshwater Ecology and indicates the proposed development stages to which they relate.

Table 7.5: Impacts Requiring Assessment

Impact	Description
Construction	
Mortality of important freshwater ecology receptors	The construction works would involve the construction of three turbines, a battery energy storage system (BESS) facility, and associated infrastructure. These activities have the potential to pollute watercourses such as from generated fine sediment input, acidity from peat disturbance, hydrocarbons, chemicals, and concrete which could result in the mortality of freshwater receptors. See **Chapter 3: Description of Development** for full details.
Damage to key freshwater habitats	Construction activities have the potential to pollute watercourses that could result in damaging key freshwater habitats e.g., generated fine sediment deposition in gravels affecting survival of eggs and young fish.
Interruptions to fish passage	Indirect effects from construction activities have the potential to cause interruptions to fish passage in terms of pollutants affecting water and substrate quality or by creating physical barriers, impeding their ability to move through the system.
Operation and maintenance	
Mortality of important freshwater ecology receptors	The potential effects from the operation and maintenance stage of the proposed development to the mortality of important freshwater ecology receptors are much reduced from the construction stage. The main potential effects stem from maintenance activities to pollute the watercourses.
Damage to key freshwater habitats	The main potential impacts on freshwater habitats during the operation and maintenance phase are indirect effects from the pollution of watercourses. However, it is expected that maintenance activities would be infrequent and small-scale, resulting in risk at a lower magnitude than those during construction.
Interruptions to fish passage	These maintenance works may also result in indirect effects on fish migration, e.g. pollution of watercourses as a result of spillage. However, the potential for indirect effects to occur during operation is generally lower than that during construction. Any retained physical barriers may influence fish distribution during operations
Decommissioning	
It is considered likely that the habitats and species would be similar at decommissioning stage. As decommissioning works are likely to be of a similar nature and duration as construction activities, the potential effects resulting from decommissioning are likely to be similar to those resulting from construction. A Decommissioning Plan would be written for the approval of the Planning Authority prior to the decommissioning phase. This Plan would include measures to protect freshwater ecology features.	

In addition, fish ecology receptors have complex life histories, with each stage often requiring distinct assessment based on differing habitat associations. This is further complicated as native fish species are adapted to specific catchment characteristics which influence their presence within the river system at any given time. To incorporate this complexity Impact Assessment Methodology described above has been

supplemented by a Seasonal Sensitivity Table (SST) commonly used by Trex Ecology Ltd in support of Planning and License applications and is presented in Table 7.6.

The timings of key sensitivities are presented as high sensitivity in red, medium sensitivity in orange, and low sensitivity in yellow. Periods where the receptor is absent or not sensitive are white.

Table 7.6: Seasonal sensitivity table.

Species	Life Stage	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Atlantic salmon	Adult migration												
	Spawning												
	Incubation												
	Swim up												
	Winter dispersal												
	Smolt migration												
	Kelts												
Brown trout (* sea trout)	Adult migration												
	Spawning												
	Incubation												
	Swim up												
	Winter dispersal												
	Smolt migration*												
	Kelts												
Eel	Adult migration												
	Juvenile migration												

Key

	High sensitivity
	Medium sensitivity
	Low sensitivity
	Non sensitive/absent

Please note lamprey have been deliberately omitted from this table.

The picture for Atlantic salmon and trout is expectedly complex. Adult salmon can return to the River Vagastie during any period in the year, with peak run timings occurring from April to November. Young salmon remain in the redds (nests) until May and migrate to winter habitats from September to November. Another important period, smolt migration, occurs from March to June. The movement of kelts (salmon which have spawned and survived) seaward occurs in December and January.

Brown trout, including sea trout, reproductive movements are limited to the period of September to November, with young fish leaving the redds by the end of April. Winter dispersal is similar to Atlantic salmon, as is smolt migration.

Adult eel may leave the River Vagastie at any time of the year. Juvenile river entry is marked as April to August, peaking during June and July.

7.5.3 Geographic Context

Impacts on Freshwater Ecology are assessed in a local and, if necessary, a regional context as appropriate. For the purposes of the assessment, a local population refers to the population within Sutherland. If a potentially significant impact on a local population or habitat extent is identified, the assessment is extended to consider potential impacts on the wider regional population or habitat extent. However, if no significant effect on the local population or habitat extent is identified, consideration of the wider geographical area is not considered necessary since this would result in potential effects that are of the same or lower level for those wider populations or habitat extents.

7.5.4 Determining Magnitude of Effects

For the purposes of this assessment, the potential effects are assigned to different levels to assist the assessment process. The level of effects is defined using the criteria in **Table 7.7**. Note that these effects relate to negative effects; where positive effects are predicted, these are not assigned different levels.

