

Chapter 13: Fish

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Glossary of Terms

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.
Anadromous	A fish that migrates up rivers from the sea to spawn.
Bathymetry	The measurement of depth of water in oceans, seas, or lakes.
Benthic	The benthic zone is the ecological region at the lowest level of a body of water such as an ocean or a lake, including the sediment surface and some sub-surface layers.
Bimodal	Having or involving two modes, in particular (of a statistical distribution) having two maxima.
Biodiversity	The diversity of life.
Biosecurity	Procedures or measures designed to protect the population against harmful biological or biochemical substances.
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.
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.
Elver	A young eel.
Entrainment	The opportunity for fish to follow the flow of diverted water and become entrained.
Extirpated	Eradicate or destroy completely.
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.
Fry	After the yolk sacs have been used up, the young hatched salmonid fish have to start to feed. At this point they are known as fry.
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.
IEF	Important Ecological Feature.
Impact	A change experienced by a receptor (this can be positive, neutral or negative).
Introgession	The transfer of genetic information from one species to another as a result of hybridisation between them and repeated backcrossing.

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.
Lochaber District Salmon Fishery Board (DSFB)	Statutory body with responsibility for salmon and sea-trout fishery protection and enhancement in the Lochaber region.
Lochaber Fisheries Trust (LFT)	Charitable organisation undertaking monitoring and protection of populations of native wild fish in Lochaber region.
Lotic	Running fresh water.
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.
Marine Scotland Science	The scientific Division of Marine Scotland, support Government's by providing expert advice and services on issues relating to marine and freshwater fisheries, aquaculture, marine renewable energy and the aquatic environment.
Morph	A variant. There may be different morphs smoothly changing into one another over time.
Morphology	A term used in river basin management to describe the geomorphological (surface features) processes and attributes of rivers and lakes.
Nutrient	Any substance that nourishes an organism.
Oligotrophic	A waterbody poor in nutrients and plant life and rich in oxygen.
Organic	Involving organisms or the products of their life processes.
Parr	Salmonid fish are known as parr once they are over a year old. They stay in freshwater for between one and four years, feeding on small insects and growing larger.
Pelagic	Pelagic fish live in the pelagic zone of ocean or lake waters – being neither close to the bottom nor near the shore.
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.
Primary productivity	The total amount of organic matter synthesised by the producers (e.g. Green plants) of an ecosystem.
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.
Salmonid	Salmonidae is a family of ray-finned fish, the only living family currently placed in the order Salmoniformes. It includes salmon, trout, chars, freshwater whitefishes, and graylings, which collectively are known as the salmonids.
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.

Smolt	Salmonid parr change into smolts in the spring of their second, third or fourth year. This change from parr into smolts is the process where the salmon are getting ready to head out to sea. Smolts head out to sea in shoals during late spring.
Spring	A natural source of water.
Substrate	The surface or material on or from which an organism lives, grows, or obtains its nourishment.
Substratum	An underlying layer or substance, in particular a layer of rock or soil beneath the surface of the ground.
Superficial deposits	Appearing on the surface of the lake bed
Transect	A straight line or narrow section through an object or natural feature along which observations are made or measurements taken
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).
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.

13 Fish

13.1 Executive Summary

- 13.1.1 The scope of the assessment on fish covers impacts on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais, and impacts on Atlantic salmon, brown/sea trout, ferox trout, Arctic charr, brook lamprey and European eel in Loch Lochy. Survey work carried out for The Consented 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. Additional survey work was undertaken on the inflow streams and shoreline habitats of Loch Lochy. 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.
- 13.1.2 The resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais is of National (UK) importance. The Atlantic salmon, brown/sea trout, ferox trout and Arctic charr populations in Loch Lochy are all of National (UK) importance. The brook lamprey population in Loch Lochy is of National (Scotland) importance and the population of European eel in Loch Lochy is of International importance.
- 13.1.3 The Proposed Development would comprise three main activities during the construction phase that could potentially result in significant negative impacts on fish. These are the construction of the dam and upper reservoir in Coire Glas, construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy, and the use of site establishment and lay down areas. The Proposed Development would comprise four main activities during the operational phase that could potentially result in significant negative impacts. These are water level changes in the upper reservoir, water level changes in Loch Lochy, 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.
- 13.1.4 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.
- 13.1.5 Significant negative effects during the construction phase are predicted on the resident brown trout population in Loch a' Choire Ghlais and Allt a'Choire Ghlais from habitat change, pollution and lighting due to construction of the dam and upper reservoir. No mitigation is possible for habitat change, which would be permanent and of moderate magnitude, but with effective mitigation during construction, temporary pollution events would be avoided and/or reduced in severity. Mitigation is also possible for lighting. Confidence in these predictions is high for lotic habitat change and intermediate for lentic habitat change, pollution and lighting.
- 13.1.6 Significant negative effects during the operational phase are predicted on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais from changes in water level in the upper reservoir. No mitigation is possible. The magnitude of this impact is major but confidence in this prediction is intermediate.

- 13.1.7 Significant negative effects during the operational phase are predicted on a precautionary basis on the Atlantic salmon, brown trout/sea trout and ferox trout populations in Loch Lochy from changes in water level. No mitigation is possible. The magnitude of this impact is low (access to spawning streams) and moderate (changes in primary productivity) but confidence in these predictions is low.

13.2 Introduction

- 13.2.1 EnviroCentre Limited was commissioned to undertake an Ecological Impact Assessment (EclA) of the Revised Coire Glas Pumped Storage Scheme (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 fish. 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 aquatic ecology is provided separately, in Chapter 12: Aquatic Ecology.
- 13.2.2 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.
- 13.2.3 The purpose of this Chapter is to:
- Identify and describe all potentially significant ecological effects relating to fish 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 relating to fish;
 - Identify how mitigation measures would be secured; and
 - Provide an assessment of the significance of any residual effects.

13.3 Scope of Assessment

Zone of Influence

- 13.3.1 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.

13.3.2 The scoping exercise narrowed down the important ecological features. The zone of influence has been set for each one (see Table 13.1 below).

Table 13.1: Important Ecological Features and Zones of Influence

Important Ecological Feature	Zone of Influence
Atlantic salmon	Loch Lochy catchment and accessible Loch Lochy inflow streams up to impassable barriers; Caledonian Canal
Brown/sea trout	Loch Lochy catchment and accessible Loch Lochy inflow streams up to impassable barriers; Loch a' Choire Ghlais and the lower reaches of its inflow streams; Allt a' Choire Ghlais above Kilfinnan Falls; Caledonian Canal
Ferox trout	Loch Lochy catchment and accessible inflow streams up to impassable barriers
Arctic charr	Loch Lochy, the River Arkaig and Loch Arkaig
Brook lamprey	The lower reaches of Loch Lochy inflow streams
European eel	Loch Lochy catchment and accessible inflow streams up to impassable barriers; Caledonian Canal

Scoping and Consultation

13.3.3 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 fish assessment. Relevant scoping responses are presented in Table 13.2 below (excluding those that refer to water quality in general terms).

Table 13.2: Scoping Responses

Consultee	Summary Response	Comment/Action Taken
Lochaber District Salmon Fishery Board (DSFB)	Specific details on how flow management will be managed at Mucomir Barrage so as to deliver an assimilated natural run off to the Rivers Spean and Lochy downstream. The delivery of water downstream of Loch Lochy has at times created serious environmental problems in the River Lochy (see documented evidence in previous responses relating to fish kills) and the increase in loch fluctuation could make this situation much more acute. How will this be properly addressed in the pre-application environmental assessments? What structure and mechanism will be left in place at Mucomir Barrage to manage flow, and will this be part of the overall planning application and CAR Licence? What fish passage arrangements will be put in place at Mucomir Barrage?	Improvements to water management and fish conservation have been made at Mucomir as a result of SSE's refurbishment project in 2017. As part of the construction of The Proposed Development, Mucomir power station would be modified and a new operating regime determined. This would include obtaining all necessary consents and relicensing. It is possible, although not guaranteed, that this modification may involve partially or completely decommissioning Mucomir as a power station and operating it solely as a regulating barrage and fish pass. See section 13.6.27 in this chapter and Chapter 6: Water Management for more details.
	How will the potential impacts downstream on the business interests of the salmon rod fishery on the River Lochy (owned and managed by the River Lochy Association) be assessed in the pre-application assessments? Unnatural fluctuations in river levels can be highly detrimental to the success of the rod	Discussed in Section 6.4 of Chapter 6: Water Management. See also above response. Full details cannot be provided at this stage. SSE request a similar Condition of Consent to that attached to the Section 36 Consent for The Consented Development,

Consultee	Summary Response	Comment/Action Taken
	<p>fishery (see previous application comments) and this fishery, as the largest salmon fishery on the West Coast of Scotland, is a major contributor to the local Fort William economy.</p>	<p>which states: <i>Prior to the Commencement of Development, the Company must submit details of any proposed modifications to the Mucomir Barrage and Power Station for approval in writing by the Planning Authority, who must consult SEPA. Details must include the proposed means of regulating flows into the River Lochy and details of any modifications proposed to the existing fish passage arrangements. The approved modifications must be implemented prior to the operation of the pumped storage hydroelectric generating station unless otherwise agreed in writing with the Planning Authority. .</i></p>
	<p>How are the risks of rapid water level fluctuation on the large salmon farm on Loch Lochy run by Marine Harvest Scotland being assessed, and have they been consulted at an early stage about these proposals and how they may affect the management and bio-security of their cages?</p>	<p>Marine Harvest Scotland has been consulted upon the proposals (see Chapter 4: EIA Approach, Scoping and Consultation). Discussions with Marine Harvest confirmed that the operation of the fish farm would not be affected by more frequent water fluctuations within Loch Lochy (see Chapter 19: Land Use and Recreation).</p>
	<p>How will the rapid fluctuations be managed with regards the delicate water level management of the Caledonian Canal and the traffic using it, and have British Waterways been consulted at an early stage?</p>	<p>See Chapter 6: Water Management. Scottish Canals have been consulted throughout the EIA process (see Chapter 4; EIA Approach, Scoping and Consultation).</p>
	<p>How are the changes in fish habitat and food availability within the loch margins being assessed under these new proposals? (The DSFB has a role in protecting salmon and sea trout but the Lochaber Fishery Trust will no doubt respond with regards to all other freshwater species.) Any loss in productivity to the local trout population could have a negative impact on the local migratory sea trout population.</p>	<p>The changes in fish habitat and food availability within the loch margins of Loch Lochy is assessed in section 13.9.44 to section 13.9.55. The assessment is based upon a 'worst case scenario' i.e. assuming prolonged or frequent drawdown at low loch levels.</p>
<p>Lochaber Fisheries Trust</p>	<p>Loch Lochy supports populations of trout (both sea and brown trout), Arctic charr and Atlantic salmon. As in most large, oligotrophic lochs, the most productive fish foraging habitat is found in a relatively narrow area around the loch margin where light is able to penetrate and drive primary production. The loch margins are also likely to be used by spawning fish, and both trout and salmon are known to spawn in the burns running into Loch Lochy. Rapid fluctuations in the height of lochs caused by the operation of large hydro schemes degrade the quality of habitat along the</p>	<p>The changes in fish habitat and food availability within the loch margins of Loch Lochy is assessed in section 13.9.44 to section 13.9.55. A field survey of selected Loch Lochy inflow streams was conducted in the summer of 2017 to assess the potential effects of fluctuating water levels in Loch Lochy on fish access for spawning. Detailed modelling of changes in loch levels was not undertaken (see above response regarding request for this to be addressed through a Condition of</p>

