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Glen Earrach Pumped Storage Hydro

Environmental Impact Assessment Report

Volume 2: Main Report
Chapter 15: Geology & Ground Conditions

Glen Earrach Energy Ltd

Glen Earrach AECOM

Quality information

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15. Geology and Ground Conditions

15.1 Introduction

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

15.1.2 The assessment provides baseline information, discusses appropriate mitigation measures and assesses the significance of residual impacts. Consideration will be given to impacts during the Pre-Construction and Enabling, Construction and Operational phases of the Proposed Development. Decommissioning has been scoped out of assessment as set out within **Chapter 4: Approach to EIA (Volume 2: Main Report)**. Potential impacts on surrounding geology and ground conditions will predominately be associated with the construction phase of the Proposed Development.

15.1.3 The Proposed Development will consist of both above and below ground infrastructure, and as such the impact on the geology and soils is significant to the design, construction and maintenance. At the time of writing, the position and alignments of the proposed components are not fixed but the key elements can be listed and their potential size, construction method, interactions with other elements and maintenance requirements can be considered following previous project experience and research.

15.1.4 Two options are proposed - Option A and Option B (see **Figure 2.4: Below Ground Infrastructure (Sheet 1 Option A, Sheet 2 Option B) (Volume 3: Figures)**, which largely vary only in the alignment / orientation of the below ground infrastructure. In alignment with **Section 2.5.7 – 2.5.10 Upper Control Works** of **Chapter 2: Project and Site Description (Volume 2: Main Report)** the assessment focuses on the above ground infrastructure of Option B (larger footprint and excavation) - the worst-case scenario in terms of impact on geology and soils.

15.1.5 This chapter assesses impacts to surface and near-surface geology and ground conditions, particularly peatlands and carbon rich soils, as these are the key sensitive receptors directly affected by the Proposed Development. While the geological context of below-ground infrastructure (e.g., bedrock) is considered, its primary potential impact pathway is to groundwater; hydrogeology and groundwater-dependent terrestrial ecosystems are not discussed here, with all relevant information provided in **Chapter 10: Water Environment** and **Chapter 7: Terrestrial Ecology (Volume 2: Main Report)**.

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

- Figure 15.1 – Topography;
- Figure 15.2 – Bedrock Geology;
- Figure 15.3 – Superficial Geology;
- Figure 15.4 – Peat Probe Survey Results; and,
- Figure 15.5 – Peat Depth Interpolation Plan.

15.1.7 This chapter is also support by the following Appendices (**Volume 5: Appendices**):

- Appendix 15.1 – Material Management Appraisal;
- Appendix 15.2 – Outline Peat Management Plan; and,
- Appendix 15.3 – Preliminary Peat Landslide Hazard and Risk Assessment (PLHRA).

15.1.8 A summary of the supporting appendices is included in **Table 15-9 Chapter 15 Appendices Summary**.

15.2 Legislation and Policy

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

- Environmental Protection Act 1990;
- Town & Country Planning (Scotland) Act 1997;
- Nature Conservation (Scotland) Act 2004; and

- National Planning Framework (NPF) 4.

15.2.2 NPF4, published in February 2023, sets out the Scottish Government's "spatial principles, regional priorities, national developments and national planning policy" and supersedes NPF3.

15.2.3 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; and

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; and

iii) the likely net effect of the development on climate emissions and loss of carbon."

Local Planning Policy

15.2.4 The Highland-wide Local Development Plan (HWLDP) is used by The Highland Council (THC) to guide development and investment in 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, it sets out local planning policy and identifies how land is used and how it can be developed. It covers the entirety of the Highlands, with separate specific plans for regions and counties, and adopts some of their previous Local Plans.

15.2.5 Policy 55 of the HWLDP focuses on *Peat and Soils* as set out below:

"*Development proposals should demonstrate how they have avoided unnecessary disturbance, degradation or erosion of peat and soils.*

Unacceptable disturbance of peat will not be permitted unless it is shown that the adverse effects of such disturbance are clearly outweighed by social, environmental or economic benefits arising from the development proposal.

Where development on peat is clearly demonstrated to be unavoidable then The Council may ask for a peatland management plan to be submitted which clearly demonstrates how impacts have been minimised and mitigated."

15.2.6 The details of Policy 55 are consistent with the requirements set out in NPF4 on the topic, as per Paragraph 15.2.3, above.

Best Practice and Guidance Documents

15.2.7 Guidance on current best practice has been used throughout this Environmental Impact Assessment Report (EIAR) to ensure the integration of relevant planning policy and compliance measures during all stages of the Proposed Development. **Table 15-1 Best Practice Guidance** lists best practice guides that have been utilised.

Table 15-1 Best Practice Guidance

Author	Guidance Document
Scottish Government, NatureScot (formerly SNH) and SEPA	Peatland Survey – Guidance on Developments on Peatland (2017)[1]
NatureScot (formerly SNH)	Advising on Peatland, carbon-rich soils and priority peatland habitats in development management (2023) [2]
	Hydroelectric Schemes and the Natural Heritage (2015)[3]
Scottish Renewables and SEPA	Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (2012)[4]
SEPA	SEPA Regulatory Position Statement – Developments on Peat (2010)[5]
	Developments on Peat and Off-Site Uses of Waste Peat (2017)[6]
Scottish Government	Peat Landscape Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, second edition (2017)[7]
NatureScot (formerly SNH) and Forestry and Land Scotland (formerly FCS)	Floating Roads on Peat (2010)[8]
NatureScot (formerly SNH), SEPA and Scottish Renewables	Guide to Hydropower Construction Good Practice (2019)[9]
Scottish Renewables, NatureScot (formerly SNH), SEPA, Forestry and Land Scotland (formerly FCS), and Historic Environment Scotland	Good Practice During Wind Farm Construction (2019) [10]
Health and Safety Executive	Approved Code of Practice and guidance - Health and Safety at Quarries, supporting the Quarries Regulations 1999 (2013)[11]

