11 GEOLOGY, SOILS & PEAT

11.1 Introduction

1. This Chapter of the Environmental Impact Assessment Report (EIA Report) provides an appraisal of the effect of Heathland Wind Farm (the Development) on Geology, Soils & Peat and provides a preliminary geological assessment on the existing ground conditions while considering peat instability, land contamination and underground mining risk. This assessment was undertaken by Arcus Consultancy Services Limited (Arcus), with mining risk assessment undertaken by Tony Gee Consulting Engineers.
2. 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 Development.
3. This Chapter of the EIA Report is supported by the following Technical Appendix documents provided in Volume 3 Technical Appendices:
   - Technical Appendix A11.1: Peat Slide Risk Assessment (PSRA);
   - Technical Appendix A11.2: Outline Peat Management Plan (OPMP); and
   - Technical Appendix A11.3: Coal Mining Risk Assessment (CMRA).
4. This Chapter is also supported by the following figures:
   - Figure 11.1: Superficial Soils;
   - Figure 11.2: Bedrock Geology;
   - Figure 11.3: National Soils of Scotland;
   - Figure 11.4: Extract from Carbon and Peatland 2016; and
   - Figure 11.5: Recorded Peat Depths; and
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.

11.2 Legislation, Policy and Guidance

6. Scottish Planning Policy (SPP)[1] was published in 2014 and is a non-statutory document which sets out the Scottish Government's policy on how nationally important land use planning matters should be addressed.
7. 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 (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO_2 to the atmosphere. Developments should aim to minimise this release.

[1] The Scottish Government (2014) Scottish Planning Policy [Online] Available at: http://www.gov.scot/Publications/2014/06/5823 (Accessed 17/09/20)

8. This chapter is guided by The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations (2017)[2] (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.

9. Additional guidance includes:

- Nature Scot (NS), formerly Scottish Natural Heritage (SNH), (2019), Good Practice During Wind Farm Construction[3];
- The Scottish Government (2017), Peat Landslide Hazard and Risk Assessments – Best Practice Guide for Proposed Electricity Generation Developments[4];
- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland. Guidance on Development on Peatland, online version only[5];
- The Scottish Government (2009), The Scottish Soil Framework[6];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[7];
- Planning Advice Note PAN 50 Controlling the Environmental Effects of Surface Mineral Workings[8]; and
- Environmental Protection Act 1990, Part IIA[9].

11.3 Assessment Methodology and Significance Criteria

11.3.1 Scoping Responses and Consultation

10. Consultation for this EIA Report topic was undertaken with the organisations displayed in Table 11.1.

[2] The Scottish Government (2017) The Electricity Works (Environmental Impact Assessment) (Scotland). Available at: https://www.legislation.gov.uk/ssi/2017/101/contents/made (Accessed 13/10/2020)
[3] SNH (2015b) Good practice during windfarm construction, 3rd Edition [Online] Available at: http://www.snh.gov.uk/docs/A1168678.pdf (Accessed 17/06/20)
[4] 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 17/06/20)
[5] Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland, on-line version only Available at: https://www.gov.scot/Resource/0051/00517174.pdf (Accessed 17/06/20)
[6] The Scottish Government (2009) The Scottish Soil Framework [Online] Available at: http://www.gov.scot/Publications/2009/05/20145602/0 (Accessed 17/06/20)
[7] The Construction Industry Research and Information Association (CIRIA) (2015) Environmental Good Practice on Site Guide (C741), CIRIA: London. (Accessed 17/06/20)
[8] Scottish Government (1996) Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings. Available at: https://www.gov.scot/publications/planning-advice-note-pan-50-controlling-environmental-effects-surface-mineral/ (Accessed 17/06/20)
[9] UK Government (1990) Environmental Protection Act, Part IIA. Available at: https://www.legislation.gov.uk/ukpga/1990/43/part/IIA (Accessed 13/10/2020)

Table 11.1 Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
Scottish Environmental Protection Agency (SEPA)	Scoping Response 17/12/2019	The submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat. Including a detailed map of peat depths and full Peat Management Plan	A full carbon calculator assessment is presented within **Chapter 17 – Climate Change and Carbon Balance** of the EIA Report. An outline Peat Management Plan is provided as Appendix A11.2:
		A detailed map of peat depths with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems.	A map is detailed in Figure 11.2.3 of Appendix A11.2: OPMP.
		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	This table can be found in Section 3 of Appendix A11.2: OPMP.
		To avoid delay and potential objection proposals must 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.	Proposals shall be in line with all relevant SEPA guidance, outlined in Section 3 of Appendix A11.2: OPMP.
		Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation.	An outline Peat Management Plan is provided as Appendix A11.2: OPMP. Should it be considered necessary, a detailed peat management plan should be prepared post-consent and implemented by planning condition.
		Please note we do not validate carbon balance assessments except where requested to by Scottish Government in exceptional circumstances. Our advice on the minimisation of peat disturbance and peatland	The carbon balance assessment can be found in **Chapter 17 – Climate Change and Carbon Balance** of this EIA Report. Advice on the

