APPENDIX 8-1

FEHILY TIMONEY – GEOTECHNICAL AND PEAT STABILITY REPORT

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GEOTECHNICAL & PEAT STABILITY REPORT

KNOCKSHANVO WIND FARM

Prepared for: **MKO Ltd**

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GEOTECHNICAL & PEAT STABILITY ASSESSMENT REPORT
KNOCKSHANVO WIND FARM

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Abstract: Fehily Timoney and Company (FT) were engaged by McCarthy Keville O'Sullivan (MKO) to undertake a geotechnical assessment of the proposed Knockshanvo wind farm site with respect to peat stability. As part of the geotechnical assessment of the proposed development, FT completed walkover surveys at the site. The findings of the geotechnical and peat stability assessment showed that the site has an acceptable margin of safety and is suitable for the proposed wind farm development.

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1. NON-TECHNICAL SUMMARY

Fehily Timoney and Company (FT) was engaged by MKO (on behalf of FuturEnergy Knockshanvo DAC) to undertake a geotechnical and peat stability assessment of the proposed Knockshanvo wind farm site and grid connection, the 'Proposed Development'), located in Co. Clare. In accordance with planning guidelines compiled by the Department of the Environment, Heritage and Local Government (Draft Revised Wind Energy Development Guidelines, DoHPLG, 2019), where peat >0.5m thickness is present on a proposed wind farm development, a peat stability assessment is required.

A walkover including intrusive peat depth probing, trial pits, desk study, stability analysis and risk assessment was carried out to assess the susceptibility of the site to peat failure following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, Scottish Government, 2017).

The findings, which involved a stability analysis of approximately 240 locations, show that the site has an acceptable margin of safety, a low risk of peat failure and is suitable for the proposed wind farm project. The findings include recommendations and control measures for construction work in peat lands to ensure that all works adhere to an acceptable standard of safety.

The proposed wind farm and grid connection comprises 9 no. wind turbines and associated infrastructure. A detailed description of the Proposed Development is included in Chapter 4 of the EIAR.

The site slopes steadily downwards from the northwest to the southeast, ranging in elevation from 140 to 307mOD. The land use within the Proposed Development site comprises commercial forestry.

Slope inclinations at the main infrastructure locations range from 2 to 18 degrees. Ground conditions comprised mainly of shallow peat overlying clay and gravel overlying bedrock.

Between September 2021 and October 2023, 575 no. peat depth readings were taken within the Proposed Development site. Peat depth recorded during the site walkovers and from the ground investigation ranged from 0.0 to 3.9m with an average peat depth of 0.55m. 88% of the probes recorded peat depths of less than 1.0m with 97% of peat depth probes recorded peat depths of less than 2.0m. A number of localised readings recorded peat depths from 2.0 to 4.0m. The average peat depth at any of the proposed turbine locations is 0.4m.

The purpose of the stability analysis was to determine the stability i.e. Factor of Safety (FoS), of the peat slopes. The FoS provides a direct measure of the degree of stability of a peat slope. A FoS of less than 1.0 indicates that a slope is unstable; a FoS of greater than 1.0 indicates a stable slope. An acceptable FoS for slopes is generally taken as a minimum of 1.3. The stability analysis for the Proposed Development, which analysed the turbine locations, access roads and related infrastructure, resulted in FoS above the minimum acceptable value of 1.3 and hence the site has a satisfactory margin of safety.

The risk assessment uses the results of the stability analysis in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability, to assess the risk of peat failure at the site. The results of the risk assessment are given in Appendix B. A construction buffer zone plan based on qualitative factors identified during the site walkover is included as Drawing P20-153-0600-0004 to 0006.

In summary, the Knockshanvo wind farm site has an acceptable margin of safety and is considered to be at **low** risk of peat failure providing appropriate mitigation measures and construction controls are implemented and is suitable for wind farm development.

2. INTRODUCTION

2.1 Fehily Timoney and Company

Fehily Timoney and Company (FT) is an Irish engineering, environmental science and planning consultancy with offices in Cork, Dublin and Carlow. The practice was established in 1990 and currently has about 100 members of staff, including engineers, scientists, planners and technical support staff. FT deliver projects in Ireland and internationally in our core competency areas of Waste Management, Environment and Energy, Civils Infrastructure, Planning and GIS and Data Management.

FT have been involved in over 100 wind farm developments in both Ireland and the UK at various stages of development i.e., preliminary feasibility, planning, design, construction, and operational stage and have established themselves as one of the leading engineering consultancies in peat stability assessment, geohazard mapping in peat land areas, investigation of peat failures and site assessment of peat.

This Report was written by Ian Higgins (FT Principal Geotechnical Engineer, MSc in Geotechnical Engineering) and Alan Whelan (FT Project Engineer). Ian is a Principal Geotechnical Engineer with Fehily Timoney and has 25 years' experience in geotechnical engineering. Alan is a Project Engineer with Fehily Timoney and has three years' experience in geotechnical engineering.

2.2 Project Description

FT was engaged in December 2020 by MKO (on behalf of FuturEnergy Knockshanvo DAC) to undertake a geotechnical and peat stability assessment of the proposed Knockshanvo Wind Farm and Grid Connection (the "Proposed Development").

The Proposed Development is located approximately 4km northeast of Sixmilebridge, Co. Clare.

The Proposed Development site comprises predominantly blanket peatland. The surrounding landscape to the south and north is predominately rolling topography with land-use comprising forestry and blanket peatland.

The Proposed Development will comprise 9 no. wind turbines and associated hardstanding areas, an on-site electricity substation, 5 no. borrow pits, 3 no. temporary construction compounds, upgrade of existing roads, construction of new site access roads, underground cabling connecting to the existing Ardnacrusha substation, road widening and accommodation works along the turbine delivery route, 1 no. permanent meteorological mast, site drainage and all associated work as described in Chapter 4 of the EIAR. A temporary transition compound is proposed on the N69 as part of the TDR, however there is no peat present at this location and as such this area does not form part of the peat stability assessment.

2.3 Peat Stability Assessment Methodology

FT undertook the assessment following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (2nd edition, PLHRAG, 2017). The Peat Landslide Hazard and Risk Assessment Guide (PLHRAG) is used in this report as it provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects.

The aforementioned best practice guide was produced following peat failures in the Shetland Islands, Scotland in September 2003 but more pertinently following the peat failure in October 2003, during the construction of a wind farm at Derrybrien, County Galway, Ireland.

This peat stability assessment has been undertaken taking into account peat failures that have occurred on peatland sites (such as recent failures at Shass Mountain (2020), Co. Leitrim and Meenbog (2020), Co. Donegal). The lessons learned from both peat slide events have been incorporated into the design of this project and the construction methodologies to be implemented. The Meenbog failure occurred during the construction of a section of floating road on a wind farm on sidelong ground in an area of weak peat. This road construction technique is not proposed on the Knockshanvo site. It is important that the existing site drainage is maintained during construction to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the turbines/access roads. However, the Shass Mountain failure occurred in an area containing a deep peat layer (4-5m in depth), and the peat depths across the Knockshanvo site are typically less than 0.75m around the infrastructure of the Proposed Development, meaning that this type of failure is highly unlikely.

A constraints study was initially undertaken by the Environmental, Hydrogeological and Ecological members of the design team to determine the developable area on the site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from FT. The extent and depth of ground investigation and peat stability analysis by FT have been undertaken in accordance with guidance within PLHRAG (2nd Edition, 2017) to investigate peat slopes that have the potential to impact on the Proposed Development, as applicable. Sufficient peat depth data has been recorded during the site walkovers to enable the characterisation of the peat depth across the Proposed Development site, with additional detail at infrastructure locations. The peat stability assessment is undertaken to identify peat slopes at risk from the Proposed Development, and to identify peat slopes that may pose a risk to the Proposed Development.

The geotechnical and peat stability assessment at the site included the following activities:

(1) Desk study, involving the review of publicly available soils and geology maps, records of historical peat failures, aerial photography.

(2) Site reconnaissance including shear strength and peat depth measurements undertaken following initial multidisciplinary constraints study (by the design team) to determine the proposed construction areas within the site i.e. the area within the overall site where development is possible following multidisciplinary review and assessment of constraints (refer to Chapter 3 of the EIAR).

(3) Peat stability assessment of the peat slopes on site using a deterministic and qualitative approach.

(4) Peat contour depth plan – compiled based on the peat depth probes carried out across the site by FT (2023) and MKO (2022 and 2023).

(5) Factor of safety plan – compiled for the short-term critical condition (undrained) for approximately 240 no. FoS points analysed along the proposed infrastructure envelope on site.

(6) Construction buffer zone plan – identifies areas with an elevated or higher construction risk where mitigation/control measures will need to be implemented during construction to minimise the potential risks, as well as areas where construction works should be avoided.

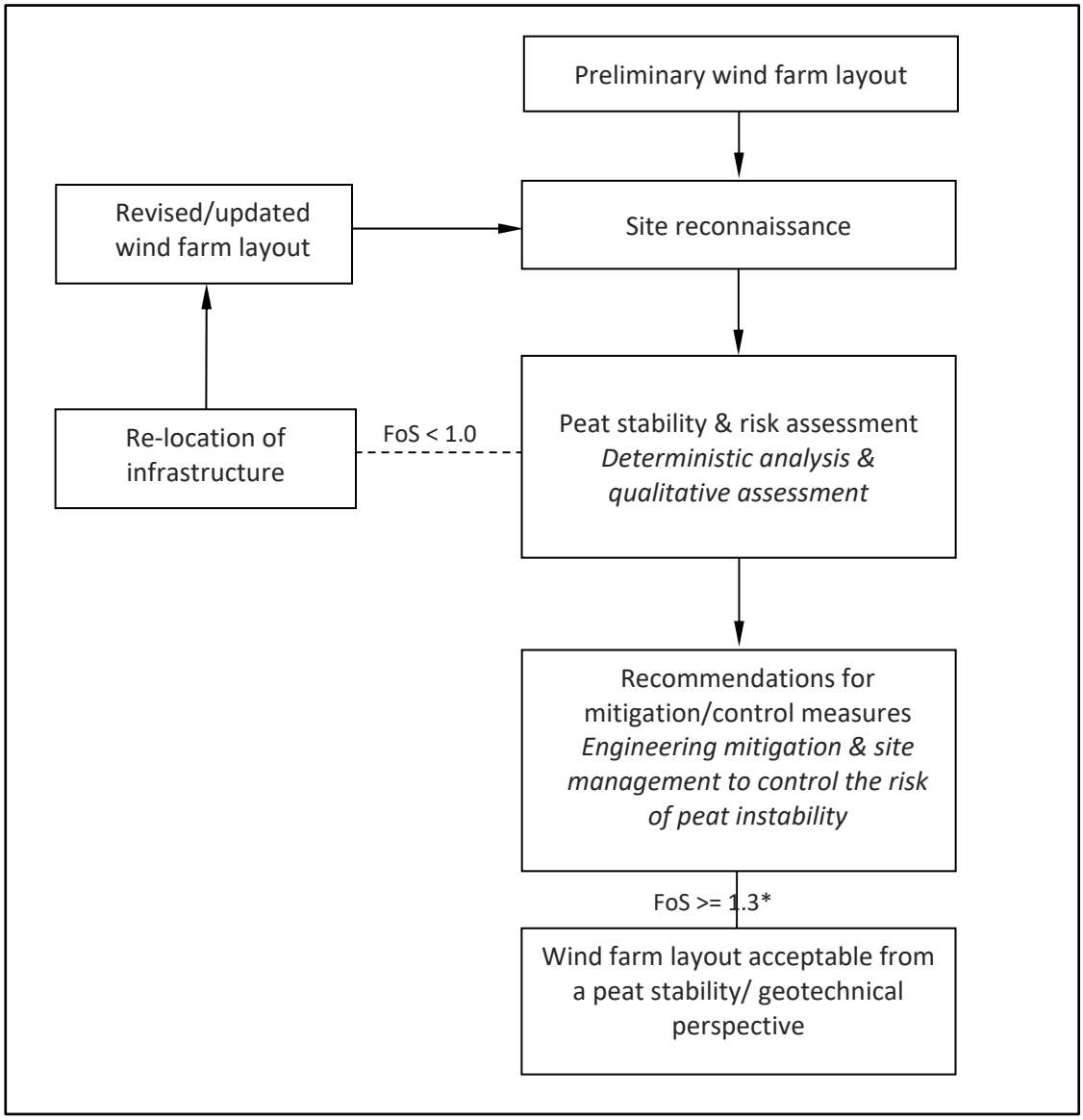
(7) A peat stability risk register was compiled to assess the potential design/construction risks at the infrastructure locations and determine adequate mitigation/control measures for each location to minimise the potential risks and ensure they are kept within an acceptable range, where necessary.

(8) Review of ground investigation carried out at the site by Irish Drilling Ltd. (IDL).

(9) Commentary of founding details for other infrastructure elements such as access roads, crane hardstands, substation & construction compound platforms and met mast foundation.

A flow diagram showing the general methodology for the peat stability assessment is shown in Figure 2.1. The methodology illustrates the optimisation of the wind farm layout based on the findings from the site reconnaissance and stability analysis and subsequent feedback.

Figure 2.1: Methodology for Peat Stability Assessment



*An FoS of between 1.0 and 1.3 does not mean that a failure will occur, but that the area requires attention. Mitigation measures can be provided for areas with an FoS of between 1.0 and 1.3 to reduce the risk of failure.

As for all construction projects, a detailed engineering construction design must be carried out by the appointed construction stage designer prior to any construction work commencing on site. This must take account of the consented project details and any conditions imposed by that consent. This must include a confirmatory peat stability assessment to account for any changes in the environment which may have occurred in the time leading up to the commencement of construction.

2.4 Peat Failure Definition

Peat failure in this report refers to a significant mass movement of a body of peat that would have an adverse impact on the proposed wind farm development or the surrounding environment. Peat failure excludes localised movement of peat that would occur below an access road, creep movement or erosion type events.

The potential for peat failure at this site is examined with respect to wind farm construction and associated activity.

2.5 Main Approaches to Assessing Peat Stability

The main approaches for assessing peat stability for wind farm developments include the following:

(1) Geomorphological

(2) Qualitative (judgement)

(3) Index/Probabilistic (probability)

(4) Deterministic (factor of safety)

Approaches (1) to (3) listed above are considered subjective and do not provide a definitive indication of stability; in addition, a high level of judgement/experience is required which makes it difficult to relate the findings to real conditions. FT apply a more objective approach, the deterministic approach (as discussed in Section 2.6).

As part of FT's deterministic approach, a qualitative risk assessment is also carried out taking into account qualitative factors, which cannot necessarily be quantified, such as the presence of mechanically cut peat, quaking peat, bog pools, sub peat water flow, slope characteristics and numerous other factors. The qualitative factors used in the risk assessment are compiled based on FT's experience of assessments and construction in peat land sites and peat failures throughout Ireland and the UK. FT have been involved with in excess of 100 wind farm developments across Ireland and the UK at various stages of development, from preliminary feasibility stage through planning and from scheme development at tender design and detailed design stage, through to the construction and operational stages. This approach follows the guidelines for geotechnical risk management as given in Clayton (2001), as referenced in the best practice for Peat Landslide Hazard and Risk Assessment Guide (PLHRAG, 2017), and takes into account the approach of MacCulloch (2005).

The risk assessment uses the results of the deterministic approach in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability to assess the risk of instability on a peatland site.

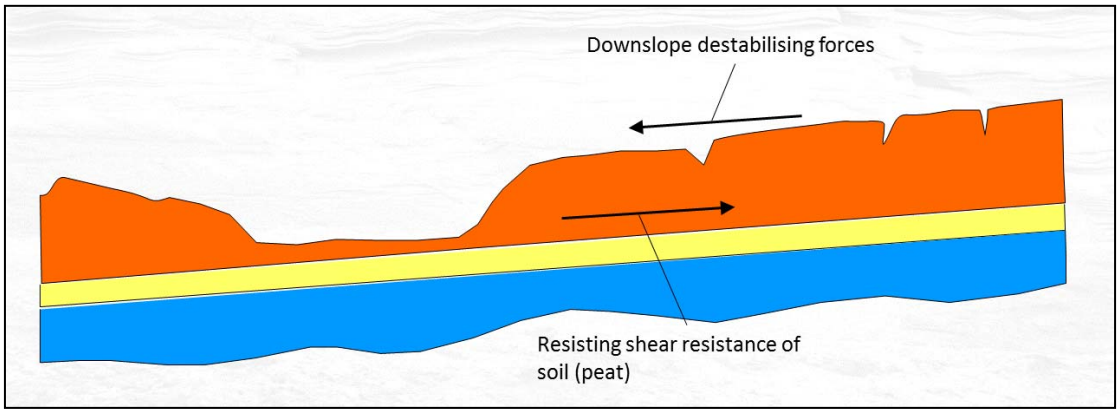
2.6 Peat Stability Assessment – Deterministic Approach

The peat stability assessment is carried out across a wide area of peatland to determine the stability of peat slopes and to identify areas of peatland that are suitable for development; this allows the layout of infrastructure on a particular wind farm site to be optimised. The assessment provides a numerical value (factor of safety) of the stability of individual parcels of peatland. The findings of the assessment discriminate between areas of stable and unstable peat, and areas of marginal stability where restrictions may apply. This allows for the identification of the most suitable locations for turbines, access roads and infrastructure.

A deterministic assessment requires geotechnical information and site characteristics which are obtained from desk study and site walkover, e.g. properties of peat/soil/rock, slope geometry, depth of peat, underlying strata, groundwater, etc. An adverse combination of the factors listed above could potentially result in instability. Using the information above, a factor of safety is calculated for the stability of individual parcels of peatland on a site (as discussed in Section 7).

The factor of safety is a measure of the stability of a particular slope. For any slope, the degree of stability depends on the balance of forces between the weight of the soil/peat working downslope (destabilising force) and the inherent strength of the peat/soil (shear resistance) to resist the downslope weight, see Figure 2.2.

Figure 2.2: Peat Slope Showing Balance of Forces to Maintain Stability



The factor of safety provides a direct measure of the degree of stability of a slope and is the ratio of the shear resistance over the downslope destabilising force. Provided the available shear resistance is greater than the downslope destabilising force then the factor of safety will be greater than 1.0 and the slope will remain stable. If the factor of safety is less than 1.0 the slope is unstable and liable to fail. The acceptable limit for factor of safety is typically 1.3.

2.7 Applicability of the Factor of Safety (Deterministic) Approach for Peat Slopes

The factor of safety approach is a standard engineering approach in assessing slopes which is applied to many engineering materials, such as peat, soil, rock, etc.

The factor of safety approach is included in the Peat Landslide Hazard and Risk Assessments Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, 2017); see Section 5.3.1 of the guide. This guide provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects.

Furthermore, the best practice guide notes that the results from the factor of safety approach 'has provided the most informative results' with respect to analysing peat stability (Section 5.3.1 of the guide).

The factor of safety approach in this report includes undrained (short-term stability) and drained (long-term stability) analyses. The undrained condition is the critical condition for the development. The purpose of the drained analysis is to identify the relative susceptibility of rainfall-induced failures at the site.

Notwithstanding the above, the stability analysis used by FT in this report also includes qualitative factors to determine the potential for peat stability i.e. the analysis used does not solely rely on the factor of safety approach.

The deterministic analysis is considered an acceptable engineering design approach. This concurs with the best practice guide referenced above.

2.8 Assessment of Intense Rainfall and Extreme Dry Events on the Peat Slope

The deterministic approach carried out by FT examines intense rainfall and extreme dry events. The deterministic approach includes an undrained (short-term stability) and drained (long-term stability) analysis to assess the factor of safety for the peat slopes against a peat failure.

The drained loading condition applies in the long-term. This condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes. For the drained analysis the level of the water table above the failure surface is required to calculate the factor of safety for the peat slope.

In order to represent varying water levels within the peat slopes, a sensitivity analysis is carried out which assesses varying water level in the peat slopes i.e. water levels ranging from 0 to 100% of the peat depth is conducted, where 0% equates to the peat been completely dry and 100% equates to the peat being fully saturated.

By carrying out such a sensitivity analysis with varying water level in the peat slopes, the effects of intense rainfall and extreme dry events are considered and analysed. The results of this analysis are presented in Section 7 of this report.

3. DESK STUDY

3.1 Desk Study

The main relevant sources of interest with respect to the site include:

- Geological plans and Geological Survey of Ireland database
- Ordnance survey plans
- Literature review of peat failures

The Geological Survey of Ireland online dataset viewer (GSI, 2023) and geological plans (GSI, 1999) for the site were used to verify the soil and bedrock conditions.

The Ordnance Survey plans were reviewed to determine if any notable features or areas of particular interest (from a geotechnical point of view) are present on the site.

The desk study also includes a review of both published literature and GSI online dataset viewer (GSI, 2023) on peat failures/landslides in the vicinity of the site.

3.2 Soils, Subsoil & Bedrock

A review of the Geological Survey of Ireland online database and published documents from GSI was carried out.

The GSI subsoils maps indicates that the site is underlain predominantly by blanket peat, with some pockets of till derived from Devonian sandstones, till derived from Lower Palaeozoic sandstones and shales and bedrock outcrop/subcrop.

In relation to bedrock, the site location and surrounding area is underlain by the following formations:

- Old Red Sandstone, described as red sandstone, conglomerate and mudstone
- Broadford Formation, a fine to conglomeratic graded greywacke
- Ballymalone Formation, a black graptolitic shale and chert
- Cornagnoe Formation, described as purple grits

Numerous faults are recorded across the site, trending in a northeast-southwest direction which cut across occasional northwest-southeast trending faults. The nearest quarry is located approximately 3km east of the site location in Faheymore, Co. Clare, and is described as a Sand & Gravel pit.

No karst features were identified within 5km of the Proposed Development site.

A single geological heritage site is noted along the southwestern edge of the site boundary and is described as streambank exposures of deep-water fossils of Upper Ordovician age. The site is of National Importance and is proposed for NHA designation.

The landslide susceptibility of the Proposed Development site was classified by the GSI (2023) as ranging from “low” to “high” susceptibility, with the higher risk areas corresponding to steeper slopes within the site.

There are no recorded peat failures within the site boundary. The nearest recorded failure is some 10km to the northeast, at Slieve Bearnagh, and is described as peat flow.

4. FINDINGS OF SITE RECONNAISSANCE

4.1 Site Reconnaissance

As part of the assessment of potential peat failure at the Proposed Development site, FT carried out a site reconnaissance in conjunction with the desk study review described in Section 3. This comprised walkover inspections of the site with recording of salient geomorphological features with respect to the wind farm development which included peat depth and preliminary assessment of peat strength. General photographs of the site are included at the end of the main text.

The following salient geomorphological features were considered:

- Active, incipient or relict instability (where present) within the peat deposits
- Presence of shallow valley or drainage line
- Wet areas
- Any change in vegetation
- Peat depth
- Slope inclination and break in slope

The survey covered the proposed locations for the turbine bases and associated infrastructure.

The method adopted for carrying out the site reconnaissance relied on experienced practitioners carrying out a visual assessment of the site supplemented with measurement of slope inclinations.

4.2 Findings of Site Reconnaissance

The site reconnaissance undertaken by FT comprised a walkover inspection of the site from the 7th to the 9th June 2023. Weather conditions for the site visit were predominately dry. Site visits were also undertaken by MKO during September and October 2021.

The findings from the site walkover have been used to optimise the layout of the infrastructure on site.

The main findings of the site walkover of the wind farm site are as follows:

(1) The site is typically covered in a layer of peat and has an undulating terrain. Peat depths vary across the site depending on mainly topography. Generally deeper peat was encountered in the flatter areas of the site with thinner peat on the surrounding slopes. The site comprises open peatland (see Appendix A).

(2) A total of approximately 569 no. peat depth probes were carried out on site during the various site visits. Peat depths recorded across the site ranged from 0 to 4.0m with an average depth of 0.55m (Drawing P20-153-0600-0001). Approximately 97 percent of peat depth probes recorded peat depths of less than 2.0m. A number of localised readings were recorded where peat depths were between 2.0 and 4.0m.

(3) The peat depths recorded at the turbine locations varied from 0.2 to 0.9m with an average depth of 0.4m.

(4) With respect to the proposed new access roads, peat depths are typically less than 1.0m (average 0.65m) with localised depths of up to 3.9m recorded.

(5) The Proposed Development will comprise both the upgrade of existing tracks and the construction of new proposed access roads, as well as widening of the local public road. The construction of new proposed access roads will be carried out using an excavate and replace construction technique which involves the removal and replacement of peat or soft ground where encountered, and replacement with granular fill.

(6) Slope angles at the turbine locations ranged from 3 to 18 degrees. These slope angle readings were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master which has an accuracy of +/- 0.25 degrees and from contour survey plans for the site.

(7) The slope angle quoted typically reflects the slope within the footprint of each infrastructure location.

(8) A summary of the site walkover findings for the wind farm are as follows:

(a) The site is typically covered in a layer of peat with undulating terrain open peatland. Peat depths recorded across the site ranged from 0.0 to 3.9m with an average depth of 0.55m.

(b) A construction buffer zone plan has been produced for the site (Drawing P20-153-0600-0004 to 0006). This shows areas on the site with an elevated or higher construction risk. No development is proposed in these areas. The above identified buffer areas are based on qualitative factors identified during the walkover survey e.g. relatively deep peat, quaking peat, mechanically cut peat, historical peat landslide, etc.

(c) The results of the peat depth probing, shear strength testing of the peat and qualitative factors identified on site have been used in the stability and risk assessments, see Sections 6, 7 and 8 of this report for details.

(d) Based on the findings from the walkover survey, the Proposed Development is considered to have a low risk of peat failure.

5. GROUND INVESTIGATION

Ground investigations were carried out at the Proposed Development site by Irish Drilling Limited (IDL) under the supervision of FT during August and September 2023. Ground investigation in the form of trial pits were carried out from the 28th to the 30th of August 2023, and rotary coring was undertaken between 11th and 15th September at three of the borrow pit locations.

The ground investigations by IDL comprised 13 no. trial pits and three number rotary cores with associated laboratory testing. The trial pits were carried out at various locations across the Proposed Development site to provide information on the ground conditions, and to investigate the potential to develop borrow pits within the site. Due to the heavily forested nature of the site, locations for ground investigation were limited, however it is considered that sufficient information has been gathered to classify the ground conditions across the site.

The laboratory testing included the following:

- Classification testing for overburden material
- Strength testing of bedrock

The trial pit logs, rotary core logs, photographs and associated laboratory testing are included within Appendix E of this report. A ground investigation location plan is included as Drawing P20-153-0600-0006 to 0009 in this report.

5.1 Summary of Ground Conditions

The ground conditions at the site can be categorised into the following deposits:

Peat – Typically described as soft black amorphous peat or soft dark brown peaty Silt.

Glacial Till – Stiff purplish brown slightly sandy gravelly Silt with occasional cobbles.

Weathered Bedrock – blackish orange angular Gravel with frequent cobbles.

Bedrock – weak to strong thinly laminated reddish brown fine and coarse grained thinly laminated Sandstone and thinly bedded dark reddish brown Siltstone. Discontinuities within the bedrock are typically described as closely spaced

Groundwater recorded in the trial pits varied from none to seepages and inflows between 0.7 and 2.3m bgl.

5.2 Summary of Laboratory Tests

Based on the results of the particle size distribution (PSD) tests, the descriptions on the final trial pit logs have been updated.

Atterberg limit tests carried out on the cohesive samples classify the cohesive material as Clay of low plasticity.

Strength testing undertaken on the bedrock samples indicates that the majority of samples were of strong and very strong rock, with one result indicting a weak bedrock.

5.3 Summary of Geotechnical Parameters

Table 5-1 contains characteristic geotechnical parameters for the main material types likely to be encountered on the Proposed Development site. Where direct measurement of parameters has not been carried out, established correlations with measured properties have been used to derive values. Characteristic values are defined as a cautious estimate of the value affecting the occurrence of limit state based on clause 2.4.5.2 from Eurocode 7.

Table 5-1: Summary of Geotechnical Parameters

Material Type/Strata	Unit Weight	Geotechnical Parameters		
		Undrained Parameters	Drained Parameters	
	γ (kN/m^3)	c_u (kPa)	φ' (°)[4]	c' (kPa)
Peat	10.5	8/10 [3]	25	4
Glacial Till	19	50	30	0
Weathered Bedrock	21	-	34	0
Bedrock	22	-	30	100

Notes
Note (1) The above parameters are indicative only and have been derived based on experience and from a review of the ground investigation carried out at the site.
Note (2) Where direct measurement of parameters has not been carried out, established correlations with measured properties have been used to derive values.
Note (3) A lower bound undrained shear strength, c_u for the peat of 8kPa (10kPa where slope is >10 degrees) was selected. The lowest recorded value on the Knockshanvo wind farm site was 12kPa, recorded in one location, hence a value of 8kPa is considered to be a conservative value.
Note (4) φ' (°) – internal angle of shearing resistance.

6. PEAT DEPTHS, STRENGTH & SLOPE AT PROPOSED INFRASTRUCTURE LOCATIONS

As part of the site walkover, peat depth, in-situ peat strength and slope angles were recorded at various locations across the site.

6.1 Peat Depth

Peat depth probes were carried out at/near to proposed turbine locations and access roads and other main infrastructure elements. At turbine locations up to 5 probes were carried out around the turbine location, and an average peat depth was calculated.

6.2 Peat Strength

The strength testing was carried out in-situ using a Geonor H-60 Hand-Field Vane Tester. From FT's experience hand vanes give indicative results for in-situ strength of peat and would be considered best practice for the field assessment of peat strength.

6.3 Slope Angle

The slope angles at each of the main infrastructure locations were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master and from contour survey plans for site.

The slope angle quoted typically reflects the slope within the footprint of each infrastructure location. It should be noted that slope angles derived from contour survey plans would be considered approximate, as such surveys are dependent on the density of survey data and do not always reflect local variations in ground topography. Slope angles recorded during the site reconnaissance by FT using handheld equipment would generally be deemed more accurate and representative of local topography.

6.4 Summary of Findings

Based on the peat depths recorded across the site by FT and MKO, the peat varied in depth from 0 to 3.9m with an average depth of 0.55m. All peat depth probes carried out on site have been utilised to produce a peat depth contour plan for the site (Drawing P20-153-0600-0001 to 0003).

A summary of the peat depths at the proposed infrastructure locations is given in Table 6.1. The data presented in Table 6.1 is used in the peat stability assessment of the site.

Table 6.1: Peat Depth & Slope Angle at Proposed Infrastructure Locations

Turbine	Easting	Northing	Peat Depth Range (m) (1)	Average Peat Depth (m)	Slope Angle (°) (2)
T01	553306	669427	0.6-0.9	0.8	14
T02	553422	670076	0.1-0.3	0.2	18
T03	553812	669851	0.2-0.3	0.2	5
T04	556212	669444	0.3-0.5	0.4	6
T05	556663	670013	0.1-0.3	0.2	5
T06	556896	669601	0.1-0.2	0.2	8
T07	556727	669042	0.1-0.2	0.1	4
T08	558463	669913	0.1-0.3	0.3	3
T09	558864	669557	0.2-0.5	0.35	6
Met Mast	556616	669888	0.2-0.4	0.3	5
Construction Compound (1)	558721	669647	0.3-0.4	0.35	4
Construction Compound (2)	556752	669614	0-0.2	0.1	4
Construction Compound (3)	553827	670016	0.1-0.4	0.25	4
Substation	557950	669555	0.1-0.9	0.5	5
Borrow Pit (1)	553448	669362	0.0-0.4	0.15	10
Borrow Pit (2)	555460	669814	0.2-0.5	0.35	4
Borrow Pit (3)	556339	669147	0.1-0.2	0.15	6
Borrow Pit (4)	555680	669600	0.6-1.2	0.75	11
Borrow Pit (5)	559145	669528	0.1-0.2	0.15	11

Note (1) Based on probe results from the site walkovers. The range of peat depths for the infrastructure locations are typically based on a 10m grid carried out around the infrastructure element, where accessible.

Note (2) The slope angles at each of the main infrastructure locations were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master (which has an accuracy of +/- 0.25 degrees) and from contour survey plans for site. The slope angle quoted typically reflects the slope within the footprint of each infrastructure location.

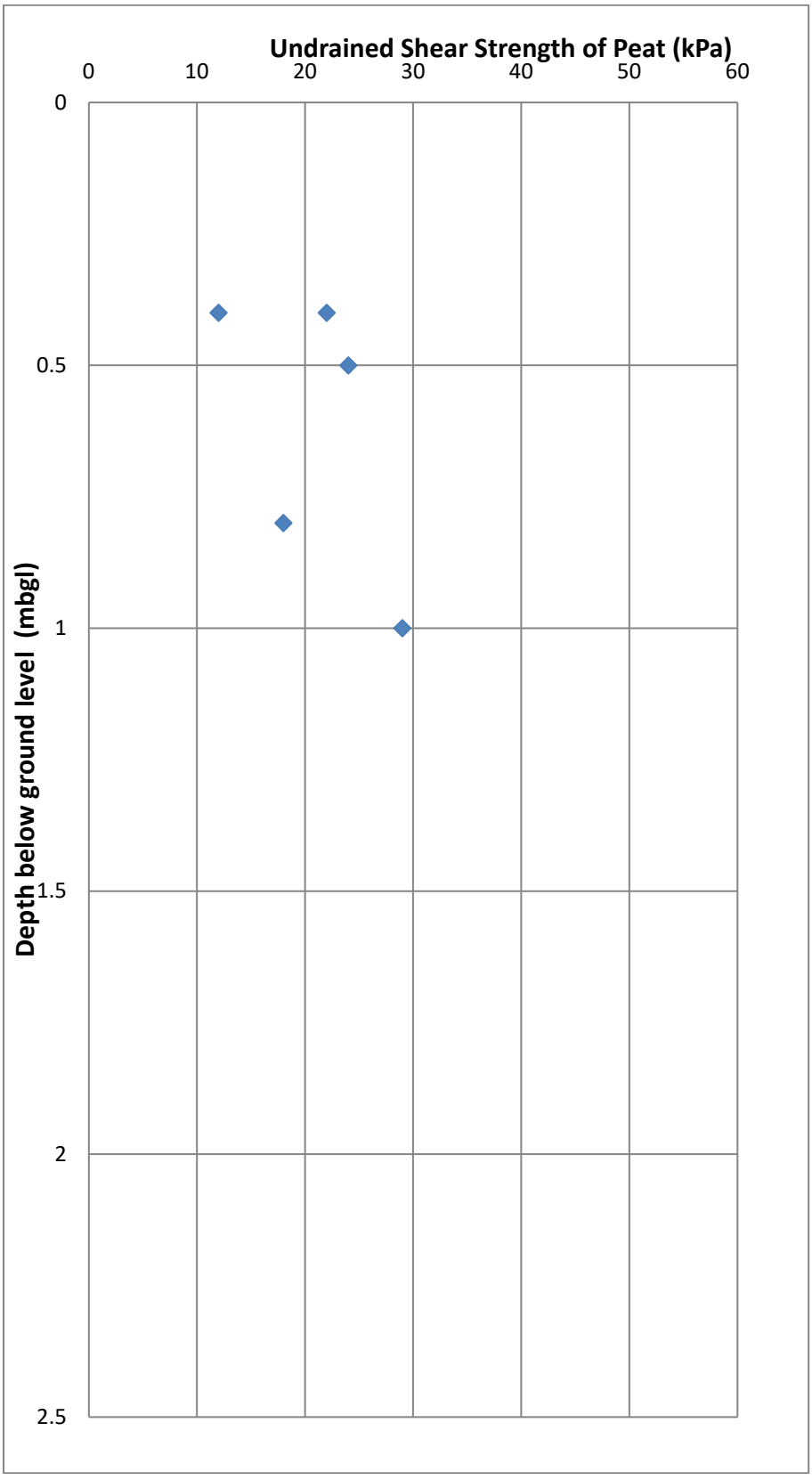
Note (3) The data presented in the Table above is used in the peat stability assessment of the site.