Table 7.7: Criteria for Defining Level of Potential Effects

Effect level	Criteria
Very High	Total or almost complete loss of an ecological feature (habitat or population), likely to result in a permanent effect on its long-term ecological integrity and affect its conservation status.
High	Large-scale, permanent changes to an ecological feature, and likely to change its ecological integrity and affect its conservation status.
Medium	Moderate-scale, long-term changes to an ecological feature, or larger-scale temporary changes, but its long-term ecological integrity is unlikely to be affected, and any changes in conservation status are reversible.
Low	Small-scale, temporary effects on an ecological feature that do not affect ecological integrity or conservation status.
Negligible	Little or no detectable effect on an ecological feature

7.5.5 Significance of Impact

For Freshwater Ecology, potential effects are identified, and the significance of the impact is assessed for each stage of the proposed development. Significance is attributed relative to the background conditions.

The latest CIEEM guidelines on EcIA avoids and discourages the use of the matrix approach to determining significance and describes only two categories: "significant" or "not-significant".

According to the CIEEM guidance, for the purpose of EcIA, a "significant effect" is an effect that either supports or undermines biodiversity conservation objectives for important ecological features and biodiversity in general. Effects can be considered significant at a wide range of scales, from international to local.

The guidance further states that "*in broad terms, significant effects encompass impacts on structure and function of defined sites, habitats, or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution)*".

In line with this guidance, rather than using a matrix to determine significance, the approach used in this chapter is to consider the importance and sensitivity of the habitats and populations and the characteristics and severity of the effect. Professional judgement, supported by the available data, is applied as to whether the ecological integrity of a habitat or population would be affected.

The term "ecological integrity" refers to the maintenance of the conservation status of a habitat or population of a species at a specific location or geographical scale. This is used here in accordance with the definition adopted by the ODPM Circular 06/2005 on Biodiversity and Geological Conservation (Ministry of Housing, Communities and Local Government, 2005)[8], whereby designated site integrity refers to *"the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified".*

Effects are more likely to be significant where they affect a habitat or species of higher levels of importance, threaten the integrity of a habitat or population, or where the severity of the effect is high. Effects not considered to be significant would be those that do not threaten the integrity of an ecological feature or where the habitat or population affected is considered to be of low importance.

In this assessment, an effect that threatens the integrity of a habitat or species population is considered to be significant. Effects that do not threaten the integrity of a habitat or population are considered to be not significant.

8 Ministry of Housing, Communities and Local Government (2005), Government Circular: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System.

Where appropriate, mitigation measures are identified to avoid and reduce potentially significant effects. It is also good practice to propose mitigation measures to reduce negative effects that are not significant. The significance of residual effects on habitats and populations following the implementation of mitigation is then determined along with any monitoring requirements.

7.5.6 Cumulative Impact Assessment

Effects may not be detected when considering the proposed development in isolation but have the potential to become significant in combination with other effects. Therefore, the need to consider cumulative effects is a requirement under CIEEM guidance. Projects to be incorporated in such an assessment must include existing and consented developments, as well as those at the application stage.

As different projects often employ differing baseline and impact assessment methods, data often cannot be directly compared. Quantitative assessment of cumulative effects is, therefore, often not possible. Furthermore, as there is no compulsion for developers to share commercial data with other companies, it is often difficult to acquire a full dataset. Therefore, a comprehensive and quantitative cumulative impact assessment is rarely possible. However, every effort has been made to provide a qualitative assessment that is as robust as the available public data allows.

The context in which cumulative effects are considered depends upon the ecology of the habitat or species in question. For example, it may be appropriate to consider cumulative effects on Atlantic salmon associated with an SAC within the context of their wider range. For other ecological features such as lamprey, it may be appropriate to consider the effects on the local population in the context of any other planned projects in the immediate vicinity which have the potential to cause additional effects on the habitat (e.g. through loss of habitat).

Where no measurable effect is predicted as a result of the proposed development, it is considered that no cumulative impacts can be assessed, as there would be no definable addition to the impacts predicted by other projects.

7.5.7 Assessment of Transboundary Effects

In line with CIEEM guidance, transboundary effects must be considered where relevant. Transboundary effects may occur where predicted effects are not limited to features within a single administrative area so that all relevant authorities are able to take appropriate action. However, in the context of the proposed development, impacts on Freshwater Ecology will be localised, and no pathway for transboundary effects has been identified.

7.5.8 Embedded Mitigation and Management Plans

As part of the design process, a number of designed-in measures have been proposed to reduce the potential for impacts on Freshwater Ecology (**Table 7.8**). As there is a commitment to implementing these measures, they are considered inherently part of the design of the proposed development and have, therefore, been

considered in the assessment presented below (i.e., the determination of magnitude of impact and therefore significance of effects assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

