Technical Appendix 8.6: Peat Landslide and Hazard Risk Assessment

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1.1 Introduction

1.1.1 The objectives of the Peat Landslide Hazard Risk Assessment (PLHRA) are to:

- undertake a desk-based review of published information including geological, hydrogeological and topographical information, to inform the baseline for the PLHRA;
- undertake site visits to identify evidence of, and potential for, active, incipient or relict peat instability, including identification of the location of features as required;
- reporting on evidence of any active, incipient or relict peat instability, and the potential risk of future instability, describing the likely causes and contributory factors;
- identify potential controls to be imposed during the construction phase to minimise the risk of any peat instability at the Site; and
- identify requirements for further work or specific construction methodologies to suit the ground conditions to mitigate against any increased risk of potential peat instability.

1.1.2 The scope of the PLHRA is as follows:

- characterise the peatland geomorphology to determine whether there have been prior occurrences of instability, and whether contributory factors that might lead to instability in the future are present across the Site;
- determine the likelihood of a future peat landslide under natural conditions and in association with construction activities associated with the Proposed Development;
- identify potential receptors that might be affected by peat landslides, should they occur, and quantify the associated risks; and
- provide appropriate mitigation and control measures to reduce the risks to acceptable levels such that the Proposed Development is constructed safely with minimal risks to the environment.

1.1.3 the contents of this PLHRA have been prepared in accordance with the Scottish Government's Best Practice Guidance[1], noting that the guidance '*should not be taken as prescriptive or used as a substitute for the developer's [consultant's] preferred methodology*'.

1.1.4 The Proposed Development is a renewable energy development comprised of up to eight wind turbines, a Battery Energy Storage System (BESS) and associated infrastructure adjacent to Sullom Voe Oil Terminal (SVT) and the Shetland Gas Plant in Shetland, Scotland. The Proposed Development is described in **Chapter 2: Proposed Development (EIAR Volume 2)**.

1.2 Methodology

1.2.1 A desk study and several field surveys were undertaken to gather baseline conditions of the Site and allow a PLHRA to be completed. The desk study included an overview of the following elements to inform the baseline design:

- bedrock and superficial geology from British Geological Society (BGS) Mapping[2];
- peatland and peat characteristic information from the NatureScot (Scottish Natural Heritage) carbon rich soils, deep peat and priority habitat[3]
- habitat survey information from **Chapter 6: Ecology (EIAR Volume 2)**;
- hydrogeological and Hydrology information from **Chapter 8: Hydrology, Hydrogeology and Geology and Soils (EIAR Volume 2)**;
- topographical information taken from published Digital Terrain Model (DTM) LIDAR data;
- media articles, historic maps and local landowner accounts of historic land movements; and
- meteorological rainfall data[4].

1.2.2 The results of the desk study are discussed **Section 1.3** of this report

Field Survey

1.2.3 Peat depth surveys were undertaken across the Site, with the survey design based on best practice guidance for surveying developments on peatland[5].

1.2.4 A Stage 1 peat survey was undertaken during April 2025 by Ramboll UK (RUK). The Stage 1 survey is a preliminary, low-density survey and was carried out on a 100 m grid across the Site within areas of likely peatland. The probing was carried out using collapsible avalanche probes, allowing for probing in excess of 6 m. However, such depths were not reached.

1.2.5 A Stage 2 peat survey was undertaken by Fluid Environmental Consulting in July 2025. The survey comprised probing at refined locations to target proposed turbine locations, access tracks and potential borrow pit locations. Survey details as follows:

- turbine Hardstanding: Peat probing was carried out at between 10 & 25 m grids across the turbine/hardstanding footprint with an easement included for potential earthworks;
- borrow pit search areas were probed at between 10 & 20 m interval dependant on peat depth encountered; and
- access tracks: 50 m intervals along the track and at points every 10 m perpendicular to the centreline on either side of the proposed track.

1.2.6 During this survey, peat cores were taken and a number of field tests and observations were undertaken to identify:

- depth of acrotelm;
- degree of humification[6], to establish amorphous, intermediate, fibrous and content; and
- degree of humification using the Von Post[7], classification.
- fine fibre content, based on scale of F0 (none) to F3 (very high);

1 Scottish Government (2017). Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity.

2 BGS Geoindex Onshore Mapping, Available at: https://www.bgs.ac.uk/map-viewers/geoindex-onshore/ [Accessed 01/04/2026]

3 NaturScot Carbon and Peatland Mapping Available at: https://opendata.nature.scot/maps/171df29c8c5b45a9b93438a3bc5700c6 [Accessed 01/04/2026]

4 Met Office Weather Data Lerwick available at https://www.metoffice.gov.uk/research/climate/maps-and-data/location-specific-long-term-averages/gfxnj5fx4 [Accessed 01/04/2026]

5 Scottish Government, Scottish Natural Heritage, SEPA. (2017). Peatland Survey. Guidance on Developments on Peatland. Available at: https://www.gov.scot/publications/peatland-survey-guidance/ [Accessed 01/04/2026]

6 Hodgson, J.M (1974) Soil Survey Field Handbook.

7 Hobbs N.B. (1986). Mire morphology and the properties and behaviour of some British and Foreign peats. Quarterly Journal of Engineering Geology, 19, pp7-80.

- coarse fibre content, based on scale of R0 (none) to R3 (very high);
- water content, based on scale of B1 (dry) to B5 (very wet); and
- substrate underlying the peat where this was possible.

1.2.7 An additional Stage 2 peat survey was undertaken by CKOS Solutions Limited in February 2026. This survey comprised probing across revised turbine and track infrastructure layouts following design changes and mapping of area of deep peat and ecological constraints.

Limitations and Assumptions

1.2.8 Surveying has been undertaken based on the Proposed Development design and associated infrastructure locations available at the time of the surveys to inform the assessment of the layout submitted for consent. The data collected to inform this PLHRA is considered sufficient to support a robust assessment of the peat landslide hazards and risks. Should the infrastructure design change outside the incorporated limits of deviation, then further surveying and subsequent amendments to the PLHRA reporting may have to be undertaken.

1.3 Desk Study and Site Information

1.3.1 The Site location and setting are described in **Chapter 2: Description of Proposed Development (EIAR Volume 2).**

Topography

1.3.2 The topography of the northern extents of the Site is generally undulating rising from mean high water level of Yell sound to 110 m above Ordnance Datum (AOD) at the summit of Hill of Crooksetter. The southern extents of the Site gently undulate between levels of 40 m AOD and 90 m AOD. Topography elevations are shown on **Figure 8.6.1.**

1.3.3 Slope angles at the Site, as shown on **Figure 8.6.2**, are summarised below:

- Turbine 1 generally moderate (5.1 to 10º);
- Turbine 2 generally shallow (2.1 to 5°);
- Turbine 3 generally moderate (5.1 to 10º);
- Turbine 4 generally moderate (5.1 to 10º), locally moderately steep (10 to 15°);
- Turbine 5 generally shallow (2.1 to 5°);
- Turbine 6 generally shallow (2.1 to 5°);
- Turbine 7 generally moderate (5.1 to 10º); and
- Turbine 8 generally shallow (2.1 to 5°), locally moderate (5.1 to 10º).

1.3.4 The borrow pit search area is located on generally moderate (5.1 to 10°) to locally moderately steep (10 to 15°) ground associated with the southern slopes of Hill of Garth.

1.3.5 The Proposed Construction Compound is located on generally shallow (2.1 to 5°) ground.

1.3.6 The Battery Energy Storage System (BESS), substation and LiDAR Area areas is located on generally shallow (2.1 to 5°) to moderate (5 to 10°) ground.

Geology

1.3.7 The 1:50,000 scale geological mapping available from the British Geological Survey (BGS)[2] shows the eastern, central and southern regions of the Site to be underlain by early Devonian-aged Graven Complex Formation rock (Granodiorite). Granodiorite is a coarse-grained (phaneritic) intrusive igneous rock. The northern extents of the Site are underlain by metamorphic rocks of the Tonian aged, Yell Sound Psammite formation (psammite and pelite). The formation comprises psammite, variably gneissose; with subsidiary layers or lenses of amphibolite, pelite, quartzite and gneissose semipelite.

1.3.8 BGS Mapping[2] shows the superficial geology across the majority of the Site is predominantly peat. Isolated areas of Quaternary aged, Devensian, Till – Diamicton are shown to be present across the Site. NatureScot Carbon and Peatland mapping[8] also shows peat to be present across virtually all of the Site, with the exception of an area located to the southwestern extents. The mapping shows the peat to be Class 1 peatland and designated as '*Nationally important carbon rich soils, deep peat and priority habitat'*

1.3.9 BGS Mapping[2] shows two major fault lines, approximately 4.6 km to the east (Nesting Fault) and 5 km west (Walls Boundary Fault) of the Site. Both faults are running approximately in a north to south direction.

Hydrogeology and Hydrology

1.3.10 The BGS 1:625,000 scale hydrogeology mapping[9] defines the rocks as follow:

- Graven Complex Formation = low productivity aquifer (limited groundwater in near surface weathered zone and secondary fractures).
- Yell Sound Psammite Formation = Low productivity aquifer (small amounts of groundwater in near surface weathered zone and secondary fractures; rare springs).

1.3.11 The average annual rainfall for the nearest weather station (Met Office weather station at Lerwick[4]) is 1252.3 mm, based on the most recent dataset (1991 to 2020).

Surface Water Features

1.3.12 The northern extent of the Site comprises an undulating plateau that ranges in elevation from mean high-water level at its northernmost extent by Ay Wick, to 106 m AOD at the Hill of Crooksetter located in the centre of the Site. The northern extent of the Site primarily drains into the Aywick Burn flowing in a north westerly direction and the Burn of Toft flowing eastwards. A small section of the Burn of Crooksetter and its tributaries are located in the west of the Site. A section of Neshion Water is located in the east of the Site. The Site is bounded in the northwest by Yell Sound (coastal waterbody).

1.3.13 Towards the southern end of the Site, the topography gently undulates between 40 m AOD and 90 m AOD. The slackness of slopes in this part of the Site is associated with a number of lochans including Sand Water, Nugla Water and the Loch of Bordigarth and their connecting watercourses. Tributaries from the Burn of Laxobigging are also located in the south of the Site.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

1.3.14 National Vegetation Classification (NVC) habitat surveys have been undertaken at the Site. The surveys confirmed that areas of the Site are classified as potentially GWDTE, with some areas with high potential. These areas are shown on **Figure 8.6.4**. A further hydrological assessment was undertaken which demonstrated that while potentially groundwater dependent vegetation communities are present,

[8] NatureScot (2016) *Carbon & Peatland mapping* [online] Available from: https://map.environment.gov.scot/Soil_maps [Accessed 05/02/2026]

[9] British Geological Survey, 1:625,000 scale digital hydrogeological data. (online) Available: http://www.bgs.ac.uk/products/hydrogeology/maps.html [Accessed 01/04/2026]

these areas are not supported by groundwater and are considered to be surface water fed (refer to **Technical Appendix 8.3: Watercourse Crossing Assessment (EIAR Volume 4)**.

Private Water Supplies

1.3.15 No Private Water Supplies were found within 2 km of the Site. Details are shown in **Chapter 8: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2).**

Land use

1.3.16 The Site comprises a combination of open heather moorland and grassland on peaty soils, which is used for rough grazing. The Site is typical of the wider landscape which exhibits a similar combination of hilly coastal terrain, small coastal islands and rocky coastal edges that mark the edge of the open waters of numerous voes (Orka Voe, Garths Voe, Tofts Voe and Firths Voe).

