

12 Geology and Peat

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12. Geology and Peat

12.1. Summary

- 12.1.1. This Chapter assesses the potential effects of the Proposed Varied Development on geological and peat receptors during construction, operation and decommissioning.
- 12.1.2. The geology and peat assessment for the Proposed Varied Development was based on a desk study, site surveys, and consultation with the Scottish Environment Protection Agency (SEPA).
- 12.1.3. The design of the Consented Development as detailed in the Shepherds' Rig Wind Farm Environmental Impact Assessment (EIA) Report (Infinergy, 2018) and the Shepherds' Rig Additional Environmental Information Report (AEI) (Infinergy, 2019) was established through an iterative process which included the identification of technical and environmental constraints determined during the EIA process, through consultation with statutory bodies and members of the local community.
- 12.1.4. Most notably from a geology and peat perspective, the Proposed Varied Development reduces the number of turbines from 17 to 11 compared to the Consented Development's design whilst increasing the remaining turbine's size as well as reducing the length of new track required by approximately 1.3 km. Several turbines on the western side of the site have been re-sited and re-oriented onto shallower peat.

Table 12.1 – Summary of Conclusions – Proposed Varied Development and Consented Development

2018 Section 36 Application, supported by Additional Environmental Information I (2019) and Additional Environmental Information II (2021) - the Consented Development	2026 Section 36C Application - the Proposed Varied Development
The Consented Development, prior to the amended design presented in AEI II (2021) comprised 19 turbines and required 97,300 m³ excavated peat (not including earthworks for levelling, clearance areas or a bulking factor). Sufficient methods were defined to ensure that peat can be sensitively handled and stored on-site to allow for effective reuse and no waste licence is required for the construction work. The Consented Development EIA assessed the likely significance of effects of the Consented Development on Geology and Peat. Given that only effects	The number of turbines and length of access tracks have decreased from 17 to 11 larger turbines and to a new access track distance of 7.7 km from 9 km. The impact of both these changes means that the disturbance of peat by the Proposed Varied Development is less than that of the previously Consented Development. The volume of excavated peat is now estimated at 80,074 m³, including earthworks and clearance areas but excluding a bulking factor. When a 10% bulking factor is applied, this increases to

2018 Section 36 Application, supported by Additional Environmental Information I (2019) and Additional Environmental Information II (2021) - the Consented Development	2026 Section 36C Application - the Proposed Varied Development
of moderate significance or greater are considered significant in terms of the EIA Regulations, the potential effects on Geology and Peat were moderate (significant) and residual effects Minor (not significant) with the mitigation of micro-siting turbines onto shallow peat deposits within the 50 m micro-siting allowance. AEI I (2019) for the revised proposed development comprised 17 turbines, 158,300 m² infrastructure footprint and required 93,687 m³ excavated peat (not including earthworks for levelling, clearance areas or a bulking factor). Sufficient methods were defined to ensure that peat can be sensitively handled and stored on-site to allow for effective reuse, and no waste licence is required for the construction work. The AEI I concluded with effective and well managed mitigation measures in place, no significant residual effects on geology and peat are predicted because of the Consented Development.	88,081 m³. Both values are lower than those reported for the Consented Development. On a like-for-like basis excluding a bulking factor, the volume of excavated peat has reduced by 13,613 m³. Even when adopting a highly conservative comparison between the total potential peat excavation for the Proposed Varied Development and the infrastructure-only excavation volume reported for the Consented Development, peat excavation is still reduced by at least 5,606 m³. All excavated peat can be appropriately reused around infrastructure. The peat slide stability risk is low. Additionally, the turbines have been carefully designed to avoid peat where possible and are located on shallower peat than the Consented Development. The carbon storage capacity of peat increases with depth (Plate 12.1), thus the Proposed Varied Development is located on less sensitive peatland. When the infrastructure is located on shallower peat, less peat is extracted per meter area, this combined with the reduced number of turbines and length of access track has led to the volume of excavated peat overall, and proportionally per turbine, being reduced. All excavated peat can be appropriately reused around infrastructure. The peat landslide stability risk is low. The Proposed Varied Development will have no significant adverse effects with standard best practice and embedded mitigation. No additional site-specific mitigation is required.

12.1.5. During construction, operation and decommissioning of the Proposed Varied Development, a number of established good practice measures will be put in place to minimise peat disturbance, peat stability, and loss and compaction of soils (refer to **Appendix 12.1, 12.2, 12.3 and 13.1**). With effective and well managed mitigation measures in place, no significant residual effects on geology and peat are predicted as a result of the Proposed Varied Development.

12.1.6. The proposed variations to the Consented Development will not result in any change to the significance of effects on the geology and peat environment overall, including cumulative effects as outlined within the 2018 EIA Report and subsequent AEI Reports for the Consented Development, which is assessed as Minor (not significant).

12.2. Introduction

12.2.1. This Chapter provides an assessment of geological effects arising from the construction, operation and decommissioning of the Proposed Varied Development. This assessment was undertaken by Fluid Environmental Consulting Limited (Fluid).

12.2.2. SETT Wind Development Limited ('the Applicant') gained Section 36 consent and deemed planning permission from Scottish Ministers in August 2023 to construct and operate Shepherds' Rig Wind Farm ('the Consented Development'). The Consented Development comprises 17 turbines (15 turbines with a maximum blade tip height of 149.9 metres (m) and two turbines with a maximum blade tip height of 125 m) and associated infrastructure.

12.2.3. The Applicant is now applying to Scottish Ministers for consent under Section 36C of the Electricity Act 1989 (as amended) and the Town and Country Planning (Scotland) Act 1997 to vary the Consented Development. The proposed variations include:

- Removal of six turbines and associated crane hard standings;
- Increase in the maximum blade tip height of the remaining 11 turbines to 220 m;
- Increase in size of associated crane hardstandings to accommodate the larger turbines;
- Relocation of eight turbines beyond the micro-siting allowance of the Consented Development, but within the same pattern of development;
- Amendments to part of the track layout to reflect turbine removal and relocation (as outlined above);
- Change to the number and location of required watercourse crossings to accommodate the amended track layout;
- Increase in size and capacity of the associated Battery Energy Storage System (BESS);
- Relocation of the temporary construction compound slightly beyond micro-siting allowance;

- Removal of the previously proposed anemometer mast; and
- Increase to the period of consent from 30 to 40 years.

12.2.4. Collectively, the proposed variations listed above are referred to as the 'Proposed Varied Development'.

12.2.5. The key element of the Proposed Varied Development is that turbine numbers are reduced, and the locations of three turbines (5, 6 and 7) are within micrositing allowance from the Consented Development. Locations of most of the remaining turbines are only slightly adjusted (within 200 m of a consented turbine position), relocated to incorporate the constraints associated with larger turbines. Four turbines (1, 2, 4 and 11) are over 200 m from a consented turbine location; however, no turbine is over 500 m from a consented location. All turbines are located within the similar habitat types and the same catchments. No significant additional impacts are therefore predicted.

12.2.6. The Chapter has been prepared with reference to the assessment undertaken for the Consented Development. The key historical documents include:

- Shepherds' Rig Wind Farm EIA Report, Chapter 12 Geology and Peat (Infinergy, 2018);
- Shepherds' Rig Additional Environmental Information Report I (Infinergy, 2019); and
- Shepherds' Rig Additional Environmental Information Report II (Infinergy, 2021).

12.2.7. This Chapter provides an assessment of the impact of the Proposed Varied Development on Geology and Peat and provides a preliminary geological assessment of the peat presence and depth, excavation volumes and peat reuse, and of the existing ground conditions while considering peat stability. A peat landslide hazard and risk assessment has been undertaken to:

- Identify areas susceptible to peat slide risk which could be affected by the construction of the Proposed Varied Development;
- Assign hazard and likelihood of occurrence; and
- Detail mitigation measures to reduce any identified risks.

12.2.8. This geological assessment identifies areas of geological interest and features of note. The information and data collated from the peat and geological assessments have informed the Site layout to minimise the potential impacts on peat and geology as a result of the Proposed Varied Development.

12.2.9. The Chapter also presents the current environmental baseline and associated links to other chapters such as hydrology and hydrogeology and terrestrial ecology (refer to **Chapter 13: Hydrology and Hydrogeology** and **Chapter 9: Ecology**) due to their potential dependence on the geological and peat environment. This is then followed by the identification and assessment of potentially significant effects on each receptor based on the baseline and assessment methodology set out. The assessment presents the

effects on each geological and peat receptor in relation to peat excavation volumes, management and reuse and peat landslide hazard risk assessment. These effects are then grouped for the assessment section and where relevant, mitigation, management and monitoring measures are then discussed and the residual effects determined.

12.2.10. The Chapter includes the following elements:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Assessment of Potential Effects;
- Mitigation and Residual Effects;
- Cumulative Effect Assessment;
- Summary of Effects; and
- Statement of Significance.

12.2.11. This Chapter is supported by the following figures and appendices:

- **Figure 12.1:** National Soil Map of Scotland;
- **Figure 12.2:** SNH Carbon and Peatland Mapping 2016;
- **Figure 12.3:** Superficial Geology;
- **Figure 12.4:** Bedrock Geology;
- **Figure 12.5a-b:** Peat Depth of Penetration and Probing Locations;
- **Figure 12.6a-b:** Estimated Peat Depth;
- **Figure 12.7a-b:** Peat Restoration Areas;
- **Appendix 12.1:** Peat Survey Report;
- **Appendix 12.2:** Outline Peat Management Plan;
- **Appendix 12.3:** Peat Landslide Hazard Risk Assessment; and
- **Appendix 12.4:** Borrow Pit Assessment

12.2.12. This Chapter should be read in conjunction with **Chapter 4: Description of Proposed Varied Development; Chapter 7: Forestry, Chapter 9: Ecology and Chapter 13: Hydrology and Hydrogeology** and reference should also be made to **Appendix 13.1: Best Practice Methodology**.

12.3. Legislation, Policy and Guidelines

- 12.3.1. There is a wide body of legislation and guidance that has been used in relation to the assessment with key documents listed below.

Legislation

- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (section 36 and 37 Guidance February 2022);
- National Planning Framework (NPF) 4: National Spatial Strategy for Scotland, approved by Scottish Parliament on 11 January 2023 adopted by Scottish Ministers on 13th February 2023 replaces NPF3 and Scottish Planning Policy; and
- Scottish Government Environmental Authorisation (Scotland) Regulations 2018 (EASR) as amended by Environmental Authorisation (Scotland) Amendment Regulations 2025 (came into effect 1st November 2025).

- 12.3.2. The EASR replaces eight regulations including: The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (revoked) (CAR), Pollution Prevention & Control (Scotland) Regulations 2012 (PPC), The Waste Management Licensing (Scotland) Regulations 2011, Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991, Landfill (Scotland) Regulations 2003.

Planning Policy

- 12.3.3. National Planning Framework (NPF) 4: National Spatial Strategy for Scotland, adopted by Scottish Ministers on 13th February 2023 replaces NPF3 and Scottish Planning Policy.
- 12.3.4. Some of the SEPA planning guidance is being reviewed and updated to reflect the NPF4 policies. It still provides useful and relevant information, but some parts may have been updated or will be updated further in the future.
- 12.3.5. Dumfries and Galloway Council (DGC) formally adopted the Dumfries and Galloway Local Development Plan (LDP) 2 on the 3rd October 2019 and DGC have started on LDP3. Relevant policies to this Chapter are:
- OP1: Development Considerations d) Biodiversity and Geodiversity;
 - NE6: Sites of National Importance for Biodiversity and Geodiversity;
 - NE4: Sites of International importance for Biodiversity;
 - NE5: Species of International Importance;
 - NE13: Agricultural Soil;
 - NE14: Carbon Rich Soil;
 - NE15: protection and restoration of peat deposits as carbon sinks;

- IN1: Renewable Energy; and
- IN2: Wind Energy.

