Creag Dhubh to Inveraray 275kV Connection

Environmental Impact Assessment

Volume 4 | Appendix 10.1

Peat Depth Results Report

June 2022

CONTENTS

List of Abbreviations

BGS	British Geological Survey
cm	Centimetre
'Deep Peat'	A carbon-rich soil with a surface peat layer greater than 0.5 m thickness (in the context of the 2016 SNH Carbon and Peatland Map) or a layer of peat greater than 1 m thickness (in the context of the Scotland Soil Classification). It should be noted that there is no agreed definition of 'deep peat'.
ECoW	Ecological Clerk of Works
EIA	Environmental Impact Assessment
GIS	Geographic Information System
Humification	The process of decomposition of organic material that occurs in peat
IDW	Inverse Distance Weighted
JNCC	Joint Nature Conservation Committee
km	Kilometre
m	Metre
NS	NatureScot
OHL	Overhead Line
'Peat'	Dead and partially decomposed plant remains that have accumulated under waterlogged conditions (Ramsar Convention, 1971). An organic soil which contains more than 60 percent of organic matter and exceeds 50 cm thickness (Macaulay Institute, 1984). It should be noted that there is no agreed definition of 'peat'.
Peatland	An ecosystem with a peat deposit that may currently support vegetation that is peat forming, may not, or may lack vegetation entirely (Ramsar Convention, 1971).
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SSEN	Scottish and Southern Electricity Networks

1 INTRODUCTION

1.1 The Proposals

1.1.1 This Appendix presents information relevant to the Creag Dhubh to Inveraray 275 kV Connection. It should be read in conjunction with **Volume 2** of the **EIA Report** for full details of the Proposed Development.

1.1.2 Scottish Hydro Electric Transmission plc (the Applicant) who, operating and known as Scottish and Southern Electricity Networks Transmission (SSEN Transmission), own, operate and develop the high voltage electricity transmission system in the north of Scotland and remote islands.

1.1.3 Due to the growth in renewable electricity generation in the north and north east of Scotland, upgrade of the transmission network is required in order to provide the necessary increase in transmission capacity.

1.1.4 The Applicant is proposing to apply for consent under Section 37 of the Electricity Act 1989 to construct and operate a 9 km double circuit 275 kV OHL, supported by steel lattice towers between a proposed substation at Creag Dhubh and the recently constructed Inveraray-Crossaig 275 kV capable OHL circuit, in Argyll, Scotland (the 'Proposed Development'). The Proposed Development is shown in **Figure 2.1: Proposed Development (EIAR Volume 3a).**

1.2 Requirement for the Report

1.2.1 Ramboll was commissioned by the Applicant to undertake peat depth and coring surveys to aid the design process and to inform an assessment of the nature and condition of the peatland for the Proposed Development.

1.2.2 This Technical Appendix has been produced in accordance with guidance published by Scottish Environmental Protection Agency (SEPA), NatureScot (NS)and the Scottish Government, which is referenced in the following sections.

1.2.3 This Technical Appendix is supported by the following:

- **Figure 10.1: Peat Depths (EIAR Volume 3a);**
- **Figure 10.2: Superficial Geology (EIAR Volume 3a);**
- **Figure 10.3: Bedrock Geology (EIAR Volume 3a);**
- **Figure 10.4: Soils Maps of Scotland (EIAR Volume 3a);**
- **Figure 11.1: Surface Water Features (EIAR Volume 3a);**
- **Annex 10.1.1: Peat Coring Data; and**
- **Annex 10.1.2: Core Sample Photographs.**

2 METHODOLOGY

2.1 Desk Study

2.1.1 A review of desk top information was undertaken to understand the likely geology and ground conditions at the Site. This included a review of the following:

- online British Geological Survey (BGS) solid and superficial geological mapping[1];
- online Scottish Natural Heritage carbon and peatland map[2];
- habitat survey information from **Chapter 8: Ecology (EIAR Volume 2)**; and
- hydrogeological and hydrological information from **Chapter 10: Water Environment (EIAR Volume 2)**.

2.2 Field Survey

2.2.1 Peat depth surveys were undertaken at the Site to understand the baseline peat conditions and potential constraints, and to inform the design of the Proposed Development to minimise, as far as practicable, the potential direct and indirect effect on peat and carbon rich soils. Two rounds of peat surveys were undertaken across the Proposed Development, based on the Proposed Development design. Surveys followed best practice guidance for development on peatland[3][4] published at the time of the surveys.

2.2.2 The first survey was undertaken during April 2022 and included microsited peat depth probing at each location tower location along the Proposed Development.

2.2.3 The second survey was undertaken in June 2022 and included:

- Towers: Peat probing was undertaken at 10 m intervals along cardinal points for a total of 50 m from the centre of each tower location; and
- Access tracks: at 50 m intervals along the track and at points every 10 m perpendicular to the centreline either side of the proposed access track.

2.2.4 Peat cores were taken using a Russian auger, with a sample volume of 0.5 l, and field tests and observations were undertaken to identify:

- Depth of acrotelm;
- Degree of humification (using Hodgson, 1974), to establish amorphous, intermediate, fibrous, and content; and
- Degree of humification using the Von Post, (Hobbs, 1986) classification.

2.2.5 Samples were subsequently submitted to a soils testing laboratory to analyse each sample for Bulk Density, Loss on Ignition (Organic Content), Moisture Content, and pH.

[1] British Geological Survey Online Viewer (2021) https://mapapps.bgs.ac.uk/geologyofbritain/home.html [Accessed June 2022]

[2] Scottish Natural Heritage. (2016).Carbon and Peatland 2016 map (http://map.environment.gov.scot/soil_maps/) [Accessed June 2022]

[3] Scottish Government, Scottish Natural Heritage, SEPA. (2017). *Peatland Survey. Guidance on Developments on Peatland, online version only*.