Geomorphology

1.3.17 Digital aerial photography and Digital Terrain Model (DTM) LIDAR data was used to interpret and map geomorphological features within the developable areas of the Site. This interpretation and the resulting geomorphological map, as shown on **Figure 8.6.4** were subsequently verified during Site walkover surveys undertaken by an experienced hydrologist in May 2025, and July 2025.

1.3.18 The geomorphological features recorded from the surveys are shown on **Figure 8.6.4**. The presence, characteristics and distribution of peatland geomorphological features have been defined to understand the hydrological function of the peatland, with reference to the balance of erosion and peat accumulation (or condition), and the sensitivity of peatland to potential land-use changes.

1.3.19 Some evidence of peat instability was identified during the surveys, with features including hags, groughs, and other peat erosion noted. Several localised areas of natural or diffuse drainage were recorded across the Site which displayed near basal erosion of peat due to surface water run-off. However, the predominant features noted were sphagnum pools indicating a lack of drainage within the peatland. No major instability features, evidence of incipient instability or past landslides were noted.

1.4 Field Survey

1.4.1 Results from the peat surveys are detailed within **Technical Appendix 8.4: Peat Depth Survey Results (EIAR Volume 4).**

Peat Depth and Character

1.4.2 A combined total of 3,242 peat depth probes were taken during the peat surveys. The results are shown on **Figure 8.6.5**. The total includes 260 peat depth probes during the Stage 1 survey and 2,982 peat depth probes across the two Stage 2 surveys.

1.4.3 The peat depth survey results indicate the Site to be predominately underlain by areas of deep peat (74% of peat depth probes recorded peat depths greater than 1 m). The definition for deep peat used in this Technical Appendix comprises areas of soil with a peat layer more than 1 m deep in line with the Joint Nature Conservation Committee (JNCC) report[10] the peat depth survey results are summarised as follows:

- 8 no. samples (0.2 %) located on land with no peat present (≤ 0.05 m depth of peat);
- 216 no. samples (6.7 %) located on land with > 0.05 m and ≤ 0.5 m depth of peat or organo-mineral soil;
- 612 no. samples (18.9 %) located on land with > 0.5 m and ≤ 1.0 m depth of peat;
- 1043 no. samples (32.2 %) located on land with > 1.0 m and ≤ 1.5 m depth of peat;
- 757 no. samples (23.3 %) located on land with > 1.5 m and ≤ 2.0 m depth of peat;
- 473 no. samples (14.6 %) located on land with > 2.0 m and ≤ 3.0 m depth of peat;
- 103 no. samples (3.2 %) located on land with > 3.0 m and ≤ 4.0 m depth of peat;
- 26 no. samples (0.8 %) located on land with > 4.0 m and ≤ 5.0 m depth of peat; and
- 4 no. samples (0.1 %) located on land with >5.0 m depth of peat.

1.4.4 The maximum depth of peat recorded at the Site during the Stage 1 survey was 6.0 m, located in the centre of the Site, approximately 280 m west of Turbine 6. The peat depth results are shown on **Figure 8.6.5** of this report.

1.5 Peat Instability

Types of Peat Instability

1.5.1 Peat instability can be defined as either 'minor instability' or 'major instability' and is observed by both field observations and through desk top review of aerial/satellite imagery of the Site:

- Minor instability can be defined as localised and small scale features that are not generally precursors to major failure and including gully sidewall collapses, pipe ceiling collapses, minor slumping along diffuse drainage pathways (e.g. along flushes). Indicators of minor instability include presence of tension cracks, compression ridges, or bulges; and
- Major instability can be defined by peat landslides.

1.5.2 For the purposes of this assessment, landslide classification is simplified and split into three main types:

- multiple peat slides with displaced slabs and exposed substrate;
- bog burst with peat retained within the failed area; and
- multiple peat soil slides with displacement of thin soils exposing substrate.

1.5.3 The term 'peat slide' is used to refer to large-scale landslides and occur 'top-down' from the point of initiation on a slope in thinner peats (between 0.5 and 1.5 m) and on moderate slope angles (typically 5-15°).

1.5.4 The term 'bog burst' is used to refer to very large-scale failures where peat is typically deeper (greater than 1.0 m and up to 10 m) and more amorphous than sites experiencing peat slides, with shallower slope angles (typically 2-5°).

1.5.5 'Peaty soil slide' is used to refer to small scale slab-like slides in organic soils generally <0.5 m thick.

Factors Contributing to Peat Instability

1.5.6 Peat landslides are caused by a combination of preconditioning factors and triggering factors. The combined factors are discussed in greater detail in the Landslide Susceptibility Approach section of this report. Triggering factors have an immediate or rapid effect on the stability of a peat accumulation whereas preconditioning factors can influence peat stability over a much longer period. Only some of these factors can be addressed by site characterisation.

1.5.7 Preconditioning factors may influence peat stability over long periods of time (years to hundreds of years), and include:

[10] JNCC Report No.445 (2011) Towards an assessment of the state of UK Peatlands

- impeded drainage caused by a peat layer overlying an impervious clay or mineral base (hydrological discontinuity);
- a convex slope or a slope with a break of slope at its head (concentration of subsurface flow);
- proximity to local drainage, either from flushes, pipes or streams (supply of water);
- connectivity between surface drainage and the peat/impervious interface (mechanism for generation of excess pore pressures);
- artificially cut transverse drainage ditches, or grips (elevating pore water pressures in the basal peat mineral matrix between cuts, and causing fragmentation of the peat mass);
- increase in mass of the peat slope through peat formation, increases in water content or afforestation;
- reduction in shear strength of peat or substrate from changes in physical structure caused by progressive creep and vertical fracturing (tension cracking or desiccation cracking), chemical or physical weathering or clay dispersal in the substrate;
- loss of surface vegetation and associated tensile strength (e.g. by burning or pollution induced vegetation change);
- increase in buoyancy of the peat slope through formation of sub-surface pools or water-filled pipe networks or wetting up of desiccated areas; and
- afforestation of peat areas, reducing water held in the peat body, and increasing potential for formation of desiccation cracks which are exploited by rainfall on forest harvesting.

1.5.8 Triggering factors are typically of short duration (minutes to hours) and any individual trigger event can be considered as a result of cumulative events:

- intense rainfall or snowmelt causing high pore pressures along pre-existing or potential rupture surfaces (e.g. between the peat and substrate);
- rapid ground accelerations (e.g. from earthquakes or blasting); unloading of the peat mass by fluvial incision or by artificial excavations (e.g. cutting);
- focusing of drainage in a susceptible part of a slope by alterations to natural drainage patterns (e.g. by pipe blocking or drainage diversion); and
- loading by plant, spoil or infrastructure.

1.5.9 External environmental triggers such as rainfall and snowmelt cannot be mitigated, though they can be managed (e.g. by limiting construction activities during periods of intense rain).

1.5.10 Unloading of the peat mass by excavation, loading of the peat by plant and focusing of drainage can be managed and mitigated by careful design, site specific stability analyses, informed working practices and monitoring.

Approaches to Assessing Peat Instability

1.5.11 This report considers a qualitative contributory factor-based approach and conventional stability analysis (through limit equilibrium or Factor of Safety (FoS) analysis).

1.5.12 The advantage of the former is that many observed relationships between reported peat landslides and ground conditions can be considered together where a FoS is limited to consideration of a limited number of geotechnical parameters. The disadvantage is that the outputs of such an approach are better at illustrating relative variability in landslide susceptibility across a site rather than absolute likelihood.

The advantage of the FoS approach is that clear thresholds between stability and instability can be defined and modelled numerically. However, in reality, there is considerable uncertainty in input parameters, and it is a generally held view that the geomechanical basis for stability analysis in peat is limited given the nature of peat as organic material, rather than mineral soil.

1.5.13 To reflect these limitations, both approaches are adopted and outputs from each approach integrated in the assessment of landslide likelihood.

Assessment of Peat Landslide Likelihood

Introduction

1.5.14 This section provides details on the landslide susceptibility and limit equilibrium approaches to the assessment of peat landslide likelihood used in this report. The assessment of likelihood is a key step in the calculation of risk, where risk is expressed as follows:

Risk = Probability of a Peat Landslide x Adverse Consequences

1.5.15 The probability of a peat landslide is expressed in this Technical Appendix as peat landslide likelihood and is considered below.

Limit Equilibrium Approach

1.5.16 Stability analysis has been undertaken using the infinite slope model to determine the FoS for a series of 25 m x 25 m cells within the developable area. The limit equilibrium approach has been applied within areas where the peat thickness is over 0.5 m. The limit equilibrium approach is the most frequently cited approach for the quantitative assessment of the stability of peat slopes. The approach assumes that failure occurs by shallow translational land sliding, which is the mechanism usually interpreted for peat slides. Due to the relative length of the slope and depth to the failure surface, end effects are considered negligible and the safety of the slope against sliding may be determined from analysis of a 'slice' of the material within the slope.

1.5.17 The stability of a peat slope is assessed by calculating a Factor of Safety, FoS, which is the ratio of the sum of resisting forces (shear strength) and the sum of driving forces (shear stress):

$$\frac{c' + (\gamma - h\gamma_w)\, z \cos^2\beta \tan\,\phi'}{\gamma z \sin\beta \cos\beta}$$

In this formula:

- c is the effective cohesion (kPa);
- γ is the bulk unit weight of saturated peat (kN/m^3);
- γw is the unit weight of water (kN/m^3);
- z is the vertical peat depth (m),
- h is the height of the water table as a proportion of the peat depth;
- β is the angle of the substrate interface (°); and
- ϕ' is the angle of internal friction of the peat (°).

1.5.18 This form of the infinite slope equation uses effective stress parameters, and assumes that there are no excess pore pressures, i.e. that the soil is in its natural, unloaded condition.

1.5.19 The choice of water table height reflects the full saturation of the soils that would be expected under the most likely trigger conditions, i.e. heavy rain.

1.5.20 Where the driving forces exceed the shear strength (i.e. where the bottom half of the equation is larger than the top), F is <1, indicating instability. A FoS between 1 and 1.4 is normally taken in engineering terms to indicate marginal stability (providing an allowance for variability in soil strength, depth to failure). Slopes with a FoS greater than 1.4 are generally considered to be stable.

1.5.21 There are numerous uncertainties involved in applying geotechnical approaches to peat, not least because of its high water content, compressibility and organic composition. Peat comprises organic matter in various states of decomposition with both pore water and water within plant constituents, and the frictional particle-to-particle contacts that are modelled in standard geotechnical approaches are different in peats. There is also a tensile strength component to peat which is assumed to be dominant in the acrotelm, declining with increasing decomposition and depth. As a result, analysis utilising geotechnical approaches is often primarily of value in showing relative stability across a site given credible and representative input parameters rather than in providing an absolute estimate of stability. With this in mind, representative data inputs have been derived from published literature and used for drained analysis only.

Data Inputs

1.5.22 Stability analysis was undertaken using GIS software and a 25 m x 25 m grid was superimposed on areas of peat only, with key input parameters derived for each grid cell. A 25 m x 25 m cell size was chosen because it is sufficiently small to define a minimum credible landslide size and avoid 'smoothing' of important topographic irregularities. Given the cell size of the input DTM, which provides a key input parameter, any smaller cell size would be unlikely to provide significant benefits.

