



ARCUS

LOCHLUICHART WIND FARM EXTENSION II

APPENDIX 13.C

OUTLINE PEAT MANAGEMENT PLAN

DECEMBER 2018



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1 INTRODUCTION

1.1 Preparation of the Peat Management Plan

This outline Peat Management Plan (oPMP) for Lochluichart Wind Farm Extension II (the Proposed Development) has been prepared initially to inform the Highland Council and statutory consultees of the proposed peat and soils management methodologies to be employed during construction.

The purpose of the oPMP is to:

- Define the materials that will be excavated as a result of the Development, focusing specifically on the excavation of peat;
- Report detailed investigations into peat depths within the Development Site;
- Detail proposals for the management of excavated peat and other soils;
- Consider the potential impact of the Development on Ground Water Dependent Ecosystems (GWDTEs);
- Determine volumes of excavated arisings, the cut/fill balance of the Development and proposals for re-use or reinstatement using excavated materials; and
- Detail management techniques for handling, storing and depositing peat for reinstatement.

The oPMP has been produced in accordance with Scottish Renewables (SR) and the Scottish Environment Protection Agency (SEPA) Guidance on Peat Excavations and Management¹. This oPMP is intended to be a document that will evolve during the different phases of the project and as such will be subject to continued review to address:

- Requirements to discharge future Planning Conditions;
- Detailed ground investigations and design development;
- Unforeseen conditions encountered during construction;
- Changes in best practice during the life of the wind farm; and
- Changes resulting from the construction methods used by the contractor(s).

Whilst this oPMP provides a base standard for good practice, where avoidance or further minimisation of risks to the environment can be demonstrated through use of alternative methods or improvements to current practices, the Contractor will implement these wherever possible and will correspond with SEPA and Highland Council.

1.2 The Development Site

The Development is located between Loch Glascarnoch and Lochluichart approximately 18km north-west of Dingwall, close to the intersection between the A835(T) and A832. The Development will comprise of 9 turbines and the 'Site Layout Plan' is detailed in Figure 1.

Published geological mapping of superficial soils indicates the site to be underlain by peat in the central and southern areas. Till deposits typically comprising gravel, sand and silt were shown across the majority of the site. In the northern section of the Site area, occasional peat deposits were shown.

Published bedrock geology mapping indicates the site to be underlain by Caradoc aged rocks comprising Vaich Pelite Formation - Semipelite, Garnet and pockets of Glascarnoch Psammite Formation – Psammite in the western area of the Development

¹ SR and SEPA (2012) Guidance on the Assessment of Peat volumes, Re-use of Excavated Peat and the Minimisation of Waste [Online] Available at: http://www.scottishrenewables.com/media/uploads/publications/a4_developments_on_peatland.pdf (Accessed 18/10/2018)

Site. A geological fault was recorded to the east of the Development Site orientated south-west to north-east, next to Loch Luichart. No other faults were noted.

1.3 Consultation

Peat management and the assessment of borrow pit potential within the Development Site was considered throughout the Environmental Impact Assessment (EIA) for the Development and the outcomes of studies are reported in the EIA Report. The EIA Report formed part of the planning application and was made available to the Scottish Government, the Highland Council and its consultees including SEPA.

This oPMP considers assessments included in the EIA Report and responds to the consultees scoping opinions.

2 OBJECTIVES

2.1 Introduction

2.1.1 Background

The preparation of an oPMP responds both to the scoping responses from April 2017 and the intent to deliver a construction project that complies with good practice in accordance with SR and SEPA guidance.

By undertaking detailed peat survey work and carrying out assessments such as Peat Slide Risk Assessment (PSRA) and Borrow Pit Assessment (BPA) for the EIA, a consistent approach to the management of peat across the Development Site can be achieved.

The overall objective of the outline design has been to minimise the excavation of peat where possible, and achieve as close as practicable an overall material balance within the Development Site. This is considered to give the best opportunity to achieve reinstatement or restoration in accordance with good practice, and remove the need for waste management controls.

This objective is achieved through:

- Ensuring the characteristics of the Development Site are understood through extensive peat probing and assessing the sites topography;
- Understand the extents of the site layout and how excavations will take place; and
- Modelling the peat depth profile based on probing and digital terrain model in 3D.

2.1.2 Approach to Minimising Peat Excavation

The following steps have been taken during the outline design stage of the Proposed Development to minimise the impact on peat:

- The development of an access track design which avoids deeper peat where practicable;
- The design and orientation of turbines and crane hardstandings considers local topographical and peat constraints; and
- Consideration of borrow pit locations in an area of shallow peat cover.

At detailed design and construction stage these steps will be further supplemented by taking the following measures to minimise disturbance:

- Maximisation of batter angles in cuttings;
- Consideration of floating tracks; and
- The use of appropriate construction plant to avoid unnecessary disturbance of the ground surface.

The fundamental principle upon which this oPMP is based is that achieving a successful materials strategy is contingent on gaining a thorough understanding of the Development Site through investigation and developing a design that achieves the materials management objectives. For the Proposed Development, this principle is achieved by undertaking significant peat investigation works prior to preparing this oPMP.

2.2 Aims and Objectives

2.2.1 Need for a Peat Management Plan

This oPMP is prepared to demonstrate to the planning authority, SEPA and other consultees that the construction of the Development will progress in a manner that is

planned, is in accordance with good practice and achieves the aim of being environmentally sustainable.

