

## **Chapter 12: Aquatic Ecology**

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### **Appendices**

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Appendix 12.2: Allt a' Coire Glas Freshwater Invertebrate Survey 2011

## Glossary of Terms

Acidification	To make or become acid.
Acidity	The state, quality, or degree of being acid.
Algal/cyanobacterial blooms	A rapid growth of microscopic algae or cyanobacteria in water, often resulting in a coloured scum on the surface.
Alkalinity / Buffering Capacity	The capability of water to neutralise acid. This is really an expression of buffering capacity. A buffer is a solution to which an acid can be added without changing the concentration of available h+ ions (without changing the pH) appreciably.
Armouring	A phenomenon in gravel bed rivers that have been subject to periods of extended low flows. Coarsening creates a bed surface where greater intergranular friction angles increase the surface stability and the stress necessary to entrain the bed.
Biodiversity	The diversity of life.
Bryological	Relating to bryophytes (mosses and liverworts).
Bryologist	A person who studies bryophytes (mosses and liverworts).
Bryophyte	Bryophytes are an informal group consisting of three divisions of non-vascular land plants (embryophytes); the liverworts, hornworts and mosses.
CIEEM	Chartered Institute of Ecology and Environmental Management.
Circum-neutral	Nearly neutral (having a pH between 6.5 and 7.5).
Compensation Flow	Water released from a dam to maintain a flow of water down a watercourse.
Conductivity	A measure of a solution's ability to conduct electricity. The unit of conductivity is siemens per metre.
Construction Environmental Management Plan (CEMP)	A document detailing measures to be followed during construction of a development to ensure that it is built in an environmentally sensitive manner.
Drift	In running water the current may cause invertebrate animals that live on the bottom to be dragged from where they are attached and pushed downstream.
Ecosystem	A community of living organisms in conjunction with the non-living components of their environment.
EcIA	Ecological Impact Assessment
ECoW (Ecological Clerk of Work)	An ecological consultant employed to monitor construction works and advise of any ecological sensitivities and suggest appropriate methods and measures to minimise effects.
Effect or Residual Effect	As the consequences for the receptor of an impact after mitigation measures have been taken into account.
Eutrophic	A waterbody rich in nutrients and plant life and poor in oxygen.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.
Flush	An area where water from underground flows out onto the surface to create an area of saturated ground, rather than a well-defined channel.
Humid	Marked by a relatively high level of water vapour in the atmosphere.
Hydromorphology	A term used in river basin management to describe the hydrological (water flow, energy etc.) and geomorphological (surface features) processes and attributes of rivers and lakes.
Hygrophilous	(Of a plant) growing in moist places.
IEF	Important Ecological Feature.
Impact	A change experienced by a receptor (this can be positive, neutral or negative).

IUCN Red Data Book	The IUCN Red List of Threatened Species, founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. The International Union for the Conservation of Nature is the world's main authority on the conservation status of species.
Lentic	Still, fresh water.
Littoral	Relating to or situated on the shore of a lake, where photosynthesis is possible.
Macroinvertebrate	An invertebrate is an animal that neither possesses nor develops a vertebral column (commonly known as a backbone or spine). A macroinvertebrate is an invertebrate that can be seen with the naked eye.
Macrophyte	A plant (typically aquatic) which is visible to the naked eye.
Mollusc	An invertebrate of a large phylum which includes snails, slugs, mussels, and octopuses. They have a soft unsegmented body and live in aquatic or damp habitats, and most kinds have an external calcareous shell.
Nutrient	Any substance that nourishes an organism.
Oceanic	A climate governed by the proximity of the ocean.
Oligotrophic	A waterbody poor in nutrients and plant life and rich in oxygen.
Organic	Involving organisms or the products of their life processes.
Phytoplankton	The self-feeding components of the plankton community. The name comes from the Greek words phyton, meaning plant, and planktos, meaning wanderer or drifter. Most phytoplankton are too small to be individually seen with the naked eye.
Priority Habitat	UK priority habitats cover a wide range of semi-natural habitat types, and were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP).
Profundal	Relating to regions of the water and bed of a lake where light penetration is insufficient to sustain photosynthesis.
Ravine	A deep, narrow gorge with steep sides.
Red data lists / Red Lists	Lists of threatened species based on criteria identified by International Union for Conservation of Nature (IUCN).
Scoping Opinion	The written opinion of the determining authority as to the scope and level of detail of information to be provided in an EIA report.
Semi-natural	Partly natural and partly cultivated.
SEPA (Scottish Environment Protection Agency)	A non-departmental public body tasked with the protection of the environment and human health in Scotland.
SNH (Scottish Natural Heritage)	The body responsible for promoting, caring for and improving natural heritage in Scotland, and advising Government on natural heritage issues.
Spring	A natural source of water.
Superficial Geology	Appearing on the surface (soils).
Taxon	A group of any rank, such as a species, family, or class.
Taxonomic	Concerned with the classification of things, especially organisms.
Topography	The arrangement of the natural and artificial physical features of an area.
Toxic	Poisonous.
Trophic Status	On the scale between oligotrophic (a waterbody poor in nutrients and plant life and rich in oxygen) and eutrophic (a waterbody rich in nutrients and plant life and poor in oxygen).
Turbid	Cloudy, opaque, or thick with suspended matter.
UK BAP (UK Biodiversity Action Plan)	A UK-wide plan outlining objectives for the improvement of biodiversity which identifies priority species and habitats as a focus for conservation and enhancement.
Zone of Influence	The area over which ecological features may be subject to significant effects as a result of a proposed development and associated activities.



## 12 Aquatic Ecology

### 12.1 Executive Summary

- 12.1.1 The scope of the assessment on aquatic ecology covers impacts on the macroinvertebrate communities in Loch a' Choire Ghlais and Allt a' Choire Ghlais, and impacts on bryophytes in Kilfinnan Burn. Survey work carried out for the previous development has been re-used. A field visit to Allt a'Choire Ghlais and Kilfinnan Burn was made in September 2017 to confirm that there were no obvious changes to the baseline conditions and that the previous survey findings were valid. Where survey work was not carried out, desk study information was used to support the assessment. Prediction of the future baseline with regard to climate change has been taken into account.
- 12.1.2 The macroinvertebrate communities in Loch a' Choire Ghlais and Allt a' Choire Ghlais are of Less than Local importance in their own right but they provide food for the resident brown trout population. The bryophyte communities in Kilfinnan Burn are categorised as A (the highest level of categorisation) by Scottish Natural Heritage (SNH) as the site has a rich, nationally/internationally important flora of uncommon hygrophilous bryophyte species. However, as there are no IUCN Red Data Book species that are globally Vulnerable, Endangered or Critically Endangered present, the site is not considered to be internationally important but nationally important.
- 12.1.3 The Proposed Development would comprise two main activities during the construction phase that could potentially result in significant negative impacts on aquatic ecology. These are the construction of the dam and upper reservoir in Coire Glas, and the use of site establishment and lay down areas. The Proposed Development would comprise three main activities during the operational phase that could potentially result in significant negative impacts. These are water level changes in the upper reservoir, changes in water flow and sediment transport in the Allt a' Choire Ghlais/Kilfinnan Burn, and mixing of Loch Lochy and Loch a' Choire Ghlais waters in the respective waterbodies and in Allt a' Choire Ghlais/Kilfinnan Burn.
- 12.1.4 Construction techniques and methodologies would be fully incorporated into a Construction Environmental Management Plan (CEMP) (including a Pollution Prevention Plan) and be fully developed prior to construction. An Ecological Clerk of Works (ECoW) would be employed during construction.
- 12.1.5 Significant negative effects during the construction phase are predicted on macroinvertebrate communities of Less than Local importance in Loch a' Choire Ghlais and Allt a' Choire Ghlais from habitat change due to construction of the dam and upper reservoir. No mitigation is possible. The impact of habitat change would be permanent and of major magnitude for Loch a'Choire Ghlais and moderate magnitude for Allt a'Choire Ghlais. Confidence in these predictions is high.
- 12.1.6 Significant negative effects during the construction phase are predicted on macroinvertebrate communities of Less than Local importance in Loch a' Choire Ghlais and Allt a' Choire Ghlais from pollution due to construction of the dam and upper reservoir. With effective mitigation under the CEMP, temporary pollution events would be avoided and/or reduced in severity. Confidence in these predictions is intermediate.