In addition to probing, in-situ shear vane testing was carried out as part of the ground investigation. Strength testing was carried out at turbine and other selected locations across the site to provide representative coverage of indicative peat strengths. The results of the vane testing with depth are presented in Figure 6.1.

The hand vane results indicate undrained shear strengths in the range 12 to 29kPa, with an average value of about 20kPa. The strengths recorded would be typical of shallow, well drained peat as is present on the Proposed Development site.

Peat strength at sites of known peat failures (assuming undrained loading failure) are generally very low, for example the undrained shear strength at the Derrybrien failure (AGEC, 2004) as derived from back-analysis, was estimated at 2.5kPa. The recorded undrained strength at Knockshanvo is greater than the lower bound values for Derrybrien indicating that there is no close correlation to the peat conditions at the Derrybrien site and that there is significantly less likelihood of failure on the Proposed Development site.

Figure 6.1: Undrained Shear Strength (c_u) Profile for Peat with Depth



7. PEAT STABILITY ASSESSMENTS

The peat stability assessment includes an assessment of the stability of the natural peat slopes for individual parcels across the site including at the turbine locations and along the proposed access roads. The assessment also analyses the stability of the natural peat slopes with a surcharge loading of 10kPa, equivalent to placing 1m of stockpiled peat on the surface of the peat slope.

7.1 Methodology for Peat Stability Assessment

Stability of a peat slope is dependent on several factors working in combination. The main factors that influence peat stability are slope angle, shear strength of peat, depth of peat, pore water pressure and loading conditions.

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To assess the factor of safety for a peat slide, an undrained (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site.

1. The undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

2. The drained loading condition applies in the long-term. The condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Undrained shear strength values (c_u) for peat are used for the total stress analysis. Based on the findings of the 2003 Derrybrien failure and other failures in peat, undrained loading during construction was found to be the critical failure mechanism.

A drained analysis requires effective cohesion (c') and effective friction angle (ø') values for the calculations. These values can be difficult to obtain because of disturbance experienced when sampling peat and the difficulties in interpreting test results due to the excessive strain induced within the peat. To determine suitable drained strength values a review of published information on peat was carried out. Table 7.1 shows a summary of the published information on peat together with drained strength values.

From Table 7.1 the values for c' ranged from 1.1 to 8.74kPa and ø' ranged from 21.6 to 43°. The average c' and ø' values are 4.5kPa and 30° respectively. Based on the above, it was considered to adopt a conservative approach and to use design values below the averages. For design the following general drained strength values have been used for the site:

c' = 4kPa
$ø'$ = 25°

Table 7.1: List of Effective Cohesion and Friction Angle Values for Peat

Reference	Cohesion, c' (kPa)	Friction Angle, ø' (degs)	Testing Apparatus/ Comments
Hanrahan et al (1967)	5 to 7	36 to 43	From triaxial apparatus
Rowe and Mylleville (1996)	2.5	28	From simple shear apparatus
Landva (1980)	2 to 4	27.1 to 32.5	Mainly ring shear apparatus for normal stress greater than 13kPa
	5 to 6	-	At zero normal stress
Carling (1986)	6.5	0	-
Farrell and Hebib (1998)	0	38	From ring shear and shear box apparatus. Results are not considered representative.
	0.61	31	From direct simple shear (DSS) apparatus. Result considered too low therefore DSS not considered appropriate
Rowe, Maclean and Soderman (1984)	1.1	26	From simple shear apparatus
	3	27	From DSS apparatus
McGreever and Farrell (1988)	6	38	From triaxial apparatus using soil with 20% organic content
	6	31	From shear box apparatus using soil with 20% organic content
Hungr and Evans (1985)	3.3	-	Back-analysed from failure
Dykes and Kirk (2006)	3.2	30.4	Test within acrotelm
Dykes and Kirk (2006)	4	28.8	Test within catotelm
Warburton et al (2003)	5	23.9	Test in basal peat
Warburton et al (2003)	8.74	21.6	Test using fibrous peat
Hendry et al (2012)	0	31	Remoulded test specimen
Komatsu et al (2011)	8	34	Remoulded test specimen
Zwanenburg et al (2012)	2.3	32.3	From DSS apparatus
Den Haan & Grognet (2014)	-	37.4	From large DSS apparatus
O'Kelly & Zhang (2013)	0	28.9 to 30.3	Tests carried out on reconstituted, undisturbed and blended peat samples

7.2 Analysis to Determine Factor of Safety (Deterministic Approach)

The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes using infinite slope analysis. The analysis was carried out at the turbine locations, along the proposed access roads and at various locations across the site.

The FoS provides a direct measure of the degree of stability of the slope. A FoS of less than 1.0 indicates that a slope is unstable, a FoS of greater than 1.0 indicates a stable slope (PLHRAG, 2nd Edition, 2017).

The acceptable safe range for FoS typically ranges from 1.3 to 1.4. The previous code of practice for earthworks BS 6031:1981 (BSI, 1981), provided advice on design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation the design FoS should be greater than 1.3.

As a general guide the FoS limits for peat slopes in this report are summarised in Table 7.2.

Table 7.2: Factor of Safety Limits for Slopes

Factor of Safety (FoS)	Degree of Stability
Less than 1.0	Unstable (red)
Between 1.0 and 1.3	Marginally stable (yellow)
1.3 or greater	Acceptable (green)

Eurocode 7 (EC7) (IS EN 1997-1:2005) now serves as the reference document and the basis for design geotechnical engineering works. The design philosophy used in EC7 applies partial factors to soil parameters, actions and resistances. Unlike the traditional approach, EC7 does not provide a direct measure of stability, since global Factors of Safety are not used.

As such, and in order to provide a direct measure of the level of safety on a site, EC7 partial factors have not been used in this stability assessment. The results are given in terms of FoS.

A lower bound undrained shear strength, c_u for the peat of 8kPa (10kPa in localised areas where slope is >10 degrees) was selected for the assessment based on the c_u values recorded within the proposed development boundary. It should be noted that a c_u of 8kPa for the peat is considered a conservative value for the analysis and is not representative of all peat present across the site. In reality the peat has a higher undrained strength than the value used for the stability analysis.

The formula used to determine the factor of safety for the undrained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c_u}{\gamma z \sin\alpha \cos\alpha}$$

Where:

F = Factor of Safety

c_u = Undrained strength

γ = Bulk unit weight of material
z = Depth to failure plane assumed as depth of peat
α = Slope angle

The formula used to determine the factor of safety for the drained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c' + (\gamma z - \gamma_w h_w)\cos^2 \alpha \tan \phi'}{\gamma z \sin \alpha \cos \alpha}$$

Where:

F = Factor of Safety
c' = Effective cohesion
γ = Bulk unit weight of material (Peat)
z = Depth to failure plane assumed as depth of peat
γ_w = Unit weight of water
h_w = Height of water table above failure plane
α = Slope angle
ϕ' = Effective friction angle

For the drained analysis the level of the water table above the failure surface is required to calculate the factor of safety for the slope. Since the water level in blanket peat can be variable and can be recharged by rainfall, it is not feasible to establish its precise location throughout the site. Therefore, a sensitivity analysis using water level ranging between 0% and 100% of the peat depth was conducted, where 0% equates to the peat being completely dry and 100% equates to the peat been fully saturated. The results quoted for the drained condition are for the fully saturated case.

The following general assumptions were used in the analysis of peat slopes at each location:

(1) Peat depths are based on the maximum peat depth recorded at each location from the walkover surveys.

(2) The slope angles used in the peat stability assessment were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment and from contour survey plans for site. It should be noted that slope angles derived from contour survey plans would be considered approximate, as such surveys are dependent on the density of survey data and do not always reflect local variations in ground topography.

(3) Slope angle at base of sliding assumed to be parallel to ground surface.

(4) A lower bound undrained shear strength, c_u for the peat of 8kPa, was selected for the assessment where the slopes were less than 10 degrees, and 10kPa where the slope is greater than 10 degrees. The lowest recorded value on the Knockshanvo wind farm site during the site walkover was 12kPa. It should be noted that a c_u of 8/10kPa for the peat is considered a conservative value for the analysis and is not representative of all peat present across the site. In reality, the majority of the peat has a significantly higher undrained strength as a result of the shallow nature of the peat and the extensive drainage present within the forestry across the site.

For the stability analysis two load conditions were examined, namely

Condition (1): no surcharge loading
Condition (2): surcharge of 10 kPa, equivalent to 1m of stockpiled peat assumed as a worst case.

7.3 Results of Analysis

7.3.1 Undrained Analysis for the Peat

The results of the undrained analysis for the natural peat slopes at all locations analysed are presented in Appendix C and the results of the undrained analysis for the most critical load case (load condition 2) are shown on Figure 7.1. The undrained analysis for load condition 2 is considered the most critical load case as most peat failures occur in the short term upon loading of the peat surface. The results from the main infrastructure locations, including along access roads, are summarised in Table 7.3 to 7.5.

The calculated FoS for load condition 1 is in excess of 1.30 for each of the locations (249 no. locations) analysed with a range of FoS of 2.10 to 229.37, indicating a low risk of peat instability.

The calculated FoS for load condition 2 is in excess of 1.30 for all of the locations) analysed with a range of FoS of 1.35 to 20.85, again indicating a low risk of peat instability.

Table 7.3: Factor of Safety Results (Undrained Condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T01	553306	669427	**4.73**	**2.24**
T02	553422	670076	**11.34**	**2.62**
T03	553812	669851	**30.71**	**7.09**
T04	556212	669444	**15.39**	**5.13**
T05	556663	670013	**30.71**	**7.09**
T06	556896	669601	**19.35**	**4.47**
T07	556727	669042	**57.48**	**9.58**
T08	558463	669913	**38.27**	**10.93**
T09	558864	669557	**15.39**	**5.13**
Met Mast	556203	669109	**30.71**	**7.09**
Construction Compound (1)	558721	669647	**3.43**	**1.80**
Construction Compound (2)	556752	669614	**57.48**	**9.58**
Construction Compound (3)	553827	670016	**22.99**	**7.66**
Substation	557950	669555	**10.24**	**4.85**
Borrow Pit (1)	553448	669362	**51.78**	**4.71**

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Borrow Pit (2)	555460	669814	**7.26**	**3.22**
Borrow Pit (3)	556339	669147	**38.48**	**6.41**
Borrow Pit (4)	555680	669600	**14.23**	**4.74**
Borrow Pit (5)	559145	669528	**38.48**	**6.41**

Table 7.4: Factor of Safety Results along Access Roads (Undrained Condition)

Location	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Site entrance – T09	Varies		**42.60**	**3.87**
T09-T08	Varies		**4.84**	**2.64**
T08-T06	Varies		**10.68**	**3.56**
T06-T07	Varies		**30.91**	**5.15**
T06-T05	Varies		**14.20**	**3.28**
T07-T04	Varies		**4.85**	**3.18**
T04-BP4	Varies		**9.75**	**3.08**
BP4-T03	Varies		**7.30**	**2.43**
T03-T01	Varies		**2.75**	**2.03**
T03-T02	Varies		**3.78**	**1.79**

Table 7.5: Factor of Safety Results Settlement Ponds (Undrained Condition)

Location	Settlement Pond Number	Factor of Safety for Load Condition	
		Condition (1)	Condition (2)
T1	tbc	**11.02**	**4.13**
T2	tbc	**4.19**	**1.99**
T3	tbc	**7.73**	**3.43**
T4	tbc	**13.16**	**5.42**
T5	tbc	**10.30**	**3.86**
T6	tbc	**22.81**	**3.80**
T7	tbc	**4.27**	**2.14**

Location	Settlement Pond Number	Factor of Safety for Load Condition	
		Condition (1)	Condition (2)
T8	tbc	23.04	6.58
T9	tbc	19.16	7.19
Met Mast	tbc	30.71	7.09
Substation	tbc	10.24	4.85
Construction Compound (1)	tbc	3.43	1.80
Construction Compound (2)	tbc	57.48	9.58
Construction Compound (3)	tbc	22.99	7.66
Borrow Pit (1)	tbc	51.78	4.71
Borrow Pit (2)	tbc	7.26	3.22
Borrow Pit (3)	tbc	38.48	6.41
Borrow Pit (4)	tbc	14.23	4.74
Borrow Pit (5)	tbc	38.48	6.41

7.3.2 Drained Analysis for the Peat

The results of the drained analysis for the peat are presented in Appendix C. The results from the main infrastructure locations, including along access roads and in areas of peat placement, are summarised in Table 7.6 to 7.8. As stated previously, the drained loading condition examines the effect of in particular, rainfall on the existing stability of the natural peat slopes and represents the post construction phase of the development.

The calculated FoS for load condition 1 is in excess of 1.30 for each of the locations (249 no. locations) analysed with a range of FoS of 1.89 to 128.04, indicating a low risk of peat instability.

The calculated FoS for load condition 2 is in excess of 1.30 for each of the locations (249 no. locations) analysed with a range of FoS of 1.88 to 33.88, indicating a low risk of peat instability.

Table 7.6: Factor of Safety Results (Drained Conditions)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T01	553306	669427	1.89	1.88
T02	553422	670076	4.54	2.15
T03	553812	669851	15.36	4.64
T04	556212	669444	7.70	5.52
T05	556663	670013	15.36	7.64
T06	556896	669601	9.67	4.78

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T07	556727	669042	28.74	10.35
T08	558463	669913	19.13	11.82
T09	558864	669557	7.70	5.52
Met Mast	556203	669109	20.69	8.87
Construction Compound (1)	558721	669647	3.00	2.35
Construction Compound (2)	556752	669614	28.74	10.35
Construction Compound (3)	553827	670016	11.50	8.28
Substation	557950	669555	10.45	7.75
Borrow Pit (1)	553448	669362	28.83	5.30
Borrow Pit (2)	555460	669814	6.95	4.93
Borrow Pit (3)	556339	669147	23.68	7.64
Borrow Pit (4)	555680	669860	11.21	6.46
Borrow Pit (5)	559145	669528	23.68	7.64

Table 7.7: Factor of Safety Results along access roads (Drained Condition)

Location	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Site entrance – T09	Varies		18.91	3.42
T09-T08	Varies		5.74	4.64
T08-T06	Varies		6.67	3.82
T06-T07	Varies		19.00	6.12
T06-T05	Varies		7.55	3.18
T07-T04	Varies		7.75	6.92
T04-BP4	Varies		6.54	4.11
BP4-T03	Varies		5.67	3.24
T03-T01	Varies		5.81	5.45
T03-T02	Varies		2.95	2.15

Table 7.8: Factor of Safety Results Settlement Ponds (Drained Condition)

Location	Settlement Pond Number	Factor of Safety for Load Condition	
		Condition (1)	Condition (2)
T1	tbc	9.31	5.86
T2	tbc	3.30	2.42
T3	tbc	7.41	5.26
T4	tbc	11.19	8.04
T5	tbc	8.69	5.47
T6	tbc	11.14	3.54
T7	tbc	4.53	3.47
T8	tbc	16.85	8.62
T9	tbc	16.25	10.26
Met Mast	tbc	20.69	8.87
Substation	tbc	10.45	7.75
Construction Compound (1)	tbc	3.00	2.35
Construction Compound (2)	tbc	28.74	10.35
Construction Compound (3)	tbc	18.16	10.50
Borrow Pit (1)	tbc	28.83	5.30
Borrow Pit (2)	tbc	6.95	4.93
Borrow Pit (3)	tbc	23.68	7.64
Borrow Pit (4)	tbc	11.21	6.46
Borrow Pit (5)	tbc	23.68	7.64

7.4 Stability of Borrow Pit Berm

A stability check has been undertaken to demonstrate the stability of the proposed perimeter berms around the proposed borrow pits. The perimeter berm is considered to be more critical than any internal buttresses, as peat is only present on one side of the buttress. Slope stability has been checked using SlopeW© slope stability software. The analysis was carried out to EC7 design standards. The design philosophy used in EC7 applies partial factors to soil parameters, actions and resistances. Unlike the traditional approach, EC7 does not provide a direct measure of stability, since global Factors of Safety are not used. Rather, it provides a result in terms of an overdesign ratio (ODR), where an ODR of >1 is stable, and an ODR of <1 is unstable.

The following material properties have been used in the stability assessment. A low strength for the peat retained within the borrow pit/repositories has been used to model the effect of disturbance on the saturated peat mass. For the purposes of the assessment shallow failures in the surface of the berm have not been considered.

Table 7.9: Material Properties

Material	Unit Weight (kN/m^3)	Undrained Shear Strength, c_u (kPa)	Angle of Shearing Resistance, ϕ (degrees)	Effective Cohesive, c' (kPa)
Intact Peat	10.5	8	25	4
Granular fill (berm)	21	-	42	0
Retained Peat within Borrow Pit (disturbed)	10.5	2	5	2
Glacial Till	19	50	30	0
Bedrock	22	-	30	100

This assessment considers the northern face of Borrow Pit 1, on the eastern side of the site. The berm along the northern side of the borrow pit will be up to 5m in height. Bedrock has been assessed at 2m below ground level based on the available ground investigation information, overlain by 0.5m of peat and 1.5m of cohesive glacial material. All peat and any soft clay that may be present will be excavated from below the perimeter berm. The base of the rock berm will be benched into the glacial till to create a level platform. The inside slope of the perimeter berm has been modelled as a 60 degree slope in intact bedrock, and the outside slope as 40 degrees. A construction loading of 20kPa has been included for the undrained (short-term analysis). Groundwater has been assumed at ground level on the downslope side of the berm. The analysis assumes that all of the material contained within the borrow pit is a low strength peat, which is conservative as it is likely that some excavated overburden (which will have a higher strength) will also be stored in the borrow pits.

The stability analysis has been undertaken using both undrained (short term) and drained (long term) strength parameters and shows that the berm is stable in both cases.

Table 7.10: Borrow Pit Stability Analysis

Borrow Pit	Over Design Ratio (ODR)	
	DA1C1	DA1C2
Undrained Analysis	1.42	1.28
Drained Analysis	1.34	1.07

Figure 7.1: Borrow Pit Stability Check, Undrained DA1C1

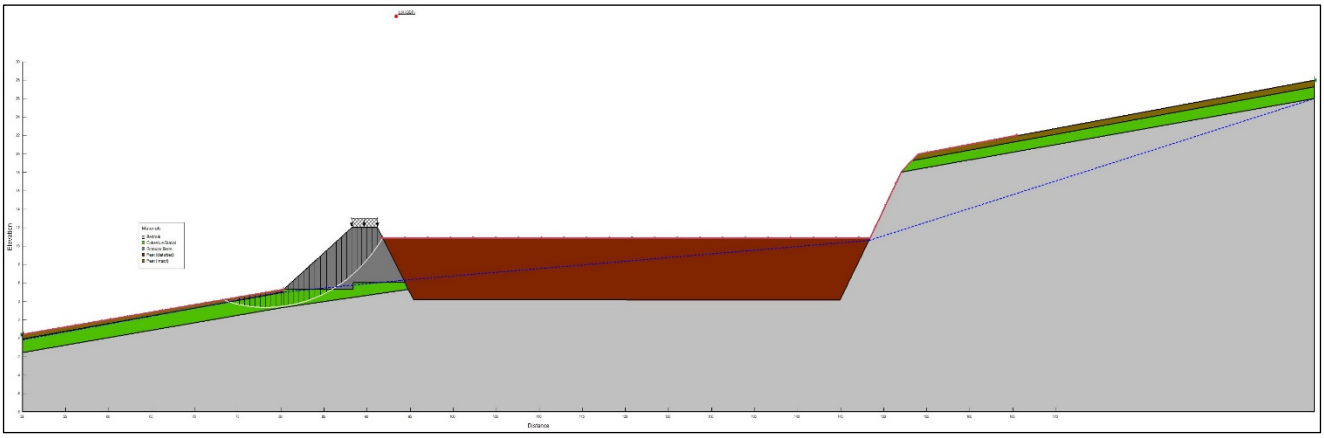


Figure 7.2: Borrow Pit Stability Check, Undrained DA1C2

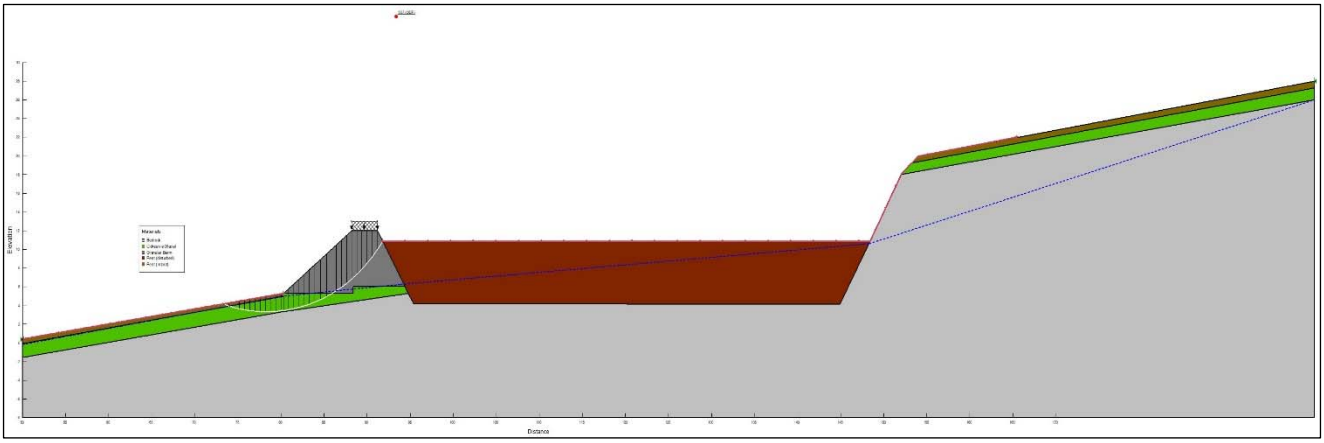


Figure 7.3: Borrow Pit Stability Check, Drained DA1C1

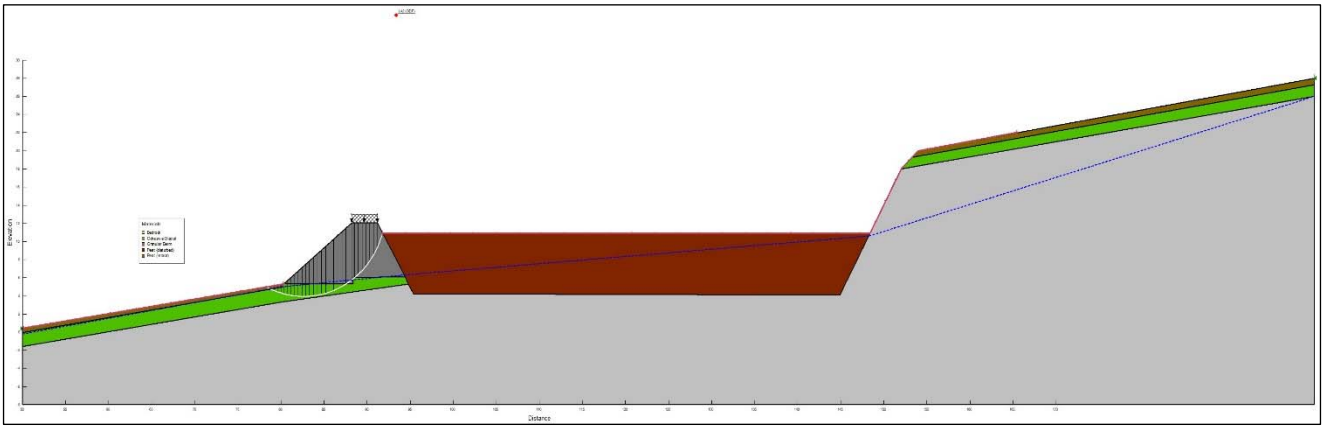
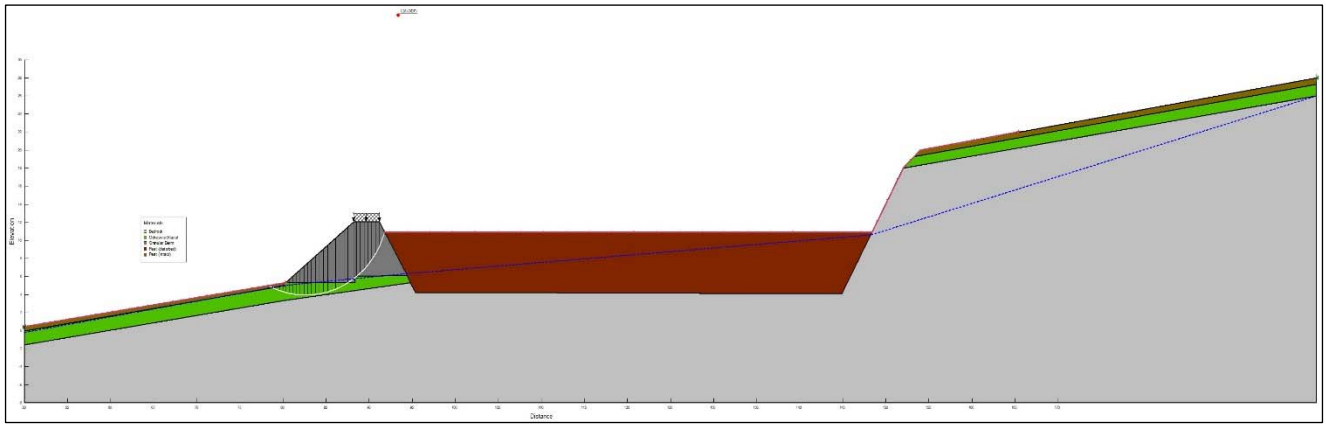


Figure 7.4: Borrow Pit Stability Check, Drained DA1C2



8. PEAT STABILITY RISK ASSESSMENT

A peat stability risk assessment was carried out for the main infrastructure elements at the Proposed Development. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRA (2017) and MacCulloch (2005).

The risk assessment uses the results of the stability analysis (deterministic approach) in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability, to assess the risk for each infrastructure element.

For each of the main infrastructure elements, a risk rating (product of probability and impact) is calculated and rated as shown in Table 8.1. Where a subsection is rated 'Medium' or 'High', control measures are required to reduce the risk to at least a 'Low' risk rating. Where a subsection is rated 'Low' or 'Negligible', only routine control measures are required.

Table 8.1: Risk Rating Legend

17 to 25	High: avoid works in area or significant control measures required
11 to 16	Medium: notable control measures required
5 to 10	Low: only routine control measures required
1 to 4	Negligible: none or only routine control measures required

A full methodology for the peat stability risk assessment is given in Appendix D.

8.1 Summary of Risk Assessment Results

The results of the peat stability risk assessment for potential peat failure at the main infrastructure elements is presented as a Geotechnical Risk Register in Appendix B and summarised in Table 8.2.

The risk rating for each infrastructure element at the Proposed Development is designated Negligible or Low following some general mitigation/control measures being implemented. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure element.

Details of the required mitigation/control measures can be found in the Geotechnical Risk Register for each infrastructure element (Appendix B) and are summarised below:

- Detailed ground investigation to confirm peat, mineral soil and bedrock condition and properties.
- Use of experienced geotechnical staff for site investigation.
- Maintain hydrology of area as far as possible by maintaining existing drains to prevent the build-up of water pressures in the peat, leading to the peat becoming "buoyant".
- Use of experienced contractors and trained operators to carry out the work.

Table 8.2: Summary of Peat Stability Risk Register

Infrastructure	Pre-Control Measure Implementation Risk Rating	Pre-Control Measure Implementation Risk Rating Category	Notable Control Measures Required	Post-General Control Measure Implementation Risk Rating	Post-General Control Measure Implementation Risk Rating Category
T01	Low	5 to 10	No	Low	5 to 10
T02	Low	5 to 10	No	Low	5 to 10
T03	Negligible	1 to 4	No	Negligible	1 to 4
T04	Negligible	1 to 4	No	Negligible	1 to 4
T05	Negligible	1 to 4	No	Negligible	1 to 4
T06	Negligible	1 to 4	No	Negligible	1 to 4
T07	Low	5 to 10	No	Low	5 to 10
T08	Negligible	1 to 4	No	Negligible	1 to 4
T09	Negligible	1 to 4	No	Negligible	1 to 4
Met Mast	Negligible	1 to 4	No	Negligible	1 to 4
Construction Compound (1)	Negligible	1 to 4	No	Negligible	1 to 4
Construction Compound (2)	Negligible	1 to 4	No	Negligible	1 to 4
Construction Compound (3)	Negligible	1 to 4	No	Negligible	1 to 4
Substation	Negligible	1 to 4	No	Negligible	1 to 4
Borrow Pit (1)	Negligible	1 to 4	No	Negligible	1 to 4
Borrow Pit (2)	Low	5 to 10	No	Negligible	1 to 4
Borrow Pit (3)	Negligible	1 to 4	No	Negligible	1 to 4
Borrow Pit (4)	Negligible	1 to 4	No	Negligible	1 to 4
Borrow Pit (5)	Negligible	1 to 4	No	Negligible	1 to 4

9. INDICTATIVE FOUNDATION TYPE AND FOUNDATION DEPTH FOR TURBINES

9.1 Summary

Based on a review of the ground investigation and walkover information for the Proposed Development site, an assessment of the likely foundation type and founding depths for each turbine location was carried out. A summary of this assessment is provided in Table 9-1.

Table 9-1: Summary of Indicative Turbine Foundation Type and Founding Depths

Turbine No.	Turbine Foundation Type	Relevant GI	Indicative founding depth (m bgl)	Summary
T01	Gravity foundation	Peat probes/TP11	3.0	Found on intact bedrock at 2.1m bgl.
T02	Gravity foundation	Peat probes/TP09	3.0	Found on intact bedrock at 2.5m bgl.
T03	Gravity foundation	Peat probes/TP10	3.0	Found on intact bedrock at 2.5m bgl.
T04	Gravity foundation	Peat probes	3.0	
T05	Gravity foundation	Peat probes/TP03	3.0	Found on intact bedrock at 3.0m bgl.
T06	Gravity foundation	Peat probes/TP02	3.0	Found on intact bedrock at 3.0m bgl.
T07	Gravity foundation	Peat probes/TP07	4.0	Found on stiff Silt at 4.0m bgl
T08	Gravity foundation	Peat probes	3.0	
T09	Gravity foundation	Peat probes	3.0	
Met Mast	Gravity foundation	Peat probes	1.0	

It should be noted that confirmatory ground investigation will be carried out prior to construction at each turbine location, in the form of a borehole with in-situ SPT testing at 1m intervals in the overburden and follow-on rotary core through bedrock, to confirm the foundation types and founding stratums indicated in Table 9-1. It is likely that following the completion of further ground investigation prior to construction that the turbine bases will be deemed suitable for gravity type foundations.

For gravity type turbine foundations, where the depth of excavation exceeds the required founding depth for the proposed turbine base, up-fill material consisting of granular fill (6N) will be used to backfill the excavation to the required founding depth.

10. FOUNDING DETAILS FOR INFRASTRUCTURE ELEMENTS (EXCEPT TURBINES)

This section provides a summary of the founding details for various elements of the proposed infrastructure across the Proposed Development site. The detailed methodologies for the construction of these elements of the Proposed Development are included in Chapter 4 of the EIAR.

10.1 Access Roads

The access roads on site will be constructed as excavate and replace (founded) type construction, which, given the ground conditions and type of terrain present, is deemed the most appropriate construction approach. Floating road construction will not be undertaken on the Proposed Development.

The total length of new proposed access road to be constructed on site is 9.1km, with 3.2km of existing roads requiring upgrade (see Drawings P20-153-0600-0013 to 0015 of the Peat and Spoil Management Plan – Appendix 4-2 of the EIAR).

The proposed make-up of the founded access roads is a minimum stone thickness of 750mm. The requirement for a layer of geotextile and geogrid and the necessary stone thickness will be confirmed at pre-construction stage.

See the Peat & Spoil Management Plan for the Proposed Development for further details on the proposed access roads on site.

10.2 Crane Hardstands

The crane hardstands will be constructed using the founded technique (i.e. not floated) technique.

Crane hardstands are constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance. The hardstands will be designed for the most critical loading combinations from the crane.

The hardstands will be founded on competent material underlying the peat deposits. The founding levels for the hardstands will vary across the Proposed Development and will be confirmed at pre-construction stage.

The make-up of the hardstands will include a minimum of 1000mm of granular stone fill with a layer of geotextile and/or geogrid, if deemed necessary by the Designer.

10.3 Substation Foundations & Platforms

The substation platform will be constructed using the founded technique (i.e. not floated technique). The substation foundations will comprise strip/raft foundations under the main footprint of the building with a basement/pit for cable connections.

Substation platforms are constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance.

The substation platform will be founded on competent material underlying the peat deposits.

Given the ground conditions likely to be present at the proposed substation, the foundations will require to be founded on firm glacial till or medium dense granular material. The founding depth for the substation platform will be 0.5-1.0m bgl.

The make-up of the substation platform will include up to 1000mm of granular stone fill with a layer of geotextile and/or geogrid if deemed necessary by the Designer. At the underside of the substation foundations, a layer of structural up-fill (class 6N) will be required.

10.4 Construction Compound Platforms

The construction compound platforms will be constructed using the founded technique (i.e. not floated technique).

The construction compound platforms will be constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance.

The construction compound platforms will be founded on material underlying the peat deposits.

Typical founding depth for construction compound platforms will require the removal of 0.5m of peat.

The typical make-up of the construction compound platform will include up to 750mm of granular stone fill with possibly a layer of geotextile and/or geogrid.

10.5 Met Mast Foundations

The met mast foundation will comprise a gravity type foundation.

Given the ground conditions present at the proposed met mast, the foundation will be founded on glacial till, or weathered bedrock.

The founding depth for the met mast foundation is envisaged to be 0.5 to 1.0m bgl. At the underside of the met mast foundation, a layer of structural up-fill (class 6N) will be required.

11. SUMMARY AND RECOMMENDATIONS

11.1 Summary

The following summary is given.

FT was engaged by MKO to undertake a geotechnical and peat stability assessment of the Proposed Development site.

The findings of the peat assessment showed that the site has a low risk of peat failure and is suitable for the Proposed Development. The findings include recommendations and control measures for construction work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

The site is typically covered in a shallow layer of blanket peat with undulating terrain of commercial forestry and open peatland.

Peat thicknesses recorded during the site walkovers from 569 probes ranged from 0.0 to 3.9m with an average depth of 0.55m. 97% of the probes recorded peat depths of less than 2.0m. The average peat depth at any of the proposed turbine locations is 0.4m.

Slope inclinations at the main infrastructure locations range from 3 to 18 degrees.

An analysis of peat sliding was carried out at the main infrastructure locations (including along all access roads) across the Proposed Development site for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes.

