Ballimeanoch Pumped Storage Hydro

Environmental Impact Assessment Report

Volume 2: Main Report
Chapter 10: Geology and Soils

ILI (Borders PSH) Ltd

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	July 2024	Submission	DL	David Lee	Technical Director

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Inserts

Tables

10. Geology and Soils

10.1 Introduction

This chapter will present the geology and ground conditions impact assessment for the effects on the Development undertaken in accordance with Institute of Environmental Management and Assessment (IEMA) guidelines.

The assessment provides baseline information, discusses appropriate mitigation measures and assess the significance of residual impacts. Consideration will be given to impacts during the construction, operational and decommissioning phases of the Development. Potential impacts on surrounding geology and ground conditions will predominately be associated with the construction phase of the Development.

Hydrogeology and groundwater dependant terrestrial ecosystems (GWDTE) will not be discussed in this chapter. All relevant information for hydrogeology and GWDTEs can be found in *Chapter 11: Water Environment* and *Chapter 8: Terrestrial Ecology*.

This chapter is supported by the following Figures (Volume 3):

- *Figure 10.1: Topography*
- *Figure 10.2: Bedrock Geology*
- *Figure 10.3: Superficial Geology*
- *Figure 10.4: Peat Probe Locations*
- *Figure 10.5: Peat Depth Interpolation*

This chapter is also supported by the following Appendices (Volume 5):

- *Appendix 10.1: Material Management Appraisal (MMA)*
- *Appendix 10.2: Peat Management Plan*

10.2 Legislation and Policy

The assessment has been undertaken in accordance with the European Union (EU) Directives, national, regional and local legislation planning policies as highlighted in *Table 10.1: Directives, Legislation and Planning Policies* as relevant to the Development.

Table 10.1: Directives, Legislation and Planning Policies

Area	Directives, Legislation and Planning Policies
EU	Environmental Liability Directive (2004/35/EC)
	Water Framework Directive (2000/60/EC)
	Dangerous Substances Directive (2006/11/EC)
	Renewable Energy Directive
	Climate Change Act 2008
National	The Environmental Liability (Scotland) Regulations (2009)
	Nature Conservation (Scotland) Act (2004)
	Pollution Prevention and Control (Scotland) Regulations (2012)
	Town & Country Planning (Scotland) Act (1997)
	Scottish National Planning Policy, including National Planning Framework 4 (NPF4)
	Scottish Planning Policy (SPP) (2014)
	Historic Environment Scotland Act 2014
	Planning Advice Note (PAN) 50 (surface mineral workings) (1996)

Area	Directives, Legislation and Planning Policies
	Planning Advice on hydro schemes, December 2013
	Planning Advice on energy storage, December 2013
	Scotland's Zero Waste Plan (2010)
	The Construction (Design and Management) Regulations 2015
	Environmental Protection Act 1990 (as amended)
	The Quarries Regulations 1999
	BS 6164 Code of Practice for Health and Safety in Tunnelling in the Construction Industry (2019)
Regional & Local	Argyll and Bute Local Development Plan (2024)
	Argyll and Bute Renewable Energy Action Plan
	Argyll and Bute Local Development plan – Supplementary Guidance (2016)

10.2.1 National Planning Policy & Legislation

Key national policies that are relevant with respect to geology and ground conditions that have been considered in this assessment are:

- Environmental Protection Act 1990;
- Town & Country Planning (Scotland) Act 1997;
- Nature Conservation (Scotland) Act 2004;
- National Planning Framework (NPF) 4.

NPF4, published in February 2023 sets out the Scottish Government's "spatial principles, regional priorities, national developments and national planning policy" and supersedes NPF 3.

The publication of the NPF4 has illustrated the importance of more considered practices within peatlands. Policy 5 of NPF4 states:

> *"c) Development proposals on peatland, carbon-rich soils and priority peatland habitat will only be supported for:*
>
> *i) Essential infrastructure and there is a specific locational need and no other suitable site;*
>
> *ii) The generation of energy from renewable sources that optimises the contribution of the area to greenhouse gas emissions reductions targets;*
>
> *v) Restoration of peatland habitats.*
>
> *d) Where development on peatland, carbon-rich soils or priority peatland habitat is proposed, a detailed site specific assessment will be required to identify:*
>
> *i) the baseline depth, habitat condition, quality and stability of carbon rich soils;*
>
> *ii) the likely effect of the development on peatland, including on soil disturbance;*
>
> *iii) the likely net effect of the development on climate emissions and loss of carbon."*

10.2.2 Regional Policy

The Argyll and Bute Local Development Plan 2 (2024) provides the local planning framework for the area. It shows the key development areas, the potential areas for future development, areas that require environmental improvement or regeneration and areas with environmental designations. In addition to setting out local planning policy and identify how land is used and how it can be developed.