Table 7.8: Embedded Mitigation Measures Specific to Freshwater Ecology

Mitigation measure	Justification
Operational Environmental Management Plan (OEMP)	The developer will collate an to guide on-going operations and maintenance activities during the life cycle of the project. The OEMP will also set out the procedures for managing and delivering the specific environmental commitments as per each technical chapter for each receptor over the operational period.
50m buffer strips along watercourses	A series of set-back or "buffer" distances would be adopted to help reduce effects of the proposed development on the hydrological environment. As the design process evolves, a 50m buffer will be ensured for all natural hydrological features identified using Ordnance Survey 1:25,000 and 1:10,000 scale mapping and site surveys. Infrastructure will be located out with this buffer except where access necessitates.
Minimal number of watercourse crossings	Any watercourse crossings associated with the new access track required as part of the proposed development would be minimised as far as practicable. All crossings of channels visible on the Ordnance Survey 1:25,000 scale maps would be designed with a suitably qualified freshwater ecologist reviewing the design to ensure that there are no impacts on fish passage or flows.
Drainage strategy to prevent run-off into watercourses	Drainage – all run-off derived from works associated with the proposed development would not be allowed to directly enter the natural drainage network. All run-off would be adequately treated via a suitably designed drainage scheme with appropriate sediment and pollution management measures. Sediment and pollution management structures should be reviewed regularly and, where capacity is reaching its limit, these structures should be cleared. The proposed development is situated in an upland hydrological area and it is imperative that the drainage infrastructure is designed to accommodate storm flows based on a 1-in-200 year event + climate change to help maintain the existing hydrological regime. The principles of the drainage design would also take cognisance of the permanent drainage associated with the adjacent CRWF. The Drainage Strategy for the proposed development is outlined in **Chapter 3: Description of Development**.
Pollution prevention plan	A Pollution Prevention Plan will be included as part of the CEMP. Proposed pollution prevention measures are outlined in **Technical Appendix 3.1.**
Wet Weather Protocol	This will detail the procedures to be adopted by all staff during periods of heavy rainfall e.g. inspection and maintenance regimes of sediment and runoff control measures will be adopted during these periods. This protocol will be detailed within the CEMP.

Mitigation measure	Justification
Emergency plans to prevent pollution	Contingency plans - plans would ensure that emergency equipment is available on site i.e., spill kits and absorbent materials, advice on action to be taken and who should be informed in the event of a pollution incident.
Staff training.	Training - All relevant staff personnel would be trained in both normal operating and emergency procedures and would be made aware of highly sensitive areas on site.
Fish Monitoring Plan.	The existing CRWF Fish Monitoring Plan would be amended to integrate the requirements for the proposed development. Standard family-level benthic macroinvertebrate surveys, annual fully quantitative electrofishing surveys and post-construction walkovers would be undertaken and compared to described baseline within earlier documents.
Appropriate timings of works.	Protect local and wider salmonid spawning and incubation by avoiding sensitive areas and undertaking works at appropriate times. This includes no instream working from 01 October to 01 May, unless authorised by the local DSFB.
Use of Ecological Clerk of Works (ECoW) as appropriate.	Ensure appropriately qualified ECoW is present at sensitive locations and/or sensitive periods where appropriate.
Water Environment (Controlled Activities) (Scotland) Regulations – CAR licence	Legal requirement issued by SEPA to regulate run-off from construction sites to the water environment.
Decommissioning Plan	A Decommissioning Plan will be prepared for the Development and agreed with the Planning Authority prior to decommissioning works being undertaken. The plan will include any measures required to protect ecological features during decommissioning which are likely to be similar to those proposed within the CEMP.

7.5.9 Data Gaps and Uncertainties

There are no known data gaps or uncertainties.

7.6 Assessment of Potential Effects

A summary of the evaluation of the importance of habitats and species recorded within the Freshwater Ecology Study Area during baseline surveys is provided in **Table 7.9**.

Table 7.9: Evaluation of the level of Important Ecological Features Identified for Freshwater Ecology

Importance	Ecological Feature(s)	Justification
Very High	Atlantic salmon Freshwater pearl mussel	River Naver SAC (of which the River Vagastie is a part of) is adjacent to the site and hosts internationally important populations of species listed under Annex II of the Habitats Directive: • Atlantic salmon; and • Freshwater pearl mussel.

Importance	Ecological Feature(s)	Justification
		It is possible that salmon may use watercourses within the vicinity of the site to breed or for migratory purposes, so potential impacts from the proposed development may have an effect on this species. It is possible that construction activities may result in pollution of watercourses which feed into River Naver SAC downstream of the proposed development, which may have effects on Atlantic salmon or freshwater pearl mussels.
High	None	None
Medium	Brown/sea trout Eels	Brown/sea trout and eels are listed as a priority species under the Scottish Biodiversity List (SBL) and may use the watercourses within the vicinity of the site to breed or for migratory purposes, so potential impacts from the proposed development may have an effect on these species. Trout are also protected under the Salmon Act 2003.
Low	None	None
Negligible	None	None

7.6.1 Designated Sites

Consultation and a search of available digital datasets indicates that the River Vagastie, which is part of the River Naver Special Area of Conservation (SAC), falls within the southern part of the application site boundary and adjacent to it. **Table 7.10**provides details of statutory designations related to freshwater ecology within 5km of the site and shown in **Figure 7.3**. Full citations for statutory designated sites can be requested from Caledonian Conservation Ltd or can be obtained at https://sitelink.nature.scot/home.

