Peat Management Plan

Derryadd Wind Farm

Jan 2019

Revision:A

Patrick J. Tobin & Co. Ltd.

REPORT

PROJECT: **PMP -Derryadd Wind Farm**

CLIENT: **Bord na Móna Powergen Ltd.**

COMPANY: **TOBIN Consulting Engineers**

DOCUMENT AMENDMENT RECORD

Client: **Bord na Móna Powergen Ltd.**

Project: **Derryadd Wind Farm**

Title: **Peat Management Plan**

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Revision	**Description & Rationale**	**Originated**	**Date**	**Checked**	**Date**	**Authorised**	**Date**
TOBIN Consulting Engineers							

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1 INTRODUCTION

The proposed development, known as Derryadd Wind Farm (See Figures 1.1 and 1.2) is located within the Mountdillon peat production bog group in Co. Longford.

The land use/activities on the site is a mixture of active peat extraction, transport of peat, peat extraction works (administration offices, machinery maintenance and storage, stores, canteen), bare cutaway peat, re-vegetation of bare peat, and two existing wind monitoring masts on Derryaroge Bog and Lough Bannow Bog. These works aside from the wind monitoring masts, form part of the Bord na Móna Mountdillon peat production facility in County Longford.

The area is approximately 12km long in the northwest/southwest direction and is approximately 4km wide in an east/west direction. The site lies between the towns and villages of Lanesborough, Derraghan, Keenagh and Killashee while the main urban centre in the region is Longford Town. The site is approximately 2km east of Lanesborough, County Longford. Longford Town is approximately 9km north east of the wind farm location. The site has an area of approximately 1900 hectares in area and mainly lies directly to the east of the R392 which runs from Lanesborough in the north to Ballymahon in the south. Derryaroge Bog to the north is adjacent to the River Shannon and Lough Bannow Bog is immediately to the west of the Royal Canal which runs in a north south direction. Lough Ree is located approximately 5km to the west of Derryadd Bog.

The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland. The landscape is predominately flat. Peat is defined as the partially decomposed remains of plants and soil organisms which have accumulated at the surface of the soil profile. Active peatlands are traditionally described using a simple 2-layer model; the acrotelm including active peat vegetation and catotelm. As the proposed development is a cutaway bog, the peat on site is predominantly drained catotelm on flat or gently sloping lands. It is proposed to manage peat within the site boundaries. Bord na Móna has considerable experience in the handling of peat in these circumstances, both during peat production operations and during the rehabilitation processes associated with its cutaway bogs. This experience has shown that when the handling and moving of such peat is appropriately managed, stability or environmental issues are not expected to arise.

Legend

Planning Application Boundary

0 250 500 1,000 1,500 2,000

Metres

Issue	Date	Description	By	Chkd.
A	JAN 2019	Report Issue	MN	ST

Client:

BORD NA MÓNA
Naturally Driven

Project:

DERRYADD WIND FARM

Title:

SITE LOCATION MAP

Scale @ A3: 1:50,000

Prepared by:	Checked:	Date:
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Project Director: D. Grehan