12.1.7 Significant negative effects during the operational phase are predicted on macroinvertebrate communities of Less than Local Importance in Loch a' Choire Ghlais and Allt a' Choire Ghlais from changes in water level in the upper reservoir and from the new flow regime. No mitigation is possible. The magnitude of these impacts is major and moderate respectively, however, confidence in these predictions is intermediate.

12.1.8 Significant negative effects during the operational phase are predicted on bryophyte communities of National importance in Kilfinnan Burn from the new flow regime. No mitigation is possible. The magnitude of this impact is moderate, however, confidence in this prediction is low, due to lack of scientific evidence.

## **12.2 Introduction**

12.2.1 EnviroCentre Limited was commissioned to undertake an Ecological Impact Assessment (EclA) of The Proposed Development, in order to identify and describe any likely significant effects arising from it. This Chapter details the specialist studies undertaken and the results of the assessment on aquatic ecology. The assessment has been carried out according to the latest guidance from the Chartered Institute of Ecology and Environmental Management (CIEEM) by experienced and competent ecologists who are all Members of CIEEM and follow its Code of Professional Conduct. The assessment of the impacts of The Proposed Development on fish is provided separately, in Chapter 13: Fish.

12.2.2 Figure 1.1: Scheme Location shows the site boundary, which is referred to as 'the site' throughout this chapter. Details of the site and The Proposed Development are provided in Chapter 3: Description of Development. Ecological surveys were carried out within specific areas, which are referred to as 'the survey areas' in this Chapter.

12.2.3 The purpose of this Chapter is to:

- Identify and describe all potentially significant ecological effects associated with The Proposed Development;
- Set out the mitigation measures required to ensure compliance with nature conservation legislation and to address any potentially significant ecological effects;
- Identify how mitigation measures would be secured;
- Provide an assessment of the significance of any residual effects; and
- Set out the requirements for post-construction monitoring.

## **12.3 Scope of Assessment**

### Zone of Influence

12.3.1 The CIEEM Guidelines identify the zone of influence as the area over which ecological features may be subject to significant effects as a result of a proposed development and associated activities. This is likely to extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundaries. Activities associated with the construction, operation (best and worst-case operating conditions), decommissioning and restoration phases should be separately identified. The zone of influence will vary for different ecological features depending on their sensitivity to an environmental change. It may be appropriate to identify different zones of influence for

different features. The features affected could include habitats, species, and ecosystems and the processes on which they depend.

- 12.3.2 The scoping exercise narrowed down the important ecological features. The zone of influence has been set for each one (see Table 12.1 below).

**Table 12.1: Important Ecological Features and Zones of Influence**

Important Ecological Feature	Zone of Influence
Macroinvertebrate communities	Loch a' Choire Ghlais and Allt a' Choire Ghlais
Bryophyte communities	Kilfinnan Burn

#### Scoping and Consultation

- 12.3.3 A scoping exercise was carried out and a Scoping Report submitted to the Scottish Government Energy Consents Unit in May 2017. A Scoping Response was received in July 2017, confirming the proposed scope of the aquatic ecology assessment. Relevant scoping responses are presented in Table 12.2 below (excluding those that refer to water quality in general terms).

**Table 12.2: Scoping Responses**

Consultee	Summary Response	Comment/Action Taken
Scottish Environment Protection Agency (SEPA)	Should the applicant choose not to twin-track their applications then the following details must be included in the planning submission to allow us to provide an indication of the potential consentability of the proposal under CAR (Controlled Activity Regulations):  Sensitive water uses, water dependent species (including bryophytes) and ecosystems.	Impacts on bryophytes are covered in this chapter.

- 12.3.4 The final scope of the impact assessment on aquatic ecology is listed in the points below. As set out in the Revised Coire Glas Pumped Storage Scheme Scoping Report (May 2017), survey work carried out for The Consented Development has been re-used. Where survey work was not carried out, desk study information was used to support the assessment. The construction and operation phases of The Proposed Development are covered in the assessment of impacts but the decommissioning phase is excluded, as The Proposed Development can remain operational indefinitely.

- Impacts on macroinvertebrate communities in Loch a' Choire Ghlais and Allt a' Choire Ghlais; and
- Impacts on bryophytes in Kilfinnan Burn.

- 12.3.5 In agreement with SEPA and Scottish Natural Heritage (SNH), a number of impacts were scoped out of the Environmental Statement (ES) prepared for The Consented Scheme in 2012. It is proposed to continue to scope these out for this Environmental Impact Assessment (EIA) Report:

- Impacts on South Laggan Fen Site of Special Scientific Interest (SSSI);
- Impacts on aquatic macrophytes (higher plants);

- Impacts on freshwater pearl mussel (survey work of the affected watercourses in 2010 located very little suitable habitat and found no mussels);
- Impacts on great crested newts and other amphibians;
- Impacts on phytoplankton;
- Impacts of Invasive Non Native Species (INNS); and
- Cumulative impacts in connection with other planned developments.

## **12.4 Policy, Legislation & Guidance**

12.4.1 The compilation of this Chapter has taken cognisance of the following legislation, conservation initiatives and general guidance:

- Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (2011 Directive);
- Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (2014 EIA Directive);
- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000;
- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Planning Circular 3 2011: The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy (The Water Framework Directive (WFD));
- The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR);
- Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (The Habitats Directive);
- The Conservation (Natural Habitats, &c.) Amendments (Scotland) Regulations 2007 (The Habitats Regulations);
- The Wildlife and Countryside Act 1981 (as amended) (WCA);
- The Nature Conservation (Scotland) Act 2004 (NCA);
- The Wildlife and Natural Environment (Scotland) Act 2011 (WANE);
- BS 42020:2013: Biodiversity Code of Practice for Planning and Development 2013;
- The Scottish Biodiversity Strategy 2004 and 2013;
- The Lochaber Biodiversity Action Plan (LBAP) 2004;
- Scottish Planning Policy (SPP) 2014;
- Planning Advice Note (PAN) 1/2013: Environmental Impact Assessment;
- PAN 50: Controlling the Environmental Effects of Surface Mineral Workings in Relation to Surface Water;



- PAN 60: Planning for Natural Heritage;
- The Highland-wide Local Development Plan (HwLDP) (April 2012);
- The West Highlands and Islands Local Plan, as continued in force (April 2012);
- Argyll and Lochaber Area Management Plan 2009-2015 by SEPA;
- Guidance for Applicants on Supporting Information Requirements for Hydropower Applications (undated) by SEPA;
- Supporting Guidance (WAT-SG-67) Assessing the Significance of Impacts – Social, Economic, Environmental 2017 by SEPA;
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd edition) 2016 by CIEEM;
- Bryological Assessment for Hydroelectric Schemes in the West Highlands (2nd edition) 2012 by SNH;
- Assessing the Impacts of Small Scale Hydroelectric Schemes on Rare Bryophytes and Lichens 2011 by SNH;
- Looking After Bryophytes and Lichens of Scotland’s Oceanic Ravines 2009 by Plantlife; and
- Guidance for Pollution Prevention (GPPs) 2017 by SEPA.

12.4.2 Details of the relevant planning policies are provided in Chapter 5: Planning Policy.

## **12.5 Methodology**

### Desk Study

12.5.1 The following desk studies were undertaken:

- Collation of existing 2010 survey data on macroinvertebrates from Loch a’ Choire Ghlais and Allt a’Choire Ghlais;
- Updating of the baseline on bryophytes in Kilfinnan ravine;
- Updating of the baseline and future baseline to take account of climate change; and
- Investigation of any recent scientific studies on the relationship between flow conditions and rare bryophytes and lichens from monitoring carried out on hydroelectric projects since 2010.

### Field Study

12.5.2 A field visit to Allt a’Choire Ghlais and Kilfinnan Burn was made in September 2017 to confirm that there were no obvious changes to the baseline conditions and that the previous survey findings were valid.