Consultee	Summary Response	Comment/Action Taken
	<p>loch margin and can prevent fish gaining access to spawning tributaries. There is no drawn-down zone currently visible along the shore of Loch Lochy, probably due to the relatively small and slow changes in water height relative to other dammed lochs.</p> <p>The report states that the new operating regime would result in loch levels that remained within the 1.68m range currently licensed by SEPA. However, the speed as well as the amplitude of change is important in determining the impact and no information is provided about the frequency at which water levels will fluctuate within the stated range under the proposed new operating procedure. We would ask that the EIA includes detailed modelling of changes in loch levels and assesses the impact this will have on loch margin habitats. The area of fish spawning and foraging habitat lost or degraded due to water height fluctuations should be estimated and the effect of water level changes on the accessibility of the River Arkaig and tributary burns for migrating fish should be assessed.</p>	<p>Consent) therefore a 'worst case scenario' has been assessed i.e. assuming prolonged or frequent drawdown at low loch levels. It is not possible to construct accurate Loch Lochy level duration information at this stage as the operation of The Proposed Development would be in response to future electricity markets.</p>
	<p>The River Lochy is the most important salmon river in Lochaber and one of only a few rivers on the west coast capable of supporting a commercial salmon fishery. Water flows in the River Lochy are currently affected by hydro schemes operated by SSE and Liberty Aluminium, and by Scottish Water's abstraction at Camisky Flats. Rapid falls in river level caused by the hydros have resulted in fish kills on the River Lochy in recent years and, though such dramatic effects are infrequent, there is probably an ongoing reduction in the availability and quality of salmon spawning and juvenile habitat in the catchment.</p> <p>We would ask that SSE put forward a proposal on how water flows into the River Lochy are to be managed when the Coire Glas scheme is in operation. Such information was not included in the previous EIA and we feel that this issue does need to be addressed before the scheme is approved and not dealt with through conditions since the potential impact is so great and any solution may need to be integrated within the wider scheme.</p>	<p>Improvements to water management and fish conservation have been made at Mucomir as a result of SSE's refurbishment project in 2017. As part of the construction of The Proposed Development, Mucomir power station would be modified and a new operating regime determined. This would include obtaining all necessary consents and relicensing (see above response regarding request for this to be addressed through a Condition of Consent). It is possible, although not guaranteed, that this modification may involve partially or completely decommissioning Mucomir as a power station and operating it solely as a regulating barrage and fish pass. See section 13.6.27 in this chapter and Chapter 6: Water Management for more details.</p>
Marine Scotland Science	<p>Section 6.8 [of the Scoping Report] relies solely on what is in the ES (2012). Unfortunately this did not document the presence in Loch Lochy of a population of</p>	<p>The question of whether or not Arctic charr is present in Loch Lochy is addressed in section 13.6.31 to section 13.6.33. A field survey of</p>

Consultee	Summary Response	Comment/Action Taken
	Arctic charr, which is a species of high conservation interest, although there was mention of potential spawning habitat for Arctic charr. This omission was discussed in correspondence subsequent to the ES, along with matters related to ferox brown trout and to underwater noise during construction. MSS requests that SSE should look at this material and revise Section 6.8 as appropriate.	selected Loch Lochy shoreline habitats was conducted in the autumn of 2017 to assess their spawning potential for Arctic charr. The potential effects of The Proposed Development on Arctic charr are assessed in section 13.9. The potential effects of underwater noise from the construction of the lower control works are assessed in section 13.9.14 to section 13.9.27.
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: c) Fish passages.	Improvements to water management and fish conservation have been made at Mucomir as a result of SSE's refurbishment project in 2017. As part of the construction of The Proposed Development, Mucomir power station would be modified and a new operating regime determined. This would include obtaining all necessary consents and relicensing. It is possible, although not guaranteed, that this modification may involve partially or completely decommissioning Mucomir as a power station and operating it solely as a regulating barrage and fish pass. See section 13.6.28 in this chapter and Chapter 6: Water Management for more details. The impacts on fish passage during the construction and the operational phases are assessed in section 13.9.

13.3.4 The final scope of the impact assessment on fish 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 of fish habitat loss and fragmentation in Loch a' Choire Ghlais and Allt a' Choire Ghlais, in particular, for ferox brown trout;
- Impacts from underwater noise due to blasting close to the shore of Loch Lochy;
- Impacts of more frequent fluctuations in water level on Loch Lochy changing fish habitat and food availability within the margins in terms of primary productivity;
- Impacts of more frequent fluctuations in water level on Loch Lochy preventing fish gaining access to spawning tributaries;
- Impacts of more frequent fluctuations in water level on Loch Lochy degrading spawning habitat for Arctic charr; and

- Impacts on fish from entrainment in Loch Lochy and the upper reservoir, in particular, the possibility of Arctic charr introgression¹.

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

- Cumulative impacts in connection with other planned developments.

13.4 Policy, Legislation & Guidance

13.4.1 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 EIA 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);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 (CITES);
- The Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003;
- 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;

¹ The transfer of genetic information from one species to another as a result of hybridisation between them and repeated backcrossing.

- 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;
- Lochaber Fisheries Management Plan 2008 by Lochaber Fisheries Trust;
- 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;
- Recommendations for a ‘Coarse Resolution Rapid-Assessment’ Methodology to Assess Barriers to Fish Migration, and Associated Prioritisation Tools. International Centre for Ecohydraulic Research (2008);
- The Salmon (Fish Passes and Screens) (Scotland) Regulations 1994;
- River Crossings and Migratory Fish: Design Guidance by the Scottish Executive (2000);
- UKTAG River Assessment Method River Continuity Barrier to Fish Migration Method (Scotland) WFD-UKTAG 2015;
- WFD111 Phase 2a Coarse resolution rapid-assessment methodology to assess obstacles to fish migration 2010;
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd edition) 2016 by CIEEM; and
- Guidance for Pollution Prevention (GPPs) 2017 by SEPA.

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

13.5 Methodology

Desk Study

13.5.1 The following desk studies were undertaken:

- Collation of existing 2010 and 2011 survey data on fish and fish habitats from Loch a’ Choire Ghlais, Allt a’Choire Ghlais, Kilfinnan Burn and Loch Lochy;
- Updating of the baseline and future baseline to take account of climate change; and
- Literature review of the effects of excessive fluctuations in water level on primary productivity and fish communities in standing waterbodies.

Field Studies

- 13.5.2 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.

Loch Lochy Inflow Streams

- 13.5.3 Twenty-one watercourses were selected for assessment based on their potential value to fish populations and fisheries. Twenty of these were assessed and one was omitted due to access restrictions.
- 13.5.4 Channel morphology and the nearshore littoral area were assessed at each inflow watercourse to determine the likelihood that fish access might become restricted at low loch levels. The criteria used in making these assessments were slope of foreshore, slope of littoral zone, foreshore substrates, littoral zone substrates, presence of exposed or submerged depositional bars and channel cross-sectional shape. Risks to fish access were ranked as minimal, low, moderate or high.
- 13.5.5 Each watercourse was assessed as to its likely value for fish populations (mainly salmonids) and fisheries. The criteria used were accessible wetted area and habitat quality, assessed from field survey and published reports. These data were supplemented with electric fishing data on fish density where available (electric fishing was not undertaken for this project).
- 13.5.6 A risk/value matrix was used to identify potential effects on salmonid fish and fisheries.
- 13.5.7 The full methods for this survey can be found in Appendix 13.1.

Spawning Habitat for Arctic Charr in Loch Lochy

- 13.5.8 At present the operating regime for The Proposed Development is unknown therefore the worst case scenario was considered. In relation to Arctic charr this would be prolonged or frequent drawdown during the spawning season, exposing eggs to be dried out and lost. Prior to the commencement of survey work advice on the specific habitat requirements for Arctic charr was sought from Professor Colin Adams, Professor of Freshwater Ecology (University of Glasgow, Institute of Biodiversity Animal Health and Comparative Medicine) who is an established and well known expert in Arctic charr.
- 13.5.9 To allow for survey effort to be targeted towards preferred areas a review of the shoreline characteristics of Loch Lochy was undertaken. This included reviewing the inflow streams work above that identified areas of Loch Lochy with suitable spawning gravels for salmonids, interrogating existing maps of loch bathymetry, superficial deposits and the predicted influence of the prevailing winds to create well washed gravels. Points around the shoreline of Loch Lochy where spawning gravels could be located were identified. A large proportion of the east shore was scoped out as unsuitable for survey as the banks are artificial and reinforced.
- 13.5.10 The shoreline of the loch was accessed by boat. From the boat a 'spyball' camera was deployed to view the bed substratum. Video footage and still images were viewed. Laser markers were used to estimate the substrate size based on Scottish Fisheries Co-ordination

Centre (SFCC) Habitat Survey guidelines. The water level was between 30.07mOD and 30.30mOD during the survey period, which was below the maximum level of 30.33mOD. The operational range of the scheme was surveyed as far as possible subject to visibility, with <1m and up to 3m being visible in the targeted areas. A transect was driven with a continuous view being provided by the 'spyball'. When the substratum became unsuitable for spawning Arctic charr the water depth was recorded and the survey terminated.

13.5.11 The full methods for this survey can be found in Appendix 13.2. The methods for the previous survey along the shoreline of the lower control works can be found in Appendix 13.3.

Evaluation of Important Ecological Features

13.5.12 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).

13.5.13 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 13.3 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 13.3: 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 An internationally important bryophyte assemblage ² .
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 ³ ; 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	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 10km grid squares); a priority species in the UKBAP ⁴ ; a Schedule 5 (animal) or Schedule 8 (plant) species included in the Wildlife and Countryside Act

² 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).

