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Peat and Spoil Management Plan for Carrig Renewables Wind Farm

MKO

Client	**MKO**
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DISCLAIMER

REVISION SUMMARY

Rev	Date	Section(s)	Detail of Change
00	29/05/2023	All	First Issue
01	10/07/2023	All	Updated for client comments
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Executive Summary

Gavin and Doherty Geosolutions Limited (GDG) was commissioned by McCarthy Keville O'Sullivan (MKO) to undertake a Peat and Spoil Management Plan (PSMP) for the proposed Carrig Renewables Wind Farm. In accordance with planning guidelines compiled by the Department of the Environment, Heritage and Local Government (DoEHLG), where peat is present on a proposed wind farm development, a peat and spoil management plan is required.

This report provides details on the approximate predicted volumes of peat and spoil to be excavated during construction, the characteristics and types of peat to be excavated, construction methodologies to reduce the volumes of peat and spoil to be excavated, and the guidelines for how and where this excavated peat will be placed, reused and managed. This peat and spoil management plan will be further developed and implemented subsequent to the Proposed Development receiving consent. Further details and specific plans are to be determined during the detailed design phase and once further confirmatory site investigations have been undertaken. These details will then be included in a detailed peat and spoil management plan as part of the detailed Construction Environment Management Plan (CEMP). The responsibility for the implementation of the PSMP will lie with the Principal Contractor. Observations from site investigations indicate that a large proportion of the site consists of cut-over Raised Peat. Peat is found across the site, aside from small areas at the far eastern, southern and western site boundaries. Recorded peat thicknesses range from 0-4.5m across the site, with an average thickness of 1.6m recorded. In total, 40.8% of recorded peat thicknesses were under 1m, and 78.2% were under 2m. Areas of deep peat of >2m in thickness have been recorded near T01, T02, T06, northeast of T03, and between T05 and the proposed construction compound. Areas of thick peat have generally been avoided during the design phase.

Existing roads will need to be upgraded and new access roads will need to be constructed at the proposed Carrig Renewables Wind Farm. The preliminary outline of road construction types and construction methodologies have been defined, along with methodologies for constructing turbine bases, hardstandings and other infrastructure foundations.

Preliminary volumes for the peat and spoil generated during construction are presented, along with guidelines for handling and storing excavated peat and recommendations for good construction practices. Eight peat and spoil repository areas have been identified, providing sufficient capacity to store all peat and spoil generated during construction.

The findings of the peat and spoil assessment show that all of the peat and spoil material excavated can be re-used or stored safely on-site during construction.

1 INTRODUCTION

Gavin and Doherty Geosolutions (GDG) was requested by McCarthy Keville O'Sullivan (MKO) to prepare a Peat and Spoil Management Plan (PSMP) as part of an application for planning permission for the proposed Carrig Renewables Wind Farm in Co. Tipperary. Based on the available information, the Proposed Development is underlain by peat. The Proposed Development and peat depth plan is presented in Appendix A.

Gavin & Doherty Geosolutions Ltd. (GDG) is a specialist geotechnical and marine civil design consultancy, providing innovative engineering solutions to a broad infrastructure problem. Established in 2010, GDG has since grown to more than 200 people. Our aim is to provide an innovative, cost effective and reliable service tailored to meet and exceed our clients' requirements. We strive to attain the highest possible standards and are consistently looking to pioneer and develop new technologies and techniques while ensuring that all relevant design codes and practices are met.

GDG brings together state of the art research and direct industry experience and offers a bespoke engineering service, delivering the most progressive, reliable, and efficient designs across a wide variety of projects and technical areas, including offering forensic engineering and expert witness services to the Insurance and Legal sectors. Our clients include large civil engineering contractors, renewable energy developers, semi-state bodies and engineering and environmental consulting firms.

GDG has been involved in many wind farm developments in both Ireland and the UK at various stages of development, i.e. preliminary feasibility, planning, peat stability assessment, design and construction. The GDG team of engineering geologists, geomorphologists, geotechnical engineers and environmental scientists has developed expertise in the design and construction of developments in peat areas.

This Report was written by Paul Quigley (GDG Director, BE (Hons) Civil Engineering) and Chris Engleman (GDG Graduate Geologist, MGeol Geological Sciences). Paul is a GDG Director and has twenty-five years' experience in civil engineering and ground engineering. Chris is a Graduate Geologist with GDG and has 4 years' experience in geotechnical engineering and geology.

This PSMP has been prepared in accordance with industry best practices relating to wind farm construction and peatlands. This best practice includes:

- Wind Energy Development Guidelines. Department of Housing, Planning and Local Government (2006);
- Draft Revised Wind Energy Development Guidelines. Department of Housing, Planning and Local Government (2019);
- Good practice during wind farm construction. A joint publication by Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency, Forestry Commission Scotland (2015);

- Scottish Government, Guidance on Developments on Peatland – Site Surveys (2017);
- Guidance on the Assessment of Peat Volumes, Re-use of Excavated Peat and the Minimisation of Waste, Scottish Renewables and SEPA (2012); and
- Floating Roads on Peat, Scottish Natural Heritage (2011).

Many of the publications listed above have been developed by the Scottish Regulators, which are considered best practice in Ireland and are therefore appropriate for refer to within this PSMP.

This PSMP and compliance with it shall not relieve the developer of its obligations to undertake confirmatory ground investigations or geotechnical design before construction or any obligations relating to other aspects of the environment.

1.1 Proposed Development

The proposed Carrig Wind Farm is located in Co. Tipperary, approximately 6km southwest of Birr, Co. Offaly and 2km west of Carrig, Co. Tipperary. It encompasses all or part of the townlands of Lissernane, Sharragh, Arragh More, Faddan More, Arragh Beg, Coolderry and Cloncorig. The EIAR site boundary encompasses and area approximately 544 hectares in size. The site can be accessed via the N52 national road and L5040 and L5041 local roads. A detailed map of the proposed site's administrative locations is provided in Figure A-1- 1 in Appendix A.

The Proposed Development infrastructure will comprise the following:

- Construction of seven wind turbines and associated hardstand areas with the following parameters:
    - a total tip height of 185m;
    - hub height 104m; and
    - rotor diameter of 162m.
    - Each turbine will be capable of generating 6.2MW, with an overall installed capacity of 43.4MW;
- One 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, battery energy storage system, security fencing, all associated underground cabling, wastewater holding tank and all ancillary works;
- 1no. meteorological mast with a height of 104 metres, and associated foundation and hard-standing area;
- All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;
- All works associated with the connection of the proposed wind farm to the national electricity grid via underground cabling to the existing Dallow substation;
- Upgrade of existing tracks and roads, provision of a new site access roads and hardstand areas;
- All works associated with the provision of a new site entrance from the L5040 local road;
- Four peat repository areas and three spoil repository areas;
- Two temporary construction compounds;
- Junction accommodation works to facilitate turbine delivery ;

- Spoil Management;
- Site Drainage;
- Tree Felling;
- Operational stage site signage; and
- All ancillary works and apparatus.

Refer to Chapter 4 of the EIAR for a detailed description of the Proposed Development.

This report examines the peat and spoil management details at the Proposed Development Site, located within the red line boundary as defined in Chapter 4 of the EIAR. The "Proposed Development Site" or "Site" in this report refers to the access road and main Development Area within the EIAR Site Boundary as defined in Chapter 4 of the EIAR.

1.2 Scope of Report

This report contains the following:

- A summary of proposed construction activities on-site;
- A review of peat conditions on-site;
- Road construction types;
    - Methodologies for the construction of each type of access road and road construction details;
- Methodologies for the excavation of turbine bases, hardstands and compounds,
- Summary of peat and spoil repository areas and typical detail drawings;
- Guidelines for handling and storing of excavated peat; and
- Recommendations for good construction practice.

1.3 Summary of Construction Activities

For the construction phase, the activities that are considered likely to generate peat and spoil are as follows:

1. The upgrade and widening of existing founded access roads. We note that widening of existing floated access roads does not require peat excavation. A plan showing the different road construction methods may be found in Figure A-1- 2 in Appendix A.
2. The construction of new founded roads. We note that floating road construction does not require peat excavation. A plan showing the different road construction methods may be found in Figure A-1- 2 in Appendix A.
3. Excavations for turbine bases, hardstands, construction compounds, met mast and substation (including battery storage facility). We note that floated sections associated with the turbine hardstands do not require peat excavation.

1.4 General Principles of Peat and Spoil Management

The general purpose of the Peat and Spoil Management Plan (PSMP) is to outline the safety methodologies of construction, outlining the safety steps required for the safe handling and management of peat and spoil. The methods outlined in the report aim to:

- Reduce the exposure of bare or excavated peat and spoil material,
- Reduce the potential for the release of sediment into watercourses or groundwater,
- Ensure that the Proposed Development does not adversely impact the landscape and environment,
- Ensure good site management practices are followed throughout the Proposed Development's construction, operation, and decommissioning phases.

All peat and spoil excavation, placement, and reinstatement, both temporary and permanent, will consider the risks identified and mitigate them.

Placement or any reinstatement of landscaped peat or spoil material will be carried out in a fashion which ties in with the existing natural topography.

All reinstatement works will be carried out considering potential peat instability having completed a diligent design, considering the findings of the associated Peat Stability Risk Assessment Report (GDG, 2023). Works will be carried out under the supervision of an appropriately experienced geotechnical engineer and Ecological Clerk of Works (ECoW).

2 PEAT CONDITIONS AND STABILITY

2.1 PEAT CONDITIONS

In respect of developments on peatlands, the Scottish Government provides guidance as to the definition of peat in their Peat Survey Guidance document:

"the Joint Nature Conservation Committee (JNCC) Report 445, Towards an Assessment of the State of UK Peatlands, definitions are used:

- Peaty (or organo-mineral) soil: a soil with a surface organic layer less than 0.5m deep;
- Peat: a soil with a surface organic layer greater than 0.5m deep, which has an organic matter content of more than 60%;
- Deep peat: a peat soil with a surface organic layer greater than 1.0m deep."

For the purposes of this report, peat is considered with respect to the two principal types:

- Acrotelm: This upper layer comprises poorly decomposed plant material and living vegetation. It is relatively dry with some tensile strength affording it limited structural properties. For peat classification of peat in this report, the Acrotelm layer will be considered to be inclusive of 'peaty soil'. Acrotelm is visible in the upper part of the peat cutting in Figure 2-3
- Catotelm: This lower layer is formed by highly decomposed humified peat decaying at a rate of several orders of magnitude slower than the acrotelm. The slow peat formation as this catotelm layer grows represents an important sink for atmospheric CO^2. The structural integrity of this layer is particularly vulnerable to excavation and handling as it tends to disrupt completely on excavation. For classification of peat in this report the Catotelm layer will be considered to be inclusive of 'peat' and 'deep peat' soils. Catotelm is visible in the lower part of the peat cutting shown in Figure 2-3.

2.2 GROUND INVESTIGATIONS AND ENCOUNTERED PEAT THICKNESSES

GDG visited the site on four occasions between July 2022 and March 2023 to conduct site walkovers, peat probing and trial pitting.

The ground investigation (GI) works carried out specifically for this development were carried out between June 2022 and March 2023 and consisted of the following:

1. MKO (June 2022): 67 peat probes.
2. GDG (July 2022): 36 peat probes and 6 hand shear vanes.
3. GDG (August 2022): 25 peat probes.
4. GDG (November 2022): 9 trial pits.
5. MKO (February 2023): 34 peat probes
6. GDG (March 2023): 27 peat probes and 6 trial pits.

In summary, intrusive ground investigations were carried out at 210 locations.

The findings of these ground investigations are summarised in the GDG Peat Stability Risk Assessment (PSRA) report, Ref:22063-PRSA-001.

The ground investigations indicate that the ground conditions at the site comprise predominantly of areas of cut-over raised peat of up to 4.5m in depth, with areas of glacial till to the south, east and west of the site. Trial pit locations suggest that the peat material is sometimes underlain by granular or cohesive glacial material or weathered rock, or by soft lacustrine silt, or directly on limestone bedrock.

Peat thickness encountered by intrusive investigations across the site varies from 0m to a maximum of 4.5m, with an average of 1.68m recorded. The frequency of different peat thicknesses are shown in Figure 2-1. In total, 40.8% of recorded peat thicknesses were under 1m, and 78.2% were under 2m. Laterally extensive regions of >2m in depth were encountered, particularly in the vicinity of T01, T02, T06, northeast of T03, and between T05 and the proposed construction compound. The depths encountered are considered moderate to deep in places: with probes identifying peat thicknesses of up to 4.5m.

The walkover indicated that the peat is being cut in several areas and has drained significantly, with the observed peat classified as the catotelm. The surface condition of the peat can be described as being varied, with some areas having bare peat at the surface where cutting is active, and other areas are vegetated with grass/rushes or forestry, as shown in Figure 2-2 and Figure 2-3.

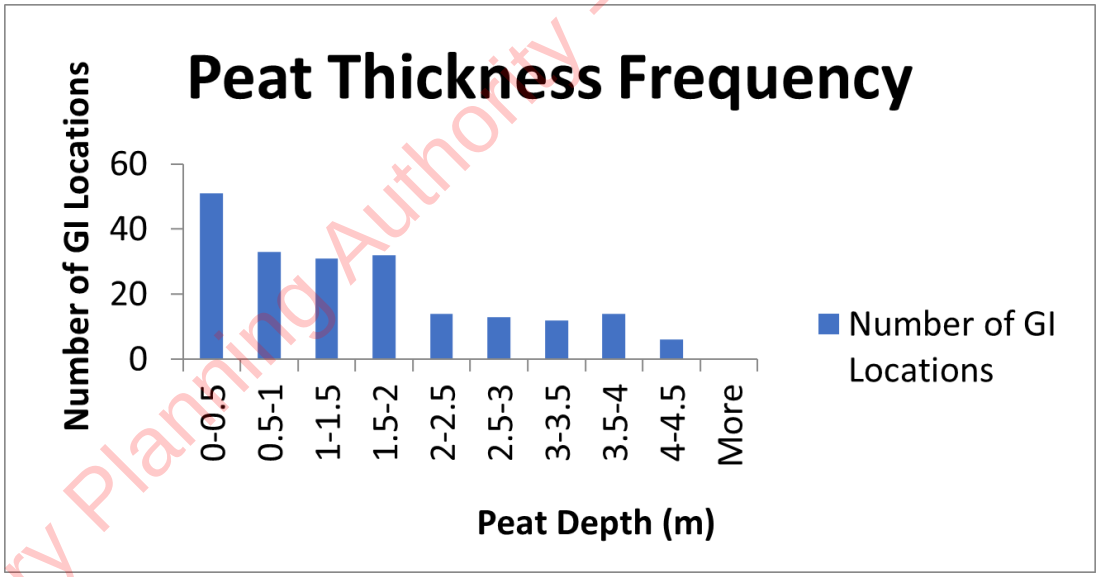

Figure 2-1: Histogram of peat probe thickness results across the site.