[1] Scottish Government, Scottish Natural Heritage and SEPA (2017j) *Guidance on Developments on Peatland*, *Peatland Survey*. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2018/12/peatland-survey-guidance/documents/peatland-survey-guidance-2017/peatland-survey-guidance-2017/govscot:document/Guidance+on+developments+on+peatland+-+peatland+survey+-+2017.pdf

[2] NatureScot (2023) *Advising on peatland, carbon-rich soils and priority peatland habitats in Development Management*, *NatureScot*. Available at: https://www.nature.scot/doc/advising-peatland-carbon-rich-soils-and-priority-peatland-habitats-development-management

[3] NatureScot (2015) *Hydroelectric Schemes and the Natural Heritage*, *NatureScot*. Available at: https://www.nature.scot/doc/hydroelectric-schemes-and-natural-heritage

[4] Scottish Government (2012) *Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste*, *Scottish Government*. Available at: https://www.gov.scot/publications/assessment-of-peat-volumes-reuse-of-excavated-peat-and-minimisation-of-waste-guidance/

[5] SEPA (2010) *SEPA Regulatory Position Statement – Developments on Peat*, *SEPA*. Available at: https://www.sepa.org.uk/media/143822/peat_position_statement.pdf

[6] SEPA (2017) *Developments on Peat and Off-Site Uses of Waste Peat*, *SEPA*. Available at: https://www.sepa.org.uk/media/287064/wst-g-052-developments-on-peat-and-off-site-uses-of-waste-peat.pdf

[7] Scottish Government (2017) *Peat Landscape Hazard and Risk Assessments*, *Scottish Government*. Available at: https://www.gov.scot/publications/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/documents/

[8] NatureScot and Forestry and Land Scotland (2010) *Floating Roads on Peat*, *ROADEX*. Available at: https://www.roadex.org/wp-content/uploads/2014/01/FCE-SNH-Floating-Roads-on-Peat-report.pdf

[9] NatureScot, SEPA and Scottish Renewables (2019) *Guide to Hydropower Construction Good Practice*, *NatureScot*. Available at: https://www.nature.scot/doc/guidance-guide-hydro-construction-good-practice

[10] Scottish Renewables *et al.* (2019) *Good Practice during Wind Farm Construction*, *NatureScot*. Available at: https://www.nature.scot/doc/guidance-good-practice-during-wind-farm-construction

[11] Health and Safety Executive (2013) *Approved Code of Practice and guidance - Health and Safety at Quarries*, *HSE*. Available at: https://www.hse.gov.uk/pubns/priced/l118.pdf

15.2.8 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.

15.3 Consultation

15.3.1 **Table 15-2 Summary of Consultation** below summarises the consultation undertaken throughout the EIAR process, including scoping and further pre-application consultation which is relevant to geology and soils.

Table 15-2 Summary of Consultation

Consultee	Key Issue	Summary of Response	Action Taken
SEPA – Scoping Response (05/07/2024)	Peat and Soils	A Peat Management Plan will be required and disturbance of peat should be minimised.	An outline peat management plan (**Appendix 15.2 Outline Peat Management Plan (Volume 5: Appendices)** has been prepared in accordance with Scottish Government guidance. The Proposed Development has been designed to minimise impacts on peatlands where practicable.
	Borrow Pits	Details of borrow pits must be provided.	Proposed Borrow Pits (BP) – referred to as BP Search Areas for the purpose of this application - are shown on **Figure 2.9 Headpond Indicative Arrangement (Volume 3: Figures)** and a typical detail is shown on **Figure 2.12 Headpond Borrow Pit (Volume 3: Figures)**.
SEPA / NatureScot – S36 and CAR License Meeting (19/09/2024)	Peat and Soils	Consultation was held with SEPA on the requirement of a Phase 2 peatland survey for the Proposed Development.	Phase 2 peatland survey was specified and carried out.
SEPA – Phase 2 Peatland Survey (21/10/2024)	Peat and Soils	Consultation was held with SEPA ahead of the Phase 2 peatland survey, with the following key points raised by SEPA: • Probing along existing access track may be required if widening proposed. • Preference for detailed probing along the main access track rather than a blanket 100 m x 100 m grid in areas that were missed during the Phase 1 survey. • Check probing in areas where deeper peat was encountered.	Phase 2 peatland survey plan was amended to focus on detailed peat probing along the proposed main access track and in areas where infrastructure was sited in locations that no probing was undertaken as part of the Phase 1 peatland survey.
SEPA – Peatland Excavation Consultation (04/11/2024)	Peat and Soils	Further consultation was held with SEPA post the Phase 2 Peatland Survey on approach to peatlands within the Headpond.	Non-excavated peatlands within the Headpond basin will be left in situ.
ECU – Scoping Response (12/24)	Peat Landslide	Where there is a demonstrable requirement for peat landslide hazard and risk assessment (PLHRA), the assessment should be undertaken as part of the EIA process.	A Peat Landslide Hazard and Risk Assessment (PLHRA) **(Appendix 15.3 Preliminary Peat Landslide Hazard and Risk Assessment (PLHRA) (Volume 5: Appendices)** has been undertaken in accordance with the Scottish Government Guidance.

15.4 Study Area

15.4.1 The Study Area for the Proposed Development is the Proposed Development Site boundary (also referred to as Red Line Boundary) as shown on **Figure 1.1 Site Location Plan (Volume 3: Figures)**.

15.5 Methodology

Desk Based Assessment (DBA)

15.5.1 A DBA was carried out to review the geology and ground conditions of the Proposed Development Site, covering a Study Area as defined by the Red Line Boundary shown on **Figure 1.1 Site Location Plan (Volume 3: Figures)**. The study was informed by various publications, documents, publicly available information, discussions with consultees and information gathered from site walkovers.

15.5.2 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 15-3 Information Sources for DBA**.