The oPMP is therefore prepared in accordance with the SR and SEPA guidance. It defines:

- How the Development has been structured and designed so far as practicably possible to reduce the volumes of peat excavated;
- How volumes of peat excavated during the course of the works have been considered in the design; and
- How excavated peat will be managed.

2.2.2 Objectives of the outline Peat Management Plan

The main objectives of the oPMP is to outline how any peat expected to be excavated will be managed and re-used during the construction of the Development.

This is achieved through responding of the following objectives:

- Providing a description of peat conditions on site and how this was determined;
- Estimation of peat volumes to be excavated and re-used;
- Classification of excavated material;
- Consideration of the use of appropriate peat(s);
- Describing how excavated peat will be handled to ensure suitability for re-use;
- Determining if temporary storage of peat will be required during construction and how this will be done to ensure suitability for re-use; and
- Considering the potential volume of peat which may not be suitable for re-use and any requirement for a Waste Management Plan for the Development.

The response to these objectives is provided in the following sections.

3 PEAT MANAGEMENT

3.1 Investigations

The existing peat depths across the Development Site have been determined through a phased survey approach undertaken during EIA. The survey was initiated to inform the EIA and site design work while supporting the PSRA. The survey comprised a total of 752 probes.

Peat depths ranged from zero to 3.75 m thickness across the Development Site and were shown as localised or isolated zones within the north-eastern site area. This was consistent with the British Geological Survey mapping.

Initial peat depth surveys were undertaken in April and August 2017 comprising 100 m grid coverage across the Development Site, where accessible. This rationale of probing is in accordance with the Phase 1 approach as detailed in the Scottish Government guidance for investigating peat.

Further peat depth surveys (Phase 2) was undertaken in June 2018. The probe positions for this visit were focussed on the proposed turbine, access tracks and other key infrastructure. Peat depths were measured along the proposed access tracks at 50 m centres with offsets of 25 m on either side of the centre line, with 10 m grid spacing at turbines east of the existing wind farm spine road where deeper peat had previously been recorded, and 10 m cross-hair at turbines west of the spine road.

The peat depths are illustrated in Figure 2 'Recorded Peat Depth'.

3.2 Summary of Peat Depths

Throughout the peat surveys to date, a total 752 probes were progressed. Over 70% of these recorded no peat or peat less than 0.5 m while 11% of probes recorded peat between 0.5 m and 1.0 m. Thick peat (where the depth was greater than >1.0 m) was recorded in 19% of locations.

The maximum peat depth recorded was 3.75 m in the eastern area of the Proposed Development in a topographically low-lying area between Meallan Caoruinn and Socach Allt Giubhais. Generally, peat depths did not exceed 0.5 m, which is anticipated with steep topography and in rocky outcrop areas.

Peat varied between 1.0 m to 2.0 m depth west of Meallan Caoruinn in the vicinity of Caochan Ban and Allt na Beinne Leithe Bige watercourses. This area was noted to be occupied by hummocky ground and there was evidence of localised 'peat creep' and local surface drainage features were abundant. The distribution of peat deposits along the proposed tracks and infrastructure are shown on Figure 3 'Peat Depth Interpolation' included in Appendix 1.

Where peat is consistently over 1.0 m thick and existing ground levels permit, the use of floating roads should be adopted (as indicated in Figure 4 'Areas of Possible Floating Roads'). Prior to commencing works on site, the Contractor as part of any floating road design will undertake further ground investigation to establish peat characteristics and surcharging strategies.

3.2.1 General Peat Classification

Acrotelmic peat is the upper layer of peat consisting of living and partially decayed material with a higher hydraulic conductivity and a variable water table. These deposits are generally found to exist in the upper 0.5 m of peat deposits and is typically suitable for re-instatement because it contains viable plant life to assist in the regeneration of peatland vegetation and carbon sequestration.

Catotelmic peat is variable in characteristics, with decomposition of fibres generally increasing with depth. Water content can be highly variable and affects the structural strength of the material. Suitability for re-use generally depends on fibre and water content. The upper catotelm is commonly deemed as being appropriate for re-use in restoration due to its relatively high fibre content.

Generally excavated semi fibrous catotelmic peat from the Development Site will have sufficient structural strength to be able to be used in the lower layers of verge restoration as it will not be 'fluid'.

The catotelmic peat would be capped with a surface layer of actrotelm to re-establish the peat vegetation. If any fluid like wet catotelmic peat is encountered then it would be placed in more appropriate locations such as low-lying section of the borrow pits or concave deposition areas.

The following assumptions have been made in classifying peat excavated during the construction work:

- Where the total peat depth was found to be less than 0.5 m, this peat material is assumed to be 100% acrotelmic;
- Where the total peat depth is between 0.5 m and 1.0 m, the upper acrotelmic peat is at least 0.5 m deep; and
- Where the total peat depth as found to be greater than 1.0 m, acrotelmic peat is assumed to account for at least 30% of total depth but generally applying minimum of 0.5 m thick.

Existing topography and permitted track gradients drive the design of the infrastructure with due consideration given to potential construction risk and effects on environmentally sensitive receptors including deep peat, watercourse buffers and any GWDTEs. Further micro-siting post-consent would take place in such a way as to avoid where possible the excavation of deep peat.

