Technical Appendix 2: Development Description

TA 2.1: Outline Construction Environmental Management Plan

TA 2.2: Borrow Pit Assessment

TA 2.3: Peat Depth Survey Results

TA 2.4: Draft Peat Management Plan

TA 2.5: Peat Landslide Hazard and Risk Assessment

Technical Appendix 2.1: Outline Construction Environmental Management Plan

Intended for
Artfield Forest Wind Farm Ltd

Date
March 2021

Project Number
1620008937

ARTFIELD FOREST WIND FARM
OUTLINE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN – DRAFT TEMPLATE FOR PLANNING

Project No. **162008937**
Issue No. **1**
Date **11/03/2021**
Made by **Briony McIntosh/Becky Rae**
Checked by **Becky Rae**
Approved by **Peter Bruce**

Version Control Log

Revision	Date	Made by	Checked by	Approved by	Description
1	11/03/2021	BM/BR	BR	PB	Issue to Client

CONTENTS

LIST OF TABLES

APPENDICES

1. INTRODUCTION

This document provides a framework for a Construction Environmental Management Plan (CEMP). This outline CEMP has been prepared as part of the Environment Impact Assessment (EIA) process for the Proposed Development and this document forms a Technical Appendix to the Environmental Impact Assessment Report (EIAR) submitted as part of the application for consent for the Proposed Development.

A CEMP would describe the environmental management and construction methods to be employed during the construction of the proposed Artfield Forest Wind Farm ('the Proposed Development'). This draft outline document would be updated with detailed information and finalised prior to commencement of construction, in consultation with the relevant authorities and taking account of the approved plans and planning conditions.

The contractor(s) appointed to construct the project will prepare detailed method statements which will be incorporated into the final CEMP.

The requirement to produce a CEMP will form part of the contract for the construction works for the Proposed Development. The management measures, method statements and referenced good practice guidance and legislation will form the basis of the detailed design to be prepared by the Contractor.

The CEMP will provide:

- a schedule of all construction and decommissioning stage mitigation measures required to address likely significant effects identified in the EIAR;
- a schedule of all additional construction and decommissioning stage good practice management measures included as part of the proposed construction work, in line with industry good practice guidance;
- a schedule of roles and responsibilities for delivering the requirements of the CEMP, including a statement of responsibility to ' stop the job/ activity' if in potential breach of a mitigation or legislation occurs;
- a method statement for monitoring, auditing, and templates for reporting and communication of environmental management performance on-site and with the client, planning authority and other relevant parties;
- construction stage environmental management measures, based on both compliance with relevant regulations and relevant good practice including but not limited to:
  - The Water Environment (Controlled Activities) (Scotland) Regulations 2011[1],[2] and the requirement for Construction Site Licence[3] (and Pollution Prevention Plan);
  - Forestry Commission (2017). UK Forestry Standard: The governments' approach to sustainable forestry, 4th Edition. Forestry Commission, Edinburgh.[4];
  - NatureScot (2019) Good Practice During Wind Farm Construction, A joint publication by Scottish Renewables, NatureScot, SEPA, Forestry Commission Scotland and Historic Environment Scotland, Marine Scotland Science, 4th Edition.[5];

[1] URL: https://www.legislation.gov.uk/ssi/2011/209/contents/made (accessed 03/11/2020)
[2] URL: https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf (accessed 03/11/2020)
[3] URL: https://www.sepa.org.uk/media/340359/wat-sg-75.pdf (accessed 03/11/2020)
[4] URL: https://forestry.gov.scot/publications/105-the-uk-forestry-standard/viewdocument (accessed 03/11/2020)
[5] URL: https://www.nature.scot/guidance-good-practice-during-wind-farm-construction (accessed 03/11/2020)

  - Netregs, Guidance for Pollution Prevention (GPP).[6];
  - CIRIA Publications including CIRIA C768 (Guidance on the construction of SuDS), CIRIA C753 (The SuDS Manual).[7]; and
  - NatureScot (2015) Constructed Tracks in the Scottish Uplands, 2nd Edition.[8].; and
- a template for the production of detailed and task/ site specific plans for on-site components of the construction work.

It is anticipated that specific mitigation plans and additional management measures will be required to address archaeology, ecology (protected species), surface water management and pollution prevention, watercourse crossings, waste, access arrangements, soil and peat management, construction and decommissioning nuisance (noise, dust), and community liaison.

An appropriately qualified Environmental/ Ecological Clerk of Works (ECoW)/ Site Environment Manager will be appointed with the responsibility of monitoring compliance the CEMP. The ECoW will be supported by an appropriately experienced and qualified engineering geologist/ geotechnical engineer for the supervision of work in any areas identified as medium to high risk of peat instability.

[6] URL: https://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/ (accessed 03/11/2020)
[7] URL: https://www.susdrain.org/resources/ciria-guidance.html (accessed 03/11/2020)
[8] URL: https://www.nature.scot/constructed-tracks-scottish-uplands (accessed 03/11/2020)

2. SCHEDULE OF ENVIRONMENTAL COMMITMENTS FROM ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR)

The CEMP will provide a schedule of commitments made in the EIAR.

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures

Reference	Commitment
Landscape and Visual Amenity	N/A
Cultural Heritage	• A walkover survey following felling but prior to commencement of construction is required to identify the extent of survival of known remains and demarcating of remains if required. • A watching brief on ground breaking works which will cross or be located in the vicinity of these assets is required. • This will ensure avoidance of inadvertent damage to heritage assets and recording of remains where assets are to be removed will ensure preservation by record leading to minimal loss of information content.
Ecology	• With the exception of the Tarf Water crossing, no infrastructure shall be micro-sited, nor associated construction activity take place, within 50 m of the River Bladnoch SAC boundary without prior approval of the DGC in consultation with NatureScot. • Best practice environmental management during construction and in particular watercourse crossing construction would be implemented through the proposed CEMP. • Monitoring of works by the ECoW, inspection of watercourses during the construction phase. • Baseline and subsequent water quality monitoring. • The CEMP will include Habitat Specific Protection Plans (HSPPs) detailing good practice measures for construction works within North Atlantic wet heath and blanket bog habitats. HSPPs would detail measures required to manage construction works within these sensitive habitats and include habitat restoration measures. • Enhancement to be provided through HMP. • Drainage management proposals to ensure groundwater flow and hydraulic continuity is maintained. • To ensure legislative compliance pre-construction surveys for protected mammals will be undertaken to identify the presence or likely presence of species within working areas to inform SPPs. • With the exception of the proposed watercourse crossings, no infrastructure shall be micro-sited, nor associated construction activity take place, within 50 m of watercourses without prior approval of the ECoW. • Implementation of best practice with regards to construction methods in close proximity to watercourses. To include diversion ditches around excavation works. • Baseline and subsequent water quality and fish population monitoring. • To ensure legislative compliance a Species Protection Plan (SPP) will be prepared and adopted for the construction phase, including precautionary avoidance measures.

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures

Ornithology	• Precautionary checks for winter roosts and the implementation of protection zones around any identified roost locations. • Mitigation included as part of the CEMP to ensure legislative compliance for breeding birds as part of the CBBPP.
Hydrology, Hydrogeology and Geology	• A site construction licence as required under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended (CAR) would be obtained from SEPA prior to any construction works being undertaken. The licence would detail the pollution prevention measures to be used on-site, the results of further site investigation and detailed site drainage and pollution control design that would be undertaken prior to construction. The construction site licence would be regulated by SEPA; • All construction and decommissioning work would be executed in accordance with the relevant good practice guidance on pollution prevention and mitigation; • With the exception of access track watercourse crossings, the design incorporates a minimum 50 m buffer distance around all surface watercourses, avoiding direct effects on watercourses; • Artificial drains will be blocked or diverted to break source – pathway-receptor linkages during construction; • Where watercourse crossings are being installed or upgraded, good practice construction measures would be adopted to prevent contamination through the use of coffer dams and sediment isolation techniques. Spill kits shall be provided to construction staff to stop any pollution entering watercourses. All watercourse crossings would be subject to appropriate CAR Authorisation; • Industry standard safeguards will be implemented to ensure existing surface water flow paths to sensitive habitats (which are sustained by rainfall and surface water runoff on the Site rather than groundwater) are maintained (e.g. where these habitats are crossed by proposed access tracks), and aggregate used to establish tracks and hardstandings etc. is derived on-site or has similar geochemical characteristics to geology present at Site; • Excavated peat should be excavated as turves, including the acrotelm (surface vegetation) and a layer of adjoining catotelm (more humified peat) typically up to 500 mm thick in total, or as blocks of catotelm; the acrotelm should not be separated from its underlying peat; - The turves should be as large as possible to minimise desiccation during storage, though the practicalities of handling should be considered; - Contamination of excavated peat with substrate materials to be avoided at all times; and - Consider timing of excavation activities to avoid very wet weather and multiple handling to minimise the likelihood of excavated peat losing structural integrity. • If possible, peat should be extracted in intact full depth acrotelm layers from the top surface of the peat deposit. This technique will maintain connectivity between the surface vegetation and the partially decomposed upper layers of the catotelm; • The following good practice applies to the storage of peaty soils/ peat: - Stripped materials should be carefully separated to keep peat and other soils apart;

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures

	- To minimised handling and haulage distances, excavated material should be stored local to the site of excavation or end point of restoration; - Peat turves should be stored in wet conditions or irrigated in order to prevent desiccation (once dried, peat will not rewet); - Stockpiling of peat should be in large volumes to minimise exposure to wind and sun (and desiccation), but with due consideration for slope stability, but should not exceed 1 m in height to maintain stability of stockpile; - Stockpiles should be isolated from watercourses or drains with appropriate bunding to minimise pollution risks; - Excavated peat and topsoil stored separately, should be stored to a maximum of 1 m thickness; - Stores of non-turf (catotelm) peat should be bladed off to reduce the surface area and desiccation of the stored peat; and - Peat storage areas should be monitored during periods of very wet weather, or during snowmelt, to identify early signs of peat instability. • Any peaty soils/ peat to be removed during construction would require a temporary storage area near to the construction works/ area of re-use. Where peat cannot be transferred immediately to an appropriate restoration area, short term storage will be required. In this case, the following good practice applies: - Peat should be stored around the turbine perimeter at sufficient distance from the cut face to prevent overburden induced failure; - Local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes should be avoided for peat storage; and - Drying of stored peat should be avoided by irrigation (although this is unlikely to be significant for peat materials stored less than 2 months). • For crane pads, borrow pits and compounds (with longer term peat storage requirements), the following good practice applies: - Peat generated from crane pad locations should be transported directly to its allocated restoration location, to minimise the volume being stockpiled with the possibility of drying out; - Stores of catotelmic peat should be bladed off to reduce their surface area and minimise desiccation; - Where transport cannot be undertaken immediately, stored peat should be irrigated to limit drying and stored on a geotextile mat to promote stability; - Monitoring of large areas of peat storage during wet weather or snowmelt should be undertaken to identify any early signs of peat instability; - Movement of turves should be kept to a minimum once excavated, and therefore it is preferable to transport peat planned for translocation and reinstatement to its destination at the time of excavation; and - If heavy goods vehicle (HGVs)/ dump trucks that are used for transporting non-peat material are also to be used for peat materials, measures should be taken to minimise cross-contamination of peat soils with other materials.

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures

	• Following refinement of the Site peat model, a detailed storage and handling plan should be provided as part of the detailed Peat Management Plan (PMP); • During peat restoration, the following best practice should be followed: - Carefully evaluate potential restoration sites, such as borrow pits, and currently forested areas to be maintained as permanent open ground (where peat turves may be used for extensive ditch blocking) for their suitability, and agree that these sites are appropriate with the ECoW, landowners and relevant consultees; - Undertake restoration and revegetation or reseeding work as soon as possible; - Where required, consider exclusion of livestock from areas of the Site undergoing restoration, to minimise impacts on revegetation; and - As far as reasonably practicable, restoration should be carried out concurrently with construction rather than at its conclusion. • To minimise the risk of peat instability, an appropriately experienced and qualified engineering geologist/ geotechnical engineer should be appointed during the construction phase, to provide advice during the setting out, micrositing and construction phases of the works. The appointed engineer should develop and maintain a Geotechnical Risk Register; • The "undercutting" of peat slopes should be minimised during construction. Where this cannot be avoided, a more detailed assessment of the area of concern by the geotechnical engineer would be required; • Careful micrositing of wind turbine bases, crane hardstandings and access track alignments would be required to minimise effects on the prevailing hydrology; • Floating access track should be used across areas of deep peat (>1.0 m) to reduce the risk of peat instability. The track design would have due regard to key principles set out in the joint NatureScot (formerly SNH) and Forestry Commission Scotland (FCS) guide to floating roads on peat; • Health and Safety awareness of the peat environment at the Proposed Development for construction staff should be incorporated into the Site induction. Include peat slide risk assessment information (e.g. peat instability indicators, best practice and emergency procedures) in toolbox talks with relevant operatives e.g. plant drivers; • Introduce a 'Peat Hazard Emergency Plan' to provide instructions for Site staff in the event of a peat slide or discovery of peat instability indicators; • For sections of track that require track side cuttings into peat, suitable support measures would need to be designed to maintain the stability of the adjacent peat terrain; • An independent and fully qualified ECoW will be employed during construction of the Proposed Development.
Traffic and Transport	• During the construction period, a project website, blog or Twitter feed would be regularly updated to provide the latest information relating to traffic movements associated with vehicles accessing the Site. This would be agreed with the local roads authority;

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures

	• The following measures would be implemented during the construction phase through the Construction Traffic Management Plan (CTMP): - Where possible the detailed design process would minimise the volume of material to be imported to site to help reduce HGV numbers; - A site worker transport and travel arrangement plan, including transport modes to and from the worksite (including pick up and drop off times); - A Traffic Management Plan; - All materials delivery lorries (dry materials) should be sheeted to reduce dust and stop spillage on public roads; - Specific training and disciplinary measures should be established to ensure the highest standards are maintained to prevent construction vehicles from carrying mud and debris onto the carriageway; - Wheel cleaning facilities may be established at or near the Site entrance, depending the views of Dumfries and Galloway Council and SEPA, having regard to the need to protect the Tarf Water; - Unless otherwise agreed with the planning authority, normal site working hours would be between 0700 and 1900 (Monday to Friday and 0700 and 1300 (Saturday), some activities may take place outside these hours such as component delivery, turbine erection and in exceptional circumstances e.g. to allow the completion of a concrete pour; - Appropriate traffic management measures would be put in place to avoid conflict with general traffic, subject to the agreement of the roads authority. Typical measures would include HGV turning and crossing signs and banksman where necessary; - Provide construction updates on the project website and or a newsletter to be distributed to residents within an agreed distance of the Site; and - Adoption of a voluntary speed limit of 20 miles per hour (mph) for all construction vehicles through local settlements. • All drivers would be required to attend an induction to include: - A tool box talk safety briefing; - The need for appropriate care and speed control; - A briefing on driver speed reduction agreements (to slow site traffic at sensitive locations through the villages); and - Identification of the required access routes and the controls to ensure no departure from these routes. • Video footage of the pre-construction phase condition of the abnormal loads access route and the construction vehicles route would be recorded to provide a baseline of the condition of the road prior to any construction work commencing. This baseline would inform any change in the road condition during the construction phase. Any necessary repairs would be coordinated with the Council's roads team; • Damage to road infrastructure caused directly by construction traffic would be made good and street furniture that is removed on a temporary basis would be fully reinstated;

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures

	• There would be a regular road review and any debris and mud would be removed from the carriageway using an on-site road sweeper to ensure road safety for all road users; and • Before the abnormal indivisible loads (AILs) traverse the route, the following tasks would be undertaken to ensure load and road user safety: - Ensure any vegetation which may foul the loads is trimmed back to allow passage; - Confirm there are no roadworks or closures that could affect the passage of the loads; and - Check no new or diverted underground services on the proposed route are at risk from the abnormal loads. • Confirm the police are satisfied with the proposed movement strategy.
Noise	• Good site practices would be implemented to minimise the likely effects. Section 8 of BS5228-1:2009+A1:2014 recommends a number of simple control measures as summarised below that would be employed on-site: - Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern; - Ensure that any extraordinary site work continuing throughout 24 hours of a day (for example, crane operations lifting components onto the tower) would be programmed, when appropriate, so that haulage vehicles would not arrive at or leave the site between 07:00 and 18:00, with the exception of abnormal loads that would be scheduled to avoid significant traffic flows; - Ensure all vehicles and mechanical plant would be fitted with effective exhaust silencers and be subject to programmed maintenance; - Select inherently quiet plant where appropriate - all major compressors would be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which would be kept closed whenever the machines are in use; - Ensure all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers; - Instruct that machines would be shut down between work periods or throttled down to a minimum; - Regularly maintain all equipment used on-site, including maintenance related to noise emissions; - Vehicles would be loaded carefully to ensure minimal drop heights so as to minimise noise during this operation. • Ensure all ancillary plant such as generators and pumps would be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures should be provided.
Traffic and transport	• Mitigation measures proposed include the development of a Construction Traffic Management Plan (CTMP) to incorporate: Site working travel plan, abnormal loads traffic management plan, traffic management measures to control and provide advance warning on the local road network, driver training, improved direction signage and

Table 2.1.1: Schedule of Mitigation and Additional Good Practice Measures	
	public information; use of on-site borrow pits to reduce traffic flows and provision of passing place enhancements; • Provision of temporary 20 mph zone and pedestrian crossing facility at the Three Lochs Holiday Park
Aviation and Telecommunications	• Aviation stakeholders will be notified of the location of temporary and permanent en-route obstacles.
Socioeconomics	• No mitigation measures have been identified.
Forestry	• All forestry felling operations must maintain good practice identified in Forestry Commission Technical Note: Protecting the Environment during Mechanical Harvesting Operations Good practice timber harvesting. • The CEMP will incorporate good practice from the 2nd edition Forestry and Water Scotland guidelines in relation to working around watercourses, including connected ditches and drains. • Compensatory planting will be provided, calculated in accordance with Annex 5 of the Scottish Government's policy on control of woodland removal: implementation guidance February 2019[9], taking into account any potential low yield class forest on deep peat, where restoration potential could be realised through the Artfield Forest restructuring.
Shadow Flicker	• None
Climate	• None

The CEMP will also maintain a schedule of commitments required by specific planning conditions.