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

⁴ The UK BAP lists of priority habitats and species have been superseded by the country biodiversity lists, but they are a useful reference source.

Level of Importance	Sites	Habitats	Species
		species.	1981; a Category A nationally important bryophyte assemblage ⁵ .
National (Scotland)	National Parks; Marine Protected Areas; Marine Consultation Areas.	Habitats of principal importance for biodiversity in the relevant countries ⁶ .	Species of principal importance for biodiversity in the relevant countries ⁷ .
Regional	Regional Parks.	Regional Local Biodiversity Action Plan ⁸ habitats noted as requiring protection.	A species that is Nationally Scarce in the UK (present in 16-100 10km grid squares); a species that is included in the Regional LBAP ⁹ ; 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 ¹⁰ habitats noted as requiring protection; semi-natural, ancient woodland >0.25ha in extent.	A species that is included in the Lochaber BAP ¹¹ ; 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

13.5.14 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.

⁵ 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).

⁶ 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.

⁷ 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.

⁸ There is no applicable Regional LBAP.

⁹ There is no applicable Regional LBAP.

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

¹¹ Lochaber BAP available at: <http://highlandbiodiversity.com/userfiles/file/acion-plans/lochaber.pdf>

13.5.15 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.

Assessment Criteria – Magnitude

13.5.16 The CIEEM Guidelines state 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.

13.5.17 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.

13.5.18 Extent: the area of which the impact occurs. When the IEF is the habitat itself, magnitude and extent may be synonymous.

13.5.19 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.

13.5.20 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.

13.5.21 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.

13.5.22 Criteria for describing the magnitude of an impact are presented in Table 13.4:

Table 13.4: 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

- 13.5.23 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).
- 13.5.24 Significant effects are quantified with reference to an appropriate geographic scale (see Table 13.3 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.
- 13.5.25 Professional judgement is used to determine the significance of effects.

Assessment Criteria – Confidence in Predictions

- 13.5.26 CIEEM does not cover levels of confidence in 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.
- 13.5.27 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

13.5.28 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').

13.5.29 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%.

13.6 Baseline Conditions

Designations

13.6.1 There are no sites of nature conservation designated for fish applicable to this assessment.

Water Quantity

Loch a' Choire Ghlais

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

Allt a' Choire Ghlais

13.6.3 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 2016¹².

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

Loch Lochy

- 13.6.4 Loch Lochy is a lake (ID: 100194) in the River Lochy catchment of the Scotland RBD. It is 17.2 km² in area. The waterbody has been designated as a Heavily Modified Water Body (HMWB). A HMWB is one where the extent of modifications prevent it from achieving Good Ecological Status (GES). The WFD requires that all waterbodies achieve GES. However, to restore HMWBs sufficiently to achieve GES would result in the loss of important benefits. Instead HMWBs have to achieve Good Ecological Potential (GEP) – the best condition that can be achieved without significantly reducing the benefits provided by the waterbody. In the case of Loch Lochy, physical alterations cannot be addressed without a significant impact on navigation and water storage for hydroelectricity generation.
- 13.6.5 SEPA have classified this waterbody as having a hydromorphology status of Poor, a morphology status of Moderate and an overall hydrology status of Poor in 2016¹³.
- 13.6.6 Further information on water quantity is presented in Chapter 6: Water Management.

Water Quality and Temperature

Loch a' Choire Ghlais

- 13.6.7 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.
- 13.6.8 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 µS/cm (mean 14.7 µS/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 CaCO₃ (mean 10.3 mg/l CaCO₃) 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 CaCO₃), 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 CaCO₃ as sensitive to acid rain. The buffering capacity of Loch a' Choire Ghlais is low.

Allt a' Choire Ghlais

- 13.6.9 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 Good¹⁴. 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

¹³ Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 041217).

¹⁴ Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 041217).

hydroelectricity scheme development (CAR licence number CAR/L/1108419) (see Licenced Abstractions/Discharges). It is noted that this licence applies to The Consented Development and that these pressures have been applied to the watercourse by SEPA in advance of any development.

- 13.6.10 Information from the macroinvertebrate surveys show that the relative proportions of invertebrate groups indicated clean well-oxygenated conditions with no evidence of organic pollution or enrichment. ASPT scores showed excellent (A1) water quality at all sites in the autumn and spring. 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 CaCO₃ in autumn and 9 mg/L CaCO₃ in spring, indicating low buffering capacity.

Loch Lochy

- 13.6.11 SEPA have classified this waterbody as having an overall status of GEP in 2016 with overall ecological status of Poor and overall chemical status of High¹⁵. There is no change in ecological potential and overall ecological status but an improvement from Pass overall chemical status from 2008. Temperature and alkalinity are not included in the assessment but its acid neutralising capacity is High.
- 13.6.12 The UK Lakes Portal¹⁶ has the following physical and chemical data for Loch Lochy (Table 13.5).

Table 13.5: UK Lakes Portal Data for Loch Lochy

Parameter	Data
Surface area	1,720 hectares
Mean depth	69.8 metres
Maximum depth	161.8 metres
Catchment area	37,244 hectares
Altitude	33 metres Above Ordnance Datum (AOD)
Perimeter length	39 kilometres
Fetch distance	15.62 kilometres
Distance to sea	10.57 kilometres
Waterbody volume	1,200,612,071 cubic metres
Catchment : lake ratio	21.7
Geology type / mean alkalinity	Low alkalinity / 88 microequivalents per litre
Humic type / mean colour	Clear / 16.0 milligrammes of platinum per litre
Mean dissolved organic carbon	2.49 milligrammes per litre
Mean conductivity	179 microsiemens per centimetre

¹⁵ Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 041217).

¹⁶ UK Lakes Portal available at: <https://eip.ceh.ac.uk/apps/lakes/detail.html#wbid=21328> (accessed 111217).

Pressures on Loch Lochy

- 13.6.13 The water resource pressures on Loch Lochy are an abstraction for hydropower generation and a lesser abstraction to feed a navigable canal, together with structures to impound water and enable those abstractions. Measures are in place to ensure that flows downstream from the abstraction never drop below an acceptable level. Any further measures would be deemed to have an unacceptable impact on renewable energy generating capacity or navigation.
- 13.6.14 SEPA holds details of six measures relating to Loch Lochy as follows:
- Two abstraction pressures (one for hydropower, one for water transport). Both measures have been screened out as they are not required for GEP as there is a significant impact on the designated use;
 - Two flow regulation (both for water transport). Both measures have been completed in full; and
 - Two morphological alteration (one for hydropower, one for water transport). Both measures have been screened out as they are not required for GEP as there is a significant impact on the designated use.
- 13.6.15 The WFD classification data provided for Loch Lochy shows that, although the waterbody classifies at Poor for hydrology (water resources), it has been classified at GEP overall. SEPA data indicate no evidence of pressures on water quality. This classification has not changed since before 2010, which means that under the WFD, no further improvements are required.

Physical Habitats

- 13.6.16 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.

Fish Habitats and Populations in the Loch a' Choire Ghlais/Allt a' Choire Ghlais /Kilfinnan Burn Catchment

- 13.6.17 Full details of the surveys undertaken in 2010 and 2011 are available in Appendix 13.3.
- 13.6.18 Kilfinnan Burn may be accessible to migratory fish only in its lower 400m, as the bridge apron at Kilfinnan appears to create a difficult obstacle at most flows. Since salmonid habitat surveys were first completed for this project in 2010 the bridge apron has degraded further. It now not only represents an almost complete barrier to fish movements both up and downstream, but it also represents a hazard which will physically damage any fish attempting to pass it.
- 13.6.19 Spawning habitats suited to salmonids and lampreys are present in the lower accessible reaches of the Kilfinnan Burn, close to Loch Lochy. Upstream from Kilfinnan the burn is steep with large areas of bedrock and numerous rapids and waterfalls. Salmonid habitat is consequently of poor quality and resident trout populations are likely to persist mainly in fragmented pockets of suitable habitat separated by obstacles. Kilfinnan Falls is impassable. Immediately upstream from the falls there is a long, incised bedrock gorge with several further waterfalls. Immediately upstream from the gorge, there are

alternating reaches of boulder and bedrock dominated habitats. Good quality trout habitat is present in the 1.2km of stream immediately below Loch a' Choire Ghlais.

- 13.6.20 The inflow stream at the northwest end of Loch a' Choire Ghlais provides large areas of good quality spawning habitat.
- 13.6.21 Juvenile trout were present at all survey sites with the exception of one small stream running into the southwest side of Loch a' Choire Ghlais. Juvenile trout were abundant in the lower reaches of the Kilfinnan Burn and some of these fish are likely to contribute to the sea trout population. Upstream from impassable obstacles, trout will largely be resident. A high density of trout fry was found in the stream running into the northwest side of Loch a' Choire Ghlais, consistent with the abundance and quality of spawning habitat in this stream.
- 13.6.22 Larval lampreys were present only in the lower reaches of the Kilfinnan Burn, accessible from Loch Lochy. These are likely to be brook lampreys.
- 13.6.23 Other fish species present in Kilfinnan Burn were eels and minnows. Eels were present at two sites downstream from Kilfinnan Falls. Minnows were found only at the site closest to Loch Lochy. It is likely that the upper catchment of the Kilfinnan Burn is largely inaccessible to eels due to the very high waterfalls and deep gorges.
- 13.6.24 Loch a' Choire Ghlais is a shallow, weedy basin that nowhere exceeds 50 cm depth. The substrate is mud and decaying vegetation. The loch was observed to hold a good number of small trout. Loch a' Choire Ghlais is considered to be unsuitable for Arctic charr due to its small size, extremely shallow water and lack of suitable substrate.

Fish Habitats and Populations in the Lochy Catchment

Catchment¹⁷

- 13.6.25 The Lochy catchment is the largest in Lochaber and includes a number of sizeable tributaries, notably the Rivers Spean and Roy, and the large oligotrophic lochs Arkaig and Lochy. The River Arkaig leaves Loch Arkaig and joins with Loch Lochy, whose outflow is the main River Lochy. The River Roy flows into the River Spean, which subsequently forms the River Lochy when it is joined by the outflow from Loch Lochy. The Caledonian Canal, constructed between 1823 and 1825, branches off from Loch Lochy at Gairloch and runs parallel to the River Lochy for 7 km before joining the sea at Banavie.
- 13.6.26 The Mucomir Barrage (Gairloch) is a hydroelectric dam installed at the top of the River Lochy in the late 1950s. The dam incorporates a Borland lift to allow the upstream migration of adults. The fish pass at the top of the Borland lift is fitted with an automatic fish counter. There is no smolt pass so the smolts mainly pass down through the turbine or down the fish lift. Past studies have shown that salmon and sea trout smolts are able to successfully negotiate the Mucomir Barrage but there are concerns about safe passage for sea trout, which are bigger than salmon and thus more likely to be hit by a blade as they go through the machine. The intake is screened but small sea trout along with salmon and sea

¹⁷ Information from the Lochaber Fisheries Management Plan 2008 and from the Lochaber DSFB Scoping Response in 2012.

trout smolts can pass through the screen. There is also anecdotal evidence that salmon smolts may congregate above the dam, delaying downward migration and exposing them to predators. On occasions the operation at Mucomir has caused fluctuation in river levels such that gravel bars and backwater sections of the mainstem of the river have been dewatered resulting in the loss of juvenile salmon and trout.