3.2.2 Excavation Calculation

An estimate of excavated volumes against access track lengths, turbines and crane hardstandings in line with the outline design stage has been undertaken. This was completed by assessing the 2D layout against the 3D interpolated peat data. Detailed earthworks volumes were not available for the project at this stage.

Volumes of excavation and an estimate on the excavated material compositions, be this non-peat superficial soils, peat or other materials is included in Table 3.1 using the anticipated construction activities that will generate excavated soils.

Table 3.1 Peat excavation volumes based on construction activity

Development Component	Estimated Volume of Excavated Peat (m ³)	Estimated Volume of Acrotelmic Peat (m ³)	Estimated Volume of Catotelmic Peat (m ³)
General earthworks associated with widening/ upgrade of existing tracks, new access tracks, crane Pads and turbine bases	42,500	14,167	28,333
Borrow pit	7,500	2,500	5,000
Construction compound/Substation	3,000	1,000	2,000
SUB-TOTAL	53,000	17,667	35,333

Development Component	Estimated Volume of Excavated Peat (m ³)	Estimated Volume of Acrotelmic Peat (m ³)	Estimated Volume of Catotelmic Peat (m ³)
Estimate of peat left in-situ through floating track areas	12,000	4,000	8,000
TOTAL	41,000	13,667	27,333

A detailed assessment of excavated volumes by location within the Development Site is provided in Appendix 2 of this report.

3.2.3 Peat Re-use Requirements

The principles of re-instating peat and peat soils should be adhered to for all elements of the infrastructure, comprising the below:

- Peat and peaty soils will be reinstated on track and infrastructure verges with turves placed on the upper horizons encouraging re-vegetation;
- All peat, soil and turves excavated from beneath infrastructure (excluding any floating track section) will be re-instated in the vicinity of its original location;
- Any wet catotelmic peat will be placed at the bottom of any restoration profile, followed by semi fibrous catotelmic peat and then acrotelmic should be placed on top; and
- Restoration activities will be overseen by the Ecological Clerk of Works to ensure methods are properly adhered to.

Table 4.2 shows the opportunities for re-use of peat with the Development Site including the demand for acrotelm and catotelm peat. Table 4.3 summarises the total peat balance estimated during construction of the Proposed Development.

Table 3.2 Peat Re-use volumes based on construction activity

Development Area	Total Demand Estimate (m ³)	Acrotelm Demand (m ³)	Catotelm Demand (m ³)	Estimated Reinstatement Thickness (max) where gradient permits (m)	Assumptions
General earthworks associated with widening/ upgrade of existing tracks, new access tracks, crane Pads and turbine bases	30,653	8,398	22,255	1.0	Dressing off and landscaping of 9 turbines bases on verge and earthwork banks, both assume up to 1.00 m thick reinstatement.
Borrow Pits	7,500	4,050	3,450	0.5	Assumption made that peat reinstatement thicknesses will reflect the peat

					excavated prior to borrow pit workings, i.e up to 0.5 m at borrow pits 1 and 2.
Construction Compounds/ Substation	3,000	1,350	1,650	0.6	Full reinstatement of compound and dressing off of side slopes at sub-station compound.
Total	41,153	13,798	27,355		

Table 3.2 is presented as a summary of the assessment of peat reinstatement volumes. A detailed assessment is provided in Appendix 2 of this report.

The following assumptions have been made in assessing peat re-use:

- New access track sections assume verges on both sides at widths of approximately 0.5 m. As the access track edges will have graded slopes, peat depths will vary across the profile to tie into existing ground levels;
- Upgraded track sections assume a verge on the upgraded side 0.5 m wide. As the access track edges will have graded slopes, peat depths will vary across the profile to tie into existing ground levels;
- Verges along the access tracks could consist of up to 0.6 m thick peat. Where possible catotelmic peat will be reinstated along verges in flatter areas;
- No peat will be placed on access track verges where the local topography is steep and/or a watercourse is in close proximity. This has been reflected in the volumes generated for access track sections;
- Peat will be laid only to a thickness that maintains hydrological conditions and to avoid drying out. Peat will not be used as a thin layer or on steeper non-peat slopes. Low verges and landscaping will be formed to permit surface water to drain off the access tracks;
- Catotelmic soils will only be used if it is suitable for purpose; and
- Borrow pit reinstatement assumes a maximum peat depth thickness of that which existed prior to borrow pits works, but anticipated not to exceed 0.5 m. This will include the re-use of acrotelmic peat soils and turves.

Table 3.3 - Peat Balance Calculations

Peat Description	Total Peat Demand Estimate for Reinstatement (m ³)	Total Peat Supply from Excavation (m ³)	Surplus (+) or Deficit (-) (m ³)
Acrotelm	13,798	13,667	-131
Catotelm	27,355	27,333	-22
Total	41,153	41,000	-153

Table 3.3 demonstrates that there will be a small deficit of peat. These volumes should be considered in the context of the total excavated peat during construction. It is likely that balance would be achieved once total excavated peat is established by the Contractor and reinstatement depths are adjusted accordingly.