Table 2.1.2: Planning Condition Commitments	
Reference	**Commitment**
TBC	TBC following planning consent

[9] Forestry Commission Scotland (2019) Scottish Government's policy on control of woodland removal: implementation guidance, revised February 2019

3. COMMUNICATION PROTOCOL

3.1 Roles and Responsibilities

The CEMP will confirm the roles, responsibilities and communication routes for environmental management during the works. This plan will make reference to or incorporate communication protocols for use during an environmental emergency or incident.

3.2 Recording and Reporting

The CEMP will set out the requirements for recording and reporting all aspects of environmental management, for example:

- minutes and attendance record of start-up meeting (on-site meeting prior to commencement of construction works);
- an environmental risk register;
- minutes of weekly meetings covering environmental (ecology, archaeology, hydrology) issues (meetings may be combined with regular construction progress meetings);
- a communication plan;
- records of toolbox talks;
- dust/ noise monitoring records;
- site waste and materials management plan and records;
- water quality monitoring records; and
- licensing and consents.

3.3 Environmental Audits

The CEMP will set out the programme of environmental audits, including audits of sub-contractors to be undertaken by the contractor, on a quarterly basis (as a minimum) and provides an audit report within two weeks of the audit being undertaken.

The contractor will develop a template for completing and reporting audits for the agreement of the employer prior to the commencement of site works.

3.4 Community Liaison

During the construction period, a community liaison group would be set up to disseminate information and take feedback and the project website would be regularly updated to provide the latest information relating to traffic movements associated with vehicles accessing the Site. This would be agreed with Council as the Local Roads Authority.

4. TYPICAL CONSTRUCTION STAGE ENVIRONMENTAL MANAGEMENT MEASURES

This section provides sub-headings for typical detail to be provided in the outline CEMP.

4.1 Contractor Requirements

A Principal Contractor would be appointed and they would ensure that all employees, sub-contractors, suppliers and other visitors to the site are made aware of the content of the CEMP and its applicability to them. Accordingly, environmental specific induction training would be prepared and presented to all categories of personnel working on and visiting the site.

As a minimum, the following information would be provided to all inductees:

- identification of specific environmental risks associated with the work to be undertaken on-site by the inductee;
- summary of the main environmental aspects of concern at the site as identified in the CEMP; and
- Environmental Incident and Emergency Response Procedures (including specific Environmental Communication Plan requirements).

A conveniently sized copy of an Environmental Risk Map or equivalent would be provided to all inductees showing all of the sensitive areas, exclusion zones and designated washout areas. The map would be updated and reissued as required. Any updates to the map would be communicated to all inductees through a tool box talk given by specialist environmental personnel. Regular tool box talks would be provided during construction to provide ongoing reinforcement and awareness of environmental issues.

4.2 Temporary Lighting

Temporary lighting would be required at the temporary construction compounds for security purposes and to ensure that a safe working environment is provided to construction staff. In addition, temporary lighting could be required to ensure safe working conditions at infrastructure locations during construction.

All temporary lighting installations would be downwards pointing passive infra-red (PIR) activated lighting and all lights would be switched off during daylight hours and outwith working hours.

4.3 Community Communication Plan

Specify proposed communication protocols and project team contacts.

4.4 Archaeological Management Plan

Specify requirement for mitigation and/ or good practices measures agreed with the planning authority and in line with measures specified in the EIAR.

4.5 Ecological Management Plan

Provide an Ecological Management Plan (EMP), to include all measures required to protect ecology at the Site and ensure compliance with relevant nature conservation and wildlife protection legislation.

Specify requirement for an ECoW.

4.6 Management of Surface, Groundwater and Water Quality Monitoring Management Plan

Specify and provide design for drainage management measures, to incorporate sustainable drainage systems (SuDS) to attenuate the volume and rate of run off and maintain water quality.

Specify requirement for monitoring (including visual inspection and sampling) of surface water courses to be undertaken on discharge waters during the construction phase to assess and manage the performance of the drainage system.

4.7 Dust Management Plan

Detail dust management controls and protocols for implementation (e.g. in the event of dry weather).

4.8 Waste Management Plan

Provide details of site waste management, identifying all waste streams and responsibilities of the contractor.

4.9 Soil and Peat Management Plan

Provide an updated Peat Management Plan (PMP), to be produced post consent using data acquired through the site investigation campaign. Specify measures to maintain soil structure and function during temporary storage and reinstatement work.

4.10 Peat Instability Risk Assessment Management Plan

Provide a geotechnical risk register and management plan to manage risks associated with construction in close proximity to areas identified as having peat instability risk.

4.11 Noise Management Plan

Specify hours of work and an outline of proposed restrictions, noise control measures required during construction work.

4.12 Construction Traffic Management Plan

Specify traffic management plan measures agreed with the planning authority.

5. CONSTRUCTION METHOD STATEMENTS

This section provides sub-headings for typical detail to be provided in the outline CEMP.

5.1 Temporary Construction Compounds, Staging Area and Site Fencing

Specify layout in temporary construction compounds.

5.2 Public Access Roads

Specify the improvements proposed along the Site access route and detail in a Traffic Management Plan (TMP) which will also set out any Agreements or Licences required with the relevant statutory authorities.

5.3 Site Entrance

Specify requirement for inspection of Site entrance roads and detail requirement/ protocol for providing a road sweeper to remove any mud or debris transferred onto the roads from Site activities if required.

5.4 Site Access Tracks

Specify construction details for Site tracks, including installation of track drainage, and the locations and use of cut and floating track design.

Specify areas requiring sub-grade drainage measures to maintain groundwater connectivity (based on detailed site investigation at pre-construction phase).

5.5 Watercourse Crossings

Specify design of watercourse crossings in accordance with the Water Environment (Controlled Activities) (Scotland) Regulations 2011 as amended (CAR).

Specifications will comply with:

- Flood Estimation Handbook (Statistical Analysis) and Flood Studies Report (FSR) - used where appropriate used to determine the design flow;
- CIRIA Culvert design and operation guide (C689); and
- Scottish Executive (2002) River Crossings and Migratory Fish: Design Guidance (where appropriate).

5.6 Construction Methodology

Specify watercourse crossing construction methodology, including detailed measures to prevent pollution.

5.7 Crane Hardstandings

Specify construction design details for crane hardstandings and construction methods for their installation.

5.8 Turbine Foundations

Specify foundation design (based on site investigation) and construction methods proposed.

5.9 Turbine and Turbine Transformer Erection

Specify construction details for turbine and turbine transformer erection.

5.10 Site Electrical Works

Specify construction details for Site electrical works.

5.11 Cable Trench Design Philosophy

Specify route and design of onsite cables, including methods of installation, watercourse crossing and measures to ensure that cable trenches do not provide a preferential pathway for dewatering peat forming habitats.

5.12 Substation, Control Building, Battery Storage Unit and Compound

Specify construction details for substation control building, energy storage unit and compound.

5.13 Permanent Meteorological Masts

Specify construction details for permanent meteorological masts.

5.14 Grid Connection

Specify interface with distribution network operator for providing grid connection.

6. DECOMMISSIONING AND RESTORATION PLAN

The expected operational life of the Proposed Development would be 30 years from the date of final commissioning. Towards the end of this period a decision would be made as to whether to refurbish, remove or replace the turbines. If refurbishment or replacement were to be chosen, then relevant applications would be made.

The CEMP will be updated on completion of the construction work for handover to the Site owner. The CEMP would provide details of all relevant 'as-built' plans/ drawings and technical details which would inform the decommissioning process.

The CEMP would provide a schedule of bill of quantities to summarise the components and constituent materials which form the Proposed Development, and the likely options or methodology envisaged for the decommissioning process.

If a decision was taken to decommission the proposed wind farm this would require the removal of all the turbine components, transformers, the substation and associated buildings. In the event of decommissioning, a Decommissioning and Restoration Plan (DRP) would be prepared and would be submitted for approval by the Council, NatureScot and SEPA no less than 12 months prior to the final decommissioning of the Proposed Development. The detailed DRP would be implemented within 18 months of final decommissioning of the Site, unless otherwise agreed with the Council.

The DRP would set out methods for the following:

- site track and hardstand areas: new site tracks and areas of hardstanding constructed during as part of the Proposed Development would be reinstated, unless otherwise agreed with the landowner and/ or Council;
- turbines: the decommissioning of the wind turbines would follow the reverse of the erection process involving similar lifting plant and equipment;
- turbine foundations: it is widely accepted that there is no appreciable effect on the local environment from buried reinforced concrete structures left in situ due to the inert state of concrete;
- cabling works: cables would remain in situ to avoid any effect to the local environment by their removal; and
- substation compounds: would be decommissioned by disconnecting and dismantling all the surface plant. Solid structures such as the building and equipment plinths would be demolished and the foundation would be removed to an agreed depth below ground level. Ducting and cabling that is within the agreed depth to be cleared would be removed. The fence surrounding the compound would be removed and the area covered with topsoil and reseeded, as required.

APPENDIX 1
FIGURES

Consented planning drawings (to be updated with 'as-built' drawings on completion)

APPENDIX 2
DRAINAGE DESIGN

1. General Philosophy
2. Hydraulic/ Water Quality design criteria
3. Working in the vicinity of watercourses
4. Working in the vicinity of Groundwater Dependent Terrestrial Ecosystems (GWDTEs)
5. Management of Silt and Water pollution

5.1. Detailed drainage design

5.1.1. Trackside Drainage

5.1.2. Sediment Ponds/ Lagoons

5.1.3. Watercourse

5.1.4. Turbine Foundations

5.1.5. Excavated Soil Management

5.1.6. Concrete Washout Area

5.2. Maintaining Site Hydrology

5.3. Maintenance/ Monitoring of SuDS performance

5.4. Decommissioning of SuDS

Technical Appendix 2.2: Borrow Pit Assessment

Technical Appendix 2.2: Borrow Pit Assessment

1.1 Introduction

1.1.1 To minimise the volume of imported aggregate transported to Site and any consequent environmental impacts, borrow pits located within the Site are proposed (subject to further geotechnical evaluation) to source the necessary aggregate required for track construction, turbine bases, crane pads, compounds and hardstanding areas. This report provides details of the proposed on-site borrow pits for use during the construction of the proposed Artfield Wind Farm ('the Proposed Development'). Four potential borrow pit locations have been identified. The Proposed Development is described in EIAR Volume 2: Main Report, Chapter 2: Proposed Development and the proposed borrow pit search areas are shown on Figure 2.2.1 of this technical appendix. Section 4.2 of this report provides specific information about the borrow pit search areas and restoration details.

Aims of this Report

1.1.2 This report provides geo-engineering information on the potential for borrow pits to be opened on the Site. The aim of this assessment is to provide:

- a preliminary indication of the suitability of the bedrock as a road building material;
- potential borrow pit locations;
- indicative borrow pit dimensions;
- indicative extraction volumes;
- estimates of overburden volumes borrow pit locations;
- an indication of potential extraction methods;
- recommendations for geotechnical testing; and
- preliminary borrow pit re-instatement proposals.

1.1.3 This report outlines the methodology used by Ramboll for borrow pit assessment along with the analysis undertaken; conclusions drawn and recommendations for borrow pit design and location.

Limitations

1.1.4 It should be noted that all borrow pit information provided within this report is indicative only and is based on desk study and site reconnaissance alone. No intrusive investigation (other than peat probing) has been carried out and consequently the suitability of the rock, suggested extraction methods and volumes are broad estimates and should be treated as such. A detailed ground investigation (such as boreholes and trial pits) will be required to determine the suitability of the rock (extent and quality), potential for groundwater ingress, and to determine geotechnical parameters. Recommendations can then be made with regards to groundwater control, slope stability, extraction methods and finalised detailed design. Search areas are identified for each borrow pit to allow for any adjustments following the results of the ground investigation. The borrow pits are likely to be significantly smaller than the search areas.

1.1.5 This report represents the findings and opinions of experienced geotechnical consultants based upon the information obtained from a variety of sources as detailed. Ramboll believes the information obtained from third parties is reliable but does not guarantee its authenticity. The information has been accepted de facto but professional judgement has been used in its interpretation.

1.2 Methodology

1.2.1 This report comprises a desk based study and notes compiled from a geo-engineering walkover survey. The desk study consisted of a review of the available geological and hydrogeological data together with additional information relating to the Site including:

- 1:50,000 and 1:25,000 scale Ordnance Survey (OS) topographic mapping;
- OS Elevation Digital Terrain Mapping (DTM) data;
- review of geological mapping[1] for the Site, British Geological Survey (BGS) 1:50,000 scale;
- review of publicly available aerial photography and OS aerial imagery;
- groundwater vulnerability map of Scotland[2];
- BGS 1:625,000 scale hydrogeological map[3];
- review of peat probe survey field data; and
- a site walkover to identify suitable borrow pit locations.

1.2.2 A walkover survey of the Site was conducted to determine suitable locations for borrow pits. One former borrow pit location is present to the east of the Site, which provided aggregate for the existing forest tracks and is considered to be a preferential location for sourcing aggregate. Other potential suitable locations for borrow pits have also been identified.

1.2.3 A reconnaissance site walkover and general survey work was undertaken between 8 - 15 September 2020. All survey work recorded detailed field notes and photographs of the potential borrow pit sites, including details of the geological and hydrogeological aspects of each identified location. A hand held GPS was used to determine the grid reference.

1.2.4 The most suitable borrow pit locations have been considered in more detail with preliminary layouts and volume estimates calculated of material which could be extracted. This is discussed in more detail in subsequent sections.

Borrow Pit Constraints

1.2.5 One of the principal factors affecting borrow pit location is the thickness of overburden material, due to the increased effort required for its excavation and handling before the source of the aggregate is reached. Therefore, this assessment has identified optimal borrow pit locations where there would be no, or only a very thin veneer of superficial deposits, especially peat (due to its high moisture content).

1.2.6 In addition, the borrow pit assessment has sought to avoid areas of high groundwater table in order to reduce potential for effects on groundwater dependent terrestrial ecosystems (GWDTE). In doing so, the potential borrow pit locations also reduce the potential for erosion and additional processes required for handling and treatment of groundwater. However, it is understood that the potential GWDTE areas assessed at the site are not considered likely to be groundwater dependent.

[1] British Geological Survey, Web Map Services (WMS) – UK Geology Datasets.[Accessed 18/11/2020] Available: http://bgs.ac.uk/data/services/wms.html

[2] Scottish Environment Protection Agency flood map. [Accessed 18/11/2020] Available: http://map.sepa.org.uk/floodmap/map.htm

[3] British Geological Survey, 1:625,000 scale digital hydrogeological data. [Accessed 18/11/2020] Available: http://www.bgs.ac.uk/products/hydrogeology/maps.html

1.2.7 Borrow pit locations have also been selected to avoid existing watercourses, due to the potential for run off of sediment and fine grained material.

1.2.8 Consideration is also given to the potential for visual effects and impacts on the setting of cultural heritage features; however it is considered that with sensitive development and appropriate restoration, long term significant effects associated with borrow pits can be avoided.

1.2.9 The location of the potential borrow pits have been selected to be close to the existing estate track. The proximity to proposed site infrastructure is a key factor which has also been considered in the identification of potential borrow pit sites.

1.3 Desk Study and Site Information

Site Location and Setting

1.3.1 The Site location and setting are described in EIAR Volume 2: Main Report, Chapter 1: Introduction.

Topography

1.3.2 The Site topography is generally undulating at elevations of between 182 m and 110 m Above Ordnance Datum (AOD), (as shown on EIAR Volume 4: Figure 2.5.1). Steeper slope angles exist to the west of the proposed access track which passes through Artfield Forest and the northern extents of the Site.

Superficial Geology

1.3.3 The superficial geology of the Site predominantly comprises peat with the south-east of the Site comprising Diamicton Till. Some areas are mapped as having no superficial deposits present which could imply that rockhead is relatively shallow in these areas.

1.3.4 Peat probing undertaken by Ramboll in 2020, and historical peat probing undertaken as part of the Gass Wind Farm proposal, confirmed the presence of peat, this largely corresponded to the 1:50,000 scale BGS geological mapping. The findings of the survey are presented within EIAR Technical Appendix TA2.3.

1.3.5 Generally, peat was noted to be shallow across the majority of the Site (60% of peat probe points recorded peat depths of <0.5 m) and the composition and integrity of the peat was noted to be highly modified within the forestry plantation areas. Further site specific information on the extent, depth and stability of peat at the Site is provided in Technical Appendix 2.5: Peat Landslide Hazard Risk Assessment.

1.3.6 The depth of superficial deposits was taken into account when selecting potential borrow pit locations, typically avoiding areas with >0.5 m peat or other superficial deposits.

Bedrock Geology

1.3.7 The 1:50,000 scale geological mapping available from the BGS[4] shows the majority of the Site to be underlain by Wacke of the Portpatrick Formation and Glenwhargen Formation, and shown on Figure 2.5.3 (EIAR Volume 4).

Structural Geology

1.3.8 BGS mapping indicates a fault is present within the northernmost area of the Site, and the underlying geology is Wacke of the Kirkcolm Formation.

Hydrogeology and Hydrology

1.3.9 The Tarf Water flows in an easterly direction along the northern margin of the Site and then in a southerly direction, initially at the north east boundary of the Site and then southwards through the Site. The topography of the Site is such that the whole Site is within the catchment of the Tarf Water. A small area in the west of the Site (on which no site infrastructure is proposed), drains initially to the Drumpall Burn, which crosses the westernmost margin of the Site flowing from the Site in a south westerly direction before eventually discharging to the Tarf Water, approximately 1.5 km downstream of the southern boundary of the Site.

1.3.10 The Tarf Water is a Special Area of Conservation (SAC, 'River Bladnoch') which is designated due to the presence of Atlantic salmon *Salmo salar*.

1.3.11 The Purgatory Burn (which forms the north west boundary of the Site), discharges to the Tarf adjacent to the north boundary of the Site. As the Tarf Water flows around the northern margin of the Site, and southwards through the Site, a number of small, unnamed burns and drains discharge surface waters to the Tarf Water from the Site area.

1.3.12 Surface water features recorded at the Site are based on a review of Ordnance Survey mapping and site observations, which are shown on Figure 2.5.4 (EIAR Volume 4).

1.3.13 The 1:625,000 UK Digital Hydrogeological Data map shows the Site is located over a low productivity aquifer comprising Portpatrick Formation and Glenwhargen Formations. Flow is virtually all through fractures and other discontinuities in highly inundated greywackes with limited groundwater in near surface weathered zone and secondary fractures.

1.3.14 The Site is underlain by the Galloway groundwater body. The groundwater body is designated as being in 'Good' overall condition including being of 'Good' water quality.