Figure 2-2: Photo of TP06 through peat and underlying cohesive glacial till close to the Turbine 5 foundation location.

Figure 2-3: Photo showing the cut-over peat and an active peat cut close to T03.

It is noted that data obtained through peat probing cannot be utilised in classifying the peat material, given that peat probing does not fully distinguish between the different types of peat material and between peat and other soft ground. It is considered that the sampling records from the trial pits provide the most accurate representation of peat depths across the site. However, it is considered that the peat probing data generally compares well with trial pitting data, and so all available data types: peat probe, shear vane and trial pit locations, have been used in the peat thickness assessment. The peat thickness plan of an area of the proposed wind farm area is shown in Figure 2-4; the interpolated peat depth plan is shown in more detail in Figure A-2- 1 and Figure A-2-2 in Appendix A.

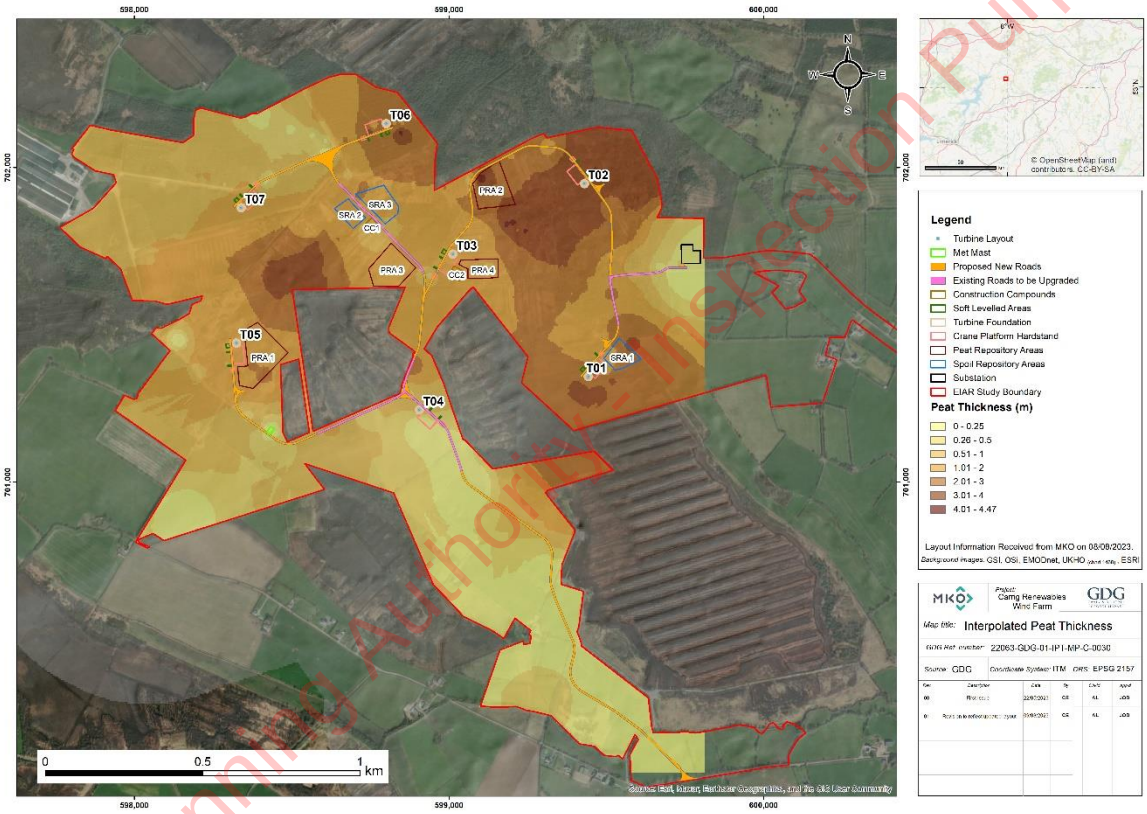

Figure 2-4: Interpolated peat thickness plan of the main site area.

The characteristics and interpreted engineering parameters of the peat material across the site are summarised in Peat Stability Risk Assessment (PSRA) Report (GDG, 2023).

The composition of the peat is described in the trial pit locations (see logs in Appendix D) using the Von Post classification system (Hobbs, 1986), as outlined in the Scottish executive Guidance (2017) suggesting a large level of variation in the peat body across the site, with no typical trend or succession in the peat layering. The peat is predominantly described as fibrous to pseudo-fibrous with varying conditions between firm, spongy and plastic. The degree of humification in the peat was examined in the trial pit locations. The Von Post rating is a numerical rating outlining the level of decomposition in the peat ranging from H1 – no decomposition to H10 – completely decomposed.

The degree of humification identified at the location of the Proposed Development range between H3 and H8, generally increasing with depth with a degree of humification in excess of H7 identified in areas where peat is in excess of 1m. The level of decomposition of peat has an impact on the undrained shear strength of the peat, which in turn has an impact on peat stability, with higher decomposition ratings associated with lower undrained shear strength values.

Considering the variation identified in the peat and the lack of a characteristic trend in the behavioural characteristics in the peat body, it is difficult to quantify the acrotelmic and catotelmic material of the peat body. This quantification is further complicated as many of the proposed development areas have been subject to peat harvesting, likely removing the upper layers of acrotelm. An assumption of generic characteristics is considered appropriate in anticipating the suitability of the peat for areas where minor re-use of peat for landscaping is anticipated. Based on site observations during site walkovers and trial pitting, the acrotelm appears to be approximately 0.3m in thickness (inclusive of 'peaty soils') in locations where peat has not been cut-away (T01 and T02). In the remaining locations where peat has been cut, the peat material should be classed as catotelm. Approximately 64% of ground investigation locations indicate a peat thickness greater than 1m. These would be the best indicator of where the above 'deep peat' classification may be present.

Several relatively deep pockets of wet and marshy peat were identified during the site walkovers, particularly near T02 and T06. These areas are generally in areas of flat topography, and as a result, they are believed not to pose an instability risk (see Peat Stability Risk Assessment: GDG, 2023). Regardless of the low risk of peat instability across the site, caution needs to be taken when excavating and transporting this peat as it will be easily disturbed and liquified.

At T06, a trial pit (TP05) identified a minimum of 1.3m of very soft, wet, lacustrine silt beneath 1.3m of peat. This material should be treated similarly to the peat during excavation, with increased precautions, as this material will be easily disturbed and liquefied.

At the remainder of the trial pit locations, non-peat material was characterised by cohesive glacial till. This material has been considered unsuitable for use as fill on-site; however, this has been considered suitable for the construction of safety berms (a linear earthwork located on the bank of a traffic way to prevent a vehicle from overturning or endangering persons in the vehicle). Any remaining non-peat material excavated, which is not used in the construction of safety berms, will require placement on site.

A detailed breakdown of the site observation at each turbine can be found in Peat Stability Risk Assessment (GDG, 2023).

2.3 PEAT STABILITY RISK ASSESSMENT

A Peat Stability Risk Assessment (PSRA; GDG, 2023) has been carried out, taking into account available desk study information and a semi-automated approach which combines the developed polygon areas of the Scottish Executive (2017) factor of safety (FoS) results, areas of risk identified during the site walkovers and potential risk areas identified from the examination of peat depths and site topography.

This report concluded that the overall risk of peat instability across the entire site, including the permanent development footprint was low, with only very limited areas, which do not interact with the proposed permanent development, indicating a FoS of <1.3, and only extremely limited areas at localised turf banks indicated a FoS of <1.

A detailed Peat Stability Risk Assessment was carried out at each permanent infrastructure location to produce a risk rating in accordance with the Scottish Guidance (2017). This concluded that for each element of the proposed permanent development footprint, the risk of peat landslides is negligible: project should proceed with monitoring and mitigation of peat landslide hazards as appropriate, in accordance with the Scottish Guidance (2017).

The PSRA identified some limited, specific areas of potential peat instability (defined as areas with FoS < 1.3), which have been identified as safety buffer areas, as outlined in Section 2.4. These areas do not interact with the proposed permanent development footprint.

2.4 SAFETY BUFFER AREAS

Particular restricted areas have been identified as part of the Peat Stability Risk Assessment (GDG, 2023) referred to as 'Safety Buffer Areas' and are presented in Appendix A.

Safety buffer areas shall be restricted for construction and will not be used for placement of peat or any overburden materials.

As outlined in the Peat Stability Risk Assessment (GDG, 2023), the development of the safety zones is a semi-automated approach which combines the developed polygon areas of the Scottish Executive (2017) factor of safety (FoS) results, areas of risk identified during the site walkovers and potential risk areas identified from the examination of peat depths and site topography. Safety Buffer Areas are outlined in Figure A-3- 1, and Figure A-3- 2 in Appendix A. Areas included in the safety buffer zone include all areas indicative as having a FoS < 1.3 in the worst-case surcharged condition with 10kPa.

The proposed development footprint and the derived safety buffer areas do not overlap, as construction is not required as part of the proposed development the safety buffer areas must be treated as peat placement and plant restriction areas and construction activities must not be carried out here without further assessment.

3 ROAD CONSTRUCTION TYPES

Existing roads will need to be upgraded and new access roads will need to be constructed at the proposed Carrig Wind Farm. The following factors are considered in the preliminary proposals for road construction types:

- Constructability;
- Serviceability requirements for construction and wind turbine delivery and maintenance vehicles;
- Peat depth;
- Horizontal longitudinal and cross-fall gradient of the roads;
- Minimisation of excavation arisings; and
- The requirement to minimise disruption to peat hydrology.

The above key principles are used to determine the road type and will be finalised with regard to the prevailing ground conditions encountered during the confirmatory site investigation stages.

Floating roads minimise the impact on the peat, particularly peat hydrology. As there is no excavation required no peat arisings are generated. However, a founded-type access road is more suitable if the underlying peat has an insufficient bearing capacity or is due to topographic restrictions or stability concerns.

The preliminary road construction details proposed for the development are summarised below in Table 3-1. The details of the road construction types are included in Appendix B.

Table 3-1: Road construction types

Construction method	Appendix B Detail reference	Construction type
Construction of new roads	A	Founded
	B	Floating
Upgrade of existing access roads	C	Founded
	D	Floated

The design criteria for the suitability of floated access roads used for the Proposed Development Site align with the Scottish Executives Best Practice guidelines document. Some sections of the proposed access track is considered suitable for floated construction when the following criteria are met:

- Maximum slope in any direction is less than 5%,
- Peat depths are greater than 1m,
- The resulting drained and undrained slope stability assessment factor of safety results are greater than 1.3, without and with a 10kPa surcharge.

The main restricting criteria for floating roads at the Proposed Development site are the peat depth and slope angle, as many of the deep areas of peat are in short spans of access roadways, which can cause difficulties in creating adequate transition zones between founded and floated roads.

It is proposed that most of the roads (62%) will be a founded construction (Detail A in Appendix B) with some sections of floated road suggested where the gradient and stability analysis results will allow. A methodology and a detail are provided for upgrading the existing founded and floated access roads (Detail C and D in Appendix B), as the existing roads will be upgraded and widened at the site.

General construction methodologies are presented in the following sections. This methodology aims to minimise impacts on the stability of the peat. These proposed methodologies will be informed by detailed design following site investigation. The methodology is not intended to cover all aspects of construction, such as drainage and environmental considerations. Inspection and monitoring plans for each method will be implemented during construction to monitor peat stability.

3.1 Construction Methodology for New Roads

The general methodology to construct new founded roads (i.e. See Detail A of the road construction detail drawings in Appendix B) is presented below.

1. Excavation of the new access road to competent strata (see Section 6 for guidance on correctly handling and storing the different peat layers). Maximum excavation side slopes will be 1:1.5.
    a. Drainage shall be installed to divert surface and groundwater from the construction areas.
2. A layer of geogrid/geotextile may be required at the base of the excavation. To be confirmed at detailed design.
3. Placement of granular fill-in layers following the designer's specification. The fill thickness is 200mm above the existing ground level, in addition to the fill thickness required to backfill the excavation to a suitable competent strata below the existing ground level.
4. Access roads are to be finished with a granular running surface across the full width of the road.

The general methodology to construct new floating roads (i.e. See Detail B of the road construction detail drawings presented in Appendix B) is presented below.

1. Placement of a geotextile-geogrid composite layer directly onto the peat surface following the designer's specification.
2. Placement of granular fill up to 800mm and reinforcing geogrids in layers following the designer's specification, with due regard to any settlement and deformation of peat anticipated at the access track.
    a. Cross-drains shall be installed within the road to divert surface and groundwater from upslope to downslope.
    b. Stone delivered to the floating road construction area shall be end-tipped onto the constructed floating road in a manner that will avoid excessive impact loading on the peat due to concentrated end-tipping. Direct tipping of stone onto the peat shall not be carried out.

   c. Stone will be spread and placed from the constructed floating road onto the peat surface using a bulldozer.
3. Access roads are to be finished with a granular running surface across the full width of the road.

No excavations (e.g. drainage, peat cuttings) shall be carried out within 5m of a completed floated access road edge or at a distance determined following a site inspection by the Project Geotechnical Engineer.

The presence of excavations can destabilise the road. Where required, for example for the installation of internal cabling offset from the footprint of the floated road, temporary excavations will be excavated in short lengths and backfilled as soon as practicable. These works will be designed and supervised by Project Geotechnical Engineer.