3.2.4 Handling and Storage of Peat

It will be necessary for the Contractor to prescribe methods and timing involved in excavating, handling and storing peat for use in reinstatement. The contractor will be responsible for appointing a chartered geotechnical engineer, as discussed in the Construction Environmental Management Plan (CEMP), who will monitor any potential stability risks. Construction methods will be based on the following principles:

- The surface layer of peat (acrotelm) and vegetation will be stripped separately from the catotelmic peat. This will typically be an excavation depth of up to 0.5 m;
- Acrotelmic material will be stored separately from catotelmic material;
- Careful handling is essential to retain any existing structure and integrity of the excavated materials and thereby maximise the potential for excavated material to be re-used;
- Less humified catotelmic peat which maintains its structure upon excavation should be kept separate from any highly humified amorphous or wet catotelmic peat;
- Acrotelmic material will be replaced as intact as possible once construction progresses / as it is complete;
- To minimise handling and transportation of peat, acrotelmic and catotelmic will be replaced, as far as is reasonably practicable, in the locality from which it was removed. Acrotelmic material is to be placed on the surface of reinstatement areas;
- Temporary storage of peat will be minimised, with restoration occurring in parallel with other works;
- Suitable areas should be sited in locations with lower ecological value, low stability risk and at a suitable distance from water courses;
- Reinstatement will, in all instances, be undertaken at the earliest opportunity to minimise storage of turves and other materials;
- Managing the construction work as much as possible to avoid periods when peat materials are likely to be wetter i.e. high rainfall events;
- Temporary storage and replacement of any peat excavated from the borrow pit should occur adjacent to and within the source pit; and
- Transport of peat on site from excavation to temporary storage and restoration site should be minimised.

3.2.5 Waste Management Plan Requirements

The CEMP contains details relating to the waste management requirements. Based on the calculations carried out, the total peat volumes excavated will be fully incorporated in to the re-instatement works, therefore is unlikely to require a waste management licence.

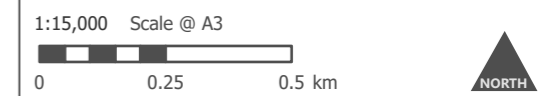
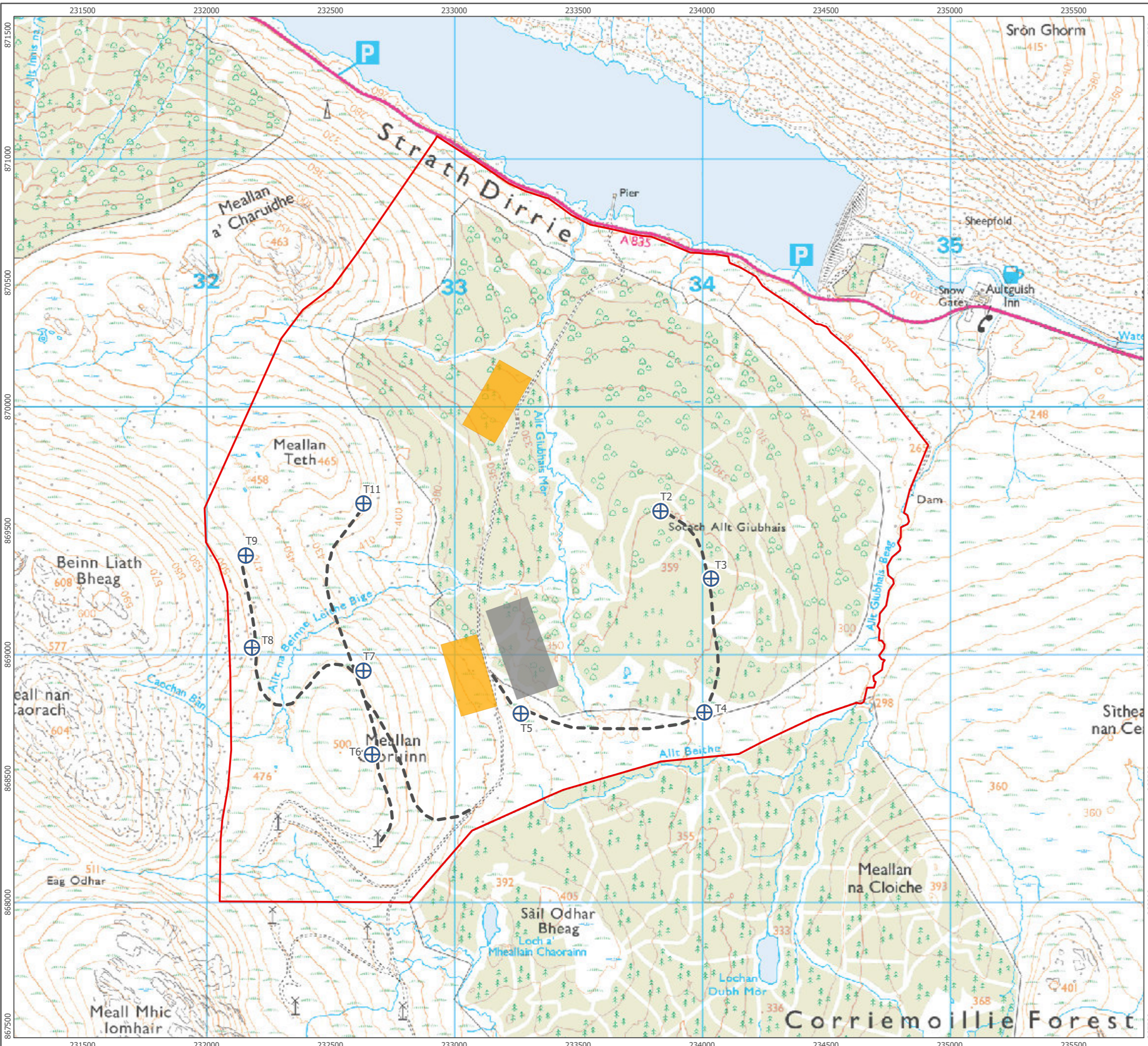
4 CONCLUSIONS

