Appendix 10.3 Outline Peat Management and Restoration Plan

Contents

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Appendix 10.3 Outline Peat Management and Restoration Plan

Introduction

This Outline Peat Management and Restoration Plan (PMP) document has been prepared by Fluid Environmental Consulting (Fluid) on behalf of the Applicant for the construction of the Proposed Development, located in the north west of Yell, Shetland Isles. The site is close to the coast on the northern and western sides and it is accessed from the south east by the A968 public road. The landscape is principally one of undulating peat moorland, with numerous waterbodies (from bog pools to small lochs) and small burns. The moorland includes areas of grassland and the whole application area is subject to sheep grazing.

The infrastructure of the Proposed Development comprises of 525m of existing tracks that will be upgraded and widened, 19,325m of new floated tracks and 1,750m of new excavated tracks, 29 wind turbine locations and associated crane hardstandings and floated laydown areas, four construction compounds, a substation, meteorological mast and nine borrow pit search areas.

The total area of the Proposed Development footprint is 483,209m^2, an additional area of 140,730m^2 (see calculations section) is also considered as this is the area outside of the infrastructure footprint that would either be excavated or covered by hardcore to build the infrastructure. The total area of the Proposed Development footprint is therefore 623,939m^2, as this incorporates the drains and batters associated with the infrastructure. The existing Old Cullivoe Road is not included in this volume, only the widened portion and any new drainage.

The design of the Proposed Development has been undertaken as an iterative process to avoid areas of deep peat as much as possible to limit peat excavation and to limit the potential for peat slide, as presented in Chapter 2: Site Selection and Design Iteration.

The PMP will be further developed and implemented subsequent to the Proposed Development receiving consent from the Scottish Government. Further details and specific plans will be determined during the detailed design process and once further site investigations have been undertaken. These details will then be included in a detailed PMP as a part of the required Contractor's detailed Construction Environmental Management Plan (CEMP). The responsibility for the implementation of the PMP will be with the Principal Contractor (PC).

The PMP has been developed due to identification of the presence of peatland and peat habitats (including blanket bog, mire and heath) on the Proposed Development site (Chapter 7, Ecology, of the EIA Report).

The potential volumes of peat extracted and re-used have been calculated based on an area specific or infrastructure specific basis using a modelled peat contour plan developed on a high-density probing grid where excavations will be undertaken. This has allowed high levels of confidence in the estimation of the volumes of peat that will be excavated and that will then require appropriate re-use. This report should be read in conjunction with Chapter 3 and it's associated figures and appendices.

The PMP addresses the management of peat during the construction period and the immediate restoration of the site once construction has been completed. In accordance with SEPA's Regulatory Position Statement (2010) Developments on Peat, as much peat as possible is reused on site.

Objectives

The PMP has been developed to demonstrate that peat has been afforded significant consideration during the construction phase of the Proposed Development should consent be granted. It aims to propose mitigation

measures that will minimise any impacts and the long-term habitat restoration and management plans for key areas of the site that are designed to enhance the site.

The PMP outlines the overall approach of minimisation of peatland disruption that has been adopted. It aims to ensure that all further opportunities to minimise peat disturbance and extraction will be taken.

The PMP seeks to identify that appropriate proposals to re-use the surplus peat can be accommodated within the site layout, without significant environmental or health and safety implications, to minimise risk in terms of carbon release and human health.

Layout

The layout of the PMP is as follows:

- legislation, policy and guidance;
- role of the peat management plan;
- definition of peat, details of peatland characteristics and peat conditions on site;
- avoidance and minimisation of peat disturbance;
- peat balance between excavation and reuse on site of surplus peat;
- peat excavation and handling methods/ controls and temporary peat storage; and
- reuse in infrastructure construction restoration.

Tables are included showing:

- a summary of depth of penetration probe data;
- a summary of interpreted peat depth at infrastructure areas;
- a summary of dimension and area details of the infrastructure;
- where excavated peat will be generated and the associated quantities;
- where excavated peat will be re-used and the associated quantities; and,
- a summary of the peat extraction and re-use balance.

Legislation, Policy and Guidance for Peat Management

Legislation, Policy and Guidance

When considered as part of a carbon landscape, peat has the capacity to act as a carbon sink. The management of peat therefore has implications for carbon emissions and climate change. There is a substantial body of relevant legislation and guidance regarding climate change and carbon which is relevant to the management of peat including:

- The Kyoto Protocol (1997) and the Kyoto Protocol and National Accounting for Peatlands (2012);
- The UK Climate Change Act (2008);
- Carbon Landscapes and Drainage, 2012 'The Carbon and Water Guidelines', www.clad.ac.uk;
- Forestry Commission, 2011, 'Forests and climate change: UK Forestry Standard Guidelines.

Other key documents relied upon to inform this draft PMP include:

- Scotland's National Peatland Plan Working for our future. Scottish Natural Heritage 2015;

- Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy', August 2009;
- Good practice during windfarm construction (Scottish Renewables, SNH, SEPA & Forestry Commission Scotland, 4th Edition 2019);
- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland;
- SEPA Regulatory Position Statement – Developments on Peat. February 2010;
- Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste Scottish Renewables, 17 January 2012;
- Forestry Civil Engineering and SNH (2010). Floating Roads on Peat: A Report into Good Practice in Design, Construction and Use of Floating Roads in Peat with particular reference to Wind Farm Developments in Scotland;
- Forestry Commission (2012). Forests & Water Guidelines. 5th Edition. HMSO;
- Scottish Executive (2017) Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Proposed Electricity Generation Developments. Second Edition; and
- Towards an assessment of the state of UK Peatlands, JNCC 2010.

Role of the Peat Management Plan

The PMP is intended to be a working document to be used throughout the key stages of the design, construction, operation, decommissioning and re-instatement phases of the Proposed Development as part of an overall Construction Environmental Management Plan (CEMP) as follows:

Stage 1: Environmental Impact Assessment

It is necessary to show how, through site investigation and iterative design, the Proposed Development has been designed to minimise, so far as reasonably practicable, the quantity of peat which will be excavated; that volumes of peat anticipated to be excavated by the Proposed Development have been considered; and how excavated peat will be managed. The overall aim is to minimise the impacts associated with excavation of peat by using the following hierarchy of design principles: prevent excavation; reduce volumes of peat excavated; and reuse excavated peat in a manner to which it is suited. This hierarchical approach comprises:

1. calculation of estimated volumes of excavated peat and potential reuse volume requirements based upon the Proposed Development site design / layout;
2. determine whether there is likely to be adverse or beneficial overall peat balance, and whether the generation of excess material can be avoided, and, if not, where reductions in the volumes of excavated materials may be achieved;
3. site layout is refined to avoid areas of deeper peat and hence reduce carbon impacts of the project construction activities;
4. record specific examples of how overriding principles of prevention and minimisation of peat disturbance are to be taken into account in the design of the site;
5. the assessment is to be consistent with and feeds into the peat stability and carbon payback assessment; and
6. identify limitations and make recommendations for further site investigation (post-consent) in order to steer detailed design and micro siting such that opportunities for further reductions in excavated peat volumes can be implemented where possible.

Stage 2: Post Consent / Pre-Construction

As part of the EIA it will have been demonstrated that, on the basis of the investigation and data gathered, it is likely that the excavated materials for the Proposed Development can be managed in an appropriate manner. The peat mass balance calculations may be further developed and refined post planning consent, and prior to the relevant works commencing, as a consequence of any further or more detailed ground investigation or survey works required to inform detailed design, or that may be required under planning consent conditions.