Table 7.10: Designated Sites

Designation	Site name	Distance (km)	Comments
SAC	River Naver	Adjacent	Designated for important populations of: • Freshwater pearl mussel (*Margaritifera margaritifera*); and • Atlantic salmon (*Salmo salar*).

7.6.2 Habitats and Species Not Taken Forward to the Assessment Phase

Freshwater Pearl Mussel

Surveys were undertaken in 2012 for freshwater pearl mussels (*Margaritifera margaritifera*) in support of the original CRWF Planning Application, none were found, and they were subsequently scoped out. As a

result of this, they have also been scoped out from this EIA Report. In addition, the implementation of the embedded mitigation (**Section 7.5.8**), would also protect any mussels further downstream within the River Naver SAC.

Lamprey

Lamprey, brook, river and sea (Lampetra planeri, *Lampetra fluviatilis, Petromyzon marinus)* have not been recorded within or in the vicinity of the site during the baseline monitoring surveys, and information provided during the CRWF Planning Application from Richard Wright, formerly River Naver Fisheries, was that they are not present in the Vagastie. While the presence of any migratory fish species cannot be definitively ruled out, cascades further downstream mean habitats within the study area are potentially unoccupied. However, the embedded mitigation (**Section 7.5.8**) would protect lamprey should they have established in the area and therefore, have been scoped out from further assessment for this EIA Report.

7.6.3 Habitats and Species Taken Forward to the Assessment Phase

Results from the desk study and all relevant field surveys have been compiled to produce baseline descriptions for each species of a low or higher level of importance recorded within the survey area. Features are described in order of importance level, with those of greatest importance considered first.

To avoid repetition, where potential effects on ecological features of the same level of importance are likely to be similar due to similarities in ecology and/or distribution, they are assessed as a group, rather than separately for each feature.

7.6.4 Ecological Features of Very High Importance

Atlantic salmon

Atlantic salmon is a designated feature of the River Naver SAC. The River Vagastie, which runs adjacent to the site, forms part of this designation. They are also protected under Salmon Act and are an SBL priority species. Their abundance has declined markedly since the 1970s (NASCO, 2019)[9]. Atlantic salmon is therefore considered to be of very high importance.

Atlantic salmon is an anadromous migratory species, i.e., adults migrate from the sea to reproduce in freshwater, with a complex life cycle (e.g., Armstrong *et al.,* 2003)[10]. After they return from the sea, adults gather in areas of suitable habitat (accumulations of coarse mobile substrates in shallow, fast water) to spawn in excavated nests called redds in winter (normally late November to January). Most adults die, but some return to the sea as kelts during late winter and spring. After a period of time, typically related to total cumulative temperature, the ova hatch and alevins emerge in spring (usually April/May). The next phase involves 'swim-up', where the fry emerges from the interstitial spaces and become free-swimming in early summer. After the first winter, during which many fry have moved to winter habitats, they become parr.

9 NASCO (2019), State of North Atlantic Salmon.

10Armstrong, J., Kemp, P., Kennedy, G., Ladle, M. & Milner, N. (2003), Habitat requirements of Atlantic salmon and brown trout in streams. Fisheries Research 62, 143-170.

Depending on several factors, following one to six winters, parr undergo an endocrinological-driven change (Bjornsson *et al.,* 2011)[11] where they begin the transition to a marine physiology and migrate to sea as smolts. Smolt migration occurs usually from mid-March to mid-April.

Each of the life history stages presented here has a defined habitat and temporal niche. This means that during an EIA process where Atlantic salmon may be subject to impacts, each individual stage requires consideration, and impacts which affect any of these stages have the potential to impact an entire cohort, depending on the scale of that impact.

Baseline

The River Vagastie is classified by the Scottish Environment Protection Agency (SEPA) for WFD regulatory purposes as a Water Body (WB), ID: 20609. The WB has been designated as heavily modified on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation. It is listed as having *Moderate Overall Status* with *Moderate* status for Ecology, Hydrology, Fish and Fish Barrier, and Water Quality listed as *Good*.

There are three identified obstacles on the SEPA barriers database available on the Marine Scotland Science (MSS) map portal NMPi (MSS, 2021a)[12]. A passable man-made barrier on the River Vagastie just by the Bridge of Vagastie on the A836 at the southern end of the proposed development and two man-made impassable barriers on tributaries within the upper catchment linked with the diversion of water to the Shin catchment as part of the Loch Shin hydro-electric scheme, however, these would not affect fish passage in the vicinity of the proposed development.

The salmonid distribution database available on the MSS map portal NMPi (MSS, 2021b)[13] indicates that salmon are "Present" in the lower reaches of the River Vagastie, which encompasses the area adjacent to the proposed development.