Spoil materials can be used for landscaping along the edge of access road sections to aid with the restoration of the peatland areas and embed the access roads into the surrounding environment where slope and ground conditions allow, limiting their ecological and environmental impact. Consideration needs to be given to the placement of excavated materials in areas of potential instability or additional mitigation requirements, as highlighted in the PSRA (GDG, 2023). Where permissible, excavated materials will be placed to a maximum height of 1m and stockpile widths of a minimum of 2 to 3m unless site-specific detail designs allow larger volumes to be placed. Large stockpiles of materials shall not be placed on or adjacent to floated access roads to avoid bearing failure of the underlying peat.

Peat placement or landscaping will be carried out only in areas where it is topographically contained and does not create a propagated landslide risk – see PSRA (GDG, 2023).

For this development, particular buffer areas including construction buffers have been highlighted in the PSRA (GDG, 2023) and are presented in Appendix A.

3.2 Construction Methodology to Upgrade Existing Roads

The general methodology to upgrade existing founded roads (i.e. See Detail C of the road construction detail drawings presented in Appendix B) is presented below.

1. Excavation on one or both sides of the existing access road to competent strata.
2. Placement of granular fill up to 800m and reinforcing geogrids in layers following the designer's specification, with due regard to any settlement and deformation of peat anticipated at the access track.
3. Overlay of the existing access road with selected granular fill following the designer's specification.
   a. Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid will be placed on top of the existing floated access road.
4. Access roads will be finished with a granular running surface across the full width of the road.

    a. A layer of geogrid/geotextile may be required at the surface of the existing access road following the designer's specification.

The general methodology to upgrade existing floating roads (i.e. See Detail D of the road construction detail drawings presented in Appendix B) is presented below.

1. Tree brash and/or a geotextile is placed on one or both sides of the existing access road directly onto the peat surface, following the designer's specification.
2. Benching of existing road and placement of granular fill and reinforcing geogrids in layers following the designer's specification, with due regard to any settlement of peat anticipated for the widened area.
    a. It may be necessary to stage the widening to maintain peat stability – i.e. to reduce the rate of placement of fill to allow the peat layers to consolidate and increase in strength.
    b. It may be necessary to anchor the geogrids into the existing roads, requiring significant benching of existing roads.
3. Overlay of the existing access road with selected granular fill following the designer's specification.
    a. Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid will be placed on top of the existing floated access road.
    b. The surface of the existing access road will be graded/levelled before the placement of any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).
4. Access roads are to be finished with a layer of capping across the full width of the road.
    a. A layer of geogrid/geotextile may be required at the surface of the existing access road following the designer's specification.

Where there are cross slopes, any road widening works required will be carried out on the upslope side of the existing access road, where possible. Particular design details will be required at detailed design at the transitions between floating and founded roads to reduce differential settlements between the two construction types.

4 EXCAVATION OF TURBINE BASES, HARDSTANDINGS, AND INFRASTRUCTURE FOUNDATIONS

Assessment of the ground conditions encountered in the ground investigations has determined that the ground conditions at the site are generally flat cut over raised peat bog, with some areas of glacial till. The average peat thicknesses identified at the proposed turbine and hardstand areas are generally less than 2.5m, except for T01 and T02, where peat thicknesses are 3.4m and 3.7m respectively. Where peat is present, the material encountered beneath it is generally a layer of soft to firm cohesive glacial till, very soft lacustrine silt and/or limestone bedrock or weathered bedrock. Generally, for constructing any structure or platform foundation, such as a turbine base, hardstand or substation, removing all soft material is required to a depth where a suitable bearing material is encountered. Rock breaking is likely required at one of the turbines and hard-standing locations to create the reduced foundation level and the levelling required for construction. The material excavated is required to be properly managed and will be re-used in other elements of the proposed wind farm design.

During turbine construction, peat will be excavated to a competent stratum to make room for the concrete turbine foundation and a small working area surrounding the foundation footprint. Breaking and excavation of bedrock may be required where it is encountered at shallow depths to achieve the reduced foundation level and level surface required by design. Turbine bases of 25m in diameter are proposed, with detailed foundation design dictated by the local ground conditions and the requirements of the turbine supplier.

The design of the turbine base foundations is subject to confirmatory ground investigation and assessment.

Similarly, all turbine crane hardstands will be founded on a suitable bearing material requiring the excavation of all peat and other soft ground materials, where present. The platform will be constructed in the excavated area using a suitable specified engineered stone fill. MKO has provided the selected locations. Following the placement of the platform, the excavated peat can be re-used to batter the platform edges and landscape the platform back into the existing topography.

The mean peat depths collected from the ground investigations are used to calculate the estimated peat volumes at each structure foundation location. This is outlined further in Section 5.

5 PEAT AND SPOIL VOLUMES

The ground investigation and design layout drawings have been reviewed to inform this section of the PMSP. Peat volumes can be estimated based on the results of the intrusive investigations and the proposed design. Non-peat overburden (spoil) was identified in trial pit locations, namely cohesive glacial till material. Where this material has an insufficient bearing capacity, excavation has been recommended. It is expected that peat and spoil excavation will be required for the following elements of the proposed development:

1. Founded and upgraded access roads;
2. Turbine foundations and crane hardstandings;
3. Construction compounds;
4. Substation and;
5. Met Mast.

Cable trenches are not anticipated to be undertaken in peat. Spoil excavated in association with the cable trenches is often replaced at its point of origin and therefore is not considered a volume loss. No further assessment of cable trench volumes will be undertaken.

A preliminary estimate of the approximate volumes of excavation and fill needed to construct the development was carried out. This was produced using typical limits to road and hardstand gradients and road and hard-standing thickness typical to the wind farm ground conditions.

5.1 Peat and Spoil Excavation Volumes

The peat depths within the footprint of the Proposed Development were reviewed at each turbine location, crane hardstands, met mast, construction compounds, substation and access tracks. The average peat depths at each structure were incorporated into the model along with the turbine and hardstand layout, access roads alignment and other associated infrastructures to estimate the volume of peat expected to be excavated. A breakdown of the estimated peat excavation volumes is summarised in Table 5-1.

Table 5-1: Summary of preliminary excavation volumes

Infrastructure Item	Approximate Plan Area (m^2)	Average Peat depth (m)	Excavated peat volume (m^3)	Excavated spoil volume (m^3)
New Access Roads (founded)	18,800	0.3	21,680	0
Upgraded Access Road (founded)	6,000			
Turbine foundations	3,500	1.9	13,810	8,500
Crane Hardstandings	15,500	1.8	33,700	13,160
Substation	3,100	0	0	1,410
Construction Compound	2,532	1.2	3,520	0
Met Mast	300	0	0	2780
Total			**72,710**	**25,850**

* The volume of peat material excavated has been estimated using the average peat depth calculated across the footprint of the structure to define the basal surface of the peat.

5.2 Peat Reinstatement Volumes

Peat generated during construction can be re-used or reinstated across the development. Peat may be re-used for landscaping on edges of constructed infrastructure (including road verges, around hardstand area and turbine foundations) and shall be placed as soon as reasonably practical after

construction. This shall act as part of the landscaping restoration and tie-in with surrounding topography, reducing visual impacts and restoring the existing habitat.

Several considerations have been made in the estimation of reinstatement volumes:

- A conservative reinstatement volume of 20% of the total peat excavation has been considered available for side casting and re-use across the site.
- A conservative estimate of 10% of the total spoil volumes has been considered as available for re-use in the construction of safety berms across the site.
- Four Peat Repository Areas and three Spoil Repository Areas have been identified for the permanent placement of peat and spoil material.

Potential peat re-use/reinstatement volumes have been estimated and are also presented in Table 5-2 and Table 5-3.

Table 5-2: Summary of preliminary peat reinstatement volumes

Comment	Peat Reinstatement volume (m^3)
20% Reinstatement of Total Volume	13,590
Peat Stockpile Areas	61,010
Total	**74,600**

Table 5-3: Summary of preliminary spoil reinstatement volumes

Comment	Spoil Reinstatement volume (m^3)
10% Reinstatement of Total Volume	2,120
Spoil Stockpile Areas	24,740
Total	**26,860**

The volumes quoted in Table 5-2 and Table 5-3 reflect normal earthworks practice where volumes of cut and fill are evaluated on a 1m^3 cut to 1 m^3 filled basis. It is acknowledged that bulking can occur where placed soils occupy a greater volume due to a reduction in density. For the cohesive spoil material it is considered that bulking will be offset to a considerable degree by the compaction of soils during placement and subsequent settlement to achieve the volumes outlined. Peat has a high-water content, high compressibility and low strength meaning it can remould and therefore bulking is negligible and has not been considered for the purposes of this report.

A preliminary assessment has been undertaken to assess the placement and reinstatement of peat and spoil material. The preliminary assessment indicates that stability is acceptable. A detailed assessment will need to be undertaken as part of the detail design when locations are confirmed and additional GI information becomes available.

A confirmatory construction stage peat stability risk assessment will be conducted by the Contractor to investigate the peat stability and landslide risks arising from variations to the layout which may occur during the detail design and/or construction stage.

The excavated non-peat overburden material has been considered unsuitable for re-use as fill, as it consists largely of cohesive glacial till. This is based on information from trial pits undertaken to

date. It is recommended that this be reassessed as part of detailed design, when additional GI becomes available.

5.3 PEAT AND SPOIL BALANCE

The volume balance of excavated and reinstated peat and spoil is outlined in Table 5-4. This table summarises the estimated volumes of peat and spoil excavation and the reinstatement volumes outlined in sections 5.1 and 5.2.

Table 5-4: Peat and spoil balance assessment

ITEM	SUPPLY	DEMAND	BALANCE
	Excavation Volume (m^3)	Reinstatement Requirement (m^3)	Surplus (+) or Deficit (-) (m^3)
Peat Balance	72,710	74,600	-1,890
Spoil Balance	25,850	26,860	-1,010
TOTAL	**98,560**	**101,460**	**-2,900**

The preliminary earthwork volume summary indicates that the development's peat and spoil placement capacity, provided once the peat repository areas are reinstated, is greater than the volume of peat excavated for the various infrastructures.

6 HANDLING AND PLACING EXCAVATED PEAT AND SPOIL

Inappropriate management of excavated peat and spoil and uncontrolled loading of peat material are considered one of the leading causes of peat instability and landslide event triggers during the wind farm construction process. Managing and controlling these activities is key to de-risking peat stability at the wind farm site.

The following outlines guidelines for the careful handling and management of peat at the site:

- Care shall be taken during peat excavation to ensure it is segregated from other soil types; therefore, particular care will be taken to review recorded peat depths.
- Peat shall be separated and stored by type, namely the acrotelmic and catotelmic layers.
    - Acrotelm (defined in section 2.2) is generally required for landscaping and shall be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping shall be undertaken before the main excavations.
    - Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage the growth of plants and vegetation.
    - All catotelm peat (defined in section 2.2) shall be transported immediately on excavation to the designated peat repository areas,
    - The careful handling and segregation of peat types will help to optimise the re-use of peat, aiding in the retention of structure and integrity of the excavated peat material.
- Peat and spoil shall be separated and stored separately, in designated peat and spoil repository areas.
- Depending on what vegetation is found on site, more fibrous material may be placed on steeper angles. Unconsolidated peat, generally comprising of catotelmic material, is often not suitable for general dressing, and any unconsolidated peat excavated must only be used for reinstatement where such re-use poses no risk of polluting water courses and evidence can be provided that the required water table at the chosen location can be maintained.
- Construction sequence planning shall minimise the time peat is stockpiled before re-use; however, some temporary peat placement may be required to manage spoil and separate spoil horizons before it can be placed in its reinstatement location. The principles on which the temporary placement of excavated peat will be based upon the placement and handling methodologies set out within this section. Temporary placement must be safe as it protects the structure and integrity of the excavated peat subject to prevailing local conditions. Reinstatement of peat and peat turves will be completed during the Construction Phase at the earliest possible opportunity to avoid prolonged placement.
- Any temporary placement locations must be in suitably wet conditions or be irrigated to prevent the peat from desiccating, and precautions will be taken to ensure that turves are not allowed to dry out before reinstatement. The condition of turves will be monitored throughout the duration of placement. Irrigation of peat turves will be agreed upon in advance with the Ecological Clerk of Works (ECoW). Should wetting of turves be required to

prevent desiccation, mitigation will be adopted to prevent runoff or discharge to any adjacent watercourses.

- Plant movements and haul distances related to earthworks activity and peat excavation shall be kept to a minimum,
- Peat and spoil repositories shall not be allowed to substantially erode or become dry.
- Material repositories shall be located at least 50m away from watercourses, including site ditches/sheughs, to reduce the potential for sediment to be transferred into the wider hydrological system.
- If possible, excavation will be timed to avoid very wet weather,
- Peat and spoil repository locations have been selected to limit re-handling as far as reasonably possible.
- Excavated peat and spoil shall be placed and re-used as close to the immediate area as possible.
- The Contractor shall consult the ECoW to agree on locations for material stockpiles and consider minimising impacting sensitive ecological receptors.
- The Contractor shall consult the site Geotechnical Engineer and review and take into account Peat Stability Risk Assessment (GDG, 2023) to avoid the risk of peat instability in peat excavations, peat stockpiling and all material stockpiling in areas underlain by peat.
- Runoff from repositories shall be directed through the site drainage system, including silt fences, settlement ponds and other drainage measures as appropriate. These details will be outlined in the Contractor's Construction and Environmental Management Plan.

The following particular recommendations/best practice guidelines for the placement of peat with respect to specific aspects of the wind farm will be considered and taken into account during construction.

6.1 ACCESS ROADS, HARDSTANDS AND OTHER INFRASTRUCTURE:

- Controlled quantities of peat and spoil shall be side-cast adjacent to access roads and other infrastructure only where it can be placed in a stable formation, i.e. where the topography and ground conditions allow.
- Side cast peat material shall consist of the acrotelm (upper layer) only, and it shall be landscaped and shaped to aid in the reinstatement of the construction into the surrounding environment.
- Peat and spoil shall only be cast to safe heights and slope angles, considering the topography and the ground conditions. This height shall be no more than 1m, and the slopes shall be not greater than 1 (V): 3 or 4 (H) unless a site-specific assessment during detailed design indicates a greater height and angle is safe.
- The effect of drainage or water runoff shall be considered when placing landscaping rising adjacent to access roads. Landscaping material shall not interfere with drainage, risk blocking of drainage systems or runoff into drainage systems.