Stage 3: Construction Stage

Actual peat volumes excavated from site during construction will be recorded against predicted volumes provided in Table 5 of this PMP. Within micro-siting allowances, the alignment and design of tracks, hardstanding orientation and construction methods will be reviewed to avoid/minimise peat disturbance as much as possible in light of the more detailed information available once construction actually commences. A regular review and update of the peat mass balance table will be undertaken by the appointed Principal Contractor and monitored by the Environmental Clerk of Works (ECoW) on site and made available to regulators as required.

Peat Conditions

Definitions of Peat

Organic material less than 0.5m depth is not defined as peat. This is in accordance with guidance from:

- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland states that *'Peat soil is an organic soil which contains more than 60 per cent of organic matter and exceeds 50 centimetres in thickness'*; and
- The James Hutton Institute define shallow peat as having *'a prescribed depth of organic matter of 50 – 100 cm'* *(*https://www.hutton.ac.uk/learning/exploringscotland/soils/organicsoils).
- Also, The Forestry Commission use 45 cm as the critical depth for peat to occur (Understanding the GHG implications of forestry on peat soils in Scotland, 2010);

Peat can therefore be classified as organic material over 0.5m in depth.

Peat can be separated into three main layers: acrotelmic (the upper living layer), catotelmic (the middle to lower layer) and occasionally amorphous (lower layer) peat:

- Acrotelmic peat is the living layer of the peat including the peat turf or turve being a thin, floating vegetation mat layer. The acrotelm is generally found within the top layer of peat (often less than 0.5m) depending on the degree of decomposition and fibrous nature of the peat (approximately H1 to H6 on the von post classification scale). The acrotelm is generally of high permeability, decreasing with depth. The water table fluctuates in this layer and conditions vary from aerobic to anaerobic. Material may be fibrous or pseudofibrous (plant remains recognisable), spongy, and when excavated strength is lost but retains integral structure and can stand unsupported when stockpiled >1m.
- Catotelmic peat is the dead layer of peat found deeper than acrotelmic peat which has some remnant plant structures. Material has high water content and is permanently below the water table (saturated) therefore organic matter decomposes anaerobically. Some plant structures may be recognisable but are highly humified losing most of their characteristics (approximately H6 to H9 on the von post classification scale) and strength. Water flow through the catotelm is slow unless peat structures such as sink holes or peat pipes are present.

- Amorphous peat is highly decomposed organic material where all recognisable plant remains are absent (approximately H9 to H10 in the von post classification scale). These deposits are dark brown to black in colour, plastic, are low tensile strength and are unable to stand unsupported >1m when stockpiled.

Peat Conditions on Site

Desk Based Review

The site was assessed for peat vegetation through desktop review of maps and plans and a number of site walkovers by ecologists and hydrologists; and through intrusive site investigation in terms of peat depth probing and coring across the Proposed Development site and access track routes.

The site area concerned covers approximately 1,679ha. It ranges in altitude between just over 0 and 120m above sea level. The site is characterised by bog pool complexes on higher ground with watercourses in the valleys and a mix of man made and natural drainage networks on the side slopes.

The land cover for the site predominantly comprises of undulating open moorland. The vegetation is upland in character, waterlogged and dominated by blanket bog and other mire types, with areas of grassland in the more sheltered valleys and on better-drained slopes.

The peatland areas are natural organic, dystrophic and oligiotrophic blanket peat mostly intact and relatively untouched with some evidence of very localised disturbance in and around occasional drainage grips and the existing access track, including historical peat cuttings and small borrow pits along the existing track.

The Ecology Chapter (Chapter 7) notes *'The relatively gentle topography of the site and the prevailing climate conditions have resulted in the widespread presence of blanket bog. Blanket bog dominates over 72.3% (1,611ha) of the site, which forms a mosaic with other habitats over a further 13.7% (305ha) - a total of 86% (1,916ha). The condition of the blanket varies across the site, but good quality bog, with numerous pool complexes occurs in several areas across the site.'*

'There is some hagging locally, mainly in the east central area north of Gossa Water, and Scottish Water notes that the Gossa watershed is partly degraded, with the water quality being characterised by a high amount of organic material as a consequence of hags and erosion gullies being present (Scottish Water, personal communication, meeting on 09 January 2019).'

'Blanket bog covers the majority of the access track Study Area and was noted as being in generally good condition, containing occasional oligotrophic pools, although some small sections are heavily eroded.'

The site overlies Gneissose Psammite and Gneissose Semipelite, metamorphic bedrock formed approximately 542 to 1000 million years ago, originally sedimentary rocks, later altered by high grade regional metamorphism, but as peat depth often exceeds 2m most of the vegetation is not within the influence of this formation. The mineral soils along the burns may derive some mineral nutrients from this source. There is no evidence of peat cutting on site however there are areas of erosion, peat hag and erosion in gullies although these are sporadic and infrequent.

Peat Survey Methodology

To obtain a detailed understanding of the spatial and depth distribution of peat and its properties, a series of tasks have been completed which include:

- National vegetation classification (NVC) habitat mapping detailed within the Ecology Chapter 7 of the EIA Report);
- Depth penetration probing (see peat survey report Appendix 10.2) at over 13,000 locations:
  - in a 100m grid over the whole of the site;

- at turbines and crane hardstandings, construction compounds and the substation on a 10m grid along with 20m probing in the surrounding area up to 50m distance;
- at borrow pit search areas on a 10m grid;
- at construction compounds and the substation on a 10m grid, and
- along the track at 50m intervals and 10m offsets along the tracks.

- Peat coring at 174 locations to verify the probing is representative of peat depth and to assess the peat structure and properties;
- Collection of 20 peat samples for laboratory analysis of total organic carbon and dry bulk density for input to the carbon calculator assessment;
- Development of a penetrable substrate depth map to indicate the maximum depth of probe penetration at all investigated points across the site;
- Development of an interpreted maximum depth of peat contour map to indicate the potential penetrable substrate or inferred peat depth based on the depth penetration probing results and verified by coring;
- Calculation of the maximum potential peat volumes that will be removed due to excavation for infrastructure based on the depth penetration probing results; and,
- Examination of areas where peat will be reused to allow calculation of reuse volumes.

Peat Surveys

Four depth of penetration surveys have been completed in 2018 and 2019.

Phase 1

A first phase of peat depth probing was undertaken in May 2018 and comprised a 100m grid across the part of the site that was considered for development with the exception of areas where ornithological restrictions were in place around lochs. A total of 1,338 peat probes were undertaken and 40 cores. These data were used as an input to the constraints map for development of the initial infrastructure layout.

Phase 2

Once the Proposed Development initial layout was determined Fluid completed further detailed probing and coring in October and November 2018 at the following specification:

- at 50m intervals with 10m offset probes along all proposed and existing access tracks and coring at 500m intervals;
- at all 29 turbine bases and hardstanding areas in a 10m grid, along with probing in the 50m micrositing area on a 20m grid and 2 cores per turbine/hardstanding area;
- at construction compounds on a 10m grid and 2 cores per construction compound;
- at the substation on a 10m grid with 10m probing within the micrositing area where there are no other constraints and 2 cores; and
- at all 9 borrow pit search areas on a 10m grid and 2 cores per borrow pit.

This totalled 9,622 probes and 119 cores.

Phase 3

Following further optimisation of the layout a further phase of depth of penetration probing was completed in January 2019 where infrastructure had moved out of the previously probed areas. This totalled 2,070 probes and 15 cores.

Phase 4

An additional area of probing on a 20m grid was completed in February 2019 where the southern construction compound was relocated. This totalled 31 probes.

A total of 13,061 probes and 174 cores were completed across the four campaigns.

Peat Survey Results

A total of 13,061 probes were undertaken during the various campaigns between May 2018 and February 2019. Each probe recorded the depth of penetration and the potential substrate at the limit of penetration (Appendix II).