10.2.3 Best Practice & Guidance Documents

Guidance on best practice has been used throughout this EIAR to ensure the integration of relevant planning policy and compliance measures during all stages of the Development design. *Table 10.2 Best Practice Guidance* lists best practice guides that have been utilised.

Table 10.2: Best Practice Guidance

Author	Guidance Document
Scottish Government, NatureScot (formerly SNH) and SEPA	Peatland Survey – Guidance on Developments on Peatland (2017)
NatureScot	Advising on Peatland, carbon-rich soils and priority peatland habitats in development management (2023)
Scottish Renewables and SEPA	Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (2012)
SEPA	SEPA Regulatory Position Statement – Developments on Peat (2010)
Scottish Government	Peat Landscape Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, second edition (2017)
Nature Scot (formerly SNH)	Constructed tracks in the Scottish Uplands (2015)
NatureScot (formerly SNH) and FCS	Floating Roads on Peat (2010)
NatureScot and SEPA	Guide to Hydro Construction good practice (2020)
Scottish Renewables, NatureScot (formerly SNH), SEPA, FCS and Historic Environment Scotland	Good Practice during Wind Farm Construction (2019)
Health and Safety Executive	Health and safety at quarries, Quarries Regulations 1999, Approved Code of Practice and guidance, 2nd edition (2013)

The 'Good Practice during Wind Farm Construction' document was produced for wind farm developments, however, principles discussed can be considered as good practice for other similar scale developments in areas with similar infrastructure (Access Tracks) and typical ground conditions seen on wind farms, particularly peat and around the water environment.

10.3 Study Area

The Study Area for the Development is the Red Line Boundary (RLB) plus a 250 m buffer.

10.4 Consultation

Table 10.3: Summary of Consultation Responses in relation to Geology and Soils below summarises the consultation undertaken throughout the EIAR process, including scoping and further pre-application consultation, relevant to Geology and Soils.

Table 10.3: Summary of Consultation Responses in relation to Geology and Soils

Organisation and Type of Consultation	Response	How response has been Considered
Energy Consents Unit (ECU) – Scoping (03/03/2023)	Borrow Pits	Any proposed borrow pits – referred to as *Borrow Pit Search Areas* for the purpose of this application - are shown on *Figure 2.5 Headpond Indicative Arrangement* and a typical detail is shown on *Figure 2.8 Headpond Borrow Pit* (*Volume 3 Figures*).
	Peat and Soils	An Outline Peat Management Plan (PMP) has been undertaken in accordance with Scottish Government guidance and can be seen in *Appendix 10.2 Outline Peat Management Plan (Volume 5 Appendices)*. The Development has been designed to minimise impact of peatlands, where practical.
SEPA – Scoping (12/08/2022)	Peat and Soils	A Preliminary Peat Management Plan (PMP) has been undertaken in accordance with Scottish Government guidance and can be seen in *Appendix 10.2 Outline Peat Management Plan (Volume 5 Appendices)*. The Development has been designed to minimise impact of peatlands, where practical. A detailed peat probing map and interpolated peat depth plan have been included in the application and shown on *Figure 10.4 Peat Probe Survey Results* and *Figure 10.5 Peat Interpolation Plan (Volume 3 Figures)*
	Borrow Pits	Any proposed borrow pits – referred to as *Borrow Pit Search Areas* for the purpose of this application - are shown on *Figure 2.5 Headpond Indicative*

Organisation and Type of Consultation	Response	How response has been Considered
		Arrangement and a typical detail is shown on *Figure 2.8 Headpond Borrow Pit (Volume 3 Figures).*
NatureScot – Scoping (09/09/2022)	Peat and Soils	An Outline Peat Management Plan (PMP) has been undertaken in accordance with Scottish Government guidance and can be seen in *Appendix 10.2 Outline Peat Management Plan (Volume 5 Appendices)*. The Development has been designed to minimise impact of peatlands, where practical.
SEPA – Peat Probing Consultation	Peat	Peat probing regime was amended to include further areas of probing to partially cover issues raised by SEPA. Peat probing undertaken as part of the Blarghour Wind Farm PLHRA reviewed and compared for consistency as per SEPA recommendation.