[4] Scottish Renewables and SEPA (2012). *Development on Peatlands. Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste*

Peat Probing

2.2.6 The Phase 1 and Phase 2 surveys were undertaken based on the layout of the Proposed Development at the time of the surveys. This used a combination of low density survey carried out on a grid across the Study Area (refer to **Figure 10.1: Peat Depths, EIAR Volume 3a** showing grid form), with additional points taken as necessary, and high-density probing on the confirmed layout of the Proposed Development, known at the time of the survey. This approach was undertaken as the layout of the Proposed Development was relatively mature at the time of the survey. The surveys included a 50 m micrositing zone where possible.

2.2.7 Probing was carried out using collapsible avalanche probes, allowing for probing greater than 6 m depth.

2.2.8 The survey points and field data were collected using a handheld Trimble GPS unit. Peat depth data was modelled using Inversive Distance Weighted (IDW) interpolation in GIS software, and a depth model generated using incremented peat depth categories.

2.2.9 Peat cores were taken using a Russian auger, with a sample volume of 0.5 l, and field tests and observations were undertaken. The probing results are included in **Annex 10.1.1**, and records taken include:

- depth of acrotelm;
- degree of humification (using Hodgson, 1974), to establish amorphous, intermediate, fibrous and content;
- degree of humification using the Von Post classification;
- fine fibre content, based on scale of F0 (none) to F3 (very high);
- coarse fibre content, based on scale of R0 (none) to R3 (very high);
- water content, based on scale of B1 (dry) to B5 (very wet); and
- substrate underlying the peat where this was possible.

2.2.10 A peat depth probe was taken adjacent to the core location, and cores were photographed (refer to **Annex 10.1.2**).

2.2.11 Samples of known volume were taken for laboratory analysis. During laboratory analysis, the samples were weighed, dried, and a subsample taken for loss on ignition testing. The total moisture content was determined from weight measurements. Peat pH was also determined.

2.3 Limitations and Assumptions

2.3.1 The design and layout of the Proposed Development was relatively advanced prior to commencement of the Phase 1 survey, therefore a more targeted approach was taken which allowed micrositing to avoid areas of deep peat.

2.3.2 However, there are some differences between the final design and the extent of the peat survey results based on design changes made through this process, as a result of micrositing etc. The safety of the surveyors was considered, particularly in areas of dense and recently felled plantation, areas of deep peat etc. and some proposed peat probe points may not have been recorded.

2.3.3 The peat survey probing points provide high resolution coverage of the Study Area, and these revealed the peatland to be typically shallow (less than 1.0 m) but with several pockets of deeper peat. It is considered that the peat depths collected, and interpolations derived from these data, are representative of the Site.

2.3.4 The Proposed Development has been located away from the deep peat locations where practicable. It has not been possible to site all the towers out of deep peat based on the other environmental and technical constraints.

3 RESULTS

3.1.1 Baseline data are required to inform an assessment of the effects the Proposed Development would have on peat and carbon rich soils. This report presents baseline data collected from a desk-based review and field survey results.

3.2 Desk Study

3.2.1 The 1:625,000 and 1:50,000 scale geological mapping available from the BGS[1] shows the majority of the northern and central regions of the Site to be underlain by the Tayvallich Volcanic Formation of the Argyll Group comprising Metalava and Metatuff. Originally igneous rocks formed by eruptions of magma, were later altered by low-grade metamorphism and formed approximately 541 to 1000 million years ago. To the south of the Site, the BGS mapping shows similar aged rocks of the Crinan Grit Formation, quartzite and pellite metamorphic bedrock also of the Argyll Group.

3.2.2 Dalradian Supergroup, Metagabbro and Metamicrogabbro metamorphic rock is also noted to be present where igneous intrusions have occurred. A fault zone is shown to be present to the south west of Tower T21 trending north east to south west. The 1:50,000 BGS solid geology mapping is shown on **Figure 10.3: Bedrock Geology, EIAR Volume 3a**.

3.2.3 The superficial geology of the Site predominantly comprises glacial deposits of Hummocky Till (diamicton), sands and gravels. Alluvial river terrace deposits are also shown to be present within river valley formations to the east of the Site. BGS mapping shows peat deposits are located outside of the Proposed Development. Areas of the Site, predominantly surrounding hill formations, are mapped as having no superficial deposits present which could indicate that rockhead is relatively shallow in these areas. The 1:50,000 BGS mapping is shown on **Figure 10.2: Superficial Geology, EIAR Volume 3a**.

3.2.4 The Scottish Natural Heritage carbon rich soils, deep peat and priority habitat mapping[2] shows limited areas of peat to the north and south of the Site, predominantly located in areas of forestry. The peat deposits are shown to be either 'Class 2'[5] or 'Class 5'[6] soils, the former being defined as 'Nationally important carbon-rich soils, deep peat and priority peatland habitat'. Class 5 soils are defined as 'dominant vegetation cover is not a priority peatland habitat'. An extract of the Scottish Natural Heritage carbon rich soils, deep peat and priority habitat mapping is shown on **Figure 10.4: Soils Maps of Scotland, EIAR Volume 3a.**

3.3 Field Survey

Peat Probing

3.3.1 During the peat depth probing surveys, a total of 2,183 peat depth probes were taken as shown in **Figure 10.1: Peat Depths (EIAR Volume 3a)**.

