Appendix 3-3

Peat and Spoil Management Plan

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Carrownagowan Wind Farm

Peat and Spoil Management Plan (PSMP)

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1 Introduction

Malachy Walsh and Partners (MWP) were engaged in 2018 by Coillte to compile a Peat and Spoil Management Plan (PSMP) for Carrownagowan Wind Farm in County Clare. This PSMP relates only to the wind farm site which is included in the proposed development and part of the overall project.,The proposed Carrownagowan Wind Farm is at a site located approximately 4km north-east of Broadford, County Clare. The proposed wind farm comprises 19 no. wind turbines with associated infrastructure including access roads (new and upgrading of existing roads), a substation compound containing a control building and a substation building, a permanent meteorological mast as well as temporary infrastructure which comprises 2 no. site construction compounds. Three proposed on-site borrow pits within the site will be used as sources of stone aggregate for construction.

2 Purpose of the Peat and Spoil Management Plan

The purpose of this Peat and Spoil Management Plan is to describe how it is planned to construct Carrownagowan Wind Farm in a manner that ensures the landscape is not adversely impacted as a result of the proposed development and that site management practices are carried out to complete the development safely and in the interest of orderly development.

The plan also sets out a methodology to prevent:

1. Peat slippage and bog burst,
2. Rock, soil or peat excavated during the construction phase from being stock-piled on site following the completion of construction works,
3. Peat excavated from the site from being dumped onto adjacent bogland,
4. Adverse local effects on sensitive habitats.

The ultimate aim is to construct the wind farm project in a manner that facilitates regeneration of all-natural habitats at all locations affected by construction works and will minimise the damage incurred on sensitive habitats. The stages of the spoil management process comprise:

1. Appropriate handling of excavated rock, soil, or peat,
2. Management of existing habitats,
3. Rehabilitation of excavated areas

3 Ground Stability

Site investigations were carried out along the proposed internal access road routes, at each turbine location and at the sites of all other infrastructural elements. This detailed information allowed a location specific assessment of the peat stability risk to be carried out. Based on this information, turbine positions were adjusted, relocated or removed and access roads avoided traversing locations identified as areas of peat instability. The outcome of identifying all of the environmental, technical and engineering constraints for the site was that an infrastructural layout could be situated in areas characterised by relatively low surface gradients and shallow peat depths. Comprehensive information on the peat characteristics throughout the site is included in the Peat Stability Report **in Volume III, Appendix 9-2** of the EIAR.

4 Peat and Spoil Management Basis Statement

4.1 Prevention of Peat Slide and Bog Burst

Application of the following procedures in Carrownagowan Wind Farm will reduce the hazard associated with peat instability: -

- Excavated spoil will not be deposited on the downslope or upslope edges of adjacent peat, a setback distance of 2m must be used. Where material is required to be stored adjacent to an excavation this spoil is to be deposited on the two flanks to either side (where gradient is least) and spread in such a way as to limit the surcharge pressure on sensitive peats.
- To guard against slippage into open excavations, the sides within excavated peat are to be battered back to an angle of 30 degrees to the horizontal. Where the depth of the excavation exceeds 2m; a 1m wide horizontal slippage platform is to be constructed every 2m of vertical fall.
- Care is to be taken to ensure that the edge of the excavation does not undermine any adjacent access road or any road adjacent to a hardstand which will be dug out and not floated.
- Movement can often occur during or following severe rainstorm events, particularly when following a prolonged dry spell. Extra vigilance is to be maintained at such times. Works are to be suspended if weather conditions pose too great a risk of slippage.
- Areas of floated roads can be more at risk of peat slide and should be checked regularly. Prior to the transportation of heavier than normal loads along floated roads, proof tests are to be carried out to assess settlement characteristics and ensure that the road is fit for purpose.
- All slopes are to be regularly checked for development of tension cracks.
- Method statements are to be followed at all times. Where modification is required this is to be agreed by the supervising engineer.
- The potential for a peat slide is to be monitored regularly during the construction works, by means of regular site visits and assessments, by a suitably qualified and experienced geotechnical and/or environmental engineer.
- Site staff are to also undergo induction training to learn about the risks associated with working on bogs and procedures aimed at reducing peat slide risk.