### Evaluation of Important Ecological Features

12.5.3 The evaluations are applied to those sites, habitats and species that have been scoped in to the assessment and those that are predicted to be affected by The Proposed Development. These are termed Important Ecological Features (IEFs).

12.5.4 European, national and local governments and specialist organisations have together identified a large number of sites, habitats and species that provide the key focus for biodiversity conservation in the UK and Ireland, supported by policy and legislation. These provide an objective starting point for identifying the important ecological features that need to be considered. Table 12.3 shows a procedure for determining the geographical level of importance of site designations, habitats and species. Where a feature is important at more than one level in the table, its overriding importance is that of the highest level. Usually only the highest level of legal protection is listed.

**Table 12.3: Geographical Level of Importance of Ecological Features**

Level of Importance	Sites	Habitats	Species
International	Designated, candidate or proposed Special Areas of Conservation, Special Protection Areas and Ramsar sites; UNESCO (Ecological) World Heritage Sites; UNESCO Biosphere Reserves; Biogenetic Reserves.	A viable area of habitat included in Annex I of the EC Habitats Directive; a habitat area that is critical for a part of the life cycle of an internationally important species.	A European Protected Species; an IUCN Red Data Book species that is globally Vulnerable, Endangered or Critically Endangered; a Category A internationally important bryophyte assemblage <sup>1</sup> .
National (UK)	Sites of Special Scientific Interest; National Nature Reserves; Nature Conservation Review Sites; Marine Conservation Zones.	A viable area of priority habitat listed in the UK Biodiversity Action Plan <sup>2</sup> ; an area of habitat fulfilling the criteria for designation as an SSSI/ASSI or MCZ; a habitat area that is critical for a part of the life cycle of a nationally important species.	An IUCN Red Data Book species that is Vulnerable, Endangered or Critically Endangered in the UK; a species that is Rare in the UK (<15 10 km grid squares); a priority species in the UKBAP <sup>3</sup> ; a Schedule 5 (animal) or Schedule 8 (plant) species included in the Wildlife and Countryside Act 1981; a Category A nationally important bryophyte assemblage <sup>4</sup> .
National (Scotland)	National Parks; Marine Protected Areas; Marine Consultation Areas.	Habitats of principal importance for biodiversity in the relevant countries <sup>5</sup> .	Species of principal importance for biodiversity in the relevant countries <sup>6</sup> .
Regional	Regional Parks.	Regional Local Biodiversity Action Plan <sup>7</sup> habitats noted as requiring protection.	A species that is Nationally Scarce in the UK (present in 16-100 10 km grid squares); a

<sup>1</sup> Averis, A.B.G, Genney, D.R, Hodgetts, N.G, Rothero, G.P. & Bainbridge, I.P. 2012. Bryological assessment for hydroelectric schemes in the west highlands – 2nd edition. Scottish Natural Heritage Commissioned Report No. 449b (available online at [www.snh.org.uk/pdfs/publications/commissioned\\_reports/449b.pdf](http://www.snh.org.uk/pdfs/publications/commissioned_reports/449b.pdf)).

<sup>2</sup> The UK BAP lists of priority habitats and species have been superseded by the country biodiversity lists, but they are a useful reference source.

<sup>3</sup> The UK BAP lists of priority habitats and species have been superseded by the country biodiversity lists, but they are a useful reference source.

<sup>4</sup> Averis, A.B.G, Genney, D.R, Hodgetts, N.G, Rothero, G.P. & Bainbridge, I.P. 2012. Bryological assessment for hydroelectric schemes in the west highlands – 2nd edition. Scottish Natural Heritage Commissioned Report No. 449b (available online at [www.snh.org.uk/pdfs/publications/commissioned\\_reports/449b.pdf](http://www.snh.org.uk/pdfs/publications/commissioned_reports/449b.pdf)).

<sup>5</sup> These are all the habitats that were identified as requiring action in the UKBAP and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, including any additions.

<sup>6</sup> These are all the species that were identified as requiring action in the UKBAP and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, including any additions.

Level of Importance	Sites	Habitats	Species
			species that is included in the Regional LBAP <sup>8</sup> ; an assemblage of regionally scarce species.
County / Metropolitan	Local Nature Reserves; Woodland Trust Sites; Royal Society for the Protection of Birds Sites; Local Wildlife Sites.	Lochaber BAP <sup>9</sup> habitats noted as requiring protection; semi-natural, ancient woodland >0.25ha in extent.	A species that is included in the Lochaber BAP <sup>10</sup> ; an assemblage of species that are scarce at the county level.
Local		Semi-natural, ancient woodland <0.25ha in extent; diverse or ecologically valuable hedgerow network; semi-natural habitats that are unique or important in the local area; flushes, springs and base rich rock that support bryophyte assemblages that are widespread but localised to these habitats.	Species as defined by Local Authority lists (if available).

### Impact Assessment

12.5.5 The assessment of impacts describes how the baseline conditions would change as a result of The Proposed Development and its associated activities and from other developments. The term 'impact' is used commonly throughout the EIA process and is usually defined as a change experienced by a receptor (this can be positive, neutral or negative). The term 'effect' (or residual effect) is commonly used at the conclusion of the EIA process and is usually defined as the consequences for the receptor of an impact after mitigation measures have been taken into account. The EIA Regulations specifically require all likely significant effects to be considered. Therefore, impacts and effects are described separately and the effects for the IEFs are assessed as being either significant or not according to the importance of the IEF.

12.5.6 Significant cumulative effects can result from the individually insignificant but collectively significant effects of actions taking place over a period of time or concentrated in a location, for example:

- Additive / incremental; or
- Associated / connected.

<sup>7</sup> There is no applicable Regional LBAP.

<sup>8</sup> There is no applicable Regional LBAP.

<sup>9</sup> Lochaber BAP available at: <http://highlandbiodiversity.com/userfiles/file/acion-plans/lochaber.pdf>

<sup>10</sup> Lochaber BAP available at: <http://highlandbiodiversity.com/userfiles/file/acion-plans/lochaber.pdf>

*Assessment Criteria – Magnitude*

- 12.5.7 The CIEEM Guidelines states that when describing changes/activities and positive or negative impacts on ecosystem structure and function, reference should be made to the following parameters:
- Magnitude;
  - Extent;
  - Duration;
  - Reversibility; and
  - Timing and frequency.
- 12.5.8 Magnitude: refers to the size, amount, intensity and volume of an impact, determined on a quantitative basis if possible, but typically expressed in terms of relative severity, such as major, moderate, low or negligible. Extent, duration, reversibility, timing and frequency of the impact can be assessed separately but they tie in to determine the overall magnitude.
- 12.5.9 Extent: the area of which the impact occurs. When the IEF is the habitat itself, magnitude and extent may be synonymous.
- 12.5.10 Duration: the time for which the impact is expected to last prior to recovery or replacement of the IEF. This is defined in relation to ecological characteristics, rather than human timeframes. The duration of an activity may differ from the duration of the resulting impact caused by the activity and this is taken into account.
- 12.5.11 Reversibility: an irreversible (permanent) impact is one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. A reversible (temporary) impact is one from which spontaneous recovery is possible or for which effective mitigation is possible and an enforceable commitment has been made.
- 12.5.12 Timing and frequency: the number of times an activity occurs will influence the resulting impact. The timing of an activity or change may cause an impact if it happens to coincide with critical life-stages or seasons.
- 12.5.13 Criteria for describing the magnitude of an impact are presented in Table 12.4 below:

**Table 12.4: Criteria for Describing Magnitude of Impact**

Magnitude	Description
Major	Total or major loss or alteration to the IEF, such that it will be fundamentally changed and may be lost from the site altogether; and/or loss of a very high or high proportion of the known population or range of the IEF.
Moderate	Loss or alteration to the IEF, such that it will be partially changed; and/or loss of a moderate proportion of the known population or range of the IEF.
Low	Minor shift away from the existing or predicted future baseline conditions. Change arising from the loss or alteration will be discernible but the condition of the IEF will be similar to the pre-development conditions; and/or having a minor impact on the known population or range of the IEF.
Negligible	Very slight change from the existing or predicted future baseline conditions. Change barely discernible, approximating to the 'no change' situation; and/or having a negligible impact on the known population or range of the IEF.

