CLOICH FOREST WIND FARM

EIA Report – Volume 1 – EIA Report Text

Chapter 9

Geology, Ground Conditions and Peat

ARCUS

9 GEOLOGY, GROUND CONDITIONS & PEAT

9.1 INTRODUCTION

1. This Chapter of the Environmental Impact Assessment Report (EIA Report) evaluates the effects of the Cloich Forest Wind Farm ('the Development') on the geology, ground conditions & peat resource.

2. This assessment was undertaken by Arcus Consultancy Services Limited (Arcus).

3. This Chapter of the EIA Report is supported by the following Technical Appendix documents provided in Volume 3 Technical Appendices:

- Technical Appendix A9.1: Peat Slide Risk Assessment (PSRA); and
- Technical Appendix A9.2: Outline Peat Management Plan (oPMP).

4. This Chapter of the EIA Report is supported by the following figures provided in Volume 2a EIA Report Figures:

- Figure 9.1: Superficial Soils;
- Figure 9.2: Bedrock Geology;
- Figure 9.3: National Soils of Scotland;
- Figure 9.4: Extract from Carbon and Peatland 2016; and
- Figure 9.5: Interpolated Peat Depths.

5. This 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;
- Statement of Significance; and
- Glossary.

9.2 LEGISLATION, POLICY AND GUIDANCE

6. This Chapter is written with consideration given to The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations) which establishes in broad terms what is to be considered when determining the effects of development proposals on Geology, Soils and Peat.

7. The Scottish Planning Policy (SPP)[1] was published in 2014 and sets out the Scottish Government's policy on how nationally important land use planning matters should be addressed.

8. In relation to peat and organic soils, paragraph 205 from SPP states that *"where peat and other carbon rich soils are present, applicants should assess the likely effects of development on carbon dioxide (CO2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO2 to the atmosphere. Developments should aim to minimise this release".*

9. In relation to minerals, PAN 50 states that part of the sustainable framework for mineral extraction was to encourage sensitive working practices during minerals extraction and

[1] The Scottish Government (2014) Scottish Planning Policy [Online] Available at: http://www.gov.scot/Publications/2014/06/5823 (Accessed 05/05/2021)

to preserve or enhance the overall quality of the environment once extraction has ceased. In addition to the SPP, guidance of relevance to this Chapter includes:

- Scottish Renewables et al. (2019) 4th Edition, Good Practice During Wind Farm Construction[2];
- The Scottish Government (2017), Peat Landslide Hazard and Risk Assessments – Best Practice Guide for Proposed Electricity Generation Developments[3];
- Scottish Government, SNH, SEPA (2017) Peatland Guidance on Development on Peatland, on-line-version-only[4];
- The Scottish Government (2009), The Scottish Soil Framework[5];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[6]; and
- Planning Advice Note PAN 50 Controlling the Environmental Effects of Surface Mineral Workings[7].

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.3.1 Scoping Responses and Consultations

10. Consultation for this EIA Report topic was undertaken with the organisations shown in Table 9.1 overleaf.

[2] SNH (2019) Good practice during windfarm construction, 4th Edition [Online] Available at: https://www.nature.scot/sites/default/files/2020-12/Good%20Practice%20during%20wind%20farm%20construction%20-%204th%20Ed.pdf (Accessed 05/05/2021)
[3] The Scottish Government (2017) Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments Guidance [Online] Available at: http://www.gov.scot/Resource/0051/00517176.pdf (Accessed 05/05/2021)
[4] Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland, on-line version only Available at: https://www.webarchive.org.uk/wayback/archive/3000/https://www.gov.scot/Resource/0051/00517174.pdf (Accessed 05/05/2021)
[5] The Scottish Government (2009) The Scottish Soil Framework [Online] Available at: http://www.gov.scot/Publications/2009/05/20145602/0 (Accessed 05/05/2021)
[6] The Construction Industry Research and Information Association (CIRIA) (2015) Environmental Good Practice on Site Guide (C741), CIRIA: London.
[7] Scottish Government (2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Available at: http://www.gov.scot/Publications/2017/04/8868/0 (Accessed 05/05/2021)