4.2 Excavated Soil Management

Spoil will invariably be generated during excavations for roads, hardstands, wind turbine foundations and trenching for ducting as well as developing silt controls. Minimisation of the production of this spoil is to be treated as a high priority, but it is nevertheless accepted that there will be generation of excess spoil in the form of a mixture of topsoil, mineral soil, peat and glacial till.

Two types of soil are generated during excavation in upland areas; glacial soils and peat soils. These spoil types need to be treated separately. Glacial soils and peat are to be separated during excavation and these two types of spoil will be disposed of generally as follows:-

- Glacial soils will be deposited directly on top of other glacial soils. This will require the removal of peat where present to facilitate the process.
- Peat can be disposed of either on top of glacial soils, on top of inactive peat or on top of the *acrotelm* where the "top mat" has been removed.

It is proposed that only material required for landscaping and reinstatement around each turbine will be stockpiled adjacent to the turbine excavations. The remainder of the excavated spoil should be transported directly from the excavation for disposal within the proposed deposition areas and at the onsite borrow pits.

The majority of the site has been under commercial forest for decades and the blanket bog is severely degraded in terms of its value for habitat restoration. The upper layer of scraw of the bog still has some benefit for landscaping and is considered a preferential material for re-use around turbines.

The following good practice applies to such peat excavation:

- Peat turves will be excavated as intact blocks of upper peat comprising the surface vegetation layer (*acrotelm*) and adjoining upper *catotelm*;
- Underlying turves will be extracted as intact as feasible, with remoulding by the excavator kept to a minimum;
- Excavation of contaminated peat turves (those incorporating substrate) will be avoided if possible, and where unavoidable will be stored separately to non-contaminated peat turves to avoid further contamination on reinstatement (or during transport).

Where possible, a technique known as macroturfing (large scale cutting and re-laying of turf blocks) should be employed to extract 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*.

4.3 Permanent Disposal of Excavated Spoil

The disposal of excavated spoil will adhere to the following principles.

Floated Roads

It is proposed to place a peat ballast berm either side of floated roads. The purpose of this berm is to act as a counterweight, spreading the weight of the road further through the blanket of bog. These berms are an integral part of the floated road design, increasing the bearing capacity of the peat under the road by 30%.

Deposition Areas

- Where the deposition area is large, the area will be subdivided into a series of cells. Each cell will be bounded by an embankment of suitably selected material capable of withstanding loads that will be applied by the peat being retained.
- The size of each cell will be dictated by the maximum working length of excavators which are working the borrow pit.
- Each cell will be bounded on all sides to prevent material slippage from the cell. All bunds will be of adequate strength to be capable of retaining the spoil stored within each cell.
- Any point source drainage from disposal areas will empty into a series of silt control measures designed in accordance with the surface water management plan.
- Water build up within deposition areas will not be permitted.
- Desiccation of excavated spoil is to be avoided. Topping off of deposition areas with 'scraw' from excavations will reduce the risk of desiccation and enhance the re-vegetation process.
- Glacial soils will be deposited at the base of any disposition area with peat deposited as the surface layer in a layer not less than 400mm thick.
- Upon completion of each cell the surface of the deposited spoil will be profiled to a gradient not exceeding 5% and vegetated with either harvested turves or allowed to vegetate naturally.

Deposition of glacial spoil on top of peat will not be permitted where the inclination of the existing ground combined with the extra weight of the deposited spoil poses a risk to the stability of the original ground surface. In such circumstances all surface peat must be removed prior to further spoil disposal. Consultation with the site geotechnical engineer is required before any works begin.

The management of excavated material will involve the following:

- Excavated mineral and peat soils shall be excavated and stored separately; this will prevent mixing of materials and facilitate reuse afterwards.
- All materials which require storage will be stockpiled at low angles (< 5-10°) to ensure their stability and secured using silt fencing where necessary. This will help to mitigate erosion and unnecessary additions of suspended solids to the drainage system.
- If necessary, mineral soils will be covered while stored to minimise run-off.
- Sediment management systems, such as silt fencing, will be provided around the proposed deposition areas where necessary. Drainage systems will also be utilised in mineral storage areas where necessary.
- The harvested *acrotelm* (vegetative layer), where encountered, will be maintained in a moist

state during construction in preparation for re-use at locations where the underlying *catotelm* or non-vegetative layer has been exposed.