10.5 Methods

10.5.1 Desk Study

A desk study was carried out on the geology and ground conditions of the Development Site, covering a study area as defined by the RLB shown on *Figure 1.2 The Development Site* (*Volume 3 Figures*) using various publications, documents, publicly available information, discussions with consultees and information from site walkovers.

A review of published geological data has been undertaken to determine the geological and topographical context of the study area. The sources of information are listed in *Table 10.4: Information Sources used for Desk Study* for reference below.

Table 10.4: Information Sources used for Desk Study

Area	Subject	Source
Geology	Site Geology	British Geological Survey (BGS) Onshore Geoindex online viewer
		NatureScot's Carbon and Peatland map 2016
		Scotland's Environment web map
Land Use	Wild Land	NatureScot's Wild Land Areas map and descriptions 2014
Topography	Site Topography	Ordnance Survey Mapping, Scale 1:25,000
Topography	Site Topography	5 m Digital Terrain Model (DTM)

10.5.2 Site Surveys – Peatland Survey

As noted above, NPF4 has defined the responsibility for developers to be conscious about the impact on peatland habitats. Policy 5d states:

> *"Where development on peatland, carbon-rich soils or priority peatland habitat is proposed, a detailed site-specific assessment will be required to identify:*

- The baseline depth, habitat condition, quality and stability of carbon rich soils;
- The likely effects of the development on peatland, including on soil disturbance and;
- The likely net effects of the development on climate emissions and loss of carbon."

Peatland surveys were undertaken in order to obtain information on peat coverage across the Development Site to inform the following:

- Site design and layout to minimise disruption to peatlands; and,
- Post-construction site reinstatement and restoration.

Details and results of the Peatland Surveys are discussed further in *Section 10.6.3 Peat*.

10.5.3 Assessment Scope

The assessment considers the effects during the three phases of the Development lifespan as identified in *Chapter 2: Project and Site Description.* The phases are pre-construction, construction, and operation.

The assessment considers the potential for likely effects on the Geology and Soils in relation to the construction of a Pump Storage Hydro scheme. It establishes the baseline geological conditions of the site, using a desk study along with a targeted peatland survey completed for the Development.

10.5.4 Baseline Data Collection

A qualitative assessment of the potential effect of the proposed Development on the geology of the site has been undertaken using a combination of legislative standards, other statutory policy and guidance, a desk-based study, site surveys and professional judgement. See *Table 10.4: Information Sources used for Desk Study* above for the sources reviewed in the desk study.

Following the review of the desk-based assessment, a peat survey was undertaken- discussed further in *Section 10.6.3 Peat*.

10.5.5 Assessment Methodology

Based on SEPA best practice guidance, peat depths are assumed as follows:

- Peat with depths ≥ 1.0 m is considered as “deep peat”;
- Peat ≥ 0.5 m but < 1.0 m is considered as “shallow” peat; and,
- Peat < 0.5 m is assumed to be topsoil.

For the purpose of this assessment, the Development Site is split into two zones:

- Zone 1: Main Development Site (Loch Awe to proposed Headpond location); and,
- Zone 2: Marine Facility on Loch Fyne and infrastructure around Inveraray.

10.6 Baseline Environment

10.6.1 Topography

The main Development Site slopes from the summit of Cruach na Gearr-choise (571 m above ordnance datum (AOD)), along the eastern boundary of the Development Site, towards Loch Awe in the west.

The proposed Headpond is located at Lochan Airigh (360 m AOD) which sits in the valley between Cruach na Gearr-Choise (c. 571 m above ordnance survey datum; AOD) to the east and an unnamed summit (c. 470 m AOD) to the west.

The Tailpond inlet / outlet is located on Loch Awe, south of Balliemeanoch. The top level of the structure is at an elevation of 38.6 m AOD and extends approximately 50 m into Loch Awe. The existing ground slopes steeply to the south-east at a gradient of approximately 14% to the existing farm track, where it levels out and slopes steadily upwards to the proposed Headpond location in the east.

Figure 10.1 Topography (Volume 3 Figures) shows the topography of the study area based upon a 5 m digital terrain model (DTM).