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		restoration may need to be taken into account when you consider such assessments.	minimisation of peat disturbance and peatland restoration has been taken into account.
Scottish Environmental Protection Agency (SEPA)	Scoping Response 17/12/2019	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.	Details of proposed borrow pits are included in Appendix A4.1: Borrow Pit Assessment (BPA) (**Chapter 3 – The Development**).
		A Site Management Plan should be submitted in support of any application with relevant information submitted for each borrow pit in accordance with Paragraphs 52 to 57 of Planning Advice Note 50 Controlling the Environmental Effects of Surface Mineral Workings (PAN 50)	Details of proposed management of drainage measures are included in Appendix A10.1: Outline Water Construction Environmental Management Plan (**Chapter 10 – Hydrology and Hydrogeology**) and Appendix A4.1: BPA (**Chapter 3 – The Development**).
The Coal Authority	Scoping Response 10/01/2020	Confirm that the site falls within a Development High Risk Area. Records show the ground has been subject to both recorded and historic unrecorded underground coal mining at shallow depth. There are approx. 50 mine entries (shafts and adits), the site is within the boundary of a site from which coal has been removed by surface mining (opencast) methods, the Coal Authority has in the past been called upon to deal with 6 surface hazard issues at or close to the site. The Coal Authority is content for a CMRA to be undertaken through a planning condition should the Development be consented.	A preliminary CMRA accompanies this chapter as Technical Appendix 11.3. A full CMRA will be undertaken which responds the findings of intrusive site investigations to establish ground conditions and required mitigation should the Development be consented. This will be secured via a planning condition and not submitted as part of the EIA Report.
		The Coal Authority advise against building in proximity to or on mine entries, they note this has been avoided through design.	The site layout has been designed to avoid the recorded mine entries as much

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
			as practical provided by the Coal Authority.
		Expect the proposed development is submitted with relevant coal mining information to support any formal planning application.	Technical Appendix 11.3 CMRA will include the site layout overlying the risk assessment information.
Scottish Natural Heritage (SNH)	Scoping Response 31/01/2020	The peat depth assessment should inform the layout to ensure areas of deep peat are avoided.	The Site layout design has avoided deep peat where possible. Peat Depths are illustrated on Figure 11.5.
Royal Society for the Protection of Birds (RSPB)	Scoping Response 31/01/2020	Agreed with methods of assessment for peat/geology, have no further information to provide in terms of details of local quarrying.	Details of borrow pits/quarrying are included in **Chapter 3 – The Development** and Appendix A3.1: BPA
West Lothian Council	Letter Response 11/08/2020	**Question:** Does West Lothian Council hold any mine abandonment plans or any other information which may provide more details of the extent on the opencast mining activities at the Site? Particularly in regards to the depth of the opencast mining. **Answer:** Details of planning applications pertaining to the site and in the vicinity of the site are freely available on the council's website. No other information held.	A review of the West Lothian Council website did not uncover any further information regarding the former opencast mining at the Site.
South Lanarkshire Council	Email Response 14/07/2020	Thank you for your email, I will forward to our admin section. They will record your enquiry and it will be allocated to an officer. The officer will contact you in due course.	N/A
	Email Response 16/07/2020	I will check our GIS and get back to you.	Replied to this email on 21/08/2020 enquiring whether the: *'GIS search in the area of the Heathland Wind Farm Development uncovered any information regarding historical opencast mining activities at the site as discussed in our previous correspondence?'* No response was received to this email.

11.3.2 Scope of Assessment

11. The key issues for the assessment of potential Geology, Soils and Peat effects relating to the Development.

    - Temporary effects arising from the construction phase such as ground instability and exposure to contaminated soils;
    - Permanent effects; and
    - Indirect effects, including creation of pollutant linkages as a result of construction works.

11.3.3 Elements Scoped Out of Assessment

12. No topics have been scoped out of this assessment.

11.3.4 Study Area / Survey Area

13. The study area includes the area within the redline boundary. This is considered to be the area in which activities at the Site could have a potential influence while the Development considers the footprint of proposed infrastructure.

14. The grid connection is to be an overhead line connection from the proposed substation on site, and then toward the south-west to an agreed grid connection point in Wishaw, North Lanarkshire.

11.3.5 Design Parameters

15. Peat depths greater than 1 metre (m) and the presence of underground mineworkings, mine entries and extent of opencast mining was considered during the site layout design process. This is discussed further throughout this Chapter.

11.3.6 Baseline Survey Methodology

16. A desk study and site reconnaissance (July 2020), were undertaken for the Development which included an overall appraisal of geology and ground conditions, contaminated land assessment and mining assessment (by Tony Gee), informing the overall assessment and conclusions for this Chapter. The desk study identified potential or actual constraints and sensitive receptors, areas requiring further consideration and informed any additional areas for the peat probe surveys and contributed to the overall site layout evolution.

11.3.7 Methodology for the Assessment of Effects

17. The significance of the potential effects of the Development has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect. The information has been reviewed in the context of the Development to evaluate both short and long-term impacts.

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

    - National Soil Map of Scotland;
    - Carbon and Peatland 2016 Map;
    - British Geological Survey (BGS) Geoindex – Superficial Soils;
    - Coal Authority Records; and
    - BGS Geoindex – Solid Geology.

19. 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.

20. Given the historical mining activities at the site and the potential for waste arisings, the presence of made ground and other contamination sources needed to be considered.

21. In relation to mining and risk posed, the assessment considers the risk to the proposed Development from historical shallow mineworkings, mine entries and areas of previous opencast mining. The findings of this assessment are considered in terms of EIA and the significance of effects on the development as a receptor.

11.3.7.1 PSRA

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

23. Initial Phase One peat probing was carried out as part of the 2016 consented Heathland Wind Farm application (EC00003124) (the Consented Wind Farm). This was supplemented by Phase One probing undertaken in the most northerly extent of the study area in May 2020, covering the Woodmuir Plantation area. This area was not included within the application for the Consented Wind Farm. The information gathered was used to inform the Phase 2 probing, the outline civil design and the supporting PSRA.

24. Through the iterative design process and consideration of key environmental constraints including deep peat, the site layout reached 'Design Freeze'. Following the design freeze, targeted peat probing was carried out where infrastructure is proposed. This probing was kept to 50 m intervals along the centre line of the proposed location of the tracks with probes at 25 m on either side of the tracks to provide a corridor for micro-siting. In addition, probing at turbine locations was recorded at 10 m intervals where possible, particularly in areas previously recording peat.