1.5.23 **Table 8.6.1** shows the input parameters and assumptions for the stability analyses undertaken. The shear strength parameters c' and ϕ' are usually derived in the laboratory using undisturbed samples of peat collected in the field and therefore site-specific values are often not available ahead of detailed site investigation for a development. Therefore, for this assessment, a literature search has been undertaken to identify a range of credible but conservative values for c' and ϕ' quoted in fibrous and humified peats. FoS analysis was undertaken with a conservative ϕ' of 22° and a value of 5 kPa for c'.

Table 8.6.1: Geotechnical Parameters for Drained Infinite Slope Analysis

Parameter	Values	Rationale	Source
Effective Cohesion (c')	5	Credible conservative cohesion values for humified peat based on literature review	5.5 - 6.1 - peat type not stated [11] 3, 4 - peat type not stated [11] 5 - basal peat [12] 8.74 - fibrous peat [13] 4 - peat type not stated [14] 7 – 12 - H8 peat [15]
Bulk Unit Weight (γ)	10.5	Mid-range value for humified catotelmic peat taken from laboratory testing	10.1 – catotelm peat [16] 10.1 – Irish bog peat [17]
Effective Angle of Internal Friction (ϕ')	22	Credible conservative friction angle for humified peat based on literature review	40 – 65 - fibrous [15] 50 – 60 - amorphous [15] 36.6 - 43.5 - peat type not stated [11] 31 – 55 - Irish bog peat [18] 34 – 48 - fibrous sedge pear [19] 32 – 58 - peat type not stated [11] 23 - basal peat [12] 21 - fibrous peat [13]
Slope Angle from Horizontal (β)	Various	Mean slope angle per 25 m x 25 m grid cell	5 m DTM of site
Peat Depth (z)	Various	Mean peat depth per 25 m x 25 m grid cell	Interpolated peat depth model of site
Height of Water Table as a Proportion of Peat Depth (h)	1	Assumes peat mass is fully saturated (normal conditions during intense rainfall events or snowmelt, which are the most likely natural hydrological conditions at failure)	Assumed

Results

1.5.24 **Figure 8.6.6** shows the results for drained analysis of the peat areas at the Site. The results indicate that the Factors of Safety demonstrates stability across most of the Site (FoS >1.4)**.** This is consistent with the lack of observation of instability features during the Site walkover and on review of aerial imagery. The assessment has used conservative mid-range values for Effective Cohesion and Effective Angle of Internal Friction of C' of 5 KPa and a ϕ' of 22° respectively as shown in **Table 8.6.1.**

1.5.25 The following areas of Marginal Unstable ground (FoS = 1.0 – 1.4):

- area noted at northern extents of Turbine 4 hardstanding;
- areas noted adjacent to Turbine 8 hardstanding and blade laydown area;
- area noted beneath alignment of access track at approximate chainage 1650 between Turbines 7 and 8; and
- areas noted beneath alignment of access track at approximate chainages 1150, 1220 and 1380 between Turbine 8 and the intersection.

1.5.26 Where areas of Marginal Unstable ground (FoS = 1.0 – 1.4) are located within the footprint of the Proposed Development. Additional, specific, mitigation measures would be required. Where Areas of stable ground are demonstrated, then general good practice construction mitigation measures are advisable to mitigate any residual risks based on the Limit Equilibrium analysis. Both specific and general good practice mitigation measures are discussed in **Section 1.8**. Areas of Marginal Unstable ground have been included within **Table 8.6.12** in the Landslide Susceptibility Approach section of this report to provide a comparison of results from both approaches.

Landslide Susceptibility Approach

1.5.27 The landslide susceptibility approach is based on the layering of contributory factors to produce unique 'slope facets' that define areas of similar susceptibility to failure. The number and size of slope facets will vary from one part of the Site to another according to the complexity of ground conditions. As with the limit equilibrium approach, facets were only defined in areas of true peat.

1.5.28 Eight contributory factors are considered in the analysis:

[11] Long M (2005) Review of peat strength, peat characterisation and constitutive modelling of peat with reference to landslides.

[12] Warburton et al (2003) Anatomy of a Pennine peat slide, Northern England. Earth Surface Processes and Landforms.

[13] Carling (1986) Peat slides in Teesdale and Weardale, Northern Pennines, July 1983: description and failure mechanisms.

[14] Dykes and Kirk (2001) Initiation of a multiple peat slide on Cuilcagh Mountain, Northern Ireland.

[15] Huat et al (2014) Geotechnics of organic soils and peat.

[16] Mills (2002) Peat slides: Morphology, Mechanisms and Recovery

[17] Boylan N, et al (2008) Peat slope failure in Ireland

[18] Hebib (2001) Experimental investigation of the stabilisation of Irish peat

[19] Farrell and Hebib (1998) The determination of the geotechnical parameters of organic soils

- slope angle (S);
- peat depth (P);
- substrate geology (G);
- peat geomorphology (M);
- drainage (D);
- forestry (F);
- slope convexity (C); and
- land use (L).

1.5.29 For each factor, a series of numerical scores between 0 and 3 are assigned to factor 'classes', the significance of which is tabulated for each factor. The higher a score, the greater the contribution of that factor to instability for any particular slope facet. Scores of 0 imply neutral/negligible influence on instability.

1.5.30 Factor scores are summed for each slope facet to produce a peat landslide likelihood score (SPL), the theoretical maximum being 24 (8 factors, each with a maximum score of 3):

SPL = SS + SP + SG + SM + SD + SF + SC + SL

1.5.31 In practice, a maximum score is unlikely, as the chance of all contributory factors having their highest scores in one location is very small.

1.5.32 Figures to show the spatial distribution of each factor across the Site are shown in **Figures 8.6.7a to 8.6.7h** of this report.

Slope Angle

1.5.33 **Table 8.6.2** shows the slope ranges, their significance and related scores for the slope angle contributory factor. Slope angles were derived from the 5 m DTM and scores assigned based on reported slope angles associated with peat landslides rather than a simplistic assumption that 'the steeper a slope, the more likely it is to fail'.

Table 8.6.2: Slope Classes, Significance and Scores

Slope Range (°)	Significance	Score
>20.0	Failure typically occurs as peaty-debris slides due to low thickness of peat	1
15.1-20.0	Failure typically occurs as peaty-debris slides due to low thickness of peat	2
10.1-15.0	Failure typically occurs as peat slides, bog slides or peaty-debris slides, a key slope range for reported population of peat failures	3
5.1-10.0	Failure typically occurs as peat slides, bog slides or peaty-debris slides, a key slope range for reported population of peat failures	3
2.1-5.0	Failure typically occurs as bog bursts, bog flows or peat flows; peat slides and peaty-debris slides are rare due to low slope angles	2
≤2.0	Failure is very rarely associated with flat ground, neutral influence on stability	0

1.5.34 **Figure 8.6.7a** shows the distribution of slope angle scores across the Site. The results show the slope angles across most of the Site are either <2° or between 2.1° and 15°. Some localised steeper gradients are shown to be present around the Hill of Crooksetter and coastline formations.

Peat Depth (P)

1.5.35 **Table 8.6.3** shows the peat depths, their significance and related scores for the peat depth contributory factor. Peat depths were derived from the peat depth model shown on **Figure 8.6.7.b** and reflect the peat depth ranges most frequently associated with peat slides[20].

Table 8.6.3: Peat Depth Classes, Significance and Scores

Depth Range (m)	Significance	Score
>1.5	Sufficient thickness for any type of peat failure	2
1.0-1.5	Sufficient thickness for peat slide or bog slide	3
0.5-1.0	Sufficient thickness for peat or bog slide and peaty-debris slide but not for bog burst	3
<0.5	Organic soil rather than peat, failures would be peaty-debris slides	1
No Organic Soil	No organic soil and therefore failures cannot be interpreted as peat slides, neutral influence on stability	0

1.5.36 **Figure 8.6.7b** shows the distribution of peat depth scores across the Site. The results indicate that the Site is predominantly covered by peat thicknesses between 0.5 and 1.5 m. All turbine locations also show areas where peat thickness is greater than 1.5 m. The Proposed Borrow pit location to the south shows areas where peat thickness is <0.5 m.

Substrate Geology

1.5.37 **Table 8.6.4** shows substrate type, significance and related scores for the substrate geology contributory factor. The shear surface or failure zone of peat failures typically overlies an impervious clay or mineral (bedrock) base giving rise to impeded drainage. This, in part, is responsible for the presence of peat, but also precludes free drainage of water from the base of the peat mass, particularly under extreme conditions (such as after heavy rainfall, or snowmelt).

1.5.38 Peat failures are frequently cited in association with glacial till deposits in which an iron pan is observed in the upper few centimetres. They have also been observed over glacial till without an obvious iron pan, or over impermeable bedrock. They are rarely cited over permeable bedrock, likely due to the reduced likelihood of peat formation.

Table 8.6.4: Substrate Geology Classes, Significance and Scores

Substrate Geology	Significance	Score
Glacial Till With Iron Pan	Failures often associated with underlying till; particularly where impermeable iron pan provides polished shear surface	3
Glacial Till	Failures often associated with underlying till	2
Impermeable Bedrock	Failures sometimes associated with bedrock, particularly if smooth top surface	1
Permeable Bedrock/Granular deposits	Failures rarely associated with permeable bedrock or granular deposits (peat is often thin or absent), neutral influence on stability	0

1.5.39 **Figure 8.6.7c** shows the distribution of substrate geology scores across the Site. The results indicate that the Site is underlain mostly by impermeable bedrock. There are several areas of localised cohesive and granular deposits shown across the Site. The results are consistent with the solid geology observed during the survey within exposures and watercourses and indicated on BGS geology mapping[2].

[20] Evans, M & Warburton, J 2007, Geomorphology of Upland Peat: Erosion, Form and Landscape Change.P104-135

Peat Geomorphology

1.5.40 **Table 8.6.5** shows the geomorphological features identified across the Site, their significance and related scores.

Table 8.6.5: Peat Geomorphology Classes, Significance and Scores		
Geomorphology	**Significance**	**Score**
Adjacent/upslope (<50 m) to existing instability (peat slide, peaty-debris slide, bank failure)	Failures often associated with underlying till; particularly where impermeable iron pan provides polished shear surface	3
Incipient instability (tension crack, compression ridge, bulging, quaking bog)	Failures are likely to occur where incipient failure morphology is observed	3
Undrained intact planar peat	Failures are most frequently recorded in intact peat, planar peat	2
Diffuse natural drainage/pool/flush	Failures are often associated with areas of diffuse subsurface drainage (such as flushes)	2
Pipe/Collapsed Pipe	Failures are often associated with areas of soil piping	2
Existing Peat Slide	Failures typically stabilise and do not reactivate after the initial event	1
Gullied/Dissected/Hagged/Eroded Peat/Bare Peat/Bare Ground	Failures are rarely recorded in peat fragmentated by erosion	1

1.5.41 **Figure 8.6.7d** shows the distribution of geomorphology scores across the Site. The results indicate that the land to the western extents (Substation, Site compound and Turbine 1 and 2) and eastern extents of the Site (Turbine 5 and 6) contain sphagnum pools and pooling. This suggests the peatland is mostly undrained. Central Sections of the Site contain drainage features including diffuse drainage. Bare Ground and erosion features including hags are shown to be present near to the Site compound and substation locations. One Peat erosion feature is shown just to the north of Turbine 6 hardstanding in the east of the Site. There are no significant geomorphological features associated with historic peat slide failure.

Drainage (D)

1.5.42 **Table 8.6.6** shows artificial drainage feature classes, their significance and related scores. Transverse/oblique drainage lines may reduce peat stability by creating lines of weakness in the peat slope and encouraging the formation of peat pipes. Review of published literature indicates that a number of peat failures have been identified which have failed over moorland grips. The influence of changes in hydrology become more pronounced the more transverse the orientation of the drainage lines are relative to the overall slope.