An undrained analysis was carried out, which applies in the short-term during construction. For the undrained condition, the calculated FoS for load conditions 1 and 2 for the locations analysed showed that all locations have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure. The undrained analysis is considered the most critical condition for the peat slopes.

A drained analysis was also carried out, which examined the effect of in particular, rainfall on the existing stability of the natural peat slopes on site. For the drained condition, the calculated FoS for load conditions (1) & (2) for the locations analysed, showed that all locations have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure.

The peat stability risk assessment at each infrastructure location, along access roads, in peat placement areas and at settlement pond locations identified a number of mitigation/control measures to reduce the potential risk of peat failure. See Appendix B for details of the required mitigation/control measures for each infrastructure element.

In summary, the findings of the peat assessment showed that the Proposed Development has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at **low** risk of peat failure provided appropriate mitigation measures, such as implementing and maintaining an appropriate drainage system are implemented. The findings include recommendations and mitigation/control measures for construction work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

11.2 Recommendations

The following recommendations are given, all of which will be implemented in full.

Notwithstanding that the Proposed Development site has a low risk of peat failure, a number of mitigation/control measures are prescribed to ensure that all works adhere to an acceptable standard of safety for work in peatlands. Mitigation/control measures identified for each of the infrastructure elements in the risk assessment will be implemented throughout design and construction works (Appendix B).

The proposed construction method for all the new proposed access roads at the wind farm is excavate and replace type construction.

The measures prescribed in FT's report 'Peat & Spoil Management Plan - Knockshanvo Wind Farm, County Clare' (FT, 2023) will be implemented in full during the design and construction stage of the wind farm development.

To minimise the risk of construction activity causing potential peat instability the Construction Method Statements (CMSs) for the project will implement in full, but not be limited to, the recommendations above. This will ensure that best practice guidance regarding the management of peat stability will be inherent in the construction phase.

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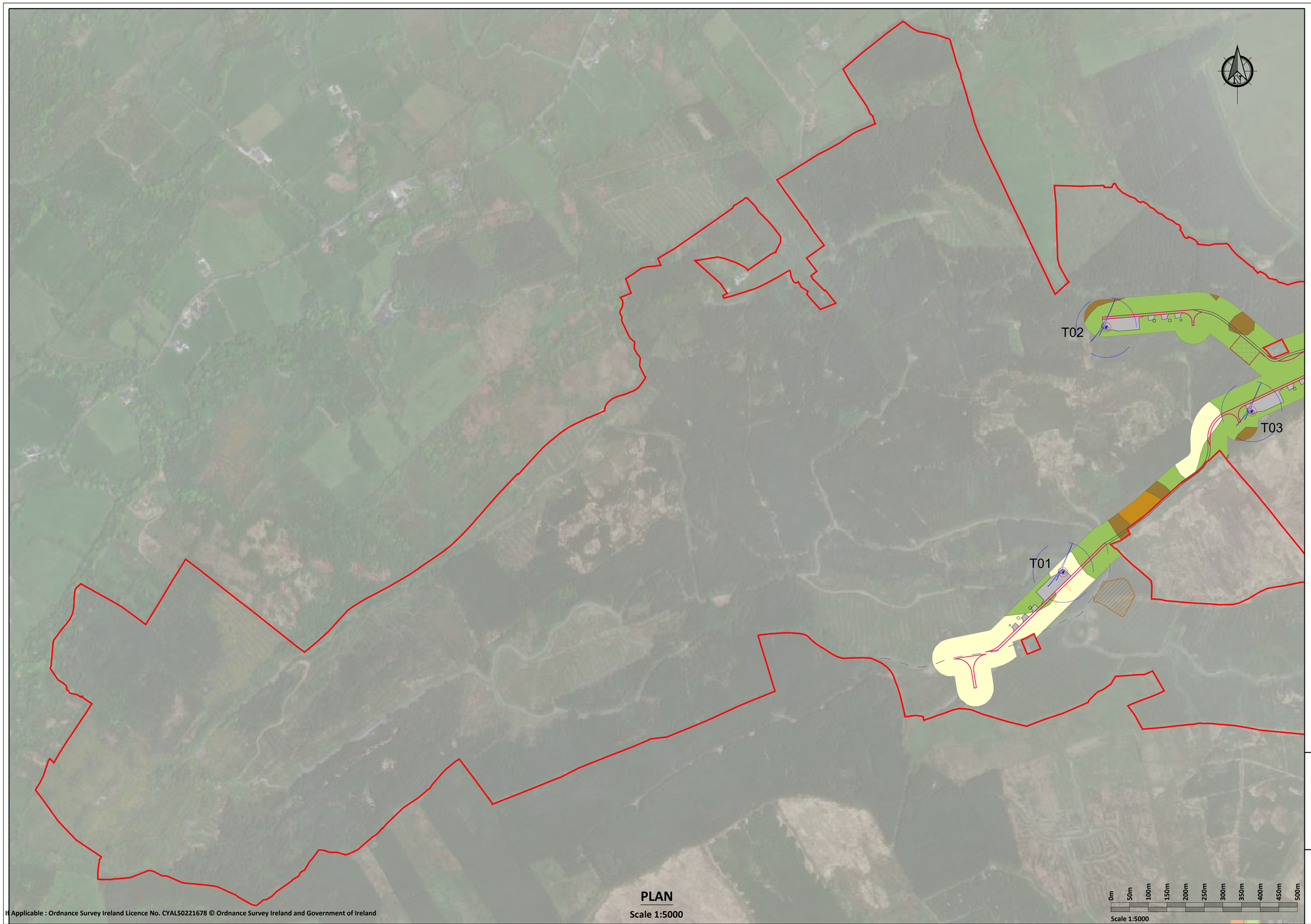
DRAWINGS



PLAN
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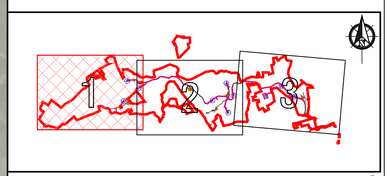
Legend:

- EIAR Planning Boundary
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Peat Depth Legend:

- ≥ 0 < 0.5
- ≥ 0.5 < 1
- ≥ 1 < 1.5
- ≥ 1.5 < 2
- ≥ 2 < 2.5
- ≥ 2.5 < 3
- ≥ 3 < 3.5
- ≥ 3.5 ≤ 4



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E	FOR INFORMATION	BDH	19.08.24

PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: PEAT DEPTH SHEET 1 OF 3

Date: 19.08.24
Drawn by: POR
Checked by: IH
Project number: P20-153
Scale (@ A1): As Shown
Drawing Number: P20-153-0600-0001
Rev: E

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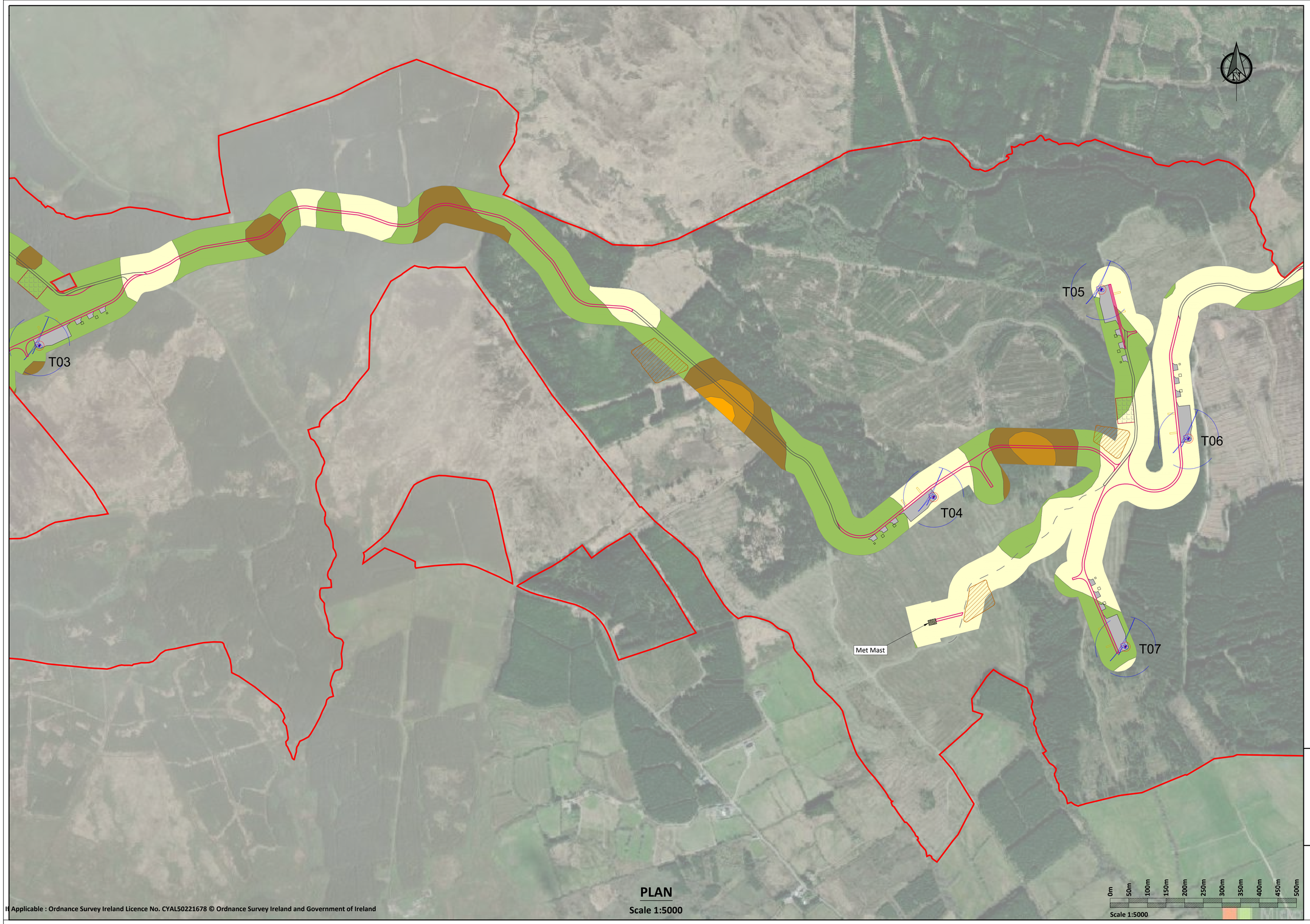
19 August 2024



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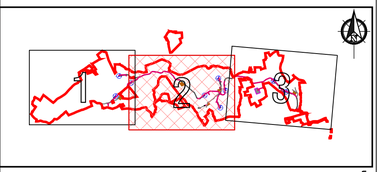

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PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: PEAT DEPTH SHEET 2 OF 3

Date: 19.08.24

Project number: P20-153

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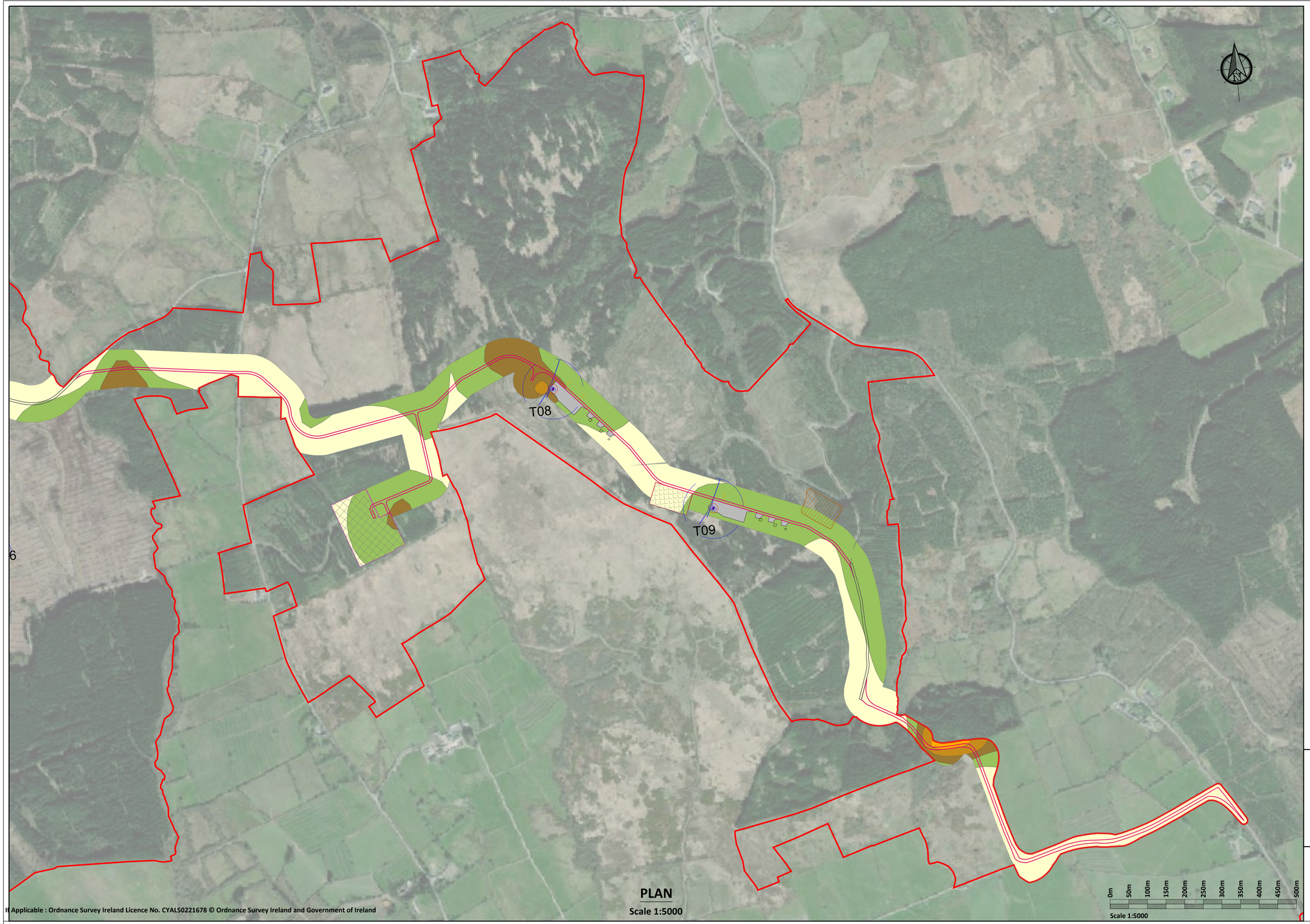

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Legend:

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Peat Depth Legend:

- ≥ 0 < 0.5
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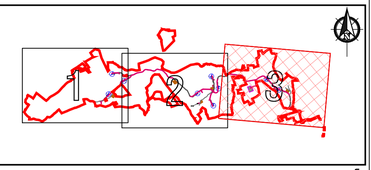

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PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: PEAT DEPTH SHEET 3 OF 3

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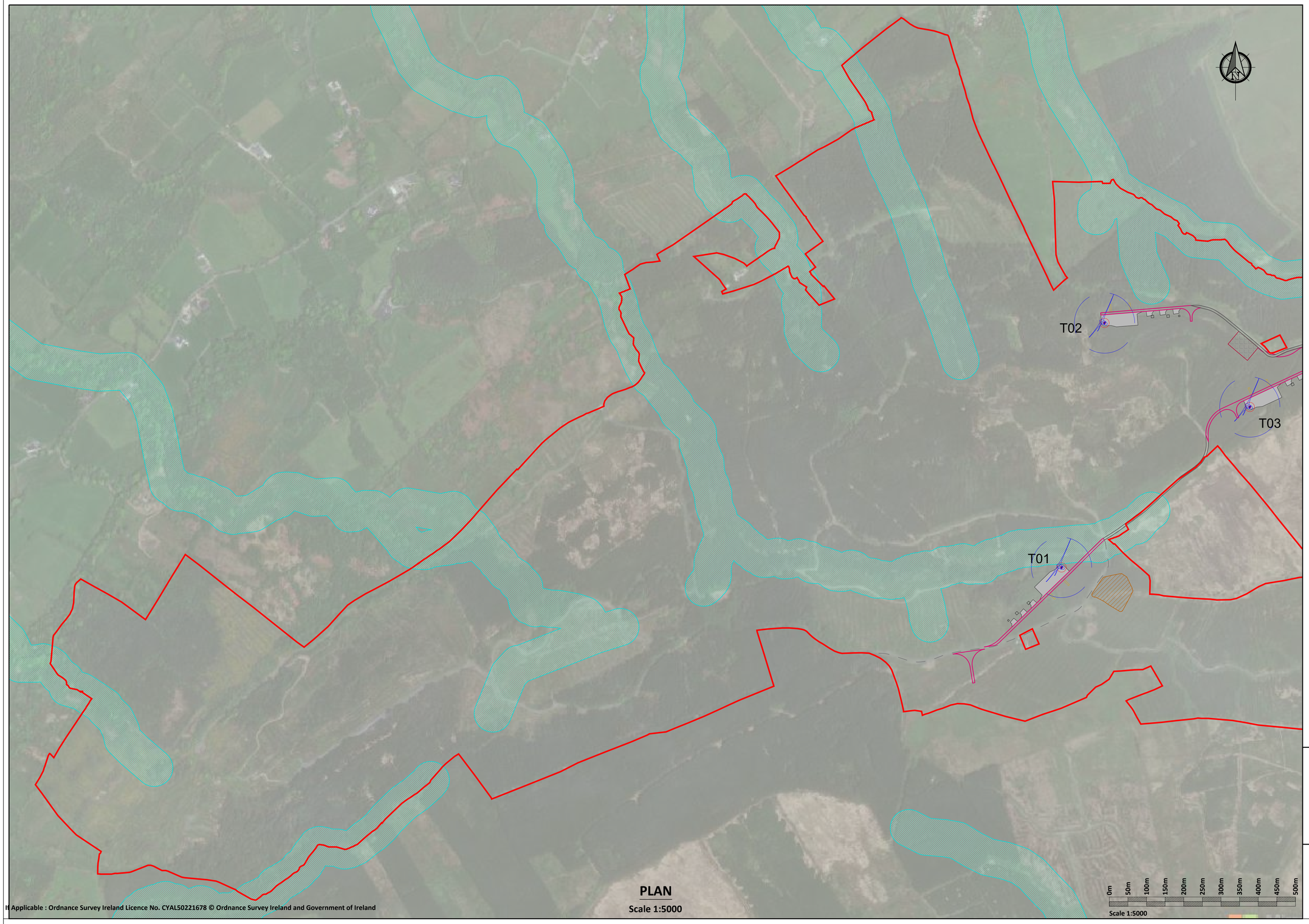

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Legend:

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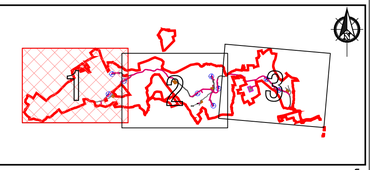
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Construction Buffer Zone Legend:

- Watercourses / Lakes with 50m buffer



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PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: CONSTRUCTION BUFFER ZONE PLAN SHEET 1 OF 3

Date: 19.08.24
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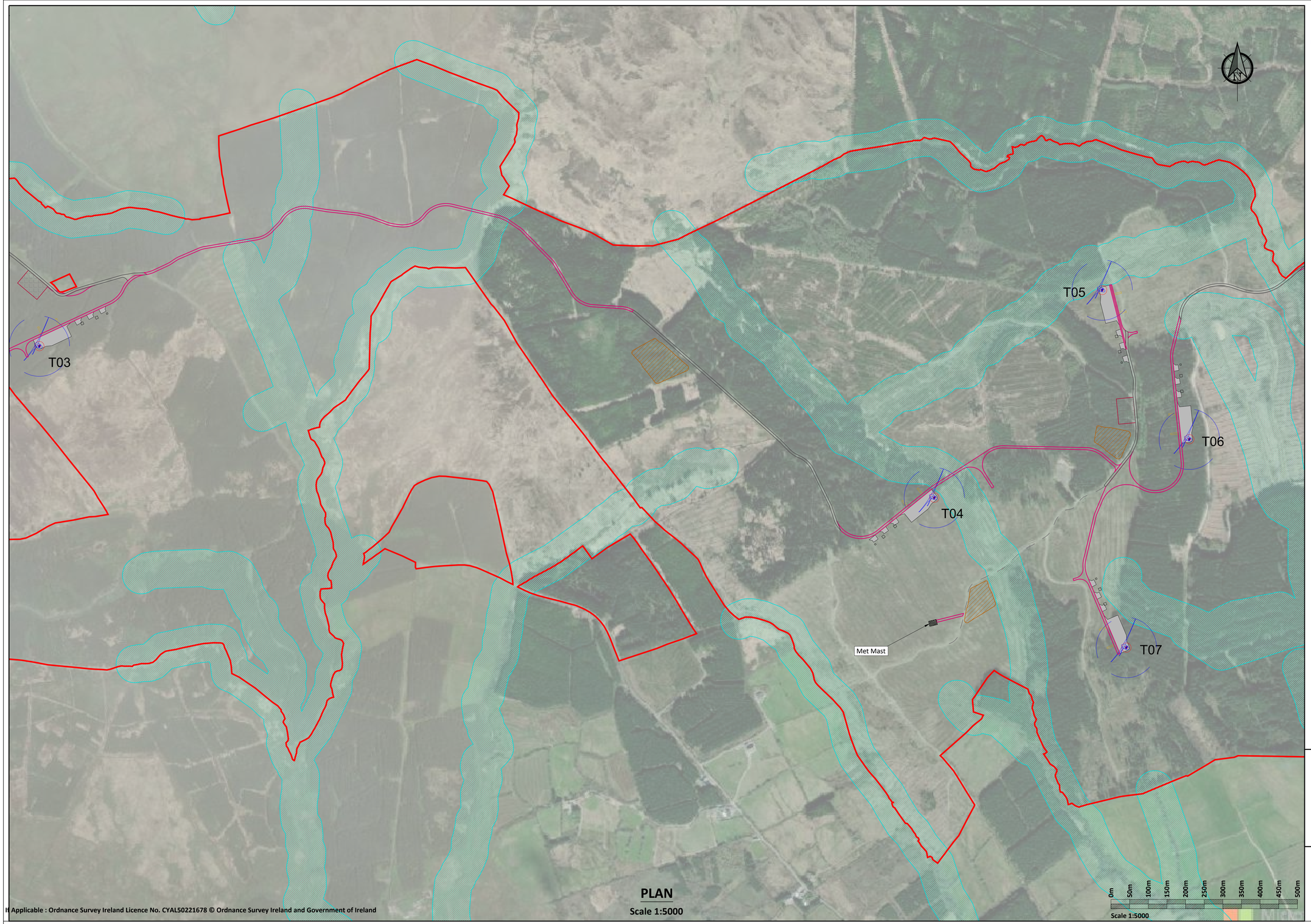

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Legend:

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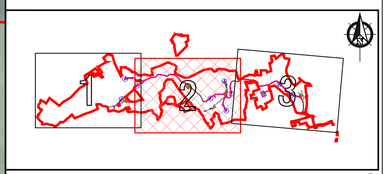
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Construction Buffer Zone Legend:

- Watercourses / Lakes with 50m buffer



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PROJECT: KNOCKSHANVO WIND FARM		CLIENT: MKO	
SHEET: CONSTRUCTION BUFFER ZONE PLAN SHEET 2 OF 3	Date: 19.08.24	Project number: P20-153	Scale (@ A1): As Shown
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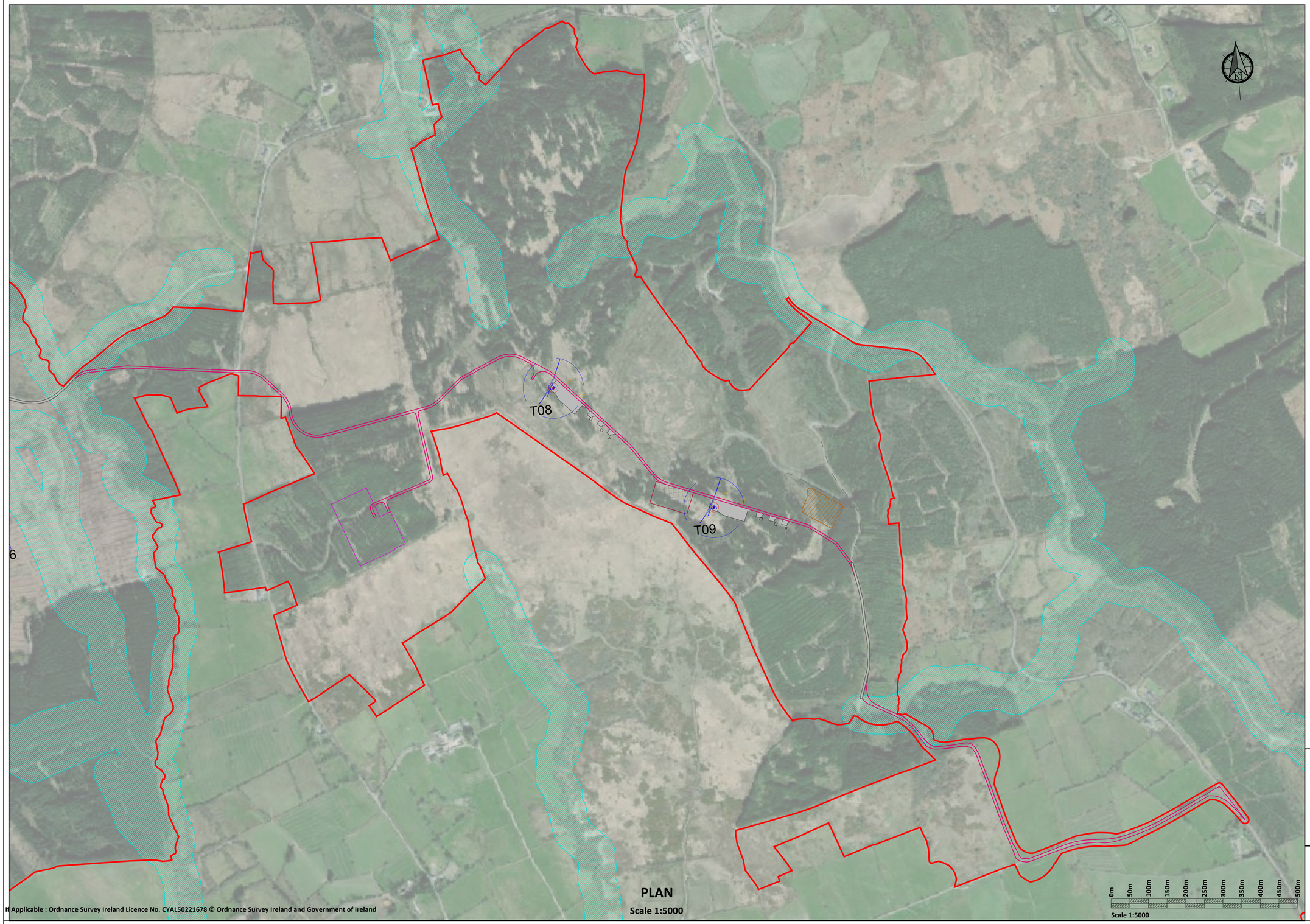

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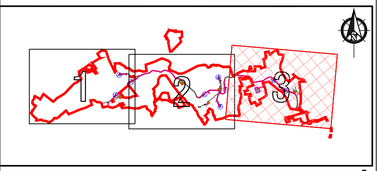

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PROJECT: KNOCKSHANVO WIND FARM

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SHEET: CONSTRUCTION BUFFER ZONE PLAN SHEET 3 OF 3

Date: 19.08.24
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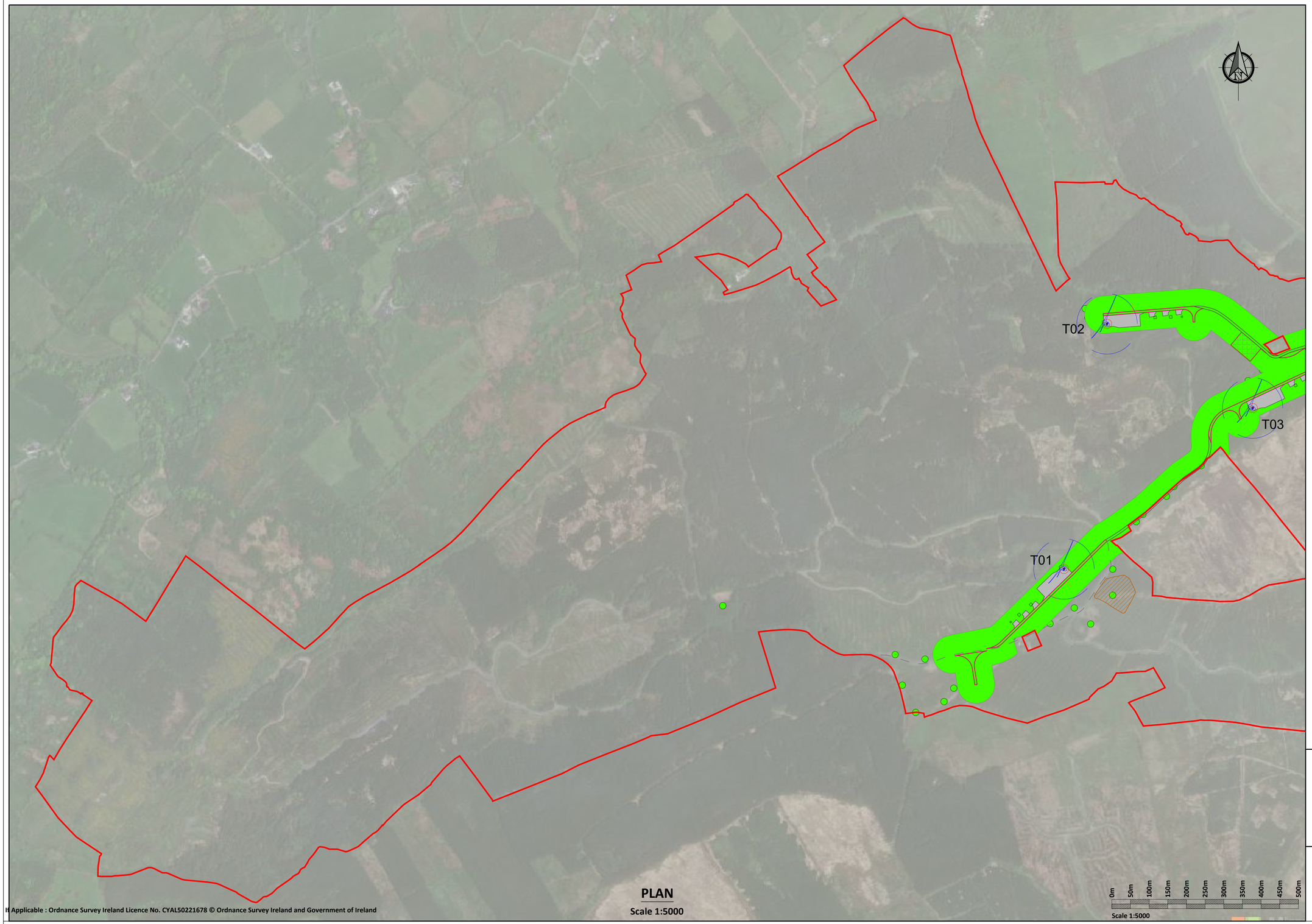

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- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Factor of Safety Legend:

- 0 < 1.0
- ≥ 1.0 < 1.3
- ≥ 1.3

Increasing Stability

No Peat Recorded At This Location

PLAN
Scale 1:5000

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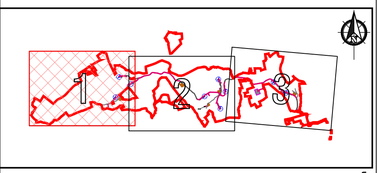

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KEYPLAN
Scale 1:100000

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E	FOR INFORMATION	BDH	19.08.24

PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: FACTOR OF SAFETY PLAN - SHORT TERM CRITICAL CONDITION (UNDRAINED) SHEET 1 OF 3

Date: 19.08.24
Project number: P20-153
Scale (@ A1): As Shown
Drawn by: POR
Drawing Number: P20-153-0600-0007
Rev: E
Checked by: IH

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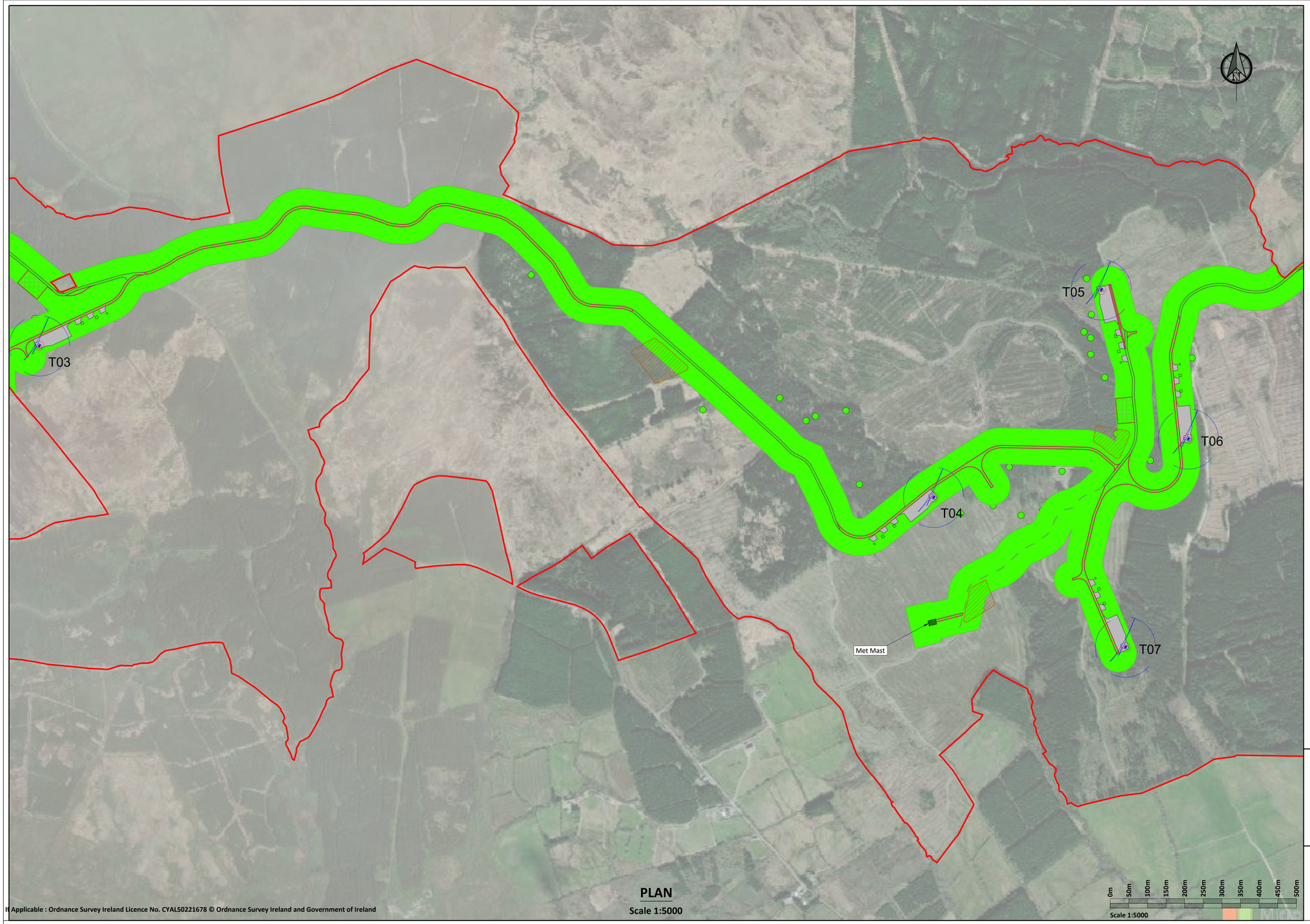
19 August 2024