- Excavated peat will be reinstated as soon as possible after excavation, to avoid potential damage in the form of soil dehydration. Swift reinstatement will promote successful re-growth.
- Excavated peat will be reused in the restoration of bare/exposed surfaces around turbines, exposed peat cuttings and access roads that are not being used.
- Excavated material shall not be spread over any existing heath, bog or rough grass.

4.4 Temporary Storage of Excavated Material

No permanent stockpiles will be left on site after the completion of the construction phase works. After completion of the turbine base reinstatement works all remaining stockpiles are to be removed for permanent disposal at the proposed 3 no. deposition areas within the site.

Any materials excavated during the construction phase which are to be used in the site reinstatement and landscaping process shall, in the first instance, be stored on site in an environmentally safe manner that will not result in the pollution of waters or the smothering of ecologically sensitive habitats.

The following principles will be adhered to when considering the temporary storage of excavated materials;

- Spoil disposal will take place within a 30m radius of each structure.
- Preparation of the spoil disposal site will involve the removal of the "top mat" which will be transplanted to an area of inactive bog and maintained for re-use during restoration operations.
- Spoil will be deposited, in layers of 0.50m and will not exceed a total thickness of 1.50m.
- Peat can be stored on top of existing, undisturbed peat, adjacent to the access roads and turbine locations.
- Where glacial spoil is to be temporarily stored adjacent to the turbine excavations the existing peat layer will first be harvested and stored separately. Upon removal of glacial spoil the peat will be reinstated and the top mat of vegetation replaced.
- Spoil will only be deposited on slopes of less than 5 degrees to the horizontal and greater than 10m from the top of a cutting. The exact location of such areas will be confirmed on consultation with the geotechnical engineer.
- Temporary storage of excavated soils will only occur where peat thickness is minimal.
- Excavated material will not be stored adjacent to turbine bases, on or adjacent to slopes (>15 degrees gradient), or in areas where peat thickness exceeds 0.5m.
- Once reinstatement is complete the disposal sites will be re-vegetated with the "top mat" removed at the commencement of disposal operations.
- Upon commencement of the restoration phase, guidance from a suitably qualified environmental professional will be sought to confirm the methodolgy and programme.

It is proposed that any temporary onsite stockpiles of soil, rock and other excavated material shall be removed and utilised in the site reinstatement programme to infill any excavated areas which will then be mounded and capped with sod prior to the completion of works.

4.5 Reinstatement

Reinstatement works will commence at an early stage of construction. Such reinstatement will occur following the completion of individual sections of work, such as the completion of a turbine foundation or hardstand. Ongoing restorative programming facilitates the immediate relocation of material from one turbine base excavation to another completed area and in doing so can limit the requirement for temporary storage of material on site.

Areas which could benefit from reinstatement of peat include any exposed areas surrounding turbine bases and crane hardstand areas, borrow pits, obsolete drainage channels and any other areas left exposed by the construction works.

Excess stone and spoil which is unsuitable as a vegetation layer shall be placed in the deposition areas. These areas will be covered with active soil to allow vegetative growth post construction.

4.6 Control Measures

The following generalised control measures will be enforced during construction:

- No storage of excavated material other than in areas selected for such activities; temporary storage within the development footprint and deposition at proposed areas..
- No stockpiling of materials or parking of plant on peat.
- Minimise tracking machinery on peat.
- Exclusion zones delineating the working corridor will be installed around all working areas using post and rope fences. No activity will be permitted past this fence.
- The environmental manager or other designated person will conduct toolbox talks with all personnel working in peat areas to explain the risks associated with such works and to explain the location of exclusion zones.
- Minimise length of unsupported excavations in peat.
- Water build up in excavations will be avoided.
- Peat excavations will not be left unsupported for extended periods.
- The use of vibrating rollers on peat surfaces will not be permitted (dead weight permitted).
- Upslope cut-off drains will be installed in advance of construction.
- Existing drainage patterns in the peat will be maintained as far as is practicable.
- There will be no uncontrolled discharges of water onto peat.
- Deviation from the agreed work methodology must be approved by a suitably qualified environmental professional or site geotechnical engineer.
- The site supervisor will suspend work if work practices or weather conditions are unsafe.
- Where suitable material is available, it will be used for the immediate backfilling of any excavations.