Baseline surveys were undertaken between 2012-2018, to support the CRWF application and subsequently as part of the 'Creag Riabhach Windfarm; Windfarm *c*onstruction and operational Fish Management Plan' (FMP) (Caledonian Conservation Ltd and Forth Rivers Trust, 2018). Four of the ten monitoring sites identified within the FMP are on the River Vagastie (see **Figure 7.4**). The results of the baseline surveys indicated that the lower reaches of the Vagastie (particularly VAG01) support populations of salmonids, indicating its importance for spawning and a nursery area for salmon. Macroinvertebrate surveys were also undertaken, and the results indicated *very good* water quality at three of the four Vagastie sites and *good* at one Vagastie site (VAG03).

11Bjornsson, B., Stefansson, S. & McCormick, S. (2011), Environmental endocrinology of salmon smoltification. 2011. General and comparative Endocrinology 170, 290-298.

12 Marine Scotland Science. (2021a), SEPA barrier database. Available online at: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=1746

13 Marine Scotland Science. (2021b), National Electrofishing Programme for Scotland data app. Available online at: https://scotland.shinyapps.io/sg-national-electrofishing-programme-scotland/

An additional habitat survey was undertaken in 2022 at two sites, E01 and E02, on the River Vagastie, as shown in **Figure 7.2**. This was done to support and augment the baseline monitoring surveys undertaken for the CRWF Planning Application. This additional walkover was used to assess the quantity and quality of available habitat for the sensitive receptors at these two locations that could be influenced by the potential effects of the proposed development.

The river runs through open moorland with no riparian cover to provide shade to keep the river cool in hot summer temperatures. The lack of trees means no in-stream large woody debris, which would add to the dynamics of the river, potentially offering opportunities for more salmonid spawning habitat and increased resilience to climate change by creating deeper water pools and direct shade.

The survey undertaken at E01, to the east of the proposed development has habitat consistent with salmonid spawning in several areas, with redd areas (salmon spawning nests) still evident. The baseline monitoring surveys for the CRWF (McDermott, 2018, 2019) also indicate the presence of salmon further downstream of the survey extent. Therefore, it should be assumed that migratory salmon are likely to be present.

The survey undertaken in the upper reach of the Vagastie (E02) was dominated by bedrock, boulder and cobble with little habitat suitable for spawning apart from just one recorded area in the upstream extent of the survey area. However, the surveys undertaken as part of baseline monitoring indicate the presence of salmon both up and downstream of this survey extent, and it should be assumed that they could be migrating through this section and also availing of the limited habitat within these locations.

It should therefore be considered that works have the potential to impact the habitat, and migration and spawning activities of Atlantic salmon.

Potential Construction Effects

Atlantic salmon could be impacted in several ways by construction activities; mortality, damage to habitat for spawning and nursery and interruptions to migration.

The tributaries within the site are considered too steep to support salmon. However, potential indirect impacts of construction activities within or affecting these tributaries would be conveyed downstream to the sensitive habitats in the River Vagastie which does support this species.

The main risks are fine sediment run-off and pollution. There is the potential for accidental release of silt, hydrocarbons, concrete leachate, acidity from disturbed peat etc., which could result in fish mortality, including fish eggs within redds. Atlantic salmon fry are unlikely to attempt to swim away from pressure, preferring to take cover as a behavioural response to pressures. Therefore, salmon ova, alevins and fry that are present would be sensitive to pollutants with no or little ability to react appropriately. Without mitigation and depending on the magnitude of the event, it could lead to a medium level of impact that is unlikely to affect the long-term ecological integrity of the species. However, with the implementation of the embedded mitigation (**Section 7.5.8**), compliance with pollution control guidance, 50m buffer zones for watercourses including for storage of material and the timing of works to avoid spawning and incubation times of year (see Table 7.6, **Section 7.5.2**) the magnitude of indirect effects would be negligible and are therefore, **no significant effect** is predicted..

These pollutants could also cause damage to key freshwater habitats for the different life history stages of salmon. They are dependent on the availability of quality habitats for all parts of their life history stages, e.g., accumulations of clean, mobile, coarse substrates for spawning, presence of cover from predators, and refuge habitats to avoid extreme climate events. The works also have the potential to destabilise the banks of the tributaries, which could lead to changes in local channel morphology, leading to impacts on habitat availability and quality in the Vagastie. However, as older salmonids are mobile, they can avoid temporary disturbances. Juvenile fish are less mobile and likely to be more affected. At the reach scale and above, the total area of the channel potentially impacted would be minor. Therefore, there is some tolerance to recover and adapt to temporary impacts on their habitat and the impact is likely to be low. The implementation of the embedded mitigation (**Section 7.5.8**), particularly timing works to avoid spawning and incubation periods, means that these impacts are unlikely, and therefore effects are expected to be negligible and therefore **no significant effect** is predicted**.**

Pollutants could also affect salmon migration through the river system for spawning, feeding and refuge purposes. Migrations are not solely the preserve of adults with seasonal (e.g., overwintering), age-dependent and salmonid smolt/lamprey transformer transitions to the marine environment, demonstrating the overwhelming role of migration in native fish species ecology. There would be no direct barriers to the Vagastie during the construction phase as it lies outside the site boundary, however, pollution events can also act as a barrier and impede fish passage. The wide window for certain migrations (e.g., river entry or smolt migration), which are often delayed naturally, suggests some resilience of salmon from temporary barriers, and there is some tolerance to recover and adapt to temporary impacts to their passage and the impact is therefore considered to be low. The risk would be minimised by undertaking work to avoid the most sensitive times, and along with the implementation of other embedded mitigation, the effects would be negligible and therefore, **no significant effect** is predicted.