SEPA Guidance

12.3.6. The Guidance for Pollution Prevention (GPP) includes the documents referred to below, which are the principal documents which establish best practice for preventing contamination of surface water from construction activities. Those relevant to the Proposed Varied Development include:

- GPP1: Understanding your Environmental Responsibilities – Good Environmental Practices version 1.2 (SEPA, DAERA, NRW & NIEA, June 2021) replaces PPG1: General guide to the prevention of pollution (EA, SEPA & EHSNI, published 2013, withdrawn December 2015);
- GPP5: Works and maintenance in or near water (SEPA, DAERA, NRW & NIEA, February 2018);
- GPP6: Working at construction and demolition sites, version 1 (EA, SEPA & NIEA, April 2023); and
- GPP21: Pollution incidence response planning, version 1.1 (SEPA, DAERA, NRW & NIEAEA, June 2021).

12.3.7. Additional SEPA Guidance:

- WAS-G-52 SEPA Guidance: Developments on Peat and Off-Site Uses of Waste Peat Version 2 (August, 2025);
- SEPA Planning Advice Note - Assessing the Impact of Developments on Peatland and Carbon-Rich Soils (December 2025);
- WAS-G-11 Construction and Remediation: On-site Management of Excavated Peat Version 1, (revised guidance on the on-site use of excavated peat) SEPA, March 2026;
- Temporary Construction Methods, Engineering in the Water Environment Good Practice Guide, WAT-SG-29 (SEPA; 2009);
- SEPA Regulatory Position Statement – Developments on peat (SEPA, 2010);
- Peatland Survey. Guidance on Developments on Peatland. Scottish Government, Scottish Natural Heritage (SEPA, 2017); and
- Land Use Planning System Guidance Note 4 (LUPS GU4) - Planning Guidance on On-shore Windfarm Developments (SEPA, September 2017).

Other Relevant Guidance

- Environmental Good Practice on Site C650 2nd Edition (CIRIA, 2005);

- Good Practice During Wind Farm Construction (NatureScot, July 2024). (superseding the Good Practice During Windfarm Construction (Scottish Renewables, SNH, SEPA & Forestry Commission Scotland, 4th Edition 2019);
- Tracks and Roads on Peatlands, IUCN UK Peatland Programme (March 2025);
- Peatland ACTION - Technical Compendium of Peatland Restoration Techniques. NatureScot, 2024 (<https://www.nature.scot/doc/peatland-action-technical-compendium>);
- Managing Forest Operations to Protect the Water Environment Practice Guide (Forestry Commission Scotland, 2019);
- The Construction Industry Research and Information Association (CIRIA), Environmental Good Practice on Site (C741) (2015);
- Planning Advice Note 50 Controlling the Environmental Effects of Surface Mineral Workings (1996);
- Guidance on Road Construction and Maintenance (Forests and Water Guidelines Fifth Edition 2011, Forestry Commission);
- A Handbook of Environmental Impact Assessment, 5th Edition (SNH (now NatureScot), 2018);
- The Scottish Government, The Scottish Soil Framework (2009);
- Advising on peatland, carbon-rich soils and priority peatland habitats in development management NPF4 (NatureScot, 2023, revised November 2023);
- Peat Landslide Hazard and Risk Assessments: Good practice Guide for Proposed Electricity Generation Developments (Scottish Government, Second Edition, 2017); and
- NatureScot Research Report 1259 - A risk-based approach to peatland restoration and peat instability (Mills, A.J. and Rushton, D. 2023).

12.4. Consultation

- 12.4.1. **Table 12.2** provides details of consultations undertaken with relevant regulatory bodies, together with action undertaken by the Applicant in response to consultation comments.

Table 12.2 – Consultations

Consultee	Key Consultee Comments	Application Action
The Scottish Government Energy	There is a demonstrable requirement for peat landslide hazard and risk assessment (PLHRA), the assessment should	A PLHRA has been undertaken for the Proposed Varied Development as is included as Appendix 12.3 .

Consultee	Key Consultee Comments	Application Action
Consents Unit Scoping Opinion 15th November 2024	be undertaken as part of the EIA process to provide a clear understanding of whether the risks are acceptable and capable of being controlled by mitigation measures. Where borrow pits are proposed as a source of on-site aggregate they should be considered as part of the EIA process and included in the EIA report detailing information regarding their location, size and nature. The impact of such facilities (including dust, blasting and impact on water) should be appraised as part of the overall impact of the working. Information should cover the requirements set out in 'PAN 50: Controlling the Environmental Effects of Surface Mineral Workings'.	The Proposed Varied Development's borrow pits remain the same as for the Consented Development and were previously assessed as part of the Consented Development's EIA Report (2018) and subsequent further AEI Report (2021). As no changes to the borrow pit number, size or location are proposed, it is considered that the Consented Development's Borrow Pit Assessment Appendix 12.4 remains valid for the Proposed Varied Development. An assessment summary is included in this Chapter.
SEPA – Scoping Response 13 August 2024	SEPA originally objected to the Consented Development due to the lack of information on the impact on peat, however the objection was withdrawn after the turbine locations were adjusted away from peat. SEPA welcomes the applicant's on-going efforts to reduce peat excavation across the site. The applicant should confirm additional volume of peat disturbed from larger turbines and therefore larger footprints in the EIA Report and how this will be reused. Drawings at a usable scale showing all permanent and temporary infrastructure, with extent of excavation required for: peat depth survey, peat depth interpolated and peat condition assessment (PCA).	The volume of peat disturbed as a result of the Proposed Varied Development, as well as information on how this will be re-used is addressed within this assessment. The additional footprint associated with the larger turbines for the Proposed Varied Development is countered by a reduction in the number of turbines, and through an iterative design process which has focused upon positioning turbines off peat deposits where possible, and the reduction in overall track length. These changes have led to a lower volume of peat being extracted in the Proposed Varied Development than in the Consented Development.

Consultee	Key Consultee Comments	Application Action
	Demonstrate proposal avoids any near natural peatland and that all proposed excavation is on peat less than 1m deep. A map showing the location, size, depths and dimensions of all borrow pits overlain with all lochs and watercourses within 250m and showing a site-specific buffer around each loch or watercourse proportionate to the depth of excavations. The information provided needs to demonstrate that a site-specific proportionate buffer can be achieved.	Peat will be reused in areas initially used by temporary infrastructure, the depth of peat used in these areas will be similar to that of the average depth of surrounding / connected peat. Figure 12.5a-b and 12.6a-b show the depth of peat and the location of both temporary and permanent infrastructure. The OPMP (Appendix 12.2) gives the percentage of infrastructure located on peat by depth. The peat condition is discussed in Chapter 9: Ecology. The majority of the peatland is heavily modified due to forestry activities and drainage and any near natural peatland and deeper peat have been avoided where possible by design a stand alone PCA is not considered to be required. Borrow pits were previously assessed as part of the Consented Development's EIA Report (2018) and AEI (2021). No changes are proposed. A site-specific buffer has been achieved.

- 12.4.2. Due to length of time between the scoping and the application for the Proposed Varied Development, further consultation was undertaken with SEPA 15th May 2026 via an online call to provide a project update, discuss design changes and assessment work undertaken.

12.5. Assessment Methodology and Significance Criteria

Study Area

- 12.5.1. The study areas utilised for the geology and peat assessment are the Proposed Varied Development's site boundary (the 'site') and the developable area of the site (the 'Peat Study Area'). The extents of the developable area of the Site, used for peat surveys, was identified during the peat depth survey for the Consented Development. The site and Peat Study Area are shown on **Figure 12.5a-b** and **Figure 12.6a-b**.

Desk Study

- 12.5.2. The assessment is based on a desk study with site surveys and walkovers for higher resolution information. The desk study involved collating and assessing the relevant information:
- identification of underlying geology and peat;
 - collation of data provided through consultations;
 - assessment of topography and slope characteristics;
 - identification of drainage and geomorphological characteristics; and
 - collation of data from published maps, aerial imagery and digital terrain mapping.
- 12.5.3. Reference was also made to the following sources of information:
- The Consented Development's EIA Report, Chapter 12 (Infinergy, 2018) and Additional Environmental Information (AEI) (Infinergy, 2021);
 - Meteorological Office website for rainfall data (accessed March 2026, <http://www.metoffice.gov.uk/climate/uk/averages/>);
 - Ordnance Survey Mapping 1:10,000 scale digital Open data, 1:25,000 scale Explorer map 326 Ayr & Troon and map 320 Castle Douglas, Loch Ken & New Galloway and 1:50,000 scale Landranger map 70 Ayr, Kilmarnock & Troon and map 77 Dalmellington & New Galloway;
 - Google Earth and Bing map aerial imagery (accessed March 2026);
 - British Geological Survey Mapping 1:50,000 Sheet 9W new Galloway Solid (1998) and Drift (1979) BGS Map Portal (Accessed March 2026, <https://webapps.bgs.ac.uk/data/MapsPortal/map.html?id=10954300010954>);
 - British Geological Society GeoIndex Boreholes database, 1:50,000 (accessed March 2026, <https://mapapps2.bgs.ac.uk/geoindex/home.html>);
 - British Geological Society Geology Viewer (accessed March 2026, <https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/>);

- National Soil Map of Scotland (Accessed March 2026, https://map.environment.gov.scot/Soil_maps/?layer=1);
- SNH Carbon and Peatland Map 2016 (accessed March 2026 <https://opendata.nature.scot/datasets/carbon-and-peatland-2016-map/explore?location=55.392037%2C-3.017924%2C8.94>);
- BGS Regionally Important Geodiversity Sites (RIGS) data;
- Joint Nature Conservations Committee (JNCC) Geological Conservation Review (GCR) data base; and
- Multi-Agency Geographic Information for the Countryside (MAGIC) website (accessed March 2026, <http://magic.defra.gov.uk/>).

Field Surveys

12.5.4. The following field surveys were carried out of the Peat Study Area to inform the assessment:

- Previous peat probing undertaken by Arcus in support of the Consented Development's EIA, completed probing 100 m grid October 2013 and detailed probing in August and September 2018 (1,405 locations and 16 additional locations without a peat depth value);
- Fluid peat probing and coring surveys in support of the Proposed Varied Development totalling 6,373 probes and 22 cores:
 - Survey 1: 25 m grid across the three areas of the site that were considered for turbine locations undertaken in May 2024;
 - Survey 2: 10 m grid around infrastructure and 20 m grid, 50 m buffer area and 50 m intervals with 10 m offsets on each side along a proposed access track undertaken in June 2024;
 - Survey 3: 10 m grid around infrastructure completed in August 2024;
 - Survey 4: 10 m grid around infrastructure and 20 m grid, 50 m buffer area and 50 m intervals with 10 m offsets on each side along a proposed access track undertaken in October 2024;
 - Survey 5: additional probes for minor layout changes November 2025;
 - Survey 6: additional probes December 2025;
 - Survey 7: additional probes for further layout changes January and February 2026; and
 - Survey 8: additional probes March 2026 for access track adjustment.

- A PLHRA and geomorphology walkover was undertaken in June 2024 by a Chartered Geologist and peatland geomorphologist with over 20 years' experience of assessing peat landslides verified the desk-based studies;
- A hydrology and borrow pit site walkover was undertaken in October 2024 and March 2026 to visually inspect surface water features and to obtain an understanding of the local topography and peat drainage regime by a hydrologist with over 18 years' experience of assessing the water, geology and soil environment.

12.5.5. The baseline conditions had not substantially altered since the previous EIA walkovers (2013 and 2018). Some minor changes in ecological habitat and forestry coup growth and felling stages were observed.

Assessment of Likely Effect Significance

12.5.6. The key issues for the assessment of potential effects on the geological and peat resources relating to the Proposed Varied Development include:

- potential erosion and sedimentation effects on the hydrological environment;
- potential changes in soil and peat interflow patterns;
- potential for the compaction of soils; and
- potential for peat destabilisation and disturbance.