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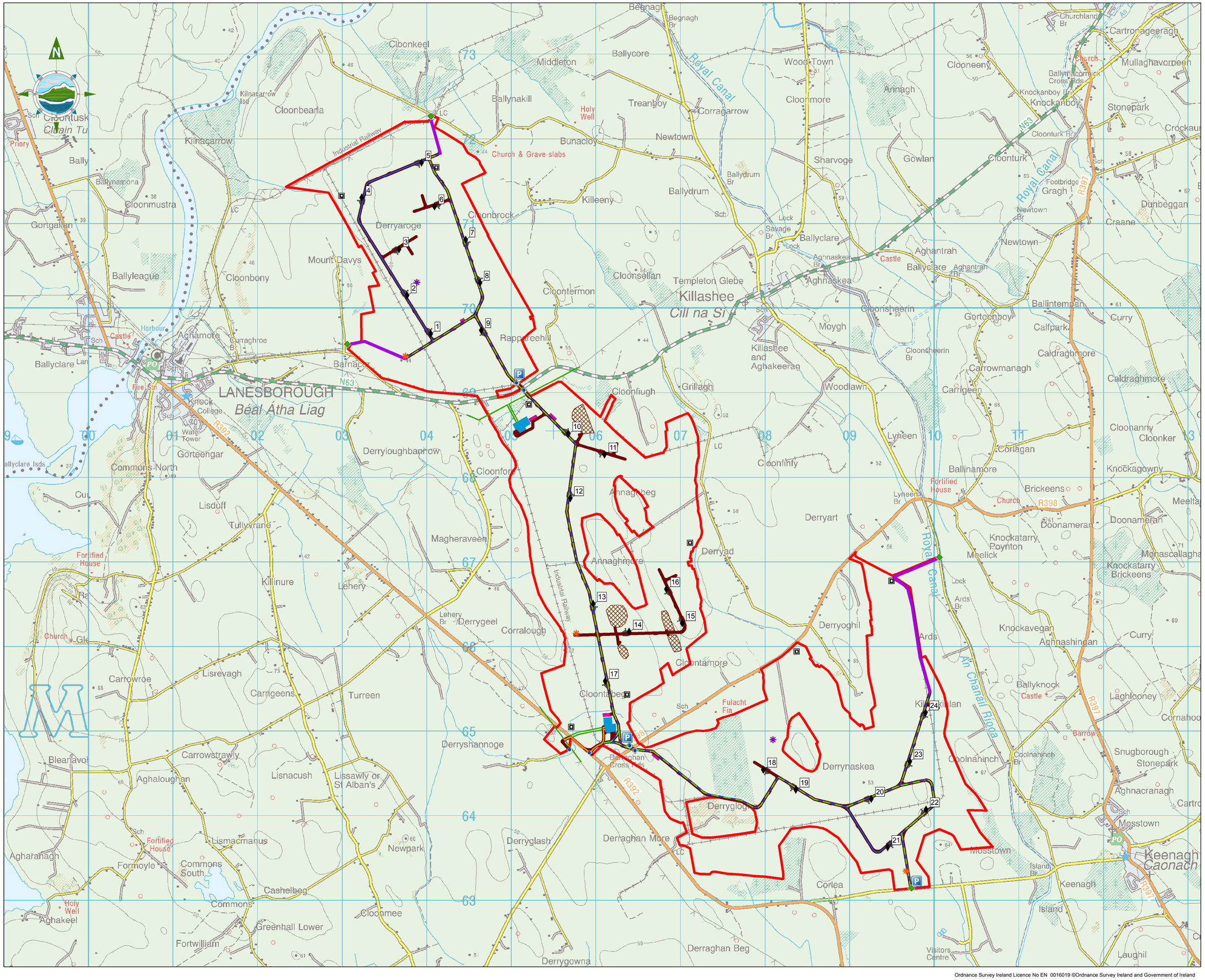
Figure 1.1



Issue	Date	Description	By	Chkd.
A	JAN 2019	Report Issue	MN	ST

Client: Bord na Móna – Naturally Driven

Project: DERRYADD WIND FARM

Title: SITE LAYOUT PLAN

Scale @ A3: 1:40,000

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Figure 1.2

Photo 1 Shallow drained peat fields and underlying subsoils comprise the majority of the site

Photo 2 Peat underlain by rock occur in several areas.

1.1 OBJECTIVE

The role of the Peat Management Plan (PMP) is to demonstrate that the management of peat excavated during construction of the proposed development has been considered and will be treated appropriately during the construction process.

This peat management plan also includes a monitoring programme which will be implemented during the construction phase of the wind farm and a contingency plan should peat instability/failure occur at the site. Arising from Information presented during the consenting process, possible planning conditions and as work is carried out on site the contents of the peat management plan and peat stability monitoring programme will be updated, as appropriate.

The PMP contains some drainage guidelines for construction works and for management of peat on site. It should be noted that the control of water quality and drainage measures for site is outlined in detail in the relevant chapter of Environmental Impact Assessment Report.

The PMP outlines the overall design approach that has been applied to the proposed development to minimise peatland disruption and aims to ensure that all further opportunities to minimise peat disturbance and extraction during construction will be taken. The PMP identifies appropriate and industry proven methods for the reuse of excess peat to restore the effects of construction activities, without significant environmental or health and safety implications and to reduce the release of carbon and minimise risk in terms of human health.

The legislation and guidance regarding the management of peat includes:

- Scottish Environment Protection Agency (SEPA), Regulatory Position Statement – Developments on Peat (2010);
- Scottish Government, Guidance on Developments on Peatland – Site Surveys (2014);
- Floating Roads on Peat, Scottish Natural Heritage (2011); and
- Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste, Scottish Renewables and SEPA (2014).

The following guidance specifically relates to wind farm construction and peatland:

- Investigating the impacts of wind farm development on peatlands in England: Part 1 Final Report (2011);
- Best Practice Guidance to Planning Policy Statement ‘Renewable Energy’ (2009);
- Wind Farm Developments on Peat Land fact sheet. Scottish Government (2011); and

- Good practice during wind farm construction, A joint publication by Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency, Forestry Commission Scotland. (2015).

Many of the publications listed above have been developed by the Scottish Government. The Scottish documents are considered to be best practice in Ireland and are therefore appropriate for use within this PMP.

1.1.1 Peat Instability

Peat instability in this report is defined as a mass movement of a body of peat that would have a significant adverse impact on the surrounding environment. Peat instability excludes localised movement of peat that would occur (say) below a floating access road, creep movement or localised erosion type events.

Adherence to the PMP should reasonably minimise the potential for all such peat movements. However, it is noted that due to the soft ground nature of the peat terrain it is not possible to completely avoid localised peat movement. As is detailed in the Peat Stability Risk Assessment (PSRA) in Appendix 7.4 and summarised in the EIAR, the risk of instability is low at this proposed development due to the low angle of the slope.