Table 15-3 Information Sources for DBA

Area	Subject	Source
Geology	Site Geology	British Geological Society (BGS) Onshore GeoIndex online viewer[12]
		NatureScot's Carbon and Peatland map 2016[13]
		Scotland's Environment web map[14]
Land Use	Wild Land	NatureScot's Wild Land Areas map and descriptions 2014[15]
	Soil Type	National Soil Map of Scotland[16]
	Land Type	Scotland Land Cover Map 2022[17]
Topography	Site Topography	Ordnance Survey (OS) Mapping, Scale 1:25,000[18]
	Site Topography	5 m Digital Terrain Model (DTM)

Peatland Surveys

15.5.3 As noted above, NPF4 has defined the responsibility for developers to be conscious of 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:*

  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; and

  iii) the likely net effect of the development on climate emissions and loss of carbon."

15.5.4 Note, Policy 5d part iii is considered as part of the Carbon Assessment set out in **Section 17.4 Lifecycle Greenhouse Gas Impact Assessment** of **Chapter 17: Climate (Volume 2: Main Report)**.

15.5.5 As such, peatland surveys were undertaken in order to obtain information on peat coverage across the Proposed Development Site to inform the following:

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

[12] BGS (n.d.) *GeoIndex Onshore* – British Geological Survey. Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html

[13] NatureScot (2016) *Carbon and Peatland 2016 Map*, Available at: https://map.environment.gov.scot/Soil_maps/?layer=10

[14] Scotland's Environment (n.d.) *Scotland's Web Map*. Available at: https://map.environment.gov.scot/sewebmap/

[15] NatureScot (2014) *Wild land areas map and descriptions 2014*, Available at: https://www.nature.scot/doc/wild-land-areas-map-and-descriptions-2014

[16] Scottish Government. (n.d.) *A review of the National Soil Map of Scotland on Scotland's Soils online map viewer*. Available at: https://opendata.nature.scot/maps/snh::scotland-land-cover-map-2022-eunis-level-1/explore?path=

[17] NatureScot (2022) – *Scotland Land Cover Map2022* Available at: https://map.environment.gov.scot/sewebmap/?layers=eunisLandCoverScotland&extent=-298028,475191,719972,1268192

[18] Ordnance Survey (ND) *OS Terrain 5*, Available at: https://www.ordnancesurvey.co.uk/products/os-terrain-5

Assessment Scope

15.5.6 The assessment considers the effects during the three phases of the Proposed Development's lifespan as identified in **Section 2.18 – 2.20** of **Chapter 2: Project and Site Description (Volume 2: Main Report).** The phases are Pre-Construction and Enabling, Construction and Operation.

15.5.7 The assessment considers the potential for likely effects on geology and soils in relation to the construction of a Pumped Storage Hydro (PSH) scheme. It establishes the baseline geological conditions of the site, using a DBA along with a targeted peatland survey.

Baseline Data Collection

15.5.8 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 DBA, surveys, and professional judgement. See **Table 15-3 Information Sources for DBA** above for the sources reviewed in the DBA.

15.5.9 Following the review of the DBA, peat surveys were undertaken as discussed further in Sections 15.6.10 - 15.6.17 Peat.

Assessment Methodology

15.5.10 The assessment is in line with the methodology set out in **Chapter 4: Approach to EIA (Volume 2: Main Report)**.

15.5.11 For the purpose of this chapter, the sensitive receptors are peatlands and carbon-rich soils. **Table 15-4 Sensitive Receptors**, sets out the sensitive receptors for this assessment and the relative sensitivity.

Table 15-4 Sensitive Receptors

Receptor	Distance from Development	Sensitivity	Reason
Peatlands	On-site	High	The receptor has low capacity to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance (as set out in Policy 5 of NPF4)

15.5.12 As set out in **Table 15-4 Sensitive Receptors**, the sensitivity is considered to be *High* as the receptor deemed to be of national importance, in line with Policy 5 of NPF4 and **Table 4.5 Sensitivity or Value Criteria** of **Chapter 4: Approach to EIA (Volume 2: Main Report).**

15.5.13 In accordance with the methodology described in **Chapter 4: Approach to EIA (Volume 2: Main Report),** the potential effects have been assessed prior to additional mitigation, considering the embedded mitigation set out in this chapter. The residual effects are therefore considered after the implementation of mitigation measures.

15.5.14 The significance of the effects arising from the Proposed Development will be reported using a seven-point scale, as follows: Major Adverse, Moderate Adverse, Minor Adverse, Negligible / Neutral, Minor Beneficial, Moderate Beneficial, and Major Beneficial.

15.5.15 **Table 15-7 Summary of Effects: Pre-Construction** and **Table 15-8 Summary of Effects: Construction** detail the assessment of effects with regard to peatlands and carbon rich soils, considering the embedded mitigation set out in Section 15.7: Embedded Mitigation.

Limitations And Assumptions

15.5.16 The works along the A82 for the Lower Control Works (LCW) are excluded from this assessment as they are viewed as waterborne works and will not affect the key receptors for this chapter.

15.5.17 No peat coring was undertaken during the peatland surveys.

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

- "*Peaty (or organo-mineral soils): a soil with a surface organic layer less than 0.5 m deep;*
- *Peat: a soil with surface organic layer greater than 0.5 m deep; and*

- *Deep Peat: a peat soil with a surface organic layer greater than 1.0 m deep*."

15.5.19 Accordingly, for the purpose of this assessment, it is assumed that peat or 'shallow peat' is > 0.5 m and ≤1.0 m deep and 'deep peat' is > 1.0 m in depth.

15.6 Baseline Environment

Topography and Features

15.6.1 Across the west of the Proposed Development Site is Balmacaan Forest, with hill tops and small lochans found throughout. Loch nam Breac Dearga, is southwest of the centre of the site. In the east is Loch Ness which will serve as the Tailpond, and a small settlement, Grotaig, with a minor road serving it. The Great Glen Way and the A82 running parallel with the edge of Loch Ness, with Ruskich Wood located to the west of this. Within Ruskich Wood and on Loch Ness' shoreline is Primrose Bay (NGR: NH 47084 20539), which BGS GeoIndex Onshore identifies an 'Old Red Sandstone (ORS)' supergroup aquifer water well, at depth of 165 m.