*Assessment Criteria – Significance*

12.5.14 Significance is a concept related to the weight that is attached to effects when decisions are made. For the purposes of EclA, a 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for IEFs. In broad terms, significant effects encompass effects on the structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution).

12.5.15 Significant effects are quantified with reference to an appropriate geographic scale (see Table 12.3 above). The CIEEM guidance has one 'level of importance' and a geographical 'scale of significance'. This is to deal with the fact that the geographical scale at which the effect is significant is not necessarily the same as the geographic level of importance of the IEF.

12.5.16 Professional judgement is used to determine the significance of effects.

*Assessment Criteria – Confidence in Predictions*

12.5.17 CIEEM does not cover the level of confidence in the predictions, therefore an approach has been adopted based on river conservation evaluation. A simple, qualitative index based on professional judgement is assigned to each predicted effect as follows:

A: high confidence.

B: intermediate confidence.

C: low confidence.

12.5.18 Factors influencing confidence include:

- The frequency and effort of field sampling;
- Constraints to the field survey;
- The completeness of the data (field and desk);

- The age of the data (although recent data are not necessarily always more reliable than old data);
- The state of scientific knowledge relating to the predicted effects of development activities on the IEF (the accuracy of the magnitude assessment); and
- The accuracy of the assessment of significance.

*Assessment Criteria – Success of Mitigation*

12.5.19 The word 'mitigation' has developed a wider meaning and common usage in environmental assessment than its strict meaning related to reducing the severity of something. Mitigation can sometimes be used as a generic term for a wide range of counter-acting measures, all of which, as the EIA Directive and EIA Regulations prescribe, are intended to prevent, reduce and where possible offset any significant adverse effect on the environment. Mitigation can be used to encompass measures intended to avoid, cancel or reduce adverse effects (this is the 'mitigation hierarchy').

12.5.20 Mitigation and compensation measures often carry a degree of uncertainty. The following objective scale is used for the success of mitigation:

- Certain/near certain: probability estimated at 95% chance or higher;
- Probable: probability estimated above 50% but below 95%;
- Unlikely: probability estimated above 5% but less than 50%; and
- Extremely unlikely: probability estimated at less than 5%.

## 12.6 Baseline Conditions

### Designations

12.6.1 No designated sites have been taken forward for assessment.

### Water Quantity

#### *Loch a' Choire Ghlais*

12.6.2 There is no water quantity information available from SEPA for Loch a' Choire Ghlais.

#### *Allt a' Choire Ghlais*

12.6.3 Allt a' Choire Ghlais is a river (ID: 20341) in the River Lochy catchment of the Scotland River Basin District (RBD). The main stem is approximately 7.5 km in length. SEPA have classified this watercourse as having a hydromorphology status of Moderate, a morphology status of High, an overall hydrology status of Moderate, a modelled hydrology status of Poor, a hydrology (medium/high flows) status of Poor and a hydrology (low flows) status of High in 2016<sup>11</sup>.

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<sup>11</sup> Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 041217).

### Water Quality and Temperature

#### *Loch a' Choire Ghlais*

- 12.6.4 There is no water quality information available from SEPA for Loch a' Choire Ghlais. Information from the macroinvertebrate surveys (the full report is provided in Appendix 12.1) is used to describe the water quality below. No information on water temperature is available.
- 12.6.5 pH recordings from all sites in both summer and autumn varied from 6.84-7.27 (mean 7.04) indicating Loch a' Choire Ghlais is circum-neutral. Conductivity was low varying from 9.0-20  $\mu\text{S}/\text{cm}$  (mean 14.7  $\mu\text{S}/\text{cm}$ ). Conductivity is related linearly to total dissolved solids (TDS). The low conductivity therefore suggests a low loading of TDS indicating unpolluted conditions. Similarly alkalinity levels were also low with recordings of 9.0-11.7 mg/l  $\text{CaCO}_3$  (mean 10.3 mg/l  $\text{CaCO}_3$ ) at Loch a' Choire Ghlais sites. In the summary of river typography used in river macrophyte classification the United Kingdom Technical Advisory Group (UKTAG) classifies alkalinity as low (<10 mg/l  $\text{CaCO}_3$ ), moderate (10-50), high (50-200) and very high (>200). The US Environmental Protection Agency classes watercourses with alkalinity levels of 10-20 mg/l  $\text{CaCO}_3$  as sensitive to acid rain. The buffering capacity of Loch a' Choire Ghlais is low.

#### *Allt a' Choire Ghlais*

- 12.6.6 SEPA have classified this watercourse as having an overall status (including temperature) of Moderate in 2016 with overall ecological status of Moderate and overall chemical status of Good<sup>12</sup>. This is a deterioration from High overall and High overall ecological status and an improvement from Pass overall chemical status in 2008. SEPA have identified pressures on Allt a' Choire Ghlais that include modifications to the waterbody, allowed as part of a hydroelectricity scheme development (CAR licence number CAR/L/1108419) (see Licenced Abstractions/Discharges). It is noted that this licence applies to the consented 2012 Coire Glas Hydro Scheme and that these pressures have been applied to the watercourse by SEPA in advance of any development.
- 12.6.7 Information from the macroinvertebrate surveys (the full report is provided in Appendix 12.2) show that the relative proportions of invertebrate groups indicated clean well-oxygenated conditions with no evidence of organic pollution or enrichment. ASPT scores (Average Score Per Taxon) showed excellent (A1) water quality at all sites in the autumn 2010 and spring 2011. Water Chemistry Status and Index of Acidity Scores indicated that the watercourse is circum-neutral or slightly acidic (>pH 5.5) with no significant acidification. pH records were circum-neutral with a mean of pH 6.48 in the autumn and pH 7.46 in the spring. ASPT indices and NTAXA both produced a WFD classification of high (H) ecological status for all sites for these parameters. Alkalinity levels were generally low with a mean of 12 mg/L  $\text{CaCO}_3$  in autumn and 9 mg/L  $\text{CaCO}_3$  in spring, indicating low buffering capacity.

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<sup>12</sup> Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 041217).

### Physical Habitats

- 12.6.8 The physical habitats of Loch a' Choire Ghlais and Allt a' Choire Ghlais/Kilfinnan Burn are described in Chapter 10: Terrestrial Ecology and Chapter 14: Geology and Water Environment.

### Macroinvertebrate Communities

#### *Loch a' Choire Ghlais*

- 12.6.9 Overall no rare species were recorded<sup>13</sup> and the relative proportions of invertebrate groups and species present indicated clean water conditions with a small level of organic enrichment (the full report is provided in Appendix 12.1). Proportionally the largest groups in all samples were Diptera and Crustacea. Diptera consisted almost entirely of chironomids, a group with a large number of species, many of which feed on decaying organic matter. The high proportion of Diptera indicates a level of organic enrichment more common in mesotrophic to eutrophic water conditions than the more typical oligotrophic upland lochs. The Crustacea species present were all microcrustacea dominated by two species, the cladoceran *Eurycerus lamellatus* and the cyclopoid copepod *Cyclops viridis*. Calanoid copepods appear to dominate oligotrophic waters while cyclopoid copepods and cladocerans are relatively more abundant in eutrophic waters<sup>14</sup>. The species composition here indicates a level of nutrient enrichment. This is partly a result of the shallow depth of Loch a' Coire Ghlais and the high cover of macrophytes providing inputs of nutrients.
- 12.6.10 Other insects present included a considerable number of the mayflies *Baetis rhodani* and *Siphonurus lacustris* in the summer, probably associated with the inlet burn. Small numbers of beetle larvae and adults were present from the families Dytiscidae and Haliplidae. Two species of water boatmen, *Sigara scotti* and *Sigara venusta*, were present almost entirely in autumn samples 2010. Two common species of damselflies were present, *Enallagma cyathigerum* common blue damselfly and *Pyrrhosoma nymphula* large red damselfly. Of the molluscs the small numbers of *Radix peregra* present indicate that acidification events are unlikely to have occurred. The numbers of Pisidium species found also suggest a level of organic enrichment, commensurate with the above.
- 12.6.11 There is no macroinvertebrate information available from SEPA for Loch a' Choire Ghlais.