6.2 PEAT REPOSITORY AREAS:

- Peat repository areas have been identified at locations where the topography (slope angle <5°), peat depth, resulting stability assessment (FoS of >1.3 for 1.5m peat surcharge as shown Figure A-4- 1 to Figure A-4- 2 in Appendix A.4) and other environmental constraints (including 50m buffer from all watercourses) have allowed. These areas are designated for the permanent placement of up to 1m of peat material, or where topography allows (e.g. localised depressions), up to a maximum of 1.5m.
- A cell berm will be constructed similarly to the peat repository area detail outlined in Appendix C. This cell berm will help to prevent the flow of saturated peat material. The stone berm will be constructed with a sufficiently coarse granular material or rock to enable the drainage of the placed peat material and prevent any instabilities within the repository area.
- The stone cell berm will require a geotextile separator. The stone cell berm should be constructed using low ground pressure machinery working from bog mats where necessary. The founding stratum for each stone buttress should be inspected and approved by a competent engineer.
- The height of the cell berm constructed will be greater than the height of the placed peat & spoil to prevent any surface peat runoff. Berms up to 1.75m in height will be required, subject to detailed design.
- The cell berm is subject to the detail designer's specification; however, some peat excavation or installation of a shear key may be required to prevent global instabilities within the stored material. The shear key will comprise an excavation below existing ground level beneath the cell berm to provide resistance against lateral forces.
- Where possible, the surface of the placed peat and spoil will be shaped to allow efficient runoff of surface water from the peat and spoil repository areas.
- Silting ponds may be required at the lower side/outfall location of the repository areas.
- Intermediate berms or buttresses of spoil material may be installed within the peat repository area to aid in the placement and stability of the peat material. These berms will be shaped to align with the contours of the repository area.
- The Contractor shall make every reasonable effort to promote growth in the peat repository areas following the placement of peat and completion of construction stage activities. Upper acrotelm layers shall be placed on the surface the right way up to promote vegetation growth. This growth will aid in stabilising the placed peat material and help in preventing it from becoming saturated following heavy periods of rain.

6.3 SPOIL REPOSITORY AREAS:

- Spoil repository areas have been identified at locations where the topography (slope angle <5°), peat depth, resulting stability assessment (Factor of Safety of >1.3 for 1.5m peat surcharge) and other environmental constraints (including 50m buffer from all watercourses) have allowed. These areas are designated for permanently placing up to 1.5m of non-peat spoil material.
- A cell berm will be constructed similarly to the peat repository area detail outlined in Appendix C. This cell berm will help to prevent the flow of saturated peat material. The

stone berm will be constructed with a sufficiently coarse granular material or rock to enable the drainage of the placed peat material and prevent any instabilities within the repository area.

- The height of the cell berm constructed will be greater than the height of the spoil to prevent any surface spoil runoff. Berms up to 1.75m in height may likely be required, subject to detailed design.
- The cell berm is subject to the detail designer's specification; however, some peat excavation or installation of a shear key may be required to prevent global instabilities within the placed material.
- Where possible, the surface of the placed peat and spoil will be shaped to allow efficient runoff of surface water from the peat placement areas.
- Silting ponds may be required at the lower side/outfall location of the repository areas.
- Intermediate berms or buttresses of granular material may be installed within the spoil repository area to aid in the placement and stability of the spoil material. These berms will be shaped to align with the contours of the repository area.

The Contractor shall make every reasonable effort to promote growth in the spoil repository areas following the placement of peat and completion of construction stage activities. Upper acrotelm layers shall be placed on the surface the right way up to promote vegetation growth. This growth will aid in stabilising the placed peat material and help in preventing it from becoming saturated following heavy periods of rain.

7 GUIDELINES FOR GOOD CONSTRUCTION PRACTICE

7.1 GENERAL

Inappropriate handling and management of excavated peat and overburden, as well as uncontrolled loading of peat material, is considered one of the leading causes of peat instability and landslide event triggers during the wind farm construction process. Managing and controlling these activities is key to de-risking peat stability at the wind farm site. It is required that the construction method statements for the project also take into account, but not be limited to, the guidance documents listed in Section 1 and the recommendations and requirements outlined throughout this document.

The general requirements for the management of peat and spoil materials and the mitigation of peat instability at the site:

- A Project Geotechnical Engineer shall be appointed for the construction stage to oversee peat excavation and management.
- Placement of peat material, including temporary and side casting, be carried out in the permitted areas only. No peat material shall be stored, side cast, or used for landscaping in the designated Safety Buffer Areas,
- Excavated peat shall not be stored on-site and will be immediately moved to the designated peat repository areas. Acrotelm (upper) peat material will be used as landscaping material where topography allows, and the detail designer has assessed the stability risk,
- Peat and spoil will only be placed in the proposed repository areas or re-used for landscaping purposes. The velocity of water flows within drainage systems will be controlled using check damns, and the uncontrolled release of water onto slopes can create a landslide risk and must be avoided,
- All construction requiring cut and fill earthworks requires a robust monitoring and inspection programme. The details of this inspection programme will depend on the purpose and methodologies of the works and the ground conditions,
- A method statement and risk assessment (RAMS), which considers the potential causes and mitigations of peat instabilities and landslides, is required and must be regularly communicated to all site staff. An observational approach by all site staff to the ground conditions and the risks will be promoted, and any changes in the ground or site conditions will be reported and the risk dynamically assessed.
- Regular briefing of all site staff (e.g. toolbox talks) to provide feedback on construction and ground performance and to promote reporting any observed change in ground conditions.

7.2 MONITORING

Installing movement monitoring posts is recommended for areas where works occur on or adjacent to identified peat depths greater than 2m and existing slope angles exceeding 5°. At those locations, monitoring posts are recommended to be installed upslope and downslope of the works areas.

Movement monitoring posts shall be observed at least once daily during construction, with more frequent inspections where adjacent works are ongoing. Should movements be recorded, the

frequency of these inspections is to be increased. A record of all monitor post inspections will be kept with reference to date, time and relative movement between posts, if any. Any movement identified in the posts shall be recorded with reference to the post numbering system. The monitoring regime will be further developed and assessed during the detailed design phase.

The Contractor shall also develop a routine inspection of all areas surrounding work in peat, not just exclusively on the monitoring posts. These inspections shall include an assessment of ground stability and drainage conditions. These inspections will identify any cracking or deformation on the peat surface, an excessive settlement on structures, drain blockages or springs etc.

8 RISK REGISTER

Table 8-1: Risk Register

Ref.	Risk	Cause	Mitigation
1	Excavation of larger quantities of peat than expected	Increase in peat depth encountered	This report outlines the calculations carried out in the peat balance exercise. The report outlines the volumes of peat excavation required for the construction of the proposed development and the capacity for the development for peat placement or rehabilitation, concluding that the peat balance is satisfactory for the construction of the proposed wind farm development. The peat depths used are developed from the ground investigations carried out at the site, including peat probes, trial pits and hand shear vanes. Satellite imagery and on-site inspection are used to prove the presence of glacial till and areas of peat material. Peat material can vary largely locally, and the risk of missing a local deep area of peat can exist at the site. An increased density of ground investigation was carried out in the areas of the proposed infrastructure. However, some areas had limited access and so ground investigations were limited. Further GI will be required across the proposed development during the detail and construction stage to assess peat depths and strengths. This will be carried out by the detail designer and Contractor's team. The design team shall develop their own peat balance calculation to satisfy and de-risk the possibility of larger peat excavation volumes being encountered at these locations.
2	Inadequate repository space for excavated peat	Inadequate peat reinstatement volumes	The peat balance calculation has considered a conservative estimate of the peat reinstatement quantities, considering only 20% of peat available for side casting and re-use and the storage of 1.0-1.5m of peat across the peat repository areas. Following detailed design, it is likely that the reinstatement volumes will be able to be increased, targeting topographically confined areas for increased volume of side casting while still remaining in compliance with the requirements outlined in this peat and spoil management plan document and industry best practices. The report outlines several contingency estimations for peat and storage volume assessments. It is assumed that a suitable construction methodology and project timeline can be developed by the construction stage contractor and design team effectively manage peat excavations and repository areas.
3	Peat slippage from side casting of peat material	Overloading of in situ peat by side casting	The peat stability risk assessment (PSRA) report (GDG, 2023) examines the stability of the peat in several conditions, including the inclusion of a 1m peat storage surcharge. This report outlines the methodologies to safely construct the proposed development, including the restriction for the storage of peat at some key infrastructure locations. The construction stage design and contractor team will need to construct the wind farm using these mitigation measures. Further GI will be required across the full site including at the identified hazard areas, during the detail and construction stage to assess peat depths and strengths. This will be carried out by the detail designer and Contractor's team. The design team shall develop their own testing criteria to satisfy and derisk the possibility of instability and peat failure. It is assumed that the works will be undertaken by a competent contractor experienced in working in peat and soft ground conditions in upland areas and will have carried out the appropriate due diligence and assessment relating to peat stability and appropriate peat storage.

9 CONCLUSION

This PSMP has been prepared to outline a peat management strategy to ensure the workable and sustainable management of peat during the construction of the proposed development.

It is concluded that this PSMP demonstrates that most material excavated will be catotelmic peat, with volumes of acrotelmic peat generated at T01 and T02 and in the construction of new roads. Volumes of catotelmic peat generated will be fully utilised in the peat placement.

For the peat balance assessment completed herein, volumes of peaty soil have been included to facilitate the evaluation of the superficial material required for restoration and infrastructure dressing at the proposed development.

The peat balance analysis represents the most likely scenario for the proposed development, and as such, it is concluded that all of the peat material excavated can be re-used safely on-site during construction. Should further refinement of the detailed infrastructure design be undertaken, the assessment completed herein will be revisited.

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Scottish-Executive. (2017). *Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments*. *Scottish Executive. 69p*.

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Scottish Natural Heritage (2011) *Floating Roads on Peat*

Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency, Forestry Commission Scotland (2015) *Good practice during wind farm construction*

Scottish Renewables and SEPA (2012) *Guidance on the Assessment of Peat Volumes, Re-use of Excavated Peat and the Minimisation of Waste*

Appendix A SITE MAPS

A.1 SITE LAYOUT AND ROAD CONSTRUCTION

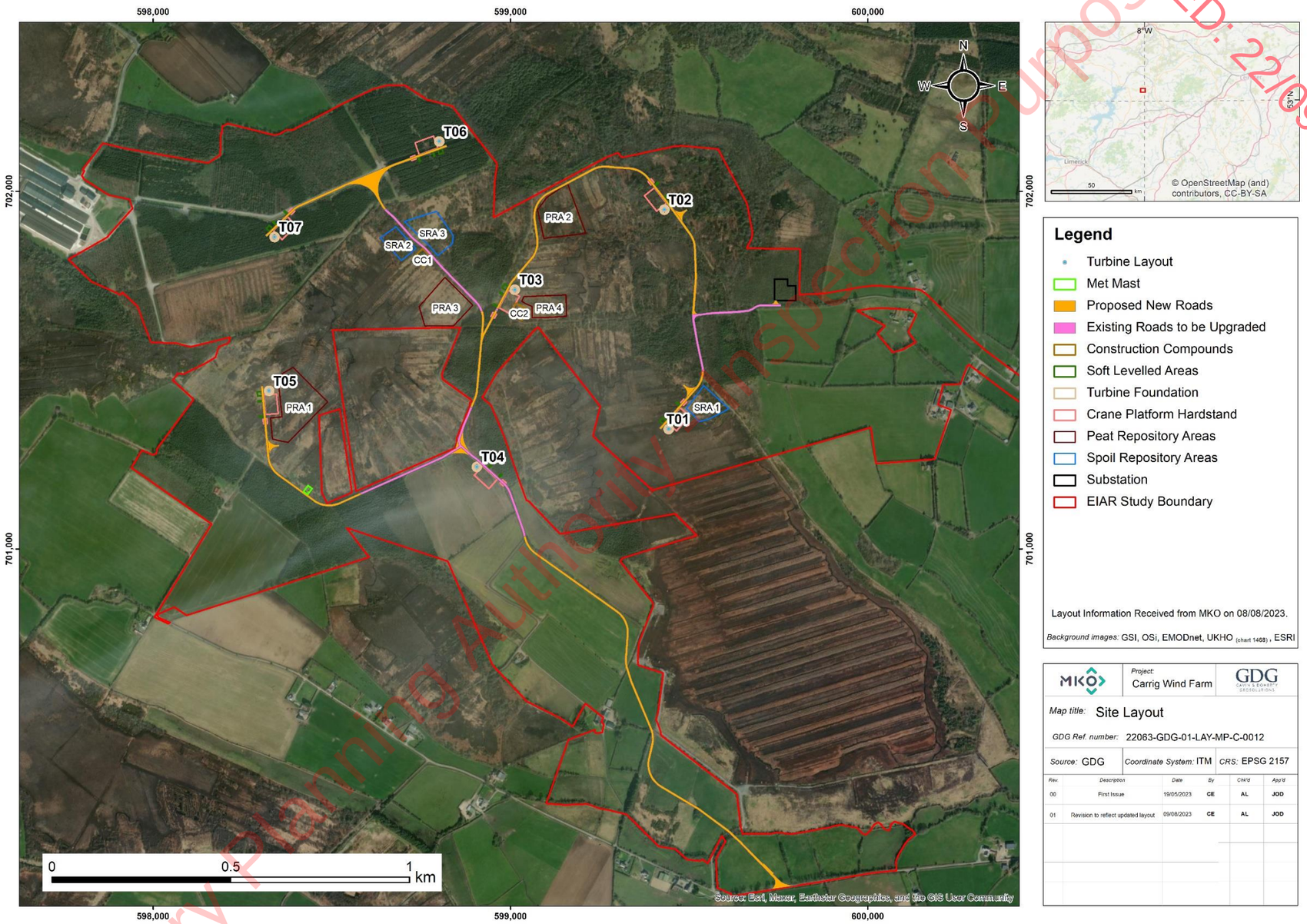


Figure A-1- 1: Site Layout (MKO, GDG)