Of the 13,063 locations probed a total of 1,067 probes (8.2%) recorded depths of 0.5m or less, 2,941 probes (22.5%) recorded depths of penetration between >0.5m and 1.0m and 9,053 probes (69.3%) recorded depths of penetration >1.0m (Table 1).

Table 1 – Depth of Penetration Distribution

Depth Range (m)	Number of Probes	Percentage of Probes
0 to 0.5 (no peat)	**1,067**	**8.2%**
>0. 5 – 1.0	2,941	22.5%
>1.0 – 1.5	3,642	27.9%
>1.5 – 2.0	3,523	27.0%
>2.0 – 2.5	1,071	8.2%
>2.5 – 3.0	494	3.8%
>3.0 – 3.5	180	1.4%
>3.5 – 4.0	92	0.7%
>4.0 – 4.5	23	0.2%
>4.5 – 5.0	16	0.1%
>5.0 – 5.5	5	0.04%
>5.5 – 6.0	6	0.05%
>6.0	1	0.01
Total	13,061	100%

The depth of penetration at each probe location is presented on Figure 10.8.

Based on the data collected an interpreted peat depth map (Figure 10.9) was produced to demonstrate the variation in peat across the site and at the various infrastructure locations. A comparison of the peat depth with the site infrastructure footprint is presented in Table 2:

Table 2 – Peat Depth Distribution across Infrastructure Footprint

Depth Range (m)	**Area of infrastructure footprint (m2)**	**Area of infrastructure footprint (%)**
0 to 0.5 (no peat)	31,821	6.59%
>0. 5 – 1.0	135,117	27.96%
>1.0 – 1.5	166,834	34.53%

Depth Range (m)	Area of infrastructure footprint (m2)	Area of infrastructure footprint (%)
>1.5 – 2.0	113,111	23.41%
>2.0 – 2.5	29,588	6.12%
>2.5 – 3.0	4,832	1.00%
>3.0 – 3.5	817	0.17%
>3.5 – 4.0	435	0.09%
>4.0 – 4.5	124	0.03%
>4.5 – 5.0	117	0.02%
>5.0 – 5.5	357	0.07%
>5.5+	56	0.01%
Total		100%

Note: The area of infrastructure footprint does not include side slopes and drains although these are calculated and included in the peat excavation calculations

These data indicate that peat (>1.0m depth) is present across 65.4% of the Proposed Development infrastructure and no peat (0 – 0.5m depth) is present across 6.6% of the Proposed Development infrastructure.

A total of 174 cores were completed with the majority encountering peat with acrotelm and catotelm layers identifiable. In parts of the site vegetation and tussocks form layers over 0.5m in thickness immediately next to acrotelm of 0.05m to 0.30m thick. A conservative average acrotelm depth of 0.15m has therefore been used and the peat depth minus the acrotelm depth can been used to calculate the potential catotelm thickness.

Peat Characteristics

The peat is fibrous and moist in nature at the surface with a large acrotelmic layer up to 30cm in thickness where vegetation at the surface was present. The catotelmic peat was up to a maximum of 6m in thickness, with well-preserved cotton grass, sphagnum moss and wood in places within the soil profile. No clear basal layer of amorphous peat (H9/H10) was observed. The peat characterisation studies concluded that the site comprises active peatland across much of the open moorland with some degradation/modification from very localised historical peat extraction near the A968 road, which mostly shows some good recovery.

These values have been used in calculations of volumes of peat across the site where the peat contour map indicates that peat is present (e.g. >0.5m probe depth). Catotelm and amorphous peat volumes were calculated together as a result of there being no clear basal layer of amorphous peat observed.

Habitat Conditions

Habitat mapping and NVC survey was undertaken by Botanaeco and is detailed within Chapter 7 Ecology and Figures 7.2-7.3 of the EIA Report.

Blanket bog dominates the site with approx. 75% cover (M17b, M17c, M1, M2 and M3). Bare peat habitat is rare across the site and confined to moderate slopes and vertical faces within areas of peat hag, although there are some erosional gullies in the Gossa Water catchment. Acid/neutral flush (M6a, M6c, M29 and M32a) is associated with the flanks and bases of the small valleys of the watercourses, or the edges of lochs and lochans.

Some influence from base-rich substrates (Flush and spring: basic – M10a) is evident in the south-western coastal area, in the occurrence of basic flushes, just beyond the Site boundary.

Avoidance and Minimisation of Peat Disturbance

Avoidance

The infrastructure layout has been designed to avoid or minimise impact on blanket bog habitats. In practice this has been undertaken where possible by avoiding the deepest peat, which is normally where the best quality blanket bog habitats occur and are to some extent preserved. The design elements aimed at minimising effects on blanket bog systems that have been incorporated are:

- avoiding the deepest intact peat with tracks, compounds, substation, borrow pits, turbines and crane pads where possible;
- avoidance of the summit bog pool complexes; and
- avoidance of areas where peat slide risk is moderate or higher.

Further Minimisation

The disturbance of peat by the construction of the tracks, crane hardstandings, turbine foundations and other infrastructure will be minimised as much as practicably possible, taking into account the other constraints to the development, in order to try and reduce any peat waste on site and reduce potential carbon losses from the peat excavation process.

Throughout the construction process, the appointed Principal Contractor (and / or Designer) will aim to minimise the volumes of excavated peat. As far as possible, appropriate handling and storage of excavated materials will be undertaken such that their integrity and subsequent reuse is not jeopardised.

Although every effort has been made to map and identify sensitive habitats as thoroughly as possible, adjustment within the micrositing limits is likely to allow further improvements to avoid particularly sensitive pockets of habitat. Therefore, the ECoW will walk the site with engineers before construction commences, pointing out areas of sensitive habitat and identifying where impact can be reduced by minor movement of infrastructure within the micro-siting available. These areas will be clearly marked with post and tape. The ECoW will also ensure that any micro-siting does not lead to movements into more sensitive habitats.

Further measures to minimise peat disturbance will be incorporated in the development and construction process. The principles of the waste hierarchy (outlined above) will be adhered to in order to:

- avoid and/or minimise production of excavated peat;
- reuse, where possible, excavated peat on site in landscaping and re-profiling works, to minimise visual impacts and facilitate habitat, ecological and hydrogeological restoration, improvement and enhancement; and
- avoid waste peat being sent for disposal, recovery and/or reuse off site.

All contractors will be made aware of the sensitivity of peat and wetland habitats and the ECoW will clearly mark sensitive habitats near to construction areas. Contractors will be required to work within the narrowest practical construction corridor when working in or near areas of peat.

All plans and method statements will be accompanied by justification of the final design and/or construction methods identified by the Principal Contractor, including reasons for discounting alternative methods. This is required in order to demonstrate that all avenues for avoiding hydrological disruption and reducing the disturbance and excavation of peat have been considered.

It is anticipated that an ECoW will be appointed for the construction of the Proposed Development that will:

- identify areas of sensitive habitat;
- clearly mark sensitive habitats near to construction areas and make the principal contractor aware of the sensitivity of peat habitats and inform all sub-contractors;
- walk the areas affected by the proposed development with engineers before construction commences;
- authorise minor movement of infrastructure within the micro-siting available where impact can be reduced; and
- monitor that any micro-siting does not result in movements into more sensitive habitats and deep peats unless unavoidable.

Excavation and Reuse Volume Estimates

Peat Excavation Assumptions

The Proposed Development infrastructure and dimensions used in the peat balance calculations are summarised in Table 3 and Table 4. The infrastructure areas and excavation calculations are based on the Proposed Development layout GIS shape files provided plus the following assumptions:

Excavated Tracks

- drains will be installed alongside excavated tracks which will increase the width of the excavated base from 5.5m to 7.5m; and
- slope batters will be installed along the 7.5m excavated width on a 2 in 1 gradient, extending the footprint to about 11.5m wide depending on peat depth.