- 13.6.27 Improvements to water management and fish conservation have been made at Mucomir as a result of SSE's refurbishment project in 2017. The main generator (G1) has been replaced with a 'fish friendly' Kaplan turbine. This machine has been shown to be significantly better in allowing successful passage of juvenile salmonids migrating downstream. The suppliers have designed and developed the turbine to minimise damage to fish under certain generating conditions, maximising clean laminar flow. The operating regime during the smolt run aims to keep the turbine operating optimally for as long as possible to minimise smolt injury. The compensation set (G2) has also been replaced and this has significantly improved the way in which fish passage is affected. With the compensation set operating continuously it provides an attractive water flow adjacent to the Borland lift entrance both at the top gate and in the tailrace, aiding upstream migrating adult salmon and sea trout from finding the lower entrance to the fish pass. The running of G2 is also important for downstream moving fish as the entrance to the fish pass is adjacent to the intake. The intake has now been adequately screened with a rakeable bar screen. With G2 running, smolts heading downstream will also find the fish pass more easily in addition to those descending via G1. This will reduce the damage done to smolts by them having to pass under floodgates in low flow scenarios. The G2 intake screens will also screen the comp valve/gate (R30), which has been overhauled and will again provide a safe water flow adjacent to the fish pass if for whatever reason G2 is not operating. Finally, the control system for the floodgates has been overhauled to improve the sensitivity over the gates' range. The result of G1, G2, R30 and the floodgates fully refurbished should mean a notable reduction in the sudden dewatering issues downstream, as well as a notable reduction in the time when the floodgates are used when high flows are not present. This scenario has been noted as a problem in the past, causing a distraction for adult salmon and sea trout in finding the fish pass.
- 13.6.28 A salmon farm run by Marine Harvest (Scotland) Limited is present at the southern end of Loch Lochy. Over 10,000 juvenile salmon escaped in 2010¹⁸. Prior to this incident there had been a number of rainbow trout escapes from the site. These escapes have raised concerns in relation to possible negative impacts on wild salmonid stocks.

*Fish Populations*¹⁹

- 13.6.29 Salmon, sea trout, brown trout, eel, brook lamprey, stickleback, flounder and stone loach have all been recorded from the Lochy catchment. Minnow and pike have become naturalised in the catchment. There are historical records of sea lamprey on the Lochy system, but local anglers report an absence of the species in recent years.

¹⁸ Information from http://aquaculture.scotland.gov.uk/data/fish_escapes.aspx?ms_site_id=FS0150 (accessed 081217).

¹⁹ Information from the Lochaber Fisheries Management Plan 2008 and from published records.

- 13.6.30 Salmon are known to migrate through the canal. The canal was drained in the winter of 2006 for maintenance and was found to contain brown trout, rainbow trout, pike and large numbers of eels.
- 13.6.31 An Arctic charr population was confirmed present in Loch Lochy by gill-netting in or around 2007 (both polymorphic with both benthic and pelagic morphs present)²⁰. The UK rod and line caught record specimen Arctic charr fish was caught in Loch Arkaig. Loch Arkaig is situated to the west of Loch Lochy and is connected to Loch Lochy by the River Arkaig which flows west to east (see Appendix 13.2).
- 13.6.32 In order to maintain suitable spawning gravels in lochs there needs to be a continuous supply of sediment transported by rivers. Loch Lochy lies in a steep sided valley with many small tributaries feeding in but few significant watercourses supplying gravels. The River Arkaig provides spawning habitat for Atlantic salmon, brown trout and anecdotally ferox trout. There is some suboptimal spawning habitat for Arctic charr.
- 13.6.33 It is noted in the literature that Arctic charr are a habitat generalist like no other and within a lake can use all major habitats and depth zones²¹. Arctic charr prefer the littoral zone but can shift flexibly to pelagic or profundal zones under competition. Parr of trout and salmon occupied the littoral habitat in several north Norwegian lakes while Arctic charr were found in the deeper and pelagic zone²². Arctic charr have also been recorded at depths of 220 m in Loch Ness²³.

Shoreline Habitats

- 13.6.34 In the area surveyed in 2010, the shoreline substrates of Loch Lochy showed consistent depth zonation, with a boulder-dominated upper shore, a mixed shallow littoral zone and a steep drop off onto mud or sand at a depth of around 4 m. The exception to the above pattern was in the shallow, weedy bay to the immediate north east of Glas-Dhoire, where the substrate was composed of sand and cobble. This bay provided suitable spawning habitat for pike. Potential spawning habitat for Arctic charr was noted to be widespread in the shallow littoral zone in this location²⁴ in scattered patches of gravel, coarse sand and pebble among the larger substrates, mainly at a depth of 1 m to 2 m. These potential spawning habitats were present in the form of scattered patches among otherwise unsuitable habitat. No optimal habitat for Arctic charr to spawn was recorded during the targeted survey of the Loch Lochy shoreline in 2017. The Glas-Dhoire bay²⁵ was surveyed and found to be not suitable. One area of suitable gravels was recorded at the mouth of the River Gloy²⁶ but this was suboptimal at best.
- 13.6.35 Table 13.6 below presents the results of the inflow streams survey.

²⁰ Mark Hirst, employed by Achnacarry Estate as keeper and acts as the Protection Order warden, confirmed that commercial Arctic charr fishermen using downrigger techniques with a number of silver spoon lures caught "plenty" of "above average sized" charr (pers. comm.).

²¹ Klemetsen, A. Amundsen, P. A., Dempson, J. B., Jonsson, B., Jonsson, N., O'Connell, M. F. and Mortensen, E. (2003). Atlantic salmon *Salmo salar* L., brown trout *Salmo trutta* L. and Arctic charr *Salvelinus alpinus* (L.): a review of aspects of their life histories. *Ecology of Freshwater Fish* 12.1: 1-59.

²² Halvorsen, M., Jørgensen, L. and Amundsen, P. A. (1997). Habitat utilisation of juvenile Atlantic salmon (*Salmo salar* L.), brown trout (*Salmo trutta* L.) and Arctic charr (*Salvelinus alpinus* L.) in two lakes in northern Norway. *Ecology of Freshwater Fish* 6: 67-77.

²³ Shine, A.J., Kubecka, J., Martin, D.S. and Duncan, A. (1993). Fish habitats in Loch Ness. *Scottish Naturalist* 105: 237-255.

²⁴ NN251931 to NN261941.

²⁵ Site 7 (NN 25327 93205).

²⁶ Site 14 (NN 22267 88389).

13.6.36 See Appendices 13.2 and 13.3 for further details on the shoreline habitats.

*Fisheries*²⁷

13.6.37 The River Lochy supports the largest salmon fishery in the region, accounting for 85% of the salmon caught in Lochaber. Salmon and sea trout are also fished on the Rivers Roy, Spean, Dessary and Pean. The River Lochy Association (RLA) has undertaken a stocking programme in the past and stocks hundreds of thousands of fry and smolts of native origin throughout the catchment.

13.6.38 The River Lochy suffered a dramatic decline in sea trout and salmon numbers in the 1990s. In recent years salmon rod catches have improved considerably, possibly due to improvements in lice management on Loch Linnhe fish farm sites and the RLA's stocking programme. However, salmon numbers are still variable between years and grilse returns show a biannual cycle of good and poor years. Sea trout numbers have remained at historically low levels.

13.6.39 Lochs Arkaig and Lochy are fished for brown trout (including ferox trout) and pike. Loch Arkaig is covered by a protection order, but fishing on Loch Lochy is largely unregulated.

13.6.40 Arctic charr are rarely fished for in Loch Lochy (see Appendix 13.1).

²⁷ Information from the Lochaber Fisheries Management Plan 2008 and from the Lochaber DSFB Scoping Response in 2012.

Table 13.6: Estimated accessible area of survey streams and classification of importance to fish and fisheries

Watercourse	Accessible length (m)	Wet width (m)	Approx. accessible area (m ²)	Habitat quality	Comment	Importance to fish and fisheries
Allt Criche	10	1	10	Poor	Little spawning potential. Poor juvenile habitat.	Minimal
Allt na h-Atha	60	1.4	84	Poor	Unstable. Lack of spawning habitat.	Minimal
Allt Tarsuinn-eas	30	3	90	Poor	No accessible spawning habitat above road.	Minimal
Dearg Allt	100	1	100	Poor	Little spawning potential. Poor juvenile habitat.	Minimal
Unnamed 3	50	2	100	Moderate	Short section of accessible productive habitat.	Low
Unnamed 1	150	0.8	120	Poor	Some spawning potential.	Low
Allt a Choilich	100	1.5	150	Poor	Spawning habitat present.	Low
Allt an Fhasaich Dhuibh	150	1.4	210	Moderate	Spawning and fry habitat but small accessible area.	Low
Allt a Mhanain	160	1.5	240	Moderate	High trout fry density 1998 but small accessible area.	Low
Unnamed 2	250	1	250	Poor	Spawning and fry habitat but small accessible area.	Low
Allt na Faing/Allt Glas-Dhoire Mor	70	5	350	Poor	Trout fry and parr present at low density in 1998.	Low
Allt Creag Innes nam Bo	800	1.5	1200	Good	Excellent trout fry density. Good spawning habitat.	High
Allt Glas-Dhoire	290	5	1450	Poor	Low trout fry density in 1998 consistent with habitat.	Moderate
River Gloy	-	-	2000	Poor	Area based on Watt <i>et al.</i> 1998 ²⁸ .	Moderate
Uisge Dubh	400	5	2000	Low	Accessible length is uncertain due to waterfalls of unknown permeability. Area based on Watt <i>et al.</i> 1998.	Moderate
Allt an t-Sidhein	1200	2	2400	Moderate	Large accessible area with spawning habitat. One of only two substantial spawning burns at N end of loch.	High
Allt Coire Choille-rais	800	4.5	3600	Good	Salmon spawning stream.	High
Kilfinnan Burn	-	-	5350	Good	Area based on Waterside Ecology 2011 ²⁹ .	High
Allt Bhan (Clunes Burn)	2800	3	8400	Good	High juvenile trout densities. Good spawning habitat.	High
River Arkaig	-	-	25000	Good	Area based on Watt <i>et al.</i> 1998.	High

²⁸ Watt, J., Bartels, B. and Spence, R. (1998). A survey of trout populations of Loch Lochy, Inverness-shire. Report to Highland Council. Lochaber Fisheries Trust.