1.1.2 Construction Activities Covered by Peat Management Plan

The proposed development is characterised by the following civil engineering works to provide the necessary infrastructure to complete the wind farm as described in Chapter 2, Description of the Proposed Development:

- Excavation of borrow pits, processing of materials;
- Construction of access roads to the wind turbines and passing bays;
- Construction of temporary compounds, passing bays, car parking, hard stands, material storage areas and site offices;
- Excavation for cable ducts and foundations for the wind turbines and handling of excavated material
- Temporary Storage and stockpiles of excavated materials;
- Reinstatement of Borrow Pits;
- Construction of surface water drainage system along the new roads; and

- Excavation of the foundation of a substation and associated infrastructure.

2 CONSTRUCTION ACTIVITIES

For the construction phase of the Derryadd Wind Farm the following activities that are considered to have potential for possible peat stability problems are as follows:

- Construction of new permanent excavated roads through peat;
- Construction of new permanent/temporary floating roads over peat;
- Excavation and placement of arisings;
- Excavations in peat for turbine bases, construction compounds, hardstands, substation and other infrastructure foundations; and
- Excavations in peat for underground cables

Peat management of the above construction activities are covered individually in this report.

The site varies in altitude between approximately 37mOD and 59mOD. Peaty soil and peat deposits cover most of the site and various overly glacially derived soils such as glacial till comprising, and in places sand and gravels and bedrock. There are exposures of bedrock and where exposed these are seen to be limestone bedrock over the entire site.

2.1 EXCAVATIONS IN PEAT FOR TURBINE BASES, HARDSTANDINGS, SUBSTATION & INFRASTRUCTURE FOUNDATIONS

The material encountered in the trial pits excavated at each turbine location was generally soft to very soft and not capable of supporting the applied loads from a wind turbine. Deeper excavations to more competent material will be required to construct the turbine foundations

During turbine construction, peat will be excavated to the substrate to make room for the concrete turbine foundation, and for a small working area surrounding the foundation footprint. Typically, turbine bases are 24m in diameter with detailed foundation design being dictated by the local ground conditions and the requirements of the turbine supplier.

Surrounding the excavation areas is a 1:2 gradient batter, the plan area of which is determined by the mean peat depth at each turbine. Once excavated, the turbine foundation is installed, occupying a foundation footprint, up to 20m in width. It is estimated that 18 of the 24 no. turbine bases are likely to require piled foundations hence arisings from these types of foundations will be minimal. The works at approximately six of the turbine bases require excavation through shallow peat to a competent founding

stratum i.e. bedrock. This will be confirmed at detailed design stage following additional ground investigation.

Volume calculations provide an approximate estimation of fill required for all the turbine foundations. It is estimated as 27,000m^3 of compacted material which is equivalent to 35,000 m^3 of un-compacted material allowing for bulking during transportation. Surrounding the foundation, peat, which will either be flush with the existing ground surface or will form a raised mound between 300 and 500mm above the existing ground level, depending on the depth of the foundation at each specific turbine location. A summary of the ground conditions encountered during the ground investigation carried out as part of this report is given in Table 2.1.

Table 2.1: Ground profile for each turbine location

Turbine	*Ground profile*	Comments
Turbine 1 Tobin's Trial Pit 01	***0.00 – 0.10m**: Black fibrous PEAT* ***0.10 – 2.00m:** Sandy gravelly CLAY* ***2.00 – 2.90m:** Very silty, slightly sandy GRAVEL with gravel, cobbles and boulders*	Concluded at 2.9m due to abundance of large boulders.
Turbine 2 Tobin's Trial Pit 02	***0.00 – 0.10m:** Black fibrous PEAT* ***0.10 – 0.50m:** Slightly sandy, gravelly CLAY* ***0.50 – 2.70m:** Slightly sandy silty CLAY with gravels, cobbles and boulders*	Concluded at 2.70m due to abundance of large boulders/ bedrock.
Turbine 3 Tobin's Trial Pit 03	***0.00 – 0.30m**: Black fibrous PEAT* ***0.30 – 0.80m**: Silty SAND* ***0.80 – 2.2m**: Sandy, gravelly SILT with sand lenses*	Concluded at 2.20m due to abundance of large boulders/ bedrock.
Turbine 4 Tobin's Trial Pit 04	***0.00 – 1.6m**: Black/ brown fibrous PEAT* ***1.60 – 3.0m**: Very sandy, gravelly SILT/CLAY*	Minor water inflow at base.
Turbine 5 Tobin's Trial Pit 05	***0.00 – 0.10m**: Black fibrous PEAT* ***0.10 – 1.30m**: Very sandy, gravelly SILT with occasional sand lenses*	Concluded at 1.30m due to bedrock.
Turbine 6 Tobin's Trial Pit 06	***0.00 – 0.80m**: Black fibrous PEAT* ***0.80 – 1.20m**: Shelly marl and organic CLAY* ***1.20 – 2.90m**: Slightly sandy laminated SILTS and CLAYS*	Concluded at 2.90m due to abundance of subsidence of adjacent ground and collapse of trial pit.
Turbine 7 Tobin's Trial Pit 07	***0.00 – 0.10m**: Black/ brown fibrous PEAT* ***0.10 – 1.50m**: Slightly gravelly SAND*	Concluded at 1.50m due to large water inflow and collapse of trial pit.
Turbine 8 Tobin's Trial Pit 08	***0.00 – 1.70m**: Red/ brown fibrous PEAT* ***1.70 – 3.30m**: Laminated sandy SILT and silty SAND*	
Turbine 9 Tobin's Trial Pit 09	***0.00 – 1.60m**: Brown/ black fibrous PEAT* ***1.60 – 3.00 m**: Very sandy, gravelly SILT/ CLAY with occasional limestone cobbles and boulders*	Concluded at 3.00m due to water ingress.
Turbine 10	***0.00 – 0.30m**: Black fibrous PEAT* ***0.30 – 2.30m**: Slightly sandy gravelly SILT*	Concluded at 2.30m due to abundance of large boulders.