12.5.7. Effects during construction, operation and decommissioning have been assessed, as well as potential cumulative effects.

Elements Scoped Out of Assessment

12.5.8. The SEPA Landfill Map has not identified any areas of contaminated land within the Study Area and no effects are anticipated. Should potentially contaminated land be encountered during excavations; however, this would be tested and appropriate action taken in accordance with The Environmental Protection Act 1990. Potential effects arising from contaminated land have, therefore, been scoped out of this assessment.

Assessment Methodology

12.5.9. The significance of any impacts of the Proposed Varied Development on baseline conditions is assessed in this Chapter. The combination of the sensitivity of the receptor and the magnitude of the potential effect combine to determine the significance of that impact.

12.5.10. There are no published guidelines or criteria for assessing and evaluating effects on geology or peat within the context of an EIA. The assessment is based on a methodology derived from EIA regulation guidance, the Institute of Environmental Management and Assessment (IEMA) guidance, the Scottish Natural Heritage [SNH] publication - A Handbook on Environmental Impact Assessment (SNH (now NatureScot), 2018), and

professional judgement and expertise. The methodology is also based upon relevant SEPA and Scottish Government guidance including Tracks and Roads on Peatlands, International Union for the Conservation of Nature (IUCN) UK Peatland Programme (March 2025).

12.5.11. The methodology sets a list of criteria for evaluating the environmental effects, as follows:

- The type of effect (i.e. whether it is strongly positive, positive, strongly negative, negative, neutral or uncertain);
- The likelihood of the effect occurring based on the scale of certain, likely, or unlikely;
- Sensitivity criteria are based on both the likely effect on a receptor due to a particular activity, as well as the importance of the resource under consideration or designated value of the receptor; and
- The magnitude of change is the potential effect in relation to the resource that has been evaluated, quantified using the scale high, medium or low and included the consideration of timing, scale, size and duration of a potential impact.

12.5.12. The sensitivity and magnitude of potential effect criteria described in this section were considered appropriate for the conditions and environments prevailing at the site.

Sensitivity of Receptors Assessment Criteria

12.5.13. Sensitivity criteria is based on both the ability of a receptor to accommodate the anticipated impact of the likely changes, as well as the importance of the resource under consideration or designated value of the receptor (e.g. a designated area of international or national importance has a higher value and therefore higher sensitivity than other areas of lower status). Evaluation of sensitivity of geology and peat requires a considerable degree of judgement, based on defined characteristics and values and professional experience.

12.5.14. The sensitivity criteria used in this assessment is presented in **Table 12.3**.

Table 12.3 – Sensitivity Criteria

Sensitivity of Environment	Definition
Very High	Internationally or nationally designated sites (e.g., Ramsar, SPA, SAC, SSSI, National Nature Reserves, Marine Nature Reserves). Habitats listed in Regional Biodiversity Action Plans or Annex I habitats that are groundwater dependent. >25 % of the infrastructure is located on Peat >2 m in open terrain or >3 m in forestry, densely drained, eroded or gullied open terrain.

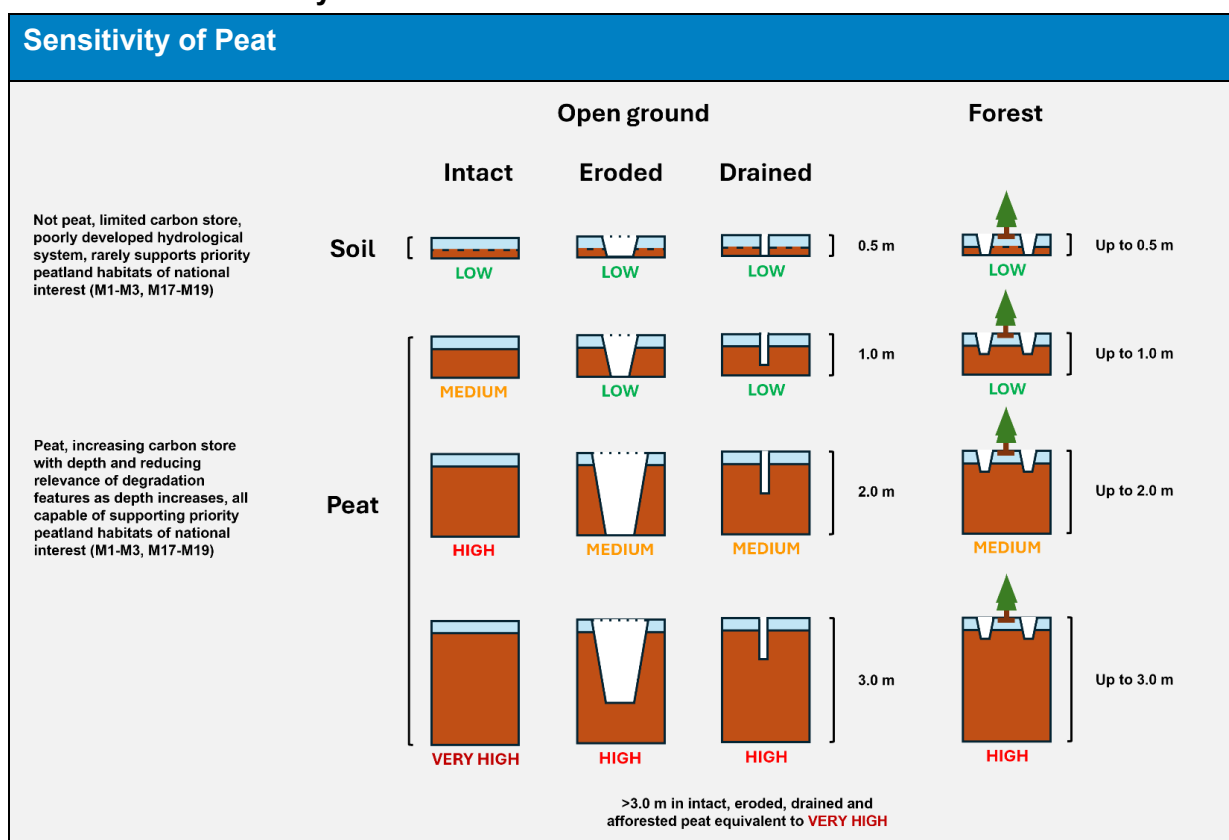
Sensitivity of Environment	Definition
High	Sites designated at a regional level, e.g. Regionally Important Geological/geomorphological Sites (RIGS), considered worthy of protection for their historic or aesthetic importance. >25% of infrastructure is located on peat with depth between 1 m – 2 m in open and undegraded terrain or >2 m in forestry, densely drained, eroded or gullied open terrain.
Medium	Sites designated at a local level. >25% of infrastructure located on peat with depth between 0.5 m – 1 m in open and undegraded terrain or with depth between 1 m – 2 m in forestry, densely drained, eroded or gullied open terrain.
Low	>75% of the infrastructure is located on non-peat or peaty/organic rich soils less than <0.5 m in depth, or peat <1 m in depth that is in forestry, densely drained, eroded or gullied open terrain.

- 12.5.15. Any assessment regarding peat resource considers the peat as a carbon store and therefore the following forms the basis for the assessment of sensitivity.

Assessment of Sensitivity of Peat

- 12.5.16. Assessment of sensitivity of peat is based on the degree by which the peatland in its baseline condition has been degraded by natural or man-made activities. Uneroded, open peatland without evidence of drainage is considered to be of highest sensitivity, while peatlands degraded by forestry, drainage or erosion are considered to have a poorer baseline condition. A depth criterion is also applied, in which deeper peats are considered to hold more carbon (for which peat volume is a proxy) and more likely to exhibit a functional hydrological system, with associated flood regulation benefits. **Plate 12.1** illustrates this approach with the sensitivity for each degradation and depth combination provided below the associated image, coloured using RAG (Red-Amber-Green) styling. The assessment of sensitivity does not consider vegetation, which is considered within the ecological impact assessment in **Chapter 9**.

Plate 12.1 – Sensitivity of Peat



Magnitude of Change Assessment Criteria

- 12.5.17. Magnitude of change is the potential effect in relation to the resource that has been quantified using the scale high, medium or low and includes the consideration of timing, scale, size and duration of a potential impact.
- 12.5.18. The magnitude of the potential effect criteria is presented in **Table 12.4**.

Table 12.4 – Magnitude of Potential Effect Criteria

Magnitude of Potential Effects	Definition
Very High	Impact resulting in loss of feature or use. Fundamental (long-term or permanent) changes to peat and geology (in terms of quantity, quality and morphology). Peat disturbance >10% of the peat across the study area is covered by infrastructure (including earthworks).
High	Impact resulting in loss of part (<10%) of feature or use.

Magnitude of Potential Effects	Definition
	Substantial but non-fundamental and short to medium term changes to the surface water, groundwater and geology (in terms of quantity, quality and morphology). Peat disturbance between >5% to <10% of the peat across the study area is covered by infrastructure (including earthworks).
Medium	Impact on feature or use. Detectable but non-fundamental and temporary changes to the surface water, groundwater and geology (in terms of quantity, quality and morphology). Peat disturbance between >2% to <5% of the peat across the study area is covered by infrastructure (including earthworks).
Low	Impact but of insufficient magnitude to affect feature or use. No perceptible changes to the surface water, groundwater and geology (in terms of quantity, quality and morphology). Peat disturbance <2% of the peat across the study area is covered by infrastructure (including earthworks).

- 12.5.19. The magnitude of the potential effects has been assessed based on the location of the receptor and the proximity of operational infrastructure, or construction activity taking place. The magnitude of potential effect takes into account the good practice and standard embedded mitigation methods described in this Chapter, associated appendices and **Appendix 13.1**.

Significance Assessment Criteria

- 12.5.20. The predicted significance of the effect was determined through a standard method of assessment based on professional judgement while considering sensitivity and magnitude of change as detailed in **Table 12.5**.
- 12.5.21. The combination of the sensitivity and magnitude of potential effect combine to provide a matrix categorisation of significance (major, moderate and minor), subject to professional judgement.
- 12.5.22. **Major** and **Moderate** effects are considered to be **significant** in the context of the EIA (Scotland) Regulations 2017 ("The EIA Regulations"). Where the significance of effect is assessed as being moderate or above, further site-specific mitigation is required. Minor or less are considered to not be significant for the purpose of EIA Regulations

Table 12.5 – Significance Criteria

Magnitude of Potential Effects	Sensitivity of Environment			
	Very High	High	Medium	Low
Very High	Major	Major	Moderate	Moderate
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Minor	Minor
Low	Minor	Minor	Minor	Minor

- 12.5.23. Embedded design measures are set out within the Best Practice Methods, Outline Peat Management Plan (OPMP), PLHRA and outline Construction Environmental Management Plan (OCEMP) (provided as **Appendix 13.1**, **Appendix 12.2**, **Appendix 12.3** and **Appendix 4.1**, respectively) which describe specific mitigation that relates to the Proposed Varied Development. They comprise good practice methods and works that are established and effective measures to which the Applicant will be committed through the development consent.
- 12.5.24. Although the outline CEMP is draft and will evolve to take account of consultee feedback and detailed design, there is sufficient confidence in the effectiveness of the measures set out in the outline CEMP for them to be treated as part of the Proposed Varied Development for the purposes of this assessment. Measures and procedures outlined in the outline CEMP will be adopted and incorporated into a single working document to be agreed with statutory consultees and the planning authority following consent by way of an appropriately worded planning condition. For ease of reference through this Chapter, reference to specific sections in the outline CEMP, detailing the appropriate embedded mitigation measures, are provided.
- 12.5.25. Accordingly, the identification of likely significant effects from the Proposed Varied Development is considered following implementation of the measures in **Appendix 13.1**, **Appendix 12.2**, **Appendix 12.3** and **Appendix 4.1**.

Nature of Effect

- 12.5.26. In addition to determining the significance of the effect, the assessment process also includes a qualitative description regarding the nature of the effect. These terms add information about how the effect would affect receptors.