15.6.2 The Proposed Development Site is populated with hill tops across the Balmacaan Forest. Meall Fuar-Mhonaidh to the east of Loch nam Breac Dearga sits at 695 m above ordnance datum (AOD), mirrored with Glas-Bheinn Mhór at 651 m AOD to the west, and the centre of the loch itself at 480 m AOD in the valley between. The site slopes from these peaks to the hills surrounding Loch Ness at around 300 m AOD, before a steep reduction in height to between 15-40 m AOD at Loch Ness' shoreline.

15.6.3 **Figure 15.1 Topography (Volume 3: Figures)** shows the local topography across the Proposed Development Site.

Bedrock Geology

15.6.4 **Table 15-5 Bedrock Geology** summarises the bedrock geology anticipated to be present within the Proposed Development site, based on published sources. The published BGS 1:50 k solid geology map is presented in **Figure 15.2 Bedrock Geology (Volume 3: Figures)**

Table 15-5 Bedrock Geology

Geologic Period / Era	Solid Geological Unit (Note 1)	Description	Anticipated Location within Proposed Development Site
Lower Devonian	Mealfuarvonie Sandstone Member. [MVS]	Conglomerate and Breccio-conglomerate. [MVS-CONG]	Anticipated to outcrop and/or underlie the central and southeastern regions of the Proposed Development Site, but also appearing as thin lenses around the northeastern extents of the Proposed Development Site. This unit forms a lot of the main peaks within the Proposed Development Site including Mealfuarvonie, Nighean a' Mhill, Mac a' Mhill, Creag Dhearg and Meall a Choire.
		Pebbly Arkosic Sandstone. [MVS-PESST]	Anticipated to outcrop and/or underlie southeast of the Proposed Development Site and may not outcrop inside the Proposed Development Site boundary
		Fine-grained Sandstone. [MVS-SDST]	Anticipated to outcrop and/or underlie the northeastern, eastern, and southeastern extents of the Proposed Development Site.
Siluro-Devonian	North Britain Siluro-Devonian Calc-Alkaline Dyke Suite.	Feldsparphyric microgranodiorite.	Anticipated as infrequent scattered intrusions within the Achnaconeran Striped Formation only.
		Quartz-microdiorite.	
		Microdiorite.	
		Mafic microdiorite.	
Pre-Cambrian	Un-named Meta-Igneous Rocks.	Amphibolite and hornblende-schist.	Anticipated as relatively frequent, scattered intrusions within the Achnaconeran Striped Formation only.

Geologic Period / Era	Solid Geological Unit (Note 1)	Description	Anticipated Location within Proposed Development Site
Pre-Cambrian	Achnaconeran Striped Formation. [ACHN]	Interbedded Psammite and semipelite. [ACHN-PSSP]	Anticipated to outcrop and/or underlie the northern, western and southwestern regions of the Proposed Development Site. May also underlie the Mealfuarvonie Sandstone Member at unknown depth.

Table notes:
1) Solid geological material may be locally faulted to form breccia (a coarse angular deposit which is different to Breccio- deposits that have a similar texture), or cataclasite that is a mixture of coarse grains in a fine matrix.

15.6.5 The BGS Onshore GeoIndex Borehole Record show that a borehole at Primrose Bay (NGR: NH 47084 20539), on the bank of Loch Ness, shows sand and gravel, bedrock, and red sandstone to a depth of 29 m below ground level (BGL). Below this, there are indicated to be damp zones and banded regions. This is the only online available borehole record taken on the site.

15.6.6 The BGS Linear Features (1:50,000 scale) map shows multiple fault lines in the site, with a particular one passing northeast to southwest through Loch nam Breac Dearga. All faults are inferred, with displacement unknown. An additional fault line of note passes through the length of Meall Fuar-Mhonaidh.

Superficial Geology

15.6.7 **Table 15-6 Superficial Geology** summarises the superficial geology shown within the Proposed Development Site, based on published information.

15.6.8 The superficial data is derived from the published BGS 1:50 k superficial map and supplemented with AECOM-digitised information from the available BGS 1:10 k field maps (numbers 13736411 and 13736201) where the BGS 1:50 k data lacked coverage over the eastern portion of the Proposed Development Site. The superficial geology is presented in **Table 15-6 Superficial Geology**.

Table 15-6 Superficial Geology

Superficial Geological Unit	Description [from 1:50k BGS, 2012]	Anticipated Location with Proposed Development Site
Peat	Peat – mainly forms a blanket accumulation of wet, acidic, partially decomposed vegetation.	Pockets of are peat recorded relatively frequently, scattered throughout the Proposed Development Site. The largest areas of peat tend to be in the northeastern Proposed Development Site extents.
Alluvium	Deposits of riverbeds and floodplains. Mainly cobbly gravel capped locally by sandy, peaty 'overbank' deposits.	Rare occurrence within the Proposed Development Site. Generally recorded as pockets of alluvium located near watercourses and / or waterbodies including the River Coiltie, Allt Coire an Ruighe and Grotaig Burn.
Alluvial Fan Deposits	Silty sand, gravel, cobbles and sandy diamicton, forming low-angle cones at tributary mouths.	Rare within the Proposed Development Site. Deposits are small and scattered throughout the Proposed Development Site – some locations include around the southeast and north sides of Meal Fuar-mhonaidh. at Alltsigh where the Allt Saigh watercourse enters Loch Ness, along Allt Coire an Ruighe and at the very northwestern extent of the River Coiltie.
Talus (scree)	Accumulations of clast-supported, angular rock fragments at the foot of crags.	Rare within the Proposed Development Site shown to be northwest of Meal Fuar-mhonaidh
Talus Cone	Matrix-rich accumulations of rock fragments at the foot of gullies.	Only recorded once within the Proposed Development Site northwest of Meal Fuar-mhonaidh
Glaciofluvial Deltaic Deposits	Flat-topped spreads of sand and gravel, cross-bedded, typically fining downwards into laminated silt and clay, formed when Loch Ness stood 17-20 m above its present level.	Only recorded once within the Proposed Development Site at Alltsigh where the Allt Saigh watercourse enters Loch Ness.
Glaciofluvial Sheet Deposits	Terraced spreads of dense cobbly gravel and sand.	Only recorded once within the Proposed Development Site within the northeastern extent of the Proposed Development Site just south of the River Coiltie.