Table 9.1 Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
SEPA	Scoping Response 30/10/2019	SEPA have requested that the following key issues must be addressed in the EIA process: d) Peat depth survey and table detailing re-use proposals. f) Map and site layout of borrow pits. h) Quarry or Borrow Pit Site Management Plan of pollution prevention measures.	Details of peat depths and a table detailing re-use proposals are presented in Technical Appendix A9.2: oPMP. The location of proposed borrow pits is presented in Figure 3.1: Detailed Development Site Layout. Details of the management of borrow pits and pollution prevention measures are outlined in Technical Appendix A3.1: Borrow Pit Assessment.
SEPA	Scoping Response 30/10/2019	In relation to disturbance and re-use of excavated peat and other carbon rich soils, SEPA require: 3.1 Where peatland is drained or otherwise disturbed, there is liable to be a release of CO2 to the atmosphere. Developments must aim to minimise this release." 3.2 The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat. 3.3 The submission must include: a) A detailed map of peat depths following the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017) b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included. 3.4 For proposals to be in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and our Developments on Peat and Off-Site uses of Waste Peat. 3.5 Consideration given on whether a full Peat Management Plan (as detailed in the above guidance) is required or whether	The design evolution is driven by avoidance of environmental constraints including deep peat. During preparation of the EIA Report, consultation has taken place to illustrate how site design has changed to avoid the deepest peat areas. See **Chapter 3: Project Description** for details. Technical Appendix A9.2: oPMP, and mitigation in Section 9.8 of this Chapter outlines the preventative measures and mitigation for avoiding the drying out or oxidisation of peat during construction. The oPMP has been prepared in accordance with Scottish Government guidelines and best practice guidance as listed in Section 9.2 of this Chapter. A Carbon Calculator, which takes into account loss of carbon through peat excavation is included in **Chapter 16: Climate Change and Carbon Balance.** Details of peat re-use and restoration would be presented in a Habitat Management Plan (HMP), further details are within **Chapter 7: Ecology.**

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		the above information would be best submitted as part of the schedule of mitigation. 3.6 Consideration for SEPA advice on the minimisation of peat disturbance and peatland restoration may need to be taken into account.	
SEPA	Scoping Response 30/10/2019	In relation to the planning and building of Borrow pits. SEPA Require: 7.1 Scottish Planning Policy states (Paragraph 243) that "Borrow pits should only be permitted if there are significant environmental or economic benefits compared to obtaining material from local quarries, they are time-limited; tied to a particular project and appropriate reclamation measures are in place." The submission must provide sufficient information to address this policy statement. 7.2 A Site Management Plan to be submitted in support of any application. The following information should also be submitted for each borrow pit: a) A map showing the location, size, depths and dimensions. b) A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 metres. Evidence that a site-specific proportionate buffer can be achieved. On this map, a site-specific buffer must be drawn around each loch or watercourse proportionate to the depth of excavations and at least 10m from access tracks. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works. c) Provide a justification for the proposed location of borrow pits and evidence of the suitability of the material to be excavated for the proposed use, including any risk of pollution caused by degradation of the rock.	Details of proposed borrow pits at the Site are presented in Technical Appendix A3.1: Borrow Pit Assessment.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		d) A ground investigation report giving existing seasonally highest water table including sections showing the maximum area, depth and profile of working in relation to the water table. e) A site map showing cut-off drains, silt management devices and settlement lagoons to manage surface water and dewatering discharge. Cut-off drains must be installed to maximise diversion of water from entering quarry works. f) A site map showing proposed water abstractions with details of the volumes and timings of abstractions. g) A site map showing the location of pollution prevention measures such as spill kits, oil interceptors, drainage associated with welfare facilities, recycling and bin storage and vehicle washing areas. The drawing notes should include a commitment to check these daily. h) A site map showing where soils and overburden will be stored including details of the heights and dimensions of each store, how long the material will be stored for and how soils will be kept fit for restoration purposes. Where the development will result in the disturbance of peat or other carbon rich soils then the submission must also include a detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements and excavation areas overlain so it can clearly be seen how the development minimises disturbance of peat and the consequential release of CO2. i) Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths and types of material to be used. j) Details of how the rock will be processed in order to produce a grade of rock that will not cause siltation problems during its end use on tracks, trenches and other hardstanding.	

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
SEPA	Scoping Response (13/10/2020)	In relation to request for further guidance on peat survey and reporting following phase one survey results. SEPA require Arcus to carry out phase 2 targeted probing due to the potential variability of peat not recorded in the phase 1 methodology. Should peat be encountered, a Peat Management Plan should be produced.	Targeted phase 2 peat probing has been completed at the Site. An oPMP is included in TA9.2.
Eddleston District Community Council (EDCC)	Scoping Response (15/11/19)	Cloich is home to a number of peat mosses which for the good of our environment must be left undisturbed.	Both preliminary and detailed site surveys did not encounter any significant peat depths. In addition, the proposed site development is located on existing forestry tracks and commercial forestry mainly.

9.3.2 Scope of Assessment

11. The following effects on geology, ground conditions, and peat resources related to the Development will be considered within the EIA Report due to the potential for significant effects as agreed during consultation (Section 9.3.1).

- Potential for peat destabilisation and peat slide risk;
- Potential effects relating to peat disturbance and the subsequent effects from excavated peat and management of peat and peaty soils;
- Potential for compaction of superficial soils; and
- Potential for loss of important geological minerals.