Table 12.6 – Nature of Effect

Term	Nature of Effect Descriptors
Adverse	An effect which has the potential to decrease receptor value or status relative to baseline conditions.
Beneficial	An effect which has the potential to increase receptor value or status relative to baseline conditions.

Term	Nature of Effect Descriptors
Short-term	Effects that persist only for a short time, e.g. during the construction (or decommissioning) phase only; includes reversible effects.
Medium-term	Effects that may persist until additional mitigation measures have been implemented and become effective.
Long-term	Effects that persist for a much longer time, e.g. for the duration of the operational phase (essentially until the development ceases or is removed/ reinstated); includes effects which are permanent (irreversible) or which may decline over longer timescales.
Temporary	A reversible effect where recovery is possible and for which effects would persist only for a short or medium-term.
Frequent	Refers to a recurring effect that occurs repeatedly; in some cases a lower level of impact may occur with sufficient frequency to reduce the ability of a receptor to recover effectively.

12.5.27. Unless otherwise stated, identified potential effects are considered to be adverse.

Assessment of Cumulative Effects

12.5.28. A cumulative effect is considered to be an additional effect on geological and peat resources arising from the Proposed Development in combination with other proposed developments likely to affect the geology and soil environment. At distances greater than 2 km, it is considered that schemes are unlikely to contribute to a cumulative geological or peat effect. Therefore, for the purposes of the assessment of potential cumulative effects on the geology and peat, only proposed developments, which require large scale construction/excavation, within approximately 2 km of the Proposed Varied Development have been considered. The methodology followed to assess the cumulative effects are the same as those used for the Proposed Varied Development in isolation.

Limitations to Assessment

- 12.5.29. The nature of some hydrological, geological and soil features means that some may not always manifest themselves and may or may not be present because of extreme weather conditions, vegetation cover or change with forestry activity. The fieldwork was undertaken in a range of weather conditions; however, it is possible that some small, minor features may have been missed because of their ephemeral or temporary nature.
- 12.5.30. Some sections of the site were not accessible for peat probing due to the presence of fallen trees as shown at proposed probing locations on **Figure 12.5a and 12.5b** (refer to **Appendix 12.1** for further information). Final infrastructure adjustments have resulted in some very minor areas having fewer peat penetration probes than guidance recommends, however these are not considered to compromise the assessment.

- 12.5.31. Overall, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental effects on the Geology and Peat.

Assumptions

- 12.5.32. In regard to peat, its excavation and reuse, the management of water-borne pollution, protection of natural heritage areas, and permitting (including waste) SEPA has statutory obligations in terms of the management of waste and control of pollution into water resources in Scotland. Where careful design has avoided sensitive receptors, it would be reasonable to assume that the adoption of SEPA's Best Practice Guidelines will, in general, prevent pollution to acceptable standards and make the majority of any 'significant' effects unlikely. Best practice assumed to be in place during construction, and which has been considered in the assessment of effects, is set out in **Appendix 13.1**. Specific 'additional' mitigation measures may be required in certain areas or at certain times of the site development, and these are set out in the assessment where relevant.
- 12.5.33. The purpose of this assessment is to identify significant effects and the key areas of the Proposed Varied Development infrastructure where specific additional mitigation and management measures are required to mitigate any significant effects. The assessment of effects has been undertaken based on the assessment of baseline conditions across the Study Areas with reference to the relevant sections in this Chapter.
- 12.5.34. Additional assumptions that have been taken into consideration during the course of the assessment are as follows:
- Construction programme is anticipated to last 21 months;
 - Micrositing will be limited to 100 m;
 - Forestry works during construction and operation will be undertaken as set out in **Chapter 7**;
 - Any widening of existing tracks within 50 m of watercourses will be undertaken on the side furthest from the watercourse works will not encroach into or closer to the watercourses.

12.6. Baseline Conditions

- 12.6.1. The following section describes the existing geological and peat conditions within and surrounding the site. This includes the physical characteristics as well as designated sites, drainage, peat coverage and inherent peat slide risk.

Topography, Land Cover and Land Use

- 12.6.2. The site occupies an upland location which is used as a commercial forestry plantation, with areas of peat within the site. The site rises from approximately 200 m above ordnance datum (AOD, approximately equivalent to sea level) at the south-eastern boundary to 401 m AOD at Craigengillan Hill in the northern section of the site.

- 12.6.3. The Proposed Varied Development site occupies a rural setting to the east of Carsphairn in Dumfries and Galloway and consists of extensive commercial forestry to the north-east of Galloway Forest Park. Except for locally steep areas in the vicinity of Marscalloch (circa 381 m AOD) and Craigengillan (circa 401 m AOD), most of the site comprises smooth rolling topography. The site is covered by a combination of mature forestry, newly planted dense conifer plantation or areas subject to felling operations. The area subject to felling operations has a brashy ground surface covered with some timber, tree roots and trunks.
- 12.6.4. The site is bounded to the south-east by the B729 and by an unnamed public road adjacent to the Water of Ken and by the Poliferie appendix to the north-east. The site is bounded to the north-west by open moorland and by plantation forestry to the south-west.
- 12.6.5. There are several existing tracks and borrow pits within the site associated with the commercial forestry operations.
- 12.6.6. Downstream of the site is the Water of Ken Water of Deugh, Kendoon Loch, Carsfad Loch, Earlstoun Loch to Loch Ken which are part of the Galloway Hydroscheme, before discharging the River Dee downstream of Loch Ken.
- 12.6.7. The nearest rainfall gauges to the site (see **Chapter 13**) indicate the site is considered to have a relatively high average annual rainfall compared to the rest of Scotland.
- 12.6.8. Morphology is typical of upland watercourses, which are generally evenly dispersed through flat boggy ground from their upper reaches, becoming increasingly steep and faster flowing as they progress downstream to the primary rivers. Site observations indicate that the morphology is relatively typical of Dendritic drainage network watercourses, which are steeper in their upper reaches and become increasingly flatter as they progress down slope.
- 12.6.9. Drainage of the site was observed to be significantly altered by forest drainage comprising larger linear drains around and through coups and ridge and furrow drainage within coups.
- 12.6.10. Existing forestry access track watercourse crossings were observed to be of singular circular piped culvert construction and therefore, mostly unsuitable for fish passage.

National Soils of Scotland

- 12.6.11. The following information is a summary of the information on soil units within Scotland's Soils, Scotland's Environment website, as shown on **Figure 12.1**.
- 12.6.12. National Soils Map of Scotland mapping indicates the northernmost part of the site to primarily be within an area of peaty gleys, with peaty podzols present in the upper regions of Craigengillan Hill, which is consistent with the Blanket Peat found to be present in the north-west site area. Within the southernmost part of the site, most of the soils were recorded as peaty gleys with peaty podzols present in the upper regions of Marscalloch Hill. Brown soil is also shown within the most southern regions, towards Knowehead.

12.6.13. A brief description of the characteristics and formation of component soil groupings is detailed below, as described by Scotland's Soils Map, although these do not include information on depths or engineering properties:

- Blanket Peat: Poorly drained upland soil with an organic surface layer generally greater than 50 cm thick, unconfined and 'blankets' the landscape;
- Podzols: Podzols are acid soils with a grey leached layer just below the surface and bright orangey-brown coloured subsoil and/or dark brown to black, organic rich subsoil;
- Gleys: Gleys are soils that are periodically or permanently waterlogged; and
- Brown soils: Brown soils are moderately acid soils with brown mineral topsoil and brown or yellowish subsoil.

Carbon-rich Soils, Deep Peat and Priority Peatland Habitats

12.6.14. The SNH (now NatureScot) Carbon and Peatland Map 2016 shown on **Figure 12.2** indicates the Carbon-rich soils and peatland categories 4 and 5 across most of the site. These categories are indicative of areas of vegetation not associated with priority peatland, category 4 contains acidic type soils and areas unlikely to include carbon rich soils whilst category 5 represents carbon-rich soils and potential deep peat.

12.6.15. Within the southern-most area, a small area of mineral soil was recorded.

12.6.16. The area outside to the west of the site indicates Class 1 peat, which is typically associated with natural, priority peatland terrain.

12.6.17. The mapping is a broad approach to peat across Scotland and is superseded by the site-specific habitat mapping and detailed peat probing surveys.

12.6.18. A summary of the peat survey is provided below, and the details are included in **Appendix 12.1**. The appendix provides site-specific peat depth information which informed the layout of the Proposed Varied Development and the subsequent assessment of effects.

Peat

12.6.19. Inspection of aerial imagery indicates a general absence of peatland geomorphology, with most of the site being coniferous plantation or in different stages of felling and/or restocking.

12.6.20. The spatial occurrence and depth distribution of peat across the site has been investigated in accordance with best practice guidance (Scottish Government, Scottish Natural Heritage, SEPA [2017] Peatland Survey. Guidance on Developments on Peatland). High-density probing at all infrastructure locations was undertaken to determine peat depth and inform design considerations where possible. The peat probing and peat coring investigations confirmed the peat distribution, peat depth, peat characteristics and underlying geological conditions within the site. Full results of the peat surveys are

described within **Appendix 12.2. Figures 12.5a and 12.5b** and **Figures 12.6a and 12.6b** show the peat depth distribution across the Peat Study Area.

12.6.21. The following tasks have been completed to obtain a detailed understanding of the distribution and properties of peat across the peat study area:

- 2018 Phase I Habitat Survey (**Chapter 9, Appendix 9.1**) and 2024 Habitats Report including National Vegetation Classification (NVC) ecological habitat mapping (**Chapter 9, Appendix 9.5** and **Figures 9.2 and 9.3**);
- For the Consented Development, a Phase 1 100 m grid peat probing survey was undertaken by Arcus in October 2013, with more detailed probing supporting an early design layout undertaken in August and September 2018; 1,405 probes were collected in total.
- Subsequently, Fluid undertook eight phases of surveys between May 2024 and March 2026 supporting the iterative design process of the Proposed Varied Development's layout.
 - 173 probes were collected in May 2024 to further characterise three main areas in which turbines are proposed.
 - 2,388 probes were collected in June 2024 along track alignments (including centrelines and offsets) while 10 m grids were collected across all other infrastructure locations.
 - 760 probes were collected in August 2024 following layout iterations post-dating the June acquisition, including further trackside locations.
 - Following a review of layout, a further 662 probes were collected in October 2024.
 - 311 probes were completed in November 2025 for minor layout adjustments with 10 m grid along infrastructure locations and 50 m intervals with 10 m offsets along a proposed track.
 - 294 probes in December 2025 for minor layout adjustments including 50 m probing along the track with 10 m offsets and 20 m grid across potential infrastructure locations.
 - Following a revision of the layout a further 1,734 probes were completed in January and February 2026
 - An additional 51 probes were completed for a track adjustment in March 2026.
- In total, 7,778 locations were probed across the original Arcus and subsequent Fluid probing campaigns. Over 5,506 probes were in non-peat soils (refer to **Table 1, Appendix 12.1**).

- Development of a maximum depth of peat contour map (**Figure 12.6a** and **12.6b**) to indicate the peat variation across the study area. The peat depth model presents an accurate peat depth surface with peat depths verified by coring.
- Examination of the variability of the depth of the acrotelm, the thickness of the catotelm and the thickness of amorphous peat. 22 cores taken across the site indicated a general absence of acrotelmic peat under forestry and an absence of amorphous peat presence.
- The Peatland Condition was assessed to be mostly modified peatland due to forestry activities in the 2018 Phase I Habitat Survey (**Chapter 9, Appendix 9.1**), 2024 Habitats Report (**Chapter 9, Appendix 9.5** and **Figures 9.2 and 9.3**) and the Outline Habitat Enhancement and Management Plan (OHEMP) (**Chapter 9, Appendix 9.8**).