PLAN
Scale 1:5000

Legend:

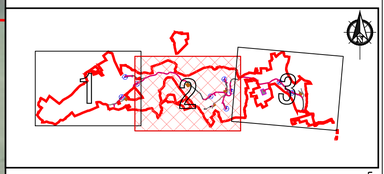
- EIAR Planning Boundary
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Factor of Safety Legend:

- 0 < 1.0
- ≥ 1.0 < 1.3
- ≥ 1.3

Increasing Stability

No Peat Recorded At This Location



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E	FOR INFORMATION	BDH	19.08.24

PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: FACTOR OF SAFETY PLAN - SHORT TERM CRITICAL CONDITION (UNDRAINED) SHEET 2 OF 3

Date: 19.08.24
Project number: P20-153
Scale (@ A1): As Shown
Drawn by: POR
Drawing Number: P20-153-0600-0008
Rev: E
Checked by: IH

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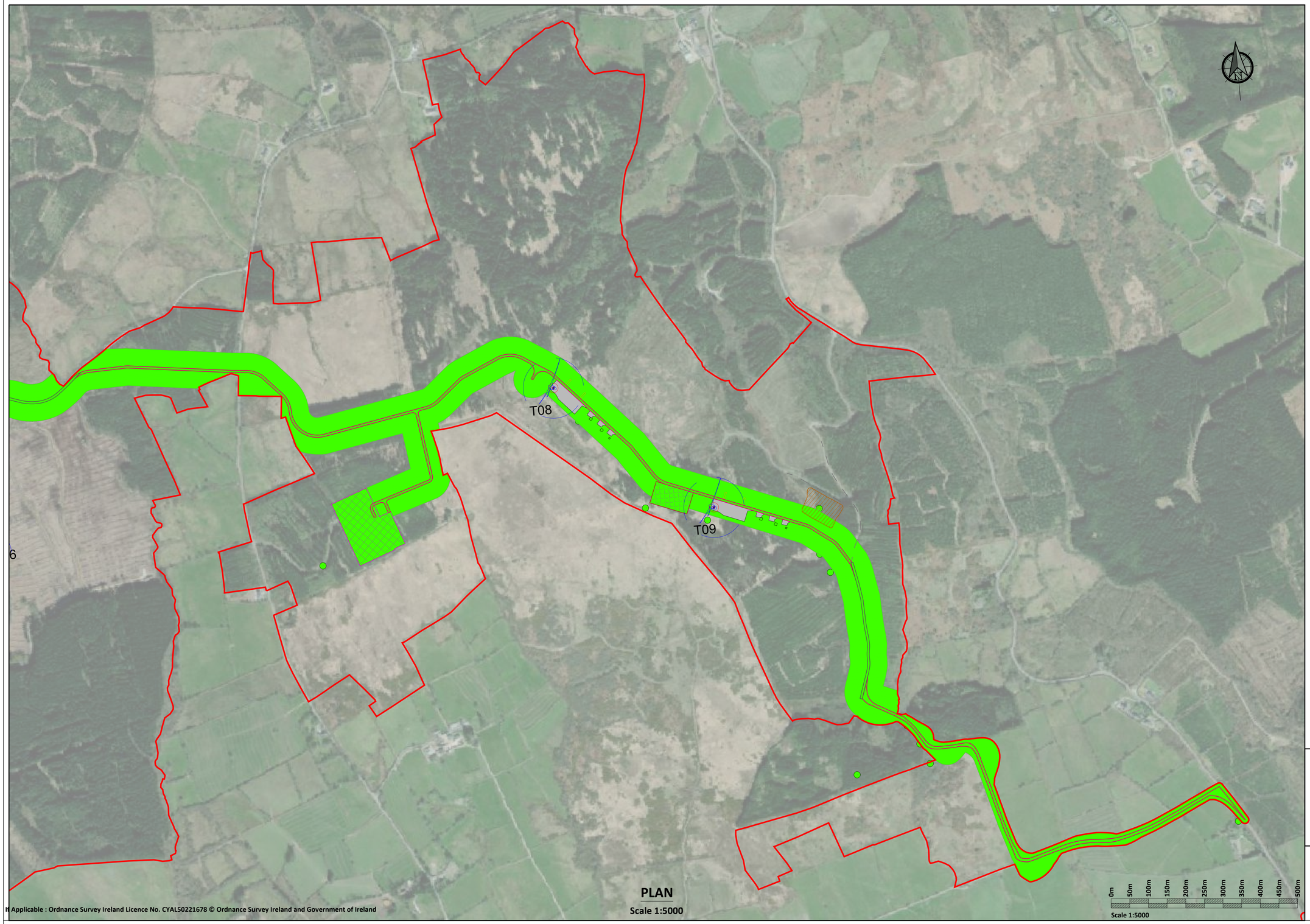

PLAN
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Scale 1:5000

Legend:

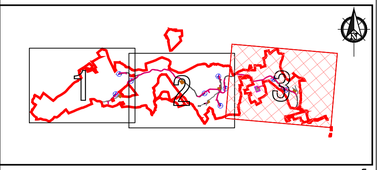
- EIAR Planning Boundary
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Factor of Safety Legend:

- 0 < 1.0
- ≥ 1.0 < 1.3
- ≥ 1.3

Increasing Stability

No Peat Recorded
At This Location



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KEYPLAN
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E	FOR INFORMATION	BDH	19.08.24

PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: FACTOR OF SAFETY PLAN - SHORT TERM CRITICAL CONDITION (UNDRAINED) SHEET 3 OF 3

Date: 19.08.24
Project number: P20-153
Scale (@ A1): As Shown
Drawn by: POR
Drawing Number: P20-153-0600-0009
Rev: E
Checked by: IH

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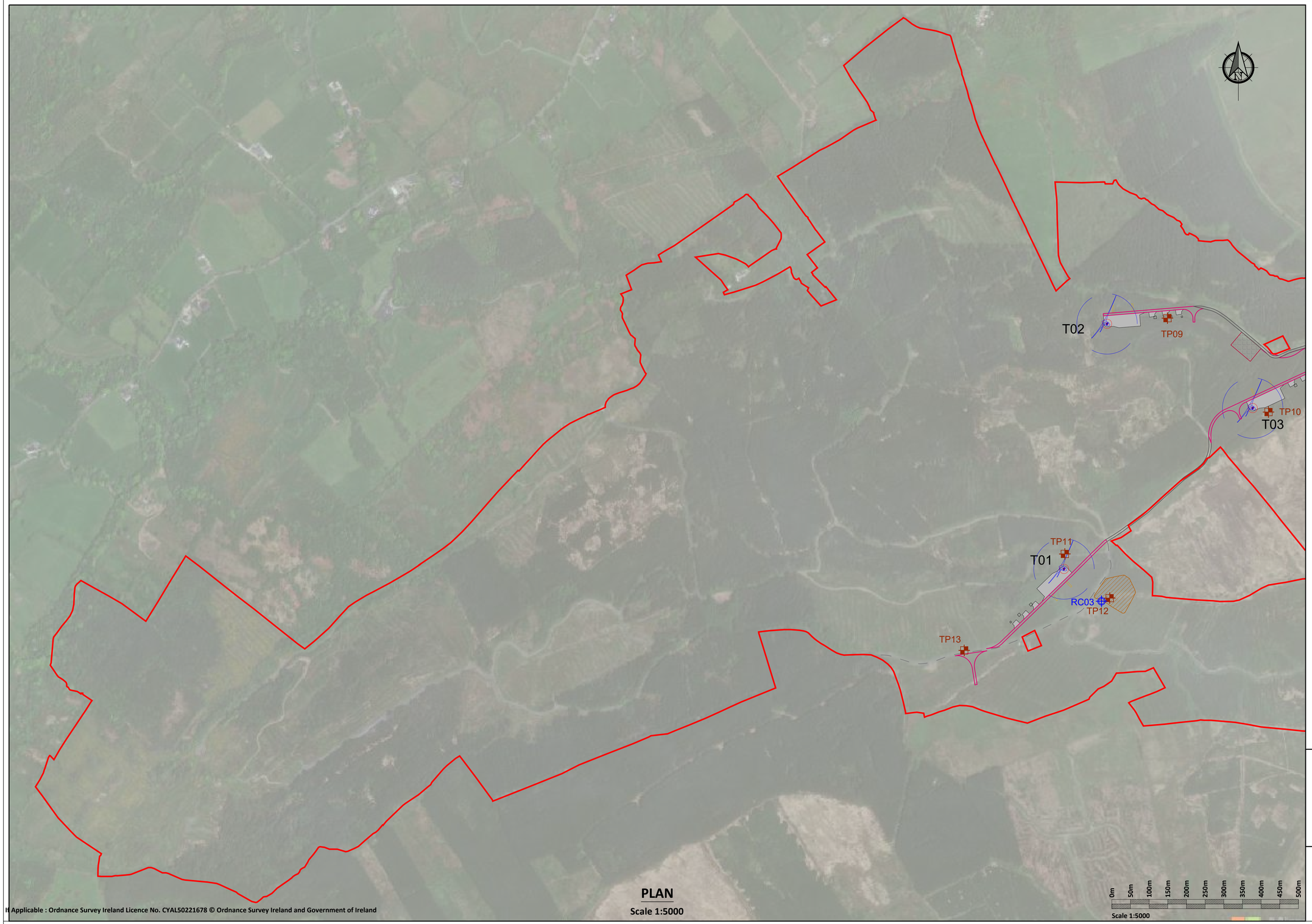


PLAN

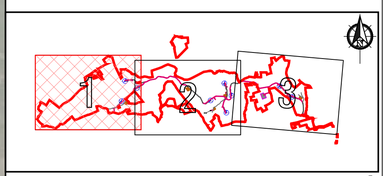
Scale 1:5000

Legend:

- EIAR Planning Boundary
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Ground Investigation Legend:

- TPXX — Trial Pit Location
- RCXX — Rotary Corehole Location



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Scale 1:100000

KEYPLAN

Scale 1:100000

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D	FOR INFORMATION	BDH	18.07.24
E	FOR INFORMATION	BDH	19.08.24

PROJECT: KNOCKSHANVO WIND FARM		CLIENT: MKO	
SHEET: GROUND INVESTIGATION LOCATION PLAN SHEET 1 OF 3	Date: 19.08.24	Project number: P20-153	Scale (@ A1): As Shown
	Drawn by: POR	Drawing Number: P20-153-0600-0010	Rev: E
	Checked by: IH		

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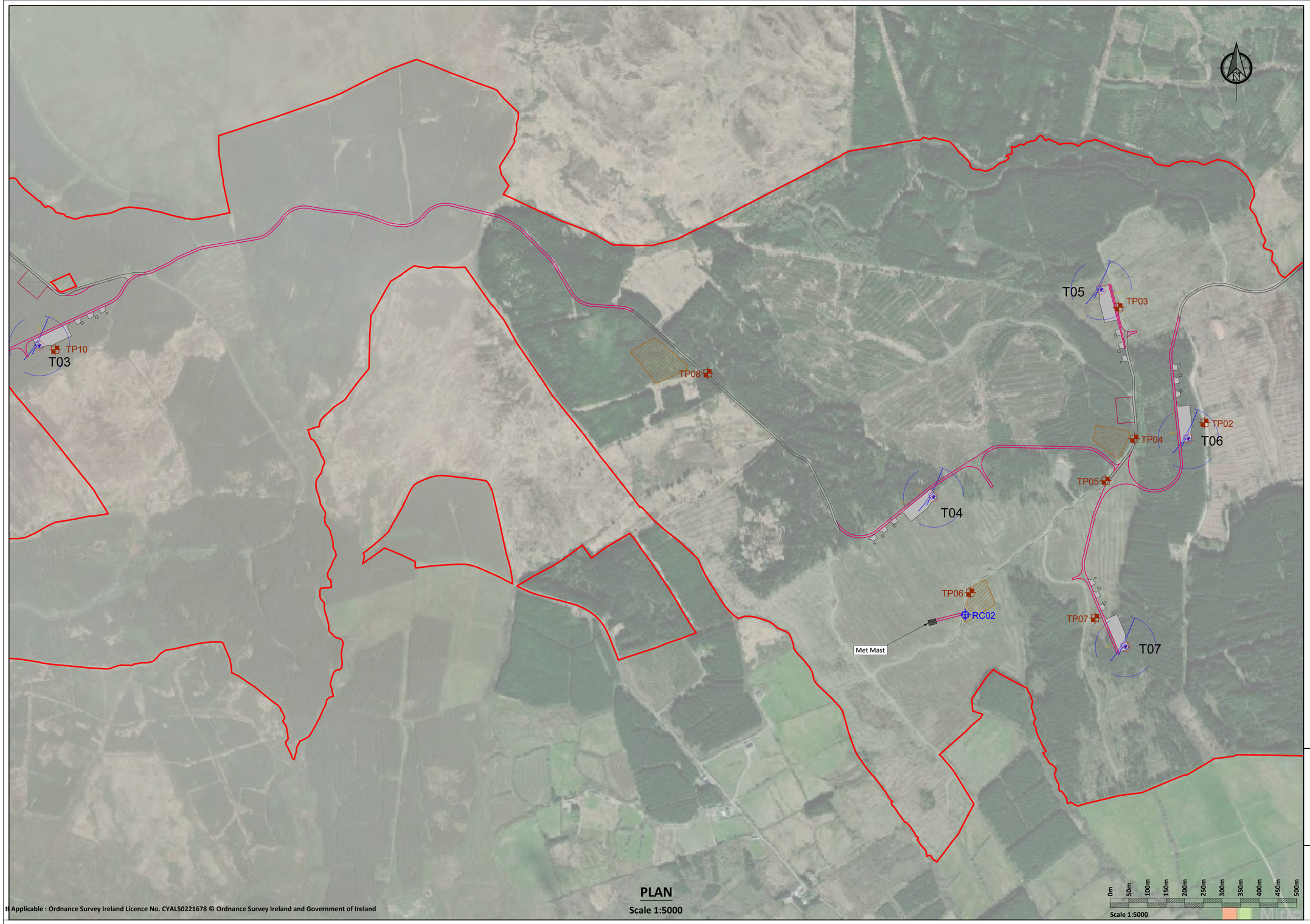

PLAN
Scale 1:5000

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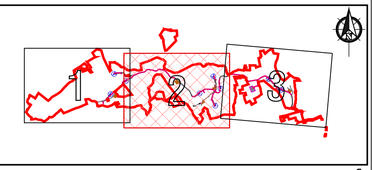
Legend:

- EIAR Planning Boundary
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Ground Investigation Legend:

- TPXX — Trial Pit Location
- RCXX — Rotary Corehole Location



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KEYPLAN
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D	FOR INFORMATION	BDH	18.07.24
E	FOR INFORMATION	BDH	19.08.24

PROJECT: KNOCKSHANVO WIND FARM		CLIENT: MKO	
SHEET: GROUND INVESTIGATION LOCATION PLAN SHEET 2 OF 3	Date: 19.08.24	Project number: P20-153	Scale (@ A1): As Shown
	Drawn by: POR	Drawing Number: P20-153-0600-0011	Rev: E
	Checked by: IH		

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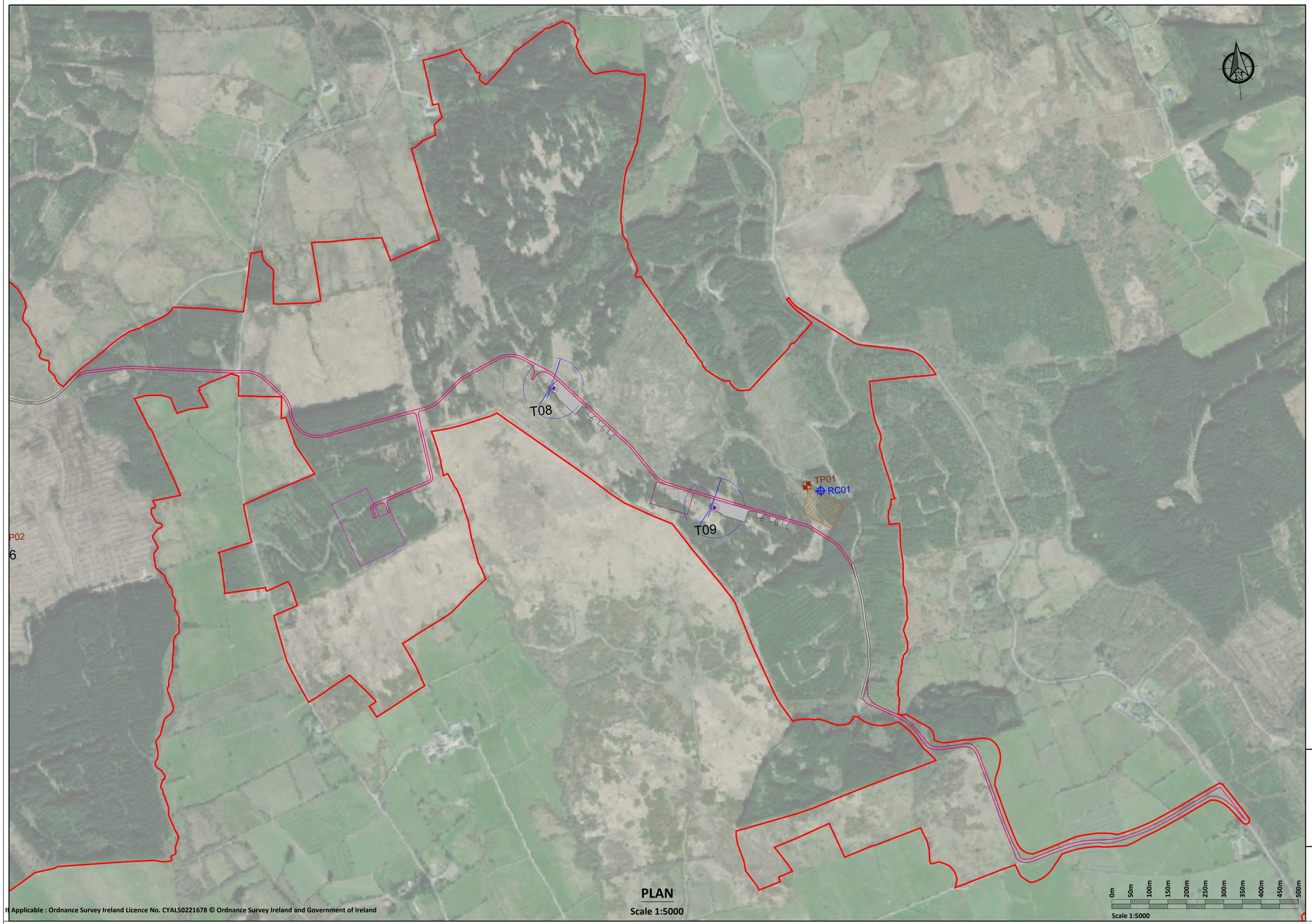


Legend:

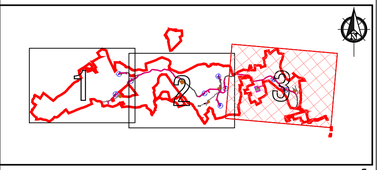
- EIAR Planning Boundary
- TXX — Turbine Location
- Existing Access Track (to be upgraded)
- New Proposed Access Track
- Substation
- Construction Compound
- Borrow Pit
- Grid Route Options
- Turbine Delivery Route

Ground Investigation Legend:

- TPXX — Trial Pit Location
- RCXX — Rotary Corehole Location

PLAN
Scale 1:5000

0m 50m 100m 150m 200m 250m 300m 350m 400m 450m 500m
Scale 1:5000



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KEYPLAN
Scale 1:100000

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PROJECT: KNOCKSHANVO WIND FARM

CLIENT: MKO

SHEET: GROUND INVESTIGATION LOCATION PLAN SHEET 3 OF 3

Date: 19.08.24
Drawn by: POR
Checked by: IH
Project number: P20-153
Scale (@ A1): As Shown
Drawing Number: P20-153-0600-0012
Rev: E

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19 August 2024

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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX A

Photos from Site Walkover

Photo 1: Example of existing access track on site

Photo 2: Route of main access track through site

Photo 3: Ground conditions close to T7

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APPENDIX B

Peat Stability Risk Registers

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T1

Grid Reference (Eastings, Northings):	553306	669427
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.6-0.9	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 9.05 (u), 12.74 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T1**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T2

Grid Reference (Eastings, Northings):	553422	670076
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.1-0.3	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.57 (u), 2.15 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		2	3	6	Low
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		2	3	6	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		2	3	6	Low
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T2**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T3

Grid Reference (Eastings, Northings):	553812	669851
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.2-0.3	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 7.09 (u), 7.64 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		2	1	2	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		2	1	2	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T3**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T4

Grid Reference (Eastings, Northings):	556212	669444
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.3-0.5	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.13(u), 5.52 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T4**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T5

Grid Reference (Eastings, Northings):	556663	670013
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.1-0.3	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.32 (u), 7.64 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T5**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T6

Grid Reference (Eastings, Northings):	556896	669601
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.1-0.3	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.38 (u), 4.75 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		2	1	2	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T6**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T7

Grid Reference (Eastings, Northings):	556727	669042
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.1-0.2	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 7.19 (u), 10.35 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T7**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T8

Grid Reference (Eastings, Northings):	558463	669913
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.3-0.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 8.20 (u), 11.82 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T8**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Turbine T9

Grid Reference (Eastings, Northings):	**558864**	**669557**
Distance to Watercourse (m)	**> 150**	
Min & Max Measured Peat Depth (m):	**0.2-0.5**	
Control Required:	**No**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.85 (u), 5.52 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T9**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Const. Comp. (1)

Grid Reference (Eastings, Northings):	558721	669647
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.3-0.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 6.16 (u), 8.87(d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Construction Compound (1)**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Const. Comp. (2)

Grid Reference (Eastings, Northings):	556752	669614
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0-0.2	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 7.19 (u), 10.35 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Construction Compound (2)**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Const. Comp. (3)

Grid Reference (Eastings, Northings):	553827	670016
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.1-0.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.75 (u), 8.28 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Construction Compound (3)**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Met Mast

Grid Reference (Eastings, Northings):	556616	669888
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.2-0.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 6.63 (u), 11.09 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Met Mast**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Substation (1)

Grid Reference (Eastings, Northings):	557806	669492
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.2-0.6	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 6.63 (u), 11.09 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Substation (1)**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Borrow Pit 1

Grid Reference (Eastings, Northings):	559145	669528
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.1-0.2	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 6.41 (u), 7.64 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Borrow Pit 1**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Borrow Pit 2

Grid Reference (Eastings, Northings):	555460	669814
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.2-0.5	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.47 (u), 10.35 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Borrow Pit 2**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Borrow Pit 3

Grid Reference (Eastings, Northings):	556339	669147
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.1-0.2	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 6.41 (u), 7.64 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Borrow Pit 3**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Borrow Pit 4

Grid Reference (Eastings, Northings):	555630	669830
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.6-1.2	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.76 (u), 8.21 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Borrow Pit 4**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Borrow Pit 5

Grid Reference (Eastings, Northings):	553448	669362
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0-0.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 9.58 (u), 11.46 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Borrow Pit 5**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine bedrock condition and properties.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	Site Entrance to T9

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**< 50**
Min & Max Measured Peat Depth (m):	**0-3.9**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.84 (u), 3.42 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		2	4	8	Low
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Site Entrance to T9**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T9 to T8

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**> 150**
Min & Max Measured Peat Depth (m):	**0.4-1.2**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.64 (u), 3.26 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		1	1	1	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T9 to T8**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T8 to T6

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**< 50**
Min & Max Measured Peat Depth (m):	**0.2-1.0**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.28 (u), 3.18 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T8 to T6**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T6 to T7

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**50 - 100**
Min & Max Measured Peat Depth (m):	**0.1-0.3**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.15 (u), 6.12 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		2	3	6	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		2	3	6	Low
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T6to T7**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T6 to T5

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**100 - 150**
Min & Max Measured Peat Depth (m):	**0.1-0.3**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.67 (u), 5.63 (d)	1	2	2	Negligible	No	See Below	1	2	2	Negligible
2	Evidence of sub peat water flow	1	2	2	Negligible	No		1	2	2	Negligible
3	Evidence of surface water flow	2	2	4	Negligible	No		1	2	2	Negligible
4	Evidence of previous failures/slips	0	2	0	Not Applicable	No		0	2	0	Not Applicable
5	Type of vegetation	2	2	4	Negligible	No		2	2	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	2	4	Negligible	No		2	2	4	Negligible
7	Evidence of very soft/soft clay at base of peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
8	Evidence of mechanically cut peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
10	Evidence of bog pools	0	2	0	Not Applicable	No		0	2	0	Not Applicable
11	Other	0	2	0	Not Applicable	No		0	2	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T6 to T5**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T7 to T4

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**< 50**
Min & Max Measured Peat Depth (m):	**0.1-0.5**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.18 (u), 6.12 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T7 to T4**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T4 to T3

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**< 50**
Min & Max Measured Peat Depth (m):	**0.1-1.9**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.06(u), 3.94 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T4 to T3**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T3 to T1

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**< 50**
Min & Max Measured Peat Depth (m):	**0.1-2.8**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.03 (u), 5.45 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		1	4	4	Negligible
4	Evidence of previous failures/slips	0	4	0	Not Applicable	No		0	4	0	Not Applicable
5	Type of vegetation	2	4	8	Low	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	4	8	Low	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
8	Evidence of mechanically cut peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	4	0	Not Applicable	No		0	4	0	Not Applicable
10	Evidence of bog pools	0	4	0	Not Applicable	No		0	4	0	Not Applicable
11	Other	0	4	0	Not Applicable	No		0	4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T3 to T1**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

Knockshanvo Wind Farm - Peat Stability Risk Register (Rev 0)

Location:	T3 to T2

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**50 - 100**
Min & Max Measured Peat Depth (m):	**0.1-0.3**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.80 (u), 2.35 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	2	3	6	Low	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **T3 to T2**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.

Note

(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
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APPENDIX C

Calculated FOS for Peat Slopes on Site

Calculated FoS of Natural Peat Slopes for Knockshanvo Wind Farm - Undrained Analysis

Turbine No./Waypoint	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
T1	553306	669427	14	10	10	0.9	1.9	**4.73**	**2.24**
T2	553422	670076	18	10	10	0.3	1.3	**11.34**	**2.62**
T3	553812	669851	5	8	10	0.3	1.3	**30.71**	**7.09**
T4	556212	669444	6	8	10	0.5	1.5	**15.39**	**5.13**
T5	556663	670013	5	8	10	0.3	1.3	**30.71**	**7.09**
T6	556896	669601	8	8	10	0.3	1.3	**19.35**	**4.47**
T7	556727	669042	4	8	10	0.2	1.2	**57.48**	**9.58**
T8	558463	669913	3	8	10	0.4	1.4	**38.27**	**10.93**
T9	558864	669557	6	8	10	0.5	1.5	**15.39**	**5.13**
CC1	558721	669647	4	8	10	0.4	1.4	**28.74**	**8.21**
CC2	556752	669614	4	8	10	0.2	1.2	**57.48**	**9.58**
CC3	553827	670016	4	8	10	0.5	1.5	**22.99**	**7.66**
Met mast	556616	669888	5	8	10	0.3	1.3	**30.71**	**7.09**
SS1	557950	669555	5	8	10	0.9	1.9	**10.24**	**4.85**
SS2 (S/S)	552934	669178	7	8	10	0.1	1.1	**66.14**	**6.01**
WP001	559561	668525	8	No peat recorded at this location					
WP002	559466	668496	6	No peat recorded at this location					
WP003	559410	668859	8	8	10	0.4	1.4	**14.51**	**4.15**
WP004	559370	668467	4	No peat recorded at this location					
WP005	559274	668440	6	No peat recorded at this location					
WP006	559240	669110	2	8	10	0.1	1.1	**229.37**	**20.85**
WP007	559232	668513	8	No peat recorded at this location					
WP008	559216	668612	5	No peat recorded at this location					
WP009	559210	669006	6	No peat recorded at this location					
WP010	559199	668710	8	No peat recorded at this location					
WP011	559196	668908	4	No peat recorded at this location					
WP012	559184	668809	6	8	10	0.2	1.2	**38.48**	**6.41**
WP013	559126	669426	4	8	10	0.3	1.3	**38.32**	**8.84**
WP014	558656	669718	6	8	10	0.5	1.5	**15.39**	**5.13**
WP015	558095	669876	3	8	10	0.4	1.4	**38.27**	**10.93**
WP016	557840	669871	3	8	10	0.2	1.2	**76.53**	**12.76**
WP017	557682	669958	3	No peat recorded at this location					
WP018	557297	670064	4	8	10	0.2	1.2	**57.48**	**9.58**
WP019	557124	670005	3	8	10	0.2	1.2	**76.53**	**12.76**
WP020	557011	670011	4	8	10	0.3	1.3	**38.32**	**8.84**
WP021	556846	669533	6	8	10	0.2	1.2	**38.48**	**6.41**
WP022	556764	669499	4	8	10	0.2	1.2	**57.48**	**9.58**
WP023	556754	669640	4	8	10	0.1	1.1	**114.96**	**10.45**
WP024	556716	669534	6	8	10	0.2	1.2	**38.48**	**6.41**
WP025	556672	669766	4	8	10	0.3	1.3	**38.32**	**8.84**
WP026	556646	669562	4	8	10	0.3	1.3	**38.32**	**8.84**
WP027	556623	669451	3	8	10	0.2	1.2	**76.53**	**12.76**
WP028	556533	669371	4	8	10	0.2	1.2	**57.48**	**9.58**
WP029	556518	669301	6	No peat recorded at this location					
WP030	556372	669422	3	8	10	0.6	1.6	**25.51**	**9.57**
WP031	556328	669532	4	8	10	0.5	1.5	**22.99**	**7.66**
WP032	556013	669479	5	8	10	0.4	1.4	**23.04**	**6.58**
WP033	555927	669446	6	8	10	0.2	1.2	**38.48**	**6.41**
WP034	555774	669612	6	8	10	1.1	2.1	**7.00**	**3.66**
WP035	555667	669701	2	8	10	0.3	1.3	**76.46**	**17.64**
WP036	555472	669897	3	8	10	0.2	1.2	**76.53**	**12.76**
WP037	555183	670077	2	8	10	0.2	1.2	**114.68**	**19.11**
WP038	554813	670169	2	8	10	0.2	1.2	**114.68**	**19.11**
WP039	554415	670148	2	8	10	0.1	1.1	**229.37**	**20.85**
WP040	554054	670042	4	No peat recorded at this location					
WP041	553977	669980	3	8	10	0.3	1.3	**51.02**	**11.77**
WP042	553933	670009	6	8	10	0.3	1.3	**25.65**	**5.92**
WP043	553886	669939	4	8	10	0.2	1.2	**57.48**	**9.58**
WP044	553742	670054	5	8	10	0.3	1.3	**30.71**	**7.09**
WP045	553729	669821	6	8	10	0.3	1.3	**25.65**	**5.92**
WP046	553724	670106	8	8	10	0.1	1.1	**58.05**	**5.28**
WP047	553698	669759	4	8	10	0.1	1.1	**114.96**	**10.45**
WP048	553648	670083	5	8	10	0.3	1.3	**30.71**	**7.09**
WP049	553581	669614	6	8	10	0.1	1.1	**76.96**	**7.00**
WP050	553549	670093	4	8	10	0.2	1.2	**57.48**	**9.58**
WP051	553500	669546	6	8	10	0.1	1.1	**76.96**	**7.00**
BP1	559145	669529	6	8	10	0.2	1.2	**38.48**	**6.41**
BP2	556557	669514	4	8	10	0.4	1.4	**28.74**	**8.21**
BP3	556339	669148	6	8	10	0.2	1.2	**38.48**	**6.41**
BP4	555870	669650	6	8	10	0.5	1.5	**15.39**	**5.13**
BP5	555132	670041	4	8	10	0.6	1.6	**19.16**	**7.19**
BP6	553707	670149	6	8	10	0.4	1.4	**19.24**	**5.50**
BP7	553378	669272	4	8	10	0.2	1.2	**57.48**	**9.58**
BP8	552392	669321	4	8	10	0.3	1.3	**38.32**	**8.84**
MKO Probes									
MKO001	552873	669108	8	8	10	0.8	1.8	**7.26**	**3.22**
MKO002	552909	669035	4	8	10	0.3	1.3	**38.32**	**8.84**
MKO004	552985	669064	2	8	10	1.0	2.0	**22.94**	**11.47**
MKO005	553011	669100	2	8	10	0.5	1.5	**45.87**	**15.29**
MKO007	553154	669243	7	8	10	0.2	1.2	**33.07**	**5.51**
MKO009	553411	669439	7	8	10	0.9	1.9	**7.35**	**3.48**
MKO011	553450	669516	6	8	10	0.5	1.5	**15.39**	**5.13**
MKO012	553518	669566	6	8	10	2.8	3.8	**2.75**	**2.03**
MKO013	553601	669640	11	10	10	0.6	1.6	**8.90**	**3.34**
MKO014	553674	669696	11	10	10	0.3	1.3	**17.80**	**4.11**
MKO016	553746	669793	5.5	8	10	0.5	1.5	**16.77**	**5.59**
MKO017	553758	669839	5.5	8	10	0.5	1.5	**16.77**	**5.59**
MKO018	553779	669871	7.5	8	10	0.8	1.8	**7.73**	**3.43**
MKO019	553809	669906	9	8	10	0.5	1.5	**10.36**	**3.45**
MKO020	553827	669873	9	8	10	0.8	1.8	**6.47**	**2.88**
MKO021	553800	669924	9	8	10	0.7	1.7	**7.40**	**3.05**
MKO022	553838	669953	9	8	10	0.6	1.6	**8.63**	**3.24**

Calculated FoS of Natural Peat Slopes for Knockshanvo Wind Farm - Undrained Analysis