10.6.2 Geology

As shown on *Figure 10.2 Bedrock Geology (Volume 3 Figures)*, the bedrock geology at the main Development Site is dominated by Metabasaltic rock of the Tayvallich Volcanic formation. The Tayvallich Volcanic formation is of the Tayvallich Subgroup which is defined on the British Geological Survey (BGS) as: “*Dominated by calcitic limestone, in part slumped, resedimented; however, east of mid-Deeside the limestone is replaced by psammite and quartzite with thin beds of calcsilicate rock; lavas, hyaloclastites and graphitic pelites present in Tayvallich area; Banffshire Coast - thick semipelite and calc sequence in upper part.”*

This formation covers the majority of the proposed Headpond and the sloping ground to the west, towards Loch Awe.

At the Tailpond inlet / outlet structure (Loch Awe), the bedrock geology is shown to be psammitic in nature of the Loch Avich Grit Formation. The Loch Avich Grit Formation is of the Southern Highland Group, which is defined on the BGS as: "*A thick pile of psammitic and pelitic greywackes and associated rocks, some volcanic.*"

The bedrock geology is made up of Tayvallich Volcanic Formation – Metalava and Metatuff and the Tayvallich Slate and Limestone Formation – Pelite, Graphitic to the north and south of the Headpond, respectively. Both of these formations are of the Tayvallich Subgroup, described above.

As shown on *Figure 10.3 Superficial Geology (Volume 3 Figures)*, no superficial deposits are identified across the majority of the main Development Site. This is an indication that bedrock is at or near ground surface. Where superficial deposits are identified, they are generally till, deposits of alluvium and peat.

A review of the Carbon and Peatland 2016 map on Scotland's Soils online map viewer (Scottish Government, 2016) shows the area surrounding the Headpond is a variety of peat soils, mostly peaty gleys with semi-confined peat, peaty gleyed pozdols with peaty gleys with distrophic semi-confined peat and peaty gleys with peaty rankers. The areas along the banks of Loch Awe and going up the slope to the East towards the Headpond is described as brown earths with humic gleys.

A review of the BGS Faults (1:625,000 scale) layer showed the presence of a fault trending south-west – north-east through the proposed Embankment 1, terminating to the east of the Headpond. The BGS indicates that the fault is at rockhead, however, no further information is available. A number of inferred faults are also present around the study area, however, they are out with any proposed infrastructure.

The hydrogeology of the Development Site is discussed in detail in *Chapter 10: Water Environment*, together with details of all known groundwater and surface water abstractions within the Development Site and immediate surrounding area.

10.6.3 Peat

As part of the requirements set out in NPF4, Peatland surveys were undertaken within the study area for the Development. To capture the extent of peat across the site, the following peat probing surveys were undertaken:

- Peat probing along Northern Access Route – August 2021
- Phase I Peatland survey – September 2023

10.6.3.1 Northern Access Route Peat Probing – August 2021

The northern access of the Development is located within the Keppochan and Upper Sonachan Forest and it is proposed that access will be made using existing forestry tracks (to be upgraded) and new Access Tracks.

Two areas of new Access Tracks were surveyed at 50 m centres with 10 m perpendicular offsets. In total, 50 probes were taken, with the majority (54%) of probes having peat depths < 0.5 m depth (assumed topsoil). Shallow peat was measured at 18% of the locations while deep peat was identified in 28% of the probed locations. The deepest peat measured was 3.2 m deep.

10.6.3.2 Phase I Peat Probing – September 2023

Prior to commencing the survey, a desk-based assessment was undertaken to assess the estimated presence of peat across the Development. A review of the BGS Onshore GeoIndex indicated that no peat or peaty soils were present across the site. Further investigation through the National soil map of Scotland indicated that a large, isolated outcrop of peaty podzols and peaty gleys was present around the proposed Headpond area.

The Headpond and surrounding areas were surveyed in a 100 m x 100 m grid, with additional peat probes taken at areas of deep peat / in areas with limited coverage. Additionally, while undertaking the peatland survey, additional features were noted, as follows:

- The northern access to the site was taken via the existing forestry tracks within the Keppochan and Upper Sonachan Forest. The forestry tracks were accessible via vehicle up to 1.5 km from the western edge of the forest at which access was made via foot. The remaining 1.5 km to the edge of the forest was along a severely overgrown access track. A hard subbase could be felt underfoot whilst walking on the overgrown track but years of organic deposit and tree growth made it difficult to traverse on foot.