12.6.22. The following summarises the results of the various phases of the peat survey and subsequent interpolated peat depth contouring across the study area:

- Peat is generally absent over large areas due to moderate slopes, with the majority of deposits in the west and centre of the study area in the saddle between the two hill summits.
- Where peat is present, it is relatively shallow, <2.0 m for the most part, but very locally >3.0 m.
- There are isolated pockets of peat adjacent to watercourses and in hollows, though the 100 m grid that identifies these deposits in likelihood overstates their extents.
- The cores identified a distinctive acrotelm layer in 8 of the 22 coring locations that ranged between 0.05 m and 0.15 m thick and averaged 0.09 m where present. There was no acrotelm layer identified in the remaining 14 coring location due to the altered ground conditions caused by the presence of forestry plantations.
- Rate of refusal / the 'feel' method indicated the majority of probes to be located over bedrock, silt or grit, with bedrock being the most commonly recorded substrate (57% of probes).
- The coring results have generally verified the depth of penetration probing to be representative of peat depth within 0.1 m, except for 5 out of the 22 cores which overestimated the peat depth.
- There was no peat (0 – 0.5 m depth) at 70.8% of probes, peat depths between >0.5 m – 1.0 m at 14.3% of probes and peat depths >1.0 m at 8.98% of probes.
- The Habitat Assessments 2018 Phase I Habitat Survey (**Chapter 9, Appendix 9.1**), 2024 Habitats Report (**Chapter 9, Appendix 9.5** and **Figures 9.2 and 9.3**) and the Outline Habitat Enhancement and Management Plan (OHEMP) (**Chapter 9, Appendix 9.8**) assess the peatland condition and demonstrate that whilst there are some minor areas of qualifying priority habitat in clearances and forestry rides all

the peat on site is of modified or poor peatland habitat condition. There is no infrastructure on good condition, unmodified peatland.

- 12.6.23. The peat present shows little vegetation or acrotelm as most of the site is covered by commercial forestry and is heavily drained as part of the forestry plantations.
- 12.6.24. The peat probing largely confirms the SNH (now NatureScot) Carbon and Peatland Map 2016 categories with the presence of peat corresponding to Class 5 (peat soil, no peatland vegetation) within the forestry, although the presence of peat is probably overstated. Areas of Class 4 (predominantly mineral soil with some peat soil) correspond well to the non-peat areas, though should probably be more extensive given the peat depth probing results.

Peatland Geomorphology

- 12.6.25. Aerial imagery and LIDAR data were reviewed to create a geomorphological map (**Appendix 9.3, Figure 12.3.6**) which was subsequently verified during a site walkover undertaken in June 2024 by a Chartered Geologist and peatland geomorphologist with over 20 years' experience of assessing peat landslides.
- 12.6.26. **Figure 12.3.6** shows the key features of the site. The presence, characteristics and distribution of these features can clarify the hydrological function of a peatland, the balance of erosion and peat accumulation (or condition), and the sensitivity of a peatland to potential land-use changes.
- 12.6.27. The site is almost entirely devoid of geomorphological features typical of upland peatlands in the UK due to the ubiquitous tree cover. There are very few glades indicating natural conditions, which likely reflects the relatively shallow peat and soil and therefore optimal planting conditions for forestry. The only unplanted areas or areas unmodified by forestry are along watercourses, where fluvial geomorphological features dominate.
- 12.6.28. Outside the site to the west, the SNH Carbon and Peatland 2016 Map indicates Class 1 peat, which is typically associated with natural peatland terrain. Where Class 1 abuts Class 5 in forestry, the Class 1 areas are usually a good indicator of what the pre-forestry conditions might have been. In this case, the unplanted area to the west shows patterned ground (hummocky terrain) with vegetated gullies and artificial drainage (not for forestry). It is likely that some of the gully forms originating in this area were present within the forestry prior to ridge and furrow ground preparations for planting.

Peat Stability and Peat Management

- 12.6.29. Due to the presence of peat within the site, a PLHRA and OPMP are included as **Appendices 12.3** and **12.2** respectively.
- 12.6.30. The PLHRA utilises the peat depths and existing slope information to identify potential hazard areas in relation to peat slide risk. Details on PLHRA methodology and data interpretation and results are provided in **Appendix 12.3**.

- 12.6.31. Construction work on peat has the potential to cause peat instability, which may affect peat soils (and their inherent carbon stores), peatland habitats and nearby watercourses, infrastructure or land uses. A PLHRA has been undertaken and is documented in **Appendix 12.3**. The PLHRA includes detailed site mapping verified by field walkover survey, qualitative and quantitative assessments of peat stability, identification of on and off-site receptors and calculation of risks associated with peat landslides through a combination of likelihood and consequence.
- 12.6.32. There was no evidence of previous peat landslides or incipient failure, mainly because the peatland is heavily altered and covered by commercial forestry.
- 12.6.33. The landslide susceptibility approach for peat landslide likelihood results (**Appendix 12.3, Figure 12.3.9**) indicates that much of the site has a 'Low' likelihood, with small areas of Very Low and Moderate likelihood. The areas of Moderate likelihood are typically on moderate side slopes with moderate peat depths and where drain orientation is oblique to slope.
- 12.6.34. The OPMP utilises peat depth data to calculate estimated excavation volumes based on the proposed civil design infrastructure, identifies rational options for reuse of excavated material and provides guidance on good practice storage and management of excavated material, including peat. Further details are provided in **Appendix 12.2**.

Superficial Geology

- 12.6.35. The British Geological Survey (BGS) superficial geological mapping indicates much of the steeper summit areas to be vacant of superficial soil cover, primarily within the regions of Craigengillan Hill and Marscalloch Hill.
- 12.6.36. Glacial till deposits typically comprising clay, sand and gravel are shown across the eastern and central site areas. Hummocky (moundy) glacial deposits are shown in the southern section and extreme northern section of the site.
- 12.6.37. Peat deposits are shown within the north-western part of the site and in the southern section.
- 12.6.38. **Figure 12.3** illustrates the published superficial soils.

Solid Geology

- 12.6.39. The BGS published bedrock geology mapping indicates the site to be underlain by Caradoc aged rocks comprising of Portpatrick Formation Wacke. The Portpatrick Wacke is described as a metamorphosed turbidite and siltstone sequence and as a low productivity aquifer comprising highly indurated greywackes with limited groundwater in near surface weathered zone and secondary fractures.
- 12.6.40. Within the northern area of the site, dykes intrude, noted as North Britain Siluro-Devonian aged Calc-Alkaline Dyke Suite comprising Microdiorite and Porphyritic rocks. One of the major dykes is orientated south-west/north-east across the western face of Craigengillan Hill.

- 12.6.41. A geological fault is recorded within the southern section of the site orientated south-west to north-east through Muirdochwood.
- 12.6.42. **Figure 12.4** illustrates the published Bedrock Geology.
- 12.6.43. The BGS Geoindex records two water well boreholes adjacent to the site, however no details on the strata were recorded within these records.

Borrow pits

- 12.6.44. Potential borrow pit locations remain unchanged from that of the Consented Development and were identified as the most optimal areas within the site boundary which could provide aggregate for construction of site access tracks, crane hardstanding areas, upgrades of existing forestry tracks. The potential borrow pit areas have been selected based on their:
- Topography;
 - Previous uses as quarry sites;
 - Accessibility from existing or proposed access tracks;
 - Orientation with respect to visibility;
 - Potential aggregate volume; and
 - Proximity of rock to the surface.
- 12.6.45. The areas subject to assessment have been selected as they can be accessed directly from either existing tracks or proposed new tracks while consideration of topography, considering steeper topography is preferable for quarrying, and where soils coverage will be limited. Landscape and visualisation impacts were also considered, with the locations on the northern side of Marscalloch Hill and western side of Craigengillan Hill reducing the visibility of the borrow workings.
- 12.6.46. The borrow pit locations are in areas where the peat cover is thin or vacant and where bedrock outcrops and aggregate reserves are expected to occur near the surface. Further details on Borrow Pits are included in the previous **2018 EIA Report Appendix 12.3: Borrow Pit Assessment** and are presented again within this EIA Report **Appendix 12.4**.

Designated Sites

- 12.6.47. There are no known statutory designated sites or Geological Conservation Review (GCR) areas or Regionally Important Geological Site (RIGS) relating to geology or peat on the site or within 10 km of the site.

General Site Conceptualisation

- 12.6.48. The site is characterised by low permeability superficial deposits (extensive areas of peat overlying glacial till) over low permeability bedrock. The low permeability of both the superficial deposits and the low permeability of the bedrock will allow limited infiltration of

rainfall and relatively high run-off rates. Groundwater movement within the superficial deposits is therefore also low.

- 12.6.49. Based on the assessment criteria defined in **Table 12.4**, a summary of the site sensitivities is presented in **Table 12.7**.

Table 12.7 – Sensitive Receptors

Sensitive Receptors		Sensitivity	Rationale/Designations
Terrestrial	Non peaty or peaty / organic rich soils <0.5 m in depth Peat <1 m in depth in forestry or in densely drained, eroded or gullied open terrain	Low	Guidance on Developments on Peatland - Site Surveys
	Peat >0.5 m to 1 m in depth in open terrain Peat >1 m to 2 m in depth in forestry or in densely drained, eroded or gullied open terrain	Medium	Guidance on Developments on Peatland - Site Surveys
	Peat >1 m in depth in open terrain Peat >2 m in depth in forestry or in densely drained, eroded or gullied open terrain	High	Guidance on Developments on Peatland - Site Surveys

Note: Receptors not potentially connected to the Proposed Varied Development have been scoped out and therefore not included in this table.

- 12.6.50. Based on the baseline information and professional judgement, the key sensitive receptors identified for the site and carried through to detailed assessment are:

- Peat deposits.

Impacts Scoped Out of Assessment

- 12.6.51. The following are scoped out of the assessment for the following reasons:

- Geological designated or sensitive sites and contaminated land as there are none known within the site.

Implications of Climate Change

- 12.6.52. The summary of the relevant climate change projections using the UK Climate Change Projections 2018 (UKCP18) are:

- Temperatures are projected to increase, particularly in summer;

- Winter rainfall is projected to increase and summer rainfall is most likely to decrease;
- Heavy rain days (rainfall greater than 25 mm) are projected to increase, particularly in winter;
- Near surface wind speeds are expected to increase in the second half of the 21st century with winter months experiencing more significant effects of winds; however, the increase in wind speeds is projected to be modest; and
- An increase in frequency of winter storms over the UK.

12.6.53. Climate change projections in the west of Scotland for the 2060s highlight that in the 2060s, summer and winter temperatures are likely to be greater than the current baseline (greater for summer), with winter rainfall increasing and summer rainfall decreasing.

12.6.54. The projected climate change scenario is likely to affect the baseline conditions in relations to the water and soil environment in the following ways:

- Deterioration in peatland habitat condition: Predicted changes in the pattern of rainfall will lead to a deterioration in the condition of the peatland habitats. Dry conditions in the summer period will draw down the water table, reducing the suitability of affected areas for sustaining peat-forming vegetation, such as abundant Sphagnum moss cover and increase drying rates at the exposed peat margins.
- Habitat loss for peatlands and other upland habitats: Increased winter rainfall may exacerbate existing erosion rates, leading to direct loss of peatland habitat.

Future Baseline in the Absence of the Proposed Varied Development

12.6.55. The predicted environmental conditions and potential changes which may occur in the absence of the Proposed Varied Development are outlined below. This includes natural changes, including climate change (see above), land use practices and future developments:

- Continued deterioration of the peatland habitats through erosion, artificial drainage and drying out from ongoing commercial forestry activities.

12.7. Standard Mitigation

12.7.1. A number of embedded design mitigation measures have already been applied as part of the iterative design process (see below and **Chapter 3: Alternatives and Scheme Evolution**), to avoid the higher value areas of habitat, peat, deep peat, waterbodies and watercourses.