Turbine No./Waypoint	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
MKO024	553797	670046	16	10	10	1.1	2.1	**3.43**	**1.80**
MKO027	553579	670137	16	10	10	0.9	1.9	**4.19**	**1.99**
MKO028	553468	670133	16	10	10	0.9	1.9	**4.19**	**1.99**
MKO029	553415	670116	16	10	10	0.3	1.3	**12.58**	**2.90**
MKO030	553376	670116	16	10	10	1.0	2.0	**3.77**	**1.89**
MKO032	553363	670117	16	10	10	1.8	2.8	**2.10**	**1.35**
MKO033	553370	670093	16	10	10	0.9	1.9	**4.19**	**1.99**
MKO036	556634	669828	7.5	8	10	0.6	1.6	**10.30**	**3.86**
MKO037	556634	669872	7.5	8	10	0.8	1.8	**7.73**	**3.43**
MKO038	556636	669935	7.5	8	10	0.8	1.8	**7.73**	**3.43**
MKO039	556643	670021	7.5	8	10	0.6	1.6	**10.30**	**3.86**
MKO040	556623	670031	7.5	8	10	0.3	1.3	**20.61**	**4.76**
MKO047	557546	670036	2	8	10	0.4	1.4	**57.34**	**16.38**
MKO048	557466	670062	4	8	10	0.3	1.3	**38.32**	**8.84**
MKO049	557399	670075	8	8	10	0.3	1.3	**19.35**	**4.47**
MKO050	557341	670081	11	10	10	0.5	1.5	**10.68**	**3.56**
MKO052	557315	670054	1	8	10	2.3	3.3	**19.93**	**13.89**
MKO053	557252	670069	3	8	10	0.5	1.5	**30.61**	**10.20**
MKO054	557215	670065	3	8	10	0.3	1.3	**51.02**	**11.77**
MKO055	557189	670044	3	8	10	0.3	1.3	**51.02**	**11.77**
MKO056	557668	670022	5	8	10	0.1	1.1	**92.14**	**8.38**
MKO057	557712	669987	10	10	10	0.2	1.2	**29.24**	**4.87**
MKO058	557748	669954	5	8	10	0.6	1.6	**15.36**	**5.76**
MKO059	557754	669891	7	8	10	0.4	1.4	**16.53**	**4.72**
MKO060	557783	669853	7	8	10	0.5	1.5	**13.23**	**4.41**
MKO061	557828	669837	4	8	10	0.5	1.5	**22.99**	**7.66**
MKO062	557877	669840	2	8	10	0.4	1.4	**57.34**	**16.38**
MKO063	557939	669858	2	8	10	0.5	1.5	**45.87**	**15.29**
MKO064	557998	669867	2	8	10	0.3	1.3	**76.46**	**17.64**
MKO065	558055	669876	3	8	10	0.6	1.6	**25.51**	**9.57**
MKO079	558112	669901	8	8	10	0.4	1.4	**14.51**	**4.15**
MKO080	558143	669940	2	8	10	1.0	2.0	**22.94**	**11.47**
MKO082	558175	669951	11	10	10	0.4	1.4	**13.35**	**3.81**
MKO083	558192	669920	6	8	10	0.5	1.5	**15.39**	**5.13**
MKO084	558227	669961	7	8	10	0.2	1.2	**33.07**	**5.51**
MKO085	558272	669984	4	8	10	1.0	2.0	**11.50**	**5.75**
MKO086	558346	670011	4	8	10	1.0	2.0	**11.50**	**5.75**
MKO088	558374	670016	6	8	10	1.3	2.3	**5.92**	**3.35**
MKO089	558424	669982	2	8	10	1.1	2.1	**20.85**	**10.92**
MKO090	558466	669925	2	8	10	1.0	2.0	**22.94**	**11.47**
MKO091	558448	669906	2	8	10	2.0	3.0	**11.47**	**7.65**
MKO092	558487	669944	5	8	10	0.4	1.4	**23.04**	**6.58**
MKO093	558508	669884	5	8	10	1.1	2.1	**8.38**	**4.39**
MKO094	558571	669850	8	8	10	1.2	2.2	**4.84**	**2.64**
MKO095	558704	669690	4	8	10	0.5	1.5	**22.99**	**7.66**
MKO096	558764	669648	4	8	10	0.5	1.5	**22.99**	**7.66**
MKO097	558828	669583	2	8	10	0.7	1.7	**32.77**	**13.49**
MKO098	558844	669524	2	8	10	1.0	2.0	**22.94**	**11.47**
MKO099	558865	669566	3	8	10	0.8	1.8	**19.13**	**8.50**
MKO100	558876	669603	4	8	10	0.6	1.6	**19.16**	**7.19**
MKO101	558918	669550	3	8	10	0.8	1.8	**19.13**	**8.50**
MKO102	558980	669518	3	8	10	0.7	1.7	**21.87**	**9.00**
MKO103	559041	669496	3	8	10	0.9	1.9	**17.01**	**8.06**
MKO104	559102	669456	10	8	10	0.5	1.5	**9.36**	**3.12**
MKO105	559136	669407	8	8	10	0.3	1.3	**19.35**	**4.47**
MKO106	559160	669356	8	8	10	0.4	1.4	**14.51**	**4.15**
MKO107	559201	669314	3	8	10	0.5	1.5	**30.61**	**10.20**
MKO108	559223	669272	9	8	10	0.3	1.3	**17.26**	**3.98**
MKO109	554145	670042	2	8	10	0.2	1.2	**114.68**	**19.11**
MKO111	554211	670106	2	8	10	0.6	1.6	**38.23**	**14.34**
MKO112	554317	670131	3	8	10	1.0	2.0	**15.31**	**7.65**
MKO113	554418	670157	2	8	10	1.9	2.9	**12.07**	**7.91**
MKO115	554490	670227	7	8	10	0.4	1.4	**16.53**	**4.72**
MKO117	554725	670196	2	8	10	0.1	1.1	**229.37**	**20.85**
MKO118	554806	670221	8	8	10	0.7	1.7	**8.29**	**3.41**
MKO120	554843	670215	7	8	10	1.1	2.1	**6.01**	**3.15**
MKO121	554898	670226	3	8	10	1.9	2.9	**8.06**	**5.28**
MKO122	554940	670228	8	8	10	0.7	1.7	**8.29**	**3.41**
MKO123	554993	670213	5	8	10	0.8	1.8	**11.52**	**5.12**
MKO125	555025	670202	2	8	10	1.2	1.6	**19.11**	**14.34**
MKO126	555089	670211	5	8	10	0.6	2.0	**15.36**	**4.61**
MKO127	555120	670157	6	8	10	1.0	1.2	**7.70**	**6.41**
MKO128	555156	670115	8	8	10	0.2	1.9	**29.02**	**3.06**
MKO129	555204	670053	14	10	10	0.9	1.5	**4.73**	**2.84**
MKO130	555235	669984	5.5	8	10	0.5	1.6	**16.77**	**5.24**
MKO131	555287	669940	6	8	10	0.6	1.5	**12.83**	**5.13**
MKO132	555974	669339	9	8	10	0.5	1.6	**10.36**	**3.24**
MKO133	555995	669352	10	10	10	0.6	1.9	**9.75**	**3.08**
MKO134	556069	669363	7	8	10	0.9	1.4	**7.35**	**4.72**
MKO135	556143	669410	7	8	10	0.4	1.4	**16.53**	**4.72**
MKO136	556189	669441	5	8	10	0.4	1.4	**23.04**	**6.58**
MKO137	556189	669459	5	8	10	0.7	1.7	**13.16**	**5.42**
MKO138	556672	669455	7.5	8	10	0.2	1.2	**30.91**	**5.15**
MKO139	556868	669589	14	10	10	0.3	1.3	**14.20**	**3.28**
MKO140	556901	669589	14	10	10	0.2	1.2	**21.30**	**3.55**
MKO141	556898	669632	14	10	10	0.2	1.2	**21.30**	**3.55**
MKO142	556884	669692	14	10	10	0.2	1.2	**21.30**	**3.55**
MKO143	556884	669753	14	10	10	0.3	1.3	**14.20**	**3.28**
MKO144	556906	669818	5	8	10	0.2	1.2	**46.07**	**7.68**
MKO145	556886	669893	8	8	10	0.2	1.2	**29.02**	**4.84**
MKO146	556881	669976	8	8	10	0.3	1.3	**19.35**	**4.47**
MKO147	556947	670020	2	8	10	0.1	1.1	**229.37**	**20.85**
MKO149	556535	669535	5	8	10	1.9	2.9	**4.85**	**3.18**
MKO150	559233	669266	8	8	10	0.7	1.7	**8.29**	**3.41**
MKO151	559250	669177	14	10	10	0.5	1.5	**8.52**	**2.84**

Calculated FoS of Natural Peat Slopes for Knockshanvo Wind Farm - Undrained Analysis

Turbine No./Waypoint	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
MKO152	559256	668999	6.5	8	10	0.4	1.4	**17.78**	**5.08**
MKO153	559302	668991	13	10	10	0.2	1.2	**22.81**	**3.80**
MKO156	559329	668928	12	10	10	0.2	1.2	**24.59**	**4.10**
MKO157	559359	668877	12	10	10	0.2	1.2	**24.59**	**4.10**
MKO158	559382	668822	14	10	10	0.1	1.1	**42.60**	**3.87**
MKO159	559416	668832	4	8	10	0.8	1.8	**14.37**	**6.39**
MKO160	559416	668853	1	8	10	3.9	4.9	**11.76**	**9.36**
MKO161	559447	668851	1	8	10	2.2	3.2	**20.84**	**14.33**
MKO162	559507	668861	6	8	10	1.8	2.8	**4.28**	**2.75**
MKO164	559527	668811	6	8	10	0.3	1.3	**25.65**	**5.92**
MKO165	559537	668732	6	8	10	0.4	1.4	**19.24**	**5.50**
MKO166	559563	668631	5	8	10	0.3	1.3	**30.71**	**7.09**
MKO167	559667	668552	6	8	10	0.2	1.2	**38.48**	**6.41**
MKO168	559764	668583	4	8	10	0.3	1.3	**38.32**	**8.84**
MKO169	559903	668583	5	8	10	0.2	1.2	**46.07**	**7.68**
MKO170	560021	668625	8	8	10	0.2	1.2	**29.02**	**4.84**
MKO171	560092	668658	8	8	10	0.2	1.2	**29.02**	**4.84**
MKO172	560192	668596	8	8	10	0.1	1.1	**58.05**	**5.28**
MKO184	555316	669945	6	8	10	0.5	1.5	**15.39**	**5.13**
MKO185	555431	669923	3	8	10	0.3	1.3	**51.02**	**11.77**
MKO196	555593	669679	1	8	10	3.0	4.0	**15.28**	**11.46**
MKO198	555598	669801	5	8	10	0.6	1.6	**15.36**	**5.76**
MKO199	555530	669831	8	8	10	0.8	1.8	**7.26**	**3.22**
MKO204	555799	669711	5	8	10	0.5	1.5	**18.43**	**6.14**
MKO205	555711	669706	4	8	10	2.2	3.2	**5.23**	**3.59**
MKO206	555816	669590	4	8	10	1.1	2.1	**10.45**	**5.47**
MKO207	555816	669537	6	8	10	0.7	1.7	**10.99**	**4.53**
MKO208	555897	669521	11	10	10	0.7	1.7	**7.63**	**3.14**
MKO223	556717	669726	7	8	10	0.8	1.8	**8.27**	**3.67**
MKO224	556703	669615	6.5	8	10	0.5	1.5	**14.23**	**4.74**
MKO225	556677	669589	6.5	8	10	0.3	1.3	**23.71**	**5.47**
MKO226	556504	669409	12	10	10	0.1	1.1	**49.17**	**4.47**
MKO227	556415	669525	4.5	8	10	1.1	2.1	**9.30**	**4.87**
MKO228	556447	669396	10	10	10	1.6	2.6	**3.65**	**2.25**
MKO264	556681	669092	7	8	10	1.0	2.0	**6.61**	**3.31**
MKO269	556794	669543	5	8	10	0.3	1.3	**30.71**	**7.09**
MKO286	556591	669278	6	8	10	0.1	1.1	**76.96**	**7.00**
MKO370	555977	669677	3	8	10	0.2	1.2	**76.53**	**12.76**
MKO371	555895	669662	2.5	8	10	0.5	1.5	**36.72**	**12.24**
MKO379	556283	669548	6.5	8	10	0.3	1.3	**23.71**	**5.47**
MKO382	556185	669486	5	8	10	0.3	1.3	**30.71**	**7.09**
MKO383	556158	669414	7	8	10	0.4	1.4	**16.53**	**4.72**
MKO384	556242	669463	9	8	10	0.1	1.1	**51.78**	**4.71**
MKO385	556285	669401	8	8	10	0.2	1.2	**29.02**	**4.84**
MKO396	558816	669593	3	8	10	0.4	1.4	**38.27**	**10.93**
MKO397	558783	669568	3	8	10	0.3	1.3	**51.02**	**11.77**
MKO398	558681	669571	2	8	10	0.3	1.3	**76.46**	**17.64**
MKO400	558676	669735	15	10	10	0.1	1.1	**80.00**	**3.81**
MKO408	558611	669803	11	10	10	0.5	1.5	**10.68**	**3.56**
MKO410	558522	669819	2	8	10	0.4	1.4	**57.34**	**16.38**
MKO425	554591	670201	5	8	10	0.7	1.7	**13.16**	**5.42**
MKO426	554643	670197	5	8	10	0.5	1.5	**18.43**	**6.14**
MKO435	554768	670145	13	8	10	0.5	1.5	**7.30**	**2.43**
MKO456	553048	669201	7	8	10	0.1	1.1	**66.14**	**6.01**
MKO457	553168	669237	7	8	10	0.2	1.2	**33.07**	**5.51**
MKO458	553269	669273	6	8	10	0.4	1.4	**19.24**	**5.50**
MKO459	553334	669315	6	8	10	0.5	1.5	**15.39**	**5.13**
MKO460	553264	669342	7	8	10	0.6	1.6	**11.02**	**4.13**
MKO461	553437	669419	7	8	10	0.4	1.4	**16.53**	**4.72**
MKO462	553356	669428	6	8	10	0.2	1.2	**38.48**	**6.41**
MKO463	553437	669349	9	8	10	0.1	1.1	**51.78**	**4.71**
MKO465	552972	669191	15	8	10	0.1	1.1	**32.00**	**2.91**
MKO466	552854	669190	15	8	10	0.1	1.1	**32.00**	**2.91**
							Minimum =	**2.10**	**1.35**
							Maximum =	**229.37**	**20.85**
							Average =	**32.04**	**6.99**

237.0

Notes:

(1) Assuming a bulk unit weight for peat of 10kN/m^3

(2) Assuming a surcharge equivalent to fill depth of 1m of peat i.e. 10kPa.

(3) Slope inclination (β) based on site readings and site contour plans

(4) A lower bound undrained shear strength, cu for the peat of 6/10kPa was selected for the assessment. It should be noted that a cu of 6/10kPa for the pea is considered a conservative value for the analysis and is not representative of all peat present across the site. In reality the peat has a significantly higher undrained strength.

(5) Peat depths based on probes carried out by FT.

(6) For load conditions see report text.

Calculated FoS of Natural Peat Slopes for Knockshanvo Wind Farm - Drained Analysis

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	Depth of In situ Peat	Friction Angle	Surcharge Equivalent Placed Fill	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition	
	α (deg)	c' (kPa)	γ (kN/m^3)	γ_w (kN/m^3)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
									100% Water	100% Water
T1	14	4	10.0	10.0	0.9	25	1.0	1.9	**1.89**	**1.88**
T2	18	4	10.0	10.0	0.3	25	1.0	1.3	**4.54**	**2.15**
T3	5	4	10.0	10.0	0.3	25	1.0	1.3	**15.36**	**7.64**
T4	6	4	10.0	10.0	0.5	25	1.0	1.5	**7.70**	**5.52**
T5	5	4	10.0	10.0	0.3	25	1.0	1.3	**15.36**	**7.64**
T6	8	4	10.0	10.0	0.3	25	1.0	1.3	**9.67**	**4.78**
T7	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
T8	3	4	10.0	10.0	0.4	25	1.0	1.4	**19.13**	**11.82**
T9	6	4	10.0	10.0	0.5	25	1.0	1.5	**7.70**	**5.52**
CC1	4	4	10.0	10.0	0.4	25	1.0	1.4	**14.37**	**8.87**
CC2	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
CC3	4	4	10.0	10.0	0.5	25	1.0	1.5	**11.50**	**8.28**
Met mast	5	4	10.0	10.0	0.3	25	1.0	1.3	**20.69**	**8.87**
SS1	5	4	10.0	10.0	0.9	25	1.0	1.9	**10.45**	**7.75**
SS2 (S/S)	7	4	10.0	10.0	0.1	25	1.0	1.1	**36.87**	**6.80**
WP001	8	4	10.0	10.0	No peat recorded at this location					
WP002	6	4	10.0	10.0	No peat recorded at this location					
WP003	8	4	10.0	10.0	0.4	25	1.0	1.4	**7.26**	**4.44**
WP004	4	4	10.0	10.0	No peat recorded at this location					
WP005	6	4	10.0	10.0	No peat recorded at this location					
WP006	2	4	10.0	10.0	0.1	25	1.0	1.1	**114.68**	**22.57**
WP007	8	4	10.0	10.0	No peat recorded at this location					
WP008	5	4	10.0	10.0	No peat recorded at this location					
WP009	6	4	10.0	10.0	No peat recorded at this location					
WP010	8	4	10.0	10.0	No peat recorded at this location					
WP011	4	4	10.0	10.0	No peat recorded at this location					
WP012	6	4	10.0	10.0	0.2	25	1.0	1.2	**19.24**	**6.90**
WP013	4	4	10.0	10.0	0.3	25	1.0	1.3	**19.16**	**9.55**
WP014	6	4	10.0	10.0	0.5	25	1.0	1.5	**7.70**	**5.52**
WP015	3	4	10.0	10.0	0.4	25	1.0	1.4	**19.13**	**11.82**
WP016	3	4	10.0	10.0	0.2	25	1.0	1.2	**38.27**	**13.79**
WP017	3	4	10.0	10.0	No peat recorded at this location					
WP018	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
WP019	3	4	10.0	10.0	0.2	25	1.0	1.2	**38.27**	**13.79**
WP020	4	4	10.0	10.0	0.3	25	1.0	1.3	**19.16**	**9.55**
WP021	6	4	10.0	10.0	0.2	25	1.0	1.2	**19.24**	**6.90**
WP022	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
WP023	4	4	10.0	10.0	0.1	25	1.0	1.1	**57.48**	**11.29**
WP024	6	4	10.0	10.0	0.2	25	1.0	1.2	**19.24**	**6.90**
WP025	4	4	10.0	10.0	0.3	25	1.0	1.3	**19.16**	**9.55**
WP026	4	4	10.0	10.0	0.3	25	1.0	1.3	**19.16**	**9.55**
WP027	3	4	10.0	10.0	0.2	25	1.0	1.2	**38.27**	**13.79**
WP028	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
WP029	6	4	10.0	10.0	No peat recorded at this location					
WP030	3	4	10.0	10.0	0.6	25	1.0	1.6	**12.76**	**10.34**
WP031	4	4	10.0	10.0	0.5	25	1.0	1.5	**11.50**	**8.28**
WP032	5	4	10.0	10.0	0.4	25	1.0	1.4	**11.52**	**7.10**
WP033	6	4	10.0	10.0	0.2	25	1.0	1.2	**19.24**	**6.90**
WP034	6	4	10.0	10.0	1.1	25	1.0	2.1	**3.50**	**3.94**
WP035	2	4	10.0	10.0	0.3	25	1.0	1.3	**38.23**	**19.09**
WP036	3	4	10.0	10.0	0.2	25	1.0	1.2	**38.27**	**13.79**
WP037	2	4	10.0	10.0	0.2	25	1.0	1.2	**57.34**	**20.68**
WP038	2	4	10.0	10.0	0.2	25	1.0	1.2	**57.34**	**20.68**
WP039	2	4	10.0	10.0	0.1	25	1.0	1.1	**114.68**	**22.57**
WP040	4	4	10.0	10.0	No peat recorded at this location					
WP041	3	4	10.0	10.0	0.3	25	1.0	1.3	**25.51**	**12.73**
WP042	6	4	10.0	10.0	0.3	25	1.0	1.3	**12.83**	**6.37**
WP043	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
WP044	5	4	10.0	10.0	0.3	25	1.0	1.3	**15.36**	**7.64**
WP045	6	4	10.0	10.0	0.3	25	1.0	1.3	**12.83**	**6.37**
WP046	8	4	10.0	10.0	0.1	25	1.0	1.1	**29.02**	**5.65**
WP047	4	4	10.0	10.0	0.1	25	1.0	1.1	**57.48**	**11.29**
WP048	5	4	10.0	10.0	0.3	25	1.0	1.3	**15.36**	**7.64**
WP049	6	4	10.0	10.0	0.1	25	1.0	1.1	**38.48**	**7.53**
WP050	4	4	10.0	10.0	0.2	25	1.0	1.2	**28.74**	**10.35**
WP051	6	4	10.0	10.0	0.1	25	1.0	1.1	**38.48**	**7.53**
BP1	6	4	10.0	10.0	0.2	25	1.0	1.2	**23.68**	**7.64**
BP2	4	4	10.0	10.0	0.4	25	1.0	1.4	**21.04**	**10.77**
BP3	6	4	10.0	10.0	0.2	25	1.0	1.2	**23.68**	**7.64**
BP4	6	4	10.0	10.0	0.5	25	1.0	1.5	**12.13**	**7.00**
BP5	4	4	10.0	10.0	0.6	25	1.0	1.6	**16.25**	**10.26**
BP6	6	4	10.0	10.0	0.4	25	1.0	1.4	**14.06**	**7.19**
BP7	4	4	10.0	10.0	0.2	25	1.0	1.2	**35.41**	**11.46**
BP8	4	4	10.0	10.0	0.3	25	1.0	1.3	**25.83**	**11.09**
MKO Probes										
MKO001	8	4	10.0	10.0	0.8	25	1.0	1.8	**6.95**	**4.93**
MKO002	4	4	10.0	10.0	0.3	25	1.0	1.3	**25.83**	**11.09**
MKO004	2	4	10.0	10.0	1.0	25	1.0	2.0	**24.82**	**19.09**
MKO005	2	4	10.0	10.0	0.5	25	1.0	1.5	**36.29**	**21.00**
MKO007	7	4	10.0	10.0	0.2	25	1.0	1.2	**20.33**	**6.55**
MKO009	7	4	10.0	10.0	0.9	25	1.0	1.9	**7.47**	**5.54**
MKO011	6	4	10.0	10.0	0.5	25	1.0	1.5	**12.13**	**7.00**
MKO012	6	4	10.0	10.0	2.8	25	1.0	3.8	**5.81**	**5.45**
MKO013	11	4	10.0	10.0	0.6	25	1.0	1.6	**5.96**	**3.73**
MKO014	11	4	10.0	10.0	0.3	25	1.0	1.3	**9.52**	**4.04**
MKO016	5.5	4	10.0	10.0	0.5	25	1.0	1.5	**13.23**	**7.64**
MKO017	5.5	4	10.0	10.0	0.5	25	1.0	1.5	**13.23**	**7.64**
MKO018	7.5	4	10.0	10.0	0.8	25	1.0	1.8	**7.41**	**5.26**
MKO019	9	4	10.0	10.0	0.5	25	1.0	1.5	**8.12**	**4.67**
MKO020	9	4	10.0	10.0	0.8	25	1.0	1.8	**6.18**	**4.38**

Calculated FoS of Natural Peat Slopes for Knockshanvo Wind Farm - Drained Analysis

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	Depth of In situ Peat	Friction Angle	Surcharge Equivalent Placed Fill	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition	
	α (deg)	c' (kPa)	γ (kN/m^3)	γ_w (kN/m^3)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
									100% Water	100% Water
MKO021	9	4	10.0	10.0	0.7	25	1.0	1.7	**6.64**	**4.47**
MKO022	9	4	10.0	10.0	0.6	25	1.0	1.6	**7.26**	**4.56**
MKO024	16	4	10.0	10.0	1.1	25	1.0	2.1	**3.00**	**2.35**
MKO027	16	4	10.0	10.0	0.9	25	1.0	1.9	**3.30**	**2.42**
MKO028	16	4	10.0	10.0	0.9	25	1.0	1.9	**3.30**	**2.42**
MKO029	16	4	10.0	10.0	0.3	25	1.0	1.3	**6.66**	**2.79**
MKO030	16	4	10.0	10.0	1.0	25	1.0	2.0	**3.14**	**2.38**
MKO032	16	4	10.0	10.0	1.8	25	1.0	2.8	**2.46**	**2.17**
MKO033	16	4	10.0	10.0	0.9	25	1.0	1.9	**3.30**	**2.42**
MKO036	7.5	4	10.0	10.0	0.6	25	1.0	1.6	**8.69**	**5.47**
MKO037	7.5	4	10.0	10.0	0.8	25	1.0	1.8	**7.41**	**5.26**
MKO038	7.5	4	10.0	10.0	0.8	25	1.0	1.8	**7.41**	**5.26**
MKO039	7.5	4	10.0	10.0	0.6	25	1.0	1.6	**8.69**	**5.47**
MKO040	7.5	4	10.0	10.0	0.3	25	1.0	1.3	**13.85**	**5.92**
MKO047	2	4	10.0	10.0	0.4	25	1.0	1.4	**42.02**	**21.55**
MKO048	4	4	10.0	10.0	0.3	25	1.0	1.3	**25.83**	**11.09**
MKO049	8	4	10.0	10.0	0.3	25	1.0	1.3	**12.99**	**5.55**
MKO050	11	4	10.0	10.0	0.5	25	1.0	1.5	**6.67**	**3.82**
MKO052	1	4	10.0	10.0	2.3	25	1.0	3.3	**36.68**	**33.66**
MKO053	3	4	10.0	10.0	0.5	25	1.0	1.5	**24.20**	**14.00**
MKO054	3	4	10.0	10.0	0.3	25	1.0	1.3	**34.41**	**14.78**
MKO055	3	4	10.0	10.0	0.3	25	1.0	1.3	**34.41**	**14.78**
MKO056	5	4	10.0	10.0	0.1	25	1.0	1.1	**51.40**	**9.52**
MKO057	10	4	10.0	10.0	0.2	25	1.0	1.2	**14.34**	**4.59**
MKO058	5	4	10.0	10.0	0.6	25	1.0	1.6	**13.01**	**8.21**
MKO059	7	4	10.0	10.0	0.4	25	1.0	1.4	**12.06**	**6.16**
MKO060	7	4	10.0	10.0	0.5	25	1.0	1.5	**10.41**	**6.00**
MKO061	4	4	10.0	10.0	0.5	25	1.0	1.5	**18.16**	**10.50**
MKO062	2	4	10.0	10.0	0.4	25	1.0	1.4	**42.02**	**21.55**
MKO063	2	4	10.0	10.0	0.5	25	1.0	1.5	**36.29**	**21.00**
MKO064	2	4	10.0	10.0	0.3	25	1.0	1.3	**51.58**	**22.18**
MKO065	3	4	10.0	10.0	0.6	25	1.0	1.6	**21.65**	**13.68**
MKO079	8	4	10.0	10.0	0.4	25	1.0	1.4	**10.57**	**5.39**
MKO080	2	4	10.0	10.0	1.0	25	1.0	2.0	**24.82**	**19.09**
MKO082	11	4	10.0	10.0	0.4	25	1.0	1.4	**7.74**	**3.92**
MKO083	6	4	10.0	10.0	0.5	25	1.0	1.5	**12.13**	**7.00**
MKO084	7	4	10.0	10.0	0.2	25	1.0	1.2	**20.33**	**6.55**
MKO085	4	4	10.0	10.0	1.0	25	1.0	2.0	**12.42**	**9.54**
MKO086	4	4	10.0	10.0	1.0	25	1.0	2.0	**12.42**	**9.54**
MKO088	6	4	10.0	10.0	1.3	25	1.0	2.3	**7.40**	**6.11**
MKO089	2	4	10.0	10.0	1.1	25	1.0	2.1	**23.78**	**18.81**
MKO090	2	4	10.0	10.0	1.0	25	1.0	2.0	**24.82**	**19.09**
MKO091	2	4	10.0	10.0	2.0	25	1.0	3.0	**19.09**	**17.18**
MKO092	5	4	10.0	10.0	0.4	25	1.0	1.4	**16.85**	**8.62**
MKO093	5	4	10.0	10.0	1.1	25	1.0	2.1	**9.52**	**7.52**
MKO094	8	4	10.0	10.0	1.2	25	1.0	2.2	**5.74**	**4.64**
MKO095	4	4	10.0	10.0	0.5	25	1.0	1.5	**18.16**	**10.50**
MKO096	4	4	10.0	10.0	0.5	25	1.0	1.5	**18.16**	**10.50**
MKO097	2	4	10.0	10.0	0.7	25	1.0	1.7	**29.74**	**20.10**
MKO098	2	4	10.0	10.0	1.0	25	1.0	2.0	**24.82**	**19.09**
MKO099	3	4	10.0	10.0	0.8	25	1.0	1.8	**18.46**	**13.15**
MKO100	4	4	10.0	10.0	0.6	25	1.0	1.6	**16.25**	**10.26**
MKO101	3	4	10.0	10.0	0.8	25	1.0	1.8	**18.46**	**13.15**
MKO102	3	4	10.0	10.0	0.7	25	1.0	1.7	**19.83**	**13.40**
MKO103	3	4	10.0	10.0	0.9	25	1.0	1.9	**17.40**	**12.93**
MKO104	10	4	10.0	10.0	0.5	25	1.0	1.5	**7.32**	**4.20**
MKO105	8	4	10.0	10.0	0.3	25	1.0	1.3	**12.99**	**5.55**
MKO106	8	4	10.0	10.0	0.4	25	1.0	1.4	**10.57**	**5.39**
MKO107	3	4	10.0	10.0	0.5	25	1.0	1.5	**24.20**	**14.00**
MKO108	9	4	10.0	10.0	0.3	25	1.0	1.3	**11.57**	**4.94**
MKO109	2	4	10.0	10.0	0.2	25	1.0	1.2	**70.70**	**22.91**
MKO111	2	4	10.0	10.0	0.6	25	1.0	1.6	**32.47**	**20.52**
MKO112	3	4	10.0	10.0	1.0	25	1.0	2.0	**16.55**	**12.72**
MKO113	2	4	10.0	10.0	1.9	25	1.0	2.9	**19.39**	**17.31**
MKO115	7	4	10.0	10.0	0.4	25	1.0	1.4	**12.06**	**6.16**
MKO117	2	4	10.0	10.0	0.1	25	1.0	1.1	**128.04**	**23.78**
MKO118	8	4	10.0	10.0	0.7	25	1.0	1.7	**7.46**	**5.03**
MKO120	7	4	10.0	10.0	1.1	25	1.0	2.1	**6.80**	**5.37**
MKO121	3	4	10.0	10.0	1.9	25	1.0	2.9	**12.93**	**11.54**
MKO122	8	4	10.0	10.0	0.7	25	1.0	1.7	**7.46**	**5.03**
MKO123	5	4	10.0	10.0	0.8	25	1.0	1.8	**11.09**	**7.89**
MKO125	2	4	10.0	10.0	1.2	25	1.0	2.2	**22.91**	**18.57**
MKO126	5	4	10.0	10.0	0.6	25	1.0	1.6	**13.01**	**8.21**
MKO127	6	4	10.0	10.0	1.0	25	1.0	2.0	**8.28**	**6.36**
MKO128	8	4	10.0	10.0	0.2	25	1.0	1.2	**17.83**	**5.74**
MKO129	14	4	10.0	10.0	0.9	25	1.0	1.9	**3.76**	**2.77**
MKO130	5.5	4	10.0	10.0	0.5	25	1.0	1.5	**13.23**	**7.64**
MKO131	6	4	10.0	10.0	0.6	25	1.0	1.6	**10.85**	**6.84**
MKO132	9	4	10.0	10.0	0.5	25	1.0	1.5	**8.12**	**4.67**
MKO133	10	4	10.0	10.0	0.6	25	1.0	1.6	**6.54**	**4.11**
MKO134	7	4	10.0	10.0	0.9	25	1.0	1.9	**7.47**	**5.54**
MKO135	7	4	10.0	10.0	0.4	25	1.0	1.4	**12.06**	**6.16**
MKO136	5	4	10.0	10.0	0.4	25	1.0	1.4	**16.85**	**8.62**
MKO137	5	4	10.0	10.0	0.7	25	1.0	1.7	**11.91**	**8.04**
MKO138	7.5	4	10.0	10.0	0.2	25	1.0	1.2	**19.00**	**6.12**
MKO139	14	4	10.0	10.0	0.3	25	1.0	1.3	**7.55**	**3.18**
MKO140	14	4	10.0	10.0	0.2	25	1.0	1.2	**10.39**	**3.29**
MKO141	14	4	10.0	10.0	0.2	25	1.0	1.2	**10.39**	**3.29**
MKO142	14	4	10.0	10.0	0.2	25	1.0	1.2	**10.39**	**3.29**
MKO143	14	4	10.0	10.0	0.3	25	1.0	1.3	**7.55**	**3.18**
MKO144	5	4	10.0	10.0	0.2	25	1.0	1.2	**28.37**	**9.17**
MKO145	8	4	10.0	10.0	0.2	25	1.0	1.2	**17.83**	**5.74**
MKO146	8	4	10.0	10.0	0.3	25	1.0	1.3	**12.99**	**5.55**

Calculated FoS of Natural Peat Slopes for Knockshanvo Wind Farm - Drained Analysis

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	Depth of In situ Peat	Friction Angle	Surcharge Equivalent Placed Fill	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition	
	α (deg)	c' (kPa)	γ (kN/m^3)	γ_w (kN/m^3)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
									100% Water	100% Water
MKO147	2	4	10.0	10.0	0.1	25	1.0	1.1	**128.04**	**23.78**
MKO149	5	4	10.0	10.0	1.9	25	1.0	2.9	**7.75**	**6.92**
MKO150	8	4	10.0	10.0	0.7	25	1.0	1.7	**7.46**	**5.03**
MKO151	14	4	10.0	10.0	0.5	25	1.0	1.5	**5.28**	**3.01**
MKO152	6.5	4	10.0	10.0	0.4	25	1.0	1.4	**12.98**	**6.63**
MKO153	13	4	10.0	10.0	0.2	25	1.0	1.2	**11.14**	**3.54**
MKO156	12	4	10.0	10.0	0.2	25	1.0	1.2	**12.03**	**3.83**
MKO157	12	4	10.0	10.0	0.2	25	1.0	1.2	**12.03**	**3.83**
MKO158	14	4	10.0	10.0	0.1	25	1.0	1.1	**18.91**	**3.42**
MKO159	4	4	10.0	10.0	0.8	25	1.0	1.8	**13.85**	**9.86**
MKO160	1	4	10.0	10.0	3.9	25	1.0	4.9	**32.59**	**31.39**
MKO161	1	4	10.0	10.0	2.2	25	1.0	3.2	**37.13**	**33.88**
MKO162	6	4	10.0	10.0	1.8	25	1.0	2.8	**6.57**	**5.81**
MKO164	6	4	10.0	10.0	0.3	25	1.0	1.3	**17.26**	**7.40**
MKO165	6	4	10.0	10.0	0.4	25	1.0	1.4	**14.06**	**7.19**
MKO166	5	4	10.0	10.0	0.3	25	1.0	1.3	**20.69**	**8.87**
MKO167	6	4	10.0	10.0	0.2	25	1.0	1.2	**23.68**	**7.64**
MKO168	4	4	10.0	10.0	0.3	25	1.0	1.3	**25.83**	**11.09**
MKO169	5	4	10.0	10.0	0.2	25	1.0	1.2	**28.37**	**9.17**
MKO170	8	4	10.0	10.0	0.2	25	1.0	1.2	**17.83**	**5.74**
MKO171	8	4	10.0	10.0	0.2	25	1.0	1.2	**17.83**	**5.74**
MKO172	8	4	10.0	10.0	0.1	25	1.0	1.1	**32.34**	**5.96**
MKO184	6	4	10.0	10.0	0.5	25	1.0	1.5	**12.13**	**7.00**
MKO185	3	4	10.0	10.0	0.3	25	1.0	1.3	**34.41**	**14.78**
MKO196	1	4	10.0	10.0	3.0	25	1.0	4.0	**34.36**	**32.45**
MKO198	5	4	10.0	10.0	0.6	25	1.0	1.6	**13.01**	**8.21**
MKO199	8	4	10.0	10.0	0.8	25	1.0	1.8	**6.95**	**4.93**
MKO204	5	4	10.0	10.0	0.5	25	1.0	1.5	**14.54**	**8.40**
MKO205	4	4	10.0	10.0	2.2	25	1.0	3.2	**9.28**	**8.46**
MKO206	4	4	10.0	10.0	1.1	25	1.0	2.1	**11.89**	**9.41**
MKO207	6	4	10.0	10.0	0.7	25	1.0	1.7	**9.93**	**6.70**
MKO208	11	4	10.0	10.0	0.7	25	1.0	1.7	**5.45**	**3.66**
MKO223	7	4	10.0	10.0	0.8	25	1.0	1.8	**7.93**	**5.63**
MKO224	6.5	4	10.0	10.0	0.5	25	1.0	1.5	**11.21**	**6.46**
MKO225	6.5	4	10.0	10.0	0.3	25	1.0	1.3	**15.95**	**6.83**
MKO226	12	4	10.0	10.0	0.1	25	1.0	1.1	**21.86**	**3.98**
MKO227	4.5	4	10.0	10.0	1.1	25	1.0	2.1	**10.57**	**8.36**
MKO228	10	4	10.0	10.0	1.6	25	1.0	2.6	**4.11**	**3.54**
MKO264	7	4	10.0	10.0	1.0	25	1.0	2.0	**7.10**	**5.45**
MKO269	5	4	10.0	10.0	0.3	25	1.0	1.3	**20.69**	**8.87**
MKO286	6	4	10.0	10.0	0.1	25	1.0	1.1	**42.91**	**7.93**
MKO370	3	4	10.0	10.0	0.2	25	1.0	1.2	**47.16**	**15.28**
MKO371	2.5	4	10.0	10.0	0.5	25	1.0	1.5	**29.04**	**16.80**
MKO379	6.5	4	10.0	10.0	0.3	25	1.0	1.3	**15.95**	**6.83**
MKO382	5	4	10.0	10.0	0.3	25	1.0	1.3	**20.69**	**8.87**
MKO383	7	4	10.0	10.0	0.4	25	1.0	1.4	**12.06**	**6.16**
MKO384	9	4	10.0	10.0	0.1	25	1.0	1.1	**28.83**	**5.30**
MKO385	8	4	10.0	10.0	0.2	25	1.0	1.2	**17.83**	**5.74**
MKO396	3	4	10.0	10.0	0.4	25	1.0	1.4	**28.03**	**14.36**
MKO397	3	4	10.0	10.0	0.3	25	1.0	1.3	**34.41**	**14.78**
MKO398	2	4	10.0	10.0	0.3	25	1.0	1.3	**51.58**	**22.18**
MKO400	15	4	10.0	10.0	0.1	25	1.0	1.1	**33.74**	**3.26**
MKO408	11	4	10.0	10.0	0.5	25	1.0	1.5	**6.67**	**3.82**
MKO410	2	4	10.0	10.0	0.4	25	1.0	1.4	**42.02**	**21.55**
MKO425	5	4	10.0	10.0	0.7	25	1.0	1.7	**11.91**	**8.04**
MKO426	5	4	10.0	10.0	0.5	25	1.0	1.5	**14.54**	**8.40**
MKO435	13	4	10.0	10.0	0.5	25	1.0	1.5	**5.67**	**3.24**
MKO456	7	4	10.0	10.0	0.1	25	1.0	1.1	**36.87**	**6.80**
MKO457	7	4	10.0	10.0	0.2	25	1.0	1.2	**20.33**	**6.55**
MKO458	6	4	10.0	10.0	0.4	25	1.0	1.4	**14.06**	**7.19**
MKO459	6	4	10.0	10.0	0.5	25	1.0	1.5	**12.13**	**7.00**
MKO460	7	4	10.0	10.0	0.6	25	1.0	1.6	**9.31**	**5.86**
MKO461	7	4	10.0	10.0	0.4	25	1.0	1.4	**12.06**	**6.16**
MKO462	6	4	10.0	10.0	0.2	25	1.0	1.2	**23.68**	**7.64**
MKO463	9	4	10.0	10.0	0.1	25	1.0	1.1	**28.83**	**5.30**
MKO465	15	4	10.0	10.0	0.1	25	1.0	1.1	**17.74**	**3.19**
MKO466	15	4	10.0	10.0	0.1	25	1.0	1.1	**17.74**	**3.19**
								Minimum =	**1.89**	**1.88**
								Maximum =	**128.04**	**33.88**
								Average =	**20.42**	**9.19**

Notes:

(1) Assuming a bulk unit weight of peat of 10 (kN/m^3)

(2) Assuming a surcharge equivalent to fill depth of 1.0m.