Table 8.6.6: Drainage Feature Classes, Significance and Scores	
Significance	**Score**
Failures are sometimes reported in association with artificial drains oblique/transverse to slope	3
Failures are rarely associated with artificial drains parallel to slope	1
Neutral influence on stability	0

1.5.43 **Figure 8.6.7e** shows the distribution of drainage feature scores across the Site. The Site is largely absent of artificial drainage with features predominantly shown around the northern coastline and the southern boundary extents. The closest artificial drainage near proposed infrastructure is located 40 m north of the track between Turbine 7 and Turbine 8, and a further area 60 m south of Turbine 7. These drains were found to be aligned to the slope.

Forestry (F)

1.5.44 **Table 8.6.7** shows forestry classes, their significance and related scores.

Table 8.6.7: Forestry Classes, Significance and Scores		
Forestry Class	**Significance**	**Score**
Afforested area (with mature trees), ridge and furrows oblique to slope	Peat underlying forestry stands with rows aligned oblique to slope has inter ridge cracks which are conducive to slope instability	2
Afforested area (with mature trees), ridge and furrows aligned to slope	Peat underlying forestry stands with rows aligned with slope is conducive to slope instability, but less so than where rows are aligned oblique to slope	1
Deforested area (few or no trees), ridge and furrows oblique to slope	Peat underlying deforested stands has a higher water table and more neutral buoyancy, but retains inter ridge cracks (lines of weakness) conducive to instability; alignment of cracks oblique to slope is most conducive to instability	3
Deforested area (few or no trees), ridge and furrows aligned to slope	Peat underlying deforested stands has a higher water table and more neutral buoyancy, but retains inter ridge cracks (lines of weakness), however, orientation of these cracks is less critical when aligned to slope	2
Not Afforested	Neutral influence on stability	0

1.5.45 **Figure 8.6.7f** shows the Site to be absent of commercial forestry and ancient woodland.

Slope Convexity (C)

1.5.46 **Table 8.6.8** shows profile convexity classes, significance and related scores. Convex and concave slopes (i.e. positions in a slope profile where slope gradient changes by a few degrees) can be associated with the initiation point of peat landslides. Convexities are often associated with thinning of peat; such that thicker peat upslope applies stresses to thinner 'retaining' peat downslope. Conversely, buckling and tearing of peat may trigger failure at concavities (Dykes and Warburton, 2007[21]). However, review of reported peat landslide locations against Google Earth elevation data (Mills and Rushton, 2023[22]) indicates that the majority of peat slides occur on rectilinear (uniform) slopes and that the reporting of convexity as a key driver may be misleading. Therefore, rectilinear slopes are assigned the highest score within this assessment.

Table 8.6.8: Convexity Feature Classes, Significance and Scores		
Convexity Feature	**Significance**	**Score**
Rectilinear Slope	Peat slides are most frequently reported on rectilinear slopes, while Bog bursts are often reported on rectilinear slopes	3
Convex Slope	Peat failures are often reported on or above convex slopes	2
Concave Slope	Peat failures are occasionally reported in association with concave slopes	1
Undulating Ground	Peat failures are rarely reported on undulating ground. A neutral influence on peat stability is assumed for this assessment	0

1.5.47 **Figure 8.6.7g** shows the distribution of convexity feature scores across the Site. Slopes are shown to be predominantly rectilinear in nature across the Site, with areas of convex slopes associated with the

[21] Dykes, A. and Warburton, J. 2007. Mass movements in peat: A formal classification scheme. Geomorphology, 86, 73-93)

[22] Mills, A.J. and Rushton, D. 2023. A risk-based approach to peatland restoration and peat instability. NatureScot Research Report 1259

watercourses located in the central and northern Site areas. Areas of undulating ground are predominantly shown within the central regions of the Site between Turbine 2 and Turbine 7, to the north of Turbine 6 and beneath the permanent hardstanding of Turbine 8.

Land use (L)

1.5.48 **Table 8.6.9** shows land use classes, significance and related scores. A variety of land uses have been associated with peat failures which form the scoring and potential for failure.

Table 8.6.9: Land Use Feature Classes, Significance and Scores

Land Use	Significance	Score
Cutting/ Turbary	Peat failures are often associated with peat cuttings/turbary	3
Adjacent Quarrying	Failures are occasionally reported adjacent to quarries (usually as bog bursts, bog flows or peat flows)	2
Burning	Failures are rarely associated with burning though this activity may create pathways for water to the base of peat	1
Other Land Use	Failures are rarely associated with other forms of land use	0

1.5.49 **Figure 8.6.7h** shows the Site to be absent of substantial peat cutting, burning and historical quarrying activities.

LIKELIHOOD SCORES

1.5.50 The eight contributory factor layers were combined in GIS software to produce likelihood scores for a peat landslide as shown on **Figures 8.6.8**. These likelihood scores were then converted into descriptive 'likelihood classes' from 'Very Low' to 'Very High' with a corresponding numerical range of 1 to 5, and are described in **Table 8.6.10** below.

Table 8.6.10: Likelihood Classes Derived from the Landslide Susceptibility Methodology

Summed Contributory Factor Scores	Typical Site Conditions Associated with Score	Qualitative Likelihood	Peat Landslide Likelihood Score
≤8	Unmodified peat with no more than low weightings for peat depth, slope angle, underlying geology and peat morphology	Very Low	1
8-13	Unmodified or modified peat with no more than moderate or some high scores for peat depth, slope angle, underlying geology and peat morphology	Low	2
14-18	Unmodified or modified peat with high scores for peat depth and slope angle and/or high scores for at least three other contributory factors	Moderate	3
19-21	Modified peat with high scores for peat depth and slope angle and several other contributory factors	High	4
>21	Modified peat with high scores for most contributory factors (unusual except in areas with evidence of incipient instability)	Very High	5

1.5.51 **Table 8.6.10** describes the basis for the likelihood classes. Professional judgement was made that for a facet to have a moderate or higher likelihood of a peat landslide, a likelihood score would be required equivalent to both the worst case peat depth and slope angle scores (3 in each case, i.e. 3 x 2 classes) alongside three intermediate scores (of 2, i.e. 2 x 3 classes) for other contributory factors. This means that any likelihood score of 14 or greater would be equivalent to at least a moderate likelihood of a peat landslide. Given that the maximum score attainable is 24, this seems reasonable.

1.6 Peat Slide Risk Assessment and Mitigation

1.6.1 **Table 8.6.11** below defines the stability risk assessment based on the peat slide likelihood and the required mitigation actions for each Risk Level.

Table 8.6.11: Risk Assessment

Peat Slide Likelihood	Potential Stability Risk (Pre-Mitigation)	Mitigation Action
Very Low	Very Low	No peat present >0.5 m and therefore no mitigation action required.
Low	Unlikely/Low	Development of a site-specific construction and management plan for peat areas.
Moderate	Likely/Medium	As for Low condition plus may require mitigation to improve site conditions.
High	Probable High	Unacceptable level of risk, the area should be avoided. If unavoidable, detailed investigation and quantitative assessment required to determine stability with long term monitoring.
Very high	Almost Certain/Very high	Unacceptable level of risk, the area should be avoided.

1.6.2 **Table 8.6.12** below shows the level of Likelihood of Peat Slide occurring from the results of the Landslide Susceptibility Approach (LSA). The FoS results have also been added to the table to provide a comparison of the results from both methods of assessments. The worst-case likelihood has been adopted for each element of the proposed design and the level of required mitigation measures proposed.

Table 8.6.12: Level of Likelihood and Mitigation

Wind Farm Infrastructure

Turbine/ Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment/Mitigation
Turbine 1	2	7.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Turbine 2	3.5	3.6	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
Turbine 3	1.6	6.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Turbine 4	2.45	5.7	Low	Moderate (Marginally Unstable)	Peat >0.5 m recorded. Average slope <10°. Moderate Likelihood from FoS. (Refer Section 1.8)
Turbine 5	1.75	7.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Turbine 6	2.1	5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Turbine 7	1.05	5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Turbine 8	4.3	4	Low	Moderate (Marginally Unstable)	Peat >0.5 m recorded. Average slope <10°. Moderate Likelihood from FoS. (Refer Section 1.8)

Table 8.6.12: Level of Likelihood and Mitigation

Wind Farm Infrastructure

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
BESS and Substation	2.1	3.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Construction Compound	2.35	4.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
Borrow Pit Search Area	1.38	8.3	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)

Access Tracks

Access Track from Site Entrance to Borrow Pit

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
Chainage (CH) 0-100	1.59	3.6	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 100-200	1.2	1.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 200-300	0.8	3	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 300 – 402.3	0.55	5.8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)

Access Track from Site Entrance to Turbine 1

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
CH 0-200	2.0	3.9	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 200-400	3.88	3.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 400-600	4.05	4.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 600-800	2.42	5.4	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 800-1000	2.31	5.8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 1000-1200	2.1	8.3	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 1200-1400	2.67	5.8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 1400-1600	2.45	8.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 1600-1700	2.45	6.9	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)

Access Track from Turbine 1 to Turbine 3

Table 8.6.12: Level of Likelihood and Mitigation

Wind Farm Infrastructure

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
CH 0-200	2.3	5.3	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 200-400	2.9	6.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 400-600	4.5	2.8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 600-800	2.8	4.9	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 800-1077.7	2.3	5.3	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)

Access Track from Track C to Substation and BESS

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
CH 0-200	2.1	3.6	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)

Access Track from Turbine 3 to Turbine 4

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
CH 0-200	2.5	7.1	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 200-400	2.3	5.4	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 400-600	1.7	5.6	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 600-700	1.5	8.1	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)

Access Track from Turbine 4 to Turbine 7

Turbine / Infrastructure	Peat Depth m (Max)	Slope Angle Deg (Average)	Likelihood from (LSA)	Likelihood from FoS	Comment / Mitigation
CH 0-200	2.8	5.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 200-400	2.7	6.6	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 400-600	2	6.7	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 600-800	2.1	6.9	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 800-1000	1.7	5.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 1000-1200	2.2	3.3	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 1200-1400	2.1	3.8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)

Table 8.6.12: Level of Likelihood and Mitigation					
Wind Farm Infrastructure					
Turbine/ Infrastructure	**Peat Depth m (Max)**	**Slope Angle Deg (Average)**	**Likelihood from (LSA)**	**Likelihood from FoS**	**Comment/Mitigation**
CH 1400-1600	3	4.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 1600-1740	2	3.9	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood atCH 1620. (Refer Section 1.8)
Access Track from Turbine 7					
CH 0-200	1.3	5.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 200-400	1.03	4.5	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 400-600	2.7	4.7	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 600-700	4	5.1	Low	Moderate (Marginally Unstable)	Peat >0.5 m recorded. Average slope <10°. Moderate Likelihood from FoS at CH650. (Refer Section 1.8)
CH 700-800	3.7	4.6	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)
CH 800-1000	4.2	7.2	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood. (Refer Section 1.8)
CH 1000 -1100	2.9	8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <10°. Low Likelihood at CH 1080. (Refer Section 1.8)
CH 1100 -1200	2.9	8.9	Low	Moderate (Marginally Unstable)	Peat >0.5 m recorded. Average slope <10°. Moderate Likelihood from FoS at CH1150. (Refer Section 1.8)
CH 1200-1300	2.1	9.1	Low	Moderate (Marginally Unstable)	Peat >0.5 m recorded. Average slope <10°. Moderate Likelihood from FoS at CH1220. (Refer Section 1.8)
CH 1300-1400	2.5	10.3	Low	Moderate (Marginally Unstable)	Peat >0.5 m recorded. Average slope <10°. Moderate Likelihood from FoS at CH1380. (Refer Section 1.8)
CH1400-1563	2.2	4.8	Low	Low (Stable)	Peat >0.5 m recorded. Average slope <5°. Low Likelihood. (Refer Section 1.8)

Results

1.6.3 From **Table 8.6.12**, the results of LSA and the FoS broadly agree that the majority of the proposed turbines, hardstanding, BESS, substation, construction compound, access tracks and borrow pit locations are classified as Low likelihood of peat slide. It is considered that general good practice mitigation measures as discussed in **Section 1.8** would be sufficient to mitigate any residual risk of peat slide.