1.3.15 The average annual rainfall for the nearest weather station (Met Office weather station at West Freugh) is 1048.6 mm, based on the most recent dataset (1981-2010)[5].

1.3.16 The borrow pit search areas have been selected to avoid borrow pit extraction within 50 m of existing watercourses or waterbodies and with standard mitigation (i.e. an upslope cut-off/ diversion ditch to intercept surface water together with minor attenuation features or soakaways) the borrow pits are not considered likely to have any significant effect on surface water.

Suitability of Bedrock at the Site as an Aggregate

1.3.17 The Site is underlain by sedimentary rock formations, predominately comprising greywacke sandstone; these are calcareous sandstone and siltstones, which are occasionally interbedded with mudstone.

1.3.18 Sandstone is a commonly used source of construction aggregate and according to the BGS, the vast majority of sandstone quarried in the UK is used for crushed rock aggregate. Its suitability as aggregate largely depends on its strength, porosity and durability, which are in turn governed by characteristics such as mineralogical composition, grain size and sorting, cementation and weathering state.

1.3.19 A key factor in the suitability of the rock as aggregate is the mineral constitution and mode of occurrence, as often their quality is not uniform. The weathering state of the rock is also of high importance, as this weakens the aggregate and reduces durability. The depth of weathering is dependent on the distribution of joints and other rock discontinuities. From the exposures observed at the Site the discontinuity spacing varies from medium to very thickly bedded. This suggests there are fewer discontinuities for weathering to exploit leaving the majority of the rock mass fresh and of good

[4] https://mapapps.bgs.ac.uk/geologyofbritain/home.html

[5] https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcu2pdv8y

quality. Where exposed the wackes generally did not appear to contain a significant amount of fine grained shaley material, with larger sandstone/ siltstone beds dominating.

1.3.20 Annex 2.2.1 provides information about the geological features recorded on-site during the walkover survey. The main constraints identified by the walkover survey include the presence of superficial deposits (including peat), very steep slopes in excess of 25 degrees and watercourses which cross the Site.

1.3.21 An existing borrow pit was noted to be present in the eastern part of the Site (referred to as Borrow Pit 3), which is assumed to have been used to supply rock aggregate for the construction of the existing forestry access tracks. This confirms that locally sourced rock is suitable for construction purposes. An inspection of the borrow pit and a review of the potential to provide further aggregate has been undertaken as part of this assessment.

1.3.22 It is considered that a smaller number of larger borrow pits is preferable to several smaller ones, however it is unlikely that a single borrow pit would be feasible to supply the requirements of the Proposed Development. Therefore, four potential borrow pit locations have been taken forward for further consideration; these are shown on Figure 2.2.1.

1.3.23 The bedrock is reportedly a turbidite sequence and the grading is unlikely to be uniform. Therefore, the likely localised presence of shale and mudstone/ siltstone beds within the bedrock formation may constrain their potential for aggregate production. As such potential extraction sites within these formations should be carefully sited and investigated to minimise extraction of argillaceous strata or material with a potential for high fines content after excavation/ grading.

1.4 Borrow Pit Search Areas and Restoration Details

1.4.1 The proposed borrow pit search areas have been selected as their morphology is ideal for stone extraction (limited cover, rock close to surface and steep slopes). Typically the proposed borrow pit locations avoid areas with >0.5 m peat or other superficial deposits. The locations also take visual, ecological, hydrological and cultural heritage constraints into account. Search areas are identified for each site to allow for any adjustments following the results of the ground investigation. The borrow pits are likely to be significantly smaller than the search areas.

1.4.2 Borrow Pit 3, is based on an existing borrow pit in the eastern part of the Site, and has the potential to be expanded to generate aggregate material for the Proposed Development. Three additional locations were identified across the western part of the Site where limited superficial deposits were identified during the walkover. Rock outcrops were identified during the walkover survey across the majority of the Site. Hence, it is considered possible that bedrock will be close to the surface in the proposed borrow pit search area locations.

1.4.3 The preliminary estimation of potential material quantities which could be extracted from these four locations are provided in Table 2.2.1 to Table 2.2.5. The volumes given have been calculated from indicative cross-sections of the borrow pit assuming all extraction is undertaken from a single layer or 'bench', taking into account gradients of the ground surface and the indicative borrow pit footprint dimension and depth approximations. Please note that these figures do not account for any reductions due to wastage (associated with bands of unsuitable fine grained bedrocks or highly weathered material) or bulking of excavated materials.

1.4.4 No account has been taken in the calculations for 'winning' rock during the construction phase (e.g. through track and turbine base excavations and widening of the existing track). The extent of material sourced in this manner would minimise the extraction of rock from the borrow pits.

1.4.5 Overburden/ soils together with processing residue would be carefully stockpiled adjacent to the excavation void for use in the borrow pit restoration process. The stockpiles would be located and battered so as to limit instability and erosion. Silt fences and mats will be used to minimise sediment levels in runoff from the stockpiles.

1.4.6 It is anticipated that, upon completion, the borrow pits would be partially reinstated. This will involve the reworking of faces to stabilise them, partial infilling with surplus material and landscaping with peat and soils excavated during the wind farm construction.

1.4.7 Typically the borrow pit restoration would utilise processing residues and overburden, and would create slopes within the excavation at an approximate gradient of 2 (V) in 1 (H). The crest of the slopes would intersect the uppermost rock face at a position which partially obscures the lower part of the faces. The toe of the restoration faces would be blended in to the borrow pit floor, which itself would be re-profiled to allow drainage and the re-introduction of appropriate cover. The upper part of the borrow pit faces would remain exposed and would be allowed to become weathered. It is envisaged that this face would acquire an appearance similar to that of other natural rock exposures in the locality.

Borrow Pit Details

1.4.8 An indicative borrow pit design has been prepared for each location, and includes the following details and assumptions:

- the footprint area of the excavation for each proposed borrow pit;
- a typical cross section for each borrow pit based on the typical borrow pit section shown in Figure 2.2.2;
- assumed quarry face profile approximately 60 degrees;
- the intermediate bench, if required, would be excavated to a maximum width of 1.5 m;
- the borrow pit floor is excavated to a nominal depth but would in practice be inclined gently down slope into the excavation;
- the maximum height of any single face would be no more than 6 m;
- localised forestry in these areas will need to be cleared (refer to EIAR Volume 2: Main Report, Chapter 14: Forestry); and
- drainage would be managed using a peripheral cut off ditch.

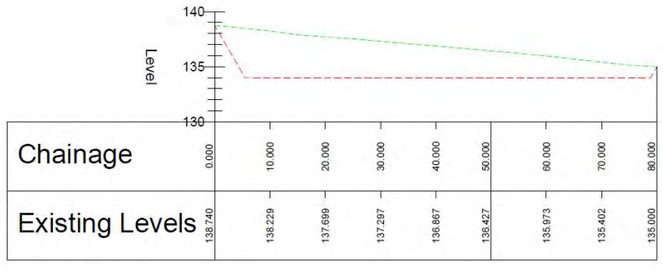
Borrow Pit 1

1.4.9 Proposed Borrow Pit 1 (BP1) is located adjacent to the existing track on the southern slope of Black Hill, as shown on Figure 2.2.1. No peat cover is present at this location based on the peat probe survey.

Table 2.2.1: Borrow Pit 1 (NGR 224817 566013)	
Site Area	Maximum dimensions of search area: 240 m length 137 m width
Height of Excavation	7 m maximum
Area of Land Impacted	7,275 m^2
Slope Angle from DTM Mapping	The slope angle of the search area is between 2 and 3 degrees
Elevation of Floor During Construction	134 m AOD
Details of Extraction	Hard digging
Overburden Type and Depth	Superficial deposits during the peat probing survey recorded 0.1 m to 0.2 m of superficial soils in this location, an overburden of less than 0.3 m is assumed
Indicative Volume of Aggregate Extraction	Approximate volume of 19,980 m^3 between depths of approximately 134 m AOD and 142 m AOD over the length of BP1
Aggregate Composition	Assumed sandstone interbedded with siltstone, with moderate weathered. Fracture spacing. No rock outcropping observed in the area

Figure 2.2.3: Borrow Pit 1 Cross Section

BP1 - CROSS SECTION
SCALE: H 1:500,V 1:250. DATUM: 130.000



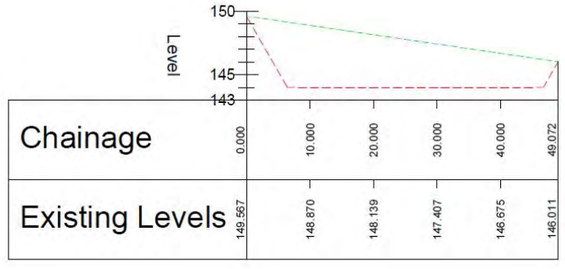
Borrow Pit 2

1.4.10 Proposed Borrow Pit 2 (BP2) is located adjacent to the proposed access track north of Black Hill, as shown on Figure 2.2.1. No peat cover is present at this location based on the peat probe survey.

Table 2.2.2: Borrow Pit 2 (NGR 224637 566888)	
Site Area	Maximum dimensions search area: 347 m length 126 m width
Height of Excavation	5 m maximum
Area of Land Impacted	5,088 m^2
Slope Angle from DTM Mapping	The slope angle of the search area is between 3 and 5 degrees
Elevation of Floor during Construction	144 m AOD - 145 m AOD
Details of Extraction	Hard digging
Overburden Type and Depth	Superficial deposits during the peat probing survey recorded 0.1 m to 0.2 m of superficial soils in this location, an overburden of less than 0.3 m is assumed
Indicative Volume of Aggregate Extraction	Approximate volume of 17,583 m^3 between depths of approximately 144 m and 150 m over the length of BP2
Aggregate Composition	Sandstone interbedded with siltstone, moderately weathered. Fracture spacing 250 mm – 100 mm (moderately wide occasionally close). Sub vertical bedding (95°) recorded rock outcrop 150 m southwest of BP2

Figure 2.2.4: Borrow Pit 2 Cross Section

BP2 - CROSS SECTION
SCALE: H 1:500,V 1:250. DATUM: 143.000



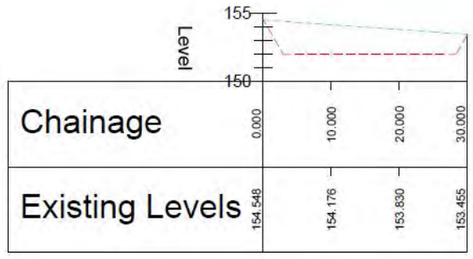
Borrow Pit 3

1.4.11 Proposed Borrow Pit 3 (BP3) is an existing borrow pit located in the eastern part of the Site. It is accessed via an existing forestry access track and some shallow peat cover is present at this location based on the peat probe survey.

Table 2.2.3: Borrow Pit 3 (NGR 225918 567227)	
Site Area	Maximum dimensions search area: 100 m length 60 m width
Height of Excavation	2 m maximum
Area of Land Impacted	1,751 m^2
Slope Angle from DTM Mapping	The slope angle of the search area is between 2 and 3 degrees
Elevation of Floor During Construction	152 m AOD
Details of Extraction	Hard digging
Overburden Type and Depth	Superficial deposits during the peat probing survey recorded 0.1 m of superficial soils at crest of cut slope in this location, an overburden of less than 0.2 m is assumed
Indicative Volume of Aggregate Extraction	Approximate volume of 2,850 m^3 between depths of approximately 152 m and 155 m over the length of BP3
Aggregate Composition	Fine grained calcareous sandstone interbedded with siltstone and mudstone, moderately weathered. Fracture spacing >250 m - 50 mm (wide occasionally very close). Sub vertical bedding recorded at existing BP3 location

Figure 2.2.5: Borrow Pit 3 Cross Section

BP3 - CROSS SECTION
SCALE: H 1:500,V 1:250. DATUM: 150.000



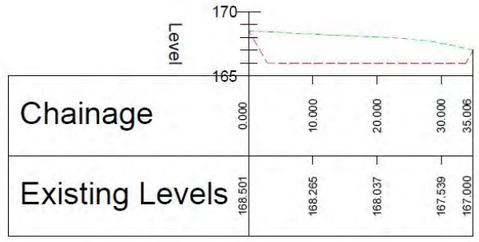
Borrow Pit 4

1.4.12 Proposed Borrow Pit 4 (BP4) is located in the north western part of the Site adjacent to the proposed Turbine 3, as shown on Figure 2.2.1. Some shallow peat cover is present at this location based on the peat probe survey.

Table 2.2.4: Borrow Pit 4 (NGR 222961 568838)	
Site Area	Maximum dimensions search area: 100 m length 60 m width
Height of Excavation	3 m maximum
Area of Land Impacted	2,988m^2
Slope Angle from DTM Mapping	The slope angle of the search area is between 2 and 3 degrees
Elevation of Floor During Construction	166 m AOD
Details of Extraction	Hard digging
Overburden Type and Depth	Superficial deposits during the peat probing survey recorded 0.1 m of superficial soils at crest of cut slope in this location, an overburden of less than 0.2 m is assumed.
Indicative Volume of Aggregate Extraction	Approximate volume of 5,763 m^3 between depths of approximately 167 m and 169 m over the length of BP4.
Aggregate Composition	Assumed sandstone interbedded with siltstone, with moderate weathered. Fracture spacing. No rock outcropping observed in the area

Figure 2.2.6: Borrow Pit 4 Cross Section

BP4 - CROSS SECTION
SCALE: H 1:500,V 1:250. DATUM: 165.000



Summary

1.4.13 Exposures of sedimentary bedrock comprising predominantly calcareous sandstone and siltstone, but occasionally interbedded with mudstone have been identified across the Site, it is considered that the proposed borrow pit search areas will provide sufficient and suitable aggregate for access track construction given its strength and likely durability, however a detailed ground investigation including boreholes and trial pits will be required to determine the suitability of the rock. An assessment will be required to confirm the exact extraction methods based on the intrusive site investigation data.

1.4.14 Indicative aggregate volumes from each borrow pit are as follows:

Table 2.2.5: Summary of Indicative Aggregate Volumes	
Borrow Pit	**Estimate of Aggregate Volumes (m^3)**
BP 1	19,980
BP 2	17,583
BP 3	2,850
BP 4	5,763

1.4.15 Borrow Pits 1, 2 and 4 are anticipated to supply the majority of the aggregate for the tracks, crane pads and bases for the northern and western parts of the Site. Borrow pit 3 could be opened to meet the Proposed Development infrastructure requirements mainly for the eastern part of the Site. However, this will be determined following the detailed investigations pre-construction. It is intended that the number and size of borrow pits opened will be minimised where practicable. However, this will depend on a number of factors including:

- results from the detailed design and intrusive investigation work prior to extraction including volume, quality and quantity of rock available for extraction at each location;
- potential visual impacts at each location;
- potential impact on forestry design; and
- haulage distances from each location to end destination.

1.4.16 Based on conservative estimates, the volume of aggregate required during the construction of the Proposed Development would be of the order of 40,000 m^3 - 50,000 m^3, however this would be further refined during the detailed design for the Proposed Development. Based on the initial assessment presented above, there would be sufficient rock to satisfy the general fill demands of the Proposed Development, although it is noted that import of aggregate is still likely to be required for wearing course layers of roads and for concrete batching.

1.5 Construction Requirements

Extraction Operations

1.5.1 The requirement to produce various grades of aggregate would necessitate the use of mobile plant and equipment. This operation would comprise of a number of different elements which are summarised below:

1.5.2 Hard Digging - it is envisaged the extraction materials would be extracted using hard digging to easy ripping based on the assessment of observed rock strength from the site walkover. Rock samples should be taken for strength testing by an approved geotechnical laboratory to derive point load and UCS values. The contractor may wish to re-evaluate any alternatives to the requirement for digging on the basis of the available rock quality data (drilling and blasting may be required but it is considered unlikely).

1.5.3 Initial Stripping and Preparation - the initial access routes to the borrow pits would need to have some preparation prior to the introduction of the main items of excavation plant, particularly, those located off the existing site access track.

1.5.4 Tree clearance would be required at BP2 and BP4 borrow pit locations, however this would be minimised where possible. Further detail on proposed felling and the forest design plan is provided in EIAR Volume 2: Main Report, Chapter 14: Forestry. It is envisaged that the significant items of mobile plant would either possess 'caterpillar' type tracks or high traction rubber tyres and would be capable of traversing surfaces which have had a relatively minimal amount of preparation.

1.5.5 It is anticipated that initial preparation would consist of a series of passes using an excavator with blade along or near to the final route of the permanent access track. This would have the effect of removing vegetation and any soft material, and also in compacting the weathered material located immediately above the bedrock. The gradients of prepared access way would be no steeper than 1(V) in 10(H). All borrow pits would be accessed from the existing track network. There is the potential for some short sections of track to be constructed from imported materials, unless locally sourced suitable materials can be located.

1.5.6 In addition the area of the proposed borrow pits would require to be stripped of the superficial material including any soil which lies above bedrock. This material would need to be carefully lifted and placed in storage mounds within an appropriate storage area.

1.5.7 Crushing and Screening - The primary component of this operation would consist of a mobile crushing and screening system. Modern mobile crushing plants are available in a number of different formats and are usually available complete with screening capability. The contractor would need to provide a plant setup that meets the project requirements in terms of the ability to process the raw material, the quantities of the material required and the quality and size gradings of the product.

1.5.8 It is also envisaged that a rubber tyred front end loader would also be required in order to serve the crushing and stockpiling operation, as well as to produce loadout facilities for the truck and shovel based roadmaking operation

1.5.9 Drainage - a drainage and surface water management system would be provided in order to control surface water run-off. Due to the relatively small size of any proposed excavation together with the associated plant site the system would comprise of a peripheral cut-off ditch together with minor attenuation features or soakaways.

1.5.10 Given the low permeability and generally thin veneer of the overlying peat and superficial deposits it is not anticipated that groundwater ingress will be significant. However, the flow capacity of the bedrock will need to be determined to identify whether fracture flow is likely to be encountered and if standing water is likely to collect in the base of the excavation.

1.5.11 Water entering the borrow pits will need to be removed by either gravity drainage design or pumping depending on the overall morphology of the pit. The general topography in the areas identified is conducive to gravity drainage owing to the moderate to steep slopes. Discharge consent/ CAR licence may be required from SEPA for this activity. Water removed from the excavations will be passed through an appropriate sediment settling system to remove suspended sediment prior to discharge. The constructed drainage system and water pumped from the excavations will not be discharged directly to any natural watercourse.