4.7 Monitoring Procedure

The following monitoring procedure has been adopted from plans for wind farms in similar soil conditions.

To monitor possible peat movements it is proposed to install sighting posts upslope and downslope of the access roads at staggered intervals at locations where the peat depth is greater than 2m for excavated access roads and 3m for floated access roads. Additional monitoring locations will be required at infrastructure locations with deeper peat deposits. The sightlines are to consist of the following:

- A line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line.
- Each set of sighting line shall comprise 6 no. posts at 5m centres that is a line 25m long.
- A string line shall be attached to the first and last posts and all intervening posts shall be adjusted so they are just touching the string line.
- Lines of sighting posts shall be placed across the existing slope about 5m away from the area to be worked. The posts will be located along the road at 10m intervals in areas of deep peat (say greater than 1m). Where there are relatively steeper slopes or softer ground a sighting line shall be placed down the slope, or at any location where monitoring would be deemed useful.
- Each line of sighting posts shall be uniquely referenced with each post in the line given a reference. The post reference shall be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, and 1-6 for posts in line 1).
- The sighting lines shall be monitored at the beginning of each working day, and during the day where considered appropriate (e.g. when working activity is concentrated at a specific location or after each critical step in the construction process).
- Monitoring of the posts shall comprise sighting along the line and recording any relative movement of posts from the string line.
- Where increased movements are recorded the frequency of monitoring shall be increased.
- A monitoring record shall be kept of the date, time and relative movement of each post, if any.

4.8 Contingency Plan

The following contingency plan has been adopted from plans for wind farms with similar soil conditions.

4.8.1 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 etc.) then the following shall be carried out:

I. All activities (if any) shall cease within the affected area.
II. Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until such time as movements have ceased.
III. Re-commencement of activities shall only start following a cessation of movement and agreement with all parties (geotechnical engineer, contractor and client).

4.8.2 Onset of Peat Slide

Where there is the onset or actual detachment of peat (e.g. cracking, surface rippling etc.) then the following shall be carried out:

I. 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.
II. 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. Due to the terrain and the inability to predict locations it may not be possible to implement any on-land prevention measures, in this case a watercourse check barrage will be implemented.
III. 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 such time as movements have ceased.

4.8.3 Check Barrage

Whilst it is not anticipated that a significant peat slide will occur on site as a contingency a check barrage procedure is included below.

The check barrage procedure deals with preventing a peat slide from moving downstream within a watercourse. The most effective method of preventing excessive peat slide debris from travelling downstream in a watercourse is the use of a check barrage. Generally, a check barrage comprises the placement of rock fill across a watercourse. The check barrage is a highly permeable construction that will allow the passage of water but will prevent peat debris from passing through. Rock fill should comprise well-graded coarse rock pieces from about 300mm up to typically 1000mm.

The rock fill for the check barrage should be sourced as close as possible to the site. A stockpile of material will be available as a contingency measure prior to construction work commencing. The size of the barrage will vary depending on the scale of the peat debris to be contained and the geometry of the watercourse at the barrage location. In general due to the low speed of a peat slide there is

generally little impact force and most of the lateral load is due to fluid pressure on the upslope face of the barrage.
Typically the check barrage should fill the entire channel width of the watercourse up to a height of 3 to 4m with a crest width of typically 2m and side slopes of about 45 degrees depending on the geometry of the barrage location.

The check barrage procedure is as follows:

I. Access to the check barrage location shall be along the existing access roads on the wind farm site and/or along public roads, where possible. When it is necessary to form the barrage then rock fill will be placed across the watercourse to effectively block the passage of peat debris.
II. Operatives employed to carry out the construction of the check barrage will need to be inducted by means of a briefing by on-site supervisors as to the proposed location of the check barrage.
III. The check barrage provides containment for peat debris in the unlikely event of a major peat slide. Further remedial measures may be required and will be assessed by all parties and carried out as soon as physically possible when the location and extent of the failure is established.
IV. Where a barrage was constructed as a precaution and no peat debris reached the watercourse then the barrage will be removed as soon as any measures to prevent further peat sliding is agreed with all parties.

5 Site Specific Peat and Spoil Management Plan

5.1 Method of Excavation

The general principles of extraction set out in this plan will be adhered to at all times during the construction phase.