Potential Operational Effects

The potential effects from the operation and maintenance phase of the proposed development to the mortality of Atlantic salmon are much less than the construction phase. There is also less potential for freshwater habitats to be damaged or for fish passage to be impacted. The main risks would be run-off and pollution from any maintenance activities in the vicinity of the three tributaries that could be conveyed to the Vagastie. As routine maintenance works during operation are likely to be infrequent and small-scale, and with the implementation of the embedded mitigation along with the ongoing monitoring required, effects would be negligible and therefore **no significant effect** is predicted.

Potential Decommissioning Effects

Potential decommissioning effects are considered likely to be of the same nature as construction effects. The relevant mitigation described under Construction Effects would also be applied during decommissioning, and therefore **no significant effect** is predicted.

However, as a precautionary measure, the Decommissioning Plan would be developed during the decommissioning phase to ensure no effects on this species. The decommissioning would occur at the same time as CRWF.

Potential Cumulative Effects

As no measurable negative effect is predicted, **no cumulative effects** are predicted**.**

Potential Transboundary Effects

Impacts on Freshwater Ecology would be localised, and no pathway for transboundary effects has been identified, therefore, **no transboundary effects are predicted**.

Impact

No significant impacts are predicted on this Important Ecological Feature.

7.6.5 Ecological Features of Medium Importance

Sea/brown trout and eels are of the same conservation value, subject to effects of the same nature, and so are assessed together.

Trout

Sea trout and brown trout are the same species, with the designation used to describe variations in life history. These life-history variations are not discrete and occur along sexual, age and resource availability gradients. However, as an anadromous salmonid, sea trout have the same legal protection as Atlantic salmon under the Salmon Act. Sea/brown trout are listed as an SBL priority species. They are therefore considered to be of medium importance.

Brown trout are a ubiquitous salmonid fish naturally occurring in all rivers in Scotland. The species represents a complex range of life history traits grounded in a mosaic of genetic diversity, founder populations, and lineages (McKeown *et al.,* 2010)[14]. Like salmon, they are freshwater spawners (Klemetsen *et al.,* 2003)[15] and demonstrate a similar life history pattern – rheophillic (preference for fast moving water) spawning with interstitial (water-filled space within riverbed substrate) incubation within redds; emergence as alevins (larvae) while remaining within the river substrate followed by free-swimming fry and a parr stage. However,

14 McKeown, N., Hynes, R., Duguid, A., Ferguson, A, & Prodohl, P. (2010), Phylogeographic structure of brown trout Salmo trutta in Britain and Ireland: glacial refugia, postglacial colonisation and origins of sympatric populations. Journal of Fish Biology 76, 319-347.

15 Klemetsen, A., Amundsen, P.A., Dempson, J., Jonsson, B., Jonsson, N., O'Connell, M, & 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 history. Ecology of Freshwater Fish 12, 1-59.

unlike Atlantic salmon, smoltification is not required by all fish, and the overwhelming majority of trout remain in freshwater. Brown trout do not normally die after spawning.

All brown trout do undertake some measure of migration to spawn; from loch to river, within rivers and from sea to river. The latter group are known as sea trout, and these are the most important group from the EcIA perspective because, as an anadromous salmonid, sea trout have the same legal protection as an Atlantic salmon under the Salmon Act.

At the fry and parr stage, and indeed after returning adults have 'coloured up' (losing their silver colour and taking the classic, spotted, dark freshwater marking) during their freshwater return, sea trout are indistinguishable from resident brown trout, and they may demonstrate an identical genome with only variation in expression leading to distinct life history behaviours (Amstutz *et al.,* 2006)[16]. It is, therefore, not possible to establish with absolute certainty whether a given trout is a sea trout or resident brown trout based on observation. This is an important consideration given the legal protection afforded to the anadromous variants.

Resident brown trout which do not migrate to saline environments are not afforded such measures of protection; however, locally, they may evolve into distinct 'types' of local and cultural importance. Their exploitation and capture are reserved under the Salmon Act.