1.5.12 It is not anticipated that groundwater will be largely encountered by the opening of the borrow pits at the Site due to the high elevations and slope angles. However, the groundwater regime would need to be verified through further ground investigation.

Environmental Management

1.5.13 The Proposed Development would be designed, constructed, operated and decommissioned in line with relevant environmental legislation, guidance and good practice, to ensure that soils, and both ground and surface waters are not contaminated.

1.5.14 During construction activities, a Construction Environmental Management Plan (CEMP) would be used to manage the potential impacts on the environment, and a specific plan covering borrow pits would be developed as part of the CEMP.

1.5.15 Assuming good practice techniques are adhered to at all times and the implementation of mitigation measures as discussed above, it is anticipated that residual impacts from borrow pit activities on surface water, groundwater and soils will not be significant.

1.6 Conclusions and Recommendations

1.6.1 A reconnaissance walkover and supporting field surveys have been carried out at the proposed Artfield Forest Wind Farm to identify potential borrow pit sites. A number of potential borrow pit search area locations have been identified from desktop data analysis, fieldwork and visual appraisals.

1.6.2 The surveys demonstrated that the areas of greatest potential in terms of bedrock excavation were located at extant borrow pits that were used as a source of stone for the construction of the existing estate tracks across the Site.

1.6.3 All borrow pits are located on bedrock comprising greywacke sandstone; these are calcareous sandstones and siltstones, but occasionally interbedded with mudstone. The quality of finer grained material should be verified through further ground investigation to minimise waste material being generated at the locations. No ground investigation has been undertaken at the Site to inform the assessment.

1.6.4 The borrow pits are generally on slopes with angles between 2° and 5°, which could be excavated within a single layer of excavation. The overburden depths at these sites are generally shallow and predominantly less than or equal to 0.2 m with no significant peat cover.

1.6.5 Based on conservative estimates, the volume of aggregate required during the construction of the Proposed Development would be of the order of 40,000 m³ - 50,000 m^3, however the detailed design for the development proposal has not yet been undertaken and the volume of aggregate required will need to be refined. The estimated amount of aggregate which could be won from the borrow pit search areas has been calculated as approximately 46,000 m³. This figure does not allow for any reduction for waste and unsuitable material. No allowance has been made for the bulking of materials on excavation.

1.6.6 The primary use of aggregate arisings would be for the construction of tracks using unbound aggregate to the turbine suppliers' specifications and conforming to the Specification for Highways Works.

1.6.7 Detailed ground investigations, slope stability assessments and geotechnical testing will be required to inform the detailed design of the borrow pits to confirm the suitability of the material for use as part of the Proposed Development. It is anticipated that impacts on groundwater, surface water and soils from extraction of aggregate will not be significant, assuming use of good practice construction techniques and implementation of mitigation measures as set out in this document.

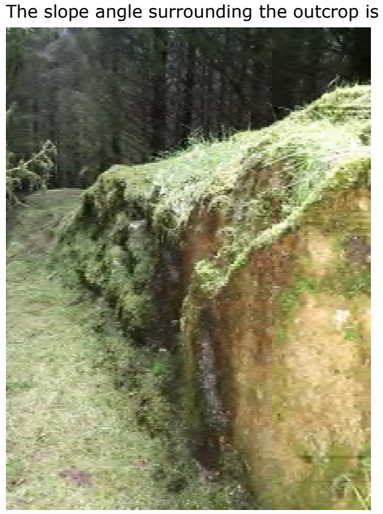
ANNEX 2.2.1 SITE WALKOVER OBSERVATIONS

Existing Borrow Pit Location (BP3)

Borrow Pit BP3 (NGR 225923 567282)	Lithology	Comment
Existing borrow pit located adjacent to the forestry track in the east of the Site within Meikle Cairn. The cutting is largely de-vegetated with brash located adjacent to the east. The existing rock cutting is set back 10 m from the existing forestry track and is 2 m in height with a width of 30 m. The slope angle above the cutting is approximately 2-3 degrees. 	Fine grained calcareous sandstone interbedded with siltstone and mudstone, moderately weathered. Fracture spacing >250 mm – 50 mm (wide occasionally very close). Sub vertical bedding.	It is considered likely that this rock cutting was previously used to provide aggregate for the forestry tracks. Additional excavation into the prevailing slope would not require slackening the slope angle and no addition of superficial benching above rock would be required to ensure permanent stability. The existing borrow pit could also be expanded by increasing the length to the North and south along the forestry track.

Rock Outcrops Observed During Walkover

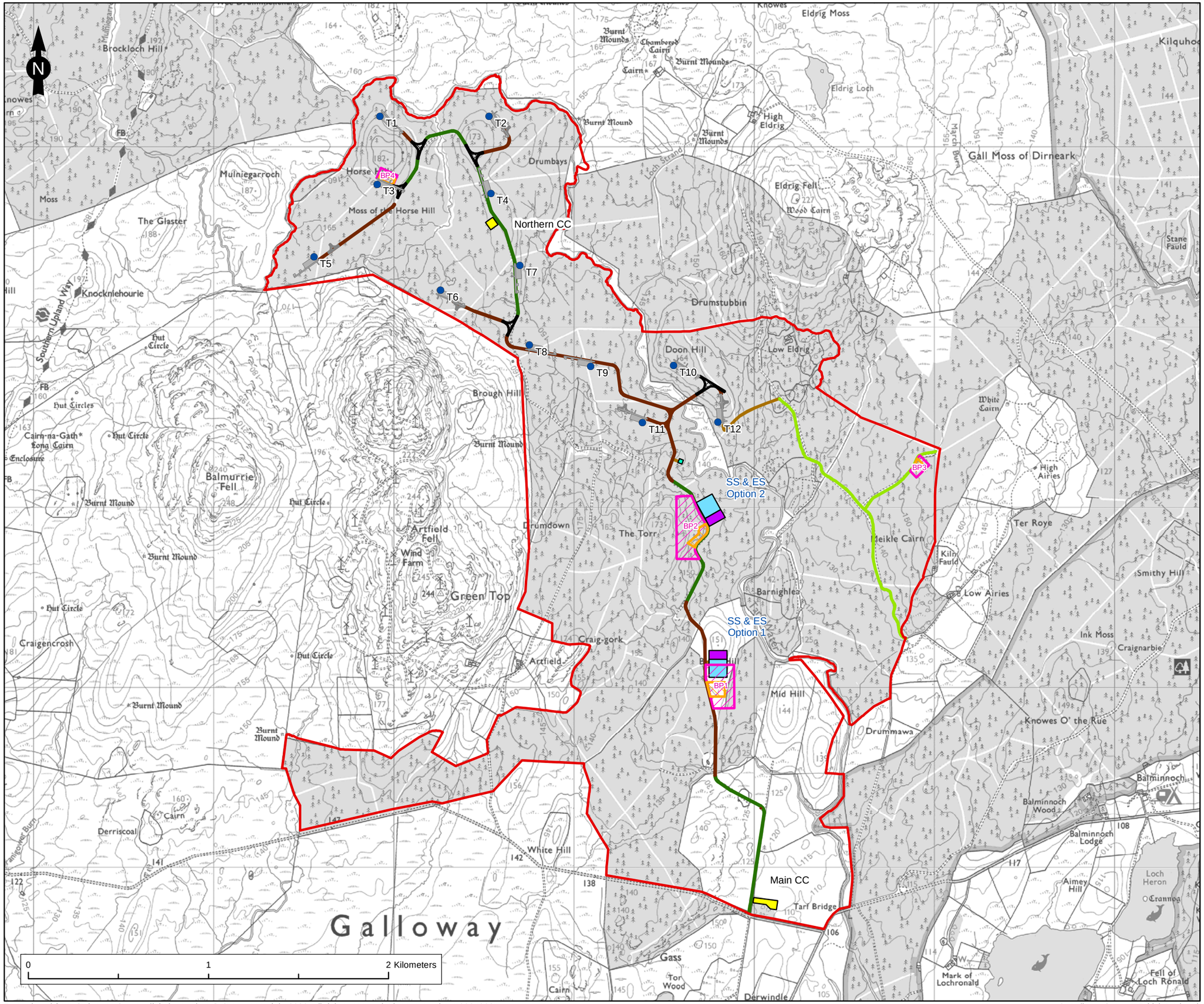
Rock Outcrop 1 (North of BP2 Search Area, NGR 224528 567245)	Lithology	Comment
Rock outcrop located 150 m to the west of Artfield Forest forestry track in the west of the Site. The outcrop is largely vegetated with lichens. The slope angle surrounding the outcrop is approximately 5-10 degrees. 	Sandstone interbedded with siltstone, moderately weathered. Fracture spacing 250 mm – 100 mm (moderately wide occasionally close). Sub vertical bedding (95°)	It is considered likely that this outcrop is indicative of the geology to west of forestry track.

Rock Outcrop 2 (West of BP2 Search Area, NGR 224565 566953)	Lithology	Comment
Rock outcrop located 120 m to the west of Artfield Forest forestry track in the west of the Site. Exposure is approx. 40 m long and up to 3 m high. The outcrop is largely vegetated with lichens. The slope angle surrounding the outcrop is approximately 5-10 degrees. 	Coarse grained sandstone, moderately weathered. Fracture spacing >500 mm – 100 mm (wide occasionally close). Sub vertical bedding (85°).	It is considered likely that this outcrop is indicative of the geology to west of forestry track.

Rock Outcrop 3 (East of BP2 Search Area, NGR 224907 566937)	Lithology	Comment
Rock outcrop located 180 m to the east of Artfield Forest forestry track in the centre of the Site. Exposure is approx. 10 m long and up to 1.5 m high The outcrop is largely vegetated with lichens and grasses. The slope angle surrounding the outcrop is approximately 2-3 degrees. 	Coarse grained sandstone interbedded with siltstone, highly weathered. Fracture spacing 250 mm – 50 mm (wide occasionally very close). Sub vertical bedding (80°).	It is considered likely that this outcrop is indicative of the geology to east of forestry track.

Rock Outcrop 4 (Southeast of BP1 Search Area, NGR 225199 565214)	Lithology	Comment
Rock outcrop located 10 m to the north of proposed access track in the south of the Site. Exposure is approx. 10 m long and up to 1.5 m high. The outcrop is largely vegetated with lichens and grasses. The slope angle surrounding the outcrop is approximately 3-5 degrees. 	Fine to medium grained sandstone interbedded with siltstone, moderately weathered. Fracture spacing 250 mm – 100 mm (wide occasionally close). Sub vertical bedding (80°).	It is considered likely that this outcrop is indicative of the geology to south of the Site and Black Hill.

FIGURES



Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Existing Forestry Track No Upgrade
- Existing Forestry Track Upgrade
- New Track (Infrastructure only 4m)
- New Track (6m)
- Proposed Turning Head (Loaded)
- Proposed Turning Head (Unloaded)
- Proposed Temporary Construction Compound (CC)
- Proposed Substation Option (SS)
- Proposed Energy Storage Option (ES)
- Proposed Met Mast and associated hardstanding
- Proposed Borrow Pit Search Area (BP)
- Potential Borrow Pit Excavation Area

Figure Title

Figure 2.2.1: Site Layout

Project Name

Artfield Forest Wind Farm
EIA Report

Project Number	Figure No.
1620008937	2.2.1
Date	**Prepared By**
November 2020	AC
Scale	**Issue**
1:20,000 @A3	2

Client

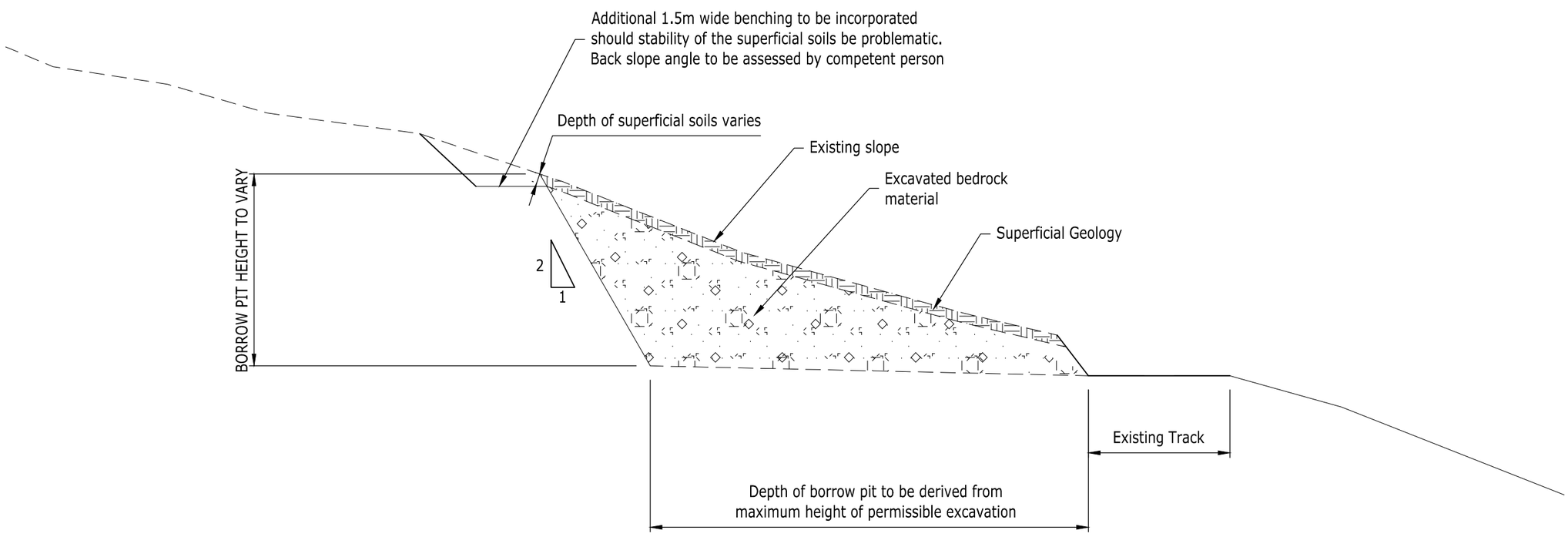
Artfield Forest Wind Farm Ltd

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE METRES UNLESS OTHERWISE STATED.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS, SPECIFICATIONS & REPORTS.
4. SECTIONS HAVE BEEN DERIVED FROM DTM DIGITAL DATA INFORMATION.
5. PROPOSED SLOPE ENGINEERING IS BASED ON SITE WALKOVER INFORMATION ONLY. NO INTRUSIVE GROUND INVESTIGATION HAS BEEN UNDERTAKEN TO DATE.



RAMBOLL

tel 01224 652 200 fax 01224 652 244 info@altra.co.uk
www.ramboll.co.uk

ARTFIELD FOREST WIND FARM

TYPICAL BORROW PIT SECTION

Rev	Description	Date	By Chk	App
	FOR INFORMATION			

Project No:	Scale (@A3):	Drawn:	Date:
1620008937	1:100	SKH	NOV.20

Drawing No: FIGURE 2.2.2

Rev: -

Technical Appendix 2.3: Peat Depth Survey Results

Technical Appendix 2.3: Peat Depth Survey Results

1 Introduction

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

1.1.2 This Technical Appendix has been produced in accordance with guidance published by Scottish Environment Protection Agency (SEPA), NatureScot (formerly Scottish Natural Heritage), and Scottish Government, which is referenced in the following sections.

1.1.3 This Technical Appendix is supported by the following:

- Figure 2.3.1: Peat Depth Survey and Interpolated Peat Depths;
- Figure 2.3.2: Solid Geology;
- Figure 2.3.3: Extract of SNH Carbon and Peatland 2016 Map;
- Annex 2.3.1: Peat Coring Data;
- Annex 2.3.2: Von Post Scale of Humification; and
- Annex 2.3.3: Core Sample Photographs.

2 The Site and Study Area

2.1.1 The Site is located approximately 8 km northwest of Kirkcowan and 15 km west of Newton Stewart, in Dumfries and Galloway, and covers an area of approximately 800 hectares (ha). The Site is centred at approximate Ordnance Survey Grid Reference NX 24367 66928 (as shown in EIAR Volume 3a: Figure 1.1: Site Location). The Site topography is generally undulating at elevations of between 182 m Above Ordnance Datum (AOD) and 110 m AOD.

2.1.2 The Site is dominated by commercially managed plantation forestry. The Site also supports areas of sheep grazed pasture in the south east and recently felled and replanted woodland together with compartments of mixed plantation woodland.

2.1.3 The Site location and setting are described in more detail within Chapter 2: Development Description (EIAR Volume 2). The peat study area focussed on the developable area of the Site (Figure 2.3.1 of this Technical Appendix).

2.1.4 The 1:50,000 scale geological mapping available from the British Geological Survey (BGS) shows the majority of the Site to be underlain by Wacke of the Portpatrick Formation and Glenwhargen Formation. A fault is present within the northernmost area of the Site and the underlying geology is Wacke of the Kirkcolm Formation. This is shown on Figure 2.3.2 of this Technical Appendix.

2.1.5 The BGS mapping shows the superficial geology of the Site predominantly comprises peat, with Diamicton Till in the south-eastern part of the Site. Some areas are mapped as having no superficial deposits present which could imply that rockhead is relatively shallow in these areas.

2.1.6 The carbon-rich soils, deep peat and priority peatland habitat mapping[1] shows the Site as predominantly 'Class 4' or 'Class 5' soils, which are defined as mineral or peat soils with no peatland vegetation. These areas are predominantly forested or clear-felled land. Small areas of 'Class 1' and 'Class 2' soils, which are of national importance are present along the northern boundary, and southern parts of the Site. These are shown in Figure 2.3.3 of this Technical Appendix.

3 Methodology

3.1.1 Peat surveys were undertaken at the Site to understand the baseline peat conditions and potential constraints, and to inform the design of wind farm infrastructure so as to minimise, as far as practicable, the potential direct and indirect effects on peat and carbon rich soils.

3.1.2 The surveys were undertaken by McKay Forestry Limited and Ramboll on the following dates:

- Phase 1 peat probing – between 20 July 2020 and 24 July 2020; and
- Phase 2 peat probing and coring – between 7 September 2020 and 15 September 2020.

3.1.3 In addition to the above, historical peat depth information collected as part of the previous Gass Wind Farm application has been used where appropriate.

3.1.4 Surveys followed best practice guidance published at the time of the surveys with regard to surveying for developments on peatland[2,3]. The methods employed for peat depth probing and peat coring are detailed further below.