(3) Slope inclination (β) based on site readings and contour survey plans of site.

(4) FoS is based on slope inclination and shear test results obtained from published data.

(5) Peat depths based on probes carried out by FT.

(6) For load conditions see Report text.

(7) Minimum acceptable factor of safety required of 1.3 for first-time failures based on BS: 6031:1981 Code of practice for Earthworks.

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APPENDIX D

Methodology for Peat Stability Risk Assessment

Methodology for Peat Stability Risk Assessment

A peat stability risk assessment was carried out for each of the main infrastructure elements at the proposed wind farm development. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRAG (2017) and MacCulloch (2005). The degree of risk is determined as a Risk Rating (R), which is the product of probability (P) and impact (I). How these factors are determined and applied in the analysis is described below.

The main approaches for assessing peat stability include the following:

(a) Geomorphological

(b) Qualitative (judgement)

(c) Index/Probabilistic (probability)

(d) Deterministic (factor of safety)

Approaches (a) to (c) listed above would be considered subjective and do not provide a definitive indication of stability; in addition, a high level of judgement/experience is required which makes it difficult to relate the findings to real conditions. FT apply a more objective approach, the deterministic approach. As part of FT's deterministic approach, a qualitative risk assessment is also carried out taking into account qualitative factors, which cannot necessarily be quantified.

Probability

The likelihood of a peat failure occurring was assessed based on the results of both the quantitative results of stability calculations (deterministic approach using factors of safety) and the assessment of the severity of several qualitative factors which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability.

The qualitative factors used in the risk assessment are outlined in Table A and have been compiled based on FT's experience of assessments and construction in peat land sites and peat failures throughout Ireland and the UK.

Table A: Qualitative Factors used to Assess Potential for Peat Failure

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
Evidence of sub peat water flow	No	Based on site walkover observations. Sub peat water flow generally occurs in the form of natural piping at the base of peat. Where there is a constriction or blockage in natural pipes a build-up of water can occur at the base of the peat causing a reduction in effective stress at the base of the peat resulting in failure; this is particularly critical during periods of intense rainfall.
	Possibly	
	Probably	
	Yes	

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
Evidence of surface water flow	Dry	Based on site walkover observations. The presence of surface water flow indicates if peat in an area is well drained or saturated and if any additional loading from the ponding of surface water onto the peat is likely.
	Localised/Flowing in drains	
	Ponded in drains	
	Springs/surface water	
Evidence of previous failures/slips	No	Based on site walkover observations. The presence of clustering of relict failures may indicate that particular pre-existing site conditions predispose a site to failure.
	In general area	
	On site	
	Within 500m of location	
Type of vegetation	Grass/Crops	Based on site walkover observations. The type of vegetation present indicates if peat in an area is well drained, saturated, etc. Vegetation that indicates wetter ground may also indicate softer underlying peat deposits.
	Improved Grass/Dry Heather	
	Wet Grassland/Juncus (Rushes)	
	Wetlands Sphagnum (Peat moss)	
General slope characteristics upslope/downslope from infrastructure location	Concave	Based on site walkover observations. Slope morphology in the area of the infrastructure location is an important factor. A number of recorded peat failures have occurred in close proximity to a convex break in slope.
	Planar to concave	
	Planar to convex	
	Convex	
Evidence of very soft/soft clay at base of peat	No	Based on inspection of exposures in general area from site walkover. Several reported peat failures identify the presence of a weak layer at the base of the peat along which shear failure has occurred.
	Yes	
Evidence of mechanically cut peat	No	Based on site walkover observations. Mechanically cut peat typically cut using a ‘sausage’ machine to extract

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
	Yes	peat for harvesting. Areas which have been cut in this manner have been linked to peat instability. The mechanical cuts can notably reduce the intrinsic strength of the peat and also allow ingress of rainfall/surface water.
Evidence of quaking or buoyant peat	No	Based on site walkover observations. Quaking/buoyant peat is indicative of highly saturated peat, which would generally be considered to have a low strength. Quaking peat is a feature on sites that have been previously linked with peat instability.
	Yes	
Evidence of bog pools	No	Based on site walkover observations. Bog pools are generally an indicator of areas of weak, saturated peat. Commonly where there are open areas of water within peat these can be interconnected, with the result that there may be sub-surface bodies of water. The presence of bog pools have been previously linked with peat instability.
	Yes	
Other	Varies	In addition to the above features/ indicators and based on site recordings the following are some of the features which may be identified: Excessively deep peat, weak peat, overly steep slope angles, etc.

Note (1) The list of features/indicators for each qualitative factor are given in increasing order of probability of leading to peat instability/failure.

It should be noted that the presence of one of the qualitative factors alone from Table A is unlikely to lead to peat instability/failure. Peat instability/failure at a site is generally the combination of a number of these factors occurring at the same time at a particular location. The probability rating assigned to the quantitative and qualitative factors is judged on a 5-point scale from 1 (indicating negligible or no probability of failure) to 5 (indicating a very likely failure), as outlined in Table B.

Table B: Probability Scale

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.01 to 1.10	Probable
5	≤1.0	Very Likely

Scale	Likelihood of Qualitative Factor leading to Peat Failure	Probability of Failure
1	Negligible/None	Least
2	Unlikely	
3	Probable	
4	Likely	
5	Very Likely	Greatest

Impact

The severity of the risk is also assessed qualitatively in terms of impact. The impact of a peat failure on the environment within and beyond the immediate wind farm site is assessed based on the potential travel distance of a peat failure. Where a peat failure enters a watercourse, it can travel a considerable distance downstream. Therefore, the proximity of a potential peat failure to a drainage course is a significant indicator of the likely potential impact.

The risk is determined based on the combination of hazard and impact. A qualitative scale has been derived for the impact of the hazard based on distance of infrastructure element to a watercourse (Table C).

The location of watercourses is based on topographic maps and supplemented by site observations from walkover survey. Note that not all watercourses are shown on maps.

Table C: Impact Scale

Scale	Criteria	Impact
1	Proposed infrastructure element greater than 150m of watercourse	Negligible/None
2	Proposed infrastructure element within 150 to 101m of watercourse	Low
3	Proposed infrastructure element within 100 to 51m of watercourse	Medium

4	Proposed infrastructure element within 50 m of watercourse	High
5	Proposed infrastructure element within 50 m of watercourse, in an environmentally sensitive area	Extremely High

Risk Rating

The degree of risk is determined as the product of probability (P) and impact (I), which gives the Risk Rating (R) as follows:

The Risk Rating is calculated from: R = P x I

Due to the 5-point scales used to assess Probability and Impact, the Risk Rating can range from 1 to 25 as shown in Table D.

Table D: Qualitative Risk Rating

		Probability				
		1	**2**	**3**	**4**	**5**
Impact	**5**	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Risk Rating & Control Measures	
17 to 25	High: avoid working in area or significant control measures required
11 to 16	Medium: notable control measures required
5 to 10	Low: only routine control measures required
1 to 4	Negligible: none or only routine control measures required

The risk rating is calculated individually for each contributory factor. Control measures are required to reduce the risk to at least a 'Low' risk rating. The control measures in response to the qualitative risk ratings are included in the peat stability risk registers for each main infrastructure element in Appendix B.

The risk rating is calculated individually for each contributory factor. Control measures are required to reduce the risk to at least a 'Tolerable' risk rating.

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APPENDIX E

Ground Investigation Information (IDL, 2023)

IRISH DRILLING LIMITED

LOUGHREA, CO. GALWAY, IRELAND

CONTRACT DRILLING
SITE INVESTIGATION

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KNOCKSHANVO WIND FARM

SITE INVESTIGATION CONTRACT FACTUAL REPORT

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Bagenalstown,
Carlow.

	Prepared by	Approved by	Rev. Issue Date:	Revision No.
	Ronan Killeen	Declan Joyce	19th October 2023	23_CE_103/01
Signature				

FOREWORD

The borehole and trial pit records have been compiled from an examination of the samples by a Geotechnical Engineer and from the Drillers' descriptions.

The report presents an opinion on the configuration of the strata within the site based on the borehole and trial pit results. The assumptions, though reasonable, are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes and trial pits.

The fieldwork was carried out in accordance with IS EN 1997-2 and BS5930, 2015 Code of Practice for Site Investigations with precedence given to IS EN 1997-2 where applicable.

Contents:

1.0 Introduction.

Irish Drilling Ltd. (IDL) was instructed by Fehiliy Timoney & Partners, Consulting Engineers, on behalf of MKO, to carry out a site investigation at the site of the proposed Knockshanvo Wind Farm Project.

This site investigation was carried out to provide detailed factual geotechnical information of the underlying ground conditions for a proposed 9nr turbine wind farm with ancillary access roads and infrastructures.

The fieldwork commenced on August 28th 2023 and was completed on September 13th 2023.

2.0 Site & Geology

The site is located at Knockshanvo, approximately 5km south of Broadford, County Clare.

The fieldwork was carried out predominantly on agricultural lands and/or densely forested lands.

Weather conditions in general were quite variable with the majority of the fieldwork carried out over a typical summer/autumn period in Ireland.

Site Plans, prepared by the client's representatives and showing approximate fieldwork locations, are included with this report as Appendix 6.

The following were the main published information sources used:
Geological Map of Ireland: 1:750,000 scale map series.

Site investigation data is available as point source data along the proposed route, and the majority of the ground in between the points can only be assumed to follow the characteristics of the nearest available data.

<u>Overview of Subsoil Geology</u>

Glacial Till:

Glacial Till is what was often referred to as Boulder Clay. It is a diverse material that is largely deposited sub-glacially and has a wide range of characteristics due to the variety of parent materials and different processes of deposition. Tills are often tightly packed, unsorted, heterogeneous, unbedded, and can have a wide range of particle sizes and types, which are often but not exclusively angular or sub-angular.

The type of parent material plays a critical role in providing the particles that create different subsoil permeability with sandstones giving rise to a high proportion of sand sized grains in the till matrix, clean limestones providing a relatively high proportion of silt, while shales, shaly limestones and mudstones break down to the finer clay sized particles.

Peat:

The deposition of peat occurred in post-glacial periods and is generally associated with the start of warmer and wetter climatic conditions. Peat is an unconsolidated usually dark brown to black organic material comprising a mixture of decomposed and undecomposed plant matter that accumulated in an acidic waterlogged environment. Peat has an extremely high-water content generally averaging over 90% by volume.

Made Ground:

Made Ground is material which has been purposefully emplaced by humans.

Solid Geology

The Geological Map of Ireland: 1:750,000 scale map series indicate that the site is underlain by the Old Red Sandstone Rock Formations.

3.0 Fieldwork.

3.1 Fieldwork Plant:

The following plant was mobilised to site to carry out fieldwork operations:
1nr. Zaxis 130 LCN Tracked Excavator.
1nr. GT1100 GoTract Rotary Core Drilling Rig.

Fieldwork carried out to date has included the following:

3.3 Rotary Core Boreholes:

Three rotary core boreholes were carried out to establish overburden conditions and rockhead and to establish the nature and integrity of the underlying rock.

The boreholes were completed using wireline drilling techniques, and HQ size (64mm core diameter, 96mm hole diameter) drill strings to recover soil and rock core samples.

A water based flush system was used as the drilling medium while a biodegradable polymer gel was also used where necessary to aid the drilling and soil / rock recovery process.

The samples were stored in wooden boxes and returned to the laboratory where there were logged and photographed by a Geotechnical Engineer and presented for testing.

The rotary core boreholes were carried out to depths ranging from 10.00m to 10.10m below ground level.

A 50mm diameter standpipe was installed in boreholes BH 01 and BH 03 to allow for the monitoring of groundwater levels over a prolonged period of time.,

Detailed engineering logs for the rotary core boreholes completed are included with this report in Appendix 1.

3.4 Trial Pits:

Thirteen trial pits were excavated on site using a Zaxis 130 tracked excavator.

The pits were logged and photographed by an Engineer with observations made on ground conditions, pit stability, water ingress and services encountered.

The pits were excavated to depths ranging from 0.70m to 4.00m below ground level.

Small and bulk disturbed soil samples were recovered at each change in strata and returned to the laboratory and presented for testing.

Detailed engineering logs for the trial pits completed are included with this report in Appendix 2.

3.8 General Summary:

The borehole and trial pit locations were set out on site using a Trimble CU Bluetooth GPS Surveying Unit and the co-ordinates are included on the logs presented in the appendices.

All fieldwork co-ordinates are reported to Irish Transverse Mercator (ITM) with Reduced Levels recorded relative to Malin Head Datum and with an accuracy level of + or – 0.10m.

Ground conditions encountered during the completion of the fieldwork were typical and as expected for this region and predominantly consisted of Glacial Tills overlying Bedrock.

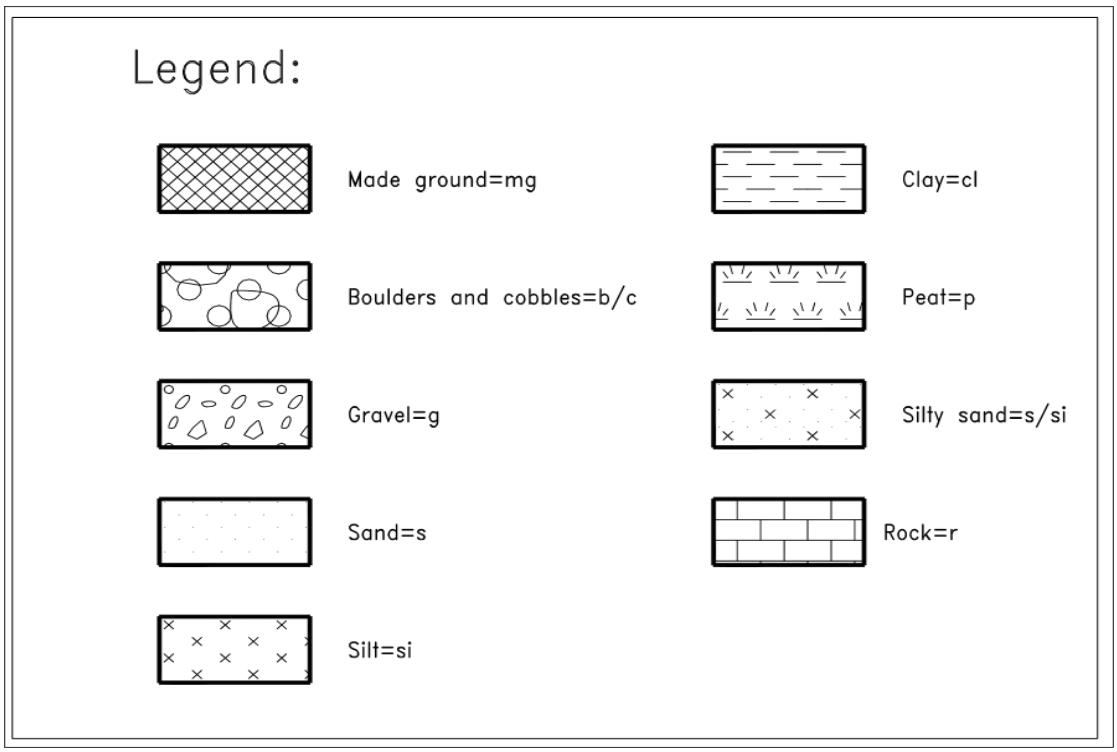
The Glacial Tills in general consisted of slightly sandy slightly gravelly silt/clay with cobbles and boulders and/or silty sands and/or gravels with cobbles and boulders.

Made Ground was encountered in a number of trial pits to depths of 0.50m to 0.60m below ground level while Peat was encountered in trial pit TP 05 from 0.60m to 0.80m below ground level.

Intact bedrock was encountered in the rotary core boreholes at depths varying from 2.30m to 4.60m below ground level and in general is described as strong, locally medium strong fine to coarse grained siltstone.

Weathered bedrock was also encountered in a number of the boreholes and trial pits at shallower depths and for detailed descriptions of the overburden and bedrock encountered please refer to the engineering logs included in the appendices of this report.

The following Key Legend Table details the symbology used on the engineering logs to describe ground conditions encountered:



The fieldwork was carried out in accordance with IS EN 1997-2 and BS5930, 1999 Code of Practice for Site Investigations with precedence given to IS EN 1997-2 where applicable.

4.0 Laboratory Testing

Representative samples recovered from the boreholes and trial pits were scheduled for testing in the laboratory.

The test schedules were prepared by the Client's Engineer and included some or all of the following tests on disturbed soil samples:

* Natural Moisture Content.
* Atterberg Limits.
* Particle Size Distribution.
* Sedimentation.
* Chemical (pH, Sulphate)

The test schedules included some or all of the following tests on rock core samples:

* Point Load.
* UCS.

The test schedules were carried out predominantly at the IDL Laboratory located at Loughrea, County Galway.

A number of specialist tests not available at the IDL laboratory were carried out by designated laboratories on a subcontract basis as follows:

Laboratory chemical tests were carried out by Alcontrol Laboratories, UK.

Soil samples (disturbed) in general were recovered from the excavation of trial pits.

Rock core samples were recovered from the completion of rotary core boreholes and the records of soil and rock core laboratory test results carried out on same are reported in Appendix 3.

The soil and rock descriptions as noted on the borehole and trial pit logs are in general visual descriptions as observed and logged by our Engineers and are described in accordance with IS EN 1997-2 and BS5930:2015+A1:2020 Code of Practice for Site Investigations.

Soils descriptions (cohesive or otherwise) are also initially assessed based on the texture and ‘feel’ of the soil materials as witnessed by our Geotechnical Engineers and in accordance with IS EN 1997-2 and BS5930:2015+A1:2020.

Where laboratory classification tests have been carried out on soil or rock samples then these visual descriptions have been amended accordingly to take into account the results of these classification tests.

The records of all fieldwork, laboratory test results and photographs are included in the appendices of this Factual Report.

Ronan Killeen
Chartered Engineer
Irish Drilling Limited
October 19th 2023

Appendix 01
Borehole Records

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Knockshanvo WF	Co Clare	**BH-01**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2023CE103	12-09-23 12-09-23	178.21	E 559,152.8 N 669,577.2

Engineer	Sheet	Status
FTCO	1 of 2	FINAL

RUN DETAILS						STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Discontinuities	Detail	Main	Instrument/ Backfill
0.00						0.00 - 2.30 : overburden.		Stiff reddish brown sandy gravelly SILT. Sand is coarse. Gravel is subrounded to subangular fine to coarse of assorted brown and reddish brown sandstone and reddish brown and brown siltstone.	
	50 - -				(2.30)				
2.00			175.91		2.30				
	93 (83) 29	11				2.30 - 4.40 Discontinuities, closely spaced, locally very closely spaced, dipping 8 to 10°, planar, rough, with 0.5 to 5mm thick reddish brown silt smear.		Strong locally medium strong and very strong thinly laminated reddish brown fine and medium grained SILTSTONE. OLD RED SANDSTONE.	
3.50		20			(2.10)	3.55 - 3.85 Joint, subvertical dip, stepped, rough, with 0.5 to 2mm thick reddish brown silt smear, open.			
	100 (94) 17	10	173.81		4.40				
5.00		9				4.40 - 6.70 Discontinuities, closely spaced and very closely spaced, locally medium spaced, dipping 10 to 12°, stepped, rough, with 0.5 to 2mm thick reddish brown silt smear. 5.10 - 5.25 Joint, subvertical dip, stepped, rough, with 0.5 to 2mm thick reddish brown silt smear, open. 5.45 - 5.65 Joint, subvertical dip, 'V' shaped, stepped, rough, with 0.5 to 2mm thick reddish brown silt smear and surficial dark orangish brown iron stain, open. 5.50 - 5.70 Joint, subvertical dip, stepped, rough, with 0.5 to 2mm thick reddish brown silt smear and surficial dark orangish brown iron stain, open. 6.70 - 6.80 Non-intact as firm reddish brown silt. 6.80 - 7.30 Discontinuities, very closely spaced, dipping 8 to 10°, planar, smooth, with 0.5 to 1mm thick reddish brown silt smear. 7.30 - 10.10 Discontinuities, medium		Strong locally very strong thinly laminated light reddish brown fine and coarse grained SANDSTONE. Sequence coarsening down. OLD RED SANDSTONE.	
	100 (94) 56	9							
6.50		7							
		NI							
	100 (76) 49	29			(5.70)				
8.00		5							

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	10.1	Water	100

GENERAL REMARKS

50mm standpipe installed.

All dimensions in metres Scale 1:50	Client: Coillte	Method/ Plant Used: Rotary Core/DB-DeltaBase		Driller: BD	Logged By: EAT

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Knockshanvo WF	Co Clare	**BH-01**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2023CE103	12-09-23 12-09-23	178.21	E 559,152.8 N 669,577.2

Engineer	Sheet	Status
FTCO	2 of 2	FINAL

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Discontinuities Detail	Main	Instrument/ Backfill
	100 (96) 94	3				spaced, locally closely spaced, dipping 10 to 12°, stepped, rough, with 0.5 to 1mm thick reddish brown silt smear.	Strong locally very strong thinly laminated light reddish brown fine and coarse grained SANDSTONE. Sequence coarsening down. OLD RED SANDSTONE. *(continued)* 8.25m to 10.10m: becoming very strong light reddish brownish grey fine to coarse grained SANDSTONE. Sequence coarsening down.	
9.50								
	100 (100) 100	1						
12.09 10.10			168.11		10.10			

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	
12/09/23	16.00	10.10										50mm standpipe installed.

All dimensions in metres Scale 1:50	Client: Coillte	Method/ Plant Used: Rotary Core/DB-DeltaBase		Driller: BD	Logged By: EAT

IDL AGS4 UK DH (SPTS) KNOCKSHANVO WF RC FILE 1 SEPT 21 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Knockshanvo WF	Co Clare	**BH-02**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2023CE103	13-09-23 13-09-23	187.88	E 556,297.3 N 669,128.0

Engineer	Sheet	Status
FTCO	1 of 2	FINAL

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Discontinuities Detail	Main	Instrument/ Backfill
0.00						0.00 - 1.60 : overburden.	Subrounded fine and medium assorted reddish brown and brown siltstone GRAVEL.	
	35 -				(1.60)			
	-		186.28		1.60			
						1.60 - 4.60 Non-intact as possible weathered rock. No recovery as washout of fines during drilling. No record of cavity.	Possible weathered rock. Strong and medium strong dark reddish brown fine grained siltstone recovered as angular fine to coarse gravel sized clasts with a little pinkish brown silt.	
2.00								
	53 (11) -				(3.00)			
3.50								
	93 (31) 25		183.28		4.60			
						4.60 - 10.10 Discontinuities, closely spaced, locally medium spaced and very closely spaced, dipping 12 to 14°, stepped, rough, with 0.5 to 4mm thick reddish brown silt smear. 5.10 - 5.30 Possible area of core loss as washout of fines during drilling. No record of cavity. 5.30 - 5.45 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick light reddish brown silt smear, open. 5.90 - 6.30 Joint, subvertical dip, stepped, smooth, with 0.5 to 1mm thick reddish brown silt smear and minor surficial orangish brown iron stain and powder, open. 6.45 - 7.10 Joint, subvertical dip, stepped, smooth, with 0.5 to 1mm thick reddish brown silt smear and minor surficial orangish brown iron stain and powder, open. 7.40 - 8.00 Joint, subvertical dip,	Strong locally medium strong thinly bedded dark reddish brown fine grained SILTSTONE. OLD RED SANDSTONE.	
5.00								
	87 (46) 17							
6.50								
	100 (65) 22				(5.50)			
8.00								

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	10.1	Water	100

GENERAL REMARKS

BH backfilled.

All dimensions in metres Scale 1:50	Client: Coillte	Method/ Plant Used: Rotary Core/DB-DeltaBase		Driller: BD	Logged By: EAT

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Knockshanvo WF	Co Clare	**BH-02**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2023CE103	13-09-23 13-09-23	187.88	E 556,297.3 N 669,128.0

Engineer	Sheet	Status
FTCO	2 of 2	FINAL

RUN DETAILS					STRATA			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Discontinuities Detail	Main	Instrument/ Backfill
	100 (92) 69					stepped, smooth, with 0.5 to 1mm thick reddish brown silt smear and minor surficial orangish brown iron stain and powder, open. 7.70 - 7.90 Non-intact as angular fine and medium gravel sized clasts with a little brown silt.	Strong locally medium strong thinly bedded dark reddish brown fine grained SILTSTONE. OLD RED SANDSTONE. *(continued)*	
9.50						9.25 - 9.40 Joint, subvertical dip, stepped, smooth, with 0.5 to 1mm thick reddish brown silt smear and minor surficial orangish brown iron stain and powder, open.		
	100 (98) 96							
13.09 10.10			177.78		10.10			

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	
13/09/23	16.00	10.10										BH backfilled.

All dimensions in metres Scale 1:50	Client: Coillte	Method/ Plant Used: Rotary Core/DB-DeltaBase		Driller: BD	Logged By: EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Knockshanvo WF	Co Clare	**BH-03**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2023CE103	11-09-23 11-09-23	268.02	E 553,407.1 N 669,333.5

Engineer	Sheet	Status
FTCO	1 of 2	FINAL

RUN DETAILS

Depth / Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick-ness)
0.00					
	55 -				(1.30)
	-		266.72		1.30
2.00		NI			(1.90)
	100 (20) -		264.82		3.20
3.50		8			
	100 (66) 30				
		23			
5.00					
	100 (87) 41	8			
6.50		20			(6.80)
	100 (33) -				
		NI			
8.00					

STRATA

DESCRIPTION

Discontinuities	Detail	Main
0.00 - 1.30 : overburden.		Stiff reddish row slightly gravelly SILT. Gravel is angular to subangular of brown and reddish brown siltstone.
1.30 - 3.20 Non-intact as probable weathered rock.		Possible weathered rock. Strong and medium strong thinly laminated reddish brown fine grained siltstone recovered as angular fine to coarse gravel sized clasts with a little reddish brown silt and surficial orangish brown iron stain and powder. 2.00m to 3.20m: recovered as fine to coarse gravel and cobble sized clasts.
3.20 - 10.00 Discontinuities, medium spaced, locally closely spaced and very closely spaced, dipping 40 to 45°, planar, smooth, with 0.5 to 2mm thick reddish brown silt smear and minor surficial orangish brown iron stain.		Strong locally medium strong thinly laminated reddish brown fine and medium grained SILTSTONE. OLD RED SANDSTONE. 4.10-4.22m: very weak.
6.10 - 6.50 Joint, subvertical dip, undulating, smooth, with 0.5 to 2mm thick reddish brown silt smear, open.		6.80m to 7.10m: medium strong light greenish brown fine grained.
7.00 - 8.00 Non-intact as extremely closely and very closely spaced discontinuities.		7.40-7.50m: weak.

Instrument/Backfill

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	10	Water	100

GENERAL REMARKS

50mm standpipe installed.

All dimensions in metres Scale 1:50	Client: Coillte	Method/ Plant Used: Rotary Core/DB-DeltaBase		Driller: BD	Logged By: EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Knockshanvo WF	Co Clare	**BH-03**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2023CE103	11-09-23 11-09-23	268.02	E 553,407.1 N 669,333.5

Engineer	Sheet	Status
FTCO	2 of 2	FINAL

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Instrument / Backfill
	80 (45) 14	NR				8.00 - 9.50 No obvious area of core loss. Core loss as probable washout of fines during drilling. No record of cavity.	Strong locally medium strong thinly laminated reddish brown fine and medium grained SILTSTONE. OLD RED SANDSTONE. *(continued)* 8.00m to 9.50m: becoming light reddish brown. 8.20-8.40m: very strong.	
9.50							9.45m to 9.60m: with orangish brown clay.	
11.09 10.00	100 (82) 68	2 NI	258.02		10.00	9.90 - 10.00 Non-intact as light greenish brown silt.		

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing
11/09/23	16.00	10.00					

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

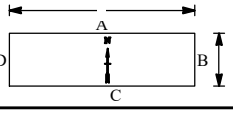
50mm standpipe installed.

All dimensions in metres Scale 1:50	Client: Coillte	Method/ Plant Used: Rotary Core/DB-DeltaBase		Driller: BD	Logged By: EAT

IDL AGS4 UK DH (SPTS) KNOCKSHANVO WF RC FILE 1 SEPT 21 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

Appendix 02
Trial Pit Records

PROJECT: Knockshanvo WF	**TRIALPIT: TP-01**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 559,116.4 N 669,594.7
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
Ground level: 177.53m O.D.	**Rev:**
GROUNDWATER	**DATE: 28.8.23**
Water strikes: Rose to after:	**PIT DIRECTION: 90°**
1st: dry	**PIT DIMENSION: 4.20m * 1.50**
2nd:	**LOGGED BY: DF**
3rd:	Shoring/Support: N/A
	Stability: Pit stable.



Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
			B 1	0.40-0.60			176.83	0.70	Heather over purplish brown slightly silty angular to subangular fine to coarse GRAVEL with frequent cobbles. Cobbles are subangular.	
1			B 2	1.30-1.50			176.03	1.50	Probable weathered rock. Recovered as angular gravel and cobble sized clasts.	
						END			TP terminated at 1.50m bgl. Obstruction as probable rock.	
2										
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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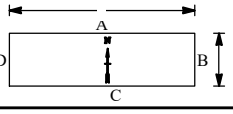
Fax

TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-02**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 556,946.1 N 669,646.7 — **Rig: Zaxis 130 LCN**
ENGINEER: FTCO	**Rev:**
Ground level: 166.00m O.D.	**DATE: 29.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 90°
PIT DIMENSION: 4.00m * 1.60
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							165.75	0.25	Grass over soft greyish brown gravelly SILT. Gravel is subangular to rounded fine to coarse.	
			B 1 D 2	0.40-0.60 0.40-0.60					Firm orangish brown sandy gravelly SILT with frequent cobbles and occasional boulders. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded. Boulders are up to 600mm in length. 0.60-1.10: with frequent boulders.	
1							164.90	1.10		
			B 3	1.40-1.60					Purplish brown silty SAND and angular to subangular fine to coarse GRAVEL with frequent cobbles and occasional boulders. Sand is fine to coarse. Cobbles are angular to subangular. Boulders are of mudstone/shale.	
2							164.00	2.00		
			B 4	2.60-2.80					Purplish brown slightly silty sandy angular to subangular fine to coarse GRAVEL with frequent cobbles and frequent boulders. Sand is fine to coarse. Cobbles are subangular. Boulders are subangular. Boulders are up to 500mm in length.	
3							163.00	3.00		
						END			TP terminated at 3.00m bgl. Obstruction as probable rock.	
4										
5										
6										
7										
8										
9										
10										

Remarks: TP damp at 2.00m bgl. TP backfilled with arisings.