The peat volume excavated therefore includes all the peat within the 7.5m width over the total length of excavated track plus the amount of peat extracted from the slope batter.

Floated Tracks

- It is assumed that floated tracks will be elevated above ground level by up to 1m. Slopes will be installed either side of the 5.5m wide tracks on 2 in 1 slopes, therefore they will extend the floating track about 2m on either side (9.5m total track width).
- V drains will be installed either side of the track at 0.5m length of each V.
- It is assumed that the short sections of track leading to areas that will be restored post construction, e.g. borrow pits and construction compounds, will also be removed post construction for restoration.

Floated Tracks alongside Old Cullivoe Road

- It is assumed the Old Cullivoe Road will require to be widened by 4m and therefore floated tracks will be elevated above ground level by up to 1m. Slopes will be installed on the sides of the Old Cullivoe Road away from the existing track on 2 in 1 slopes; and
- V drains will be installed either side of the track at 0.5m length of each V.

Temporary Floated Construction Compounds

- It is assumed that the floated construction compounds will be elevated above ground level by up to 1m. Slopes will be installed on all sides of the construction compounds on 2 in 1 slopes.
- V drains will be installed on all sides of the construction compounds at 0.5m length of each V.

- It is assumed that the geogrid and hardcore comprising the floated construction compounds will be removed at the end of the construction period.

Excavated part of the substation

- The excavated substation will be raised to the level of the floated part of the substation which surrounds it. As it adjoins the floated area on all sides the excavated part of the substation is comprised of solely the footprint.

Floated part of the substation

- It is assumed that the floated part of the substation will be elevated above ground level by up to 1m. Slopes will be installed on all sides of the substation on 2 in 1 slopes.
- V drains will be installed on all sides of the substation at 0.5m length of each V.

Turbine Foundations

- Turbine foundations will be backfilled with concrete. The areas outside of this footprint will have sloped sides for construction. Where these adjoin the crane hardstanding they will be filled with hardcore. Where these adjoin the surrounding habitat they will be backfilled with the material removed.
- V drains will be installed on the side of the turbine foundations not connected to the crane hardstandings at 0.5m length of each V.

Crane Hardstandings

- The excavated crane hardstanding areas will have slope batters installed along the perimeter on a 2 in 1 gradient to ground level where the base is raised above the surrounding ground.
- V drains will be installed on all sides of the crane hardstandings at 0.5m length of each V.

Laydown Areas

- The laydown areas are temporary and comprised of bog mats which will be removed at the end of construction.
- V drains will be installed on the sides of the laydown area connected to the surrounding habitat at 0.5m length of each V.

Borrow Pits

- Borrow pits will be excavated with a perimeter diversion V ditch on all sides of the borrow pit at 0.5m length of each V.

Table 3 – Infrastructure Dimension Final Layout

Infrastructure	Dimensions	Area (m^2)
Turbines 1 to 29	24m diameter (450m2 area)	13,051
Crane hardstanding 1 to 29	Irregular shape of between 2,980m2 and 3,521m2	94,039
Laydown Area 1 to 29	Irregular shape of between 1,303m2 and 1,852m2	47,682
Construction Compound 1	Approximately square 100m x 100m	9,990
Construction Compound 2	Approximately square 50m x 51m	2,499

Infrastructure	Dimensions	Area (m^2)
Construction Compound 3	Approximately square 50m x 50m	2,515
Construction Compound 4	Approximately rectangular 50m x 60m	3,000
Substation	Approximately rectangular 60m x 100m	6,010
Borrow Pit A	Approximately rectangular 100 x 240	24,926
Borrow Pit B	Irregular	14,618
Borrow Pit C	Irregular	13,184
Borrow Pit D	Irregular	6,734
Borrow Pit E	Irregular	38,468
Borrow Pit F	Irregular	28,831
Borrow Pit G	Irregular	4,160
Borrow Pit H	Approximately rectangular 130 x 185	24,629
Borrow Pit I	Irregular	36,252
New Excavated Track	Width of 5.5m and approximate length of 1,750m which includes bellmouths and turning areas	12,763
New Floated Track	Width of 5.5m and approximate length of 18,350m which includes bellmouths and turning areas	92,057
Existing track (widened)	2m wide strip either side of 523m length of existing track	2,103
New floated track to be restored	Width of 5.5m and approximate length of 928m which includes bellmouths and turning areas	5,698
Total		483,209

The following areas are also used for the peat calculations:

Table 4 – Infrastructure Additional Dimensions

Infrastructure	Dimensions	Area (m^2)
Turbines 1 to 29	2 in 1 excavation around free perimeter of between 29m and 39m, plus 0.5m V drains	3,226
Crane hardstanding 1 to 29	2 in 1 excavation around free perimeter of between 217m and 300m, plus 0.5m V drains	22,819
Laydown Area 1 to 29	0.5m V drains along free perimeter	2,587
Construction Compound 1	2 in 1 slope back to ground level around free perimeter of 400m, plus 0.5m V drains	1,084
Construction Compound 2	2 in 1 slope back to ground level around free perimeter of 150m, plus 0.5m V drains	407
Construction Compound 3	2 in 1 slope back to ground level around free perimeter of 195m, plus 0.5m V drains	528
Construction Compound 4	2 in 1 slope back to ground level around free perimeter of 138m, plus 0.5m V drains	374
Substation	2 in 1 slope back to ground level around free perimeter of 221m, plus 0.5m V drains	599
Borrow Pit A	0.5m V drains along free perimeter	493
Borrow Pit B	0.5m V drains along free perimeter	266
Borrow Pit C	0.5m V drains along free perimeter	332
Borrow Pit D	0.5m V drains along free perimeter	251
Borrow Pit E	0.5m V drains along free perimeter	641
Borrow Pit F	0.5m V drains along free perimeter	507
Borrow Pit G	0.5m V drains along free perimeter	120
Borrow Pit H	0.5m V drains along free perimeter	448
Borrow Pit I	0.5m V drains along free perimeter	542
New Excavated Track	1m wider than footprint on each side of track for drainage and 2 in 1 slope back to ground level along free perimeter of 3,443m	14,612
New Floated Track	2 in 1 slope back to ground level around free perimeter of 30,724m, plus 0.5m V drains	83,262

Infrastructure	Dimensions	Area (m^2)
Existing track (widened and floated)	2 in 1 slope back to ground level around free perimeter of 1,053m, plus 0.5m V drains	2,854
New floated track to be restored	2 in 1 slope back to ground level around free perimeter of 1,763m, plus 0.5m V drains	4,778
Total		140,730

Excavated Volumes

Peat excavation volumes associated with the project have been calculated using the GIS package ArcGIS based on the data in Tables 3 and 4 and these further assumptions:

- A contour map of assumed peat depth based on interpolation of values from probing undertaken across the site (shown in Figure 10.9).
- Dimensions of the proposed areas for excavation for site infrastructure based on the layout shape files provided (shown in Figure 10.9) and detailed in Table 3.
- An estimated acrotelm depth of 0.15m across infrastructure area where peat (>0.5m organic soil) is present based on the peat core data.
- An estimated catotelm thickness of the average depth of the peat minus the acrotelm (0.15m) across infrastructure area where peat is present and based on the peat core data.
- An assumption that the probe depth is representative of the actual depth of the peat (validated by the spatial coverage of 174 cores).
- Any peat excavated for cable trenches is stored adjacent to the trench while the track is laid and then replaced, therefore this volume is not applicable to the excavated volume.
- The Met Mast will be suspended and supported by ballast above ground and therefore no excavation is required.