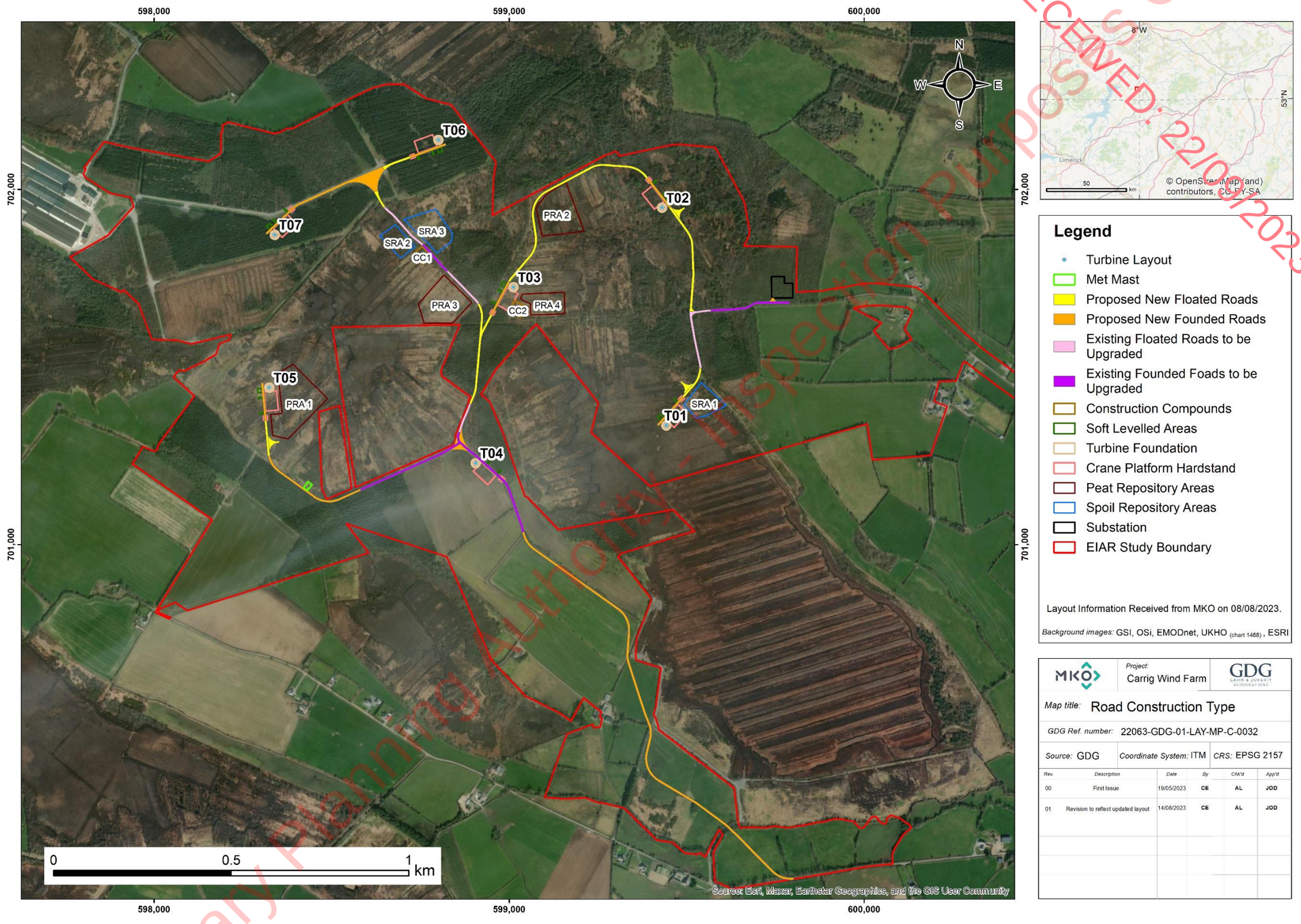


Figure A-1- 2: Site layout and road construction types (MKO, GDG).

A.2 Peat Depth Plan

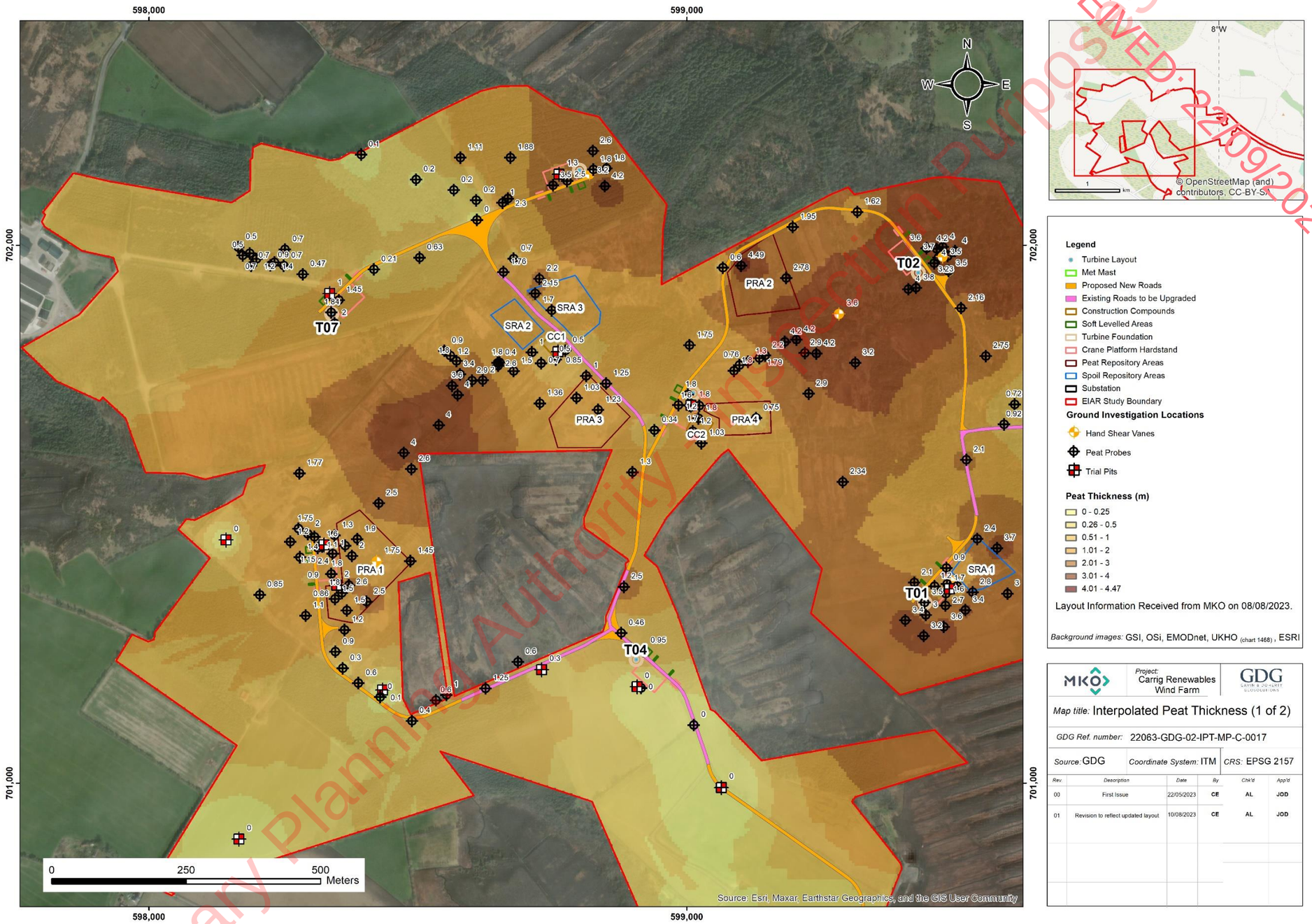
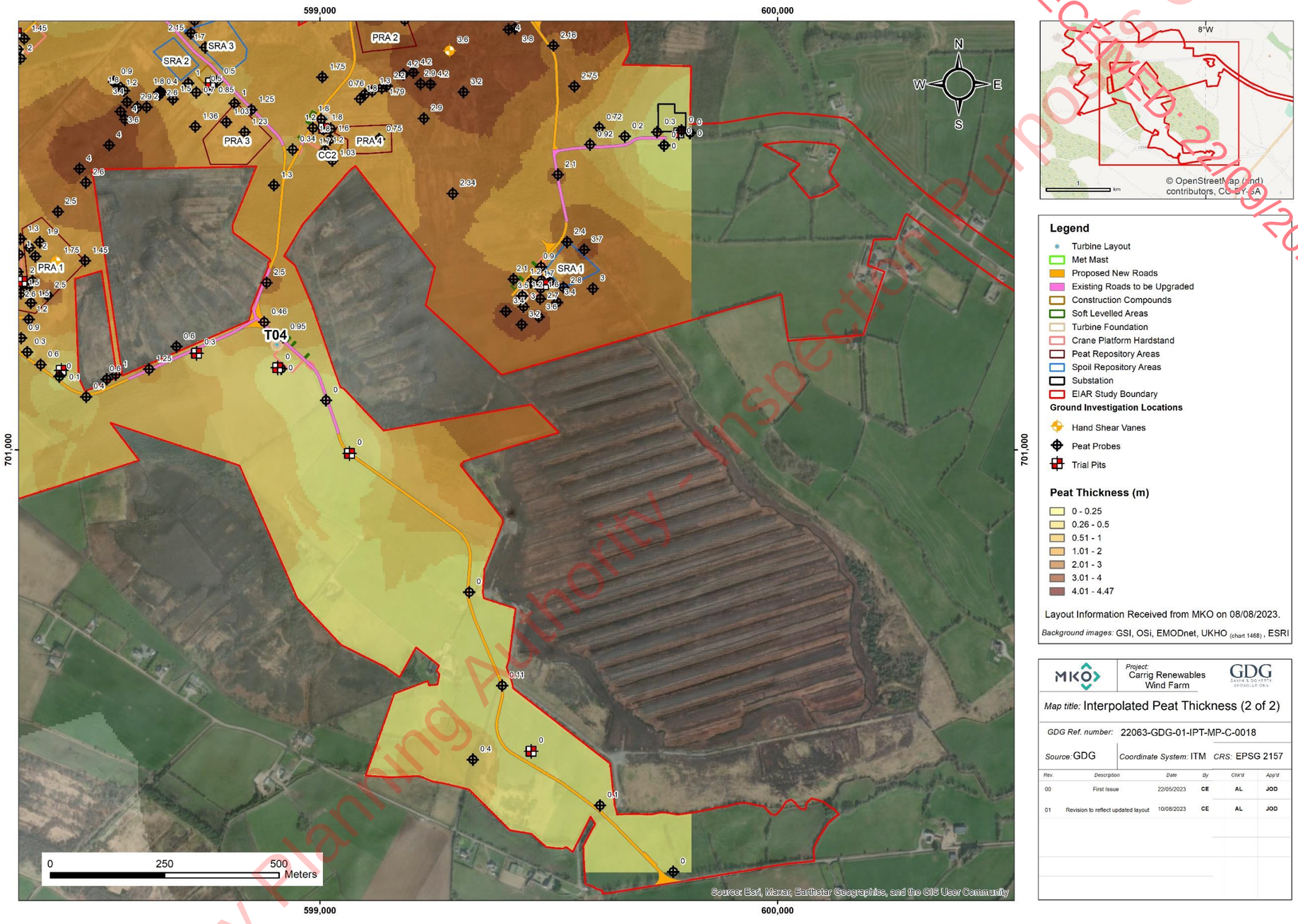


Figure A-2- 1: Peat depth interpolation (1 of 2).



Legend

- Turbine Layout
- Met Mast
- Proposed New Roads
- Existing Roads to be Upgraded
- Construction Compounds
- Soft Levelled Areas
- Turbine Foundation
- Crane Platform Hardstand
- Peat Repository Areas
- Spoil Repository Areas
- Substation
- EIAR Study Boundary

Ground Investigation Locations

- Hand Shear Vanes
- Peat Probes
- Trial Pits

Peat Thickness (m)

- 0 - 0.25
- 0.26 - 0.5
- 0.51 - 1
- 1.01 - 2
- 2.01 - 3
- 3.01 - 4
- 4.01 - 4.47

Layout Information Received from MKO on 08/08/2023.

Background images: GSI, OSi, EMODnet, UKHO (chart 1468), ESRI

MKO | GDG

Project: Carrig Renewables Wind Farm

Map title: Interpolated Peat Thickness (2 of 2)

GDG Ref. number: 22063-GDG-01-IPT-MP-C-0018

Source: GDG | *Coordinate System:* ITM | *CRS:* EPSG 2157

Rev.	Description	Date	By	Chk'd	App'd
00	First Issue	22/05/2023	CE	AL	JOD
01	Revision to reflect updated layout	10/08/2023	CE	AL	JOD

Figure A-2- 2: Peat depth interpolation (2 of 2).