Scale: 1:50

Irish drilling LTD

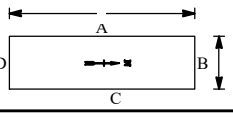
Ph.
Fax

TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-03**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates: E 556,715.0 N 669,954.6**
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
	Rev:
Ground level: 187.73m O.D.	**DATE: 29.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 0°
PIT DIMENSION: 4.20m * 1.60
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							187.33	0.40	Reeds over soft dark brown peaty SILT.	
		1	B 1	0.50-0.70			186.83	0.90	Yellowish brown silty fine to medium SAND.	
1			B 2	1.10-1.30					Purplish brown silty sandy angular to subangular fine to coarse GRAVEL with frequent cobbles and occasional large boulders. Sand is fine to coarse. Cobbles are angular to subangular. Boulders are angular. Boulders are up to 700mm in length.	
									1.80-2.10: becoming locally very silty.	
2			B 3	1.90-2.10			185.63	2.10	Purplish brown COBBLES and BOULDERS within a silty sandy matrix.	
3							184.73	3.00		
						END			TP terminated at 3.00m bgl. Obstruction as probable rock.	
4										
5										
6										
7										
8										
9										
10										

Remarks: Seepage of water at 0.70m bgl. TP backfilled with arisings.

Scale: 1:50

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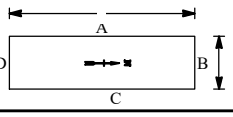
Fax

TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-04**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 556,759.0 N 669,606.4
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
Ground level: 201.13m O.D.	**Rev:**
GROUNDWATER	**DATE: 29.8.23**
Water strikes: Rose to after:	**PIT DIRECTION: 0°**
1st: dry	**PIT DIMENSION: 4.40m * 1.50**
2nd:	**LOGGED BY: DF**
3rd:	Shoring/Support: N/A
	Stability: Pit stable.



Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							200.53	0.60	Grass over firm brown slightly sandy gravelly SILT with occasional cobbles. Gravel is angular to rounded fine to coarse. Cobbles are subangular.	
			B 1	0.70-0.90			199.83	1.30	Orangish brown slightly silty slightly sandy angular elongate tabular and flat GRAVEL with frequent cobbles. Sand is fine to coarse. Cobbles are angular elongate tabular and flat.	
			B 2	1.50-1.70			199.08	2.05	Probable weathered rock. Shale/mudstone recovered as redish-brown slightly silty sandy coarse flat angular and tabular gravel and cobble sized clasts.	
2						END			TP terminated at 2.05m bgl. Obstruction as probable rock.	

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

Irish drilling LTD

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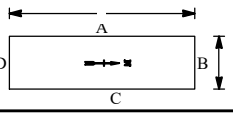
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-05**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 556,678.2 N 669,484.0
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
Ground level: 202.15m O.D.	**Rev:**
GROUNDWATER	**DATE: 29.8.23**
Water strikes: Rose to after:	**PIT DIRECTION: 0°**
1st: dry	**PIT DIMENSION: 4.20m * 1.50**
2nd:	**LOGGED BY: DF**
3rd:	Shoring/Support: N/A
	Stability: Pit unstable. Sidewall collapse.



Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
			B 1	0.40-0.60			201.55	0.60	MADE GROUND: Grass over purplish brown silty (locally very silty) gravelly SAND with occasional cobbles. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular.	
							201.35	0.80	Soft black amorphous PEAT.	
							201.25	0.90	Soft greyish white sandy SILT.	
1			B 2	1.00-1.20			200.65	1.50	Orangish brown and black slightly sandy silty flat elongate and tabular mudstone/shale GRAVEL with frequent cobbles. Sand is fine to coarse. Cobbles are flat elongate and tabular of mudstone/shale.	
2		▼	B 3	2.20-2.40			199.15	3.00	Probable weathered rock. Recovered as orangish brown and black elongate and tabular cobble sized clasts. 1.80-3.00: with occasional elongate boulder sized clasts. Boulders are up to 500mm in length.	
3						END			TP terminated at 3.00m bgl. Obstruction as probable rock.	
4										
5										
6										
7										
8										
9										
10										

Remarks: Ingress of water at 2.30m bgl. TP backfilled with arisings.

Scale: 1:50

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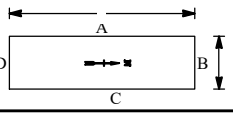
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-06**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 556,306.8 N 669,186.8
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
Ground level: 189.54m O.D.	**Rev:**
GROUNDWATER	**DATE: 30.8.23**
Water strikes: Rose to after:	**PIT DIRECTION: 0°**
1st: dry	**PIT DIMENSION: 4.30m * 1.50**
2nd:	**LOGGED BY: DF**
3rd:	Shoring/Support: N/A
	Stability: Pit stable.



Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
			B 1	0.40-0.60			188.94	0.60	MADE GROUND: Grass over firm brown SILT mixed with yellowish brown silty SAND with occasional cobbles. Cobbles are angular.	
							188.74	0.80	Grey silty coarse SAND.	
1			B 2	0.80-1.00			188.04	1.50	Orange and grey slightly silty medium to coarse SAND with frequent cobbles and occasional large boulders. Cobbles are flat and angular. Boulders are of mudstone/shale. Boulders are up to 1000mm in length.	
			B 3	1.70-1.90			186.94	2.60	Purplish grey very silty very gravelly SAND with frequent cobbles. Sand is fine to coarse. Cobbles are angular blocky and tabular. Gravel is angular blocky and tabular.	
2						END			TP terminated at 2.60m bgl. Obstruction as probable rock.	
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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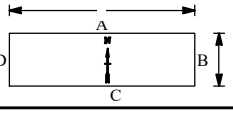
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-07**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 556,644.9 N 669,119.8
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
Ground level: 182.69m O.D.	**Rev:**
	DATE: 30.8.23

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 90°
PIT DIMENSION: 4.40m * 1.50
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
							182.19	0.50	MADE GROUND: Soft brownish black peaty SILT with occasional cobbles. Cobbles are angular.	
			B 1 D 2	0.50-0.70 0.50-0.70			181.79	0.90	Soft yellowish brown organic SILT.	
1			B 3 D 4	1.00-1.20 1.00-1.20					Stiff purplish brown slightly sandy slightly gravelly SILT with occasional cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse. Cobbles are angular.	
									1.50-2.90: becoming firm. 1.50-4.00: with occasional large boulders. Boulders are angular. Boulders are up to 700mm in length.	
2										
			B 5 D 6	2.40-2.60 2.40-2.60						
3									2.90-4.00: becoming stiff very gravelly.	
			B 7 D 8	3.20-3.40 3.20-3.40						
							178.69	4.00		
4						END			TP terminated at 4.00m bgl. Obstruction as boulders.	
5										
6										
7										
8										
9										
10										

Remarks: Seepage of water at 1.95m bgl. TP backfilled with arisings.

Scale: 1:50

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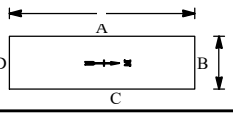
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-08**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** E 555,608.8 N 669,770.6 — **Rig: Zaxis 130 LCN**
ENGINEER: FTCO	**Rev:**
Ground level: 255.86m O.D.	**DATE: 29.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 0°
PIT DIMENSION: 4.00m * 1.50
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							255.76	0.10	Grass over soft brown peaty SILT.	
							255.61	0.25	Firm orangish brown slightly gravelly SILT. Gravel is angular to rounded fine to coarse.	
			B 1	0.40-0.60						
							255.16	0.70	Probable weathered rock. Sandstone recovered as angular and flat cobble and boulders sized clasts. Boulders are up to 500mm in length.	
						END			TP terminated at 0.70m bgl. Obstruction as probable rock.	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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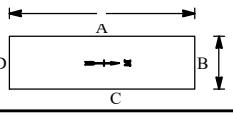
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-09**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** **Rig: Zaxis 130 LCN**
ENGINEER: FTCO	**E 553,585.7 N 670,094.2** **Rev:**
Ground level: 236.53m O.D.	**DATE: 28.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 0°
PIT DIMENSION: 3.80m * 2.00
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							236.18	0.35	Angular flat and tabular brown GRAVEL with frequent cobbles. Cobbles are angular flat and tabular.	
			B 1	0.60-0.80			235.53	1.00	Orangish brown slightly clayey gravelly angular flat and tabular mudstone/shale COBBLES. Gravel is angular fine to coarse.	
1									Probable weathered rock. Mudstone/shale recovered as angular flat and tabular gravel and cobble sized clasts.	
			B 2	1.60-1.80						
2							234.23	2.30		
			B 3	2.30-2.50			234.03	2.50	Probable weathered rock. Recovered as angular cobble and boulder sized clasts.	
						END			TP terminated at 2.50m bgl. Obstruction as rock.	
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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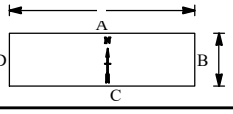
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-10**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** **Rig: Zaxis 130 LCN**
ENGINEER: FTCO	**E 553,949.9 N 670,024.9** **Rev:**
Ground level: 247.04m O.D.	**DATE: 28.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: **dry**
2nd:
3rd:

PIT DIRECTION: 90°
PIT DIMENSION: 4.00m * 1.50
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							246.74	0.30	Soft brownish grey SILT.	
			B 1	0.40-0.60			246.19	0.85	Firm brown slightly gravelly CLAY.	
1			B 2	0.90-1.10					Blackish orange angular GRAVEL with frequent cobbles. Cobbles are flat tabular and blocky.	
2			B 3	2.30-2.50			244.74	2.30		
							244.54	2.50	Obstruction as rock.	
							END		TP terminated at 2.50m bgl. Obstruction as rock.	
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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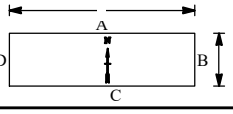
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-11**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates: E 553,311.6 N 669,456.2**
ENGINEER: FTCO	**Rig: Zaxis 130 LCN**
	Rev:
Ground level: 247.75m O.D.	**DATE: 28.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 90°
PIT DIMENSION: 3.00m * 1.50
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							247.45	0.30	Firm grey slightly sandy SILT.	
			B 1	0.40-0.60					Orangish brown coarse SAND and subangular fine to coarse GRAVEL with occasional cobbles. Cobbles are angular. Increase in cobble size and content with depth.	
1		▼							1.60-1.90: becoming grey.	
							245.85	1.90		
2			B 2	1.90-2.10			245.65	2.10	Possible weathered rock. Recovered as angular and blocky cobble sized clasts.	
						END			TP terminated at 2.10m bgl. Obstruction as rock.	
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: Moderate ingress of water at 1.70m bgl. TP backfilled with arisings.

Scale: 1:50

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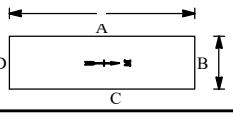
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF	**TRIALPIT: TP-12**
LOCATION: Co Clare	**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:** **Rig: Zaxis 130 LCN**
ENGINEER: FTCO	**E 553,430.5 N 669,340.6** **Rev:**
Ground level: 268.19m O.D.	**DATE: 28.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 0°
PIT DIMENSION: 4.00m * 1.20
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
			B 1	0.30-0.50					Purplish brown sandy angular fine to coarse GRAVEL with frequent cobbles. Cobbles are angular.	
			B 2	0.65-0.80			267.54	0.65		
									Probable weathered rock. Mudstone/shale recovered as angular cobble sized clasts.	
1							267.14	1.05		
						END			TP terminated at 1.05m bgl. Obstruction as rock.	
2										
3										
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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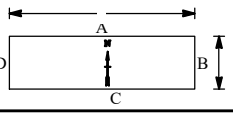
TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

PROJECT: Knockshanvo WF		**TRIALPIT: TP-13**
LOCATION: Co Clare		**Sheet 1 of 1**
CLIENT: Coillte	**Co-ordinates:**	**Rig: Zaxis 130 LCN**
ENGINEER: FTCO	**E 553,036.9 N 669,206.8**	**Rev:**
Ground level: 256.78m O.D.		**DATE: 28.8.23**

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 90°
PIT DIMENSION: 4.10m * 1.50
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit stable.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			B 1	0.20-0.40			255.98	0.80	Grass over brownish grey slightly sandy angular GRAVEL.	
1			B 2	1.50-1.70			254.03	2.75	Brown and grey silty very sandy angular GRAVEL with frequent cobbles. Gravel is fine and medium. Cobbles are tabular and flat. 1.50-2.75: becoming slightly clayey.	
2										
3						END			TP terminated at 2.75m bgl. Obstruction as probable rock.	
4										
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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TRIALPIT KNOCKSHANVO TPS FILE 1 SEPT 5 WF 2023.GPJ ID GINT AGS 4_0_4.GDT 17/10/23

Appendix 03
Laboratory Test Results

Project ID	2023CE103		Client	Coillte	Remarks	Turnaround
ject Name	Knockshanvo WF		Due Date	07/10/2023 08:31		
chedule ID	2023CE103_1		Scheduled Date	07/09/2023 08:31		

Sample Details							Classification						Chemical / Concrete								Compaction					res	Rock		Other							
Location	Depth (m)	Base Depth	Sample Type	Sample Ref	Date Sampled	Storage	Moisture Content	Atterberg 4 Point	Particle Density by Gas Jar	Particle Density by Small Py	Particle Size Distribution	Hydrometer	Organic Content	Loss On Ignition	Sulphate Total	Sulphate Water Gravimetric	Carbonate Titration	ph	Chloride Content	Chloride Content Acid	Compaction Light	Compaction Heavy	Compaction Vibrating Hamm	Moisture Condition Value	Moisture Condition Relation	CBR	Rock Uniaxial compression	Point Load								
total completed							4	1	0	0	5	1	0	0	0	3	0	3	0	0	0	0	0	0	0	1	12	0	0	0					
TP-01	0.40	0.60	B	1	28/08/23																														Sch01
TP-01	1.30	1.50	B	2	28/08/23																														Sch01
TP-02	0.40	0.60	B	1	29/08/23																														Sch01
TP-02	0.40	0.60	D	2	29/08/23																														Sch01
TP-02	1.40	1.60	B	3	29/08/23		1				1																								Sch01
TP-02	2.60	2.80	B	4	29/08/23																														Sch01
TP-03	0.50	0.70	B	1	29/08/23																														Sch01
TP-03	1.10	1.30	B	2	29/08/23																														Sch01
TP-03	1.90	2.10	B	3	29/08/23											1		1																		Sch01
TP-04	0.70	0.90	B	1	29/08/23																														Sch01
TP-04	1.50	1.70	B	2	29/08/23		1				1																								Sch01
TP-05	0.40	0.60	B	1	29/08/23																														Sch01
TP-05	1.00	1.20	B	2	29/08/23																														Sch01
TP-05	2.20	2.40	B	3	29/08/23																														Sch01
TP-06	0.40	0.60	B	1	30/08/23																														Sch01
TP-06	0.80	1.00	B	2	30/08/23																														Sch01
TP-06	1.70	1.90	B	3	30/08/23		1				1																								Sch01
TP-07	0.50	0.70	B	1	30/08/23																														Sch01
TP-07	0.50	0.70	D	2	30/08/23																														Sch01

0 = test scheduled,
1 = test completed as scheduled,
0* = sample not suitable for scheduled test

Project ID	2023CE103
ject Name	Knockshanvo WF
:hedule ID	2023CE103_1

Client	Coillte
Due Date	07/10/2023 08:31
Scheduled Date	07/09/2023 08:31

Remarks	Turnaround

Sample Details							Classification						Chemical / Concrete								Compaction					res	Rock		Other							
Location	Depth (m)	Base Depth	Sample Type	Sample Ref	Date Sampled	Storage	Moisture Content	Atterberg 4 Point	Particle Density by Gas Jar	Particle Density by Small Py	Particle Size Distribution	Hydrometer	Organic Content	Loss On Ignition	Sulphate Total	Sulphate Water Gravimetric	Carbonate Titration	ph	Chloride Content	Chloride Content Acid	Compaction Light	Compaction Heavy	Compaction Vibrating Hamm	Moisture Condition Value	Moisture Condition Relation	CBR	Rock Uniaxial compression	Point Load							
TP-07	1.00	1.20	B	3	30/08/23						1	1																							Sch01
TP-07	1.00	1.20	D	4	30/08/23																														Sch01
TP-07	2.40	2.60	B	5	30/08/23											1		1																	Sch01
TP-07	2.40	2.60	D	6	30/08/23		1	1																											Sch01
TP-07	3.20	3.40	B	7	30/08/23																														Sch01
TP-07	3.20	3.40	D	8	30/08/23																														Sch01
TP-08	0.40	0.60	B	1	29/08/23																														Sch01
TP-09	0.60	0.80	B	1	28/08/23																														Sch01
TP-09	1.60	1.80	B	2	28/08/23																														Sch01
TP-09	2.30	2.50	B	3	28/08/23																														Sch01
TP-10	0.40	0.60	B	1	28/08/23																														Sch01
TP-10	0.90	1.10	B	2	28/08/23																														Sch01
TP-10	2.30	2.50	B	3	28/08/23																														Sch01
TP-11	0.40	0.60	B	1	28/08/23											1		1																	Sch01
TP-11	1.90	2.10	B	2	28/08/23																														Sch01
TP-12	0.30	0.50	B	1	28/08/23																														Sch01
TP-12	0.65	0.80	B	2	28/08/23																														Sch01
TP-13	0.20	0.40	B	1	28/08/23																														Sch01
TP-13	1.50	1.70	B	2	28/08/23						1																									Sch01
BH-01	0.00	2.00	C		12/09/23																														Sch02
BH-01	2.00	3.50	C		12/09/23																							1							Sch02

0 = test scheduled,
1 = test completed as scheduled,
0* = sample not suitable for scheduled test

Project ID	2023CE103		Client	Coillte	Remarks	Turnaround
ject Name	Knockshanvo WF		Due Date	07/10/2023 08:31		
:hedule ID	2023CE103_1		Scheduled Date	07/09/2023 08:31		

Sample Details							Classification						Chemical / Concrete								Compaction					res	Rock		Other							
Location	Depth (m)	Base Depth	Sample Type	Sample Ref	Date Sampled	Storage	Moisture Content	Atterberg 4 Point	Particle Density by Gas Jar	Particle Density by Small Py	Particle Size Distribution	Hydrometer	Organic Content	Loss On Ignition	Sulphate Total	Sulphate Water Gravimetric	Carbonate Titration	ph	Chloride Content	Chloride Content Acid	Compaction Light	Compaction Heavy	Compaction Vibrating Hamm	Moisture Condition Value	Moisture Condition Relation	CBR	Rock Uniaxial compression	Point Load								
BH-01	3.50	5.00	C		12/09/23																							1							Sch02
BH-01	5.00	6.50	C		12/09/23																							1							Sch02
BH-01	6.50	8.00	C		12/09/23																							1							Sch02
BH-01	8.00	9.50	C		12/09/23																						1								Sch02
BH-01	9.50	10.10	C		12/09/23																														Sch02
																																			Sch02
BH-02	0.00	2.00	C		13/09/23																														Sch02
BH-02	2.00	3.50	C		13/09/23																														Sch02
BH-02	3.50	5.00	C		13/09/23																														Sch02
BH-02	5.00	6.50	C		13/09/23																							1							Sch02
BH-02	6.50	8.00	C		13/09/23																							1							Sch02
BH-02	8.00	9.50	C		13/09/23																							1							Sch02
BH-02	9.50	10.10	C		13/09/23																							1							Sch02
																																			Sch02
BH-03	0.00	2.00	C		11/09/23																														Sch02
BH-03	2.00	3.50	C		11/09/23																														Sch02
BH-03	3.50	5.00	C		11/09/23																							1							Sch02
BH-03	5.00	6.50	C		11/09/23																							1							Sch02
BH-03	6.50	8.00	C		11/09/23																							1							Sch02
BH-03	8.00	9.50	C		11/09/23																							1							Sch02
BH-03	9.50	10.00	C		11/09/23																														Sch02

0 = test scheduled,
1 = test completed as scheduled,
0* = sample not suitable for scheduled test

Summary of Classification Test Results

Project No.	Project Name
2023CE103	Knockshanvo WF

Hole No.	Sample Ref	Top	Base	Type		Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
TP-02	3	1.40	1.60	B		Brown silty very sandy coarse GRAVEL.			14.0	41					
TP-04	2	1.50	1.70	B		Reddish-brown slightly silty sandy coarse GRAVEL.			12.0	5					
TP-06	3	1.70	1.90	B		Reddish-brown very silty very gravelly medium SAND.			11.0	56					
TP-07	3	1.00	1.20	B		Reddish-brown slightly gravelly sandy SILT. Sand is medium.			12.0	64					
TP-07	6	2.40	2.60	D		Reddish-brown slighlty sandy gravelly SILT.			13.0	62	23	15	8		CL
TP-13	2	1.50	1.70	B		Dark greyish-brown silyt very sandy fine and medium GRAVEL.			8.9	17					

All tests performed in accordance with BS1377:1990 unless specified otherwise

Key w = water content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index

Density test: Linear measurement unless : wd - water displacement; wi - immersion in water

Liquid Limit: 4pt cone unless : 1pt - single point test; NP - Non Plastic

Particle density: sp - small pyknometer; gj - gas jar

Date Printed: 13/10/2023 15:47

QC From No: R1

Approved By: DCD

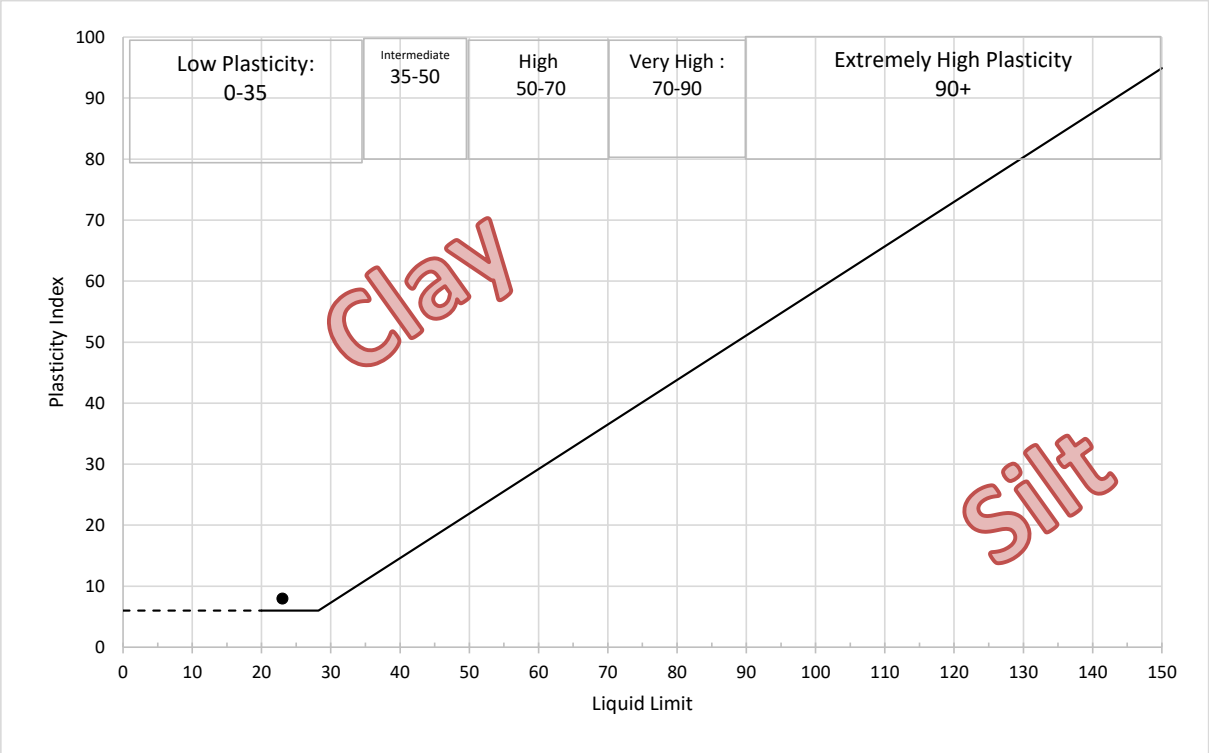
Table 1

sheet 1

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

	Plasticity (A-Line) Chart	Project Number
Project Name:	**Knockshanvo WF**	
Location:		2023CE103



Abreviations in the remarks column of the Classification Summary Sheet: C = Clay, M = Silt

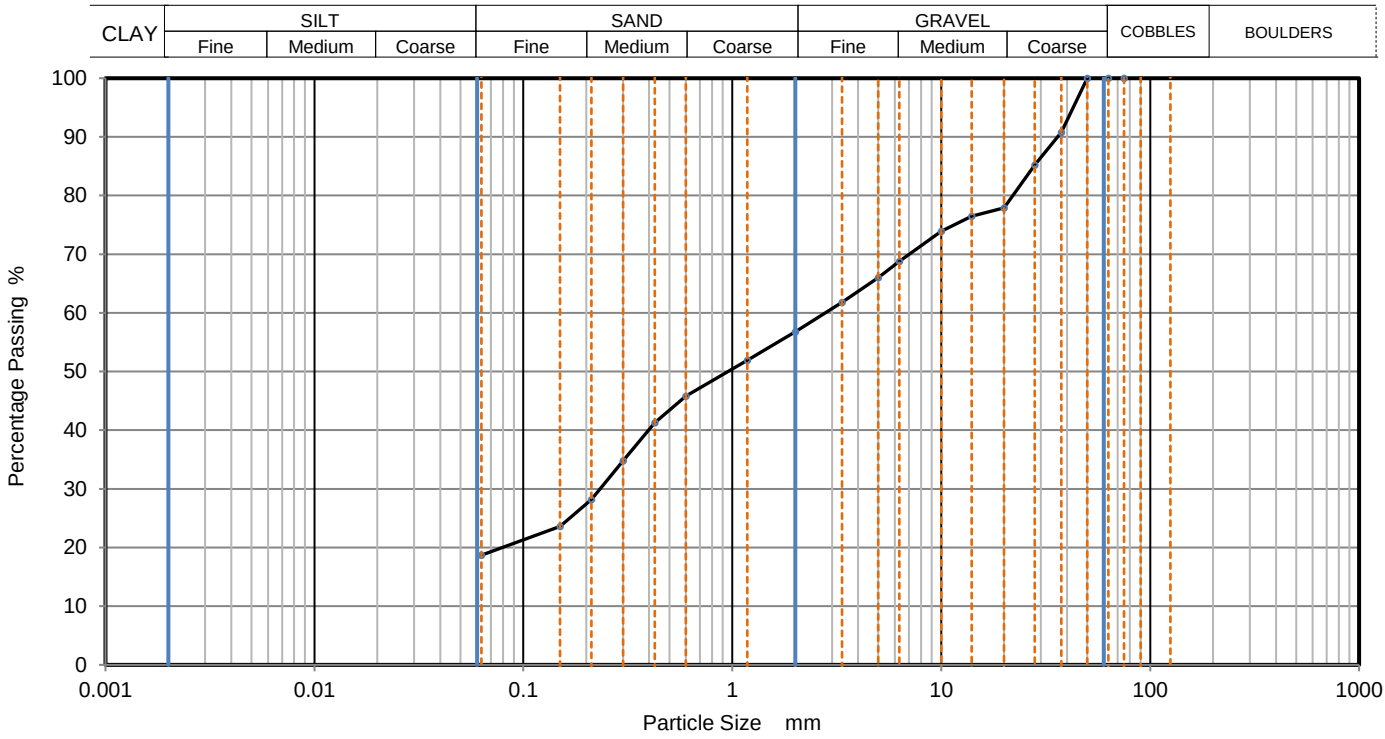
Plasticity abeviations: L = Low, I = Intermediate = H = High, V = Very High, E = Extremely High.

The letter O is added to the symbol of any material containing a significant proportion of organic material.

Chart taken from BS5930: 2010

QC Form: R1

IRISH DRILLING LIMITED	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**2023CE103**
				Borehole/Pit No.	TP-02
Site Name	Knockshanvo WF			Sample No.	3
Soil Description	Brown silty very sandy coarse GRAVEL.			Depth, m	1.40
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL1202309074



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	91		
28	85		
20	78		
14	77		
10	74		
6.3	69		
5	66		
3.35	62		
2	57		
1.18	52		
0.6	46		
0.425	41		
0.3	35		
0.212	28		
0.15	24		
0.063	19		

Dry Mass of sample, g	832

Sample Proportions	% dry mass
Very coarse	0
Gravel	43
Sand	38
Fines <0.063mm	19

Grading Analysis		
D100	mm	
D60	mm	2.78
D30	mm	0.233
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

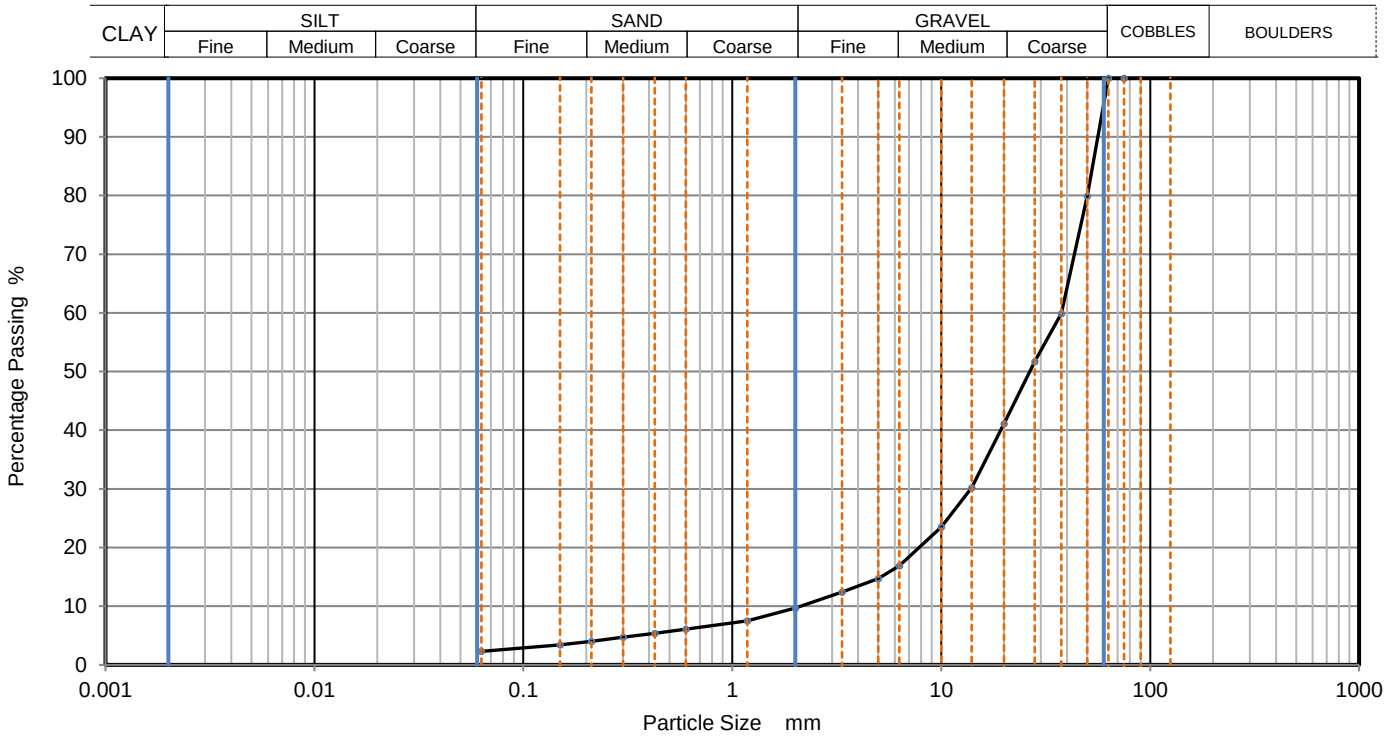
Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	13/10/2023 15:48	**1** QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

IRISH DRILLING LIMITED	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**2023CE103**
				Borehole/Pit No.	TP-04
Site Name	Knockshanvo WF			Sample No.	2
Soil Description	Reddish-brown slightly silty sandy coarse GRAVEL.			Depth, m	1.50
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL12023090710



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	80		
37.5	60		
28	52		
20	41		
14	30		
10	24		
6.3	17		
5	15		
3.35	12		
2	10		
1.18	8		
0.6	6		
0.425	5		
0.3	5		
0.212	4		
0.15	3		
0.063	2		

Dry Mass of sample, g	584

Sample Proportions	% dry mass
Very coarse	0
Gravel	90
Sand	7
Fines <0.063mm	2

Grading Analysis		
D100	mm	
D60	mm	37.6
D30	mm	13.9
D10	mm	2.13
Uniformity Coefficient		18
Curvature Coefficient		2.4

Remarks

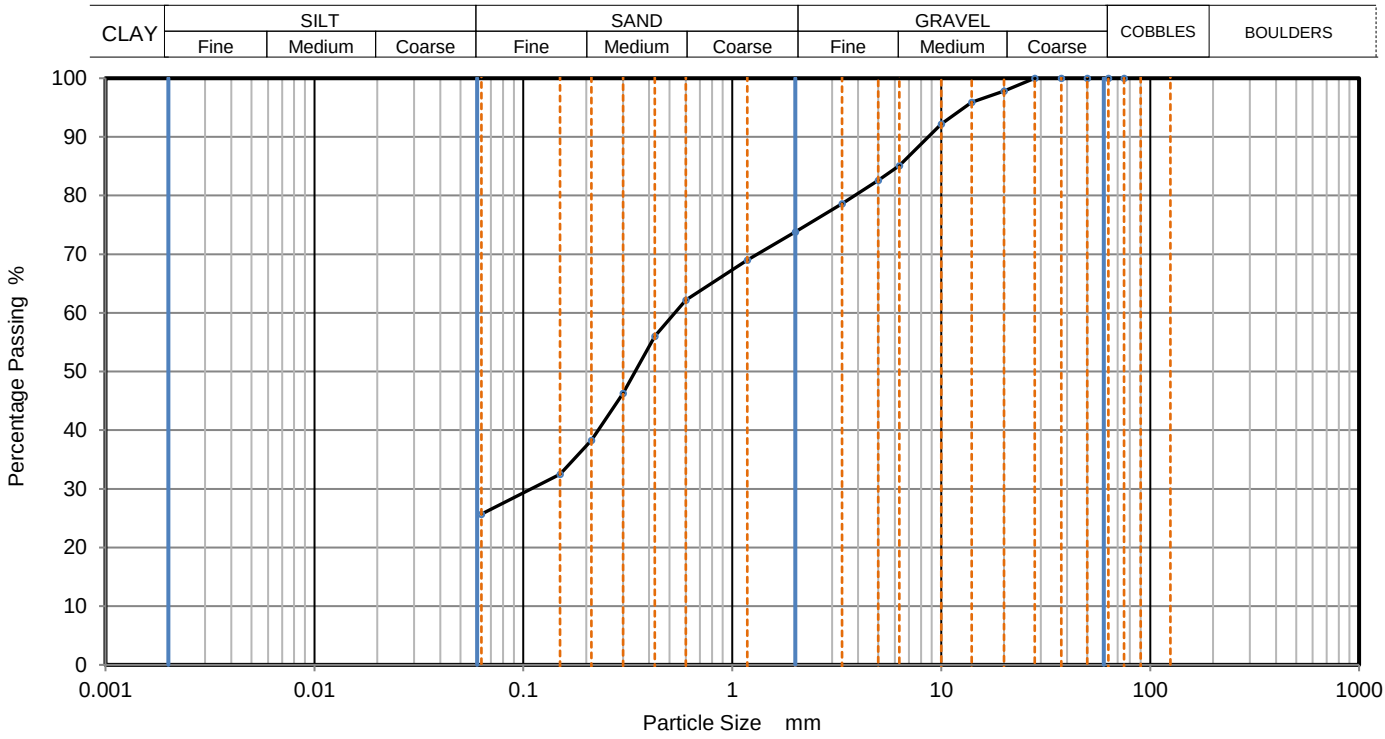
Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	13/10/2023 15:48	**1** QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