25. It should be noted that the PSRA was undertaken on the findings of all phases of probing with focus upon the Phase Two peat probe data, as this was within the proposed infrastructure envelope. Details of the assessment are included in Appendix A11.1: PSRA.

11.3.7.2 Sensitivity of Receptors

26. The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site or the sensitivity of potentially affected receptors, will be assessed in line with best practice guidance, legislation, statutory designations and / or professional judgement.

27. The sensitivity of the receiving environment is defined as its ability to absorb an effect without perceptible change and can be classified as very high, high, medium, low or negligible. 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, purpose and existing influences, such as land-use.

28. Table 11.2 provides an overview of the different categories of sensitivity that are used within this chapter to inform the assessment of effects on existing geology and peat and to identify whether the effects would be significant under EIA Regulations.

Table 11.2 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

Sensitivity of Receptor	Definition
	• 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 • 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) • 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.

11.3.7.3 Magnitude of Change

29. 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 a change and professional judgement, best practice guidance and legislation.

30. The criteria for assessing the magnitude of change are presented in Table 11.3.

Table 11.3 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.

Magnitude of Effects	Definition
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.

11.3.7.4 Significance of Effect

31. 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 11.4 summarises guideline criteria for assessing the significance of effects.

Table 11.4 Framework for Assessment of the Significance of Effects

Magnitude of Effect	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

32. 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.

11.3.7.5 Contaminated Land Assessment

33. A contaminated land assessment has been undertaken in accordance with BS 10175 'Investigation of Potentially Contaminated Sites' and the desk-based researches and site walkover have supported the development of a preliminary Conceptual Site Model.

34. The contamination risk at the site is discussed in further detail in sections 11.4.8 and 11.5.1.5 of this chapter and the assessment considers the impact on the potential receptors at the site including:

- Site users (end-user and personnel);
- Water Environment;
- Ecological Environment; and
- Construction Materials.

35. The risk assessment has been carried out adopting the Source-Pathway-Receptor assessment principle in line with guidance provided in CIRIA Report C552, "Contaminated Land Risk Assessment – a guide to good practice"[10] as shown in Tables 11.5 and 11.6. Risk classification of Moderate or higher are considered to be significant in terms of EIA.

Table 11.5: Risk Classification Matrix

Likelihood					
	High Likelihood	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low

[10] Construction Industry Research and Information Association (CIRIA) (2001) Contaminated land risk assessment. A guide to good practice (C552). CIRIA: London (Accessed 13/10/2020)

	Low Likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low
		Severe	**Medium**	**Mild**	**Minor**
		Consequence			

Table 11.6: Risk Classification Definition

Risk Classification	Definition
Very High	Avoid project development at these locations.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Moderate/Low	
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

11.3.8 Assessment Limitations

36. Following the design freeze, the second phase of probing targeted the areas where infrastructure is proposed to assist with the stability assessment and ascertain additional peat depths.

37. All proposed turbine locations and tracks were probed despite dense vegetation and trees at the Site, particularly in northern and western areas. A vast area of fallen trees was encountered to the south-west of T2 in the western sector of the Site which inhibited access and prevented the possibility to gain probing data at the furthest most extent of the proposed hardstanding area. Probes were, however, obtained from within 50 m to the north, south and west of this inaccessible area and no peat at a depth greater than 0.5 m was recorded, this is reflective of the wider peat probing results in this area of the Site.

11.3.9 Embedded Mitigation

38. Embedded mitigation measures are set out within Appendix A10.1: Outline Water Construction Environmental Management Plan (**Chapter 10 – Hydrology and Hydrogeology**) which sets out specific mitigation which relates to this Development. They comprise good practice methods and works that are established and effective

measures to which the Heathland Wind Farm Partnership LLP (the Applicant) will be committed through deemed planning permission conditions.

39. Mitigation also takes place through embedded design of the site layout avoiding key environmental constraints including avoidance of deep peat or limiting the impacts on deep peat where possible, as well as taking cognisance of hydrological and ecological features and associated buffers. Examples of embedded mitigation include the repositioning of T4 to take it out with the 50 m watercourse buffer and the repositioning of T9 to move it to an area of shallower peat.

11.3.10 Micrositing

40. In relation to Geology, Soils and Peat the assessment conclusions allow for micrositing of up to 100 m, with the following caveats:

- T3 should not be microsited into peat greater than that which it is currently located;
- T13 should not be microsited to the west in to deeper peat; and
- T14 should not be microsited west in to deeper peat; and
- T12 should limit micrositing towards the west and south west in order to avoid on impact on the quarry operated by Forestry Land Scotland (FLS).

11.4 Baseline Conditions

11.4.1 Study Area

41. The majority of the Site is located within the local authority of South Lanarkshire Council (SLC) however, the northern part of the Site is located within the administrative boundary of West Lothian Council (WLC). The Site is located approximately 1.5 km north-east of Forth, South Lanarkshire, as shown on **Figure 1.1**. The Site lies adjacent to the A206 on the west side of the Site.

11.4.2 Topography

42. The topography of the Site and the immediate vicinity is generally gently sloping with relatively low lying, but exposed hills. The elevation ranges from approximately 290 m Above Ordnance Datum (AOD) in the south-west part of the Site to approximately 362 m AOD at the north-east part of the Site. The site encompasses several low-lying hills, for example Worm Law (343 m AOD).

11.4.3 Superficial Soils

43. Published geological mapping of superficial soils indicates the majority of the Site to be underlain by Peat or Glacial Till. Peat is recorded to be sedimentary deposits of lacustrine and palustrine in origin, formed up to three million years ago. The peat is present as large pockets spread across the entire site area, while within the central and northern regions locally superficial soils were not mapped, typical of shallow rock. Figure 11.2 illustrates the Superficial Soils Map.