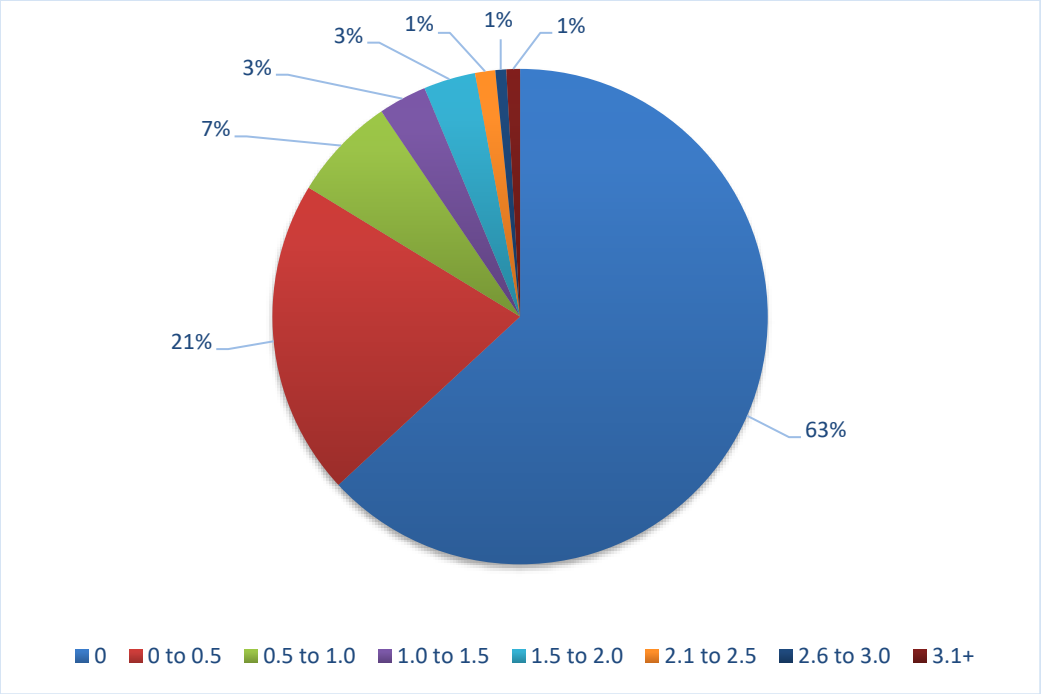
3.3.2 **Figure 10.1: Peat Depths (EIAR Volume 3a)** shows the results of the peat depth survey at the Site, as well as the specific depth class at each sample location and is based on IDW data interpolation and consequently the peat depth contours and boundaries are to a degree indicative.

[5] Class 2 soils are described as indicative of 'Peat soil with occasional peaty soil' with indicative vegetation defined as 'peatland or areas with high potential to be restored to peatland'. Class description is described as 'nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas of potentially high conservation value and restoration potential'.

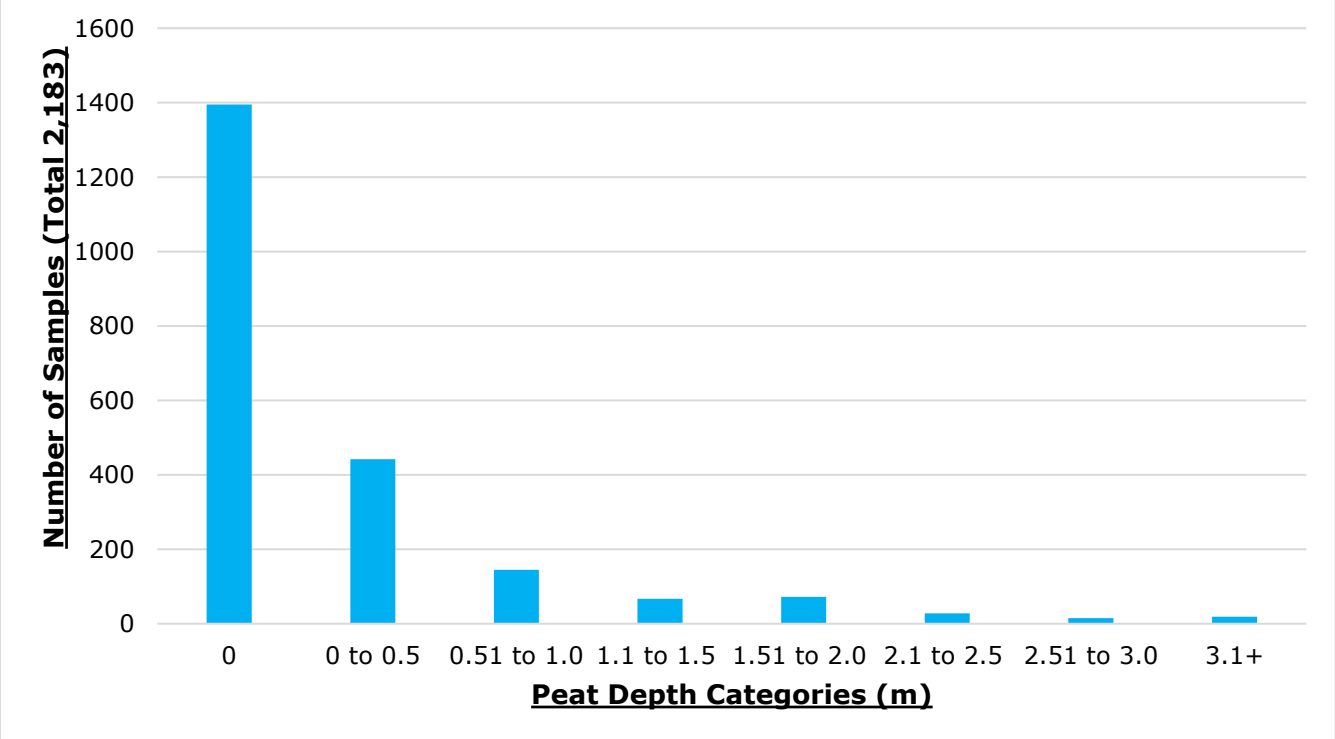
[6] Class 5 soils are described as indicative of 'Peat Soil' with no indicative vegetation. Class description is described as 'soil information takes precedence over vegetation data. No peatland habitat recorded. May also include areas of bare soil. Soils are carbon rich and deep peat'.