Using the interpreted peat depth contour map (Figure 10.9), the volumes of peat that would be excavated during construction were calculated based on the infrastructure dimensions (ArcGIS shapefiles) and associated excavation areas provided for the Proposed Development. These calculations produced the following volume estimates and are detailed in Table 5, Table 6 and Table 7:

- a total volume of peat to be excavated of 394,171m^3;
- a total volume of acrotelm to be excavated of 52,466m^3;
- a total volume of catotem to be excavated of 341,705m^3; and
- a total volume of penetrable soils to be excavated of 9,112m^3.

Table 5 – Excavated Peat Volumes based on Actual Footprint

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Turbine 1	450	1.17	100.0	450	1.17	529	68	461	0
Turbine 2	450	0.68	88.9	400	0.71	284	60	224	22
Turbine 3	450	0.72	88.0	396	0.76	302	59	242	23
Turbine 4	450	0.40	33.7	152	0.72	109	23	87	71
Turbine 5	450	0.91	100.0	450	0.91	410	68	342	0
Turbine 6	450	1.91	100.0	450	1.91	859	68	792	0
Turbine 7	450	1.05	100.1	450	1.05	473	68	406	0
Turbine 8	450	0.74	87.6	394	0.79	311	59	251	21
Turbine 9	450	1.49	100.0	450	1.49	669	68	601	0
Turbine 10	450	0.79	93.6	421	0.82	345	63	282	12
Turbine 11	450	1.96	100.0	450	1.96	883	68	815	0
Turbine 12	451	1.11	100.0	451	1.11	498	68	431	0
Turbine 13	450	0.83	100.0	450	0.83	373	68	305	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Turbine 14	450	1.48	100.0	450	1.48	667	68	600	0
Turbine 15	450	0.72	99.6	448	0.73	325	67	258	1
Turbine 16	450	1.37	100.0	450	1.37	615	68	547	0
Turbine 17	450	1.08	100.0	450	1.07	484	68	416	4
Turbine 18	450	1.89	100.0	450	1.89	849	68	781	0
Turbine 19	450	1.80	100.0	450	1.80	808	68	741	0
Turbine 20	450	1.75	100.0	450	1.75	787	68	719	0
Turbine 21	450	0.98	100.0	450	0.98	441	68	373	0
Turbine 22	450	0.77	100.0	450	0.77	346	68	278	2
Turbine 23	450	1.46	100.0	450	1.46	656	68	589	0
Turbine 24	450	1.70	100.0	450	1.70	764	68	697	0
Turbine 25	450	1.51	100.0	450	1.51	679	68	611	0
Turbine 26	450	1.70	100.0	450	1.70	763	68	696	0
Turbine 27	450	1.98	100.0	450	1.98	889	68	822	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Turbine 28	450	0.49	40.0	180	0.83	149	27	122	71
Turbine 29	450	1.40	100.0	450	1.39	626	68	559	2
Crane hardstanding 1	3350	0.86	93.7	3139	0.88	2,767	471	2,296	102
Crane hardstanding 2	3394	0.76	87.9	2984	0.80	2,390	448	1,942	174
Crane hardstanding 3	3228	0.96	94.4	3046	1.00	3,052	457	2,595	61
Crane hardstanding 4	3201	0.28	15.1	483	0.83	401	72	329	507
Crane hardstanding 5	3102	1.21	97.7	3031	1.23	3,734	455	3,279	26
Crane hardstanding 6	3222	1.55	99.1	3195	1.56	4,973	479	4,494	13
Crane hardstanding 7	3271	1.64	99.9	3267	1.64	5,358	490	4,868	3
Crane hardstanding 8	3254	0.93	98.9	3220	0.94	3,017	483	2,534	12
Crane hardstanding 9	2988	1.52	100.0	2988	1.52	4,533	448	4,085	0
Crane hardstanding 10	3178	0.97	99.8	3172	0.97	3,066	476	2,590	3
Crane hardstanding 11	3249	1.96	100.0	3249	1.96	6,372	487	5,884	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Crane hardstanding 12	3210	1.37	100.0	3210	1.37	4,399	481	3,918	0
Crane hardstanding 13	3226	1.22	100.0	3226	1.22	3,943	484	3,459	0
Crane hardstanding 14	3192	1.55	100.0	3192	1.55	4,938	479	4,459	12
Crane hardstanding 15	3147	1.03	100.0	3147	1.03	3,234	472	2,762	0
Crane hardstanding 16	3276	1.57	100.0	3276	1.57	5,144	491	4,652	0
Crane hardstanding 17	2980	0.87	93.1	2774	0.91	2,515	416	2,099	78
Crane hardstanding 18	3323	2.09	98.5	3275	2.12	6,936	491	6,445	16
Crane hardstanding 19	3311	1.52	100.0	3311	1.52	5,027	497	4,530	1
Crane hardstanding 20	3226	1.77	100.0	3226	1.77	5,720	484	5,236	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Crane hardstanding 21	3277	0.95	96.8	3174	0.96	3,056	476	2,580	44
Crane hardstanding 22	3180	1.24	100.0	3180	1.24	3,940	477	3,463	1
Crane hardstanding 23	3279	1.21	98.7	3237	1.22	3,940	486	3,455	18
Crane hardstanding 24	3334	1.56	100.0	3334	1.56	5,210	500	4,709	0
Crane hardstanding 25	3187	1.48	100.0	3187	1.48	4,721	478	4,243	3
Crane hardstanding 26	3304	1.83	100.0	3304	1.83	6,035	496	5,539	0
Crane hardstanding 27	3133	2.00	100.0	3133	2.00	6,266	470	5,796	0
Crane hardstanding 28	3521	0.87	77.5	2730	1.04	2,826	410	2,416	236
Crane hardstanding 29	3496	1.72	98.1	3429	1.75	6,006	514	5,492	21
Laydown Area 1	1576	0.88	99.8	1572	0.88	0	0	0	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Laydown Area 2	1553	0.68	88.4	1373	0.71	0	0	0	0
Laydown Area 3	1662	1.14	96.8	1608	1.17	0	0	0	0
Laydown Area 4	1709	0.47	40.2	686	0.86	0	0	0	0
Laydown Area 5	1758	1.25	97.5	1714	1.27	0	0	0	0
Laydown Area 6	1678	1.61	99.6	1672	1.62	0	0	0	0
Laydown Area 7	1547	1.71	100.0	1547	1.71	0	0	0	0
Laydown Area 8	1667	1.14	100.0	1667	1.13	0	0	0	0
Laydown Area 9	1852	1.35	100.0	1852	1.35	0	0	0	0
Laydown Area 10	1616	1.10	98.9	1598	1.11	0	0	0	0
Laydown Area 11	1590	2.15	100.0	1590	2.15	0	0	0	0
Laydown Area 12	1725	1.56	100.0	1725	1.56	0	0	0	0
Laydown Area 13	1408	1.86	100.0	1408	1.86	0	0	0	0
Laydown Area 14	1720	1.55	100.0	1720	1.55	0	0	0	0
Laydown Area 15	1733	1.15	99.6	1726	1.15	0	0	0	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Laydown Area 16	1620	1.56	100.0	1620	1.56	0	0	0	0
Laydown Area 17	1854	0.97	99.9	1852	0.97	0	0	0	0
Laydown Area 18	1612	2.07	98.7	1591	2.09	0	0	0	0
Laydown Area 19	1503	1.53	100.0	1503	1.53	0	0	0	0
Laydown Area 20	1681	1.57	100.0	1681	1.57	0	0	0	0
Laydown Area 21	1644	0.82	100.0	1644	0.82	0	0	0	0
Laydown Area 22	1715	1.27	99.7	1709	1.28	0	0	0	0
Laydown Area 23	1642	1.47	100.0	1642	1.47	0	0	0	0
Laydown Area 24	1612	1.34	100.0	1612	1.34	0	0	0	0
Laydown Area 25	1681	1.55	100.0	1681	1.55	0	0	0	0
Laydown Area 26	1629	1.76	100.0	1629	1.76	0	0	0	0
Laydown Area 27	1676	1.82	100.0	1676	1.82	0	0	0	0
Laydown Area 28	1716	0.89	82.6	1417	1.00	0	0	0	0
Laydown Area 29	1303	1.46	100.0	1303	1.46	0	0	0	0