11.4.4 Bedrock Geology

44. Published bedrock geology mapping indicates the Site to be underlain by various rock types. The majority of the site is comprised of Limestone (Coal Formation) comprising sedimentary rock cycles of Clackmannan group. Within the north, the bedrock was noted as Lower Limestone Formation with sedimentary rock cycles of Clackmannan group type. A localised pocket of Midland Valley Carboniferous to Early Permian Alkaline Basic Sill Suite was recorded in the south of the site. Narrow seams/bands of Hosie Limestone were also present throughout the site. **Figure 11.2** illustrates the Bedrock Geology Map.

11.4.5 National Soils of Scotland

45. The following is a summary of the information on soil units within Scotland's Soils, Scotland's Environment Website[11].

46. National Soils Map of Scotland mapping indicates the majority of the Site, with the exception of the most southern Site area, can be characterised by the soils group 'peaty gleys' which have associated component soils consistent with blanket peat. Peaty gleys are normally found in undulating foothills with gentle and strong slopes. The extreme southern Site area can be classified as 'Mineral Gleys' which have component soils characterised as noncalcareous gleys which can be found in undulating lowlands with gentle and strong slopes. **Figure 11.3** 'National Soils Map of Scotland' illustrates the soils underlain within the Site boundary.

47. 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: Gleys are 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.

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

48. The Carbon and Peatland Map[12] indicates the Carbon-rich soils and peatland importance to be predominantly Category 5, described as 'peat soil', with pockets of Category 4, described as 'mineral soil with some peat soil' in the southern Site area, which is consistent with the soils mapping. There is a localised area of blanket peat to the extreme east of the Site, extending past the boundary. **Figure 11.4** 'Carbon and Peatland mapping (2016, SNH)' provides the Carbon and Peatland 2016 Map extract with the Site boundary and infrastructure overlain.

49. A summary of the peat survey is detailed in Appendix A11.2: OPMP. The Appendix provides site-specific peat depth information which informed the design of the layout for the Development and the subsequent assessment of effects.

11.4.7 Coal Mining

50. In the wider area, there is a long industrial heritage predominantly associated with coal, limestone and ironstone mining. To the west of the Site around Leven Seat are old quarries and kilns associated with limestone mining. This includes the identification of collieries, opencasts, bings and mineral infrastructure. A number of reservoirs and settling ponds have also been recorded within close proximity to the Site boundary. The more recent maps (circa 1965) indicate the decline of coal mining within the region, and it is of note that previously worked areas, surface mines and reservoirs have been back-filled, in some cases as refuse pits. It is suspected that these pits contain colliery waste as well as domestic refuse.

51. The application for the Consented Wind Farm included a detailed coal mining desk study which indicated several mine entries spread across the western site area. In addition,

[11] Scotland's Environment (2020) Scotland's Soils. Available at: http://soils.environment.gov.scot/ (Accessed 18/06/20)
[12] Scotland's Environment (2020) Scotland's Soils, Carbon and Peatland 2016 Map. Available at: https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/ (Accessed 13/10/2020)

areas of historical shallow mineworking and probably shallow mine workings were also present in the western and northern site areas. An area of past opencast coal mining was also recorded in the western site area.

52. A review of the Coal Authority Interactive Map Viewer[13] confirms that the Site is extensively underlain by historical mine workings, both from opencast extraction and from underground extraction. A number of surface features have also been identified including shafts, adits and remnants of opencast workings. Opencast working is known to have taken place over large areas in the northern, central and south-western sectors of the site. These workings were, at least partially, unlicensed and the extent of the workings may therefore not be accurately represented on recorded mapping.

53. A Coal Mining Report (Ref: 51002235525001 provided as Appendix B to Appendix A11.3: CMRA) was obtained from the Coal Authority on 23rd January 2020 to gain more information regarding past mining activities at the Site.

54. The report confirmed that 46 mine shafts and seven adits are recorded within the Site. It should also be noted that there remains a possibility that further entries may exist on the Site which are not recorded.

55. The Coal Mining Report also records a number of worked coal seams at shallow depth beneath the Site which has the potential to pose constraints to the construction of the Development. The seams may be voided, partially collapsed or packed with unstable waste which could lead to instability at surface level if insufficient rockhead cover is present relative to the thickness of the seam.

56. Opencast mining is also recoded within a number of areas of the Site and would be considered to pose a potentially high risk to the Development. The Councils were contacted to ascertain whether they had any information regarding the nature of the opencast mining, in particular relating to the depths of the workings, however they did not hold any information further to what is already publicly available.

57. Coal Authority Catalogue No. S762 Sheets 1 and 2, SEAM PLAN (included in Appendix B of Appendix A11.3: CMRA) records the presence of opencast mining in the northern sector of the Site. The plans dated November 1980 indicate that in the deepest areas, opencast mining was undertaken in excess of 30m below ground level. It remains unknown what material was used to backfill the opencast mines.

11.4.8 Land Contamination

58. There is potential for contaminated land to be present at the Site associated with former mining activities and infilling of land. A mineral railway used to transport mined materials from the Site formally cut across the south-western corner of the Site during the first half of the twentieth century and could have resulted in contaminants being present in the adjacent soils.

59. The widespread presence of opencast mining at the Site as well as records of 46 mine shafts and seven adits could have resulted in significant areas of infilled land. The nature of the material used during backfill is currently unknown and is therefore considered to be a potential source of contamination.

60. A rifle range was recorded in the western sector of the Site between 1898 and 1956 and could have resulted in the presence of heavy metal compounds within the surrounding soils.