Turbine	*Ground profile*	Comments
Tobin's Trial Pit 10		
Turbine 11 Tobin's Trial Pit 11	***0.00 – 0.40m**: Black/ brown fibrous PEAT* ***0.40 – 1.30m**: Gravelly SILT*	Concluded at 1.30m due to bedrock.
Turbine 12 Tobin's Trial Pit 12	***0.00 – 2.00m**: Red/ brown fibrous PEAT* ***2.00 – 2.60m**: Laminated sandy SILT* ***2.60 – 3.20m**: Gravelly SILT/ CLAY*	
Turbine 13 Tobin's Trial Pit 13	***0.00 – 0.70m**: Brown/ black fibrous PEAT* ***0.70 – 3.00m**: Very sandy, gravelly SILT/ CLAY with occasional limestone cobbles and boulders*	Trial pit Concluded at 3m due to water ingress.
Turbine 14 Tobin's Trial Pit 14	***0.00 – 0.60m**: Brown fibrous PEAT*	Peat probe at 2.1m; possible gravel/ gravelly till or bedrock.
Turbine 15 Tobin's Trial Pit 15	***0.00 – 1.00m**: Black/ brown fibrous PEAT* ***1.00 – 2.60m**: Slightly sandy SILT/ CLAY* ***2.60 – 3.00m:** Very silty, sandy GRAVEL with large sub-angular to sub-rounded boulders and cobbles*	Concluded at 3.00m due to boulders.
Turbine 16 Tobin's Trial Pit 16	***0.00– 2.10m:** Red/ brown fibrous PEAT* ***2.10 – 3.70m:** Sandy, gravelly SILT/ CLAY*	Minor inflows present.
Turbine 17 Tobin's Trial Pit 17	***0.00 – 1.60m**: Brown/ black fibrous PEAT* ***1.60 – 2.70m**: Sandy, gravelly SILT/CLAY with occasional cobbles and boulders*	Terminated at 2.70m due to boulders.
Turbine 18 GDG Trial Pit 101	***0.00 – 0.90m:** Black PEAT with very little discernible fibres and roots* ***0.90 – 3.10m:** Light grey soft slightly sandy gravelly CLAY with significant amount of cobbles and boulders and occasional minor lenses of yellow fine to medium sand.*	Significant amount of water trickling from the interface of peat and gravelly clay. Trial Pit walls crumbling / slightly unstable after that.
Turbine 19 GDG Trial Pit 06	***0.00 – 1.10m**: Black to brown fibrous PEAT* ***1.10 – 2.00m**: Slightly clayey SILT with abundant gravels and cobbles* ***2.00 – 2.50m**: Slightly clayey SILT with abundant gravels, cobbles and boulders*	Terminated at 2.50m due to obstruction.
Turbine 20 GDG Trial Pit 07	***0.00 – 1.10m**: Black to brown fibrous PEAT* ***1.10 – 1.40m**: Slightly silty CLAY with occasional gravels* ***1.40 – 2.00m**: Silty SAND with numerous gravels and cobbles*	Water strike at 2.00m Terminated at 2.00m due to obstruction.
Turbine 21 GDG Trial Pit 08	***0.00 – 2.00m**: Black to brown fibrous PEAT* ***2.00 – 2.70m**: Slightly clayey, gravelly SILT* ***2.70 – 3.70m**: Silty, gravelly SAND with numerous cobbles and boulders*	
Turbine 22 GDG Trial Pit 03	***0.00 – 3.50m**: Black to brown fibrous PEAT* ***3.50 – 4.50m**: Silty, gravelly SAND with abundant cobbles*	
Turbine 23 GDG Trial Pit 04	***0.00 – 0.05m**: Plastic fibrous Black Organic PEAT*	Terminated at 2.20m due to obstruction.