1.6.4 Turbine 4 and Turbine 8 have areas of Marginally Unstable ground and are included from the FoS, which has been assigned as a Moderate likelihood of peat slide. Similarly, four areas of access track near Turbine 7 have been identified as possessing a Moderate likelihood from the FoS assessment.

1.6.5 The LSA shows that all areas of the proposed development have a Low likelihood of peat slide. The LSA results and scoring for peat slide likelihood is shown on **Figure 8.6.8.**

1.6.6 Where the results of the FoS and LSA assessments disagree, the worst case scenario has been adopted within the consequence and peat slide risk evaluation below.

1.6.7 In order for there to be a 'High' or 'Medium' risk associated with Proposed Development, combined peat landslide likelihood must be 'Moderate' or higher at an infrastructure location, as defined by Scottish Government Guidance[1].

1.6.8 Where combined peat landslide likelihoods are assessed as 'Low' or 'Very Low', post-consent site investigations and application of good practice construction mitigation methods should be employed prior to and during construction as detailed in **Section 1.8** below.

1.6.9 Additional, specific, mitigation methods for areas assessed as 'Moderate' likelihood are also detailed in **Section 1.8.**

1.7 Consequence Evaluation

1.7.1 Based on the assessment of consequence of risk methodology, as defined by the Scottish Government Best Practice Guidance[1], five receptors (refer to **Figure 8.6.9**) have been identified at the Site, and are assessed for consequence in **Table 8.6.13** below:

- watercourse;
- non-riverine habitats.
- highway infrastructure;
- residential properties; and
- proposed infrastructure locations.

Table 8.6.13: Assessment of Consequence and Risk					
Receptor ID	**Receptor**	**Consequence**	**Score**	**Justification for Score**	**Consequence Scale**
1	Watercourse – NGR 441841, 1176430	Increased turbidity and acidification, fish kill, blockage of drainage, effects on private water supplies.	3	Water Quality, Flood risk and Private water supplies have been considered within **Chapter 8: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2).**	High
2	Non Riverine Habitat (SSSI)– National Grid Reference 441616,1178131	Medium term loss of vegetation cover, disruption of peat hydrology, carbon release.	3	Effects on peatland habitats, though the effects of peat landslides are generally short in duration.	High
3	A968 Highway – National Grid Reference 443396,1176092	Medium term loss of access for transport link. Significant cost to restore highway infrastructure and public access.	3	Disruption to local highways routes. Although highways are bounded via cut off ditches and elevated verge, significant peat slide could temporarily disrupt traffic/access.	High
4	Residential Property – National Grid	Medium term loss of residency for local	5	Loss of life, though unlikely, is a severe consequence;	Extremely High

Table 8.6.13: Assessment of Consequence and Risk					
Receptor ID	Receptor	Consequence	Score	Justification for Score	Consequence Scale
	Reference 440611,1174428	occupants. Significant cost to restore property and temporary accommodation. Possible injury, loss of life to occupants.		financial implications of damage and repair to residents property are less significant.	
5	Proposed Development Infrastructure, Access Track near Turbine 7- National Grid Reference 441763,1176204	Damage to infrastructure, possible injury, loss of life.	5	Loss of life, though unlikely, is a severe consequence; financial implications of damage and repair to infrastructure are less significant.	Extremely High

1.7.2 There are eight areas of moderate likelihood of peat slide identified directly at infrastructure (turbine, hardstanding and access track) locations. Receptors have been included in **Table 8.6.14** below to confirm the evaluation for the level of risk associated with the Proposed Development.

Table 8.6.14 Risk levels derived from Likelihood vs Consequence						
Receptor	Qualitative Likelihood worst case (See Table 8.6.12)	Consequence Scale/Score (See Table 8.6.13)	Risk Level	Minimum Distance to Receptor	Level of Mitigation Required	Risk Level (Post Mitigation)
Watercourse	Moderate (3)	High (4)	Moderate	50 m southeast of Eastern Turbine 8 hardstanding	Specific Mitigation detailed in **Section 1.8**	Low
Non riverine Habitat (SSSI)	Moderate (3)	High (4)	Moderate	12 m west of Turbine 4 hardstanding	Specific Mitigation detailed in **Section 1.8**	Low
A968 Highway	Moderate (3)	High (4)	Moderate	1.4 km east of Turbine 8 hardstanding	Specific Mitigation detailed in **Section 1.8**	Low
Residential Property	Low (2)	Extremely High (5)	Low	1.2 km southwest of Site Compound	General good practice mitigation detailed in **Section 1.8**	Low
Proposed Development Infrastructure	Moderate (3)	Extremely High (5)	Moderate	Beneath Proposed Access Track near Turbine 7	Specific Mitigation detailed in **Section 1.8**	Low

1.7.3 The risk levels identified above for each potential receptor are based on the worst case likelihood and closest proximity to the receptor. The risk level for these areas is considered to be Moderate for the watercourse, non riverine habitat, A968 highway, Proposed Development infrastructure and Low for the residential property, based on:

- proximity of potential for unstable ground from infrastructure location;
- level and slope angle both up and down slope; and
- run out distances to potential receptors (Refer to **Figure 8.6.9**).

1.7.4 Implementing specific mitigation measures would lower the post mitigation risk to low for the receptors identified as moderate risk, **Section 1.8**.

1.7.5 Based on the combined Qualitative Likelihood vs Consequence and the findings within the FoS assessment previously outlined, it is considered that the combined risk level of peat landslide in association with the construction of the Proposed Development is assessed as being Low risk once specific and general mitigation measures are implemented. This assessment of Risk level is based on Low likelihood or Moderate likelihood vs High or Extremely High consequence as outlined in Table 5.3 of ECU best practice guidance[1], as shown below:

		Table 8.6.15 Indicative Risk Level				
		Adverse Consequence				
Peat Landslide Probability or Likelihood	Receptor	Extremely high	High	Moderate	Low	Very Low
	Very High (Almost certain)	High	High	Moderate	Moderate	Low
	High (Probable)	High	Moderate	Moderate	Low	Negligible
	Moderate (Likely)	Moderate	Moderate	Low	Low	Negligible
	Low (Unlikely)	Low	Low	Low	Negligible	Negligible
	Very Low (Negligible)	Low	Negligible	Negligible	Negligible	Negligible

Table 8.6.15 is Based on Table 5.3: Extract from Scottish Government (2017). Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments.

1.8 Mitigation Measures

Specific Mitigation Methods

1.8.1 Turbine 4 and Turbine 8 both have areas identified as Moderate Risk either adjacent to or beneath the proposed associated turbine hardstanding based on the results of FoS assessment.

1.8.2 Four areas of proposed access track have also been identified as having areas of moderate risk beneath their proposed alignments from the FoS assessment results.

1.8.3 The assessment has used conservative mid-range values for Effective Cohesion and Effective Angle of Internal Friction within the FoS Assessment. To ensure that these values are suitable, the undertaking of a detailed post consent ground investigation is recommended, with appropriate in-situ testing and geotechnical laboratory analysis on undisturbed samples of the peat to validate the results of the FoS assessment.

1.8.4 Following additional post-consent ground investigation and detailed design, should areas of Moderate Risk of peat slide remain, then micrositing infrastructure away from these areas is recommended. Where micrositing is not practicable then excavation of the peat to remove the potential risk would be required.

1.8.5 General good practice should be applied across the Site to engender awareness of peat instability and enable early identification of potential displacements and opportunities for mitigation.

General Mitigation Measures

1.8.6 A comprehensive intrusive geotechnical assessment should be undertaken post-consent based on the combined ground investigation, to support the engineering design of turbine foundations, tracks and ancillary infrastructure for the Proposed Development.

1.8.7 Appropriate field and laboratory testing would also be undertaken as part of the comprehensive ground investigation to confirm the peat stability baseline across the Site to cover the areas affected by the tracks and ancillary infrastructure, and further design mitigation used as appropriate to reduce the likelihood of peat instability (where required).

1.8.8 A geotechnical risk register would be prepared detailing any ground risks identified during the ground investigation and providing mitigation measures as appropriate. The risk register should be considered a live document and updated throughout the phases of the Proposed Development. The monitoring requirements discussed in the following paragraphs would be undertaken by the Contractor.

1.8.9 During construction of the Proposed Development the following mitigation would be undertaken for excavations:

- A geotechnical risk register would be prepared for the Proposed Development following intrusive investigations post consent and location specific stability analyses.
- Site inspections and audits would be undertaken at scheduled intervals to identify any unusual or unexpected changes to ground conditions (which may be associated with construction or which may occur independently of construction).
- All construction activities and operational decisions that involve disturbance to peat deposits would be overseen by an appropriately qualified geotechnical engineer with experience of construction on peat sites.
- Awareness of peat instability and pre-failure indicators would be incorporated in site induction, tool box talks, and training to enable all site personnel to recognise ground disturbances and features indicative of incipient instability.
- Monitoring checklists would be prepared with respect to peat instability addressing all construction activities forming the Proposed Development.
- Use of appropriate supporting structures around peat excavations, where required, (e.g. for towers, crane pads and compounds) to prevent collapse and the development of tension cracks.
- Avoid cutting trenches or aligning excavations across slopes (which may act as incipient back scars for peat failures) unless appropriate mitigation has been put in place.
- Implement methods of working that minimise the cutting of the toes of slope, e.g. working up-to-downslope during excavation works.
- Monitor the ground upslope of excavation works for creep, heave, displacement, tension cracks, subsidence or changes in surface water content.
- Monitor cut faces for changes in water discharge, particularly at the peat-substrate contact;
- Minimise the effects of construction on natural drainage by ensuring natural drainage pathways are maintained or diverted such that there is no significant alteration of the hydrological regime of the Site; drainage plans should avoid creating drainage/infiltration areas or settlement ponds towards the tops of slopes (where they may act to both load the slope and elevate pore pressures).

1.8.10 During construction of the Proposed Development the following mitigation would be undertaken for excavated tracks:

- maintain drainage pathways through tracks to avoid ponding of water upslope;
- monitor the top line of excavated peat deposits for deformation post-excavation; and
- monitor the effectiveness of cross-track drainage to ensure water remains free-flowing and that no blockages have occurred.

1.8.11 During construction of the Proposed Development the following mitigation would be undertaken for temporary storage of peat and restoration activities:

- where practicable, ensure temporary stores of peat are located on non-peat soils to minimise potential for instability of the underlying soils;
- avoid storing peat on slope gradients >3° and preferably store on ground with neutral slopes and natural downslope barriers to peat movement;
- monitor effects of wetting/re-wetting stored peat on surrounding peat areas, and prevent water build up on the upslope side of peat mounds; and
- maximise the interval between material deliveries over newly constructed tracks that are still observed to be within the primary consolidation phase.