European Eel

The European eel is an SBL priority species and is listed as *Critically Endangered* (Jacoby & Gollock, 2014)[17] on the IUCN Red List of Threatened Species. They are protected under The Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008 and are also protected by measures relating to previous compliance with Council Regulation (EC) No 1100/2007 - *Establishing measures for the recovery of the stock of European eel.* An eel management plan has been produced for Scotland (DEFRA, 2010)[18] in support of this regulation. Eels are therefore considered to be of medium conservation importance.

Up-to-date information on their distribution and abundance in Scotland is sparse, and despite their extensive presence within the Scottish faunal list, very basic elements of their ecology and behaviour are still only being uncovered (e.g., Wright *et al.,* 2022)[19].

16 Amstutz. U., Giger, T., Champigneulle, A., Day, P, &.Largiadèr, C.R. (2006), Distinct temporal patterns of Transaldolase 1 gene expression in future migratory and sedentary brown trout (Salmo trutta). Aquaculture 260, 326-336.

17 Jacoby, D. & Gollock, M. (2014), Anguilla anguilla. The IUCN Red List of Threatened Species 2014.

18 DEFRA (2010), Eel Management plans for the United Kingdom: Scotland River Basin District. Department for Environment, Food and Rural Affairs Commissioned Report. DEFRA.

19 Wright, R.M., Piper, A.T., Aarestrup, K., Azevedoe, J.M.N., Cowan, G., Don, A., Gollock, M., Ramallo, S.R., Velterop, R., Walker, A., Westerberg, H. & Righton, D. (2022), First direct evidence of adult European eels migrating to their breeding place in the Sargasso Sea. Scientific Reports 12, 1562-1568.

They are widely distributed within European freshwaters and can be found in a range of habitats from small streams, large rivers, lakes, estuaries and coastal waters. They are catadromous - living in fresh, brackish and coastal waters, but migrating to the Sargasso Sea to breed. Their decline is due, in part, to anthropogenic activities, including barriers to migration and pollution. Their distribution in Scotland is poorly understood, and they are often only an incidental catch in standard fish monitoring surveys.

European eel is a complex species. A review by van Ginneken & Maes, (2005)[20] consolidates much of the known information; however, Wright *et al*., (2022) demonstrate that much information remains to be uncovered. Following hatch, the leptocephali larvae use a range of currents to return to Europe, taking eight to nine months. They metamorphose into glass eel and migrate up rivers in spring and early summer, attracted by olfactory cues. Their entry is influenced by the tide and lunar cycles and is easily observed. After 6 to 10 years as yellow eels, they transition into pre-mature silver eels, migrate downstream and to their spawning areas in the Sargasso, where they breed and die.

Baseline

The findings of the desktop study and field survey described above for Atlantic salmon also apply to trout.

Spawning habitat was recorded in the Vagastie that could be used by trout as well as salmon, and the survey undertaken as part of baseline monitoring for the CRWF (McDermott, 2018, 2019) indicates the presence of both salmon and trout up and downstream of the survey extent.

It should, therefore, be considered that works have the potential to impact the habitat and migration and spawning activities of sea/brown trout.

In addition, eels have also been recorded during the baseline monitoring surveys and should also be assumed to be present or accessing the site for migration purposes.

Potential Construction Effects

The potential construction effects identified for Atlantic salmon above also apply to sea/brown trout and will, therefore, not be repeated here. The main risks are run-off and pollution that could result in mortality, damage to habitat for spawning and nursery and interruptions to migration. Without mitigation and depending on the magnitude of the event, it could lead to a medium level of impact that is unlikely to affect the long-term ecological integrity of the species.

As eels spawn at sea, the main risk to eels is interruptions to their migration or feeding habitats, and prey mortality. Without mitigation and depending on the magnitude of the event, it could lead to a low level of impact that is unlikely to affect the long-term ecological integrity of the species.

20Van Ginneken, V.J.T & Maes, G.E. (2005), The European eel (Anguilla anguilla, Linnaeus), its lifecycle, evolution and reproduction: a literature review. Rev Fish Biol Fisheries 15,367-398.

However, with the implementation of the identified embedded mitigation (**Section 7.5.8**), these impacts are unlikely to occur for sea/brown trout and eel, and therefore effects are expected to be negligible and therefore **no significant effect** is predicted.

Potential Operational Effects

The potential effects from the operation and maintenance phase of the proposed development to the mortality of sea/brown trout and eel are much reduced from the construction phase. There is also less potential for freshwater habitats to be damaged or for fish passage to be impacted. The main risks would be run-off and pollution from any maintenance activities in the vicinity of the three tributaries that could be conveyed to the Vagastie. As routine maintenance works during operation are likely to be infrequent and small-scale, and with the implementation of the embedded mitigation along with the ongoing monitoring required, effects would be negligible and therefore **no significant effect** is predicted.

Potential Decommissioning Effects

Potential decommissioning effects are considered likely to be of the same nature as construction effects. The relevant mitigation described under Construction Effects would also be applied during decommissioning, and therefore **no significant effect** is predicted.

However, as a precautionary measure, the Decommissioning Plan would be developed during the decommissioning phase to ensure no effects on these species. The decommissioning would occur at the same time as CRWF.