9.3.3 Study Area / Survey Area

12. The Development is located on an area of land approximately 1,080 ha, located approximately 5.5 km north-west of Peebles ('the Site') and is shown on Figure 3.1 of this EIA Report. The Study Area for the purposes of this chapter and assessment relates to the redline boundary, as shown on Figure 3.1, however the peat surveys were focussed on an area defined as 'developable' which represented areas of the site which could potentially have infrastructure, where there were no significant other restricting environmental constraints. The Site boundary largely follows the Cloich Forest boundary which covers the Cloich Hills consisting of Peat Hill to the north-east, Ewe Hill in the central site area and Crailzie Hill in the south-west site area. The topography of the Site is typical of rolling hillside with varying conditions with elevations ranging from approximately 280 m Above Ordnance Datum (AOD) in the north-east Site area to approximately 476 m AOD at the peak of Crailzie Hill.

9.3.4 Elements Scoped Out of Assessment

13. Desk studies have not identified any areas of contaminated land within the Study Area. Should potentially contaminated land be encountered during excavations, appropriate action would be taken in accordance with The Environmental Protection Act 1990[8]. As a result, potential effects arising from contaminated land have been scoped out of this assessment.

9.3.5 Design Parameters

14. The parameters of the design that will influence the geology, ground conditions and peat assessment in relation to physical effects has been based on the turbine layout and associated infrastructure. No additional design parameters, other than those set out in **Chapter 3: Project Description** of this EIA Report, are required for the assessment presented in this Chapter.

15. As set out in **Chapter 3: Project Description**, the turbines and associated infrastructure may be micro-sited up to 50 m, where constraints allow. Such relocations have been considered when undertaking the assessment, and mitigation recommended, where appropriate.

9.3.6 Baseline Survey Methodology

16. The assessment of geology, ground conditions, and peat has included the review of publicly available information in relation to the current condition of the soils at the Site and the information is detailed in the baseline description. This was supported by detailed Site walkover surveys in line with peat probing activities between March 2020 and April 2021. The information has been reviewed in the context of the Development to evaluate both short and long-term impacts.

[8] https://www.legislation.gov.uk/ukpga/1990/43/contents

17. The assessment has involved a review of the following data sources detailed below:

- National Soils Map of Scotland[9];
- Carbon and Peatland 2016 Map[10];
- British Geological Survey (BGS) Geoindex – Superficial Soils Solid Geology[11].

18. The methodology employed for the PSRA is in accordance with Energy Consents Unit (ECU) Scottish Government guidance. Using experience from other wind farm projects, the assessment endeavours to assess the effects on geology and soils either affected directly or indirectly by construction or operation of the Development.

9.3.6.1 Stage One Peat Probing

19. Initial phase one peat probing was carried out in March 2020 in accordance with Scottish Government guidance[12] with probe points sunk in a 100 m grid carried out across the developable Site area and the information gathered to inform the preliminary Site layout design. Peat probe data is acquired using the GIS Collector Application and a group of extendable carbon-fibre rods, each measuring just under 1 m, one of which features a pointed end for effective entry into soil with overall measuring capabilities correlated to the length of rod that is able to be submerged and the visual evidence of peat once removed. On the Collector App a fishnet with squares measuring 100m^2 is overlain on a map showing the Site boundary and any other necessary features for effective GPS point data entry. Probing was limited to the developable area derived from key constraints mapping, the scoping layout turbine locations and a subsequent 250 m buffer of the scoping layout. This avoided areas of the Site with constraints and areas outwith influencing distance of proposed Development infrastructure, while still achieving a wide Site coverage.

9.3.6.2 Stage Two Peat Probing

20. Following design freeze, targeted peat probing was carried out across the locations for proposed infrastructure. This probing was generally at 50 m intervals along the centre line of the tracks with probes at 10 - 25 m on either side of the tracks to provide a corridor for micro-siting. In addition, probing at turbine locations were recorded at 10 m intervals. Peat probe points were gathered utilising the fishnet method discussed above, using targeted fishnets with different interval areas (10m^2 / 50m^2) allowing each infrastructure type to be probed in accordance with Scottish Government Guidance.

21. It should be noted that the PSRA was undertaken on the findings of all phases of probing with focus on the Phase two peat probe data, as this was within the proposed infrastructure envelope. Details of the assessment are included in Technical Appendix A9.1.

9.3.6.3 Peat Slide Risk Assessment and Peat Management Plan

22. A PSRA and OPMP are provided in Technical Appendices A9.1 and A9.2 respectively. These assess the potential for peat de-stabilisation and the potential for disturbance of peat, considering the impact on key sensitive receptors. These include:

- Existing infrastructure in the form of tracks and footpaths and dwellings;
- Proposed infrastructure in the form of turbine foundations, crane hardstandings, tracks and other infrastructure;
- Sensitive areas of GWDTEs, blanket bog and other sensitive habitats; and
- Major and minor watercourses.