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Construction Compound 1	9990	0.75	84.1	8404	0.82	0	0	0	0
Construction Compound 2	2499	1.87	100.0	2499	1.87	0	0	0	0
Construction Compound 3	2515	1.22	100.0	2515	1.22	0	0	0	0
Construction Compound 4	3000	1.29	99.1	2973	1.30	0	0	0	0
Substation Excavated Area	3767	1.16	100.0	3767	1.16	4,370	565	3,805	0
Substation Floated Area	2243	0.97	99.8	2238	0.97	0	0	0	0
Borrow Pit A	24926	0.60	53.6	13365	0.84	11,208	2,005	9,203	3,628
Borrow Pit B	14618	1.05	99.2	14496	1.05	15,268	2,174	13,094	57
Borrow Pit C	13184	1.21	100.0	13184	1.21	16,011	1,978	14,034	3
Borrow Pit D	6734	1.14	98.7	6645	1.15	7,617	997	6,620	31
Borrow Pit E	38468	1.07	92.2	35483	1.13	40,027	5,323	34,704	1,047

Infrastructure	Infrastructure area (m^2)	Average peat depth over infrastructure area (m)	Percentage of infrastructure with >0.5m depth of peat	Area of infrastructure with >0.5m depth of peat (m^2)	Average peat depth over area of infrastructure with >0.5m depth of peat (m)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)	Volume of soils excavated (m^3)
Borrow Pit F	28831	1.64	100.0	28826	1.64	47,207	4,324	42,883	7
Borrow Pit G	4160	1.03	93.4	3884	1.08	4,180	583	3,598	102
Borrow Pit H	24629	1.42	99.7	24557	1.42	34,827	3,684	31,144	23
Borrow Pit I	36252	0.80	85.1	30837	0.87	26,848	4,626	22,222	2,127
New Track Excavated	12763	1.12	89.1	11371	1.21	13,791	1,706	12,085	530
Upgraded Track Floating	2103	1.70	98.4	2069	1.73	0	0	0	0
New Track Floating	92057	1.49	99.0	91145	1.50	0	0	0	0
New floating track to be restored	5698	1.53	100.0	5,698	1.53	0	0	0	0
Total	483,209					360,763	43,174	317,589	9,113

Table 6 – Excavated Peat Volumes based on Excavated Slopes and Drains around Infrastructure

Infrastructure	Additional Infrastructure area– slopes and drains (m^2)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)
Turbine 1	104	51	14	37
Turbine 2	70	20	9	11
Turbine 3	71	21	9	12
Turbine 4	48	9	6	3
Turbine 5	78	30	10	19
Turbine 6	145	121	20	100
Turbine 7	110	48	15	33
Turbine 8	81	25	10	14
Turbine 9	107	68	15	53
Turbine 10	80	26	10	16
Turbine 11	181	155	25	129
Turbine 12	99	46	13	32
Turbine 13	88	30	11	19
Turbine 14	125	79	17	62
Turbine 15	73	22	9	13
Turbine 16	110	64	15	49
Turbine 17	86	39	12	27
Turbine 18	166	136	23	113
Turbine 19	146	114	20	94
Turbine 20	143	108	20	88
Turbine 21	93	38	12	25
Turbine 22	77	25	10	15
Turbine 23	138	86	19	67
Turbine 24	144	105	20	85

Infrastructure	Additional Infrastructure area– slopes and drains (m^2)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)
Turbine 25	134	86	18	68
Turbine 26	148	108	21	88
Turbine 27	186	161	26	135
Turbine 28	61	13	7	6
Turbine 29	133	79	18	61
Crane hardstanding 1	562	199	74	125
Crane hardstanding 2	482	151	62	89
Crane hardstanding 3	599	240	80	160
Crane hardstanding 4	291	47	33	14
Crane hardstanding 5	696	354	94	260
Crane hardstanding 6	875	580	121	459
Crane hardstanding 7	893	630	124	506
Crane hardstanding 8	638	246	84	161
Crane hardstanding 9	820	531	113	418
Crane hardstanding 10	592	237	79	158
Crane hardstanding 11	1,005	862	141	721
Crane hardstanding 12	721	419	99	320
Crane hardstanding 13	773	397	105	292
Crane hardstanding 14	888	589	123	467
Crane hardstanding 15	653	279	87	192
Crane hardstanding 16	874	588	121	467
Crane hardstanding 17	532	191	70	122
Crane hardstanding 18	1,219	1,121	171	949
Crane hardstanding 19	836	542	115	427
Crane hardstanding 20	1,030	791	144	647

Infrastructure	Additional Infrastructure area– slopes and drains (m^2)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)
Crane hardstanding 21	601	236	80	156
Crane hardstanding 22	765	399	104	295
Crane hardstanding 23	690	350	94	256
Crane hardstanding 24	943	631	130	501
Crane hardstanding 25	838	529	115	414
Crane hardstanding 26	1,091	865	152	713
Crane hardstanding 27	984	862	138	724
Crane hardstanding 28	735	264	97	168
Crane hardstanding 29	1,193	889	166	723
Laydown Area 1	89	16	10	5
Laydown Area 2	88	16	10	5
Laydown Area 3	90	16	11	5
Laydown Area 4	92	16	11	5
Laydown Area 5	92	16	11	5
Laydown Area 6	91	16	11	5
Laydown Area 7	88	16	10	5
Laydown Area 8	90	16	11	5
Laydown Area 9	94	17	11	5
Laydown Area 10	89	16	11	5
Laydown Area 11	89	16	10	5
Laydown Area 12	92	16	11	5
Laydown Area 13	84	15	10	5
Laydown Area 14	92	16	11	5
Laydown Area 15	92	16	11	5
Laydown Area 16	89	16	11	5

Infrastructure	Additional Infrastructure area– slopes and drains (m^2)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)
Laydown Area 17	94	17	11	6
Laydown Area 18	89	16	11	5
Laydown Area 19	87	15	10	5
Laydown Area 20	91	16	11	5
Laydown Area 21	90	16	11	5
Laydown Area 22	92	16	11	5
Laydown Area 23	90	16	11	5
Laydown Area 24	89	16	11	5
Laydown Area 25	91	16	11	5
Laydown Area 26	89	16	11	5
Laydown Area 27	91	16	11	5
Laydown Area 28	92	16	11	5
Laydown Area 29	61	11	7	4
Construction Compound 1	1,084	50	33	17
Construction Compound 2	407	19	13	6
Construction Compound 3	528	24	16	8
Construction Compound 4	374	17	12	6
Substation Excavated Area	0	0	0	0
Substation Floated Area	599	28	18	9
Borrow Pit A	493	87	58	29
Borrow Pit B	266	47	31	15
Borrow Pit C	332	58	39	19

Infrastructure	Additional Infrastructure area– slopes and drains (m^2)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)
Borrow Pit D	251	44	30	15
Borrow Pit E	641	113	75	37
Borrow Pit F	507	89	60	30
Borrow Pit G	120	21	14	7
Borrow Pit H	448	79	53	26
Borrow Pit I	542	96	64	32
New Track Excavated	14,612	12,061	2,114	9,947
Upgraded Track Floating	2,854	132	88	44
New Track Floating	83,262	3,841	2,569	1,272
New floating track to be restored	4,778	220	147	73
Total	140,730	33,411	9,292	24,119

Table 7 – Total Peat Excavation Volumes

	Total area of infrastructure, slopes and drains (m^2)	Volume of peat excavated (m^3)	Volume of acrotelm peat excavated (m^3)	Volume of catotelm peat excavated (m^3)
Total Infrastructure Footprint	483,209	360,763	43,174	317,589
Excavated slopes and drains around infrastructure	140,730	33,411	9,292	24,119
Total	623,939	394,175	52,467	341,708

In order to determine accurate peat volumes probing and/ or other ground investigation techniques will be employed as necessary prior to and during the works in order to inform micro-siting requirements and to further update the peat management plan.