5.2 Method of Construction

For the construction phase of Carrownagowan Wind Farm the activities that are considered likely to generate peat and spoil are as follows:

- Upgrading and widening of existing roads,
- Construction of new excavated roads,
- Excavation and reinstatement areas for peat and spoil,
- Excavations in peat for turbine bases, crane hardstands, substation compound and substation buildings, the permanent meteorological mast, the temporary site construction compounds and the borrow pits,

Prior to the commencement of construction work on the required infrastructure above, the following will be considered:

- Existing ground profile,
- Existing ground soil type,
- Bearing capacity of required roads, turbine bases and hardstands,
- Existing natural drainage regimes on site,
- Proposed turbine manufacturer assembly and transport delivery specifications,
- Environmental buffer areas and zones,

5.2.1 Upgrading and Widening of Existing Roads

For the construction of the wind farm it is proposed to utilise 8.4km of existing internal roads which accounts for 43% of roads to service the site. These roads will be widened by removing organic material and soft subsoil to formation level and constructing a road on a layer of geogrid or geotextile as required by site conditions. This road construction will be similar in build up to the excavated road construction which is outlined in detail in Section 5.2.2 below. The new width of road and the existing road surface, where required, will be capped with a 150mm layer of hard wearing Class 6F stone or similar.

This road type will have a crossfall of 2.5% from one edge to the other. The existing roadside drains on the lower side of the road will be used as part of the dirty water drainage system for the site. The existing roadside drains on the higher side of the road will be retained as clean water drains.
The sequence for upgrading and widening existing access roads will comprise the following:

I. The appointed contractor will survey the area for any unforeseen hazards prior to the commencement of works and set up warning signage as appropriate.

II. The material required for widening and upgrading the existing site roads is proposed to be won from the three proposed on-site borrow pits within the wind farm site. Sufficient passing bays will need to be constructed to allow for the safe movement of site traffic along the existing roads. A site traffic management plan is included with this application and will be finalised by the appointed contractor.

III. The extraction of stone aggregate from the proposed borrow pits will be undertaken by 30-60 Ton 360° excavators and loaded onto articulated dumper trucks that will deliver the aggregate to the required road widening / upgrading locations.

IV. Widening works will begin with the use of excavators that will first remove any topsoil / vegetative layer which may be present. This material will be transported to an agreed temporary storage area at the hardstanding areas and maintained for re-use during the restoration phase of the wind farm construction. Topsoil / vegetative removal will be kept to a minimum in order to prevent any runoff of silt during heavy rainfall.

V. Excavators will continue to strip and excavate the soft subsoil / peat underneath which will be temporarily stored adjacent to the access roads in accordance with approved methods described in this report with the use of an articulated dumper truck. Excavated material will only be temporarily stored on slopes under 5° and to a maximum height of under 1.0m until they are transported to the selected deposition areas where they will be permanently stored.

VI. Once a section of the widened access road is exposed to formation level; a layer of geogrid or geotextile material will be placed along its formation depending on ground conditions.

VII. The stone to be used for the widening works will be delivered to the required work area and spread out locally with the use of excavators on top of the geogrid / geotextile material. This will be compacted with the use of a roller which will roll the stone aggregate in maximum 250mm layers in order to achieve the required design strength.

VIII. The road upgrading works will involve the use of a roller compacting the site won stone aggregate in maximum 250mm layers laid over the existing road pavement. A layer of geogrid or geotextile material may be placed along the existing road pavement prior to the placement of the stone aggregate in order to achieve the required design strength.

IX. All upgraded / widened access roads will be constructed to a minimum drivable width of 5.0m with a maximum crossfall of 2.5% in order that water can flow off the roads and reduce the risk of rutting / potholes occurring.

X. Roadside drains as outlined in the Surface Water Management Plan will be constructed to manage clean and dirty water runoff along widened and upgraded access roads.

XI. The final running surface of the new widened / upgraded access roads will be capped with a minimum 150mm layer of hard wearing Class 6F stone or similar using a road grader.

XII. Any surplus spoil material generated from the road widening works will be transported to the borrow pits to aid final reinstatement. Excavated topsoil and subsoil will be kept separate at the excavation and storage areas.

XIII. All excavations to be carried out will be battered back to a safe angle of repose (minimum slope angle of 45°) and will comply with the Construction and Environmental Management Plan (CEMP.) and any update thereof.