[9] https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland/
[10] https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/
[11] https://mapapps2.bgs.ac.uk/geoindex/home.html
[12] https://www.gov.scot/publications/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/

23. Details of GWDTEs and the presence of blanket bog are discussed in further details in **Chapter 7: Ecology** while the impacts on watercourses are included in **Chapter 10: Hydrology & Hydrogeology**.

9.3.7 Methodology for the Assessment of Effects

24. The assessment of effects is based on the final design of the Development detailed in **Chapter 3: Project Description** of this EIA Report. The assessment considers the sensitivity of the receptor and the magnitude of any potential change, to conclude whether the effect is significant by assessing the potential for both peat slide risk assessment at the site, and the potential impact from peat disturbance.

9.3.7.1 Sensitivity of Receptors

25. Soil types are considered to be of high sensitivity where they are categorised as peat soils of high moisture content, such as those found in blanket bog.

26. The sensitivity of the receiving environment is defined as its ability to absorb an effect without perceptible change and can be classified as high, medium or low. These classifications are dependent on factors such as the nature and extent of peat, associated habitats, and soil characteristics as well as the Site geology and their purpose and existing influences, such as land-use.

27. Table 9.2 provides an overview of the different categories of sensitivity that are used within this chapter to inform the assessment of effects on existing geology, ground conditions, and peat, identifying whether the effects would be significant under Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017[13] ('the EIA Regulations').

Table 9.2 Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	• The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.
High	• Soil type and associated land use are highly sensitive (e.g. peat/blanket bog); • Class 1 or 2 priority peatland, carbon-rich and peaty soils cover >20% of the development area; and • Receptor contains areas of regionally important economic mineral deposits.
Medium	• Soil type and associated land use are moderately sensitive (e.g. commercial forestry); • Class 1 or 2 priority peatland, carbon-rich and peaty soils cover <20% of the Development Area; • Class 3 and 5 peatland areas, carbon rich and peaty soils; and • Receptor contains areas of locally important economic mineral deposits.
Low	• Soil type and associated land use not sensitive to change in hydrological regime (e.g. intensive grazing); and • Receptor contains Class -2, -1, 0, and 4 non-peatland areas, with no carbon-rich and/or peaty soils.
Negligible	• The receptor is resistant to change and is of little environmental value.

[13] The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: https://www.legislation.gov.uk/ssi/2017/101/contents/made (Accessed 05/05/2021)

9.3.7.2 Magnitude of Change

28. The magnitude of potential change will be identified through consideration of the Development, the degree of change to baseline conditions predicted as a result of the Development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

29. The criteria for assessing the magnitude of a change can be classified as high, medium, low or negligible as presented in Table 9.3.

Table 9.3 Framework for Determining Magnitude of Change

Magnitude of Effects	Definition
High	• Major or total loss of or alteration to peatland resource such that post development characteristics or quality will be fundamentally or irreversibly changed; • Long term/permanent change to human or environmental health; • Catastrophic failure of site infrastructure due to ground instability; • Long term/permanent change to baseline resource; and • Major or total loss of a geological site or mineral deposit, where the value of the site would be severely affected.
Medium	• Loss of, or alteration to the baseline resource such that post development characteristics or quality will be partially changed; • Mid-term/permanent change to human or environmental health; • Ground failure that requires remediation but does not cause catastrophic failure of site infrastructure; • Mid-term/permanent change to baseline resource; and • Partial loss of a geological site or mineral deposit, with major effects to the settings, or where the value of the site would be affected.
Low	• Small loss of soils or peatland, or where soils will be disturbed but the value not impacted; • Short-term change to human or environmental health; • Ground settlement/subsidence that does not adversely affect site infrastructure or require remedial action; • Short-term change to baseline resource; and • Small effect on a geological site or mineral deposit, such that the value of the site would not be affected.
Negligible	• Minimal or no change to soils or peatland deposits; • Minimal or no change to human or environmental health; • Minimal or no change to ground stability; • A very slight change from the baseline conditions. The change is barely distinguishable, and approximates to the 'no-change' situation; and • Minimal or no change to a geological site or mineral deposit.

9.3.7.3 Significance of Effect

30. The sensitivity of the asset and the magnitude of the predicted effects will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects. Table 9.4 summarises guideline criteria for assessing the significance of effects.

Table 9.4 Framework for Assessment of the Significance of Effects

Magnitude of Change	**Sensitivity of Resource or Receptor**				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

31. Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations, and are shaded in light grey in the above table.

9.3.8 Assessment Limitations

32. There were no assessment limitations in relation to the geology, ground conditions and peat.

9.3.9 Embedded Mitigation

33. Embedded Mitigation comprises best practice methods and works as outlined in publication 'Good Practice during Wind Farm Construction'[14] that are established and effective measures to which the Applicant will be committed through the planning consent.