1.8.12 During the operational phase of the Proposed Development monitoring of key infrastructure locations would continue through Site walkovers and inspections by the maintenance contractor to look for signs of unexpected ground disturbance, including:

- ponding on the upslope side of infrastructure sites and on the upslope side of access tracks;
- subsidence and lateral displacement of tracks;
- changes in the character of natural or artificial peat drainage within a 50 m buffer strip of tracks and infrastructure (e.g. development of quaking bog, waterlogging of previously dry drains);
- blockage or underperformance of the installed site drainage system;
- slippage or creep of stored peat deposits (including in restored peat cuttings); and
- development of tension cracks, compression features, bulging or quaking bog anywhere in a 50 m corridor surrounding the Site of any construction activities or site works.

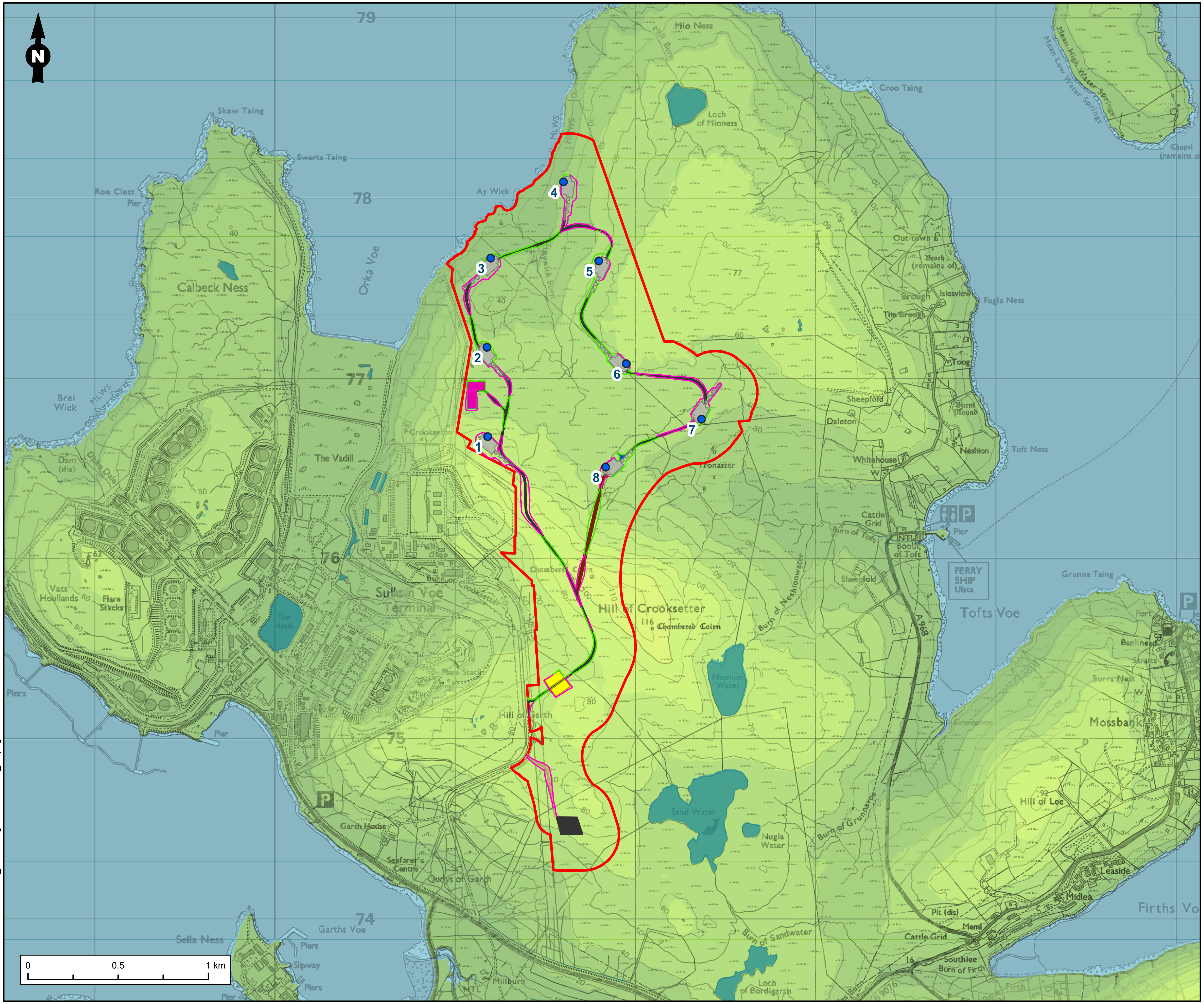
1.8.13 Monitoring would be undertaken during construction and as part of the commissioning phase the need for on-going monitoring would be reviewed and any ongoing monitoring requirements identified.

1.9 Conclusion

1.9.1 The majority of the Proposed Development Site is considered to be Low risk with regards to peat slide risk with the exception of areas adjacent to Turbine 4 and Turbine 8 and four areas beneath track neat Turbine 7 which are considered to be at Moderate Risk.

1.9.2 It is considered that the general good practice mitigation measures included within **Section 1.8** of this Technical Appendix will be sufficient to provide mitigation for low risk areas of the Site.

1.9.3 For areas of moderate risk, specific mitigations including micrositing of infrastructure should be considered following post consent ground investigation and detailed design. Where micrositing cannot be employed then excavation of the peat would be required to remove the risk of peat slide.



Legend

- Application Boundary
- Proposed Turbine
- Proposed Hardstanding
- Proposed Substation, BESS and Lidar Area
- Proposed Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Operation and Maintenance Access Track
- Proposed Access Tracks
- Proposed Turning Head
- Proposed Temporary Borrow Pit Access Track
- Earthworks - Fill
- Earthworks - Cut

Elevation (m)

- -2 - 0
- 1 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120

Figure Title
Elevation

Project Name
Neshion Energy Park

Project No./Filery ID
1620016691 / REH2024N00248

Date	Figure No.	Revision
March 2026	8.6.1	1.0

Prepared By	Scale
SR	1:20,000 @A3

Client **Neshion Ltd**

RAMBOLL

1620016691-RAM-MA-IA-00110_PLHRAFig8.6.1Elevation_01.pagx

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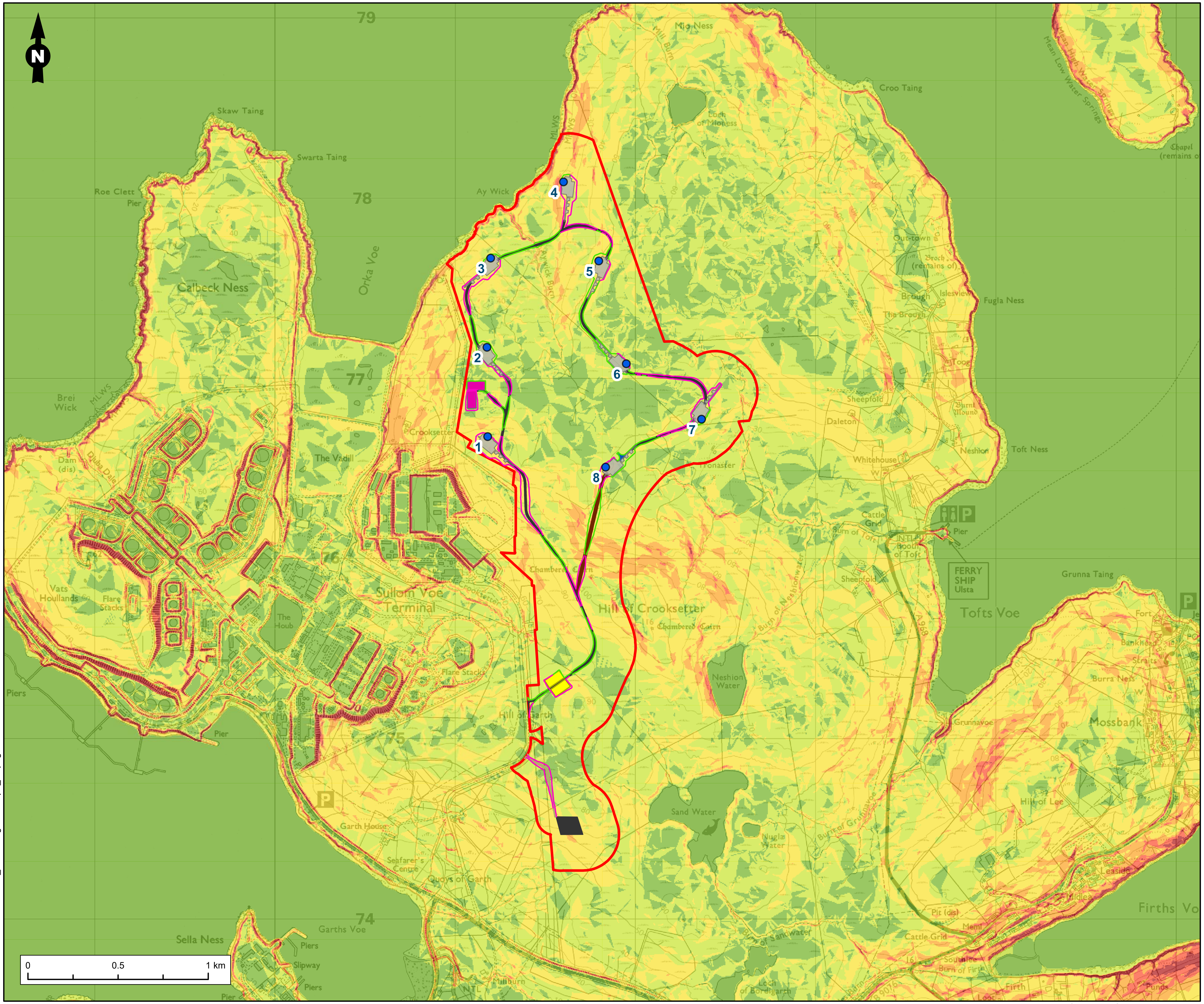

1620016691-RAM-MA-IA-00111_PLHRAFig8.6.2Slope_01.pagx

Legend

- Application Boundary
- Proposed Turbine
- Proposed Hardstanding
- Proposed Substation, BESS and Lidar Area
- Proposed Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Operation and Maintenance Access Track
- Proposed Access Tracks
- Proposed Turning Head
- Proposed Temporary Borrow Pit Access Track
- Earthworks - Fill
- Earthworks - Cut

Slope Angle (Degrees)

- 0.01 - 2
- 2.01 - 5
- 5.01 - 10
- 10.01 - 15
- 15.01 - 20
- > 20

Figure Title	
Slope	
Project Name	
Neshion Energy Park	
Project No./Filery ID	
1620016691 / REH2024N00248	