Superficial Geological Unit	Description [from 1:50k BGS, 2012]	Anticipated Location with Proposed Development Site
Hummocky Glacial Deposits / Morainic Deposits	Very poorly sorted and consolidated deposits of boulders, gravel, sand and sandy diamicton forming boulder-strewn mounds.	Recorded to be present in only a few locations within the north and northeastern extents of the Proposed Development Site.
Till	Diamicton, silty, clayey, sandy and stony, very stiff, mainly pale yellowing brown with clasts of micaceous psammite, some granodiorite, porphyry and granite. Uppermost parts generally less consolidated, crudely stratified and sandy.	Occurs in localised areas throughout the Proposed Development Site however, predominantly recorded in the northwestern and northeastern extents.

Notes
1. Although not recorded on any of the BGS maps, made ground associated with existing Access Tracks and settlements within the Proposed Development Site is also anticipated.
2. A lot of the Proposed Development Site is anticipated to have rock at or near the surface.

15.6.9 The hydrogeology of the Proposed Development Site is discussed in detail in **Chapter 10: Water Environment (Volume 2: Main Report)**, together with details of all known groundwater and surface water abstractions within the Proposed Development Site and immediate surrounding area.

Peat

15.6.10 As per the requirements set out in NPF4 and relevant best practice guidance, due to the presence of peat, peatland surveys were undertaken to quantify the extent of peatlands across the Proposed Development Site.

15.6.11 Two phases of peatland surveys were undertaken as follows:

- Site Phase 1 Survey – June 2024; and
- Site Phase 2 Survey – October 2024.

Site Phase 1 Peatland Survey

15.6.12 The Phase 1 peatland survey was undertaken across the Proposed Development Site in June 2024. The probing regime was developed in line with best practice guidance, as follows:

- 100 m x 100 m grid across the Headpond, the expected construction compound and access road locations;
- 500 m x 500 m grid across the area to the northwest of the Headpond where there is no expected development; and
- Check probes in areas of deeper peat across the survey area.

15.6.13 As a result of breeding birds in parts of the required survey area, part of the Phase 1 peatland survey was not completed. These outstanding probes were reviewed, and relevant probes were included in the Phase 2 Survey.

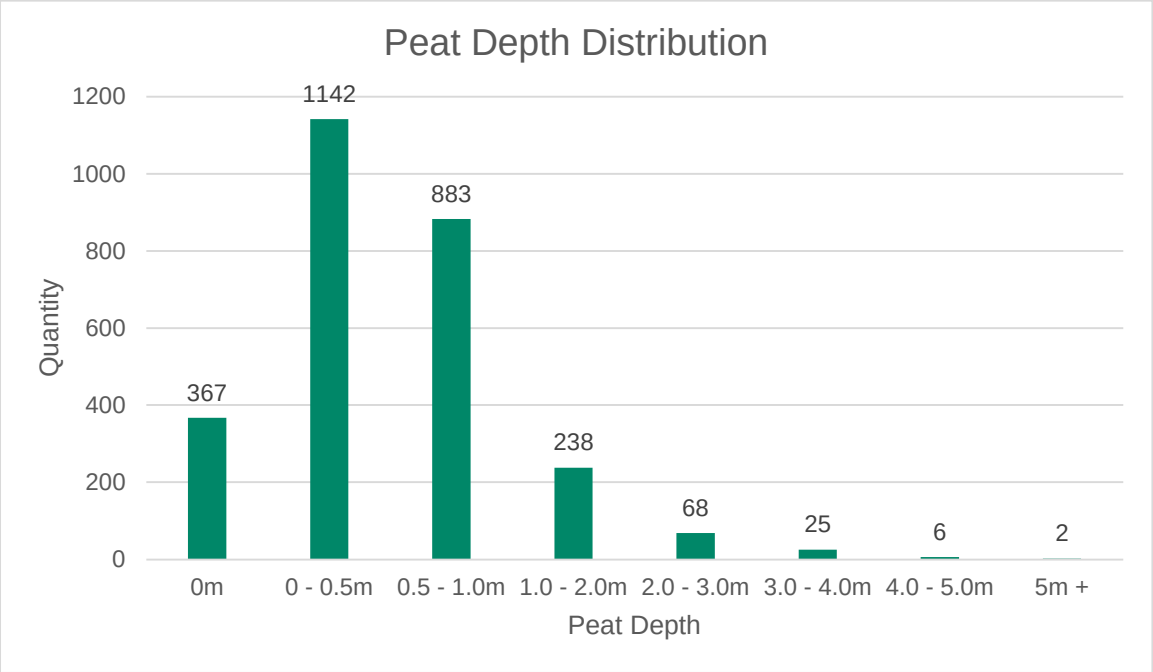
Site Phase 2 Peat Survey

15.6.14 The Phase 2 peatland survey was undertaken in October 2024. Prior to mobilisation, consultation was undertaken with SEPA and the following probing regime was agreed upon:

- 100 m x 100 m grid around Saddle Dam 1 and Saddle Dam 2 which were inaccessible due to breeding birds during the Phase 1 Survey;
- Targeted probing at 50 m centres with 10 m perpendicular offsets along proposed access track alignments; and
- Targeted probing at 50 m centres with 10 m perpendicular offsets along existing access track alignments.