Phase 1 Peat Probing

3.1.5 The Phase 1 is a preliminary, low density survey and was carried out on a 100 m grid across the developable area of the Site, with additional points taken at the then considered turbine bases. The probing was carried out using collapsible avalanche probes, allowing for probing in excess of 6 m. However, such depths were not reached. This peat depth data along with other environmental and engineering constraints were used to inform the layout of the Proposed Development, including the turbine locations, substation, access tracks, met mast, borrow pits and compounds.

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

Phase 2 Peat Probing and Coring

3.1.7 The high-density probing during the Phase 2 survey was carried out along the access tracks, and in the planned turbine, crane pad, and compound locations, known at the time of the survey. This included a 50 m micrositing zone around each turbine location. The sampling pattern comprised:

- Proposed turbine locations: peat probing was undertaken at 10 m intervals along cardinal points from the central point of the infrastructure; and
- Proposed new tracks: the alignment was probed at 50 m intervals along the track and at points every 10 m perpendicular to the centreline on either side of the proposed track.

3.1.8 Again, this was carried out using collapsible avalanche probes, allowing for probing in excess of 6 m, and data collected using a handheld Trimble GPS unit.

[1] Scottish Natural Heritage. (2016). *Carbon and Peatland 2016 map (http://map.environment.gov.scot/soil_maps/).*

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

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

3.1.9 Peat cores were taken using a Russian auger, with a sample volume of 0.5 l, and a number of field tests and observations were undertaken. The probing results are included in Annex 2.3.1 of this Technical Appendix, and records taken include:

- Depth of acrotelm;
- Degree of humification (using Hodgson, 1974), to establish amorphous, intermediate, fibrous and content;
- Degree of humification using the Von Post classification (refer to Annex 2.3.2 of this Technical Appendix);
- Fine fibre content, based on scale of F0 (none) to F3 (very high);
- Coarse fibre content, based on scale of R0 (none) to R3 (very high);
- Water content, based on scale of B1 (dry) to B5 (very wet); and
- Substrate underlying the peat where this was possible.

3.1.10 A peat depth probe was taken adjacent to the core location, and cores were photographed (refer to Annex 2.3.3 of this Technical Appendix).

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

4 Limitations

4.1.1 The design of the Proposed Development has considered the proximity of peat, along with other technical and environmental constraints, and wind farm infrastructure has been sited away from these areas, where possible.

4.1.2 Peat probing and mapping has been used to inform the design process, at strategic points in the design evolution of the Proposed Development. However, there are some differences between the final design and the extent of the peat survey results based on design changes made through this process, as a result of micrositing etc.

4.1.3 However, the peat survey probing points do provide high resolution coverage of the Site, and these revealed the peatland to be typically shallow (less than 1.0 m) but with several pockets of deeper peat. It is considered that the peat depths collected, and interpolations derived from these data, are representative of the Site and have adequately informed the layout of the Proposed Development.

5 Results

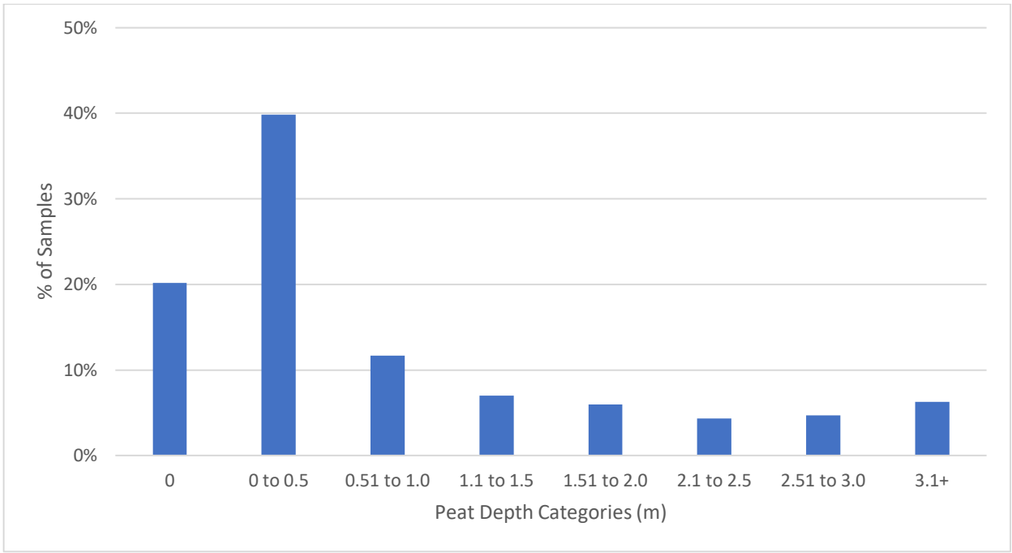
Peat Probing

5.1.1 During the peat depth probing surveys, a total of 338 peat depth probes were taken during the Phase 1 peat survey and 1,370 peat depth probes during Phase 2. The relevant historical peat probe information from the Gass Farm application comprised an additional 517 peat depth probes. Therefore, there is a combined peat depth dataset of 2,225 probes, as shown in Figure 2.3.1 (of this Technical Appendix).

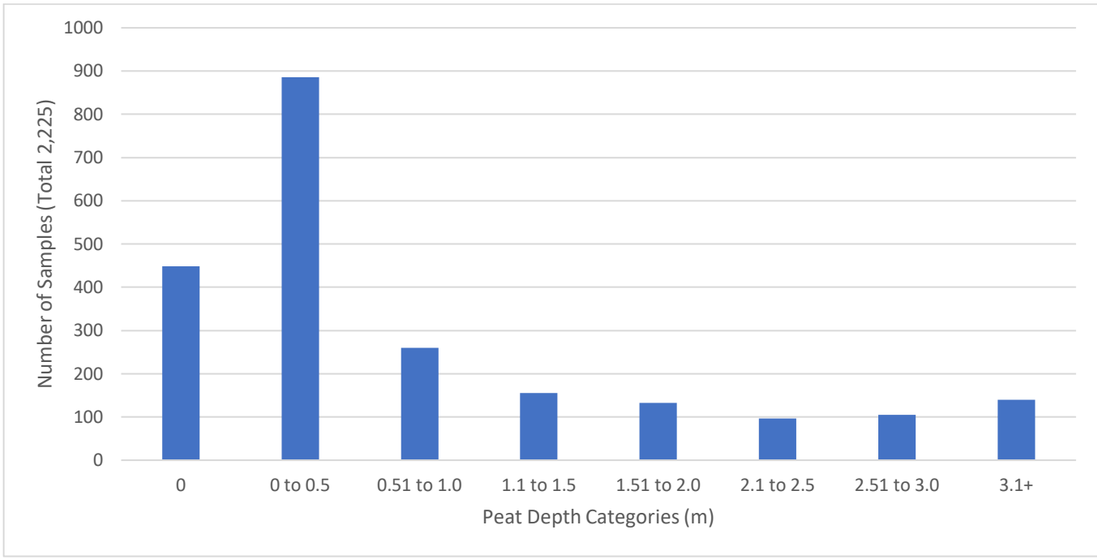
5.1.2 Figure 2.3.1 (of this Technical Appendix) shows the results of the peat depth survey at the Site, as well as the specific depth class at each sample location. Figure 2.3.1 (of this Technical Appendix) is based on IDW data interpolation and consequently the peat depth contours and boundaries are to a degree indicative.

5.1.3 Graph 1 and Graph 2 below present the percentage and frequency of peat probe results within the specific peat depth categories recorded during the Phase 1 and Phase 2 surveys.

Graph 1: Percentage Peat Depth Categories (All Surveys Combined)



Graph 2: Peat Depth Frequency Distribution



5.1.4 As shown on Graph 1 and Graph 2, most of the developable area of the Site has either no peat present or has a shallow depth of peat present (approximately 60 % were <0.5 m in depth). These areas of shallow peat can be considered as organo-mineral soils. These are further summarised as follows:

- 449 no. samples (20.0 %) located on land with no peat/ absent;
- 886 no. samples (40 %) located on land with less than or equal to 50 cm depth of peat or organo-mineral soil;

- 260 no. samples (12 %) fell on land with between 51 cm and 100 cm depth of peat; and
- 630 no. samples (28 %) located on land with more than 100 cm depth of peat.

5.1.5 The maximum depth of peat recorded at the Site was 6.4 m, located in the south-western part of the Site during the peat survey for the Gass Wind Farm. The maximum depth of peat recorded during the Phase 1 peat probe survey was 5.5 m, located to the north-western part of the Site. The maximum depth of peat recorded during the Phase 2 peat probe survey was 5.7 m, located east of Turbine 10. The mean peat depth recorded was 0.87 m.

5.1.6 Land where peat depth is greater than 50 cm is classified as 'blanket bog' by SNH (MacDonald *et al.*, 1998)[4] and JNCC (JNCC, 2010)[5]; however, some areas with a peat depth of less than 50 cm can still form part of the wider hydrologically connected mire, or macrotope. As per above, much of the peatland or organo-mineral soil habitats within the Site have less than 50 cm of peat/ soil present.

Accuracy of Peat Depth Probes

5.1.7 At each core sample location, a peat depth probe was taken adjacent to the core sample to compare the probed depth against the true depth determined by measuring the depth of material retained in the core sample.

5.1.8 To ensure the full depth of peat is sampled, a core is extracted that confirms the peat/ substratum boundary has been reached. This approach allows a relative assessment of the accuracy of the peat depth probing. Peat or organo-mineral soil was present at all sample locations. The results are presented in Table 2.3.1.

Table 2.3.1: Comparison of Peat Probe and Coring Depth

Sample ID	Probed Depth (cm)	Cored Depth (cm)	Difference Probed to Cored (cm)	Location
PC01	320	200	120	NGR Ref:223005, 568677. 100 m southeast of Turbine T3
PC02	70	70	0	NGR Ref: 223539, 568893. 150 m north of Turbine T7
PC03	100	100	0	NGR Ref: 223611, 568027. 370 m southeast of Turbine T5
PC04	180	150	30	NGR Ref: 223846, 567805. 250 m west of Turbine T9
PC05	90	90	0	NGR Ref: 223782, 567908. 30 m southeast of Turbine T8
PC06	140	140	0	NGR Ref: 224379, 567453. 20 m east of Turbine T11
PC07	60	50	10	NGR Ref: 224536, 567369. 120 m northwest of met mast location
PC08	50	30	20	NGR Ref: 224744, 566908. 10 m east of existing Artfield forest Access Track

5.1.9 As can be seen within Table 2.3.1 there was a slight tendency for the peat probes to overestimate the true peat depths determined via coring at the Site (mean overestimation of 22.5 cm). Density of peat and underlying substrate has the potential to affect the estimation of peat depth. This is generally as a result of the difference in design of the peat probe and Russian auger, whereby the probe is narrower and is easier to penetrate deeper into the peat layers.

Core Sample Results

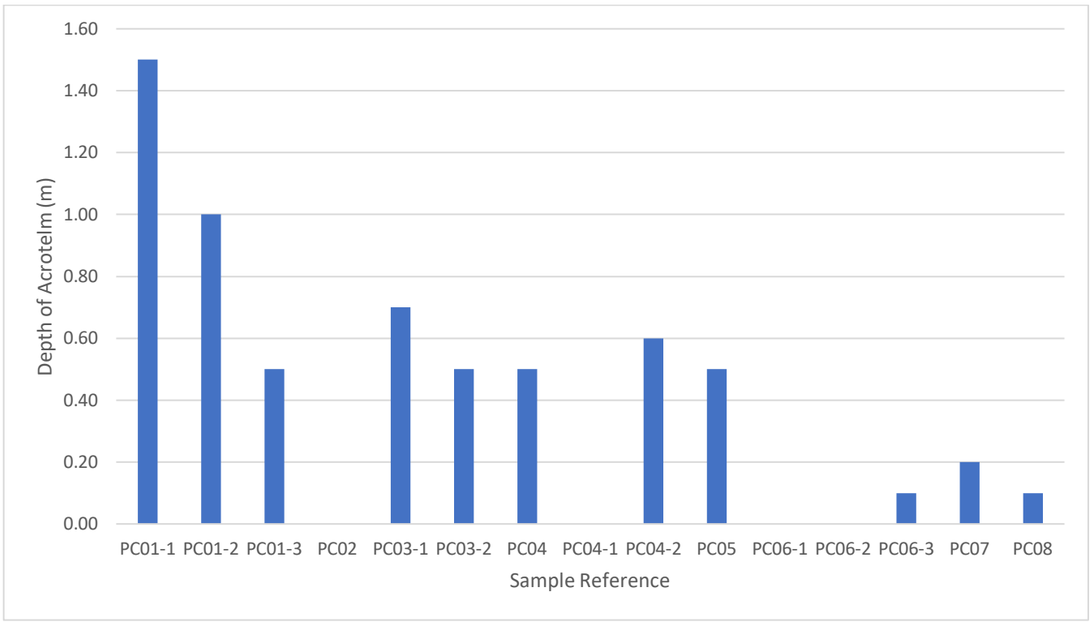
Depth of Acrotelm

5.1.10 The acrotelm and catotelm represent two distinct layers within undisturbed peat that control the hydrological regime. The catotelm is the bottom layer of peat that is mostly below the water table. The acrotelm overlies the catotelm and is the 'living' layer in which most water table fluctuations occur. The thickness of the acrotelm usually varies up to around 50 cm, but it largely depends upon the habitat. Anaerobic and aerobic conditions alternate periodically with the fluctuation of the water table, favouring more rapid microbial activity than in the catotelm. The acrotelm consists of the living parts of mosses and dead and poorly decomposed plant material. It has a very loose structure that can contain and release large quantities of water in a manner that limits variations of the water table in peat bogs.

5.1.11 Graph 3 shows that acrotelm was recorded at all but three sample locations, with a mean depth of 0.41 m (41 cm). The other sample locations indicated no discernible acrotelm.

5.1.12 In the context of any development, it is recommended that for the purposes of construction and subsequent reinstatement, that where a sufficient peat depth exists, the top 50 cm of material should be treated as acrotelm. This approach will allow excavation of intact turves for reinstatement purposes where they are present, which will in turn facilitates quicker regeneration of disturbed areas. Even if little vegetation is present within this top layer it should still be treated as acrotelmic material as it may contain a seedbank, particularly in open habitats, which will aid re-vegetation of reinstatement areas.

Graph 3: Depth of Acrotelm



[4] MacDonald, A. Stevens, P., Armstrong, H., Immirzi, P. and Reynolds, P. (1998). A Guide to Upland Habitats: Surveying Land Management Impacts (Volume 1). Scottish Natural Heritage, Edinburgh.

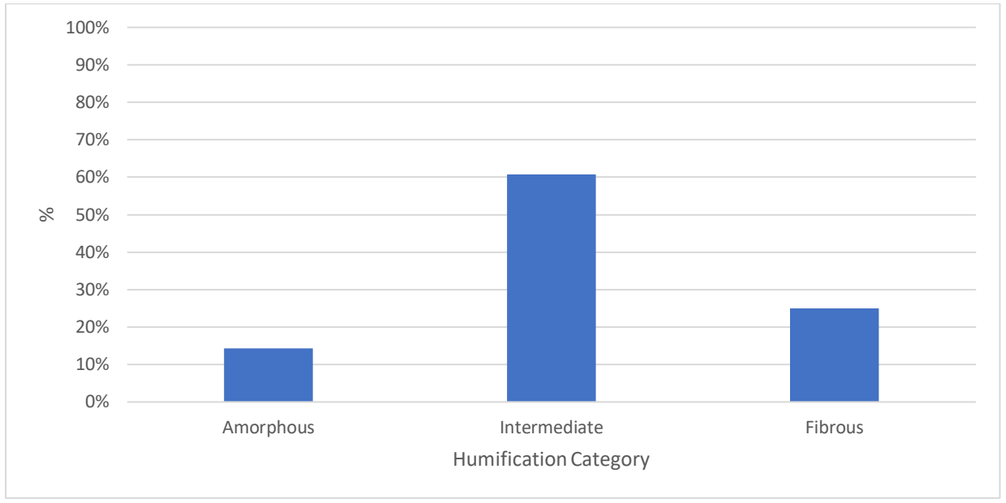
[5] JNCC (2010) *Handbook for Phase 1 Habitat Survey, Joint Nature Conservation Committee, Peterborough.*

Degree of Humification

5.1.13 The degree of humification was recorded in the field, in accordance with the methods discussed in the methodology section, with each 0.5 m sub-sample being categorised as either fibrous, intermediate, or amorphous peat.

5.1.14 Graph 4 summarises the degree of humification, which indicates that most of the samples are classed as intermediate. This is suggestive that there is a degree of humification present.

Graph 4: Degree of Humification



Fibrous Content

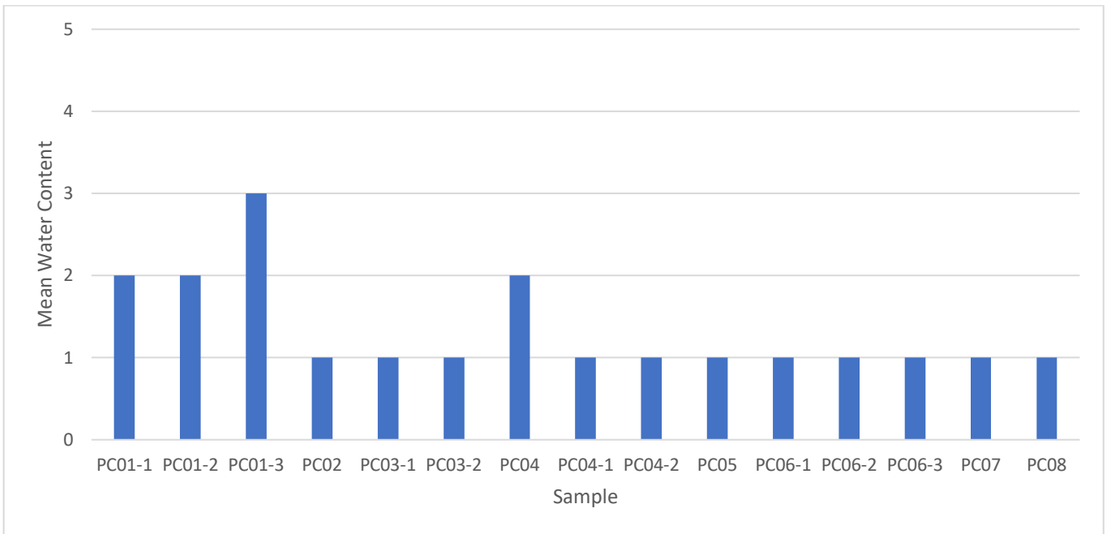
5.1.15 The proportions of coarse and fine fibres within the peat samples were derived in the field according to the Hobbs scale. This indicates that the majority of the samples were assessed as having moderate fine fibre content (F2). The majority of the sample locations were assessed as having a low coarse fibre content (R1), with four locations having a moderate coarse fibre content (R2), and one sample having a high coarse fibre content (R3). These results are summarised in Graph 5.