²⁹ Waterside Ecology (2011). Coire Glas pumped storage scheme: assessment of fish habitats and populations. Commissioned report to EnviroCentre Ltd., August 2011.

13.7 Prediction of Future Baseline

Climate change³⁰

- 13.7.1 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.
- 13.7.2 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.
- 13.7.3 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 rainfall³¹ would lead to more flash flooding.
- 13.7.4 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 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.
- 13.7.5 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.

³⁰ Taken from <http://www.nerc.ac.uk/research/partnerships/ride/lwec/report-cards/> (accessed 111217). Source papers can be found at this link.

³¹ 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.

13.7.6 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. Increased water temperatures may threaten cold-water fish species, with invasive and non-native fish species finding conditions more favourable. 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.

13.8 Evaluation

13.8.1 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 13.7 below.

Table 13.7: Evaluation of Important Ecological Features

IEF	Importance	Justification
Atlantic salmon	National (UK)	Atlantic salmon is a UK BAP Priority Species and is on the Scottish Biodiversity List (SBL). The Lochaber BAP's River, Loch and Wetland chapter states the decline in Atlantic salmon as a main issue in the region. Despite this decline, the River Lochy catchment, which includes Loch Lochy and the Caledonian Canal, continues to support one of the largest populations of Atlantic salmon in western Scotland. There is no Atlantic salmon population in Allt a' Choire Ghlais/Kilfinnan Burn above the major waterfalls.
Brown/sea trout	National (UK)	Brown/sea trout is a UK BAP Priority Species and sea trout is on the SBL. The Lochaber BAP's River, Loch and Wetland chapter states the decline in sea trout as a main issue in the region. Despite this decline, the River Lochy, Loch Lochy and Caledonian Canal support a large and potentially diverse brown/sea trout population. There are resident brown trout populations in Loch a' Choire Ghlais and Allt a' Choire Ghlais/Kilfinnan Burn in suitable habitats upstream of major waterfalls. Small, isolated populations of resident brown trout are widespread and abundant in upland lochs and streams in Highland Region.
Ferox trout	National (UK)	Ferox trout is a UK BAP Priority Species but it is not listed specifically on the SBL nor mentioned in the Lochaber BAP. Loch Lochy supports a ferox trout population.
Arctic charr	National (UK)	Arctic charr is a UK BAP Priority Species and is on the SBL. The Lochaber BAP's River, Loch and Wetland chapter states that isolated Arctic charr populations, remnants since fish colonisation after the last Ice Age, are found in some of the deep freshwater lochs. Arctic charr are present in Loch Lochy and in Loch Arkaig, which is connected to Loch Lochy by the River Arkaig. The River Arkaig may provide spawning habitat for Arctic charr and there is suboptimal spawning habitat in Loch Lochy. Loch a' Choire Ghlais is considered to be unsuitable for Arctic charr due to its small size, extremely shallow water and lack of suitable substrate.
Brook lamprey	National (Scotland)	Brook lamprey is not listed in the UK BAP but it is on the SBL and it is a local priority in the Lochaber BAP. Brook lampreys are present in

IEF	Importance	Justification
		the River Lochy and were found in suitable habitat on the Kilfinnan Burn near Loch Lochy. It is also probable that larval lampreys are present at low density in the softer areas of sediment at Glas-Dhoire. It can therefore be concluded that they are present in Loch Lochy. Brook lampreys are absent from many rivers in the west Highlands.
European eel	International	The European eel is a UK BAP Priority Species and is on the SBL. It has recently been added to Appendix II of CITES and it is Critically Endangered on the IUCN Red List ³² . The River Lochy, Loch Lochy and the Caledonian Canal support an eel population and there are extensive areas of suitable eel habitat present. Eels were absent from Allt a' Choire Ghlais and are restricted to the lower reaches of Kilfinnan Burn downstream of Kilfinnan Falls. There are very large areas of suitable eel habitat in the catchment.

13.9 Potential Effects

13.9.1 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 13.7 (for full details please refer to Chapter 3: Description of Development):

- Construction of the dam and upper reservoir in Coire Glas;
- Construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy; and
- The use of site establishment and lay down areas.

13.9.2 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 13.7 (for full details please refer to Chapter 3: Description of Development):

- Water level changes in the upper reservoir;
- Water level changes in Loch Lochy;
- 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.

13.9.3 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.

³² IUCN Red List available here: www.iucnredlist.org (accessed 111217).

Construction Phase

Construction of the dam and upper reservoir in Coire Glas

Nature of Impacts

- 13.9.4 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

- 13.9.5 The impacts from the construction of the dam would be of relatively short duration (between Year 3 and Year 6). Normal construction shifts would generally apply for the surface works but these would be subject to some variation to suit the work in hand and weather conditions, to be agreed with The Highland Council. It is anticipated that underground operations would need to continue 24 hours a day, seven days a week. Outdoor area lighting would be provided in the parking areas, construction areas, along main access routes, and at key project structures as required.
- 13.9.6 The loch and the upper reaches of the burn would not be restored to their former states during the operational phase, therefore there would be a permanent impact on brown trout.

Magnitude of Impacts

- 13.9.7 The impact from the creation of the upper reservoir would extend to the whole loch and approximately one sixth of the length of the Allt a' Choire Ghlais. The impact would be irreversible. The magnitude of the impact is predicted to be 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.
- 13.9.8 The brown trout in the loch and the watercourse above the dam would remain during the construction period, although passage between the three sections of the waterbody would be blocked. Inundation behind the dam would then cause the loss of lentic and lotic habitats. It is unlikely that trout would persist in the upper reservoir; the fluctuations in water level would destroy the existing spawning habitats and no new spawning habitats would be created on the eroded shoreline. However, it is conceivable that even if the trout population behind the dam is extirpated, trout may become re-established from Loch Lochy, although, again, water level fluctuations would mean that there would be little suitable spawning and foraging habitat in the upper reservoir.
- 13.9.9 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. There could also be releases of hydrocarbons and concrete from the works. Pollution of Loch a' Choire Ghlais and Allt a' Choire Ghlais 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 and spawning habitat) could also be smothered. There could be indirect and direct impacts on brown trout as a result. 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, pollution events would be avoided and/or reduced in severity.

- 13.9.10 The detail of the works lighting during construction is not available at this stage. The magnitude of lighting impacts is predicted to be 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. This is due to the majority of the surface works being carried out in daylight hours.

Importance of IEF

- 13.9.11 Brown trout is of National (UK) importance.

Significance of Effects

- 13.9.12 The creation of the upper reservoir, pollution and lighting during construction would result in significant effects at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a'Choire Ghlais. If a replacement trout population establishes in the upper reservoir, then the loss of lentic trout habitat would not be significant.

Confidence in Assessment

- 13.9.13 Loss of lotic habitat, A: high confidence. Loss of lentic habitat, B: intermediate confidence, due to the uncertainty of whether a replacement trout population would establish in the upper reservoir. Pollution, B: intermediate confidence, due to uncertainty about the methods of working during construction and the ability to contain pollution events. Lighting, B: intermediate confidence, due to lack of detail at this stage.

Construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy

Nature of Impacts

- 13.9.14 The lower control works would be constructed below minimum water level but part of the structures would be visible. The finished structures frontage would be approximately 200 m long, 17 m in height (mostly underwater), 1.5 m above the existing maximum Loch Lochy surface level, and extending approximately 10 m from the natural shoreline into Loch Lochy.
- 13.9.15 The majority of construction would take place in dry conditions using drill, blast, muck and haul techniques. The tailrace tunnel portals would be formed close to loch elevation, positioned behind a natural cofferdam of unexcavated rock to minimise the amount of underwater construction work. No detailed information is available on the nature of

blasting or piling at this stage. Blasting and piling would produce underwater noise in Glas-Dhoire bay and the noise may also propagate further out into Loch Lochy.

- 13.9.16 To facilitate use of the Caledonian Canal for the transport of heavy equipment and materials, and the removal of tunnel spoil, a jetty would be constructed on the shore of Loch Lochy. A jetty of length 200 m and minimum water depth of approximately 5 m is proposed. The jetty is anticipated to extend approximately 20 m into Loch Lochy (from low water level). At the end of construction it is anticipated that some of the jetty would be removed, leaving the remaining structure for use during project operation.

Duration of Impacts

- 13.9.17 The impacts from the construction of the lower control works and jetty would be of relatively short duration (between Year 3 and Year 6). Normal construction shifts would generally apply for the surface works but these would be subject to some variation to suit the work in hand and weather conditions, to be agreed with The Highland Council. It is anticipated that underground operations would need to continue 24 hours a day, seven days a week. Outdoor area lighting would be provided in the parking areas, construction areas, along main access routes, and at key project structures as required.

- 13.9.18 The impact of habitat loss would be permanent, apart from in the small area of fish habitat under the portion of the jetty that would be removed.

Magnitude of Impacts

- 13.9.19 The construction of the lower control works would extend to 200 m x 10 m (2,000 m² or 0.2 hectares) along the shoreline of Loch Lochy. The construction of the jetty would extend to approximately 200 m, with approximately 20 m being into the loch. However, the construction footprint is likely to be larger than the infrastructure footprint (no details are available at this stage). The majority of the impacts of habitat loss in this area would be irreversible. The magnitude of the impacts is predicted to be 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 IEFs will be similar to the pre-development conditions; and/or having a minor impact on the known populations or ranges of the IEFs.

- 13.9.20 Releases of sediment, hydrocarbons and concrete from the works could affect natural sediment processes and cause smothering and contamination, although mitigation is provided through working for the majority of the time in the dry. There could be indirect and direct impacts on the IEFs as a result. 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.

- 13.9.21 The magnitude of underwater noise and lighting impacts is predicted to be low due to the majority of the work being carried out in the dry and in daylight hours.

Importance of IEFs

- 13.9.22 The shoreline habitats in Glas-Dhoire bay are suitable for Atlantic salmon (National (UK) importance), brown/sea trout (National (UK) importance), ferox trout (National (UK) importance), brook lamprey (National (Scotland) importance) and European eel (International importance). These species are either anadromous or undergo loch to stream migrations. There is some suitable habitat for Arctic charr (National (UK) importance) within the area of the shore surveyed (see Appendix 13.3).