#### *Allt a' Choire Ghlais*

- 12.6.12 The invertebrate communities at all the Allt a' Choire Ghlais sites were dominated by Ephemeroptera, Plecoptera and Trichoptera combined (EPT). EPT in the autumn varied from 77% to 90% (mean 84%) and in the spring 75% to 97% (mean 83%). Common species such as the mayflies *Baetis rhodani*, *Baetis muticus*, *Ecdyonurus* sp. and *Rhithrogena semicolorata*; and the stonefly *Amphinemura sulcicollis* were responsible for the high

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<sup>13</sup> JNCC (2011). Taxon designations 20110121. Excel spreadsheet. Available at <http://jncc.defra.gov.uk/page-3408>

<sup>14</sup> J. E. Gannon and R. S. Stemberger (1978). Zooplankton (Especially Crustaceans and Rotifers) as Indicators of Water Quality. Transactions of the American Microscopical Society, Vol. 97, No. 1, pp. 16-35.



dominance of these groups. No rare species were found<sup>15</sup>. Overall invertebrate abundance was low. Numbers of taxa present varied from 15-31 (mean 24) and 14-23 (mean 18) in autumn and spring samples respectively. At this taxonomic level the watercourse had moderate diversity. The two most upstream sites had the greater diversity in both autumn and spring samples. The Average Score Per Taxon (ASPT) scores support the evidence from the proportions of different groups in the invertebrate community, indicating that the watercourse had excellent water quality with no sign of organic pollution. The full report is provided in Appendix 12.2.

- 12.6.13 SEPA have classified this waterbody as having an overall invertebrate animal status of Good Ecological Status (GES) in 2016, although this is a deterioration from High status in 2008<sup>16</sup>. Macroinvertebrates (RiCT/WHPT) was GES in 2016 but High in 2008, macroinvertebrates (ASPT) was GES in 2016 but High in 2008, and macroinvertebrates (NTAXA) was High in 2016 and 2008.

#### Bryophyte Communities

##### *Kilfinnan Burn*

- 12.6.14 The classification system of watercourses for bryophytes developed by SNH<sup>17</sup> is based on records of 29 nationally uncommon humidity-demanding bryophyte species and the habitat potential for these species at unsurveyed or partly surveyed sites. The species were selected as follows:

- They are uncommon in Great Britain (either Nationally Rare, Nationally Scarce or with otherwise markedly restricted distributions);
- Their occurrences are mainly or entirely in very humid habitats such as watercourses and their environs, sheltered woods, and rocky slopes and ravines, especially in western areas with a wet climate; and
- Rocks and trees close to watercourses, in the zone that could be affected by water abstraction for hydroelectric development, are a particularly important habitat for these species.

- 12.6.15 Each of the species was given a score between 1 and 12<sup>18</sup>. These scores are based on a combination of the species' rarity in Great Britain and the degree of threat according to the IUCN categories. The species scoring system is shown in Table 12.5. At sites with records of any of these species, all scores for those species recorded at that site are summed to give a site score. Each site was placed into one of five categories (A – E) based on its site score and (if unsurveyed or partially surveyed) its bryological potential. These five categories are described in Table 12.6.

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<sup>15</sup> Based on SEPA data as at 15/03/2010.

<sup>16</sup> Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 04/12/17).

<sup>17</sup> Bryological assessment for hydroelectric schemes in the West Highlands (2nd edition).

<sup>18</sup> 2357 watercourses were initially classified in the first edition of the SNH report; however, since then an additional 3272 sites have been classified and some changes have been made to the scoring system. The second edition incorporates these additions and changes.

**Table 12.5 Species Scoring System for Scottish Hygrophilous Bryophytes**

Species Score	Description
1	Neither Nationally Scarce nor Nationally Rare
3	Nationally Scarce
6	Near-Threatened (most are Nationally Rare; one is Nationally Scarce)
9	Vulnerable (all of these are Nationally Rare)
12	Endangered (all of these are Nationally Rare)

Nationally Scarce = 16-100 post-1950 10 km sq. records

Nationally Rare = <16 post-1950 10 km sq. records

**Table 12.6 Categories used to classify West Highland watercourses by their bryological significance, for use in relation to proposed hydroelectric schemes**

Category Letter	Category Description
A	The site has been surveyed and has a score of 6 or more points indicating a rich, nationally/internationally important flora of uncommon hygrophilous bryophyte species. The whole site is associated with a particular watercourse (for example the site is a ravine), so the records contributing to the site score are all relevant for consideration in relation to a proposed hydroelectric scheme. Therefore no further survey should be necessary in order to evaluate site importance in relation to a proposed hydroelectric scheme; the score of 6 or more points indicates that the site is of such bryological importance that hydroelectric development could have a significant national/international impact on humidity-demanding oceanic bryophyte assemblages.
B	The site has been surveyed and has a score of 6 or more points (i.e. a rich flora of uncommon hygrophilous species), but the watercourse and its environs form only a part of the site. The site species list may include records made well away from the watercourse, and this watercourse may be one of two or more watercourses within the site. Some of the records contributing to the site score may not therefore be from this particular watercourse and may not be relevant for consideration in relation to a proposed hydroelectric scheme. Survey of this particular watercourse is therefore required, to assess its richness.
C	The site has a score of between 0 and 5 points, and the survey of the watercourse area was sufficiently thorough that it seems unlikely that further survey will produce enough additional records of uncommon hygrophilous species to raise the site score to 6 or more points. No further survey should be necessary in relation to a proposed hydroelectric scheme. With a score of <6 points the site is of low to medium bryological importance and hydroelectric development is unlikely to have a significant national/international impact on humidity-demanding oceanic bryophyte assemblages. However, the following points should be noted for a hydroelectric scheme at a site in this category: (1) the bryophyte flora may be of local importance, for example including a species that is rare locally or is at the edge of its geographical range; (2) the watercourse may be important for other groups such as invertebrates; (3) the ecological acceptability of a proposed scheme might be reduced if many other watercourses in the local area already have hydroelectric schemes (i.e. few unmodified watercourses left in the area concerned).
D	The site has a score of between 0 and 5 points and is either unsurveyed or only partially surveyed, but maps and aerial photographs show topography and/or woodland that suggest potential for a site score exceeding 6 points. Further survey of the watercourse area is required in relation to any hydroelectric proposal.
E	The site has a score of between 0 and 5 points and is unsurveyed (score = 0 points) or in a few cases partially surveyed, and maps and aerial photographs show a gentle watercourse gradient and/or little or no ravine topography or woodland, so it seems unlikely that the bryophyte flora present will score as much as 6 points. Photographs of the site should be taken (looking upstream at regular intervals along the watercourse), and from these the appearance and bryological potential of the habitats should be

Category Letter	Category Description
	assessed by a bryologist (or other ecologist using guidance supplied by bryologists) and a decision made on whether the habitat has sufficient potential to require a bryophyte survey.

12.6.16 Kilfinnan Burn ravine is categorised as A (the highest level of categorisation) as it has five scoring species and a score of six or more points. The species are *Paraleptodontium recurvifolium* (Nationally Scarce, score 3), *Trichostomum hibernicum* (Nationally Scarce, score 3), *Aphanolejeunea microscopica* (Neither Nationally Scarce nor Nationally Rare, score 1), *Plagiochila exigua* (Neither Nationally Scarce nor Nationally Rare, score 1), and *Radula aquilegia* (Neither Nationally Scarce nor Nationally Rare, score 1)<sup>19</sup>.

## 12.7 Prediction of Future Baseline

### Climate change<sup>20</sup>

12.7.1 Annual total river flow has increased since the 1960s in Scotland, Wales and parts of northern and western England; in contrast, no pronounced changes have occurred in the lowlands of south east England. Winter flows have increased in upland, western catchments. Autumn flows have increased in central England and parts of eastern Scotland. There is no apparent pattern of change in summer flows across the UK. Over the last 30 years, high winter flows have increased and there has been an increase in the frequency and magnitude of flooding, particularly in the west and north. There is little evidence of changes in very low flows.