Graph 5: Fibrous Content

Water Content

5.1.16 The water content of the samples was determined in the field using the Hobbs scale, where B1 is dry and B5 is very wet. The results are summarised in Graph 6.

Graph 6: Water Content

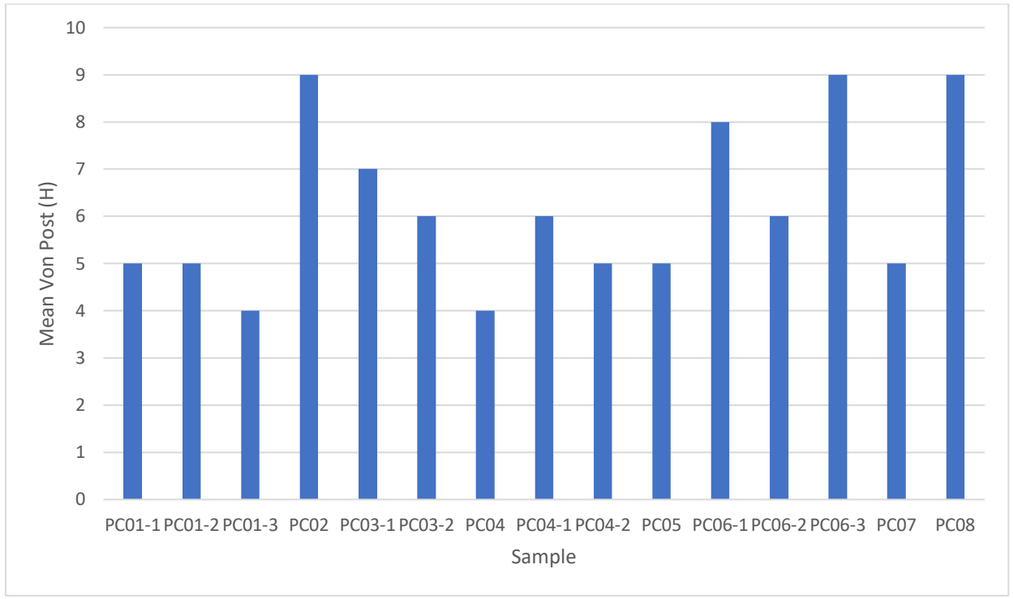


5.1.17 The results indicate that most of the of the samples recorded are indicative of dry peat (B1), with the remainder being between B2 and B3 (semi-dry peat). No samples were recorded as wet or very wet (B4 or B5).

Von Post (Degree of Humification)

5.1.18 An estimate of the degree of humification according to the Von Post scale was carried out on samples at all core locations. The results are shown in Graph 7 below, where the vertical axis refers to the Von Post scale of peat decomposition (on a scale of H1 to H10). The criteria associated with the Von Post scale is included in Annex 2.3.2 (of this Technical Appendix).

Graph 7: Mean Von Post

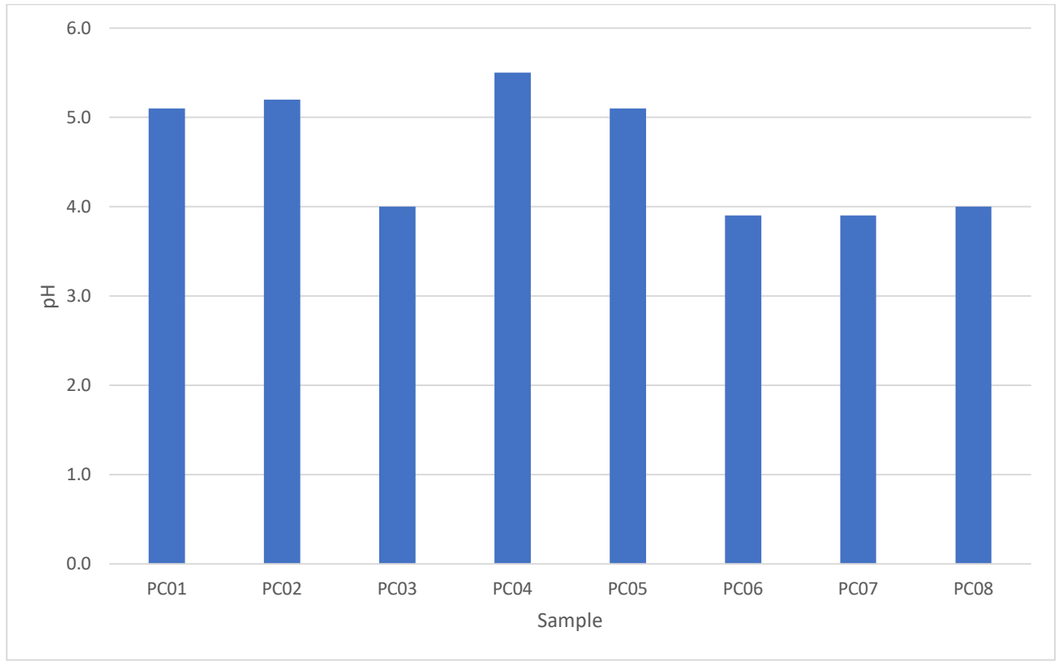


5.1.19 The results indicate that nearly all the samples were found to be scored relatively high on the Von Post scale (>H4) indicating a stronger rate of decomposition (between H5 and H6), with three sample described as almost completely decomposed. This is likely to be as a result of the presence of commercial forestry at the Site, and modified nature of the soils present.

pH of Samples

5.1.20 The pH values of the core samples were analysed in a laboratory, and the results provided in Graph 8 below.

Graph 8: Mean pH

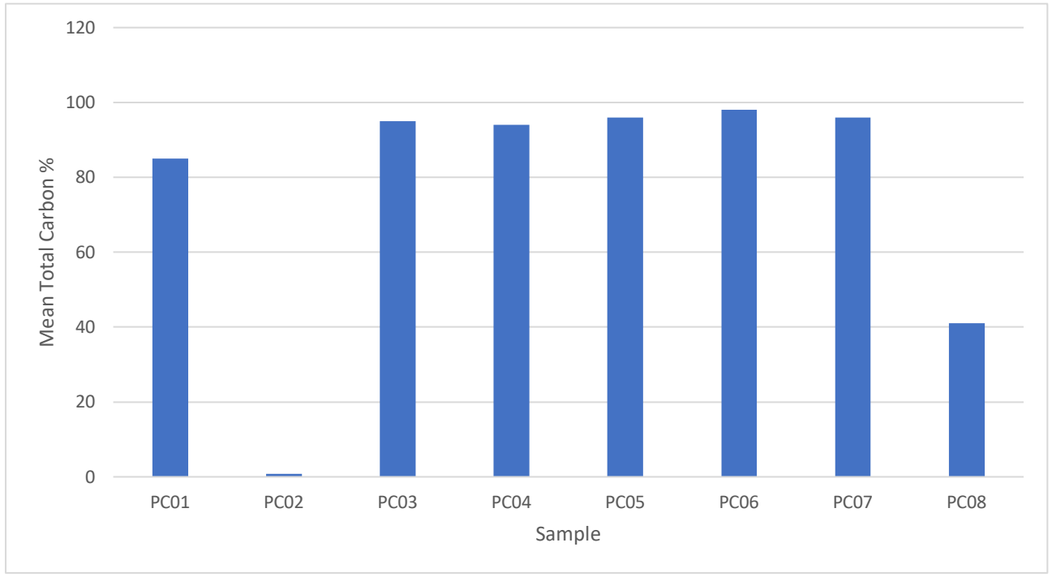


5.1.21 The mean pH value was 4.6, with a range between 3.9 and 5.1, which indicates that all samples are acidic in nature. This result is typical of peat and carbon rich soils.

Total Carbon (%)

5.1.22 The total carbon context was derived by laboratory analysis for each sample and is summarised in Graph 10. This indicates a consistent high carbon content with a mean of 75.7%. Two samples recorded lower carbon contents.

Graph 9: Total Carbon (%)



Underlying Substrates

5.1.23 At each location, where possible, a broad characterisation was made of the underlying substrate below the peat horizon. It was not possible to characterise the underlying substrate by correlating the probed and cored depth, due to the density of the peat.

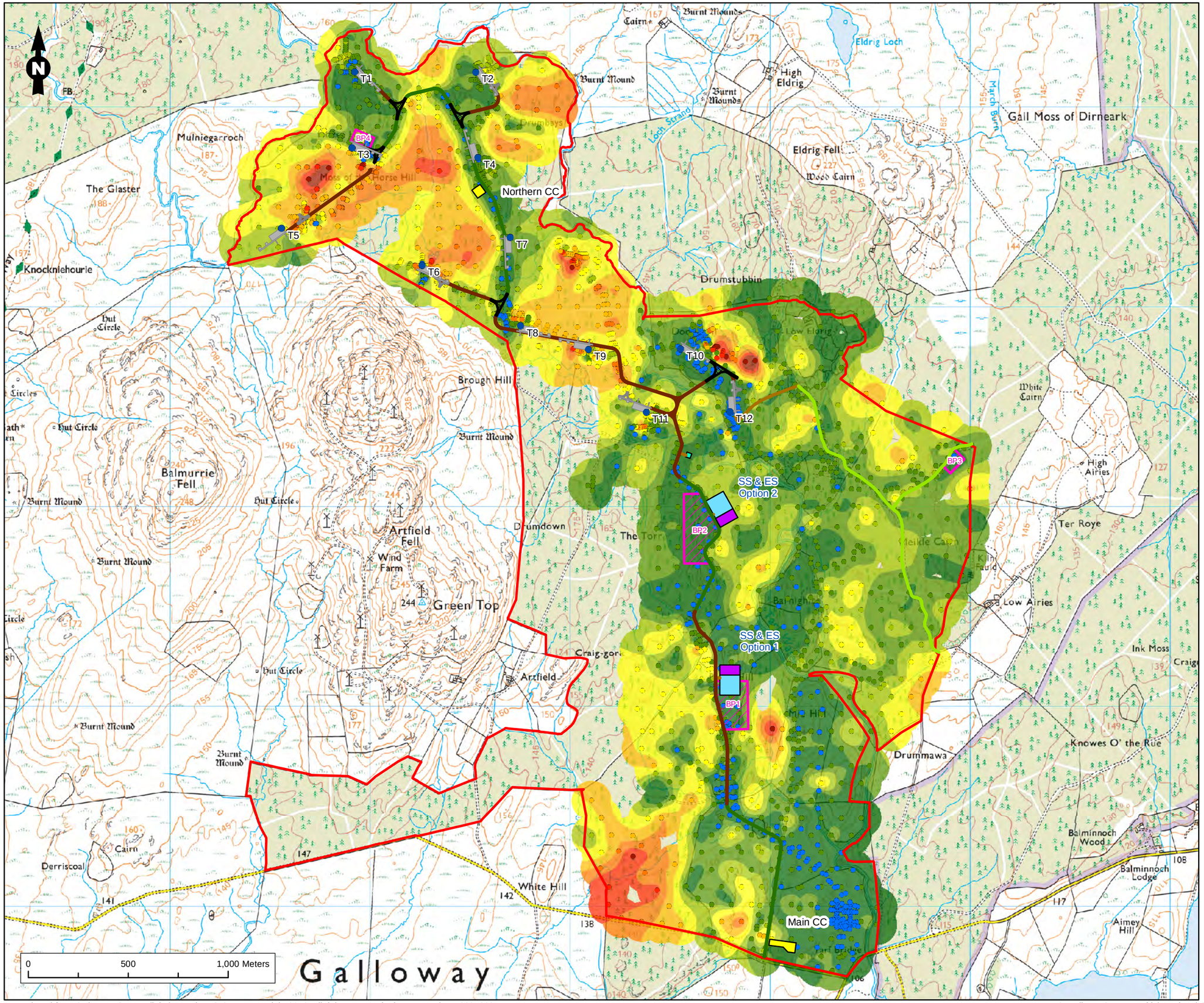
Summary

5.1.24 The results of the Phase 1 and Phase 2 surveys, including the historical peat depth data for the Gass Wind Farm are summarised as follows:

- Overall, the peat depth within the developable area is relatively shallow (<0.5 m). However, a deeper area of peat (>1.0 m) is located in the north western part of the Site, with localised areas of deeper peat to 4.0 m to 6.0 m. Other small pockets of deeper peat were noted in the south western and north eastern parts of the Site. These are shown on Figure 2.3.1 (of this Technical Appendix). The wind farm infrastructure has been located away from these deeper peat locations where practicable, taking into account other environmental and technical constraints, or microsited to minimise potential adverse effects. No turbines are located on deep peat;
- The depth of the acrotelm from the sample locations is 41 cm, although it has been assumed for the purpose of assessment that the depth of acrotelm is 50 cm;
- The peat across the Site is generally intermediate in nature, with the majority of the samples assessed as having medium fine fibre content (F2), with five samples having a low fine fibre content (F1). The majority of the sample locations were assessed as having a low coarse fibre content (R1), with five locations having a moderate or high coarse fibre content (R2 and R3);
- The results of the Von Post indicate that the majority of the samples tested scored relatively high on the Von Post scale (H5+) indicating a relatively strong rate of decomposition, with several sample showing advanced decomposition;
- The mean water content of the peat at all sample locations was dry and semi-dry, which is consistent with the high degree of modification to the peatland integrity and composition through artificial drainage and overplanting with coniferous plantation forest. The drainage of the Site for the purposes of plantation forestry has caused drying, oxidation, and erosion of peat and carbon-rich soils, which have likely increased carbon release;
- The peat was found to be acidic with a mean pH value of 4.6, and a range between 3.9 and 5.1, indicative of peat and carbon rich soils; and
- Laboratory analysis of samples indicates that the peat has a high total carbon content.

.

FIGURES



Legend

- Site Boundary
- Proposed Turbine
- Proposed Temporary Construction Compound (CC)
- Proposed Substation Option (SS)
- Proposed Turbine Hardstanding
- Proposed Turning Head (Unloaded)
- Proposed Turning Head (Loaded)
- Existing Forestry Track No Upgrade
- Existing Forestry Track Upgrade
- New Track (Infrastructure only 4m)
- New Track (6m)
- Proposed Met Mast and associated hardstanding
- Proposed Energy Storage Option (ES)
- Proposed Borrow Pit Search Area (BP)

Peat Sample Location Depth (m)

- 0.00
- 0.01 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
- 4.01 - 5.00
- 5.01 - 6.40

Interpolated Peat Depth (m)

- 0.00 - 0.20
- 0.21 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
- 4.01 - 5.00
- 5.01 - 6.40

Figure Title
Peat Depth Survey and Interpolated Peat Depths

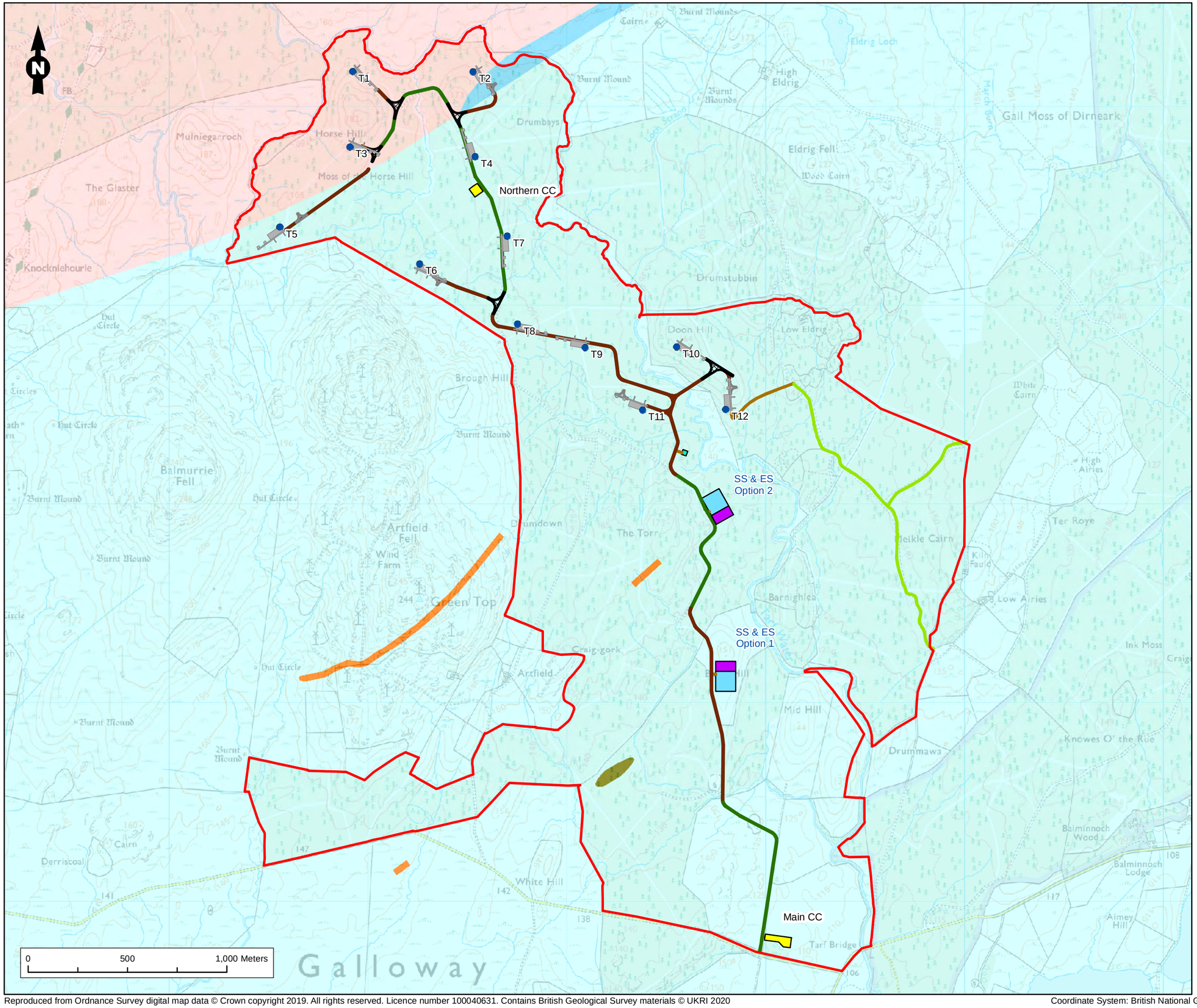
Project Name
Artfield Forest Wind Farm

Project Number	Figure No.
1620008937	2.3.1
Date	**Prepared By**
January 2021	AB
Scale	**Issue**
1:18,000@A3	1