3.3.3 **Graph 3.1** and Error! Reference source not found. below present the percentage and frequency of peat probe results within the specific peat depth categories recorded during the peat depth probe surveys.

Graph 3.1: Percentage Peat Depth (m) Categories (All Surveys Combined)



Graph 3.2: Peat Depth Frequency Distribution



3.3.4 As shown on **Graph 3.1** and **Graph 3.2**, most of the Site has either no peat present or has a shallow depth of peat present (approximately 84% of peat probes were <0.5 m in depth). These areas of shallow peat can be considered as organo-mineral soils. These are further summarised as follows:

- 1,395 no. samples (64%) located on land with no peat/ absent;

- 442 no. samples (20%) located on land with less than or equal to 50 cm depth of peat or organomineral soil;
- 145 no. samples (7%) on land with between 51 cm and 100 cm depth of peat; and
- 201 no. samples (9%) located on land with more than 100 cm depth of peat.

3.3.5 The peat thickness along the Proposed Development was found to be mostly shallow (where present), with some deep pockets near to Towers T2 and T3 and between Towers T1, T2 and T3. The peat probe depth and interpolated contours are shown on **Figure 10.1: Peat Depths, EIAR Volume 3a**. The mean peat depth recorded was approximately 0.11 m (10.6 cm).

3.3.6 A summary of the areas of deep peat recorded (>0.5 m) thickness is presented in **Table 3.1** below.

Table 3.1: Areas of Deep Peat

Tower/ Infrastructure	Maximum Peat Depth (m)
Tower T2	**2.7 m**
Tower T3	**2.0 m**
Tower T7	0.8 m
Tower T30	2.0 m
Tower T32	0.9 m

Core Sample Results

3.3.7 At each core sample location, a peat depth probe was taken adjacent to the core sample to compare the probed depth against cored depth, and the results are presented in **Error! Not a valid bookmark self-reference.** below.

Table 3.2: Comparison of Peat Probe and Coring Depth

Sample ID	Probed Depth (cm)	Cored Depth (cm)	Difference Probed to Cored (cm)
LT1294-PC-001	200	150	50
LT1294-PC-002	150	100	50
LT1294-PC-003	70	50	20
LT1294-PC-004	150	100	50
LT1294-PC-005	150	150	0

3.3.8 The results indicate that the peat probing potentially overestimates the true peat depths, as coring indicates that there is a potential mean overestimation of 34 cm. This is due to the density of peat and underlying substrate and the diameters of the peat probe and Russian auger, whereby the probe is narrower and is easier to penetrate deeper into the peat layers.

Depth of Acrotelm

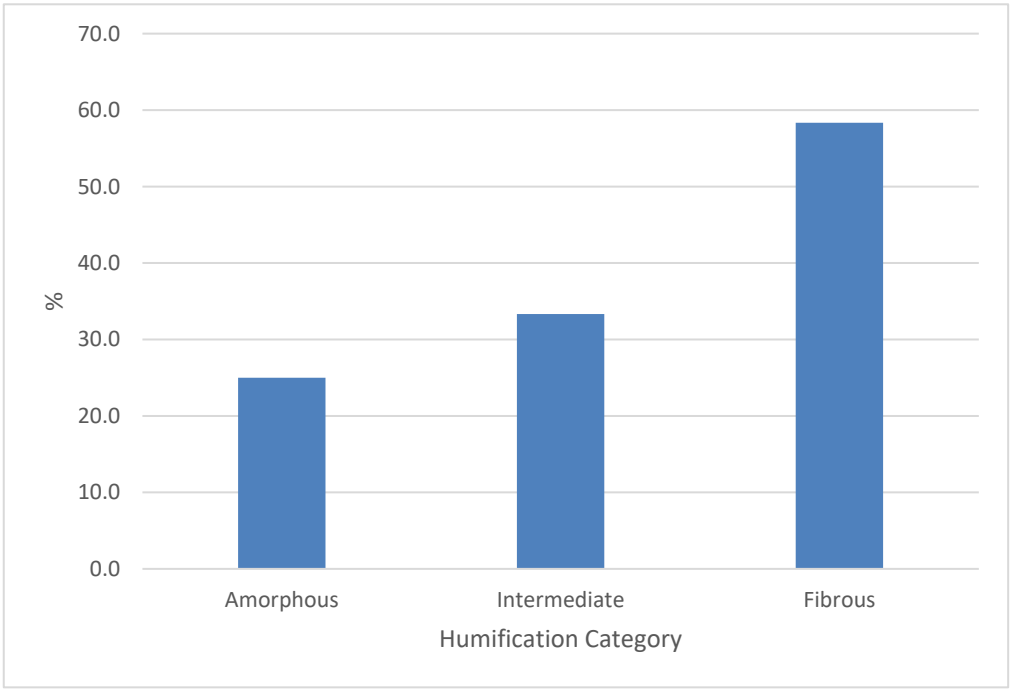
3.3.9 Acrotelm was recorded in only one sample location (LT1294-PC-001), where the depth was 0.5 m. The other sample locations indicated no discernible acrotelm. It is recommended that for the purposes of construction and subsequent reinstatement, that where a sufficient peat depth exists, the top 50 cm of material should be treated as acrotelm. This approach will allow excavation of intact turves for reinstatement purposes where they are present, which will in turn facilitate quicker regeneration of disturbed areas. Even if little vegetation is present within this top layer, it should still be treated as acrotelmic material as it may contain a seedbank, particularly in open habitats, which will aid re-vegetation of reinstatement areas.