Significance of Effects

- 13.9.23 The shallow weedy habitats in Glas-Dhoire bay provide good foraging habitat for adult and juvenile trout. It is also probable that larval lampreys are present at low density in the softer areas of sediment. The lower reaches of the Allt Glas-Dhoire were briefly inspected in 2010 and appeared to offer a few patches of spawning habitat likely to be utilised by trout and, perhaps, occasional salmon (see Appendix 13.3). Due to the limited accessible area and the poor quality of habitat in Allt Glas-Dhoire Mor and Allt Glas-Dhoire, their importance to fish and fisheries was assessed as being low and moderate respectively in 2017 (see Appendix 13.1). Habitat loss due to the construction of the lower control works and the jetty in this area is not predicted to result in any significant effects on the salmonid IEFs. Likewise, no significant effects are predicted on brook lamprey or European eel as there is more and better suitable habitat in other areas of the loch and within its inflow streams.
- 13.9.24 The effects of noise on fish can be behavioural, sub-lethal or lethal, depending on the magnitude of the sound level. Sound travels much faster in water than in air and the pressures associated with underwater sounds tend to be much higher than in air. Noise may have important behavioural effects on a species, such as avoidance of the noisy area. The significance of the effect requires an understanding of its consequences; for instance, avoidance may be significant if it causes a migratory species to delay for an extended period or avoid entirely their natural migratory routes. However, in other cases, the movement of species from one area to another may be of no consequence³³. Avoidance appears to be associated with a sensation of 'unbearable loudness', therefore the perception of sound by a species needs to be understood. In fish species, the variation in perception appears to be linked to the distance between the swim bladder and the inner ear. For example, the swim bladder of the Atlantic salmon is not in close proximity to the ear anatomy and as such this species has poor hearing. Salmon is one of the most sensitive 'hearing generalists'; other hearing generalists include the brown trout. Underwater noise negatively affects small fish to a greater extent than large fish.
- 13.9.25 The group most sensitive to noise, salmonids, of all life stages, may be in close proximity to the noise sources. It is near certain that these fish would avoid the noisy environment in the bay during blasting and piling, thereby avoiding sublethal and lethal effects, but incurring behavioural effects, especially in sensitive migration periods. Salmon smolts are not likely to be migrating south west along the shoreline from streams in the north east of Loch Lochy as none have been found in these streams. Electro-fishing data show salmon only to be present in the River Arkaig and Allt Coire Choille-rais, therefore salmon have

³³ Subacoustech Environmental Limited (2009). Subsea noise impact modelling in support of piling operations at Torry Quay, Aberdeen.

been discounted. Brown trout are likely to spawn in Allt Glas-Dhoire, therefore there may be a dip in the population in one year when the cofferdam is removed. Juvenile trout that may become sea trout may be present in the area, as may the juvenile stages of Arctic charr, but both are more likely to be further out into the loch. As there are many variables that affect trout survival no significant effects are predicted. No significant effects are predicted on salmonids overall, as temporary avoidance of the area is of no consequence.

- 13.9.26 There is a tendency towards increasing sound speed at increasing depth. A clear and relatively consistent depth zonation of substrate type was evident along most of the surveyed area in Loch Lochy (see Appendix 13.1). The upper shore is composed largely of boulder with wave-washed gravel and pebble. There are occasional outcrops of bedrock, but these are not abundant. In 1 m to 2 m depth of water the substrates are composed of scattered boulders with more pebble, coarse sand and cobble than is visible on the upper shore. This habitat appears quite stable, with occasional small patches of vegetation. At a distance of 20 m to 30 m offshore and a depth of about 3 m the gradient of the littoral zone increases in a classic 'drop-off'. The first part of the down-slope is composed almost entirely of cobble with a rapid transition to sand or mud at a depth of ≤ 4 m. This sandy/muddy substrate extends down to the limit of visibility. Available bathymetry suggests that the steep gradient continues, with a depth of 30 m attained at a distance of around 50 m to 75 m from the shore. The chief exception to the above pattern is found in Glas-Dhoire bay. Here the nearshore substrate is composed of sand and cobble with abundant vegetation and woody debris. Such habitat extends some 40 m offshore before shelving off into deeper water. This environment is presumably created by fine material and organic matter, propelled by local currents and the prevailing south westerly winds, depositing behind the spit that runs out into the loch from the Allt Glas-Dhoire. The combination of the predicted low magnitude of underwater noise, the shallow water conditions at the lower control works site, and the suspected presence of Arctic charr in the deeper waters of Loch Lochy, has led to the conclusion that there would be no significant effects on this species in particular from underwater noise.
- 13.9.27 Pollution and lighting during construction of the lower control works and jetty are not predicted to result in significant effects on the IEFs, even in sensitive migration periods, for the reasons described above in section 13.9.25.

Confidence in Assessment

- 13.9.28 Habitat loss, A: high confidence. Noise, B: intermediate confidence, due to uncertainty about the methods of working during construction and the propagation of underwater noise. Pollution, B: intermediate confidence, due to uncertainty about the methods of working during construction and the ability to contain pollution events. Lighting, B: intermediate confidence, due to lack of detail at this stage.

The use of site establishment and lay down areas

Nature of Impact

- 13.9.29 As far as practicable, temporary works at the dam site would be established within the upper reservoir area in order to minimise disruption to other areas during construction. However, it is likely that a site compound and laydown area would also be required at the dam site located outside the upper reservoir footprint. There would also be a need for site

establishment and lay down areas in the vicinity of the surge shaft and lower control works, as shown indicatively on Figure 3.1: Scheme Overview.

Duration of Impact

- 13.9.30 The anticipated construction programme for the core civil engineering construction period would last up to seven years. Normal construction shifts would generally apply for the surface works but these would be subject to some variation to suit the work in hand and weather conditions, to be agreed with The Highland Council. It is anticipated that underground operations would need to continue 24 hours a day, seven days a week. Outdoor area lighting would be provided in the parking areas, construction areas, along main access routes, and at key project structures as required.

Magnitude of Impact

- 13.9.31 Releases of sediment, hydrocarbons and concrete from the site establishment area located outside the upper reservoir footprint could affect natural sediment processes and cause smothering and contamination. There could be indirect and direct impacts on brown trout in Loch a' Choire Ghlais and Allt a' Choire Ghlais as a result. There could be similar indirect and direct impacts on the IEFs in Loch Lochy from pollution from the site establishment areas in the vicinity of the surge shaft and lower control works. 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 construction, pollution events would be avoided and/or reduced in severity.
- 13.9.32 The detail of the works lighting is not available at this stage. The magnitude of lighting impacts is predicted to be 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 IEFs will be similar to the pre-development conditions; and/or having a minor impact on the known population or range of the IEFs. This is due to the majority of the work being carried out in daylight hours.

Importance of IEFs

- 13.9.33 Loch a' Choire Ghlais and Allt a' Choire Ghlais: brown trout is of National (UK) importance.
- 13.9.34 Loch Lochy: The shoreline habitats in Glas-Dhoire bay are suitable for Atlantic salmon (National (UK) importance), brown/sea trout (National (UK) importance), ferox trout (National (UK) importance), brook lamprey (National (Scotland) importance) and European eel (International importance). There is some suitable habitat for Arctic charr (National (UK) importance) within the area of the shore surveyed (see Appendix 13.3).

Significance of Effects

- 13.9.35 Pollution and lighting during construction would result in significant effects at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais.
- 13.9.36 No significant effects on the IEFs in Loch Lochy are predicted as the site establishment and lay down areas are in the dry behind the cofferdam.

Confidence in Assessment

- 13.9.37 Pollution, B: intermediate confidence, due to uncertainty about the methods of working during construction and the ability to contain pollution events. Lighting, B: intermediate confidence, due to lack of detail at this stage.

Operational Phase

Water level changes in the upper reservoir

Nature of Impact

- 13.9.38 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. These levels would be subject to detailed design.

Duration of Impact

- 13.9.39 The impacts of changes in water level in Loch a' Choire Ghlais would be permanent.

Magnitude of Impact

- 13.9.40 The magnitude of the impact of changes in water level would be major; major alteration to the IEFs, such that they will be fundamentally changed. The superficial deposits would be eroded between the minimum and maximum operating levels. 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.

Importance of IEFs

- 13.9.41 Brown trout is of National (UK) importance.

Significance of Effects

- 13.9.42 It is unlikely that trout would persist in the upper reservoir; the fluctuations in water level would destroy the existing spawning habitats and no new spawning habitats would be created on the eroded shoreline. However, it is conceivable that even if the trout population behind the dam is extirpated, trout may become re-established from Loch Lochy, although, again, water level fluctuations would mean that there would be little suitable spawning and foraging habitat in the upper reservoir. It is therefore concluded that there would be significant effects at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a'Choire Ghlais.

Confidence in Assessment

- 13.9.43 B: intermediate confidence, due to uncertainty over the operating regime.

Water level changes in Loch Lochy

Nature of Impact

- 13.9.44 It is not intended to manage Loch Lochy outwith the existing level range imposed by the (Gairloch) spillway and the sill levels of the first locks at Gairloch and Laggan, although variation in Loch Lochy level within these limits is expected to be more frequent. It is not possible to construct accurate Loch Lochy level duration information at this stage as the operation of The Proposed Development would be in response to future electricity markets. The Proposed Development would not result in a change to the maximum and minimum level limits that Loch Lochy currently operates under, although variations in level between these limits are expected to be more frequent. The maximum volume that could be transferred between the two reservoirs by the operation of The Proposed Development is 26 Mm³, based upon an installed generation capacity of 1500 MW this would take 17-28 hours continuous operation at maximum output. This represents the maximum single transfer of water which The Proposed Development could physically perform. This case would result in a rate of change of level in Loch Lochy due to The Proposed Development of around 0.06 – 0.1 m/hour within the parameters discussed above (see also Chapter 6: Water Management).

Duration of Impact

- 13.9.45 This operating scenario would be permanent.

Magnitude of Impact

- 13.9.46 The littoral zone is an important habitat for fish, specifically during spawning and for predator avoidance. Fish that use the littoral zone have adapted to natural fluctuations in water level and have evolved lifecycles to complement these fluctuations. However, unnatural fluctuations (and extreme natural fluctuations) have been noted to have 'severe negative effects' on fish, both directly and indirectly, including (but not limited to): mortality of eggs, impaired feeding, and changes in behaviour and competition. If the water levels fluctuate beyond natural levels, 'bottom-up' and 'top-down' effects can occur and niches for invasive species can become available³⁴. For example, salmon change from a territorial-demersal lifestyle when sufficient food is available to a non-territorial-pelagic one when food is scarce. This change has been shown to be non-linear but bimodal, and fish switch from one behaviour to the other at a certain threshold level of food availability.
- 13.9.47 Table 13.8 below simplifies the use of the littoral zone throughout the year for each IEF in Loch Lochy.