Survey Results

15.6.15 In total, 2,731 probes were taken across the Phase 1 and Phase 2 peatland surveys combined. The results from the survey are shown graphically in **Figure 15.4 Peat Probe Survey Results** and summarised in **Insert 15.1 Peat Depth Distribution**.



Insert 15.1 Peat Depth Distribution

15.6.16 The results of the peat probing were used to create an interpolated peat surface to determine the peat depths across the Proposed Development Site – as detailed in **Figure 15.5 Peat Depth Interpolation Plan**. This peat surface was then used to calculate peat excavation volumes and to amend designs to avoid deep peat where necessary.

Site Observations

15.6.17 During the peatland surveys, the following was observed:

- The northeast access to the Proposed Development Site, accessible via Balnain village, is a high-quality forestry access track with a number of passing places.
- Across the Headpond there are large areas of shallow peat and areas with no peat, with a number of small pockets of deeper peat in naturally occurring basins in the bedrock.
- Peat depth only reached > 3 m at a small number of locations tested, with only one point measuring a depth of greater than 5 m.
- To the north of the Headpond the peat was generally only found in the valleys between hills.
- The unnamed watercourse valley located north of Saddle Dam 2 is extremely steep and provided a significant challenge when probing across it.

Land Use

15.6.18 The Scotland Land Cover Map 2022 (Scottish Natural Heritage) map shows a range of landscape categories across the Proposed Development Site. The predominant category is raised and blanket bogs, with large patches of temperate shrub heathland to the north and around the Headpond. To the east of the Headpond, towards Loch Ness, there is dry grass and artic, alpine and subalpine scrub. Along the northern bank of Loch Ness is Ruskich Wood, with the landscape categories being Scots Pine woodland, highly artificial coniferous woodland, broadleaved deciduous woodland, and mixed deciduous woodland.

15.6.19 The entire site is a Drinking Water Protected Area (Ground), and around Loch Ness and thus covering the east of the site, is a Drinking Water Protected Area (Surface). Just outside the Red Line Boundary in the north is a small Site of Special Scientific Interest (SSSI) which is co-located with a Special Protection Area (SPA) called Dubh Lochs. The Proposed Development does not affect the Dubh Lochs SSSI.

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

Seismic Risk

15.6.21 There have been no historical earthquakes (BGS GeoIndex Onshore) within the site, but there has been in the wider area. Of the seven identified around Loch Ness, five occurred within the 1800's, with a maximum European Macroseismic Scale (EMS) intensity of 7, one in 1768 at intensity 5, and one occurred in 1901 with the maximum EMS intensity at 7. These larger earthquakes were situated > 5km from the Red Line Boundary.

15.6.22 Regarding Modern Instrument Recorded Earthquakes (BGS GeoIndex Onshore), a 1997 earthquake was recorded at Richter local magnitude of 1.4 and maximum EMS intensity of 0 just outside of the Red Line Boundary towards Wester Bunloit in the northeast. On the opposite side of Loch Ness, a Richter 1.2 (and maximum EMS intensity 0) earthquake was recorded in 2016. Multiple other small-scale earthquakes have been recorded within 5km of the Red Line Boundary, with the largest being Richter 3.0 and maximum EMS intensity 2.4 east of Drumnadrochit along the A82.

15.6.23 Due to the very low risk found there is no further scope for seismic mapping and risk evaluation within this EIAR. However, additional seismic assessments will be undertaken in conjunction with the Embankment and Tunnel designs.

Ground Contamination

15.6.24 A review of historic satellite imagery from 2005 and historic maps from 1871 to the present shows the Headpond and its surrounding area has had no significant historic use and as such is unlikely to be contaminated. The National Soil Map of Scotland (NSMoS) classifies the Headpond area as Class F7 for forestry 'land unsuitable for producing tree crops' and Class F6.3 for agriculture 'land capable of use as rough grazings with low quality plants'. The area to the north of the Headpond currently accommodates commercial forestry operations. Given this long-term and ongoing activity, there may be a risk of contamination from forestry equipment and associated practices.

15.6.25 A review of historic satellite imagery from 2005 and historic maps from 1871 shows the area to the south of the Headpond has no evidence of agricultural or forestry use. The NSMoS classifies this area of the site to be mostly Class F6 'land with very limited flexibility for the growth and management of tree crops' forestry, with an area of class F5 'land with limited flexibility for the growth and management of tree crops´ along the existing Alltsigh access track.

15.6.26 Aside from forestry use in the north, the Proposed Development Site is uninhabited and void of large intrusive or potential contaminating historical developments. It is therefore unlikely that the Proposed Development Site will contain contamination from other sources.

15.7 Embedded Mitigation

15.7.1 Embedded mitigation measures are incorporated into the design of a development and aim to avoid or reduce adverse effects, including those on geology and ground conditions. Embedded mitigation can be considered at the impact assessment stage, whereas specific mitigation measures which are not part of the design and are developed after the initial impact assessment, are assessed at a later stage when considering the residual effects.

15.7.2 The Proposed Development has sought to avoid impacts on geology and ground conditions as far as possible through the implementation of several design principles, as set out below:

- Access tracks, Permanent / Temporary Compounds and permanent infrastructure have been located to avoid areas of peat > 1.0 m in depth.
- Where this was not possible, alternative construction methodologies have been specified; as a result, only access tracks are situated on peat > 1.0 m depth, using floating construction in these limited locations. Please refer to **Figure 15.5 Peat Depth Interpolation Plan** for locations and **Figure 2.32 Floating Access Track Details (Volume 3: Figures)** for details. All other permanent infrastructure (e.g., compounds) avoids deep peat.
- In line with consultation held with SEPA, peatlands within the Headpond basin that is not excavated for the construction of the Proposed Development, will be left in situ and not excavated.

15.7.3 The measures set out above have been embedded in the design of the Proposed Development to reduce the impact on peatlands.