Turbine	*Ground profile*	Comments
	***0.05 – 0.40m**: Slightly clayey sandy, gravelly SILT with numerous cobbles* ***0.40 – 2.20m**: Slightly sandy, gravelly SILT/ CLAY with numerous cobbles and occasional boulders*	
Turbine 24 GDG Trial Pit 05	***0.00 – 1.30m**: Black to brown fibrous PEAT* ***1.30 – 2.70m**: Slightly clayey sandy SILT with abundant cobbles*	Terminated at 2.70m due to obstruction.
Borrow Pit 17-1	***0.00 – 0.70m:** Black/ brown fibrous PEAT* ***0.70 – 1.00m:** Organic SILTS and shelly MARL* ***1.00 – 2.25m:** Sandy, gravelly CLAY*	Concluded at 2.25 due to presence of large angular boulders.
Borrow Pit 17-2	***0.00 – 0.20m:** Black and brown organic PEAT* ***0.20 – 2.50m:** Very silty, clayey GRAVEL with numerous cobbles and boulders*	Concluded at 2.50m due to presence of large angular boulders.
Borrow Pit 17-3	***0.00 – 0.44m:** Black and brown organic PEAT* ***0.44 – 1.80m:** Sandy, gravelly SILT/ CLAY*	Water inflows at base of trial pit. Concluded at 1.80m due to abundance of large angular boulders and bedrock.
Borrow Pit 17-4N	***0.00 – 0.20m:** Black organic PEAT* ***0.20 – 0.90m:** Slightly sandy, gravelly CLAY*	Concluded at 0.90m due to bedrock
Borrow Pit 17-4S	***0.00 – 0.25m:** Black organic PEAT* ***2.50 – 2.40m:** Slightly sandy, gravelly CLAY*	Water inflows at base of trial pit. Concluded at 2.40m due to obstruction.
Borrow Pit 17-5	***0.00 – 0.20m:** PEAT* ***Noted as an area of bedrock subcrop during trial pitting***	stone was hit at 0.2m
Substation A (Trial Pit STP1, STP2, STP3, STP4)	***0.00 – 1.50m**: Brown to Black PEAT* ***1.50 – 3.15m**: Slightly sandy SILT/CLAY* ***3.10 – 3.30m**: Sandy, gravelly SILT/CLAY with Large cobbles of sandstone and limestone.*	
Substation B (Trial Pit STP5, STP6)	***0.00 – 1.50m**: Red/Brown fibrous PEAT* ***1.50 – 2.25m**: Organic shelly MARL with occasional rootlets* ***2.30 – 4.50m**: Thinly laminated slightly sandy SILT/CLAY*	

Similarly, hardstanding for cranes and other infrastructure foundations on site are to be founded on material underlying peat deposits which will also require excavation through peat. A crane hardstanding is required adjacent to each turbine for the purpose of turbine installation and maintenance. Each crane pad has an area of 25m x 40m and will required the full excavation of peat (where present) to substrate and replacement with rock is required to provide a suitably stable surface for turbine component handling. Once excavated, peat will be re-used to batter the edges of platforms grading the bases into the local topography.

The construction compounds and substation options are all located in areas with limited peat (i.e. average peat soil depth is <1m). Full excavation of peat (where present) to substrate and replacement with rock is required to provide a suitably stable surface for turbine placement. Once excavated, peat will be re-used to batter the edges grading the bases into the local topography.

2.2 EXCAVATIONS FOR THE UNDERGROUND CABLE

The proposed wind farm will connect to the grid via a short section of overhead line or via underground cable along onsite roads in Bord na Móna lands and the curtilage of the public road. Final design of the grid connection will be subject to receiving a grid connection offer and EirGrid post planning system studies. As outlined in Section 2.4.4 there are two options for the substation location and consequently there are two associated grid connection options as follows:

- Substation Option A, in Cloonfore townland, will connect to the national electricity grid via overhead line to the existing Lanesborough/Richmond 110 kV line; or
- Substation Option B, in Derraghan More townland, will connect to the national grid via either an underground cable or overhead line to the existing Lanesborough/ Mullingar 110 kV line.

See Figure 1.1 for the general layout of the proposed substations and their associated grid connections. For clarity, it should be noted that two options are presented in the report for the underground cable works, substation and associated grid connections. However, only one option will be constructed.

It is proposed to excavate the trenches for the underground cable at a uniform level in peat or overburden material. The trenches will typically be 600mm wide and 1200mm deep.

2.2.1 Cable Methodology

This methodology includes procedures that are to be included during the construction phase to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations.

With respect to placement of arisings from excavation, the guidelines below are to be followed.

- All excavations within peat are to be adequately supported or peat slopes are to be battered to a safe slope inclination typically of 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate;
- Where areas of weaker peat are encountered then slacker slopes will be required;
- Excavations shall always be kept reasonably free from water; and
- Backfill requirements for the cable trench will be decided as part of the detailed design/construction.