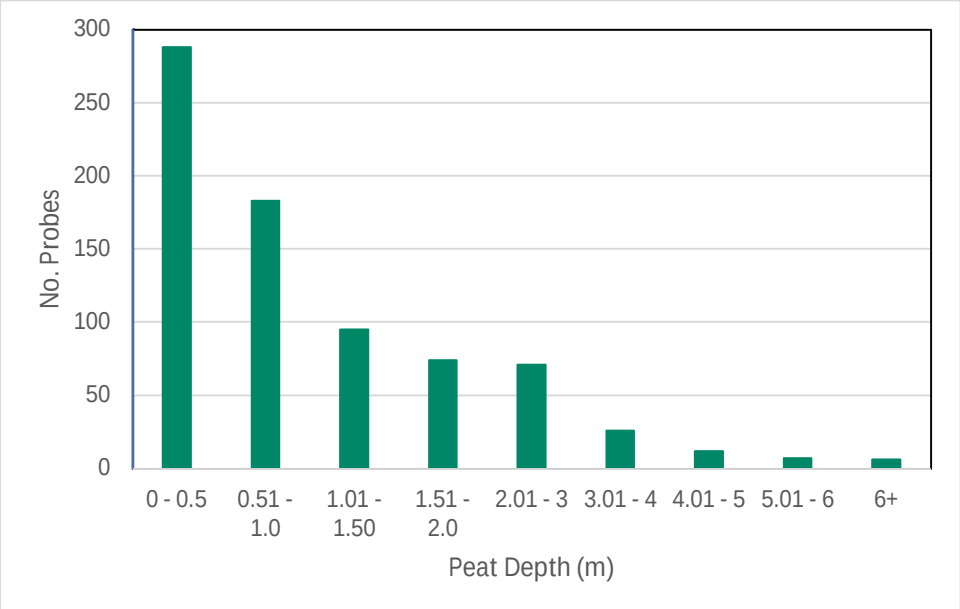
- The southern Access Track went through the current landowner's farmland, the track was in good condition, but it was steep in some sections and a 4x4 vehicle was necessary to drive up. The areas to the side of the track were mostly shallow peat (between 0m and 0.5m) though when coming closer to the proposed location for Temporary Compound 07 some areas of very deep peat (between 3 m and 5 m) were recorded to the west of the track.
- The eastern area of the site generally showed evidence of deeper peat and regularly displayed peaty hollows and peat bogs. The presence of peat in these areas is likely due to the topography, evidenced by small rolling hills which creates dips and pockets that promote the creation of peat as organic material and water are contained in these hollows.
- The western area of the site was notably less peaty. This is likely due in part to the natural topography and lack of conditions for peat development.
- There were many watercourses on site which ranged from many small brooks through peat and grass caused by heavy rainfall, feeding into larger streams going across most of the site and further into the Beochlich Hydro Electric Site.
- The site has regular changes in topography, mainly sloping down from the outer edges of the site to the area where Lochan Airigh is currently located, and further to the reservoir of Beochlich hydro.

Prior to mobilising on site, AECOM consulted with SEPA and proposed to undertake around 550 peat probes across a 100 m x 100 m grid. SEPA requested that a "dynamic probing regime be undertaken", as such, as detailed in Section 10.6.3.2, additional peat probes were taken in areas of deep peat and as requested by SEPA, 1) along the extents of the existing access tracks, 2) along the proposed Access Track and 3) across the proposed Embankments.

In total, 766 peat probes were taken during the Phase I Peat Survey (216 extra probes compared to the proposed 550). The results from the survey are listed below and shown graphically in *Insert 10.1 Peat Depth Range* below.

- 288 probes recorded a depth of peat below 0.5 m (38% of the site surveyed).
- 183 probes recorded a depth of peat between 0.5 m and 1.0 m (24% of the site surveyed).
- 95 probes recorded a depth of peat between 1.0 m and 1.5 m (12% of the site surveyed).
- 75 probes recorded a depth of peat between 1.5 m and 2.0 m (10% of the site surveyed).
- 71 probes recorded a depth of peat between 2.0 m and 3.0 m (9% of the site surveyed).
- The last 7% of the site has depths of peat ranging between over 3.0 m and up to 7.30 m, which equates to 57 locations of very deep peat, mostly located on the outer eastern edges of the survey extents.