XIV. Where drop offs greater than 1.0m in height occur alongside road edges; physical edge protection will be constructed in order to reduce the risk of vehicles overturning. Roadside marker posts will also be erected to delineate road edges in poor weather.

XV. The appointed contractor will ensure that all on-site personal are aware of environmental constraints / sensitive areas within the wind farm site in which works will be are avoided.

Figure 1 – Typical upgraded forestry road on a wind farm

5.2.2 New Excavated Roads

Approximately 7.6km of new excavated road construction will be required. These will be constructed using site won stone aggregate obtained from the proposed borrow pits and placed over a layer of geogrid, , after all organic and soft subsoil material is excavated to formation level. Geotextile material, will be used to separate the road building material from the subsoil, laid at formation level.

Typically the sequence of constructing new excavated access roads will comprise the following:

I. The appointed contractor will survey the area for any unforeseen hazards prior to the commencement of works and set up warning signage as appropriate.
II. Excavators will first remove any topsoil / vegetative layer which may be present. This material will be transported to an agreed temporary storage area and maintained for re-use during the restoration phase of the wind farm construction. Topsoil / vegetative removal will be kept to a minimum in order to prevent any runoff of silt during heavy rainfall.
III. Excavators will continue to strip and excavate the soft subsoil / peat underneath which will be temporarily stored adjacent to the access roads in accordance with approved methods with the use of an articulated dumper truck. Excavated material will only be temporarily stored on slopes under 5° and to a maximum height of under 1.0m at the required setback from streams until they are transported to the selected deposition areas where they will be permanently stored.
IV. All excavations to be carried out will be battered back to a safe angle of repose (minimum slope angle of 45°) and comply with the final Construction and Environmental Management Plan (CEMP) to be produced by the appointed contractor for Carrownagowan Wind Farm.
V. Once a section of the excavated access road is exposed to formation; a layer of geogrid or geotextile material will be placed along its formation depending on ground conditions which will be covered with site won aggregate stone as required compacted in maximum 250mm layers.
VI. The stone aggregate required for the new access roads up to running surface level is proposed to be won from three on-site borrow pits within the wind farm site. The extraction of stone aggregate from the proposed borrow pits will be undertaken by 30-60 Ton 360° excavators and loaded onto articulated dumper trucks that will deliver the stone aggregate to the required excavated access road locations.
VII. The stone will be delivered to the required work area and spread out locally with the use of excavators and compacted with the use of a roller which will roll the stone aggregate in maximum 250mm layers on top of the geogrid / geotextile material in order to achieve the required design strength.
VIII. All new excavated access roads will be constructed to a minimum drivable width of 5.0m with a maximum crossfall of 2.5% in order that water can flow off the roads and reduce the risk of rutting / potholes occurring.
IX. Roadside drains as outlined in the Surface Water Management Plan will be constructed to manage clean and dirty water runoff along excavated access roads.
X. The final running surface of the new excavated access roads will be capped with a minimum 150mm layer of hard wearing Class 6F stone or similar using a road grader. This will be imported or can be generated from the borrow pit if the rock proves suitable.
XI. Any surplus spoil material generated from the excavated access road works will be transported back to the borrow pits to aid final reinstatement. Excavated topsoil and subsoil will be kept separate at the excavation and storage areas.

XII. Where drop offs greater than 1.0m in height occur alongside road edges; physical edge protection will be constructed in order to reduce the risk of vehicles overturning. Roadside marker posts will also be erected to delineate road edges in poor weather.

XIII. The appointed contractor will ensure that on site personnel are aware of environmental constraints / sensitive areas within the wind farm site in which works are to be avoided.

Figure 2 – Typical new excavated road on a wind farm

5.3 Borrow Pits / Permanent Deposition Areas

There are three borrow pits proposed within the site which will be used to obtain approximately 126,627m³ of site won stone aggregate. One borrow pit will be located close to each of the three main clusters of turbines where they will be used as sources of hardcore for the construction of infrastructure and construction compounds.