Client
Artfield Forest Wind Farm Ltd

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Site Boundary
- Proposed Turbine
- Proposed Temporary Construction Compound (CC)
- Proposed Substation Option (SS)
- Proposed Turbine Hardstanding
- Proposed Turning Head (Unloaded)
- Proposed Turning Head (Loaded)
- Existing Forestry Track No Upgrade
- Existing Forestry Track Upgrade
- New Track (Infrastructure only 4m)
- New Track (6m)
- Proposed Met Mast and associated hardstanding
- Proposed Energy Storage Option (ES)

Bedrock Geology

- Kirkcolm Formation - Wacke
- Moffat Shale Group - Mudstone
- North Britain Siluro-Devonian Calc-Alkaline Dyke Suite - Felsite
- North Britain Siluro-Devonian Calc-Alkaline Dyke Suite - Lamprophyre
- Portpatrick Formation - Wacke

Figure Title
Bedrock Geology

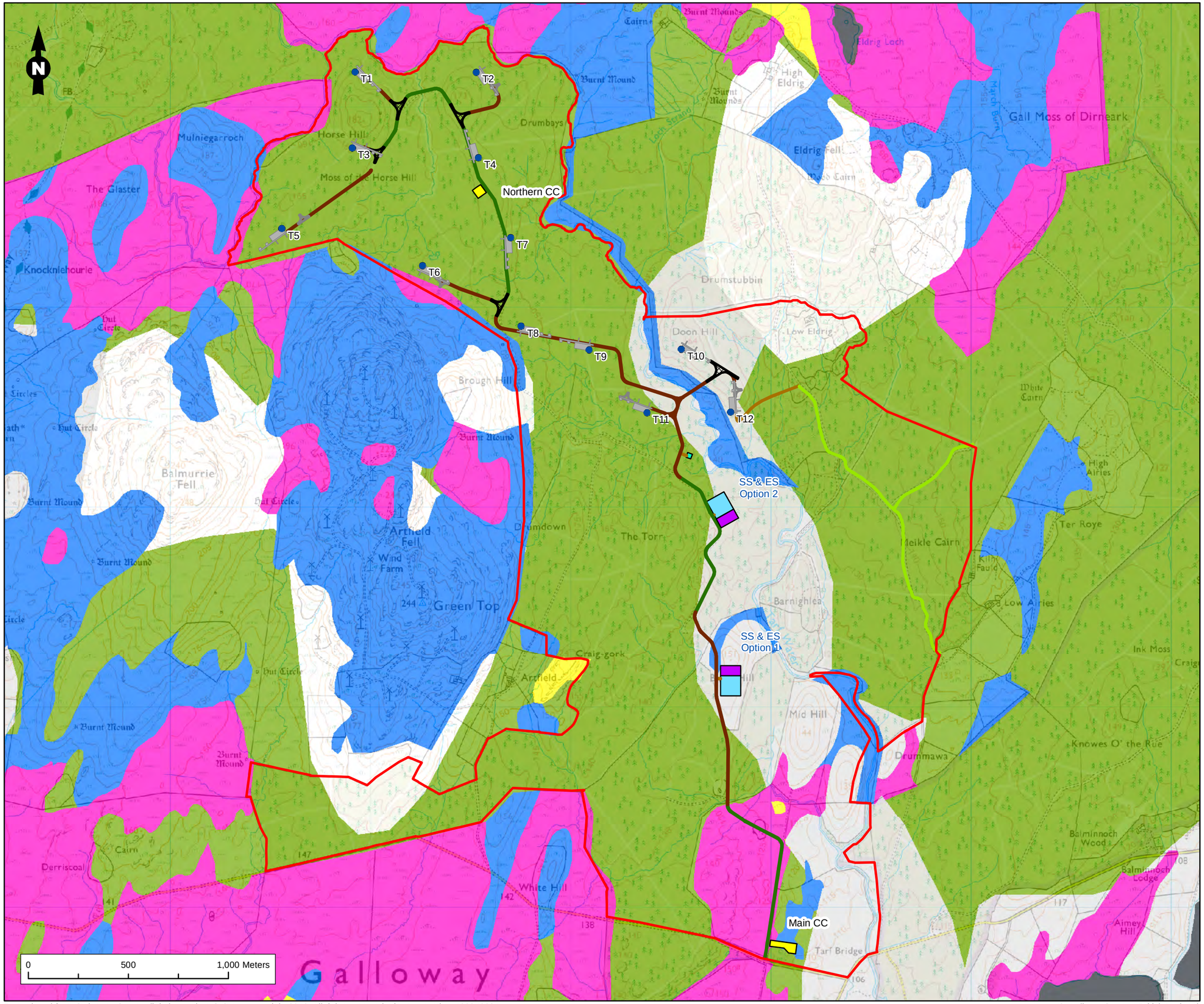
Project Name
Artfield Forest Wind Farm

Project Number	Figure No.
1620008937	2.3.2
Date	**Prepared By**
January 2021	AB
Scale	**Issue**
1:18,000 @A3	1

Client
Artfield Forest Wind Farm Ltd

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Site Boundary
- Proposed Turbine
- Proposed Temporary Construction Compound (CC)
- Proposed Substation Option (SS)
- Proposed Turbine Hardstanding
- Proposed Turning Head (Unloaded)
- Proposed Turning Head (Loaded)
- Existing Forestry Track No Upgrade
- Existing Forestry Track Upgrade
- New Track (Infrastructure only 4m)
- New Track (6m)
- Proposed Met Mast and associated hardstanding
- Proposed Energy Storage Option (ES)

Carbon and Peatland 2016 - Importance

- Unknown soil type
- Mineral soils
- 1
- 2
- 3
- 4
- 5

Figure Title
Carbon and Peatland 2016

Project Name
Artfield Forest Wind Farm

Project Number	Figure No.
1620008937	2.3.3
Date	Prepared By
January 2021	AB
Scale	Issue
1:18,000 @A3	1

Client
Artfield Forest Wind Farm Ltd

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

ANNEX 2.3.1 – PEAT CORING DATA

Sample ID	PC01-1	PC01-2	PC01-3	PC02	PC03-1	PC03-2	PC04	PC04-1	PC04-2	PC05	PC06-1	PC06-2	PC06-3	PC07	PC08
Turbine/ Infrastructure	T3	T3	T3	T7	T5	T5	T9	T9	T9	T8	T11	T11	T11	Met mast	Track
Planted/ Unplanted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted	Planted
Probed Depth	3.20	3.20	3.20	0.70	1.00	1.00	1.80	1.80	1.80	0.90	1.40	1.40	1.40	0.60	0.50
Cored Depth	2.00	1.50	0.50	1.70	1.00	0.50	0.50	1.50	1.00	0.90	1.40	1.00	0.50	0.50	0.30
Depth of Acrotelm	1.50	1.00	0.50	0.00	0.70	0.50	0.50	0.00	0.60	0.50	0.00	0.00	0.10	0.20	0.10
Colour	Brown	Dark Brown	Light Brown	Light Brown Black	Dark Brown	Medium Brown	Reddish Brown	Dark Brown	Light to Medium Brown	Light to Medium Brown	Orange Brown	Medium Brown	Light Brown with Dark Bands	Black Brown	Light Brown
Depth of Sub Sample	1.50	1.50	0.50	0.70	1.00	0.50	0.50	1.50	1.00	0.90	1.40	1.00	0.50	0.50	0.30
Amorphous (0=No/1=Yes)	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Fibrous (0=No/1=Yes)	0	0	1	0	0	0	1	0	0	0	0	0	1	1	0
Intermediate (0=No/1=Yes)	1	1	0	0	1	1	0	1	1	1	0	1	0	1	0
Fine Fibres (F)	1	2	2	1	2	2	2	1	2	2	1	2	2	2	1
Coarse Fibres (R)	1	1	2	1	1	1	2	2	1	1	3	1	0	1	2
Water Content (B)	2	2	3	1	1	1	2	1	1	1	1	1	1	1	1
Von Post Scale (H)	5	5	4	9	7	6	4	6	5	5	8	6	9	5	9
% Moisture	-	93	-	83	84	-	-	87	-	86	-	83	-	86	84
pH	-	5.1	-	5.2	4.0	-	-	5.5	-	5.1	-	3.9	-	3.9	4.0
Total Carbon (%)	-	85	-	0.76	95	-	-	94	-	96	-	98	-	96	41
Substrate	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven	Not Proven

ANNEX 2.3.2 – VON POST SCALE OF HUMIFICATION

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

ANNEX 2.3.3 – CORE SAMPLE PHOTOGRAPHS

T3 (PC01-1 Depth: 1.5 to 2.0mbgl)

T3 (PC01-2 Depth: 1.0 to 1.5mbgl)

T3 (PC01-3 Depth: 0.0 to 0.5mbgl)

T7 (PC02 Depth: 0.2 to 0.7mbgl)

T5 (PC03-1 Depth: 0.5 to 1.0mbgl)

T5 (PC03-2 Depth: 0.0 to 0.5mbgl)

T9 (PC04-1 Depth: 1.0 to 1.5mbgl)

T9 (PC04-2 Depth: 0.0 to 1.0mbgl)

T8 (PC05 Depth: 0.4 to 0.9mbgl)

T11 (PC06-1 Depth: 0.9 to 1.4mbgl)

T11 (PC06-2 Depth: 0.5 to 1.0mbgl)

T11 (PC06-3 Depth: 0.0 to 0.5mbgl)

Met Mast (PC07 Depth: 0.0 to 0.5mbgl)

Track (PC08 Depth: 0.0 to 0.3mbgl)

Technical Appendix 2.4: Draft Peat Management Plan

Technical Appendix 2.4: Draft Peat Management Plan

1 Introduction

1.1.1 Ramboll was commissioned by the Applicant to produce a stage 1 peat management plan (PMP) for the Proposed Development. The draft PMP has been prepared in accordance with appropriate guidance and best practice[1,2].

1.1.2 This draft PMP should be read in conjunction with the Outline Construction Environmental Management Plan (CEMP) (EIAR Volume 4: Technical Appendix 2.1) and the various other reports that contribute to it, including the Peat Depth Survey Report (EIAR Volume 4: Technical Appendix 2.3) and Peat Landslide Risk Assessment (PLRA) (EIAR Volume 4: Technical Appendix 2.5).

1.1.3 The draft PMP describes principles and methods to be used by the Applicant's infrastructure contractor when excavating, moving and reinstating peat. It includes a volumetric peat balance and contains requirements for the final PMP, that will be developed by the contractor post consent, prior to construction. A final PMP will be produced by the Applicant's infrastructure Contractor.

1.1.4 The overarching aim of the PMP is to provide guidance and a framework for the contractor to effectively re-use peat excavated during construction in order to maintain and improve peatland habitats, minimise the risks to water quality and volumes, and retaining and using peat as close as possible to the point of extraction. The main requirement for the contractor is to plan peat management in detail and incorporate its progressive reinstatement and restoration of adjacent peatland areas into the construction programme so that they take place concurrently, minimising time the peat is in temporary storage and avoiding double-handling of peat.

2 Summary of Peat Depth

2.1.1 Most of the developable area of the Site has either no peat present or has a shallow depth of peat soil present (~60% <0.5 m in depth). Whilst the majority of the coverage is relatively shallow, the maximum depth of peat recorded at the Site was 6.4 m, located in the south western part of the Site during the peat survey for the Gass Wind Farm. The maximum depth of peat recorded during the Phase 1 peat probe survey was 5.5 m, located to the north western part of the Site. The maximum depth of peat recorded during the Phase 2 peat probe survey was 5.7 m, located east of Turbine 10. The mean peat depth recorded was 0.87 m. The design of the Proposed Development has taken into consideration peat depths, along with other technical and environmental constraints, and the Proposed Development's infrastructure has been sited away from these areas, where possible.

3 Limitations

3.1.1 Peat probing and mapping have been used to inform the design process, at strategic points in the design evolution of the Proposed Development. However, there are some differences between the final design and the extent of the peat survey results based on design changes made through this process, as a result of micrositing etc.

3.1.2 However, the peat survey probing points do provide high resolution coverage of the Site, and these revealed the peatland to be typically shallow (>1.0 m) but with pockets of deeper peat, particularly in the north western and north eastern part of the Site. It is considered that the peat depths collected, and interpolations derived from these data, are representative of the Site and have adequately informed the layout of the Proposed Development.

3.1.3 The peat excavation and reuse volumes included in this draft PMP are intended as an initial indication. The total peat volumes are based on a series of design assumptions and estimates for the Proposed Development layout and peat depth sample data interpolated across discrete areas of the Site. Such parameters can still vary over a small scale and therefore local topographic changes in the geological profile may impact the total accuracy of the volume calculations.

3.1.4 The PMP is a 'live' document and would be developed into a final PMP post-consent and in advance of construction commencing, when the contractor has been appointed. As part of this process it is proposed that further peat depth probing and coring will be undertaken at infrastructure locations, particularly wind turbine locations, post-consent and during pre-construction ground investigation surveys. This additional data will be used to aid micrositing of wind turbines away from any pockets of deeper peat into the shallowest areas, thereby minimising impacts on peatland within the micrositing tolerances, and to gather further information on the characteristics of the peat deposits present. A finalised post-consent layout would be completed once detailed ground investigations have been undertaken and before construction works commence. This will demonstrate how any newly collected information has been used to inform the proposed layout and minimise impacts on features such as deep peat.

4 Peatland Condition

4.1.1 Two peat depth probing surveys were undertaken at the Site, with a combined total of 1,708 peat probes taken. This comprised 338 peat depth probes during the Phase 1 survey, as part of a low resolution survey across the developable area of the Site, and a further 1,370 probes during Phase 2 survey based on a more mature development layout. An additional 517 peat probes taken as part of the previous Gass Wind Farm application were also used. The combined peat depth dataset was 2,225 probes. The results of the surveys were used to inform the design layout of the Proposed Development.

4.1.2 Most of the developable area of the Site has either no peat present or has a shallow depth of peat present (~60% <0.5 m in depth). These areas of shallow peat can be considered as organo-mineral soils. These are further summarised as follows:

- 449 no. samples (20.0%) located on land with no peat/absent;
- 886 no. samples (40.0%) located on land with less than or equal to 50 cm depth of peat or organo-mineral soil;
- 260 no. samples (12.0%) fell on land with between 51 cm and 100 cm depth of peat; and
- 630 no. samples (28%) located on land with more than 100 cm depth of peat.

4.1.3 The maximum depth of peat recorded at the Site was 6.4 m, located in the south western part of the Site during the peat survey for the Gass Wind Farm. The maximum depth of peat recorded during the Phase 1 peat probe survey was 5.5 m, located to the north western part of the Site. The maximum depth of peat recorded during the Phase 2 peat probe survey was 5.7 m, located east of Turbine 10. The mean peat depth recorded was 0.87 m.

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

[2] SEPA, (2011).Restoration Techniques Using Peat Spoil from Construction Works.

4.1.4 The peat depth data was interpolated in GIS using an inverse distance weighting approach, the results of which are shown on Figure 2.3.1 (EIAR Volume 4).

4.1.5 Overall, the peat sampled across the developable area of the Site were relatively shallow, particularly in the southern and central parts of the Site. Deeper areas of peat were noted, particularly in the north western, north eastern and south western areas of the Site. The peat was found to be generally dry and in a state of advanced decomposition. This is likely to be as a result of the presence of coniferous plantation and extensive artificial drainage across the Site, which has resulted in modification to the integrity and composition of the peat and carbon rich soils.

4.1.6 The Proposed Development's infrastructure has been located away from these deeper peat locations where practicable, taking into account other environmental and technical constraints, or microsited to minimise potentially significant adverse effects. No turbines are located on deep peat.

4.1.7 Further details of the peatland condition and findings from the peat surveys are included in the Peat Depth Survey Report (EIAR Volume 4: Technical Appendix 2.3).

5 Estimated Peat Balance

5.1.1 The volume of peat excavated and to be reinstated has been estimated based on the following data and assumptions:

- peat surface model generated using Ordnance Survey 5 m Digital Terrain Model;
- peat depth survey data from probing during the Phase 1, 2 and historical Gass Wind Farm EIAR;
- excavations take place only within the footprint of the Proposed Development;
- peat will shrink on replacement due to some inevitable dewatering during handling and compaction at placement;
- currently assumed that there is potential to use floating access tracks dependent on the findings of ground investigations for specific sections of track where peat depth is >1.0 m – consideration of use of floating construction is likely to be limited to the section of track between T8 and T9, and between T3 and T5 (~800 m total);
- assumed that ditch backfilling and reinstatement of historic peat cutting, ploughed furrow and destumped areas could be subject to backfilling with peat, along with improvement to other areas of degraded or existing peatland as part of habitat management and restoration (as laid out in the outline habitat management plan, Technical Appendix 7.3). These will be confirmed and developed further as part of the detailed PMP and habitat management plans prior to construction;
- assumed that temporary peat excavated from temporary infrastructure such as the construction compound and cable runs could be reinstated, and therefore not considered as part of the permanent excavation volumes;
- borrow pits are proposed as part of the Proposed Development; and
- a proportion of acrotelm peat will become unsuitable for reuse as the top layer due to unavoidable damage to vegetation during the excavations.