Peat Reuse Volumes

From Table 7 above, the volume of peat that will be excavated for construction of the infrastructure is ~52,500 m^3 of acrotelm, and ~341,700 m^3 of catotelm peat. This volume of peat will be reused around the site in the following areas:

- In all nine borrow pits to a depth of 2m;
- along the 2 in 1 sloped verges along all tracks and around all infrastructure in a 0.5m thickness;
- in areas where floated track, floated construction compounds and laydown areas are removed from subsequent to the construction period in a 0.3m thickness; and
- in any drains that can be backfilled subsequent to restoration, e.g. around the borrow pits.

This is detailed below in Table 8 and on Figure 10.11.

Table 8 – Estimated Reuse Volumes

Reuse Type	Reuse Summary	Area (m2)	Acrotelm volume (m3)	Catotelm volume (m3)	Total Volume (m3)
Peat reinstatement around free perimeter of turbine foundation	Length of 29m to 39m per turbine with a 2 in 1 slope. Excavated peat stored adjacent for replacement once turbine concreting complete.	2,509	354	1,432	1,785
Peat reinstatement along verges of crane hardstanding	Length of 217m to 300m per crane hardstanding with 0.5m thickness of peat reinstatement on a 2 in 1 slope.	18,002	3,019	7,044	10,063
Peat reinstatement on Laydown areas after infrastructure removed	Irregular area of between 1,303m2 and 1,852m2 reinstated with 0.3m thickness of peat.	47,682	7,152	7,152	14,304
Peat reinstatement on construction compound areas after infrastructure removed	Areas between 2,500 and 9,990m2 plus slope around perimeter. To be reinstated with 0.3m of peat.	19,770	2,966	2,966	5,932
Peat reinstatement along verges of substation	Perimeter of 221m with 0.5m thickness of peat reinstatement on a 2 in 1 slope.	442	72	168	240
Peat reinstatement in all 9 borrow pits	Peat placed at a thickness of 2m in each borrow pit.	191,802	28,770	354,834	383,604

Reuse Type	Reuse Summary	Area (m2)	Acrotelm volume (m3)	Catotelm volume (m3)	Total Volume (m3)
Peat reinstatement along verges of excavated tracks	Peat placed in a 0.3m thickness along excavated track verges	8,643	778	1,815	2,593
Peat reinstatement along verges of new and upgraded floated tracks	Peat placed in a 0.5m thickness along floated track verges	63,554	10,663	24,881	35,545
Peat reinstatement in temporary floated track sections	Area of 5,698m2 put verges of 3,526m2. To be reinstated with 0.3m of peat.	9,224	1,384	1,384	2,768
Backfilling of drains associated with temporary construction areas	Length of drains alongside borrow pits, construction compounds and temporary floated tracks. Peat to be reinstated to surface	5,479	648	316	965
Total		367,107	55,806	401,992	457,799

It is assumed that the cable trenches will have no impact on peat as the removed volume will be replaced and clay will be used at regular intervals to prevent preferential pathways developing in the sand/cable layer at the base of the trench.

Final implementation of peat reuse and classification will be subject to geotechnical on site tests e.g. shear vane testing, to determine peat stability and type and use potential.

Net Peat Balance

The volume of peat predicted to be excavated does not exceed the intended re-use volume so no disposal of excess peat off site is expected for this Proposed Development. The excavated peat volumes and volumes of peat to be re-used are summarised in Table 9 below.

Table 9 – Net Peat Balance

	Acrotelm volume (m3)	Catotelm volume (m3)	Total Volume (m3)
Excavated Peat	52,467	341,708	394,175
Potential Peat Reuse	55,806	401,992	457,799
Total Balance	-3,339	-60,284	-63,624

Over the life time of the Proposed Development it is expected that there will be a potential for more peat to be reused on the site than the volume excavated. This is as a result of 30.6 ha of peatland habitat being directly lost to tracks, turbines and crane hardstandings generating a total amount of excavated peat of around 394,000m^3 and there is a capacity for the reuse of almost 458,000m^3 of peat onsite.

The calculations for the re-use of excavated peat are based on discussions with SEPA on the re-use of peat which indicated that peat could be re-used for restoration up 2 metres thick in borrow pits given the deep peat nature of the site along with up to 0.5m along verges.

Handling Excavated Materials

Excavation

The following methodologies for excavation of peat are recommended:

- Areas of peat within the footprint of any excavation will have the top layer of vegetation stripped off as turf prior to construction by an experienced specialist contractor. When excavating areas of peat, excavated turfs should be as intact as possible. Often it is easiest to achieve this by removing large turfs up to 500mm in order to keep the peat intact.
- These turfs should be stored adjacent to the construction area in a way that ensures they remain moist and viable (see temporary storage below). Excavated turfs should be as intact as possible so as to minimise carbon losses.
- Peat will then be removed, stored separately and kept damp (Carbon and Water Guidelines 2012). The moisture content of stored/stockpiled peat will be monitored monthly and if it falls below 25% of that in surrounding, intact peat then it will be watered.
- Excavated soils and turfs will be handled so as to avoid cross contamination between distinct horizons and ensure reuse potential is maximised.
- Prior to any excavations, the Contractor will produce a detailed Method Statement identifying where and how excavated peat will be used in reinstatement or landscaping works. Specific requirements for the excavation, handling, storage and reinstatement of peat will be outlined in this Method Statement. The Contractor will consider potential impacts on downstream hydrological receptors and also the potential for instability issues with the excavated material.
- Care will be taken when stripping and removing topsoil and peat turfs and appropriate storage methods used on site, i.e. excavated material will be stored in separate horizons and vegetation rich top layers will be stored vegetation side up.

- Classification of excavated materials will depend on their identified re-use in reinstatement works. At this site it is anticipated that the material to be excavated will comprise peat (which may be sub-divided into turf, acrotelm and catotelm/amorphous), peaty soils and mineral soils (subsoil and topsoil).

Temporary Storage

Following excavation, peat will be required to be temporarily stored before reuse, although peat restoration will commence in locations as soon as feasible e.g. in borrow pits as they are completed. Excavated peat should be stored in stockpiles to minimise carbon losses while being stored.

Where possible excavated turfs will be stored adjacent to the construction area such that they remain moist and viable.

Areas for temporary storage required for peat will be identified in the Principal Contractors Method Statement taking into account constraints and mitigation requirements identified in further pre construction investigations. This will describe any intended drainage, pollution prevention and material stability mitigation measures that may be required. The following general guidelines will apply:

- The appropriate temporary storage areas for excavated peat will also be as close to the excavation as practicable.
- A number of areas for temporary peat storage have been identified alongside the proposed tracks (Figure 10.11). These have been determined to be suitable area for temporary excavated peat storage as the ground conditions are suitable for some loading, the peat slide risk is low, they are outside of the main watercourse buffers and the gradients are low (Figures 10.10a and 10.10b). This would be supplemented by smaller peat storage areas near to each section of infrastructure where the peat is extracted and to be re-used to minimise the handling and transportation requirements.
- The design and location of stockpiles, including incorporated drainage elements, will be agreed with the ECoW and Geotechnical Consultant / Geotechnical Clerk of Works prior to excavation works commencing.
- Temporary peat storage areas should be located so that erosion and run off is limited, leachate from the material is controlled, and stability of the existing peatland in the vicinity is not affected.
- Excavated material is to be stockpiled at least 50m away from watercourses. This will ensure that any wetting required on stored peat does not runoff and discharge into adjacent watercourses.
- Any edges of cut peat that may remain exposed, or areas of peat excavation on steep slopes, will be covered with geotextile or similar approved. This will allow re-turfing and re-vegetation and reduce erosion risks.
- Suitable storage areas are more appropriately sited in areas with lower ecological value and low slopes. Cleared areas of forestry are preferred to areas of higher ecological value or areas close to watercourses.
- Temporary peat storage should be in locations where the water table can be kept artificially high.
- An up-gradient cut off ditch should be installed around the edge of the storage bund in order to collect up-gradient surface water runoff and divert water runoff from eroding the toe of the bund.