Degree of Humification

3.3.10 The degree of humification was recorded in the field with each 0.5 m sub-sample being categorised as either fibrous, intermediate, or amorphous peat (see **Section 2: Methodology**).

3.3.11 **Graph 3.3** summarises the degree of humification, which indicated that most of the samples are classed as fibrous, which is suggestive of low humification in the samples. However, 58.3% of the samples are classified as either amorphous or intermediate which indicates that there is a degree of humification present.

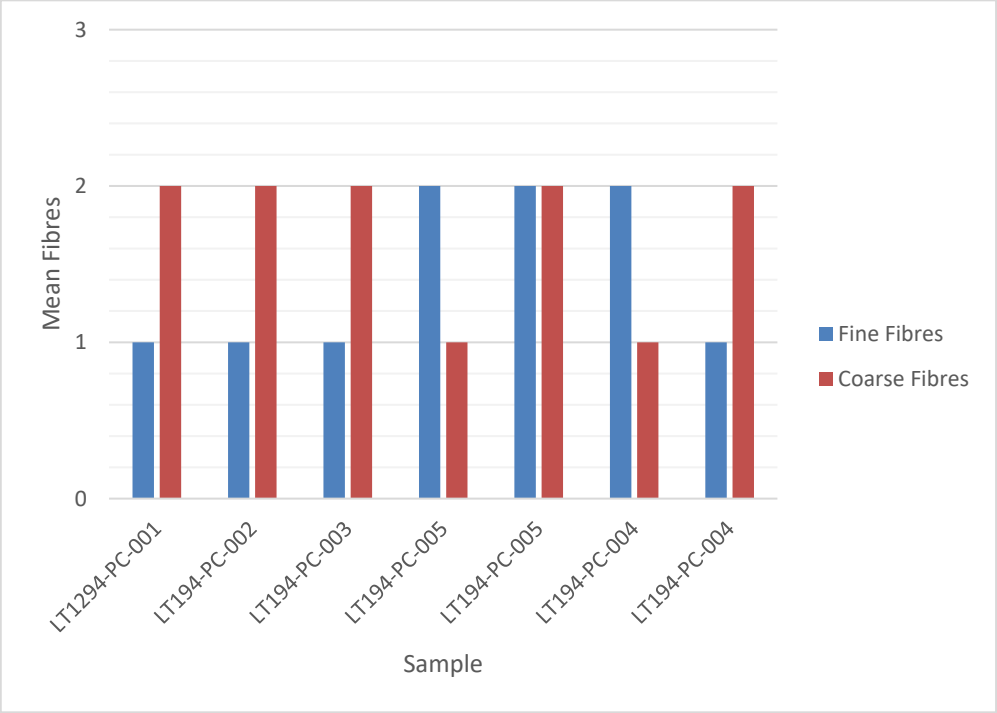
Graph 3.3: Degree of Humification



Fibrous Content

3.3.12 The fibrous content was recorded in the field, in accordance with the methods discussed in **Section 2.2**, with each 0.5 m sub-sample categorised for coarse and fine fibre content. The proportions of course and fine fibres within the peat samples were derived in the field according to the Hobbs scale, where F0/R0 indicate no fine/coarse fibre content to F3/R3 which is indicative of high fine/coarse fibre content respectively. The results indicate that the fine fibre contents are mostly low (F1) with the remainder as moderate (F2). The majority of the sample locations were assessed as moderate coarse fibre content (R2) with the remainder being low (R1). These results are summarised in **Graph 3.4**.