5.1.2 Specific design assumptions used to estimate the peat volumes to be excavated and reinstated are:

- the area for construction of the wind turbine foundations has been estimated to be a maximum 25 m diameter excavation to allow for an excavated working area around the concrete foundation (refer to EIAR Volume 2: Chapter 2: Development Description). A concrete foundation slab of approximately 22 m diameter would sit on the underlying rock or suitable substratum with a founding depth of between 3 m to 4 m. With regard to backfilling at these foundations, it has been assumed that an area of the 'compacted backfill between foundation and excavation face', would partially comprise peat. Peat would not be used to backfill the excavation void over the 22 m diameter plan footprint of the foundation due to its potential low strength; instead, rockfill, sands, or gravel would be required to backfill, but could be used outside of this area. The area of potential peat backfill equates to 302.38 m^2 per wind turbine. As above, the founding depth would be up to 4.0 m, however for the majority of the Site it has been assumed a depth of up to 2.0 m can be used as an approximation to backfill excavations to ground level;
- it has been assumed a restoration area of 650.9 m^2 per turbine could be used for surface reinstatement of peat around each turbine (based on a thickness of 0.2 m);
- a crane hardstanding would be required at each wind turbine location, these would be maintained during the operational phase of the Proposed Development. It has been assumed that one length and one width of each hardstanding would be available for reinstatement during construction, with verges 2 m in width;
- a 50 m x 100 m substation and 100 m x 100 m energy storage compounds would be required, and it is assumed that two lengths and one width would be available for verge reinstatement, with verges 2 m in width; and
- new access tracks would be flanked by low angle landscaped verges that would seek to provide visual continuity and topographical tie-in between the access tracks and the surrounding peatland. The verges used for finishing and landscaping of the new access tracks would be extended to 2 m either side of the full track width (e.g. running width and track shoulders).

5.1.3 Table 2.4.1 provides estimates of the volumetric peat balance for the Proposed Development. These volumes would be subject to review and updated following ground investigation, detailed design and micrositing as part of the post-consent process, prior to construction.

Table 2.4.1: Estimated Peat Volume to Be Excavated

Element	Estimated Peat Volume to be Excavated (m^3)
New cut tracks, turbine hardstandings and met mast	28,485
New floating tracks[3]	0
Permanent compound and energy storage facility	15,000
Turbine 1 – foundation and excavation area	98.1
Turbine 2 – foundation and excavation area	245.3
Turbine 3 – foundation and excavation area	490.6
Turbine 4 – foundation and excavation area	245.3
Turbine 5 – foundation and excavation area	735.9
Turbine 6 – foundation and excavation area	981.3
Turbine 7 – foundation and excavation area	245.3
Turbine 8 – foundation and excavation area	490.6
Turbine 9 – foundation and excavation area	490.6
Turbine 10 – foundation and excavation area	98.1
Turbine 11 – foundation and excavation area	490.6
Turbine 12 – foundation and excavation area	98.1
Borrow pits (4no)	1,753.8

[3] As a worst-case scenario, no floating track has been assumed.

Table 2.4.1: Estimated Peat Volume to Be Excavated	
Element	**Estimated Peat Volume to be Excavated (m^3)**
TOTAL	**49,948.60**

5.1.4 Table 2.4.2 provides an estimate of the potential reinstatement opportunities for the Proposed Development.

Table 2.4.2: Estimated Peat Volume to be Reinstated			
Element	**Area to be Restored (m^2)**	**Average Depth of Restoration Area (m)**	**Total Reinstatement (m^3)**
Turbine foundations – surface	7,810.80	0.20	1,562.16
Turbine foundations - backfill	3,616.56	2.0	7,233.12
Crane and met mast hardstanding verges	1,800 + 800	0.5	1,300.00
Permanent compound, battery storage and energy storage facility verges	500+600	0.5	550.00
Access track verges	28,360	0.5	14,180
Borrow pit restoration	17,102	0.6	10,261
Ditch backfilling/ Habitat management and restoration	15,000*	1.0	15,000
Total			**50,086.28**
*Based on 30 ha restoration area with ditch density at 1 ditch every 15 m, 0.75 m width			

5.1.5 On this basis, there is potential that the peat excavated as part of the Proposed Development can be reused on Site.

6 Classification of Peat

6.1.1 Peat was characterised as part of the Phase 2 peat survey which considered the physical properties of peat cores taken across the Site. The key measures of peat condition, which are important to establishing the appropriate type of reuse, are noted in Table 2.4.3. Overall, the sample results suggest that the acrotelm layer is variable in depth and it is recommended that the upper 0.5 m should be reused as part of the reinstatement programme, where this depth of material is available. Excavation of 0.5 m ensures that the acrotelm remains as intact as possible and captures much of the underlying seed bank material which would aid vegetation regeneration. With regards to the catotelm material within the proposed developable area of the Site, the results indicate that all material is intermediate.

Table 2.4.3: Peat Classification	
Peat Type	**Key Measure and Survey Summary** **Survey Results**
Acrotelm	Depth - The depth of the acrotelm ranged from 0 cm to 150 cm, with a mean depth of 41 cm. Due to the difficulties of excavating a thin layer of acrotelm, without causing significant damage to it, it is recommended that 0.5 m of surface peat is excavated (where possible) for reuse as acrotelm material.
Acrotelm/ catotelm	Degree of humification – the sub-samples were mostly recorded as intermediate.
	Fibrous content – the majority of the sub samples were assessed as having moderate fine fibre content (F2).
	Coarse samples were mostly assessed as being of low coarse fibre content, with five having a moderate or high coarse fibre content.
	Water content - the results indicate that all the samples were noted to be dry or semi-dry peat (B1 to B3). No samples were recorded as wet.
	Von Post - the results indicate that nearly all the samples were found to be scored relatively high on the Von Post scale (>H4) indicating a stronger rate of decomposition (between H5 and H6), with three sample described as almost completely decomposed. This is likely to be as a result of the presence of commercial forestry at the Site, and modified nature of the soils present.

7 Requirements for the Detailed Peat Management Plan

7.1.1 The contractor would be required to update the draft PMP prior to the construction phase commencing, based on additional information such as the results of ground investigation and detailed design. As part of this update the contractor would be required to ensure excavated peat and other soils are reused on-site, subject to the conditions and methods of reinstatement described in the draft PMP. The final PMP would detail the following:

- a construction timetable and highlight any seasonal considerations;
- comply with SEPA construction site licence, as required;
- include measures to be put in place to deal with weather related events (flash floods, peat slide, snow melt, dust);
- appropriate use of track and road material, and other hard-standing material to minimise pollution;
- detail measures to enable sediment management in emergency situations, to cope with high rainfall and runoff;
- detail how construction would be scheduled around key site constraints (such as the breeding or migration seasons for bird and fish). Where scheduling is not practical it would state what other mitigation could be put in place; and
- detail how construction would be scheduled to benefit site restoration.

8 Project Phasing

8.1.1 There are three distinct project phases, construction, operation, and decommissioning. Key activities for each phase are described in the following sections.

Construction

8.1.2 The key activities to be undertaken during the construction phase include:

- prepare the final PMP referring to the detailed design and additional Site information (such as ground investigation);
- set-out peat stripping areas;
- set-out temporary peat and no peat soil storage areas;
- set-out receptor areas for direct translocation of peat as per detailed peat translocation plan;
- strip peat in pre-defined phases;
- put peat and other soils into temporary storage;

- translocate peat where pre-planned;
- reinstate the peat and other soils that have been in temporary storage; and
- monitor vegetation and stability of reinstated soil around the infrastructure, restored peatland areas, and soils to be stored for the duration of the construction period.

Operation

8.1.3 During this phase no peat excavation is anticipated.

Decommissioning

8.1.4 The peat management during decommissioning would follow the same principles as during the construction. It is not expected that disturbance of adjacent peat will be required upon the removal of turbine hardstandings.

8.1.5 The main mitigation measure relating to decommissioning would be blocking of any artificial ditches (that were created during construction and were required during the operation of the Proposed Development) to facilitate rewetting of adjacent peatland. It is likely that the main tracks would remain in place to facilitate ongoing access to the Site, depending on the arrangements with the landowner and other users of the Site.

9 Monitoring and Record Keeping

9.1.1 An Ecological Clerk of Works (ECoW) would be appointed by the contractor prior to commencement of the construction phase. They would be responsible for monitoring compliance against the final PMP and other relevant documents such as the final CEMP. They would also be responsible for ensuring the legislative requirements would be complied with.

9.1.2 The contractor and the ECoW would be responsible for maintaining clear records during the construction phase such as depths and types of peat excavated, plans showing peat storage areas and locations of reinstated peat.

10 Peat and Mineral Soil Handling Methods

10.1.1 This section provides guidance to help the contractor in both planning and executing the construction works at the Proposed Development. Working in peat cannot be avoided because the Site is underlain by peat of variable depth and thickness (refer to Figure 2.3.1 in EIAR Volume 4: Technical Appendix 2.3). Peat would be excavated and could be stored temporarily in an appropriate location as set out previously where temporary storage is necessary. Careful handling of the peat would also be required to ensure its suitability for reuse.

10.1.2 The contractor would provide a detailed method statement for works in peat habitats, including but not limited to:

- how to minimise the area of impact;
- how to avoid areas of higher quality bog vegetation (with the assistance of the ECoW);
- means of access to areas of work and to areas where peat would be reused;
- methods of peat removal;
- managing water in the peat and pollution prevention;
- where to avoid unnecessary intrusive work wherever possible;
- drainage measures and design and use of appropriate techniques to maintain local hydrology; and
- plans for the deposition of peat on Site to be agreed with the Applicant and the ECoW.

10.1.3 It would be necessary for the final PMP to detail the methods and timing involved in handling, storing and using peat for reinstatement, all of which would be dependent on the equipment adopted for the construction activities. The final method statement for this should be based on the following principles:

- the surface layer of peat and vegetation (acrotelm) would be stripped separately from the catotelmic peat. Where possible this would involve an excavation depth of 0.5 m and the creation of turves;
- the turves should be as large as practicably possible to minimise desiccation effects during storage;
- the turves should be kept wet but not saturated, and not allowed to dry out when in temporary storage;
- contamination of excavated peat with other substrate materials (e.g. gravels, clays or silts) should be avoided and these materials stored separately where excavated;
- acrotelmic material would be stored separately from catotelmic material even if some of this layer appears to be lacking vegetation, since it may contain a seedbank that is useful for re-establishing vegetation;
- any risk of peat slide must be considered by a suitably qualified engineer and where risk is identified protective measures developed and agreed with the Applicant before further construction works take place;
- careful handling would be essential to retain any existing structure and integrity of the excavated materials and thereby maximise the potential for excavated material to be reused;
- plan all works to reduce the need for double handling the peat;
- movement of excavated turves and peat should be kept to a minimum and it is preferable to transport peat intended for translocation to its final destination at the time of excavation;
- less humified catotelmic peat (consolidated peat), which maintains its structure upon excavation, should be kept separate from any highly humified amorphous peat;
- consider the timing of excavation activities to avoid very wet weather periods in order to reduce the risk of peat becoming wet and unconsolidated, thereby reducing pollution or peat slide risk;
- acrotelmic material would be replaced as intact as possible once construction is complete; and
- to minimise handling and transportation of peat, acrotelmic and catotelmic materials would be replaced, as far as is reasonably practicable, in the location from which it was removed. Acrotelmic material must be placed on the surface.

10.1.4 The handling of peat should be monitored by the ECoW and the Applicant to ensure the above principles are adopted and implemented during construction of the Proposed Development.

Minimising Damage to Existing Vegetation

10.1.5 To minimise damage to the existing vegetation, construction plant required for reinstatement and landscaping works would be positioned on constructed access tracks, hardstanding areas or existing disturbed areas wherever possible. Areas to be excavated would be clearly marked on the plans and then on the ground to ensure that no work is undertaken outside the construction footprint.

10.1.6 Tracked, low ground-pressure, long reach excavators would be used for peat handling and reinstatement works. A low ground-pressure excavator would be used if the extent of the long reach arm is insufficient. Other machinery, such as tippers, would also be tracked and low-ground pressure type when required to travel on soft ground and the use of ground protection mats could be required.

10.1.7 Reinstatement of vegetation would be focused on natural regeneration utilising peat vegetated turves (acrotelm). In the unlikely event that the quantity of excavated acrotelm turves is not sufficient, a nurse moorland grass seed mix would be used. The species mixture would be specified in the final PMP and could include lowland species to encourage early establishment.

Planning of Peat Reinstatement

10.1.8 Peat reinstatement would be undertaken using methods to minimise double handling of peat and the distances between source and receptor areas. Peat translocation, reinstatement and restoration would be carried out concurrently with other elements of the Proposed Development's construction. To achieve this, a detailed peat translocation plan would be included in the final PMP. The final PMP would include peat management recommendations as per SEPA guidance[1].

10.1.9 When peat is disturbed or translocated artificially it is prone to drying because fragmentation lets the water drain away and prevents it from accumulating. To create conditions suitable for wet bog restoration, the reinstated peat needs to be kept wet, otherwise, the vegetation would dry out, the peat would shrink and crack, and would ultimately be eroded by water and wind, which would make the restoration unsuccessful and is likely to create problems such as peat floods, water pollution, and peat landslides.

10.1.10 The main principle of keeping the water close to the reinstated surface (maintenance of high-water table) is to use natural and artificial enclosures to slow down the horizontal flow of water. For the enclosure to work, the peat surface needs to be flush with or only slightly (<0.3 m) above the level of adjacent land (to allow for settlement). If the level of translocated peat is substantially higher, then it would be at high risk of drying out and being easily eroded as the water would not be held effectively by the peat alone, it would naturally flow sideways.

Temporary Peat Storage

10.1.11 It is anticipated that during construction, on most occasions, peat and peaty soil would only be handled once and would be placed at its end use locations. However, during construction a degree of temporary peat storage would be required before the excavated material could be re-used in restoration and placed in its end use location.

10.1.12 It would be necessary for the final PMP to detail the methods and timing involved in temporary storage, where this is required. It is likely that a degree of temporary peat storage would be required, for instance in association with stripping areas of any area used for temporary land take; this material would then be used in the subsequent restoration of this temporary construction area.

10.1.13 The final method statement for this temporary storage of peat would be based on the following guiding principles:

- temporary storage of peat should be minimised. Where required it should be temporarily stored in stockpiles/ bunds adjacent to and surrounding each infrastructure site;
- acrotelm, catotelm, and any clay/ glacial till or other substrata should be stored separately and appropriately to ensure no mixing of materials and to prevent cross-contamination;
- suitable storage areas should be sited in areas with lower ecological value, low stability risk areas and at a minimum distance of 50 m from watercourses. Identified suitable areas would form part of the final PMP and would be agreed in advance with the ECoW;
- peat turves should be stored in wet conditions where possible (e.g. within waterlogged former excavations) or irrigated in order to prevent desiccation;
- larger stockpiles are preferable to numerous small stockpiles, which minimises exposure to sun and wind, which could lead to desiccation. Stockpiles would not exceed 2 m in height and would be sited with due consideration for slope stability. Benching of stored peat could be necessary to provide stability;
- stores of non-turf, i.e. catotelm, should be bladed off to reduce surface area and desiccation of the stored peat;
- stores of peat, particularly catotelmic material, should be inspected regularly (at least weekly) and following heavy rainfall or thaw conditions to check for any evidence of movement, tension cracks or instability in the stored peat. If there is any evidence of instability, appropriate remedial measures should be taken as necessary on the advice from a suitably qualified engineer;
- in dry weather periods, consideration should be given to watering stored turves and peat to prevent drying out, wastage and erosion;
- pollution prevention measures should be installed around peat storage areas;
- reinstatement would, in all instances, be undertaken at the earliest opportunity to minimise storage of turves and other materials;
- timing the construction work, as much as possible, to avoid periods when peat materials are likely to be wetter; and
- where practical, transportation of peat on Site, from excavation to temporary storage and restoration locations, should be minimised.

Reinstatement of Peat

Access Tracks

10.1.14 The reinstatement would be carried out progressively with peat excavated from other areas placed directly on the sides of the tracks. This will take place everywhere where the cut tracks pass through peat. The surplus peat, not reinstated along the verges, would be either directly translocated to the receptor areas or stored temporarily in designated areas.

10.1.15 The construction of the track involves the excavation of the acrotelm and catotelm, or top, organic layer of peaty soils, and some mineral subsoil. These would be separated on excavation, ensuring no mixing of the different peat layers, and different soil types. Once all the soil has been excavated and the higher bearing underlying subsoil has been reached, good quality aggregate should then be placed. Up to 50 cm of acrotelm would be used to reinstate the track verges.

10.1.16 Following construction of the section of access track, turves would be replaced along the road edges to allow quicker re-vegetation and soften visual landscaping of the road edges. Acrotelm turves would be used for this purpose, this would be done in a manner to ensure works tie in with the surrounding topography, landscape and ground conditions, and only where this is required and would not result in adverse environmental effects.

Turbine Foundations and Hardstanding

10.1.17 Once the wind turbine foundation has been constructed, depending on the target depth of reinstated peat, some catotelmic peat could be replaced around the turbine base excavations (subject to detailed foundation construction requirements), and re-turfed with acrotelm. Peat would be placed into any areas disturbed by the construction activities, around the crane hardstandings, rotor assembly hardstandings and other areas used in the construction phase. Other hardstanding areas, such as around the substation and battery storage compound would also include areas for re-use of acrotelm.

Temporary Compounds and Cable Runs

10.1.18 The temporary construction compound would be restored following removal of the stone hardstanding. The peat would be reinstated to be flush with the adjacent ground. Similarly, cable runs would be reinstated using peat as excavated, to ensure that the soil horizons would be replaced as removed.

Borrow Pit Restoration

10.1.19 As part of the borrow pit restoration, it is assumed that a thickness of 0.5 m of peat can be reused provided that it presents no residual pollution risks or harm to human health. The excavated peat would need to be suitable for restoration purposes to achieve the establishment of peatland habitats and a functional hydrological regime would need to be established in the borrow pit restoration to prevent desiccation of peat.

Ditch Backfilling and Habitat Restoration

10.1.20 Where possible, ditches and other cut areas, such as historic peat cut areas, should be considered for reinstatement. This would be explored further as part of the final PMP but it is assumed that there is potential to reinstate peat excavated in these areas. This would also include the consideration of other areas of the site that could be used for the suitable reuse of peat as part of habitat and peatland improvements.

10.1.21 The ECoW would monitor back-filling works to check compliance with relevant documents (such as PMP and CEMP). The main parameters for ditch backfilling that would be required are:

- areas with relatively dry peat would be chosen;
- works would be carried out during a period of dry weather;
- specialist low-ground pressure tracked dumpers would be used;
- bog mats would be used where required;
- both source and receptor areas would have good vegetation cover;
- Site supervision by the ECoW would enforce changing routes to avoid damage to vegetation;
- acrotelm excavated from the source location would be kept vegetated side up; and
- excavated catotelm would be used in ditch-backfilling shall be of H6-H8 level of decomposition.