15.7.4 As there will be peatlands excavated for the Proposed Development, management of peatlands has also been embedded into the design of the Proposed Development in line with the waste hierarchy of The Waste Management Licensing (Scotland) Amendment Regulations 2016 and the guidance set out by SEPA in Developments on Peat and Off-Site Uses of Waste Peat (2017)[6]. Both sources specify a similar approach to the management of peat, as follows:

1. Prevention of Waste Peat
2. Use on Site
3. Use off-site for peatland restoration
4. Recycling / Recovery
5. Disposal

15.7.5 Accordingly, an Outline Peat Management Plan (oPMP) has been prepared alongside this chapter and summarises the approximate volumes of peat expected to be disturbed / excavated, the potential re-use options and handling and storage methods to be used in support of the Proposed Development's construction, including details of alternative construction methodologies such as floating access tracks. The oPMP is considered to be further embedded mitigation as part of this assessment. Refer to **Appendix 15.2: Outline Peat Management Plan (Volume 5: Appendices)** for details.

15.7.6 Additionally, refer to **Table 15-9 Chapter 15 Appendices Summary** for a summary of the oPMP.

15.8 Assessment of Effects

Background Information

15.8.1 The assessment of effects for geology and ground conditions is as per the standard assessment as described in **Chapter 4: Approach to the EIA (Volume 2: Main Report)**. However, as the potential effects on geological and soil receptors are extremely limited, this chapter also provides information on the basis of other potential indirect effects from the excavation of material in order to construct the Proposed Development, and signposts to the relevant assessments where required.

15.8.2 For impacts on hydrogeology and groundwater dependant terrestrial ecosystems refer to **Chapter 10: Water Environment (Volume 2: Main Report)**.

15.8.3 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.

15.8.4 Given the locality of the Proposed Development Site 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.

15.8.5 Seismic activity in the area could have the potential to destabilise the embankments, however, embedded within the design is the legal requirement that the Embankments will be designed constructed, operated and decommissioned in line with the Reservoirs Act 1975[19], therefore this is scoped out.

15.8.6 The DBA and peatland surveys have found that the majority of the site does not have superficial deposits, suggesting bedrock is at or near the surface. However, in locations where superficial geology is present, it is defined as Peatland Class 1 (across the Headpond) and 2 (around the Headpond), and Class 5 elsewhere across the site, based on the Carbon and Peatland 2016 map.

Pre-Construction and Enabling Phase

15.8.7 The Pre-Construction and Enabling phase will consist of the construction of above-ground infrastructure as set out in **Section 2.18** of **Chapter 2 Project and Site Description (Volume 2: Main Report)**. Accordingly, this phase of the project will require excavation, storage and re-use of peat deposits.

15.8.8 As set out in **Assessment Methodology**, Peat is considered to be a High sensitivity receptor. However, due to the embedded mitigation set out in **Section 15.7 Embedded Mitigation**, the permanent adverse effect is considered

[19] Reservoirs Act 1975. Available at: https://www.legislation.gov.uk/ukpga/1975/23

to be negligible, resulting in a Minor Adverse (Not Significant) significance on peat deposits within the Proposed Development Site.

15.8.9 It is the intention to source aggregate for the construction of the access tracks and establishment of temporary and permanent compounds from an existing on-site BP, located along the existing Forestry and Land Scotland (FLS) forestry track, subject to agreement with FLS. 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 on public roads and carbon emissions associated with construction traffic.

15.8.10 The final location, number and estimate of material from each potential BP will be determined once full Ground Investigation (GI), testing and agreement with FLS have been completed. The BP will require the use of plant to both extract and crush the resulting rock to the required grading. It is anticipated that rock will be extracted by breakers and blasting.

15.8.11 The stockpiling of excavated material from the primary tunnel construction will occur during the Pre-Construction and Enabling phase of the project. The material will be stockpiled and stored in accordance with the details set out in **Appendix 3.1 Outline Construction Environmental Management Plan (CEMP) (Volume 5: Appendices)**.

Construction Phase

15.8.12 Likewise, the construction phase of the project will require excavation, storage and re-use of excavated peat. The permanent adverse effect is considered to be negligible, resulting in a Minor Adverse (Not Significant) significance on peat deposits within the Proposed Development Site.

15.8.13 It is the intention to source aggregate for construction of the Embankments from an on-site BP Search Area, located within the Headpond. The material from the Pre-Construction and Enabling phase will be temporarily stockpiled in Temporary Construction Compounds and utilised for the construction of other parts of the Proposed Development.

15.8.14 The location of the BP Search Area have 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 EIAR. The final location, number and quantity of material from each potential BP Search Areas will be determined once full GI works and testing have been completed. The BP Search Areas 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 BP Search Area has been identified within the Headpond area. A typical detail of the BP Search Area is shown in **Figure 2.12 – Headpond Borrow Pit Plan and Section (Volume 3: Figures)**. The BP Search Area is expected to yield a maximum bulked volume of up to 2,200,000 m³ of aggregate. The bedrock geology where it is located is psammite and semipelite (Achnaconeran Striped Formation) and can be seen on **Figure 15.2 – Bedrock Geology (Volume 3: Figures)**.

Operational Phase

15.8.15 Peat excavated during the construction phase will be permanently displaced from the areas required for above ground infrastructure. Therefore, as the impact has occurred already in the construction phase, there are no operational effects on peat.

15.9 Additional Mitigation

15.9.1 Due to the embedded mitigation in the design of the Proposed Development, no additional mitigation measures are proposed or required for geology and ground conditions.

15.9.2 Please refer to **Appendix 7.6 Outline Peatland Restoration Plan (Volume 5: Appendices)** for details on peatland restoration.

15.10 Residual Effects

15.10.1 In accordance with the methodology described in **Chapter 4: Approach to EIA (Volume 2: Main Report)** potential effects have been assessed prior to additional mitigation, with the residual effects after implementation of the mitigation measures detailed in **Table 15-7 Summary of Effects: Pre-Construction** and **Table 15-8 Summary of Effects: Construction**.