12.7.2 Changes in UK river flows have not been attributed to anthropogenic climate change; there are periods of high and low flows throughout the UK record. The UK floods of winter 2000 and summer 2007 are thought to have been made more likely by climate change, and recent preliminary work suggests that the heavy rain and consequent flooding in December 2015 may have been more likely because of anthropogenic climate change.

12.7.3 Projections of future river flow are uncertain because of uncertainties in both future rainfall and evapotranspiration. Studies tend to agree on a trend towards similar or increased average winter flows and reduced average summer flows, with mixed patterns in spring and autumn. High flows and flooding are expected to increase over the 21st century because of increased rainfall, particularly in winter. Increased convective rainfall<sup>21</sup> would lead to more flash flooding.

12.7.4 UK river water temperature has increased over the second half of the 20th century, broadly in line with changes in air temperature. Changes have not been attributed to climate change as the processes (energy exchanges and flow) that control water temperature are complex, but increasing river water temperature is consistent with climate change. River water temperature is expected to increase across the UK through the

<sup>19</sup> Taken from <https://www.snh.scot/professional-advice/planning-and-development/renewable-energy-development/types-renewable-technologies/hydroelectric-power/hydroelectric-development> (accessed 061217).

<sup>20</sup> Taken from <http://www.nerc.ac.uk/research/partnerships/ride/lwec/report-cards/> (accessed 051217).

<sup>21</sup> Convective rainfall occurs when the energy of the sun (or insolation) heats the earth's surface and causes water to evaporate changing to water vapour. This warm, moist air then rises and as it rises it cools.

21st century but the rate and pattern of change are not clear. Increases in water temperature will be modified by hydrological changes, which may either magnify or reduce the impact of changes in energy balance.

12.7.5 Over the last 30 years there has been an overall improvement in river water quality, although nutrient levels have increased because of the use of fertilisers. Improvements to water quality have mainly been achieved through regulation of point source discharges and a reduction in toxic pollution. Upland catchments have begun to recover from acidification as a result of reductions in sulphur emissions since the 1980s. Freshwater ecosystems may be responding to changes in water temperature, for example with reductions in some fish species in some catchments. Improvements in river water quality as a result of better management have had a far greater impact than any climate change signal.

12.7.6 Changes in river flow patterns may lead to changes in the mobility and dilution of nutrients and contaminants. Higher water temperatures will increase chemical reactions and accelerate biological process. Lower summer flows may enhance the potential for algal and cyanobacterial blooms and reduce dissolved oxygen levels. Storms may flush nutrients and other pollutants from urban and rural areas and may cause acid pulses in some upland catchments. Future conditions are expected to be more favourable to invasive species. Other changes may be complex and there is little information on how freshwater ecosystems will respond to the combined effects of changes in river flows and water temperature and other changes to water quality.

## 12.8 Evaluation

12.8.1 The evaluations have been applied only to those species that have been scoped in to the assessment and those where there is the potential for impacts that could result in significant adverse ecological effects as a result of The Proposed Development. The IEFs and the evaluations are presented in Table 12.7 below.

**Table 12.7 Evaluation of Important Ecological Features**

IEF	Importance	Justification
Macroinvertebrate communities in Loch a' Choire Ghlais	Less than Local	There are no Red Data Book, rare or legally protected species present. There are no UK BAP, Scottish Biodiversity List, Lochaber BAP or nationally/regionally/county scarce species present. There are no Local Authority lists available.  The community is of some importance as food for fish.
Macroinvertebrate communities in Allt a' Choire Ghlais	Less than Local	There are no Red Data Book, rare or legally protected species present. There are no UK BAP, Scottish Biodiversity List, Lochaber BAP or nationally/regionally/county scarce species present. There are no Local Authority lists available.  The community is of some importance as food for fish.
Bryophyte communities in Kilmannan Burn	National	Categorised as A by SNH: <i>the site has a rich, nationally/internationally important flora of uncommon hygrophilous bryophyte species.</i> There are no IUCN Red Data Book species that are globally Vulnerable, Endangered or Critically Endangered, therefore the site is not considered to be internationally important but nationally important.

## 12.9 Potential Effects

12.9.1 The Proposed Development would comprise the following main activities during the construction phase that could potentially result in significant negative impacts on the IEFs in Table 12.7 (for full details please refer to Chapter 3: Description of Development):

- Construction of the dam and upper reservoir in Coire Glas; and
- The use of site establishment and lay down areas.

12.9.2 The Proposed Development would comprise the following main activities during the operational phase that could potentially result in significant negative impacts on the IEFs in Table 12.7 (for full details please refer to Chapter 3: Description of Development):

- Water level changes in the upper reservoir;
- Changes in water flow and sediment transport in the Allt a' Choire Ghlais/Kilfinnan Burn; and
- Mixing of Loch Lochy and Loch a' Choire Ghlais waters in the respective waterbodies and in Allt a' Choire Ghlais/Kilfinnan Burn.

12.9.3 In accordance with CIEEM guidance, mitigation by design and proven good practice mitigation are included in the impact assessment below. The assessment is based on the 'worst case scenario' for a 1500 MW scheme.

### Construction Phase

#### Macroinvertebrate communities in Loch a' Choire Ghlais

##### *Importance of IEF*

12.9.4 The macroinvertebrate communities in Loch a' Choire Ghlais are of Less than Local importance.

##### *Nature of Impacts*

12.9.5 During the construction period the upper reservoir area would be utilised for a quarry and various work and storage areas. It is not anticipated that the existing Loch a' Choire Ghlais would be drained during construction of the dam. However, a diversion structure would be required to divert river flow and floods around the working area of the dam during construction.

##### *Duration of Impacts*

12.9.6 The impacts from the construction of the dam would be of short duration (between Year 3 and Year 6). However, the loch would not be restored to its former state during the operational phase, therefore there would be permanent impacts on the macroinvertebrate communities.

### *Magnitude of Impacts*

- 12.9.7 The impact from the creation of the upper reservoir would extend to the whole loch and would be irreversible. The magnitude of the impact is predicted to be major; major alteration to the IEF, such that it will be fundamentally changed. Loch a' Choire Ghlais is a shallow loch with extensive macrophyte growth and associated macroinvertebrate communities. The character of most of the loch is littoral and only small areas of profundal habitat occur. The current level of macrophyte growth promotes nutrient input resulting in the current relative proportions of invertebrate groups present. The proposals would enlarge and deepen the loch, destroying the existing littoral areas and changing the character of the macroinvertebrate communities. After impoundment the macroinvertebrate communities would likely change to one where profundal species are dominant (for further detail see Appendix 12.1). However, macroinvertebrates as food for fish would persist in the reservoir.
- 12.9.8 The superficial geology of the catchment consists of areas of peat, alluvial clay, silt, sand and gravel, and till (see Chapter 14: Geology and Water Environment). This superficial material is highly erodible if disturbed during construction, causing sediment plumes and dust deposition. Pollution of Loch a' Choire Ghlais with eroded material could affect natural sediment processes and cause smothering and contamination. Phytoplankton (food for macroinvertebrates) could be affected by decreased light levels due to turbidity or by direct toxicity. Aquatic plants (habitat and food for macroinvertebrates) could be affected due to smothering by silt or direct toxicity causing damage or death of the plant. Areas of fine gravels (habitat for invertebrates) could also be smothered. There could be indirect and direct impacts on macroinvertebrates, although all groups have the ability to move away from the affected area to some extent. The magnitude of these impacts could be negligible, low, moderate or major, depending on the size of the pollution event. Dispersion and settlement would occur but weather conditions would determine the area affected at the time of the event. If mitigation measures are employed effectively during the construction phase, pollution events would be avoided and/or reduced in severity.

### *Significance of Effects*

- 12.9.9 The creation of the upper reservoir and pollution during construction would result in significant effects at the Less than Local level on macroinvertebrate communities in Loch a' Choire Ghlais.