³⁴ Winfield, I. J., (2004). Fish in the littoral zone: ecology, threats and management. *Limnologica* Vol 34 pp 124-131.

Zohary, T. and Ostrovsky, L. (2011). Ecological impacts of excessive water level fluctuations in stratified lakes. *Inland Waters* 1:1 pp 47-59.

Fischer, P. and Ohl, U. (2005). Effects of water-level fluctuations on the littoral benthic fish community in lakes: a mesocosm experiment. *Behavioural Ecology*. ResearchGate link: doi:10.1093/beheco/ari047.

Hill, N. M., Keddy, P. A. and Wisheu, I. C. (1998). A hydrological model for predicting the effects of dams on the shoreline vegetation of lakes and reservoirs. *Environmental Management* Vol 22 pp. 723-736.

Table 13.8: IEF use of the littoral zone in Loch Lochy

IEF	Use of the littoral zone
Atlantic salmon Brown/sea trout Ferox trout	Spawn between October and December (January for salmon). Fry emerge between March and May ³⁵ . Juveniles use littoral loch habitats as well as stream habitats. This may particularly be the case where stream habitats provide lots of spawning but limited space for growth, so a proportion of trout and salmon parr will be present in the margins of Loch Lochy through the year. Young trout will tend to migrate out of the streams and into the loch throughout the year, but usually with a peak in the autumn as the temperature falls. Juvenile salmon probably drop back into lakes in a similar way to juvenile trout; gradually and at any time but with an autumn peak. As juveniles, both species will remain in the loch margins through the whole year.
Arctic charr	Spawn between September and December. Fry emerge between March and May ³⁶ . It is likely that the emerging fry start off feeding in the littoral zone before moving off into deeper and pelagic areas. Klemetsen <i>et al</i> (2003) ³⁷ considers the early feeding period to be a potential 'bottleneck' as it is a time of high risk.
Brook lamprey	Spawn between April and May, metamorphose between July and September, migrate upstream in October, present in the sediment between November and March ³⁸ .
European eel	Present and active March to October. Present and torpid November to February, although they can be active all winter depending on the temperature. Migrations from the littoral zone to the profundal zone in autumn and back to the littoral zone in spring ³⁹ . Downstream migration of silver eels on their way to the Sargasso Sea to spawn occurs in autumn, typically from August to November ⁴⁰ . Upstream migration of elvers is mainly in spring ⁴¹ .

13.9.48 It is considered that salmonids are the most sensitive IEFs. More frequent fluctuations in water level in Loch Lochy may prevent fish gaining access to spawning tributaries. It is not considered that these rapid fluctuations in water level would degrade spawning habitat for Arctic charr as there is so little suitable spawning habitat available in the littoral zone (see Appendices 13.2 and 13.3). The inflow streams survey conducted in 2017 (see Appendix 13.1) used a risk/value matrix to identify the magnitude of impacts on salmonids. Three watercourses providing an estimated 4,750 m² of accessible habitat were classified as potentially being at high risk. These are: Allt Glas-Dhoire Mor, the River Gloy and Allt an t-Sidhein. Of these, Allt an t-Sidhein is likely to be of the greatest value as the data suggest it is an important spawning stream for trout. Eleven watercourses were judged to be at moderate risk, but eight of these were classified as being of minimal or low value. One, Uisge Dubh, was classified as being of moderate value and two, Allt Bhan and Allt Creag Innes nam Bo, were classified as being of high value. All of the streams assessed as being at moderate or high risk are likely to be used by spawning trout. None is known to be used by salmon, which seem likely to be restricted to the River Arkaig and Allt Coire Choille-rais. These assessments are based on a worst case scenario and are precautionary. Furthermore, salmonids are most likely to migrate into streams on an elevated discharge, which would be expected to mitigate some drawdown effects on stream access in some

³⁵ Scotland's Freshwater Fish: Ecology, Conservation and Folklore (2007) by Peter S. Maitland.

³⁶ Scotland's Freshwater Fish: Ecology, Conservation and Folklore (2007) by Peter S. Maitland.

³⁷ Klemetsen, A., Amundsen, P-A., Dempson, J. B., Jonsson, B., Jonsson, N., O'Connell, M. F. and Mortensen, E. (2003). Atlantic salmon *Salmo salar* L., brown trout *Salmo trutta* L. and Arctic charr *Salvelinus alpinus* L.: a review of aspects of their life histories. Ecology of Freshwater Fish 12 pp1–59.

³⁸ Scotland's Freshwater Fish: Ecology, Conservation and Folklore (2007) by Peter S. Maitland.

³⁹ Winfield, I. J. (2004). Fish in the littoral zone: ecology, threats and management. Limnologica Vol 34 pp 124-131.

⁴⁰ Sandlund O. T., Diserud, O. H., Poole, R., *et al* (2017). Timing and pattern of annual silver eel migration in two European watersheds are determined by similar cues. Ecol Evol 7 pp956–5966.

⁴¹ Scotland's Freshwater Fish: Ecology, Conservation and Folklore (2007) by Peter S. Maitland.

places if a clear channel formed. It is assumed that Loch Lochy would be at low levels more often than it would be at high levels, so that the water is ready to be used to generate power from the upper reservoir when prices are high. Currently the loch does not reach its lowest level very often. When the loch is at its lowest level, the proportion of trout spawning habitat that would be inaccessible is estimated at between 4.5% (including the River Arkaig) and 8.5% (excluding the River Arkaig) (see Table 3 in Appendix 13.1). The magnitude of impact is predicted to be limited to trout and to be 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. However, there would be a disproportionately higher level of impact on the trout spawning habitats at the north end of the loch.

- 13.9.49 More frequent fluctuations in water level in Loch Lochy may change the food availability within the margins in terms of primary productivity⁴², with knock-on impacts on invertebrate food sources. It is predicted that the juvenile life stages of salmonids are the most sensitive to these changes. At low loch levels, which would be more prevalent, as stated above, large areas of littoral habitat would be exposed (the worst case scenario). The magnitude of impact is predicted to be 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. However, there would be a disproportionately higher level of impact on the littoral habitats at the north and south ends of the loch where there are large shallow areas. Losses would be greatest in the areas with gentle slopes, which is the best productive habitat and where fish are likely to be feeding.
- 13.9.50 Fish will respond to changes in water level by moving. There is some evidence that brown trout utilise a home range, to which they will probably return if fluctuations are short-term. However, they have also been known to undertake long distance movements. Most likely, the majority would make a local movement in relation to water level change, staying broadly within their usual range. They might only make longer distance movements if prolonged periods of low level rendered the majority of their foraging range unproductive. If that were correct, trout response would probably vary somewhat with shoreline type/slope as well as with duration and frequency of fluctuations and productivity of remaining habitats.
- 13.9.51 The distribution of pike, which predate on juvenile salmonids, will vary seasonally and spatially. It is probable that densities will be highest in the areas where there is cover, around the NE end (Allt an t-Sidhean) and the weedy bays at Kilfinnan and Glas Dhoire. Low water level might compress more trout into pike foraging areas. However, prolonged periods of low loch level might also be bad for pike, as it could impact on their weedy spawning habitat.

Importance of IEFs

- 13.9.52 Loch Lochy supports Atlantic salmon (National (UK) importance), brown/sea trout (National (UK) importance), ferox trout (National (UK) importance), Arctic charr (National (UK)

⁴² Primary productivity is a term used to describe the rate at which plants and other photosynthetic organisms produce organic compounds in an ecosystem.

importance, brook lamprey (National (Scotland) importance) and European eel (International importance).

Significance of Effects

13.9.53 Currently Atlantic salmon have a number of difficulties accessing Loch Lochy, some of which have been explained above. In recent electro-fishing surveys no salmon fry have been found at all. Also explained above is the fact that Arctic charr use of the littoral habitat in Loch Lochy is likely to be low. With regard to trout, sea trout also have access difficulties, but there are some suggestions that nutrient enrichment in both Loch Arkaig and Loch Lochy has changed the way in which the trout populations behave, with a lot more fish staying in the lochs rather than heading to the sea⁴³. In situations where Arctic charr co-exist with brown trout, the former are generally confined to deeper epibenthic or pelagic habitats where they feed on zooplankton and deep water zoobenthos⁴⁴. If spawning habitat is thinly and widely spread for charr then there are more opportunities during periods of drawdown.

13.9.54 The combination of impacts on access to spawning streams and impacts on productivity leads to a complex assessment of cumulative effects and, with so many variables to consider, accurate predictions of significance are impossible. It is cautiously predicted that the impact of water level changes in Loch Lochy would have significant effects at the Local level on the Atlantic salmon, brown trout/sea trout and ferox trout populations but would have no significant effects on the Arctic charr population.

Confidence in Assessment

13.9.55 C: low confidence, due to the number of assumptions that have had to be made in terms of the operating regime, the areas affected, ecological responses and fish behaviour.

Changes in water flow and sediment transport in the Allt a' Choire Ghlais/Kilfinnan Burn

Nature of Impact

13.9.56 Operation of The Proposed Development would change the water flow and sediment transport regime in Allt a' Choire Ghlais. The 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). However, good flow standards in the lower reaches of Kilfinnan Burn may not be maintained.

Duration of Impact

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

⁴³ Alastair Stephen, personal communication.

⁴⁴ Hindar and Jonsson 1982; Klemetsen et al. 2003; L'Abée-Lund et al. 1992 (footnote to be completed).

Magnitude of Impact

- 13.9.58 The impacts on macroinvertebrates have been shown to lessen downstream of big dams and disappear once a major tributary enters. In addition, climate change may trend towards increased flows, particularly in winter, which would facilitate community recovery. The community composition would change over a period of many years but would remain as food for fish. The magnitude of any impacts on trout, should they occur, would be 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.
- 13.9.59 A Q95 compensation flow would be provided. Assuming that this is adequate to maintain the wetted stream habitat, it is probable that trout would persist through the upper reaches of the Allt a' Choire Ghlais, therefore habitat loss and fragmentation impacts due to reduced flows would be unlikely. The impacts of colder water on trout would likely be a reduced growth rate and fecundity, although the population would survive. The magnitude of any impacts, should they occur, would be low.
- 13.9.60 Good flow standards may not be maintained in the lower reaches of Kilfinnan Burn. This may result in fewer opportunities for the larger ferox trout to ascend in the spawning season. As only the very low reaches of the burn close to the loch provide suitable spawning habitat and there are no flow dependent obstacles downstream of the bridge apron (see Appendix 13.3), the magnitude of this impact would be low.
- 13.9.61 The magnitude of the impacts of sediment starvation in the reach of the Allt a' Choire Ghlais immediately downstream of the dam would also be low. 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 14.5 and 14.6) 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 trout would remain.
- 13.9.62 The area of the catchment of the Allt a' Choire Ghlais/Kilfinnan Burn is approximately 10.09 km² and the area of the catchment upstream of the dam is 3.04 km² i.e. 27.87% of the total catchment. The removal of this source area of catchment would have a low magnitude impact on the sediment balance and hence the hydromorphology of the watercourse. This is because the predominant sediment supply is from downstream tributary sources, although this would be small due to the well vegetated catchment surface that does not exhibit any significant erosion features. Following dam construction, the hydromorphology would remain dominated by the high energy available to transport the available sediment supply, which would remain low. Hence the regime of the outlet of the Kilfinnan Burn would remain in its stable state.