A.3 SAFETY BUFFER AND STOCKPILE RESTRICTION MAP

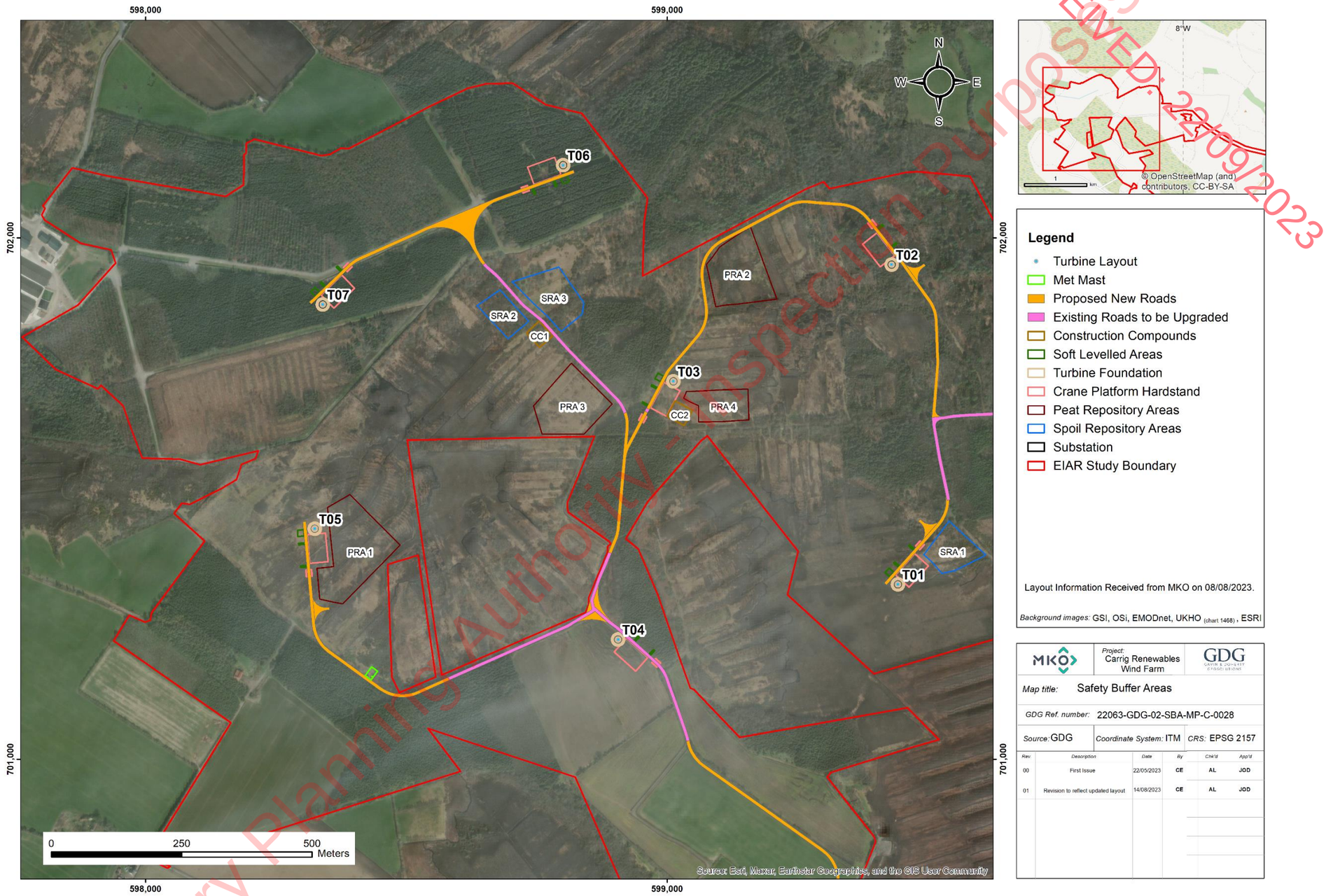


Figure A-3- 1: Safety buffer zones (1 of 2).

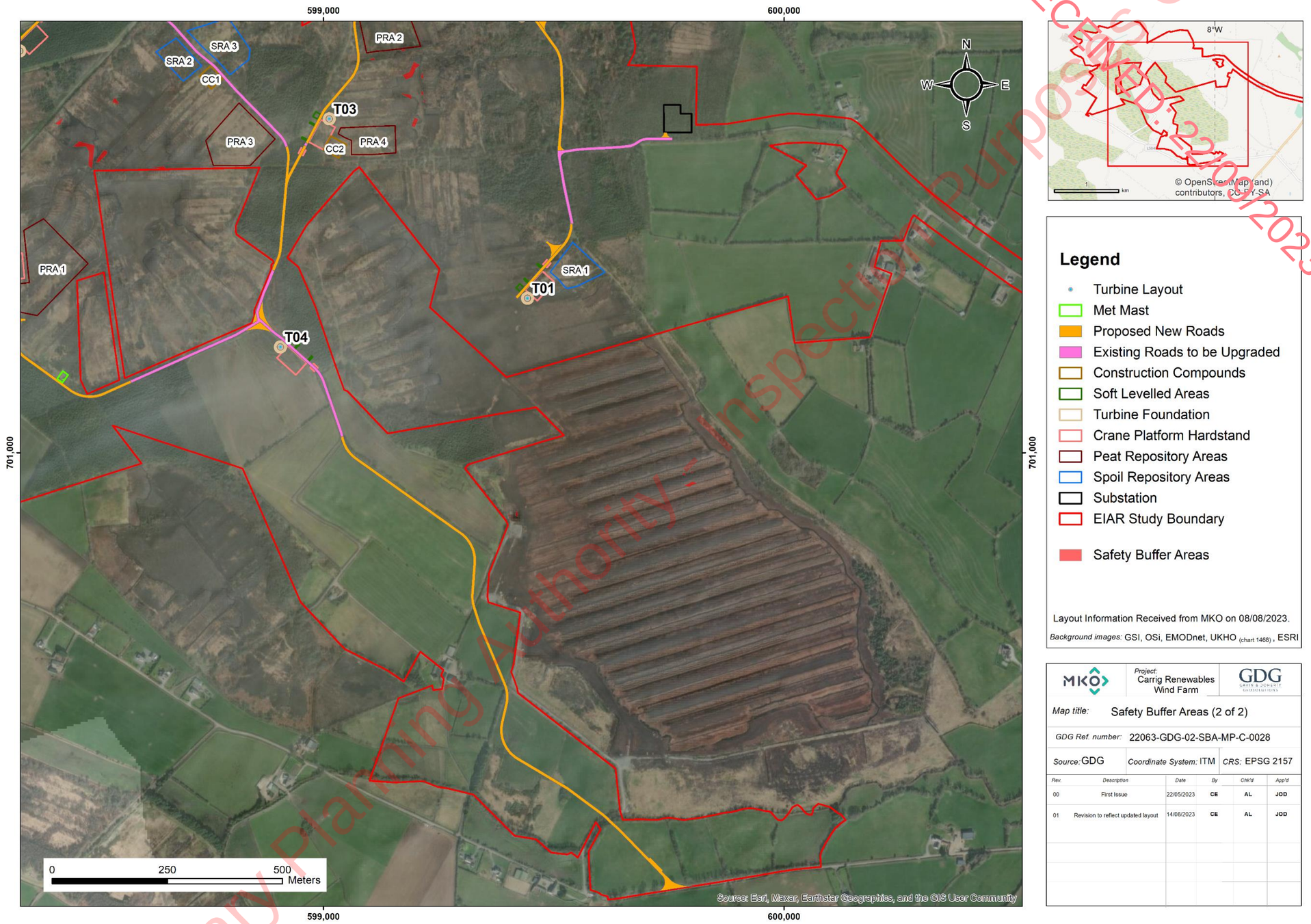


Figure A-3- 2: Safety buffer zones (2of 2).

A.4 Peat Stability Factor of Safety for 1.5m of Peat Placement

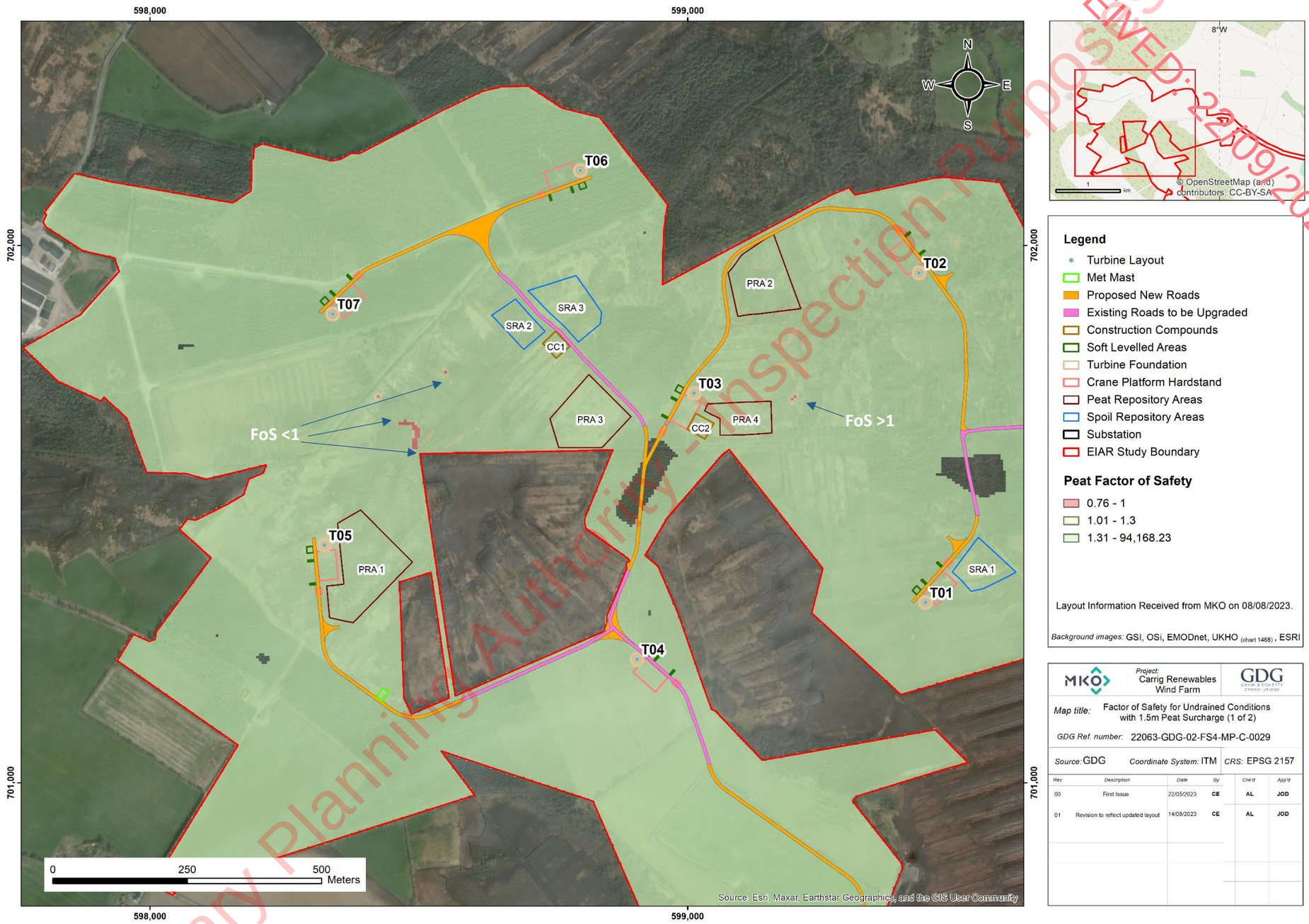


Figure A-4- 1: Peat Factor of Safety for Undrained Conditions with 1.5m of Peat Surcharge (1 of 2).

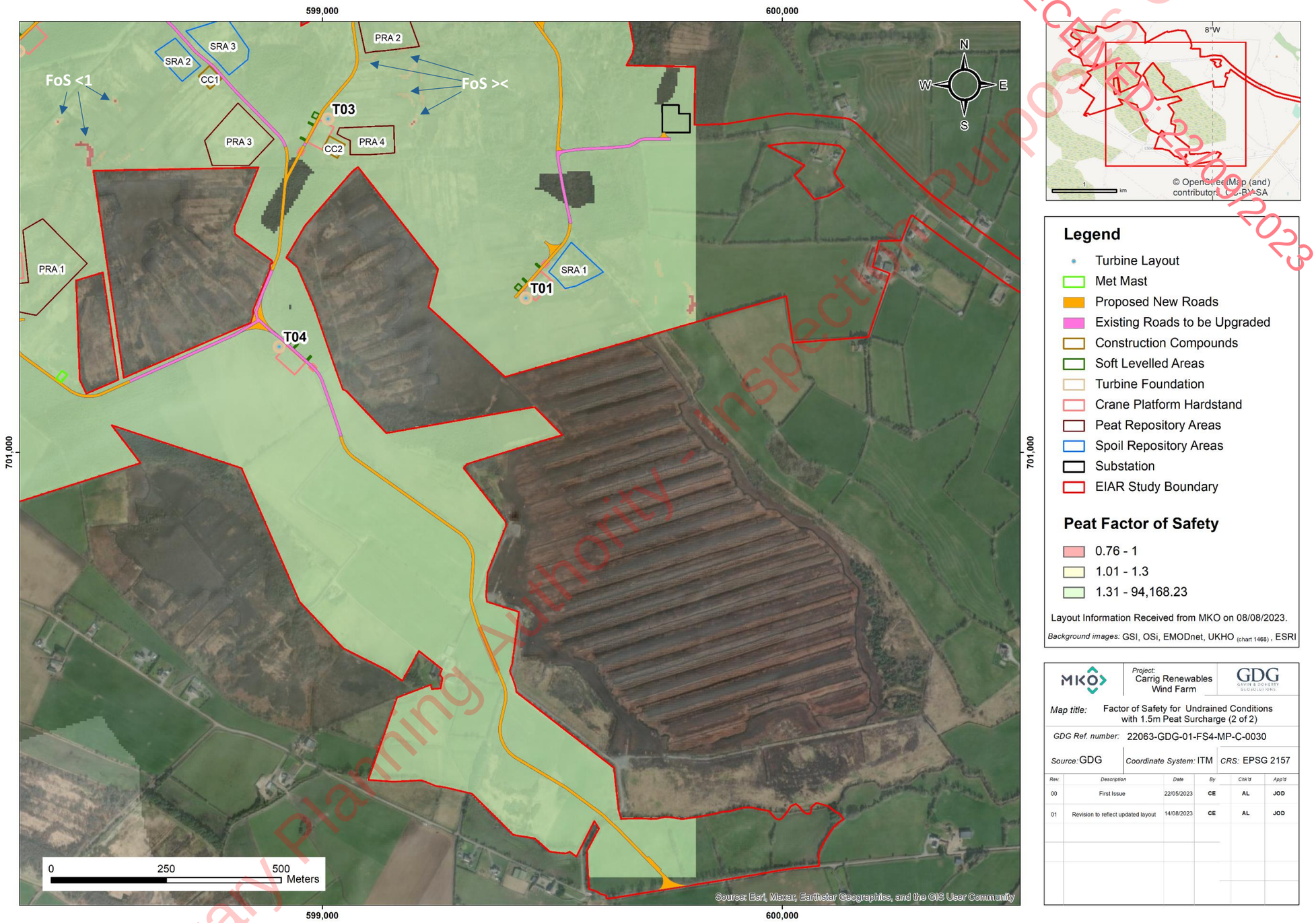
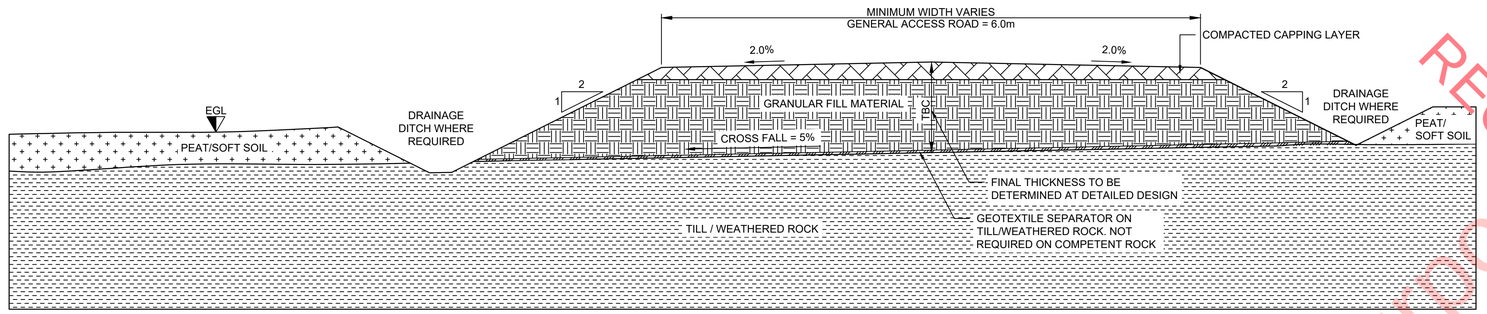


Figure A-4- 2: Peat Factor of Safety for Undrained Conditions with 1.5m of Peat Surcharge (2 of 2).