34. Mitigation also takes place through embedded design of the site layout avoiding key environmental constraints including avoidance of deepest peat (i.e. no turbines sited in peat > 1 m) or limiting the impacts on deep peat where possible, as well as taking cognisance of hydrological and ecological features and associated buffers.

35. The Site layout design was presented through pre-application consultation to SEPA to illustrate how the Site layout had considered the avoidance of deep peat where possible and how infrastructure sited in peat greater than 1.0 m was generally located within the shallowest peat possible. This consultation also illustrated the key constraints, such as watercourse buffers and GWDTEs.

[14] Scottish Renewables et al. (2019) Good Practice during Wind Farm Construction, 4th Edition 2019 [Online]. Available at: https://www.nature.scot/sites/default/files/2020-12/Good%20Practice%20during%20wind%20farm%20construction%20-%204th%20Ed.pdf (Accessed 04/05/2021)

9.4 BASELINE CONDITIONS

36. This section reports the findings from review of published geology, augmented by field survey and peat probing which provides a more detailed geological context of the local environs within the Site. Further details of baseline peatland habitats are also included in **Chapter 7: Ecology**.

9.4.1 Superficial Soils

37. Published geological mapping of superficial soils indicates a majority of the Site to be underlain by deposits of Diamicton Till of Devensian Age. No superficial deposits are recorded across the remainder of the Site other than small localised pockets of Peat and Alluvium in the central eastern areas and at the northern extent of the Site. The Superficial Soils at the Site is presented in Figure 9.1.

9.4.2 Bedrock Geology

38. Published bedrock geology mapping indicates the majority of the Site to be underlain by sandstone and siltstone of the Kirkcolm Formation, with wacke and siltstone of the Portpatrick Formation present in the south-western Site area. A thin lens of the Moffat Shale Group comprising mudstone is also present in the south-western Site area. Bedrock Geology is presented in Figure 9.2.

9.4.3 National Soils of Scotland

39. The following information is a summary of the information on soil units within Scotland's Soils, Scotland's Environment Website[15]

40. National Soils Map of Scotland mapping indicates the Site to consist of peaty gleys sustaining some peat in the northern Site area and peaty podzols in the central and southern Site areas, with non-calcareous mineral gleys and brown forest soils also present across central and eastern areas of the Site.

41. A brief description of the characteristics and formation of component soil groupings is detailed below, 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 'blankets' the landscape;
- Podzols: Podzols are acid soils with a grey leached layer just below the surface and bright orangey-brown coloured subsoils and/or dark brown to black, organic rich subsoils;
- Gleys: Soils that are periodically or permanently waterlogged; and
- Brown Soils: Brown Soils are moderately acid soils with brown mineral topsoils and brown or yellowish subsoils.

42. Figure 9.3 presents an Extract from the National Soils of Scotland.

9.4.4 Carbon-rich Soils, Deep Peat and Priority Peatland Habitats

43. The Carbon and Peatland Map (SNH, 2016) indicates the Carbon-rich soils and peatland importance categories to be:

- Class 1 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value;
- Class 2 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas of potentially high conservation value and restoration potential;

[15] Scotland's Environmental Website: http://soils.environment.gov.scot/ (Accessed 05/05/2021)

- Class 3 - Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found. Most soils are carbon-rich soils, with some areas of deep peat;
- Class 4 - Area unlikely to be associated with peatland habitats or wet and acidic type. Area unlikely to include carbon-rich soils;
- Class 5 - Soil information takes precedence over vegetation data. No peatland habitat recorded. May also include areas of bare soil. Soils are carbon-rich and deep peat;
- Mineral soil - Peatland habitats are not typically found on such soils (Class 0);
- Unknown soil type – information to be updated when new data are released (Class -1); and
- Non-soil (e.g. loch, built up area, rock and scree) (Class -2).

44. Figure 9.4 provides the Carbon and Peatland 2016 Map extract which indicates that at the macro level the Site is underlain by pockets of Class 4 soils in north, central and southern areas; these soils are unlikely to be associated with peatland habitats or to include carbon-rich soils. Numerous small pockets of Class 5 soils are also present at the Site, primarily in northern and central areas; these soils are not recorded as peatland habitat but there is potential for carbon-rich soils and deep peat. The remainder of the Site is recorded as Class 0 (Mineral Soils) where peatland habitats are not typically found, other than a small area of Class 3 soil which is recorded at the southern boundary of the site; these are soils where occasional peatland habitats can be found and most soils are carbon-rich with some areas of deep peat.

45. A summary of the peat survey is summarised below, and the details are included in Appendix A9.2: oPMP. The appendix provides Site-specific peat depth information which informed the design of the layout of the Development and the subsequent assessment of effects. Figure 9.4 provides the Carbon and Peatland 2016 Map extract.