2.3 CONSTRUCTION OF NEW ROADS THROUGH PEAT

2.3.1 Road Construction Types

To provide access within the site and to connect the wind turbines and associated infrastructure new roads will need to be constructed. The identification of the access road layout is an iterative procedure. The road construction preliminary design has considered the following key factors:

- Requirement to minimise disruption to peat hydrology;
- Minimise excavation arisings;
- Serviceability requirements for construction and wind turbine delivery and maintenance vehicles; and
- Buildability considerations.

Whilst the above key factors are used to determine the road design the actual construction technique employed for a particular length of road will be determined on the prevailing ground conditions encountered along that length of road. The proposed development has avoided intact peat areas at the edge of the peatlands.

The general road construction techniques to be considered are given in Table 2.2.

Access roads to enable the construction works, provide access to turbine locations and provide amenity cycleways for the whole life cycle of the wind farm have been designed. The roads will be constructed using unbound crushed aggregates and incorporate drainage to maintain the performance of the pavement during wet weather. The majority of the roads are likely to be constructed as founded roads. Founded roads are excavated down to and constructed up from a competent geological stratum. The roads shall be constructed to heights ranging from ground level to 1.0m above existing ground level.

Ground investigation in the form of peat probing and trial pitting has been carried out along the proposed access routes to inform the depth of excavation and upfill required for the access tracks.

Table 2.2: General Construction Access Tracks

Construction Method	Typical Site Conditions		
	Description	**Typical Peat Depth (m)**	**Typical Slope Inclination (degs)**
Construction of new excavated roads through peat	Flat slopes with relatively shallow peat	Typically, less than 1.5m, locally up to 4.8m	Less than 3 degrees
Construction of new floating roads over peat	Flat slopes with relatively deeper peat	>3m	-

2.4 GENERAL ROAD CONSTRUCTION TECHNIQUES

It should be noted that Table 2.2 summarises the general road construction techniques only. Prior to the construction of any access roads on site a detailed design will need to be carried out.

2.4.1 Excavated Road Construction Methodology

Given the flat topography and relatively shallow peat on site, excavated access roads are deemed an appropriate construction technique.

This methodology includes procedures that are to be included in the construction phase to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations.

- Prior to commencing the construction of the excavated roads movement monitoring posts will be installed in areas where the peat depth is greater than 2.0m;
- Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area;
- Excavation of roads shall be to the line and level given in the design requirements. Excavation should take place to a competent stratum beneath the peat (as agreed with the site designer);

- Road construction will be carried out in sections of approximately 50m lengths; i.e. no more than 50m of access road should be excavated without re-placement with stone fill unless otherwise agreed with the resident engineer on site;
- All excavated peat shall be placed/spread alongside the excavations;
- Side slopes in peat shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required. Battering of the side slopes of the excavations should be carried out as the excavation progresses;
- The surface of the finished excavated access road will be finished above current ground level;
- A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer);
- At transitions between floating and excavated roads a length of road of about 10m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated road;
- Where slopes of greater than 5 degrees are encountered along with relatively deep peat (i.e. greater than 1.5m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability. It should be noted that slopes greater than 5 degrees are not envisaged on site; and
- A final surface layer shall be placed over the excavated road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.

Wind farm tracks require careful monitoring to ensure that there is no significant standing water forming, which would lead to potholes in the surface. If areas of track are causing concern, repairs should be carried out in favourable, preferably dry, conditions, to ensure that there is no saturation of the surface of the track.

2.4.2 Construction of New Floating Roads over Peat

It is expected that founded roads will constitute the majority of the site, however floating roads will also be considered were suitable. Floating road sections will be designed by the geogrid manufacturer, or by a consultant assisted by the geogrid manufacturer. It can also be designed in-house by a contractor with experience in road construction over peat. The design will have a geotechnical input to fully understand the principles at work in the floating road. Design can be by calculation or, more usually by the application of semi-empirical rules based on experience. EN 1997 (Geotechnical Design).

Transitions between floating tracks and excavated tracks (or other forms of track not subject to long term settlement) should be gentle (e.g. 1:10 basal transition slope) in order to minimise likelihood of track failure at the boundary between construction types.

2.4.2.1 Floating Road Construction Methodology

This methodology includes procedures that are to be included in the construction phase to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations. Note: Details of geogrid arrangement will be provided by the specialist geogrid provider/designer.

- Mark out the line of road;
- Install advance drainage ahead of construction where necessary;
- Clear the intended floating road area of major protrusions such as rocks, trees, bushes etc down to ground level leaving any residual stumps and roots in place;
- Leave the local surface vegetation and soils in place if possible;
- Fill any local hollows and depressions with a suitable local lightweight fill such as tree brash, logs, or a combination of lightweight fill and suitable material. (Brash mats and fascines can also be used to form an initial surface on difficult ground.);
- Floating road construction shall be to the line and level requirements as per design/planning conditions;
- Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements; and
- Construction of road to be in accordance with appropriate design from the designer.