- It is desirable to keep haul distances of excavated peat as short as possible and as close to intended re-use destinations to minimise plant movements in relation to any earthworks activity including peat management in order to minimise the potential impact on the peat structure. It is important that temporary storage is safe and keeps the material suitable for its planned reuse.
- The handling and storage of peat will seek to ensure that excavated peat does not lose either its structure or moisture content. Peat turves require careful storage and wetting and to be maintained to prevent drying out and subsequent oxidisation to ensure that they remain fit for re-use.
- Stockpiling of peat should be in large volumes, taking due regard to potential loading effects. Piles should be bladed off at the side to minimise the available drying surface area.
- Higher piles are more likely to become dewatered, while smaller piles expose a greater area to evaporation. Reducing mound size may also increase likelihood of erosional losses as particulate organic carbon (POC). Overall volumes of stockpiling should be minimised and height and surface areas kept to a minimum – for example, a maximum of 1m high and against rock faces in borrow pits where possible.
- Stockpiles should be battered so as to limit instability and erosion and should be bunded or covered using impermeable material. The bunds should extend to a level above the toe of the stockpiled material to provide restraint to surface runoff.
- When planning the temporary storage areas any additional disturbance areas should be minimised.
- Transport of peat to temporary storage areas, restoration areas or designated spoil areas will be by low ground pressure vehicles to avoid excessive compaction of the peat.

Reuse of Peat in Infrastructure and Borrow Pit Restoration

Bare Peat

There are a number of important methodologies regarding the exposure of bare peat including:

- The amount of time any bare peat will be exposed will be minimised to preserve its integrity.
- The phasing of work should be carried out to minimise the total amount of exposed ground at any one time. By stripping turf and replacing as soon as possible after peat has been re-distributed there will be minimal areas of bare peat.
- Any peat areas on steep ground or that remains partially bare will be covered using geotextile or a similar method to stop erosion.
- Any areas of bare peat, where vegetation is not re-growing, will be seeded with a seed mixture obtained from the existing habitat. Areas where full recovery is complete will have fences removed.

This approach has been shown to be effective on other peat sites and the turfs re-grow quickly both establishing vegetation and consolidating the peat. The re-vegetated areas will be monitored. Any areas of bare peat, where vegetation is not re-growing, will be seeded with a seed mixture obtained from the existing habitats on site. Stock exclusion in these areas will continue until vegetation is properly established.

Infrastructure Re-use

Peat reuse around and within infrastructure areas is an important aspect of the Proposed Development as it allows an opportunity to maintain the integrity of the excavated peat, enhance habitats and create new habitats. This will be undertaken through:

- The Principal Contractor will be required to provide appropriate plant for undertaking all reinstatement works such that no unnecessary disturbance of the ground surface occurs. In order to minimise disturbance and damage to the ground surface, any mobile plant required for reinstatement and landscaping works will be positioned on constructed access tracks, hard standing areas or existing disturbed areas wherever possible. The use of a long reach excavator for excavations and reinstatement works is preferable as it enables sufficient room to allow initial side casting and subsequent pulling back of turves over reinstated peat or soil.
- Excavated catotelm or amorphous peat will only be used in restoration works where the topography allows straight forward deposition with no pre-treatment or containment measures and without risk to the environment. Suitable scenarios may be present in those disturbed areas where natural topography profile allows such use. A fibrous layer of acrotelm and turf will be placed above any catotelm or amorphous peat reinstated.
- Reinstatement of vegetation will be focused on natural regeneration utilising peat vegetated turfs. To encourage stabilisation and early establishment of vegetation cover, where available, peat turfs (acrotelmic material) or other topsoil and vegetation turves in keeping with the surrounding vegetation type will be used to provide a dressing for the final surface.
- Appropriate drainage will be required where peat is used in reinstatement, for instance track verges and reinstatement of construction compounds, etc so that the peat will be maintained in a saturated condition.
- Any reinstatement and re-profiling proposals will consider, and mitigate against, identified significant risks to environmental receptors. In particular, in areas of replaced peat, water management will be considered in the Contractor's Construction Method Statements to ensure that as far as possible an appropriate hydrological regime is re-established within areas of disturbance. Particular attention will be paid to maintaining hydrological continuity and preventing the creation of preferential subsurface flow paths (for instance within backfilled cable trenches).
- Peat turfs should be replaced on all disturbed areas, including constructed roadside drainage channel embankments where possible.
- When constructing tracks rapid restoration will be undertaken as track construction progresses.
- Immediately following construction some turfs will be replaced along the road edges to allow quicker re-vegetation and to soften the road edges
- Any landscaping or road batters should be limited to the areas of ground already disturbed.
- Track edges and passing places would be reinstated post construction through the removal of capping material and the reuse of peat turves. Where peat turves are used to reinstate track edges this will be done in a manner to ensure works tie in with the surrounding topography, landscape and ground conditions.
- The design and construction of tracks on peat shall be done in such a way so as to reduce impacts on the existing peat hydrology at the site. The built track should allow for the transmittance of water, so natural drainage can be maintained as far as possible.

- The re-vegetation of temporary hardstanding areas will depend on the identified reinstatement use and associated vegetation character bounding the areas of restoration, with the aim being to match turves and topsoil to similar ground conditions. Where appropriate, excess peat turves, if acrotelm in nature and considered suitable by the ECoW, could be used for screening bunds, landscaping or as part of a HMP in conjunction with reseeding. The seed mix used on site would be agreed with the ECoW and SNH and would use local native species akin to the local ecological baseline.

Summary

A high density grid of over 13,000 peat probes and associated cores has been completed at all site infrastructure to obtain a detailed understanding of peat variability, depth and characteristics at the site.

The total volume of excavated peat associated with the infrastructure footprint, associated excavated slopes and drains has been calculated at about 394,000m^3 with almost 52,500m^3 of acrotelmic peat and 342,700m^3 of catotelmic peat.

The potential reuse of excavated peat has been calculated based on SEPA guidance and totals almost 458,000m^3, comprised of 55,800m^3 of acrotelmic peat and 402,000m^3 of catotelmic peat.

Based on the peat depth, characteristics and distribution investigations undertaken across the development area and the wind farm infrastructure layout, a surplus of peat is not expected to be generated by the Proposed Development. All estimated excavated peat is planned for re-use for restoration work during the construction, post-construction, and decommissioning phases of the Proposed Development.

Further investigations will be undertaken prior to works commencing to confirm peat depth, distribution and characterisation. The additional survey data will be used to inform any micro-siting, and potentially further minimise the volume of peat extracted. The peat management plan will be further updated using the additional survey data and detailed infrastructure design.

An ECoW will maintain a record of actual peat volumes excavated and the subsequent peat re-use to compare the predicted and actual peat volumes. This record during the construction, operation, decommissioning and restoration phases of the Proposed Development will be made available for review by regulators as and when required.

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