Date	Figure No.	Revision
March 2026	8.6.2	1.0

Prepared By	Scale
SR	1:20,000 @A3

Client: **Neshion Ltd**

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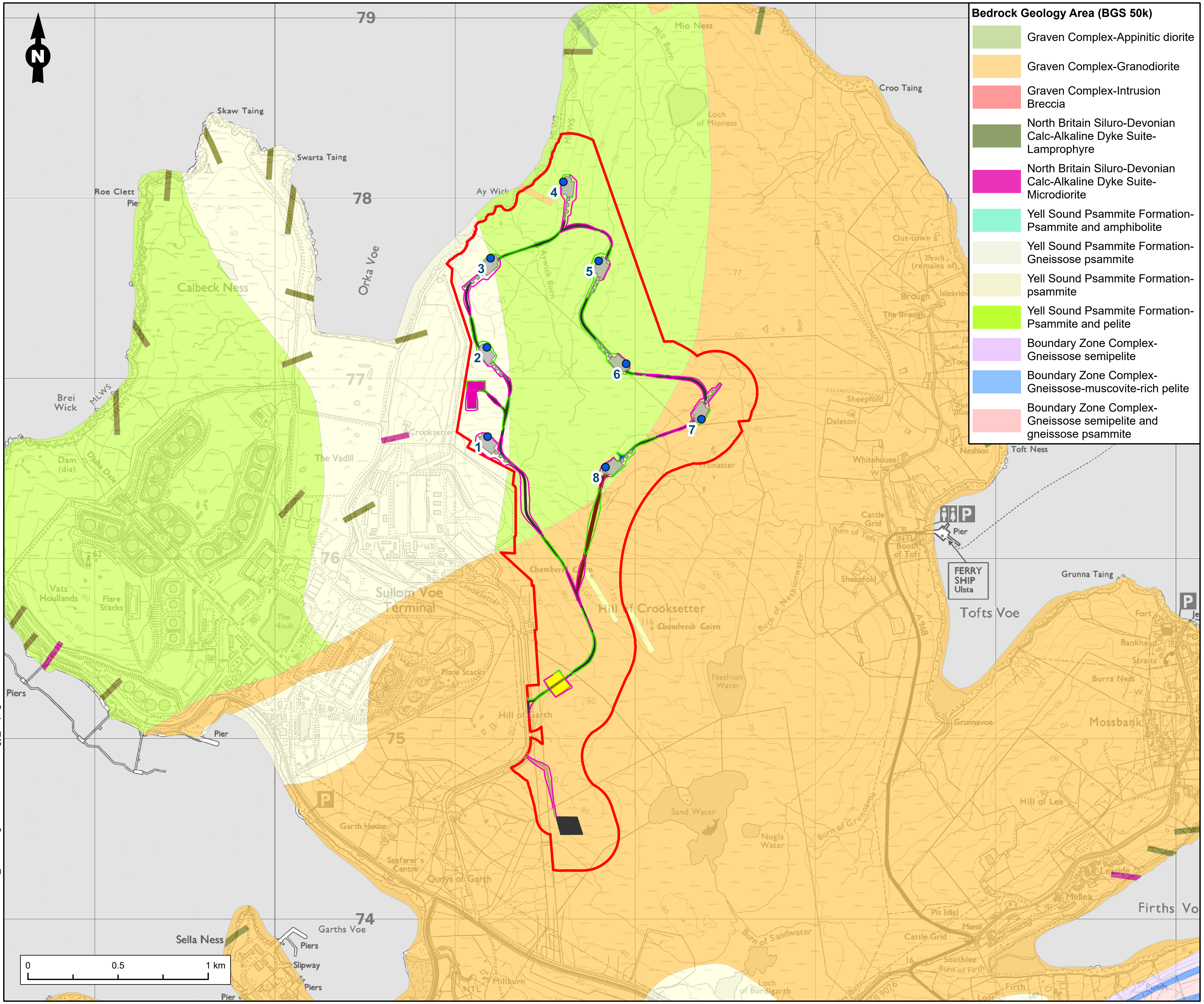
Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Bedrock Geology Area (BGS 50k)

- Graven Complex-Appinitic diorite
- Graven Complex-Granodiorite
- Graven Complex-Intrusion Breccia
- North Britain Siluro-Devonian Calc-Alkaline Dyke Suite-Lamprophyre
- North Britain Siluro-Devonian Calc-Alkaline Dyke Suite-Microdiorite
- Yell Sound Psammite Formation-Psammite and amphibolite
- Yell Sound Psammite Formation-Gneissose psammite
- Yell Sound Psammite Formation-psammite
- Yell Sound Psammite Formation-Psammite and pelite
- Boundary Zone Complex-Gneissose semipelite
- Boundary Zone Complex-Gneissose-muscovite-rich pelite
- Boundary Zone Complex-Gneissose semipelite and gneissose psammite

Legend

- Application Boundary
- Proposed Turbine
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- Earthworks - Fill
- Earthworks - Cut

Figure Title	Bedrock Geology
Project Name	Neshion Energy Park
Project No./Filery ID	1620016691 / REH2024N00248

Date	Figure No.	Revision
April 2026	8.6.3a	1.0

Prepared By	Scale
SR	1:20,000 @A3

Client **Neshion Ltd**

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1620016691-RAM-MA-IA-00112_PLHRAFig8.6.3aBedrockGeology_01.pagx

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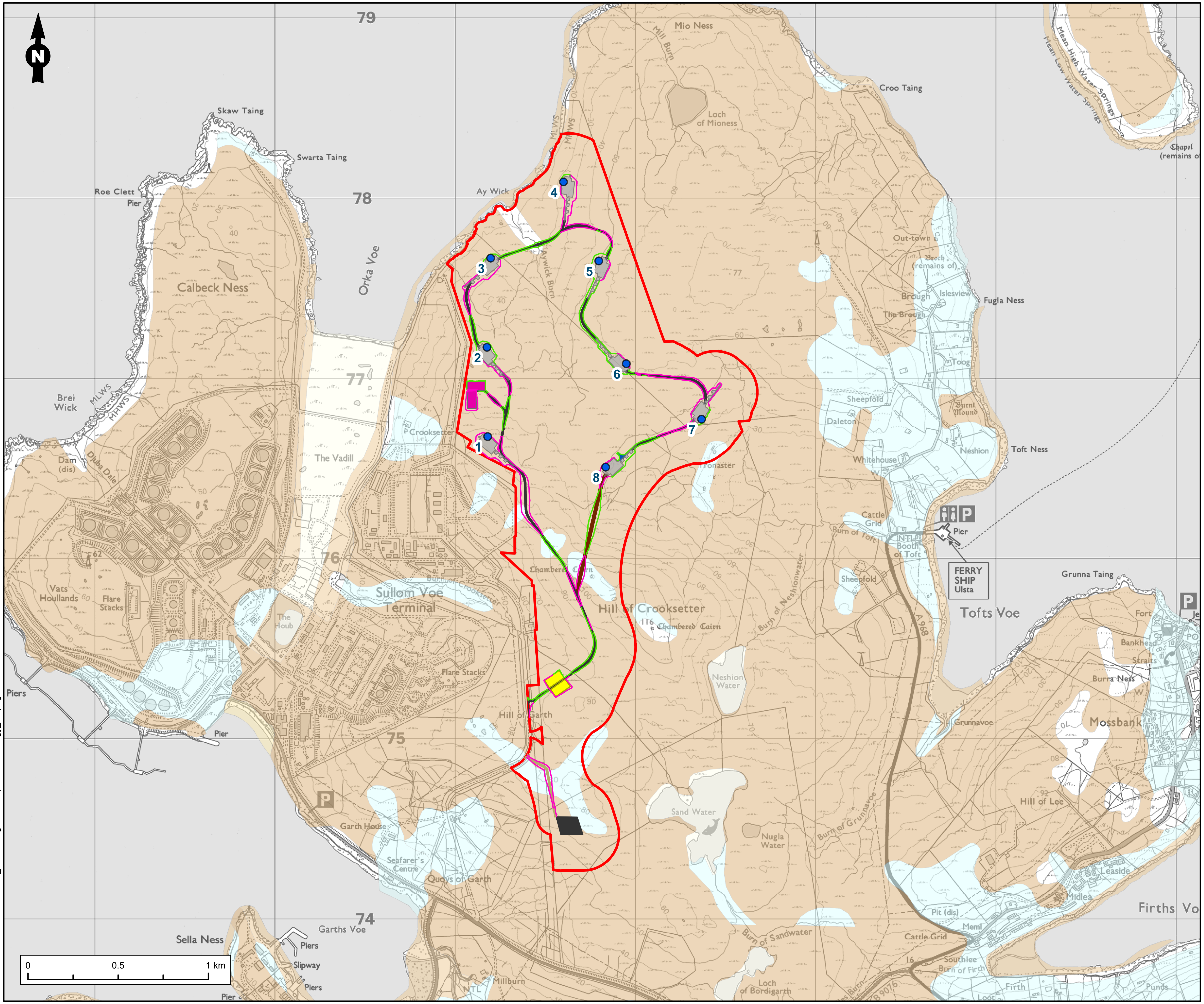

Legend

- Application Boundary
- Proposed Turbine
- Proposed Hardstanding
- Proposed Substation, BESS and Lidar Area
- Proposed Construction Compound
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- Proposed Access Tracks
- Proposed Turning Head
- Proposed Temporary Borrow Pit Access Track
- Earthworks - Fill
- Earthworks - Cut

Superficial Geology (BGS 50 k)

- Diamicton
- Peat

Figure Title	Superficial Geology
Project Name	Neshion Energy Park
Project No./Filery ID	1620016691 / REH2024N00248
Date	April 2026
Figure No.	8.6.3b
Revision	1.0
Prepared By	SR
Scale	1:20,000 @A3
Client	Neshion Ltd

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1620016691-RAM-MA-IA-00113_PLHRAFig8.6.3bSuperficialGeology_01.pagx

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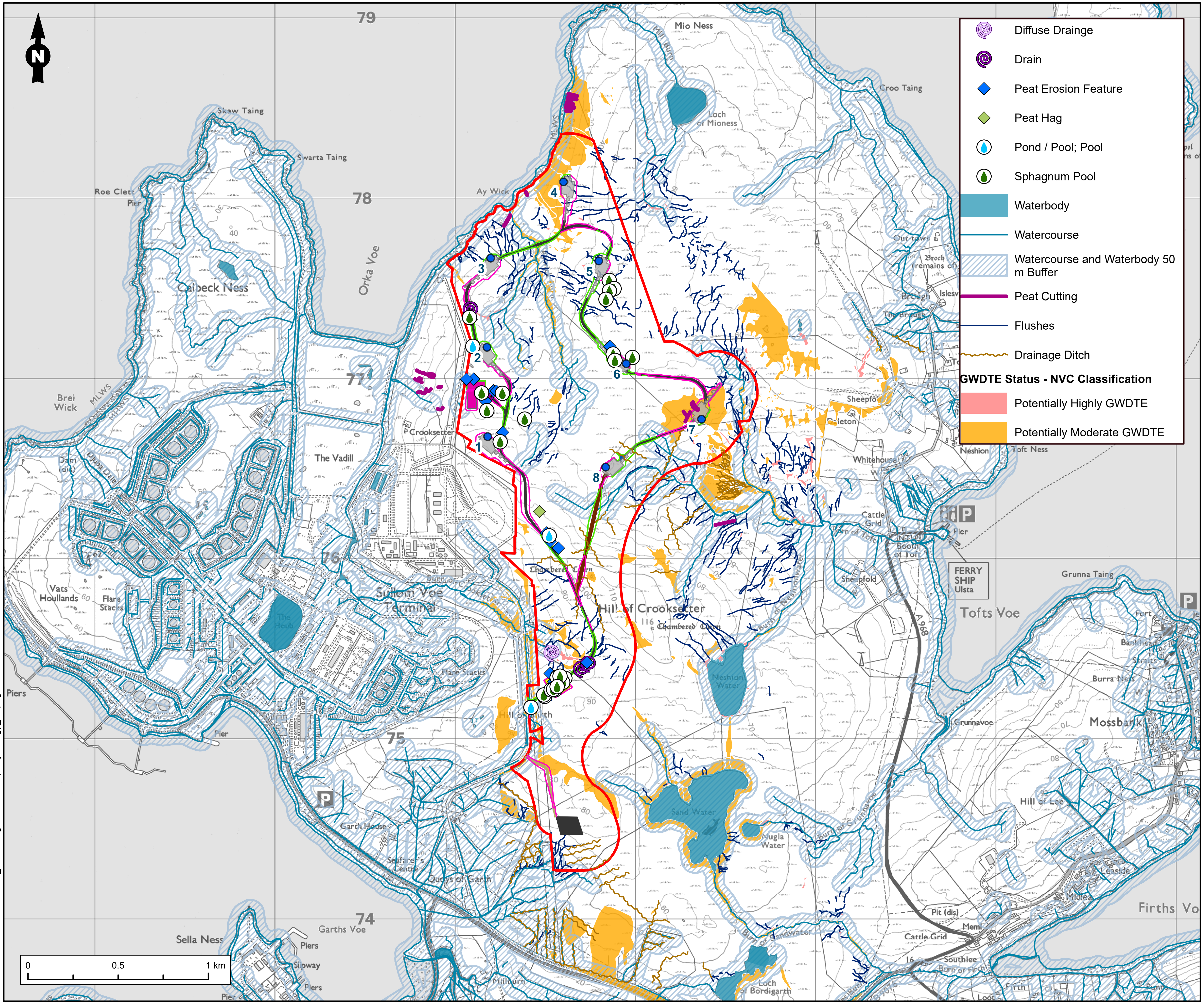