The following conclusions are drawn regarding the management of peat and excavated materials within the Proposed Development Site:

- As a result of the peat excavation and re-use estimates, it is demonstrated that all excavated peat can be suitably re-used on site;
- The re-use calculations includes the assumption of using floating track construction methods as identified in Figure 4 'Areas of Possible Floating Roads';
- Excavated peat will be used for the reinstatement of access track verges, cut and fill embankment slopes, reinstatement of turbine hardstandings, reinstatement of borrow pits and compound areas;
- The estimates of excavated peat provided in this report are likely to be higher than actually occur, as micro-siting during construction will allow for the avoidance of localised pockets of deeper peat;
- Sufficient methods have been defined to ensure that peat can be sensitively handled and stored on -site to allow for effective re-use; and
- No waste licence is required for the construction work.

APPENDIX 1 - DRAWINGS

- Site Boundary
- ⊕ Proposed Turbine Location
- Access Tracks
- Borrow Pit
- Sub-station / Control Building



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Site Layout Plan
Figure 1

**Lochluichart Extension II
Peat Management Plan**

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- Site Boundary
 - ⊕ Proposed Turbine Location
 - Borrow Pit
 - Sub-station / Control Building
- Peat Depth (m)
- 0 - 0.50
 - 0.51 - 1.00
 - 1.01 - 1.50
 - 1.51 - 2.00
 - 2.01 - 2.50
 - 2.51 - 3.00
 - 3.01 - 3.50
 - 3.51 - 4.00