Potential Cumulative Effects

As no measurable negative effect is predicted, **no cumulative effects** are predicted**.**

Potential Transboundary Effects

Impacts on Freshwater Ecology would be localised, and no pathway for transboundary effects has been identified, therefore, **no transboundary effects are predicted**.

Impact

No significant impacts are predicted on these Important Ecological Features.

7.7 Habitat Management and Monitoring

As part of the original CFWF development a Fish Management Plan, ‘Creag Riabhach Windfarm; Windfarm construction and operational Fish Management Plan’ (FMP) (McDermott, 2018), was produced to establish

a monitoring programme for the construction and operational phases of the project (**Technical Appendix 7.2**).

The existing FMP would be amended to integrate the monitoring requirements for the proposed development. Standard family-level benthic macroinvertebrate surveys, annual fully quantitative electrofishing surveys and post-construction walkovers should be undertaken and compared to the baseline set in 2018-2019.

7.8 Summary of Residual Impacts

Table 7.11 details the predicted effects after mitigation has been considered. As decommissioning activities are of a similar type and intensity as construction activities, the assessment considers that potential effects of decommissioning would be of a similar nature to the potential effects of construction. In the case of the proposed development, mitigation measures during construction would also apply to the decommissioning phase and so are not repeated. This is likely to be precautionary as, in practice, many of the decommissioning effects are likely to be of a smaller scale than the construction effects. **Table 7.101** summarises the effects of all impacts assessed alongside mitigation.

Table 7.11: Summary of Significant Residual Freshwater Ecology Effects Following Mitigation

Phase	Receptor	Importance	Description of Change	Mitigation Measure	Magnitude of Change	Nature of Change			
						Positive or Negative	Permanent or Temporary	Reversible or Irreversible	Residual Significance
Construction	Atlantic salmon	Very High	Potential fine sediment run-off and other pollutants entering the watercourse which could lead to salmon mortality, damage to their spawning and nursery habitats and interrupt their migration. Creation of physical barriers would also affect migration.	Implementation of embedded mitigation: Including compliance with pollution prevention plan, drainage plan, emergency protocols, CAR licencing, the timing of works to avoid sensitive migration, spawning and incubation periods, Fish Monitoring Plan.	Negligible	Negative	Temporary	Reversible	Not significant
	Sea/brown trout and European eel	Medium	Potential fine sediment run-off and other pollutants entering the watercourse which could lead to salmon mortality, damage to their spawning and nursery habitats and interrupt their migration. Creation of physical barriers would also affect migration.	Implementation of embedded mitigation: Including compliance with pollution prevention plan, drainage plan, emergency protocols, CAR licencing, the timing of works to avoid sensitive migration, spawning and incubation periods, Fish Monitoring Plan.	Negligible	Negative	Temporary	Reversible	Not significant
Operation and maintenance	Atlantic salmon	Very High	Potential find sediment run-off and other pollutants entering the watercourse which could lead to salmon mortality, damage to their spawning and nursery habitats and interrupt their migration. Creation of physical barriers would also affect migration.	Implementation of embedded mitigation: Including compliance with pollution prevention plan, drainage plan, emergency protocols, CAR licencing, the timing of works to avoid sensitive migration, spawning and incubation periods, Fish Monitoring Plan.	Negligible	Negative	Temporary	Reversible	Not significant
	Sea/brown trout and European eel	Medium	Potential fine sediment run-off and other pollutants entering the watercourse which could lead to salmon mortality, damage to their spawning and nursery habitats and interrupt their migration. Creation of physical barriers would also affect migration.	Implementation of embedded mitigation: Including compliance with pollution prevention plan, drainage plan, emergency protocols, CAR licencing, the timing of works to avoid sensitive migration, spawning and incubation periods, Fish Monitoring Plan.	Negligible	Negative	Temporary	Reversible	Not significant

7.9 Statement of Significance

An assessment has been made of the likely effects of the proposed development during the construction, operation and decommissioning stages. It is concluded that provided best practice is followed to avoid disturbance to protected species, pollution, run-off, sedimentation and other potential environmental effects during construction, there would be no likely significant effects on any Freshwater Ecology important ecological feature. Mitigation is recommended to minimise potential effects on the important ecological features identified. After mitigation is considered, the effect on important ecological features is assessed as not significant.

The FMP would be implemented to monitor the effects of the proposed development and inform on the effectiveness of the mitigation and amend if deemed necessary.

Climate change is widely accepted as the cause of some adverse ecological events, and predictions indicate that declines will occur in many habitat types and ecological taxa. Furthermore, *Scottish Biodiversity Strategy 2022 to 2045. Tackling the Nature Emergency in Scotland,* recognises the important role of renewable energy in tackling this crisis whilst emphasising the importance of halting and reversing biodiversity loss. It is also important in the decision-making process to consider the positive contribution that the proposed development would have in tackling the issue of climate change.

7.10 References

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