Embedded Design Considerations

12.7.2. Where possible, the following principles have been adhered to in the design of the Proposed Varied Development:

- All of the Proposed Varied Development's infrastructure has been sited with an objective to maintain at least a 50 m 'buffer zone' from natural watercourses and water bodies shown on 1:50,000 scale and 1:25,000 scale Ordnance Survey mapping.
- Peat deposits were identified in localised areas across approximately a quarter of the peat survey area (23.7% of 7,778 probes) during the peat depth surveys (**Appendix 12.1**).
- The majority of the peat across the site is heavily modified by commercial forestry activities.
- Avoidance of peat, particularly unmodified peatland habitat on depths > 1 m, and >2 m depth within forestry due to the carbon store being compromised, led the design process, though cognisance was required to be paid to other environmental considerations.
- To optimise locations of infrastructure against holistic environmental constraints, it was necessary to site minor sections of infrastructure in areas of peat, although these were all modified peatland habitats (M17 blanket mire or marshy grassland in forest rides) due to forestry activities and previous drainage. In instances (see **Chapter 3** for further detail on wider design considerations) it was necessary to locate infrastructure on peat as this was optimal when considering impacts across several environmental receptors. In these cases, further design steps were applied to microsite and reduce environmental impacts, such as the optimisation of the orientations of hardstandings to reduce excavation volumes and to allow reinstatement of impacted areas following their usage during construction (i.e. siting of temporary over permanent infrastructure). Additionally, further investigation following consent on the ground conditions, and micro-siting of the tracks and turbines will be undertaken to ensure the minimal amount of peat is disturbed.
- All of the Proposed Varied Development's infrastructure has been designed, where possible, to avoid potential peat landslide hazard risk areas, and further investigation to identify detailed peat landslide mitigation will be undertaken post consent.
- Where feasible, and considering other constraints, floating tracks are proposed where tracks are located on peat >0.5 m depth and slopes are <5 %, to reduce peat excavation.
- Where possible extracted peat will be appropriately reused and restored concurrently without storage, however where this is not feasible it will be stored appropriately in proximity to its reuse location.
- During the detailed design and construction phase, sections of track will be surveyed and further micro-sited to optimise the distance from water bodies, minimise peat disturbance and peat slide hazard.

Good Practice Measures

- 12.7.3. **Appendix 13.1** details the good practice techniques that will be employed during construction and operation. These techniques are assumed to be in place for the purposes of the assessment, thus they are not considered as mitigation but as an inherent part of the construction process. The list in **Appendix 13.1** is not exhaustive, and the latest guidance and good practice literature will be used when construction commences. Where required, additional mitigation measures will be identified which are specific to the source-pathway-receptor at risk to address likely significant effects.
- 12.7.4. To ensure all reasonable precautions are taken to avoid negative effects on habitats, protected species and aquatic interests, a suitably qualified Environmental Clerk of Works (ECoW) will be appointed prior to the commencement of construction, and they will advise the Applicant and the Principal Contractor on all ecological and hydrological matters. A Drainage Management Plan (DMP), Pollution Prevention Plan (PPP) and Water Quality Management Plan (WQMP) will also be implemented as part of the CEMP to minimise effects to the water environment. A draft OCEMP is presented in **Appendix 4.1**.
- 12.7.5. The OPMP presented in **Appendix 12.2** also presents additional best practice techniques with regards to peat management of excavated and reuse of peat.
- 12.7.6. The risk of peat slide can be mitigated through good engineering practice prior to construction, during construction and post construction as set out in **Appendix 12.3**. All construction activities and operational decisions that involve disturbance to peat deposits should be overseen by an appropriately qualified geotechnical engineer with experience of construction on peat sites.
- 12.7.7. Further good practice and enhancement measures in relation to peat re-use and further avoidance of deep peat are discussed in the assessment below.

Micrositing

- 12.7.8. Micrositing of infrastructure up to 100 m may be required to take account of local conditions. If this is required, consideration will be given to the potential effects on hydrology, geology and peat, including the presence of peat, proximity to water features and PLHRA.
- 12.7.9. Where micrositing is required, where possible, this will not decrease the distance to the sensitive water features, move onto deeper peat or higher peat landslide risk areas.
- 12.7.10. A suitably qualified ECoW and Geotechnical Engineer will be present on site during the construction period to provide initial onsite advice for micrositing.

12.8. Potential Effects

- 12.8.1. The assessment of effects is based on the project description as outlined in **Chapter 4**. Unless otherwise stated, potential effects are considered to be adverse.

- 12.8.2. The following section describes the potential effects of the Proposed Varied Development during the construction phase in relation to the sensitive receptors of the Site as highlighted in **Table 12.7**, prior to additional mitigation and management, but assuming that all embedded mitigation and good practice methods are employed. The purpose of this assessment is to identify areas of the Proposed Varied Development infrastructure where specific mitigation and management measures are required to mitigate any **significant (Major or Moderate)** effects. The assessment of effect significance has been undertaken based on the assessment of baseline conditions across the site and with reference to the significance criteria in **Table 12.5**.
- 12.8.3. Where the significance of effect is assessed as being **moderate (significant)** or above with good practice and standard mitigation applied, further site-specific (additional) mitigation is required. Where applicable, the additional mitigation and the residual significance of effects are summarised and discussed below.
- 12.8.4. The assessment concentrates on the effects of construction and operation of the Proposed Varied Development upon those receptors identified during the review of desk-based information and field surveys for which a significant effect could occur. Effects upon the following features are assessed:
- Direct effects during construction on the peat resource, such as dewatering of peat due to excavation or pumping, as well as the removal of peat, and a change in the peat landslide risk;
 - Direct effects during operation on the peat resource following peat reuse and forest to bog restoration measures;
 - Direct effects during construction on local solid and superficial geology, including through direct removal or from erosion due to the infrastructure changing the hydrological environment; and
 - Indirect effects during construction on the alteration of drainage and geomorphology, sediment loading and pollution.

Construction

- 12.8.5. Possible geological effects resulting from the construction of the Proposed Varied Development are detailed below:
- Alteration of Geology, including impacts on peat resource.
- 12.8.6. Erosion and sedimentation are further covered in **Chapter 13**.

Borrow Pits

- 12.8.7. The Borrow Pit Assessment is presented in **Appendix 12.4**. To minimise the volume of imported material brought onto the site and any associated environmental impact, borrow pits located within the site will be used to source suitable stone aggregate for access track and compound construction. A borrow pit is an area where material has been excavated for use at another location.

- 12.8.8. Two borrow pit search areas have been identified within the site boundary and remain the same as that for the Consented Development (refer to **Figure 4.1**). These search areas were identified as part of the Consented Development's design iteration as areas anticipated to have suitable bedrock geology (based on BGS mapping), shallow peat depth and suitable topography, sited to minimise visual, hydrological and ecological impacts (refer to the 2018 EIA Report for further detail). Proposed borrow working drawings are shown on **Figures 4.20 - 4.21** and the Borrow Pit Assessment is presented in **Appendix 12.4**.
- 12.8.9. Detailed site investigations prior to construction will be carried out to further confirm the rock type, rock characteristics and suitability, as well as potential volumes to be extracted from the search area. The final borrow pit(s) identified during the geotechnical evaluation will be defined within the CEMP (refer to **Appendix 4.1**). The pollution control measures to be implemented during usage of the borrow pit(s) and its reinstatement will also be covered within this document.
- 12.8.10. The borrow pits will require the use of plant to both win and crush the resulting rock to the required grading. It is anticipated that rock will be extracted by breakers and other relevant methods that may be required.
- 12.8.11. Environmental considerations have influenced the location of the borrow pit search areas to minimise the effect on ecology, hydrology and landscape, and to allow successful reinstatement measures to be put in place as appropriate. Following construction, the borrow pit(s) will be restored and reinstated to agreed profiles.

Peat Landslide Hazard Risk Assessment

- 12.8.12. The PLHRA is presented in **Appendix 12.3**. There are no identified source zones where proposed infrastructure overlapped with Moderate likelihood or Factors of Safety <1.4 (under both the baseline and crane-loaded assessments). This gives a low peat landslide likelihood score.
- 12.8.13. Key receptors identified were areas near watercourses which were assigned a Low to Moderate sensitivity (see **Chapter 13**).
- 12.8.14. Based on the analysis presented in the PLHRA the risks are calculated to be of "Low" significance across the site. Therefore, the significance of effect is Minor and additional site-specific mitigation above best practice is not required to reduce risks pre-consent. An outline of general best practice in relation to peat landslide hazard risk is presented in **Appendix 12.3**.
- 12.8.15. The Consented Development's updated Peat Slide Risk Assessment (Infinergy, 2019) (included as AEI Appendix 12.2) confirmed that the risk of peat slide associated with the Consented Development was negligible. On this basis, in the absence of mitigation, the Proposed Varied Development is considered to result in a potential minor effect which is not significant, in accordance with the EIA Regulations.

- 12.8.16. Both the previous 2019 consented Peat Slide Risk Assessment and the PLHRA for the Proposed Varied Development indicate a negligible to minor effect and therefore are not significant with embedded best practice.

Peat Resource

- 12.8.17. The sensitivity of peat to disturbance for the peat study area has the potential to be from Low to Medium based on the definitions presented in **Table 12.3**. Proposed infrastructure and earthworks are in areas of commercial forestry on modified peat with depths between <1 m (Low sensitivity) and 1-2 m (Medium sensitivity) based on individual infrastructure components. Overall, most of the proposed infrastructure and earthworks are located in areas of commercial forestry on modified peat with depths <1 m (Low sensitivity).
- 12.8.18. The best quality unmodified peatland has been avoided by design and all excavated peat is therefore considered to be modified. No unmodified peat will be excavated. Forestry rides are still considered to be modified as they are disturbed ground with altered drainage.
- 12.8.19. Despite there being the presence of peat, <25% of the infrastructure (including earthworks) is located on peat (probing depths >0.5 m). No infrastructure is on peat with an average depth of >2 m. Only two pieces of infrastructure other than the floating track section are located on modified peat with an average depth >1 m (T5 and its hardstanding and earthworks and T6 clearance area and earthworks area). Overall, greater than 75% of the total proposed infrastructure (including earthworks) footprint is located on modified peat with depth of <0.5 m and therefore, the proposed infrastructure footprint is classified as Low sensitivity overall in accordance with **Table 12.3**.
- 12.8.20. The total volume of peat that is present across the peat study area within the site boundary has been calculated as 6,373,488 m³. The total volume of peat that will be excavated for the construction of the infrastructure including associated earthworks is 88,081 m³, as detailed below, which represents approximately 1.38% of the peat volume within the peat study area on site. This is a Low magnitude of effect according to **Table 12.5**.
- 12.8.21. For the Proposed Varied Development the conservative estimates for the volume of peat that will be excavated (including footprints, a wider distance for slope batters, earthwork footprints and a 10 % bulking factor), as detailed in **Appendix 12.2** are:
- Total volume of peat once excavated = ~88,081 m³ (equating to ~ 8,007 m³ per turbine);
 - Total volume of acrotelm once excavated = ~7,964 m³; and
 - Total volume of catotelm once excavated = ~80,117 m³.
- 12.8.22. Of these volumes, 26,818 m³ is estimated to be excavated within the earthwork's footprint, representing an increase of ~30% to the reported excavations from the infrastructure footprint alone.