All peat probes taken during the peat probing surveys can be seen on *Figure 10.4 Peat Probe Locations* (*Volume 3 Figures*)**.**



Insert 10.1 Peat Depth Range

The results of the Phase I Peat Probing survey were used to create a map of the varying depths of the peat surface across the Development – shown on *Figure 10.5 Peat Depth Interpolation (Volume 3 Figures)***.**

10.6.4 Land Use and Soils

A review of the National Soil Map of Scotland on Scotland's Soils online map viewer (Scottish Government, n.d.) identified the Headpond location is covered with soils described mostly as peaty gleys with semi-confined peat, peaty gleyed pozdols with peaty gleys with distrophic semi-confined peat and peaty gleys with peaty rankers.

At the shoreline of Loch Awe there is evidence of "brown soils", which according to The James Hutton Institute are "*well drained with brownish subsoils where iron oxides created through weathering processes are bonded to silicate clays*" (James Hutton Institute, n.d.).

The Beochlich hydroelectric scheme, situated on Buinne Dhubh watercourse, is located around 2 km southwest from where the Headpond will be constructed. The scheme is a small scale run of river hydro scheme which incorporates a storage reservoir to regulate the flow of Buinne Dhubh and has a capacity of around 1.0 MW. In conjunction with the hydro scheme, there are some existing access tracks that lead from the B840 (Loch Awe) to the hydro scheme.

As per the 2014 Wild Land Areas map and descriptions (NatureScot 2014), the area of the proposed PSH Development is not recognised as Wild Land.

From a geology and ground conditions perspective, the soils at the Headpond are viewed as a sensitive receptor and will be assessed further in Assessment of Effects below. However, the general land use is not viewed as a sensitive receptor and will not be discussed further in this chapter.

10.6.5 Seismic Risk

A review of the BGS Onshore GeoIndex has shown no evidence of historic earthquakes within the Development Site; however, there are a few historic events that have occurred in the wider area as detailed in *Table 10.5: Seismic Activity.*

Table 10.5: Seismic Activity

Type			Easting	Northing	Year	Magnitude	Depth (km)	Distance from Development Site (km)
Modern Earthquakes	Instrument	Recorded	202612	714498	1993	1.1	0.6	2.7 km south-west
Modern Earthquakes	Instrument	Recorded	202169	714187	1993	1.3	0.6	3.2 km south-west
Modern Earthquakes	Instrument	Recorded	203710	720822	1993	1.1	5.9	4.5 km north
Modern Earthquakes	Instrument	Recorded	206911	720901	2011	2.1	12.2	5.0 km north-east
Modern Earthquakes	Instrument	Recorded	209478	720656	1999	1.1	6.4	6.5 km north-east
Modern Earthquakes	Instrument	Recorded	210470	719611	1999	1.3	3.6	6.7 km north-east
Modern Earthquakes	Instrument	Recorded	206816	724014	2019	1.8	7.0	8.0 km north
Modern Earthquakes	Instrument	Recorded	203085	724847	1979	1.5	2.7	8.5 km north
Modern Earthquakes	Instrument	Recorded	213214	717214	2016	1.0	2.5	8.7 km east
Modern Earthquakes	Instrument	Recorded	199832	708905	2018	2.1	4.7	9.0 km south-west

Type			Easting	Northing	Year	Magnitude	Depth (km)	Distance from Development Site (km)
Modern Earthquakes	Instrument	Recorded	199164	708879	1980	1.2	N/A	9.2 km south-west
Modern Earthquakes	Instrument	Recorded	213564	713793	2007	1.6	8.7	9.3 km east
Modern Earthquakes	Instrument	Recorded	198660	724530	1986	1.5	0.0	10.0 km north

10.6.6 Ground Contamination

Given that the land for the Development is largely uninhabited and unexploited and avoid of large intrusive or potential contaminating historical developments, it is unlikely that the Development Site will contain contamination.

10.6.7 Sensitive Receptors

The value of receptors is based on the definitions provided in *Chapter 4: Approach to EIA.* Sensitive receptors that may be directly or indirectly affected by the Development and the value of each receptor are summarised in *Table 10.6: Sensitive Receptors.*

Table 10.6: Sensitive Receptors

Receptor	Distance from Development	Sensitivity	Reason
Peat	On-site	High	Potential release of carbon due to disturbance (raised concern by SEPA and NatureScot)

10.7 Assessment of Effects

The assessment of effects for Geology and Soils is not as per the standard assessment as described in *Chapter 4: Approach to the EIA*. This approach has been taken as the potential effects on geological and soil receptors are extremely limited. However, the volume of material to be excavated does have the potential to affect other receptors which are contained in other chapters. Therefore, this chapter provides information on the basis of other potential indirect effects from the excavation of material in order to construct the Development, and signposts to the relevant assessments where required.