1:15,000 Scale @ A3

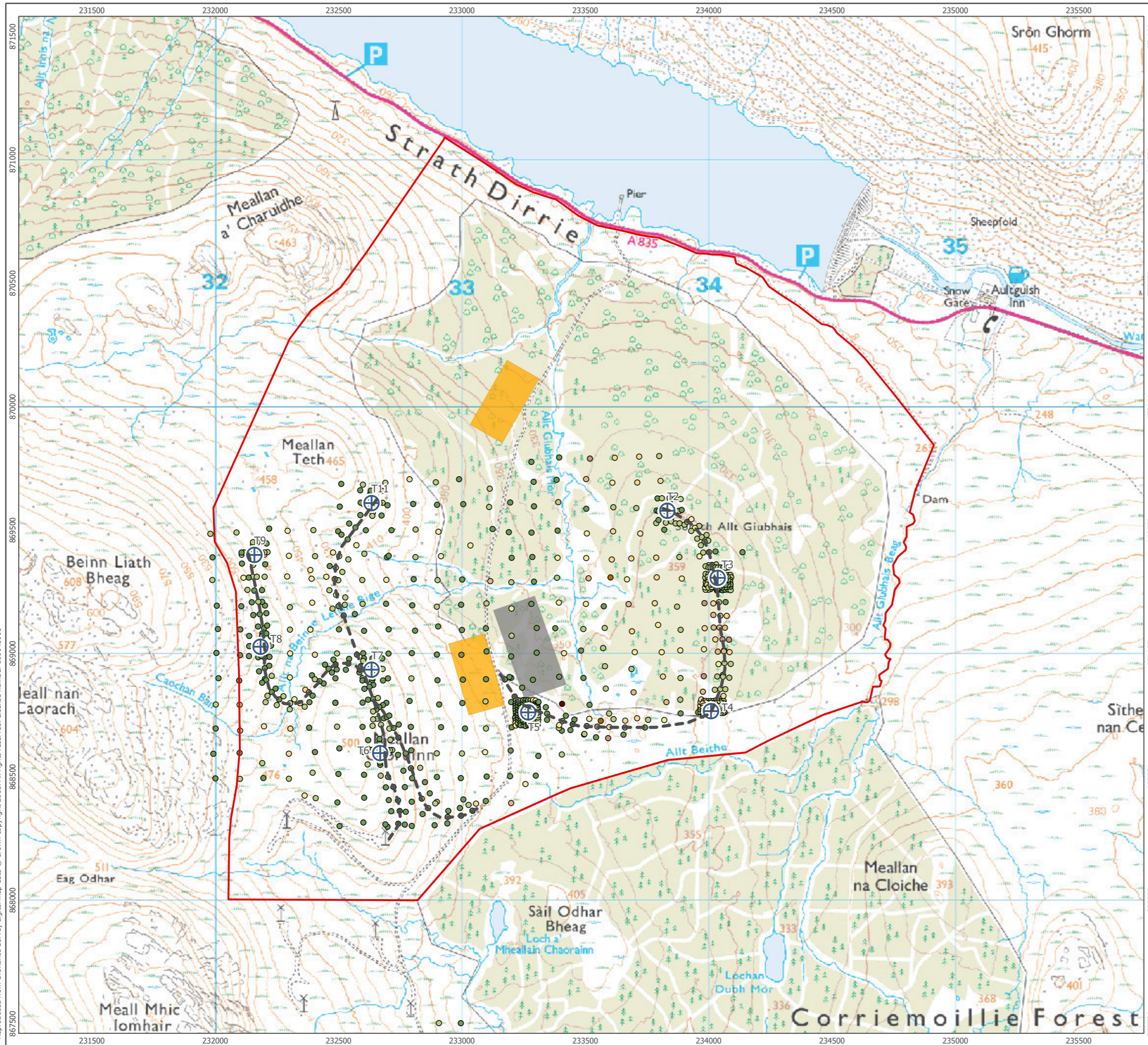
 0 0.25 0.5 km



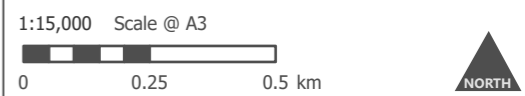
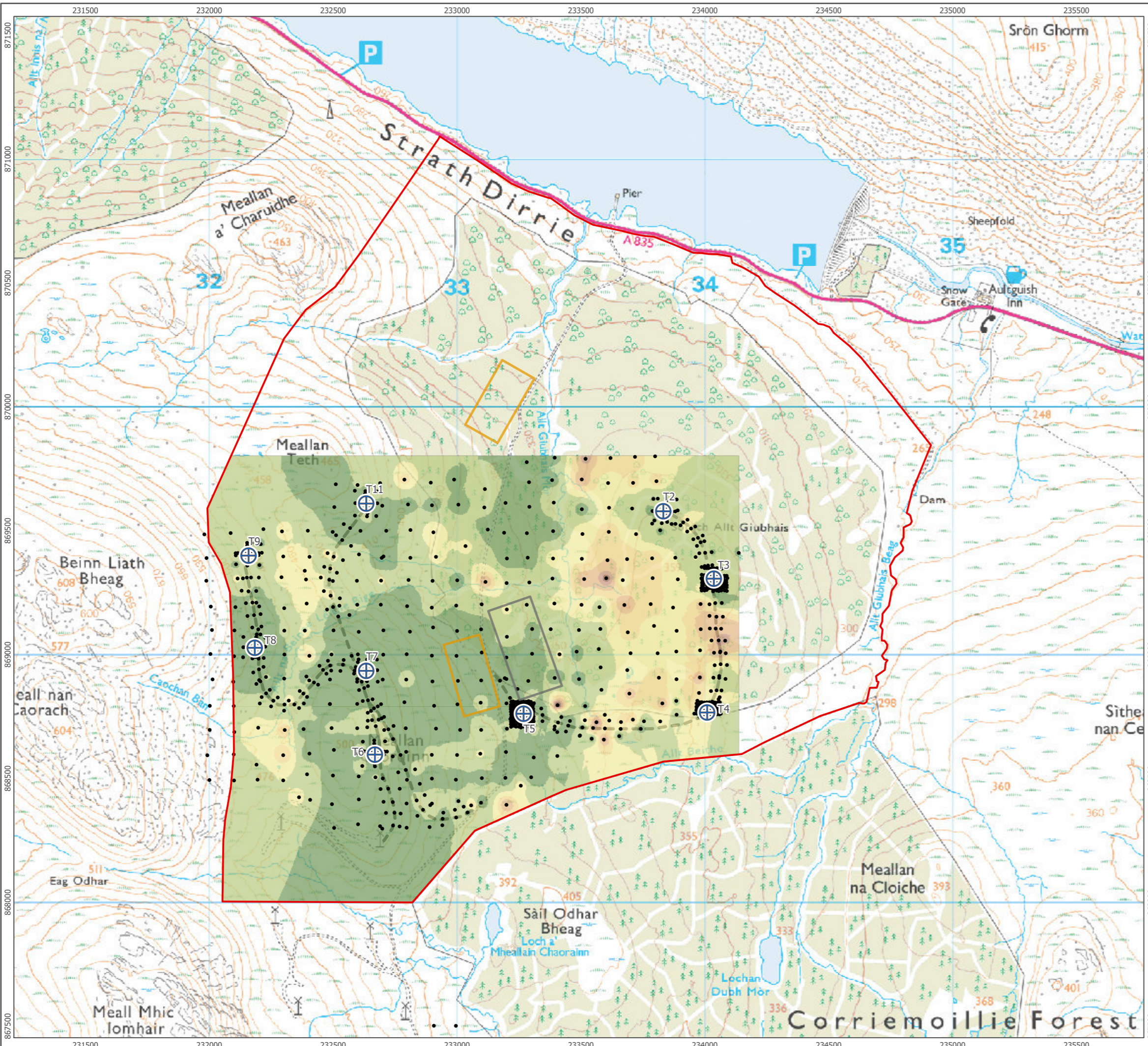
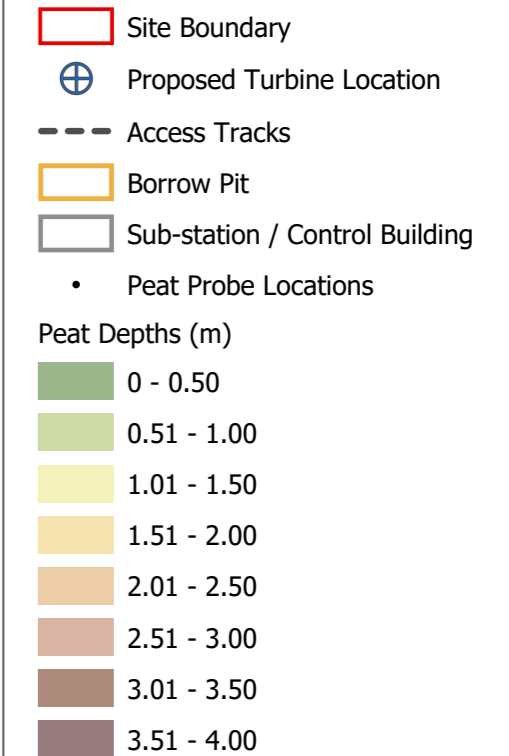
Produced By: RL	Ref: 2414-REP-034
Checked By: AG	Date: 14/11/2018