Prior to the stripping of peat overburden over the area of the proposed borrow pits; an interceptor drain will first be excavated upslope in order to intercept existing overland flows and divert them around the borrow pits prior to discharge via a buffer zone on the downslope side. The shallow peat overburden will then be stripped and temporarily stockpiled, vegetated side upwards adjacent to the borrow-pit in order for it to be re-used in its reinstatement on completion. Any subsoil material overlying the rock will then be excavated and stockpiled separately from the peat. The stockpile will be sealed and a perimeter drain installed to intercept any run-off so that it can be discharged through an appropriately designed silt trap.

Standing water and any surface water runoff from the borrow pits is likely to contain an increased concentration of suspended solids. Runoff from the borrow pits will be isolated from the clean catchment runoff by means of a series of open drains that will be constructed within the area. These drains will be of check dams that will attenuate the flow and provide storage for the increased runoff from exceptional rainfall events. The settlement ponds have been designed to a modular size where if larger areas of runoff have to be catered for at a single discharge point the size of the settlement pond will be increased pro rata.

Inspections of the borrow pits will be made by a geotechnical engineer through regular monitoring of the opening works. The appointed contractor will review work practices at the borrow pits where periods of heavy rainfall are expected where work will be stopped so as to stop excessive runoff from being generated. Excavators will extract the stone using buckets and a ripper attachment or rock-breaker attachments may be utilised in the borrow pit locations Depending on the rock quality, a geotechnical Engineer may recommend blasting instead of breaking. It is expected that 30-60 Ton 360° excavators will be utilised in tandem in the extraction of rock from the borrow pits. The larger excavators will extract rock from the face and floor of the excavation using digging buckets and rock rippers and will be assisted by smaller excavators, removing rock as it is broken, stockpiling locally within the excavation as well as loading articulated dumper trucks removing rock as required for distribution within the wind farm site. The sides of the excavations will be battered back to a suitable angle of repose to be determined by the nature of the rock present. Regular examination of these batters will be carried out by a geotechnical engineer to ensure that there is no risk of collapse. There will be no public access permitted to or within the borrow pits. Secure edge protection and fencing will be erected around the borrow pits with warning signage erected. A berm will be constructed as required, at the leading edge to ensure that articulated dumper trucks are stopped at a safe distance from the edge of the borrow pit during loading of extracted stone aggregate.

On completion of extraction activities in any cell at the borrow pits; the pits will be used for the permanent storage of the excavated peat and spoil material from the turbine bases, crane hardstands and internal access road construction. The proposed 3 no. deposition areas will be subdivided into a series of cells. Each cell will be bunded by an embankment of engineered fill material capable of allowing a tracked excavator to move between the cells during deposition activities. The size of each

cell will be dictated by the maximum working length of the excavators working the borrow pits. Each cell will be bunded on all downslope sides. The bund will be of adequate strength to retain the spoil stored within each cell. Water build up within the disposal areas will not be permitted. Water will free drain to the sump of the pit from where it will be discharged utilising a 6" pump discharging to a settlement pond constructed for this purpose. Permanent design features are proposed to allow drainage function correctly over the deposition areas.

Upon completion of each cell the surface of the deposited spoil will be profiled to a gradient not exceeding 5% and vegetated with either harvested turves where available or allowed to vegetate naturally as indicated by the project ecologist. Each cell will be lined at the base with glacial spoil followed by basal (*catotelm*) peat, followed by transport of upper peat turves. The peat deposition areas will need to be completed and restored in a continuous cycle so as to minimise the length of time the peat turves is stored and to allow the vegetation to be re-established as quickly as possible. It is important that *acrotelm,* where identified, is handled carefully and that it is not allowed to dry out while it is being stored. Regular watering may be necessary during dry weather periods. Where basal peat is left exposed for extended periods prior to topping off with vegetative layers, the surface will be smoothened off or 'bladed off' to reduce the surface area and minimise desiccation. Continuous monitoring of the deposition areas will be required throughout construction but particularly during wet weather or snowmelt to identify any early signs of peat instability.

It has been calculated that there will be approximately 280,550m^3 of material excavated during the construction of Carrownagowan Wind Farm. Of this, an estimated 140,775m^3 will be peat and 139,775m^3 will be spoil. Excavated peat, estimated at 68,370m^3, and spoil, estimated at 19,894m^3 will be reused for the backfilling, landscaping and restoration around wind farm infrastructure such as turbines and hardstands. Peat will be deposited only within the buildable areas around the turbines to a maximum height of 0.3m and will not impact on any of the constrained areas as defined at the preliminary stages of the design process. Berms will be formed along sections of floated access roads in order to store an additional volume of 9,713m³ of excavated peat. These berms will also act as a physical edge protection measure to prevent vehicles falling off the raised floated road edge. This form of storage will be provided on both sides of the internal floated roads where the overall dimensions of the berms will be 1m high by 2.5m wide.