The superficial deposits identified within the desk study has found that the majority of the soil on the Development Area is peat of Class 2 and 5 which are described as peat soil with occasional peaty soil and peat soil, respectively.

For impacts on hydrogeology and GWDTE refer to *Chapter 10: Water Environment.*

There is likely to be no contaminated land within the study area, therefore any potential impacts from this, on human health and other receptors have been scoped out.

Given the locality of the Development in relation to faults, there is potential for varying rock quality, even at significant depths. To mitigate issues with varying rock quality, which could result in unstable rock faces during underground excavation and tunnelling works, the potential requirement for lining of the tunnels and underground excavations is embedded in the design.

Seismic activity in the area could have the potential to destabilise the Embankment, however, embedded within the design is the legal requirement that the Embankment will be designed constructed, operated and decommissioned in line with the Reservoirs Act 1975, therefore, this is scoped out.

Although the impacts on geology have largely been scoped out, during the construction phase substantial excavation, tunnelling and earthworks will be undertaken.

Approximately 20,110,000 m^3 of bulked material will be excavated in order to construct the Headpond Embankments from the tunnelling operations, above and below ground excavations and from the Headpond borrow

pit. The Material Management Assessment (MMA) provides detailed calculations of the balance of the Development and can be seen in *Appendix 10.1 Material Management Appraisal (MMA), Volume 5 Appendices.*

As demonstrated in the MMA, there will be no excess material generated from the construction of the Development, with all of the excavated material used on site.

Site Investigation works will be undertaken during the detailed design stage, post consent, to confirm rock properties across the Development Site, in addition to the design optimisation opportunities as detailed in *Chapter 3: Design Evolution and Alternatives*.

10.7.1 Construction Phase

The construction of above-ground infrastructure will require excavation, storage, re-use and waste disposal of peat deposits. As this is a high sensitive receptor, this is expected to have a permanent adverse effect of Medium magnitude resulting in a Moderate significance on peat deposits within the Development Site without mitigation. This is therefore a **Significant** effect.

It is the intention to source aggregate for the construction of the Embankments from an on-site borrow pit, located within the Headpond. Sourcing aggregate from within the site rather than from an off-site quarry has the overall benefit of reducing the number of heavy good vehicles (HGV) on public roads and associated carbon footprint.

The locations of the borrow pit has been influenced by environmental considerations to minimise the impacts on ecology, peatlands, cultural heritage, hydrology and landscape as described within the relevant technical chapters of this EIA Report. The final location, number and estimate of material from each potential site will be determined once full ground investigation works and testing have been completed. The borrow pit will require the use of plant to both extract and crush the resulting rock to the required grading. It is anticipated that most rock will be extracted by breakers however some blasting may be required. Precise details will be confirmed at the construction stage.

- One potential borrow pit (BP01) has been identified within the Headpond area. A typical detail of the borrow pit is shown in *Figure 10.4 Peat Probe Survey Results* and *Figure 10.5 Peat Interpolation Plan (Volume 3 Figures*).
- BP01 is expected to yield a maximum bulked volume of up to 15,790,000 m³ of aggregate. The bedrock geology where it is located have a mix of metabasaltic rock, metalava and metatuff (Tayvallich Volcanic formation) and pelite, graphitic rock (Tayvallich slate and limestone formation), and some veins of metagabbro and metamicrogabbro (Dalradian supergroup).

10.7.2 Operational and Decommissioning Phase

Peat excavated during the construction phase will be permanently displaced from the areas required for above ground infrastructure. At the end of the construction phase, all peat will be reused on site, as per the *Appendix 10.2 Outline PMP (Volume 5 Appendices).*

Operationally, most of the works will be undertaken underground, within permanent above ground compounds or for maintenance purposes. As such, during operation, there is expected to be no further impact on peat.