The typical make-up of the new floated access road is between 600mm and 1000mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a geotextile separator. This may vary depending on designer requirements.

Following the detailed design of the floated access roads it may be deemed necessary to include pressure berms either side of the access road in some of the deeper peat areas. The inclusion of a 2 to 5m wide pressure berm (typically 0.5m in height) either side of the access road will reduce the likelihood of potential bearing failures beneath the access road.

The finished road width will be approximately 6m (to be confirmed by the designer).

Stone delivered to the floating road construction shall be end-tipped onto the constructed floating road. Direct tipping of stone onto the peat shall not be carried out.

To avoid excessive impact loading on the peat due to concentrated end-tipping all stone delivered to the floating road shall be tipped over at least a 10m length of constructed floating road.

Where it is not possible to end-tip over a 10m length of constructed floating road then dumpers delivering stone to the floating road shall carry a reduced stone load (not greater than half full) until such time as end-tipping can be carried out over a 10m length of constructed floating road.

Following end-tipping suitable machinery shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.

A final surface layer shall be placed over the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.

3 EXCAVATION AND STORAGE OF ARISINGS

The handling, storage and re-use of excavated materials are of importance during the construction phase of the project.

As the works are located within cutover bog, it is intended that peat and unsuitable founding soils will be side cast, i.e. placed adjacent to works locations. Considering the topography, it should be appropriate to do this across most of the site.

Any surplus excavated material will be sidecast, profiled and bermed as close to the excavation areas as practical as set out in the Peat Management Plan. A two to three-metre-wide working area will be required around each hard-standing area, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur.

The site has been extensively harvested by Bord na Móna using mechanical cutting resulting in well drained and extensively trafficked peat. Bord na Móna has considerable experience in the handling of peat in these circumstances, both during peat production operations and during the rehabilitation processes associated with its cutaway bogs. This experience has shown that when the handling and moving of such peat is appropriately managed, stability or environmental issues are not expected to arise.

3.1.1 Excavation & Storage of Arisings Methodology

This methodology includes procedures that are to be included in the construction phase to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations.

Prior to any excavations, the Principal Contractor will produce a detailed Method Statement identifying where and how excavated peat will be used in reinstatement or landscaping works. Specific requirements for the excavation, handling, storage and reinstatement of peat will be outlined in this Method Statement. The Principal Contractor will consider potential impacts on downstream receptors and the potential for instability issues with the excavated material.

Some of the requirements to be contained within this are outlined below. The majority of the site comprises bare peat with some areas where revegetation is occurring. Areas of peat within the footprint of excavation will have the top layer of vegetation stripped prior to construction by an experienced specialist contractor. Underlying peat or bare peat will then be removed.

Classification of excavated materials will depend on their identified re-use in reinstatement works. At this site it is anticipated that the material to be excavated will comprise peat, alluvial/lacustrine soils and mineral subsoil.

All excavated peat and overburden will be placed/spread alongside the excavations for the infrastructure elements. The proposed borrow pits are in the Derryadd Bog. Borrow pit material will be excavated using standard excavators and stockpiled within the borrow pit pending reuse onsite. Peat, overburden, and rock will be reused where possible on site to reinstate borrow pits and other excavations where appropriate.

3.1.2 Guidelines for the Placement/Spreading of Material alongside Excavations

The majority of the site's access tracks will be constructed using a cut and fill methodology. Excavated peat from cut and fill sections of access tracks will be used for dressing the side slopes of track sections.

Where gradients permit, peat edges may be built up slightly above the road level to reduce visual effects from the surrounding area if it is necessary to limit track visibility. The design and construction of tracks on peat will be done in such a way to reduce impacts on and maintain the existing site drains. The built track will allow for the transmittance of water, so the existing drainage can be maintained.

The following recommendations and best practice guidelines for the placement/spreading of material alongside excavations should be considered and taken into account during construction.

All excavated peat and overburden will be placed/spread alongside the excavations for the infrastructure elements on site, where possible. Given the flat topography/nature of the site, this approach for the placement of excavated material is deemed appropriate.

During the construction process the material will be relayed to the side by an excavator and spread on the bog on one or both sides of the excavations.

The material will be spread to a depth not exceeding 2.0m in height, shall be tracked in to ensure it is adequately compacted and stable and graded to complement the topography and drainage system on the site.

Where practical, it should be ensured that the surface of the placed material is shaped to allow efficient surface water runoff. Where possible, shaping of the surface of the spread material should be carried out as placement of material progresses. This will reduce the likelihood of debris run-off and ensure stability of the spread material.