### *Confidence in Assessment*

- 12.9.10 Creation of the upper reservoir, A: high confidence. Pollution, B: intermediate confidence, due to uncertainty about the methods of working during construction and the ability to contain pollution events.

### Macroinvertebrate communities in Allt a' Choire Ghlais

### *Importance of IEF*

- 12.9.11 The macroinvertebrate communities in the Allt a' Choire Ghlais are of Less than Local importance.

*Nature of Impacts*

- 12.9.12 During the construction period the inundation area would be utilised for a quarry and various work and storage areas. It is not anticipated that the existing Loch a' Choire Ghlais would be drained during construction of the dam. However, a diversion structure would be required to divert river flow and floods around the working area of the dam during construction.

*Duration of Impacts*

- 12.9.13 The impacts from the construction of the dam would be of short duration (between Year 3 and Year 6). However, the upper reaches of the Allt a' Choire Ghlais would not be restored to their former state during the operational phase, therefore there would be permanent impacts on the macroinvertebrate communities.

*Magnitude of Impacts*

- 12.9.14 The impact from the creation of the upper reservoir would extend to approximately one sixth of the length of the Allt a' Choire Ghlais and would be irreversible. The magnitude of the impact is predicted to be moderate; alteration to the IEF, such that it will be partially changed. Lotic communities would be replaced by lentic communities in the inundation area. However, macroinvertebrates as food for fish would persist in the reservoir and in the downstream habitats as a result of the compensation flow released from the dam (see Chapter 6: Water Management).
- 12.9.15 Pollution of Allt a' Choire Ghlais with eroded material could affect natural sediment processes and cause smothering and contamination (as above for Loch a' Choire Ghlais). There could be indirect and direct impacts on macroinvertebrates, although all groups have the ability to move away from the affected area to some extent. The magnitude of these impacts could be negligible, low, moderate or major, depending on the size of the pollution event. Dispersion and settlement would occur but weather conditions would determine the area affected at the time of the event. If mitigation measures are employed effectively during the construction phase, pollution events would be avoided and/or reduced in severity.

*Significance of Effects*

- 12.9.16 The creation of the upper reservoir and pollution during construction would result in significant effects at the Less than Local level on macroinvertebrate communities in Allt a' Choire Ghlais.

*Confidence in Assessment*

- 12.9.17 Creation of the upper reservoir, A: high confidence. Pollution, B: intermediate confidence, due to uncertainty about the methods of working during construction and the ability to contain pollution events.

## Operational Phase

### Macroinvertebrate communities in Loch a' Choire Ghlais

#### *Importance of IEF*

- 12.9.18 The macroinvertebrate communities in Loch a' Choire Ghlais are of Less than Local importance.

#### *Nature of Impacts*

- 12.9.19 Loch a' Choire Ghlais water is likely to have a different trophic status to Loch Lochy water. In the absence of any changes in land-use in the catchment, any increase in nutrients in the upper reservoir would certainly come from the inclusion of waters from Loch Lochy. The introduction of the Loch Lochy waters would dictate the make-up of the algal communities of the upper reservoir. Water from the profundal zone of the new reservoir would be delivered into the Allt a' Choire Ghlais as compensation flow.

- 12.9.20 The operation of the upper reservoir is described Chapter 6: Water Management. An indicative maximum operational draw down of approximately 64 m is anticipated within the upper reservoir. For the purposes of assessment within this EIA Report, the assumed maximum water level within the upper reservoir would be 558.1 m OD and the assumed minimum water level would be 494 m OD. The upper reservoir rate of change of level would be on average between around 2 – 4 m/hour.

#### *Duration of Impacts*

- 12.9.21 The impacts of an increase in nutrients and changes in water level in Loch a' Choire Ghlais would be permanent.

#### *Magnitude of Impacts*

- 12.9.22 Total phosphorus and phytoplankton are High status in Loch Lochy<sup>22</sup>. This is an improvement from GES in 2008 for both parameters. There is no data for Loch a' Choire Ghlais but information from the macroinvertebrate survey (Appendix 12.1) indicates that the loch is currently 'unpolluted'. Based on studies carried out for the Loch Sloy Pumped Storage Scheme<sup>23</sup>, the chlorophyll a and cyanobacteria concentrations in the upper reservoir are likely to reduce, owing to its exposed location. Algal population maxima are likely to be short lived (days rather than weeks), reducing the probability of nuisance algal blooms and the associated de-oxygenation of the water, which might otherwise have impacts on the macroinvertebrate communities. However, changes in river flow patterns may lead to changes in the mobility and dilution of nutrients. Higher water temperatures will increase chemical reactions and accelerate biological process. Lower summer flows may enhance the potential for algal and cyanobacterial blooms and reduce dissolved oxygen levels (see section 12.7 above). Any water quality degradation from the

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<sup>22</sup> Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 061217).

<sup>23</sup> Sloy Pumping Station Environmental Statement (August 2009). ASH design + assessment Ltd. for SSE



phytoplankton population is likely to be of negligible magnitude; very slight change from the existing or predicted future baseline conditions. Change barely discernible, approximating to the 'no change' situation, and limited to warm and sunny times of year (unlikely and intermittent). Macroinvertebrates as food for fish would persist in the upper reservoir.

- 12.9.23 The magnitude of the impacts of changes in water level would be major; major alteration to the IEF, such that it will be fundamentally changed. The superficial deposits would be eroded between the minimum and maximum operating levels (see Chapter 14: Geology and Water Environment). The greatest magnitude of erosion would be caused by wind induced waves on the shoreline, which would effectively remove the majority of fine material over the exposed surface and this material would wash into the base of the upper reservoir over time. The result would be the creation of a de-vegetated and eroded zone around the perimeter of the upper reservoir to the full height of the operating level. The remaining material would consist predominantly of boulders and cobbles interspersed with sands and gravels and bare rock. The eroded area would eventually stabilise with coarse material armouring the underlying sands and gravels.

#### *Significance of Effects*

- 12.9.24 The increase in nutrients would be not significant. The changes in water level would be significant at the Less than Local level on macroinvertebrate communities in Loch a' Choire Ghlais.

#### *Confidence in Assessment*

- 12.9.25 Increase in nutrients, B: intermediate confidence, due to data limitations. Changes in water level, B: intermediate confidence, due to uncertainty over the operating regime.

#### Macroinvertebrate communities in Allt a' Choire Ghlais

#### *Importance of IEF*

- 12.9.26 The macroinvertebrate communities in the Allt a' Choire Ghlais are of Less than Local importance.

#### *Nature of Impacts*

- 12.9.27 Operation of The Proposed Development would change the water flow and sediment transport regime in the Allt a' Choire Ghlais. The new dam would incorporate a spillway, a spillway discharge channel, and dam drawdown and constant compensation water release facilities. It is assumed that adequate compensation flow would be provided to maintain the wetted stream habitat, as a Q95 flow would be provided even when natural conditions drop below Q95. It is not anticipated that the spillway would be used regularly (see Chapter 6: Water Management).

#### *Duration of Impacts*

- 12.9.28 The impacts of the new flow regime and sediment starvation in the Allt a' Choire Ghlais would be permanent.

### *Magnitude of Impacts*

- 12.9.29 The downstream impacts of big dams have been studied all over the world for many years; documented effects on macroinvertebrates include reduced taxon richness and changes in community composition (also see Appendix 12.2). These impacts have been shown to lessen downstream and disappear once a major tributary enters and macroinvertebrate drift is re-established. In addition, climate change may trend towards increased flows, particularly in winter, which would facilitate community recovery. Reduced taxon richness is near certain in the upper reaches of Allt a'Choire Ghlais just below the dam due to the predominantly lower flows and the input of colder water with a different chemistry. It is also probable that profundal macroinvertebrate species would be released through the compensation flow and temporarily change the community composition before they drift downstream to more suitable habitats in Loch Lochy. Changes in the fauna are likely to occur over a period of many years. These impacts are predicted to be of moderate magnitude; loss or alteration to the IEF, such that it will be partially changed.
- 12.9.30 The magnitude of the impacts of sediment starvation in the reach of the Allt a' Choire Ghlais immediately downstream of the dam would be low; minor shift away from the existing or predicted future baseline conditions. Change arising from the alteration will be discernible but the condition of the IEF will be similar to the pre-development conditions. This is due to the fact that little sediment production takes place above the dam and also to the fact that the channel has a stable nature, with predominantly very large material present in the channel above the dam. Although these reaches would have no sediment supply (very fine sediment would be flushed straight through), there would only be slow movement of the existing sediment from erosion, as the compensation flow is only Q95. The geomorphology studies (Appendices 14.3 and 14.4) show that there is currently a 'supply limited' geomorphic process regime in this upper region of the river; the rate of sediment supplied to the channel is less than the ability of the channel to transport that imposed supply (transport capacity). With the dam in place, the transport capacity would also be reduced so the majority of the sediment would remain in place and habitats for macroinvertebrates would remain.