IRISH DRILLING LIMITED	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**2023CE103**
				Borehole/Pit No.	TP-06
Site Name	Knockshanvo WF			Sample No.	3
Soil Description	Reddish-brown very silty very gravelly medium SAND.			Depth, m	1.70
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL12023090716



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	96		
10	92		
6.3	85		
5	83		
3.35	79		
2	74		
1.18	69		
0.6	62		
0.425	56		
0.3	46		
0.212	38		
0.15	33		
0.063	26		

Dry Mass of sample, g	926

Sample Proportions	% dry mass
Very coarse	0
Gravel	26
Sand	48
Fines <0.063mm	26

Grading Analysis		
D100	mm	
D60	mm	0.53
D30	mm	0.109
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

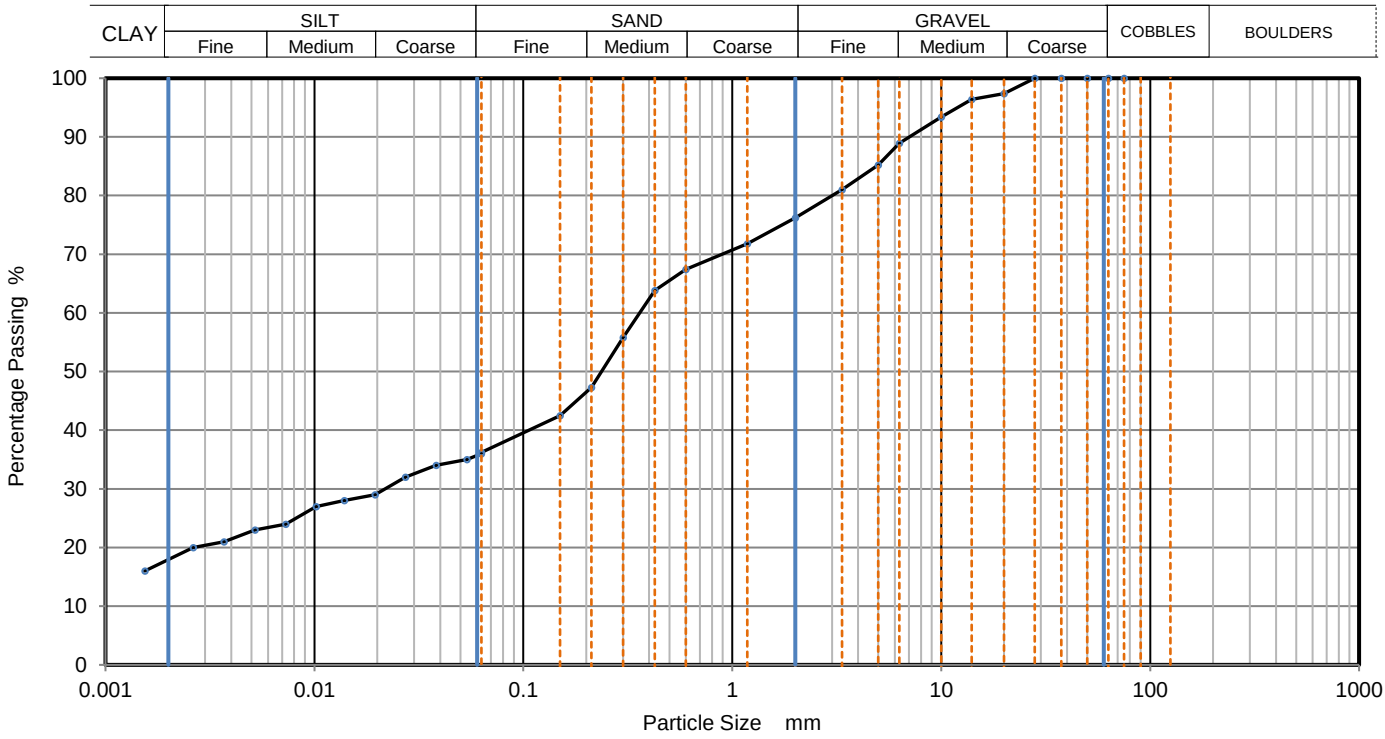
Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	13/10/2023 15:48	**1** QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

IRISH DRILLING LIMITED	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**2023CE103**
				Borehole/Pit No.	TP-07
Site Name	Knockshanvo WF			Sample No.	3
Soil Description	Reddish-brown slightly gravelly sandy SILT. Sand is medium.			Depth, m	1.00
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	IDL12023090719



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0630	36
		0.0538	35
75	100	0.0383	34
63	100	0.0272	32
50	100	0.0195	29
37.5	100	0.0139	28
28	100	0.0102	27
20	97	0.0073	24
14	96	0.0052	23
10	93	0.0037	21
6.3	89	0.0026	20
5	85	0.0015	16
3.35	81		
2	76		
1.18	72		
0.6	67	Particle density (assumed)	
0.425	64	2.65 Mg/m3	
0.3	56		
0.212	47		
0.15	43		
0.063	36		

Dry Mass of sample, g	1031

Sample Proportions	% dry mass
Very coarse	0
Gravel	24
Sand	40
Silt	18
Clay	18

Grading Analysis		
D100	mm	
D60	mm	0.36
D30	mm	0.0208
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

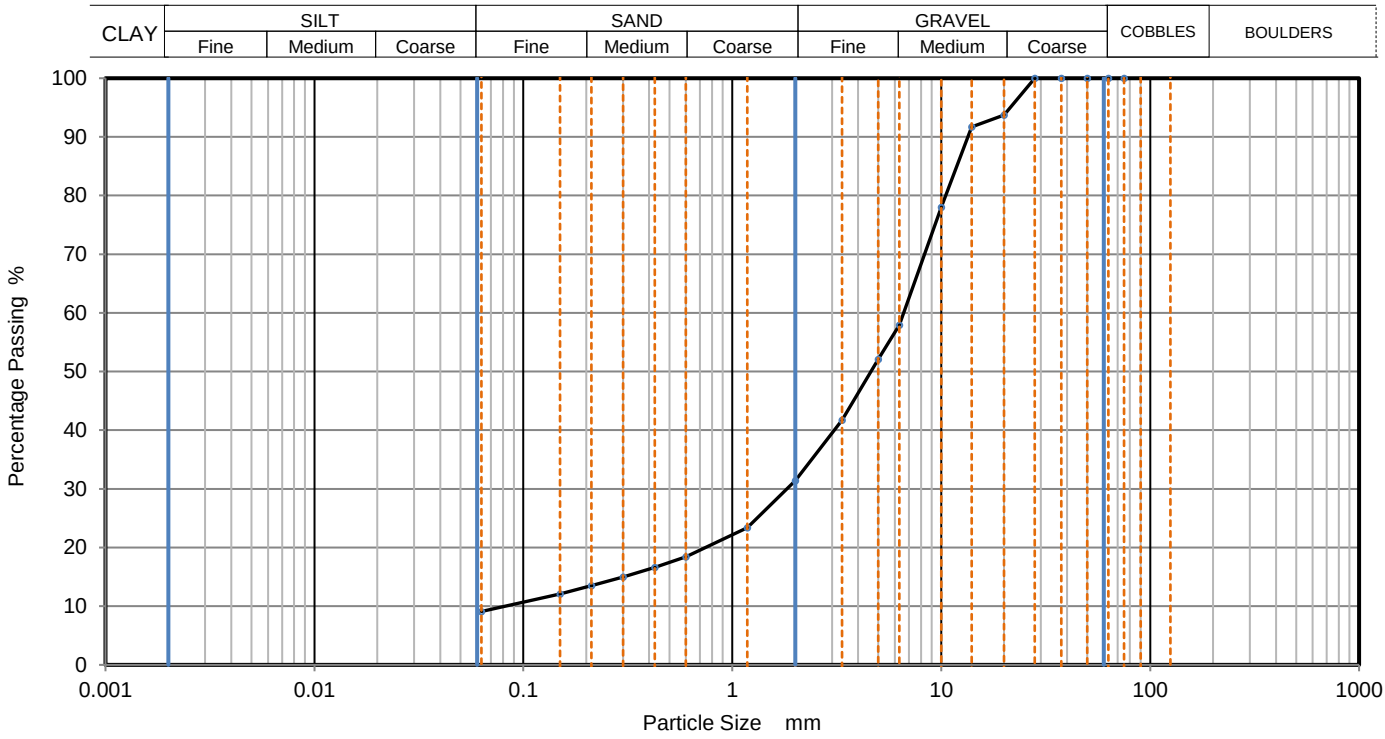
Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	13/10/2023 15:48	**1** QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

PARTICLE SIZE DISTRIBUTION

				Job Ref	**2023CE103**
				Borehole/Pit No.	TP-13
Site Name	Knockshanvo WF			Sample No.	2
Soil Description	Dark greyish-brown silyt very sandy fine and medium GRAVEL.			Depth, m	1.50
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL12023090737



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	94		
14	92		
10	78		
6.3	58		
5	52		
3.35	42		
2	31		
1.18	23		
0.6	18		
0.425	17		
0.3	15		
0.212	14		
0.15	12		
0.063	9		

Dry Mass of sample, g	812

Sample Proportions	% dry mass
Very coarse	0
Gravel	69
Sand	22
Fines <0.063mm	9

Grading Analysis		
D100	mm	
D60	mm	6.62
D30	mm	1.83
D10	mm	0.0814
Uniformity Coefficient		81
Curvature Coefficient		6.2

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	13/10/2023 15:48	**1** QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

IDL

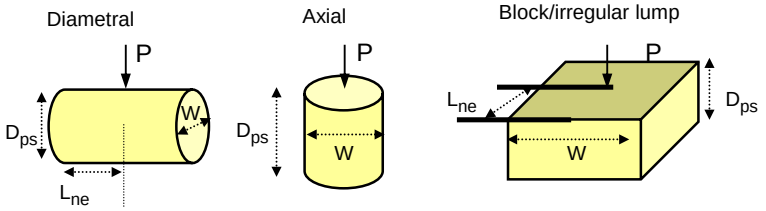
Point Load Strength Index Tests
Summary of Results

Project No.: 2023CE103

Project Name: Knockshanvo WF

Borehole No.	Sample			Specimen		Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Top Depth	Base Depth	Type	Ref	Top		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m	m			m					mm	mm	mm	mm	kN	mm	MPa	MPa	
BH-01	2.00	3.5	C	2.2-2.3	2.20		D	U	YES		63.4		63.4	0.3	63.4	0.1	0.1	Very Weak
BH-01	3.50	5	C	4.3-4.5	4.30		D	U	YES		63.4		63.4	25.3	63.4	6.3	7.0	Very Strong
BH-01	5.00	6.5	C	5.6-5.8	5.60		D	U	YES		63.4		63.4	25.4	63.4	6.3	7.0	Very Strong
BH-01	6.50	8	C	7.3-7.4	7.30		D	U	YES		63.4		63.4	27.4	63.4	6.8	7.6	Very Strong
BH-02	5.00	6.5	C	6.1-6.2	6.10		D	U	YES		63.4		63.4	9.7	63.4	2.4	2.7	Strong
BH-02	6.50	8	C	7.2-7.4	7.20		D	U	YES		63.4		63.4	6.2	63.4	1.5	1.7	Medium Strong
BH-02	8.00	9.5	C	8.6-8.8	8.60		D	U	YES		63.4		63.4	6.8	63.4	1.7	1.9	Medium Strong
BH-02	9.50	10.1	C	9.8-10.0	9.80		D	U	YES		63.4		63.4	9.8	63.4	2.4	2.7	Strong
BH-03	3.50	5	C	4.1-4.22	4.10		D	U	YES		63.4		63.4	0.3	63.4	0.1	0.1	Very Weak
BH-03	5.00	6.5	C	5.7-5.94	5.70		D	U	YES		63.4		63.4	4.0	63.4	1.0	1.1	Medium Strong
BH-03	6.50	8	C	7.4-7.5	7.40		D	U	YES		63.4		63.4	2.1	63.4	0.5	0.6	Weak
BH-03	8.00	9.5	C	8.2-8.4	8.20		D	U	YES		63.4		63.4	14.4	63.4	3.6	4.0	Very Strong

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P



Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise
Detailed legend for test and dimensions, based on ISRM, is shown above.
Size factor, F = (De/50)0.45 for all tests.

Date Printed: 13/10/2023

Approved By: DCD

Table 1 sheet 1

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

IDL

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.	Project Name
2023CE103	Knockshanvo WF

Hole No.	Sample				Specimen Depth (m)	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
	Ref	Top	Base	Type		Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
BH-01		8.00	9.50	C	9.17	63.4	159.7	2.5	2.67		as received	0.4595	F	130.0	Very Strong

Notes

1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS

2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density

3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

above notes apply unless annotated otherwise in the remarks

Mode of failure :

S - Single shear MS - multiple shear

AC - Axial cleavage F - Fragmented

Test Specification	Date Printed	Approved By	Table
International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007	13/10/2023	DCD	sheet 1 of 1

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528777
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Irish Drilling Limited
Old Galway Road
Loughrea
Co. Galway

Attention: Dympna Darcy

CERTIFICATE OF ANALYSIS

Date of report Generation:	29 September 2023
Customer:	Irish Drilling Limited
Sample Delivery Group (SDG):	230925-30
Your Reference:	2023CE103
Location:	Knockshanvo WF
Report No:	705887
Order Number:	12948

We received 3 samples on Monday September 25, 2023 and 3 of these samples were scheduled for analysis which was completed on Friday September 29, 2023. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan
Operations Manager

1291

CERTIFICATE OF ANALYSIS

SDG: 230925-30 **Report Number:** 705887 **Superseded Report:**
Client Ref.: 2023CE103 **Location:** Knockshanvo WF

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
28679688	TP-03	B3	1.90 - 2.10	29/08/2023
28679690	TP-07	B5	2.40 - 2.60	30/08/2023
28679692	TP-11	B1	0.40 - 0.60	28/08/2023

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG: 230925-30 **Report Number:** 705887 **Superseded Report:**
Client Ref.: 2023CE103 **Location:** Knockshanvo WF

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water
Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			28679688	28679690	28679692
Customer Sample Reference			TP-03	TP-07	TP-11
AGS Reference			B3	B5	B1
Depth (m)			1.90 - 2.10	2.40 - 2.60	0.40 - 0.60
Container			1kg TUB with Handle (ALE260)	250g Amber Jar (ALE210)	250g Amber Jar (ALE210)
Sample Type			S	S	S
Anions by Kone (soil)	All	NDPs: 0 Tests: 3	X	X	X
pH	All	NDPs: 0 Tests: 3	X	X	X
Sample description	All	NDPs: 0 Tests: 3	X	X	X

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
28679688	TP-03	1.90 - 2.10	Dark Brown	Sandy Clay Loam	Stones	None
28679690	TP-07	2.40 - 2.60	Dark Brown	Sandy Clay Loam	Stones	None
28679692	TP-11	0.40 - 0.60	Dark Brown	Sandy Loam	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Validated

CERTIFICATE OF ANALYSIS

SDG: 230925-30 **Report Number:** 705887 **Superseded Report:**
Client Ref.: 2023CE103 **Location:** Knockshanvo WF

Results Legend	
#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+$@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	TP-03	TP-07	TP-11			
			Depth (m)	1.90 - 2.10	2.40 - 2.60	0.40 - 0.60			
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)			
			Date Sampled	29/08/2023	30/08/2023	28/08/2023			
			Sample Time	.	.	.			
			Date Received	25/09/2023	25/09/2023	25/09/2023			
			SDG Ref	230925-30	230925-30	230925-30			
			Lab Sample No.(s)	28679688	28679690	28679692			
			AGS Reference	B3	B5	B1			
Moisture Content Ratio (% of as received sample)	%	PM024		9	11	8.6			
pH	1 pH Units	TM133		5.6 @ M	5.89 @ M	4.95 @ M			
Water Soluble Sulphate as SO4 2:1 Extract	<0.004 g/l	TM243		<0.004 @ M	<0.004 @ M	0.0144 @ M			

Table of Results - Appendix

Method No	Description
PM024	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM133	Determination of pH in Soil and Water using the GLpH pH Meter
TM243	Mixed Anions In Soils By Kone

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden (Method codes TM).

CERTIFICATE OF ANALYSIS

SDG: 230925-30 **Report Number:** 705887 **Superseded Report:**
Client Ref.: 2023CE103 **Location:** Knockshanvo WF

Test Completion Dates

Lab Sample No(s)	28679688	28679690	28679692
Customer Sample Ref.	TP-03	TP-07	TP-11
AGS Ref.	B3	B5	B1
Depth	1.90 - 2.10	2.40 - 2.60	0.40 - 0.60
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Anions by Kone (soil)	29-Sep-2023	29-Sep-2023	29-Sep-2023
pH	27-Sep-2023	27-Sep-2023	27-Sep-2023
Sample description	26-Sep-2023	26-Sep-2023	26-Sep-2023

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 15 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of 15 days after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

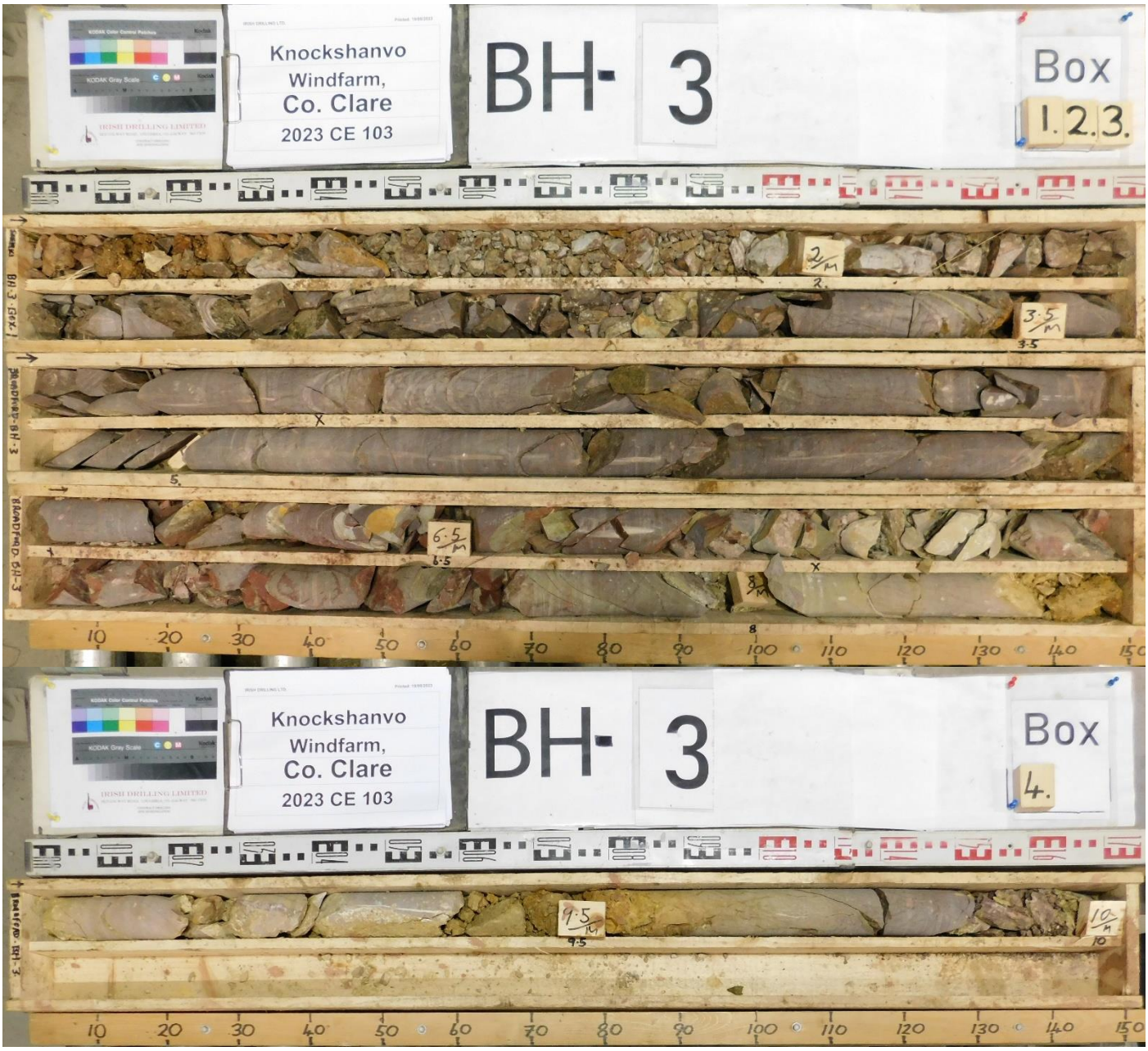
Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix 04
Photographs (Rotary Core)


Knockshanvo
Windfarm,
Co. Clare
2023 CE 103
BH- 1
Box
1.2.3.
2m
3.5
5m
6.5m
8m
Knockshanvo
Windfarm,
Co. Clare
2023 CE 103
BH- 1
Box
4.
10.1m
Bottom EOH


Knockshanvo
Windfarm,
Co. Clare
2023 CE 103
BH- 2
Box
1.2.3.
10-1m EOH


Knockshanvo
Windfarm,
Co. Clare
2023 CE 103
BH- 3
Box
1.2.3.
2m
3.5m
6.5m
9.5m
10m
Knockshanvo
Windfarm,
Co. Clare
2023 CE 103
BH- 3
Box
4.

Appendix 05
Photographs (Trial Pits)

Figure 1 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp1 (2).jpg

Figure 3 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp1.jpg

Figure 2 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp1 (3).jpg

Figure 4 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp10 (2).jpg

Figure 5 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp10 (3).jpg

Figure 7 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp11 (2).jpg

Figure 6 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp10.jpg

Figure 8 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp11 (3).jpg

Figure 9 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp11.jpg

Figure 11 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp12 (3).jpg

Figure 10 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp12 (2).jpg

Figure 12 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp12.jpg

Figure 13 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp13 (2).jpg

Figure 15 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp13.jpg

Figure 14 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp13 (3).jpg

Figure 16 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp2 (2).jpg

Figure 17 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp2 (3).jpg

Figure 19 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp3 (2).jpg

Figure 18 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp2.jpg

Figure 20 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp3 (3).jpg

Figure 21 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp3.jpg

Figure 23 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp4 (3).jpg

Figure 22 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp4 (2).jpg

Figure 24 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp4.jpg

Figure 25 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp5 (2).jpg

Figure 27 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp5.jpg

Figure 26 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp5 (3).jpg

Figure 28 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp6 (2).jpg

Figure 29 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp6 (3).jpg

Figure 31 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp7 (2).jpg

Figure 30 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp6.jpg

Figure 32 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp7 (3).jpg

Figure 33 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp7.jpg

Figure 35 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp8 (3).jpg

Figure 34 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp8 (2).jpg

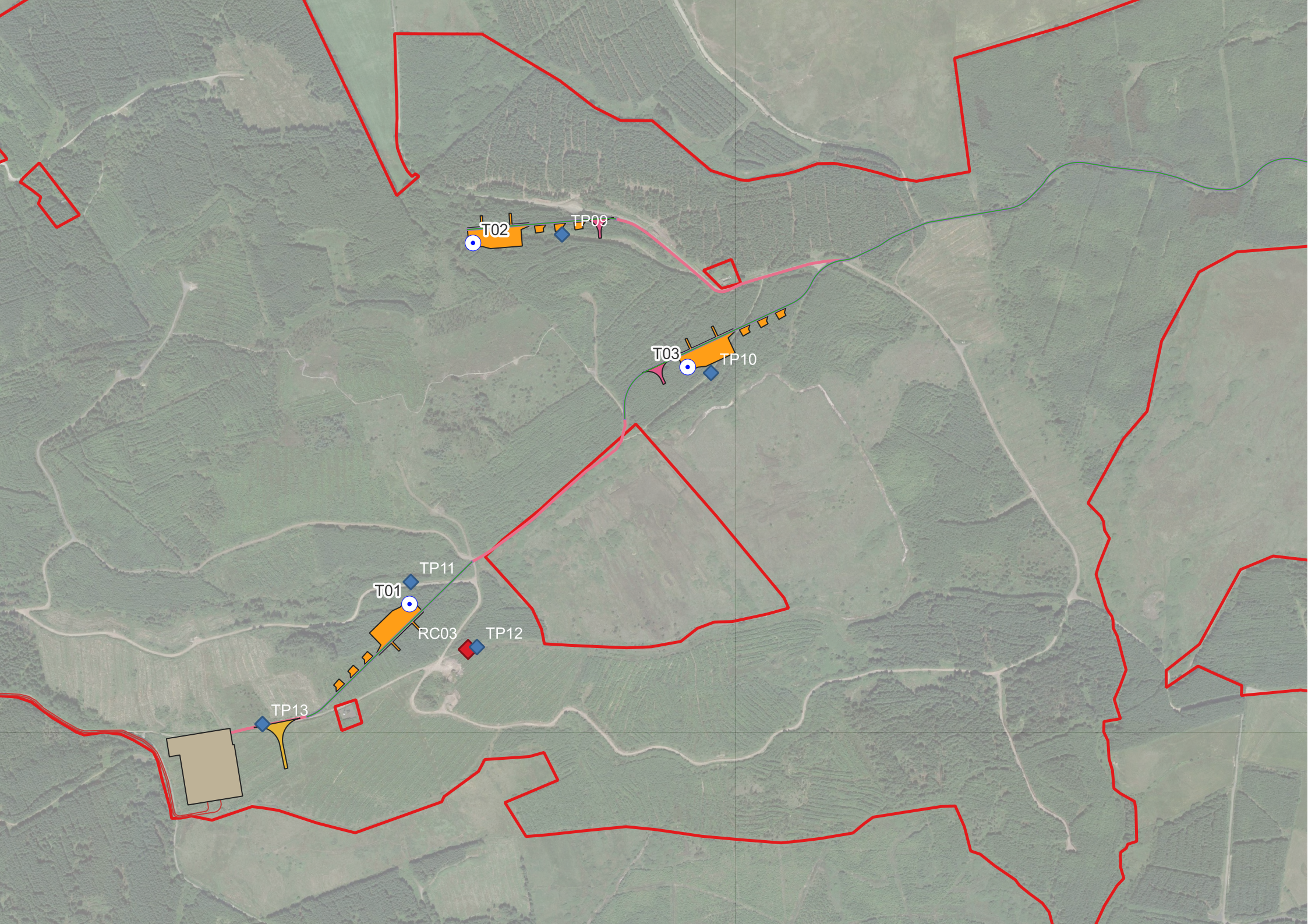
Figure 36 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp8.jpg

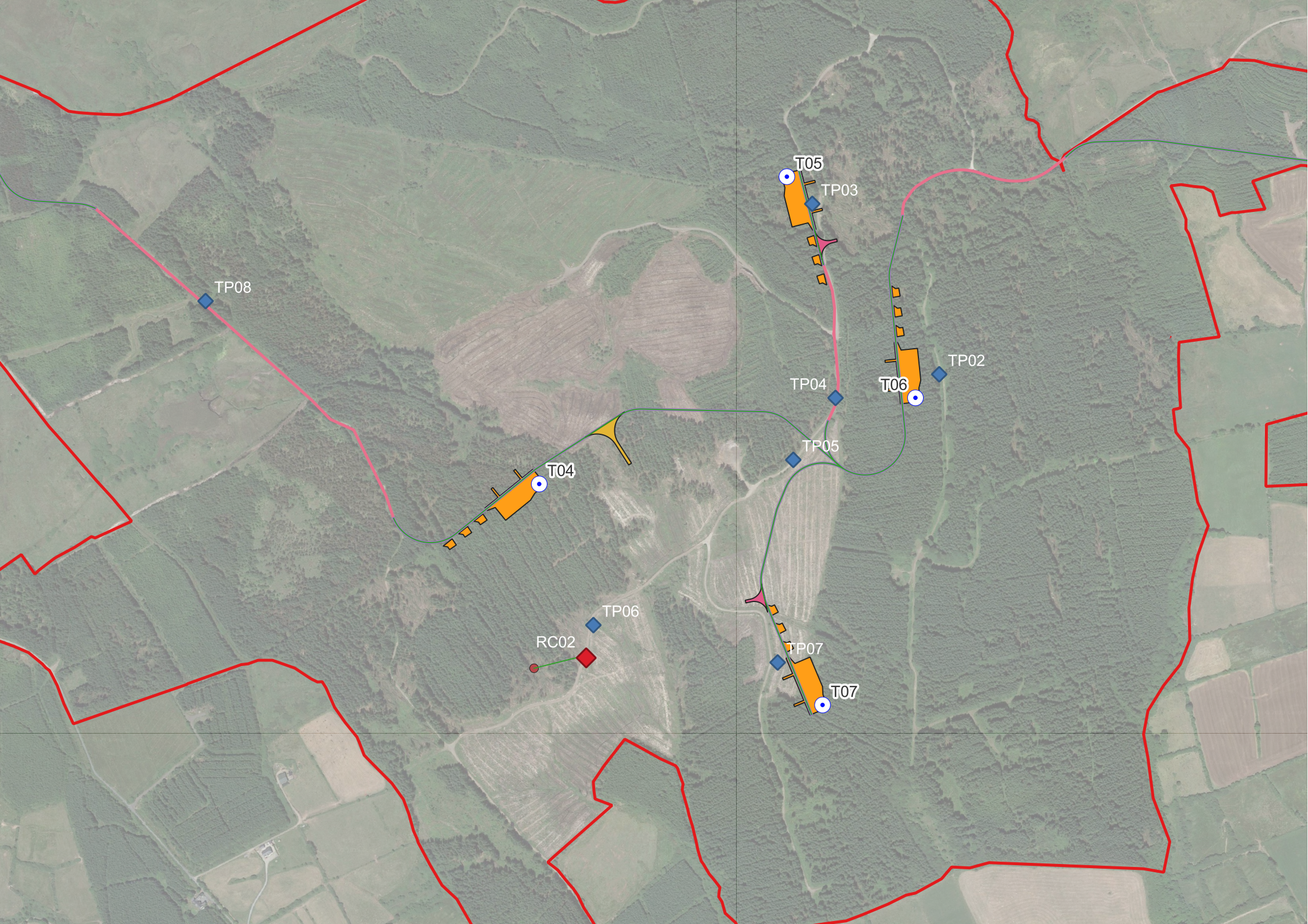
Figure 37 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp9 (2).jpg

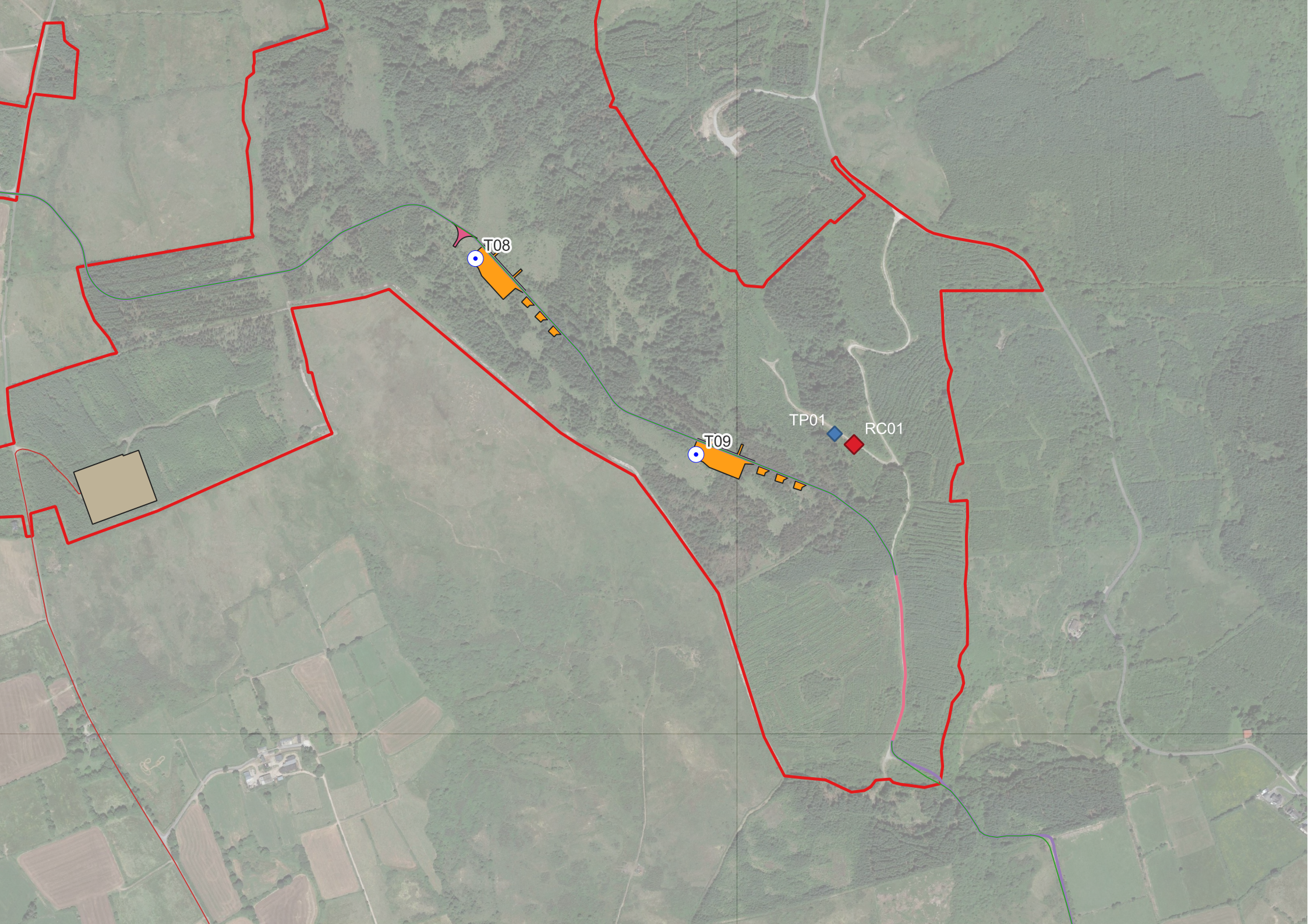
Figure 39 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp9.jpg

Figure 38 H:\23CE103 KNOCKSHANVO\Knockshanvo (1)\Knockshanvo\tp9 (3).jpg

Appendix 06
Site Plan


T02
TP09
T03
TP10
TP11
T01
RC03
TP12
TP13


T05
TP03
TP08
TP02
TP04
T06
TP05
T04
TP06
RC02
TP07
T07


T08
T09
TP01
RC01

Appendix 07
AGS Data

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