- The placement of excavated material is to be avoided without first establishing the adequacy of the ground to support the load. This may involve a visual inspection by competent personnel. The placement of material may require the use of long reach excavators and low ground pressure machinery in localised areas;
- Where there is any doubt as to the stability of the peat surface then no material shall be placed on to the peat surface;
- Finished/shaped side slopes in the placed material is likely to be in the region of 1 (v): 2 to 3 (h). This slope inclination should be reviewed during construction, as appropriate. Where areas of weaker material are encountered then slacker slopes may be required;
- All placed/spread material will be allowed to revegetate naturally from the extensive seed source of the plants that have already colonised in the area. Alternatively, and possibly in addition seeding of the placed material could be carried out which would aid in stabilising the placed material in the long term;

- Movement monitoring instrumentation may be required in deeper in-situ peat areas. The locations where monitoring is required will be identified prior to construction works commencing on site;
- Supervision by a geotechnical engineer or appropriately competent person is recommended for the works;
- An interceptor drain should be installed upslope of the placed material areas to divert any surface water away from these areas. This will help ensure stability of the placed material and reduce the likelihood of debris run-off.

All the above-mentioned general guidelines and requirements will be confirmed by the designer prior to construction.

3.2 SUMMARY OF EXCAVATED PEAT VOLUMES ON SITE

A summary of the excavated peat volumes calculated for the Derryadd Wind Farm site is provided in Table 3.1. Please note there are 2 no. potential grid connection and substation options proposed for the project, namely Option A and Option B, and both are presented in Table 3.1. It should also be noted that only one option (A or B) will be constructed. The summary table below includes the combined volumes of both compacted and uncompacted material necessary for infrastructure.

Table 3.1: Excavation Volume Summary

Area	Combined Excavated volume compacted (m^3)	Combined Excavated volume uncompacted(m^3)
Access roads	590,000	770,000
Cycle/amenity tracks	40,500	52,500
Temporary compound	20,000	26,000
Turbines	27,000	35,000
Hardstandings	215,000	280,000
Substation A / B - worst case and used in total volume below	12,000/8,800	15,000/11,000
Met masts	100	150
Total	**904,600**	**1,178,650**

Presently, the estimated volume of compacted material arising from construction is 0.905 million m^3.

3.3 GENERAL RECOMMENDATIONS FOR GOOD CONSTRUCTION PRACTICE

To minimise the risk of construction activity causing potential peat instability it is recommended that the Construction Method Statements (CMS's) for the project should also take into account, but not be limited, to the general recommendations below together with the specific recommendations above. Some of the general recommendations are already included in more detail within the specific recommendations.

- Avoidance of uncontrolled concentrated water discharge onto peat slopes identified as being unsuitable for such discharge;
- Avoidance of unstable excavations. All excavations shall be suitably supported to prevent collapse and development of tension cracks;
- Avoidance of placing fill and excavations near steeper peat slopes, that is at the crest or toe of the slope;
- Installation and regular monitoring of geotechnical instrumentation, as appropriate, during construction in areas of possible poor ground, such as deeper peat deposits (see section 10);
- Site reporting procedures to ensure that working practices are suitable for the encountered ground conditions. Ground conditions will be assessed by suitably experienced geotechnical engineer;
- Regular briefing of all site staff (e.g. toolbox talks) to provide feedback on construction and ground performance and to promote reporting of any observed change in ground conditions; and
- Routine inspection of wind farm site by contractor to include an assessment of ground stability conditions (e.g. cracking, excessive floating road settlement, disrupted surface, closed-up drains) and drainage conditions (e.g. blocked drains, absence of water in previously flowing drains, springs, etc).

4 MONITORING

To monitor possible peat movements, it is proposed to install sighting posts upslope and downslope of the access road at staggered intervals at locations where the peat depth is greater than 2.0m. Details of sighting posts are given below.

4.1.1 Excessive Movement

Where there is excessive movement or continuing peat movement recorded at a monitoring location or identified at any location within the site but no apparent signs of distress to the peat (e.g. cracking, surface rippling) then the following shall be carried out.

- All activities (if any) shall cease within the affected area;
- Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until movements have ceased; and

- Re-commencement of activities shall only start following a cessation of movement and agreement with all parties.

4.1.2 Onset of Peat Slide

The site is relatively flat lying with cutaway/cutover peat overlying a soft to very soft glacial till/lacustrine marls. Due to the relatively flat, drained cutaway nature of the site, the risk of a regional scale landslide is low. In the event of a localised peat slide the following measures will be put in place. Where the onset or actual detachment of peat (e.g. cracking, surface rippling) then the following shall be carried out:

- On alert of a peat slide incident, all activities (if any) in the area should cease and all available resources will be diverted to assist in the required mitigation procedures;
- Where considered possible, action will be taken to prevent a peat slide reaching any watercourse. This will take the form of the construction of check barrages on land; and
- All relevant authorities should be notified if a peat slide event occurs on site.

For localised peat slides that do not represent a risk to a watercourse and have essentially come to rest, the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and stabilisation procedures implemented. The area will be monitored, as appropriate, until movements have ceased.

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