[13] The Coal Authority (2020) Coal Authority Interactive Map Viewer. Available at: https://mapapps2.bgs.ac.uk/coalauthority/home.html (Accessed 17/07/2020)

11.4.9 Peat

61. Significant peat deposits were recorded as part of the Consented Wind Farm application assessment material as large pockets, noted in the north western area (2 m – 4 m depth), southern area (4 m – 6 m depth) and eastern area (>6 m depth).

62. 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, highly amorphous and has a very high water content, generally lying below the ground water table and has a very low tensile strength.

63. Interpolation of these principal types of peat are discussed further in Appendix A11.2: OPMP.

11.4.10 Field Surveys

64. The desk-based assessment recorded the potential presence of peat and peaty soils in line with SNH data described above. The results of the peat probing indicated that the peat was generally across the Site, varying only with depth according to local topographical conditions, with pockets of deep peat situated in topographically flat areas.

65. During the course of the 2020 works and the historical peat probing for the 2016 application, a total of 2,704 probes were sunk within the study area. The peat probe locations and peat depths are shown in Figure 11.5 and further details on the peat probing works are included in Appendix A11.2: OPMP.

66. **Table 11.7** summarises the peat depth findings.

Table 11.7: Peat Depth Summary

Peat Depth Range (m)	Number of peat probes	Percentage of Total (%)
0.00 - 0.50 m	1380	51.0
0.51m - 1.00 m	511	18.9
1.01m - 1.50 m	256	9.5
1.51m - 2.00 m	159	5.9
2.01m - 2.50 m	117	4.3
2.51m - 3.00 m	78	2.9
3.01m – 3.50 m	56	2.1
3.51m – 4.00 m	55	2.0
4.01m – 4.50 m	28	1.0
4.51m – 5.00 m	22	<1.0
5.01m – 5.50 m	17	<1.0

Peat Depth Range (m)	Number of peat probes	Percentage of Total (%)
5.51m – 6.00 m	7	<1.0
6.01m – 6.50 m	5	<1.0
6.51m – 7.00 m	5	<1.0
7.01m – 7.50 m	2	<1.0
7.51m – 8.00 m	6	<1.0

67. Recorded peat depths averaged 0.97 m, with 51% less than 0.5 m and 69.9% less than 1.0 m. Peat greater than 1.0 m was localised, generally found in topographically low lying, flat areas in the western sector of the Site and at the very eastern boundary where the deepest peat was encountered.

68. A more detailed assessment of the peat is undertaken in the PSRA, provided as Appendix A11.1: PSRA**.**

11.4.11 Peat Stability and Peat Management

69. Due to the presence of peat within the Site, a PSRA and OPMP are included in Appendices A11.1 and A11.2 respectively.

70. The PSRA utilises the peat depths and existing slope information to identify hazard areas in relation to peat slide risk. Due to extensive forestry operations at the Site, peat depths are generally low, there are a number of localised pockets of deeper peat, however these tend to be in topographically flatter areas and therefore reduces the slide risk. Further details are provided in Appendix A11.1: PSRA.

71. The OPMP utilises peat depth data to calculate estimated volumes based on 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 A11.2: OPMP.

11.5 Assessment of Potential Effects

72. 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 and decommissioning are considered to be short term effects, with those occurring as a result of the operational development being considered as long-term effects.

11.5.1 Construction Phase

11.5.1.1 Peat Disturbance

73. Construction activities including excavation of track alignments, turbine foundations and crane hardstanding can lead to disturbance of peat. Beyond the main construction activities, other considerations included the formation of borrow pits and temporary storage of soils and peat on Site. These elements are discussed further in Appendix A11.2: OPMP.

74. The turbines and associated infrastructure affecting deep peat are restricted to T3. This turbine is surrounded by deep peat and has been located in a position which will cause the least disturbance possible. An existing track runs through the area of the proposed turbine meaning that peat in the area has already been subject to disturbance and by placing the turbine in this location that will keep further disturbance to a minimum and

limit the requirement to construct a new section of track which would in turn cause even more disturbance.

75. The assessment of peat disturbance has highlighted localised areas of peat at risk from the Development, in particular in the area of T3 which, based on the Carbon & Peatland 2016 Map[14] is located in a Class 5 peatland area.

76. Within a Class 5 area soil information takes precedence over vegetation data with no peatland habitat recorded. These areas could include areas of bare soil which are carbon-rich and likely to be deep peat. Class 5 peatland is defined as a medium sensitivity receptor in Table 11.2. It is considered that the magnitude of change, outlined in Table 11.3 is low across the Site with the exception of the area around T3 where the magnitude of change is medium.

77. It should be noted that this is the only area which significantly affects deep peat and the general vicinity has been subject to commercial forestry planting or felling and the T3 infrastructure is also located in the vicinity of an existing forestry track.

78. On this basis, in the absence of mitigation, the Development is considered to result in a potential effect of **Minor** significance on peatland across the Site and is **not significant** in terms of the EIA Regulations. In one area of the Site around T3 there is the potential for an effect of **Moderate** significance which is **significant** in terms of the EIA regulations.

79. Mitigation measures are outlined in Section 11.8 and summarised in Section 11.10 of this Chapter.

11.5.1.2 Peat Stability

80. 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.

81. Construction activities that have the potential to increase the likelihood of peat slides include locating proposed infrastructure, including track networks, on sloping ground which often involves the removal of surface vegetation and excavation of peat and other soils.

82. Peat slides can affect soils and local sensitive habitats while having the potential to affect surface water systems from soil inundation, leading to sedimentation. This can reduce water quality and/or modify drainage patterns. Receptors identified across the Development area are:

- Existing forestry tracks and paths;
- Existing minor watercourses;
- Existing Major Watercourses;
- GWDTES and sensitive peatlands; and
- Proposed Wind Farm Infrastructure.