15.10.2 As noted in **Section 15.7 Embedded Mitigation**, mitigation for geology and ground conditions have been embedded into the design of the Proposed Development.

Table 15-7 Summary of Effects: Pre-Construction

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Peat	Excavation for Proposed Development Site above ground infrastructure, resulting in loss of peatlands.	Minor Adverse	Not required	Minor Adverse	**Not Significant**

Table 15-8 Summary of Effects: Construction

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Peat	Excavation for Proposed Development Site above ground infrastructure, resulting in loss of peatlands.	Minor Adverse	Not required	Minor Adverse	**Not Significant**

15.10.3 As noted in **Section 15.8.15 Operational Phase**, there are expected to be no operational effects on peat.

15.11 Cumulative Effects

15.11.1 Inter-project effects were considered for the cumulative developments listed in **Table 4.8 Cumulative Developments** of **Chapter 4: Approach to EIA (Volume 2: Main Report)**. No direct combined effects on geology or ground conditions were identified from the Proposed Development Site and the cumulative developments.

15.11.2 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 Proposed Development Site and create a combined adverse effect of greater significance. However, as demonstrated in the **Appendix 15.1 Material Management Appraisal (Volume 5: Appendices)**, all excavated material can and will be reused within the Proposed Development Site, minimising any potential intra-project transport effects.

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

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

15.12 Summary

15.12.1 This chapter presents the baseline conditions of the Proposed Development Site and highlights the potential effects and their significance on geology and soils – with a focus on the impact on peatlands.

15.12.2 Initially, a DBA was conducted which indicated the presence of peatlands across the Proposed Development Site. In accordance with best practice guidance, peatlands surveys were conducted to validate the findings of the DBA. The peatland surveys were scoped via consultation with SEPA and aimed to establish the baseline depth and extent of peatlands across the Proposed Development Site.

15.12.3 Two phases of peatland survey were conducted to validate the findings of the DBA, with 2,731 peat probes taken. The results indicated that where peatland is present, it was relatively shallow, with the majority of probes (~ 87%) sitting in the 0 – 1.0 m banding.

15.12.4 The design of the Proposed Development was undertaken considering the results of the peatland surveys, with an aim to avoid infrastructure in areas of peat with depth > 1.0m. Where this was not possible, alternative construction methodologies have been prescribed (floating access tracks etc.). These design considerations form the embedded mitigation assessed in this chapter.

15.12.5 This chapter is supplemented by **Appendix 15.1: Material Management Appraisal**, **Appendix 15.2: Outline Peat Management Plan** and **Appendix 15.3: Outline PLHRA (Volume 5: Appendices)** summarised as set out in **Table 15-9 Chapter 15 Appendices Summary**.

Table 15-9 Chapter 15 Appendices Summary

Appendix No.	Appendix Conclusion
15.1: Material Management Appraisal	• The Material Management Appraisal indicates that approximately 6,100,000 m³ of material is required to construct the Headpond Embankments and Spillway – to form the upper reservoir. • It is estimated that a total of approximately 8,710,000 m³ of material suitable for use in construction of the Headpond Embankments and Spillway will be excavated. *Note ~ 960,000 m³ of additional material will be excavated but is not considered to be suitable for use in the construction of the upper reservoir and is considered in the surplus calculations.* • It is proposed that the Headpond BP Search Area and UCW be the main source of material for the Headpond Embankment and Spillway construction, constituting approximately 5,100,000 m³ (84%). The remaining 980,000 m³ (16%) will be sourced from the remaining above and below ground excavation. • It is estimated that there will be surplus of approximately 2,950,000 m³ (including the 960,000 m³ deemed to be not usable for construction of the Embankments). The material surplus will be used site-wide in landscaping works (post-construction), as aggregate in concrete batching (during construction) and as material for road resurfacing (during and post-construction). It is estimated that approximately 2,850,000 m³ of excavated material will be used across the site during and post-construction, leaving a final surplus of approximately 100,000 m³. • While a surplus is shown, this is considered to be a conservative value and is likely to be minimal. As such it is estimated that there will be no wate material left on site or exported off site, with the exception of the LCW Excavation. The material excavated from the LCW will be removed by waterborne transport and repurposes in an appropriate location, external to the Proposed Development.
15.2: Outline Peat Management Plan (oPMP)	• The oPMP indicates that approximately 405,000 m³ of peat will be excavated for the construction of the Proposed Development. The volume of excavated peat has been minimised through conscious design and the embedded mitigation as set out in **Section 3.2** of **Appendix 15.2: Outline Peat Management Plan (Volume 5: Appendices)** and **Section 15.7 Embedded Mitigation** of this chapter. • Through the series of peat re-use measures, as set out in **Table 3** of **Appendix 15.2: Outline Peat Management Plan (Volume 5: Appendices)** it is estimated that all the excavated peat will be re-used within the Proposed Development Site, with no waste peat removed expected. • The oPMP will be developed into a final Peat Management Plan following site-specific GI, which will be adopted by the construction contractor pre-construction.
15.3: Preliminary PLHRA	• The Preliminary PLHRA highlighted that the majority of the Proposed Development Site has a 'Low' Hazard Ranking with localised areas of 'Negligible' and 'Moderate' Hazard Ranking. • Worst-case mitigation has been considered, however, further updates to the PLHRA followed site-specific GI may reduce the assessed Hazard Rankings. • Based on the assessment undertaken and as further development of the PLHRA and mitigation is undertaken, the project can proceed as is recommended in Table 5.4 of Peat Landscape Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, second edition (2017).

15.12.6 In summary, through the adoption of good working practices and embedded mitigation in the design of the Proposed Development, the potential effects on geology and soil are considered to be **Minor Adverse** and therefore **Not Significant**. This is consistent for all construction phases of the development.

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