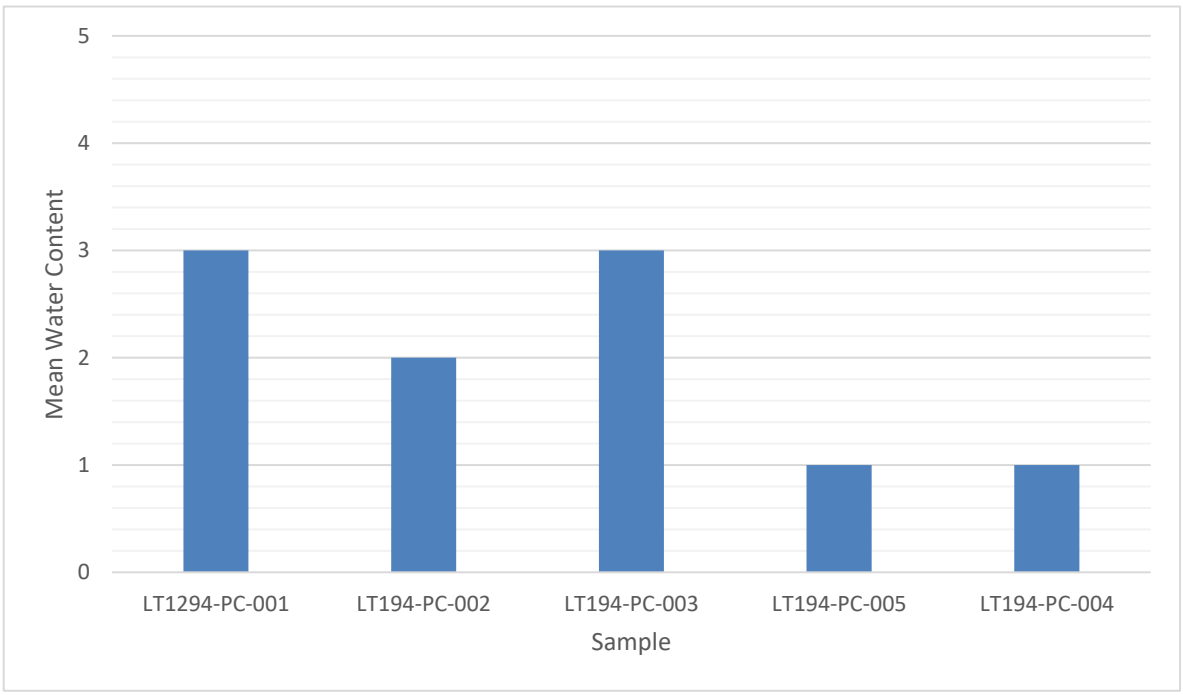
Graph 3.4: Fibrous Content



Water Content

3.3.13 The water content of the samples was determined in the field using the Hobbs scale, where B1 is dry and B5 is very wet. The results are summarised in **Graph 3.5**. The results indicate that the majority of the samples are indicative of dry or semi-dry peat (B1/B2), with the remaining samples classified as having some moisture present. No samples were recorded as wet or very wet.

Graph 3.5: Water Content



Von Post (Degree of Humification)

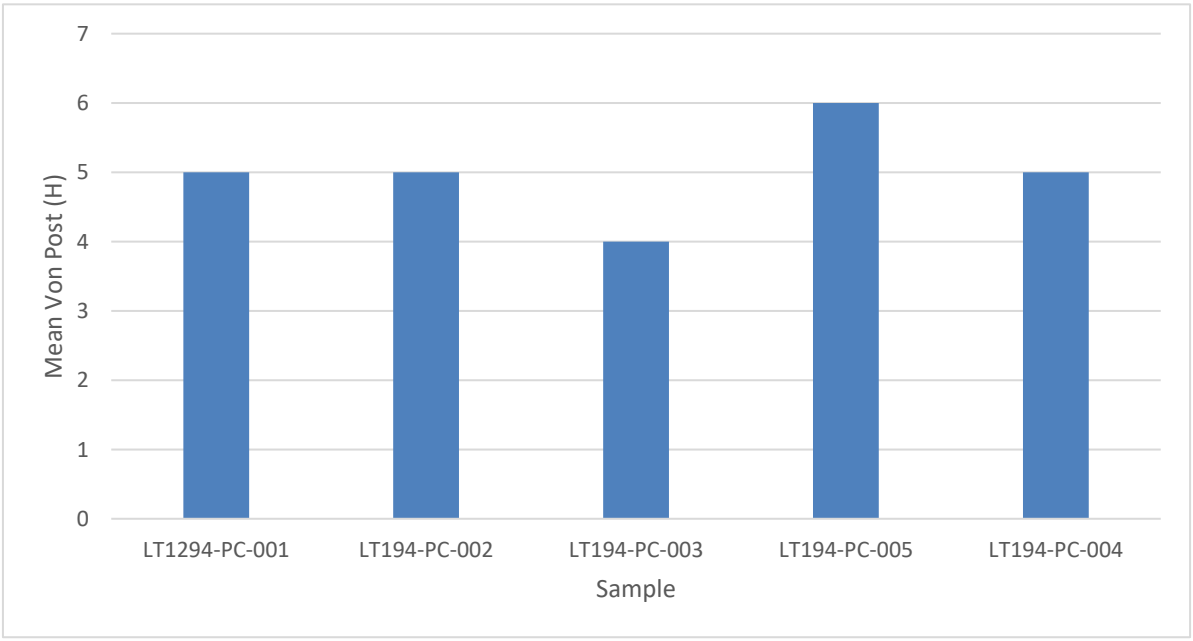
3.3.14 An estimate of the degree of humification according to the Von Post scale was carried out on samples at all core locations. This was undertaken using the criteria as shown in **Table 3.3** below.

Table 3.3: Degree of Humification using Von Post

Von Post Score	Squeezed Liquid Appearance	Extruded Peat	Plant Residue	Humification Description
H1	Clear, colourless	None	Plant structure unaltered. Fibrous, elastic	Undecomposed
H2	Almost clear, yellow-brown	None	Plant structure distinct, almost unaltered	Almost undecomposed
H3	Slightly turbid, brown	None	Plant structure distinct, most remains easily identifiable	Very weakly decomposed
H4	Strongly turbid, brown	None	Plant structure distinct, most remains identifiable	Weakly decomposed
H5	Strongly turbid, contains a little peat in suspension	Very little	Plant structure clear but indistinct and difficult to identify	Moderately decomposed
H6	Muddy, much peat in suspension	One third	Plant structure indistinct but clearer in residue, most remains undefinable	Well decomposed
H7	Strongly muddy	One half	Plant structure indistinct	Strongly decomposed
H8	Thick mud, little free water	Two thirds	Plant structure very indistinct – only resistant material such as roots	Very strongly decomposed
H9	No free water	Nearly all	Plant structure almost unrecognisable	Almost completely decomposed
H10	No free water	All	Plant structure not recognisable, amorphous	Completely decomposed

3.3.15 The results are shown in **Graph 3.6** below, where the vertical axis refers to the Von Post scale of peat decomposition (on a scale of H1 to H10).