83. Peat depths are typically shallow, averaging less than 1m across the wider Site area, and localised potential peat stability issues are generally on topographically flatter areas. Within the Development footprint, no areas were highlighted as having a high hazard rank in terms of slide risk.

84. On this basis, in the absence of mitigation, the Development is considered to result in a potential effect of **minor** significance, and **not significant** in accordance with the EIA regulations.

[14] Carbon & Peatland 2016 Map, Scotland's Soils. Available at: https://map.environment.gov.scot/Soil_maps/?layer=10 [Accessed 24/09/2020]

85. Good practice measures are embedded in the design principles and adoption of further best practices, as detailed in Appendix A10.1: Outline Water Construction Environmental Management Plan (**Chapter 10 – Hydrology and Hydrogeology**). The good practices measures will significantly reduce the effect of peat instability. Steep slopes and deep peat have generally been avoided and there would be further avoidance of the loading materials on or at top of slopes, and the removal of slope support during construction.

11.5.1.3 Loss and Compaction of Peat and Soils

86. 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".

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

88. While the layout design process has sought to avoid most areas where deep peat is recorded, one turbine and associated crane hardstandings are located in deep peat, following the design exercise. Appendix A11.1: OPMP details the volumes estimated for excavated materials and re-use possibilities.

89. Given the majority of soils being affected by the Site are thin deposits, generally classified as either peaty or mineral soils, and that soils would be reinstated fully within the areas of origination, the significance of effects associated with the loss of soils is considered to be minor and **not significant**, in accordance with the EIA Regulations.

90. In relation to compaction of soils, investigations at the Site have recorded generally thin soil cover, and construction of access tracks and movement of construction traffic, in the absence of construction good practice, could lead to the compaction of soils. This can reduce soil permeability, potentially leading to increased run-off and increased erosion. 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. The total surface area affected by the footprint of the proposed layout equates to approximately 268,200 m^2, just over 3% of the total Study Area.

91. Therefore, in the absence of mitigation, the significance of effects associated with the compaction of soils is considered to be minor and **not significant**, in accordance with the EIA Regulations.

11.5.1.4 Impact on Geology – Borrow Pit Excavations

92. Two potential borrow pit locations have been identified within the Site. There is evidence on site of existing quarry activities undertaken locally in the central site areas, understood to be utilised by FLS as part of their asset management. Furthermore, the wider area outwith the Site has been utilised for quarrying for many years.

93. The total surface area of excavation at the proposed borrow pit locations is approximately 71,500 m^2 and at conservative estimation 74,000 m^3 of aggregate may be required to construct the hardstandings and tracks to a suitable standard. This is considered to be a small effect on a geological site or mineral deposit, such that the value of the site would not be affected or that there would be a loss of a regional geological resource.

94. On this basis, in the absence of mitigation, the Development is considered to result in a potential effect of **minor** magnitude and considered **not significant**, in accordance with the **EIA Regulations**.

11.5.1.5 Contaminated Land Risk Assessment

95. A Contaminated Land Risk Assessment for the Site is presented in Table 11.8. This details the potential connectivity between potential sources, pathways and receptors. A pathway must be present for the source to provide any risk to any given receptor. The magnitude of any such risk is assessed by considering the vulnerability of the receptor and the possible impact of the source.

Table 11.8 – Contaminated Land Risk assessment and Potential Mitigation

Potential Receptor	Potential Source	Potential Pathway	Consequence of Risk	Likelihood of Risk	Level of Risk (without Mitigation)	Potential Mitigation
Site Personnel	Made Ground or contaminated soil associated with historical mining and rifle range. Groundwater contamination associated with historical mining activities.	Direct dermal contact/ingestion/ inhalation of soil/water/dust and vapours.	Medium	Low Likelihood	Moderate/Low	Ground investigation should be undertaken at the Site to allow for a suite of chemical testing to determine ground conditions and the presence of any contamination. Site personnel should wear appropriate PPE during all works. this may include hand protection along with the provision of adequate welfare facilities and dust control measures, as required.
	Asbestos contamination of soils in Made Ground in Made Ground deposits.	Inhalation of soil dust/particles.	Severe	Low Likelihood	Moderate/Low	Ground investigation including asbestos screen and quantification as appropriate on Made Ground deposits. Where identified, ACM should be mitigated through the development of a detailed enabling works strategy following guidance and protocol specified within the Control of Asbestos Regulations (2012) and industry best practice as detailed in CIRIA733 (Asbestos in Soil and Made Ground: A guide to understanding risk). Site personnel should wear appropriate PPE during all works including asbestos specific PPE, if deemed necessary.
	Infilled ground associated with former opencast mining.	Exposure to ground generating gases such as carbon dioxide, hydrogen sulphide, methane or depleted oxygen.	Medium	Low Likelihood	Moderate/Low	Ground investigation should be undertaken to determine ground conditions on the Site and to allow for the installation of gas monitoring wells to enable a period of ground gas monitoring in accordance with CIRIA 665 to classify the ground gas risk at the Site.
Water Environment	Contamination in groundwater from contaminated soils.	Vertical or lateral migration of contaminants to surface watercourses and underlying aquifers.	Medium	Unlikely/Low Likelihood	Moderate/Low	Leachate analysis should be included within the chemical testing of Made Ground deposits to determine the leachability of any contaminants. A series of groundwater monitoring wells should be advanced to allow for groundwater sampling.
Construction Materials	Elevated contamination aggressive/corrosive to proposed construction materials.	Exposure to elevated pH and/or sulphates or other corrosive contaminants through soil infiltration to buried concrete.	Medium	Unlikely/Low Likelihood	Moderate/Low	Ground investigation should be undertaken at the Site to allow for a suite of chemical testing to determine ground conditions and chemical composition of the soils.