- 12.8.23. While overlap with peat occurs across the site, extensive efforts have been made to minimise overlap with the deepest peat deposits, locating turbines away from carbon-rich soils where possible, or on shallower depths if this cannot be achieved.
- 12.8.24. Further attempts to prevent peat excavation have been made by making use of the existing forest road network within forestry, utilising built tracks as the principal accesses with short spur roads to individual turbines. Approximately 2.6 km of the track network comprises existing tracks, many of which will be minimal in footprint given the good quality of the forest tracks. For the purposes of the peat extraction calculations, only where existing track will be widened, and new earthworks are required have been included. There will be approximately 7.7 km comprising new track, of which approximately 0.2 km is floating track.
- 12.8.25. Where new tracks are required, opportunities to use floating track (and therefore avoid peat excavation) have been used wherever possible (~200 m). An important constraint on floating track construction is gradient, which must not exceed 5% (or 2.86°). All track located on peat (>0.5 m depth) will be floating track, where possible, requiring no excavation of peat and therefore reducing the magnitude of effect.
- 12.8.26. The excavation volumes for the Proposed Varied Development (~88,081 m³) are not considered to be substantial by comparison to other wind farm developments for an 11 turbine scheme. This reflects both the number of turbines and the approach to capturing 'worst case' construction footprints, which include earthwork cut and fill surrounding infrastructure footprints (noting that previously most applications for wind farms in Scotland have not included earthworks within their calculation volumes) and a bulking factor.
- 12.8.27. The overall Low sensitivity of peat resource across the site combined with the Low magnitude of effect results in a Minor (not significant) effect in relation to peat disturbance. All peat disturbed is heavily modified including in the forest rides, and no unmodified peatland will be disturbed for the Proposed Varied Development.
- 12.8.28. The Minor adverse effect on peat resource has the potential to become a Minor beneficial effect depending on the degree of success of both the peat reuse and the 66.75 ha of forest to bog restoration proposals detailed in the OHEMP included as **Appendix 9.8**.
- 12.8.29. The Consented Development, prior to the amended design presented in AEI I, originally comprised 19 turbines, a 245,000 m² infrastructure footprint, and was located on up to 4.5 m depth peat and required 97,300 m³ of excavated peat (not including cut and fill earthworks, clearance areas or a bulking factor, but did assume peat <0.5 m depth to be acrotelmic). Sufficient methods were defined to ensure that peat can be sensitively handled and stored on-site to allow for effective reuse and no waste licence is required for the construction work. Given that only effects of moderate significance or greater are considered significant in terms of the EIA Regulations, the potential effects on Geology and Peat were moderate (significant) and residual effects Minor (not significant).
- 12.8.30. AEI I (Infinergy, 2019) of the Consented Development presented a revised (now consented) design that comprises 17 turbines, a 158,300 m² infrastructure footprint and a requirement of 93,687 m³ excavated peat (not including clearance areas or a bulking

factor). Sufficient methods were defined to ensure that peat can be sensitively handled and stored on-site to allow for effective reuse and no waste licence is required for the construction work. As the number of turbines was reduced from 19 to 17, less peat was disturbed, therefore the significance of effects decreased, while the risk of peat slide risk was assessed as mainly negligible or locally low. Therefore, the significance of the effects was not increased and remained not significant as per the 2018 EIA Report.

- 12.8.31. The Proposed Varied Development has a Minor (not significant) adverse effect on peat disturbance due to careful design avoiding peat deposits and where it does encroach on peat, keeping to the shallower areas of peat where possible and appropriate reuse of excavated peat on-site.
- 12.8.32. Effects on the Geology and Peat associated with the Proposed Varied Development are not significant. This represents no significant change to the conclusions outlined in the 2018 EIA Report and subsequent AEI Reports for the Consented Development. However, it should be noted that as a result of the number of turbines reducing, the length of new track is reducing, and the careful positioning of the turbines and associated infrastructure has overall reduced the volume of peat being disturbed in comparison to the Consented Development even with the Proposed Varied Development being conservative and including additional earthworks, clearance areas and bulking factor.

Operation

- 12.8.33. Effects during the operational period have been scoped out of the assessment, as although it is recognised that effects will occur, these will be substantially less than during the construction period which represents a worst-case scenario.
- 12.8.34. Possible geological effects resulting from the operation of the Proposed Varied Development are related to two main factors as detailed below:
- Alteration of Flow, Natural Drainage Patterns/ Run-off Volumes and Rates and geomorphology; and
 - Disturbance of peat from peat landslide hazard risk.
- 12.8.35. Erosion and sedimentation, and disturbance of peat by peat landslide effects are considered to be **Minor (not significant)** as a result of careful design and construction. Any potential effects will be less than the construction period.

Decommissioning

- 12.8.36. The effects during decommissioning are anticipated to be similar to, or lesser than, the construction phase effects and therefore are Minor (not significant).

12.9. Additional Mitigation and Enhancement

- 12.9.1. Details of proposed good practice and enhancement measures are outlined in the following sections.

- 12.9.2. There are no significant effects on geology and peat requiring additional mitigation beyond standard best practice techniques requiring any additional mitigation, however the following further good practice and enhancement measures will be employed to reduce effects where possible.

Construction

Peat Slide

- 12.9.3. The following monitoring will be undertaken post consent:

- A geotechnical risk register and further PLHRA will be undertaken following the review of further ground investigation information. Geotechnical monitoring will be undertaken in accordance with further detailed assessments as discussed in **Appendix 12.3**.

Peat Resource

- 12.9.4. Where possible, following further detailed ground investigations and subsequent detailed infrastructure specification and design post consent, micro-siting of infrastructure to further reduce the amount of peat being disturbed will be undertaken. This is to be a particular focus on the infrastructure with peat depths approaching and exceeding 1 m in forestry. Micro-siting will have cognisance of other sensitive ecological, hydrological, hydrogeological, geological and peat features identified.
- 12.9.5. The total volume of peat predicted to be excavated does not exceed the intended peat reuse volume on-site for infrastructure reinstatement, so no disposal of excess peat off-site is expected.
- 12.9.6. On site, there is an opportunity for the following volumes of peat to be re-used within temporary infrastructure areas which will be implemented through the PMP:
- Total volume of peat that can potentially be reused on site reinstating infrastructure = ~ 91,600 m³ comprised of 7,896m³ acrotelm and 83,703 m³ catotelm).
- 12.9.7. The peat reuse areas that have been used for the calculations are shown in **Figure 12.7a-b**.
- 12.9.8. The peat balance for the Proposed Varied Development (shown in **Table 7 of Appendix 12.2: OPMP**) indicates that there are sufficient opportunities within the Site to enable reuse of peat restoration and minimise the impacts of construction through infrastructure reinstatement.
- 12.9.9. The peat mass balance is c. 3,519 m³ in deficit, which means that more peat is required to deliver the reuse options than is available from construction. This represents an approximate 4% difference compared with the overall peat excavation volume. Achieving further precision at the pre-consent stage is not considered appropriate given that micro-siting may lead to adjustments in infrastructure positions, and the earthworks footprints included in the calculations are conservative, worst-case values to support the EIA.

- 12.9.10. All excavated peat volumes have been demonstrated to be able to be appropriately re-used on-site. The peat restoration and reuse strategy for the excavated peat is focused on immediate reinstatement of peat around infrastructure. This reduces potential degradation of peat through storage, continued forestry activity and links areas of peat together.
- 12.9.11. The reinstatement and restoration around the infrastructure would be a positive enhancement to the current peatland conditions on-site, would reduce the impact on peat resource, and would complement the additional peatland restoration measures proposed across the site as a means of habitat enhancement (refer to **Appendix 9.8**).
- 12.9.12. Full details of these measures will be provided in a detailed CEMP and updated PMP which will be prepared and agreed with SEPA, NatureScot and DGC post consent as part of planning conditions.
- 12.9.13. A geotechnical risk register and additional PLHRA will be undertaken following the review of further ground investigation information. Geotechnical monitoring will be undertaken in accordance with further detailed assessments as discussed in **Appendix 12.3**.
- 12.9.14. Further ecological surveys will be undertaken by an ECoW prior to earthworks in each area to check for protected species. Peat reinstatement, restoration and enhancements will be monitored during the lifetime of the Proposed Varied Development, with a higher frequency of monitoring during the construction and immediate period following this to ensure good peatland recovery. Habitat enhancements and further monitoring are described in **Appendix 12.2** and **Appendix 9.8**.

Operation and Decommissioning

- 12.9.15. No additional mitigation or enhancement is required. The majority of the Proposed Varied Development has the potential to have less effect in comparison to the Consented Development on the geology and soil environment during the operation assuming best practice has been applied. The significance of effect for the operational phase is Minor (not significant) for all activities.

12.10. Existing Planning Conditions

- 12.10.1. The Shepherds' Rig Wind Farm (the Consented Development) Decision Letter outlines:
- Scottish Environment Protection Agency (SEPA) originally objected to the proposed Development on the basis of a lack of information on the impact on the peat environment. This was based on the original proposed location of 7 turbines positioned in areas of deep peat (previous proposed turbines T4, T6, T8, T9, T10, T13 and T16). These have been adjusted where possible so that they would now lie outwith areas of deep peat and the objection has been withdrawn.*
 - Ironside Farrar (Scottish Government advisor on peat landslide matters) advise that the Stage 1 checking report considered that the methodology of the Company's peat landslide hazard risk assessment set out in appendix 12 of the EIAR needed revision in a number of areas, including the integration of desk and field surveys, the calculations*

of risk and the proposed mitigation measures. It was recommended that a revised report be submitted. Following the updated risk assessment in appendix 12 of the AEI, Ironside Farrar confirms in its Stage 2 checking report that the developer has generally addressed the queries raised at Stage 1, with the exception of one point on scoring which was not considered to affect the outcome of the risk assessment.

- c. Royal Society for the Protection of Birds Scotland has no objection to the proposed Development, subject to the inclusion of a habitat management plan for the restoration of deep peat and associated habitat, to minimise the impact on black grouse and deep peat habitats.*

12.10.2. Annex 2 of the Shepherds' Rig Wind Farm (the Consented Development) Decision Letter outlines the Conditions attached to the Deemed Planning Permission. The following conditions relate to geology and peat and all remain applicable to the Proposed Varied Development:

12.10.3. Condition 14: Ecological Clerk of Works

(1) There shall be no Commencement of Development unless the terms of appointment of an independent and suitably qualified Ecological Clerk of Works (ECoW) by the Company have been submitted to, and approved in writing by the Planning Authority, in consultation with NatureScot and SEPA.

(2) The terms of appointment shall:

impose a duty on the ECoW to monitor compliance with the ecological, ornithological and hydrological commitments provided in the EIA Report, AEI and AEI II lodged in support of the application and the Construction Environmental Management Plan, Peat Management Plan, Biodiversity Plan, Species Protection Plan(s), Breeding Bird Protection Plan, Water Construction Environmental Management Plan, Biosecurity Plan and other plans approved in terms of the conditions of this permission (the ECoW Works);

- d. advise on micro-siting proposals issued pursuant to condition 15;*
- e. require the ECoW to report to the nominated construction project manager any incidences of non-compliance with the ECoW Works at the earliest practical opportunity and stop the job where any breach has been identified until the time that it has been reviewed by the construction project manager; and d) require the ECoW to report to the Planning Authority any incidences of non-compliance with the ECoW Works at the earliest practical opportunity.*

(3) The ECoW shall be appointed on the approved terms during the establishment of the Habitat Management Plan and throughout the period from Commencement of Development to completion of post construction restoration works and aftercare phase of the Development.

(4) No later than 18 months prior to decommissioning of the Development or the expiry of the section 36 consent (whichever is the earlier), details of the terms of appointment of an ECoW by the Company throughout the decommissioning, restoration and aftercare

phases of the Development shall be submitted for the written approval of the Planning Authority.

(5) The ECoW shall be appointed on the approved terms throughout the decommissioning, restoration and aftercare phases of the Development. Reason: To secure effective monitoring of and compliance with the environmental mitigation and management measures associated with the Development during the decommissioning, restoration and aftercare phases.

12.10.4. Condition 16. Borrow pits – scheme of works

(1) No works to excavate a borrow pit shall commence unless the following borrow pit details have been submitted to and approved in writing by the Planning Authority:

- a) precise location, extent and means of working;*
- b) proposed volume of material to be extracted;*
- c) storage of overburden;*
- d) assessment of the potential for air over pressure or ground vibration to disturb nearby buildings as a result of any aspect of use of the borrow pits, with proposals for mitigating any nuisance that might arise;*
- e) details of any need for blasting and, if proposed, a scheme for publicising the times and dates of any such blasting; and*
- f) a fully detailed restoration scheme with landscaping, planting and timescale information.*

(2) Thereafter, the excavation works shall be implemented in accordance with the approved details.