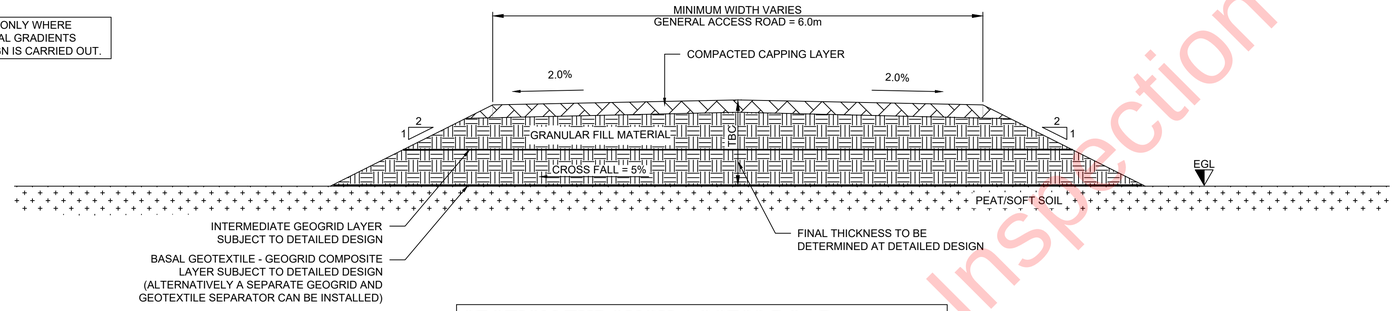
Appendix B ROAD CONSTRUCTION DETAILS



SECTION THROUGH ACCESS ROAD NEW CONSTRUCTION: FOUNDED - DETAIL 01

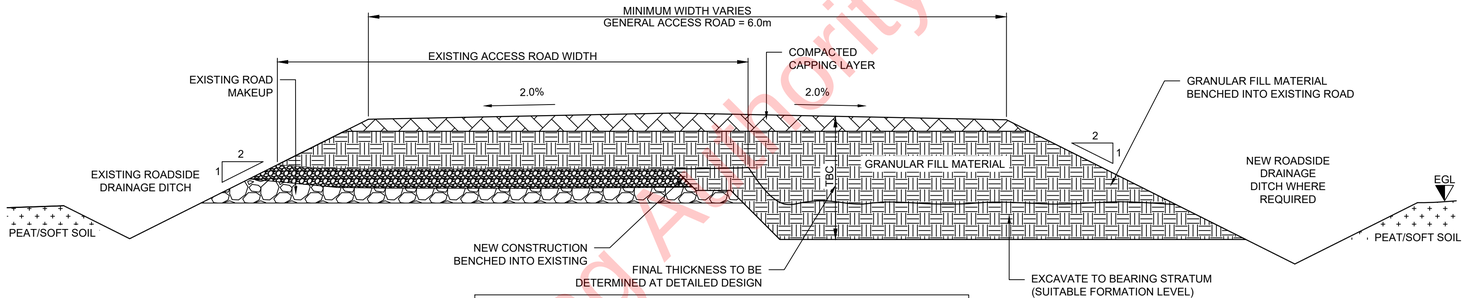
SCALE: 1:25

FLOATING ROADS TO BE CONSTRUCTED ONLY WHERE CROSSFALLS ARE <5% AND LONGITUDINAL GRADIENTS ARE <5% UNLESS A SITE SPECIFIC DESIGN IS CARRIED OUT.



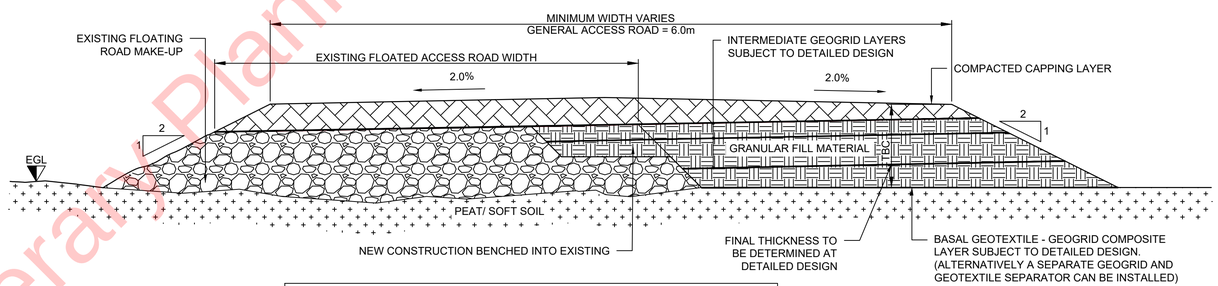
SECTION THROUGH ACCESS ROAD NEW CONSTRUCTION: FLOATED - DETAIL 02

SCALE: 1:25



SECTION THROUGH WIDENING OF EXISTING ACCESS ROAD: FOUNDED - DETAIL 03

SCALE: 1:25



SECTION THROUGH WIDENING OF EXISTING ACCESS ROAD: FLOATED - DETAIL 04

SCALE: 1:25

NOTES:

1. THIS DRAWING IS FOR PLANNING AND ENVIRONMENTAL IMPACT ASSESSMENT PURPOSES AND SHOULD NOT BE USED AS DETAILED DESIGN OR FOR CONSTRUCTION.
2. DO NOT SCALE FROM DRAWINGS.
3. THE STRENGTH OF THE SUBFORMATION SOILS TO BE ASSESSED BY A SUITABLY QUALIFIED GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION / PLACEMENT OF FILL.
4. DRAINAGE TO BE PROVIDED TO PREVENT WATER DEGRADATION OF THE SUBFORMATION SOILS IN-LINE WITH DRAINAGE STRATEGY.

HEALTH & SAFETY:

1. NO OPERATIVES TO ACCESS ANY UNSUPPORTED TRENCHES. TRENCHES TO BE ADEQUATELY BATTERED BACK OR SUPPORTED WHERE NECESSARY. SAFE TEMPORARY BATTER ANGLES TO BE ASSESSED IN ACCORDANCE WITH CIRIA REPORT 97 "TRENCHING PRACTICE".

REV:	S2-P02	DATE:	17/08/23	DRAWN BY:	JMG	CHECKED BY:	C.E.
DESCRIPTION:	UPDATED TO ADDRESS MKO COMMENTS						
REV:	S2-P01	DATE:	30/05/23	DRAWN BY:	EFC	CHECKED BY:	CE
DESCRIPTION:	ISSUED FOR INFORMATION						

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ISSUED AS: FOR INFORMATION

CLIENT: MKO

PROJECT TITLE: CARRIG RENEWABLES WIND FARM

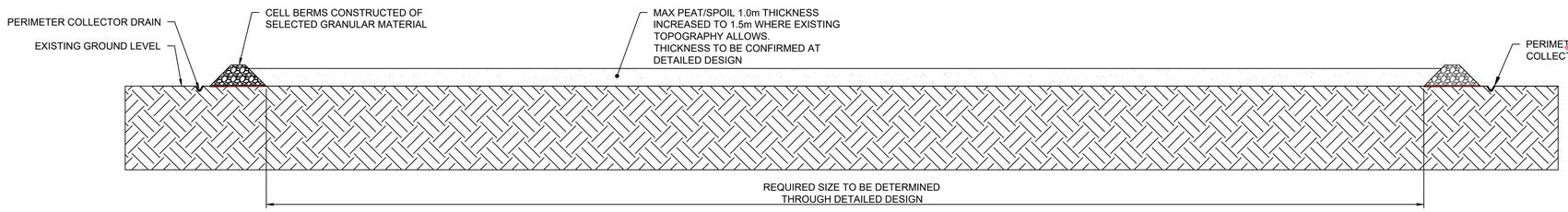
DRAWING No: 22063-GDG-ZZ-XX-DR-C-1000

Revision: -S2-P02

DRAWING TITLE: ACCESS ROAD STANDARD DETAILS

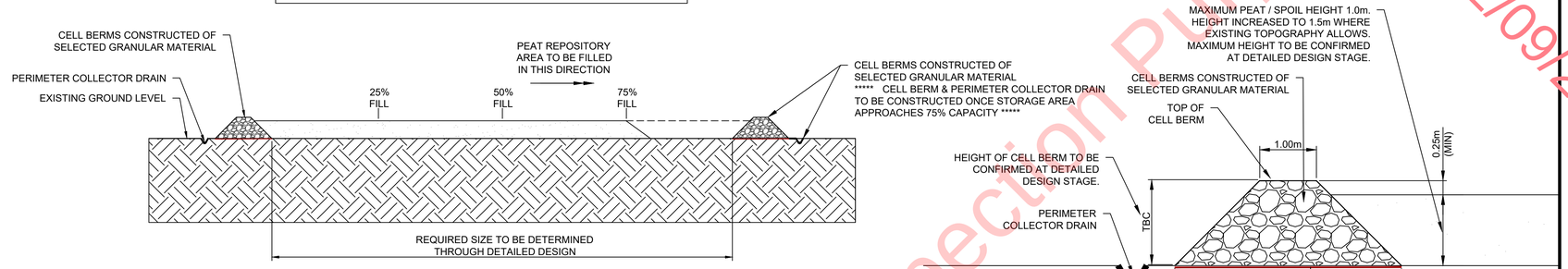
SCALE:	SHOWN	SHEET SIZE:	A1	DATE:	30/05/2023
DRAWN BY:	EFC	CHECKED BY:	C.E.	APPROVED BY:	J.O'D

Appendix C Peat and Spoil Repository Area Details



PEAT/SPOIL REPOSITORY- SECTION A-A

SCALE: 1:200

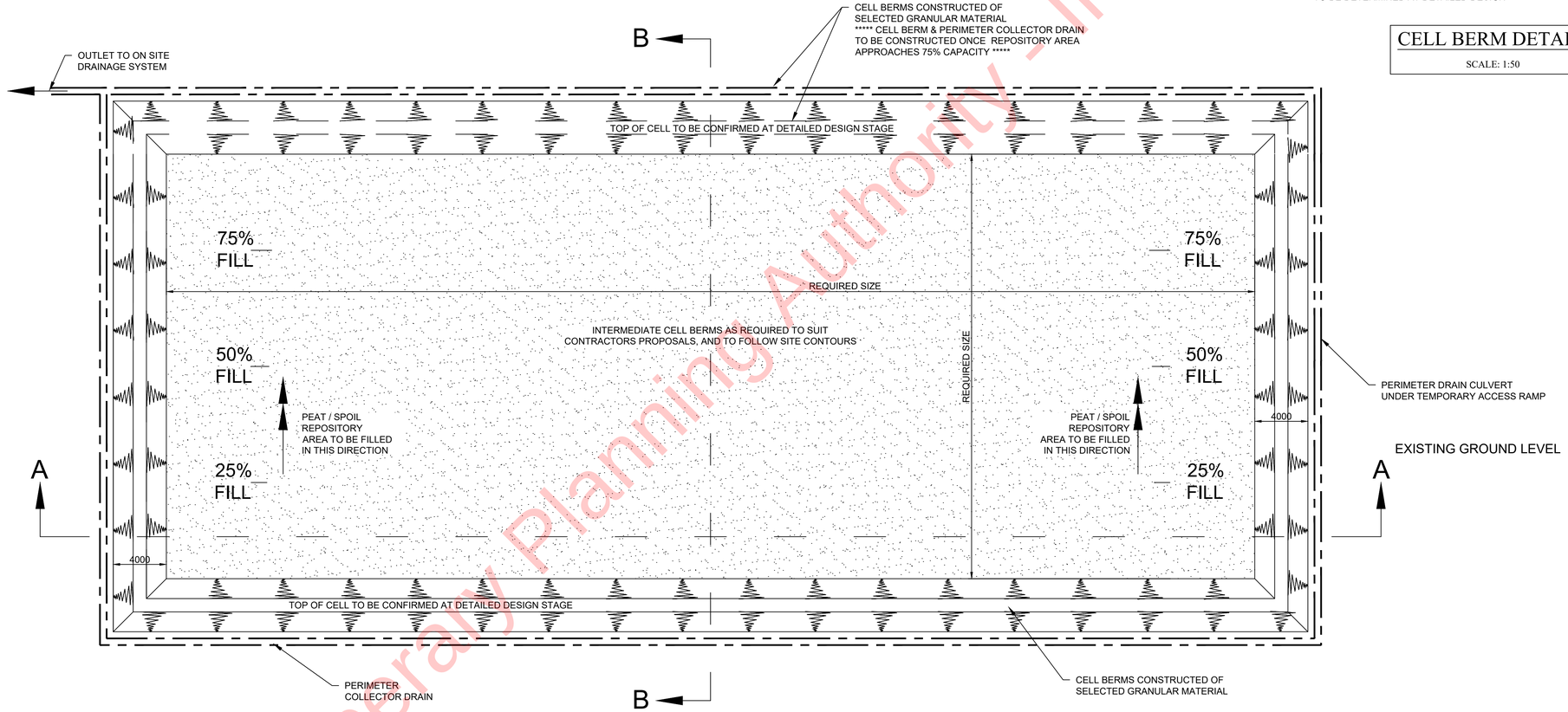


PEAT / SPOIL REPOSITORY - SECTION B-B

SCALE: 1:200

CELL BERM DETAIL

SCALE: 1:50



PEAT / SPOIL REPOSITORY - PLAN

SCALE: 1:200

NOTES:

1. THIS DRAWING IS FOR PLANNING AND ENVIRONMENTAL IMPACT ASSESSMENT PURPOSES AND SHOULD NOT BE USED AS DETAILED DESIGN OR FOR CONSTRUCTION.
2. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL PLACED 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 SPOIL COULD BE CARRIED OUT WHICH WOULD AID IN STABILISING THE PLACED SPOIL IN THE LONG TERM.
5. WHERE POSSIBLE, THE ACROTELM SHALL BE STORED WITH THE VEGETATION PART OF THE SOD FACING THE RIGHT WAY UP TO ENCOURAGE GROWTH OF PLANTS AND VEGETATION AT THE SURFACE OF THE STORED PEAT WITHIN THE PEAT STORAGE AREAS.
6. BOG MATS TO BE USED WHERE NECESSARY TO FACILITATE PLANT & MACHINERY ACCESS OVER SOFT GROUND.

REV:	S2-P02	DATE:	17/08/23	DRAWN BY:	JMG	CHECKED BY:	CE
DESCRIPTION:	UPDATED TO ADDRESS MKO COMMENTS						
REV:	S2-P01	DATE:	30/05/23	DRAWN BY:	EFC	CHECKED BY:	CE
DESCRIPTION:	ISSUED FOR INFORMATION						

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ISSUED AS: FOR INFORMATION

CLIENT: MKO

PROJECT TITLE: CARRIG RENEWABLES WIND FARM

DRAWING No: 22063-GDG-ZZ-XX-DR-C-2000

Revision: -S2-P02

DRAWING TITLE: PEAT AND SPOIL REPOSITORY AREAS STANDARD DETAILS

SCALE:	SHOWN	SHEET SIZE:	A1	DATE:	30/05/2023
DRAWN BY:	EFC	CHECKED BY:	C.E.	APPROVED BY:	J.O'D

Appendix D TRIAL PIT LOGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP01
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 599783.90 - 701692.49 Level: 58.80	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 2.60 x 1.40 Depth 2.30	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Light brown silty TOPSOIL with high root and wood content.
				0.40	58.40		Firm light grey slightly sandy slightly gravelly CLAY with moderate cobble content. Sand and gravel are fine to coarse, gravel is angular to subrounded. Cobbles are subrounded of limestone.
				2.30	56.50		End of Pit at 2.30m

1 2 3 4 5

Remarks: No water encountered. Terminated due to confined space in forested area - limited space for excavator to move and to store spoil. Elevation taken from DEM.

Stability: Stable.

AGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP02
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 599488.37 - 701360.83 Level: 59.60	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 4.50 × 2.20 Depth 4.00	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.50	59.10		Spongy black slightly decomposed PEAT (H4) with moderate wood and coarse fibre content.
				1.70	57.90		Plastic black pseudofibrous decomposed PEAT (H7) with strong organic odour.
				4.00	55.60		Firm grey slightly sandy slightly gravelly CLAY with moderate cobble and low boulder content. Sand and gravel are fine to coarse, gravel is angular to subangular. Cobbles and boulders are subangular to subrounded of limestone.
							End of Pit at 4.00m

1 2 3 4 5

Remarks: No water encountered. Terminated at target depth. Elevation taken from DEM.

Stability: Stable.

AGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP03
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 599007.56 - 701702.47 Level: 58.30	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 4.00 x 1.40 Depth 1.80	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	58.10		Spongy dark brown pseudofibrous PEAT (H3) with moderate coarse fibre and high wood content. Moderate odour.
▼				0.90	57.40		Plastic dark brown oxidising to black amorphous PEAT (H6) with low coarse fibre content. Strong odour.
				1.80	56.50		Plastic black decomposed amorphous PEAT (H8) with strong odour.
				1.80	56.50		Weathered LIMESTONE bedrock. End of Pit at 1.80m

Remarks: Rapid water ingress at 0.9m bgl. Terminated as bedrock encountered. Elevation taken from DEM.

Stability: Poor.

AGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP04
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598760.37 - 701801.88 Level: 59.10	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 4.00 x 1.40 Depth 2.80	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	58.90		Spongy dark brown fibrous PEAT (H3) with moderate fine and coarse fibre content.
				0.85	58.25		Plastic black pseudofibrous PEAT (H5) with low coarse fibre content. Moderate organic odour.
▼				2.80	56.30		Stiff bluish grey gravelly CLAY with moderate cobble content. Gravel is fine to coarse, angular to subrounded. Cobbles are angular of limestone.
				2.80	56.30		LIMESTONE bedrock. End of Pit at 2.80m

1 2 3 4 5

Remarks: Moderate water ingress at 1m bgl. Pit terminated as bedrock encountered. Elevation taken from DEM.

Stability: Poor.

AGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP05
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598762.41 - 702132.11 Level: 57.20	Date 23/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 4.00 × 2.10 Depth 2.60	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	56.90		Plastic black pseudofibrous PEAT (H5) with strong organic odour.
▼				1.30	55.90		Plastic black highly decomposed PEAT (H8) with strong organic odour.
				2.60	54.60		Very soft damp light grey slightly sandy SILT with occasional rootlets. Sand is fine.
							End of Pit at 2.60m

1 2 3 4 5

Remarks: Water seepage at base of PEAT at 1.3m bgl. Pit terminated due to walls collapsing. Elevation taken from DEM.

Stability: Poor.

AGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP06
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598348.71 - 701367.84 Level: 61.60	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 4.00 x 1.40 Depth 3.70	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	61.20		Spongy dark brown oxidising to black fibrous PEAT (H4) with moderate coarse fibres and wood fragments. Slight organic odour.
				2.00	59.60		Spongy black H6 pseudofibrous PEAT (H6) with low wood content. Moderate organic odour.
▼				3.70	57.90		Soft damp grey slightly sandy slightly gravelly CLAY with moderate cobble and boulder content. Sand is fine to coarse, gravel is fine to coarse, angular to subangular. Cobbles and boulders are subangular of limestone. One boulder is 70cm.
							End of Pit at 3.70m

Remarks: Terminated due to moderate water ingress at 3.6m bgl and unstable sides. Elevation taken from DEM.

Stability: Poor

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Trial Pit Log

TrialPit No TP07
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598434.31 - 701173.31 Level: 62.20	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): Depth 2.20 (4.00 × 2.20)	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	62.10		Spongy black fibrous PEAT (H3) with moderate coarse fibre content.
							Soft grey slightly sandy slightly gravelly slightly silty CLAY with high cobble and boulder content. Sand and gravel are fine to coarse, gravel is angular to subrounded. Cobbles and boulders are subrounded of limestone.
				2.20	60.00		End of Pit at 2.20m

1
2
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Remarks: No water encountered. Terminated due to pit walls collapsing. Elevation taken from DEM.

Stability: Poor

AGS

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Trial Pit Log

TrialPit No TP08
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598907.34 - 701179.10 Level: 60.60	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 3.50 x 1.30 Depth 2.50	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	60.50		Black organic rich TOPSOIL.
							Firm grey mottled orange slightly sandy slightly gravelly CLAY with moderate cobble and low boulder content. Sand and gravel are fine to coarse, gravel is subangular to subrounded. Cobbles and boulders are subrounded of limestone.
▼				2.50	58.10		End of Pit at 2.50m

1
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Remarks: Slight water seepage at 2.5m bgl. Pit terminated due to collapsing sides. Elevation taken from DEM.

Stability: Poor

AGS

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Trial Pit Log

TrialPit No: TP09
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 599064.09 - 700991.90 Level: 61.50	Date 22/11/2022
Location: Sharragh, Co. Tipperary		Dimensions (m): 4.00 x 1.40 Depth 2.10	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)			Logged CE

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	61.30		TOPSOIL.
							Firm grey mottled orange slightly sandy slightly gravelly CLAY with moderate cobble and boulder content. Sand and gravel are fine to coarse, gravel is subangular to subrounded. Cobbles and boulders are subrounded of limestone. One boulder is 80cm.
				2.10	59.40		End of Pit at 2.10m

Remarks: No water encountered. Terminated due to pit walls collapsing. Elevation taken from DEM.

Stability: Poor

AGS

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Trial Pit Log

TrialPit No: TP101
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 599461.00 - 700341.00 Level: 60.00	Date 24/03/2023
Location: Sharragh, Co. Tipperary		Dimensions (m):	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)		Depth 3.50	Logged IPP

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Dark brown slight sandy clay with presence of cobbles [TOPSOIL]
				0.30	59.70		Large rounded boulders in a granular matrix
				1.00	59.00		Grey slightly gravelly sandy CLAY. Sand is fine to coarse, subangular to subrounded. Presence of rounded cobbles.
▼				1.60	58.40		Gery very gravelly CLAY. Gravel is medium to coarse, angular to subrounded. Presence of rounded cobbles
				3.50	56.50		End of Pit at 3.50m

1 2 3 4 5

Remarks: Elevation extracted from Google Earth. Groundwater encountered at 2.2 mBGL

Stability: Stable.

AGS

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Trial Pit Log

TrialPit No
TP102
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598730.00 - 701211.00 Level: 61.00	Date 23/03/2023
Location: Sharragh, Co. Tipperary		Dimensions (m):	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)		Depth 2.05	Logged IPP

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	60.70		Spongy black pseudofibrous PEAT (H3) with moderate coarse fibre and high wood content. Moderate odour.
				0.35	60.65		Grey mottled orange slightly sandy CLAY. Sand is fine to medium, subangular to subrounded.
▼							Grey very gravelly sandy CLAY. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse, subangular to subrounded. High presence of cobbles and boulders
				2.05	58.95		End of Pit at 2.05m

1
2
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Remarks: Elevation extracted from Google Earth. Groundwater encountered at 1.8 mBGL

Stability: Stable.

AGS

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Trial Pit Log

TrialPit No: TP103
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598336.00 - 701910.00 Level: 59.00	Date 24/03/2023
Location: Sharragh, Co. Tipperary		Dimensions (m):	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)		Depth 2.70	Logged IPP

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Black psudo-fibrous PEAT (H3). High content of wood at the bottom of the layer.
				0.80	58.20		Grey very gravelly very sandy CLAY. Sand is fine to coarse, angular to subrounded. Gravel is fine to coarse, angular to subrounded.
▼				2.70	56.30		End of Pit at 2.70m

1 2 3 4 5

Remarks: Elevation extracted from Google Earth. Groundwater encountered at 2 mBGL

Stability: Unstable .

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Trial Pit Log

TrialPit No: TP104
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598325.00 - 701443.00 Level: 60.00	Date 24/03/2023
Location: Sharragh, Co. Tipperary		Dimensions (m):	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)		Depth 3.50	Logged IPP

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
▼							Soft to firm spongy dark brown pseudofibrous PEAT (H3) with moderate coarse fibre and high wood content. Moderate odour. Stiffness increase with depth.
				1.60	58.40		Light grey sandy CLAY [MARL]. Sand if fine to medium, subangular to subrounded. Presence of cobbles (15-30cm). Presence of white loose fine to medium sand.
▼				3.50	56.50		End of Pit at 3.50m

1
2
3
4
5

Remarks: Elevation extracted from Google Earth. Groundwater encountered at 0.3 mBGL (based of Peat layer) related to percolation from the surface; and, at 3.5 mBGL.

Stability: Unstable.

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GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP105
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598167.00 - 700896.00 Level: 68.00	Date 24/03/2023
Location: Sharragh, Co. Tipperary		Dimensions (m):	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)		Depth 2.60	Logged IPP

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown slightly gravelly CLAY [TOPSOIL]. Presence of black organic material at the bottom of the layer.
				0.60	67.40		Large subangular to rounded boulders (>1m)
				1.50	66.50		Very gravelly sandy CLAY. Gravel is fine to coarse, angular to subrounded. Sand is fine to coarse, angular to subrounded.
				2.60	65.40		End of Pit at 2.60m

1
2
3
4
5

Remarks: Elevation extracted from Google Earth.

Stability: Stable.

AGS

GDG GAVIN & DOHERTY GEOSOLUTIONS

Trial Pit Log

TrialPit No: TP106
Sheet 1 of 1

Project Name: Sharragh Wind Farm	Project No. 22063	Co-ords: 598143.00 - 701452.00 Level: 60.00	Date 24/03/2023
Location: Sharragh, Co. Tipperary		Dimensions (m):	Scale 1:25
Client: McCarthy Keville O'Sullivan Ltd. (MKO)		Depth 2.10	Logged IPP

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	59.90		Black organic CLAY [TOPSOIL]
							Orangeish brown CLAY
				0.40	59.60		Light grey slightly sandy gravelly CLAY. Sand is fine to medium, subangular to subrounded. Gravel is coarse, subangular to subrounded. Presence of cobbles and boulders.
▼							
				2.10	57.90		End of Pit at 2.10m

1 2 3 4 5

Remarks: Elevation extracted from Google Earth. Groundwater encountered at 1.6 mBGL

Stability: Unstable.

AGS

Global Project Reach

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