96. It is considered that there is low likelihood of construction personnel becoming exposed to soil or groundwater contamination during excavations or construction at the Site where concentrations of contaminants exceed generic assessment criteria, and risk of contamination is classified as **Moderate/Low**.

97. Construction personnel may potentially be exposed to asbestos should it be present within soils during excavation or groundworks. There is a potential for asbestos containing material to be present within materials used to backfill former opencast mining areas and therefore the risk of encountering asbestos without mitigation is classified as **Moderate**. It is considered that if appropriate mitigation strategies were implemented, including the use of PPE, the risks could be minimised. Specialist advice from an asbestos contractor should be sought.

98. Risk to Site end-users (maintenance personnel) being exposed to soil contamination is classified as **Low** given that only sporadic visits by maintenance personnel is anticipated and operational groundworks will be limited. Similarly, the risk to Site end-users from ground gas is considered **Low** given the lack of development on the Site other than the substation building which will only be occupied for short periods of time.

99. The upper horizon of soils, particularly Made Ground, are considered to have low levels of permeability; this means there it is unlikely for contamination caused by nearby contamination sources leaching to underlying groundwater (if present). The bedrock is classified as a moderately productive aquifer where nearly all flow of groundwater is in the near-surface weathered zone and secondary fractures. Groundwater units are overlain by till and peat superficial deposits for the majority of the Core Study Area which are largely impermeable and act as a barrier to vertical flow of water. Therefore, the risk posed to the water environment is considered **Low**.

100. The construction materials proposed for use in the Development have a low likelihood of coming into contact with aggressive ground conditions, such as elevated pH or sulphates, or contamination from infilled Made Ground. It is therefore considered that the risk posed to building materials on Site is classified as **Moderate/Low**.

101. On this basis, in the absence of mitigation, the **Moderate** risk identified in relation to encountering asbestos on site is considered to result in the potential for **significant** effect in accordance with the EIA Regulations. Other potential effects are assessed as of **Moderate/Low** and **Low** risk and as such considered **not-significant**. Mitigation to reduce all risk is presented in Section 11.8.

11.5.1.6 Coal Mining

102. The Coal Authority operates a risk-based approach to the assessment of potential instability issues associated with future development of land located within the predefined Coal Authority consultation areas. This risk-based approach subdivides the potential risk into "low" and "high" risk categories.

103. The risk categories can be defined as:

104. ***Low-Risk Sites*** – Deemed to be land where coal mining has taken place, however it was at such depth not to pose a risk to new development and it therefore contains no known recorded risks and as such no further assessment is required.

105. ***High-Risk Sites*** – Deemed to be landholdings located within an area known to contain legacy risks that include:

- Mine entries (shaft or adit);
- Shallow coal workings (recorded and probable);
- Workable coal seam outcrops;
- Mine gas sites and areas;
- Recorded coal-mining-related hazards;

- Geological features (fissures and break lines); and/or
- Former surface mining sites (sometimes using historic opencast extraction methods).

106. Coal mining records for the Site indicate the presence of a majority of the above listed legacy risks which would deem the Site to be at High-Risk from potential instability issues.

107. Areas identified at highest potential risk from historical mining activities are the northern, central and western sectors of the Site as displayed in 'Mining Summary Plan' Ref: S119051-TG-00-XX-SK-C-0001 in Technical Appendix A11.3.

108. Where possible, risk has been reduced by locating turbines and Site infrastructure in areas less affected by historic mining activities, however seven proposed turbines remain in areas at high risk of ground instability.

109. A CMRA for the Site has been undertaken by Tony Gee and is included within Technical Appendix A11.3. The assessment indicates that the Site is extensively underlain by historical mineworkings, both from opencast extraction and from underground extraction. A number of surface features have also been identified including shafts, adits and remnants of opencast workings. Opencast working is known to have taken place over large areas in the south-east and north-west of the site. These workings were (at least partially) unlicensed and the extent of the workings may therefore not be accurately represented on the drawing.

110. Turbines are at particular risk from mineworkings. If a worked shallow seam were to collapse, it is possible that ground movements could be propagated to the surface. If these movements were sufficiently large, then it may cause excessive settlements, loss of stiffness or loss of bearing capacity. This may result in catastrophic failure of the turbine. In the case of opencast mining, these mines may have been backfilled in an uncontrolled manner and may therefore result in poor ground conditions.

111. The findings of the CMRA conclude that the risk to the Development from mining is of significant risk. On this basis, in the absence of mitigation, the Development is considered to result in a potential effect of **Major** significance and therefore significant, in accordance with the EIA regulations.

11.5.2 Operational Phase

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

11.5.3 Decommissioning Phase

113. During decommissioning, the 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 months. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely.

114. Therefore, it is considered that decommissioning activities would be less intrusive and would not disturb peat, therefore no significant effects are anticipated.

11.6 Cumulative Effect Assessment

115. Geology and peat are considered as a site-specific consideration and it is not considered that there will be cumulative effects. Similarly potential significant effects from historical mining identified are specific to the Development with no implications for cumulative effects.

11.7 Grid Connection

116. While the grid connection route has not been finalised, this will be overhead or underground cable between the proposed substation and the agreed grid connection point in Wishaw.

117. The sensitive receptors which would require consideration in relation to the grid connection would vary dependent on the method of installation, with underground connection being the most onerous in relation to impact on Geology, Soils and Peat. In such circumstances the key sensitive receptors would be areas of sensitive peatland in the open moorlands between the two connections points, and the impact on any regionally important minerals. An overhead connection would present a much lesser impact on these receptors.

118. Mitigation in this regard could include but not be limited to:

- Desk-based assessment;
- Preliminary and detailed on-site survey work;
- Micrositing to avoid deep peat and other sensitive areas; and, if required
- Peat and soils management and associated reinstatement.