### *Significance of Effects*

- 12.9.31 The new flow regime would result in significant effects at the Less than Local level on macroinvertebrate communities in Allt a' Choire Ghlais. There would be no significant effects from sediment starvation on macroinvertebrate communities in Allt a' Choire Ghlais.

### *Confidence in Assessment*

- 12.9.32 New flow regime, B: intermediate confidence, due to uncertainty over the operating regime. Sediment starvation, B: intermediate confidence, due to uncertainty over the operating regime.

### Bryophyte communities in Kilfinnan Burn

#### *Importance of IEF*

- 12.9.33 The bryophyte communities in Kilfinnan Burn are of International/National importance.

### *Nature of Impacts*

- 12.9.34 Operation of The Proposed Development would change the water flow in Kilfinnan Burn. As above, a Q95 flow would be provided even when natural conditions drop below Q95. At Kilfinnan Falls, 2.75 km downstream of the dam, the reduction in catchment area would be approximately 30%.

### *Duration of Impacts*

- 12.9.35 The impacts of the new flow regime in Kilfinnan Burn would be permanent.

### *Magnitude of Impacts*

- 12.9.36 The bryophytes in the Kilfinnan ravine require very high humidity, with a combination of spate scouring and splash/spray. The flow of water over the falls is important in maintaining these conditions. However, the ecology of nationally rare bryophytes and lichens is poorly understood. By their very nature, many species of conservation concern occur in very few locations within Scotland<sup>24</sup>. Based on so few sites it is difficult to determine the ecological requirements of such species and their occurrence may in fact be stochastic (determined by predictable and random elements). Our current state of knowledge therefore, does not allow minimum flow conditions to support these species in ravines to be defined, as they will vary depending on topography and location, and with such a long response time it is very unlikely that there will be any suitable scientific evidence in the short term. Changes in species distributions in response to changes in stream flow are likely to be slow. The bryophytes in Kilfinnan Burn ravine are likely to be permanently affected by the changes in the hydrological regime and the magnitude of impacts is assessed as moderate; alteration to the IEF, such that it will be partially changed. It is not possible to compensate or mitigate these impacts with any certainty.

### *Significance of Effects*

- 12.9.37 There are no long-term studies of the effects of a lower level of discharge down ravines but knowledge of the ecology of the bryophytes and lichens involved and observations on the extant communities in ravines altered by hydro-schemes tens of years ago gives some pointers<sup>25</sup>. The most likely effects are:
- a downward shift to the new median water level of riparian species;
  - a growth of more robust, woodland floor species on the rocks above this;
  - a loss of habitat for the community of lichens and small liverworts on rock faces as a result of increased competition; and
  - a decrease in frequency of spate flows and resultant erosion which frees-up habitat for lichens and the smaller liverworts.

- 12.9.38 The new flow regime would likely result in significant effects at the National level on bryophyte communities in Kilfinnan Burn. The SNH guidance states that *where a*

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<sup>24</sup> Assessing the Impacts of Small Scale Hydroelectric Schemes on Rare Bryophytes and Lichens by Scottish Natural Heritage (2011).

<sup>25</sup> Looking after Bryophytes and Lichens of Scotland's Oceanic Ravines by Plantlife (2009).

*watercourse has a site score of 6 or more points (i.e. category A) it is considered to be of high national and international importance, and a hydroelectric scheme could have a significant impact on the national bryophyte flora.*

*Confidence in Assessment*

12.9.39 C: low confidence, due to lack of scientific evidence.

**12.10 Mitigation**

12.10.1 Mitigation is possible for one of the predicted significant negative impacts on the IEFs, during the construction phase: water pollution. Construction techniques and methodologies would be fully incorporated into a Construction Environmental Management Plan (CEMP) (including a Pollution Prevention Plan) and be fully developed prior to construction (see Appendix 3.3). Contractor Method Statements (CMSs) would be provided for these works and SEPA GPPs would be followed. An Ecological Clerk of Works (ECoW) would be employed during construction. The success of this mitigation is assessed as probable.

**12.11 Residual Effects**

12.11.1 Please refer to Table 12.8 for residual effects.

**Table 12.8: Summary of Effects on Important Ecological Features**

IEF	Importance of IEF	Nature of Impacts	Duration of Impacts	Magnitude of Impacts	Significance of Effects	Confidence in Assessment
<b>Construction Phase</b>						
Macroinvertebrate communities in Loch a' Choire Ghlais	Less than Local	Habitat change from construction of the dam and upper reservoir	Permanent	Major	Significant at the Less than Local level	A
Macroinvertebrate communities in Loch a' Choire Ghlais	Less than Local	Pollution during the construction of the dam and upper reservoir	Temporary	Negligible, low, moderate or major	Significant at the Less than Local level	B
Macroinvertebrate communities in Allt a' Choire Ghlais	Less than Local	Habitat change from construction of the dam and upper reservoir	Permanent	Moderate	Significant at the Less than Local level	A
Macroinvertebrate communities in Allt a' Choire Ghlais	Less than Local	Pollution during the construction of the dam and upper reservoir	Temporary	Negligible, low, moderate or major	Significant at the Less than Local level	B
<b>Operational Phase</b>						
Macroinvertebrate communities in Loch a' Choire Ghlais	Less than Local	Increase in nutrients in the new reservoir	Permanent	Negligible	Not significant	B
Macroinvertebrate communities in Loch a' Choire Ghlais	Less than Local	Changes in water level in the new reservoir	Permanent	Major	Significant at the Less than Local level	B
Macroinvertebrate communities in Allt a' Choire Ghlais	Less than Local	New flow regime	Permanent	Moderate	Significant at the Less than Local level	B
Macroinvertebrate communities in Allt a' Choire Ghlais	Less than Local	Sediment starvation	Permanent	Low	Not significant	B
Bryophyte communities in Kilfinnan Burn	National	New flow regime	Permanent	Moderate	Significant at the National level	C

## 12.12 Conclusions

12.12.1 The main conclusions from the aquatic ecology impact assessment are as follows:

- Significant negative effects during the construction phase are predicted on macroinvertebrate communities of Less than Local importance in Loch a' Choire Ghlais and Allt a' Choire Ghlais from habitat change due to construction of the dam and upper reservoir. No mitigation is possible. The impact of habitat change would be permanent and of major magnitude for Loch a'Choire Ghlais and moderate magnitude for Allt a'Choire Ghlais. Confidence in these predictions is high.
- Significant negative effects during the construction phase are predicted on macroinvertebrate communities of Less than Local importance in Loch a' Choire Ghlais and Allt a' Choire Ghlais from pollution due to construction of the dam and upper reservoir. With effective mitigation under the CEMP, temporary pollution events would be avoided and/or reduced in severity. Confidence in these predictions is intermediate.
- Significant negative effects during the operational phase are predicted on macroinvertebrate communities of Less than Local Importance in Loch a' Choire Ghlais and Allt a' Choire Ghlais from changes in water level in the upper reservoir and from the new flow regime. No mitigation is possible. The magnitude of these impacts is major and moderate respectively, however, confidence in these predictions is intermediate.
- Significant negative effects during the operational phase are predicted on bryophyte communities of National importance in Kilfinnan Burn from the new flow regime. No mitigation is possible. The magnitude of this impact is moderate, however, confidence in this prediction is low, due to lack of scientific evidence.