Recorded Peat Depths
Figure 2

**Lochluichart Extension II
Peat Management Plan**



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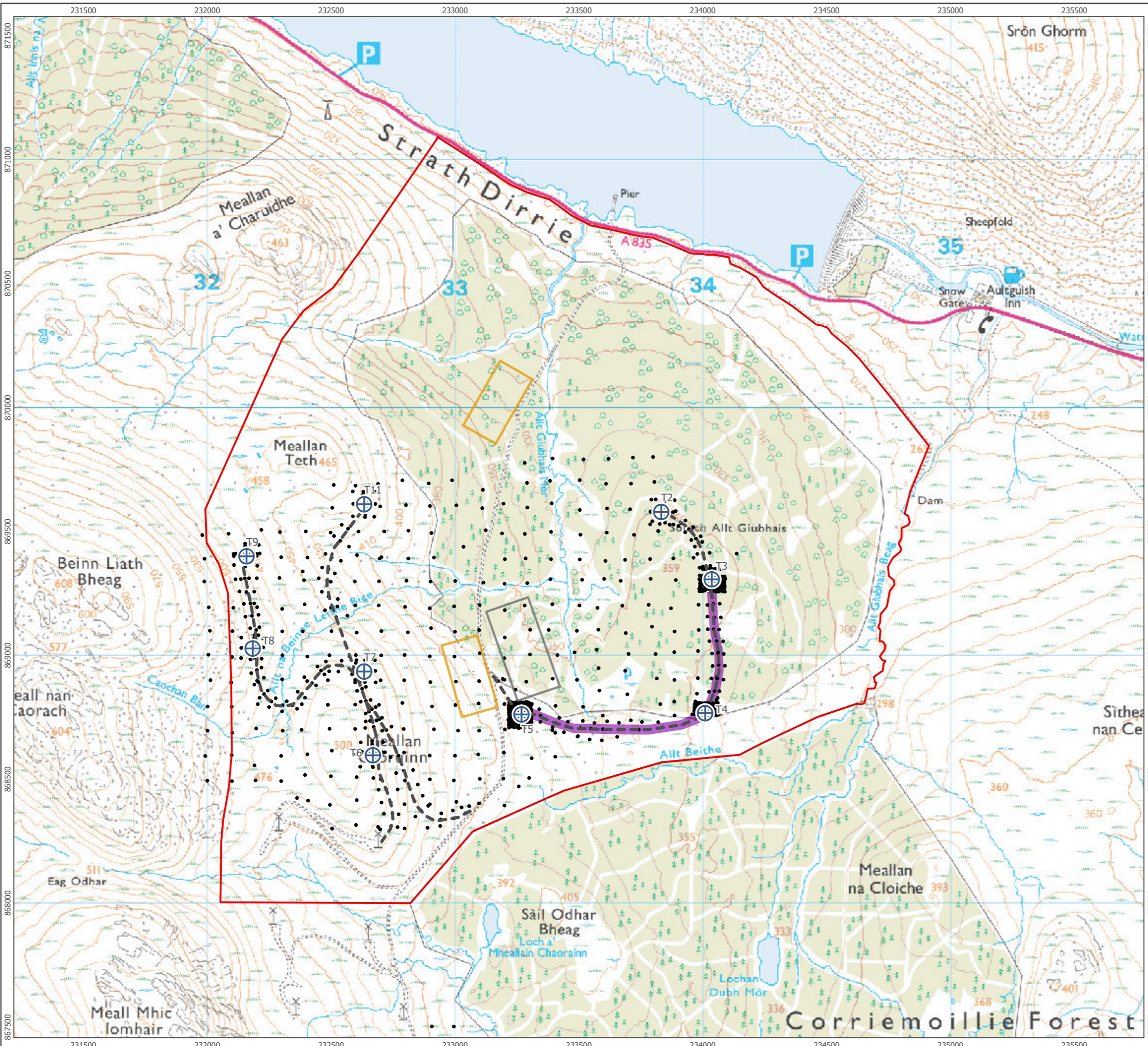


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Interpolated Peat Depths
 Figure 3
Lochluichart Extension II
Peat Management Plan