9.4.5 Peat (Site Specific Environs)

46. Peat is a sedimentary material, which is dark brown or black in colour, and comprises partially decomposed remains of plants and organic materials preserved in anaerobic conditions, essentially within a waterlogged environment. There are two principal types of peat:

- Acrotelm is the upper layer, quite fibrous and contains plant roots. Acrotelmic peat is relatively dry, generally lying above the groundwater table and has some tensile strength; and
- Catotelm is the lower layer of peat which is highly amorphous and has a very high water content. Catotelm generally lies below the ground water table and has a very low tensile strength.

47. Interpretation of these principle types are discussed further in the Appendix A9.2: Outline Peat Management Plan.

9.4.5.1 Field Surveys

48. The desk-based assessment recorded the potential presence of peat and peaty soils in line with NatureScot data described above. Peat depths were consistent throughout the Site, with 92.5% of probes recording peat depths of 0.5 m or less. A small area of deep peat of up to 4.6 m was recorded in the eastern Site area in an area of flat topography, this is confirmed to be a localised pocket of deep peat in an area where no turbines, tracks or associated infrastructure are proposed. The average peat depth was recorded as 0.26 m.

49. The results of the peat probing indicated that peat was scarcely present across much of the Site, in line with the published geological data. A small area of deep peat of up to 4.6 m was recorded in the eastern site area in an area of flat topography, in a low-lying area

adjacent to the existing track being utilised for the southern access. This is a localised pocket of deep peat in an area where no turbines, new tracks or associated infrastructure is proposed.

50. During the course of the works, a total of 1081 probes were sunk within the study area. The peat probe locations and peat depth interpolation are shown in Figure 9.5 and further details on the peat probing included in Appendix A9.2: oPMP.

51. Table 9.5 below summarises the peat depth findings.

Table 9.1: Peat Depth Summary

Peat Depth Range (m)	No of peat probes	Percentage of Total (%)
0 – 0.50	1,000	92.5
0.51 – 1.00	50	4.6
1.01 – 1.50	12	1.1
1.51 – 2.00	8	<1.0
2.01 – 2.50	3	<1.0
2.51 – 3.00	0	0
3.01 – 3.50	4	<1.0
3.51 – 4.00	0	0
4.01 – 4.50	3	<1.0
4.51 – 5.00	1	<1.0

52. Recorded peat depths averaged 0.26 m, with 92.5% of probes recording peat depths of 0.5 m or less. A small area of deep peat of up to 4.6 m was recorded in the eastern Site area in an area of flat topography, in a low-lying area adjacent to the existing track being utilised for the southern access. This is a localised pocket of deep peat in an area where no turbines, new tracks or associated infrastructure is proposed.

53. A more detailed representation of peat within the Site is available in Appendix A9.1: Peat Slide Risk Assessment and Appendix A9.2: oPMP.

Table 9.6: Peat Depths Recorded at Turbines

Proposed Turbine No.	Average Peat Depths at 50 m Radius (m)
T1	0.15
T2	0.18
T3	0.29
T4	0.14
T5	0.21
T6	0.16
T7	0.06
T8	0.48

Proposed Turbine No.	Average Peat Depths at 50 m Radius (m)
T9	0.12
T10	0.13
T11	0.11
T12	0.11

9.4.5.2 Peat Stability and Peat Management

54. The recorded peat depths and existing slope information has been utilised to identify hazard areas in relation to peat slide risk. The assessment found that with only 7.5% of peat at the Site being recorded at depths >0.5 m and the severely fragmented nature of the majority of peat due to the afforested nature of the Site, the presence of peat with the potential to slide is minimal. Furthermore, where deep peat has been identified, it has been in isolated areas of low-lying ground, in depressions between the rolling hills which have been avoided through an iterative design process, further reducing the likelihood of peat slide occurring. Further details are provided in Appendix A9.1: Peat Slide Risk Assessment.

55. The peat depth data is utilised to calculate estimated peat excavation and re-use volumes based on an outline 3-D civil Site layout design. In this, rational options are provided for reuse of excavated material and guidance on good practice storage and management of excavated material, including peat. Further details are provided in Appendix A9.2: Outline Peat Management Plan.

9.5 ASSESSMENT OF POTENTIAL EFFECTS

56. The effect of the Development on soils and geological receptors has been considered for the duration of the construction and operation phases. Effects occurring during construction are considered to be short term effects, with those occurring as a result of the operation of the Development being considered as long-term.

9.5.1 Potential Construction Effects

9.5.1.1 Disturbance of Deep Peat

57. Construction activities including excavation of tracks, turbine foundations, crane hardstanding, and other infrastructure can lead to disturbance of peat. Beyond the main construction activities, other considerations include the temporary storage of soils and peat on Site. The details of peat disturbance through excavations and subsequent re-use methods are included in Appendix A9.2: oPMP**.** Figure 9.5 Interpolated Peat Depths illustrates the areas of deep peat.