Importance of IEFs

- 13.9.63 The brown trout population in Allt a' Choire Ghlais is of National (UK) importance.
- 13.9.64 The lower reaches of Kilfinnan Burn is suitable for Atlantic salmon (National (UK) importance), brown/sea trout (National (UK) importance), ferox trout (National (UK) importance), brook lamprey (National (Scotland) importance) and European eel (International importance). These species are either anadromous or undergo loch to stream migrations. There is some suitable habitat for Arctic charr (National (UK) importance) within the area of the shore surveyed (see Appendix 13.3).

Significance of Effects

- 13.9.65 The new flow regime and sediment starvation would not result in any significant effects on the brown trout population in Allt a' Choire Ghlais.
- 13.9.66 There would be no significant effects on the populations of Atlantic salmon, brown/sea trout, ferox trout, Arctic charr, brook lamprey or European eel in the lower reaches of Kilfinnan Burn and Loch Lochy.

Confidence in Assessment

- 13.9.67 Allt a' Choire Ghlais, B: intermediate confidence, due to uncertainty over the operating regime. Lower reaches of Kilfinnan Burn and Loch Lochy, A: high confidence.

Mixing of Loch Lochy and Loch a' Choire Ghlais waters in the respective waterbodies and in Allt a' Choire Ghlais/Kilfinnan Burn

Nature of Impact

- 13.9.68 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 upper reservoir would be delivered into the Allt a' Choire Ghlais as compensation flow.
- 13.9.69 When The Proposed Development is in pumping mode, there could be entrainment of small life stages of fish from Loch Lochy up into the upper reservoir. When The Proposed Development is in generating mode, there could be entrainment of small life stages of fish that establish in the upper reservoir down into Loch Lochy.

Duration of Impact

- 13.9.70 The impacts of nutrient enrichment and entrainment would be permanent.

Magnitude of Impact

- 13.9.71 Total phosphorus and phytoplankton are High status in Loch Lochy⁴⁵. 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 Scheme⁴⁶, 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 and fish 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 13.7 above). Any water quality degradation from the 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 reservoir.
- 13.9.72 The magnitude of the impact of entrainment would depend on the frequency and timing of pumping, which is not known at this stage. Entrainment of juvenile trout and (possibly) salmon parr as they descend from Allt Glas-Dhoire into Loch Lochy is probable, as they drop out into the loch from the stream near the surface. Entrainment of brook lamprey and European eels is also probable. The tailrace structures would require smolt screens, likely to be vertical bar screens with a spacing of 12 mm and a maximum approach velocity limit of 300 mm/sec in front of the screens. These would protect larger fish from entering the lower control works and salmon smolts are not considered to be at risk as they would be further out in the loch. Juvenile Arctic charr are unlikely to be present in Loch Lochy as there is very little suitable habitat for spawning. The magnitude of the impact therefore is likely to be 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 IEFs will be similar to the pre-development conditions; and/or having a minor impact on the known population or range of the IEFs.
- 13.9.73 A fish community is unlikely to establish in the upper reservoir (see section 13.9.42, Chapter 12: Aquatic Ecology and Chapter 14: Geology and Water Environment), therefore the probability of entrainment is extremely unlikely. The magnitude of the impact would therefore be negligible.

Importance of IEFs

- 13.9.74 Loch Lochy supports Atlantic salmon (National (UK) importance), brown/sea trout (National (UK) importance), ferox trout (National (UK) importance), brook lamprey (National

⁴⁵ Information from SEPA's Water Classification Hub available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> (accessed 061217).

⁴⁶ Sloy Pumping Station Environmental Statement (August 2009). ASH design + assessment Ltd. for SSE.

(Scotland) importance) and European eel (International importance). Arctic charr (National (UK) importance) may be present in the shallow water close to the pumps but, as there is very limited spawning habitat in this location, they are expected to be mainly present in the deeper water of the loch.

Significance of Effects

- 13.9.75 There would be no significant effects on the IEFs in the upper reservoir nor in Allt a' Choire Ghlais/Kilfinnan Burn from an increase in nutrients.
- 13.9.76 No significant effects are predicted on the IEFs in Loch Lochy (or on any fish population established in the upper reservoir) from entrainment.
- 13.9.77 Loch a' Choire Ghlais is unsuited to Arctic charr (see Appendix 13.3). It is extremely unlikely that small life stages of Arctic charr would be entrained up into the upper reservoir and, should they get there, it is extremely unlikely that a new population would survive, due to the lack of a productive littoral zone and the lack of access to suitable spawning habitat. No significant effects on Arctic charr are predicted from introgression.

Confidence in Assessment

- 13.9.78 Nutrient enrichment in the upper reservoir, B: intermediate confidence, due to data limitations. Entrainment of fish, B: intermediate confidence, due to uncertainty over the operating regime. Arctic charr introgression, A: high confidence.

13.10 Mitigation

- 13.10.1 Mitigation is possible for two of the predicted significant negative impacts on the IEFs, during the construction phase, and these are water pollution and lighting. 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.

13.11 Residual Effects

- 13.11.1 Please refer to Table 13.9 for residual effects.

Table 13.9: Summary of Effects on Important Ecological Features

Nature of Impacts	Duration of Impacts	Magnitude of Impacts	Importance of IEF(s)	Significance of Effects	Confidence in Assessment
Construction Phase					
Construction of the dam and upper reservoir in Coire Glas – habitat loss	Permanent	Moderate	Brown trout (National (UK))	Significant at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais	Loss of lotic habitat: A Loss of lentic habitat: B
Construction of the dam and upper reservoir in Coire Glas - pollution	Temporary	Negligible, low, moderate or major	Brown trout (National (UK))	Significant at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais	B
Construction of the dam and upper reservoir in Coire Glas - lighting	Temporary	Low	Brown trout (National (UK))	Significant at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais	B
Construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy – habitat loss	Permanent	Low	Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	A
Construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy – underwater noise	Temporary	Low	Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	B
Construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy - pollution	Temporary	Negligible, low, moderate or major	Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	B

Nature of Impacts	Duration of Impacts	Magnitude of Impacts	Importance of IEF(s)	Significance of Effects	Confidence in Assessment
Construction of the lower control works, jetty and administration building on the north west shore of Loch Lochy - lighting	Temporary	Low	Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	B
The use of site establishment and lay down areas - pollution	Temporary	Negligible, low, moderate or major	Loch a' Choire Ghlais and Allt a' Choire Ghlais: brown trout (National (UK)) Loch Lochy: Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Significant at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais, not significant on Loch Lochy IEFs	B
The use of site establishment and lay down areas - lighting	Temporary	Low	Loch a' Choire Ghlais and Allt a' Choire Ghlais: brown trout (National (UK)) Loch Lochy: Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Significant at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais, not significant on Loch Lochy IEFs	B
Operational Phase					
Water level changes in the upper reservoir	Permanent	Major	Brown trout (National (UK))	Significant at the Local level on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais	B
Water level changes in Loch Lochy – access to spawning streams	Permanent	Low	Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Significant effects at the Local level on the Atlantic salmon, brown trout/sea trout and ferox trout populations, not significant on the Arctic charr population	C

Nature of Impacts	Duration of Impacts	Magnitude of Impacts	Importance of IEF(s)	Significance of Effects	Confidence in Assessment
Water level changes in Loch Lochy – changes in primary productivity	Permanent	Moderate	Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Significant effects at the Local level on the Atlantic salmon, brown trout/sea trout and ferox trout populations, not significant on the Arctic charr population	C
Changes in water flow and sediment transport in the Allt a' Choire Ghlais/Kilfinnan Burn	Permanent	Low	Allt a' Choire Ghlais: brown trout (National (UK)) Lower reaches of Kilfinnan Burn and Loch Lochy: Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	Allt a' Choire Ghlais: B Lower reaches of Kilfinnan Burn and Loch Lochy: A
Mixing of Loch Lochy and Loch a' Choire Ghlais waters in the respective waterbodies and in Allt a' Choire Ghlais/Kilfinnan Burn – change in trophic status of the upper reservoir	Permanent	Negligible	Loch Lochy: Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	B
Mixing of Loch Lochy and Loch a' Choire Ghlais waters in the respective waterbodies and in Allt a' Choire Ghlais/Kilfinnan Burn – entrainment	Permanent	Low	Loch Lochy: Atlantic salmon (National (UK)), brown/sea trout (National (UK)), ferox trout (National (UK)), Arctic charr (National (UK)), brook lamprey (National (Scotland)), European eel (International)	Not significant	B
Mixing of Loch Lochy and Loch a' Choire Ghlais waters in the respective waterbodies and in Allt a' Choire Ghlais/Kilfinnan Burn – introgression	Permanent	Negligible	Loch Lochy: Arctic charr (National (UK))	Not significant	A

13.12 Conclusions

13.12.1 The main conclusions from the fish impact assessment are as follows:

- Significant negative effects during the construction phase are predicted on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais from habitat change, pollution and lighting due to construction of the dam and upper reservoir. No mitigation is possible for habitat change, which would be permanent and of moderate magnitude, but with effective mitigation during construction, temporary pollution events would be avoided and/or reduced in severity. Mitigation is also possible for lighting. Confidence in these predictions is high for lotic habitat change and intermediate for lentic habitat change, pollution and lighting.
- Significant negative effects during the operational phase are predicted on the resident brown trout population in Loch a' Choire Ghlais and Allt a' Choire Ghlais from changes in water level in the upper reservoir. No mitigation is possible. The magnitude of this impact is major but confidence in this prediction is intermediate.
- Significant negative effects during the operational phase are predicted on a precautionary basis on the Atlantic salmon, brown trout/sea trout and ferox trout populations in Loch Lochy from changes in water level. No mitigation is possible. The magnitude of this impact is low (access to spawning streams) and moderate (changes in primary productivity) but confidence in these predictions is low.