Legend

- Application Boundary
- Proposed Turbine
- Proposed Hardstanding
- Proposed Substation, BESS and Lidar Area
- Proposed Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Operation and Maintenance Access Track
- Proposed Access Tracks
- Proposed Turning Head
- Proposed Temporary Borrow Pit Access Track
- Earthworks - Fill
- Earthworks - Cut

*No Drinking Water Protection Areas (DWPA) or Private Water Supplies have been identified within proximity of the Application Boundary

Figure Title	Geomorphology and Hydrogeology
Project Name	Neshion Energy Park
Project No./Filery ID	1620016691 / REH2024N00248
Date	April 2026
Figure No.	8.6.4
Revision	1.0
Prepared By	SR
Scale	1:20,000 @A3
Client	Neshion Ltd

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1620016691-RAM-MA-IA-00114_PLHRAFig8.6.4GeomorphHydrology_02.pagx

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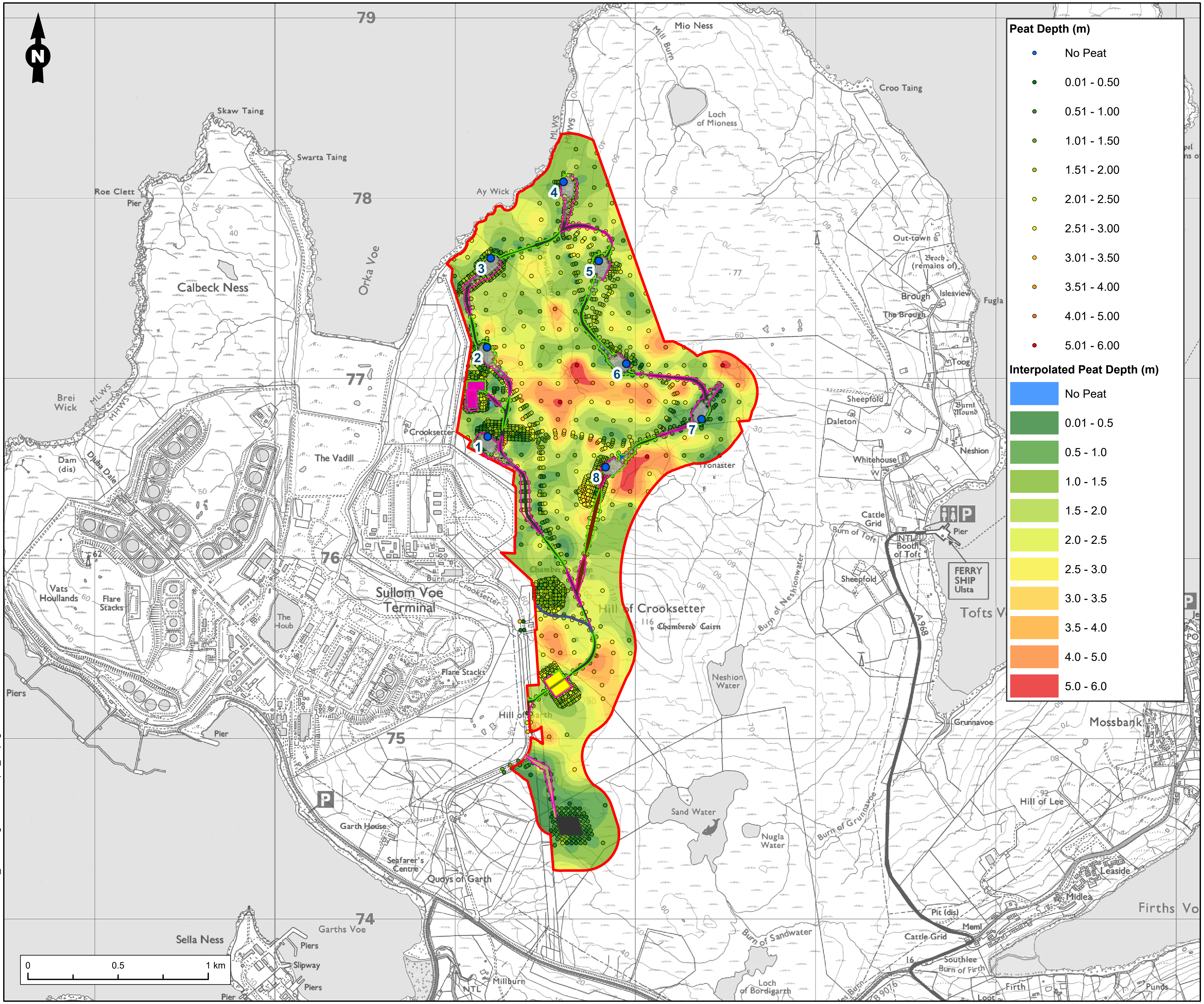

Legend

- Application Boundary
- Proposed Turbine
- Proposed Hardstanding
- Proposed Substation, BESS and Lidar Area
- Proposed Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Operation and Maintenance Access Track
- Proposed Access Tracks
- Proposed Turning Head
- Proposed Temporary Borrow Pit Access Track
- Earthworks - Fill
- Earthworks - Cut

Figure Title	Peat Depth
Project Name	Neshion Energy Park
Project No./Filery ID	1620016691 / REH2024N00248
Date	March 2026
Figure No.	8.6.5
Revision	1.0
Prepared By	SR
Scale	1:20,000 @A3
Client	Neshion Ltd

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1620016691-RAM-MA-IA-00115_PLHRAFig8.6.5PeatDepth_01.pagx

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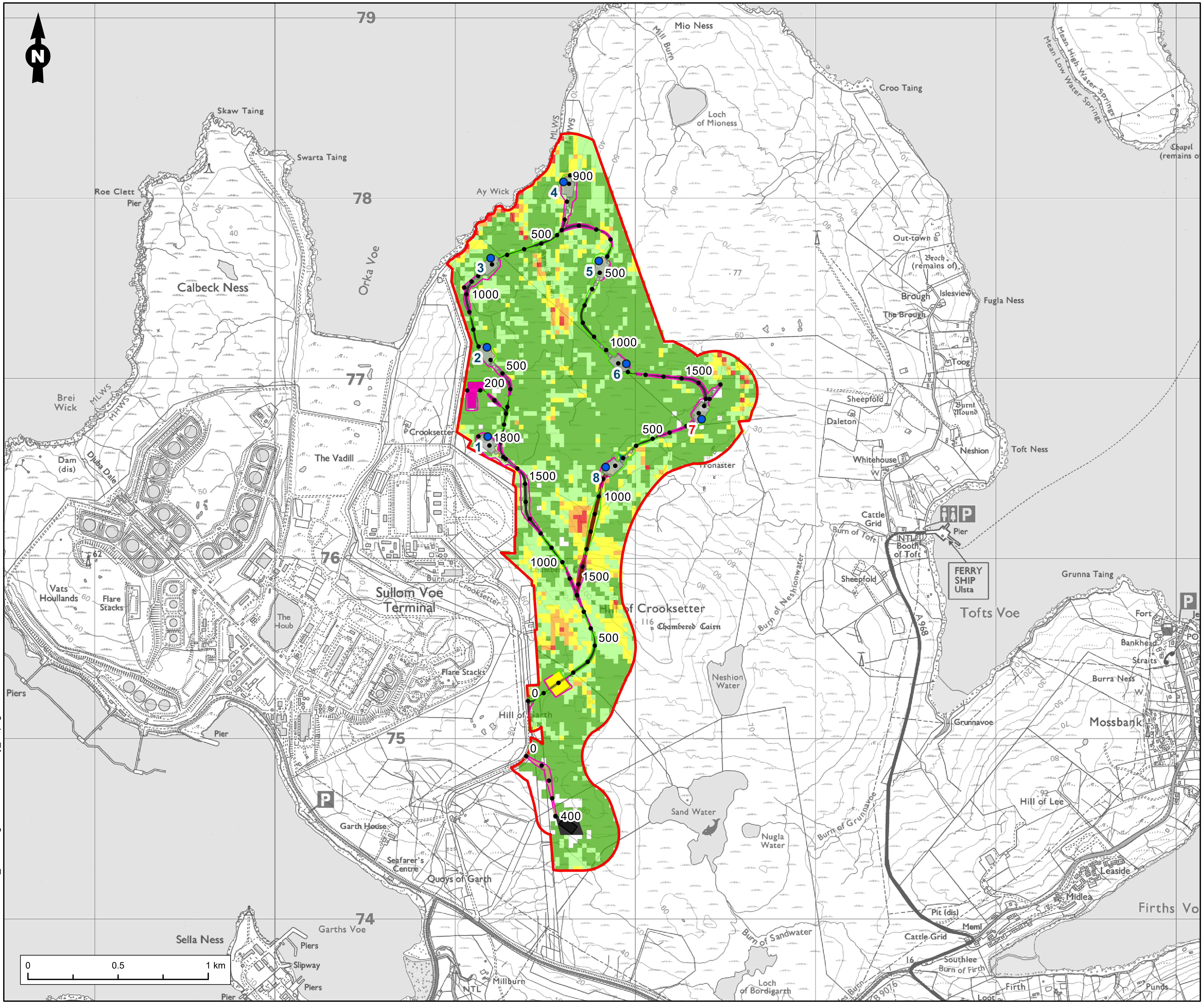

Legend

- Application Boundary
- Proposed Turbine
- Proposed Hardstanding
- Proposed Substation, BESS and Lidar Area
- Proposed Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Temporary Operation and Maintenance Access Track
- Proposed Access Tracks
- Proposed Access Track Chainage Markers
- Proposed Turning Head
- Proposed Borrow Pit Access Track
- Earthworks - Fill
- Earthworks - Cut

Factor of Safety (Cohesion = 5)

- < 1.0 (unstable)
- 1.0 - 1.4 (marginally unstable)
- 1.4 - 2.0 (stable)
- 2.0 - 3.0 (stable)
- >3.0 (stable)

Figure Title	Factor of Safety (Effective Cohesion = 5)
Project Name	Neshion Energy Park
Project No./Filery ID	1620016691 / REH2024N00248
Date	April 2026
Figure No.	8.6.6
Revision	1.0
Prepared By	SR
Scale	1:20,000 @A3
Client	**Neshion Ltd**

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1620016691-RAM-MA-IA-00116_PLHRAFig8.6.6FactorOfSafety_03.pagx

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