58. The assessment of peat disturbance has not highlighted any areas of deep peat at risk from the Development, with the deepest peat recorded out with the footprint of the Development. All turbines are sited in areas where peat is <1.0 m, and only very short sections of proposed track are located in areas where peat is >1.0 m e.g. to the north of T8 (as detailed in Table 9.6).

59. On this basis and in the absence of mitigation, the Development is considered to result in a potential minor effect that would be **not significant**, in terms of the EIA Regulations.

9.5.1.2 Peat Stability

60. Peat instability is generally the result of a combination of causative factors. Several construction activities have the potential to increase the likelihood of peat slides in areas where peat is present at a sufficient depth and where gradients are sufficiently steep to result in a peat slide event.

61. Construction activities have the potential to increase the likelihood of peat slides by way of locating proposed infrastructure including track networks on sloping ground where peat is present. All construction activities involve the removal of surface vegetation and excavation of peat and other near surface soils from the bedding surface of the underlying rock which naturally increases potential for slide.

62. Peat slides can affect soils, local sensitive habitats and have the potential to affect surface water systems from soil inundation, leading to sedimentation. This can have an effect by slip materials sliding onto areas of sensitive habitat, or causing damage to local surrounding surface soils and can also reduce water quality and/or modify drainage patterns. Receptors identified across the Development area are:

- Existing major and minor watercourses;
- Localised peat soils; and
- Proposed Wind Farm Infrastructure.

63. The majority of peat was recorded at depths less than 1.0 m across the Site, however localised pockets of deep peat have also been recorded. Across the majority of the Site, infrastructure associated with the Development has avoided these pockets of deep peat, with all turbines being sited in areas where peat is <1.0 m, and only very short sections of proposed track are located in areas where peat is >1.0 m. The peat slide risk assessment analysis has highlighted the Site to be of negligible or low hazard rank in terms of slide risk.

64. Therefore, the Development is considered to result in a potential effect of minor and would therefore **not significant**, in terms of the EIA regulations.

9.5.1.3 Loss of Soils

65. In its regulatory position statement, SEPA states that:

"Developments on peat should seek to minimise peat excavation and disturbance to prevent unnecessary production of waste soils and peat".

66. The key items of infrastructure which influence this effect are the dimensions, location and type of new access tracks, turbine base foundations and crane hardstanding. Other features which should be considered for excavation requirements include the substation and temporary construction compound facilities.

67. The layout design process has sought to avoid areas where deep peat is recorded. This has been achieved due to 92.5% of probes recorded less than 0.5 m of peat, meaning that the Site layout design achieves a very low impact on peat. Furthermore, the design has utilised existing track which will significantly reduce the loss of soils that new tracks would cause. Further information on peat excavation is also included in Appendix A9.2: Outline Peat Management Plan which details the volumes estimated for excavated materials and re-use possibilities.

68. Given the limited amount of peat on the Site, and considering the design of the Site layout avoids any deep peat, it is considered that limited disturbance to peat will take place during construction and therefore, the Development will not have any significant environmental effects in relation to peat.

69. The significance of effects associated with the loss of soils is considered to be minor and **not significant**, in terms of the EIA regulations.

9.5.1.4 Compaction of Peat and Soils

70. In relation to compaction of soils, investigations at the Site have recorded pockets of deep peat in localised areas. The design process has sought to avoid the disturbance of deep peat where possible and peat depths are generally thin across the majority of the proposed Development area. Nonetheless, the construction of turbine hardstands, access tracks and movement of construction traffic, in the absence of construction good practice, could lead to the compaction of soil. This can reduce soil permeability, potentially leading to increased run-off and increased erosion.

71. The superficial soils underlying the Development are of a varying permeability, so the effects of compaction could result in a significant increase in a runoff from existing conditions. However, the total surface area affected by the footprint of the proposed layout equates to approximately 328,770 m^2, just over 3.0% of the total Site area and has a total of 4.3 km of existing tracks being utilised as part of the total 9.4 km of tracks. The Site contains sloping topography and as peat probing has proven, relatively thin soils onto rockhead or gravel (weathered rockhead). In addition the turbines are mainly situated in areas of commercial forestry.

72. Therefore, in the absence of mitigation, the significance of effects associated with the compaction of peat and soils is considered to be Negligible and **not significant**, in terms of the EIA Regulations.