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- Site Boundary
- ⊕ Proposed Turbine Location
- Access Tracks
- Borrow Pit
- Sub-station / Control Building
- Peat Probe Locations
- Assumed Floating Track Areas



1:15,000 Scale @ A3
 0 0.25 0.5 km ▲ NORTH

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Assumed Floating Track Areas
Figure 4

**Lochluichart Extension II
Peat Management Plan**

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APPENDIX 2 - EARTHWORKS VOLUMES AND CALCULATIONS

2414 - Lochluichart Windfarm Extension II - Outline Peat Management Plan - Calculations and Estimations								Notes/Assumptions
Peat Excavation Calculations and Estimates								
Turbine No.	Ave. Peat Depth	Crane Hardstand/Foundation Area		Peat Excavation Estimation	Acrotelmic	Catotelmic		
2	1.00	1875.00		1875.00	625.00	1250.00		
3	1.00	1875.00		1875.00	625.00	1250.00		
4	2.00	1875.00		3750.00	1250.00	2500.00		
5	0.50	1875.00		937.50	312.50	625.00		
6	0.35	1875.00		656.25	218.75	437.50		
T6-EW	0.35	1875.00		656.25	218.75	437.50		
7	0.35	1875.00		656.25	218.75	437.50		
T7-EW	0.35	1875.00		656.25	218.75	437.50		
8	0.25	1875.00		468.75	156.25	312.50		
T8-EW	0.25	1875.00		468.75	156.25	312.50		
9	0.50	1875.00		937.50	312.50	625.00		
T9-EW	0.50	1875.00		937.50	312.50	625.00		
10	0.50	1875.00		937.50	312.50	625.00		
T10-EW	0.50	1875.00		937.50	312.50	625.00		
Turbine-Crane Hardstand Totals				15750.00	5250.00	10500.00		
Tracks	Ave. Peat Depth	Estimated m2	Distance of Track Over Peat Depth	Peat Excavation Estimation	Acrotelmic	Catotelmic		
Western Side of Spine Road	0.50	12500.00		6250.00	2083.33	4166.67	Assumed that the western side of spine road will have wide verges and earthworks associated with the construction works due to topography. Allowance of 5m wide verges to the west and 2m wide verges to the east.	
Associated EW West	0.50	12500.00		6250.00	2083.33	4166.67		
Eastern Side of Spine Road	0.75	7500.00	2500.00	1875.00	625.00	1250.00		
Associated EW East	0.75	3000.00	500.00	375.00	125.00	250.00		
Eastern Side of Spine Road	1.50	7500.00	2500.00	3750.00	1250.00	2500.00		
Associated EW East	1.50	3000.00	500.00	750.00	250.00	500.00		
Eastern Side of Spine Road	2.50	7500.00	2500.00	6250.00	2083.33	4166.67		
Associated EW East	2.50	3000.00	500.00	1250.00	416.67	833.33		
Track Totals				26750.00	8916.67	17833.33		
Construction Compound	Ave. Peat Depth	Estimated m2		Peat Excavation Estimation	Acrotelmic	Catotelmic		
Construction Compound	0.60	5000.00		3000.00	1000.00	2000.00		
CC Totals				3000.00	1000.00	2000.00		
Borrow Pits	Ave. Peat Depth	Estimated m2		Peat Excavation Estimation	Acrotelmic	Catotelmic		
Borrow Pits	0.50	15000.00		7500.00	2500.00	5000.00		
Borrow Pit Totals				7500.00	2500.00	5000.00		
TOTAL PEAT EXCAVATION				53000.00	17666.67	35333.33		
Deduction Due to Floating Tracks				12000.00	4000.00	8000.00	Floating Tracks assumed for T5 and T4, and T4 and T3	
TOTAL PEAT EXCAVATION following FLOATING TRACKS				41000.00	13666.67	27333.33		
Peat Re-Use Calculations and Estimates								
Infrastructure Element	Peat Depth Reinstated max depth	Area for Peat Reinstatement		Peat Re-Use Estimation	Acrotelmic	Catotelmic		
T2-EW	1.00	1067.00		1067	288.09	778.91	Full reinstatement of laydown areas in addition to re-dressed landscape batters along crane hardstanding edges.	
T3-EW	1.00	1067.00		1067	288.09	778.91		
T4-EW	1.00	1067.00		1067	288.09	778.91		
T5-EW	1.00	1067.00		1067	288.09	778.91		
T6-EW	1.00	1067.00		1067	288.09	778.91		
T7-EW	1.00	1067.00		1067	288.09	778.91		
T8-EW	1.00	1067.00		1067	288.09	778.91		
T9-EW	1.00	1067.00		1067	288.09	778.91		
T10-EW	1.00	1067.00		1067	288.09	778.91		
Associated EW West of Spine Road	1.00	12500.00		12500	3375	9125.00		
Associated EW East of Spine Road	0.95	9000.00		8550	2430	6120.00		
Construction Compound	0.60	5000.00		3000	1350	1650.00	Full construction compound Reinstatement. Reinstatement at borrow pits only to depths of the soils originating from the borrow pit.	
Borrow Pits	0.50	15000.00		7500	4050	3450.00		
TOTAL REUSE				41153	13797.81	27355.19		
BALANCE (+/- Surplus/Deficit)				-153.00	-131.14	-21.86		