At the decommissioning phase of the project, it is expected that a specific decommissioning consent will be issued at the time. Due to the project lifespan (~ 100 years) any life extension, re-use or repowering (Table 1 of Life Extension and Decommissioning of Onshore Windfarms (SEPA, 2016)) will be subject to a detailed of the Development infrastructure, namely the Headpond Embankments, Power Cavern Complex, Access Tunnels and Waterways, at the time of decommissioning. Should life extension, re-use or repowering not be an option at decommissioning, the scheme will be decommissioned. Permanent compounds and Access Tracks may removed and reinstated to pre-construction condition, in accordance with best practice guidance and agreement from the relevant consenting authority and landowners. As such, during decommissioning, there is expected to be no further impact on peat.

10.8 Cumulative Effects

10.8.1 Inter-Cumulative Effects

Inter-project effects were considered for the cumulative developments listed in *Table 4.8 of Chapter 4: Approach to EIA.* No direct combined effect on geology or ground conditions were identified from the Development and the

cumulative developments. Shared fault lines and geology between Beochlich hydroelectric site and the Development were considered, however no effect was identified given the distance between the two sites and the safety standards and requirements incorporated into the design.

The potential for indirect combined effects on the transport network was also considered. Although the material management for Beochlich hydroelectric is unknown, no combined effect between the Development and Beochlich Hydroelectric was identified, due to the proposal to retain and re-use excavated material on the Development Site. This is to be managed and implemented via the MMA (*Appendix 10.1: Material Management Appraisal (MMA), Volume 5 Appendices*). Therefore, there are no inter-project cumulative effects anticipated with the cumulative developments.

Intra-project effects were also considered. No potential direct combined effects on geology or ground conditions were identified. Potential indirect combined effects were identified from material management on the transport network, and on human receptors from nuisance such as reduced amenity, dust and noise. If excavated material were transported off-site, this would increase the required number of vehicle journeys to and from the Development Site and create a combined adverse effect of greater significance. However, as demonstrated in the MMA (*Appendix 10.1: Material Management Appraisal (MMA), Volume 5 Appendices*) all excavated material can and will be reused within the Development Site, removing any potential intra-project transport effects.

Amenity effects from noise and dust generation as a result of material excavation, transportation within the Development Site and storage could be compounded as a result of the overlapping construction programme for the different Development Components. The Outline Construction Environment Management Plan (CEMP) (*Appendix 3.1 Outline CEMP, Volume 5 Appendices*) provides mitigation in relation to generation of dust, noise and other emissions.

Therefore, there are not expected to be any significant cumulative effects on geology or ground conditions, and other shared receptors.

10.9 Mitigation and Monitoring

10.9.1 Embedded Mitigation

Post-consenting SI works will confirm soil and rock properties to assist the detailed design. SI works are likely to include additional peat probing to inform the exact routes / location of above and below ground infrastructure.

The Phase 1 Peat Probing survey identified areas of peat > 1.0 m in depth across the Development. The following embedded mitigation measures have been included in the design, with respect to peat:

- Where Access Tracks are present, areas of peat > 1.0 m have been avoided where possible, however, where this was not feasible, floating Access Tracks have been defined.
- Where peat > 1.0 m was identified within the Headpond at elevations below the BWL (374 m AOD). Peat in this area will not be excavated and left in-situ.

Within the Headpond basin, in elevations above BWL (374 m AOD) peat will be permanently lost. The Outline PMP (*Appendix 10.2 Peat Management Plan, Volume 5 Appendices*) has been produced which demonstrates the approximate volumes of peat expected to be disturbed / excavated, the potential re-use options and handling and storage methods to be used.

10.10 Residual Effects

In accordance with the methodology described in *Chapter 4: Approach to EIA*, potential effects have been assessed prior to mitigation, with the residual effects after implementation of the mitigation measures detailed in *Table 1.7: Potential and Residual Effects*.

As demonstrated in *Table 1.7: Potential and Residual Effects*, there are no significant residual effects anticipated to remain after the implementation of mitigation

Table 1.7: Potential and Residual Effects

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Peat	Excavation for Development Site above ground infrastructure, resulting in loss of peat and release of carbon into the atmosphere.	Moderate Adverse	Layout developed to minimise infrastructure in areas of peat > 1.0 m where possible. Where unavoidable floating Access Tracks and alternative construction methods to be utilised. Peat within Headpond in elevations below BWL (374 m AOD) to be left in-situ and not disturbed. Appropriate peat guidance to be adhered to. Outline PMP (*Appendix 10.2, Volume 5 Appendices*) to be implemented and updated to Final PMP post consent.	Minimisation of peat disturbance of peat reducing the magnitude of the effect from Medium to Negligible.	Minor Adverse (**Not Significant**)

10.11 References

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