9.5.1.5 Effects on Geology

73. The total excavation area at the proposed borrow pit locations is approximately 4.7 ha while the total site boundary equates to approximately 1,080 ha. Limited peat is anticipated and soils cover is expected to be thin as documented on published mapping and probing proved this across large areas of the site, and hence bedrock is near surface. Both borrow pits lie in areas of historical quarrying and so a degree of disturbance already exists at the selected locations. It should be noted however that there are environmental advantages of winning materials on Site and, each borrow pit should be suitably re-instated with topsoil and suitable quantities of peat, peaty soils and turves to re-establish where possible geological, hydrological and ecological conditions and reduce any potential visual impacts.

74. On this basis, the overall impact on geological resources at the site is considered to be negligible and **not significant**. Details on borrow workings is included in Appendix A3.1 Borrow Pit Assessment.

9.5.2 Operational Phase

75. There would be minimal or no impacts upon peat and soils during the operational phase, and significant effects are not anticipated.

9.5.3 Decommissioning Phase

76. During decommissioning, the turbine foundation bases would be broken out to below ground level. All cables would be cut off below ground level, de-energised, and left in the ground. Access tracks would be left for use by the landowner. No stone would be removed from the Site. The decommissioning works are estimated to take eight to twelve months. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely.

77. Therefore, it is considered that decommissioning activities would be less intrusive with infrastructure in place for access meaning no or little requirement for further disturbance of peat, therefore **no significant** effects are anticipated.

9.6 CUMULATIVE EFFECT ASSESSMENT

78. A cumulative effect is considered to be an additional effect on peat and geology resources arising from the Development in addition to the combination of other developments likely to impact the peat and geological environment.

79. Peat was recorded to be 1.0 m or thinner at 92.5% of probing locations across the Site with one localised areas of deep peat, which has been avoided in the design of Development infrastructure. Any peat excavated during construction will be suitably re-used in reinstatement and restoration as detailed in Appendix A9.2: Outline Peat Management Plan.

80. Therefore, for the purposes of the assessment of potential cumulative effects Geology, soils and Peat is considered as a site-specific consideration and it is not considered that there will be cumulative effects.

9.7 MITIGATION AND RESIDUAL EFFECTS

9.7.1 Mitigation measures

81. Mitigation in relation to peat disturbance is initiated through embedded mitigation in design and adopting best practices during construction.

82. Mitigation proposed states that where infrastructure associated with turbines found to encroach on deep peat, this will be microsited (if possible) out with these areas in order to reduce the overall effect on peat disturbance, stability and loss of soils. Micrositing limits (of 50m) are discussed in **Chapter 3: Project Description**. Maintenance of existing drainage is critical to avoid compaction of soils, therefore, all existing drainage network channels would be maintained and, where necessary, channelled below the access track construction drainage ditches on the upslope of the track. Further details are provided in **Chapter 10: Hydrology and Hydrogeology**.

83. Intrusive site investigations will be undertaken across the infrastructure areas prior to construction, particularly at turbine locations, therefore further determining the extent and nature of any peat.

84. Slope stability monitoring will occur during pre-construction and construction phases of work, including for both peat stability and non-peat related stability. These would focus on locations highlighted as being of risk in Technical Appendix 9.1.

85. Best practice measures for managing excavated peat and peaty soils are detailed in Appendix A9.2.

9.7.2 Residual Effects

86. Following the incorporation of mitigation measures as detailed in Table 9.7, residual effect associated with peat disturbance, peat stability and peat and soil losses will all be negligible.

87. With the mitigation proposed, the magnitude of effects on peat disturbance can be reduced from minor to negligible, and are therefore remains **not significant** in terms of the EIA Regulations.

9.8 SUMMARY OF EFFECTS

88. Table 9.7 provides a summary of the effects detailed within this chapter.

Table 9.7 Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Construction				
Peat and Peaty Soils	Disturbance of peat and peaty soils – Affect carbon-rich and peaty soils; Disturbance to an area <20% of the Development Area, the presence of class 5 peatland areas (carbon rich and peaty soils) Affecting commercial forestry.	Minor	Adoption of best practice measures for dealing with peat excavations, storage and subsequent backfilling.	Negligible
Peat and Peaty Soils	Peat Stability - Small loss of soils or peatland, or where soils will be disturbed but the value not impacted.	Minor	Adoption of best practice measures for dealing with peat excavations, storage and subsequent backfilling. Additional ground investigations following forestry felling. Slope stability monitoring will occur during pre-construction and construction phases of work.	Negligible
Operation				
Peat and Peaty Soils	Minimal impact anticipated	Negligible	None	Negligible
Decommissioning				
Peat and Peaty Soils	Works would be less intrusive and not considered to have a significant impact.	Negligible	None	Negligible

9.9 STATEMENT OF SIGNIFICANCE

89. This chapter has assessed the likely significance of effects relating to the Development on Geology, Ground Conditions and Peat. Given that only effects of moderate significance or greater are considered significant in terms of the EIA Regulations, the potential effects on Geology, Soils and Peat are considered to be **not significant**.