119. On this basis it is likely that the impact on Geology, Soils and Peat would not be considered as significant, however for the purposes of this assessment is not considered further.

11.8 Mitigation Measures

120. The peat disturbance mitigation measures are location-specific and relate to turbine locations and associated infrastructure being within areas of moderate risk. Probing data available indicates that the turbines have primarily been placed in areas where peat depths are less than 1 m with the exception of T3 which could not be micro-sited within 50 m of the original location to avoid deep peat.

121. In order to reduce the impact on peat, best practice drainage and peat management measures would be implemented across the site and in particular in areas where peat depths are greater than 1.0 m. Any peat excavated will be done so and managed in line with current best practices as outlined in Appendix A11.2 OPMP. Best practice drainage measures are set out in Appendix A10.1: Outline Water Construction Environmental Management Plan (**Chapter 10 – Hydrology and Hydrogeology**) potentially reducing significantly the impact on deep peat and peaty soils.

122. 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.

123. Best practice measures for managing excavated peat and peaty soils are detailed in Appendix A11.2: OPMP.

124. Additional site investigation will be undertaken following forest clearance at turbine locations located across the site infrastructure to determine more details on peat, geology, contamination and mining conditions.

125. A thorough ground investigation will be undertaken post consent to determine the presence of mining features at the Site including mine entries, shallow workings and surface mining. Following the ground investigation, a quantitative CMRA would be completed to assess the risk to the Development and to inform any necessary mitigation. A micrositing allowance of 100 m is being sought as part of the application to support this process. This allowance has been included within the EIA assessment process. This

is required to be secured by planning conditions in line with the assessment and the Coal Authority response at Scoping.

126. Should the 100 m micrositing not achieve a re-location of turbines into less risk in relation to the underlying mining conditions, then a series of further mitigation measures will be considered, informed by the ground investigations scheme. This could include one or more of the following circumstances and related mitigation (but not be limited to this):

- Turbine is located in an extensive areas of development risk from shallow underground mining – Mine Working Consolidation would be required directly beneath the area of the turbine and associated infrastructure by injection of a cement-based grout; and
- Turbine is located in an extensive area of former opencast mining – Turbine foundation would require to be an abnormal-solution, possibly piling (to be informed by results of intrusive ground investigations).

127. Mitigation measures in relation to contamination are required due to the potential for contaminants to exist within the soils, particularly the risk of asbestos in the soil which has been classified through the risk assessment as being 'moderate' risk. Table 11.8 in Section 11.5.1 sets out the risk assessment and proposed mitigation in this regard.

11.9 Residual Effects

128. Following the incorporation of mitigation measures as detailed in Table 11.9, there will only be one minor residual effect associated with peat disturbance while soil compaction, soil losses and operational and de-commissioning phases will all be negligible.

129. With the mitigation proposed, the magnitude of effects on peat disturbance can be reduced from moderate to minor, and are therefore **not significant** in accordance with the EIA Regulations.

130. In relation to effects identified through the CMRA, the Development would be designed and constructed in line with findings of the detailed ground investigations to be secured through planning condition. Through this process, the potential for significant effect on the Development infrastructure would be removed.

131. Following the incorporation of mitigation measures as detailed in Table 11.8, the risk would be reduced such that the residual effects associated with contaminated land will be **not significant** in accordance with the EIA Regulations.

11.10 Summary of Effects

132. This Chapter identified no likely residual significant effects, through inclusion of the measures as outlined in **Table 11.9**.

Table 11.9: 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	Minor	Adoption of best practice measures for dealing with peat excavations, storage and subsequent backfilling.	Minor

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
	presence of class 5 peatland areas (carbon rich and peaty soils) Affecting commercial forestry;			
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 where necessary.	Negligible
Peat and Peaty Soils	Soil Compaction - Impediments to Flow	Minor	Adoption of best practice measures for dealing with peat excavations, storage and subsequent backfilling.	Negligible
Peat and Peaty Soils	Loss of Soils - Acidification as a result of felling	Minor	Adoption of best practice measures for dealing with peat excavations, storage and subsequent backfilling.	Negligible
Contaminated Land	Exposure of contaminated materials to Site personnel as a result of historic land use at the Site	Moderate	Ground investigations being carried out post-consent should consider the potential for contaminated land. Site personnel should appropriate PPE.	Minor
Mining	Ground settlement and loss of bearing capacity may lead to collapse and failure of turbine	Major	Pre-construction intrusive ground investigation and associated mitigation to inform detailed design of foundations and present a viable development, respectively. Vigilance should be maintained throughout the	Minor

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
			construction period to identify any potential unrecorded mining features. Mining specialist should be appointed to provide technical support post-consent. Additional mitigation based on results of pre-construction ground investigations. Could include consolidation of abandoned mine workings, mine entries, and abnormal foundations such as piling for instances of backfilled opencast areas.	
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		Negligible

11.11 Statement of Significance

133. This chapter has assessed the likely significance of effects relating to the Development on Geology, Soils and Peat. Additionally the Chapter has considered the potential for effects of contaminated land on construction personnel and the potential for the impact of historical mining on the Development infrastructure.

134. All residual effects on Geology, Soils and Peat are considered not significant in terms of the EIA Regulations.

135. The CMRA has identified the potential for a significant effect from historic mining before mitigation. Following detailed site investigations to be undertaken post-consent the Site design would be reviewed to ensure no potential significant risk remained to the infrastructure. A micrositing allowance of 100 m, which has been assessed as part of this EIA, has been requested to support this process.

136. With the incorporation of mitigation measures as detailed in Table 11.8, the risk would be reduced such that the residual effects associated with contaminated land will be **not significant** in accordance with the EIA Regulations.