Graph 3.6: Mean Von Post

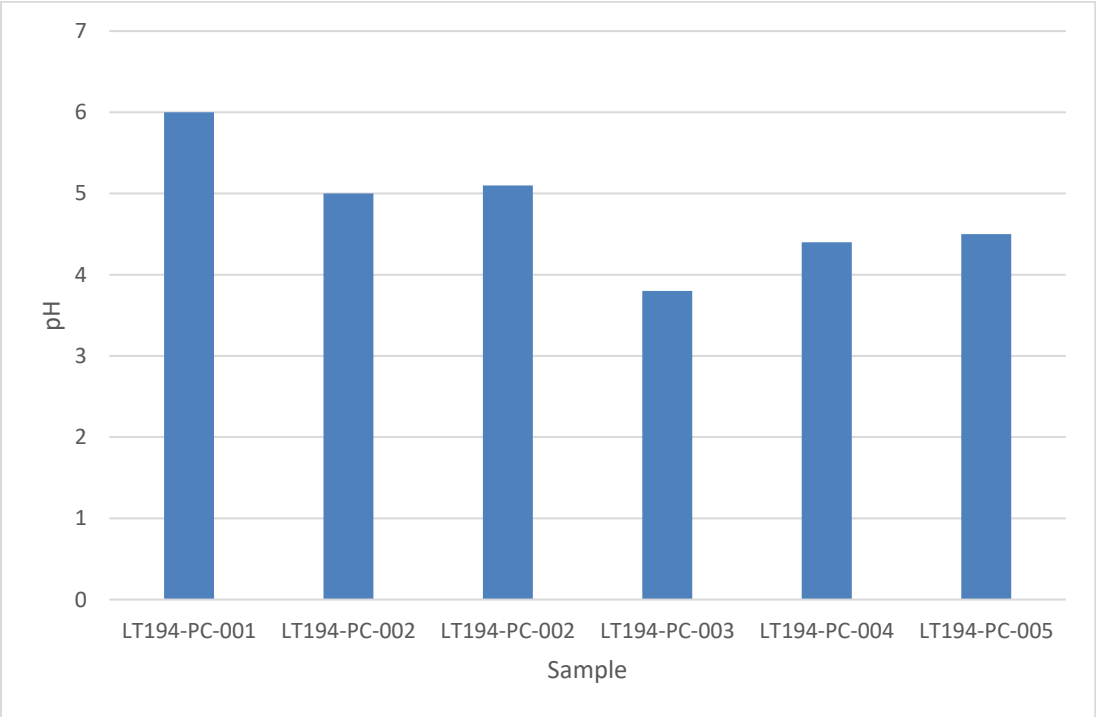


3.3.16 The results indicate that all the samples were found to be between H4 and H6 on the Von Post scale, indicating weakly decomposed to well decomposed peat. This is reflective of the intensively managed nature of the Site, where there are significant areas of commercial forestry plantation and felling, and artificial drainage. In some areas diffuse natural drainage systems were also noted. It is likely that the acrotelmic and peat is highly modified as result of desiccation associated with forestry and drainage.

pH of Samples

3.3.17 The pH values of the core samples were analysed in a laboratory, and the results provided in **Graph 3.7** below.

Graph 3.7: Mean pH

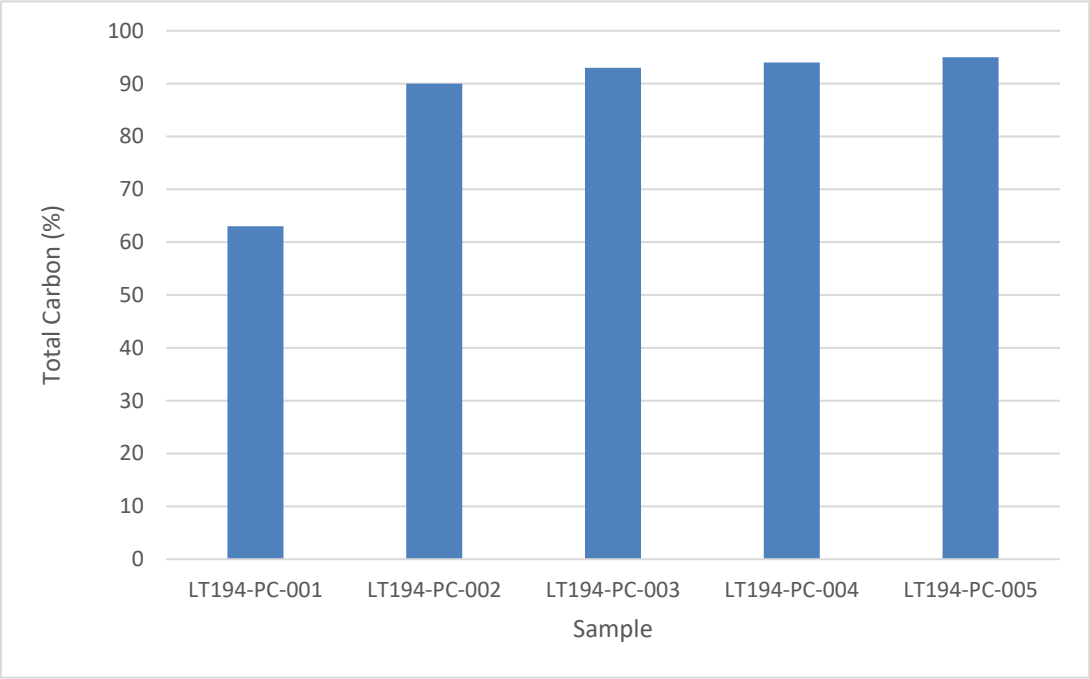


3.3.18 The mean pH value was 4.7, with a range between 3.8 and 6.0, which indicates that all samples are acidic in nature. This result is typical of peat and carbon rich soils.