(3) Rock crushing will at all times be confined to inside the borrow pits.

Reason: To ensure that excavation of materials from the borrow pit(s) is carried out in a manner that minimises the impact on road safety, amenity and the environment, and to secure the restoration of borrow pit(s) at the end of the construction period.

12.10.5. Condition 18: Construction Environmental Management Plan

There shall be no Commencement of Development unless a Construction and Environment Management Plan (CEMP) has been submitted to and approved in writing by the Planning Authority, in consultation with NatureScot, HES, SEPA, the roads authority and the council's Environmental Health Officer (EHO). The CEMP shall integrate best practice methods for the Scottish / UK wind farm industry with the mitigation measures identified in the EIA and AEI reports.

- t) a peat management plan.*

(3) Thereafter, the construction of the Development shall be implemented in complete accordance with the approved CEMP, unless otherwise agreed in writing with the Planning Authority.

12.10.6. Condition 23: Floating Roads

(1) Floating roads shall be installed in areas where peat depths are in excess of 1 metre. Prior to the installation of any floating road, the detailed location and cross section of the floating road to be installed shall be submitted to and approved in writing by the Planning Authority.

(2) The floating road shall then be implemented in accordance with the approved details, unless otherwise agreed in writing by the Planning Authority.

Reason: To ensure peat is not unnecessarily disturbed or destroyed.

12.10.7. Condition 24: Biodiversity plan

(1) There shall be no Commencement of Development unless a Biodiversity Plan setting out proposals for the monitoring, restoration, enhancement and management of the peatland habitat of the site during construction, operation and decommissioning, has been submitted to and approved in writing by the Planning Authority.

12.11. Residual Effects

Construction

- 12.11.1. The residual effects represent the likely significant effects of the Proposed Varied Development on the environment taking account of the applied embedded mitigation and good practice measures as referred to above.
- 12.11.2. There are no significant residual operational effects.
- 12.11.3. The re-use of peat in reinstatement around the infrastructure will provide the opportunity for peatland habitats to be restored. The residual effect on peat disturbance will remain as Minor (Not Significant). These Minor adverse effects on the peat resource could become beneficial should the reuse and restoration be successful as the currently compromised upper layer of peat, essentially devoid of carbon, could be recovered.
- 12.11.4. Other peatland habitat enhancements, as detailed in **Appendix 9.8**, will contribute to further reducing the residual effects on peatland by off-setting the adverse effects on peat volumes with beneficial effects to peatland habitat.
- 12.11.5. These effects should also be considered in the context of the likely future condition of peatland on the site, which in areas is actively drained and disturbed by extensive commercial forestry activity and is expected to deteriorate and reduce in extent without intervention. Therefore, the enhancements and reuse restoration detailed would improve the current situation.

- 12.11.6. Effects on peat have been reduced by relocating turbines, removing turbines from previous layouts, reducing track length and including floating track. The incorporation of standard best practice and embedded mitigation measures in relation to peat disturbance and stability, would maintain any risks from the Proposed Varied Development to Low (insignificant).

Operation

- 12.11.7. There are no significant residual operational effects.

Decommissioning

- 12.11.8. There are no significant residual decommissioning effects.

12.12. Cumulative Assessment

- 12.12.1. The EIA regulations require the cumulative effects of the Proposed Varied Development with other relevant projects or plans to be assessed. NatureScot guidance on assessing cumulative effects has been followed (NatureScot, 2021c).
- 12.12.2. Cumulative effects are most likely to occur on those receptors for which a significant residual effect is predicted, particularly if the core range of these receptors includes other planned, consented or built development. This assessment considers that cumulative effects can result from effects that were individually assessed as non-significant, but in combination with effects or actions taking place over time, or across a wider spatial range (such as catchment) non-significant effects may cumulatively be considered significant.
- 12.12.3. Consideration of combined effects in a cumulative context would not sufficiently increase the scale of impacts to allow any potential effect to be considered cumulatively significant. All identified residual impacts of the Proposed Varied Development on geological and peat features are predicted to be Minor, and therefore not significant. In addition, the nature of these impacts is considered to be spatially or temporally limited.
- 12.12.4. The following developments and their site boundaries are located within 5 km of the site. Further details on these developments are presented in **Chapter 2: Site Description**.

Table 12.8 – Summary of Cumulative Effects

Site	Status	Distance from Site (km)	Significance of Effects
Lorg Overhead Line (OHL) Grid Connection	In planning	On-site	No significant impact predicted. No significant residual effects. Concluded following the application of mitigation measures to protect water supplies and peat, including measures to be implemented through embedded design, good practice mitigation

Site	Status	Distance from Site (km)	Significance of Effects
			methods, micro-siting, CEMP and Soil and Peat Management Plan (SPMP), no significant effects are predicted during construction of the OHL, and operation effects were excluded from the assessment on the basis no adverse impacts on the existing water and soil environment were expected.
Quantans Hill 15 turbines	In planning	0.75 km west	No significant impact predicted. Small areas of infrastructure are on Class 1 peat and deep peat on open moorland. Demonstrated that there is sufficient capacity for excavated peat to all be re-used as part of infrastructure dressing and reinstatement on the Proposed Development. Significance of effect on geology, soils and peat was assessed as negligible. No significant effects from the Proposed Development on the hydrological, hydrogeological and geological environment
Windy Rig 12 turbines	Operational	3.3 km north	No significant impact predicted.
Manquhill 8 turbines	Consented	4.1 km east	No significant impact predicted. Peat surveys undertaken demonstrated average peat depth at infrastructure was less than 0.5 m depth (no peat) at all locations except T3 and therefore a PLHRA or OPMP was not undertaken. The site hydrological, hydrogeological and geological conditions were assessed not significant under the terms of The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 New application for same number of turbines with increased tip height to 220 m submitted September 2025.
Cornharrow 7 turbines	Consented and in planning for reapplication to amend tip heights.	4.1 km east	No significant impact predicted.

*Measurements taken from nearest infrastructure elements.

- 12.12.5. These grid connections and wind farm proposals all demonstrate a disturbance of geology and peat, that either the infrastructure could avoid deep peat or that excavated peat can be appropriately reused on-site and that the residual impact is Minor or not significant.
- 12.12.6. The majority of the Lorg Wind Farm Grid Connection OHL has no peat coverage based on the BGS superficial geology mapping. Based on the Proposed Varied Development's peat surveys, there is the potential for peat to be present along the OHL route with the Proposed Varied Development site. It is recommended that further investigation and micro-siting of infrastructure is undertaken in context of both developments to identify if construction compound footprints could be shared or re-used to further reduce peat disturbance and improve restoration.
- 12.12.7. It is also recommended that wind farm development construction earthworks and large-scale forest felling activities in the same hydrological catchments avoid being undertaken at the same time to minimize potential cumulative effects of acidification and sediment laden runoff. This is further discussed in **Chapter 13**.
- 12.12.8. In line with the Consented Development's 2018 EIA submission and the subsequent 2019 AEI Report (which included the consideration of the cumulative effects of the Lorg OHL), the Geology and Peat are considered as a site-specific consideration and it is not considered that there will be cumulative effects relating to peat.
- 12.12.9. As discussed previously, the peat disturbance and excavation has been kept to a minimum by careful design. The peat on-site is actively drained and disturbed by extensive commercial forestry activity and is expected to deteriorate and reduce in extent without intervention. All excavated peat can be appropriately used around the infrastructure and with habitat enhancements may have a minor beneficial effect when considered in the context of the likely future condition of peatland on the site.

12.13. Summary

- 12.13.1. The infrastructure, and associated construction activities, will result in an overall significance of effect that is **Minor (not significant)** for erosion/sedimentation and disturbance of geology and peat. This result was also seen in the previous EIA Report (November 2018) and the AEI Report (October 2019) which both gave the effect as not significant for geology and peat.
- 12.13.2. Where possible, following further detailed ground investigations, subsequent detailed infrastructure specification and design post consent, micro-siting of infrastructure to further reduce the amount of peat being disturbed will be undertaken.
- 12.13.3. The reinstatement and restoration around the infrastructure would be a positive enhancement to the current peatland conditions on-Site, would reduce the impact on peat resource, and would complement the additional peatland restoration measures proposed across the site as a means of habitat enhancement (**Appendix 9.8**).

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- 12.13.4. Full details of these measures will be provided in a detailed CEMP and updated PMP which will be prepared and agreed with SEPA, NatureScot and DGC post consent as part of planning conditions.
 - 12.13.5. A geotechnical risk register and further PLHRA will be undertaken following the review of further ground investigation information. Geotechnical monitoring will be undertaken in accordance with further detailed assessments as discussed in **Appendix 12.3**.
 - 12.13.6. Further ecological surveys will be undertaken by an ECoW prior to earthworks in each area to check for protected species etc. Peat reinstatement, restoration and enhancements will be monitored during the lifetime of the development, with a higher frequency of monitoring during the construction and immediate period following this to ensure good peatland recovery.

Table 12.8 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation and/or Enhancement Measure	Significance of Residual Effect		Change to Consented Development Conclusion
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Construction						
Disturbance of Peat - Peat resource	Minor (not significant)	Adverse	Mitigation by design, best practice and standard embedded mitigation. No specific additional mitigation required.	Minor (not significant)	Adverse	No change to significance overall. Reduction in peat disturbance (when including earthworks, clearance and bulking factor) compared to original proposal and consented revised development. Therefore, no additional mitigation is required beyond standard best practice.
Disturbance of Peat - Peat Stability	Minor (not significant)	Adverse	Mitigation by design, best practice and standard embedded mitigation. No specific additional mitigation required.	Minor (not significant)	Adverse	No change to significance overall. Therefore, no additional mitigation is required beyond standard best practice.
Geology – borrow pits	Minor (not significant)	Adverse	Mitigation by design, best practice and standard embedded mitigation. No specific	Minor (not significant)	Adverse	No change to significance overall as borrow pits for the Proposed Varied Development are the same as the Consented Development.

			additional mitigation required.			
Operation						
Disturbance of Peat	Minor (not significant)	Adverse	Best practice and standard embedded mitigation. No specific additional mitigation required.	Minor (not significant)	Adverse/Beneficial	None
Geology	Minor (not significant)	Adverse	Best practice and standard embedded mitigation. No specific additional mitigation required.	Minor (not significant)	Adverse	None
Decommissioning						
Disturbance of Peat	Minor (not significant)	Adverse	Best practice and standard embedded mitigation. No specific additional mitigation required.	Minor (not significant)	Adverse/Beneficial	None
Geology	Minor (not significant)	Adverse	Best practice and standard embedded mitigation.	Minor (not significant)	Adverse	None

			No specific additional mitigation required.			
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Table 12.9 – Summary of Cumulative Effects

Receptor	Effect	Cumulative Developments	Significance of Cumulative Effect	
			Significance	Beneficial/Adverse
No cumulative effects anticipated, assuming embedded best practice.				

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Abbreviations

Abbreviations	Definition
AOD	Above Ordnance Datum
BAP	Biodiversity Action Plan
BGS	British Geological Society
CEMP	Construction Environmental Management Plan
CMS	Construction Method Statements
DGC	Dumfries and Galloway Council
DMP	Drainage Management Plan
ECOW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
FCS	Forestry Commission Scotland
GCR	Geological Conservation Review Area
GPP	Guidelines on Pollution Prevention
LNCS	Local Nature Conservation Sites
NNR	National Nature Reserves
NPF	National Planning Framework
PAN	Planning Advisory Note
PLHRA	Peat Landslide Hazard Risk Assessment
OHL	Overhead Line
OPMP	Outline Peat Management Plan
SAC	Special Areas of Conservation

SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage (Now NatureScot)
SSSI	Site of Special Scientific Interest