The remainder of the surplus excavated peat and spoil material, estimated at 114,083m^3 will be stored within the 3 no. deposition areas at the proposed onsite borrow pits. Additionally storage will be provided for peat that is stripped at the borrow pit locations and any remaining peat which cannot be stored within the borrow pit areas.

The quantity of peat and spoil material, requiring management on site has been calculated as shown in Table 1 below.

Development Type	Approx. Peat Excavation Volume (m^3)	Approx. Subsoil Excavation Volume (m^3)
19. no Turbine Base and Hardstand Areas	63,964	59,755
Substation Compound	2,108	38,296
2 no. Site Construction Compounds	1,670	9,231
Access Roads	72,996	32,243
Permanent Meteorological Mast Hardstand	37	250
Total	**140,775**	**139,775**
Total Peat and Spoil to be Managed	**280,550**	

Table 1 Peat and spoil excavation volumes

A summary of the peat and spoil storage volumes are shown in Table 2. Note a conservative assumption based on the site investigations has been made that up to 50% of the total spoil material excavated on site (68,490m^3) will be reusable as site won stone aggregate and therefore will not require storage.

Peat and Spoil Storage Area	Approx. Volume (m^3)
Backfilling, landscaping and restoration around Turbine Bases and Hardstands	88,264
Roadside Berms along Internal Floated Access Roads (at 1m height)	9,713
3 no. Deposition Areas at Borrow Pit Locations	114,083
Total	**212,060**

Table 2 Peat and spoil storage volumes

5.4 Temporary Spoil Storage Areas

Temporary storage of spoil may be required on a turbine by turbine basis. Such areas will be managed by a suitably qualified and experienced environmental professional or the site geotechnical engineer. Under such circumstances it will not be permitted to store material on active peat or on peat with a depth of greater than 0.5m. Temporary stockpile heights on site will be limited to <1m and a safe batter angle.

5.5 Peat Stability Monitoring

Sightline Monitoring, as described in Section 4.7, is the most effective method for peat stability monitoring at Carrownagowan Wind Farm. Monitoring by sightlines entails driving a series of posts at approx 5m centres, exactly aligned, across the section of bog being monitored. Signs of distress or deformation in the bog will quickly manifest itself by some of the posts moving out of alignment. Early discovery of stress in the peat will give the developer a chance to implement emergency procedures to prevent the onset of a bog burst or localised peat slide. The precautionary principle dictates that

monitoring posts will be installed in work areas where peat has been deposited or currently in-situ at gradients greater than 10%.

The geotechnical engineer for the project should impart the philosophy that everyone on the site should be aware of peat stability and report any sign of misalignment in monitoring posts. Vigilance is a fundamental requirement when working on peat where inappropriate construction methodology can cause instability in otherwise benign conditions. This will be highlighted to all Carrownagowan Wind Farm staff in the form of toolbox talks.

The methodology of all civil works will be reviewed by the geotechnical engineer and the monitoring posts will be the subject of a dedicated inspection on a weekly basis by the site geotechnical engineer and / or the environmental manager. Monitoring frequencies may be changed depending on the sensitivities of particular areas of the site.

5.6 Role of Environmental Manager

An environmental manager will be appointed for the construction phase of the development. As part of this role the environmental manager will conduct the following works in relation to surplus spoil management:

- Mark ecological constraints on the working areas and route corridors, in consultation with the Geotechnical/Civil Designer as necessary,
- Agree proposals for temporarily side casting and temporary storage areas as development proceeds,
- Agree methodology for stripping existing vegetation and locations where material is to be deposited,
- Agree timing of restoration and reinstatement of access track sides,
- Monitor excess peat receptor areas along existing face banks once peat is placed in-situ,
- Monitor the condition of stored turves and determining watering requirements,
- Issue instruction to cease work if unexpected risks arise, until an agreed alternative solution is identified, and risks are avoided or minimised.