Total Carbon (%)

3.3.19 The total carbon context was derived by laboratory analysis for each sample and is summarised in **Graph 3.8**. The results indicate a predominantly consistent high carbon content with a mean of 87.6 % with the exception of one location where the total carbon was found to be 66%.

Graph 3.8: Total Carbon (%)



Underlying Substrates

3.3.20 At each location, where possible, a broad characterisation was made of the underlying substrate below the peat horizon. The underlying substrate was found to vary by location between cohesive, granular and rock.

4 SUMMARY

4.1.1 The results of the peat surveys for the Proposed Development are summarised as follows:

- Overall, the peat depth is relatively shallow (<0.5 m) or is absent, with some deep pockets of peat present (>1.0 m) located near Towers T2 and T3, and between Towers T1, T2 and T3. The deepest peat recorded in these areas was 4.2 m thickness. The mean peat depth was 0.11 m across the Study Area. Peat depths are shown on **Figure 10.1: Peat Depths, EIAR Volume 3a**;
- The Proposed Development has been located away from the deep peat locations where practicable. It has not been possible to site all the towers out of deep peat based on the other environmental and technical constraints. It is proposed that towers located in deep peat would be constructed using piled foundations where practicable to minimise peat excavated;
- Some permanent and temporary access tracks are located over deep peat. Micrositing has been used to minimise the volume of peat to be excavated/disturbed but some of these tracks can be 'floated' to minimise the volume of peat disturbed;
- Acrotelmic peat was only found at one sample location (to a depth of 0.5 m), although it has been assumed for the purpose of assessment that the depth of acrotelm is 50 cm;
- The peat across the Study Area is generally fibrous in nature, with the samples assessed as having mostly low fine fibre content (F1) but ranging to moderate (F2). The majority of the sample locations were assessed as having a moderate coarse fibre content (R2), with the remainder being low coarse fibre content (R1);
- The results of the Von Post indicate that the majority of the samples tested scored relatively high on the Von Post scale (H4+) indicating weakly to well decomposed peat. Areas of the Site have historically been intensively managed with significant areas of commercial forestry plantation and felling, with artificial drainage measures used. In some areas diffuse natural drainage systems were also noted. Within the commercial plantation and forestry areas it was noted that the acrotelmic peat was highly modified as a result of planting and felling activities. No evidence of peat erosion or instability were generally noted within the forestry areas;
- The mean water content of the peat were generally noted to be dry or semi-dry, with some samples containing some moisture, which is consistent with the high degree of modification to the peatland integrity and composition through artificial drainage and overplanting with coniferous plantation forest. This can cause drying, oxidation, and erosion of peat and carbon-rich soils, which have likely increased carbon release;
- The peat was found to be acidic with a mean pH value of 4.7, and a range between 3.8 and 6.0, indicative of peat and carbon rich soils; and
- Laboratory analysis of samples indicates that the peat has a high total carbon content.

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Annex 10.1.1– Peat Coring Data

Sample ID	LT194-PC- 01	LT194-PC- 01	LT194-PC- 01	LT194-PC-02	LT194-PC- 02	LT194-PC-03	LT194-PC-04	LT194-PC-04	LT194-PC-05	LT194-PC-05
Infrastructure	Tower	Tower	Tower	Tower	Tower	Tower	Tower	Tower	Tower	Tower
Planted/ Unplanted	Planted	Planted	Planted	Unplanted	Planted	Planted	Planted	Planted	Planted	Planted
Probed Depth	2.0	2.0	2.0	1.5	1.5	0.7	1.5	1.5	1.5	1.5
Cored Depth	0.5	1.0	1.5	0.5	1.0	0.5	0.5	1.0	0.5	1.5
Depth of Acrotelm	0.5	0	0	0	0	0	0	0	0	0
Colour	Medium Brown	Dark Brown	Dark Brown	Medium Brown	Dark Brown	Medium Brown	Medium Brown	Medium to Dark Brown	Dark to Medium Brown	Dark Brown
Depth of Sub Sample	0.5	1.0	1.5	0.5	1.0	0.5	0.5	1.0	0.5	1.5
Amorphous (0=No/1=Yes)	0	0	1	0	1	0	0	0	1	0
Fibrous (0=No/1=Yes)	1	1	0	0	1	1	0	0	0	1
Intermediate (0=No/1=Yes)	0	0	0	1	0	1	1	1	0	0
Fine Fibres (F)	2	1	1	2	1	1	2	1	2	2
Coarse Fibres (R)	2	2	2	3	2	2	1	2	1	2
Water Content (B)	1	3	3	2	2	3	2	1	2	1
Von Post Scale (H)	6	5	4	4	5	4	4	5	5	6

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Sample ID	LT194-PC- 01	LT194-PC- 01	LT194-PC- 01	LT194-PC-02	LT194-PC- 02	LT194-PC-03	LT194-PC-04	LT194-PC-04	LT194-PC-05	LT194-PC-05
% Moisture	87	84	86	86	88	87	88	83	86	87
pH	5.3	6.0	4.9	4.2	5.0	3.8	4.3	4.4	4.1	4.5
Total Carbon (%)	69	63	86	93	90	93	92	94	93	95
Substrate	Cohesive	Cohesive	Cohesive	Granular	Granular	Cohesive	Rock	Rock	Rock	Rock

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Annex 10.1.2– Core Sample Photographs

LT194-PC-01 1.0 m – 1.5 m

LT194-PC-02 0.5 m – 1.0 m

LT194-PC-03 0.0 m – 0.5 m

LT194-PC-04 0.5 m – 1.0 m

	
LT194-PC-05 1.0 m – 1.5 m	